SECTION 02200
EARTHWORK

PART 1 - GENERAL

1.01 SUMMARY:

A. Section Includes: The work covered by this section consist of site clearing, grading, general and building excavation, disposal of debris and spoils, dewatering preparation of subgrade, foundations, borrow, embankment, structural and general backfill, restoration, and cleanup necessary to construct the project, all as shown on the drawings and as specified herein.

B. Related Sections: Drawings and General Provisions of the Contract, including the General Covenants and Provisions, Supplementary Covenants and Provisions and General Requirements as well as, but not limited to, the following:

Section 02506 – Crushed Stone paving
Section 02930 - Lawns and Grasses
Section 03100 - Concrete Formwork
Section 03300 - Cast-In-Place Concrete

1.02 QUALITY ASSURANCE:

A. Codes and Standards: Perform all excavation work in compliance with applicable requirements of governing authorities having jurisdiction.

B. Safety: All excavation work and methods of construction shall conform to the state of Iowa Bureau of Labor and all OSHA Standards.

1.03 JOB CONDITIONS:

A. Site information shown on the Drawings regarding existing conditions is of a general nature. Visit the site and become familiar with existing conditions.

B. Observe weather conditions. Attempt no work in frozen conditions without the approval of the DNR Construction Inspector.

1.04 PROTECTION OF PERSONS AND PROPERTY:

A. Protect from damage existing buildings, walks, paving, fencing, sod, and other items noted to remain.

1. Maintain benchmarks, monuments, property stakes, and other reference points.

B. Protect existing underground utilities to remain.

1. Notify the DNR Construction Inspector of underground utilities or structures encountered but not indicated on drawings.

2. Contractor responsibilities: correcting damage caused to existing construction, utilities, surfacing, and other items noted to remain at no additional expense to the Owner.

C. Barricade open excavations occurring as part of this work and provide warning lights.

1.05 EXPLOSIVES:

A. The use of explosives is not permitted.

PART 2 - PRODUCTS

2.01 GENERAL FILL AND EMBANKMENT MATERIAL:

A. Materials to be incorporated in the top 12 inches of earth embankment or general fill shall be earthy materials, free from stones larger than 2 inches, broken concrete, roots, or other materials that would significantly affect scarifying, compacting and finishing the subgrade.

B. Obtain approval of fill material prior to any placement from the DNR Construction Inspector.

2.02 STRUCTURAL BACKFILL MATERIAL:

A. Structural backfill material shall consist of natural sand or a mixture of sand with gravel, crushed stone, or other broken fine material to fill all voids in coarser material.

1. The maximum size of any gravel, stone, or broken or fragmented material shall be of such size that 100 percent passes a 6-inch sieve.

2. The liquid limit of the material shall not be greater than 25 and the plasticity index shall not be more than 6.

3. The portion of the material which passes a No. 4 sieve shall conform to the following requirements:

Sieve Size	Percentage By Weight Passing
No. 4	100
No. 40	Not more than 75
No. 100	Not more than 15
No. 200	Not more than 8

B. The material shall be capable of being compacted to 95 percent maximum density without undue weaving and heaving as defined by ASTM D698, Method D.

C. Obtain approval of fill material prior to any placement from the DNR Construction Inspector.

2.03 GRANULAR DRAINAGE FILL MATERIAL:

A. Granular drainage fill for use under concrete slabs and walks where shown on the Drawings shall consist of granular free--draining material; consisting of clean bank run gravel or crushed stone of full range of sizes.

B. Maximum size of aggregate shall be 3/4 inch. 15 to 50% of that portion of weight of fill shall be passing the No. 4 sieve.

PART 3 - EXECUTION

3.01 LAYING OUT WORK:

A. Commission surveyor to locate new construction, set slope and grade stakes, and otherwise fully lay out work.

1. Provide grade staking to maintain proper grades and control.

2. Check existing grades at site against grades or contours indicated on Drawings, and report any differences to Architect before starting of grading.

3. Stake out building and verify location before start of grading.

B. Preserve stakes and markers.

1. Replace at no cost to the Owner' stakes or markers carelessly or willfully damaged by operation.

2. Assume responsibility for accuracy of lines, grades, and dimensions.

3.02 DEWATERING:

A. Dewatering System: Provide, maintain and operate sufficient well points, headers, pumps, trenches, and sumps to keep all excavations for structures free from water at all times. Submit proposal to the DNR Construction Inspector for review prior to construction.

B. Surface Runoff: Control grading around the excavation to prevent surface water from running into the excavations for the structure.

C. Saturated Foundations: Prior to placing any concrete for foundations, remove soils in footing excavation that have become saturated with surface water.

3.03 EXCAVATION - GENERAL:

A. General: General excavation consists of removal of materials of whatever nature, including boulders smaller than 1 cubic yard in volume, required for the construction of structures, roads, and walks.

1. The method of excavating shall be at the Contractor's option, exercising great care to leave the final grade in an undisturbed condition.

2. If final grade is disturbed, restore to requirements and satisfaction of the DNR Construction Inspector/Architect.

3. Prior to placing any concrete for footings and foundation work, notify the DNR Construction Inspector to inspect the excavation and obtain approval to proceed with the placement.

B. Frozen Ground: Provide frost protection for all structural excavation work and do not place concrete for foundation work on frozen ground.

C. Protection of Existing Work: Protect existing work, including underground utilities and piping, from damage caused by excavation work.

1. Repair any damage to existing work, utilities, or piping at Contractor's expense.

D. Storage of Fill Materials: Store suitable excavated fill material away from excavations to avoid slides.

1. Deposit excess earth on site, where directed by DNR Construction Inspector.

E. Removal of Unsuitable Materials: The DNR Construction Inspector may find that changes to cross-sectional dimensions and depths shown on Drawings are necessary to secure foundations free from soft, weathered, shattered and loose materials or other objectionable materials.

1. Remove unsuitable material encountered and replace with granular materials from established pits satisfactory to the DNR Construction Inspector.

2. Compact granular materials to at least 95 percent of maximum density.

3. When the excavation of unsuitable materials and replacement with granular fill material directed by the DNR Construction Inspector is found to be above normal expectations, it will be paid for at the unit prices listed in the Contractor's submitted cost breakdown.

a. What constitutes normal expectations will be determined by the Architect.

b. The Architect's decision will be final.

F. Disposal of Excavated Materials: Materials free from sticks, roots, and other objectionable material may be used on site as directed by the DNR Construction Inspector.

1. Remove excavated materials not suitable for fill as directed by the DNR Construction Inspector.

3.04 STRUCTURAL EXCAVATION:

A. Excavate to elevations and dimensions indicated on the Drawings. Allow additional space as required for construction operations and inspection.

B. Remove all existing construction, encountered within the excavation, to a depth of 6 inches below the indicated elevation of footings and subgrades, to receive floor slabs, walks, and paving.

C. If suitable bearing for foundations is not encountered at depth indicated on the Drawings, immediately notify the DNR Construction Inspector.

1. Do not proceed until instructions are given and necessary measurements made for the purpose of establishing additional volume of excavation.

D. Excavate last 4 inches by hand, if machines are used for excavation.

E. Fill with concrete, at Contractor's expense, unauthorized excavation carried below bottom of foundation levels shown.

F. The DNR Construction Inspector will inspect and approve the bottoms of all excavation prior to concrete placement.

3.05 STRUCTURAL BACKFILL:

A. Start backfill around foundations not less than 24 hours nor more than seven (7) days after application of waterproofing if applicable.

1. Backfill walls and piers to about the same elevation on each side to equalize pressure.

B. Compacted structural backfill to 95 percent of its maximum density.

1. Compact to density and construction requirements as determined by ASTM D698, Method D or by AASHO Method T-180 (Modified Proctor Density).

C. Compact subgrade to receive structural backfill to 95 percent density.

3.06 DRAINAGE FILL UNDER INTERIOR SLABS:

A. Unless otherwise indicated on the Drawings, place a 6-inch minimum layer of granular drainage fill.

B. Compact this fill material to 95 percent of maximum density at optimum moisture content.

3.07 DRAINAGE FILL UNDER EXTERIOR SLABS:

A. Unless otherwise noted, provide 4-inch minimum layer of granular drainage fill sub-base for exterior concrete slabs.

B. Compact with mechanical platform tamper or as approved by DNR Construction Inspector.

3.08 PLACING BACKFILL ADJACENT TO WALLS AND FOOTINGS:

A. Deposit fill on each side of piers, walls and freestanding structures simultaneously to approximately the same elevation.

1. Where applicable, protect below grade waterproofing, dampproofing and insulation with a single thickness of 1/2" fiberboard, 1/8" asphalt impregnated board or other approved means.

2. Place fill in workable condition, free of clods, frost, or debris, in 6" lifts and thoroughly compact each lift with mechanical tamper.

B. Do not operate heavy equipment for spreading and compacting backfill closer to any wall than a distance equal to the height of the backfill above the top of the footings.

1. Backfill adjacent to walls shall be compacted to the same density as the adjacent fill with a small vibratory or hand tamping compactor.

3.09 PREPARATION OF EARTH SUBGRADE FOR CONCRETE:

A. When excavating for footings or bottom mat slabs to be cast on native soil, excavate to final grade in a manner as to not disturb the existing soil.

1. If the soil is disturbed, compact it to the satisfaction of the DNR Construction Inspector.

2. If the soil is not capable of compaction to the satisfaction of the DNR Construction Inspector, remove the disturbed material, and replace it with thoroughly compact structural backfill material.

B. Do not place concrete on surfaces that are muddy, frozen or contain frost.

C. If during the course of construction, bottom surfaces become saturated with water or muddy, remove the undesirable material and replace with compacted structural backfill as indicated above.

3.10 PLACING PIPE IN FILL:

A. When it is necessary to place pipe culverts, drain piping, or other appurtenances in general or structural backfill, bring the fill up to at least one foot above the top of the pipe or appurtenances.

1. Do not leave areas of backfill depressed to allow for trenches.

2. After the compacted fill is complete, excavate for the pipe or appurtenances.

3. Backfill materials and compaction shall conform to the fill in which it is placed.

3.11 TRIMMING AND CLEAN UP:

A. Conduct final trimming and cleaning up shall as follows:

1. Smooth out all irregularities, fill all washouts, make slopes uniform, slightly rounded at top and bottom, and compact the entire area of the fill to the required lines, grades and cross sections, within 1/10 foot above or below the established grade.

2. Where additional material is required, provide similar fill as the one used, and obtain such material from source approved by the Architect/DNR Construction Inspector.

3. When work is completed, remove and dispose of surplus material including stumps, trees and brush, and leave premises in a condition acceptable to the DNR Construction Inspector.

3.12 FINISH GRADING:

A. After completion of rough grading, scarify areas to receive topsoil to finish grade shown.

B. Deposit topsoil to a minimum depth of 6".

1. In areas with existing topsoil, no additional topsoil is required.

C. Grade topsoil to eliminate water pockets or irregularities.

D. Eliminate soil lumps and round abrupt changes in slope.

E. Spread excess earth on site as directed by DNR Construction Inspector.

3.13 SITE RESTORATION:

A. All disturbed areas within the boundaries of this project not specifically receiving a finished surface are to be seeded in accordance with Section 02930.

B. Prepare all surfaces to receive seeding per "Standard Specifications" 2001 I.D.O.T., Section 2601.04.

END OF SECTION 02200

SECTION 024300
STRUCTURE MOVING

PART 1 - GENERAL

1.01 SUMMARY:

A. Section Includes: The work consists of furnishing all labor, material and equipment for moving the structure described herein, as indicated on the drawings and as required for the construction of all work of this contract.

1. Relocate existing the lodge masonry masonry walls.

B. Related Sections: Drawings and General Provisions of the Contracts, including the General Covenants and Provisions, Supplementary Covenant and Provisions and General Requirements, as well as, but not necessarily limited to, the following:

Section 310000 - Earthwork
Section 311000 - Site Clearing
Section 033000 - Cast-In-Place Concrete
Section 040100 - Maintenance of Masonry

1.02 REFERENCES:

A. Standards of Material and construction: Conform with the Standard Specification for Highway and Bridges Construction, latest edition of the Iowa Department of Transportation.

B. Safety: Conform with the requirements of the State of Iowa Bureau of Labor and all OSHA standards.

C. Where conflicts arise between the Drawings and Code Requirements, the latter shall prevail, unless the Drawings are more stringent.

1. Bring conflicts to the attention of the Architect/DNR Construction Inspector.

1.03 SUBMITTALS:

A. Provide submittals in accordance with Section 013300 – Submittals Procedures.

B. Provide description for the Architect’s approval, of the method selected to accomplish the work of this section.

1.04 QUALITY ASSURANCE:

A. Qualifications: Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work in this Section.

1.05 PROJECT CONDITIONS OR SITE CONDITIONS:

A. Environmental Requirements:

1. Observe weather conditions.

2. Do not attempt any work in frozen conditions without written approval from the DNR Construction Inspector.

B. Existing Conditions: Survey job condition prior to commencing work.

1. Report any discrepancies between existing conditions, the specifications, and the Drawings to the attention of the Architect/DNR Construction Inspector.

2. Connect to existing facilities in accordance to the obvious intent of Drawings and Specifications.

3. Claims for extra payments as a result of failure to examine existing conditions will not be allowed.

1.06 SEQUENCING:

A. Properly coordinate the work of this section with all other trades.

B. Do not proceed with the work of this section until all other prerequisite work as been completed and approved by the DNR Construction Inspector.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Architect.

PART 3 - EXECUTION

3.01 EXAMINATION:

A. Site Verification of Conditions: Examine the areas and conditions under which work of this Section will be performed.

1. Correct conditions detrimental to timely and proper completion of the Work.

2. Do not proceed until unsatisfactory conditions are corrected.

3.02 CONSTRUCTION:

A. Special Techniques:

1. At contractor's option subject to the approval of the Architect/DNR Construction Inspector, remove, relocate and re-erect the existing masonry walls, in whole or in section.

2. Follow the selected method proposed by the Contractor as approved by the Architect.

B. Interface with Other Work: Interface with the new concrete foundation.

C. Site Tolerances: The final product will be subject to the approval of the DNR Construction Inspector.

3.03 REPAIR/RESTORATION:

A. Restore and repair re-erected unit in accordance with the requirements of division 4.

END OF SECTION 024300

SECTION 02506
CRUSHED STONE PAVING

PART 1 - GENERAL

1.01 SUMMARY:

A. Section Includes: The work covered by this section consist of furnishing all materials, labor, and equipment necessary or required to do the grading, placing and compacting of fill materials and surfacing, paving for roadways, parking area as shown on the Drawings and as specified herein.

B. Related Sections: Drawings and General Provisions of the contract, including the General Covenants and Provisions, Supplementary Covenants and Provisions and General Requirements as well as, but not necessarily limited to, the following:

Section 02200 - Earthwork

C. Measurements and Payments:

1. Measure the quantity of material delivered in tons.

2. Weight on accurate scales designed for weighing loaded trucks.

3. Load vehicles to insure against loss of material between the scales and the point of delivery.

a. No deductions will be made for the weight of moisture naturally occurring in the material.

b. Material will not be deposited and spread until the scale weight ticket is delivered to the inspector and the weight of material verified.

4. The Contract Documents provide for payment of a lump sum bid amount for the entire project, part of which is the work of this contract.

a. The quantity of material provided will be verified by scale tickets and compared to the estimated quantity provided as part of the Contractor's Price Breakdown.

b. In the event that the estimated quantity is larger than the quantity provided, the Contractor shall pay a deduct to the Owner for the difference in cost for both quantity and labor.

c. Additional payments for increased quantities or labor will only be allowed if a change order is warranted due to a change in project scope or for unforeseen situations, as determined by the Architect, warranting additional material and labor to accomplish the original work of this section.

c. The Owner will make no additional payments for additional material or labor to correct deficiencies, shortages or mistakes by the Contractor.

D. Basis of payment:

1. Include in the contract lump sum amount, a lump sum amount for the cost of the work of this section based on unit price per ton for the surfacing material, which shall be full compensation for furnishing all material, tools, equipment and labor necessary to complete the work of this section in conformance with the Drawings and Specifications.

2. This shall be full payment for furnishing, delivering, depositing and spreading the surfacing material as directed and approved by the DNR Construction Inspector.

3. The DNR Construction Inspector will:

   a. Verify that all quantities are in accordance with requirements.

   b. Calculate the value of deducts owed the Owner at the unit price provided in the Contractor's Price Breakdown.

1.02 REFERENCES:

A. Standards of materials and construction shall conform with the Standard Specifications for Highway and Bridge Construction, Series of 2001 of the Iowa Department of Transportation.

1.03 SUBMITTALS:

A. Provide submittals as required is section 01300

1.04 CONTROL OF MATERIALS:

A. General: Use materials as specified in this section, tested and approved for use by the DNR Construction Inspector in accordance with the applicable portions of 2001 Series, I.D.O.T. Section 1106.

B. Samples and Tests: Submit samples of materials to the DNR Construction Inspector in advance of the anticipated use to avoid construction delays. Submit samples and tests in accordance with 2001 Series, IDOT Section 1106.02.

C. Field Testing: Testing of materials and workmanship will continue throughout the project as conducted by the DNR Construction Inspector. Cooperate in these tests in any way needed to obtain the required data and samples.

D. Unacceptable Materials: Unacceptable materials will be rejected in accordance with 2001 Series, IDOT Section 1106.04.

1.05 JOB CONDITIONS:

A. Survey job conditions prior to commencing work. Bring any discrepancies between existing work and the Drawings and Specifications to the attention of the Architect/DNR Construction Inspector. Observe weather conditions. Attempt no work in frozen conditions without written approval from the DNR Construction Inspector.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. Provide class "A" crushed stone consisting of a uniform mixture of coarse and fine particules produced by crushing ledge rock, predominently limestone, dolomite, or quartzite.

1. Percentage of wear: No more than 45, when tested in accordance with AASHTO T96, Grading B.

2. Gradation: In accordance with gradation number 11, when teated with section 4109 of IDOT Standard Specifications, as follows:

Percent	Sieve Size
100	1
20-75	4
20-40	8
6	200

3. Additional Requirements: Provide material containing no more than 4% mud balls.

PART 3 - EXECUTION

3.01 GENERAL:

A. Accomplish the work of this section in accordance with the applicable portions of the 2001 Series, IDOT Standard Specification for Highway and Bridge Construction.

3.02 PREPARATION OF SUBGRADE:

A. Conform to 2001 Series, IDOT Section 2111. If unsuitable subgrade materials are encountered, remove this material to a depth as indicated by the DNR Construction Inspector and replace with suitable ballast material.

3.03 PLACING OF CRUSHED STONE COURSE:

A. Construct base course using crushed rock top course material as defined by 2001 Series, IDOT Section 4122. Place the base course in accordance with applicable sections of the IDOT Standard Specifications for Granular Subbase, Standard Compaction as defined by the IDOT Standard Specifications.

3.05 CLEAN UP:

A. Upon completion of construction, remove all excess materials and construction debris, and restore any damage done to existing buildings or landscape.

END OF SECTION 02506

PART 1 - GENERAL

1.01 SUMMARY:

A. Section Includes: The work covered by this section consist of furnishing all materials, labor, and equipment necessary or required to do the grading, placing, and compacting of fill materials and sidewalk paving as shown on the Drawings and as specified herein.

B. Related Sections: Drawings and General Provisions of the contract, including the General Covenants and Provisions, Supplementary Covenants and Provisions and General Requirements as well as, but not limited to, the following:

Section 03100 - Concrete Form Work
Section 03200 - Concrete Reinforcement
Section 03300 - Cast-In-Place Concrete

1.02 REFERENCES:

A. Standards of materials and construction shall conform with the Standard Specifications for Highway and Bridge Construction, 2001 Series of the Iowa Department of Transportation.

1.03 DELIVERY, STORAGE, AND HANDLING:

A. General: Use only materials as specified for this section and tested and approved for use by the DNR Construction Inspector in accordance with the applicable portions of 2001 Series, I.D.O.T. Section 1106.

B. Samples and Tests: Submit samples of materials to be used to the DNR Construction Inspector in advance of anticipated use to avoid construction delays. Submit samples and tests in accordance with 2001 Series, I.D.O.T. Section 1106.02.

C. Field Testing: Testing of materials and workmanship will continue throughout the project as conducted by the DNR Construction Inspector. Cooperate in these tests in any way needed to obtain the required data and samples.

D. Unacceptable Materials: Unacceptable materials will be rejected in accordance with 2001 Series, I.D.O.T. Section 1106.04.

1.04 PROJECT/SITE CONDITIONS:

A. Environmental Requirements: Observe weather conditions. Attempt no work in frozen conditions without written approval from the DNR Construction Inspector.

B. Existing Conditions: Survey job conditions prior to commencing work. Bring any discrepancies of existing work with the Drawings and Specifications to the attention of the Architect/DNR Construction Inspector.

PART 2 - PRODUCTS

2.01 GRANULAR DRAINAGE MATERIAL:

A. Granular drainage fill for use under concrete walks shall consist of granular free-draining material; consisting of clean bank run gravel or crushed stone of full range of sizes. Maximum size of aggregate shall be 3/4 inch. 15 to 50% of that portion of weight of fill shall be passing the No. 4 sieve.

2.02 CONCRETE SIDEWALK & APRON MATERIALS:

A. Provide materials in accordance with Section 03300.

2.03 EXPANSION JOINT FILLER:

A. Provide expansion joint filler in accordance with Section 03300.

2.04 EXPANSION JOINT SEALER:

A. Provide expansion joint sealer in accordance with Section 03300.

2.05 CONCRETE MIX DESIGN:

A. Air entrained, 4,000 PSI, compressive strength as specified in Section 03300 with slump of two inches to four inches.

2.06 CONCRETE COLOR ADMIXTURES:

A. Admixtures for color-conditioned concrete to color integrally in accordance with ASTM C979. Colors to be selected by the Architect.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Preparation of Subgrade: Conform to 2001 Series, I.D.O.T. Section 2111. If unsuitable subgrade materials are encountered, remove this material to a depth as indicated by the DNR Construction Inspector and replace with suitable ballast material.

B. Placement of Granular Drainage Fill: Place granular drainage fill under all exterior concrete sidewalks, to a compacted minimum depth of six inches, or as indicated on the Drawings and in the details. Compact to 95 percent maximum density as determined in accordance with ASTM Method D.

C. Subgrade Preparation for Concrete Surfacing: Level and compact granular subbase. Sprinkle with water, if dry, until subbase will no longer absorb moisture.

D. Concrete Forms: Forms for concrete surfacing: wood or metal, staked so they are firmly held to line and grade. Make upper edge of form level with finish grades. Do not use twisted,

warped, or broken forms. Coat forms before placing concrete. Lap reinforcing mesh six inches. Leave forms in place 12 hours minimum unless directed otherwise.

E. Concrete Sidewalks & Aprons:

1. Concrete Surfacing: Construct exterior concrete sidewalks where shown on the Drawings. Construct in accordance with the applicable portions of the I.D.O.T. Portland Portland Cement Concrete Sidewalks, Section 2511.

    a. Employ color admixtures in accordance with manufacturer's recommended procedures.

    b. Install expansion joints at transitions of walks and other work in addition to those locations specified in I.D.O.T. Section 2511.

2. Concrete Placement: Do not place concrete over frozen subbase, or ice-coated forms. Tamp and spade or vibrate concrete enough to compact firmly during placement.

3. Concrete: Between 50 and 70 degrees Fahrenheit when placed. In cold weather, heat materials to obtain required temperature. In hot weather, a water-reducing retarder may be used, if approved by the Architect. Erect tight and plump bulkheads, when stopping placement and forming construction joint. Brush on new cement when pouring against hardened concrete.

4. Concrete Sidewalks: 4" thick minimum.

5. Concrete Aprons: 6" thick minimum.

6. Expansion Joints: Install specified one-half inch (1/2") thick, pre-molded expansion filler at abutting or intersecting construction and in expansion joints. Set top of joint filler within one inch (1") of slab surface. Hot pour joints to within one-fourth inch (1/4") of surface with specified joint sealer. Expansion joints: full depth of slab.

7. Control Joints: Score concrete with 1/4" x 1-1/4" deep control joints. Use straightedge guide when scoring joints. Where required depth of control joint cannot be made by scoring, cut joints with carborundum saw.

8. Finishing: Finish surface with fiber broom after leveling and floating. Tool expansion and control joint edges to one-fourth inch (1/4") radius.

9. Do not overwork concrete. Do not allow coarse aggregate to be visible in the final finish.

10. Protecting and Curing: Protect concrete surfaces from rapid drying or wash by rain. Cure and seal immediately after finishing by applying two spray coats of membrane curing compound, in accordance with manufacturer's instructions, at the rate of 500 square feet, or less, per gallon, per coat. Unless otherwise directed by DNR Construction Inspector, do not open surfaced areas to traffic for seven (7) days after concrete placement. In cold weather, avoid opening surfaces where there is danger of de-icing salts from vehicles damaging concrete surface.

3.02 FIELD QUALITY CONTROL:

A. Slump and Control Tests: Meet requirements of Section 03300 and I.D.O.T. Take one set of control test cylinders for every 20 cubic yards and minimum of one set of three cylinders for each day's pour.

3.03 CLEANING:

A. Upon completion of construction, remove all excess materials and construction debris, and restore any damage done to existing buildings or landscape.

END OF SECTION 02510

PART 1 - GENERAL

1.01 SUMMARY:

A. Section Includes: All labor, materials, and equipment required to construct, shore, and remove all forms to accommodate all concrete specified in Section 03300, Cast-In-Place Concrete, as shown on the Drawings, and as specified in other sections of these specifications.

B. Related Sections: Drawings and General Provisions of the Contract, including the General Covenants and Provisions, Supplementary Covenants and Provisions and General Requirements as well as, but not necessarily limited to, the following:

Section 02200 - Earthwork
Section 03300 - Cast-In-Place Concrete
Section 15400 - Plumbing

1.02 REFERENCES:

A. All formwork and methods of construction shall conform to the requirements of the state of Iowa Bureau of Labor and all OSHA Standards and A.C.I. 347.

1.03 SUBMITTALS:

A. Provide submittals in accordance with Section 01300.

B. Manufacturer's Data: Within 30 calendar days after award of the contract, submit manufacturer's data and installation instruction for proprietary materials including form coatings, ties and accessories, and manufacturer's form system if used.

C. Shop Drawings: When requested by the DNR Construction Inspector or the Architect for the purpose of explaining details or structural integrity, the Contractor shall submit those drawings requested prior to erection of the project.

1.04 QUALITY ASSURANCE:

A. Formwork: Design of formwork is the responsibility of the Contractor.

B. Standards: Comply with all applicable provisions of ACI 347.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. Form Materials:

1. Construct formwork for exposed concrete surfaces with smooth-faced undamaged plywood, undented metal, or other panel-type materials acceptable to the DNR

Construction Inspector, to provide continuous, straight, plumb, smooth cast surface, furnish in largest practical sizes to minimize number of joints.

2. Provide form material with sufficient thickness to withstand pressure of newly-placed concrete without reflection or bowing.

B. Form Ties:

1. Provide factory-fabricated, adjustable length removable or snap-off metal form ties, designed to prevent form deflection and to prevent spalling concrete surfaces upon removal.

2. Provide ties so that portion remaining within concrete after removal of exterior parts is at least 1-1/2" from the outer concrete surface.

3. Form ties shall not leave a hole larger than 1" diameter in the concrete surface.

C. Form Coating: Provide commercial formulated form-coating compounds that will not bond with, stain, nor adversely affect concrete surfaces requiring bond or adhesion, nor impede the wetting of surfaces to be cured with water or curing compounds.

2.02 DESIGN OF FORMWORK:

A. General:

1. Design, erect, support, brace, and maintain formwork so that it will safely support vertical and lateral loads that might be applied, until such loads can be supported by the concrete structure.

2. Carry vertical and lateral loads to ground by formwork system and in-place construction that has attained adequate strength for that purpose.

3. Construct formwork so that concrete members and structures are of correct size, shape, alignment, elevation, and position.

4. Design forms and falsework to include assumed values of live load, dead load, weight of moving equipment operated on formwork, concrete mix, height of concrete drop, vibrator frequency, ambient temperature, foundation pressures, stresses, lateral stability, and other factors pertinent to safety of structure during construction.

5. Provide shore and struts with positive means of adjustment capable of taking up formwork settlement during concrete placing operations, using wedges or jacks or a combination thereof.

6. Provide trussed supports when adequate foundations for shores and struts cannot be secured.

7. Support form facing materials by structural members spaced sufficiently close to prevent objectionable deflection.

8. Fit forms placed in successive units for continuous surfaces to accurate alignment, free from irregularities, and within allowable tolerances.

9. Provide camber in formwork as required for anticipated deflections due to weight and pressures of fresh concrete and construction loads.

10. Provide formwork sufficiently tight to prevent leakage of cement paste during concrete placement.

11. Solidly butt joints and provide backup material at joints as required to prevent leakage and fins.

B. Earth Forms: Side forms of footings may be omitted and concrete placed directly against excavation only when requested by the Contractor and accepted by the DNR Construction Inspector.

1. When omission of forms is accepted, provide additional concrete 1" on each side of the minimum design profiles and dimensions shown.

PART 3 - EXECUTION

3.01 EXAMINATION:

A. Examine the substrate and conditions under which work of this section is to be performed.

B. Correct unsatisfactory conditions which would prevent proper and timely completion of the work.

C. Do not proceed until unsatisfactory conditions have been corrected.

3.02 ERECTION:

A. General:

1. Construct forms complying with ACI 347, to the exact sizes, shapes, lines, and dimensions shown, and as required to obtain accurate alignment, location, grades, level, and plumb work in finish structures.

2. Provide for openings, offsets, sinkages, keyways, recesses, moldings, reglets, chamfers, blocking, screeds, bulkheads, anchorages, inserts, and other features required.

a. Use selected materials to obtain required finishes.

3. Forms for openings and construction which accommodates installation by other trades whose materials and products must be fabricated before the opportunity exists to verify the measurements of adjacent construction which effects such installations, shall be accurately sized and located as dimensioned on the Drawings.

4. In the event that deviation from the Drawing dimensions results in problems in the field, the Contractor shall be responsible for resolution of the conditions as approved by the Architect, without additional expense to the Owner.

B. Fabrication:

1. Fabricate forms for easy removal without hammering or prying against concrete surfaces.

2. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces.

3. Provide top forms for inclined surfaces where the slope is too steep to place concrete with bottom forms only.

4. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and assure ease of removal.

5. Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete.

6. Brace temporary closures and set tightly to temporary openings on forms in as inconspicuous locations as possible, consistent with design requirements.

7. Form intersecting planes to provide true, clean cut corners.

C. Falsework:

1. Erect falsework and support, brace and maintain it to safely support vertical, lateral, and asymmetrical loads applied until such loads can be supported by in-place construction.

2. Construct falsework so that adjustments can be made for take-up and settlement.

3. Provide wedges, jacks, or camber strips to facilitate vertical adjustments.

4. Carefully inspect falsework and formwork during and after concrete placement operations to determine abnormal deflection or signs of failure; make necessary adjustments to produce work of required dimensions.

D. Forms for Exposed Concrete:

1. Drill forms to suit ties used and to prevent leakage of concrete mortar around tie holes.

2. Do not splinter forms by driving ties through improperly prepared holes.

3. Provide sharp, clean corners at intersecting planes, without visible edges or offsets.

4. Back joints with extra studs or girts to maintain true, square intersections.

5. Use extra studs, walers, and bracing to prevent objectionable bowing of forms between studs and to avoid bowed appearance in concrete.

6. Do not use narrow strips of form material which will produce bow.

7. Assemble forms so they may be readily removed without damage to exposed concrete surfaces.

E. Corner Treatment: Unless shown otherwise, form chamfers with 3/4" x 3/4" strips, accurately formed and surfaced to produce uniformly straight lines and tight edge joints on exposed concrete.

1. Extend terminal edges to required limit and miter chamfer strips at changes in direction.

F. Control Joints: Locate as directed by DNR Construction Inspector or as indicated on the Drawings.

G. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades.

1. Verify size and location of openings, recesses and chases with the trade requiring such items.

2. Accurately place and securely support items to be built into forms.

H. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete.

1. Remove chips, wood, sawdust, dirt, and other debris just before concrete is placed.

2. Retighten forms immediately after concrete placement as required to eliminate mortar leaks.

3.03 INSTALLATION:

A. Embedded Items:

1. General: Set and build into the work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete.

2. Use setting drawings, diagrams, instructions and directions provided by suppliers of the items to be attached thereto.

3. Edge Forms and Screeds: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in the finished slab surface.

4. Provide and secure units to support types of screeds required.

B. Shores and Supports: Comply with ACI 347 for shoring construction, and as herein specified.

1. Submit a shore removal and reshoring schedule and drawings for the DNR Construction Inspector review before proceeding with this work. Do not proceed until schedule and drawings have been reviewed.

3.04 APPLICATION:

A. Form Coating: Coat form contact surfaces with form-coating compound before reinforcement is placed.

1. Do not allow excess form coating material to accumulate in the forms or to come in contact with surfaces which will be bonded to fresh concrete. Apply in compliance with manufacturer's instructions.

3.05 FIELD QUALITY CONTROL:

A. Inspection: Concrete shall not be placed in forms until inspected by DNR Construction Inspector and permission is given to start placing concrete.

3.06 CLEANING:

A. General: Formwork not supporting concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 10 degrees C (50 degrees F) for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form removal operation, and provided that curing and protection operations are maintained.

B. Formwork: Formwork supporting weight of concrete, such as beam soffits, joists, slabs, and other structural elements may not be removed in less than 14 days, and not until concrete has attained design minimum 28-day compressive strength.

1. Determine potential compressive strength of in-place concrete by testing field-cured specimens representative of the concrete location or members, as specified in other sections.

C. Form-Facing Material: Form-facing material may be removed four days after placement, only if shores and other vertical supports have been arranged to permit removal of form-facing material without loosening or disturbing shores and supports.

D. Reuse of Forms: Clean and repair surfaces of forms to be reused in the work.

1. Split, frayed, delaminated or otherwise damaged form-facing material will not be acceptable. Apply new form-coating compound material to concrete contact surfaces as specified for new formwork.

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

END OF SECTION 03100

PART 1 - GENERAL

1.01 SUMMARY:

A. Section Includes: All reinforcing steel, steel mesh, and accessories and the installation of these items for all concrete reinforcement for this project.

B. Related Sections: Drawings and General Provisions of the contract, including the General Covenants and Provisions, Supplementary Covenants and Provisions and General Requirements as well as, but not necessarily limited to, the following:

Section 03100 Concrete Formwork
Section 03300 Cast-In-Place Concrete

1.02 REFERENCES:

A. Comply with all applicable provisions of the following standards:

1. CRSI "Manual of Standard Practice"

2. ACI 315 "Details and Detailing of Concrete Reinforcement"

3. ACI 318 "Building Code Requirements for Reinforced Concrete"

4. ASTM A82 "Standard Specifications for Cold Drawn Steel Wire For Concrete Reinforcement"

5. ASTM A185 "Standard Specifications for Welded Steel Wire Fabric For Concrete Reinforcement"

6. ASTM A615 "Standard Specifications for Deformed and Plain Billet-Steel Bars For Concrete Reinforcement"

1.03 SUBMITTALS:

A. Shop Drawings: Submit complete shop drawings of all materials proposed to be furnished and installed under this section in accordance with ACI "Manual of Standard Practice for Detailing Concrete Structure," ACI 315. Show:

1. Bar schedule, stirrup spacing, diagrams of bent bars, and arrangements and assemblies.

2. Review shop drawings requirements with DNR Construction Inspector before ordering shop drawings.

B. Mill Certificates: Submit steel producer's certificates of mill analysis, tensile and bend tests for reinforcing steel.

1. Submit certificates showing conformity with these requirements and those of ASTM A615 to the Architect for each melt.

1.04 DELIVERY, STORAGE AND HANDLING:

A. Delivery: Deliver reinforcement to the job site bundled, tagged, and marked.

1. Use metal tags indicating bar size, lengths, and other information corresponding to markings shown on placement diagrams.

B. Storage: Store reinforcement at the job site in a manner to prevent damage and accumulation of dirt and excessive rust.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. Steel and Wire Reinforcement:

1. Provide reinforcing steel consisting of deformed bars of the sizes shown on the Drawings.

2. Provide steel conforming to ASTM A615 Grade 60 with deformation conforming to ASTM A305.

3. Provide wire reinforcement conforming to ASTM A82 and welded wire fabric conforming to ASTM A185.

B. Wire Reinforcement: Provide in accordance with ASTM A82.

C. Welded Wire Fabric: Provide in accordance with ASTM A185.

1. Unless otherwise noted elswere, reinforce all sloabs with 6 x 6 - W 1.4 x W 1.4.

D. Tie Wire: No. 16 double annealed iron wire.

E. Accessories: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcement in place:

1. Use wire bar-type supports complying with CRSI recommendations, unless otherwise indicated.

a. Do not use wood, brick and other such unacceptable materials.

2. For slabs on grade, use supports with sand plates or horizontal runners where base material will not support chair legs.

3. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with either hot-dip galvanized or plastic protected legs.

PART 3 - EXECUTION

3.01 EXAMINATION:

A. Examine the substrate, formwork, and the conditions under which concrete reinforcement is to be placed, and correct conditions which would prevent proper and timely completion of the work.

B. Do not proceed with the work until satisfactory conditions have been corrected.

3.02 INSTALLATION:

A. General: Comply with the specified standards for details and methods of reinforcement placement and supports, and as herein specified.

1. Clean reinforcement to remove loose rust and mill scale, earth, and other materials which reduce or destroy bond with concrete.

2. Position, support, and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as required.

3. Place reinforcement to obtain the minimum coverage for concrete protection.

4. Arrange, space, and securely tie bars and bar supports together with 16 gauge wire to hold reinforcement accurately in position during concrete placement operations.

5. Set wire ties so that twisted ends are directed away from exposed concrete surfaces.

6. Install welded wire fabric in lengths as long as practicable.

7. Lap adjoining pieces at least one full mesh.

8. Provide sufficient numbers of supports and of strength to carry reinforcement.

9. Do not place reinforcing bars more than 2" beyond the last leg of any continuous bar support.

10. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.

11. Splices: Provide standard reinforcement splices by lapping ends, placing bars in contact, and tightly wire tying.

a. Lap horizontal splices a minimum of 18".

b. Lap Vertical splices a minimum of 28".

c. Place bars in contact and tightly tie wire.

END OF SECTION 03200

PART 1 - GENERAL

1.01 SUMMARY:

A. Section Includes: Provisions for all labor, materials and equipment required to construct all items classified as cast-in-place concrete.

1. All concrete foundations and slabs as shown on the foundation plan floor plans and building section, as well as all other concrete not specifically specified elsewhere, are classified as cast-in-place concrete.

2. All sidewalks and exterior slabs are specified in Section 02500.

B. Related Sections: Drawings and General Provisions of the Contract, including the General Covenants and Provisions, Supplementary Covenants and Provisions and General Requirements as well as, but not necessarily limited to, the following:

Section 02200 - Earthwork
Section 02500 - Paving and Surfacing
Section 03100 - Concrete Formwork
Section 03200 - Concrete Reinforcement

1.02 REFERENCES:

A. Codes and Standards: Comply with provisions of following codes, specifications and standards except where more stringent requirements are shown or specified.

1. Uniform Building Code, U.B.C., latest edition.

2. American Concrete Institute (ACI).

a. Manual of Concrete Practice.

b. ACI 301 - Specifications for Structural Concrete for Buildings.

c. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete.

d. ACI 305 - Hot Weather Concreting.

e. ACI 306 - Cold Weather Concreting.

f. ACI 308 - Standard Practice for Curing Concrete.

g. ACI 318 - Building Code Requirements for Reinforced Concrete.

3. American Society for Testing of Materials (ASTM).

a. ASTM C33 - Standard specification for concrete aggregates.

b. ASTM C31 - Making and curing compressive and flexural strength test specimens in the field.

c. ASTM C94 - Standard specification for ready-mixed

d. ASTM C138 - Test for unit weight, yield and air content of concrete.

e. ASTM C143 - Test for slump test of Portland cement concrete.

f. ASTM C150 - Standard specification for Portland cement.

g. ASTM C260 - Standard specification for air-entraining admixture for concrete.

h. ASTM C309 - Standard specification for liquid membrane-forming compounds for curing concrete.

i. ASTM C494 - Standard specification for chemical admixtures for concrete.

j. ASTM D994 - Standard specification for pre-formed expansion joint filler for concrete.

k. ASTM D1850 - Standard specification for concrete joint sealer, cold application type.

4. Concrete Reinforcing Steel Institute (CRSI).

a. Manual of Standard Practice.

5. Iowa State Building Code, latest edition.

1.03 SUBMITTALS:

A. Product Data: Submit to the Architect manufacturer's product data with application and installation instructions for proprietary materials and items, accessories, admixtures, patching compounds, water stops, joint systems, curing compounds, dry-shake finish materials, and others as requested by Architect.

B. Samples: Submit to the DNR Construction Inspector samples of materials specified, as requested, including names, sources and descriptions.

C. Quality Control Submittals:

1. Design Data: Submit data on proposed design mixes when trial batch method is used.

2. Test Reports: Employ, at Contractor's expense, a testing laboratory acceptable to the Architect to perform material evaluation tests and submit reports.

3. Material Certificates: Provide, in lieu of laboratory test reports when permitted by Architect, certificates signed by Manufacturer and Contractor verifying that each item complies with or exceeds specified requirements, .

1.04 QUALITY ASSURANCE:

A. Qualifications:

1. Provide at least one person, on site, thoroughly familiar with the specified requirements, completely trained, and experienced in the necessary skills, to direct all work performed under this section.

2. Use adequate numbers of skilled workers to ensure construction in strict accordance with the approved design.

1.05 DELIVERY, STORAGE, AND HANDLING:

A. Protection: Use all means necessary to protect the materials of this section before, during, and after installation and to protect the work and materials of all other trades.

B. Replacement: In the event of damage, immediately make all repairs and replacements necessary to the approval of the DNR Construction Inspector and at no additional cost to the Owner.

1.06 PROJECT/SITE CONDITIONS:

A. Environmental Requirements: Observe weather conditions. Attempt no work in frozen conditions without written approval from the DNR Construction Inspector.

B. Existing Conditions: Survey site conditions prior to commencing work.

1. Bring any discrepancies between existing work and the Drawings and Specifications to the attention of the Architect/DNR Construction Inspector.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. Subject to compliance with requirements, products from the following manufacturers can be incorporated into the work of this section.

1. Euclid Chemical Co., 19218 Redwood Road, Cleveland, Ohio 44110.

2. Master Builders Co., Ltd., 79 Kincort Street, Toronto, Ontario M6M3E4.

3. Sika Chemical Corporation, P. O. Box 297, Lyndhurst, New Jersey 07071.

4. Chem-Master Corporation, 477 Industrial Parkway, Chagrin Falls, Ohio 44022.

5. W. R. Grace and Co., 62 Wittemore Avenue, Cambridge, Massachusetts 02140.

6. W. R. Meadows, Inc., P. O. Box 543, Elgin, Illinois 60120.

7. Protex Industries, Inc., 1331 West Evans Avenue, Denver, Colorado 80223.

8. Sonneborn Building Products, 7711 Computer Avenue, Minneapolis, Minnesota 55435.

9. Antihydro Co., 265 Badger Avenue, Newark, New Jersey 07108.

10. L & M Construction Chemicals, Inc., 8316 Blondo Street, Omaha, Nebraska 68134.

11. Glifford-Hill and Co., Inc., Woodland Green, Charlotte, North Carolina 28210.

12. The Celotex Corporation, 1500 North Dale Mabry Highway, Tampa, Florida 33607.

13. J & P Petroleum Products, Tex-Mastic Construction Materials, 2715 South Westmoreland, P. O. Box 4206, Dallas, Texas 75208.

2.02 MATERIALS:

A. Portland Cement: ANSI/ASTM C 150, Type I or Type III, high early-strength cements unless otherwise acceptable to Architect.

B. Normal Weight Aggregates: ANSI/ASTM C 33, and as herein specified.

1. Coarse aggregate crushed limestone.

2. Provide fine aggregate, regularly graded from coarse to fine, from source approved by Iowa D.O.T. Maximum size of aggregate not more than three-fourths minimum clear spacing between reinforcing bars and not more than one-fifth of smallest dimension of slab or member for which concrete is being used.

3. Aggregate for unreinforced slabs maximum size one-third of slab thickness.

C. Water: Provide clean, potable water for concrete, free from injurious amounts of foreign matter.

D. Water-Reducing Admixtures: ANSI/ASTM, C 494, Type A and contain not more than one percent (1%) chloride ions.

"Eucon WR-74;" Euclid Chemical Co.
"Pozzolith 322N;" Master Builders.
"Plastocrete 160;" Sika Chemical Corp.
"Chemtard;" Chem-Masters Corp.
or approved equal

E. Air-Entraining Admixture: ANSI/ASTM C 260, added to mixer in lieu of air-entrained cement.

"Darex (AEA);" W. R. Grace Co.
"Ad-Aire;" Carter-Waters Corp.
"Protex AES;" Protex Industries, Inc.
"Seal-Tight;" W. R. Meadows, Inc.

F. Liquid Membrane-Forming Curing Compound: Liquid type membrane-forming curing compound complying with ANSI/ASTM C 309, Type I, Class A.

"Masterseal;" Master Builders.
"A-H 3 Way;" Sealer' Anti-Hydro Waterproofing Co.
"Ecocure;" Euclid Chemical Co.
"Clear Seal;" W. R. Grace.
"Kure-N-Seal;" Sonneborn-Contech.
"Polyclear;" Upco Chemical/USM Corp.
"L & M Cure;" L & M Construction Materials.
"LR-151;" Protex Industries.
"Hardtop;" Glifford - Hill.

1. Curing compound: Provide a continuous, unbroken membrane adhering to moist concrete without disintegration, checking or peeling from the surface, nor showing signs of such deterioration within 30 days after application under actual working conditions.

   a. Provide a color free compound sufficiently transparent allowing no permanent change in concrete color.

   b. The compound may contain, however, a temporary dye of sufficient color to make the membrane clearly visible for a period of at least four hours after application.

2.03 EQUIPMENT:

A. Batching, Mixing, and Delivery Equipment: Use transit-mixed concrete from approved batching and mixing plant. Batch, mix, and transport concrete to site is accordance with ANSI/ASTM 94.

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

2.04 ACCESSORIES:

A. Pre-formed Joint Filler: ASTM D 994 and as herein specified.

1. Pre-formed non extruding resilient material, one-half (1/2) inch wide depth required to bring surface to within one-half (1/2) inch of surface.

2. Available Products: Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:

   "Flexcell;" Celotex Corporation.
   "Sealtight;" W. R. Meadows, Inc.
   "Tex Mastic;" J & P Petroleum Products.

B. Joint Sealer: ASTM D 1850 Concrete Joint Sealer, cold-application type.

C. Vapor Barrier: Under slabs on ground, 4 mil polyethylene film.

D. Storage: Store all cement materials in weather-tight enclosure, clear of ground, and protected from weather with suitable covering.

E. Embedded Items: Verify and coordinate embedded items furnished by other trades.

F. Admixtures: Use air-entraining admixture in exterior exposed concrete, unless otherwise indicated as determined by ANSI/ASTM C 138.

1. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having air content within following limits:

2. Concrete structures and slabs exposed to freezing and thawing or subjected to hydraulic pressure:

Maximum Size Aggregate	Amount of Air (%)
1 1/2" or 2"	5% + 1%
3/4" or 1"	6% + 1%
3/8" or 1/2"	7 1/2% + 1%

G. Under slab Insulation: Provide manufacturer standard lengths and width polystyrene board insulation where shown on the Drawings.

1. Rigid, close cell, extruded, expanded polystyrene board with integral high density skin; complying with FS HH-1-524 C, Type IV, minimum 20 PSI compressive strength, K-value of 0.20; 0.3% maximum water absorption; 1.1 perm.-inch maximum water vapor transmission.

2. Thickness: As shown on the Drawings.

2.05 MIXES:

A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301.

1. If trial batch method used, use an independent testing facility acceptable to Architect for preparing and reporting proposed mix designs.

2. Do not use the same testing facility as used for field quality control testing without Architect's approval.

B. Design mixes to provide normal weight concrete with the following properties, as indicated on drawings and schedules:

1. 4,000 psi 28-day compressive strength; 560 lbs. cement per cubic yard minimum; W/C ratio, 0.44 maximum.

2. 3,000 psi 28-day compressive strength; 480 lbs. cement per cubic yard minimum; W/C ratio; 0.58 maximum.

C. Consistency: Determine the quantity of water required for proper consistency of concrete by slump test in accordance with ANSI/ASTM C 143.

1. For Vertical Wall Sections, Columns -- Maximum slump, 4 inches, plus or minus one inch tolerance.

2. For Footings, Beams, Slabs -- Maximum slump, 3 inches, plus or minus one inch tolerance.

PART 3 - EXECUTION

3.01 EXAMINATION:

A. Coordinate the installation of joint materials and moisture barriers with placement of forms and reinforcing steel.

B. Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast-in.

C. Notify other crafts to permit installation of their work; cooperate with other trades in setting such work.

D. Moisten wood forms immediately before placing concrete where form coatings are not used.

3.02 PREPARATION:

A. Drain and pump all water from excavations, forms, and any locations where concrete is to be placed.

1. Bottom of excavations shall be undisturbed earth free of frost or debris, level and compacted.

2. Do not place any concrete until the Architect or DNR Construction Inspector has inspected and approved forms and soil conditions, and until reinforcing, sleeves, and embedded items have been placed.

3. Clean all dirt and debris from transporting equipment. Clean reinforcement of all foreign matter. Clean forms and oil or wet (except in freezing conditions) surfaces.

4. Compact, level, and dampen base fill material under slabs on grade.

5. Prior to placing concrete, install polyethylene vapor barrier under interior slabs.

6. Do not puncture or otherwise damage vapor barrier or membrane waterproofing.

B. Transport concrete to prevent separation of materials in accordance with ACI practices.

1. Do not add water to concrete during transporting.

2. Handle from mixer to point of placement with carts, buggies, or conveyors.

3. Do not dump concrete from mixer or from transporting equipment with a free fall of more than three feet.

4. Clean transporting equipment at frequent intervals during placement.

5. Do no use partially hardened or contaminated concrete.

3.03 PLACEMENT OF CONCRETE:

A. Place concrete in accordance with ACI 304 "Recommended practice for measuring, mixing, transporting and placing concrete" and as herein specified.

B. Place concrete continuously or in layers of such thickness that no fresh concrete will be placed on concrete which as hardened sufficiently to cause the formation of seams or planes of weakness.

1. If a section cannot be placed continuously, provide construction joints as herein specified.

2. Deposit concrete as nearly as practicable to its final location to avoid segregation.

C. Work concrete into corners and around reinforcement.

1. Machine vibrate sufficiently to insure thorough compaction and complete embedment of reinforcing.

2. Stop placement at point of no shear, or where directed, and erect tight, plumb dams through forms.

3. Place concrete between construction joints in one continuous operation. Locate construction joints in slabs under partitions.

4. Brush on neat cement when pouring against hardened concrete.

D. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers not deeper than 24" and in a manner to avoid inclined construction joints.

1. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.

2. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding or tamping.

a. Use equipment and procedures for consolidation of concrete in accordance with ACI recommended practices.

3. Do not use vibrators to transport concrete inside forms.

a. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine.

b. Place vibrators to rapidly penetrate placed layer and at least six (6) inches into preceding layer.

c. Do not insert vibrators into lower layers of concrete that have begun to set.

d. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.

E. Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.

1. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.

2. Bring slab surfaces to correct level with straight edge and strike off.

3. Use bull floats or darbies to smooth surface, free of humps or hollows.

4. Do not disturb slab surfaces prior to beginning finishing operations.

5. Maintain reinforcing in proper position during concrete placement operations.

F. Cold Weather Placing: Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306, "Cold Weather Concreting," and as herein specified.

1. When air temperature has fallen to or is expected to fall below 40°F. (4°C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 40°F. (4°C), and not more than 80°F. (27°C) at point of placement, and maintain minimum temperature over the entire work for no less than 72 hours.

a. Do not use frozen materials or materials containing ice or snow.

b. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

c. Do not use calcium chloride, salt and other materials containing antifreeze agents or chemical accelerators unless otherwise accepted in mix designs.

G. Hot Weather Placing: When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305, "Hot Weather Concreting," and as herein specified.

1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90°F. (32°C). Mixing water may be chilled, or chopped ice may be used to control temperature provided water equivalent of ice is calculated to total amount of mixing.

2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.

3. Wet forms thoroughly before placing concrete.

4. Use water-reducing retarding admixture (Type A) when required by high temperatures, low humidity, or other adverse placing conditions.

H. Expansion Joints: Unless otherwise specifically designated on the Drawings, install expansion joint filler where interior slabs abut exterior walls, interior bearing walls and columns, and at perimeter of concrete equipment pads.

1. Omit expansion joint filler and install 15 lb. felt, centered below door, to break bond at exterior doors with concrete platforms, unless otherwise shown on the Drawings.

I. Control Joints: Cut control joints 12 to 15 feet o.c. each way in all exposed concrete floor slabs on grade.

1. Locate in a uniform pattern within room spaces and centered below partitions separating spaces.

2. Locate at doorways between rooms, at centerlines of exposed columns and to divide areas of irregular-shaped rooms.

3. Verify location and cut to depth of one-sixth (1/6) of slab thickness with minimum of three-fourths (3/4) inch.

4. Cut with carborundum saw, approximately six (6) to twenty-four (24) hours after placing concrete and when a minimum amount of raveling occurs in concrete.

5. On exterior walks, score with one-fourth inch by one inch (1/4" x 1") deep control joints.

6. Use straight edge guide when scoring joints.

7. Where required depth of control joint cannot be made by scoring, cut joints with carborundum saw.

3.04 CONCRETE FINISHING:

A. Finish on Formed Surfaces: Verify that finished or formed surfaces conform accurately to the shape, alignment, grades and sections shown on the Drawings.

1. Finish surfaces free from fins, bulges, ridges, offsets, honeycombing or roughness, presenting a finished, continuous, hard surface.

2. Round and bevel all sharp angles, where required.

3. In accordance with coating manufacturer's specifications, do not permit the presence of any material detrimental to the specified paint or coating on any formed or finished surface to be painted or otherwise coated.

4. Rough Form Finish:

    a. Provide as-cast rough form finish to formed concrete surfaces that are to be concealed in the finish work or by any other construction.

    b. Standard rough form finish shall be the concrete surface having the texture imparted by the form facing material used, with tie holes and defective areas repaired and patched, and all fins and other projections exceeding one-fourth inch (1/4") in height rubbed down or chipped off.

5. Smooth Form Finish:

    a. Provide as-cast smooth form finish for formed concrete surfaces that are to be exposed to view, or that are to be covered with a coating material other than cement plaster applied directly to the concrete.

    b. Produce smooth form finish by selecting form material to impart a smooth, hard, uniform texture and arranging them orderly and symmetrically with a minimum of seams.

    c. Repair and patch defective areas with all fins and other projections completely removed and smoothed.

B. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces, strike off smooth and finish with a smooth troweled finish.

C. Slab and Floor Finished: Provide an adequate slope to the drains or to suitable points of disposal for all floor and flat roof surfaces and all exterior concrete floor, sidewalk and flat slab surfaces.

1. Provide the direction of slope and the amount of crowning as shown on the Drawings or as prescribed by the Architect or the DNR Construction Inspector. Do not allow dry topping on any of the finishes.

2. Scratch Finish:

    a. Apply scratch finish to monolithic slab surfaces that are to receive concrete floor topping or mortar setting beds for tile and other bonded applied cementitious-finish flooring material.

    b. After placing slabs, plane the surface to a tolerance not exceeding one-fourth inch (1/4") in twenty-four inches (24") when tested with a straight edge.

    c. Slope surfaces uniformly to drains where required.

d. After leveling, roughen the surface before the final set by using stiff broom brush or rake.

3. Float Finish:

a. Apply float finish to monolithic slab surfaces that are to receive trowel finish and other finishes hereinafter specified, and to slab surfaces which are to be covered with insulation, and as otherwise shown on the Drawings or in the schedules.

b. After placing concrete slabs, do not work the surface further until ready for floating.

c. Begin floating when the surface water has disappeared and when the concrete has stiffened sufficiently to permit operation of a power-driven float, hand float, or both.

d. Consolidate the surface with power-driven floats, or by hand-floating if area is small or inaccessible to power units.

e. Check and level the surface plane to a tolerance not exceeding one-fourth inch (1/4") in ten feet (10'-0") when tested with a ten-foot (10'-0") straight edge placed on the surface at not less than two different angles.

f. Cut down high spots and fill low spots.

g. Uniformly slope surfaces to drains where required.

h. Immediately after leveling, refloat the surface to a uniform, smooth, granular texture.

4. Trowel Finish:

a. Apply trowel finish to monolithic slab surfaces that are to be exposed to view, unless otherwise shown, and to slab surfaces that are to be covered with resilient flooring, carpeting, paint, or other thin-film finish coating system.

b. After floating, begin the 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.

c. Consolidate the concrete surface by the final hand troweling operation, free from trowel marks, uniform in texture and appearance, and with a surface plane tolerance not exceeding one-eighth inch (1/8") in ten feet (10'-0") when tested with a ten-foot (10'-0") straight edge.

d. Grind smooth those surface defects which would telegraph through applied floor covering system.

5. Nonslip Broom Finish:

a. Apply nonslip broom finish to exterior concrete platforms, steps and ramps, and elsewhere as shown on the Drawings or in the schedules.

b. Immediately after trowel finishing, slightly roughen the concrete surface by brooming in the direction perpendicular to the main traffic route. Use a fiber bristle broom.

c. Coordinate the required finish with the Architect or DNR Construction Inspector prior to the application.

3.05 CONCRETE CURING:

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

1. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing.

2. Weather permitting, keep continuously moist for not less than seven (7) days.

3. Begin final curing procedures immediately following initial curing and before concrete has dried.

4. Continue final curing for at least seven (7) days in accordance with ACI 308, "Standard Practice for Curing Concrete."

5. Avoid rapid drying at end of final curing period.

B. Curing Method: Perform curing of concrete by moist curing, by moisture-retaining cover curing, by curing compound, and by combinations thereof as herein specified.

1. Provide moisture curing by the following methods:

a. Keep concrete surface continuously wet by covering with water.

b. Continuous water-fog spray.

c. Covering concrete surface with specified absorbent cover, thoroughly saturating cover with water and keeping continuously wet.

d. Place absorbent cover to provide coverage of concrete surfaces and edges, with four-inch (4") lap over adjacent absorbent cover.

2. Provide moisture-cover curing as follows: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least three inches (3") and sealed by waterproof tape or adhesive.

a. Immediately repair any holes and tears during curing period using cover material and waterproof tape.

3. Apply curing compounds to slabs as follows:

a. Apply specified curing and sealing compound to concrete slabs as soon as final finishing operations are complete (within two [2] hours).

b. Apply uniformly in continuous operation by power-spray or roller in accordance with manufacturer's directions.

c. Recoat areas subjected to heavy rainfall within three (3) hours after initial application.

d. Maintain continuity of coating and repair damage during curing period.

4. Do not use membrane curing compounds on surfaces which are to be covered with coating material applied directly to concrete, such as; liquid floor hardener, waterproofing, dampproofing, membrane roofing, flooring, painting, and other coatings and finish materials, unless otherwise acceptable to the coating manufacturer.

3.06 MISCELLANEOUS CONCRETE ITEMS:

A. Filling-In: Fill-in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place.

1. Mix, place, and cure concrete as herein specified to blend with in-place construction.

2. Provide other miscellaneous concrete filling shown or required to complete work.

B. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on the Drawings or required for the machine and equipment actually furnished.

1. Set anchor bolts for machines and equipment to template, at correct elevations, complying with certified diagrams or templates of the manufacturer furnishing the machines and equipment.

2. Provide isolation joints surrounding bases where indicated or required.

3.07 FIELD QUALITY CONTROL:

A. Test of Materials and Installed Work: Materials and installed work may require testing and retesting, as directed by Architect, at any time during progress of work.

1. Allow free access to material stockpiles and facilities.

2. Tests, not specifically indicated to be done at Owner's expense, including retesting of rejected materials and installed work, shall be done at Contractor's expense.

3. Slump Tests: Take one slump test for each 20 yards, or as directed by Architect, of concrete placed at one operation in accordance with ASTM C 143. Keep job record of test results and location.

4. Control Tests: During placement of concrete, take three standard 6" test cylinders in accordance with ACI 318-63 and ASTM C 31 for each type of concrete used. Test one at seven (7) days and one at twenty-eight (28) days.

a. Take one set for every 20 cubic yards and any fraction with a minimum of one set of three cylinders for each day's pour. Tag cylinders to show date and location of test cylinder.

b. Have compressive strength tests made by independent laboratory and results sent directly to Architect.

c. Hold remaining cylinders in case of breakage.

d. Should retention at job site delay testing beyond seven (7) days, fourteen (14) day test is acceptable.

e. Keep test cylinders shaded and damp until sent to laboratory.

3.08 REMEDIAL WORK:

A. General: Reinforce or replace deficient work as directed by the Architect or DNR Construction Inspector and at no additional cost to the Owner.

B. Patching: Repair defective areas and fill form-tie holes and similar defects in accordance with ACI 301.

1. Where, in the opinion of the Architect or DNR Construction Inspector surface defects such as honeycomb occur, repair the defective areas as directed by the Architect or DNR Construction Inspector.

3.09 PROTECTION OF CONCRETE CONSTRUCTION:

A. All surfaces shall be protected against injury.

1. During the first 72 hours after placing the concrete, any wheeling, working or walking on the concrete shall not be permitted.

2. All slabs subject to wear shall be covered with a layer of sand or other suitable material as soon as the concrete has set.

3. Sisalcraft paper or other similar tough waterproof paper may also be used, provided all joints between adjacent strips of paper are carefully sealed. This does not alter the requirements for proper curing.

B. Do not place concrete slabs or top surfaces of walls during rain unless acceptable protective shelter is provided; and during such weather, all concrete placed within the preceding 12 hours shall be protected with waterproof canvas or other suitable coverings. These shall be provided and kept ready at hand.

C. All concrete construction shall be protected from excessive loading.

D. Installation of mechanical and electrical equipment shall be accomplished by employing shores, bearing plates, frames, cranes and temporary beams.

END OF SECTION 03300

PART 1 - GENERAL

1.01 SECTION INCLUDES:

A. Grout materials.

B. Thermal conductivity

C. Packaging

D. Mixing

1.02 REFERENCES:

A. ASTM D-5334 - Standard Test Method for Determination of Thermal Conductivity of Soils and Soft Rock by Thermal Needle Probe Procedure;

B. ASTM D-5084 - Measurement of Hydraulic Conductivity of Saturated Porous Materials using a Flexible Wall Pereater, Method C;

C. (EPRI) TR-109169 - Electric Power Research Institute, Geothermal Heat Pump Grouting Manual- Engineering design and Field Procedures Manual; 1997

1.03 MATERIAL DESCRIPTION:

A. Thermally-enhanced bentonite grout shall be used to seal and backfill each vertical u-bend well bore of the closed loop ground heat exchanger to insure proper thermal contract with the earth and to ensure the environmental integrity of the well field. The grouting material shall remain in a plastic state (moldable) throughout the life of the system and shall not generate heat during the hydration process.

B. No other backfill material to be allowed.

1.04 SUBMITTALS:

A. Product Data: Provide manufacturer published data including thermal conductivity, permeability, percent solids, grout weight, linear shrinkage potential, maximum particle size and unit yield.

1.05 QUALITY ASSURANCE:

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

B. Installer Qualifications: Company specializing in performing the work of this section with minimum three years of experience.

C. Grouting compound shall be certified and listed by the NSF (National Sanitation Foundation International) to ANSI/NSF standard 60, "Drinking Water treatment Chemicals-Health

Effects"

1.06 DELIVERY, STORAGE, AND PROTECTION:

A. Store all materials under cover and elevated above grade.

1.07 WARRANTY:

A. Manufacture to guarantee grout properties within 10% of specifications.

B. Testing to be completed during mixing of grout material at 1/3 and 2/3 completion. Adjustments to be made at no additional cost to mixture to compensate for errors.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. Thermally-Enhanced Grout: Grout material shall be bentonite base.

1. Thermal Conductivity: The thermal conductivity of the grouting material must be 0.85 Btu/hr-ft-F or greater as determined when tested in accordance with ASTM D-5334

PART 3 - EXECUTION

3.01 EXAMINATION:

A. Verify that all materials have been provided per manufacturers requirements prior to commencing.

3.02 APPLICATION:

A. Apply in accordance with manufacturer's instructions.

3.03 FIELD QUALITY CONTROL:

A. Provide daily test samples for conductivity testing. Adjust grout mixture as needed to maintain average conductivity as specified.

B. Conductivity testing to be provided by contractor and performed by qualified person.

3.04 CLEANING AND PROTECTION:

A. Clean all leftover grout and remove from site when completed.

B. Protect all piping to prevent plugging of piping with grout or foreign material.

END OF SECTION 03650

SECTION 05500
METAL FABRICATIONS

PART 1 - GENERAL

1.01 SUMMARY:

A. Section Includes: The furnishing and installation of all structural steel work, steel tubing, aluminum items, anchor bolts, steel bearing plates, and miscellaneous embedded and nonembedded metal work, as specified herein and as indicated on the Drawings.

B. Related Sections: Drawings and General Provisions of the Contract, including the General Covenants and Provisions, Supplementary Covenants and Provisions and General Requirements as well as, but not necessarily limited to, the following:

Section 06100 - Rough Carpentry
Section 09900 - Painting

1.02 SUBMITTALS:

A. Provide submittals in accordance with Section 01300.

B. Product Data: Submit manufacturer's specifications, anchor details and installation instructions for products used in miscellaneous metal fabrications, including paint products and grout.

C. Shop Drawings: Submit shop drawings for fabrication and erection of miscellaneous metal fabrications.

1. Include plans, elevations and details of sections and connections.

2. Show anchorage and accessory items.

3. Provide templates for anchor and bolt installation by others.

4. Where materials or fabrications are indicated to comply with certain requirements for design loadings, include structural computation, material properties and other information needed for structural analysis.

D. Samples: Submit two sets of representative samples of materials and finished products as may be requested by the Architect.

1.03 QUALITY ASSURANCE:

A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work in this section.

B. Perform shop and/or field welding required in connection with the work of this section in strict accordance with pertinent recommendations of the American Welding Society.

C. Field Measurement: Take field measurements prior to preparation of shop drawings and fabrication, where possible.

1. Do not delay job progress; allow for trimming and fitting where taking field measurements before fabrication might delay work.

D. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing. Disassemble units only as necessary for shipping and handling limitations.

1. Clearly mark units for reassembly and coordinated installation.

1.04 DELIVERY, STORAGE, AND HANDLING:

A. Protection: Use all means necessary to protect the materials of this section before, during and after installation and to protect the work and materials of all other trades.

B. Replacement: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. Metal Surfaces, General: For fabrication of the work of this section which will be exposed to view, use only those materials which are smooth and free from surface blemishes including pitting, seams marks, roller marks, rolled trade names, and roughness.

B. Metal Standards: Provide materials complying with:

1. Steel plates, shapes, and bars: ASTM A36.

2. Steel plates to be bent or cold formed: ASTM A283, Grade C.

3. Steel tubing, cold formed, ASTM 500; or hot-rolled, ASTM A 501.

4. Gray iron castings: ASTM A48, Class 30.

5. Steel bars and bar-size shapes: ASTM A306, Grade 65, or ASTM A36.

6. Cold-finished steel bars: ASTM A108.

7. Cold-rolled carbon steel sheets: ASTM A336.

8. Galvanized carbon steel sheets: ASTM A526, with G90 zinc coating in accordance with ASTM A525.

9. Stainless steel sheets: AISI type 302 or 304, 24 gauge, with number 4 finish.

10. Malleable iron castings: ASTM A47, grade as selected by the fabricator.

11. Steel pipe: ASTM A53, type as selected, Grade A, black finish unless galvanizing is required, standard weight (Schedule 40), unless otherwise indicated.

12. Concrete inserts: Threaded or wedge type, galvanized ferrous castings, either malleable iron ASTM A47 or cast steel ASTM A27. Provide bolts, washers, and shims as required, hot-dip galvanized, ASTM A153.

C. Grout: Nonshrink Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with CE CRD-C588.

1. Provide grout specifically recommended by manufacturer for interior and exterior applications of type specified in this section.

D. Fasteners: General: Provide zinc-coated fasteners, for exterior use or where built into exterior walls, of the type, grade and class required, complying with:

1. Bolts and Nuts: Regular hexagon head type, ASTM A 307, Grade A.

2. Lag Bolts: Square head type, FS FF-B-561.

3. Machine Screws: Cadmium plated steel, FS FF-S-92.

4. Wood Screws: Flat head carbon steel, FS FF-S-111.

5. Plain Washers: Round, carbon steel, FS FF-W-92.

6. Masonry Anchorage Devices: Expansion shields, FS FF-S-325.

7. Toggle Bolts: Tumble-wing type, FS FF-B-588, type, class and style as required.

8. Lock Washers: Helical spring type carbon steel, FS FF-W-84.

E. Paint:

1. Metal Primer Paint: Red lead mixed pigment, alkyd varnish, linseed oil paint, FS TT-P-86, Type II; or red lead iron oxide, raw linseed oil, alkyd paint, Steel Structures Painting Council (SSPC) Paint 2-64; or basic lead silicon chromate base iron oxide, linseed oil, alkyd paint, FS TT-P-615, Type II.

2. Primer selected must be compatible with finish coats of paint. Coordinate selection of metal primer with finish paint requirements specified in Division 9.

3. Galvanizing Repair Paint: High zinc dust content paint for re-galvanizing welds in galvanized steel, complying with the Military Specifications MIL-P-21035 (Ships).

4. Galvanized Primer: High zinc dust content primer to galvanize surfaces of metal fabrication specified as galvanized as an alternative to hot dipping, complying FS TT-P-641, Type II.

F. Other Materials: Provide other materials, not specifically described but required for a complete and proper installation, as selected by the contractor subject to the approval of the Architect/DNR Construction Inspector.

2.02 MANUFACTURED UNITS:

A. Fabricate items to sizes, shapes and dimensions required. Furnish malleable iron washers for heads and nuts which bear on wood structural connections; elsewhere, furnish steel washers.

B. Rough Hardware: Furnish bent or otherwise custom fabricated bolts, plates, anchors, hangers, dowels and other miscellaneous steel and iron shapes as required for framing and supporting woodwork, and for anchoring or securing woodwork to concrete or other structures.

1. Straight bolts and other stock rough hardware items are specified in Division-6 sections.

C. Loose Bearing and Leveling Plates: Provide loose bearing and leveling plates for steel items bearing on concrete construction, made flat, free from warps or twists, and of required thickness and bearing area.

1. Drill plates to receive anchor bolts and for grouting as required.

D. Provide other manufactured units as shown on the Drawings, or if not shown on the Drawings, as required for a complete and proper installation.

2.03 FABRICATION:

A. Shop Assembly: Use materials of size and thickness indicated or, if not indicated, as required to produce strength and durability in finished product for use intended.

1. Work to dimensions shown or accepted on shop drawings, using proven details of fabrication and support.

2. Use type of materials shown or specified for various components of work.

3. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.

4. Ease exposed edges to a radius of approximately 1/32" unless otherwise shown.

5. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

6. Weld corners and seams continuously, complying with AWS recommendations.

7. At exposed connections, grind exposed welds smooth and flush to match and blend with adjoining surfaces.

8. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners wherever possible.

9. Use exposed fasteners of type shown or, if not shown, Phillips flat-head (countersunk) screws or bolts.

10. Provide for anchorage of type shown, coordinated with supporting structure.

11. Fabricate and space anchoring devices to provide adequate support for intended use.

12. Cut, reinforce, drill and tap miscellaneous metal work as indicated to receive finish hardware and similar items.

B. Shop/Factory Finishing: Shop paint miscellaneous metal work, except members or portions of members to be embedded in concrete or masonry, surfaces and edges to be field welded, and galvanized surfaces, unless otherwise indicated.

1. Remove scale, rust and other deleterious materials before applying shop coat.

a. Clean off heavy rust and loose mill scale in accordance with SSPC SP-2 "Hand Tool Cleaning," or SSPC SP-3 "Power Tool Cleaning," or SSPC SP-7 "Brush-Off Blast Cleaning."

2. Remove oil, grease and similar contaminants in accordance with SSPC SP-1 "Solvent Cleaning."

3. Immediately after surface preparation, brush or spray on primer in accordance with manufacturer's instructions, and at a rate to provide uniform dry film thickness of 2.0 mils for each coat.

a. Use painting methods which will result in full coverage of joints, corners, edges and exposed surfaces.

4. Apply one shop coat to fabricated metal items, except apply two coats of paint to surfaces inaccessible after assembly or erection.

a. Change color of second coat to distinguish it from the first.

PART 3 - EXECUTION

3.01 EXAMINATION:

A. Examine the areas and conditions under which miscellaneous metal items are to be installed, and correct conditions detrimental to the proper and timely completion of the work.

B. Do not proceed until satisfactory conditions have been corrected.

3.02 PREPARATION:

A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, such as concrete inserts, sleeves, anchor bolts and

miscellaneous items having integral anchors, which are to be embedded in concrete or masonry construction.

B. Coordinate delivery of such items to project site.

3.03 INSTALLATION:

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction; including, threaded fasteners for concrete inserts, toggle bolts, through-bolts, lag bolts, wood screws and other connectors as required.

B. Cutting, Fitting, and Placement: Perform cutting, drilling and fitting required for installation of miscellaneous metal fabrications.

1. Set work accurately in location, alignment and elevation, plumb level, true and free of rack, measured from established lines and levels.

2. Provide temporary bracing or anchors in form work for items which are to be built into concrete, masonry or similar construction.

C. Fit exposed connections accurately together to form tight hairline joints.

1. Weld connections which are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations.

2. Grind exposed joints smooth and touch-up shop paint coat.

3. Do not weld, cut or abrade the surfaces of exterior units which have been hot-dip galvanized after fabrication, and are intended for bolted or screwed field connections.

D. Field Welding: Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of welds made, and methods used in correcting welding work.

E. Setting Loose Plates:

1. Clean concrete bearing surfaces of any bond-reducing materials, and roughen to improve bond to surfaces.

3. Clean bottom surface of bearing plates.

4. Set loose leveling and bearing plates on wedges, or other adjustable devices.

5. After the bearing members have been positioned and plumbed, tighten the anchor bolts.

6. Do not remove wedges or shims, but if protruding, cut-off flush with the edge of the bearing plate before packing with grout.

7. Use metallic nonshrink grout in concealed locations where not exposed to moisture; use nonmetallic nonshrink grout in exposed locations, unless otherwise indicated.

8. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

F. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installation of miscellaneous metal fabrications.

1. Set work accurately in location, alignment, and elevation, and make plumb, level, true, and free from rack, measured from established lines and levels.

2. Provide temporary bracing or anchors in form work for items which are to be built into concrete or similar construction.

3. Fit exposed connections accurately together to form tight hairline joints.

4. Grind exposed joints smooth, and touch-up shop paint coat.

5. Do not weld, cut or abrade the surfaces of exterior units which have been hot-dip galvanized after fabrication and are intended for bolted or screwed field connections.

5. Weld connections which are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations.

G. Touch-Up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting.

1. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.

END OF SECTION 05500

SECTION 06100
ROUGH CARPENTRY

PART 1 - GENERAL

1.01 SUMMARY:

A. Section Includes: Providing all labor, material and equipment necessary to accomplish all the carpentry work not otherwise included as part of other sections and which is generally not exposed except as otherwise indicated. Types of work in this section include, but are not limited to rough carpentry for:

1. Wood framing
2. Timber for posts and beams
3. Wood grounds, nailers, blocking, sleepers and furring
4. Sheathing
5. Nails, bolts, screws, and framing anchors
6. Rough hardware

B. Related Sections: Drawings and General Provisions of the contract, including the General Covenants and Provisions, Supplementary Covenants and Provisions and General Requirements as well as, but not necessarily limited to, the following:

Section 03100 Concrete Formwork
Section 06134 Pole Building System
Section 06190 Wood Trusses
Section 06200 Finish Carpentry
Section 09120 Ceiling Suspension System
Section 09250 Gypsum Wallboard

1.02 REFERENCES:

A. Lumber Standards: Comply with applicable rules of the respective grading and inspecting agencies for species and products indicated, as well as with the latest edition of:

1. PS 20 American Softwood Lumber Standard, National Bureau of Standards

B. Plywood Product Standards: Comply with applicable America Plywood Standard (APA) Performance Standards for type of panel indicated. Also comply with the latest edition of:

1. PS 1 Plywood Standard (ANSI A 199.1), National Bureau of Standards

1.03 SUBMITTALS:

A. Provide submittals in accordance with Section 01300.

B. Material Certificates: Where dimensional lumber is provided to comply with minimum allowable unit stresses, submit listing of species and grade selected for each use, and submit evidence of compliance with specified requirements.

1. Compliance may be in form of a signed copy of applicable portion of lumber producer's grading rules showing design values for selected species and grade.

2. Design values shall be as approved by the Board of Review of American Lumber Standards Committee.

C. Wood Treatment Data: Submit treatment manufacturer's instructions for proper use of each type of treated material.

1. Pressure Treatment: For each type specified, include certification by treating plant stating chemicals and process used, net amount of preservative retained and conformance with applicable standards.

2. Fire-Retardant Treatment: Include certification by treating plant that treatment material complies with governing ordinances and that treatment will not bleed through finished surfaces.

3. For water-borne preservatives, include statement that moisture content of treated materials was reduced to a maximum of 15 percent prior to shipment to project site.

1.04 QUALITY ASSURANCE:

A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work in this section.

1.05 DELIVERY, STORAGE, AND HANDLING:

A. Keep materials dry at all times.

B. Protect against exposure to weather and contact with damp or wet surfaces.

C. Stack lumber and plywood, and provide air circulation within stacks.

D. Deliver the materials to the job site and store, all in a safe area, out of the way of traffic, and shored up off the ground surface.

E. Identify all framing lumber as to grades, and store all grades separately from other grades.

F. Protect all metal products with adequate waterproof outer wrappings.

G. Use extreme care in the off-loading of lumber to prevent damage, splitting, and breaking of materials.

1.06 PROJECT/SITE CONDITIONS:

A. Fit carpentry work to other work; scribe and cope as required for accurate fit.

B. Correlate location of furring, nailers, blocking, grounds and similar supports to allow proper attachment of other work.

C. In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. Lumber, General:

1. Factory-mark each piece of lumber with type, grade, mill and grading agency, except omit marking from surfaces to be exposed with transparent finish or without finish.

2. Nominal sizes are indicated, except as shown by detail dimensions.

3. Provide actual sizes as required by PS 20, for moisture content specified for each use.

4. Identify all plywood as to species, grade, and blue type by the stamp of the American Plywood Association.

5. Provide dressed lumber, S4S, unless otherwise indicated.

6. Provide seasoned lumber with 19 percent maximum moisture content at time of dressing.

B. Materials: All materials, unless otherwise specifically approved in advance by the Architect, shall meet or exceed the following:

	ITEM	SPECIES	GRADE
1.	Sills	Southern Yellow Pine	Standard or Better
2.	2 x 4 Studs	Douglas Fir Southern Pine	Standard or Better Standard or Better
3.	Joists and Planks	Douglas Fir Southern Pine	Number 2 or Better Number 1
4.	Posts and Beams	Douglas Fir Southern Pine	Number 1 Number 1
5.	All Other Horizontal Framing Members	Douglas Fir Southern Pine	Construction Construction
6.	All Other Vertical Framing Members	Douglas Fir Southern Pine	Standard or Better Standard or Better
7.	Exposed Framing	Douglas Fir	Appearance Framing

	Lumber	Southern Pine	Appearance Grade
8.	Exposed Boards	Redwood Cedar	Select Select
9.	Concealed Boards	Redwood Southern Pine	Construction Number 2
10.	Miscellaneous Lumber	Any Species	Construction
11.	Steel Hardware	ASTM A7 or A 36 (use galvanized at exterior locations)	
12.	Machine Bolts	ASTM 307	
13.	Lag Bolts	Fed. Spec. FF-13-561	
14.	Nails	Common (except as noted) Fed. Spec. FF-N-1-1 (use galvanized at exterior locations)	
15.	Timber Connectors	Simpson, Teco or Equal	

C. Plywood:

1. Trademark: Identify each plywood panel with appropriate APA trademark.

2. Concealed Performance-Rated Plywood: Where plywood panels will be used for the following concealed types of applications, provide APA Performance-Related Panels complying with requirements indicated for grade designation, span rating, exposure durability classification, edge detail (where applicable), and thickness.

    a. Wall Sheathing: APA Rated Sheathing, Exposure Durability Classification: Exposure 1, Span Rating: 16/0

D. Plywood Backing Panels: For mounting electrical or telephone equipment, provide fire-retardant treated plywood panels with grade designation, APA C-D PLUGGED INT with exterior glue, in thickness indicated, or if not otherwise indicated, not less than 1/2".

E. Miscellaneous Materials:

1. Fasteners and Anchorages: Size, type, material, and finish indicated and recommended by applicable standards and Federal Specifications for nails, staples, screws, bolts, nuts, washers, and anchoring devices.

    a. Provide metal hangers and framing anchors of the size and type recommended by the manufacturer for each use including recommending nails.

    b. Where rough carpentry work is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners and anchorages with a hot-dip zinc coating (ASTM A 153).

F. Wood Treatment/Preservative Treatment: Where lumber or plywood is indicated as "Trt-Wd" or "Treated," or is specified herein to be treated, comply with applicable requirements of AWPA Standards C2 (Lumber) and C9 (Plywood) and of AWPB Standards listed below.

1. Mark each treated item with the AWPB Quality Mark Requirements.

2. Pressure-treat above-ground items with water-borne preservatives complying with AWPB LP-2.

3. After treatment, kiln-dry to a maximum moisture content of 15 percent.

4. Treat indicated items and the following:

   a. Wood cants, nailers, curbs, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.

   b. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.

   c. Wood framing members less than 18" above grade.

5. Pressure-treat the following with water-borne preservatives for ground contact use complying with AWPB LP-22:

   a. Wood members in contact with ground.

   b. Wood members in contact with fresh water.

6. Complete fabrication of treated items prior to treatment, where possible.

7. If cut after treatment, coat cut surfaces with heavy brush coat of same chemical used for treatment.

8. Inspect each piece of lumber or plywood after drying and discard damaged or defective pieces.

PART 3 - EXECUTION

3.01 EXAMINATION:

A. Examine the substrate surfaces, conditions, and embedded attachments that carpentry work will be applied or attached to.

B. Any conditions that are incomplete or unsatisfactory shall be brought to the attention of the Architect or DNR Construction Inspector.

C. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION:

A. Discard units of material with defects which might impair quality of work, and units which are too small to use in fabricating work with minimum joints or optimum joint arrangement.

B. Set carpentry work accurately to required levels and lines, with members plumb and true and accurately cut and fitted.

C. Securely attach carpentry work to substrate by anchoring and fastening as shown and as required by recognized standards.

1. Countersink nail heads on exposed carpentry work and fill holes.

D. Use common wire nails, except as otherwise indicated. Use finishing nails for finish work.

1. Select fasteners of size that will not penetrate members where opposite side will be exposed to view or will receive finish materials.

2. Make tight connections between members.

3. Install fasteners without splitting of wood; predrill as required.

E. Carefully lay out, cut, fit, and install rough carpentry items.

1. Use sufficient nails, spikes, screws, and bolts to ensure rigidity and permanence.

2. Drive nails perpendicular to wood grain in lieu of toenailing, where feasible.

3. Provide for installation and support of plumbing, hearing, and ventilating and electrical work.

4. Take care to isolate acoustically from other members.

5. Install work to true lines, plumb, and level, unless indicated otherwise.

F. Develop full length and width of bearing intended at all supports.

1. Members cut too short, or for any other reason do not develop this bearing, will have to be replaced.

G. All sills, plates, and other wood in contact with masonry or under metal flashings shall be pressure preservative treated.

H. Provide framing members of sizes and on spacings shown, and frame openings as shown, or if not shown, comply with recommendations of "Manual for House Framing" of National Forest Products Association.

1. Do not splice structural members between supports.

I. Anchor and nail as shown, and to comply with "Recommended Nailing Schedule" of "Manual for House Framing" and other recommendations of N.F.P.A.

J. Firestop concealed spaces with wood blocking not less than 2" thick, if not blocked by other framing members.

1. Provide blocking at each building story level and at ends of joist spans.

K. Wood Grounds, Nailer, Blocking and Sleepers:

1. Provide wherever shown and where required for screeding or attachment of other work.

2. Form to shapes as shown and cut as required for true line and level of work to be attached.

3. Coordinate location with other work involved.

4. Attach to substrates as required to support applied loading.

a. Countersink bolts and nuts flush with surfaces, unless otherwise shown.

b. Build into masonry during installation of masonry work.

c. Where possible, anchor to formwork before concrete placement.

5. Provide permanent grounds of dressed, preservative treated, key-bevelled lumber not less than 1-1/2" wide and of thickness required to bring face of ground to exact thickness of finish material involved.

6. Remove temporary grounds when no longer required.

L. Wood Furring: Install plumb and level with closure strips at edges and openings.

1. Shim with wood as required for tolerance of finish work.

2. Secure to backing with approved-type fasteners.

M. Stud Framing: Provide stud framing where shown.

1. Unless otherwise shown, use 2" x 4" wood studs spaced 16" o.c. with 4" face perpendicular to direction of wall or partition.

2. Provide single-bottom plate and double-top plates 2" thick by width of studs; except single-top plate may be used for nonloadbearing partitions.

a. Nail or anchor plates to supporting construction. Construct corners and intersections with not less than three studs.

3. Provide miscellaneous blocking and framing as shown and as required for support of facing materials, fixtures, specialty items and trim.

4. For loadbearing partitions, provide double-jamb studs for openings six feet and less in width, and triple-jamb studs for wider openings.

a. Provide headers of depth shown, or if not shown, provide as recommended by N.F.P.A. "Manual for House Framing."

3. Provide diagonal bracing in stud framing of exterior walls, except as otherwise indicated.

a. Brace both walls at each external corner, full story height, at a 45ø angle, using either a let-in 1 x 4 or 2 x 4 blocking or metal diagonal bracing.

b. Omit bracing where following types of sheathing are indicated.

c. Plywood sheathing or corner bracing, 4' wide panels vertically.

d. Gypsum sheathing, 4' panels vertically.

e. Fiberboard sheathing, intermediate type, 4' panels vertically.

f. Diagonal board sheathing.

4. Frame openings with multiple studs and headers. Provide nailed header members of thickness equal to width of studs.

a. Set headers on edge and support on jamb studs.

b. For nonbearing partitions, provide double-jamb studs and headers not less than 4" deep for openings 3' and less in width, and not less than 6" deep for wider openings.

N. Joist Framing: Provide framing of sizes and spacings shown. Install with crown edge up and support ends of each member with not less than 1-1/2" of bearing on wood or metal, or 3" on masonry.

1. Attach to woodbearing members with metal connectors; frame to wood supporting members with wood ledgers as shown, or if not shown, with metal connectors.

2. Fire-cut members built into masonry (if any).

3. Frame openings with headers and trimmers supported by metal joist hangers; double headers and trimmers where span of header exceeds 4'.

4. Do not notch in middle third of joists; limit notches to 1/6-depth of joist, 1/3 at ends.

5. Do not bore holes larger than 1/3-depth of joist or locate closer than 2" from top of bottom.

6. Provide solid blocking (2" thick by depth of joist) at ends of joists unless nailed to header or brand member.

7. Lap framing members from opposite sides of beams, girders or partitions not less than 4" or securely tie opposing members together.

8. Provide solid blocking (2" thick by depth of joist) over supports.

9. Provide bridging between joists where nominal depth-to-thickness ratio exceeds 4, at intervals of 8'.

    a. Use bevel cut 1" x 4" or 2" x #" wood bracing, double-crossed and nailed both ends to joists, or use solid wood bridging 2" thick by depth of joist, end nailed to joist.

O. Ceiling Joist Framing:

1. Provide member size and spacing shown, and as previously specified for joist framing.

    a. Face nail to ends of parallel rafters.

    b. Where principal ceiling joists are at right angles to rafters, frame as indicated with additional short joists from wall plate to first joist; nail to ends of rafters and to top plate and nail to long joists or anchor with framing anchors or metal straps.

    c. Provide 1 x 8 or 2 x 4 stringers spaced 4' o.c. crosswise over principal ceiling joists.

P. Provide special framing as shown for eaves, overhangs, corners and similar conditions, if any.

Q. Installation of Plywood: Comply with recommendations in Form No. E 304, :APA Design/Construction Guide- Residential and Commercial," for types of plywood products and applications indicated.

1. Fastening Methods: Fasten panels as indicated below:

    a. Sheathing: Nail to framing.

END OF SECTION 06100

SECTION 06 12 19
STRUCTURAL INSULATED PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Structural insulated panels for wall applications.

B. Related Sections:
Section 06100 Rough Carpentry
Section 06190 Wood Trusses

1.2 REFERENCES

A. ASTM International (ASTM):
1. C578-06 - Standard Specification for Preformed Cellular Polystyrene Thermal Insulation.
2. D2559-03 - Standard Specification for Adhesives for Structural Laminated Wood Products for Use Under Exterior (Wet Use) Exposure Conditions.
3. E84-05 - Standard Test Method for Surface Burning Characteristics of Building Materials.

B. National Institute of Standards and Technology (NIST):
1. Product Standard PS 1-95 - Construction and Industrial Plywood.
2. Product Standard PS 2-04 - Performance Standards for Wood-Based Structural Use Panels.
3. Product Standard PS 20-05 - American Softwood Lumber Standard.

C. Western Wood Products Association (WWPA) G-5 - Western Lumber Grading Rules.

1.3 SYSTEM DESCRIPTION

A. Design Requirements: Panel system design performed by or under direct supervision of professional Structural Engineer with experience in work of this Section.

B. Performance Requirements; Design panel system to withstand:
1. Live and dead loads in accordance with applicable building code.

1.4 SUBMITTALS

A. Provide submittals in accordance with Section O0812 and section 01300.

B. Product Data: Submit manufacturer's product information, specifications and installation instructions for building components and accessories.

C. Shop Drawings: Submit four complete sets of erection drawing showing post spacing, endwall, sidewalls, transverse cross sections, installation details to clearly indicate proper assembly of building components, and supporting engineering design calculation.

1. Drawings and calculations shall be stamped and certified by a structural engineer registered in the state of Iowa.

D. Certification: Submit written certification prepared and signed by a professional engineer registered to practice in the state of Iowa, verifying that building design meets indicated loading requirements and codes of authorities having jurisdiction.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Minimum 2 years experience in work of this Section.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver panels to site with manifest drawings containing following information:
1. Manufacturer.
2. Product standard and type.
3. Flame spread/smoke developed rating.
4. Identification of quality assurance agency.

B. Store panels flat, on level base, evenly supported.

C. Cover panels during transportation and storage with waterproof coverings, properly vented.

D. Protect panels from moisture absorption and exposure to sunlight.

E. When lifting panels by crane, support panels with straps or I-bolts.

1.7 SEQUENCING

A. Cover wall panels with moisture barrier or final wall cladding as soon as practical after erection.
B. Cover roof panels with water-resistant paper or roofing underlayment immediately after erection.

PART 2 - PRODUCTS

Energy Panel Structures 06 12 19-3 Structural Insulated Panels 01/17/07

2.1 MANUFACTURERS

A. Contract Documents are based on products by Energy Panel Structures.

B. Substitutions:Not permitted.

2.2 MATERIALS

A. Insulation:
1. Expanded polystyrene, ASTM C578, Type I.
2. Minimum density: 0.90 pounds per cubic foot.
3. Maximum flame spread/smoke developed rating: 75/450, tested to ASTM E84.

B. Facings:

1. Plywood conforming to NIST PS 1 and PS 2.
2. Bear trademark or certification of inspecting agency in accordance with NIST PS 2.

C. Lumber Framing:
1. Species: Spruce-Pine-fir or equivalent.
2. Grade: WWPA No. 2.

D. Panel Finish: Prefinished steel sheet, 0.032 inch thickness – Kynar finish, Color TBD – submit samples

2.3 ACCESSORIES

A. Panel Adhesive: ASTM D2559, Type II, Class 2.

B. Panel Sealant: Type recommended by panel manufacturer.

C. Fasteners: Galvanized or corrosion resistant coated; types and sizes as recommended by panel manufacturer.

2.4 FABRICATION

A. Fabricate panels with 7/16 to 3/4 inch thick plywood facings of thickness to meet design criteria pressure laminated to insulation core using adhesive.
B. Finish exterior of panels with steel sheet siding.
C. Panel Thickness: Nominally 8-1/2 inches.

D. R-Value: 33.0

PART 3 - EXECUTION

3.1 INSTALLATION
Structural Insulated Panels 06 12 19-4 Energy Panel Structures 01/17/07

A. Install panel system in accordance with manufacturer's instructions and approved Shop Drawings.

B. Install continuous bottom plate of width equal to panel:
1. Attach bottom plates at exterior walls to concrete foundation with anchor bolts spaced maximum 6 feet on center and within 12 inches of ends of pieces, with minimum of two anchors per piece, or with foundation anchor straps.
2. Attach interior bottom plates to concrete foundation with approved anchors.

C. Install continuous top plates of width equal to panel. Overlap plates at corners, intersections and splines.

D. Drill 1-1/2 inch diameter access holes in splines to align with electrical chases.

E. Apply panel sealant in continuous beads to wood-to-wood, wood-to-insulation, and insulation-to-insulation joints per manufacturer’s recommendations.

F. Fasten panels to framing through both facing surfaces unless otherwise indicated.

G. Provide temporary bracing during erection and until final connections are complete.

H. Do not install panels directly on concrete; use double plate sill detail or place sill sealer under panels.

I. Do not place plumbing in panels without approval of panel manufacturer.

J. Do not cut panel skins for electrical chases. Cut for electrical boxes as needed, but do not cut through to panel edges.

END OF SECTION

SECTION 06190
WOOD TRUSSES

PART 1 - GENERAL

1.01 SUMMARY:

A. Section Includes: Provide wood trusses where shown on the Drawings, as specified herein, and as needed for a complete and proper installation.

B. Related Sections: Drawings and General Provisions of the contract, including the General Covenants and Provisions, Supplementary Covenants and Provisions and General Requirements as well as, but not necessarily limited to, the following.

Section 06100 - Rough Carpentry
Section 06134 - Pole Building Systems

1.02 REFERENCES:

A. Compliance: Comply with the pertinent provisions of:

1. The American Institute of Timber Construction's "Timber Construction Standards."

2. The "Quality Control Manual" of the Truss Plate Institute.

3. The Uniform Building Code, UBC.

1.03 SUBMITTALS:

A. Provide submittals in accordance with Section 00812 and Section 01300.

B. Material List: Submit list of items to be provided under this section.

C. Product Data: Submit manufacturer's specifications and other data needed to prove compliance with the specified requirements.

D. Shop Drawings: Submit drawings showing species, sizes and stress grade of lumber proposed to be used; pitch, span, lumber configuration, and spacing of trusses; connector type, thickness, size, location, and design value; and bearing details.

1.04 QUALITY ASSURANCE:

A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work in this section.

1.05 DELIVERY, STORAGE, AND HANDLING:

A. Keep materials dry at all times. Protect against exposure to weather and contact with damp or wet surfaces.

1. Stack lumber and plywood, and provide air circulation within stacks.

B. Deliver the materials to the job site and store, all in a safe area, out of the way of traffic, and shored up off the ground surfaces.

C. Use extreme care in the off-loading of lumber to prevent damage, splitting and breaking of materials.

D. Store trusses on temporary bearing support, braced in vertical position.

E. In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

PART 2 - PRODUCTS

2.01 WOOD TRUSSES:

A. Design: Provide the services of a structural engineer registered to practice in the state of Iowa, who shall design the wood trusses to sustain the indicated loads for the spans, profiles and arrangements shown on the Drawings.

1. Wood trusses and their installation must conform to Iowa State Building Code requirements regarding live loads.

2. Design roof trusses for a minimum 30 psf live load and 10 psf dead load for top chord and 10 psf for bottom chord.

3. Live load plus dead load for each truss is 50 psf.

4. Deflection for live load only is limited to L/360.

5. Submit drawings of trusses with certification of a professional engineer registered in the state of Iowa included on the drawings.

B. Fabrication: Fabricate in strict accordance with the shop drawings and other data approved by the Architect.

C. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Architect.

PART 3 - EXECUTION

3.01 EXAMINATION:

A. Examine the areas and conditions under which work of this section will be performed and correct conditions detrimental to timely and proper completion of the work.

C. Do not proceed until unsatisfactory conditions are corrected.

3.02 INSTALLATION:

A. Coordinate as required with other trades to assure proper and adequate provision in the work of those trades for interface with the work of this section.

B. Install the work of this section in strict accordance with the original design, the approved shop drawings, pertinent requirements of governmental agencies having jurisdiction, and the manufacturer's recommended installation procedures as approved by the Architect, anchoring all components firmly into position for long life under hard use.

C. Hoist trusses into position with secured at designated lifting points and exercise care to keep out of place bending of trusses to a minimum.

D. Install temporary horizontal and cross bracing to hold trusses plumb and in safe condition until permanent bracing is installed.

E. Install permanent bracing and related components prior to application of loads to trusses and tighten all loose connectors.

F. Restrict construction loads and prevent overstressing of truss members and do not cut or remove truss members.

END OF SECTION 06190

PART 1 - GENERAL

1.01 SUMMARY:

A. Section Includes:

1. Providing all labor, material and equipment necessary to accomplish all the necessary work not otherwise included as part of other sections and which is non-structural and exposed to view.

2. Types of work of this section include, but are not limited to, finish carpentry for:

a. Interior running and standing trim.

B. Related Sections: Drawings and General Provisions of the contract, including the General Covenants and Provisions, Supplementary Covenants and Provisions and General Requirements as well as, but not necessarily limited to, the following:

Section 06100 Rough Carpentry
Section 07900 Joint Sealers
Section 08100 Metal Doors and Frames
Section 08200 Wood Doors
Section 08360 Sectional Overhead Doors
Section 08520 Aluminum Windows
Section 08700 Builder' s Hardware

1.02 REFERENCES:

A. Softwood Lumber Standards: Comply with applicable rules of the respective grading and inspecting agencies for species and product indicated, as well as with latest editions of:

1. PS 20 American Softwood Lumber Standard, National Bureau of Standards.

B. Plywood Products Standard: Comply with applicable American Plywood Association (APA) Performance Standards for type of panel indicated. Also comply with latest edition of:

1. PS 1 Plywood Standard - National Bureau of Standards.

2. PS 51 Hardwood Plywood Standard - National Bureau of Standards.

C. Hardwood Lumber Standards: Comply with National Hardwood Lumber Association (NHLA) rules.

D. Woodworking Standard: Where indicated for a specific product, comply with specified provision of the following:

1. Architectural Woodwork Institute (AWI) "Quality Standards."

E. In addition to complying with the pertinent codes and regulations of governmental agencies having jurisdiction, as well as the above, comply with the Standard Grading Rules for Western Lumber published by the Western Wood Product Association, wherever applicable, and the Grading Rules of the California Redwood Association.

1.03 SUBMITTALS:

A. Provide submittals in accordance with Section 01300.

B. Product Data: Submit manufacturer's specifications and installation instructions for each item of factory-fabricated siding and paneling.

C. Samples: Submit the following samples for each species and cut or pattern of finish carpentry.

1. Standing and running trim for transparent finish: set of three (3) pieces for boards and for each type of worked product (molding) required, 2'-0" long x full board or molding width, finished on one side and one edge.

2. Standing and running trim for paint finish; set of three (3) pieces for each type of work and product required, 2'-0" long x full board or molding width, unfinished.

1.04 QUALITY ASSURANCE:

A. Grade Stamps: Factory-mark each piece of lumber and plywood with type, grade, mill and grading agency identification; except omit marking from surfaces to receive transparent finish, and submit mill certificate that material has been inspected and graded in accordance with requirements if it cannot be marked on a concealed surface.

B. Throughout progress of the work of this section, provide at least one person who shall be thoroughly familiar with the specified requirements, completely trained and experienced in the necessary skills, and who shall be present at the site and shall direct all work performed under this section.

C. In actual installation of the work of this section, use adequate numbers of skilled workers to ensure installation in strict accordance with the approved design and the approved recommendations of the materials manufacturers.

1.05 DELIVERY, STORAGE, AND HANDLING:

A. Protect finish carpentry materials during transit, delivery, storage and handling to prevent damage, soiling and deterioration.

B. Do not deliver finish carpentry materials, until painting, wet work, grinding and similar operations which could damage, soil or deteriorate woodwork have been completed in installation areas.

C. If, due to unforeseen circumstances, finish carpentry materials must be stored in other than installation areas, store only in areas meeting requirements specified for installation areas.

D. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

1.06 PROJECT/SITE CONDITIONS:

A. Conditioning: Installer shall advise Contractor of temperature and humidity requirements for finish carpentry installation areas.

1. Do not install finish carpentry until required temperatures and relative humidity have been stabilized and will be maintained in installation areas.

B. Maintain temperature and humidity in installation areas as required to maintain moisture content of installed finish carpentry within a 1.0 percent tolerance of optimum moisture content, from date of installation through remainder of construction period.

1. The fabricator of woodwork shall determine optimum moisture content and required temperature and humidity conditions.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. Nominal sizes are indicated, except as shown by detailed dimensions. Provide dressed or worked and dressed lumber, as applicable, manufactured to the actual sizes as required by PS 20 or to actual sizes and pattern as shown, unless otherwise indicated.

B. Moisture Content of Softwood Lumber: Provide kiln-dried (KD) lumber having a moisture content from time of manufacture until time of installation not greater than values required by the applicable grading rules of the respective grading and inspecting agency for the species and product indicated.

C. Moisture Content of Hardwood Lumber: Provide kiln-dried (KD) lumber having a moisture content from time of manufacture until time of installation within the ranges required in the referenced woodworking standard.

D. Lumber for Transparent Finish: Use pieces made of solid lumber stock.

E. Lumber for Painted Finish: At Contractor's option, use pieces which are either glued-up lumber or made of solid lumber stock.

F. Interior Finish Carpentry:

1. Standing and Running Trim for Transparent Finish: Plain Sawn Red Oak manufactured to sizes and patterns (profile) shown from select First Grade lumber (NHLA); complying with following grade requirements of referenced woodworking standard, for quality of materials and manufacture:

a. Grade: Custom

b. Finish: Semi-transparent stain as selected by the Architect, and urethane varnish.

2. Standing and Running Trim for Painted Finish: Any Western Pine species graded and inspected by WWPA complying with following requirements:

a. Grade for Standard Sizes and Patterns: "C Select" or "Choice" for Idaho White Pine.

G. Miscellaneous Materials:

1. Fasteners and Anchorages: Provide nails, screws and other anchoring devices of the proper type, size, material and finish for application indicated to provide secure attachment, concealed where possible, and complying with applicable federal specifications.

a. Where finish carpentry is exposed on exterior or in areas of high relative humidity, provide fasteners and anchorages with stainless steel nails.

2. Screen for Soffit Vents: 18 x 16 or 18 x 14 mesh of plastic coated fiber threads, complying with FS L-S-25, with black or dark gray finish.

H. Wood Treatment/Preservative Treatment: Following basic fabrication, provide 3-minute dip treatment of finish carpentry items in 5 percent solution of pentachlorophenol, with vehicle which will not interfere with finish application and will produce minimum effect upon appearance.

1. Apply brush coat on surfaces cut after treatment.

I. Other Materials: Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Architect.

PART 3 - EXECUTION

3.01 EXAMINATION:

A. Examine the areas and conditions under which work of this section will be performed.

B. Correct conditions detrimental to the proper and timely completion of the work.

C. Do not proceed until unsatisfactory conditions have been corrected.

3.02 PREPARATION:

A. Pre-Installation Meeting: Meet at project site prior to delivery of finish carpentry materials and review coordination and environmental controls required for proper installation and ambient conditioning in areas to receive work.

1. Include in meeting the Contractor; Architect and other Owner Representatives (if any); Installers of finish carpentry, wet work including plastering, other finishes, painting, mechanical work and electrical work; and firms and persons responsible for continued operation (where temporary or permanent) of HVAC system as required to maintain temperature and humidity conditions.

2. Proceed with finish carpentry on interior only when everyone concerned agrees that required ambient conditions can be properly maintained.

B. Condition wood materials to average prevailing humidity conditions in installation areas prior to installing.

C. Backprime lumber for painted finish exposed on the exterior, or where indicated, to moisture and high relative humidities on the interior.

1. Comply with requirements of section on painting within Division 9 for primers and their application.

3.03 INSTALLATION:

A. Discard units of material which are unsound, warped, bowed, twisted, improperly treated, not adequately seasoned or too small to fabricate work with minimum of joints or optimum jointing arrangements, or which are of defective manufacturer with respect to surfaces, sizes or patterns.

B. Install the work plumb, level, true and straight with no distortions. Shim as required using concealed shims.

1. Install to a tolerance of 1/8" in 8'-0" for plumb and level countertops; and with 1/16" maximum offset in flush adjoining 1/8" maximum offsets in revealed adjoining surfaces.

C. Scribe and cut work to fit adjoining work, and refinish cut surfaces or repair damaged finish at cuts.

D. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to the greatest extent possible.

1. Stagger joints in adjacent and related members.

2. Cope at returns, miter at corners, to produce tight-fitting joints with full surface contact throughout length of joint.

3. Use scarf joints for end-to-end joints.

4. Make exterior joints water-resistant by careful fitting.

E. Anchor finish carpentry work to anchorage devices or blocking built-in or directly attached to substrates.

1. Secure to grounds, stripping and blocking with countersunk, concealed fasteners and blind nailing as required for a complete installation.

2. Except where prefinished matching fastener heads are required, use fine finishing nail for exposed nailings, countersunk and filled flush with finished surface, and matching final finish where transparent is indicated.

3.04 ADJUSTING:

A. Repair damaged and defective finish carpentry work wherever possible to eliminate defects functionally and visually; where not possible to repair properly, replace woodwork.

B. Adjust joinery for uniform appearance.

3.05 CLEANING:

A. Clean finish carpentry work on exposed and semi-exposed surfaces.

B. Touch-up shop-applied finishes to restore damaged or soiled areas.

C. Refer to Division 9 sections for final finishing of installed finish carpentry work.

3.06 PROTECTION:

A. Installer of finish carpentry work shall advise Contractor of final protection and maintained conditions necessary to ensure that work will be without damage or deterioration at time of acceptance.

END OF SECTION 06200

SECTION 07110
SHEET WATERPROOFING

PART 1 - GENERAL

1.01 SUMMARY:

A. Section Includes:

1. Extent of each type of sheet waterproofing work (S-WP) is shown on Drawings and is hereby defined to include all sheet materials applied with sealed joints and flashings as needed to form concealed waterproof membranes.

2. Types of sheet waterproofing specified in this section include the following:

a. Asphalt/polyethylene waterproof membranes.
b. Neoprene waterproof membranes.
c. Butyl waterproof membranes.
d. EPDM waterproof membranes.
e. Vinyl waterproof membranes.
f. Polyethylene waterproof membranes.
g. Asphalt/polyethylene waterproofing.

B. Related Sections: Drawings and General Provisions of the contract, including the General Covenants and Provisions, Supplementary Covenants and Provisions and General Requirements as well as, but not necessarily limited to, the following:

Section 03300 Cast-In-Place Concrete
Section 04200 Unit Masonry

1.02 SUBMITTALS:

A. Provide submittals in accordance with Section 01300.

B. Product Data: Submit specifications, installation instructions, and general recommendations from waterproofing materials manufacturer for types of waterproofing required.

C. Include data substantiating that materials comply with requirements.

1.03 QUALITY ASSURANCE:

A. Manufacturer: Obtain primary waterproofing materials of each type required from a single manufacturer, to greatest extent possible.

B. Provide secondary materials only as recommended by manufacturer of primary materials.

C. Installer: Firm with not less than three years of successful experience in installation of waterproofing sheets similar to requirements for this project and which is acceptable to or licensed by manufacturer of primary waterproofing materials.

1.04 PROJECT/SITE CONDITIONS:

A. Substrate: Proceed with work of this section only after substrate construction, openings, and penetrating work have been completed.

B. Weather: Proceed with waterproofing and associated work only when existing and forecasted weather conditions will permit work to be performed in accordance with manufacturers' recommendations and warranty requirements.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. General: Provide sheet waterproofing materials recognized to be of generic type indicated and tested to show compliance with indicated performances, or provide other similar materials certified in writing to be equal-to-or-better-than specified in every significant respect, and acceptable to Architect.

2.02 NEOPRENE SHEET WATERPROOFING:

A. Neoprene Synthetic Rubber formed into uniform flexible sheets of thicknesses shown or, if no thickness is shown, not less than 1/16" thick, in widths of not less than 72", complying with the following:

1. Hardness (ASTM D 2240): 50 to 70 Shore A.

2. Tensile Strength (ASTM D 412): 1,500 psi.

3. Ultimate Elongation (ASTM D 412): 250%

4. Brittleness Temperature (ASTM D 746): -30°F. (-35°C).

5. Tear Resistance (ASTM D 624): 120 lbs. per lin. in. (Die C).

6. Resistance to Heat Aging (ASTM D 573): Maximum hardness increase of 10 points, maximum reduction in elongation of 40% and maximum loss of tensile strength of 15% (70 hrs. at 121° F., 100°C).

7. Persistence to Ozone Aging (ASTM D 1149): No cracks for 100 hours exposure of 20% elongated samples at 104°F. (40°C) and 100 pphm ozone.

8. Resistance to Water Absorption (ASTM D 471): Less than 1.0% weight gain for seven (7) days of water immersion at 158°F. (70°C).

B. Products offered by manufacturers to comply with requirements include the following:

1. Sure-Seal Neoprene: Carlisle Tire and Rubber Company.
2. Plastisheet Neoprene: Progress Unlimited, Inc.
3. N-35 Neoprene: Gates Engineering Company, Inc.

2.03 BUTYL SHEET WATERPROOFING:

A. Butyl Synthetic Rubber formed into uniform flexible sheets of thicknesses shown or, if no thickness is shown, not less than 1/16" thick, in widths of not less than 72", complying with the following:

1. Hardness (ASTM D 2240): 50 to 70 Shore A.

2. Tensile Strength (ASTM D 412): 1,200 psi.

3. Ultimate Elongation (ASTM D 412): 300%.

4. Brittleness Temperature (ASTM D 746): -40°F. (-40°C).

5. Tear Resistance (ASTM D 624): 125 lbs. per lin. inch (Die C).

6. Resistance to Heat Aging (ASTM D 573): Maximum hardness increase of 15 points, maximum reduction in elongation of 30%, and maximum loss of tensile strength of 30% (168 hours at 240°F., 116°C).

7. Resistance to Ozone Aging (ASTM D 1149): No cracks for 168 hours exposure of 10% elongated samples at 104°F. (70°C) and 50 pphm ozone.

8. Resistance to Water Absorption (ASTM D 471): Less than 3.0% volume gain for 72 hours of water immersion at 212°F. (100°C).

B. Products offered by manufacturers to comply with requirements include the following:

1. Hydro-Seal Butyl: American Hydrotec, Inc.
2. Sure-Seal Butyl: Carlisle Tire and Rubber Company.
3. Plastisheet Butyl: Progress Unlimited, Inc.
4. or equal as approved by the Architect.

2.04 EPDM SHEET WATERPROOFING:

A. Ethylene Propylene Diene Monomers formed into uniform flexible sheets of thickness shown or, if no thickness is shown, not less than 1/16" thick, in widths of not less than 72", complying with the following:

1. Hardness (ASTM D 2240): 50 to 70 Shore A.

2. Tensile Strength (ASTM D 412): 1,400 psi.

3. Ultimate Elongation (ASTM D 412): 300%.

4. Brittleness Temperature (ASTM D 746): -75°F. (-59°C).

5. Tear Resistance (ASTM D 624): 125 lbs. per lin. inch (Die C).

6. Resistance to Heat Aging (ASTM D 573): Maximum hardness increase of 15 points, maximum reduction in elongation of 30% and maximum loss of tensile strength of 15% (168 hrs. at 240°F., 116°C).

7. Resistance to Ozone Aging (ASTM D 1149): No cracks for 168 hours exposure of 50% elongated sample at 104°F. (70°C) and 100 pphm ozone.

8. Resistance to Water Absorption (ASTM D 471): Less than 0.5% volume gain for 72 hours immersion at 212°F. (100°C).

B. Products offered by manufacturers to comply with requirements include the following:

1. Hydro-Seal EPDM: American Hydrotec, Inc.
2. Sure-Seal EPDM: Carlisle Tire and Rubber Company
3. Plastisheet EPDM: Progress Unlimited, Inc.
4. or equal as approved by the Architect.

2.05 VINYL SHEET WATERPROOFING:

A. Virgin Polyvinyl Chloride with plasticizers and other modifiers, formed into uniform flexible sheets of thickness shown or, if no thickness is shown, not less than 56 mils thick, in widths of not less than 72", complying with the following:

1. Hardness (ASTM D 2240): 60 to 80 Shore A.

2. Tensile Strength (ASTM D 412): 2,000 psi.

3. Ultimate Elongation (ASTM D 412): 250%.

4. Brittleness Temperature (ASTM D 746): -20°F. (-29°C).

5. Tear Resistance (ASTM D 624): 125 lbs. per lin. inch (Die C).

6. Resistance to Heat Aging (ASTM D 573): Maximum hardness increase of 15 points, maximum reduction in elongation of 25%, and maximum loss of tensile strength of 20% (168 hrs. at 200°F., 93°C).

7. Resistance to Ozone Aging (ASTM D 1149): No cracks for 5,000 hours exposure of 20% elongated sample at 104°F. (70°C) and 50 pphm ozone.

8. Resistance to Water Absorption (ASTM D 570): Less than 0.5% weight gain for 48 hours of immersion at 212°F. (100°C).

B. Products offered by manufacturers to comply with requirements include the following:

1. PVC Vi-Seal: Afco Products, Inc.
2. BFG Water Barrier: B.F. Goodrich Company.
3. PVC Plasta Seal: Phoenix Building Products, Inc.
4. Plastisheet PVC: Progress Unlimited, Inc.
5. Nervastral PVC: Rubber and Plastics Compound Company, Inc.
6. Nu-Flex PVC: Sandell Manufacturing Company, Inc.
7. Vinylseal PVC: Sonneborn-Contech Division.
8. Rhenofol PVC: Braas.
9. Wascoseal PVC: Wasco Products, Inc.
10. or equal as approved by Architect.

2.06 POLYETHYLENE SHEET WATERPROOFING:

A. Chlorinated Polyethylene formed into uniform flexible sheets, either plain at 40-mil. thickness or reinforced with laminated synthetic fabric at 30-mil. thickness. Provide one of the following products:

1. Chloraloy: Noble Company.
2. Plyroof CPE 30R: Water Guidance Systems, Inc.
3. or equal as approved by the Architect.

2.07 ASPHALT/POLYETHYLENE SHEET WATERPROOFING:

A. Self-adhering membrane of rubberized asphalt integrally bonded to polyethylene sheeting, formed into uniform flexible sheets of thickness shown, or not less than 56 mils if no thickness is shown, in widths of not less than 36", and complying with the following:

1. Tensile Strength (ASTM D 412): 250 psi min.
2. Ultimate Elongation (ASTM D 412): 200% min.
3. Brittleness Temperature (ASTM D 746): -25°F. (-32°C).

B. Hydrostatic Head Resistance: 75 feet min.

1. Water Absorption (ASTM D 570): Not more than 0.5% weight gain for 48 hours of immersion at 70°F. (21°C).

C. Products offered by manufacturers to comply with requirements include the following:

1. Bituthene: W.R. Grace and Company.
2. Hey' Di SK 2000: Hey' Di American Corporation.
3. Polyguard No. 650: Polyguard Products, Inc.
4. Plastiwrap: Progress Unlimited, Inc.
5. or equal as approved by the Architect.

2.08 MISCELLANEOUS MATERIALS:

A. Adhesives: Provide types of adhesive compound and tapes recommended by waterproofing sheet manufacturer, for bonding to substrate (if required), for waterproof sealing of seams in membrane, and for waterproof sealing of joints between membrane and flashings, adjoining surfaces and projections through membrane.

B. Primers: Provide type of concrete primer recommended by manufacturer of sheet waterproofing material for applications required.

C. Coatings: Provide type of coating (if any) recommended by waterproofing sheet manufacturer, for improvement of weathering resistance on exposed areas of membrane, including areas extended as flashing (if any).

1. Provide black coating except as otherwise indicated.

D. Flashing Materials: Except as otherwise indicated, provide types of flexible sheet material recommended by waterproofing sheet manufacturer for flashing.

E. Protection Course: Where shown, provide type recommended by waterproofing sheet manufacturer, unless another type is indicated; include adhesives recommended by manufacturer.

PART 3 - EXECUTION

3.01 EXAMINATION:

A. Installer must examine substrate and conditions under which waterproofing work is to be performed and must notify Contractor in writing of unsatisfactory conditions.

B. Do not proceed until unsatisfactory conditions have been corrected in manner acceptable to installer.

3.02 PREPARATION:

A. Prior to installation of waterproofing and associated work, meet at project site with installer of each component of associated work, inspection and testing agency representatives (if any), and installers of work requiring coordination with waterproofing work, for purpose of reviewing material selections and procedures to be followed in performing work.

B. Apply primer to concrete and masonry surfaces at rate recommended by manufacturer of primary waterproofing materials.

1. Prime only area which will be covered by WP membrane in same working day; reprime areas not covered by WP membrane within 24 hours.

C. Do not advance laying of insulation ahead of waterproofing more than necessary for sequence of operation.

1. Cover insulation exposed at end of day's work (and when rain threatens) with waterproofing materials.

2. Remove and dispose of insulation which has become wet; replace before proceeding with insulating and waterproofing work.

3.03 INSTALLATION:

A. Comply with manufacturer's instructions of handling and installation of sheet waterproofing materials, except where more stringent requirements are shown or specified.

B. Coordinate installation of waterproofing materials and associated work to provide complete system complying with combined recommendations of manufacturers and installers involved in work. Schedule installation to minimize period of exposure of sheet waterproofing materials.

C. Extend waterproofing sheet and flashings as shown to provide complete membrane over area indicated to be waterproofed.

1. Seal to projections through membrane and seal seams.

2. Bond to vertical surfaces and also, where shown or recommended by manufacturer, bond to horizontal surfaces.

D. Coat exposed areas of sheet and flashing materials.

1. Comply with sheet manufacturer's recommendations for application and cure of coating.

E. Install protection course of type indicated over completed membrane, complying with manufacturer's recommendations for both waterproofing sheet and protection course materials.

3.04 PROTECTION:

A. Institute all required procedures for protection of completed membrane during installation of work over membrane and throughout remainder of construction period. Do not allow traffic of any type on unprotected membrane.

END OF SECTION 07110

PART 1 - GENERAL

1.01 SUMMARY:

A. Section includes: Provide fluid-applied waterproofing where indicated on the Drawings, as specified herein, and as needed for a complete and proper installation, including, but not necessarily limited to, the following:

1. Provide treatment for all exposed exterior concrete slabs and sidewalk surfaces.

B. Related Sections: Drawings and General Provisions of the contract, including the General Covenants and Provisions, Supplementary Covenants and Provisions and General Requirements as well as, but not necessarily limited to, the following:

Section 02510 Sidewalk Paving
Section 03300 Cast-In-Place Concrete

1.02 REFERENCES:

A. Codes and Standards: Comply with provisions of the following codes, specifications and standard except where more stringent requirements are shown or specified.

1. American Society for Testing of Material (ASTM)

2. Uniform Building Code, U.B.C. Latest Edition

3. Iowa State Building Code, latest edition

1.03 SUBMITTALS:

A. Provide submittals in accordance to Section 01300.

B. Data Warranty: Deliver to the DNR Construction Inspector all information available on the manufacturer warranty and the installer guarantee as specified herein.

1.04 QUALITY ASSURANCE:

A. Qualification of Workers: Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the requirements and the methods needed for proper performance of the work of this section.

1.05 DELIVERY, STORAGE, AND HANDLING:

A. Packing and Shipping: Materials shall be delivered in their original, tightly sealed containers or unopened packages, all clearly labeled with manufacturer's name, product identification, and lot number where appropriate.

B. Acceptance at Site: Opened or damaged container will be rejected as non-complying with requirements by the DNR Construction Inspector.

1. Promptly remove unacceptable material from the job site and promptly replace with material meeting the specified requirements, at no additional cost to the Owner.

C. Storage and Protection: Store Materials out of the weather, in their original, tightly sealed containers, or unopened packages, and keep dry prior to and during application.

1.06 PROJECT/SITE CONDITIONS:

A. Environmental Requirement: Do not apply material during inclement weather or when precipitation appears imminent.

B. Existing Conditions: Do not apply material unless surfaces to receive treatment are clean, free from dirt, grease, oil and other material which would interfere with penetration.

1. Accomplish tuckpointing, caulking and expansion joint sealing before application.

1.07 SEQUENCING AND SCHEDULING:

A. Properly coordinate the work of this section with all other trades.

B. Do not start the work of this section until the work of all other trade has been completed unless otherwise approved by the DNR Construction Inspector.

1.08 WARRANTY:

A. Upon completion of the work of this section and as condition of its acceptance, deliver one copy to the Architect and one copy to the DNR Construction Inspector of a written warranty signed by the Contractor, the application subcontractor, and the material manufacturer, under which:

1. The three parties mutually agree to maintain, at no additional cost to the Owner, surfaces treated by the work of this section free from penetration of water for a period of two years from date of substantial completion.

2. The manufacturer agrees to provide, at no additional cost to the Owner, material as required for that purpose for a period of ten years following date of completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. Use in the work of this section:

1. Professional Water Sealant, Professional Products of Kansas, 4456 South Clifton, Wichita, Kansas 67216, Tel 1-800-676-7346.

2.02 MATERIALS:

A. Water Sealant: One coat penetrating silicone waterproofing treatment for above ground use.

1. Provide waterproofing permanent treatment Sein Silicone from Professional Water Sealant.

B. Physical Properties: Provide product which meets or exceeds all the following performance criteria in its cured state:

1. Perm Rate (ASTM E96-66, Method B): Perm 14

2. Hardness (ASTM D676, Shore A): 32

3. Tensile Strength (ASTM D412): 270 PSI

4. Elongation (ASTM D412): 415%

5. Brittle Point (ASTM D746): -100 degrees Fahrenheit (-73 degrees Celsius)

C. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Architect.

PART 3 - EXECUTION

3.01 EXAMINATION:

A. Examine the areas and conditions under which work of this section will be performed.

B. Correct conditions detrimental to timely and proper completion of the work.

C. Do not proceed until unsatisfactory conditions are corrected.

3.02 PREPARATION:

A. Protection: Cover landscaping in immediate area and provide additional protection as required by manufacturer's instructions.

B. Surface Preparation: Perform preparation and cleaning procedures in compliance with manufacturer's instructions for particular substrate conditions involved, and as herein specified.

C. Test application on each surface to receive treatment to ensure compatibility and check for penetration.

3.03 APPLICATION:

A. Apply treatment in accordance with manufacturer's instructions.

B. Apply by floodcoating with low pressure, airless spray, brush, roller, broom or dipping.

C. Apply sufficient amount of material in one coat application to achieve a consistent and uniform appearance, free from runs and sags, which surface will prevent penetration of water.

D. Curing: Allow curing time as required by manufacturer's instructions or, if not instructed from 30 to 45 minutes after application, before allowing traffic on treated horizontal surfaces.

END OF SECTION 07120

UNDER-SLAB VAPOR BARRIER/RETARDER

PART 1 – GENERAL

1.1 SUMMARY

A. Products Supplied Under This Section

1. Vapor Barrier, seam tape, pipe boots, detail strip for installation under concrete slabs.

B. RELATED SECTIONS

1. Section 03300 Cast-in-place Structural Concrete
2. Section 07260 Under-Slab Vapor Retarder

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM)

1. ASTM E 1745-97 Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil
   Or Granular Fill Under Concrete Slabs
2. ASTM E 154-88 Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs
3. ASTM E 96-95 Standard Test Methods for Water Vapor Transmission of Materials
4. ASTM E 1643-98 Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs

B. American Concrete Institute (ACI)

1. ACI 302.1R-96 Vapor Barrier Component (plastic membrane) is not less than 10 mils thick

1.3 SUBMITTALS

A. Quality Control / Assurance

1. Independent laboratory test results showing compliance with ASTM & ACI Standards.
2. Manufacturer's samples, literature
3. Manufacturer's installation instructions for placement, seaming and pipe boot installation

PART 2 – PRODUCTS

2.1 MATERIALS

A. Extremely low permeance vapor barriers for critically sensitive, low permeance floor coverings. Includes floor coverings of rubber, vinyl, urethane, epoxy and methyl methacrylate, as well as linoleum and wood.

1. Vapor Barrier must have the following qualities
   a. Minimum WVTR as tested by ASTM E96 of 0.008
2. Vapor Barriers
   a. Stego Wrap (15 mil) Vapor Barrier by STEGO INDUSTRIES LLC, San Juan Capistrano, CA
      (877) 464-7834 www.stegoindustries.com
   b. W.R. Meadown Premoulded Membrane with Plasmatic Core.
   c. Vaporguard by Reef industries.

2.2 ACCESSORIES

A. Seam Tape

1. High Density Polyethylene Tape with pressure sensitive adhesive. Minimum width 4 inches.

B. Pipe Boots
   1. Construct pipe boots from vapor barrier material and pressure sensitive tape per manufacturer's instructions.

PART 3 – EXECUTION

3.1 PREPARATION
A. Ensure that subsoil is approved by architect
   1. Level and tamp or roll aggregate, sand or tamped earth base.

3.2 INSTALLATION

A. Install Vapor Barrier:
   1. Installation shall be in accordance with manufacturer's instructions and ASTM E 1643–98.

      A. Unroll Vapor Barrier with the longest dimension parallel with the direction of the pour.
      B. Lap Vapor Barrier over footings and seal to foundation walls.
      C. Overlap joints 6 inches and seal with manufacturer's tape.
      D. Seal all penetrations (including pipes) with manufacturer's pipe boot.
      E. No penetration of the vapor barrier is allowed except for reinforcing steel and permanent utilities.
      F. Repair damaged areas by cutting patches of vapor barrier, overlapping damaged area 6 inches and taping all four sides with tape.

SECTION 072000
INSULATION

PART 1 - GENERAL

1.01 SUMMARY:

A. Section Includes:

1. Extent of insulation work is shown on Drawings and indicated by provisions of this section.

2. Where insulation is required, provide insulation of the type specified as indicated, in sufficient quantities to meet or exceed building code requirements.

3. Applications of insulation specified in this section include the following:

a. Insulation under slabs-on-grade.
b. Foundation wall insulation.
c. Board-type building insulation, concealed.
d. Blanket-type building insulation.
e. Loose-fill building insulation.

B. Related Sections: Drawings and General Provisions of the Contract, including the General Covenants and Provisions, Supplementary Covenants and Provisions and General Requirements as well as, but not necessarily limited to, the following:

Section 06100 Rough Carpentry
Section 15400 Plumbing
Section 15500 Heating, Ventilating, and Air Conditioning

1.02 REFERENCES:

A. ASTM E 84 - Standard specification for surface burning characteristics of building material.

B. ASTM C 549 - Standard specification for perlite loose-fill insulation.

C. ASTM C 516 - Standard specification for vermiculite loose-fill insulation.

D. FS HH-I-524C - Polystyrene board insulation.

E. FS HH-I-521 - Mineral fiber blanket insulation.

F. FS HH-I-1030 - Mineral fiber, loose-fill insulation.

1.03 SUBMITTALS:

A. Provide submittals in accordance with Section 01300.

B. Product Data: Submit manufacturer's product specifications and installation instructions for each type of insulation and vapor barrier material required.

1. Certified Tests: With product data, submit copies of certified test report showing compliance with specified performance values, including k-values (aged values for plastic insulations), densities, compression strengths, burning characteristics, perm ratings, water absorption ratings, and similar ratings.

1.04 QUALITY ASSURANCE:

A. Federal Specifications: Where compliance with FS standard is indicated, specified requirements for marking individual boards/batts/blankets are waived, provided packages of units are labeled to show compliances.

B. Thermal Conductivity: Thicknesses indicated are for thermal conductivity (k-value at 75°F. or 24°C) specified for each material. Provide adjusted thicknesses as directed for equivalent use of material having a different thermal conductivity.

1. Where insulation is identified by "R" value, provide thickness required to achieve indicated value.

C. Fire and Insurance Ratings: Comply with fire-resistance, flammability and insurance ratings indicated, and comply with regulations as interpreted by governing authorities.

D. Labels: Manufacturer's labels required on each piece or package of insulation.

1. Do not remove labels or open packages until inspected and approved by the DNR Construction Inspector.

1.05 DELIVERY, STORAGE, AND HANDLING:

A. General Protection: Protect insulations from physical damage and from becoming wet, soiled, or covered with ice or snow.

1. Comply with manufacturer's recommendations for handling, storage, and protection during installation.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. Polystyrene Board Insulation: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:

1. Dow Chemical Company; Midland, Michigan
2. UC Industries/U.S. Gypsum; Chicago, Illinois
3. or equal as approved by the Architect

B. Mineral/Glass Fiber Blanket/Batt Insulation: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:

1. Certain-Teed Products Corp.; Valley Forge, Pennsylvania
2. Manville Bldg. Materials Corp.; Denver, Colorado
3. Mizell Bros. Co.; Atlanta, Georgia
4. Owens-Corning Fiberglas Corp.; Toledo, Ohio

2.02 MATERIALS: *Note: All insulation must have a low – VOC certification

A. Extruded Polystyrene Board Insulation: Rigid, closed-cell, density skin; complying with FS HH-1-524C, Type IV, min. 20 psi compressive strength, k-value of 0.20; 0.3% maximum water absorption; 1.1 perm-inch maximum water vapor transmission; manufacturer's standard lengths and widths.

B. Mineral/Glass Fiber Blanket/Batt Insulation: Inorganic (nonasbestos) fibers formed with hinders into resilient flexible blankets or semi-rigid batts; FS HH-1-521, type as indicated, densities of not less than 0.5 lb. per cubic foot for glass fiber units and not less than 2.5 lb. per cubic foot for mineral wool units, k-value of 0.27; manufacturer's standard lengths and widths as required to coordinate with spaces to be insulated; types as follows:

1. Provide Type I unfaced units where indicated semi-rigid in vertical spaces and where self-support is required.

2. Provide Type II nonreflective vapor barrier faced units where indicated, with integral nailing flanges; barrier rating of 0.5 perms, other face (if any) with rating greater than 5.0 perms.

3. Provide Type III reflective vapor barrier faced units where indicated, with integral nailing flanges; aluminum foil barrier with rating of 0.5 perms, other face (if any) with rating greater than 5.0 perms.

a. Flame-Spread Rating: Provide units with rating of 25, ASTM E 84.

b. Fire-Resistance Ratings: Where units are included in rated wall/ceiling/floor construction, provide mineral wood units which have been tested and rated as required for the indicated assembly.

C. Loose Mineral Fiber Insulation: Inorganic (nonasbestos) fibers processed to form a loose resilient wool mass (for blowing) or granular nodules (for pouring); FS HH-1-1030; 1.0 lb. minimum in-place density; k-value of 0.30; Class B (or Class A); provide appropriate type (blowing or pouring) as for configuration of space to be insulated, Contractor's option appropriate, unless otherwise indicated.

D. Polyethylene Vapor Barrier: 4-mil polyethylene film with laboratory-tested vapor transmission rating of 0.2 perms, natural color.

E. Sound Insulation Batts: One layer R11 fiberglass insulation.

PART 3 - EXECUTION

3.01 EXAMINATION:

A. Installer must examine substrates and conditions under which insulation work is to be performed, and must notify Contractor in writing of unsatisfactory conditions.

B. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 PREPARATION:

A. Clean substrates of substances harmful to insulations or vapor barriers, including removal of projections which might puncture vapor barriers.

B. Close off openings in cavities to receive poured-in-place insulation, sufficiently to prevent escape of insulation.

1. Provide bronze or stainless steel screen (inside) where openings must be maintained for drainage or ventilation.

3.03 INSTALLATION:

A. Comply with manufacturer's instructions for particular conditions of installation in each case.

1. If printed instructions are not available or do not apply to project conditions, consult manufacturer's technical representative for specific recommendations before proceeding with work.

B. Extend insulation full thickness as shown over entire area to be insulated.

1. Cut and fit tightly around obstructions, and fill voids with insulation.

2. Remove projections which interfere with placement.

C. Apply a single layer of insulation of required thickness, unless otherwise shown or required to make up total thickness.

D. Perimeter and Under-Slab Insulation: On vertical surfaces, set units in adhesive applied in accordance with manufacturer's instructions.

1. Use type adhesive recommended by manufacturer of insulation.

2. Do not place polystyrene foam on solvent base waterproofing until waterproofing is well cured to avoid chemical reaction of foam with solvent.

E. General Building Insulation:

1. Apply insulation units to substrate by method indicated, complying with manufacturer's recommendations.

2. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

3. Set vapor barrier faced units with vapor barrier to warm side of construction, except as otherwise shown.

   a. Do not obstruct ventilation spaces, except for fire stopping.

   b. Tape joints and ruptures in vapor barriers, and seal each continuous area of insulation to surrounding construction to ensure vapor-tight installation.

4. Place loose fiber insulation into spaces and onto surfaces as shown, either by pouring or by machine-blowing.

   a. Level horizontal applications to uniform thickness as indicated, lightly settled to uniform density, but not excessively compacted.

5. Stuff loose mineral fiber insulation into miscellaneous voids and cavity spaces where shown. Compact to approximately 40% of normal maximum volume (to a density of approximately 2.5 lbs. per cubic foot).

F. Vapor Barrier Installation: General: Extend vapor barriers to extremities of areas to be protected from vapor transmission.

1. Secure in place with adhesives or other anchorage system as indicated.

2. Extend vapor barriers to cover miscellaneous voids in insulated substrates, including those which have been stuffed with loose fiber-type insulation.

3. Seal joints/seams in vapor barriers, seal to objects penetrating barriers, and seal to other surfaces at extremities of coverage by lapping with adhesive or taping to form a continuous barrier.

4. Repair punctures and tears in vapor barriers, immediately before concealment by other work.

5. Cover with adhesively applied vapor barrier material or with self-adhesive vapor barrier type.

3.04 PROTECTION:

A. General: Protect installed insulation and vapor barriers from harmful weather exposures and from possible physical abuses, where possible by nondelayed installation of concealing work or, where that is not possible, by temporary covering or enclosure.

B. Installer shall advise Contractor of exposure hazards, as well as of possible sources of deterioration and fire hazards.

END OF SECTION 07200

SECTION 074100
PREFORMED METAL STANDING SEAM ROOFING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. This section covers the pre-finished, pre-fabricated Architectural standing seam roof system. All metal trim, accessories, fasteners, insulation and sealants indicated on the drawings as part of this section.
B. Drawings and general provisions of the Contract, including general and Supplementary Conditions and Division 01 Specifications, apply to this section.
C. Related Work Specified Elsewhere
    1. Roof Deck structural steel, flat roof systems, perimeter edge systems. Roof hatches, firestopping not included in this section.

1.2 SUMMARY

A. Section Includes
    1. Factory formed Standing Seam metal roof panels
B. Related work specified elsewhere. (Note: select from the below or add appropriate sections)
    1. Section 05100 - Structural Steel
    2. Section 05200 or 05400 - Steel Joists
    3. Section 07600 - Flashing and Sheet Metal

1.3 DEFINITIONS

A. Metal Roof Panel Assembly**:** Metal roof panels, attachment system components, miscellaneous metal framing, thermal, and accessories necessary for a complete weathertight roofing system.
B. References:
    1. American Society for Testing and Materials (ASTM)
        a. ASTM A 653: Steel Sheet, Zinc Coated by the Hot Dip Process
        b. ASTM A 792: Steel Sheet, Aluminum-Zinc Alloy Coated by the Hot Dip Process
        c. ASTM B 209: Aluminum and Aluminum Alloy Sheet and Plate
        d. ASTM B370 Standard Specification for Copper Sheet and Strip for Building Construction
    2. Sheet Metal and Air Conditioning Contractors National Association (SMACNA)
        a. SMACNA Architectural Sheet Metal Manual, 1993 edition
    3. American Iron and Steel Institute (AISI)
        a. AISI Cold Formed Steel Design Manual
    4. Aluminum Association
        a. Aluminum Design Manual
    5. Metal Construction Association

        a. Preformed metal Wall Guidelines
    6. Code References
        a. ASCE, Minimum Loads for Buildings and Other Structures
        b. BOCA National Building Codes
        c. UBC Uniform Building Code
        d. SBC Standard Building Code

1.4 QUALITY ASSURANCE

A. Petersen Aluminum Corp, Acworth, GA, 800-272-4482 products establish a minimum of quality required.
B. Manufacturer and erector shall demonstrate experience of a minimum of five (5) years in this type of project.
C. Panels shall be factory-produced only. No portable, installer-owned or installer-rented machines will be permitted.

1.5 SUBSTITUTIONS

A. The material, products and equipment specified in this section establish a standard for required function, dimension, appearance and quality to be met by any proposed substitution.

1.6 SYSTEM DESCRIPTION

A. Material to comply with:
    1. ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process

1.7 ROOF SYSTEM PERFORMANCE TESTING

A. General Performance: Metal roof panels shall comply with performance requirements without failure due to defective manufacture, fabrication, installation or other defects in construction.
B. Roof System shall be designed to meet Standard Building Code Wind Load requirements.
C. Panels to meet:
    1. Water Penetration: When tested per ASTM E-283/1680 and ASTM E-331/1646 there shall be no uncontrolled water penetration or air infiltration through the panel joints.
    2. Roof System shall be designed to meet a UL Class 90 wind uplift in accordance with UL standard 580 and panel system shall be ASTM 1592 Tested and approved
    3. UL 2218 - Impact Resistance rated.

1.8 WARRANTIES

A. Weathertight warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace standing seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.
    1. Warranty Period: 20 Years from date of Substantial Completion
B. Finish warranty: Manufacturer's standard form in which manufacturer agrees to repair finish or replace standing seam metal roof panels that show evidence of deterioration of factory-applied finish within specified warranty period.
    1. Exposed Panels Finish - deterioration includes the following:
        a. Color fading more than 5 hunter units when tested according to ASTM D 2244
        b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214
        c. Cracking, checking, peeling or failure of a paint to adhere to a bare metal.
    2. Warranty Period: 20 Years from the date of substantial completion
C. Applicator shall furnish written warranty for a two (2) year period from date of substantial completion of building covering repairs required to maintain roof and flashings in watertight condition.

1.9 SUBMITTALS

A. Furnish detailed drawings showing profile and gauge of exterior sheets, location and type of fasteners, location, gauges, shape and method of attachment of all trim locations and types of sealants, and any other details as may be required for a weather-tight installation.
B. Provide finish samples of all colors specified.
C. Shop drawings: Show fabrication and installation layouts of metal roof panels, metal wall panels or metal soffit panels, details of edge conditions, side-seam joints, panel profiles, corners, anchorages, trim, flashings, closures and accessories, and special details. Distinguish between factory and field-assembled work
D. Coordination Drawings: Roof plans, drawn to scale, on which the following are shown and coordinated with each other, base don input from installer of the items involved:
    1. Roof panels and attachments
    2. Metal trusses, bracings and supports
    3. Roof-mounted items including snow guards and items mounted on roof curbs.
E. LEED Submittals
    1. Product Test reports for Credit SS 7.2. For roof panels, indicating that the panels comply with Solar Reflective Index requirement
    2. Product data for Credit MR 4.1 and credit MR 4.2: Indicating the percentages by weight of postconsumer and preconsumer recycled content for products having recycled content.

1.10 DELIVERY, STORAGE AND HANDLING

A. Ordering: Comply with manufacturer's ordering instruction and lead time requirements to avoid construction delays.

B. Deliver components, sheets, metal roof panels and other manufactured items so as not to be damaged or deformed. Package metal roof panels for protection during transportation and handling.
C. Unload, store and erect metal roof panels in a manner to prevent bending, warping, twisting and surface damage.
D. Stack metal roof panels on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal roof panels to ensure dryness. Do not store metal roof panels in contact with other materials that might cause staining, denting or other surface damage.
E. Protect strippable protective coating on any metal coated product from exposure to sunlight and high humidity, except to the extent necessary for material installation.

1.11 PROJECT CONDITIONS

A. Weather Limitations: proceed with installation only when existing and forecasted weather conditions permit metal roof panel work to be performed.
B. Field Measurements: Verify actual dimensions of construction contiguous with metal roof panels by field measurements before fabrication.

1.12 COORDINATION

A. Coordinate sizes and locations of roof curbs, equipment supports and roof penetrations with actual equipment provided.
B. Coordinate metal roof panels with rain drainage work, flashing, trim and construction of decks, parapet walls and other adjoining work to provide a leakproof, secure and noncorrosive installation.

PART 2 - PRODUCTS

2.1 PANEL DESIGN

A. General: Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates and accessories required for a weathertight installation.
B. Roof panels shall be standing seam Tite-Loc in 18" widths with 2" high seams that are mechanically seamed together @ 90 degrees.
    1. Curving Option: Roof panels may be "field-curved/radiused" with the Factory-Supplied Curving Machine to achieve the proper installation of these panels on the radiused/curved roofs on this project
C. Panels to be produced with Factory supplied hot melt mastic in the seams.
D. Panels to be produced Smooth - Factory Standard.
E. Panels to be designed for attachment with concealed fastener clips, spaced as required by the manufacturer to provide for both positive and negative design loads, while allowing for the expansion and contraction of the entire roof system resulting from variations in temperature.

F. Forming: Use continuous end rolling method. No end laps on panels. No portable rollforming machines will be permitted on this project, no installer-owned or installer-rented machines will be permitted. It is the intent of the Architect to provide Factory-Manufactured panel systems only for this project.

2.2 ACCEPTABLE MANUFACTURERS

A. This project is detailed around the roofing product of Petersen Aluminum Corporation Petersen Aluminum Corp, Acworth, GA, 800-272-4482, Tite-Loc.

2.3 MATERIALS AND FINISHES

A. Preformed roofing panels shall be fabricated of 24 GA Steel
B. Color shall be *Standard Pac-Clad Finish – Submit Samples
C. Finish shall be Kynar 500 or Hylar 5000 Fluorocarbon coating with a top side film thickness of 0.70 to 0.90 mil over a 0.25 to 0.3 mil prime coat to provide a total dry film thickness of 0.95 to 1.25 mil, to meet AAMA 621. Bottom side shall be coated with a primer with a dry film thickness of 0.25 mil. Finish shall conform to all tests for adhesions, flexibility and longevity as specified by Kynar 500 or Hylar 5000 finish supplier.
D. If Strippable coating to be applied on the pre-finished panels to the top side to protect the finish during fabrication, shipping and handling, film shall be removed before installation.
E. Trim: Trim shall be fabricated of the same material and finish to match the profile, and will be press broken in lengths of 10 to 12 feet. Trim shall be formed only by the manufacturer of their approved dealer. Trim to be erected in overlapped condition. Use lap strips only as indicated on drawings. Miter conditions shall be factory welded material to match the sheeting.
F. Closures: use composition or metal profiled closures at the top of each elevation to close ends of the panels. Metal closures to be made in the same material and finish as face sheet.
G. Fasteners: Fasteners shall be of type, material, size, corrosion resistance, holding power and other properties required to fasten miscellaneous framing members to substrates.
H. Substrate shall be Plywood
I. Roofing Underlayment
    1. On all surfaces to be covered with roofing material, furnish and install a 40 mil "Peel & Stick membrane", required as outlined by metal panel manufacturer. Membrane to be a minimum of 40 mil thickness, smooth, non-granular, by one of the following manufacturers:
        a. W.R Grace "Ice & water Shield"
        b. Cetco Strongseal
        c. Carlisle CCW WIP 300HT
        d. Interwrap Titanium PSU
        e. MFM Corp "Wind & Water Shield"
        f. Polyguard Deck Guard HT of Polyglas HT
        g. Tamko TW Tile and Metal Underlayment

2. Underlayment shall be laid in horizontal layers with joints lapped toward the eaves a minimum of 6", and well secured along laps and at ends as necessary to properly hold the felt in place. All underlayment shall be preserved unbroken and whole.
3. Ice and Water Shield shall lap all hips and ridges at least 12" to form double thickness and shall be lapped 6" over the metal of any valley or built-in gutters and shall be installed as required by the Standing Seam Panel Manufacturer to attain the desired 20 Year Weathertightness Warranty.

J. Sealants
1. Provide two-part polysulfide class B non-sag type for vertical and horizontal joints or
2. one part polysulfide not containing pitch or phenolic extenders or
3. Exterior grade silicone sealant recommended by roofing manufacturer or
4. One part non-sag, gun grade exterior type polyurethane recommended by the roofing manufacturer.

2.4 FABRICATION

A. Comply with dimensions, profile limitations, gauges and fabrication details shown and if not shown, provide manufacturer's standard product fabrication.
B. Fabricate components of the system in factory, ready for field assembly.
C. Fabricate components and assemble units to comply with fire performance requirements specified.
D. Apply specified finishes in conformance with manufacturer's standard, and according to manufacturer's instructions.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine alignment of structural steel and related supports, primary and secondary roof framing, solid roof sheathing, prior to installation.
B. For the record, prepare written report, endorsed by installer, listing conditions detrimental to performance of the Work.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FASTENERS

A. Secure units to supports
B. Place fasteners as indicated in manufacturer's standards.

3.3 INSTALLATION

A. Panels shall be installed plumb and true in a proper alignment and in relation to the structural framing. The erector must have at least five years successful experience with similar applications.

B. Install metal panels, fasteners, trim and related sealants in accordance with approved shop drawings and as may be required for a weather-tight installation.
C. Remove all strippable coating and provide a dry-wipe down cleaning of the panels as they are erected.

3.4 DAMAGED MATERIAL

A. Upon determination of responsibility, repair or replace damaged metal panels and trim to the satisfaction of the Architect and Owner.

END OF SECTION

SECTION 074100
FACTORY MANUFACTURED PREFORMED WALL PANELS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. This section covers the pre-finished, pre-fabricated exposed fastener metal roof and wall system. All metal trim, accessories, fasteners, insulation and sealants indicated on the drawings as part of this section.
B. Drawings and general provisions of the Contract, including general and Supplementary Conditions and Division 01 Specifications, apply to this section.
C. Related Work Specified Elsewhere
    1. Roof Deck structural steel, flat roof systems, perimeter edge systems. Roof hatches, firestopping not included in this section.

1.2 SUMMARY

A. Section Includes
    1. Factory formed exposed fastener metal roof and wall panels
B. Related work specified elsewhere. (Note: select from the below or add appropriate sections)
    1. Section 05100 - Structural Steel
    2. Section 05200 or 05400 - Steel Joists
    3. Section 07600 - Flashing and Sheet Metal

1.3 DEFINITIONS

A. Metal Roof/Wall Panel Assembly: Metal roof/ panels, attachment system components, miscellaneous metal framing, thermal, and accessories necessary for a complete weathertight roofing system.
B. References:
    1. American Society for Testing and Materials (ASTM)
        a. ASTM A 653: Steel Sheet, Zinc Coated by the Hot Dip Process
        b. ASTM A 792: Steel Sheet, Aluminum-Zinc Alloy Coated by the Hot Dip Process
        c. ASTM B 209: Aluminum and Aluminum Alloy Sheet and Plate
        d. ASTM B370 Standard Specification for Copper Sheet and Strip for Building Construction
    2. Sheet Metal and Air Conditioning Contractors National Association (SMACNA)
        a. SMACNA Architectural Sheet Metal Manual, 1993 edition
    3. American Iron and Steel Institute (AISI)
        a. AISI Cold Formed Steel Design Manual
    4. Aluminum Association
        a. Aluminum Design Manual
    5. Metal Construction Association

a. Preformed Metal Wall Guidelines

6. Code References
    a. ASCE, Minimum Loads for Buildings and Other Structures
    b. BOCA National Building Codes
    c. UBC Uniform Building Code
    d. SBC Standard Building Code

1.4 QUALITY ASSURANCE

A. Petersen Aluminum Corp, Acworth, GA, 800-272-4482 products establish a minimum of quality required.
B. Manufacturer and erector shall demonstrate experience of a minimum of five (5) years in this type of project.
C. Panels shall be factory-produced only. No portable, installer-owned or installer-rented machines will be permitted.

1.5 SUBSTITUTIONS

A. The material, products and equipment specified in this section establish a standard for required function, dimension, appearance and quality to be met by any proposed substitution.
B. Manufacturers listed in this section are prequalified manufacturers. Substitution of manufacturer's products for those specified shall not be allowed at any time during construction.

1.6 SYSTEM DESCRIPTION

A. Material to comply with:
    1. ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated by the Hot-Dip Process

1.7 ROOF SYSTEM PERFORMANCE TESTING

A. General Performance: Metal roof/wall panels shall comply with performance requirements without failure due to defective manufacture, fabrication, installation or other defects in construction.
B. Roof System shall be designed to meet Standard Building Code Wind Load requirements.
C. Panels to meet:
    1. Roof/Wall System shall be designed to meet applicable Local Building Code and the System shall have tested by the Manufacturer per ASTM E-1592 and have the applicable Load Tables published from this testing for loads.

1.8 WARRANTIES

A. Finish warranty: Manufacturer's standard form in which manufacturer agrees to repair finish or replace standing seam metal roof panels that show evidence of deterioration of factory-applied finish within specified warranty period.
    1. Exposed Panels Finish - deterioration includes the following:
        a. Color fading more than 5 hunter units when tested according to ASTM D 2244
        b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214
        c. Cracking, checking, peeling or failure of a paint to adhere to a bare metal.
    2. Warranty Period: 20 Years from the date of substantial completion
B. Applicator shall furnish written warranty for a two (2) year period from date of substantial completion of building covering repairs required to maintain roof and flashings in watertight condition.

1.9 SUBMITTALS

A. Furnish detailed drawings showing profile and gauge of exterior sheets, location and type of fasteners, location, gauges, shape and method of attachment of all trim locations and types of sealants, and any other details as may be required for a weather-tight installation.
B. Provide finish samples of all colors specified.
C. Shop drawings: Show fabrication and installation layouts of metal roof panels, metal wall panels or metal soffit panels, details of edge conditions, side-seam joints, panel profiles, corners, anchorages, trim, flashings, closures and accessories, and special details. Distinguish between factory and field-assembled work
D. Coordination Drawings: Roof plans, drawn to scale, on which the following are shown and coordinated with each other, based on input from installer of the items involved:
    1. Roof panels and attachments
    2. Metal trusses, bracings and supports
    3. Roof-mounted items including snow guards and items mounted on roof curbs.
E. LEED Submittals
    1. Product Test reports for Credit SS 7.2. For roof panels, indicating that the panels comply with Solar Reflective Index requirement
    2. Product data for Credit MR 4.1 and credit MR 4.2: Indicating the percentages by weight of postconsumer and preconsumer recycled content for products having recycled content.

1.10 DELIVERY, STORAGE AND HANDLING

A. Ordering: Comply with manufacturer's ordering instruction and lead time requirements to avoid construction delays.
B. Deliver components, sheets, metal roof/wall panels and other manufactured items so as not to be damaged or deformed. Package metal roof/wall panels for protection during transportation and handling.
C. Unload, store and erect metal roof/wall panels in a manner to prevent bending, warping, twisting and surface damage.

D. Stack metal roof panels on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal roof/wall panels to ensure dryness. Do not store metal roof panels in contact with other materials that might cause staining, denting or other surface damage.
E. Protect strippable protective coating on any metal coated product from exposure to sunlight and high humidity, except to the extent necessary for material installation.

1.11 PROJECT CONDITIONS

A. Weather Limitations: proceed with installation only when existing and forecasted weather conditions permit metal roof panel work to be performed.
B. Field Measurements: Verify actual dimensions of construction contiguous with metal roof panels by field measurements before fabrication.

1.12 COORDINATION

A. Coordinate sizes and locations of roof curbs, equipment supports and roof penetrations with actual equipment provided.
B. Coordinate metal roof panels with rain drainage work, flashing, trim and construction of decks, parapet walls and other adjoining work to provide a leakproof, secure and noncorrosive installation.

PART 2 - PRODUCTS

2.1 PANEL DESIGN

A. General: Provide factory-formed, prefinished, lappable exposed fastener, structural ribbed metal roof/wall panel system, that has been pretested and certified by manufacturer to comply with specified requirements under installed conditions.
B. Roof panels shall be 7.2 Rib exposed fastener with 1 1/2" high ribs at 7.2" on centers. The width of the crests shall be 2"; the width of the valleys shall be 2". Coverage for this panel shall be 36" for both roofing and wall applications.
C. Structural Requirements: Engineer panels for structural properties in accordance with latest edition of American Iron and Steel Institute's Cold Formed Steel Design Manual using effective width concept and Aluminum Associations Aluminum Design Manual.
D. Forming: Use continuous end rolling method. No end laps on panels. No portable rollforming machines will be permitted on this project, no installer-owned or installer-rented machines will be permitted. It is the intent of the Architect to provide Factory-Manufactured panel systems only for this project.
E. Panels shall be directly fastened to the substrate.
F. The panel shall have an overlapping sidelap feature.

2.2 ACCEPTABLE MANUFACTURERS

A. This project is detailed around the roofing product of Petersen Aluminum Corporation Petersen Aluminum Corp, Acworth, GA, 800-272-4482, 7.2 Panel.

2.3 MATERIALS AND FINISHES

A. Preformed roofing panels shall be fabricated of 24 GA Steel
B. Color shall be *Standard Pac-Clad Finish – Submit samples.
C. Texture: Panel shall be smooth.
D. Finish shall be Kynar 500 or Hylar 5000 Fluorocarbon coating with a top side film thickness of 0.70 to 0.90 mil over a 0.25 to 0.3 mil prime coat to provide a total dry film thickness of 0.95 to 1.25 mil, to meet AAMA 621. Bottom side shall be coated with a primer with a dry film thickness of 0.25 mil. Finish shall conform to all tests for adhesions, flexibility and longevity as specified by Kynar 500 or Hylar 5000 finish supplier.
E. If Strippable coating to be applied on the pre-finished panels to the top side to protect the finish during fabrication, shipping and handling, film shall be removed before installation.
F. Trim: Trim shall be fabricated of the same material and finish to match the profile, and will be press broken in lengths of 10 to 12 feet. Trim shall be formed only by the manufacturer of their approved dealer. Trim to be erected in overlapped condition. Use lap strips only as indicated on drawings. Miter conditions shall be factory welded material to match the sheeting. Trim to be fabricated in accordance with standard SMACNA procedure and details.
G. Closures: shall be pre-molded polyethylene to match the profile of the exposed fastener panel and shall be in lengths as supplied by the panel manufacturer.
H. Accessories/Fasteners: Fasteners shall be of type, material, size, corrosion resistance, holding power and other properties required to fasten miscellaneous framing members to substrates. Accessories and their fasteners shall be capable of resisting the specified design wind uplift forces and shall allow for thermal movement of the roof panel system. Exposed fasteners shall not restrict free movement of the roof panel system resulting from thermal forces, except at designed points of roof panel fixity
    1. Fasteners shall have combination steel and EPDM washers
    2. Screws for panel to girt/purlins shall be sufficient to penetrate the supporting member by 1". All fasteners shall be applied in accordance with the fastening schedule as provided by panel manufacturer.
    3. Screws for flashings and sidelaps shall be #14 HHA x 3/4" sheet metal stitch screws. All accessories, flashings and sidelaps shall be fastened 12" OC.
I. Substrate shell be Plywood
J. Caulking: Shall be a polyurethane where it is exposed and there is no thermal movement. All caulking and sealing shall be done in a neat manner with excess caulking or sealant removed from exposed surfaces.
K. Caulking shall be non-skinning, non hardening gun grade butyl sealant or butyl sealant tape with a minimum thickness of ?" where it is concealed and where thermal movement must be accommodated. All caulking or sealing shall be done in a neat manner with excess caulking or sealant removed from exposed surfaces.
L. Vapor Retarder: retarder with a permeance of 0.05 or less as determined by ASTM 98.

2.4 FABRICATION

A. Comply with dimensions, profile limitations, gauges and fabrication details shown and if not shown, provide manufacturer's standard product fabrication.
B. Fabricate components of the system in factory, ready for field assembly.
C. Fabricate components and assemble units to comply with fire performance requirements specified.
D. Apply specified finishes in conformance with manufacturer's standard, and according to manufacturer's instructions.
E. Panels are lappable. It is recommended that individual aluminum roof panels not exceed 16' in length and steel roof panels not exceed 32' in length for thermal movement reasons.
F. Panels shall be roll formed on a stationary industrial type rolling mill to gradually shape the sheet metal. Portable rollformers rented or owned by the installer, are not acceptable.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine alignment of structural steel and related supports, primary and secondary roof framing, solid roof sheathing, prior to installation. Components should comply with shop drawings and be smooth, even, sound and free of depressions.
B. For the record, prepare written report, endorsed by installer, listing conditions detrimental to performance of the Work.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FASTENERS

A. Secure units to supports
B. Place fasteners as indicated in manufacturer's standards.

3.3 INSTALLATION

A. Panels shall be installed plumb and true in a proper alignment and in relation to the structural framing. The erector must have at least five years successful experience with similar applications.
B. Install metal panels, fasteners, trim and related sealants in accordance with approved shop drawings and as may be required for a weather-tight installation. Conform to standards set forth in SMACNA architectural sheet metal manuals and approved shop drawings for this project.
C. Remove all strippable coating and provide a dry-wipe down cleaning of the panels as they are erected.
D. Install panel system so it is watertight, without waves, warps, buckles or distortions, and allow for thermal movement considerations.
E. Abrasive devices shall not be used to cut on or near roof or wall panel system.
F. Apply sealant tape or caulking as necessary at flashing and panel joints to prevent water penetration.
G. Remove any strippable film immediately upon exposure to direct sunlight.

H. Vapor retarder: The joints, perimeter, and all openings shall be sealed per the manufacturer's instructions to provide a continuous vapor retarder.
I. Underlayment (solid substrate):
    1. Provide one layer of 30# felt with horizontal overlaps and endlaps staggered between layers.
    2. Provide ice and water shield membrane at all valley and eave conditions as well as any area at less than a 3:12 slope.
    3. Lay parallel to ridge line with 2 1/2" horizontal laps and 6" vertical laps

3.4 DAMAGED MATERIAL

A. Upon determination of responsibility, repair or replace damaged metal panels and trim to the satisfaction of the Architect and Owner.

END OF SECTION

SECTION 077123
MANUFACTURED GUTTERS AND DOWNSPOUTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Gutters and downspouts, the extent of which is shown on the Drawings and includes:

1. Gutters and downspouts with built-in leaf protection.

B. Related Sections: Drawings and General Provisions of the contract, including the General Covenants and Provisions, Supplementary Covenants and Provisions and General Requirements.

1. Section 077123 – Manufactured Gutters and Downspouts.

1.02 SUBMITTALS

A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.

B. Product Data: Submit manufacturer's product data for specified products.

C. Samples: Submit selection and verification samples for finishes, colors and textures.

1. Selection Samples: For each product requiring color selection, 2 sets of manufacturer's sample chips representing full range of colors and finishes available.

2. Verification Samples: For each color and finish selected, 2 chips indicating match to selected color and finish.

D. Quality Assurance Submittals: Submit the following:

1. Manufacturer's Instructions: Manufacturer's installation instructions.

E. Closeout Submittals: Submit the following:

1. Warranty: Warranty documents specified herein.

2. Record Documents: Project record documents for installed materials in accordance with Division 1 Closeout Submittals (Project Record Documents) Section.

1.03 QUALITY ASSURANCE

A. Installer Qualifications: Installer experienced in performing work of this section who has specialized in the installation of work similar to that required for this project.

B. Preinstallation Meetings: Conduct preinstallation meeting to verify project requirements, substrate conditions, manufacturer's installation instructions and manufacturer's warranty requirements.

1.04 DELIVERY, STORAGE & HANDLING

A. General: Comply with Division 1 Requirements Sections.

1. Ordering: Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.

B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact. Identify fabricated components with UL 90 label where appropriate.

C. Storage and Protection: Store materials protected from exposure to harmful conditions. Store material in dry, above-ground location.

1. Stack prefinished material to prevent twisting, bending, abrasion, scratching and denting.

1.05 PROJECT CONDITIONS

A. Field Measurements: Verify actual measurements/openings by field measurements before fabrication; show recorded measurements on shop drawings. Coordinate field measurements, fabrication schedule with construction progress to avoid construction delays.

1.06 WARRANTY

A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.

B. Manufacturer's Warranty: Submit, for Architect's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under the Contract Documents.

1. Gutters and Downspouts: In addition to the manufacturer' standard guarantees, provide the manufacturer' standard lifetime warranty on baked on finish.

PART 2 - PRODUCTS

2.01 GUTTERS AND DOWNSPOUTS

A. Gutters: Provide seamless, rolled-formed, .032 aluminum, one piece gutter units designed to prevent built-up of leaves within the gutters, provide superior protection against wind and storm damage, and eliminates the possibility of debris entering the gutter from behind.

1. Screw gutters to the fascia board every 2 feet with internal hanging brackets. Do not attach with spikes.

2. Do not provide units with multiple parts, multi-piece gutters and separate leaf-shedding covers unless otherwise approved by the Architect.

3. Finish: Baked-on enamel.

4. Color: As selected by the Architect from manufacturer' standard colors matching roofing system.

B. Downspouts: Corrugated, prepainted, rectangular shape aluminum, .025" thick (minimun).

1. Finish: Baked-on enamel.

2. Color: As selected by the Architect from manufacturer' standard colors.

PART 3 - EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

A. Compliance: Comply with manufacturer's product data, recommendations and installations instructions for substrate verification, preparation requirements and installation.

3.02 EXAMINATION

A. Site Verification of Conditions: Verify substrate conditions, which have been previously installed under other sections, are acceptable for product installation in accordance with manufacturer's instructions.

1. Installer's Examination:

a. Have installer of this section examine conditions under which construction activities of this section are to be performed, then submit written notification if such conditions are unacceptable.

b. Transmit 2 copies of installer's report to Architect/DNR Construction Inspector within 24 hours of receipt.

c. Delay construction activities of this section until unacceptable conditions have been corrected.

d. Beginning construction activities of this section indicates installer's acceptance of conditions.

3.03 PREPARATION

A. Coordination: Coordinate with other work including drainage, flashing and trim, walls and other adjoining work to provide a noncorrosive and leakproof installation.

B. Dissimilar Metals: Prevent galvanic action of dissimilar metals if any.

3.04 INSTALLATION

A. General: Install gutters and ownspouting profiles, patterns and drainage indicated and required for leakproof installation. Seal joints for leakproof installation.

1. Fasteners: Conceal fasteners where possible in exposed work. Cover and seal fasteners and anchors for watertight and leakproof installation.

2. Sealant-Type Joints: Provide sealant-type joint where indicated. Form joints to conceal sealant. Comply with Division 7 Joint Sealants Section for sealant installation.

3.05 CLEANING

A. Cleaning: Remove temporary coverings and protection of adjacent work areas. Repair or replace damaged installed products. Clean installed products in accordance with manufacturer's instructions prior to DNR Construction Inspector's acceptance. Remove construction debris from project site and legally dispose of debris.

3.06 PROTECTION

A. Protection: Protect installed product's finish surfaces from damage during construction.

1. Replace products having damage other than minor finish damage.

2. Repair products having minor damage to finish in accordance with panel manufacturer's recommendations.

3. The DNR Construction Inspector shall be sole judge of acceptability of repair to damaged finishes; replace products having rejected repairs.

END OF SECTION 077123

SECTION 07900
JOINT SEALERS

PART 1 - GENERAL

1.01 SUMMARY:

A. Section Includes: Furnishing of all materials and labor to complete caulking and sealing of all joints which require caulking or sealing.

B. Spaces noted on the Drawings to be caulked or sealed to make weathertight or neat appearing are included herein.

1. The extent of each form and type of joint sealer is indicated on Drawings and by provisions of this section.

2. The applications for joint sealers as work of this section include the following:

a. Pavement and sidewalk joints.
b. Concrete construction joints.
c. Floor joints (interior).
d. Wall joints (exterior).
e. Flashing and coping joints.
f. Interior wall/ceiling joints.
g. Gasketing of assemblies.

3. Refer to Division 8 sections for glazing requirements; not work of this section.

4. Refer to sections of Divisions 15 and 16 for joint sealers in mechanical and electrical work; not work of this section.

5. General Performance: Except as otherwise indicated, joint sealers are required to establish and maintain air-tight and waterproof continuous seals on a permanent basis, within recognized limitations of wear and aging as indicated for each application.

a. Failures of installed sealers to comply with this requirement will be recognized as failures of material and workmanship.

B. Related Sections: Drawings and General Provisions of the contract, including the General Covenants and Provisions, Supplementary Covenants and Provisions and General Requirements as well as, but not necessarily limited to, the following:

Section 02500 Paving and Surfacing
Section 03300 Cast-In-Place Concrete
Section 06100 Rough Carpentry
Section 06200 Finish Carpentry

1.02 SUBMITTALS:

A. Provide submittals in accordance with Section 01300.

B. Product Data: Submit manufacturer's product information, specifications, handling, installation and curing instructions, and performance tested data sheets for each elastomeric product required.

1.03 QUALITY ASSURANCE:

A. Qualifications of Manufacturers: Products used in the work of this section shall be produced by manufacturers regularly engaged in manufacture of similar items and with a history of successful production acceptable to the Architect.

B. Qualifications of Installers: Proper caulking and proper installation of sealants require that installers be thoroughly trained and experienced in the necessary skills and thoroughly familiar with the specified requirements.

C. For caulking and installation of sealants throughout the work, use only personnel who have been specifically trained in such procedures and who are completely familiar with the joint details shown on the Drawings and the installation requirements called for in this section.

1.04 PROJECT/SITE CONDITIONS:

A. Weather Conditions: Do not proceed with installation of liquid sealants under unfavorable weather conditions.

B. Install elastomeric sealants when temperature is in lower third of temperature range recommended by manufacturer for installation.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. General: Manufacturers listed in this article include those known to product the indicated category of prime joint sealer material, either as a nominally pure generic product or as an equivalent-performance modification thereof or proprietary product.

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:

1. Manufacturers of acrylic latex sealant compounds:

a. VIP Enterprises, Inc.; Miami, FL
b. Sonneborn/Contech, Inc.; Minneapolis, MN
c. Gibson-Homans Co.; Cleveland, OH
d. W. R. Meadows, Inc.; Elgin, IL
e. Thoro Systems Products

2. Manufacturers of elastomeric sealants:

a. Dow Corning Corp.; Midland, MI
b. Gibson-Homans Co.; Cleveland, OH
c. Pecora Corp.; Harleysville, PA
d. Sonneborn/Contech, Inc.; Minneapolis, MN
e. Thoro Systems Products
f. Woodmont Products, Inc.; Huntington Valley, PA

3. Manufacturers of nonelastomeric sealants/caulks:

a. Gibson-Homans Co.; Cleveland, OH
b. W. R. Meadows, Inc.; Elgin, IL
c. Pecora Corp.; Harleysville, PA
d. Sonneborn/Contech, Inc.; Minneapolis, MN
e. Tremco, Inc.; Miami, FL

4. Manufacturers of joint fillers/sealant backers:

a. Dow Chemical Co.; Midland, MI
b. J & P Petroleum Products, Inc.; Dallas, TX
c. W. R. Meadows, Inc.; Elgin, IL
d. Sonneborn/Contech, Inc.; Minneapolis, MN
e. Williams Products, Inc.; Troy, MI

2.02 MATERIALS: *Note – All interior sealants must have low – VOC certification

A. General Sealer Requirements: Provide colors indicated or, if not otherwise indicated, as selected by Architect from manufacturer's standard colors.

B. Type A, Single-Component Polysulfide Sealant: Except as otherwise indicated, provide manufacturer's standard, nonmodified, one-part, polysulfide-based, air-curing, elastomeric sealant; complying with either ASTM C 920 Type S Class 25, or FS TT-S-00230C Class A; self-leveling grade/type where used in joints of surfaces subject to traffic, otherwise nonsag grade/type.

C. Type B, Single-Component Polyurethane Sealant: Except as otherwise indicated, provide manufacturer's standard, nonmodified, one-part, polyurethane-based, air-curing, elastomeric sealant; complying with either ASTM C 920 Type S Class 25, or FS TT-S-00230C Class A; self-leveling grade/type where used in joints of surfaces subject to traffic, otherwise nonsag grade/type.

1. Bituminous Modification: Where joint surfaces contain or are contaminated with bituminous materials, provide manufacturer's modified type sealant compatible with joint surfaces (modified with coal tar or asphalt as required).

D. Type C, Single-Component Silicon Rubber Sealant: Except as otherwise indicated, provide manufacturer's standard, nonmodified, one-part, silicone-rubber-based, air-curing, nonsag, elastomeric sealant; complying with either ASTM C 920 Type S Class 25 Grade NS, or FS TT-S-001543A Class A Type Nonsag.

1. Sanitary Interior Type: Where indicated and where applied in high-humidity or wet service, provide manufacturer's mold/mildew-resistant, acid type sealants for application to nonporous sealant bond surfaces.

E. Type D, Acrylic-Emulsion Sealant: Provide acrylic-emulsion or latex-rubber-modified acrylic-emulsion sealant compound, permanently flexible, nonstaining and nonbleeding; recommended by manufacturer for protected exterior exposure and general interior exposure.

F. Bituminous and Fiber Joint Filler: Provide resilient and nonextruding type premolded bituminous-impregnated fiberboard units complying with ASTM D 1751; FS HH-F-341, Type I; or AASHTO M 213.

G. Joint Primer/Sealer: Provide type of joint primer/sealer recommended by sealant manufacturer for joint surfaces to be primed or sealed.

H. Bond Breaker Tape: Provide polyethylene tape or other plastic tape as recommended by sealant manufacturer, to be applied to sealant-contact surfaces where bond to substrate or joint filler must be avoided for proper performance of sealant.

1. Provide self-adhesive tape where applicable.

I. Sealant Backer Rod: Provide compressible rod stock of polyethylene foam, polyurethane foam, polyethylene jacketed polyurethane foam, butyl rubber foam, neoprene foam or other flexible, permanent, durable nonabsorptive material as recommended by sealant manufacturer for back-up of and compatibility with sealant.

1. Where used with hot-applied sealant, provide heat-resistant type, which will not be deteriorated by sealant application temperature, as indicated.

PART 3 - EXECUTION

3.01 EXAMINATION:

A. Installer must examine substrates (joint surfaces) and conditions under which joint sealer work is to be performed, and must notify Contractor in writing of unsatisfactory conditions.

B. Do not proceed with joint sealer work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.02 PREPARATION:

A. Clean joint surfaces immediately before installation of gaskets, sealants or caulking compounds.

1. Remove dirt, insecure coatings, moisture and other substrates which could interfere with seal of gasket or bond of sealant or caulking compound.

2. Etch concrete and masonry joint surfaces as recommended by sealant manufacturer.

3. Roughen vitreous and glazed joint surfaces as recommended by sealant manufacturer.

B. Prime or seal joint surfaces where indicated, and where recommended by sealant manufacturer.

C. Confine primer/sealer to areas of sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.03 INSTALLATION:

A. Comply with manufacturer's printed instructions except where more stringent requirements are shown or specified, and except where manufacturer's technical representative directs otherwise.

B. Set joint filler units at depth or position in joint as indicated to coordinate with other work, including installation of bond breakers, backer rods and sealants.

1. Do not leave voids or gaps between ends of joint filler units.

C. Install sealant backer rod for liquid-applied sealants, except where shown to be omitted or recommended to be omitted by sealant manufacturer for application indicated.

D. Install bond breaker tape where indicated and where required by manufacturer's recommendations to ensure that liquid-applied sealants will perform as intended.

E. Employ only proven installation techniques, which will ensure that sealants are deposited in uniform, continuous ribbons without gaps or air pockets, with complete "wetting" of joint bond surfaces equally on opposite sides.

1. Except as otherwise indicated, fill sealant rabbet to a slightly concave surface, slighting below adjoining surfaces.

2. Where horizontal joints are between a horizontal surface and vertical surface, fill joint to form a slight cove so that joint will not trap moisture and dirt.

F. Install liquid-applied sealant to depths as shown; or, if not shown, as recommended by sealant manufacturer, but within the following general limitations, measured at center (thin) section of beads (not applicable to sealants in lapped joints).

1. For sidewalks, pavements and similar joints sealed with elastomeric sealants and subject to traffic and other abrasion and indentation exposures, fill joints to a depth equal to 75% of joint width, but neither more than 5/8" deep nor less than 3/8" deep.

2. For normal moving joints sealed with elastomeric sealants but not subject to traffic, fill joints to a depth equal to 50% of joint width, but neither more than 1/2" deep nor less than 1/4" deep.

3. For joints sealed with nonelastomeric sealants and caulking compounds, fill joints to a depth in range of 75% to 125% of joint width.

G. Spillage: Do not allow sealants or compounds to overflow from confines of joints, or to spill onto adjoining work, or to migrate into voids of exposed finishes.

1. Clean adjoining surfaces by whatever means may be necessary to eliminate evidence of spillage.

3.04 APPLICATION:

A. Type A, Polysulfide Sealant: Apply in accordance with manufacturer's instructions for sealing cracks or joints on masonry, concrete, bricks, stone, tile, glass, aluminum, or stainless steel.

B. Type B, Polyurethane Sealant: Apply in accordance with manufacturer's instructions instead of Type A on similar material where Type A can be used.

C. Type C, Silicone Rubber Sealant: Use various categories of this type for above ground applications in accordance with manufacturer's instructions.

D. Type D, Acrylic Type Sealant: Use this type to caulk surfaces which are slated to receive paint finish.

1. Apply as recommended by product manufacturer.

3.05 PROTECTION:

A. Cure sealants and caulking compounds in compliance with manufacturer's instructions and recommendations to obtain high early bond strength, internal cohesive strength and surface durability.

B. Advise Contractor of procedures required for cure and protection of joint sealers during construction period, so that they will be without deterioration or damage (other than normal wear and weathering) at time of substantial completion.

C. Cure and protect sealants in a manner which will minimize increases in modulus of elasticity and other accelerated aging effects.

D. Replace or restore sealants which are damaged or deteriorated during construction period.

END OF SECTION 07900

PART 1 - GENERAL

1.01 SUMMARY:

A. Section Includes: Furnish and install all hollow metal doors and frames hollow metal frames for sidelights, and fixed hollow metal windows complete with all hardware and accessories.

1. The extent of metal doors, frames, sidelights, and windows is shown and scheduled on the Drawings.

B. Related Sections: Drawings and General Provisions of the contract, including the General Covenants and Provisions, Supplementary Covenants and Provisions and General Requirements as well as, but not necessarily limited to, the following:

Section 03300 Cast-In-Place Concrete
Section 06100 Rough Carpentry
Section 07900 Joint Sealers
Section 08700 Hardware
Section 08800 Glazing
Section 09900 Painting

1.02 REFERENCES:

A. All door and frame materials shall be fabricated and installed in strict accordance with and approved by the following organizations:

1. Underwriters' Laboratories
2. Steel Door Institute
3. State Building Code

1.03 SUBMITTALS:

A. Provide submittals in accordance with Section 01300.

B. Product Data: Submit manufacturer's specifications for fabrications and installation, including data substantiating that products comply with requirements.

C. Shop Drawings: Submit for fabrication and installation of steel doors and frames. Include details of each frame type, elevations of door design types, conditions at openings, details of construction, location and installation requirements of finish hardware and reinforcements, and details of joints and connections. Show anchorage and accessory items.

1.04 QUALITY ASSURANCE:

A. Provide doors and frames complying with Steel Door Institute "Recommended Specifications: Standard Steel Doors and Frames" and as specified herein.

1.05 DELIVERY, STORAGE, AND HANDLING:

A. Deliver hollow metal work cartoned or crated to provide protection during transit and job storage.

1. Provide additional sealed plastic wrapping for factory-finished doors.

B. Inspect hollow metal work upon delivery for damage.

1. Minor damages may be repaired provided finished items are equal in all respects to new work and acceptable to the Architect; otherwise, remove and replace damaged items as directed.

C. Store doors and frames at building site under cover.

1. Place units on wood sills at least 4" high, or otherwise store on floors in manner that will prevent rust and damage.

2. Avoid use of nonvented plastic or canvas shelters which could create humidity chamber. If cardboard wrapper on door becomes wet, remove carton immediately.

3. Provide 1/4-inch spaces between stacked doors to promote air circulation.

1.06 PROJECT/SITE CONDITIONS:

A. Verify opening size, exact wall materials and partition thickness prior to frame fabrication.

B. Fabrication work to provide the following maximum clearances:

1. 1/8 inch between doors and side and head jamb members.
2. 1/4 inch at meeting edges of pairs of doors.
3. 3/4 inch maximum between door and floor.
4. 1/4 inch above carpet.
5. 3/16 inch between door threshold or saddle or as required for weatherstripping at threshold.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. Provide standard steel doors and frames by a single firm specializing in the production of this type of work.

B. Provide steel doors and frames by one of the following:

Basis of design: Steelcraft Series “A”

Alternate Manufacturers to be reviewed via submittal

2.02 MATERIALS:

A. Hot-Rolled Steel Sheets and Strip: Commercial quality carbon steel, pickled and oiled, complying with ASTM A 569 and ASTM A 568.

B. Cold-Rolled Steel Sheets: Commercial quality carbon steel, complying with ASTM A 366 and ASTM A 568.

C. Galvanized Steel Sheets: Zinc-coated carbon steel sheets of commercial quality, complying with ASTM A 526, with ASTM A 525, G60 zinc coating, mill phosphatized.

D. Supports and Anchors: Fabricate of not less than 18 gauge galvanized sheet steel.

E. Inserts, Bolts and Fasteners: Manufacturer's standard units, except hot-dip galvanize items to be built into exterior walls, complying with ASTM A 153, Class C or D as applicable.

F. Shop-Applied Paint: Primer-Rust-inhibitive enamel or paint, either air-drying or baking, suitable as a base for specified finish paints.

2.03 MANUFACTURED UNITS:

A. Steel Doors: Provide metal doors of types and styles indicated on Drawings or schedules and comply with S.D.I. 100 for materials and construction requirements and as modified herein.

1. Doors shall be full flush type with insulated cores.

2. Doors shall have 16-gauge face panels reinforced for locks and surfaced applied hardware.

3. Hinge reinforcement shall be 3/16-inch thick material.

4. Both lock and hinge rail shall be welded, filled and ground smooth the full height of door with no seam showing.

5. Glass and Louvers:

a. Glazed Openings: Make provisions for glass where indicated in accordance with standard specifications. Leave stops loose for glazing.

b. Louvers: Provide louvers where indicated on Drawings, insert into door panels in accordance with Section 10200. All louvers shall be sight tight.

B. Steel Frames: Provide metal frames for doors, transoms, sidelights, borrowed lights, and other openings, of types and styles as shown on drawings and schedules.

1. Conceal fastenings, unless otherwise indicated.

2. Fabricate with mitered and welded corners.

3. Form frames of hot dip galvanized steel.

4. Provide additional top channel if necessary so that top of door presents a flush surface.

5. Door Silencers: Except on weatherstripped frames, drill stops to receive two silencers on strike jambs of single-swing frames and two silencers on heads of double-swing frames.

   a. Manufacturer's "stick-on" silencers will be acceptable in lieu of drilled type.

6. Plaster Guards: Provide 26 gauge steel plaster guards or mortar boxes, welded to frame, at back of finish hardware cutouts where mortar or other materials might obstruct hardware operation.

C. Thermal-Rated (Insulating) Assemblies: At exterior locations and elsewhere as shown or scheduled, provide doors which have been fabricated as thermal insulating door and frame assemblies and tested in accordance with ASTM C 236.

1. Unless otherwise indicated, maximum apparent U factor for thermal-rated assemblies is 0.24 BTU/hr (ft2) øF.

2.04 FABRICATION:

A. Fabricate steel door and frame units to be rigid, neat in appearance and free of defects, warp or buckle.

1. Wherever practicable, fit and assemble units in manufacturer's plant.

2. Clearly identify work that cannot be permanently factory-assembled before shipment, to assure proper assembly at project site.

B. Fabricate exposed faces of doors and panels, including stiles and rails of nonflush units, from only cold-rolled steel.

C. Fabricate frames, concealed stiffeners, reinforcement, edge channels, louvers and moldings from either cold-rolled or hot-rolled steel (at fabricator's option).

D. Fabricate exterior doors, panels, and frames from galvanized sheet steel.

1. Close top and bottom edges of exterior doors as integral part of door construction or by addition of inverted steel channels.

2. Fill seams and ground smooth.

E. Exposed Fasteners: Unless otherwise indicated, provide countersunk flat Phillips heads for exposed screws and bolts.

F. Shop/Factory Finishing:

1. Clean, treat, and paint exposed surfaces of steel door and frame units, including galvanized surfaces.

2. Clean steel surfaces of mill scale, rust, oil, grease, dirt, and other foreign materials before application of paint.

3. Apply shop coat of prime paint of even consistency to provide a uniformly finished surface ready to receive finish paint.

4. Field or shop paint at Contractor option, two finish coats. Field paint as specified in Section 09900.

   a. Shop paint according to manufacturer's specification for type of door specified.

   b. Colors as specified or, if not specified, as designated by the Architect.

PART 3 - EXECUTION

3.01 EXAMINATION:

A. Installer must examine substrate and conditions under which steel doors and frames are to be installed and must notify Contractor in writing of any conditions detrimental to proper and timely completion of work.

B. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 PREPARATION:

A. Prepare doors and frames to receive mortised and concealed finish hardware in accordance with final Finish Hardware Schedule and templates provided by hardware supplier.

   1. For concealed overhead door closers, provide space, cutouts, reinforcing and provisions for fastening in top rail of doors or head of frames, as applicable.

   2. Comply with applicable requirements of ANSI A 115 series specifications for door and frame preparation for hardware.

B. Reinforce doors and frames to receive surface-applied hardware.

   1. Drilling and tapping for surface-applied finish hardware may be done at project site.

C. Locate finish hardware as shown on final shop drawings or, if not shown, in accordance with "Recommended Locations for Builder's Hardware," published by Door and Hardware Institute.

3.03 INSTALLATION:

A. General: Install standard steel doors, frames, and accessories in accordance with final shop drawings and manufacturer's data, and as herein specified.

B. Placing Frames:

1. Comply with provisions of SDI-105 "Recommended Erection Instructions for Steel Frames," unless otherwise indicated.

2. Except for frames located at in-place concrete or masonry and at drywall installations, place frames prior to construction of enclosing walls and ceilings.

3. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set.

    a. After wall construction is completed, remove temporary braces and spreaders leaving surfaces smooth and undamaged.

4. In masonry construction, locate three wall anchors per jamb at hinge and strike levels.

    a. Building-in of anchors and grouting of frames is specified in Division 4.

5. At in-place concrete or masonry construction, set frames and secure to adjacent construction with machine screws and masonry anchorage devices.

6. Install fire-rated frames in accordance with NFPA Std. No. 80.

7. In metal stud partitions, install at least three wall anchors per jamb at hinge and strike levels.

    a. In open steel stud partitions, place studs in wall anchor notches and wire tie.

    b. In closed steel stud partitions, attach wall anchors to studs with tapping screws.

C. Door Installation:

1. Fit hollow metal doors accurately in frames, within clearances specified in SDI-100.

2. Place fire-rated doors with clearances as specified in NFPA Standard No. 80.

3.04 ADJUSTING:

A. Prime and Touch-Up: Immediately after erection, sand smooth any rusted or damaged areas of prime coat and apply touch-up of compatible air-drying primer.

B. Protection Removal: Immediately prior to final inspection, remove protective plastic wrappings from prefinished doors.

C. Final Adjustment: Check and readjust operating finish hardware items, leaving steel doors and frames undamaged and in complete and proper operating condition.

END OF SECTION 08100

SECTION 08210
WOOD DOORS

PART 1 - GENERAL

1.01 SUMMARY:

A. Section Includes: Furnish and install all wood doors, complete in place with finish hardware and accessories installed, as specified herein and as required for a complete and proper installation. See the drawings for door locations and door schedule.

B. Related Sections: Drawings and General Provisions of the contract, including the General Covenants and Provisions, Supplementary Covenants and Provisions and General Requirements as well as, but not necessarily limited to, the following:

Section 06200 Finish Carpentry
Section 08100 Metal Doors and Frames
Section 08700 Builders Hardware

1.02 REFERENCES:

A. Codes and Standards: Comply with provisions of the following codes, specifications and standards except where more stringent requirements are shown or specified.

1. Uniform Building Code (UBC), latest edition.

2. Iowa State Building Code, latest edition.

3. National Wood Windows and Door Association (NWWDA) standards.

a. General requirements for wood flush doors I.S.1.1.

b. Solid core wood flush doors I.S.1.2.

c. Hollow core wood flush doors I.S.1.3.

d. Special construction wood flush doors I.S.1.4.

e. Specified options for wood flush doors I.S.1.5.

f. Testing and inspection requirements for wood flush doors I.S.1.6.

g. Hardware location for wood flush doors I.S.1.7.

4. Underwriter's Laboratories.

1.03 SUBMITTALS:

A. Provide submittals in accordance with Section 01300.

B. Product Data: Submit manufacturer's specifications for fabrications and installation, including data substantiating that products comply with requirements.

C. Shop Drawings: Submit for fabrication and installation of wood doors and frames. Include details of each frame type, elevations of door design types, conditions at openings, details of construction, location and installation requirements of finish hardware and reinforcements, and details of joints and connections. Show anchorage and accessory items.

1.04 QUALITY ASSURANCE:

A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this section.

B. In addition to complying with pertinent codes and regulations of governmental agencies having jurisdiction, comply with:

1. "Architectural Woodwork Quality Standards" of the Architectural Woodwork Institute, for the grade or grades specified.

2. Certification and stamps will not be required.

1.05 DELIVERY, STORAGE, AND HANDLING:

A. Delivery:

1. Deliver doors to site after plaster and cement are dry, and after the building has reached average prevailing humidity of its locality.

2. Deliver prefinished doors in manufacturer's original containers, clearly marked with manufacturer's name, brand name, size, thickness, and identifying symbol on the covering.

3. Seal all four edges of unfinished doors when delivered to the job site.

B. Storage:

1. Stack flat on 2" x 4" lumber, laid 12" from ends and across center.

2. Under bottom door and over top of stack, provide plywood or corrugated cardboard to protect door surfaces.

3. Store doors in clean area where there will be no great variations in heat, dryness, and humidity.

4. If they are to be stored for an extended period of time, seal doors with a non-water base sealer or primer.

C. Handling:

1. Do not expose to excessive moisture, heat, dryness, or direct sunlight.

2. Handle with clean hands or with clean gloves.

3. Do not drag doors across one another; lift doors and carry them into position.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. Subject to compliance with requirements, products manufactured by, but not limited to, the following may be incorporated in the work of this section.

1. Georgia-Pacific
2. Eggers Industries
3. Glen-Mar Door Manufacturing Company
4. IPIK Door Company, Inc.
5. Weyerhauser Company
6. Graham Manufacturing Corporation, Marshfield, WI
7. Haley Bros. Inc. Buena Park, CA.
8. Mohawk Flush Doors Inc., South Bend IN.

2.02 MATERIALS:

A. Provide flush wood doors of the types, designs, and thicknesses shown on the Door Schedule in the Drawings, labeled or non-labeled as indicated and required, and in solid core or hollow core as shown on the Door Schedule.

1. Solid Core: At Contractor's option provide mat-formed wood particle board core, other mat-formed particleboard core, glued block core, framed block glued core, framed block non-glued core, or stile and rail core.

B. Grade: Except as may be shown otherwise on the Drawings, fabricate the work of this section to "custom grade" standards of the referenced organization.

D. Species:

1. Provide Grade “A” Custom Birch faces for clear finish.

E. Site finish or mill finish wood doors in accordance with provisions of Section 09900 of these specifications.

2.03 FABRICATION:

A. Verify opening size, exact wall materials and partition thickness prior to frame fabrication.

B. Fabrication work to provide the following maximum clearances:

1. 1/8 inch between doors and side and head jamb members.
2. 1/16 inch between door hinge edge and jamb member.
3. 3/4 inch maximum between door and floor.
4. 1/4 inch above carpet.
5. 3/16 inch between door threshold or saddle or as required for weatherstripping at threshold.

PART 3 - EXECUTION

3.01 EXAMINATION:

A. Examine the areas and conditions under which work of this section will be performed.

B. Correct conditions detrimental to timely and proper completion of the work.

C. Do not proceed until unsatisfactory conditions are corrected.

3.02 PREPARATION:

A. Field Finishing:

1. Insure that building atmosphere is dried to a normal, interior relative humidity.

2. Remove all handling marks, raised grain and other undesirable blemishes by sanding all surfaces with 100 to 150 fine grit abrasive.

3. Seal all exposed wood surfaces including top and bottom rails.

4. Apply finish specified in section 09900 in accordance with manufacturer's recommendation.

3.03 INSTALLATION:

A. Fitting and Machining:

1. Unless doors are completely fitted and machined at the mill, fit them for width by planing and fit them for height by sawing.

2. Machine doors for hardware in accordance with recommendations of the hardware manufacturers, upon approval of these recommendations by the Architect.

3. Do not impair utility or structural strength of door in fitting to opening, applying hardware, preparing for louvers or other detailing.

4. Unless otherwise specified elsewhere, apply sealer, primer or first coat of specific finish on exterior doors, immediately after fitting, cutting for hardware, weatherstripping, and other required items, and before the installation of these.

B. Receive and retain custody of finish hardware furnished for the work of this section under Section 08710 of thesespecifications and, except as otherwise directed by the Architect, install all such finish hardware in strict accordance with the recommendations of its manufacturer.

C. Replace or rehang doors which are hingebound and do not swing or operate freely.

3.04 SCHEDULES:

A. Interior solid core, flush wood doors: 1-3/4 inches thick for doors 2'-8" wide and wider and 1-3/8 inches thick for doors 2'-6" wide and narrower.

END OF SECTION 08210

PART 1 - GENERAL

1.01 SUMMARY:

A. Section Incudes: Furnishing and install all sectional overhead doors complete with all hardware and accessories. The extent of sectional overhead doors is shown and scheduled on the Drawings.

B. Related Sections: Drawings and General Provisions of the contract, including the General Covenants and Provisions, Supplementary Covenants and Provisions and General Requirements as well as, but not necessarily limited to, the following.

Section 03300 Cast-In-Place Concrete
Section 07900 Joint Sealers
Section 08800 Glazing
Section 09900 Painting

1.02 REFERENCES:

A. American Society for Testing of Material (ASTM).

1. ASTM A 153 - Standard specification for zinc coating (hot dipped) on iron and steel hardware.

2. ASTM A 366 - Standard specification for steel sheet, carbon, cold rolled, commercial quality.

3. ASTM A 525 - Standard specification for general requirements of steel sheet, zinc coated (galvanized) by hot dipped process.

4. ASTM A 526 - Standard specification for steel sheet, zinc coated (galvanized) by hot dipped process, commercial quality.

5. ASTM A 568 - Standard specification for general requirements for carbon and high strength low-alloy steel, hot-rolled strip, hot-rolled sheets, and cold-rolled sheets.

6. ASTM A 569 - Standard specification for steel carbon, hot-rolled sheet and strip, commercial quality.

1.03 SUBMITTALS:

A. Provide submittals in accordance with Section 01300.

B. Product Data: Submit manufacturer's specifications for fabrications and installation, including data substantiating that submitted products comply with requirements.

C. Shop Drawings: Submit for fabrication and installation of steel doors and frames.

1. Include details of each frame type, elevations of door design types, conditions at openings, details of construction, location and installation requirements of finish hardware and reinforcements, and details of joints and connections.

2. Show anchorage and accessory items.

1.04 QUALITY ASSURANCE:

A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work in this section.

1.05 DELIVERY, STORAGE, AND HANDLING:

A. Delivery: Deliver products to the job site in the manufacturer's original containers with labels intact and legible.

1. Maintain seals unbroken and labels intact until time of use.

B. Inspect products upon delivery for damages.

1. Minor damages may be repaired at no cost to the Owner provided finished items are equal in all respect to new work and acceptable to the DNR Construction Inspector.

2. Promptly remove unacceptable damaged material and unsuitable items from the job site, and promptly replace with material meeting the specified requirements, at no additional cost to the Owner.

1.06 PROJECT/SITE CONDITIONS:

A. Verify opening size, exact wall materials and partition thickness prior to frame fabrication.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. Provide standard sectional overhead doors, hardware and accessories from a single firm specializing in the production of this type of work.

B. Subject to compliance with requirements, provide sectional overhead doors, hardware and accessories by one of the following:

1. Raynor Manufacturing Company
2. Wayne Dalton
3. Clopay Corporation
4. Delden Manufacturing Company
5. Door Systems, Inc.
6. Martin Door Company
7. Overhead Door Company
8. Windsor Door Company, Division of Ceco Corporation

2.02 MATERIALS:

A. Hot-Rolled Steel Sheets and Strip: Commercial quality carbon steel, pickled and oiled, complying with ASTM A 569 and ASTM A 568.

B. Cold-Rolled Steel Sheets: Commercial quality carbon steel, complying with ASTM A 366 and ASTM A 568.

C. Galvanized Steel Sheets: Zinc-coated carbon steel sheets of commercial quality, complying with ASTM A 526, with ASTM A 525, G60 zinc coating, mill phosphatized.

D. Supports and Anchors: Fabricate of not less than 18 gauge galvanized sheet steel.

E. Inserts, Bolts and Fasteners: Manufacturer's standard units, except hot-dip galvanize items to be built into exterior walls, complying with ASTM A 153, Class C or D as applicable.

F. Shop-Applied Paint: Primer--Rust-inhibitive enamel or paint, either air-drying or baking, suitable as a base for specified finish paints.

2.03 MANUFACTURED UNITS:

A. Standard Steel Sectional Overhead Doors: Provide units of the dimension and arrangement shown on the Drawings.

1. Door Section: Two-inch thick, 24-gauge minimum ribbed steel.

a. End stiles 13-gauge minimum.

b. Center stiles, 16-gauge minimum.

c. Provide insulated doors in heated spaces.

d. Provide three 12” windows at 6’-0” centered A.F.F.

2. Finish: Precoat exterior of door with two coats of bake-on polyester white enamel finish over epoxy primer.

a. Coat interior of door with bake-on gray polyester enamel.

b. Field painting requirement and colors to be determined by the Architect.

3. Tracks: To be bracket or continuous angle mounted minimum 2" wide galvanized track.

4. Hardware: All hinges and brackets to be made of galvanized steel.

a. Track rollers to be made with steel races and hardened steel ball bearings.

5. Spring Counterbalance: Heavy duty oil tempered wire helical wound torsion spring.

6. Locking Device: Exterior locking to be S pin tumbler cylinder and steel bar engaging latch.

a. Provide interior deadbolt with padlock.

7. Weatherstripping: Bottom of door to have flexible vinyl seal.

8. Wind Loads: Door designed to withstand 20 pounds per square foot.

9. Provide insulated units in heated spaces.

10. Insulation: R-6 minumum

11. Electric Door Opener: For all overhead door units, provide manufacturer's standard, heavy-duty electric opener with interior switch and exterior remote device.

    a. Provide units able to handle remote operation and provide two (2) such opening devices per door as well as pad operated electric control for each door from the exterior.

PART 3 - EXECUTION

3.01 EXAMINATION:

A. Installer must examine substrate and conditions under which section overhead doors are to be installed and must notify Contractor in writing of any conditions detrimental to proper and timely completion of work.

B. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 INSTALLATION:

A. General: Install standard sectional overhead doors, hardware and accessories in accordance with final shop drawings and manufacturer's data, and as herein specified.

B. Coordinate as required with other trades to assure proper and adequate provision in the work of these trades for interface with the work of this section.

3.03 ADJUSTING:

A. Immediately after erection, sand smooth any rusted or damaged area of prime coat and apply touch-up of compatible air drying primer.

B. Upon completion of installation, put all items through at least ten operating cycles.

1. Make required adjustments and assure that components are in optimum operating conditions.

END OF SECTION 08360

PART 1 - GENERAL

1.01 SUMMARY:

A. Section Includes: Provide entrances and storefronts where shown on the Drawings, as specified herein, and as needed for a complete and proper installation.

B. Related Sections: Drawings and General Provisions of the contract, including the General Covenants and Provisions, Supplementary Covenants and Provisions and General Requirements as well as, but not necessarily limited to, the following:

Section 03300 Cast-In-Place Concrete
Section 04480 Natural Stone Veneer
Section 06100 Rough Carpentry
Section 06134 Pole Building System
Section 07900 Joint Sealers
Section 08520 Aluminum Windows

1.02 REFERENCES:

A. Codes and Standards: Comply with provisions of the following codes, specifications and standard except where more stringent requirements are shown or specified.

1. Uniform Building Code, U.B.C., latest Edition, as incorporated in the Iowa State Building Code.

2. Iowa State Building Code, latest edition

1.03 SUBMITTALS:

A. Provide submittals in accordance with Section 01300.

B. Product Data: Submit full information on all materials proposed for use in the work of this section, prior to procurement of said material, for Architect's review.

1. Purchase nor install any material until approved by the Architect.

2. Materials list of items proposed to be provided under this section.

3. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.

C. Shop Drawings: Submit shop drawings for fabrication and erection.

1. Include plans, elevation, details of sections and connections.

2. Show anchorage, accessory items, and interface of the work of this section with the work of adjacent trades.

D. Samples: Submit, for verification purposes, samples of each type of material, to be used in the work of this section, requested by the Architect.

1. Include in each set of samples the full range of color and texture to be expected in the completed work.

E. Quality Control Submittals:

1. Manufacturer's recommended installation procedures which, when approved by the Architect, will become the basis for accepting or rejecting actual installation procedures used on the work.

F. Contract Close Out Submittals:

1. Operation and Maintenance:

a. Data Warranty: Deliver to the DNR Construction Inspector all information available on the manufacturer warranty and the installer guarantee as specified herein.

1.04 QUALITY ASSURANCE:

A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work in this section.

1.05 SEQUENCING AND SCHEDULING:

A. Coordinate as required with other trades to assure proper and adequate provision in the work of those trades for interface with the work of this section.

B. Make measurements as required in the field to assure proper fit.

1.06 WARRANTY:

A. Upon completion of this portion of the Work, and as a condition of its acceptance, deliver to the Architect two copies of a written Warranty agreeing to replace work of this section which fails due to defective materials or workmanship, within three years after date of substantial completion as that date is determined in accordance with the General Conditions.

B. Failure due to defective materials or workmanship is deemed to include, but not to be limited to:

1. Failures in operation of operating component or components;

2. Leakage or air infiltration in excess of the specified standard;

3. Deterioration of finish to an extent visible to the unaided eye;

4. Defects which contribute to unsightly appearance, potential safety hazard, or potential untimely failure of the work of this section or the Work as a whole.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:

1. YKK 20D Series – Basis of Design

2.02 MATERIALS:

A. Provide aluminum entrance and storefronts in the dimensions and arrangements shown on the Drawings.

1. Provide manufacturer's preglazed, standard narrow style swing doors and frames, where shown on the Drawings.

a. Doors and Framing Sections: Extruded aluminum 6063-T5 Alloy, free from defect impairing strength, durability or appearance, and conforming to Architect-approved drawing details.

b. Hardware: Manufacturer standard hardware and locking devices keyed the same. Provide manufacturer standard push/pull and closer devices.

B. Finish: Anodized finish TBD. AA-C22A42/44, Class I, (minimum thickness of 0.7 mils) integral or electrolytically deposited.

C Color: TBD.

2.03 FABRICATION:

A. Fabricate in strict accordance with the manufacturers' specifications and Shop Drawings as approved by the Architect, prefabricating in the shop to the maximum extent practicable.

B. Provide hairline fit at joints, with smooth continuity of line and accurate relation of planes and angles, fastened securely.

PART 3 - EXECUTION

3.01 EXAMINATION:

A. Examine the areas and conditions under which work of this section will be performed.

B. Correct conditions detrimental to timely and proper completion of the work.

C. Do not proceed until unsatisfactory conditions are corrected.

3.02 PREPARATION:

A. Prepare for and install the finish hardware as specified herein.

1. Perform all fitting of finish hardware to door and frame at the factory;

2. Do not drill or tap for surface-mounted items until time of installation at the site.

3. Use concealed fasteners to the maximum extent practicable.

3.03 INSTALLATION:

A. Install the work of this section in strict accordance with the original design, the approved Shop Drawings, pertinent requirements of governmental agencies having jurisdiction, and the manufacturer's recommended installation procedures as approved by the Architect.

B. Remove protective coating completely from exposed surfaces as soon as progress of the Work will permit with safety.

C. When glazing is performed under this section, provide the types of glass required and glaze in accordance with pertinent provisions of Section 08800 of these specifications.

END OF SECTION 08410

SECTION 085400
COMPOSITE WINDOWS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Gliding windows.

1.2 ACTION SUBMITTALS

A. Product Data: Manufacturer's product data and installation guides.

B. Sustainable Building Submittals:
   1. Indoor Environmental Quality.
      a. Provide third party certification that window materials used on project, including factory applied finishes, meet indoor air quality standards for low emitting materials under California CA Section 01350 Specifications.

C. Shop Drawings: Indicate direction of operable parts, typical jamb, head and sill conditions, and special mullion reinforcement details.

D. Color Samples: Selection and verification samples, including the following:
   1. Hardware: Sample indicating typical finish on hardware.
   2. Exterior: Samples of exterior colors.

1.3 INFORMATIONAL SUBMITTALS

A. Quality Assurance/Control Submittals:
   1. Performance Data: Manufacturer's published performance data for specified products.

1.4 CONTRACT CLOSEOUT SUBMITTALS

A. Warranty documents specified herein.

B. Owner's Manual: Bound manual clearly identified with project name, location, and completion date. Identify type and size of units installed. Provide recommendations for periodic inspections, care, and maintenance. Identify common causes of damage with instructions for temporary repair.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer capable of fabricating doors that meet or exceed Performance Criteria indicated and of documenting this performance by inclusion in lists and by labels, test reports, and calculations.

B. Installer Qualifications: Utilize an installer having demonstrated experience on projects of similar size and complexity.

C. Certifications:
   1. National Fenestration Rating Council (NFRC). Products shall be certified and labeled for U-Factor, Solar Heat Gain Coefficient (SHGC), and Visible Transmittance per NFRC 100 and 200 Procedures. Unique glass types that are special ordered may not apply, check with Manufacturer.
   2. Window and Door Manufacturers Association (WDMA). Products shall be certified and labeled per WDMA Hallmark Certification Program to the AAMA/WDMA/CSA 101/I.S.2/A440 industry standard.
   3. Insulating Glass Units: Provide insulating glass units permanently marked with certification label of Insulating Glass Certification Council (IGCC) indicating compliance.

D. Pre-Installation Meetings: Pre-Installation Meetings: Conduct meeting at Project site to comply with requirements in Division 01 Section – Project Management and Coordination.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.

B. Delivery: Deliver materials in manufacturer's original unopened, undamaged containers with identification labels intact.

C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.

D. Store materials and accessories off ground, under cover, and protected from weather and construction activities.

1.7 SITE CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication. Record measurements on Shop Drawings. Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.

B. Install units per manufacturer's safety and weather requirements.

1.8 WARRANTY

A. Project Warranty: Refer to Conditions of the Contract for project Warranty provisions.

B. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard limited warranty document. Manufacturer's limited warranty is in addition to, and not a limitation of, other rights Owner may have under contract documents.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Provide products from the following manufacturer:
   1. Andersen Corporation
      100 4th Ave. N.
      Bayport, MN 55003-1096.
      Phone: (800) 299-9029.
      Fax: (800) 752-9230.
      E-mail: technicalsupport@andersenwindows.com
      www.andersenwindows.com.

2.2 PERFORMANCE CRITERIA

A. Performance Requirements: Provide products/systems that have been manufactured, fabricated, and installed following performance criteria of Andersen 100 Series Windows

2.3 MANUFACTURED UNITS

A. Proprietary Products/Systems:
   1. Andersen® 100 Series Gliding Windows.
   2. Substitutions: To be reviewed and determined equal by Architect, via submittal.

2.4 MATERIALS

A. Frame and Sash: Fabricated from Fibrex® material composite material in the following color:
   1. Color: TBD.

B. Gliding Weatherstripping:
   1. Head Weatherstripping: Fin/pile.
   2. Jamb Weatherstripping: Fin/pile.
   3. Check Rail Interlock Weatherstripping: Fin/pile.
   4. Vertical Weatherstripping: Fin/pile.

2.5 GLAZING

A. General: Insulating glass units certified through the Insulating Glass Certification Council as conforming to the requirements of IGCC. Provide dual sealed units consisting of polyisobutylene primary seal and silicone secondary seal. Provide metal spacers with bent or soldered corners.

B. General: Insulating glass units certified through the Insulating Glass Manufacturers Alliance of Canada (IGMAC) conforming to the requirements of Canadian General Standards Board CAN/CGSB 12.8. Provide dual sealed units consisting of polyisobutylene primary seal and silicone secondary seal. Provide metal spacers with bent or soldered corners.

C. Where safety glass is indicated or required by applicable code, provide Kind FT heat-treated float glass.

D. Dual-Pane Insulating Glass Units:
   1. Glass: Insulating glass units consisting of 2 lites of clear tempered glass conforming to ASTM C1048, Type 1, Class 1, q3, Kind FT where indicated on Drawings and as required by window manufacturer.

2.6 HARDWARE:

A. Single-Hung and Gliding Window Hardware:
   1. Sash Locks and Keepers: Self latching sash locks with the following integral color:
      a. White.
   2. Rollers: Fit operating sash with 2 dual brass adjustable rollers.
   3. Guides: Provide extruded PVC glide track for operating sash.
      a. Color: TBD.

2.7 ACCESSORIES

   a. Exterior Surface: TBD
   b. Interior Surface: White.
   c. Width: 3/4 inch (19 mm).

d. Pattern: As indicated on Drawings.

B. Insect Screens: Provide venting sash with an insect screen, including attachment hardware.
1. Frames: 0.024 inch (0.61 mm) rolled aluminum frame with chromate conversion coating. Provide matching corner locks and latch retainers.
2. Insect Screen Cloth: Fiberglass mesh.
3. Frame Finish: Painted finish in the following color:
a. Color: white

2.8 FABRICATION

A. Fibrex® Composite Material:
1. Sash Members: Fibrex® material sash members with co-extruded interior and exterior colored cap stock.
2. Frame Units: Fibrex® material frame member co-extruded interior and exterior colored cap stock and with co-extruded flanges for installation.
a. Exterior Finish: White.
b. Interior Finish: White.

B. Glazing: Factory glazed with glazing sealant and snap-in rigid vinyl glazing bead.

C. Weatherstripping: Factory-applied to unit frame. Field-applied interlocking weatherstripping at panel meeting stiles.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Site Verification of Conditions: Verify that site conditions are acceptable for installation of units, including the following:
1. Concrete surfaces are dry and free of excess mortar, rocks, sand, and other construction debris.
2. Masonry openings are square and dimensions are correct.
3. Rough openings are square and dimensions are correct.
4. Sill plates are level.

B. Do not proceed with installation of units until unacceptable conditions are corrected.

3.2 INSTALLATION

A. General:
1. Comply with the instructions and recommendations of window manufacturer.
2. Remove unit components, parts, accessories, and installation guides from carton.
3. Inspect unit components and verify that components are not damaged and that parts are included before disposing of carton.
4. Shop-assemble multiple units before installation per manufacturer’s installation guides.
5. Field-assemble multiple units before installation per manufacturer’s installation guides.

B. Interface With Other Work:
1. Perform installation per Manufacturer’s instructions.
2. Install units plumb, level, square, true to line, without distortion, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction. Install drip cap at head of single units and joined assemblies.

3. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.
4. Install insulation in shim space around unit perimeter to maintain continuity of building insulation. Do not overfill.
5. Hold back exterior siding or other finish materials from edge of unit to allow for expansion and contraction and installation of proper joint sealant with backing materials. Seal perimeter of unit after exterior finish is applied per requirements of Section 079200 – Joint Sealants.
6. Finish interior units per requirements specified in related sections. Refer to, and comply with, additional requirements in manufacturer's installation guides.
7. Install optional hardware and unit accessories after cleaning.

C. Site Tolerances:
1. Adjust operation, insect screens, hardware, and accessories for a tight fit at contact points and weatherstripping for smooth operation and weathertight closure.

D. Extend vapor barrier to interior face of unit frame and attach.

3.3 FIELD TESTING

A. General: If applicable, test units per with the following procedures:
1. Inspect units and verify installation per Manufacturer's instructions.
2. For products installed less than 6 months, comply with AAMA 502-08 Voluntary Specification for Field Testing of Windows and Sliding Glass Doors, Procedure B.
3. For products installed longer than 6 months, comply with AAMA 511-08: Voluntary Guideline for Forensic Water Penetration Testing of Fenestration Products. If test indicates that field testing of units is necessary, test product as indicated in paragraph 1 above.
4. Do not proceed with installation of additional units until unacceptable conditions are corrected.

3.4 CLEANING

A. Clean units using cleaning material and methods specifically recommended by window manufacturer.

B. Remove excess sealants, glazing materials, dirt, and other substances.

C. Avoid damaging protective coatings and finishes.

D. Protect unit surfaces from masonry cleaning solution that could damage insulation glass panels or hardware.

E. Remove debris from work site and properly dispose of debris.

3.5 PROTECTION

A. Protect installed work from damage due to subsequent construction activity on site.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY:

A. Section Includes: The furnishing of all materials and labor to install all Builders' Hardware with suitable fastenings for completed work in accordance with the Drawings and Specifications.

1. Quantities listed in each instance are for the Contractor's convenience only and are not guaranteed. Items not specifically mentioned but necessary to complete the work shall be furnished, matching in quality and finish the items specified for similar locations.

a. Should any item listed herein be incorrect due to construction details, it shall be the Hardware Supplier's responsibility to furnish the proper item at no additional cost to the Owner.

2. Types of items in this section may include, but are not necessarily limited to, the following:

a. Hinges
b. Pivots
c. Spring hinges
d. Lock cylinders and keys
e. Lock and latch sets
f. Bolts
g. Exit devices
h. Push/pull units
i. Sliding door equipment
j. Bi-fold door hardware
k. Closers
l. Overhead holders
m. Miscellaneous door control devices
n. Door trim units
o. Protection plates

B. Related Sections: Drawings and General Provisions of the contract, including the General Covenants and Provisions, Supplementary Covenants and Provisions and General Requirements as well as, but not necessarily limited to, the following.

Section 06200 Finish Carpentry
Section 08100 Metal Doors and Frames
Section 08200 Wood Doors
Section 08360 Sectional Overhead Doors

1.02 REFERENCES:

A. Builders' Hardware Manufacturer Association numbers taken from the following BHMA standards. Provide products complying with these standards and requirements specified elsewhere in this section.

1. Butts and Hinges: ANSI A156.1 (BHMA 101)
2. Locks and Lock Trim: ANSI A156.2 (BHMA 601)
3. Exit Devices: ANSI A156.3 (BHMA 701)
4. Door Controls - Closers: ANSI A156.5 (BHMA 501)
5. Auxiliary Locks: ANSI A 156.5 (BHMA 501)
6. Architectural Door Trim: ANSI A156.6 (BHMA 1001)
7. Template Hinge Dimensions: ANSI A156.7
8. Door Controls - Overhead Holders: ANSI A156.8 (BHMA 311)
9. Mortise Locks and Latches: ANSI A156.13 (BHMA 621)
10. Sliding and Folding Door Hardware: ANSI A1567.14 (BHMA 401)
11. Spring Hinges: BHMA 1101
12. Auxiliary Hardware: BHMA 1201

B. Federal Specification numbers taken from following federal specifications. Provide products complying with these specifications and requirements specified elsewhere in this section.

1. Locks and Door Trim: FS FF-H-106
2. Hinges: FS FF-H-116
3. Shelf & Miscellaneous Builders' Hardware: FS FF-H-111
4. Door Closers: FS FF-H-121

C. American National Standard Institute (ANSI)

1. ANSI A117.1 - Specifications for making buildings and facilities accessible to, and usable by, physically handicapped people.

1.03 DEFINITIONS:

A. Definition: "Builders' Hardware" includes items known commercially as builders' hardware which are required for swing, sliding and folding doors, except special types of unique and nonmatching hardware specified in the same section as the door and door frame.

1.04 SUBMITTALS:

A. Provide submittals in accordance with Section 01300.

B. Product Data: Submit manufacturer's technical information for each item of hardware, including whatever information may be necessary to show compliance with requirements, and instructions for installation and for maintenance of operating parts and finish.

C. Hardware Schedule: Submit final hardware schedule in manner indicated below, for coordination of work.

D. Final Hardware Schedule Content: Based on builders' hardware indicated, organize hardware schedule into "hardware sets" indicating complete designations of every item required for each door or opening, including the following information:

1. Type, style, function, size and finish of each hardware item.

2. Name and manufacturer of each item.

3. Fastenings and other pertinent information.

4. Location of hardware set cross-referenced to indications on Drawings both on floor plans and in door and frame schedule.

5. Explanation of all abbreviations, symbols, codes, etc. contained in schedule.

6. Mounting locations for hardware.

7. Door and frame sizes and materials.

8. Keying Schedule: Submit separate detailed schedule indicating clearly how the Owner's final instruction on keying of locks has been fulfilled.

E. Samples: Prior to submittal of the final hardware schedule and prior to final ordering of builders' hardware, submit one sample of each type of exposed hardware unit, finished as required, and tagged with full description for coordination with schedule.

1. Samples will be returned to the supplier.

2. Units which are acceptable and remain undamaged through submittal, review and field comparison procedures may, after final check of operation, be used in the work, within limitations of keying coordination requirements.

1.05 QUALITY ASSURANCE:

A. Manufacturer: Obtain each kind of hardware (latch and lock sets, hinges, closers, etc.) from only one manufacturer, although several may be indicated as offering products complying with requirements.

B. Supplier: A recognized builders' hardware supplier who has been furnishing hardware in the project's vicinity for a period of not less than two (2) years, and who is or employs an experienced hardware consultant who is available at reasonable times during the course of the work for consultation about project's hardware requirements to Owner, Architect, and Contractor.

C. Installer: Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this section.

1.06 DELIVERY, STORAGE, AND HANDLING:

A. Packaging of hardware on a set-by-set basis is the responsibility of the supplier.

1. As material is received by the hardware supplier from the various manufacturers, sort and repackage in containers marked with the hardware set number.

2. Two or more identical sets may be packed in the same container.

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

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

1.07 SEQUENCING AND SCHEDULING:

A. Coordination: 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.

1. Furnish hardware items of proper design for use on doors and frames of the thicknesses, profile, swing, security and similar requirements indicated as necessary for proper installation and function.

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

B. Templates: Furnish hardware templates to each fabricator of doors, frames, and other work to be factory-prepared for the installation of hardware.

1. Upon request, check the Shop Drawings of such other work to confirm that adequate provisions are made for the proper installation of hardware.

1.08 MAINTENANCE:

A. Instruct Owner's personnel in proper adjustment and maintenance of hardware and hardware finishes during the final adjustment of hardware.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. Subject to compliance with the requirements, products from, but not limited to, the following can be incorporated in the work of this section: Refer to sheet A-600

B. Hardware Manufacturer Designation: Listed names of manufacturers and products, names and numbers in "schedule" are used to establish minimum requirements for design, grade, function, finish, size, and other distinctive quality for each type of buildings' hardware specified for this project.

1. Provide the product designated or comparable product from another manufacturer complying with requirements including those specified elsewhere in this section.

C. Selected Manufacturers: Refer to Sheet A-600

2.02 MATERIALS:

A. General:

1. Hand of Door: The Drawings show the direction of slide, swing or hand of each door leaf.

a. Furnish each item of hardware for proper installation and operation of the door movement as shown.

2. Base Metals: Produce hardware units of the basic metal and forming method indicated, using the manufacturer's standard metal alloy, composition, temper and hardness, but in no case of lesser (commercially recognized) quality than specified for the applicable hardware units by FS FF-H-106, FS FF-G-111, FS FF-H-116 and FS FF-H-121.

a. Do not furnish "optional" materials or forming methods for those indicated, except as otherwise specified.

3. Fasteners: Manufacture hardware to conform to published templates, generally prepared for machine screw installation.

a. Do not provide hardware which has been prepared for self-tapping sheet metal screws, ubless specifically indicated.

4. Furnish screws for installation with each hardware item.

a. Provide Phillips flat-head screws except as otherwise indicated.

b. 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 such other work as closely as possible, including "prepared for paint" in surfaces to receive painted finish.

5. Provide concealed fasteners for hardware units which are exposed when the door is closed, except to the extent no standard units of the type specified are available with concealed fasteners.

a. Do not use through bolts for installation where the bolt head or the nut on the opposite face is exposed in other work, except where it is not feasible to adequately reinforce the work.

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

B. Hinges, Butts, and Pivots:

1. Templates: Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template-produced units.

2. Screws: Furnish Phillips flat-head all-purpose or machine screws for installation of units, except furnish Phillips flat-head all-purpose or wood screws for installation of units into wood.

   a. Finish screw heads to match surface of hinges or pivots.

3. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:

   a. Steel Hinges: Steel pins.

   b. Nonferrous Hinges: Stainless steel pins.

   c. Exterior Doors: Nonremovable pins.

   d. Out-Swing Corridor Doors: Nonremovable pins.

   e. Interior Doors: Nonrising pins.

   f. Tips: Flat button and matching plug, finished to match leaves, except where hospital tip (HT) indicated.

   g. Number of Hinges: Provide number of hinges indicated, but not less than three (3) hinges for door leaf for doors 90" or less in height and one additional hinge for each 30" of additional height.

C. Lock Cylinders and Keying:

1. Standard System: Except as otherwise indicated, provide new masterkey system for project.

2. Review the keying system with the Owner and provide the type required (master, grandmaster or great-grandmaster), either new or integrated with Owner's existing system.

3. Equip locks with manufacturer's standard six-pin tumbler cylinders.

4. Comply with Owner's instructions for masterkeying and, except as otherwise indicated, provide individual change key for each lock which is not designated to be keyed alike with a group of related locks.

5. Key Material: Provide keys of nickel silver only.

6. Key Quantity: Furnish three (3) change keys for each lock; five (5) master keys for each master system; and five (5) grandmaster keys for each grandmaster system.

7. Deliver keys to Owner's representative.

D. Locks, Latches and Bolts:

1. Strikes: Provide manufacturer's standard wrought box strike for each latch or lock bolt, with curved lip extended to protect frame, finished to match hardware set.

   a. Provide standard (open) strike plates for interior doors of residential units where wood door frames are used.

2. Lock Throw: Provide five-eighths inch (5/8") minimum throw of latch and deadbolt used on pairs of doors. Comply with UL requirements for throw of bolts and latch bolts on rated fire openings.

   a. Provide one-half inch (1/2") minimum throw on other latch and deadlock bolts.

3. Flush Bolt Heads: Minimum of one-half inch (1/2") diameter rods of brass, bronze or stainless steel, with minimum of twelve-inch (12") long rod.

4. Exposed Fasteners: Provide manufacturer's standard exposed fasteners for installation; through-bolted for matched pairs, but not for single units.

E. Closers:

1. Size of Units: Except as otherwise specifically indicated, comply with the manufacturer's recommendations for size of door control unit, depending upon size of door, exposure to weather and anticipated frequency of use.

   a. Where parallel arms are indicated for closures, provide closer unit one size larger than recommended for use with standard arms.

   b. Provide parallel arms for all overhead closers, except as otherwise indicated.

2. Access-Free Manual Closers: Where manual closers are indicated for doors required to be accessible to the physically handicapped, provide adjustable units complying with ANSI A 117.1 provisions for door opening force and delayed action closing.

3. Provide matching finishes for hardware units at each door or opening to the greatest extent possible and except as otherwise indicated.

   a. Reduce differences in color and textures as much as commercially possible where the base metal or metal forming process is different for individual units of hardware exposed at the same door or opening.

   b. In general, match items to the manufacturer's standard finish for the latch and lock set (or push-pull units if no latch-lock sets) for color and texture.

4. Provide finishes which match those established by BHMA or, if none established, match the Architect's sample.

    a. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness and other qualities complying with manufacturer's standards, but in no case less than specified for the applicable units of hardware by referenced standards.

5. Provide protective lacquer coating on all exposed hardware finishes of brass, bronze and aluminum except as otherwise indicated.

    a. The suffix "-NL" is used with standard finish designations to indicate "No Lacquer."

6. The designations used in schedules and elsewhere to indicate hardware finishes are those listed in "Materials and Finishes Standard 1301" by BHMA, including coordination with the traditional U.S. finishes shown by certain manufacturers for their products.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Mount hardware units at heights indicated in "Recommended Locations for Builders' Hardware for Standard Steel Doors and Frames" by the Door and Hardware Institute, except as specifically indicated or required to comply with governing regulations, and except as may be otherwise directed by the Architect.

B. Mount hardware units at heights indicated in "Recommended Locations for Builders' Hardware for Custom Steel Doors and Frames" by the Door and Hardware Institute, except as specifically indicated or required to comply with governing regulations and except as otherwise directed by the Architect.

C. Install each hardware item in compliance with the manufacturer's instructions and recommendations.

    1. 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 and reinstallation or application of surface protections with finishing work specified in the Division sections.

    2. Do not install surface-mounted items until finishes have been completed on the substrate.

D. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

E. Drill and countersink units which are not factory-prepared for anchorage fasteners.

    1. Space fasteners and anchors in accordance with industry standards.

3.02 ADJUSTING:

A. Adjust and check each operating item of hardware and each door to ensure proper operation or function of every unit.

B. Replace units which cannot be adjusted to operate freely and smoothly as intended for the application made.

3.03 SCHEDULES: Refer to Sheet A-600

END OF SECTION 08700

PART 1 - GENERAL

1.01 SUMMARY:

A. Section Includes:

1. Furnish all materials, labor, and equipment to install gypsum wallboard and accessories as shown on the Drawings and as required to complete the building.

2. Types of work include:

a. Gypsum wallboard applied to wood framing and furring.

b. Gypsum wallboard applied to metal stud framing system.

d. Gypsum wallboard applied to solid substrate.

e. Gypsum wallboard applied to ceilings and soffits.

f. Drywall finishing including joint tape-and-compound treatment.

3. Wood framing and furring are specified in Division 6.

B. Related Sections: Drawings and General Provisions of the contract, including the General Covenants and Provisions, Supplementary Covenants and Provisions and General Requirements as well as, but not necessarily limited to, the following:

Section 06100 Rough Carpentry
Section 06200 Finish Carpentry
Section 09120 Ceiling Suspension System

1.02 REFERENCES:

A. Gypsum Board Standard: Comply with applicable requirements of ANSI/ASTM C 840 for application and finishing of gypsum board, unless otherwise indicated.

B. Gypsum Board Terminology Standard: GA-505 by Gypsum Association.

C. Federal Specifications:

1. Fed Spec SS-L-30D
2. Fed Spec QQ-S-775

D. American Society for Testing of Materials (ASTM):

1. ASTM C 380 - Standard specifications for annular ringed nails for gypsum wallboard.

2. ASTM C 475 - Standard specifications for joint treatment material for gypsum wallboard construction.

3. ASTM C 514 - Standard specifications for nails for application of gypsum wallboard.

4. ASTM C 630 - Standard specifications for water resistant gypsum backing boards.

1.03 SUBMITTALS:

A. Provide submittals in accordance with Section 01300.

B. Product Data: Submit manufacturer's specifications and installation instructions for each gypsum drywall component, including other data as may be required to show compliance with these specifications.

1.04 QUALITY ASSURANCE:

A. Qualifications of Manufacturer: Products used in the work of this section shall be produced by manufacturers regularly engaged in manufacture of similar items and with a history of successful production acceptable to the Architect.

B. Qualifications of Installers: Use adequate number of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this section.

C. Mock-Ups: When requested by the DNR Construction Inspector, provide mock-ups for each type of gypsum wallboard finish used in the work of this section.

1. Make mock-up panels approximately 4'-0" square.

2. The mock-ups may be used as part of the work, and may be included in the finished work, when approved by the DNR Construction Inspector.

3. Revise mock-ups as necessary to receive approval from the DNR Construction Inspector.

4. The approved mock-up panels will be used as datum points for comparison with the remainder of the work of this section to determine acceptance or rejection.

5. Demolish and remove from the project site, rejected panels not permitted as part of the finish work.

1.05 DELIVERY, STORAGE, AND HANDLING:

A. Deliver, identify, store, and protect gypsum drywall materials to comply with referenced standards and manufacturer's instructions.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

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

1. Gypsum Board and Related Products:

a. The Celotex Corporation

b. The Flintkote Company

c. Georgia-Pacific Corporation

d. Gold Bond Building Products Div., National Gypsum Co.

e. United States Gypsum Company

2.02 MATERIALS:

A. Gypsum Wallboard: Provide gypsum wallboard complying with Fed Spec SS-L-30D, in 48" widths and in such length as will result in a minimum of joints, with tapered edges and of type and thickness as shown.

1. Regular Wallboard: Provide Type III, Grade R, Class 1, 5/8" thick except as may be shown otherwise on the Drawings.

2. Fire-Retardant Wallboard: Provide Type III, Grade X, Class 1, 5/8" thick.

3. Water-Resistant Wallboard: Provide Type IV, Grade W or X as required, Class 2, 5/8" thick except otherwise shown on the Drawings complying with ASTM C 630.

4. Foil Backed Wallboard: Provide as shown on the Drawings.

B. Shaft Walls: Where so indicated on the Drawings, provide gypsum wallboard system specifically designed for encasing shafts of the required fire-resistivity, and complying with Fed Spec SS-L-30D, Type IV, Grade R or X, Class 1, in the dimensions shown or otherwise required.

C. Sheathing: Where gypsum wallboard sheathing is indicated on the Drawings, provide gypsum wallboard complying with Fed Spec SS-L-30D, Type II, Grade W, Class 2.

2.03 ACCESSORIES:

A. Metal Trim: Provide manufacturer's standard trim formed from zinc coated (galvanized) steel not lighter than 26 gauge, complying with Fed Spec QQ-S-775, Type I, Class d or e.

B. Casing Beads: Provide channel-shapes with exposed wing, and with a concealed wing not less than 7/8" wide. The exposed wing shall be suitable for joint treatment.

C. Corner Beads: Provide angle shapes with wings not less than 7/8" wide and perforated for nailing and joint treatment, or with combination metal and paper wings bonded together, not less than 1-1/4" wide and suitable for joint treatment.

D. Jointing System: Provide jointing system, including reinforcing tape and compound. Complying with ASTM C 475.

1. Unless otherwise specified, use a system recommended by the manufacturer for the indicated application.

E. Water-Resistant Joint Compound: Special water-resistant type for treatment of joints, fastener heads and cut edges of water-resistant backing board.

1. Available Product: Sheetrock Brand W/R Compound; United States Gypsum Company.

F. Fastening to Metal Studs: For fastening gypsum wallboard in place on metal studs and metal channels, use flat-head screws, shouldered, specially designed for use with power-driven tools, not less than 1" long, with self-tapping threads and self-drilling points.

G. Fastening to Wood: For fastening gypsum wallboard in place on wood, use 1-1/4" type W bugle-head screws, or use annular ring-type nail complying with ASTM C 514 or gypsum board nails complying with ASTM C 380, and of the length required by governmental agencies having jurisdiction.

H. Access Doors: In partitions and ceilings installed under this section, provide doors where required for access to mechanical and electrical installations.

1. Unless otherwise required, provide 24" x 24" metal access doors with concealed hinges to metal frame and with allen-key lock.

2. For doors into fire-rated surfaces, provide access doors having the same fire rating as the surfaced being pierced.

3. For tile surfaces and toilet rooms, provide stainless steel access doors and frames, with satin finish.

4. For other installations, provide prime-coated steel access doors and frames for finish painting to be performed at the job site under Section 09900 of these specifications.

I. Texturing: Provide for spray texturing of gypsum surfaces within this project.

1. Ceilings: Very Light Orange Peel

2. Walls: Very Light Orange Peel

J. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Architect.

PART 3 - EXECUTION

3.01 EXAMINATION:

A. Examine the area and conditions under which the work of this section will be performed.

B. Correct conditions detrimental to timely and proper completion of the work.

C. Prior to installation of the work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

1. Verify that gypsum drywall may be installed in strict accordance with all pertinent codes and regulations, the manufacturers' recommendations as approved by the Architect, and the original design.

D. Do not install gypsum drywall until all unsatisfactory conditions have been corrected.

3.02 INSTALLATION:

A. General: Unless otherwise specified, install gypsum wall board in accordance with the Drawings, ANSI 97.1, the above referenced, publications, and manufacturer's installation instructions.

1. Place separate boards in moderate contact, do not force into place.

2. Conceal the cut edges of boards at internal and external corners by overlapping covered edges of the abutting boards.

3. Stagger the boards so that corners of any four boards will not meet at a common point except in vertical corners.

4. Do not apply gypsum board to wood framing with wood moisture content in excess of 15 percent.

5. Space fasteners 3/8" minimum from ends and edges.

B. Ceilings: Install gypsum wallboards to ceilings with their long dimension at right angle to the supporting members.

1. Wallboards may be installed with the long dimension parallel to supporting members that are spaced 16" on center when attachment members are provided at end joints.

C. Walls: Install gypsum wallboard to studs at right angles to the furring or framing members.

1. Make end joints, where required, over framing or furring members.

D. Fastening to Metal Studs: Drive specified screws with clutch-controlled power screwdrivers, spacing the screws 12" on center at ceilings and 16" on center at walls, unless otherwise specified.

1. Where framing members are spaced 24" apart on walls, space screws 12" on center along framing member.

2. Attach double layers in accordance with the pertinent codes and the manufacturer's recommendations as approved by the Architect.

E. Fastening to Wood: Attach to wood as required by governmental agencies having jurisdiction.

F. Access Door: Install access door where specified on the Drawings.

1. Coordinate exact location with other trades.

2. Anchor firmly into position and align flush with the finish surface.

3.03 APPLICATION:

A. Joint Treatment, General:

1. Inspect areas to be joint-treated, verifying that the gypsum wallboard fits snugly against supporting framework.

2. In areas where joint treatment and compound finishing will be performed, maintain a temperature of not less than 55 degrees for 24 hours prior to commencing the treatment, and until joint and finishing compounds have dried.

3. Apply the joint treatment and finishing compound by machine or hand tool.

4. Provide a minimum drying time of 24 hours between coats, with additional drying time in poorly ventilated areas.

B. Embedding Compounds:

1. Apply to gypsum wallboard joints and fastener heads in a thin uniform layer.

2. Spread the compound not less than 3" wide at joints, center the reinforcing tape in the joint, and embed the tape in the compound, and spread a thin layer of compound over the tape.

3. After this treatment has dried, apply a second coat of embedding compound to joints and fastener heads, spreading in a thin uniform coat to not less than 6" wide at joints, and feather edged.

4. Sandpaper between coats as required. When thoroughly dry, sandpaper to eliminate ridges and high points.

C. Finishing Compounds: After embedding compound is thoroughly dry and has been completely sanded, apply a coat of finishing compound to joints and fastener heads.

1. Feather the finishing compound to no less than 12" wide.

2. When thoroughly dry, sandpaper to obtain a uniformly smooth surface, taking care to not scuff the paper surface of the wallboard.

D. Corner Treatment:

1. Internal Corners: Treat as specified for joints, except fold the reinforcing tape lengthwise through the middle and fit neatly into the corner.

2. External Corners: Install the specified corner bead, fitting neatly over the corner and securing with the same type fastener used for installing the wallboard.

a. Space the fasteners approximately 6" on centers, and drive through the wallboard into the framing or furring member.

b. After the corner bead has been secured into position, treat the corner with joint compound and reinforcing tape as specified for joints, feathering the joint compound out from 8" to 10" on each side of the corner.

E. Other Metal Trim:

1. The Drawings may not show all the locations and requirements for metal trim.

2. Carefully study the Drawings and the installation, and provide all metal trim normally recommended by the manufacturer of the gypsum wallboard approved for use in this work.

F. Finishing Water-Resistant Gypsum Board Base for Ceramic Tile: Treat joints and fasteners to comply with directions of water-treatment joint compound manufacturer.

1. In areas not to be tiled, treat fastener heads and embed tape as indicated above using water-resistant joint compound, but finish with two (2) coats of joint compound used for regular gypsum board work.

G. Texturing: Surfaces, including joint-treated areas must be smooth, clean and dry.

1. Allow a minimum of 48 hours for drying of joint treatments, nail spottings and surface levelings.

2. Apply only if room temperature is between 55° to 70°.

3. If texturing is the finish surface first apply a coat of good quality white alkyd flat oil base paint or primer/sealer.

4. Follow manufacturer's instructions in material application and usage of spray equipment.

5. If a second coat is required, do not apply until first coat is completely dry.

H. Refer to sections on painting, coatings, and wall-coverings in Division 9 for decorative finishes to be applied to drywall work.

3.04 CLEANING:

A. In addition to other requirements for cleaning, use necessary care to prevent scattering gypsum wallboard scraps and dust, and to prevent tracking gypsum and joint finishing compound onto floor surfaces.

B. At completion of each segment of installation in a room or space, promptly pick up and remove from the working area all scrap, debris, joint compound droppings, texturing materials and surplus material of this section.

3.05 PROTECTION:

A. Installer shall advise Contractor of required procedures for protecting gypsum drywall work from damage and deterioration during remainder of construction period.

END OF SECTION 09250

SECTION 095113

ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

Drawings and general conditions of Contract, including General and Supplementary Conditions and Divisions-1 Specification sections apply to work of this section.

1.2 SUMMARY

A. Section Includes:
   1. Acoustical ceiling panels.
   2. Exposed grid suspension system.
   3. Wire hangers, fasteners, main runners, cross tees, and wall angle moldings.

B. Related Sections:
   1. Section 01350, Special Environmental Requirements
   2. Section 09250 - Gypsum Board
   3. Section 09120 - Suspension System Framing and Furring for Plaster and Gypsum Board Assemblies
   4. Division 15 Sections - Mechanical Work
   5. Division 16 Sections - Electrical Work

C. Alternates
   1. Prior Approval: Unless otherwise provided for in the Contract documents, proposed product substitutions may be submitted no later than TEN (10) working days prior to the date established for receipt of bids. Acceptability of a proposed substitution is contingent upon the Architect's review of the proposal for acceptability and approved products will be set forth by the Addenda. If included in a Bid are substitute products which have not been approved by Addenda, the specified products shall be provided without additional compensation.
   2. Submittals which do not provide adequate data for the product evaluation will not be considered. The proposed substitution must meet all requirements of this section, including but not necessarily limited to, the following: Single source materials suppliers (if specified in Section 1.5); Underwriters' Laboratories Classified Acoustical performance; Panel design, size, composition, color, and finish; Suspension system component profiles and sizes; Compliance with the referenced standards.

1.3 REFERENCES

A. American Society for Testing and Materials (ASTM):
   1. ASTM A 1008 Standard Specification for Steel, Sheet, Cold Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
   2. ASTM A 641 Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
   3. ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.
   4. ASTM C 423 Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
   5. ASTM C 635 Standard Specification for Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
   6. ASTM C 636 Recommended Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels.
   7. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials.
   8. ASTM E 1414 Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum.
   9. ASTM E 1111 Standard Test Method for Measuring the Interzone Attenuation of Ceilings Systems.
   10. ASTM E 1264 Classification for Acoustical Ceiling Products.
   11. ASTM E 1477 Standard Test Method for Luminous Reflectance Factor of Acoustical Materials by Use of Integrating-Sphere Reflectometers.
   12. ASTM D 3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
   13. ASTM E 119 Standard Test Methods for Fire Tests of Building Construction and Material.

B. ASHRAE Standard 62.1-2004, "Ventilation for Acceptable Indoor Air Quality"

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's technical data for each type of acoustical ceiling unit and suspension system required.
B. Samples: Minimum 6 inch x 6 inch samples of specified acoustical panel; 8 inch long samples of exposed wall molding and suspension system, including main runner and 4 foot cross tees.
C. Shop Drawings: Layout and details of acoustical ceilings. Show locations of items which are to be coordinated with, or supported by the ceilings.
D. Certifications: Manufacturer's certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards. For acoustical performance, each carton of material must carry an approved independent laboratory classification of NRC, CAC, and AC.
E. If the material supplied by the acoustical subcontractor does not have an Underwriter's Laboratory classification of acoustical performance on every carton, subcontractor shall be required to send material from every production run appearing on the job to an independent or NVLAP approved laboratory for testing, at the architect's or owner's discretion. All products not conforming to manufacturer's current published values must be removed, disposed of and replaced with complying product at the expense of the Contractor performing the work.

1.5 QUALITY ASSURANCE

A. Single-Source Responsibility: Provide acoustical panel units and grid components by a single manufacturer.
B. Fire Performance Characteristics: Identify acoustical ceiling components with appropriate markings of applicable testing and inspecting organization.
    1. Surface Burning Characteristics: As follows, tested per ASTM E 84 and complying with ASTM E 1264 for Class A products.
        a. Flame Spread: 25 or less
        b. Smoke Developed: 50 or less
C. Handle acoustical ceiling units carefully to avoid chipping edges or damaged units in any way.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical ceiling units to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.
B. Before installing acoustical ceiling units, permit them to reach room temperature and a stabilized moisture content.
C. Handle acoustical ceiling units carefully to avoid chipping edges or damaged units in any way.

1.7 PROJECT CONDITIONS

A. Space Enclosure:

All ceiling products and suspension systems must be installed and maintained in accordance with Armstrong written installation instructions for that product in effect at the time of installation and best industry practice. Prior to installation, the ceiling product must be kept clean and dry, in an environment that is between 32°F (0°C) and 120°F (49°C) and not subject to Abnormal Conditions.
Abnormal conditions include exposure to chemical fumes, vibrations, moisture from conditions such as building leaks or condensation, excessive humidity, or excessive dirt or dust buildup.

HumiGuard Plus Ceilings: Installation of the products shall be carried out where the temperature is between 32°F (0° C) and 120°F (49° C). It is not necessary for the area to be enclosed or for HVAC systems to be functioning. All wet work (plastering, concrete, etc) must be complete and dry.
The ceilings must be maintained to avoid excessive dirt or dust buildup that would provide a medium for microbial growth on ceiling panels. Microbial protection does not extend beyond the treated surface as received from the factory, and does not protect other materials that contact the treated surface such as supported insulation materials.

1.8 WARRANTY

A. Acoustical Panel: Submit a written warranty executed by the manufacturer, agreeing to repair or replace acoustical panels that fail within the warranty period. Failures include, but are not limited to:
    1. Acoustical Panels: Sagging and warping as a result of defects in materials or factory workmanship.
    2. Grid System: Rusting and manufacturer's defects

3. Acoustical Panels with BioBlock Plus or designated as inherently resistive to the growth of micro-organisms installed with Armstrong suspension systems: Visible sag and will resist the growth of mold/mildew and gram positive and gram negative odor and stain causing bacteria.

B. Warranty Period Humiguard:
   1. Acoustical panels: Ten (10) years from date of substantial completion.
   2. Grid: Ten (10) years from date of substantial completion.
   3. Acoustical panels and grid systems with HumiGuard Plus or HumiGuard Max performance supplied by one source manufacturer is thirty (30) years from date of substantial completion.

C. The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

1.9 MAINTENANCE

A. Extra Materials: Deliver extra materials to Owner. Furnish extra materials described below that match products installed. Packaged with protective covering for storage and identified with appropriate labels.
   1. Acoustical Ceiling Units: Furnish quality of full-size units equal to 5.0 percent of amount installed.
   2. Exposed Suspension System Components: Furnish quantity of each exposed suspension component equal to 2.0 percent of amount installed.

Part 2-PRODUCTS

2.1 MANUFACTURERS

A. Ceiling Panels:

1. Armstrong World Industries, Inc.

2.2.0 ACOUSTICAL CEILING UNITS

A. Acoustical Panels Type ACT-1:

1. Surface Texture: Fine
2. Composition: Mineral Fiber
3. Color: White
4. Size: 24in X 24in X 3/4in
5. Edge Profile: Square Lay-In for interface with Prelude XL 15/16" Exposed Tee.
6. Noise Reduction Coefficient (NRC): ASTM C 423; Classified with UL label on product carton, 0.70.
7. Ceiling Attenuation Class (CAC): ASTM C 1414; Classified with UL label on product carton, 35
8. Emissions Testing: Section 01350 Protocol, < 13.5 ppb of formaldehyde when used under typical conditions required by ASHRAE Standard 62.1-2004, "Ventilation for Acceptable Indoor Air Quality"
9. Flame Spread: ASTM E 1264; Class A (UL)
10. Light Reflectance (LR): ASTM E 1477; White Panel: Light Reflectance: 0.90.
11. Dimensional Stability: HumiGuard Plus - Temperature is between 32°F (0° C) and 120°F (49° C). It is not necessary for the area to be enclosed or for HVAC systems to be functioning. All wet work (plastering, concrete, etc) must be complete and dry.
12. Antimicrobial Protection: BioBlock Plus - Resistance against the growth of mold/mildew and gram positive and gram negative odor and stain causing bacteria.
13. Acceptable Product: Ultima, 1900 as manufactured by Armstrong World Industries.

2.3.0 SUSPENSION SYSTEMS

A. Components: All main beams and cross tees shall be commercial quality hot-dipped galvanized (galvanized steel, aluminum, or stainless steel) as per ASTM A 653. Main beams and cross tees are double-web steel construction with 15/16 IN type exposed flange design. Exposed surfaces chemically cleansed, capping pre-finished galvanized steel (aluminum or stainless steel) in baked polyester paint. Main beams and cross tees shall have rotary stitching (exception: extruded aluminum or stainless steel).
   1. Structural Classification: ASTM C 635 HD.
   2. Color: White and match the actual color of the selected ceiling tile, unless noted otherwise.
   3. Acceptable Product: Prelude XL 15/16" Exposed Tee as manufactured by Armstrong World Industries, Inc.

B. Attachment Devices: Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.
C. Wire for Hangers and Ties: ASTM A 641, Class 1 zinc coating, soft temper, pre-stretched, with a yield stress load of at least time three design load, but not less than 12 gauge.
D. Edge Moldings and Trim: Metal or extruded aluminum of types and profiles indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations, including light fixtures, that fit type of edge detail and suspension system indicated. Provide moldings with exposed flange of the same width as exposed runner.
E. Accessories

PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not proceed with installation until all wet work such as concrete, terrazzo, plastering and painting has been completed and thoroughly dried out, unless expressly permitted by manufacturer's printed recommendations. (Exception: HumiGuard Max Ceilings)

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less than half width units at borders, and comply with reflected ceiling plans. Coordinate panel layout with mechanical and electrical fixtures.
B. Coordination: Furnish layouts for preset inserts, clips, and other ceiling anchors whose installation is specified in other sections.
    1. Furnish concrete inserts and similar devices to other trades for installation well in advance of time needed for coordination of other work.

3.3 INSTALLATION

A. Install suspension system and panels in accordance with the manufacturer's instructions, and in compliance with ASTM C 636 and with the authorities having jurisdiction.
B. Suspend main beam from overhead construction with hanger wires spaced 4-0 on center along the length of the main runner. Install hanger wires plumb and straight.
C. Install wall moldings at intersection of suspended ceiling and vertical surfaces. Miter corners where wall moldings intersect or install corner caps.
D. For reveal edge panels: Cut and reveal or rabbet edges of ceiling panels at border areas and vertical surfaces.
E. Install acoustical panels in coordination with suspended system, with edges resting on flanges of main runner and cross tees. Cut and fit panels neatly against abutting surfaces. Support edges by wall moldings.

3.4 ADJUSTING AND CLEANING

A. Replace damaged and broken panels.
B. Clean exposed surfaces of acoustical ceilings, including trim, edge moldings, and suspension members. Comply with manufacturer's instructions for cleaning and touch up of minor finish damage.
    1. Ceiling Touch-Up Paint, (Item #5760, 8oz. bottles) (Item #5761, quart size cans), "global white" latex paint should be used to hide minor scratches and nicks in the surface and to cover field tegularized edges that are exposed to view.
C. Remove and replace work that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY:

A. Section Includes:

1. Extent of painting work is shown on Drawings and Schedules, and as herein specified.

2. The work includes painting and finishing of interior and exterior exposed items and surfaces throughout project, as indicated on the Drawings.

a. Surface preparation, priming and coats of paint specified are in addition to shop-priming and surface treatment specified under other sections of work.

B. The work of this section also includes backpriming of non-exposed surfaces where shown and as specified herein.

3. Paint exposed surfaces whether or not colors are designated in "schedules," except where natural finish of material is specifically noted as a surface not to be painted.

a. Where items or surfaces are not specifically mentioned, paint same as adjacent similar materials or areas.

b. If color or finish is not designated, Architect will select these from standard colors available for materials systems specified.

4. Shop Priming: Unless otherwise specified, shop priming of ferrous metal items is included under various sections for structural steel, miscellaneous metal, hollow metal work, and similar items.

a. Also, for fabricated components such as architectural woodwork, wood casework, and factory-built or shop-fabricated mechanical and electrical equipment or accessories.

5. Prefinished Items: Unless otherwise indicated, do not include painting when factory finishing or installer finishing is specified for such items as (but not limited to) metal toilet enclosures, prefinished partition systems, acoustic materials, architectural woodwork and casework, finished mechanical and electrical equipment including light fixtures, switchgear and distribution cabinets, elevator entrance frames, doors and equipment.

6. Concealed Surfaces: Unless otherwise indicated, painting is not required on surfaces such as wells or ceilings in concealed areas and generally inaccessible areas, foundation spaces, furred areas, utility tunnels, pipe spaces, duct shafts, and elevator shafts.

7. Finished Metal Surfaces: Metal surfaces of anodized aluminum, stainless steel, chromium plate, copper, bronze and similar finished materials will not require finish painting, unless otherwise indicated.

8. Operating Parts and Labels: Moving parts of operating units, mechanical and electrical parts, such as valve and damper operators, linkages, sinkages, sensing devices, motor and fan shafts will not require finish painting, unless otherwise indicated.

9. Do not paint over any code-required labels, such as Underwriters' Laboratories and Factory Mutual, or any equipment identification, performance rating, name, or nomenclature plates.

B. Related Sections: Drawings and General Provisions of the contract, including the General Covenants and Provisions, Supplementary Covenants and Provisions and General Requirements.

1.02 DEFINITIONS:

A. "Paint," as used herein, means coating systems materials including primers, emulsions, epoxy, enamels, sealer, fillers, and other applied materials whether used as prime, intermediate, or finish coats.

1.03 SYSTEM DESCRIPTION:

A. Review Finish Schedule Sheet A-600

1.04 SUBMITTALS:

A. Provide submittals in accordance with Section 01300.

B. Product Data: Submit manufacturer's technical information including paint label analysis, color selection catalogs and application instructions for each material proposed for use.

C. Samples: Submit samples for Architect's review of color and texture only. Provide a listing of material and application for each coat of each finish sample.

D. On 12" x 12" hardboard, provide two samples of each color and material, with texture to simulate actual conditions. Resubmit samples as requested by Architect until acceptable sheen, color, and texture is achieved.

E. On actual wood surfaces, provide two 4" x 8" samples of natural and stained wood finish. Label and identify each as to location and application.

1.05 QUALITY ASSURANCE:

A. Qualification of Manufacturer: Products used in the work of this section shall be produced by manufacturers regularly engaged in manufacture of similar items and with a history of successful production acceptable to the Architect.

B. Qualification of Workers:

1. Provide at least one person who shall be present at all times during execution of the work of this section, who shall be thoroughly familiar with the specified requirements and the materials and methods needed for their execution, and who shall direct all work performed under this section.

2. Provide adequate numbers of workers skilled in the necessary crafts and properly informed of the methods and materials to be used.

3. In acceptance or rejection of the work of this section, the Architect will make no allowance for lack of skill on the part of workers.

1.06 DELIVERY, STORAGE, AND HANDLING:

A. Deliver materials to job site in original, new and unopened packages and containers bearing manufacturer's name and label, and following information:

1. Name or title of material.
2. Fed. Spec. Number, if applicable.
3. Manufacturer's stock number and date of manufacturer.
4. Manufacturer's name.
5. Contents by volume, for major pigment and vehicle constituents.
6. Thinning instructions.
7. Application instructions.
8. Color name and number.

B. Material delivered damaged, open, or in containers not properly labeled will be rejected by the DNR Construction Inspector.

C. Promptly remove unacceptable material from the job site, and promptly replace with material meeting the specified requirements, at no additional cost to the Owner.

1.07 PROJECT/SITE CONDITIONS:

A. Apply water-base paints only when temperature of surfaces to be painted and surrounding air temperatures are between 50°F. (10°C) and 90°F. (32°C), unless otherwise permitted by paint manufacturer's printed instructions.

B. Apply solvent-thinned paints only when temperature of surfaces to be painted and surrounding air temperatures are between 45°F. (7°C) and 95°F. (35°C), unless otherwise permitted by paint manufacturer's printed instructions.

C. Do not apply paint in snow, rain, fog or mist; or when relative humidity exceed 85%; or to damp or wet surfaces; unless otherwise permitted by paint manufacturer's printed instructions.

D. Painting may be continued during inclement weather if areas and surfaces to be painted are enclosed and heated within temperature limits specified by paint manufacturer during application and drying periods.

1.08 SEQUENCING AND SCHEDULING:

A. Coordination with other trades: Do not start work of this section until the work of other trades, unless otherwise specified, has been completed in the areas to be painted.

B. Follow manufacturer's instructions and schedule sufficient drying time between coats to achieve maximum thickness.

1. Exterior System: Unless otherwise recommended by paint system manufacturer, do not apply second and third coats until a minimum of 16 hours has elapsed since preceding application.

2. Interior System: Unless otherwise recommended by the paint system manufacturer, do not apply the second and third coats, if any, until a minimum of 34 hours has elapsed since preceding application.

C. The DNR Construction Inspector may require notification of starting and finishing times for each coat in order to verify complete and proper application of each system under this contract.

1.09 MAINTENANCE:

A. Provide manufacturer recommended maintenance instructions in accordance with Section 01730.

B. Maintenance by Owner: In addition to following the recommended maintenance instruction provided by the Contractor, the owner representative will:

1. Unless otherwise indicated in the manufacturer's instruction, recoat exterior wood every three (3) years, as follows;

a. Power wash exterior structure as specified in part 3 of this section and in accordance with the manufacturer's recommended procedures.

b. Allow wood to dry for three (3) Days.

c. Unless otherwise recommended, apply one coat of the same product used as third coat in the initial application.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work of this section include:

1. ICI Delux Paints, Cleveland, OH
2. Iowa Paint Manufacturing Co., Des Moines, IA
3. Fuller-O'Brien Paints and Coatings, San Francisco, CA
4. Diamond Vogel Paint, Marshalltown, IA
5. Sherwin-Williams Co., Cleveland, OH
6. Pittsburg Paints, PPG Industries, Inc., Pittsburg, PA

7. Sikkens Woodfinishes, Division of Akzo Coatings Inc., Troy, Michigan
8. Enviro-Chem, Inc., Walla Walla, Washington

2.02 MATERIALS:

A. Provide best quality grade of various types of coatings as regularly manufactured by acceptable paint materials manufacturers. Materials not displaying manufacturer's identification as a standard, best-grade product will not be acceptable.

B. Provide undercoat paint produced by same manufacturer as finish coats.

1. Use only thinners approved by paint manufacturer, and use only within recommended limits.

C. Paint Coordination: Provide finish coats which are compatible with prime paints used. Review other sections of these specifications in which prime paints are to be provided to ensure compatibility of total coatings system for various substrates.

1. Upon request from other trades, furnish information on characteristics of finish materials proposed for use, to ensure compatible prime coats are used.

2. Provide barrier coats over incompatible primers or remove and reprime as required.

3. Notify Architect in writing of any anticipated problems using specified coating systems with substrates primed by others.

D. Color Pigments: Pure, nonfading, applicable types to suit substrates and service indicated.

1. Lead content in pigment, if any, is limited to contain not more than 0.5% lead, as lead metal based on the total nonvolatile (dry-film) of paint by weight.

2. This limitation is extended to interior surfaces and those exterior surfaces, such as stairs, decks, porches, railings, windows, and doors which are readily accessible to children under seven years of age.

E. Schedules: Paint colors, surface treatments, and finishes are indicated in "schedules" of the contract documents. Except as noted, listed coating names, numbers, and colors are used to establish the quality, type and color of coating.

1. Proprietary names used to designate colors or materials are not intended to imply that products of named manufacturers are required to exclusion of equivalent products of other manufacturers.

2. Manufacturer's products which comply with coating qualitative requirements of applicable Federal Specifications, yet differ in quantitative requirements, may be considered for use when acceptable to Architect.

a. Furnish material data and manufacturer's certificate of performance to Architect for any proposed substitutions.

PART 3 - EXECUTION

3.01 EXAMINATION:

A. Applicator must examine areas and conditions under which painting work is to be applied and notify Contractor in writing of conditions detrimental to proper and timely completion of work.

1. Do not proceed with work until satisfactory conditions have been corrected in a manner acceptable to Applicator.

B. Starting of painting work will be construed as Applicator's acceptance of surfaces and conditions within any particular area.

C. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions otherwise detrimental to formation of a durable paint film.

3.02 PREPARATION:

A. General: Perform preparation and cleaning procedures in accordance with paint manufacturer's instruction and as herein specified, for each particular substrate condition.

B. Remove hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items in place and not to be finish-painted, or provide surface-applied protection prior to surface preparation and painting operations.

1. Remove, if necessary, for complete painting of items and adjacent surfaces.

2. Following completion of painting of each space or area, reinstall removed items.

C. Clean surfaces to be painted before applying paint or surface treatments. Remove oil and grease prior to mechanical cleaning.

1. Program cleaning and painting so that contaminants from cleaning process will not fall onto wet, newly painted surfaces.

D. Determine alkalinity and moisture content of surfaces to be painted by performing appropriate tests.

1. If surfaces are found to be sufficiently alkaline to cause blistering and burning of finish paint, correct this condition before application of paint.

2. Do not paint over surfaces where moisture content exceeds that permitted in manufacturer's printed directions.

E. Wood: Clean wood surfaces to be painted of dirt, oil, or other foreign substances with scrapers, mineral spirits, and sandpaper, as required.

1. Sandpaper smooth those finished surfaces exposed to view, and dust off. Scrape and clean small, dry, seasoned knots and apply a thin coat of white shellac or other recommended knot sealer, before application of priming coat.

2. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood-filler and sandpaper smooth when dried.

G. Prime, stain, or seal wood required to be job-painted immediately upon delivery to job. Prime edges, ends, faces, undersides, and backsides of such wood, including cabinets, counters, cases, and paneling.

H. When transparent finish is required, use spar varnish for backpriming.

I. Backprime paneling on interior partitions only where masonry, plaster, or other wet wall construction occurs on backside.

J. Seal tops, bottoms, and cut-outs of unprimed wood doors with a heavy coat of varnish or equivalent sealer immediately upon delivery to job.

K. Ferrous Metals: Clean ferrous surfaces, which are not galvanized or shop-coated, of oil, grease, dirt, loose mill scale, and other foreign substances by solvent or mechanical cleaning.

1. Touch-up shop-applied prime coats wherever damaged or bare, where required by other sections of these specifications.

2. Clean and touch-up with same type of shop primer.

L. Galvanized Surfaces: Clean free of oil and surface contaminants with non-petroleum based solvent.

M. Material:

1. Mix and prepare painting materials in accordance with manufacturer's directions.

2. Store materials not in actual use in tightly covered containers.

3. Maintain containers used in storage, mixing and application of paint in a clean condition, free of foreign materials and residue.

4. Stir materials before application to produce a mixture of uniform density, and stir as required during application.

5. Do not stir surface film into material. Remove film and, if necessary, strain material before using.

3.03 APPLICATION:

A. General: Apply paint in accordance with manufacturer's directions.

1. Use applicators and techniques best suited for substrate and type of material being applied.

B. Apply additional coats when undercoats, stains or other conditions show through final coat of paint, until paint film is of uniform finish, color, and appearance.

1. Pay special attention to ensure that surfaces, including edges, corners, crevices welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.

C. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces.

1. Paint surfaces behind permanently fixed equipment of furniture with prime coat only before final installation of equipment.

D. Paint back sides of access panels, and removable or hinged covers to match exposed surfaces.

E. Finish exterior doors on tops, bottoms and side edges same as exterior faces, unless otherwise indicated.

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

G. Unless otherwise indicated, omit primer coat on metal surfaces which have been shop-primed and touch-up painted,

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

I. Allow sufficient time between successive coatings to permit proper drying.

1. Do not recoat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.

J. Minimum Coating Thickness: Apply materials at not less than manufacturer's recommended spreading rate, to establish a total dry film thickness as indicated or, if not indicated, as recommended by coating manufacturer.

K. Prime Coats: Apply prime coat on material required to be painted, and which has not been prime coated by others.

L. Recoat primed and sealed surfaces where there is evidence of suction spots or unsealed areas in first coat, to assure a finish coat with no burn-through or other defects due to insufficient sealing.

M. Completed Work: Match approved samples for color, texture, and coverage.

1. Remove, refinish or repaint work not in compliance with specified requirements.

3.04 CLEANING:

A. Clean-Up: During progress of work, remove from site discarded paint materials, rubbish, cans and rags at end of each workday.

B. Upon completion of painting work, clean window glass and other paint-spattered surfaces.

1. Remove spattered paint by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.

C. At the completion of work of other trades, touch-up and restore all damaged or defaced painted surfaces.

3.05 PROTECTION:

A. Protect work of other trade, whether to be painted or not, against damage by painting and finishing work.

1. Correct any damage by cleaning, repairing or replacing, and repainting as acceptable to Architect.

B. Provide "Wet Paint" signs as required to protect newly painted finishes.

1. Remove temporary protective wrappings provided by others for protection of their work, after completion of painting operations.

3.06 SCHEDULES:

A. Provide the following paint finishes by ICI Delux Paints or other manufacturers of equal products as specified herein.

B. EPS-1: Exterior Alkyd Enamel - Ferrous Metals:

1st Coat -	Alkyd Metal Primer	Devoe DevGuard No. 4160
2nd Coat -	Alkyd Gloss Enamel	Devoe DevGuard No. 4308 Series
3rd Coat -	Alkyd Gloss Enamel	Devoe DevGuard No. 4308 Series

c. EPS-2: Exterior Alkyd Enamel - Galvanized and Aluminum Metals:

1st Coat -	Alkyd Metal Primer	Devoe DevGuard No. 4129
2nd Coat -	Alkyd Gloss Enamel	Devoe DevGuard No. 4308
3rd Coat -	Alkyd Gloss Enamel	Devoe DevGuard No. 4308

E. IPS-1: Interior Latex Emulsion (Semi-Gloss) - Gypsum Wallboard

1st Coat -	Primer Sealer	Ultra-Hide No. 1060
2nd Coat -	Latex Enamel	Ultra-Wall No. 1434
3rd Coat -	Latex Enamel	Ultra-Wall No. 1434

F. IPS-2: Interior Alkyd Enamel (Semi-Gloss) – Woodwork - Plywood

1st Coat -	Alkyd Primer	Ultra-Hide No. 1120
2nd Coat -	Alkyd Enamel	Ultra-Hide No. 1516
3rd Coat -	Alkyd Enamel	Ultra-Hide No. 1516

G. IPS-3: Interior Alkyd Enamel - Ferrous Metals:

1st Coat -	Alkyd Metal Primer	Devoe DevGuard No. 4160
2nd Coat -	Alkyd Gloss Enamel	Devoe DevGuard No. 4308 Series

3rd Coat -	Alkyd Gloss Enamel	Devoe DevGuard No. 4308 Series

H. IPS-4: Interior Alkyd Enamel - Galvanized and Aluminum Metals:

1st Coat -	Alkyd Metal Primer	Devoe DevGuard No. 4129
2nd Coat -	Alkyd Gloss Enamel	Devoe DevGuard No. 4308
3rd Coat -	Alkyd Gloss Enamel	Devoe DevGuard No. 4308

I. IPS-5: Interior Urethane Varnish (satin Sheen) - Protected Wood:

1st Coat -	Oil Stain Semi-Transp.	Woodpride No. 1700
2nd Coat -	Urethane Alkyd	Woodpride No. 1902
3rd Coat -	Urethane Alkyd	Woodpride No. 1902

END OF SECTION 09900

SECTION 15010
BASIC MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Requirements applicable to all Division 15 Sections. Also refer to Division 1 - General Requirements.

B. All materials and installation methods shall conform to the applicable standards, guidelines and codes referenced in the specification section.

1.2 SCOPE OF WORK

A. This Specification and the associated drawings govern the furnishing, installing, testing and placing into satisfactory operation the Mechanical Systems.

B. Each Contractor shall provide all new materials indicated on the drawings and/or in these specifications, and all items required to make his portion of the Mechanical Work a finished and working system.

C. All work will be awarded under a single General Contract. The division of work listed below is for the Contractor's convenience and lists normal breakdown of the work.

D. Scope of Work:

1. Plumbing Work shall include, but is not necessarily limited to:

a. Furnish and install all items listed in the Plumbing Material List.

b. Furnish and install a new domestic water service to the building.

c. Furnish and install domestic water backflow preventer as required by Code.

d. Furnish and install a complete domestic water piping system including cold and hot and hot circulating water piping within the building. Insulate all piping as specified.

e. Furnish and install gas piping system.

f. Furnish and install water heater and circulating pump.

g. Furnish and install condensate drain piping from plumbing and cooling related equipment such as ice machine and furnace.

h. Furnish and install a complete sanitary sewer and vent system.

2. Heating Work shall include, but is not necessarily limited to:

a. Contractor shall review and coordinate with the Air Conditioning and Ventilation Contractor's detailed ductwork drawings.

b. Furnish and install refrigerant piping, accessories, and final charge of refrigerant.

3. Air Conditioning and Ventilating Work shall include, but is not necessarily limited to:

a. Furnish and install a furnace unit complete with filters, coils, fans, motor, and curb.

b. Furnish and install air-cooled condensing units and curbs.

c. Furnish and install complete supply air ductwork systems including all fittings, insulation, and outlets.

d. Furnish and install complete return air ductwork systems including all fittings, insulation, and inlets.

e. Furnish and install complete exhaust ductwork systems including all fittings, insulation, inlets, and fans.

f. Furnish and install gas flues.

g. Furnish and install all temperature control systems.

h. This Contractor is responsible for coordinating utilities with all other contractors.

4. Testing, Adjusting, and Balancing Work shall include, but is not necessarily limited to:

a. Furnish complete testing, adjusting, and balancing as specified in Section 15990, including, but not limited to, air systems, hydronic systems, plumbing systems, and verification of control systems.

1.3 OWNER FURNISHED PRODUCTS

A. The Owner will supply manufacturer's installation data for Owner-purchased equipment for this project.

B. This Contractor shall make all mechanical system connections shown on the drawings **or** as required for fully functional units.

C. This Contractor is responsible for all damage to Owner furnished equipment caused during installation.

1.4 DIVISION OF WORK BETWEEN MECHANICAL, ELECTRICAL & CONTROL CONTRACTORS

A. Definitions:

1. "Mechanical Contractors" refers to the following:

a. Plumbing Contractor.
b. Heating Contractor.
c. Air Conditioning and Ventilating Contractor.
d. Testing, Adjusting, and Balancing Contractor.

2. Motor Control Wiring: The wiring associated with the remote operation of the magnetic coils of magnetic motor starters or relays, or the wiring that permits direct cycling of motors by means of devices in series with the motor power wiring. In the latter case the devices are usually single phase and are usually connected to the motor power wiring through a manual motor starter having "Manual-Off-Auto" provisions.

3. Control devices such as start-stop push buttons, thermostats, pressure switches, flow switches, relays, etc., generally represent the types of equipment associated with motor control wiring.

4. Motor control wiring is single phase and usually 120 volts. In some instances, the voltage will be the same as the motor power wiring. Generally, where the motor power wiring exceeds 120 volts, a control transformer is used to give a control voltage of 120 volts.

5. Temperature Control Wiring: The wiring associated with the operation of a solenoid valve or motorized valve, etc., either modulating or two-position, as opposed to wiring which directly powers or controls a motor used to drive equipment such as fans, pumps, etc.

6. This wiring will be from a 120 volt source and may continue as 120 volt, or be reduced in voltage (24 volt) in which case a control transformer shall be furnished as part of the temperature control wiring.

7. Control Motor: An electric device used to operate valves, etc. It may be two-position or modulating. Conventional characteristics of such a motor are 24 volts, 60 cycles, 1 phase, although other voltages may be encountered.

B. General:

1. The purpose of these Specifications is to outline the Electrical and Mechanical Contractor's responsibilities related to electrical work required for items such as temperature controls, mechanical equipment, fans, compressors, and the like. The exact wiring requirements for much of the equipment cannot be determined until the systems have been selected and submittals reviewed. Therefore, the electrical drawings show only known wiring related to such items. All wiring not shown on the electrical drawings, but required for mechanical systems, is the responsibility of the Mechanical Contractor.

2. Where the drawings require the Electrical Contractor to wire between equipment furnished by the Mechanical Contractor, such wiring shall terminate at terminals provided in the equipment. The Mechanical Contractor shall provide complete wiring diagrams and supervision to the Electrical Contractor and designate the terminal numbers for correct wiring.

3. All electrical work shall conform to the National Electrical Code. All provisions of the Electrical Specifications concerning wiring, protection, etc., apply to wiring provided by the Mechanical Contractor unless noted otherwise.

4. All Contractors shall establish utility elevations prior to fabrication and shall coordinate their material and equipment with other trades. When a conflict arises, priority is as follows:

   a. Light fixtures.
   b. Gravity flow piping, including condensate.
   c. Electrical busduct.
   d. Sheet metal.
   e. Electrical cable trays, including access space.
   f. Other piping.
   g. Electrical conduits and wireway.

C. Mechanical Contractor's Responsibility:

1. Assumes responsibility for internal wiring of all equipment provided by the Mechanical Contractor, for example:

   a. Furnaces and condensing unit.

2. Assumes all responsibility for the Temperature Control wiring, when the Temperature Control Contractor is a Subcontractor to the Mechanical Contractor.

3. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

D. Electrical Contractor's Responsibility:

1. Provides all combination starters, manual starters and disconnect devices shown on the Electrical Drawings or indicated to be by the Electrical Contractor on the Mechanical Drawings or Specifications.

2. Installs and wires all remote control devices furnished by the Mechanical Contractor or Temperature Control Subcontractor when so noted on the Electrical Drawings.

3. Provides motor control and temperature control wiring, where so noted on the drawings.

4. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

1.5 COORDINATION DRAWINGS

A. Definitions:

1. Coordination Drawings: A compilation of the pertinent layout and system drawings that show the sizes and locations, including elevations, of system components and required access areas to ensure that no two objects will occupy the same space.

    a. Mechanical trades shall include, but are not limited to, mechanical equipment, ductwork, plumbing piping, hydronic piping, and any item that may impact coordination with other disciplines.

    b. Electrical trades shall include, but are not limited to, electrical equipment, conduit 1.5” and larger, conduit racks, cable trays, pull boxes, transformers, raceway, busway, lighting, ceiling-mounted devices, and any item that may impact coordination with other disciplines.

    c. Technology trades shall include, but are not limited to, technology equipment, racks, conduit 1.5” and larger, conduit racks, cable trays, ladder rack, pull boxes, raceway, ceiling-mounted devices, and any item that may impact coordination with other disciplines.

    d. Maintenance clearances and code-required dedicated space shall be included.

    e. The coordination drawings shall include all underground, underfloor, in-floor, in chase, and vertical trade items.

2. The contractors shall use the coordination process to identify the proper sequence of installation of all utilities above ceilings and in other congested areas, to ensure an orderly and coordinated end result, and to provide adequate access for service and maintenance.

B. Participation:

1. The contractors and subcontractors responsible for work defined above shall participate in the coordination drawing process.

2. One contractor shall be designated as the Coordinating Contractor for purposes of preparing a complete set of composite electronic CAD coordination drawings that include all applicable trades, and for coordinating the activities related to this process. The Coordinating Contractor for this project shall be the Mechanical Contractor.

    a. The Coordinating Contractor shall utilize personnel familiar with requirements of this project and skilled as draftspersons/CAD operators, competent to prepare the required coordination drawings.

3. Electronic CAD drawings shall be submitted to the Coordinating Contractor for addition of work by other trades. KJWW will provide electronic file copies of ventilation drawings for contractor's use if the contractor signs and returns an "Electronic File Transfer" waiver provided by KJWW. KJWW will not consider blatant reproductions of original file copies an acceptable alternative for coordination drawings.

C. Drawing Requirements:

1. The file format and file naming convention shall be coordinated with and agreed to by all contractors participating in the coordination process and the Owner.

a. Scale of drawings:

1.) General plans: 1/4 Inch = 1 '-0" (minimum).

2.) Mechanical, electrical, communication rooms, and including the surrounding areas within 10 feet: 1/2 Inch = 1'-0" (minimum).

3.) Shafts and risers: 1/2 Inch = 1'-0" (minimum).

4.) Sections of shafts and mechanical and electrical equipment rooms: 1/4 Inch = 1 '-0" (minimum).

5.) Sections of congested areas: 1/2 Inch = 1'-0" (minimum).

2. Ductwork layout drawings shall be the baseline system for other components. Ductwork layout drawings shall be modified to accommodate other components as the coordination process progresses.

D. General:

1. Coordination drawing files shall be made available to the A/E and Owner's Representative. The A/E will only review identified conflicts and give an opinion, but will not perform as a coordinator.

2. The contract drawings are schematic in nature and do not show every fitting and appurtenance for each utility. Each contractor is expected to have included in his/her bid sufficient fittings, material, and labor to allow for adjustments in routing of utilities made necessary by the coordination process and to provide a complete and functional system.

3. The contractors will not be allowed additional costs or time extensions due to participation in the coordination process.

4. The contractors will not be allowed additional costs or time extensions for additional fittings, reroutings or changes of duct size, that are essentially equivalent sizes to those shown on the drawings and determined necessary through the coordination process.

5. The A/E reserves the right to determine space priority of equipment in the event of spatial conflicts or interference between equipment, piping, conduit, ducts, and equipment provided by the trades.

6. Changes to the contract documents that are necessary for systems installation and coordination shall be brought to the attention of the A/E.

7. Access panels shall preferably occur only in gypsum board walls or plaster ceilings where indicated on the drawings.

   a. Access to mechanical, electrical, technology, and other items located above the ceiling shall be through accessible lay-in ceiling tile areas.

   b. Potential layout changes shall be made to avoid additional access panels.

   c. Additional access panels shall not be allowed without written approval from the A/E at the coordination drawing stage.

   d. Providing additional access panels shall be considered after other alternatives are reviewed and discarded by the A/E and the Owner's Representative.

   e. When additional access panels are required, they shall be provided without additional cost to the Owner.

1.6 QUALITY ASSURANCE

A. Contractor’s Responsibility Prior to Submitting Pricing Data:

1. The Contractor is responsible for constructing complete and operating systems. The Contractor acknowledges and understands that the Contract Documents are a two-dimensional representation of a three-dimensional object, subject to human interpretation. This representation may include imperfect data, interpreted codes, utility guidelines, three-dimensional conflicts, and required field coordination items. Such deficiencies can be corrected when identified prior to ordering material and starting installation. The Contractor agrees to carefully study and compare the individual Contract Documents and report at once in writing to the Design Team any deficiencies the Contractor may discover. The Contractor further agrees to require each subcontractor to likewise study the documents and report at once any deficiencies discovered.

2. The Contractor shall resolve all reported deficiencies with the Architect/Engineer prior to awarding any subcontracts, ordering material, or starting any work with the Contractor’s own employees. Any work performed prior to receipt of instructions from the Design Team will be done at the Contractor’s risk.

B. Qualifications:

1. Only products of reputable manufacturers are acceptable.

2. All Contractors and subcontractors shall employ only workers skilled in their trades.

C. Compliance with Codes, Laws, Ordinances:

1. Conform to all State Codes.

2. If there is a discrepancy between the codes and regulations and these specifications, the Engineer shall determine the method or equipment used.

3. If the Contractor notes, at the time of bidding, any parts of the drawings or specifications that do not comply with the codes or regulations, he shall inform the Architect/Engineer in writing, requesting a clarification. If there is insufficient time for this procedure, he shall submit with his proposal a separate price to make the system comply with the codes and regulations.

4. All changes to the system made after letting of the contract, to comply with codes or requirements of Inspectors, shall be made by the Contractor without cost to the Owner.

5. If there is a discrepancy between manufacturer's recommendations and these specifications, the manufacturer's recommendations shall govern.

6. All rotating shafts and/or equipment shall be completely guarded from all contact. Partial guards and/or guards that do not meet all applicable OSHA standards are not acceptable. Contractor is responsible for providing this guarding if it is not provided with the equipment supplied.

D. Permits, Fees, Taxes, Inspections:

1. Procure all applicable permits and licenses.

2. Abide by all laws, regulations, ordinances, and other rules of the State or Political Subdivision where the work is done, or as required by any duly constituted public authority.

3. Pay all charges for permits or licenses.

4. Pay all fees and taxes imposed by the State, Municipal and/or other regulatory bodies.

5. Pay all charges arising out of required inspections by an authorized body.

6. Pay all charges arising out of required contract document reviews associated with the project and as initiated by the Owner or authorized agency/consultant.

7. Where applicable, all fixtures, equipment and materials shall be approved or listed by Underwriter’s Laboratories, Inc.

E. Utility Company Requirements:

1. Secure from the appropriate private or public utility company all applicable requirements.

2. Comply with all utility company requirements.

3. Make application for and pay for service connections, such as sewer, water and gas.

F. Examination of Drawings:

1. The drawings for the mechanical work are completely diagrammatic, intended to convey the scope of the work and to indicate the general arrangements and locations of equipment, outlets, etc., and the approximate sizes of equipment.

2. Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing of pipes and ducts to best fit the layout of the job.

3. Scaling of the drawings is not sufficient or accurate for determining these locations.

4. Where job conditions require reasonable changes in indicated arrangements and locations, such changes shall be made by the Contractor at no additional cost to the Owner.

5. Because of the scale of the drawings, certain basic items, such as fittings, boxes, valves, unions, etc., may not be shown, but where required by other sections of the specifications or required for proper installation of the work, such items shall be furnished and installed.

6. If an item is either on the drawings or in the specifications, it shall be included in this contract.

7. Determination of quantities of material and equipment required shall be made by the Contractor from the documents. Where discrepancies arise between drawings, schedules and/or specifications, the greater number shall govern.

8. Where used in mechanical documents, the word "furnish" shall mean supply for use, the word "install" shall mean connect complete and ready for operation, and the word "provide" shall mean to supply for use and connect complete and ready for operation.

    a. Any item listed as furnished shall also be installed, unless otherwise noted.

    b. Any item listed as installed shall also be furnished, unless otherwise noted.

G. Field Measurements:

1. Verify all pertinent dimensions at the job site before ordering any materials or fabricating any supports, pipes or ducts.

H. Electronic Media/Files:

1. Construction drawings for this project have been prepared utilizing AutoCAD MEP.

2. Contractors and Subcontractors may request electronic media files of the contract drawings and/or copies of the specifications. Specifications will be provided in PDF format.

3. Upon request for electronic media, the Contractor shall complete and return a signed “Electronic File Transmittal” form provided by KJWW.

4. If the information requested includes floor plans prepared by others, the Contractor will be responsible for obtaining approval from the appropriate Design Professional for use of that part of the document.

5. The electronic contract documents can be used for preparation of shop drawings and as-built drawings only. The information may not be used in whole or in part for any other project.

6. The drawings prepared by KJWW for bidding purposes may not be used directly for ductwork layout drawings or coordination drawings.

7. The use of these CAD documents by the Contractor does not relieve them from their responsibility for coordination of work with other trades and verification of space available for the installation.

8. The information is provided to expedite the project and assist the Contractor with no guarantee by KJWW as to the accuracy or correctness of the information provided. KJWW accepts no responsibility or liability for the Contractor's use of these documents.

1.7 SUBMITTALS

A. Submittals shall be required for the following items, and for additional items where required elsewhere in the specifications or on the drawings.

1. Submittals list:

Referenced Specification Section	**Submittal Item**
15245	Vibration Isolation Equipment
Refer to drawings	Plumbing Material List Items
15623	Furnaces
15835	Terminal Heat Transfer Equipment
15870	Power Ventilators
15936	Grilles, Registers, and Diffusers
15990	Testing, Adjusting, and Balancing

B. In addition to the provisions of Division 1, the following provisions are required:

1. Submittals shall include all fabrication, erection, layout, and setting drawings; manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures; performance and test data; wiring and control diagrams; and all other drawings and descriptive data of materials of construction as may be required to show that the materials, equipment or systems and the location thereof conform to the requirements of the contract documents.

2. The Contractor shall submit electronic copies of each shop drawing for review by the Architect/Engineer BEFORE releasing any equipment for manufacture or shipment.

3. Shop drawings which are larger than 11" x 17" or are plan size layout or erection drawings such as ductwork layout or sprinkler system drawings shall be submitted on reproducible media. Submit one reproducible and one print of each drawing or plan. All Contractor approval stamps shall be made on the reproducible.

4. The Contractor shall thoroughly review and approve all shop drawings before submitting them to the Architect/Engineer. CONTRACTOR'S APPROVAL STAMP IS REQUIRED ON ALL SUBMITTALS. APPROVAL WILL INDICATE THE CONTRACTOR'S REVIEW of all material and a COMPLETE UNDERSTANDING OF EXACTLY WHAT IS TO BE FURNISHED. Contractor shall clearly mark all deviations from the contract documents on all submittals. IF DEVIATIONS ARE NOT MARKED BY THE CONTRACTOR, THEN THE ITEM SHALL BE REQUIRED TO MEET ALL DRAWING AND SPECIFICATION REQUIREMENTS.

5. The Contractor shall clearly mark each item with the same nomenclature applied on the drawings or in the specifications.

6. The Contractor shall clearly indicate the size, finish, material, etc.

7. Assemble and submit by specification section numbers for all submittals. All sets shall be identical and contain an index of the items enclosed with a general topic description on the cover.

8. Each set shall be bound in a manufacturer's folder or inside of a manila file folder.

9. Where more than one model is shown on a manufacturer's sheet, the Contractor shall clearly indicate exactly which item and which data is relevant to the work.

10. Failure to comply with the above shall be reason to resubmit all shop drawing submittals.

11. The Engineer's responsibility shall be to review one set of shop drawing submittals for each product. If the first submittal is incomplete or does not comply with the drawings and/or specifications, the Contractor shall be responsible to bear the cost for the Engineer to recheck and handle the additional shop drawing submittals.

C. Provide Schedule of Values:

1. Application forms: Use AIA Document Continuation Sheets G703 (or similar) as the form for application.

2. Provide line items on the Schedule of Values including:

   a. Mechanical Contractor General Conditions (mobilization, bonds, insurance, etc.)
   b. Plumbing (sanitary waste & vent, domestic water piping, pipe insulation, water heater, etc.)
   c. Piping (refrigerant, heating, cooling, pipe insulation, etc.)
   d. HVAC (equipment, ductwork, exhaust, fans, etc.)
   e. Temperature Controls

3. Change orders shall have schedule of values broken out as listed above submitted with each change order.

4. Coordinate with the Project Engineer the items included in the Schedule of Values. The intent is to not create schedules in addition to those the Mechanical Contractor normally submits to the General Contractor for payment.

1.8 PRODUCT DELIVERY, STORAGE, HANDLING & MAINTENANCE

A. Exercise care in transporting and handling to avoid damage to materials. Store materials on the site to prevent damage. Keep materials clean, dry and free from harmful conditions. Immediately remove any materials that become wet or that are suspected of becoming contaminated with mold or other organisms.

B. Keep all bearings properly lubricated.

C. Coordinate the installation of heavy and large equipment with the General Contractor and/or Owner. If the Mechanical Contractor does not have prior documented experience in rigging and lifting similar equipment, he/she shall contract with a qualified lifting and rigging service that has similar documented experience. Follow all equipment lifting and support guidelines for handling and moving.

D. Contractor is responsible for moving equipment into the building and/or site. Contractor shall review site prior to bid for path locations and any required building modifications to allow movement of equipment. Contractor shall coordinate his/her work with other trades.

1.9 WARRANTY

A. Provide one-year warranty, unless otherwise noted, to the Owner for all fixtures, equipment, materials, and workmanship.

B. The warranty period for all work in this Division of the specifications shall commence on the date of final acceptance, unless a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization. In this instance, the warranty period shall commence on the date when such whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the Owner.

C. Warranty requirements shall extend to correction, without cost to the Owner, of all Work found to be defective or nonconforming to the contract documents. The Contractor shall bear the cost of correcting all damage resulting from defects or nonconformance with contract documents.

1.10 INSURANCE

A. Contractor shall maintain insurance coverage as set forth in Division 0 of these specifications.

1.11 MATERIAL SUBSTITUTION

A. Where several manufacturers' names are given, the manufacturer for which a catalog number is given is the basis for job design and establishes the quality required.

B. Equivalent equipment manufactured by the other named manufacturers may be used. Contractor shall ensure that all items submitted by these other manufacturers meet all requirements of the drawings and specifications, and fits in the allocated space.

C. Any material, article or equipment of other unnamed manufacturers which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured in writing from the Architect/Engineer not later than ten days prior to the bid opening.

D. This Contractor assumes all costs incurred as a result of using the offered material, article or equipment, on his part or on the part of other Contractors whose work is affected.

E. This Contractor may list voluntary add or deduct prices for alternate materials on the bid form. These items will not be used in determining the low bidder.

F. All material substitutions requested later than ten (10) days prior to bid opening must be listed as voluntary changes on the bid form.

PART 2 - PRODUCTS

NOT APPLICABLE

PART 3 - EXECUTION

3.1 JOBSITE SAFETY

A. Neither the professional activities of the Engineer, nor the presence of the Engineer or his or her employee and subconsultants at a construction site, shall relieve the Contractor and other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Engineer and his or her personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The Engineer and the Engineer's consultants shall be indemnified and shall be made additional insureds under the Contractor's general liability insurance policy.

3.2 EXCAVATION, FILL, BACKFILL, COMPACTION

A. General:

1. Prior to the commencement of any excavation or digging, the Contractor shall verify all underground utilities with the regional utility locator. Provide prior notice to the locator before excavations. Contact information for most regional utility locaters can be found at the following website: www.call811.com.

2. The Contractor shall do all excavating, filling, backfilling and compacting associated with his work.

B. Excavation:

1. Make all excavations to accurate, solid, undisturbed earth, and to proper dimensions.

2. Where excavations are made in error below foundations, concrete of same strength as specified for the foundations or thoroughly compacted sand-gravel fill, as determined by the Architect/Engineer, shall be placed in such excess excavations. Place thoroughly compacted, clean, stable fill in excess excavations under slabs on grade, at the Contractor's expense.

3. Trim bottom and sides of excavations to grades required for foundations.

4. Protect excavations against frost and freezing.

5. Take care in excavating not to damage surrounding structures, equipment or buried pipe. Do not undermine footing or foundation.

6. Perform all trenching in a manner to prevent cave-ins and risk to workmen.

7. Where original surface is pavement or concrete, the surface shall be saw cut to provide clean edges and assist in the surface restoration.

8. Where satisfactory bearing soil for foundations is not found at the indicated levels, the Architect/Engineer or their representative shall be notified immediately, and no further work shall be done until further instructions are given by the Architect/Engineer or their representative.

C. Dewatering:

1. Contractor shall furnish, install, operate and remove all dewatering pumps and pipes needed to keep trenches and pits free of water.

D. Underground Obstructions:

1. Known underground piping, foundations, and other obstructions in the vicinity of construction are shown on the drawings. Use great care in making installations near underground obstruction.

2. If objects not shown on the drawings are encountered, remove, relocate, or perform extra work as directed by the Architect/Engineer.

E. Fill and Backfilling:

1. No rubbish or waste material is permitted for fill or backfill.

2. Provide all necessary sand for backfilling.

3. Dispose of the excess excavated earth as directed.

4. Backfill materials shall be suitable for required compaction, clean and free of perishable materials and stones greater than 4 inches in diameter. Water shall not be permitted to rise in unbackfilled trenches. No material shall be used for backfilling that contains frozen earth, debris or earth with a high void content.

5. Backfill all trenches and excavations immediately after installing pipes, or removal of forms, unless other protection is provided.

6. Around piers and isolated foundations and structures, backfill and fill shall be placed and consolidated simultaneously on all sides to prevent wedge action and displacement. Fill and backfill materials shall be spread in 6 inch uniform horizontal layers with each layer compacted separately to required density.

7. Lay all piping on a compacted bed of sand at least 3 inches deep. Backfill around pipes with sand, 6 inch layers, and compact each layer.

8. Use sand for backfill up to grade for all piping under slabs or paved areas. All other piping shall have sand backfill to 6 inches above the top of the pipe.

9. Place all backfill above the sand in uniform layers not exceeding 6 inches deep. Each layer shall be placed, then carefully and uniformly tamped, to eliminate lateral or vertical displacement.

10. Where the fill and backfill will ultimately be under a building, floor or paving, each layer of fill shall be compacted to 95% of the maximum density determined by AASHTO Designation T-99 or ASTM Designation D-698. Moisture content of soil at time of compaction shall not exceed plus or minus 2% of optimum moisture content determined by AASHTO T-99 or ASTM D-698 test.

F. Surface Restoration:

1. Where trenches are cut through graded, planted or landscaped areas, the areas shall be restored to the original condition. Replace all planting removed or damaged to its original condition. A minimum of 6 inches of topsoil shall be applied where disturbed areas are to be seeded or sodded.

2. Concrete or asphalt type pavement, seal coat, rock, gravel or earth surfaces removed or damaged shall be replaced with comparable materials and restored to original condition.

3.3 ENGINEER OBSERVATION OF WORK

A. The Contractor shall provide seven (7) calendar days notice to the Engineer prior to:

1. Placing fill over underground and underslab utilities.

2. Covering exterior walls, interior partitions and chases.

3. Installing hard or suspended ceilings and soffits.

B. The Engineer will have the opportunity to review the installation and provide a written report noting deficiencies requiring correction. The Contractor's schedule shall account for these reviews and show them as line items in the approved schedule.

C. Above-Ceiling Final Observation

1. All work above the ceilings must be complete prior to the Engineer's review. This includes, but is not limited to:

a. Pipe insulation is installed and fully sealed.

b. Pipe and duct wall penetrations are sealed.

c. Pipe identification and valve tags are installed.

d. Main, branch and flexible ducts are installed.

e. Diffusers, registers and grilles are installed and connected to ductwork.

2. In order to prevent the Above-Ceiling Final Observation from occurring too early, the Contractor shall review the status of the work and certify, in writing, that the work is ready for the Above-Ceiling Final Observation.

3. It is understood that if the Engineer finds the ceilings have been installed prior to this review and prior to 7 days elapsing, the Engineer may not recommend further payments to the contractor until such time as full access has been provided.

3.4 PROJECT CLOSEOUT

A. The following paragraphs supplement the requirements of Division 1.

B. Final Jobsite Observation:

1. In order to prevent the Final Jobsite Observation from occurring too early, the Contractor is required to review the completion status of the project and certify that the job is ready for the final jobsite observation.

2. Attached to the end of this section is a typical list of items that represent the degree of job completeness expected prior to requesting a review.

3. Upon Contractor certification that the project is complete and ready for a final punch, the Contractor shall sign the attached certification and return it to the Architect/Engineer so that the final observation can be scheduled.

4. It is understood that if the Engineer finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the Engineers additional time and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.

C. Before final payment is authorized, This Contractor must submit the following:

1. Operation and maintenance manuals with copies of approved shop drawings.

2. Record documents including marked-up or reproducible drawings and specifications.

3. A report documenting the instructions given to the Owner's representatives complete with the number of hours spent in the instruction. The report shall bear the signature of an authorized agent of This Contractor and shall be signed by the Owner's representatives.

4. Start-up reports on all equipment requiring a factory installation inspection or start-up.

5. Provide spare parts, maintenance, and extra materials in quantities specified in individual specification sections. Deliver to project site and place in location as directed; receipt by Architect/Engineer required prior to final payment approval.

3.5 OPERATION AND MAINTENANCE INSTRUCTIONS

A. Submit three properly indexed and bound copies, in 'D' Ring style notebooks, of the Operations and Maintenance Instructions to the Architect/Engineer. Make all corrections or additions required.

B. Manuals shall be completed and in the Owner's possession prior to Owner's acceptance and at least 10 days prior to instruction of operating personnel.

C. Operation and maintenance data shall consist of written instructions for the care, maintenance, and operation of all equipment and systems. Include all instruction books, cards, and manuals furnished with the equipment.

3.6 INSTRUCTING THE OWNER'S REPRESENTATIVES

A. Adequately instruct the Owner's designated representatives in the maintenance, care, and operation of all systems installed under this contract.

B. Provide verbal and written instructions to the Owner's representatives by FACTORY PERSONNEL in the care, maintenance, and operation of the equipment and systems.

C. Contractor shall make a DVD format videotape of instructions to the Owner while explaining the system so additional personnel may view the instructions at a later date. The videotape shall be the property of the Owner.

D. The Owner has the option to video tape all instructions. Coordinate schedule of instructions to facilitate this recording.

E. The instructions shall include:

1. Explanation of all system flow diagrams.
2. Explanation of all air handling systems.
3. Temperature control system operation including calibration, adjustment and proper operating conditions of all sensors.
4. Maintenance of equipment.
5. Start-up procedures for all major equipment.
6. Explanation of seasonal system changes.

F. The Architect/Engineer shall be notified of the time and place instructions will be given to the Owner's representatives so he or his representative can attend if desired.

G. Minimum hours of instruction for each item shall be:

1. Domestic Hot Water System – 0.5 hour.
2. Furnace System(s) - 1 hour.

H. Operating Instructions:

1. Contractor is responsible for all instructions to the Owner's representatives for the mechanical and control systems.

2. If the Contractor does not have staff that can adequately provide the required instructions he shall include in his bid an adequate amount to reimburse the Owner for the Engineer to perform these services.

3.7 SYSTEM COMMISSIONING

A. The mechanical systems shall be complete and operating. System start-up, testing, balancing, and satisfactory system performance is the responsibility of the Contractor. This includes calibration and adjustments of all controls, noise level adjustments and final comfort adjustments as required.

B. Operate all HVAC systems continuously for at least one week prior to occupancy to bring construction materials to suitable moisture levels. Areas with mechanical cooling shall be maintained below 60% RH.

C. Contractor shall adjust the mechanical systems and controls at season changes during the one year warranty period, as required, to provide satisfactory operation and to prove performance of all systems in all seasons.

D. All operating conditions and control sequences shall be tested during the start-up period. Test all interlocks, safety shutdowns, controls, and alarms.

E. The Contractor, subcontractors, and equipment suppliers shall have skilled technicians to ensure that all systems perform properly. If the Architect/Engineer is requested to visit the job site for trouble shooting, assisting in start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period, through no fault of the design; the Contractor shall reimburse the Owner on a time and materials basis for services rendered at the Architect/Engineer's standard hourly rates in effect when the

services are requested. The Contractor shall pay the Owner for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

3.8 PAINTING

A. Paint all equipment that is marred or damaged prior to the Owner's acceptance. Paint and color shall match original equipment paint and shall be obtained from the equipment supplier if available.

B. Equipment cabinets, casings, covers, metal jackets, etc., in equipment rooms or concealed spaces, shall be furnished in standard or prime finish, free from scratches, abrasions, chips, etc.

C. Equipment in occupied spaces, or if standard to the unit, shall have a baked primer with baked enamel finish coat free from scratches, abrasions, chips, etc. If color option is specified or is standard to the unit, this Contractor shall, before ordering, verify with the Architect/Engineer his color preference and furnish this color.

3.9 ADJUST AND CLEAN

A. Thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project. Clean all foreign paint, grease, oil, dirt, labels, stickers, and other foreign material from all equipment.

B. Clean all drain pans and areas where moisture is present. Immediately report any mold, biological growth, or water damage.

C. Remove all rubbish, debris, etc., accumulated during construction from the premises.

3.10 SPECIAL REQUIREMENTS

A. Contractor shall coordinate the installation of all equipment, valves, dampers, operators, etc., with other trades to maintain clear access area for servicing.

B. All equipment shall be installed in such a way to maximize access to parts needing service or maintenance. Review the final field location, placement, and orientation of equipment with the Owner’s designated representative prior to setting equipment.

C. Installation of equipment or devices without regard to coordination of access requirements and confirmation with the Owner’s designated representative will result in removal and reinstallation of the equipment at the Contractor’s expense.

END OF SECTION

READINESS CERTIFICATION PRIOR TO FINAL JOBSITE OBSERVATION

In order to prevent the final job observation from occurring too early, we require that the Contractor review the completion status of the project and, by copy of this document, certify that the job is indeed ready for the final job observation. The following is a typical list of items that represent the degree of job completeness expected prior to your requesting a final job observation.

1. Penetrations fire sealed and labeled in accordance with specifications.
2. All air handling units operating and balanced.
3. All fans shall be operating and balanced.
4. All pumps operating and balanced.
5. All miscellaneous mechanical systems (unit heaters, cabinet heaters, etc.) operating.
6. All temperature control systems operating, programmed and calibrated.
7. All plumbing fixtures installed and caulked.
8. Pipe insulation complete, pipes labeled and valves tagged.

Accepted by:

Prime Contractor _____

By _____ Date _____

Upon Contractor certification that the project is complete and ready for a final job observation, we require the Contractor to sign this agreement and return it to the Engineer so that the final observation can be scheduled.

It is understood that if the Engineer finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the Engineers for additional time and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.

* * * * *

SECTION 15140
SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Hangers, Supports, and Associated Anchors.
B. Equipment Bases and Supports.
C. Sleeves and Seals.
D. Flashing and Sealing of Equipment and Pipe Stacks.
E. Cutting of Openings.
F. Escutcheon Plates and Trim.

1.2 WORK FURNISHED BUT INSTALLED UNDER OTHER SECTIONS

A. Furnish sleeves and hanger inserts to General Contractor for placement into formwork.

1.3 REFERENCES

A. ANSI/ASME B31.1 - Power Piping.
B. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, and Manufacture.
C. MSS SP-69 - Pipe Hangers and Supports - Selection and Application.
D. MSS SP-89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

PART 2 - PRODUCTS

2.1 HANGER RODS

A. Hanger rods for single rod hangers shall conform to the following:

Pipe Size	Hanger Rod Diameter	
	Column #1	Column #2
2" and smaller	3/8"	3/8"
2-1/2" through 3-1/2"	1/2"	1/2"
4"	5/8"	1/2"

Column #1: Cast iron and steel pipe.
Column #2: Copper pipe.

B. Rods for double rod hangers may be reduced one size. Minimum rod diameter is 3/8 inches.

C. Hanger rods and accessories used in mechanical spaces or otherwise dry areas shall have ASTM B633 electro-plated zinc finish.

2.2 PIPE HANGERS AND SUPPORTS

A. All pipe hangers, clamps, and supports shall conform to Manufacturers Standardization Society MSS-SP-69.

B. Oversize all hangers, clamps, and supports on insulated piping to allow insulation and jacket to pass through unbroken. This applies to both hot and cold pipes.

C. On all insulated piping, provide a semi-cylindrical metallic shield and fire resistant vapor barrier jacket.

D. As an alternative to separate pipe insulation insert and saddle, properly sized integral rigid insulation sections may be used for this application.

Acceptable Products:

Cooper/B-Line - Fig. B3380 through B3384
Pipe Shields - A1000, A2000
Erico - Model 124, 127

E. Place restrained neoprene mounts beneath vertical pipe riser clamps to prevent sweating of cold pipes. Insulate over mounts.

Acceptable Products: Mason RBA, RCA, or BR.

F. Hangers in direct contact with copper pipe shall be coated with plastic with appropriate temperature range. HYDRA-ZORB clamps are permitted for this application for bare pipes within their temperature limits of - 65°F to + 275°F.

G. Unless otherwise indicated, hangers shall be as follows:

1. Clevis Type:

Service: Bare Metal Pipe
Insulated Cold Pipe
Insulated Hot Pipe - 3 inches & Smaller

Acceptable Products:	Bare Steel or Insulated Pipe	Bare Copper Pipe
Anvil	Fig. 260	Fig. CT65
Cooper/B-Line	Fig. 3100	Fig. B3104CT
Erico	Model 400	Model 402
Nibco/Tolco	Fig. 1	Fig. 81

2. Adjustable Swivel Ring Type:

Service: Bare Metal Pipe - 4 inches and Smaller

Acceptable Products:	Bare Steel Pipe	Bare Copper Pipe
Anvil	Fig. 69	Fig. CT69
Cooper/B-Line	Fig. B3170NF	Fig. B170CT
Erico	Model FCN	
Nibco/Tolco	Fig. 200	Fig. 202

H. Support may be fabricated from U-Channel strut or similar shapes. Piping less than 4" in diameter shall be secured to strut with clamps of proper design and capacity as required to maintain spacing and alignment. Strut shall be independently supported from hanger drops or building structure. Size and support shall be per manufacturer's installation requirements for structural support of piping. Clamps shall not interrupt piping insulation.

1. Strut used in mechanical spaces or otherwise dry areas shall have ASTM B633 electro-plated zinc finish.

2. Strut used in garage shall have ASTM A123 hot-dip galvanized finish applied after fabrication.

I. Unless otherwise indicated, pipe supports for use with struts shall be as follows:

1. Clamp Type:

Service: Bare Metal Pipe
Insulated Cold Pipe
Insulated Hot Pipe - 3 inches and smaller

a. Clamps in direct contact with copper pipe shall be plastic coated.

b. Pipes subject to expansion and contraction shall have clamps slightly oversized to allow limited pipe movement.

Acceptable Products:	Bare Steel or Insulated Pipe	Bare Copper Pipe
Unistrut	Fig. P1100 or P2500	
Cooper/B-Line	Fig. B2000 or B2400	Fig. BVT
Nibco/Tolco	Fig. A-14 or 2STR	

J. Unless otherwise shown, upper attachments for hanger rods or support struts shall be as follows:

1. <u>Beam Clamps:</u>

Acceptable Products:	
Anvil	Fig. 228, 292
Cooper/B-Line	Fig. B3054
Erico	Model 360
Nibco/Tolco	Fig. 329

K. Copper piping located in an exposed area, including indirect waste piping in kitchens and janitors closets, shall use split ring standoff hangers for copper tubing. Support shall have copper electroplating for corrosion resistance. Use electro-galvanized or more corrosion resistant and threaded rod for floor applications. Use anchors applicable to the wall type with corrosion resistant threaded rod for wall applications.

Acceptable Products:	
Erico/M-Co	Model #456
B-Line	Fig. 3198HCT
Anvil	Fig. CT138R
Nibco/Tolco	Fig. 301CT

L. Wall supports shall be used where vertical height of structure exceeds minimum spacing requirements. Install wall supports at same spacing as hangers or strut supports along vertical length of pipe runs.

2.3 FOUNDATIONS, BASES, AND SUPPORTS

A. Basic Requirements:

1. Furnish and install bases and supports (not specifically indicated on the Drawings or in the Specifications of either the General Construction or Mechanical work as provided by another Contractor) for mechanical equipment.

2. All bases and supports shall be reinforced. All steel bases and supports shall receive a prime coat of zinc chromate or red metal primer. After completion of work, give steel supports a final coat of gray enamel.

B. Concrete Bases (Housekeeping Pads):

1. Unless shown otherwise on the drawings, concrete bases shall be nominal 4 inches thick and shall extend 3 inches on all sides of the equipment (6 inches larger than factory base).

2. Where a base is less than 12 inches from a wall, extend the base to the wall to prevent a “dirt-trap”.

3. Concrete materials and workmanship required for the Contractor's work shall be provided by him. Materials and workmanship shall conform to the applicable standards of the Portland Cement Association. Reinforce with 6” x 6”, W1.4-W1.4 welded wire fabric. Concrete shall withstand 3,000 pounds compression per square inch at twenty-eight days.

4. Equipment requiring bases is as follows:

a. Furnace
b. Water Heater

C. Supports:

1. Provide sufficient clips, inserts, hangers, racks, rods, and auxiliary steel to securely support all suspended material, equipment and conduit without sag.

D. Grout:

1. Grout shall be non-shrinking premixed (Master Builders Company "Embecco"), unless otherwise indicated on the drawings or approved by the Architect/Engineer.

2. Use Mix No. 1 for clearances of 1" or less, and Mix No. 2 for all larger clearances.

3. Grout under equipment bases, around pipes, at pipe sleeves, etc., and where shown on the drawings.

2.4 OPENINGS IN FLOORS, WALLS AND CEILINGS

A. Exact locations of all openings for the installation of materials shall be determined by the Contractor and given to the General Contractor for installation or construction as the structure is built.

B. Coordinate all openings with other Contractors.

C. Hire the proper tradesman and furnish all labor, material and equipment to cut openings in or through existing structures, or openings in new structures that were not installed, or additional openings. Repair all spalling and damage to the satisfaction of the Architect/Engineer. Make saw cuts before breaking out concrete to ensure even and uniform opening edges.

D. Said cutting shall be at the complete expense of each Contractor. Failure to coordinate openings with other Contractors shall not exempt the Contractor from providing openings at his expense.

E. Do not cut structural members without written approval of the Architect or Structural Engineer.

2.5 ROOF PENETRATIONS

A. Seal pipes with surface temperature below 150ºF penetrating single-ply roofs with conical stepped pipe flashings and stainless steel clamps equal to Portals Plus Pipe Boots. Material shall match roofing membrane.

B. Break insulation only at the clamp for pipes between 60ºF and 150ºF. Seal outdoor insulation edges watertight.

2.6 PIPE SLEEVES AND LINTELS

A. Each Contractor shall provide pipe sleeves and lintels for all openings required for the Contractor’s work in masonry walls and floors, unless specifically shown as being by others.

B. Fabricate all sleeves from standard weight black steel pipe or as indicated on the drawings. Provide continuous sleeve. Cut or split sleeves are not acceptable.

C. Fabricate all lintels from structural steel shapes or as indicated on the drawings. Have all lintels approved by the Architect or Structural Engineer.

D. Sleeves through the floors on exposed risers shall be flush with the ceiling, with planed squared ends extending 1" above the floor in unfinished areas, and flush with the floor in finished areas, to accept spring closing floor plates.

E. Sleeves shall not penetrate structural members without approval from the Structural Engineer. Sleeves shall then comply with the Engineer's design.

F. Openings through unexcavated floors and/or foundation walls below the floor shall have a smooth finish with sufficient annular space around material passing through opening so slight settling will not place stress on the material or building structure.

G. Install all sleeves concentric with pipes. Secure sleeves in concrete to wood forms. This Contractor is responsible for sleeves dislodged or moved when pouring concrete.

H. Where pipes rise through concrete floors that are on earthen grade, provide 3/4" resilient expansion joint material (asphalt and cork) wrapped around the pipe, the full depth of concrete, at the point of penetration. Secure to prevent shifting during concrete placement and finishing.

I. Size sleeves large enough to allow expansion and contraction movement. Provide continuous insulation wrapping.

J. Wall Seals ("Link-Seals"):

1. Where shown on the drawings, pipes passing through walls, ceilings, or floors shall have their annular space (sleeve or drilled hole - not tapered hole made with knockout plug) sealed by properly sized sealing elements consisting of a synthetic rubber material compounded to resist aging, ozone, sunlight, water and chemical action.

2. Sleeves, if used, shall be standard weight steel with primed finish and waterstop/anchor continuously welded to sleeve. If piping carries only fluids below 120ºF, sleeves may be thermoplastic with integral water seal and textured surface.

3. Sleeves shall be at least 2 pipe sizes larger than the pipes.

4. Pressure shall be maintained by stainless steel bolts and other parts. Pressure plates may be of composite material for Model S.

5. Sealing element shall be as follows:

Model	Service	Element Material	Temperature Range
S	Standard (Stainless)	EPDM	-40ºF to 250ºF

6. Acceptable Manufacturers: Thunderline Corporation "Link-Seals", O-Z/Gedney Company, Calpico, Inc., Innerlynx, or Metraflex Company (cold service only).

2.7 ESCUTCHEON PLATES AND TRIM

A. Fit escutcheons to all insulated or uninsulated exposed pipes passing through walls, floors, or ceilings of finished rooms.

B. Escutcheons shall be heavy gauge, cold rolled steel, copper coated under a chromium plated finish, heavy spring clip, rigid hinge and latch.

C. Install galvanized steel (unless otherwise indicated) trim strip to cover vacant space and raw construction edges of all rectangular openings in finished rooms. This includes pipe openings.

2.8 PIPE PENETRATIONS

A. Seal all pipe penetrations. Seal non-rated walls and floor penetrations with grout or caulk. Backing material may be used.

B. Seal fire rated wall and floor penetrations with fire seal system as specified.

2.9 PIPE ANCHORS

A. Provide all items needed to allow adequate expansion and contraction of all piping. All piping shall be supported, guided, aligned, and anchored as required.

B. Repair all piping leaks and associated damage. Pipes shall not rub on any part of the building.

2.10 FINISH

A. Prime coat exposed steel hangers and supports. Hangers and supports in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

PART 3 - EXECUTION

3.1 PIPE HANGERS AND SUPPORTS

A. Install all items per manufacturer's instructions.

B. Support all piping and equipment, including valves, strainers, traps and other specialties and accessories to avoid objectionable or excessive stress, deflection, swaying, sagging or vibration in the piping or building structure during erection, cleaning, testing and normal operation of the systems.

C. Do not, however, restrain piping to cause it to snake or buckle between supports or to prevent proper movement due to expansion and contraction.

D. Support piping at equipment and valves so they can be disconnected and removed without further supporting the piping.

E. Piping shall not introduce strains or distortion to connected equipment.

F. Set all concrete inserts in place before pouring concrete.

G. Furnish, install and prime all auxiliary structural steel for support of piping systems that are not shown on the Drawings as being by others.

H. Install hangers and supports complete with lock nuts, clamps, rods, bolts, couplings, swivels, inserts and required accessories.

I. Hangers for horizontal piping shall have adequate means of vertical adjustment for alignment.

J. Parallel horizontal pipes may be supported on trapeze hangers made of structural shapes and hanger rods; otherwise, pipes shall be supported with individual hangers.

K. Trapeze hangers may be used where ducts interfere with normal pipe hanging.

L. Coordinate the location and method of support of piping systems with all installations under other Divisions and Sections of the Specifications.

M. Provided the installation complies with all loading requirements of truss and joist manufacturers, the following practices are acceptable:

1. Loads of 100 lbs. or less may be attached anywhere along the top or bottom chords of trusses or joists with a minimum 3’ spacing between loads.

2. Loads greater than 100 lbs. must be hung concentrically and may be hung from top or bottom chord, provided one of the following conditions is met:

a. The hanger is attached within 6” from a web/chord joint.

b. Additional L2x2x1/4 web reinforcement is installed per manufacturer’s requirements.

3. It is prohibited to cantilever a load using an angle or other structural component that is attached to a truss or joist in such a fashion that a torsional force is applied to that structural member.

4. If conditions cannot be met, coordinate installation with truss or joist manufacturer and contact Architect/Engineer.

N. Do not exceed 25 lbs. per hanger and a minimum spacing of 2’-0” on center when attaching to metal roof decking (limitation not required with concrete on metal deck). This 25 lbs. load and 2’-0” spacing include adjacent electrical and architectural items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off steel framing will need to be added.

O. Do not exceed the manufacturer's recommended maximum load for any hanger or support.

P. Provide additional supports where pipe changes direction, adjacent to flanged valves and strainers, at equipment connections and heavy fittings.

Q. Provide at least one hanger adjacent to each joint in cast iron soil pipe, grooved end steel pipe with mechanical couplings, and glass pipe.

R. Spacing of Hangers shall not exceed the compressive strength of the insulation inserts, and in no case shall exceed the following:

Pipe Material	Maximum Spacing
1. Steel (Std. Weight or Heavier – Liquid Service):	
1-1/4" & under	7'-0"
1-1/2"	9'-0"
2"	10'-0"

Pipe Material	Maximum Spacing

2. Steel (Std. Weight or Heavier – Vapor Service):

1-1/4" and under	9'-0"
1-1/2"	12'-0"
2" & larger	12'-0"

3. Hard Drawn Copper & Brass (Liquid Service):

3/4" and under	5'-0"
1"	6'-0"
1-1/4"	7'-0"
1-1/2"	8'-0"
2"	8'-0"
2-1/2"	9'-0"
3"	10'-0"

4. Hard Drawn Copper & Brass (Vapor Service):

3/4" & under	7'-0"
1"	8'-0"
1-1/4"	9'-0"
1-1/2"	10'-0"
2"	11'-0"
2-1/2" & larger	12'-0"

5. Cast Iron Soil Pipe - All Sizes:

Over 5' pipe lengths	10'-0"
Less than 5' pipe lengths	5'-0"

Support all direction changes and branch connections.

6. Installation of hangers shall conform to MSS SP-69, MSS SP-89 and the applicable Plumbing Code.

END OF SECTION

SECTION 15161
DOMESTIC WATER PUMPS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Domestic Water In-Line Circulators.

1.2 SUBMITTALS

A. Submit shop drawings under provisions of Section 15010.

B. Submit certified pump performance curves with pump and system operating point plotted. Include NPSH curve when applicable.

C. Pumps with motors operating above the RPM the pump curves are based on shall have impellers trimmed to deliver GPM and head scheduled.

PART 2 - PRODUCTS

2.1 GENERAL

A. Statically and dynamically balance rotating parts.

B. Construction shall permit complete servicing without breaking piping or motor connections.

C. Pumps shall operate at 1750 rpm unless specified otherwise.

D. Pump connections shall be flanged, whenever available.

E. Domestic hot water pumps shall be suitable for 225ºF water.

F. Motors shall comply with Section 15170.

G. Submitted pump selections must have a diameter impeller that meets or exceeds the scheduled pump. The inlet and discharge pipe sizes shall also meet or exceed the scheduled pump.

2.2 DOMESTIC WATER IN-LINE CIRCULATORS

A. Provide pump as specified on the Plumbing Material List.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install all products per manufacturer's recommendations.

B. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.

C. Support in-line pumps individually so there is no strain on the piping. Install with a minimum of five diameters of straight pipe on pump suction and discharge.

D. Ensure pumps operate at specified fluid temperatures without vapor binding or cavitation, are non-overloading in parallel or individual operation, and operate within 25% of midpoint of published maximum efficiency curve.

E. Pumps shall be factory aligned. If alignment is not satisfactory, as determined by the Engineer, manufacturer shall provide a factory trained representative to field align the shafts.

F. For pumps not powered by a VFD, trim impeller to meet maximum operating conditions. Coordinate final trimmed diameter with Testing, Adjusting, and Balancing Contractor.

END OF SECTION

SECTION 15170
MOTORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Single Phase and Three Phase Electric Motors.

1.2 REFERENCES

A. AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

B. AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

C. ANSI/IEEE 112 - Test Procedure for Polyphase Induction Motors and Generators.

D. ANSI/NEMA MG 1 - Motors and Generators.

E. ANSI/NFPA 70 - National Electrical Code.

1.3 SUBMITTALS

A. Submit shop drawings under provisions of Section 15010. Include nominal efficiency and power factor for all premium efficiency motors. Efficiencies must meet or exceed the nominal energy efficiency levels presented below.

B. Submit shop drawings for all three phase motors.

C. Submit motor data with equipment when motor is installed by the manufacturer at the factory.

D. Submit shaft grounding device for all motors as required.

1.4 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data including assembly drawings, bearing data including replacement sizes, and lubrication instructions.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in the manufacture of commercial and industrial motors and accessories, with a minimum of three years documented manufacturing experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weatherproof coverings. For extended outdoor storage, follow manufacturer's recommendations for equipment and motor.

PART 2 - PRODUCTS

2.1 GENERAL CONSTRUCTION AND REQUIREMENTS

A. Refer to the drawings for required electrical characteristics.

B. Design motors for continuous operation in 40ºC environment, and for temperature rise in accordance with ANSI/NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.

C. Visible Nameplate: Indicating horsepower, voltage, phase, hertz, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, insulation class.

D. Electrical Connection: Boxes, threaded for conduit. For fractional horsepower motors where connection is made directly, provide conduit connection in end frame.

E. Unless otherwise indicated, motors 3/4 HP and smaller shall be single phase, 60 hertz, open drip-proof or totally enclosed fan-cooled type.

F. Unless otherwise indicated, motors 1 HP and larger shall be three phase, 60 hertz, squirrel cage type, NEMA Design B (low current in-rush, normal starting torque), open drip-proof or totally enclosed fan-cooled type.

G. Each contractor shall set all motors furnished by him.

H. All motors shall have a minimum service factor of 1.15.

I. All motors shall have ball or roller bearings with a minimum L-10 fatigue life of 150,000 hours in direct-coupled applications and 50,000 hours for belted applications.

J. Bearings shall be sealed type for 10 HP and smaller motors.

2.2 PREMIUM EFFICIENCY MOTORS (INCLUDING MOST 3-PHASE GENERAL PURPOSE MOTORS)

A. All motors, unless exempted by EPAct legislation that became federal law on December 19, 2010, shall comply with the efficiencies listed in that standard, which are reprinted below. These match the 2010 NEMA premium efficiency ratings. All ratings listed are nominal full load efficiencies, verified in accordance with IEEE Standard 112, Test Method B. Average expected (not guaranteed minimum) power factors shall also be at least the following:

Full-Load Efficiencies %

HP	Open Drip-Proof			Totally Enclosed Fan Cooled		
	1200 rpm	1800 rpm	3600 rpm	1200 rpm	1800 rpm	3600 rpm
1.0	82.5	85.5	77.0	82.5	85.5	77.0
1.5	86.5	86.5	84.0	87.5	86.5	84.0
2.0	87.5	86.5	85.5	88.5	86.5	85.5
3.0	88.5	89.5	85.5	89.5	89.5	86.5
5.0	89.5	89.5	86.5	89.5	89.5	88.5
7.5	90.2	91.0	88.5	91.0	91.7	89.5

B. Motor nameplate shall be noted with the above ratings.

2.3 MOTOR DRIVEN EQUIPMENT

A. No equipment shall be selected or operate above 90% of its motor nameplate rating. Motor size may not be increased to compensate for equipment with efficiency lower than that specified.

B. If a larger motor than specified is required on equipment, the contractor supplying the equipment is responsible for all additional costs due to larger starters, wiring, etc.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All rotating shafts and/or equipment shall be completely guarded from all contact. Partial guards and/or guards that do not meet all applicable OSHA standards are not acceptable. Contractor is responsible for providing this guarding if it is not provided with the equipment supplied.

B. For flexible coupled drive motors, mount coupling to the shafts in accordance with the coupling manufacturer's recommendations. Align shafts to manufacturer's requirements or within 0.002 inch per inch diameter of coupling hub.

END OF SECTION

SECTION 15190
MECHANICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Identification of products installed under Division 15.

1.2 REFERENCES

A. ANSI/ASME A13.1 - Scheme for the Identification of Piping Systems.

B. UL 1581 Standard for Electrical Wires, Cables, and Flexible Cords.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. 3M, Bunting, Calpico, Craftmark, Emedco, Kolbi Industries, Seton, W.H. Brady, Marking Services.

2.2 MATERIALS

A. All pipe markers shall conform to ANSI A13.1. Marker lengths and letter sizes shall be at least the following:

O.D. of Pipe or insulation	Marker Length	Size of Letters
Up to and including 1-1/4”	8”	1/2”
1-1/2” to 2”	8”	3/4”
2-1/2” to 6”	12”	1-1/4

Plastic tags may be used for outside diameters under 3/4".

B. Plastic Nameplates: Laminated three-layer phenolic with engraved black, 1/4" minimum letters on light contrasting background.

C. Aluminum Nameplates: Black enamel background with natural aluminum border and engraved letters furnished with two mounting holes and screws.

D. Plastic Tags: Minimum 1-1/2" square or round laminated three-layer phenolic with engraved, 1/4" minimum black letters on light contrasting background.

E. Brass Tags: Brass background with engraved black letters. Tag size minimum 1-1/2" square or 1-1/2" round.

F. Plastic Pipe Markers: Semi-rigid plastic, preformed to fit around pipe or pipe covering; indicating flow direction and fluid conveyed.

G. Vinyl Pipe Markers: Colored vinyl with permanent pressure sensitive adhesive backing.

H. Underground Pipe Markers: Bright colored continuously printed plastic ribbon tape 6" wide by 3.5 mils thick, manufactured for direct burial, with aluminum foil core for location by non-ferric metal detectors and bold lettering identifying buried item.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install all products per manufacturer's recommendations.

B. Degrease and clean surfaces to receive adhesive for identification materials.

C. Valves:

1. All valves (except shut-off valves at equipment) shall have numbered tags.

2. Provide or replace numbered tags on all existing valves that are connected to new systems or that have been revised.

3. Provide all existing valves used to extend utilities to this project with numbered tags. Review tag numbering sequence with the Owner prior to ordering tags.

4. Secure tags with heavy duty key chain and brass "S" link or with mechanically fastened plastic straps.

5. Attach to handwheel or around valve stem. On lever operated valves, drill the lever to attach tags.

6. Number all tags and show the service of the pipe.

7. Provide two sets of laminated 8-1/2" x 11" copies of a valve directory listing all valves, with respective tag numbers, uses, and locations. The directory shall be reviewed by the Owner and Engineer prior to laminating final copies. Laminated copies shall have brass eyelet in at least one corner for easy hanging.

D. Pipe Markers:

1. Adhesive Backed Markers: Use Brady Style 1, 2, or 3 on pipes 3" diameter and larger. Use Brady Style 4, 6, or 8 on pipes under 3" diameter. Similar styles by other listed manufacturers are acceptable. Secure all markers at both ends with a wrap of pressure sensitive tape completely around the pipe.

2. Snap-on Markers: Use Seton "Setmark" on pipes up to 5-7/8" OD. Use Seton "Setmark" with nylon or Velcro ties for pipes 6" OD and over. Similar styles by other listed manufacturers are acceptable.

3. Apply markers and arrows in the following locations where clearly visible:

a. At each valve.
b. On both sides of walls that pipes penetrate.
c. At least every 20 feet along all pipes.
d. On each riser and each leg of each "T" joint.
e. At least once in every room and each story traversed.

4. Underground Pipe Markers: Install 8" to 10" below grade, directly above buried pipes.

E. Equipment:

1. All equipment not easily identifiable such as controls, relays, gauges, etc.; and all equipment in an area remote from its function such as air handling units, exhaust fans, filters, dampers, etc.; shall have nameplates or plastic tags listing name, function, and drawing symbol. Do not label exposed equipment in public areas.

2. Fasten nameplates or plastic tags with stainless steel self-tapping screws or permanently bonding cement.

F. Miscellaneous:

1. Attach self-adhesive vinyl labels at all duct access doors used to reset fusible links or actuators on fire, fire/smoke, or smoke dampers. Lettering shall be a minimum of 1/2" high. Labels shall indicate damper type.

3.2 SCHEDULE

A. Pipes to be marked:

Pipe Service	Lettering Color	Background Color
Condensate Drain	Black	Yellow
Domestic Cold Water	White	Green
Domestic Hot Water - 120°F	Black	Yellow
Domestic Hot Water Circulating	Black	Yellow
Sanitary Sewer	Black	Yellow
Vent	Black	Yellow
Propane	Varies	Varies
All Underground Pipes		

END OF SECTION

SECTION 15245
VIBRATION ISOLATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Vibration Isolation.
B. Flexible Connectors.

1.2 SUBMITTALS

A. Submit shop drawings per Section 15010 and the Vibration Isolation Submittal Form at the end of this section.

B. Vibration isolation submittals may be included with equipment being isolated, but must comply with this section.

C. Base submittals shall include equipment served, construction, coatings, weights, and dimensions.

D. Isolator submittals shall include:

1. Equipment served
2. Type of Isolator
3. Load in Pounds per Isolator
4. Recommended Maximum Load for Isolator
5. Spring Constants of Isolators (for Spring Isolators)
6. Load vs. Deflection Curves (for Neoprene Isolators)
7. Specified Deflection
8. Deflection to Solid (at least 150% of calculated deflection)
9. Loaded (Operating) Deflection
10. Free Height
11. Loaded Height
12. Kx/Ky (horizontal to vertical stiffness ratio – for spring isolators)
13. Materials and Coatings
14. Spring Diameters

E. Make separate calculations for each isolator on equipment where the load is not equally distributed.

F. Flexible connector shop drawings shall include overall face-to-face length and all specified properties.

PART 2 - PRODUCTS

2.1 BASIC CONSTRUCTION AND REQUIREMENTS

A. Vibration isolators shall have either known undeflected heights or other markings so deflection under load can be verified.

B. All isolators shall operate in the linear portion of their load versus deflection curve. The linear portion of the deflection curve of all spring isolators shall extend 50% beyond the calculated operating deflection (e.g., 3" for 2" calculated deflection). The point of 50% additional deflection shall not exceed the recommended load rating of the isolator.

C. The lateral to vertical stiffness ratio (Kx/Ky) of spring isolators shall be between 0.8 and 2.0.

D. All isolators shall be designed or treated for corrosion resistance. Steel bases shall be cleaned of welding slag and primed for interior use, and hot dip galvanized after fabrication for exterior use. All bolts and washers over 3/8" diameter located outdoors shall be hot dip galvanized per ASTM A153. All other bolts, nuts and washers shall be zinc electroplated. All damage to coatings shall be field repaired with two coats of zinc rich coating.

E. Equip all mountings used with structural steel bases with height-saving brackets. Bottoms of the brackets shall be 1-1/2" to 2-1/2" above the floor or housekeeping pad, unless shown otherwise on the drawings. Steel bases shall have at least four points of support.

F. All isolators, except M1, shall have provision for leveling.

2.2 HANGERS

A. Type H1:

1. Vibration hangers shall consist of a double-deflection neoprene element with a projecting bushing or oversized opening to prevent steel-to-steel contact.

2. Static deflection shall be at least 0.15" at calculated load and 0.35" at maximum rated load.

3. Provide hangers with end connections as required for hanging ductwork or piping.

4. Acceptable Manufacturers: Mason "HD" or "WHD", Kinetics "RH", Aeroflex "RHD", Vibration Eliminator Co. “ALH”.

B. Type H2:

1. Vibration hangers shall contain a steel spring in a neoprene cup with a grommet to prevent short circuiting the hanger rod.

2. The cup shall have a steel washer to distribute load on the neoprene and prevent its extrusion.

3. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30º arc before contacting the grommet and short circuiting the spring.

4. Provide end connections for hanging ductwork or piping.

5. Acceptable Manufacturers: Mason "30" or "W30", Kinetics "SRH", Amber/Booth "BSRA", Aeroflex “RSH”, Vibration Eliminator Co. “SNC”.

C. Type H3:

1. Vibration hangers shall have a steel spring in a neoprene cup with a grommet to prevent short circuiting of the hanger rod.

2. The cup shall have a steel washer to distribute load on the neoprene and prevent its extrusion.

3. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30º arc before contacting the grommet and short circuiting the spring.

4. Provide end connections for hanging ductwork or piping.

5. Hangers shall be capable of holding the load at a fixed elevation during installation. They shall have a secondary adjustment to transfer the load to the spring and maintain the same position.

6. Deflection shall be indicated by a pointer and scale.

7. Acceptable Manufacturer: Mason "PC30", Kinetics “SFH”, Amber/Booth “BSW”, Vibration Eliminator Co. “PCS”.

2.3 FLEXIBLE CONNECTORS (NOISE AND VIBRATION ELIMINATORS)

A. Type FC1:

1. Spherical flexible connectors with multiple plies of nylon tire cord fabric and either EPDM or molded and cured neoprene. Outdoor units shall be EPDM.

2. Steel aircraft cables or threaded steel rods shall be used to prevent excess elongation.

3. All straight through connections shall be made with twin-spheres properly pre-extended as recommended by the manufacturer.

4. Connectors up to 2" size may have threaded ends.

5. Connectors 2-1/2" and over shall have floating steel flanges recessed to lock raised face neoprene flanges.

6. All connectors shall be rated for a minimum working pressure of 150 psi at 220ºF.

7. Acceptable Manufacturer: Metraflex "Double Cable-Sphere", Minnesota Flex Corp., Mercer “200 Series”, Twin City Hose “MS2”.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. Install all products per manufacturer's recommendations.

B. Provide vibration isolation as indicated on the drawings and as described herein.

C. All static deflections listed in the drawings and specifications are the minimum acceptable actual deflection of the isolator under the weight of the installed equipment - not the maximum rated deflection of the isolator.

D. Support equipment to be mounted on structural steel frames with isolators under the frames or under brackets welded to the frames. Where frames are not needed, fasten isolators directly to the equipment.

E. Where a specific quantity of hangers is noted in these specifications, it shall mean hanger pairs for support points that require multiple hangers, such as rectangular ducts or pipes supported on a strut rack.

3.2 PIPE ISOLATION

A. The first three hangers from vibration-isolated equipment shall be type H1.

B. Install flexible connectors in all piping connected to vibration producing equipment. This includes all fans, compressors, etc. Absence of flexible connectors on piping diagrams does not imply that they are not required.

C. Use Type FC1 where pressures are lower than 150 psi, temperatures are below 220ºF, and the fluid handled is compatible with neoprene and EPDM.

D. Provide sufficient piping flexibility for vibrating refrigerant equipment, or furnish flexible connectors with appropriate temperature and pressure ratings.

E. Vibration isolators shall not cause any change in position of piping that will result in stresses in connections or misalignment of shafts or bearings. Equipment and piping shall be maintained in a rigid position during installation. Do not transfer load to the isolators until the installation is complete and under full operational load. Hanger H3 may be used instead of other products for this purpose.

F. Support piping to prevent extension of flexible connectors.

3.3 VIBRATION ISOLATION OF DUCTWORK

A. The first three hangers on all fan systems shall be Type H1 with at least 0.20" minimum static deflection (Alternates 1 and 3).

B. Provide flexible duct connections as described in Section 15910 at all fan inlets and outlets.

VIBRATION ISOLATION SUBMITTAL FORM											
COLUMN 1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
		PROPOSED ISOLATOR							**CALCULATIONS**		
ITEM SERVED	**MIN DEFL (")**	**TAG**	**MODEL**	**MAX LOAD (#)**	**DEFL @ MAX LOAD (")**	**DEFL TO SOLID (")**	**FREE HT (")**	**Kx/Ky**	**LOAD (#)**	**DEFL (")**	**DEFL RATIO**

COLUMN NOTES: Note numbers correspond to the column numbers above.

1. Item served should match designation on the design drawings.
2. List the deflection scheduled or specified in the design documents.
3. List the designation for this isolator. This is most useful when one item has multiple different isolators to support its weight.
4. List the manufacturer's complete model designation for the isolator.
5. List the manufacturer's maximum rated load for the isolator.
6. List the isolator deflection at the maximum rated load in column 5.
7. For spring isolators list the deflection when the springs are solid. This is not normally the same entry as in column 6.
8. List the height of the isolator when unloaded. Shop drawings must show where this is measured.
9. List the rated horizontal to vertical stiffness ratio. This must be between 0.8 and 2.0.
10. List the calculated equipment load on each isolator. For items with unequal weight distribution, calculate each isolator separately.
11. List the calculated deflection under the calculated load. For springs this will be column 10*(column 6 / column 5).
12. List the answer from dividing column 7 by column 11. This must be at least 1.5. If not, select an isolator with more nominal deflection.

GENERAL NOTES:

1. When submitting hangers or supports for a weight range, fill in two rows - one for the maximum and one for the minimum weight.

END OF SECTION

SECTION 15260
PIPING INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Piping Insulation.
B. Insulation Jackets.

1.2 REFERENCES

A. ANSI/ASTM C195 - Mineral Fiber Thermal Insulation Cement.

B. ANSI/ASTM C533 - Calcium Silicate Block and Pipe Thermal Insulation.

C. ANSI/ASTM C534 - Elastomeric Foam Insulation.

D. ANSI/ASTM C547 - Mineral Fiber Preformed Pipe Insulation.

E. ANSI/ASTM C552 - Cellular Glass Block and Pipe Thermal Insulation.

F. ASTM B209 - Aluminum and Aluminum-alloy Sheet and Plate.

G. ASTM C449 - Mineral Fiber Hydraulic-setting Thermal Insulating and Finishing Cement.

H. ASTM C591 - Unfaced Preformed Rigid Cellular Polyisocyanurate Insulation.

I. ASTM C578 - Preformed Cellular Polystyrene Thermal Insulation.

J. ASTM E84 - Surface Burning Characteristics of Building Materials.

K. NFPA 255 - Surface Burning Characteristics of Building Materials.

L. UL 723 - Surface Burning Characteristics of Building Materials.

M. National Commercial & Industrial Insulation Standards - 1999 Edition - as published by Midwest Insulation Contractors Association and endorsed by National Insulation Contractors Association.

1.3 QUALITY ASSURANCE

A. Applicator: Company specializing in piping insulation application with five years minimum experience.

B. Materials: Flame spread/smoke developed rating of 25/50 in accordance with ASTM E84, NFPA 255, or UL 723 (where required).

PART 2 - PRODUCTS

2.1 INSULATION

A. Type A: Glass fiber; ANSI/ASTM C547; 0.24 maximum 'K' value at 75ºF; non-combustible. All purpose, white kraft jacket bonded to aluminum foil and reinforced with fiberglass yarn, 25/50 flame spread/smoke developed rating.

B. Type B: Elastomeric cellular foam; ANSI/ASTM C534; flexible plastic; 0.27 maximum 'K' value at 75ºF, 25/50 flame spread/smoke developed rating. Maximum 3/4" thick per layer where multiple layers are specified.

C. Type C: Molded rigid cellular glass; ANSI/ASTM C-552; 0.35 maximum 'K' value at 75ºF; moisture resistant, non-combustible; suitable for -100ºF to +900ºF. For below grade installations use asphaltic mastic paper vapor barrier jacket. Use self-seal all-purpose white kraft jacket for above grade installations.

D. Type E: Hydrous Calcium Silicate; ASTM C533; rigid molded pipe insulation; asbestos free; 0.40 'K' value at 300ºF; 1200ºF maximum service temperature; 16 gauge stainless steel tie wires on maximum 12" centers.

2.2 VAPOR BARRIER JACKETS

A. Kraft reinforced foil vapor barrier with self-sealing adhesive joints. Beach puncture resistance ratio of at least 50 units. Tensile strength: 35 psi minimum. Single, self-seal acrylic adhesive on longitudinal jacket laps and butt strips.

2.3 JACKET COVERINGS

A. Plastic Jackets and Fitting Covers: High impact, glossy white, 0.020" thick, self-extinguishing plastic. Suitable for use indoors or outdoors with ultraviolet inhibitors. Suitable for -40ºF to 150ºF. 25/50 maximum flame spread/smoke developed.

PART 3 - EXECUTION

3.1 PREPARATION

A. Install insulation after piping has been tested. Pipe shall be clean, dry and free of rust before applying insulation.

3.2 INSTALLATION

A. Install materials per manufacturer's instructions, building codes and industry standards.

B. Continue insulation with vapor barrier through penetrations. This applies to all insulated piping. Maintain fire rating of all penetrations.

C. On exposed piping, locate and cover seams in least visible locations.

D. On insulated piping operating below 60ºF, insulate fittings, valves, unions, flanges, strainers, flexible connections, flexible hoses, and expansion joints. Seal all penetrations of vapor barrier.

E. On piping operating below 60ºF in locations that are not mechanically cooled (e.g., penthouses, mechanical rooms, tunnels, chases at exterior walls, etc.), Type B insulation shall be used.

F. On insulated piping operating between 60ºF and 140ºF, do not insulate flanges and unions, but bevel and seal ends of insulation at such locations. Insulate all fittings, valves and strainers.

G. On all insulated piping, provide at each support an insert of same thickness and contour as adjoining insulation, between the pipe and insulation jacket, to prevent insulation from sagging and crushing. The insert shall be suitable for planned temperatures, be suitable for use with specific pipe material, and shall be a 180° cylindrical segment the same length as metal shields. Inserts shall be a cellular glass or molded hydrous calcium silicate, with a minimum compressive strength of 50 psi. High density polyisocyanurate insulation with a compressive strength of 24 psi is acceptable for pipe sizes below 6", 50 psi over 6", and operate below 260°F. Factory fabricated inserts may be used. Rectangular blocks, plugs, or wood material are not acceptable. Temporary wood blocking may be used by the Piping Contractor for proper height; however, these must be removed and replaced with proper inserts by the Insulation Contractor.

H. Neatly finish insulation at supports, protrusions, and interruptions.

I. Install metal shields between all hangers or supports and the pipe insulation. Shields shall be galvanized sheet metal, half-round with flared edges. Adhere shields to insulation. On cold piping, seal the shields vapor-tight to the insulation as required to maintain the vapor barrier, or add separate vapor barrier jacket.

J. Shields shall be at least the following lengths and gauges:

	Pipe Size	Shield Size
1.	1/2" to 3-1/2"	12" long x 18 gauge

K. Where exposed insulated piping extends above the floor, provide a sheet metal guard around the insulation extending 12" above the floor. Guard shall be .016" cylindrical smooth or stucco aluminum and shall fit tightly to the insulation.

L. All piping and insulation that does not meet 25/50 that is located in an air plenum shall have written approval from the Authority Having Jurisdiction and the local fire department for authorization and materials approval. If approval has been allowed, the non-rated material shall be wrapped with a product that has passed ASTM E84 and/or NFPA 255 testing with a rating of 25/50 or below.

M. All balance valves with fluid operating below 60°F shall be insulated with a removable plug wrapped with vapor barrier tape to allow reading and adjusting of the valve.

N. On exposed piping serving plumbing fixtures, the piping does not need to be insulated if less than four feet in developed length. If piping is longer than four feet in developed length, the piping shall be insulated and have a plastic jacket.

O. On 1" and smaller piping routed through metal wall studs, provide a plastic grommet to protect the piping. The piping shall be insulated between the wall studs, and the insulation shall butt up to each stud.

3.3 INSULATION

A. Type A Insulation:

1. All Service Jackets: Seal all longitudinal joints with self-seal laps using a single pressure sensitive adhesive system. Do not staple.

2. Insulation without self-seal lap may be used if installed with Benjamin Foster 85-20 or equivalent Chicago Mastic, 3M or Childers lap adhesive.

3. Apply insulation with laps on top of pipe.

4. Fittings, Valve Bodies and Flanges: For 4" and smaller pipes, insulate with 1 lb. density insulation wrapped under compression to a thickness equal to the adjacent pipe insulation. For pipes over 4", use mitered segments of pipe insulation. Finish with preformed plastic fitting covers. Secure fitting covers with pressure sensitive tape at each end. Overlap tape at least 2" on itself. For pipes operating below 60ºF, seal fitting covers with vapor retarder mastic in addition to tape.

B. Type B Insulation:

1. Elastomeric Cellular Foam: Where possible, slip insulation over the open end of pipe without slitting. Seal all butt ends, longitudinal seams, and fittings with adhesive. At elbows and tees, use mitered connections. Do not compress or crush insulation at cemented joints. Joints shall be sealed completely and not pucker or wrinkle. Paint the outside of outdoor insulation with two coats of latex enamel paint recommended by the manufacturer.

2. Self-seal insulation may be used on pipes operating below 170ºF.

C. Type C Insulation:

1. Seal all longitudinal joints with manufacturer approved adhesive. Secure butt joint strips in a similar manner.

2. Insulate fittings with prefabricated fittings.

D. Type E Insulation:

1. Use pre-molded half sections. Butt longitudinal and circumferential joints tightly. Wire in place with 16 gauge stainless steel wire on maximum 12" centers.

2. Apply in two layers. Stagger all joints between layers. Wire each layer individually.

3.4 JACKET COVER INSTALLATION

A. Plastic Covering:

1. Provide vapor barrier as specified for insulation type. Cover with plastic jacket covering. Position seams to shed water.

2. Solvent weld all joints with manufacturer recommended cement.

3. Overlap all laps and butt joints 1-1/2" minimum. Repair any loose ends that do not seal securely. Solvent weld all fitting covers in the same manner. Final installation shall be watertight.

4. Use plastic insulation covering on all exposed pipes including, but not limited to:

   a. All exposed piping below 8'-0" above floor.
   b. All piping in mechanical rooms that are subject to damage from normal operations. (Example: Piping that must be stepped over routinely.)

5. Elastomeric piping insulation may have two coats of latex paint instead of plastic jacket.

3.5 SCHEDULE

	Piping System	Insulation Type/Thickness		
A.	Domestic Hot Water and Circulating - Potable Up to 2" Pipe Size	A / 1”		
B.	Domestic Cold Water - Potable	A / 1”		
C.	Domestic Hot & Cold Water (concealed in chases or walls)	A / 1/2”	OR	B / 1/2”
D.	Plumbing Vents Within 10' from Roof Penetration	A / 1/2”	OR	B / 1/2”
E.	Cooling Coil Condensate Drains & Dedicated Floor Drain Branch Piping, Sanitary and Indirect Waste Piping Conveying Fluids below 55°F	B / 1/2”		
F.	Insulation Inserts at hangers	C or E - Match pipe insulation thickness		
G.	Refrig. Suction Lines (25°F and above) Up to 1-1/2"	B / 1-1/2”		

END OF SECTION

SECTION 15290
DUCTWORK INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Ductwork Insulation.
B. Insulation Jackets.

1.2 REFERENCES

A. ANSI/ASTM C553 - Mineral Fiber Blanket and Felt Insulation.

B. ANSI/ASTM C612 - Mineral Fiber Block and Board Thermal Insulation.

C. ASTM E84 - Surface Burning Characteristics of Building Materials.

D. ASTM E136 - Standard Test Method for the Behavior of Materials in a Vertical Tube Furnace at 750°C.

E. National Commercial & Industrial Insulation Standards - 1999 Edition - as published by Midwest Insulation Contractors Association and endorsed by National Insulation Contractors Association.

F. NFPA 255 - Surface Burning Characteristics of Building Materials.

G. UL 263 - Full Scale External Fire Tests with Hose Stream.

H. UL 723 - Surface Burning Characteristics of Building Materials.

1.3 QUALITY ASSURANCE

A. Applicator: Company specializing in ductwork insulation application with five years minimum experience. When requested, installer shall submit manufacturer’s certificate indicating qualifications.

B. Materials: UL listed in Category HNKT; flame spread/smoke developed rating of 25/50 in accordance with ASTM E84, NFPA 255, or UL 723.

C. Adhesives: UL listed, meeting NFPA 90A/90B requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Type A: Flexible Fiberglass - Outside Wrap; ANSI/ASTM C553; commercial grade; 0.28 maximum 'K' value at 75°F; foil scrim kraft facing, 1.0 lb./cu. ft. density.

B. Type C: Flexible Fiberglass Liner; ANSI/ASTM C1071; 0.28 maximum 'K' value at 75°F; 1.5 lb/cu ft minimum density; coated air side for 4000 fpm air velocity.

2.2 JACKETS

A. Vapor Barrier Jackets: Kraft reinforced foil scrim vapor barrier with self-sealing adhesive joints. Beach puncture resistance ratio of at least 25 units. Tensile strength: 35 psi minimum. Single, self-seal acrylic adhesive on longitudinal jacket laps and butt strips.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install materials in accordance with manufacturer's instructions, codes, and industry standards.

B. Install materials after ductwork has been tested.

C. Clean surfaces for adhesives.

D. Provide insulation with vapor barrier when air conveyed may be below ambient temperature.

E. Exterior Duct Wrap - Flexible, Type A:

1. Apply with edges tightly butted.

2. Cut slightly longer than perimeter of duct to insure full thickness at corners. Do not wrap excessively tight.

3. Seal joints with adhesive backed tape.

4. Apply so insulation conforms uniformly and firmly to duct.

5. Provide high-density insulation inserts at trapeze duct hangers and straps to prevent crushing of insulation. Maintain continuous vapor barrier through the hanger.

6. Tape all joints with Royal Tapes #RT 350 (216-439-7229), Venture Tape 1525CW, or Compac Type FSK. No substitutions will be accepted without written permission from the Architect/Engineer.

7. Press tape tightly to the duct covering with a squeegee for a tight continuous seal. Fish mouths and loose tape edges are not acceptable.

8. Staples may be used, but must be covered with tape.

9. Vapor barrier must be continuous.

10. Mechanically fasten on 12" centers at bottom of ducts over 24" wide and on all sides of vertical ducts.

F. Interior Insulation - Flexible Duct Liner, Type C:

1. Observation of Duct Lining:

a. After installation of ductwork, Architect/Engineer may select random observation points in each system.

1) At each observation point, cut and remove an 18" x 18" section of ductwork and liner for verification of installation.

2) Random observation points based on one opening per 75 lineal ft. of total duct run.

b. When any of the observation points shows non-compliance, additional points will be designated by the Architect/Engineer, and observation repeated.

c. If 20% of points observed do not comply, remove and replace all lined ducts and repeat tests. Where replacement is not required, correct all non-compliances.

d. At end of observation, repair all duct lining and observation holes by installing standard, insulated, hinged access doors per Section 15910.

e. Paint or finish to match adjacent duct surfaces.

2. Impale on spindle anchors welded or mechanically fastened to the duct. Adhesive or glue fastened anchors are not acceptable. Maximum anchor spacing per SMACNA Duct Construction Standards or manufacturer's recommendations, whichever is more restrictive. Locate pins less than 3" from corners and at intervals not over 6" around the perimeter at leading and trailing edges. Locate pins within 3" of transverse joints and at intervals not over 16" long the length of the duct. Pins must be long enough to prevent compressing the insulation.

3. In addition to anchors, secure liner with UL listed adhesive covering over 90% of the duct surface.

4. Install per the latest edition of the SMACNA Manual.

5. Leading edges shall be covered as follows:

a. For duct velocities below 3000 fpm, coat leading edges with adhesive. Neatly butt liner without gaps at transverse joints. Cut liner flush with end of the duct section for tight joints with no exposed duct. If adhesive is shop installed, field apply additional adhesive to the end of each duct section for complete adhesion of the liner. Protect edges from dirt and debris.

b. Install metal nosing in the following locations (regardless of velocity):

1) The first three fittings downstream of all fans.
2) At all duct liner interruptions. This includes fire dampers, access doors, branch connections, and all other locations where the edge of the liner is exposed.
3) Trailing edges of transverse joints do not require metal nosings.

6. Overlap liner at longitudinal joints. Make longitudinal joints at corners of the duct unless the duct size does not allow this.

7. Seal all damaged duct liner with adhesive and glass cloth. Do not damage duct liner surface coatings.

8. Duct dimensions given are net inside dimensions. Increase sheet metal to allow for insulation thickness.

G. Continue insulation with vapor barrier through penetrations unless code prohibits.

3.2 SCHEDULE

A. Refer to Section 15890 for scheduling of insulation.

END OF SECTION

SECTION 15410
PLUMBING PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pipe and Pipe Fittings.
B. Valves.
C. Domestic Water Piping System.
D. Propane Piping System.
E. Sanitary Drainage and Vent Piping System.

1.2 REFERENCES

A. ANSI/ASME B16.22 - Wrought Copper and Bronze Solder-Joint Pressure Fittings.

B. ANSI/ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings - DWV.

C. ANSI/ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.

D. ANSI/ASME B16.3 - Malleable Iron Threaded Fittings Class 150 NS 300.

E. ANSI/ASME B16.5 - Pipe Flanges and Flanged Fittings.

F. ANSI/ASTM B32 - Solder Metal.

G. ASME - Boiler and Pressure Vessel Code.

H. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.

I. ASTM A74 - Hub and Spigot Cast Iron Soil Pipe and Fittings.

J. ASTM A234 - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.

K. ASTM A888 - Hubless Cast Iron Soil Pipe and Fittings.

L. ASTM B88 - Seamless Copper Water Tube.

M. ASTM B306 - Copper Drainage Tube (DWV).

N. ASTM C564 - Rubber Gaskets for Cast Iron Soil Pipe and Fittings.

O. ASTM C1540 - Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings.

P. AWS A5.8 - Brazed Filler Metal.

Q. AWWA C651 - Disinfecting Water Mains.

R. CISPI 301 - Cast Iron Soil Pipe and Fittings for Hubless Cast Iron Sanitary Systems.

S. CISPI 310 - Joints for Hubless Cast Iron Sanitary Systems.

T. FM 1680 - Couplings Used in Hubless Cast Iron Systems.

U. NFPA 54 - National Fuel Gas Code.

V. NFPA 58 - Storage and Handling of Liquefied Petroleum Gases.

W. NSF - National Sanitation Foundation

1.3 QUALITY ASSURANCE

A. Valves: Manufacturer's name and pressure rating marked on valve body. Remanufactured valves are not acceptable.

B. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.

C. Welders Certification: In accordance with ANSI/ASME Sec 9 or ANSI/AWS D1.1.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store valves in shipping containers with labeling in place.

PART 2 - PRODUCTS

2.1 COLD WATER - POTABLE
HOT WATER - POTABLE

A. Design Pressure: 175 psi.
Maximum Design Temperature: 200°F.

B. Piping - All Sizes:

1. Tubing: Type L hard drawn seamless copper tube, ASTM B88.

2. Joints: Solder with 100% lead-free solder and flux, ASTM B32.

3. Fittings: Wrought copper solder joint, ANSI B16.22.

C. Piping 4” and Under (Contractor’s Option):

1. Tubing: Type L hard drawn seamless copper tube, ASTM B88.

2. Joints: Mechanical press connection.

3. Fittings: Copper, ANSI B-16.22, with embedded EPDM o-ring, NSF-61.

4. Acceptable Manufacturers: Viega ProPress, Elkhart Xpress, Nibco Press System Fittings and Valving.

D. Shut-Off Valves:

1. Ball Valves:

a. BA-1:

1) 3" and under, 150 psi saturated steam, 600 psi CWP, full port, screwed or solder ends (acceptable only if rated for soldering in line with 470°F melting point of lead-free solder), bronze body of a copper alloy containing less than 15% zinc, stainless steel ball and trim, Teflon seats and seals. Apollo #77C-140, Stockham #S-255-FB-P-UL BR1-R, Milwaukee #BA-400, Watts, Nibco #585-70-66, National Utilities Co., RUB.

NOTES:

a) Provide extended shaft for all valves in insulated piping.

E. Check Valves:

1. CK-1: 2" and under, 125# steam @ 406ºF, 200# CWP @ 150ºF, screwed, bronze, horizontal swing. Crane #37, Hammond #IB904, Stockham #B319-Y, Walworth #3406, Milwaukee #509, Watts #G-5000, Nibco T-413B.

F. Strainers:

1. ST-1: Bronze body, screwed ends, screwed cover, 150 psi S @ 350°F, 200 psi CWP @ 150°F. Armstrong #F4SC, Metraflex #TS, Mueller Steam Specialty Co. #351, Sarco #BT, Watts #777.

2.2 SERVICE WATER - POTABLE

A. Design Pressure: 200 psi.
Maximum Design Temperature: 150ºF.

B. Piping - 2" and Under:

1. Tubing: Type K soft annealed copper tube, ASTM B88.

2. Joints: Solder with 100% lead-free solder and flux, ASTM B32.

3. Fittings: Wrought copper solder joint, ANSI B16.22.

C. Shut-Off Valves:

1. Gate Valves:

a. GA-1: 2" and under, 150# steam @ 406ºF, 300# CWP @ 150ºF, screwed, bronze, rising stem, screwed bonnet. Crane #431, Hammond #IB641, Stockham #B122, Walworth #56, Milwaukee #1150, Watts #B-3210, Nibco T-131.

2. Ball Valves:

a. BA-11: 2" and under, 300 psig water, standard port, screwed or compression. Bronze body and ball of a copper alloy containing less than 15% zinc, chrome plated, Teflon coated, or stainless steel ball. Teflon or Buna-N seats. One piece “T” style cap and stem. A.Y. McDonald 6100 Series, Mueller 300 Series.

b. BA-12: 2" and under, 300 psig water, standard port, screwed or compression. Bronze body and ball of a copper alloy containing less than 15% zinc, chrome plated, Teflon coated, or stainless steel ball. Teflon or Buna-N seats. One piece "T" style cap and stem. Minneapolis Pattern threaded top. A.Y. McDonald 6100 Series, Mueller 300 Series.

2.3 PROPANE GAS (0 TO 125 PSI)

A. Design Pressure: 125 psi.
Maximum Design Temperature: 350ºF

B. Piping - 2" and Under:

1. Pipe: Standard weight steel, threaded and coupled, ASTM A53.

2. Joints: Screwed. (NOTE: For below ground, all sizes to have welded joints.)

3. Fittings: 150# steam - 300# CWP, black malleable iron, banded, ASTM A197, ANSI B16.3.

4. Unions: 250# - 500# CWP, black malleable iron, ANSI B16.39, ground joint with brass seat.

C. Piping – 2” and Under:

1. Pipe: Corrugated stainless steel tubing, ASTM A240 Series 300 stainless steel, ANSI AGA-LC1.

2. Jacket: Polyethylene, color: yellow, ASTM E84 25-50 flame and smoke.

3. Fittings: Brass with mechanical ends to fit tubing. ASME B1.20.1 threaded ends for connections to threaded pipes and components.

4. Striker Plates: Minimum 16 GA hardened steel, corrosion resistant, primed and zinc coated. Install to protect tubing from penetrations.

5. Limits: 5 psi or less. For use only at termination to fixed outlets or equipment, maximum length: 48”. Provide malleable iron, flange mounted, straight or 90 fitting at wall termination with maximum 12” length of tubing on inlet of flange.

6. Manufacturer: TracPipe, Gastite, Parker PGP2.

D. For Underground Gas Piping – Refer to paragraph “Underground Piping Protection.”

E. Shut-Off Valves/Throttling Valves:

1. PL-1: 2" and under, 125# steam @ 450ºF, 175# CWP @ 180ºF, cast iron body, screwed, full port. Walworth #1700, DeZurik #425, S-RS49.

2.4 SANITARY DRAINAGE (ABOVE GROUND)
SANITARY INDIRECT DRAINAGE (ABOVE GROUND)
SANITARY VENT (ABOVE GROUND)
CONDENSATE DRAINAGE (ABOVE GROUND)

A. Design Pressure: Gravity
Maximum Design Temperature: 180ºF

B. Piping - All Sizes:

1. Pipe & Fittings: Standard weight cast iron soil pipe, corrosion protective coating inside and outside, ASTM A74, NSF Certified, CISPI Trademark.

2. Joints: Compression gasket, ASTM C564.

3. Adapters: Transitions from cast iron soil pipe to other pipe materials with manufactured adapters. Heavy duty neoprene sleeve gasket, ASTM C-564, 300 Series stainless steel shield, clamp, and screws with not less than four screw type clamps, FM 1680 or ASTM C1540.

C. Piping - 1-1/4" through 4":

1. Pipe: Type M hard temper seamless copper drainage tube, ASTM B306.

2. Joints: Solder with 100% lead-free solder and flux, ASTM B32.

3. Fittings: Cast brass solder joint drainage type, ANSI B16.23 or wrought copper solder joint drainage type, ANSI B16.29.

D. Piping - 1-1/2" through 15":

1. Pipe & Fittings: Standard weight cast iron soil pipe, corrosion protective coating inside and outside, CISPI 301 or ASTM A888, NSF Certified, CISPI Trademark.

2. Joints: Heavy duty, neoprene sleeve gasket, ASTM C-564, 300 Series stainless steel shield, clamp, and screws with at least four screw type clamps, FM 1680 or ASTM C1540.

3. Adapters: Transitions from cast iron soil pipe to other pipe materials with manufactured adapters. Heavy duty neoprene sleeve gasket, ASTM C-564, 300 Series stainless steel shield, clamp, and screws with not less than four screw type clamps, FM 1680 or ASTM C1540.

2.5 SANITARY DRAINAGE (BELOW GROUND - INSIDE BUILDING)
SANITARY VENT (BELOW GROUND - INSIDE BUILDING)

A. Design Pressure: Gravity
Maximum Design Temperature: 180ºF

B. Piping - All Sizes:

1. Pipe & Fittings: Standard weight cast iron soil pipe, corrosion protective coating inside and outside, ASTM A74, NSF Certified, CISPI Trademark.

2. Joints: Compression gasket, ASTM C564.

3. Adapters: Transitions from cast iron soil pipe to other pipe materials with manufactured adapters. Heavy duty neoprene sleeve gasket, ASTM C-564, 300 Series stainless steel shield, clamp, and screws with not less than four screw type clamps, FM 1680 or ASTM C1540.

C. Piping - 1-1/2" through 15":

1. Pipe & Fittings: Standard weight cast iron soil pipe, corrosion protective coating inside and outside, CISPI 301 or ASTM A888, NSF Certified, CISPI Trademark.

2. Joints: Heavy duty neoprene sleeve gasket, ASTM C-564, 300 Series stainless steel shield, clamp, and screws with at least four screw type clamps, FM 1680 or ASTM C1540.

3. Adapters: Transitions from cast iron soil pipe to other pipe materials with manufactured adapters. Heavy duty neoprene sleeve gasket, ASTM C-564, 300 Series stainless steel shield, clamp, and screws with not less than four screw type clamps, FM 1680 or ASTM C1540.

D. Piping 4” and Larger:

1. Pipe: Ductile iron pressure water pipe, ANSI/AWWA C151/A21.51, 200 psi pressure class. Cement mortar lined per ANSI/AWWA C104/A21.4.

2. Fittings: Ductile iron, ANSI/AWWA C110/A21.10, or ANSI/AWWA C153/A21.53, 200 psi pressure class, long radius, push-on joints.

3. Joints: Push-on joint with rubber gasket. ANSI/AWWA C111/A21.11.

E. Piping - 1-1/4” through 6” (Maximum Design Temperature: 140°F):

1. Pipe: Schedule 40 rigid, unplasticized PVC-DWV, or ABS-DWV, normal impact Type I, with plain ends, conforming to ASTM Standards D2665 or D2661. Cellular core piping is not acceptable.

2. Joints: Solvent-weld socket type with solvent recommended by pipe manufacturer.

3. Fittings: Unplasticized PVC-DWV, or ABS-DWV, normal impact Type I, with solvent-weld socket ends for Schedule 40 pipe.

4. Use: Use PVC or ABS only where allowed by local jurisdiction. Comply with all special requirements or limitations.

2.6 SANITARY DRAINAGE (BELOW GROUND - OUTSIDE OF BUILDING)

A. Design Pressure: Gravity
Maximum Design Temperature: 160ºF

B. Piping - All Sizes:

1. Pipe & Fittings: Standard weight cast iron soil pipe, corrosion protective coating inside and outside, ASTM A74, NSF Certified, CISPI Trademark.

2. Joints: Compression gasket, ASTM C564.

3. Adapters: Transitions from cast iron soil pipe to other pipe materials with manufactured adapters. Heavy duty neoprene sleeve gasket, ASTM C-564, 300 Series stainless steel shield, clamp, and screws with not less than four screw type clamps, FM 1680 or ASTM C1540.

C. Piping - 1-1/2" through 15":

1. Pipe & Fittings: Standard weight cast iron soil pipe, corrosion protective coating inside and outside, CISPI 301 or ASTM A888, NSF Certified, CISPI Trademark

2. Joints: Heavy duty neoprene sleeve gasket, ASTM C-564, 300 Series stainless steel shield, clamp, and screws with at least four screw type clamps, FM 1680 or ASTM C1540.

3. Adapters: Transitions from cast iron soil pipe to other pipe materials with manufactured adapters. Heavy duty neoprene sleeve gasket, ASTM C-564, 300 Series stainless steel shield, clamp, and screws with not less than four screw type clamps, FM 1680 or ASTM C1540.

D. Piping 4” and Larger:

1. Pipe: Ductile iron pressure water pipe, ANSI/AWWA C151/A21.51, 200 psi pressure class. Cement mortar lined per ANSI/AWWA C104/A21.4.

2. Fittings: Ductile iron, ANSI/AWWA C110/A21.10, or ANSI/AWWA C153/A21.53, 200 psi pressure class, long radius, push-on joints.

3. Joints: Push-on joint with rubber gasket, ANSI/AWWA C111/A21.11.

E. Piping - All Sizes (Maximum Design Temperature: 140°F):

1. Pipe & Fittings: PVC pipe, Schedule 40 and SDR 26 or less with bell and spigot ends, ASTM D1785 or ASTM D3034. Cellular core piping is not acceptable.

2. Joints: Elastomeric gaskets, ASTM F477.

3. Adapters: Transitions from cast iron soil pipe to other pipe materials with manufactured adapters. Heavy duty neoprene sleeve gasket, ASTM C-564, 300 Series stainless steel shield, clamp, and screws with not less than four screw type clamps, FM 1680 or ASTM C1540.

4. Use: Use PVC or ABS only where allowed by local jurisdiction. Comply with all special requirements or limitations.

2.7 CONDENSATE DRAINAGE

A. Design Pressure: Gravity

B. Furnace Piping:

1. Pipe: Schedule 40 rigid, unplasticized polyvinyl chloride PVC-DWV, or ABS-DWV, normal impact Type I, with plain ends, conforming to ASTM Standards D2665 or D2661. Cellular core piping is not acceptable.

2. Joints: Solvent-weld socket type with solvent as recommended by pipe manufacturer.

3. Fittings: Unplasticized polyvinyl chloride PVC-DWV, or ABS-DWV, normal impact Type I, with solvent-weld socket type ends for Schedule 40 pipe.

4. Limitations:

a. Schedule 40 PVC-DWV, or ABS-DWV pipe must not be threaded.

b. Do not use in return air plenums.

5. Application: Use PVC or ABS only where allowed by local jurisdiction. Comply with any special requirements or limitations.

2.8 UNIONS

A. Copper pipe - wrought copper fitting - ground joint.

B. Black Steel (Schedule 40) Pipe - malleable iron, ground joint, 150 psi, bronze to bronze seat.

C. Galvanized Steel Pipe - galvanized malleable iron, ground joint, 150 psi, bronze to bronze seat.

2.9 AIR VENTS

A. Provide means for venting air at all high points in the piping system and at all other points where air may be trapped.

B. At end of main and other points where large volume of air may be trapped - Use 1/4" globe valve, angle type, 125 psi, Crane #89, attached to coupling in top of main, 1/4" discharge pipe turned down with cap.

2.10 STRAINERS

A. Unless otherwise indicated, strainers shall be Y-pattern and have stainless steel screens with perforations as follows:

Pipe Size	1/4" - 2"	2-1/2" - 10"	12" - 18"
air and gases	1/32"	3/64"	1/16"
water	3/64"	1/16"	1/8"

B. Furnish pipe nipple with shutoff valve to blow down all strainer screens.

C. Use bronze body strainers in copper piping and iron body strainers in ferrous piping.

2.11 DRAIN VALVES

A. Drain valves shall be shutoff valves as specified for the intended service with added 3/4" male hose thread outlet and cap.

2.12 CONNECTIONS BETWEEN DISSIMILAR METALS

A. Connections between dissimilar metals shall be insulating dielectric types that allow no metal path for electron transfer and that provide a water gap between the connected metals.

B. Joints shall be rated for the temperature, pressure, and other characteristics of the service in which they are used, including testing procedure.

C. Aluminum, iron, steel, brass, copper, bronze and stainless steel are commonly used and require isolation from each other with the following exceptions:

1. Iron, steel, and stainless steel connected to each other.

2. Brass, copper, and bronze connected to each other.

3. Brass or bronze valves and specialties connected to steel or iron in closed systems. Where two brass items occur together, they shall be connected with brass nipples.

4. Brass or bronze valves or specialties under 3/4" size connected to steel, iron, or stainless steel.

D. Dielectric protection is required at connections to equipment of a material different than the piping.

E. Screwed Joints (acceptable up to 2" size):

1. Dielectric union rated for 125 psi CWP and 250°F.

2. Where a sweat-to-screw union is used, the union shall be soldered onto the copper pipe prior to screwing the union onto opposing pipe material.

3. Install dielectric unions per manufacturer's recommendations.

4. Acceptable Manufacturers: HCI Terminator U, Central Plastics, Wilkins DUX-HT, Watts.

F. Flanged Joints (any size):

1. Use 1/8" minimum thickness, non-conductive, full-face gaskets.

2. Employ one-piece molded sleeve-washer combinations to break the electrical path through the bolts.

3. Sleeve-washers are required on one side only, with sleeves minimum 1/32" thick and washers minimum 1/8" thick.

4. Install steel washers on both sides of flanges to prevent damage to the sleeve-washer.

5. Separate sleeves and washers may be used only if the sleeves are manufactured to exact lengths and installed carefully so the sleeves must extend partially past each steel washer when tightened.

6. Acceptable Manufacturers: EPCO, Central Plastics, Pipeline Seal and Insulator, F. H. Maloney, or Calpico.

2.13 VALVE CONNECTIONS

A. Provide all connections to match pipe joints. Valves shall be same size as pipe unless noted otherwise.

PART 3 - EXECUTION

3.1 PREPARATION

A. Install all products per manufacturer's recommendations.

B. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

C. Remove scale and dirt, on inside and outside, before assembly.

D. Connect to equipment with flanges or unions.

E. Use only piping materials rated for the maximum temperature of the application.

3.2 TESTING PIPING

A. Sanitary Drainage:
Sanitary Vent:

1. Test all piping with water to prove tight.

2. Test piping before insulation is applied.

3. Hydrostatically test all soil, waste, and vent piping inside of building with 10 feet head of water for 15 minutes. Inspect before fixtures are connected. If leaks appear, repair them and repeat the test.

4. A smoke/air test at the same pressure may be used in lieu of the hydrostatic water test.

5. Test force mains with water at 105% of the operating pump discharge pressure for 15 minutes.

6. Test pressures stated above shall be as listed or as required by the Authority Having Jurisdiction, whichever is most stringent.

B. Hot Water - Potable:
Cold Water - Potable:
Service Water:

1. Test pipes underground or in chases and walls before piping is concealed.

2. Test all pipes before the insulation is applied. If insulation is applied before the pipe is tested and a leak develops which ruins the insulation, replace damaged insulation.

3. Test the pipe with 100 psig water pressure or equal inert gas such as nitrogen.

4. Hold test pressure for at least 2 hours.

5. Test to be witnessed by the Architect/Engineer's representative, if requested by the Architect/Engineer.

C. Gas Piping:

1. Low Pressure - Up to 1 psi:

a. Test piping with 20 psi air pressure. System must hold this pressure without adding additional air for two hours.

2. A non-combustible odorant, such as oil of wintergreen, may be added to help locate leaks.

D. All Other Piping:

1. Test piping at 150% of normal operating pressure.

2. Piping shall hold this pressure for one hour with no drop in pressure.

3. Test piping using water, nitrogen, or air as compatible with the final service of the pipe. Do not use combustible fluids.

4. Drain and clean all piping after testing is complete.

3.3 CLEANING PIPING

A. Assembly:

1. Before assembling pipe systems, remove all loose dirt, scale, oil and other foreign matter on internal or external surfaces by means consistent with good piping practice subject to approval of the Architect/Engineer's representative. Blow chips and burrs from machinery or thread cutting operation out of pipe before assembly. Wipe cutting oil from internal and external surfaces.

2. During fabrication and assembly, remove slag and weld spatter from both internal and external joints by peening, chipping and wire brushing.

3. Notify the Architect/Engineer's representative before starting any post erection cleaning in sufficient time to allow witnessing the operation. Consult with and obtain approval from the Architect/Engineer's representative with regard to specific procedures and scheduling. Dispose of cleaning and flushing fluids properly.

4. Prior to blowing or flushing erected piping systems, disconnect all instrumentation and equipment, open wide all valves, and be certain all strainer screens are in place.

B. All Water Piping:

1. Flush all piping using faucets, flush valves, etc. until the flow is clean.

2. After flushing, thoroughly clean all inlet strainers, aerators, and other such devices.

3. If necessary, remove valves to clean out all foreign material.

3.4 INSTALLATION

A. Install shutoff valves that permit the isolation of equipment/fixtures in each room without isolating any other room or portion of the building. Individual fixture angle stops do not meet this requirement. Exception: Back-to-back rooms in no more than two adjacent rooms.

B. Provide dielectric connections between dissimilar metals.

C. Route piping in orderly manner and maintain gradient. Install to conserve building space.

D. Do not install piping or other equipment above electrical switchboards or panelboards. This includes a dedicated space extending 25 feet from the floor to the structural ceiling with width and depth equal to the equipment.

E. Group piping whenever practical at common elevations.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or equipment.

G. Provide clearance for installation of insulation and access to valves and fittings.

H. Provide access doors for concealed valves and fittings.

I. Slope water piping and arrange to drain at low points.

J. Install buried water piping outside the building with at least 5 feet of cover.

K. Where pipe supports are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.

L. Install valve stems upright or horizontal, not inverted.

M. Provide one plug valve wrench for every ten plug valves 2" and smaller, minimum of one. Provide each plug valve 2-1/2" and larger with a wrench with set screw.

N. Install corrugated, stainless steel tubing system according to manufacturer's written instructions. Include striker plates to protect tubing from puncture where tubing is restrained and cannot move.

O. Install bell and spigot piping with bells upstream.

P. Install all sanitary piping inside the building with a slope of at least the following:

Pipe Size	Minimum Slope
3" and under	- 0.25" per foot
4" and over	- 0.125" per foot

Q. Slope sanitary piping outside the building to meet the invert elevations shown on the drawings and to maintain a minimum velocity of 3 feet per second.

R. All sanitary piping shall have at least 42" of cover when leaving the building.

S. Install a length of ductile iron piping where underground cast iron storm or sanitary piping system passes through or under building footings and foundations.

T. Lay all underground piping in trenches. Provide and operate pumping equipment to keep trenches free of water.

U. For all underground piping, provide a foundation (the layer below the bedding) if the trench bottom is unstable. Lay underground plastic piping on 4" to 6" of sand bedding. When the trench is in rock, lay underground metallic piping on 6" of sand bedding. Provide recessed areas for pipe bells and joints. After joints are made, any misalignment in elevation shall be corrected by tamping sand around the pipe. Backfill with sand in uniform layers not over 6" deep to the spring line of all underground pipes, and carefully compact each layer to 90 percent Standard Proctor density. Backfill with sand up to 6" above pipe for landscaped areas. Remaining backfill may be soil. Under paving and buildings, the remaining backfill shall be sand and compacted to 98 percent Standard Proctor density.

V. Underground Piping Protection:

1. Direct buried, uninsulated steel pipe shall have a factory applied external protective coating consisting of two coats with an intermediate layer of 18 mil fibrous glass mat. Coating thickness shall total not less than 3/32". The outer coating shall be further protected by a wrapping of heavy kraft paper. This external protection shall extend and be exposed for a minimum of 1 foot beyond the buried or concealed portion of the pipe.

    a. Acceptable Manufacturers: Pipe Line Service Co., Franklin Park, Illinois, Lithcote Corp., Melrose Park, Illinois.

2. As an option, the Contractor may provide factory applied protective coatings consisting of a polyethylene plastic film bonded to the pipe surface by a hot applied thermo-plastic adhesive.

    a. Acceptable Manufacturer: Republic Steel Corp. "X-Tru-Coat"

3. Exercise care in handling, storing and laying pipe to avoid damaging factory applied coatings. If any damage occurs, repair the coating to a condition equal to the original.

4. Field application of protective coatings to joints, fittings and to any damaged factory applied coatings shall be similar to factory applied coatings specified above and shall be done in strict accordance with recommendations of the supplier of pipe coatings.

5. After completion of the fabrication, laying and field coating of the joints and fittings, but prior to backfilling, inspect the entire line in the presence of the Architect/Engineer's representative with an electronic holiday detector. Any defects in the protective coatings shall be repaired in accordance with requirements for original coatings.

6. Coat flange bolts and nuts in pits and below ground at the time of installation with a corrosion protective coating.

W. Seal pipes passing through exterior walls with a wall seal per Section 15140. Provide Schedule 40 galvanized sleeve at least 2 pipe sizes larger than the pipe.

X. All non-potable outlets shall be clearly marked with a permanently affixed laminated sign with 3/8" high lettering saying "Non-Potable Water Not for Human Consumption." Sign shall have black lettering on a yellow background.

Y. All vertical pipe drops to sinks or other equipment installed below the ceiling shall be routed within a wall cavity, unless specifically noted otherwise to be surface mounted.

3.5 PIPE ERECTION AND LAYING

A. Carefully inspect all pipe, fittings, valves, equipment and accessories before installation. Any items that are unsuitable, cracked or otherwise defective shall be removed from the job immediately.

B. All pipe, fittings, valves, equipment and accessories shall have factory applied markings, stampings, or nameplates with sufficient data to determine their conformance with specified requirements.

C. Exercise care at every stage of storage, handling, laying and erecting to prevent entry of foreign matter into piping, fittings, valves, equipment and accessories. Do not install any item that is not clean.

D. Until system is fully operational, all openings in piping and equipment shall be kept closed except when actual work is being performed on that item or system. Closures shall be plugs, caps, blind flanges or other items specifically designed and intended for this purpose.

E. Run pipes straight and true, parallel to building lines with minimum use of offsets and couplings. Provide only offsets required to provide needed headroom or clearance and to provide needed flexibility in pipe lines.

F. Make changes in direction of pipes only with fittings or pipe bends. Changes in size only with fittings. Do not use miter fittings, face or flush bushings, or street elbows. All fittings shall be of the long radius type, unless otherwise shown on the drawings or specified.

G. Provide flanges or unions at all final connections to equipment, traps and valves.

H. Arrange piping and connections so equipment served may be totally removed without disturbing piping beyond final connections and associated shut-off valves.

I. Use full and double lengths of pipe wherever possible.

J. Unless otherwise indicated, install all piping, including shut-off valves and strainers, to coils, pumps and other equipment at line size with reduction in size being made only at control valve or equipment.

K. Cut all pipe to exact measurement and install without springing or forcing except in the case of expansion loops where cold springing is indicated on the drawings.

L. Underground pipe shall be laid in dry trenches maintained free of accumulated water. Provide and operate sufficient pumping equipment to maintain excavations, trenches and pits free of water. Dispose of pumped water so operation areas and other facilities are not flooded. Pipe laying shall follow excavating as closely as possible.

M. Unless otherwise indicated, branch take-offs shall be from top of mains or headers at either a 45º or 90º angle from the horizontal plane for air and gas lines, and from top, bottom or side for liquids.

3.6 DRAINING AND VENTING

A. Unless otherwise indicated on the drawings, all horizontal water and gas lines, including branches, shall pitch 1" in 40 feet to low points for complete drainage, removal of condensate and venting.

B. Maintain accurate grade where pipes pitch or slope for venting and drainage. No pipes shall have pockets due to changes in elevation.

C. Provide drain valves at all low points of water piping systems for complete or sectionalized draining.

D. Provide drip legs at low points and at the base of all risers in compressed air and gas pipes. Drip legs shall be full line size on pipes through 4" and at least 4", but not less than half line size over 4". Drip legs shall be 12" minimum length, capped with a reducer to a drain valve.

E. Use eccentric reducing fittings on horizontal runs when changing size of pipes for proper drainage and venting. Install compressed air, gas and gravity drain pipes with bottom of pipe and eccentric reducers in a continuous line; all other liquid lines with top of pipe and eccentric reducers in a continuous line.

F. Provide air vents at high points and wherever else required to eliminate air in all water piping systems.

G. Install air vents in accessible locations. If necessary to trap and vent air in a remote location, install an 1/8" pipe from the tapping location to an accessible location and terminate with a venting device.

H. All vent and drain piping shall be of same materials and construction for the service involved.

3.7 PLUMBING VENTS

A. Vent as shown on the drawings and in accordance with all codes having jurisdiction.

B. Extend the high side of the soil and waste stacks at least 12" above roof.

C. Increase vent pipes through the roof two pipe sizes with long increasers located at least 12" below the roof.

D. In no case shall the vent through the roof be less than 3" in diameter.

E. Vent pipes through the roof shall be located a minimum of 15 feet from any air intake or exhaust opening on the roof.

3.8 BRANCH CONNECTIONS

A. For domestic water and vent systems only, make branch connections with standard tee or cross fittings of the type required for the service.

B. Reducers are generally not shown. Where pipe sizes change at tee, the tee shall be the size of the largest pipe shown connecting to it.

C. All branch piping connections for propane shall take off on the top or on the side of the main.

D. Do not use double wye or double combination wye and eighth bend DWV fittings in horizontal piping.

E. Branch connections from the headers and mains may be mechanically formed using an extraction device. The branch piping connection shall be brazed connection for the following services only:

1. Domestic water piping above grade.

3.9 JOINING OF PIPE

A. Threaded Joints:

1. Threads shall conform to ANSI B2.1 "Pipe Threads".

2. Ream pipe ends and remove all burrs and chips formed in cutting and threading.

3. Protect plated pipe and valve bodies from wrench marks when making up joints.

4. Apply thread lubricant to male threads as follows:

Vents and Roof Conductors:	Red graphite
All Other Services:	Teflon tape

B. Flanged Joints:

1. Steel pipe flanges shall conform to ANSI B16.5 "Steel Pipe Flanges and Flanged Fittings". Cast iron pipe flanges shall conform to ANSI B16.1 "Cast Iron Flanged and Flanged Fittings". Steel flanges shall be raised face except when bolted to flat face cast iron flange.

2. Bolting for services up to 500ºF shall be ASTM A307 Grade B with square head bolts and heavy hexagonal nuts conforming to ANSI B18.2.1 "Square and Hex Bolts" and B18.2.2 "Square and Hex Nuts".

3. Set flange bolts beyond finger tightness with a torque wrench for equal tension in all bolts. Tighten bolts so those 180º apart are torqued in sequence.

4. Gaskets for flat face flanges shall be full face type. Gaskets for raised faced flanges shall conform to requirements for "Group I Gaskets" in ANSI B16.5. Unless otherwise specified gaskets shall be 3/32" thick of following types:

   Water (Up to 250ºF): Red Rubber, Heavy Duty Type

C. Solder Joints:

1. Make up joints with 100% lead-free solder, ASTM B32. Cut tubing so ends are perfectly square and remove all burrs inside and outside. Thoroughly clean sockets of fittings and ends of tubing to remove all oxide, dirt and grease just prior to soldering. Apply flux evenly, but sparingly, over all surfaces to be joined. Heat joints uniformly so solder will flow to all mated surfaces. Wipe excess solder, leaving a uniform fillet around cup of fitting.

2. Flux shall be non-acid type.

3. Solder end valves may be installed directly in the piping system if the entire valve is suitable for use with 470ºF melting point solder. Remove discs and seals during soldering if they are not suitable for 470ºF.

D. Mechanical Press Connection:

1. Copper press fitting shall be made in accordance with the manufacturer’s installation instructions.

2. Fully insert tubing into the fitting and mark tubing.

3. Prior to making connection, the fitting alignment shall be checked against the mark made on the tube to ensure the tubing is fully engaged in the fitting.

4. Joint shall be pressed with a tool approved by the manufacturer.

5. Installers shall be trained by manufacturer personnel or representative. Provide documentation upon request.

E. Mechanical Joints:

1. Joints shall conform to ANSI A21.11 "Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings". Gasket material shall be neoprene. The standard bolts and nuts of the pipe manufacturer shall be used and shall be coated at the factory with rust preventive lubricant after threading and tapping.

2. Final tightening of bolts shall be with a torque wrench to insure equal tension in all bolts.

F. Compression Gasket Joints - Sanitary Pipe:

1. Joint shall be one piece double seal compression type gasket made specifically for joining cast iron soil pipe. Gasket shall be neoprene, permitting joint to flex as much as 5 degrees without loss of seal. Gasket shall be extra heavy weight class, conforming to ASTM C-564.

G. Solvent Weld Joints (PVC):

1. Make joints with a two-step process. Use primer conforming to ASTM F656 and solvent cement conforming to ASTM D2564.

H. Elastomeric Gaskets (Sanitary Pipe):

1. Hub and spigot pipe joints with elastomeric gaskets shall be made in accordance with the manufacturer's installation instructions.

I. Sleeve Gaskets (No-Hub) (Sanitary and Storm Pipe):

1. Gasket shall be heavy weight class, conforming to ASTM C564.

2. The gasket shall have an internal center stop.

3. The gasket shall be covered by a stainless steel band secured with a minimum of four stainless steel bands per fitting/joint.

4. Sleeve gaskets shall be installed in accordance with the manufacturer’s installation instructions.

3.10 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Provide necessary connections at the start of individual sections of mains for adding chlorine.

B. Before starting work, verify system is complete, flushed and clean.

C. Ensure pH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).

D. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.

E. Bleed water from outlets to ensure distribution and test residual at minimum 15% of outlets.

F. Maintain disinfectant in system for 24 hours.

G. If final disinfectant residual tests less than 25 mg/L, repeat treatment.

H. Flush disinfectant from system until residual is equal to that of incoming water or 1.0 mg/L.

I. Take samples no sooner than 24 hours after flushing, from 2% of outlets and from water entry, and analyze in accordance with AWWA C651.

3.11 SERVICE CONNECTIONS

A. Provide new sanitary sewer service. Before commencing work check invert elevations needed for sewer connections, confirm inverts and verify these can be properly connected with slope for drainage and cover to avoid freezing.

B. Provide new water service. Provide sleeve in wall for service main per Section 15140.

C. Connect to propane system.

END OF SECTION

SECTION 15430
PLUMBING SPECIALTIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Floor Drains.
B. Cleanouts.
C. Traps.
D. Backflow Preventers.
E. Water Hammer Arresters and Air Chambers.

1.2 REFERENCES

A. ANSI A112.21.1 - Floor Drains.

B. ASSE 1010 - Water Hammer Arresters.

C. ASSE 1012 - Backflow Preventers with Intermediate Atmospheric Vent.

D. ASSE 1047 - Reduced Pressure Detector Assemblies.

E. AWWA C506 - Backflow Prevention Devices - Reduced Pressure Principle and Double Check Valve Types.

F. PDI WH-201 - Water Hammer Arresters.

1.3 QUALITY ASSURANCE

A. Manufacturer: For each product specified, provide components by same manufacturer throughout.

1.4 SUBMITTALS

A. Submit shop drawings under provisions of Section 15010.

B. Include sizes, rough-in requirements, service sizes, and finishes.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Provide cleanouts as specified on drawings.

B. Coordinate floor cleanout cover with surrounding floor finish. Provide either solid, recessed for tile or terrazzo or carpet marker as applicable.

C. Cleanouts on exposed pipes shall be cast iron with heavy duty cast brass plug with raised head.

D. Cleanout shall be same size as the pipe.

2.2 YARD CLEANOUTS

A. Provide yard cleanouts as specified on the drawings.

B. Cleanout shall be same size as pipe.

2.3 TRAPS

A. Provide all individual connections to the sanitary system with P-traps, except where such drains discharge directly into a properly trapped collection basin or sump. Unless otherwise specified or shown, traps shall be:

1. Chromium plated cast brass when used with plumbing fixtures or when installed exposed in finished spaces.

2. Insulated at accessible lavatories.

3. Cast iron, deep-seal pattern where concealed above ceiling, below grade or in unfinished areas.

4. Deep-seal pattern of the same material and/or coating where drainage lines are of special materials or coatings such as Duriron, glass, etc.

B. All traps shall have accessible, removable cleanouts, except where installed on floor drains with removable strainers.

2.4 FLOOR DRAINS AND SINKS

A. Provide floor drains and sinks as specified on the drawings.

2.5 BACKFLOW PREVENTERS

A. Provide backflow preventers as specified on the drawings.

2.6 WATER HAMMER ARRESTERS AND AIR CHAMBERS

A. Provide water hammer arresters as specified on the drawings.

B. ANSI A112.26.1; sized in accordance with PDI WH-201, precharged for operation between -100ºF and 300ºF and maximum 250 psig working pressure.

C. Air chambers shall meet the requirements of the applicable plumbing code. Minimum 12” long at fixtures and minimum 24” long on risers. Air chambers shall be the same size or larger than the piping it is connected to.

PART 3 - EXECUTION

3.1 INSTALLATION AND APPLICATION

A. Coordinate construction to receive drains at required invert elevations.

B. Install all items per manufacturer's instructions.

C. Water Hammer Arresters and Air Chambers:

1. Install water hammer arresters in accessible locations. Provide access doors as required. Coordinate type with Architect/Owner.

2. Install air chambers at each fixture not protected by a water hammer arrester.

D. Cleanouts:

1. Provide cleanouts where shown on the drawings and as required by code, but in no case farther apart than 50 feet in pipe less than 6" size and 100 feet apart in 6” and larger pipes inside the building.

2. Provide cleanouts at bases of all sanitary risers.

3. Extend cleanouts to the floor with long sweep elbows.

4. Install a full size cleanout within 5 feet of the foundation inside or outside of building.

5. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with graphite and linseed oil. Ensure clearance at cleanouts for rodding of drainage system.

6. Wall cleanouts shall be installed above the flow line of the pipe they serve, but no less than 12” above the finished floor.

E. Yard Cleanouts:

1. Install cleanouts on maximum 90 foot centers (including riser) for pipes 8" and smaller.

2. Extend cleanout to grade. Encase cleanout in 5" thick concrete pad extending 6" beyond cleanout, set low enough not to interfere with lawn mowers.

F. Floor Drains:

1. Coordinate sloping requirements with the architectural plans and specifications.

G. Backflow Preventer:

1. Provide an air gap fitting and piping to drain. On 2-1/2" and larger units, install a tail piece from air gap fitting to drain to prevent water from spraying out of drain air gap receptor. Maintain air gap distance required by Code.

2. Units shall be field tested and tagged in accordance with manufacturer’s instructions and applicable codes by a certified tester before initial operation.

3. Install unit between 12" and 60" above finish floor.

END OF SECTION

SECTION 15440
PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. All plumbing fixtures.

1.2 REFERENCES

A. ANSI A112.6.1M - Supports for Off-the-Floor Plumbing Fixtures for Public Use.

B. ANSI A112.18.1 - Finished and Rough Brass Plumbing Fixture Fittings.

C. ANSI A112.19.1M - Enameled Cast Iron Plumbing Fixtures.

D. ANSI A112.19.2M - Vitreous China Plumbing Fixtures.

E. ANSI A112.19.5 - Trim for Water-Closet Bowls, Tanks, and Urinals.

F. ASSE 1002 - Water Closet Flush Tank Ball Cocks.

G. Americans with Disabilities Act (ADA), Title III

1.3 SUBMITTALS

A. Submit product data under provisions of Section 15010. Submittals shall include fixture carriers for record purposes only. Engineer does not review or approve carriers except for manufacturer.

B. Include fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Wall Hung Fixture Carriers:

1. Material: All Metal, ASME/ANSI A112.6.1M.

2. Acceptable Manufacturers: Zurn, Smith, Wade, Josam, Watts, Mifab.

B. All fixtures shall be as scheduled on the drawings.

C. All china shall be from the same manufacturer where possible.

D. All lavatory and sink trim shall be from the same manufacturer where possible.

E. All fixtures shall be lead free.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

B. Install each fixture with trap easily removable for servicing and cleaning. Use screwed tailpiece couplings. Connect fixture waste to stack with slip fitting.

C. Provide fixtures with chrome plated rigid or flexible supplies, loose key stops, reducers, and escutcheons.

D. Install components level and plumb.

E. Caulk joint between finish floor and floor mounted fixtures and between finish walls and wall mounted fixtures with silicon caulk. Caulk the joint, between rim and fixture where a fixture builds into a counter top, with caulking compound. Refer to DIVISION 7 for "Caulking" requirements. Color to match fixture.

F. Where there is a possibility of water following pipe brackets, etc., into a wall; caulk escutcheons, space around brackets, etc., to exclude water. Refer to DIVISION 7 for "Caulking" requirements.

G. All wall mounted fixtures shall have compatible carriers designed for their intended service and suitable for the space available and configuration of fixtures. All carriers shall extend to the floor and be anchored to the slab.

H. All traps exposed under fixtures or inside accessible cabinets shall be chrome plated brass.

I. All handicapped accessible lavatory traps, piping and angle stops shall be installed with an insulating kit specially manufactured for this installation. Armaflex with duct tape is not acceptable.

J. All water or waste piping for plumbing fixtures that is exposed or inside cabinets shall be chrome plated.

K. All exposed water supply piping and fittings in a finished space to a shower valve, hose bibb, or other water outlet shall be chrome plated.

L. Refer to Plumbing Material List for fixture mounting heights.

M. All acrylic and fiberglass showers shall have a non-shrink grout or manufacturer-approved material installed between the finished floor and floor of the fixture to prevent damage caused by deflection.

N. Where floor mounted fixtures are installed on a sloped floor, the open void below the fixture shall be grouted, leveled, and caulked to eliminate stress on the fixture and to prevent water migration to the floor below.

O. All rough-in pockets for showers and tubs located in basement floor installations shall be filled in with concrete and sealed tight.

3.2 ADJUSTING AND CLEANING

A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

B. At completion, clean plumbing fixtures, equipment, and faucet aerator screens.

3.3 FIXTURE ROUGH-IN SCHEDULE

A. Rough-in fixture piping connections in accordance with table on plumbing drawings of minimum sizes for particular fixtures.

END OF SECTION

SECTION 15450
PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Water Heaters.

1.2 REFERENCES

A. ANSI ASHRAE 90A - Energy Conservation in New Building Design.

B. ANSI/ASME Section 8D - Pressure Vessels.

C. ANSI Section 21.10.1 or Section ANSI 21.10.3 - Gas Water Heaters Ratings 75,000 BTU per Hour and Less.

D. ANSI/NFPA 30 - Flammable and Combustible Liquids Code.

E. ANSI/NFPA 54 - National Fuel Gas Code.

F. ANSI/NFPA 70 - National Electrical Code.

G. ASSE 1005 - Water Heater Drain Valves, 3/4" Iron Pipe Size.

1.3 QUALITY ASSURANCE

A. Products and installation of specified products shall conform to recommendations and requirements of the following organizations:

1. American Gas Association (AGA).
2. National Sanitation Foundation (NSF).
3. American Society of Mechanical Engineers (ASME).
4. National Board of Boiler and Pressure Vessel Inspectors (NBBPVI).
5. National Electrical Manufacturers' Association (NEMA).
6. Underwriters' Laboratories (UL).

1.4 REGULATORY REQUIREMENTS

A. Water heaters shall conform to ASHRAE 90A and AGA, ANSI/NFPA 54, ANSI/NFPA 70, ANSI/UL 1453 as applicable.

B. Conform to ANSI/ASME Section 8D for manufacture of heat exchanger pressure vessels.

1.5 SUBMITTALS

A. Submit shop drawings under provisions of Section 15010.

B. Include dimension drawings of water heaters indicating components and connections to other equipment and piping.

C. Include heat exchanger dimensions, size of tappings, and performance data.

D. Include dimensions of tanks, tank lining methods, anchors, attachments, lifting points, tappings, and drains.

E. Submit manufacturer's installation instructions.

F. Submit manufacturer's certificate that pressure vessels meet or exceed specified requirements.

G. Submit operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

PART 2 - PRODUCTS

2.1 WATER HEATERS

A. All water heaters shall be as scheduled on the drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install all items in accordance with manufacturer's instructions.

3.2 WATER HEATER INSTALLATION

A. Install water heater on concrete base. Coordinate size and location of concrete base. See Specification Section 15140.

B. Install water heaters level and plumb, according to drawings, manufacturer's instructions, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

C. Install combination temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend drain piping full size from relief valve and discharge by positive air gap onto closest floor drain. Discharge pipe material shall be same as domestic water piping.

D. Install gas water heaters according to NFPA 54.

END OF SECTION

SECTION 15623
FORCED AIR FURNACES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Forced Air Furnaces.
B. Refrigerant Cooling Coil and Condensing Unit.
C. Controls.

1.2 REFERENCES

A. ARI 210 - Standard for Unitary Air-Conditioning Equipment.

1.3 QUALITY ASSURANCE

A. Conform to requirements of UL and applicable codes.

B. Cooling system tested and rated per ARI Standard 210.

1.4 SUBMITTALS

A. Submit shop drawings and product data per Section 15010 showing dimensions, connections, arrangement, accessories, and controls.

B. Submit manufacturer's installation instructions.

C. Submit manufacturer's descriptive literature, operating instructions, and maintenance and repair data.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Lennox
B. Bryant
C. Carrier

2.2 TYPE

A. Provide upflow type with gas burner and electric refrigeration.

B. Provide self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, heat exchanger, burner or heater, controls, air filter, refrigerant cooling coil and outdoor package containing compressor, condenser coil and condenser fan.

C. Provide zonable type furnace where scheduled on drawings.

1. Provide control panel, zone thermostats, and motorized zone dampers equal to Lennox “Harmony” system.

2. Provide all required control wiring between furnace, zone dampers, and zone thermostats.

2.3 FABRICATION

A. Cabinet: Galvanized steel with baked enamel finish, easily removed and secured access doors, glass fiber insulation and reflective liner.

B. Combustion Chamber: Pre-cast refractory.

C. Supply Fan: Centrifugal type, rubber mounted with direct drive, rubber isolated 1750 rpm, 4-speed motor.

D. Air Filters: 1" thick glass fiber, disposable type arranged for easy replacement.

2.4 BURNER

A. Gas Burner: Condensing sealed combustion type, combustion gas valve and pressure regulator incorporating manual shut-off, intermittent spark or glow coil ignition, flame sensing device, and 100% shut-off pilot. 90% minimum efficiency.

B. Gas Burner Safety Controls: Thermocouple sensor prevents opening solenoid gas valve until pilot flame is proven and stops gas flow on ignition failure. Should loss of flame occur, the controls shall attempt to re-ignite three times before locking the unit out for 60 minutes. The controls shall automatically reset after 60 minutes.

2.5 OPERATING CONTROLS

A. Provide low voltage, programmable/digital room thermostats to control burner and damper operation.

B. Controls shall be such that if there is a call for heating from any zone thermostat the furnace shall start. The zone thermostats shall then modulate zone dampers as required to meet set point.

C. Provide high limit control, with fixed stop at maximum permissible setting, to de-energize burner on excessive bonnet temperature and energize burner when temperature drops to lower safe value.

D. Control supply fan based on bonnet temperature independent of burner controls. Include manual switch for continuous fan operation.

2.6 DRAFT CONTROL

A. Provide each furnace with PVC combustion air inlet and CPVC outlet piping.

B. Provide induced draft blower. Pressure switch prove blower operation before allowing gas valve to open. Draft blower shall only operate during heating cycle.

2.7 EVAPORATOR COIL

A. Mount in furnace supply plenum, copper tube, aluminum fin, coil assembly, and refrigerant piping connections.

B. Install a drain pan under each cooling coil per ASHRAE 62.1. Extend drain pans the entire width of each coil, including piping and header if in the air stream, and from the upstream face of each coil to a distance 1/2 of the vertical coil height downstream from the downstream face. Pitch drain pans in two directions towards the outlet, with a slope of at least 1/8" per foot.

C. Provide factory installed thermostatic expansion valve.

2.8 REFRIGERATION PACKAGE

A. Compressor: Hermetically sealed, 3,600 rpm, resiliently mounted integral with condenser, with positive lubrication, crankcase heater, high pressure control, hard start kit, motor thermal overload protection, service valves, and drier.

B. Air Cooled Condenser: Aluminum fin and copper tube coil, direct drive propeller fan resiliently mounted, galvanized fan guard.

C. Use manufacturer recommended line sets and routing for refrigerant piping.

D. Shutter head pressure control for starting and operating down to 30ºF.

2.9 REFRIGERATION OPERATING CONTROLS

A. Low voltage, room thermostat controls dampers, compressor, condenser fan, and supply fan.

B. Controls shall be such that if there is a call for cooling from any zone thermostat, the supply fan, compressor and condenser fan shall start. The zone thermostats shall then modulate zone dampers as required to meet set point.

C. Include thermostat system selector switch (heat-cool-off) and fan control switch (on-auto).

D. Timer shall limit compressor starts to 12 per hour.

E. Provide all required control wiring.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Mount air cooled condenser package on concrete pad.

END OF SECTION

SECTION 15835
TERMINAL HEAT TRANSFER UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Gas Fired Unit Heaters.

1.2 REFERENCES

A. ANSI/ASHRAE 62.1 - Ventilation for Acceptable Indoor Air Quality.

B. ANSI/ASHRAE 90.1 - 07 - Energy Standard for Buildings Except Low-Rise Residential Buildings.

C. ANSI/NFPA 70 - National Electrical Code.

1.3 QUALITY ASSURANCE

A. All filters shall be UL listed Class 1 or Class 2.

B. All electrical equipment shall have a UL label.

C. All gas fired units shall be AGA approved or UL listed.

D. All gas trains shall comply with utility company and code requirements.

E. All louvers and dampers shall have AMCA certified ratings.

F. Factory wired equipment shall conform to ANSI/NFPA 70.

1.4 SUBMITTALS

A. Submit shop drawings per Section 15010.

B. Submit catalog data including arrangements, cross sections of cabinets, grilles, bracing, typical elevations.

C. Submit schedules of equipment and enclosures indicating length, number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, and comparison of specified to actual heat output.

D. Indicate mechanical and electrical service locations and requirements. Show deviations from scheduled products.

E. Submit manufacturers' installation instructions.

1.5 REGULATORY REQUIREMENTS

A. Conform to ASHRAE 90.1 - 07.

1.6 OPERATION AND MAINTENANCE DATA

A. Submit manufacturer's operation and maintenance data. Include operating, installation, maintenance and repair data, and parts listings.

1.7 DELIVERY, STORAGE AND HANDLING

A. Protect units from physical damage by storing in protected areas and leaving factory covers in place.

PART 2 - PRODUCTS

2.1 GAS FIRED UNIT HEATERS

A. Units shall be propeller-fan horizontal discharge type.

B. Include the following controls: Electric room thermostat, solenoid gas valve, safety pilot valve, main gas pressure regulator, pilot gas pressure regulator, main manual shut-off, high limit switch, fan control thermostat.

C. Stainless steel combustion chamber and aluminized steel burners.

D. Acceptable Manufacturers: Trane, Modine, Hastings, Rupp, Sterling, or Reznor.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install all products per manufacturers' instructions.

B. Coordinate recess sizes for recessed equipment.

C. Hang unit heaters from building structure, not from piping. Mount as high as possible unless otherwise indicated.

D. Protect units with protective covers during construction.

E. Comb all coils to repair bent fins.

3.2 CLEANING

A. After construction is complete, including painting, clean exposed surfaces of units. Vacuum clean coils and inside of cabinets.

B. Touch-up marred or scratched surfaces of factory-finished cabinets, with materials furnished by manufacturer.

C. Install new filters.

END OF SECTION

SECTION 15870
POWER VENTILATORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Room Exhaust Fan.

1.2 REFERENCES

A. AMCA 99 - Standards Handbook.

B. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes.

C. AMCA 300 - Test Code for Sound Rating Air Moving Devices.

D. AMCA 301 - Method of Publishing Sound Ratings for Air Moving Devices.

E. SMACNA - HVAC Duct Construction Standards, 1995 Edition.

1.3 QUALITY ASSURANCE

A. Performance Ratings: Conform to AMCA 210 and bear AMCA Certified Rating Seal.

B. Sound Ratings: AMCA 301, tested to AMCA 300.

C. Fabrication: Conform to AMCA 99.

1.4 SUBMITTALS

A. Submit shop drawings per Section 15010. Include product data on wall and roof exhausters, and ceiling and cabinet fans.

B. Provide multi-rpm fan curves with specified operating point clearly plotted.

C. Submit manufacturer's installation instructions.

PART 2 - PRODUCTS

2.1 ROOM EXHAUST FAN

A. Fiberglass lined sheet metal housing.

B. Rubber torsion motor mounts.

C. Plug type disconnect.

D. Built-in backdraft damper.

E. Centrifugal fan.

F. Molded white plastic or aluminum ceiling grille.

G. Provide variable speed controller if called for on the drawings.

H. Acceptable Manufacturers: Twin City, ACME, Broan, Carnes, Cook, JencoFan, Penn, Greenheck, Panasonic.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

END OF SECTION

SECTION 15890
DUCTWORK

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Galvanized Ductwork
B. Ductwork Sealants
C. Rectangular Ductwork - Single Wall
D. Round Ductwork - Single Wall
E. Flexible Duct
F. Leakage Testing
G. Ductwork Penetrations

1.2 REFERENCES: Conform to all applicable requirements of the following publications:

A. ADC Flexible Duct Performance and Installation Standards, 3rd Edition 1996.

B. ASHRAE - Handbook 2004 Systems and Equipment; Chapter 16 - Duct Construction.

C. ASHRAE - Handbook 2005 Fundamentals; Chapter 35 - Duct Design.

D. ASHRAE – Standard 90.1-2004 “Energy Standard for Buildings Except Low-Rise Residential Buildings”

E. ASTM A167- Stainless & Heat-Resisting Chromium-Nickel Steel Plate, Sheet, & Strip.

F. ASTM A653 - Steel Sheet, Zinc-Coated (Galvanized) or zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

G. ASTM A90 - Standard Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.

H. ASTM A924 - Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.

I. ASTM E90-02 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.

J. ASTM E413-87 - Classification for Rating Sound Insulation.

K. AWS D9.1M/D9.1 - Sheet Metal Welding Code.

L. NFPA 90A - Installation of Air-Conditioning and Ventilating Systems.

M. NFPA 90B - Installation of Warm Air Heating and Air- Conditioning Systems.

N. NFPA 96 - Ventilation Control and Fire Protection of Commercial Cooking Equipment.

O. SMACNA – Air Duct Leakage Test Manual – 1985 Edition.

P. SMACNA - HVAC Duct Construction Standards - 2005 Edition.

Q. SMACNA - Round Industrial Duct Construction Standards - 1999 Edition.

R. UL 181 - Factory-Made Air Ducts and Air Connectors.

S. UL 181A - Closure Systems for Use With Rigid Air Ducts and Air Connectors

T. UL 181B - Closure Systems for Use With Flexible Air Ducts and Air Connectors.

1.3 DEFINITIONS

A. Duct Sizes shown on drawings are inside clear dimensions. Maintain clear dimensions inside any lining.

B. Transitions are generally not shown in single-line ductwork. Where sizes change at a divided flow fitting, the larger size shall continue through the fitting.

1.4 SUBMITTALS

A. Submit shop drawings per Section 15010.

B. The Engineer may require field verification of sheet metal gauges and reinforcing to verify compliance with these specifications. At the request of the engineer, the contractor shall remove a sample of the duct for verification. The contractor shall repair as needed.

1.5 COORDINATION DRAWINGS

A. Duct drawings shall be at 1/4" minimum scale complete with the following information:

1. Actual duct routing, ductwork fittings, actual sheet metal dimensions including insulation liner and wrap, duct hanger and support types, ductwork accessories, etc. with lengths and weights noted.

2. Differentiate ducts that are lined or wrapped. Include insulation thickness, type of insulation, and acoustical lagging.

3. Room names and numbers, ceiling types, and ceiling heights.

B. KJWW will provide electronic file copies of ventilation drawings for contractor’s use if the contractor signs and returns the “Electronic File Transfer” waiver attached at the end of this specification section. KJWW will not consider blatant reproductions of original file copies an acceptable alternative to coordination drawings. Architectural plans will need to be obtained from the Architect.

PART 2 - PRODUCTS

2.1 GALVANIZED DUCTWORK

A. General Requirements:

1. Duct and reinforcement materials shall conform to ASTM A653 and A924.

2. Interior Ductwork and reinforcements: G60 galvanized (0.60 ounces per square foot total zinc coating for two sides per ASTM A90) unless noted otherwise.

3. Ductwork reinforcement shall be of galvanized steel.

4. Ductwork supports shall be of galvanized or painted steel. Slip cable hangers are acceptable. Acceptable manufacturers are Gripple, Ductmate, Duro Dyne, or engineer approved.

5. All fasteners shall be galvanized or cadmium plated.

2.2 DUCTWORK SEALANTS

A. One part joint sealers shall be water-based mastic systems that meet the following requirements: maximum 48-hour cure time, service temperature of -20°F to +175°F, resistant to mold, mildew and water, flame spread rating below 25 and smoke-developed rating below 50 when tested in accordance with ASTM E84, suitable for all SMACNA seal classes and pressure classes. Mastic used to seal flexible ductwork shall be marked UL 181B-M. All other mastics shall be marked UL 181A-M.

B. Pressure sensitive tape used for sealing ductwork shall be minimum 2.5-inch wide, listed and marked UL 181A-P, having minimum 60 oz/inch peel adhesion to steel, and service temperature range from -20°F to +250°F.

C. Where pressure sensitive tape is called for on drawings and specifications for sealing flexible ductwork, tape shall be minimum 2.5-inch wide, UL 181 B-FX listed, and marked tape having minimum 60 oz/inch peel adhesion to steel and service temperature range from -20°F to +250°F. Acceptable manufacturers include: Venture Tape 1581A, Compac #340, Scotch Foil Tape 3326, Polyken 339.

2.3 RECTANGULAR DUCT - SINGLE WALL

A. General Requirements:

1. All ductwork gauges and reinforcements shall be as listed in SMACNA Duct Construction Standards Chapter 2. Where necessary to fit in confined spaces, furnish heaviest duct gauge and least space consuming reinforcement.

2. Offsets and transitions shall not exceed the angles in Figure 4-7.

B. Exceptions and modifications to the 2005 HVAC Duct Construction Standards are:

1. All ducts shall be cross-broken or beaded.

2. Turning vanes shall be used in all 90° mitered elbows, unless clearly noted otherwise on the drawings. Vanes shall be as follows:

   a. Type 1:

      1) **Description**: Single wall type with 22-gauge (0.029") or heavier vanes, 3-1/4" blade spacing, and 4 to 4-1/2" radius. Vanes hemmed if recommended by runner manufacturer. Runners shall have extra long locking tabs. C-value independently tested at below 0.26. EZ Rail II by Sheet Metal Connectors or equal.

      2) **Usage**: Limited to 3,000 fpm and vane lengths 36" and under.

   b. Turning vanes shall operate quietly. Repair or replace vanes that rattle or flutter.

   c. Runners must be installed at a 45° angle. Elbows with different size inlet and outlet must be radius type.

   d. Omitting every other vane is prohibited.

3. Where smooth radius rectangular elbows are shown, they shall be constructed per SMACNA Figure 4-2. Type RE1 shall be constructed with a centerline duct radius R/W of 1.0. Where shown on drawings, Type RE3 elbows with 3 vanes shall be used with centerline duct radius R/W of 0.6 (SMACNA r/W=0.1). RE1 or RE3 elbows may be used where mitered elbows are shown if space permits. Do not make branch takeoffs within 4 duct diameters on the side of the duct downstream from the inside radius of radius elbows.

4. Rectangular branch and tee connections in ducts over 1" pressure class shall be 45° entry type per Figs. 4-5 and 4-6. Rectangular straight taps are not acceptable above 1" pressure class.

5. Bellmouth fittings shown on return duct inlets shall expand at a 60-degree total angle horizontally and vertically (space permitting) and have length of at least 25% of the smallest duct dimension.

6. Round taps off rectangular unlined ducts shall be flanged conical or bellmouth type (equal to Buckley Bellmouth or Sheet Metal Connectors E-Z Tap), or 45° rectangular with transition to round (equal to Sheet Metal Connectors Inc. High Efficiency Takeoff). Straight taps are acceptable if pressure class is 1" or less, round duct is 12" diameter or less, and the tap is not located between fans and TAB devices.

7. All lined duct shall utilize dovetail joints where round or conical taps occur. The dovetail joints shall extend past the liner before being folded over.

8. Slide-on flanged transverse joint systems are acceptable provided they are a manufactured product that has been tested for conformance with Chapter 2 of the SMACNA HVAC Duct Construction Standards for sheet and joint deflection at the specified pressure class.

   a. Apply sealant to all inside corners. Holes at corners are not acceptable.

b. Acceptable Manufacturers: Ductmate Industries - 25/35/45, Nexus, Mez, or WDCI. Other manufacturers must submit test data and fabrication standards and receive Engineer's approval before any fabrication begins.

9. Formed-on flanged transverse joint systems are acceptable provided they are a manufactured product that has been tested for conformance with Chapter 2 of the SMACNA HVAC Duct Construction Standards for sheet and joint deflection at the specified pressure class.

a. Apply sealant to all inside corners. Holes at corners are not acceptable.

b. Flanges shall be 24 gauge minimum (not 26 gauge).

c. Acceptable Manufacturers: Lockformer TDC, TDF, United McGill, or Sheet Metal Connectors. Other manufacturers must submit test data and fabrication standards and receive Engineer's approval before any fabrication begins.

2.4 ROUND DUCTWORK - SINGLE WALL

A. Conform to applicable portions of Rectangular Duct Section. Round ductwork may be substituted for rectangular ductwork where approved by the Engineer. The ductwork shall meet or exceed the specified cross-sectional area and insulation requirements. The substitution shall be coordinated with all other trades prior to installation.

B. Snap lock seams are not permitted.

C. 90° elbows shall be smooth radius or have a minimum of five sections with mitered joints and R/D of at least 1.5.

D. Duct and fittings shall meet the required minimum gauges listed in chapter 3 of the SMACNA requirements for the specified pressure class. Ribbed and lightweight duct are not permitted.

E. Ductwork shall be suitable for velocities up to 5,000 fpm.

F. Divided flow fittings may be made as separate fittings or factory installed taps with sound, airtight, continuous welds at intersection of fitting body and tap.

G. Spot weld and bond all fitting seams in the pressure shell. Coat galvanizing damaged by welding with corrosion resistant paint to match galvanized duct color.

H. Ducts with minor axis less than 22" shall be spiral seam type. Larger ducts may be rolled, longitudinal welded seam type. SMACNA seams RL-2 and RL-3 are not permitted.

I. Transverse Joint Connections:

1. Crimped joints are not permitted.

2. Ducts and fittings 36" in diameter and smaller shall have slip joint connections. Size fitting ends to slip inside mating duct sections with minimum 2-inch insertion length and a stop bead. Use inside slip couplings for duct-to-duct joints, and outside slip couplings for fitting-to-fitting joints.

3. Ducts and fittings larger than 36" shall have flanged connections.

4. Secure all joints with at least 3 sheet metal screws before sealing.

5. Slide-on flanges as manufactured by Ductmate Industries, Accuflange, or Sheet Metal Connectors are acceptable. Self-sealing duct systems are also acceptable (Lindab, Ward "Keating Coupling").

2.5 FLEXIBLE DUCT

A. Flexible duct shall be listed and labeled as UL 181 Class 1 Air Duct Material, and shall comply with NFPA 90A and 90B, and meet GSA, FHA and other U.S. Government agency standards. Flexible duct shall bear the ADC Seal of Certification.

B. Flame Spread/Smoke Developed: Not over 25/50.

C. Flexible duct shall have corrosion-resistant wire helix, bonded to an inner liner that prevents air from contacting the insulation, covered with 1-1/2", 3/4 pound density fiberglass insulation blanket, sheathed in a vapor barrier of metalized polyester film laminated to glass mesh.

D. Inner liner shall be airtight and suitable for 6" WC static pressure through 10" diameter and shall be airtight and suitable for 4" WC static pressure 12" through 16" diameter. Outer jacket shall act as a vapor barrier only with permeance not over 0.1 perm per ASTM E96, Procedure A. "U" value shall not exceed 0.23 Btuh/ft^2/ºF. Temperature range of at least 0-180ºF. Maximum velocity of 4,000 fpm.

E. Usage:

1. Take-offs from supply ducts to inlets of terminal air boxes. Do not exceed 36" in length.

2. Connections to air inlets and outlets. Do not exceed 6'-0" in length.

F. Stretch all flexible duct to prevent sags and reduce air friction. Shorten and reinstall all sagging or loose flexible duct. Avoid sharp elbows. Elbows shall maintain 1.5 diameter centerline turning radius.

G. Install per the SMACNA Flexible Duct Manual. Secure inner layer with draw band. Wrap with pressure sensitive tape for protection prior to installing draw band. Pressure sensitive tape alone is <u>not</u> acceptable.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide openings in ducts for thermometers and controllers.

B. Locate ducts with space around equipment for normal operation and maintenance.

C. Do not install ducts or other equipment above electrical switchboards or panelboards. This includes a dedicated space extending from floor to 6 feet above the electrical equipment. Unless intended to serve these rooms, do not install any ductwork or equipment in electrical rooms, transformer rooms, electrical closets, telephone rooms or elevator machine rooms

D. During construction provide temporary closures of metal or taped polyethylene on open ducts to prevent dust from entering ductwork.

E. Repair all duct insulation and liner tears.

F. Install manual volume dampers in branch supply ducts so all outlets can be adjusted. Do not install dampers at air terminal device or in outlets, unless specifically shown.

G. Install flexible duct in accordance with the ADC Flexible Duct Performance and Installation Standards.

H. Support all duct systems in accordance with the SMACNA HVAC Duct Construction Standards: Metal and Flexible.

I. Adhesives, sealants, tapes, vapor retarders, films, and other supplementary materials added to ducts, plenums, housing panels, silencers, etc. shall have flame spread/smoke developed ratings of under 25/50 per ASTM E84, NFPA 255, or UL 723.

3.2 DUCTWORK APPLICATION SCHEDULE

USAGE	**MATERIAL**	**PRESSURE CLASS**	**SEAL CLASS †**	**INSULATION** (Refer to Specification Section 15290 for insulation types)
Supply Duct	Galvanized Sheet Metal - Rectangular	+2”	A	1” thick Type C
Supply Duct	Galvanized Sheet Metal - Round	+2”	A	1-1/2" thick Type A
Return Duct	Galvanized Sheet Metal	-2"	A	1" thick Type C
Exhaust Air Duct from fan to Exhaust Outlet	Galvanized Sheet Metal	+2"	A	1-1/2" thick Type A
Ductwork Accessories (Fabric Flex Connectors, Equipment Flanges, etc.)	---	---	---	1-1/2” thick Type A
† Seal Class is per SMACNA HVAC Air Duct Leakage Test Manual				

3.3 DUCTWORK SEALING

A. General Requirements:

1. Openings, such as rotating shafts, shall be sealed with bushings or similar.

2. Pressure sensitive tape shall not be used as the primary sealant unless it has been certified to comply with UL-181A or UL-181B by an independent testing laboratory and the tape is used in accordance with that certification.

3. All connections shall be sealed including, but not limited to, taps, other branch connections, access doors, access panels, and duct connections to equipment. Sealing that would void product listings is not required. Spiral lock seams need not be sealed.

4. Mastic-based duct sealants shall be applied to joints and seams in minimum 3 inch wide by 20 mil thick bands using brush, putty knife, trowel, or spray, unless manufacturer’s data sheet specifies other application methods or requirements.

B. For Seal Class A ducts, all transverse joints, longitudinal seams, and duct wall penetrations shall be sealed. Joints are inclusive of, but not limited to, girth joints, branch and sub-branch intersections, duct collar tap-ins, fitting subsections, louver and air terminal connections to ducts, access door and access panel frames and jambs, duct, plenum, and casing abutments to building structures.

1. Continuously welded and locking-type longitudinal joints and seams in ducts operating at static pressures less than 2 inches of water column pressure classification shall not require additional closure systems.

3.4 TESTING

A. Duct - 2" WG or Less (positive or negative):

1. Systems shall not leak more than permitted by Table 4-1 of SMACNA HVAC Air Duct Leakage Test Manual for Seal Class A.

2. Leak testing of these systems is not normally required for interior ductwork. However, leak tests will be required if, in the opinion of the Architect/Engineer, the leakage appears excessive. Contractor shall be responsible for testing costs.

3. Leak test shall be at the Contractor's expense and shall require capping and sealing all openings.

4. Seal ducts to bring the air leakage into compliance.

5. Contractor shall notify the Architect/Engineer five business days prior to pressurizing ductwork for testing.

3.5 DUCTWORK PENETRATIONS

A. Seal all duct penetrations of walls that are not fire rated by caulking or packing with fiberglass. Install galvanized steel (unless otherwise indicated) trim strip to cover vacant space and raw construction edges of all rectangular openings in finished rooms.

END OF SECTION

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SECTION 15910
DUCTWORK ACCESSORIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Manual Volume Dampers.
B. Fabric Connectors.
C. Duct Access Doors.
D. Duct Test Holes.

1.2 REFERENCES

A. ASTM E-477-99 - Standard Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers.

B. ASTM E2336-04 – Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems.

C. NFPA 90A - Installation of Air-Conditioning and Ventilating Systems.

D. SMACNA - HVAC Duct Construction Standards – Third Edition - 2005.

PART 2 - PRODUCTS

2.1 MANUAL VOLUME DAMPERS

A. Fabricate in accordance with SMACNA Duct Construction Standards, and as indicated.

B. Fabricate single blade dampers for duct sizes to 9-1/2 x 30 inches.

C. Fabricate multi-blade damper of opposed blade pattern with maximum blade sizes 12" x 72". Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.

D. Except in round ductwork 12 inches and smaller, provide end bearings. On multiple blade dampers, provide molded synthetic or oil-impregnated nylon or sintered bronze bearings.

E. Provide locking quadrant regulators on single and multi-blade dampers.

F. On insulated ducts, mount quadrant regulators on stand-off mounting brackets, bases, or adapters.

G. If blades are in open position and extend into the main duct, mount damper so blades are parallel to airflow.

2.2 FABRIC CONNECTORS

A. Fabric connectors shall be installed between all fans or fan units and metal ducts or casings to prevent transfer of fan or motor vibration.

B. The fabric connectors shall be completely flexible material which shall be in folds and not drawn tight.

C. Fabric connectors shall be of glass fabric double coated with neoprene, with UL approval. Weight = 30 oz. per square yard minimum. Fabric shall not be affected by mildew and shall be absolutely waterproof, airtight and resistant to acids, alkalies, grease and gasoline, and shall be noncombustible.

D. Fabric connections shall not exceed 6" in length on ductwork that has a positive pressure. On ductwork that has a negative pressure, the length shall not exceed 2" in length.

E. All corners shall be folded, sealed with mastic and stapled on 1" centers.

F. Fabric connectors shall not be painted.

G. Unless otherwise shown on the drawings, the fabric connection at the inlet to centrifugal fans shall be at least one duct diameter from the fan to prevent inlet turbulence.

H. Acceptable Materials: Durodyne MFN-4-100, Vent Fabrics, Inc. "Ventglas", or Proflex PFC3NGA.

2.3 DUCT ACCESS DOORS

A. Fabricate per Fig. 7-2 and 7-3 of the SMACNA HVAC Duct Construction Standards and as indicated.

B. Review locations prior to fabrication. Install access doors at fire dampers, smoke dampers, motorized dampers, fan bearings, filters, automatic controls, humidifiers, louvers, duct coils and other equipment requiring service inside the duct.

C. Construction shall be suitable for the pressure class of the duct. Fabricate rigid, airtight, and close-fitting doors of materials identical to adjacent ductwork with sealing gaskets butt or piano hinges, and quick fastening locking devices. For insulated ductwork, install minimum one inch thick insulation with sheet metal cover.

D. Access doors with sheet metal screw fasteners are not acceptable.

E. Minimum size for access doors shall be 24"x16" or full duct size, whichever is less.

F. Provide quantity of access doors such that two hands can fit inside ductwork to manually reset fire dampers. This will typically require one access door on the bottom and one access door on an accessible side of the duct for sizes 12x12 and smaller.

2.4 DUCT TEST HOLES

A. Cut or drill temporary test holes in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories in accordance with manufacturer's instructions.

B. Provide manual volume dampers at points on low pressure supply, return, and exhaust systems where branches are taken from larger ducts where indicated on drawings and as required for air balancing.

C. Provide ceiling access doors for manual volume dampers. When manual volume dampers are located above an inaccessible ceiling and an access door cannot be installed, provide a remote controlled volume control device for operation of the damper. Coordinate location with the Architect/Engineer.

D. Where duct access doors are located above inaccessible ceilings, provide ceiling access doors. Coordinate location with the Architect/Engineer.

E. Coordinate and install access doors provided by others.

F. Provide access doors for all equipment requiring maintenance or adjustment above an inaccessible ceiling. Minimum size shall be 24”x24”.

G. Provide duct test holes where indicated and as required for testing and balancing purposes.

END OF SECTION

SECTION 15936
AIR INLETS AND OUTLETS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Grilles and Registers.
B. Architectural Square Panel Diffusers.

1.2 REFERENCES

A. ANSI/ASHRAE 70 - Method of Testing for Rating the Air Flow Performance of Inlets and Outlets.

B. ANSI/NFPA 90A - Installation of Air-Conditioning and Ventilating Systems.

C. SMACNA - Duct Construction Standards.

1.3 QUALITY ASSURANCE

A. Test and rate performance of air inlets and outlets per ASHRAE 70.

1.4 REGULATORY REQUIREMENTS

A. Conform to ANSI/NFPA 90A.

1.5 SUBMITTALS

A. Submit product data under provisions of Section 15010.

B. Submit schedule of inlets and outlets indicating type, size, location, application, and noise level.

C. Review requirements of inlets and outlets as to size, finish, and type of mounting prior to submitting product data and schedules of inlets and outlets.

D. Submit manufacturer's installation instructions.

PART 2 - PRODUCTS

2.1 GRILLES AND REGISTERS

A. Reference to a grille means an air supply, exhaust or transfer device without a damper.

B. Reference to a register means an air supply, exhaust or transfer device with a damper.

C. The type of unit, margin, material, finish, etc., shall be as shown on the drawing schedule and suitable for the intended use.

D. All margins shall be compatible with ceiling types specified (including 'Thin-Line' T-bar lay-in grid system). Any discrepancies in contract documents shall be brought to the attention of

the Architect/Engineer, in writing, prior to Bid Date. Submission of Bid indicates ceiling and air inlet and outlet types have been coordinated.

E. The capacity and size of the unit shall be as shown on the drawings.

F. All units shall handle the indicated cfm as shown on the drawings while not exceeding an NC level of 25, referenced to 10^{-12} watts with a 10 dB room effect.

G. Refer to the drawings for construction material, color and finish, margin style, deflection, and sizes of grilles and registers.

H. Provide with 3/4" blade spacing. Blades shall have steel friction pivots to allow for blade adjustment, plastic pivots are not acceptable.

I. Corners of steel grilles and registers shall be welded and ground smooth before painting. Aluminum grilles and registers shall have staked corners.

J. Where specified to serve registers, provide opposed blade volume dampers operable from the face of the register.

K. Screw holes for surface fasteners shall be countersunk for a neat appearance. Provide concealed fasteners for installation in lay-in ceilings and as specified on the drawings.

L. Acceptable Manufacturers: Tuttle & Bailey, Titus, Price, Nailor, Carnes, or Krueger.

2.2 ARCHITECTURAL SQUARE PANEL DIFFUSERS

A. Reference to a diffuser means an air supply device, ceiling mounted, that shall diffuse air uniformly throughout the conditioned space.

B. The type of unit, margin, material, finish, etc., shall be as shown on the drawing schedule. Flat-oval inlets are not acceptable for connection to flexible ducts.

C. All margins shall be compatible with ceiling types specified (including 'Thin-Line' T-bar lay-in grid system). Any discrepancies in contract documents should be brought to the attention of the Architect/Engineer, in writing, prior to Bid Date. Submission of Bid indicates ceiling and air inlet and outlet types have been coordinated.

D. The capacity and size of the unit shall be as shown on the drawings.

E. All units shall handle the indicated cfm as shown on the drawings while not exceeding an NC level of 25, referenced to 10^{-12} watts with a 10 dB room effect.

F. Diffusers shall be Architectural solid square panel and flush with ceiling.

G. The exposed surface shall be smooth, flat and free of visible fasteners. The face panel shall be 22 gauge steel with a rolled edge or shall be 18 gauge with a smooth ground, uniform edge.

H. The back pan shall be one piece 22 gauge stamped and shall include an integral inlet. (Welded inlets and corner joints are not acceptable).

I. Diffusers with a 24x24 back pan shall have a minimum 18x18 face panel size. Diffusers with a 12x12 back pan shall have a minimum 9x9 face panel size.

J. The face panel shall be mechanically fastened to the back panel with steel components. (Plastic fasteners are not acceptable.)

K. Acceptable Manufacturers: Tuttle & Bailey, Titus, Price, Nailor, Carnes, or Krueger.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install items in accordance with manufacturers' instructions.

B. Check location of inlets and outlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

C. Install diffusers to ductwork with air tight connections.

D. Provide manual volume dampers on duct take-off to diffusers when there are multiple connections to a common duct. Locate volume dampers as far as possible from the air inlet or outlet.

E. Flexible ducts shall NOT be joined to flat-oval connections. Provide sheet metal oval-to-round transitions where required.

END OF SECTION

SECTION 15980
INSTRUMENTATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pressure Gauge.
B. Pressure Gauge Accessories.
C. Thermometers.
D. Test Plugs.
E. Static and Differential Airflow Pressure Gauges.

1.2 REFERENCES

A. ASME B40.1 - Gauges - Pressure Indicating Dial Type - Elastic Element.

B. ASME MFC-3M - Measurement of Fluid Flow in Pipes Using Orifice, Nozzle and Venturi.

C. ASTM E1 - Specification for ASTM Thermometers.

1.3 SUBMITTALS

A. Submit shop drawings per Section 15010. Include list that indicates use, operating range, total range and location for manufactured components.

PART 2 - PRODUCTS

2.1 PRESSURE GAUGES

A. Gauges shall be 4-1/2" diameter with aluminum or stainless steel case with phosphor bronze bourdon tube, brass socket for air, steam, water or oil application, 1/4" bottom connection. Gauges shall be 1% full scale accurate with bronze bushed brass movement and adjustable pointer. Standard ranges to be either pressure or pressure and vacuum as required of application.

B. Acceptable Manufacturers: U. S. Gauge Figure 5801, Marshalltown, Marsh, Weiss, Weksler, Ashcroft, Wika.

C. Select gauge range for normal reading near center of gauge.

2.2 PRESSURE GAUGE ACCESSORIES

A. All pressure gauges shall have valves and pressure snubbers.

B. Shut-off Valve: 1/4" ball valve as specified for each piping system.

C. Pressure snubber, brass with 1/4" connections, porous metal type.

2.3 THERMOMETERS

A. Alcohol/Spirit Filled Type:

1. 9" long phenolic case, steel stem, accuracy of 1% full scale. Adjustable elbow joint with locking device to allow rotation of thermometer to any angle.

2. Select thermometer for appropriate temperature range.

3. Stem lengths as required for application with minimum insertion of 3-1/2".

4. Thermometers for water, steam, or oil shall have brass or steel separable socket. Wells shall extend through insulation. Thermometers for air shall have an aluminum or brass duct flange.

B. Select scales to cover expected range of temperatures.

2.4 TEST PLUGS

A. Test Plug: 1/4" or 1/2" brass fitting and cap, with Nordel core for temperatures up to 275°F, for receiving 1/8" outside diameter pressure or temperature probe. Plugs shall be rated for zero leakage from vacuum to 500 psi.

B. Provide extended units for all plugs installed in insulated piping.

C. Test Kit: Carrying case, internally padded and fitted containing one 3-1/2" diameter pressure gauge with 0-100 psi range, one gauge adapter with 1/8" probes, two 1-1/2" dial thermometers with 0° to 220°F and -25°F to 125°F ranges and 5" stems.

D. Acceptable Manufacturers: Sisco, Flow Design, or Peterson Equipment.

2.5 STATIC AND DIFFERENTIAL AIRFLOW PRESSURE GAUGES

A. Diaphragm-activated gauge with 4-3/4" dial, cast aluminum case, sealed interior, designed to resist shock and vibration, and rated for 15 psig.

B. Accuracy shall be ± 3% of full scale maximum throughout entire range at 70°F.

C. Provide mounting brackets, probes, and shut-off valves required for proper installation.

D. The range and service shall be as required for application or as noted on the drawings.

E. Acceptable Manufacturers: Dwyer Magnehelic Series 2000, Marshalltown Instrument Series 85C.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install per manufacturer's instructions.

B. Connect pressure gauges to suction and discharge side of all pumps.

C. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2" for installation of thermometer sockets.

D. Install thermometer sockets adjacent to control system thermostat, transmitter and sensor sockets.

E. Locate duct thermometers minimum 10 feet downstream of mixing dampers, coils, or other devices causing air turbulence.

F. Coil and conceal excess capillary on remote element instruments.

G. Install gauges and thermometers in locations where they are easily read from normal operating level.

H. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

END OF SECTION

SECTION 15990
TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Testing, adjusting, and balancing of air systems.
B. Testing, adjusting, and balancing of heating/cooling systems.
C. Testing, adjusting, and balancing of plumbing systems.
D. Measurement of final operating condition of HVAC systems.

1.2 REFERENCES

A. AABC - National Standards for Total System Balance, 2002.

B. ADC – Test Code for Grilles, Registers, and Diffusers.

C. AMCA – Publication 203-90; Field Performance Measurement of Fan Systems.

D. ASHRAE - 2003 HVAC Applications Handbook; Chapter 37, Testing, Adjusting and Balancing.

E. ASHRAE/ANSI - Standard 111-1988; Practices for Measurement, Testing, Adjusting and Balancing of Building HVAC&R Systems.

F. NEBB - Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems, Sixth Edition, 1998.

G. SMACNA - HVAC Systems; Testing, Adjusting and Balancing, Third Edition, 2002.

H. TABB – International Standards for Environmental Systems Balance.

1.3 SUBMITTALS

A. Submit copies of report forms, balancing procedures, and the name and qualifications of testing and balancing agency for approval within 30 days after award of Contract.

B. Submit four (4) certified copies of test reports to the Architect/Engineer for approval in soft cover, 3-hole binder manuals, with cover identification. Include index page and indexing tabs.

1.4 REPORT FORMS

A. Submit reports on AABC, SMACNA or NEBB forms. Use custom forms approved by the Architect/Engineer when needed to supply specified information.

B. Include in the final report a schematic drawing showing each system component, including balancing devices, for each system. Each drawing shall be included with the test reports required for that system. The schematic drawings shall identify all testing points and cross-reference these points to the report forms and procedures.

C. Refer to PART 4 for required reports.

1.5 QUALITY ASSURANCE

A. Agency shall be a company specializing in the adjusting and balancing of systems specified in this section with minimum three years experience. Perform work under supervision of AABC Certified Test and Balance Engineer, NEBB Certified Testing, Balancing and Adjusting Supervisor, SMARTA Certified Air and Hydronic Balancer, or TABB Certified Supervisor.

B. Work shall be performed in accordance with the requirements of the references listed at the start of this section.

1.6 WARRANTY/GUARANTEE

A. The TAB Contractor shall include an extended warranty of 90 days after owner receipt of a completed balancing report, during which time the Owner may request a recheck of terminals, or resetting of any outlet, coil, or device listed in the test report. This warranty shall provide a minimum of 24 manhours of on site service time. If it is determined that the new test results are not within the design criteria, the balancer shall rebalance the system according to design criteria.

B. Warranty/Guarantee must meet one of the following programs: TABB International Quality Assurance Program, AABC National Project Performance Guarantee, NEBB's Conformance Certification.

1.7 SCHEDULING

A. Coordinate schedule with other trades. Provide a minimum of seven days notice to all trades and the Architect/Engineer prior to performing each test.

PART 2 - PRODUCTS

NOT APPLICABLE

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. All procedures must conform to a published standard listed in Paragraph 1.2. All equipment shall be adjusted in accordance with the manufacturer's recommendations. Any system not listed in this specification but installed under the contract documents shall be balanced using a procedure from a published standard listed in Paragraph 1.2.

B. Recorded data shall represent actual measured or observed conditions.

C. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing is complete, close probe holes and patch insulation with new materials as specified. Restore vapor barrier and finish as specified.

D. Permanently mark setting of valves, dampers, and other adjustment devices allowing for settings to be restored. Set and lock memory stops.

E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, plugging test holes, and restoring thermostats to specified settings.

F. Installations with systems consisting of multiple components shall be balanced with all system components operating.

3.2 EXAMINATION

A. Before beginning work, verify that systems are complete and operable. Ensure the following:

1. Equipment is safe to operate and in normal condition.
2. Equipment with moving parts is properly lubricated.
3. Temperature control systems are complete and operable.
4. Proper thermal overload protection is in place for electrical equipment.
5. All filters are clean and in place. If required, install temporary media.
6. Duct systems are clean and free of debris.
7. Direction of rotation of all fans and pumps is correct.
8. Manual volume dampers are in place, functional and open.
9. Coil fins have been cleaned and combed.
10. Access doors are closed and end caps are in place.
11. Air outlets are installed and connected.
12. Duct system leakage has been minimized.
13. Hydronic systems have been cleaned, filled, and vented.
14. Strainer screens are clean and in place.
15. Shut-off, throttling and balancing valves are open.

B. Report any defects or deficiencies to Architect/Engineer.

C. Promptly report items that are abnormal or prevent proper balancing.

D. If, for design reasons, system cannot be properly balanced, report as soon as observed.

E. Beginning of work means acceptance of existing conditions.

3.3 PREPARATION

A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to the Architect/Engineer for spot checks during testing.

B. Instruments shall be calibrated within six months of testing performed for project, or more recently if recommended by the instrument manufacturer.

3.4 INSTALLATION TOLERANCES

A. Adjust supply, return, and exhaust air-handling systems to +10% / -5% of scheduled values.

B. Adjust air inlets and outlets to ± 10% of scheduled values.

C. Adjust piping systems to ± 10% of design values.

3.5 ADJUSTING

A. After adjustment, take measurements to verify balance has not been disrupted or that disruption has been rectified.

B. Once balancing of systems is complete, at least one damper or valve must be 100% open.

C. After testing, adjusting and balancing are complete, operate each system and randomly check measurements to verify system is operating as reported in the report. Document any discrepancies.

D. Contractor responsible for each motor shall also be responsible for replacement sheaves. Coordinate with contractor.

E. Contractor responsible for pump shall trim impeller to final duty point as instructed by this contractor on all pumps not driven by a VFD. Coordinate with contractor.

3.6 SUBMISSION OF REPORTS

A. Fill in test results on appropriate forms.

PART 4 - SYSTEMS TO BE TESTED, ADJUSTED AND BALANCED

4.1 GENERAL REQUIREMENTS

A. Title Page:

1. Project name.
2. Project location.
3. Project Architect.
4. Project Engineer (KJWW Engineering Consultants).
5. Project General Contractor.
6. TAB Company name, address, phone number.
7. TAB Supervisor's name and certification number.
8. TAB Supervisor's signature and date.
9. Report date.

B. Report Index

C. General Information:

1. Test conditions.
2. Nomenclature used throughout report.
3. Notable system characteristics/discrepancies from design.
4. Test standards followed.
5. Any deficiencies noted.
6. Quality assurance statement.

D. Instrument List:

1. Instrument.
2. Manufacturer, model, and serial number.
3. Range.
4. Calibration date.

4.2 AIR SYSTEMS

A. Air Moving Equipment:

1. Drawing symbol.
2. Location.
3. Manufacturer, model, arrangement, class, discharge.
4. Supply flow rate (cfm): specified and actual.
5. Return flow rate (cfm): specified and actual.
6. Exhaust flow rate (cfm): specified and actual.
7. Filter pressure drop: specified and actual.
8. Total static pressure: specified and actual. (Indicate if across fan or external to unit).
9. Inlet pressure.
10. Discharge pressure.
11. Fan RPM.
12. Multiple RPM fan curve with operating point marked. (Obtain from equipment supplier).

B. Fan Data:

1. Drawing symbol.
2. Location.
3. Manufacturer and model.
4. Flow rate (cfm): specified and actual.
5. Total static pressure: specified and actual. (Indicate measurement locations).
6. Inlet pressure.
7. Discharge pressure.
8. Fan RPM.

C. Electric Motors:

1. Drawing symbol of equipment served.
2. Manufacturer, Model, Frame.
3. Nameplate: HP, phase, service factor, RPM, operating amps, efficiency.
4. Measured: Amps in each phase.

D. Air Terminal (Inlet or Outlet):

1. Drawing symbol.
2. Room number/location.
3. Terminal type and size.
4. Velocity: specified and actual.
5. Flow rate (cfm): specified and actual.
6. Percent of design flow rate.

4.3 HEATING/COOLING SYSTEMS (ALTERNATES 1 AND 3)

A. Pump Data (Loop Pumps and Radiant Pump):

1. Existing drawing symbol or equipment TAG
2. Service.
3. Manufacturer, size, and model.
4. Impeller size: specified, actual, and final (if trimmed).
5. Flow Rate (gpm): specified and actual.
6. Pump Head: specified, operating and shut-off.
7. Suction Pressure: Operating and shut-off.
8. Discharge Pressure: Operating and shut-off.

B. Electric Motors (Associated Pump Motors):

1. Drawing symbol of equipment served.
2. Manufacturer, Model, Frame.
3. Nameplate: HP, phase, service factor, RPM, operating amps, efficiency.
4. Measured: Amps in each phase.

C. Terminal Heat Transfer Units:

1. Drawing symbol.
2. Location.
3. Manufacturer and model.
4. Flow rate (cfm): specified and actual.
5. Entering air temperature: specified and actual.
6. Leaving air temperature: specified and actual.
7. Water flow rate (gpm): specified and actual.
8. Entering water temperature: specified and actual.
9. Leaving water temperature: specified and actual.
10. Air Btuh (cfm x temperature rise x 1.09).
11. Water Btuh (gpm x temperature drop x 500). Repeat tests if not within 10% of air Btuh.
12. Include air data only for forced air units.

4.4 PLUMBING SYSTEMS

A. Gas Fired or Electric Water Heater (Alternates 1 and 3):

1. Drawing symbol.
2. Service.
3. Location.
4. Manufacturer and model.
5. Capacity (Btuh): specified, nameplate, and actual.
6. Entering water temperature: specified and actual.
7. Leaving water temperature: specified and actual.
8. Pressure Drop: specified and actual.
9. Control Setting: specified and actual.

END OF SECTION

SECTION 16010
BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Requirements applicable to all Division 16 Sections. Also refer to Division 1 - General Requirements. This section is also applicable to Interior Communications Pathways Section 17130.

B. All materials and installation methods shall conform to the applicable standards, guidelines and codes referenced in each specification section.

1.2 SCOPE OF WORK

A. This Specification and the associated drawings govern furnishing, installing, testing and placing into satisfactory operation the Electrical Systems.

B. The Contractor shall furnish and install all new materials as indicated on the drawings, and/or in these specifications, and all items required to make his portion of the Electrical Work a finished and working system.

C. Description of Systems shall be as follows:

1. Electrical power system to and including light fixtures, equipment, motors, devices, etc.

2. Electrical power service system from the Utility Company to and including service entrance equipment, distribution and metering.

3. Grounding system.

4. Wiring system for temperature control system as shown on the drawings.

5. Technology Systems as described in Division 17 and on the T-series documents as described in the Suggested Matrix of Scope Responsibility.

D. Work Not Included:

1. Temperature control wiring for plumbing and HVAC equipment (unless otherwise indicated) will be by other Contractors.

1.3 DIVISION OF WORK BETWEEN MECHANICAL, ELECTRICAL, AND CONTROL CONTRACTORS

A. Division of work is the responsibility of the Prime Contractor. Any scope of work described at any location on the contract document shall be sufficient for including said requirement in the project. The Prime Contractor shall be solely responsible for determining the appropriate subcontractor for the described scope. In no case shall the project be assessed an additional cost for scope that is described on the contract documents on bid day. The following division of responsibility is a guideline based on typical industry practice.

B. Definitions:

1. "Mechanical Contractors" refers to the Contractors listed in Division 15 of this Specification.

2. "Technology Contractors" refers to the Contractors furnishing and installing systems listed in Division 17 of this Specification.

3. Motor Power Wiring: The single phase or 3 phase wiring extending from the power source (transformer, panelboard, feeder circuits, etc.) through disconnect switches and motor controllers to, and including the connections to the terminals of the motor.

4. Motor Control Wiring: The wiring associated with the remote operation of the magnetic coils of magnetic motor starters or relays, or the wiring that permits direct cycling of motors by means of devices in series with the motor power wiring. In the latter case, the devices are usually single phase, have "Manual-Off-Auto" provisions, and are usually connected into the motor power wiring through a manual motor starter.

5. Control devices such as start-stop push buttons, thermostats, pressure switches, flow switches, relays, etc., generally represent the types of equipment associated with motor control wiring.

6. Motor control wiring is single phase and usually 120 volts. In some instances, the voltage will be the same as the motor power wiring. When the motor power wiring exceeds 120 volts, a control transformer is usually used to give a control voltage of 120 volts.

7. Temperature Control Wiring: The wiring associated with the operation of a motorized damper, solenoid valve or motorized valve, etc., either modulating or two-position, as opposed to wiring that directly powers or controls a motor used to drive equipment such as fans, pumps, etc. This wiring will be from a 120 volt source and may continue as 120 volt, or be reduced in voltage (24 volt), in which case a control transformer shall be furnished as part of the temperature control wiring.

8. Control Motor: An electric device used to operate dampers, valves, etc. It may be two-position or modulating. Conventional characteristics of such a motor are 24 volts, 60 cycles, 1 phase, although other voltages may be encountered.

9. Low Voltage Technology Wiring: The wiring associated with the Technology Systems, used for analog or digital signals between equipment.

10. Telecommunications Rough-in: Relates specifically to the backboxes, necessary plaster rings and other miscellaneous hardware required for the installation or mounting of telecommunications information outlets.

C. General:

1. The purpose of these Specifications is to outline the Electrical and Mechanical Contractors' responsibilities related to electrical work required for items such as temperature controls, mechanical equipment, fans, chillers, compressors, etc. The exact wiring requirements for much of the equipment cannot be determined until the

systems have been selected and submittals approved. Therefore, the electrical drawings show only known wiring related to such items. All wiring not shown on the electrical drawings, but required for mechanical systems, is the responsibility of the Mechanical Contractor.

2. Where the drawings require the Electrical Contractor to wire between equipment furnished by the Mechanical Contractor, such wiring shall terminate at terminals provided in the equipment. The Mechanical Contractor shall furnish complete wiring diagrams and supervision to the Electrical Contractor and designate the terminal numbers for correct wiring.

3. The Electrical Contractor shall establish electrical utility elevations prior to fabrication and installation. The Electrical Contractor shall coordinate utility elevations with other trades. When a conflict arises, priority shall be as follows:

   a. Lighting Fixtures
   b. Gravity flow piping, including steam and condensate.
   c. Electrical bus duct.
   d. Sheet metal.
   e. Cable trays, including access space.
   f. Other piping.
   g. Conduits and wireway.

D. Mechanical Contractor's Responsibility:

1. Assumes responsibility for internal wiring of all equipment furnished by the Mechanical Contractor.

2. Assumes all responsibility for miscellaneous items furnished by the Mechanical Contractor that require wiring but are not shown on the electrical drawings or specified in the Electrical Specification. If items such as relays, flow switches, or interlocks are required to make the mechanical system function correctly or are required by the manufacturer, they are the responsibility of the Mechanical Contractor.

3. Assumes all responsibility for Temperature Control wiring, if the Temperature Control Contractor is a Subcontractor to the Mechanical Contractor.

4. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

E. Temperature Control Contractor's or Subcontractor's Responsibility:

1. Wiring of all devices needed to make the Temperature Control System functional.

2. Verifying any control wiring on the electrical drawings as being by the Electrical Contractor. All wiring is required for the Control System, but not shown on the electrical drawings, is the responsibility of the Temperature Control Contractor or Subcontractor.

3. Coordinating equipment locations (such as PE's, EP's, relays, transformers, etc.) with the Electrical Contractor, where wiring of the equipment is by the Electrical Contractor.

F. Electrical Contractor's Responsibility:

1. Furnishes and installs all combination starters, manual starters and disconnect devices shown on the Electrical Drawings or indicated to be by the Electrical Contractor in the Mechanical Drawings or Specifications.

2. Installs and wires all remote control devices furnished by the Mechanical Contractor or Temperature Control Contractor when such so noted on the Electrical Drawings.

3. Furnishes and installs motor control and temperature control wiring, when noted on the drawings.

4. Furnishes, installs, and connects all relays, etc., for automatic shutdown of certain mechanical equipment (supply fans, exhaust fans, etc.) upon actuation of the Fire Alarm System.

5. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

G. General (Electrical/Technology):

1. "Electrical Contractor" as referred to herein shall be responsible for scope listed in Division 17 of this specification when the "Suggested Matrix of Scope Responsibility" indicated work shall be furnished and installed by the EC. Refer to the Contract Documents for this "Suggested Matrix of Scope Responsibility".

2. The purpose of these Specifications is to outline the Electrical and Technology Contractor's work responsibilities as related to Telecommunications Rough-in, conduit, cable tray, power wiring and Low Voltage Technology Wiring.

3. The exact wiring requirements for much of the equipment cannot be determined until the systems have been purchased and submittals approved. Therefore, only known wiring, conduits, raceways and electrical power related to such items is shown on the Technology drawings. Other wiring, conduits, raceways, junction boxes and electrical power not shown on the Technology Drawings but required for operation of the systems is the responsibility of the Technology Contractor and included in said Contractor's bid.

4. Where the Electrical Contractor is required to install conduit, conduit sleeves and/or power connections in support of Technology systems, the final installation shall not be until a coordination meeting between the Electrical Contractor and the Technology Contractor has convened to determine the exact location and requirements of the installation.

5. Where the Electrical Contractor is required to install cable tray that will contain Low Voltage Technology Wiring, installation shall not begin prior to a coordination review of the cable tray shop drawings by the Technology Contractor.

H. Technology Contractor's Responsibility:

1. Assumes all responsibility for the Low Voltage Technology Wiring of all systems, including cable support where open cable is specified.

2. Assumes all responsibility for all required backboxes, conduit and power connections not specifically shown as being furnished and installed by the Electrical Contractor on the "Suggested Matrix of Scope Responsibility".

3. Assumes all responsibility for providing and installing all ladder rack and other cable management hardware (as defined in here-in).

4. Responsible for providing the Electrical Contractor with the required grounding lugs or other hardware for each piece of Technology equipment which is required to be bonded to the telecommunications ground bar.

5. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

1.4 QUALITY ASSURANCE

A. Contractor's Responsibility Prior to Submitting Pricing/Bid Data:

1. The Contractor is responsible for constructing complete and operating systems. The Contractor acknowledges and understands that the Contract Documents are a two-dimensional representation of a three-dimensional object, subject to human interpretation. This representation may include imperfect data, interpreted codes, utility guides, three-dimensional conflicts, and required field coordination items. Such deficiencies can be corrected when identified prior to ordering material and starting installation. The Contractor agrees to carefully study and compare the individual Contract Documents and report at once in writing to the Architect/Engineer any deficiencies the Contractor may discover. The Contractor further agrees to require each subcontractor to likewise study the documents and report at once any deficiencies discovered.

2. The Contractor shall resolve all reported deficiencies with the Architect/Engineer prior to awarding any subcontracts, ordering material, or starting any work with the Contractor's own employees. Any work performed prior to receipt of instructions from the Architect/Engineer will be done at the Contractor's risk.

B. Qualifications:

1. Only products of reputable manufacturers as determined by the Engineer are acceptable.

2. All Contractors and subcontractors shall employ only workmen who are skilled in their trades. At all times, the number of apprentices at the job site shall be less than or equal to the number of journeymen at the job site.

C. Compliance with Codes, Laws, Ordinances:

1. Conform to all requirements of the State of Iowa's Codes, Laws, Ordinances and other regulations having jurisdiction over this installation.

2. If there is a discrepancy between the codes and regulations and these specifications, the Engineer shall determine the method or equipment used.

3. If the Contractor notes, at the time of bidding, any parts of the drawings or specifications that do not comply with the codes or regulations, he shall inform the Architect/Engineer in writing, requesting a clarification. If there is insufficient time for this procedure, he shall submit with his proposal a separate price to make the system comply with the codes and regulations.

4. All changes to the system made after the letting of the contract to comply with codes or the requirements of the Inspector, shall be made by the Contractor without cost to the Owner.

5. If there is a discrepancy between manufacturer's recommendations and these specifications, the manufacturer's recommendations shall govern.

6. If there are no local codes having jurisdiction, the current issue of the National Electrical Code shall be followed.

D. Permits, Fees, Taxes, Inspections:

1. Procure all applicable permits and licenses.

2. Abide by all laws, regulations, ordinances, and other rules of the State or Political Subdivision where the work is done, or as required by any duly constituted public authority.

3. Pay all charges for permits or licenses.

4. Pay all fees and taxes imposed by State, Municipal, and other regulatory bodies.

5. Pay all charges arising out of required inspections by an authorized body.

6. Pay all charges arising out of required contract document reviews associated with the project and as initiated by the Owner or authorized agency/consultant.

7. Where applicable, all fixtures, equipment and materials shall be listed by Underwriter's Laboratories, Inc. or a nationally recognized testing organization.

E. Utility Company Requirements:

1. Secure from the private or public utility company all applicable requirements.

2. Comply with all utility company requirements.

3. The Owner shall make application for and pay for new electrical service equipment and installation. The Contractor shall coordinate schedule and requirements with the Owner and Utility Company.

4. Furnish the meter socket. Verify approved manufacturers and equipment with the Utility Company.

5. The Owner shall apply and pay for any changes for removal of existing electrical service by the utility company. The Contractor shall verify approved manufacturers and equipment with the Utility Company.

F. Examination of Drawings:

1. The drawings for the electrical work are completely diagrammatic, intended to convey the scope of the work and to indicate the general arrangements and locations of equipment, outlets, etc., and the approximate sizes of equipment.

2. Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing of raceways so as to best fit the layout of the job.

3. Scaling of the drawings will not be sufficient or accurate for determining these locations.

4. Where job conditions require reasonable changes in arrangements and locations, such changes shall be made by the Contractor at no additional cost to the Owner.

5. Because of the scale of the drawings, certain basic items, such as junction boxes, pull boxes, conduit fittings, etc., may not be shown, but where required by other sections of the specifications or required for proper installation of the work, such items shall be furnished and installed.

6. If an item is either shown on the drawings or called for in the specifications, it shall be included in this contract.

7. The Contractor shall determine quantities and quality of material and equipment required from the documents. Where discrepancies arise between drawings, schedules and/or specifications, the greater and better quality number shall govern.

8. Where used in electrical documents the word “furnish” shall mean supply for use, the word “install” shall mean connect up complete and ready for operation, and the word “provide” shall mean to supply for use and connect up complete and ready for operation.

9. Any item listed as furnished shall also be installed unless otherwise noted.

10. Any item listed as installed shall also be furnished unless otherwise noted.

G. Electronic Media/Files:

1. Construction drawings for this project have been prepared utilizing AutoCAD MEP Release 2011.

2. Contractors and Subcontractors may request electronic media files of the contract drawings and/or copies of the specifications. Specifications will be provided in PDF format.

3. Upon request for electronic media, the Contractor shall complete and return a signed "Electronic File Transmittal" form provided by KJWW.

4. If the information requested includes floor plans prepared by others, the Contractor will be responsible for obtaining approval from the appropriate Design Professional for use of that part of the document.

5. The electronic contract documents can be used for preparation of shop drawings and as-built drawings only. The information may not be used in whole or in part for any other project.

6. The drawings prepared by KJWW for bidding purposes may not be used directly for ductwork layout drawings or coordination drawings.

7. The use of these CAD documents by the Contractor does not relieve them from their responsibility for coordination of work with other trades and verification of space available for the installation.

8. The information is provided to expedite the project and assist the Contractor with no guarantee by KJWW as to the accuracy or correctness of the information provided. KJWW accepts no responsibility or liability for the Contractor's use of these documents.

H. Field Measurements:

1. Verify all pertinent dimensions at the job site before ordering any conduit, conductors, wireways, bus duct, fittings, etc.

1.5 SUBMITTALS

A. Submittals shall be required for the following items, and for additional items where required elsewhere in the specifications or on the drawings.

1. Submittals list:

Referenced Specification Section	**Submittal Item**
16141	Wiring Devices
16412	Surge Protection Devices
16440	Disconnect Switches
16470	Panelboards
16477	Fuses
16480	Motor Control
16510	Lighting
16535	Emergency Lighting Equipment
16570	Lighting Control System
Drawings	Photocells, Timeclocks, Relays

B. In addition to the provisions of Division 1, the following provisions are required:

1. Submittals shall include all fabrication, erection, layout, and setting drawings; manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures; performance and test data; wiring and control diagrams; and all other drawings and descriptive data of materials of construction as may be required to show that the materials, equipment or systems and the location thereof conform to the requirements of the contract documents.

2. The Contractor shall submit electronic PDF copies of each shop drawing for review by the Architect/Engineer BEFORE releasing any equipment for manufacture or shipment.

3. Review and markup air conditioning and ventilating contractor's layout drawings with electrical equipment and conduit routings for coordination.

4. The Contractor shall thoroughly review and approve all shop drawings before submitting them to the Architect/Engineer. CONTRACTOR’S APPROVAL STAMP IS REQUIRED ON ALL SUBMITTALS. APPROVAL WILL INDICATE THE CONTRACTOR'S REVIEW of all material and a COMPLETE UNDERSTANDING OF EXACTLY WHAT IS TO BE FURNISHED. Contractor shall clearly mark all deviations from the contract documents on all submittals. IF THE CONTRACTOR DOES NOT MARK DEVIATIONS, THEN THE ITEM SHALL BE REQUIRED TO MEET ALL DRAWING AND SPECIFICATION REQUIREMENTS.

5. Each data sheet shall clearly show at the top of the sheet what General Electrical Equipment Schedule symbol (and applicable variations and subscripts) that data sheet corresponds to.

6. Each data sheet shall show the size, rating, style, finish, material, catalog number, manufacturer name and product photos for each item to ensure compliance with these specifications.

7. Assemble all submittals in sets, such as panelboards, fire alarm, lighting, or motor control. All sets shall be identical and contain an index of the items enclosed with a general topic description on the cover.

8. Where more than one model is shown on a manufacturer's sheet, clearly indicate exactly which item and which data is relevant to the work.

9. Where the manufacturer lists multiple part numbers or options on a single data sheet, the part number and options to be used shall be clearly set apart from other part numbers shown on that sheet.

10. Failure to comply with the above shall be reason to resubmit all shop drawings.

11. The Engineer's responsibility shall be to review one set of shop drawing submittals for each product. If the first submittal is incomplete or does not comply with the drawings and/or specifications, the Contractor shall be responsible to bear the cost to the Owner, for the Engineer to recheck and handle the additional shop drawing submittals.

C. Provide Schedule of Values:

1. Application forms: Use AIA Document Continuation Sheets G703 (or similar) as the form for application.

2. Provide line items on the Schedule of Values including:

a. General Conditions (mobilization, bonds, insurance, etc.)
b. Lighting
c. Power

3. Change orders shall have schedule of values broken out as listed above submitted with each change order.

4. Coordinate with the Project Engineer the items included in the Schedule of Values. The intent is to not create schedules in addition to those the Electrical Contractor normally submits to the General Contractor for payment.

1.6 PRODUCT DELIVERY, STORAGE, HANDLING AND MAINTENANCE

A. Exercise care in transporting and handling to avoid damage to materials. Store materials on the site to prevent damage.

B. Keep all materials clean, dry and free from damaging environments.

C. Coordinate the installation of heavy and large equipment with the General Contractor and/or Owner. If the Electrical Contractor does not have prior documented experience in rigging and lifting similar equipment, he/she shall contract with a qualified lifting and rigging service that has similar documented experience. Follow all equipment lifting and support guidelines for handling and moving.

D. Contractor is responsible for moving equipment into the building and/or site. Contractor shall review site prior to bid for path locations and any required building modifications to allow movement of equipment. Contractor shall coordinate his/her work with other trades.

1.7 WARRANTY

A. Provide one-year warranty for all fixtures, equipment, materials, and workmanship.

B. The warranty period for all work in this specification Division shall commence on the date of Substantial Completion or successful system performance whichever occurs later. The warranty may also commence if a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization of the Owner. In this instance, the warranty period shall commence on the date when such whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the Owner.

C. Warranty requirements extend to correction, without cost to the Owner, of all work found to be defective or nonconforming to the contract documents. The Contractor shall bear the cost of correcting all damage due to defects or nonconformance with contract documents excluding repairs required as a result of improper maintenance or operation, or of normal wear as determined by the Architect/Engineer.

1.8 INSURANCE

A. This Contractor shall maintain insurance coverage as set forth in Division 1 of these specifications.

1.9 MATERIAL SUBSTITUTION

A. Where several manufacturers' names are given, the manufacturer for which a catalog number is given is the basis of design and establishes the quality required.

B. Equivalent equipment manufactured by the other named manufacturers may be used. Contractor shall ensure that all items submitted by these other manufacturers meet all requirements of the drawings and specifications, and fit in the allocated space. The Engineer shall make the final determination of whether a product is equivalent.

C. Any material, article or equipment of other unnamed manufacturers which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured in writing from the Architect/Engineer via addendum. The Contractor assumes all costs incurred as a result of using the offered material, article or equipment, on his part or on the part of other Contractors whose work is affected.

D. Voluntary add or deduct prices for alternate materials may be listed on the bid form. These items will not be used in determining the low bidder. This Contractor assumes all costs incurred as a result of using the offered material or equipment on his part or on the part of other Contractors whose work is affected.

E. All material substitutions requested after the final addendum must be listed as voluntary changes on the bid form.

PART 2 - PRODUCTS

2.1 GENERAL

A. All items of material having a similar function (e.g., safety switches, panelboards, switchboards, contactors, motor starters, dry type transformers) shall be of the same manufacturer unless specifically stated otherwise on drawings or elsewhere in specifications.

PART 3 - EXECUTION

3.1 JOBSITE SAFETY

A. Neither the professional activities of the Engineer, nor the presence of the Engineer or his or her employees and subconsultants at a construction site, shall relieve the Contractor and any other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Engineer and his or her personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The

Engineer and the Engineer's consultants shall be indemnified and shall be made additional insureds under the Contractor's general liability insurance policy.

3.2 EXCAVATION, FILL, BACKFILL, COMPACTION

A. General:

1. Prior to the commencement of any excavation or digging, the Contractor shall verify all underground utilities with the regional utility locator and provide prior notice to the locator before excavations. Contact information for most regional utility locaters can be found by calling 811.

2. The Contractor shall do all excavating, filling, backfilling, compacting, and restoration in connection with his work.

B. Excavation:

1. Make all excavations to accurate, solid, undisturbed earth, and to proper dimensions.

2. If excavations are carried in error below indicated levels, concrete of same strength as specified for the foundations or thoroughly compacted sand-gravel fill, as determined by the Architect/Engineer shall be placed in such excess excavations under the foundation. Place thoroughly compacted, clean, stable fill in excess excavations under slabs on grade, at the Contractor's expense.

3. Trim bottom and sides of excavations to grades required for foundations.

4. Protect excavations against frost and freezing.

5. Take care in excavating not to damage surrounding structures, equipment or buried pipe. Do not undermine footing or foundation.

6. Perform all trenching in a manner to prevent cave-ins and risk to workmen.

7. Where original surface is pavement or concrete, the surface shall be saw cut to provide clean edges and assist in the surface restoration.

8. If satisfactory bearing soil is not found at the indicated levels, immediately notify the Architect/Engineer or their representative, and do no further work until the Architect/Engineer or their representative gives further instructions.

9. Excavation shall be performed in all ground conditions, including rock, if encountered. Bidders shall visit the premises and determine the soil conditions by actual observations, borings, or other means. The cost of all such inspections, borings, etc., shall be borne by the bidder.

10. If a trench is excavated in rock, a compacted bed with a depth of 3" (minimum) of sand and gravel shall be used to support the conduit unless masonry cradles or encasements are used.

11. Mechanical excavation of the trench to line and grade of the conduit or to the bottom level of masonry cradles or encasements is permitted, unless otherwise indicated on the electrical drawings.

12. Mechanical excavation of the trench to line and grade where direct burial cables are to be installed is permitted provided the excavation is made to a depth to permit installation of the cable on a fine sand bed at least 3 inches deep.

C. Dewatering:

1. Furnish, install, operate and remove all dewatering pumps and pipes needed to keep trenches and pits free of water.

D. Underground Obstructions:

1. Known underground piping, conduit, feeders, foundations, and other obstructions in the vicinity of construction are shown on the drawings. Review all Bid Documents for all trades on the project to determine obstructions indicated. Take great care in making installations near underground obstructions.

2. If objects not shown on the drawings are encountered, remove, relocate, or perform extra work as directed by the Architect/Engineer.

E. Fill and Backfilling:

1. No rubbish or waste material is permitted for fill or backfill.

2. Furnish all necessary sand for backfilling.

3. Dispose of the excess excavated earth as directed.

4. Backfill materials shall be suitable for required compaction, clean and free of perishable materials, frozen earth, debris, earth with a high void content, and stones greater than 4 inches in diameter. Water is not permitted to rise in unbackfilled trenches.

5. Backfill all trenches and excavations immediately after installing of conduit, or removing forms, unless other protection is directed.

6. Around piers and isolated foundations and structures, backfill and fill shall be placed and consolidated simultaneously on all sides to prevent wedge action and displacement. Spread fill and backfill materials in 6” uniform horizontal layers with each layer compacted separately to required density.

7. For conduits that are not concrete encased, lay all conduits on a compacted bed of sand at least 3" deep. Backfill around conduits with sand, in 6" layers and compact each layer.

8. Conduits that are concrete encased or in a ductbank, conduit spacers, and cradles shall be installed on a bed of compacted CA-6 gravel. Refer to conduit section for backfilling and ductbank requirements.

9. Backfill with sand up to grade for all conduits under slabs or paved areas. All other conduits shall have sand backfill to 6" above the top of the conduit.

10. Place all backfill above the sand in uniform layers not exceeding 6” deep. Place then carefully and uniformly tamp each layer to eliminate lateral or vertical displacement.

11. Where the fill and backfill will ultimately be under a building, floor or paving, each layer of fill shall be compacted to 95% of the maximum density as determined by AASHTO Designation T-99 or ASTM Designation D-698. Moisture content of soil at time of compaction shall not exceed plus or minus 2% of optimum moisture content as determined by AASHTO T-99 or ASTM D-698 test.

12. After backfilling of trenches, no superficial loads shall be placed on the exposed surface of the backfill until a period of 48 hours has elapsed.

F. Surface Restoration:

1. Where trenches are cut through graded, planted or landscaped areas, the areas shall be restored to the original condition. Replace all planting and landscaping features removed or damaged to its original condition. At least 6" of topsoil shall be applied where disturbed areas are to be seeded or sodded. All lawn areas shall be sodded unless seeding is called out in the drawings or specifications.

2. Concrete or asphalt type pavement, seal coat, rock, gravel or earth surfaces removed or damaged shall be replaced with comparable materials and restored to original condition. Broken edges shall be saw cut and repaired as directed by Architect/Engineer.

3.3 ENGINEER OBSERVATION OF WORK

A. The contractor shall provide seven (7) calendar days notice to the Engineer prior to:

1. Placing fill over underground and underslab utilities.

2. Covering exterior walls, interior partitions and chases.

3. Installing hard or suspended ceilings and soffits.

B. The Engineer will review the installation and provide a written report noting deficiencies requiring correction. The contractor's schedule shall account for these reviews and show them as line items in the approved schedule.

C. Above-Ceiling Final Observation:

1. All work above the ceilings must be complete prior to the Engineer's review. This includes, but is not limited to:

a. All junction boxes are closed and identified in accordance with Section 16195 Electrical Identification.

b. Light fixtures, including ceiling-mounted exit and emergency lights, are installed and operational.

c. Light fixture whips are suspended above the ceiling.

d. Conduit identification is installed in accordance with Section 16195 Electrical Identification.

e. Light fixtures are suspended independently of the ceiling system when required by these contract documents.

f. All wall penetrations have been sealed.

2. In order to prevent the Above-Ceiling Final Observation from occurring too early, the Contractor shall review the status of the work and certify, in writing, that the work is ready for the Above-Ceiling Final Observation.

3. It is understood that if the Engineer finds the ceilings have been installed prior to this review and prior to seven days elapsing, the Engineer may not recommend further payments to the contractor until such time as full access has been provided.

3.4 PROJECT CLOSEOUT

A. The following paragraphs supplement the requirements of Division 1.

B. Final Jobsite Observation:

1. In order to prevent the Final Jobsite Observation from occurring too early, the Contractor shall review the completion status of the project and certify that the job is ready for the final jobsite observation.

2. Attached to the end of this section is a typical list of items that represent the degree of job completeness expected prior to requesting a review. The Contractor shall sign the attached certification and return it to the Architect/Engineer so that the final observation can be scheduled.

3. It is understood that if the Engineer finds the job not ready for the final observation and additional trips and observations are required to bring the project to completion, the cost of the additional time and expenses incurred by the Engineers will be deducted from the Contractor’s final payment.

4. Contractor shall notify Engineer 72 hours prior to installation of ceilings or lay-in ceiling tiles.

C. The following must be submitted before Architect/Engineer recommends final payment:

1. Operation and maintenance manuals with copies of approved shop drawings.

2. Record documents including marked-up drawings and specifications.

3. A report documenting the instructions given to the Owner's representatives complete with the number of hours spent in the instruction. The report shall bear the signature of an authorized agent of this Contractor and shall be signed by the Owner's representatives.

4. Provide spare parts, maintenance, and extra materials in quantities specified in individual specification sections. Deliver to project site and place in location as directed and submit receipt to Architect/Engineer.

5. Inspection and testing report by the fire alarm system manufacturer.

6. Start-up reports on all equipment requiring a factory installation or start-up.

3.5 OPERATION AND MAINTENANCE INSTRUCTIONS

A. Submit three (3) properly indexed and bound copies, in “D” ring style notebooks, of the Operations and Maintenance Instructions to the Architect/Engineer. Make all corrections or additions required.

B. Operation and Maintenance Instructions shall include:

1. Notebooks shall be heavy duty locking three ring binders and incorporate clear vinyl sheet sleeves on the front cover and spine for slip-in labeling. “Peel and stick” labels are **not** acceptable. Sheet lifters shall be supplied at the front of each notebook. Provide “Wilson-Jones” or equal, color black. Size notebooks a minimum of 1/2" thicker than material for future inserts. Label the spine and front cover of each notebook. If more than one notebook is required, label in consecutive order. For example; 1 of 2, 2 of 2. No other forms of binding will be acceptable.

2. Prepare binder covers (front and spine) with printed title “Operation and Maintenance Instructions”, title of project, and subject matter of binder when multiple binders are required.

3. Title page with project title, Architect, Engineer, Contractor, and Subcontractor with addresses, telephone numbers, and contacts.

4. Table of Contents describing all index tabs.

5. Listing of all Subcontractors and major equipment suppliers with addresses, telephone numbers, and contacts.

6. Index tabs dividing information by specification section, major equipment, or systems. All tab titles shall be clearly printed under reinforced plastic tabs. Label all equipment to match the identification in the construction documents.

7. Copies of warranties.

8. Copies of all final approved shop drawings and submittals. Copy of power system study and overcurrent protective device settings.

9. Copies of all factory inspection and/or equipment start-up reports.

C. Operation and maintenance data shall consist of written instructions for the care, maintenance, and operation of the equipment and systems. Instruction books, cards, manuals furnished with the equipment shall be included.

3.6 INSTRUCTING THE OWNER'S REPRESENTATIVE

A. Adequately instruct the Owner's designated representatives in the maintenance, care, and operation of the complete systems installed under this contract.

B. Provide verbal and written instructions to the Owner's representatives by FACTORY PERSONNEL in the care, maintenance, and operation of the equipment and systems.

C. The Owner has the option to video tape all instructions. Coordinate schedule of instructions to facilitate this recording.

D. The instructions shall include:

1. Maintenance of equipment.
2. Start-up procedures for all major equipment.
3. Description of emergency system operation.

E. Notify the Architect/Engineer of the time and place for the verbal instructions to the Owner's representative so his representative can be present if desired.

F. Minimum hours of instruction time for each item and/or system shall be as indicated in each individual specification section.

G. Operating Instructions:

1. Contractor is responsible for all instructions to the Owner’s representatives for the electrical and specialized systems.

2. If the Contractor does not have staff that can adequately provide the required instructions, he shall include in his bid an adequate amount to reimburse the Owner for the Engineer to perform these services.

3.7 RECORD DOCUMENTS

A. The following paragraphs supplement the requirements of Division 1.

B. Maintain at the job site a separate and complete set of electrical drawings and specifications with all changes made to the systems clearly and permanently marked in complete detail.

C. Mark drawings and specifications to indicate approved substitutions; Change Orders, and actual equipment and materials used. All Change Orders, RFI responses, Clarifications and other supplemental instructions shall be marked on the documents. Record documents that merely reference the existence of the above items are not acceptable. Should this Contractor fail to complete Record Documents as required by this contract, this Contractor shall reimburse Architect/Engineer for all costs to develop record documents that comply with this requirement. Reimbursement shall be made at the Architect/Engineer’s hourly rates in effect at the time of work.

D. Record changes daily and keep the marked drawings available for the Architect/Engineer's examination at any normal work time.

E. Upon completing the job, and before final payment is made, give the marked-up drawings to the Architect/Engineer.

3.8 PAINTING

A. Paint all equipment that is marred or damaged prior to the Owner's acceptance. Paint and color shall match original equipment paint and shall be obtained from the equipment supplier if available. All equipment shall have a finished coat of paint applied unless specifically allowed to be provided with a prime coat only.

B. Equipment in finished areas that will be painted to match the room decor will be painted by others. Should this Contractor install equipment in a finished area after the area has been painted, he shall have the equipment and all its supports, hangers, etc., painted to match the room decor. Painting shall be performed as described in project specifications.

C. Equipment cabinets, casings, covers, metal jackets, etc., located in equipment rooms or concealed spaces, shall be furnished in standard finish, free from scratches, abrasions, chippings, etc.

D. Equipment in occupied spaces, or if standard to the unit, shall have a baked primer with baked enamel finish coat free from scratches, abrasions, chipping, etc. If color option is specified or is standard to the unit, verify with the Architect/Engineer his color preference before ordering.

3.9 ADJUST AND CLEAN

A. Thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project.

B. Clean all foreign paint, grease, oil, dirt, labels, stickers, etc. from all equipment.

C. Remove all rubbish, debris, etc., accumulated during construction from the premises.

3.10 SYSTEM COMMISSIONING

A. The electrical systems shall be complete and operating. System start-up, testing, balancing, and satisfactory system performance is the responsibility of the Contractor. This includes all calibration and adjustment of electrical controls, balancing of loads, troubleshooting and verification of software, and final adjustments that may be needed.

B. All operating conditions and control sequences shall be tested during the start-up period. Testing all interlocks, safety shut-downs, controls, and alarms.

1. The Contractor, subcontractors, and equipment suppliers shall have skilled technicians to ensure that all systems perform properly. If the Architect/Engineer is requested to visit the job site for trouble shooting, assisting in start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period, through no fault of the design; the Contractor shall reimburse the Owner on a time and materials basis for services rendered at the Architect/Engineer's standard hourly rates in effect when the services are requested. The Contractor shall pay the Owner for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

3.11 FIELD QUALITY CONTROL

A. General:

1. Conduct all tests required during and after construction.

2. Supply necessary instruments, meters, etc., for the tests. Supply competent technicians with training in the proper testing techniques.

3. All cables and wires shall be tested for shorts and grounds following installation and connection to devices. Replace shorted or grounded wires and cables.

4. Any wiring device, electrical apparatus or lighting fixture, if grounded or shorted on any integral "live" part, shall have all defective parts or materials replaced.

5. Test cable insulation of service and panel feeder conductors for proper insulation values. Tests shall include the cable, all splices, and all terminations. Each conductor shall be tested and shall test free of short circuits and grounds and have an insulation value not less than the National Electrical Code Standards. Take readings between conductors, and between conductors and ground.

6. If the results obtained in the tests are not satisfactory make adjustments, replacements, and changes as needed. Then repeat the tests, and make additional tests, as the Architect/Engineer or authority having jurisdiction deems necessary.

B. Ground Resistance:

1. Conduct service ground resistance tests using an approved manufactured ground resistance meter. Submit to the Architect/Engineer a proposed test procedure including type of equipment to be used. (The conventional ohmmeter is not an acceptable device.)

2. Make ground resistance measurements during normal dry weather and not less than 48 hours after a rain.

3. If the ground resistance value obtained is more than the value set forth in Section 16450 , the following shall be done to obtain the value given:

a. Verify that all connections in the service ground system are secure.

b. Increase the depth to which ground rods are driven by adding section lengths to the rods and retest. If the resistance is still excessive increase the depth by adding an additional rod section and retest.

c. If the resistance is still excessive, furnish and install additional ground rods, spaced not less than 20 feet from other ground rods unless otherwise noted on plans, and connect into the ground electrode system. Retest.

d. Review results with the Architect/Engineer.

4. Before final payment is made to the Contractor submit a written report to the Architect/Engineer including the following:

a. Date of test.

b. Number of hours since the last rain.

c. Soil condition at the time of the test in the ground electrode location. That is: dry, wet, moist, sand, clay, etc.

d. Diagram of the test set-up showing distances between test equipment, ground electrode, auxiliary electrodes, etc.

e. Make, model, and calibration date of test equipment.

f. Tabulation of measurements taken and calculations made.

C. Other Equipment:

1. Give other equipment furnished and installed by the Contractor all standard tests normally made to assure that the equipment is electrically sound, all connections properly made, phase rotation correct, fuses and thermal elements suitable for protection against overloads, voltage complies with equipment nameplate rating, and full load amperes are within equipment rating.

D. If any test results are not satisfactory, make adjustments, replacements and changes as needed and repeat the tests and make additional tests as the Architect/Engineer or authority having jurisdiction deem necessary.

END OF SECTION

READINESS CERTIFICATION PRIOR TO FINAL JOBSITE OBSERVATION

In order to prevent the final job observation from occurring too early, we require that the Contractor review the completion status of the project and, by copy of this document, certify that the job is indeed ready for the final job observation. The following is a typical list of items that represent the degree of job completeness expected prior to your requesting a final job observation.

1. Electrical panels have typed circuit identification.
2. Per Specification Section 16010, cable insulation test results have been submitted.
3. Operation and Maintenance manuals have been submitted as per Specification Section 16010.
4. Bound copies of approved shop drawings have been submitted as per Specification Section 16010.
5. Report of instruction of Owner's representative has been submitted as per Specification Section 16010.

Accepted by:

Prime Contractor _____

By _____ Date _____

Upon Contractor certification that the project is complete and ready for a final job observation, we require the Contractor to sign this agreement and return it to the Engineer so that the final observation can be scheduled.

It is understood that if the Engineer finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the Engineers for additional time and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.

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SECTION 16111
CONDUIT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Rigid metallic conduit and fittings
B. Intermediate metallic conduit and fittings
C. Electrical metallic tubing and fittings
D. Flexible metallic conduit and fittings
E. Liquidtight flexible metallic conduit and fittings
F. Rigid non-metallic conduit and fittings

1.2 REFERENCES

A. American National Standards Institute (ANSI):

1. ANSI C80.1 - Rigid Steel Conduit, Zinc-Coated

2. ANSI C80.3 - Electrical Metallic Tubing, Zinc-Coated and Fittings

3. ANSI C80.4 - Fittings for Rigid Metal Conduit and Electrical Metallic Tubing

4. ANSI C80.6 – Intermediate Metal Conduit, Zinc Coated

5. ANSI C80.5 – Aluminum Rigid Conduit

B. Federal Specifications (FS):

1. A–A–50553A – Fittings for Conduit, Metal, Rigid, (Thick-Wall and Thin-Wall (EMT) Type

2. A–A–55810 – Specification for Flexible Metal Conduit

C. NECA “Standards of Installation”

D. National Electrical Manufacturers Association (NEMA):

1. ANSI/NEMA FB 1 – Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable

2. RN 1 – Polyvinyl chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit

3. TC 2 – Electrical Polyvinyl Chloride (PVC) Conduit

4. TC 3 – PVC Fittings for use with Rigid PVC Conduit and Tubing

5. TC 6/TC 8 – PVC Plastic Utilities Duct for Underground Installations

6. TC 7 – Smooth-Wall Coilable Electrical Polyethylene Conduit

7. TC 9 – Fittings for PVC Plastic Utilities Duct for Underground Installation

8. TC13 – Electrical Non-Metallic Tubing

9. TC14 – Filament-Wound Reinforced Thermosetting Resin Conduit and Fittings

E. National Fire Protection Association (NFPA):

1. ANSI/NFPA 70 – National Electrical Code

F. Underwriters Laboratories (UL): Applicable Listings

1. UL 1 – Flexible Metal Conduit

2. UL 6 – Rigid Metal Conduit

3. UL 6A – Standard for Electrical Rigid Metal Conduit - Aluminum

4. UL 360 – Liquid Tight Flexible Steel Conduit

5. UL514-B – Conduit Tubing and Cable Fittings

6. UL651-A – Type EB and a PVC Conduit and HDPE Conduit

7. UL651-B – Continuous Length HDPE Conduit

8. UL746A – Standard for Polymeric Materials – Short Term Property Evaluations

9. UL797 – Electrical Metal Tubing

10. UL1242 – Intermediate Metal Conduit

G. American Standard of Testing and Materials (ASTM):

1. ASTM D 570 - Standard Test Method for Water Absorption of Plastics

2. ASTM D 638 - Standard Test Method for Tensile Properties of Plastics

3. ASTM D 648 - Standard Test Method for Deflection Temperature of Plastics under Flexural Load in the Edge Wise Position

4. ASTM D 2412 - Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading

5. ASTM D 2447 - Standard Specification for Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter

6. ASTM D 3350 - Standard Specification for Polyethylene Plastic Pipe and Fittings Material

H. Definitions:

1. Fittings: Conduit connection or coupling.

2. Body: Enlarged fittings with opening allowing access to the conductors for pulling purposes only.

3. Mechanical Spaces: Enclosed areas, usually kept separated from the general public, where the primary use is to house service equipment and to route services. These spaces generally have exposed structures, bare concrete and non-architecturally emphasized finishes.

4. Finished Spaces: Enclosed areas where the primary use is to house personnel and the general public. These spaces generally have architecturally emphasized finishes, ceilings and/or floors.

5. Concealed: Not visible by the general public. Often indicates a location either above the ceiling, in the walls, in or beneath the floor slab, in column coverings, or in the ceiling construction.

6. Above Grade: Not directly in contact with the earth. For example, an interior wall located at an elevation below the finished grade shall be considered above grade but a wall retaining earth shall be considered below grade.

7. Slab: Horizontal pour of concrete used for the purpose of a floor or sub-floor.

1.3 SUBMITTALS

A. Include conduits 1.5” and larger in coordination files. Include all in--floor and underfloor conduit in coordination files. Refer to Section 16010 for coordination drawing requirements.

PART 2 - PRODUCTS

2.1 RIGID METALLIC CONDUIT (RMC) AND FITTINGS

A. Acceptable Manufacturers:

1. Acceptable Manufacturers: Allied, LTV, Steelduct, Wheatland Tube Co, O-Z Gedney, or approved equal.

2. Acceptable Manufacturers of RMC Conduit Fittings: Appleton Electric, O-Z/Gedney Co., Electroline, Raco, Bridgeport, Midwest, Regal, Thomas & Betts, Crouse-Hinds, Killark, or approved equal.

B. Minimum Size Galvanized Steel: 3/4 inch (19mm), unless otherwise noted.

C. Fittings and Conduit Bodies:

1. End Bell Fittings: Malleable iron, hot dip galvanized, threaded flare type with provisions for mounting to form.

2. Expansion Joints: Malleable iron and hot dip galvanized providing a minimum of 4 inches of movement. Fitting shall be watertight with an insulating bushing and a bonding jumper.

3. Expansion Joint for Concrete Encased Conduit: Neoprene sleeve with bronze end coupling, stainless steel bands and tinned copper braid bonding jumper. Fittings shall be watertight and concrete-tight.

4. Conduit End Bushings: Malleable iron type with molded-on high impact phenolic thermosetting insulation. Where required elsewhere in the contract documents, bushing shall be complete with ground conductor saddle and clamp. **High impact phenolic threaded type bushings are not acceptable.**

5. All other fittings and conduit bodies shall be of malleable iron construction and hot dip galvanized.

2.2 INTERMEDIATE METALLIC CONDUIT (IMC) AND FITTINGS

A. Minimum Size Galvanized Steel: 3/4 inch, unless otherwise noted.

B. Acceptable Manufacturers: Allied, LTV, Steelduct, Wheatland Tube Co, O-Z Gedney, or approved equal.

C. Fittings and Conduit Bodies:

1. End Bell Fittings: Malleable iron, hot dip galvanized, threaded flare type with provisions for mounting to form.

2. Expansion Joints: Malleable iron and hot dip galvanized providing a minimum of 4 inches of movement. Fitting shall be watertight with an insulating bushing and a bonding jumper.

3. Expansion Joint for Concrete Encased Conduit: Neoprene sleeve with bronze end coupling, stainless steel bands and tinned copper braid bonding jumper. Fittings shall be watertight and concrete-tight.

4. Conduit End Bushings: Malleable iron type with molded-on high impact phenolic thermosetting insulation. Where required elsewhere in the contract documents, bushing shall be complete with ground conductor saddle and clamp. **High impact phenolic threaded type bushings are not acceptable.**

5. All other fittings and conduit bodies shall be of malleable iron construction and hot dip galvanized.

2.3 ELECTRICAL METALLIC TUBING (EMT) AND FITTINGS

A. Minimum Size Electrical Metallic Tubing: 3/4 inch, unless otherwise noted.

B. Acceptable Manufacturers of EMT Conduit: Allied, LTV, Steelduct, Wheatland Tube Co, or approved equal.

C. Fittings and Conduit Bodies:

1. 2" Diameter or Smaller: Compression or steel set screw type of steel designed for their specific application.

2. Larger than 2": Compression or steel set screw type of steel designed for their specific application.

3. Acceptable Manufacturers of EMT Conduit Fittings: Appleton Electric, O-Z/Gedney Co., Electroline, Raco, Bridgeport, Midwest, Regal, Thomas & Betts, or approved equal.

2.4 FLEXIBLE METALLIC CONDUIT (FMC) AND FITTINGS

A. Minimum Size Galvanized Steel: 3/4 inch, unless otherwise noted. Lighting branch circuit wiring to an individual luminaire may be a manufactured, UL listed 3/8” flexible metal conduit with #12 AWG THHN conductors and an insulated ground wire.

B. Acceptable Manufacturers: American Flex, Alflex, Electri-Flex Co, or approved equal.

C. Construction: Flexible steel, approved for conduit ground, zinc coated, threadless type formed from a continuous length of spirally wound, interlocked zinc coated strip steel. Provide a separate equipment grounding conductor when used for equipment where flexibility is required.

D. Fittings and Conduit Bodies:

1. Threadless hinged clamp type, galvanized zinc coated cadmium plated malleable cast iron or screw-in type, die-cast zinc.

2. Fittings and conduit bodies shall include plastic or cast metal inserts supplied by the manufacturer to protect conductors from sharp edges.

3. Acceptable Manufacturers: O-Z/Gedney Co., Thomas & Betts, Appleton Electric, Electroline, Bridgeport, Midwest, Regal, or approved equal.

2.5 LIQUIDTIGHT FLEXIBLE METALLIC CONDUIT (LFMC) AND FITTINGS

A. Acceptable Manufacturers: Anaconda Type UA, Electri-Flex Type LA, Alflex, Carlon (Lamson & Sessions), or approved equal.

B. Construction: Flexible steel, approved for conduit ground, zinc coated, threadless type formed from a continuous length of spirally wound, interlocked zinc coated strip steel and an extruded PVC cover.

C. Fittings and Conduit Bodies:

1. Watertight, compression type, galvanized zinc coated cadmium plated malleable cast iron, UL listed.

2. Fittings and conduit bodies shall include plastic or cast metal inserts supplied by the manufacturer to protect conductors from sharp edges.

3. Acceptable Manufacturers: Appleton Electric, O-Z/Gedney Co., Electroline, Bridgeport, Thomas & Betts, Midwest, Regal, Carlon (Lamson & Sessions), or approved equal.

2.6 RIGID NON-METALLIC CONDUIT (RNC) AND FITTINGS

A. Minimum Size Rigid Smooth-Wall Nonmetallic Conduit: 3/4 inch, unless otherwise noted.

B. Acceptable Manufacturers: Carlon (Lamson & Sessions) Type 40, Cantex, J.M. Mfg., or approved equal.

C. Construction: Schedule 40 and Schedule 80 rigid polyvinyl chloride (PVC), UL labeled for 90°C.

D. Fittings and Conduit Bodies: NEMA TC 3; sleeve type suitable for and manufactured especially for use with the conduit by the conduit manufacturer.

E. Plastic cement for joining conduit and fittings shall be provided as recommended by the manufacturer.

PART 3 - EXECUTION

3.1 CONDUIT SIZING

A. Size conduit as shown on the drawings and specifications. Where not indicated in the contract documents, conduit size shall be according to N.E.C. (Latest Edition). Conduit and conductor sizing shall be coordinated to limit conductor fill to less than 40%, maintain conductor ampere capacity as required by the National Electrical Code (to include enlarged conductors due to temperature and quantity derating values) and to prevent excessive voltage drop and pulling tension due to long conduit/conductor lengths.

B. Minimum Conduit Size (Unless Noted Otherwise):

1. Above Grade: 3/4 inch. (The use of 1/2 inch would be allowed for installation conduit to individual light switches, individual receptacles and individual fixture whips from junction box.)

2. Below Grade 5' or less from Building Foundation: 3/4 inch.

3. Below Grade More than 5' from Building Foundation: 3/4 inch.

4. Telecommunication Conduit: 1 inch.

C. Conduit sizes shall change only at the entrance or exit to a junction box, unless specifically noted on the drawings.

3.2 CONDUIT ARRANGEMENT

A. In general, conduit shall be installed concealed in walls, in finished spaces and where possible or practical, or as noted otherwise. In unfinished spaces, mechanical and utility areas, conduit may run either concealed or exposed as conditions dictate and as practical unless noted otherwise on drawings. Installation shall maintain headroom in exposed vicinities of pedestrian or vehicular traffic.

B. Conduit shall not share the same cell as structural reinforcement in masonry walls.

C. Conduit runs shall be routed as shown on large scale drawings. Conduit routing on drawings scaled 1/4"=1'-0" or less shall be considered diagrammatic, unless noted otherwise. The correct routing, when shown diagrammatically shall be chosen by the Contractor based on information in the contract documents, in accordance with manufacturer's written instructions, applicable codes, the NECA's "Standard of Installation", in accordance with recognized industry standards, and coordinated with other contractors.

D. Contractor shall adapt his work to the job conditions and make such changes as required and permitted by the Architect/Engineer, such as moving to clear beams and joists, adjusting at columns, avoiding interference with windows, etc., to permit the proper installation of other mechanical and/or electrical equipment.

E. Contractor shall cooperate with all Contractors on the project. He shall obtain details of other Contractor's work in order to ensure fit and avoid conflict. Any expense due to the failure of This Contractor to do so shall be paid for in full by him. The other trades involved as directed by the Architect/Engineer shall perform the repair of work damaged as a result of neglect or error by This Contractor. The resultant costs shall be borne by This Contractor.

3.3 CONDUIT SUPPORT

A. Conduit runs installed above a suspended ceiling shall be properly supported. In no case shall conduit rest on the suspended ceiling construction, nor utilize ceiling support system for conduit support.

B. Conduit shall <u>not</u> be supported from ductwork, water, sprinkler piping, or other non-structural members, unless approved by the Architect/Engineer. All supports shall be from structural slabs, walls, structural members, and bar joists, and coordinated with all other applicable contractors, unless noted otherwise.

C. Conduit shall be held in place by the correct size of galvanized one-hole conduit clamps, two-hole conduit straps, patented support devices, clamp back conduit hangers, or by other means if called for on the drawings.

D. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps.

E. Spring-steel conduit clips specifically designed for supporting single conduits or tubing may be used in lieu of malleable-iron hangers for 1-1/2" and smaller raceways serving lighting and receptacle branch circuits above accessible ceilings and for securing raceways to slotted channel and angle supports.

F. Group conduits in parallel runs where practical and use conduit racks or trapeze hangers constructed of steel channel, suspended with threaded solid rods or wall mounted from metal channels with conduit straps or clamps. Provide space in each rack or trapeze for 25% additional conduits.

G. Do not exceed 25 lbs. per hanger and a minimum spacing of 2'-0" on center when attaching to metal roof decking (excludes concrete on metal deck). This 25 lbs. load and 2'-0" spacing include adjacent electrical and mechanical items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off steel framing will need to be added.

H. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried entirely by raceway supports, with no weight load on raceway terminals.

I. Supports for metallic conduit shall be no greater than 10 feet. A smaller interval may be used if necessitated by building construction, but in no event shall support spans exceed the National Electrical Code requirements. Conduit shall be securely fastened within 3 feet of each outlet box, junction box, device box, cabinet, or fitting.

J. Supports of flexible conduit shall be within 12 inches of each outlet box, junction box, device box, cabinet, or fitting and at intervals not to exceed 4.5 feet.

K. Supports for non-metallic conduit shall be at sufficiently close intervals to eliminate any sag in the conduit. The manufacturer's recommendations shall be followed, but in no event shall support spans exceed the National Electrical Code requirements.

L. Where conduit is to be installed in poured concrete floors or walls, provide concrete-tight conduit inserts securely fastened to forms to prevent conduit misplacement.

M. Finish:

1. Prime coat exposed steel hangers and supports. Hangers and supports in crawl spaces, pipe shafts, and above suspended ceiling spaces are not considered exposed.

2. Trim all ends of exposed field fabricated steel hangers, slotted channel and threaded rod to within 1" of support or fastener to eliminate potential injury to personnel unless shown otherwise on the drawings. Smooth ends and install elastomeric insulation with two coats of latex paint if exposed steel is within 6'-6" of finish floor and presents potential injury to personnel.

3.4 CONDUIT INSTALLATION

A. Conduit Connections:

1. Shorter than standard conduit lengths shall be cut square using industry standards. The ends of all conduits cut shall be reamed or otherwise finished to remove all rough edges.

2. Metallic conduit connections in slab on grade installation shall be sealed and one coat of rust inhibitor primer applied after the connection is made.

3. Where conduits with tapered threads cannot be coupled with standard couplings, then approved split or Erickson couplings shall be used. Running threads will not be permitted.

4. Install expansion/deflection joints where conduit crosses structure expansion/seismic joints.

B. Conduit terminations for all low voltage wiring shall have nylon bushings installed on each end of every conduit run.

C. Conduit Bends:

1. Use a hydraulic one-shot conduit bender or factory elbows for bends in conduit 2" in size or larger. All steel conduit bending shall be done cold; no heating of steel conduit shall be permitted.

2. All bends of rigid non-metallic conduit (RNC) shall be made with the manufacturer's approved bending equipment. The use of spot heating devices will not be permitted (i.e. blow torches).

3. A run of conduit shall not contain more than the equivalent of four (4) quarter bends (360°), including those bends located immediately at the outlet or body.

4. Telecommunications conduits shall have no more than two (2) 90 degree bends between pull points and contain no continuous sections longer than 100 feet. Insert pull points or pull boxes for conduits exceeding 100 feet in length.

a. A third bend is acceptable if:

1) The total run is not longer than (33) feet.

2) The conduit size is increased to the next trade size.

5. Telecommunications pull boxes shall not be used in lieu of a bend. Align conduits that enter into the pull box from opposite ends with each other. Pull box size shall be twelve (12) times the diameter of the largest conduit. Slip sleeves or gutters can be used in place of a pull box.

6. Provide product submittals, per specifications, on slip sleeves and/or gutters to the Engineer for approval prior to purchase and installation.

7. Telecommunications conduit bend radius shall be six (6) times the diameter for conduits under 2” and ten (10) times the diameter for conduits over 2”.

8. Rigid non-metallic conduit (RNC) runs longer than 100 feet or runs which have more than two 90° equivalent bends (regardless of length) shall use rigid steel factory elbows for bends.

9. Use conduit bodies to make sharp changes in direction (i.e. around beams).

D. Conduit Placement:

1. Conduit shall be mechanically continuous from source of current to all outlets. Conduit shall be electrically continuous from source of current to all outlets, unless a properly sized grounding conductor is routed within the conduit. All metallic conduits shall be bonded per the National Electrical Code.

2. Route exposed conduit and conduit above suspended ceilings (accessible or not) parallel/perpendicular to the building structural lines, and as close to building structure as possible. Wherever possible, route horizontal conduit runs above water and steam piping.

3. Route conduit through roof openings provided for piping and ductwork where possible. If not provided or routing through provided openings is not possible, route through roof jack with pitch pocket. Coordinate roof penetrations with other trades.

4. Conduits, raceway, and boxes shall not be installed in concealed locations in metal deck roofing or less than 1.5” below bottom of roof decking.

5. Avoid moisture traps where possible. Where unavoidable, provide a junction box with drain fitting at conduit low point.

6. All conduits through walls shall be grouted or sealed into openings. Where conduit penetrates firewalls and floors, seal with a UL listed sealant. Seal penetrations with intumescent caulk, putty, or sheet installed per manufacturer's recommendations. All materials used to seal penetrations of firewalls and floors shall be tested and certified as a system per ASTM E814 Standard for fire tests or through-penetration fire stops as manufactured by 3M or approved equal.

7. CONTRACTOR SHALL BE RESPONSIBLE FOR ALL OPENINGS REQUIRED IN MASONRY OR EXTERIOR WALLS UNDER THIS DIVISION. A QUALIFIED MASON AT THE EXPENSE OF THIS CONTRACTOR SHALL REPAIR ALL OPENINGS TO MATCH EXISTING CONDITIONS.

8. Seal interior of conduit at exterior entries, air handling units, coolers/freezers, etc., and where the temperature differential can potentially be greater than 20°F, to prevent moisture penetration. Seal shall be placed where conduit enters warm space. Conduit seal fitting shall be a drain/seal, with sealing compound, equal to O-Z/Gedney type EYD.

9. Conduits, if run in concrete structure, shall be in middle one-third of slab thickness, and leave at least 3” min. concrete cover. Conduits shall run parallel to each other and spaced at least 8” apart centerline to centerline. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement. Maximum conduit outside diameter 1”.

10. Do not route conduits across each other in slabs on grade.

11. Rigid non-metallic conduit (RNC) shall be installed when material surface temperatures and ambient temperature are greater than 40°F.

12. Where rigid non-metallic conduit (RNC) conduit is used below grade, in a slab, below a slab, etc., a transition to rigid galvanized steel or PVC-coated steel conduit shall be installed before conduit exits earth. The metallic conduit shall extend a minimum of 6" into the surface concealing the non-metallic conduit.

13. Contractor shall provide suitable mechanical protection around all conduits stubbed out from floors, walls or ceilings during construction to prevent bending or damaging of stubs due to carelessness with construction equipment.

14. Contractor shall provide a polypropylene pull cord with 2000 lbs. tensile strength in each empty conduit (indoor and outdoor), except in sleeves and nipples.

15. Telecommunications conduits that protrude through the structural floor shall be installed 1 to 3” above finished floor (AFF).

16. Telecommunications conduits that enter into Telecommunications rooms below the finished ceiling shall terminate a minimum of 4” below ceiling and as close to the wall as possible.

17. Telecommunications conduits that are below grade and enter into a building shall terminate a minimum of 4” above finished floor (AFF) and as close to the wall as possible.

3.5 CONDUIT TERMINATIONS

A. Where conduit bonding is indicated or required in the contract documents, the bushings shall be a grounding type sized for the conduit and ground bonding conductor as manufactured by O-Z/Gedney, Appleton, Thomas & Betts, Burndy, Regal, or approved equal.

B. Conduits with termination fittings shall be threaded for one (1) lock nut on the outside and one (1) lock nut and bushing on the inside of each box.

C. Where conduits terminate in boxes with knockouts, they shall be secured to the boxes with lock nuts and provided with approved screw type tinned iron bushings or fittings with plastic inserts.

D. Where conduits terminate in boxes, fittings, or bodies with threaded openings, they shall be tightly screwed against the shoulder portion of the threaded openings.

E. Conduit terminations to all motors shall be made with flexible metallic conduit (FMC), unless noted otherwise. Final connections to roof exhaust fans, or other exterior motors and motors in damp or wet locations shall be made with liquidtight flexible metallic conduit (LFMC). Motors in hazardous areas, as defined in the National Electrical Code, shall be connected using flexible conduit rated for the environment.

F. Rigid non-metallic conduit (RNC) conduit shall be terminated using fittings and bodies produced by the manufacturer of the conduit, unless noted otherwise. Prepare conduit as per manufacturer’s recommendations before joining. All joints shall be solvent welded by applying full even coat of plastic cement to the entire areas that will be joined. Turn the conduit at least a quarter to one half turn in the fitting and let the joint cure for 1-hour minimum or as per the manufacturer's recommendations.

G. All conduit ends shall be sealed with plastic immediately after installation to prevent the entrance of any foreign matter during construction. The seals shall be removed and the conduits blown clear of any and all foreign matter prior to any wires or pull cords being installed.

3.6 UNDERGROUND CONDUIT INSTALLATION

A. Conduit Connections:

1. Conduit joints in a multiple conduit run shall be staggered at least one foot apart.

B. Conduit Bends (Lateral):

1. Conduits shall have long sweep radius elbows instead of standard elbows wherever special bends are indicated and noted on the drawings, or as required by the manufacturer of the equipment or system being served.

2. Telecommunications conduit bend radius shall be six times the diameter for conduits under 2” and ten times the diameter for conduits over 2”. Where long cable runs are involved, sidewall pressures may require larger radius bends. Coordinate with Engineer prior to conduit installation to determine bend radius.

3. All Telecommunications conduits and innerducts, including those containing cables, shall be plugged at the building and vault with “JackMoon” or equivalent duct seal, capable of withstanding a 10 foot head of water (5 PSI).

C. Conduit Elbows (vertical):

1. Minimum steel elbow radiuses shall be 30 inches for primary conduits (>600V) and 18 inches for secondary conduits (<600V). Increase radius, as required, based on pulling tension calculation requirements.

D. Conduit Placement:

1. Conduit runs shall be pitched a minimum of 4" per 100 feet to drain toward the terminations. Duct runs shall be installed deeper than the minimum wherever required to avoid any conflicts with existing or new piping, tunnels, etc.

2. For parallel runs, use suitable separators and chairs installed not greater than 4' on centers. Band conduit together with suitable banding devices. Securely anchor conduit to prevent movement during concrete placement or backfilling.

3. Where concrete is required, the materials for concreting shall be thoroughly mixed to a minimum f'c = 2500 and immediately placed in the trench around the conduits. No concrete that has been allowed to partially set shall be used.

4. Before the Contractor pulls any cables into the conduit he shall have a mandrel 1/4" smaller than the conduit inside diameter pulled through each conduit and if any concrete or obstructions are found, the Contractor shall remove them and clear the conduit. Spare conduit shall also be cleared of all obstructions.

5. Conduit terminations in manholes, masonry pull boxes, or masonry walls shall be with malleable iron end bell fittings.

6. All spare conduits not terminated in a covered enclosure shall have its terminations plugged as described above.

7. Ductbanks and conduit shall be installed a minimum of 24" below finished grade, unless otherwise noted on the drawings or elsewhere in these specifications.

8. All non-metallic conduit installed underground outside of a slab shall be rigid.

E. Horizontal Directional Drilling:

1. Entire drill path shall be accurately surveyed, with entry and exit stakes placed and coordinated with other contractors. If using a magnetic guidance system, entire drill path shall be surveyed for any surface geo-magnetic variations or anomalies.

2. Any utility locates within 20 feet of the bore path shall have the exact location physically verified by hand digging or vacuum excavation. Restore inspection holes to original condition after verification.

F. Raceway Seal:

1. Where a raceway enters a building or structure, it shall be sealed with a sealing bushing or duct seal to prevent the entry of liquids or gases. Seal must be compatible with conductors and raceway system. Spare or unused raceway shall also be sealed.

3.7 CONDUIT INSTALLATION SCHEDULE

A. In the event the location of conduit installation represents conflicting installation requirements as specified in the following schedule, a clarification shall be obtained from the Architect/Engineer. If This Contractor is unable to obtain a clarification as outlined above, concealed rigid galvanized steel conduit installed per these specifications and the National Electrical Code shall be required.

B. The following schedule shall be adhered to unless they constitute a violation of applicable codes or are noted otherwise on the drawings. The installation of RMC conduit will be permitted in place of any and all conduit specified in this schedule.

1. Dry Mechanical Spaces:

a. Exposed:

1) Switchboards, panel feeders, etc.: EMT.
2) Branch Circuits (lighting, receptacles, controls, etc.): EMT.
3) Mechanical Equipment Feeders (pumps, AHU's, chillers, etc.): EMT.
4) Floor Mounted Pump Feeders: EMT with no more than 6’ of PVC coated flexible metal conduit to pump.

b. Concealed: EMT.

2. Wet or Damp Locations: RMC Conduit.

3. Finished Spaces: Concealed EMT.

4. In or Under Slabs on Grade or Site Conduits:

   a. Within 5' from the Perimeter of a Building Foundation: Concrete encased RNC conduit with a minimum of 3" thickness between the surface of the concrete and the nearest conduit. Concrete to be doweled into the foundation.

   b. 5' or Greater from the Perimeter of a Building Foundation: RNC.

5. Interior Locations:

   a. Exposed: EMT conduit.

   b. Concealed: EMT.

6. Hazardous Locations as Defined by the National Electrical Code: RMC conduit complete with screwed fittings and conduit seals.

END OF SECTION

SECTION 16120
WIRE AND CABLE

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Building wire
B. Cable
C. Wiring connections and terminations

1.2 REFERENCES

A. ASTM B800-05 – Standard Specification for 8000 Series Aluminum Alloy Wire Electrical Purposes-Annealed and Intermediate Tempered.

B. ASTM B801-07 – Standard Specification for Concentric-Lay-Stranded Conductors of 8000 Series Aluminum Alloy for Subsequent Covering or Insulation

C. NEMA WC 3 - Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

D. NEMA WC 5 - Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

E. UL 44 – Thermoset-Insulated Wires and Cables

F. UL 854 – Service-Entrance Cables

PART 2 - PRODUCTS

2.1 BUILDING WIRE

A. Thermoplastic-insulated Building Wire: NEMA WC 5.

B. Rubber-insulated Building Wire: NEMA WC 3.

C. Feeders and Branch Circuits Larger than 6 AWG: Aluminum, AA-8000 series alloy, compact stranded conductor, 600 volt insulation, USE-2/RHH/RHW-2 or XHHW-2.

D. Feeders and Branch Circuits Larger than 6 AWG in Underground Conduit: Aluminum, AA-8000 series alloy, compact stranded conductor, 600 volt insulation, USE-2/RHH/RHW-2

E. Feeders and Branch Circuits 6 AWG and Smaller: Copper conductor, 600 volt insulation, THHN/THWN. 6 and 8 AWG, stranded conductor; smaller than 8 AWG, solid or stranded conductor, unless otherwise noted on the drawings. Aluminum, compact stranded conductor is not acceptable for feeder and branch circuits 6 AWG and smaller.

F. Control Circuits: Copper, stranded conductor 600 volt insulation, THHN/THWN.

2.2 REMOTE CONTROL AND SIGNAL CABLE

A. Control Cable for Class 1 Remote Control and Signal Circuits: Copper conductor, 600 volt insulation, rated 60°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 60ºC, 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°C, individual conductors twisted together, shielded, and covered with a nonmetallic jacket; UL listed for use in air handling ducts, hollow spaces used as ducts, and plenums.

2.3 METAL-CLAD CABLE (MC)

A. At the contractors option metal clad cables may be utilized for branch circuit wiring as defined in NEC 330 subject to acceptance by the state and local codes.

B. Minimum conductor size for branch circuit wiring shall be 12 AWG with larger wires used where specified.

PART 3 - EXECUTION

3.1 GENERAL WIRING METHODS

A. Use no wire smaller than 12 AWG for power and lighting circuits, and no smaller than 14 AWG for control wiring.

B. Use 10 AWG conductor for 20 ampere, 120 volt branch circuit home runs longer than 75 feet, and for 20 ampere, 277 volt branch circuit home runs longer than 200 feet.

C. Use no wire smaller than 8 AWG for outdoor lighting circuits.

D. The ampacity of multiple conductors in one conduit shall be derated per National Electrical Code, Article 310. In no case shall more than 4 conductors be installed in one conduit to such loads as motors larger than 1/4 HP, panelboards, motor control centers, etc.

E. Where installing parallel feeders, place an equal number of conductors for each phase of a circuit in same raceway or cable.

F. Splice only in junction or outlet boxes.

G. Neatly train and lace wiring inside boxes, equipment, and panelboards.

H. Make conductor lengths for parallel circuits equal.

I. All conductors shall be continuous in conduit from last outlet to their termination.

3.2 CONTRACTOR CHANGES

A. The basis of design is copper conductors installed in raceway based on ambient temperature of 30°C, NEC Table 310.16. Service entrance conductors are based on copper conductor installed in underground electrical ducts, NEC Table B.310.7.

B. The Contractor shall be responsible for derating and sizing conductors and conduits to equal or exceed the ampacity of the basis of design circuits, if he/she chooses to use methods or materials other than the basis of design.

C. Underground electrical duct ampacity rating shall be in accordance with NEC Table B.310.7 or calculated in accordance with Annex B Application Information for Ampacity Calculation. The calculations and a sketch of the proposed installation shall be submitted prior to any conduit being installed.

D. Record drawing shall include the calculations and sketches.

3.3 WIRING INSTALLATION IN RACEWAYS

A. Pull all conductors into a raceway at the same time. Use UL listed wire pulling lubricant for pulling 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. Pulling shall be continuous without unnecessary stops and starts with wire or cable only partially thru raceway.

D. Where reels of cable or wire are used, they shall be set up on jacks close to the point where the wire or cable enters the conduit or duct so that the cable or wire may be unreeled and run into the conduit or duct with a minimum of change in the direction of the bend.

E. Cables or wires shall not be laid out on the ground before pulling.

F. Cables or wires shall not be dragged over earth or paving.

G. Care shall be taken so as not to subject the cable or wire to high mechanical stresses that would cause damage to the wire and cable.

H. Conductors shall not be pulled through conduits until plastering or masonry work is completed and conduits are free from moisture. Care shall be taken so that long pulls of wire or pulls around several bends are not made where the wire may be permanently stretched and the insulation damaged.

I. Only nylon rope shall be permitted to pull cables into conduit and ducts.

J. At least six (6) inch loops or ends shall be left at each outlet for installation connection of fixtures or other devices.

K. All wires in outlet boxes not connected to fixtures or other devices shall be rolled up, spliced if continuity of circuit is required, and insulated.

L. Completely and thoroughly swab raceway system before installing conductors.

3.4 CABLE INSTALLATION

A. Provide protection for exposed cables where subject to damage.

B. Use suitable cable fittings and connectors.

C. Run all open cable in a neat and symmetrical manner. Follow the routing as illustrated on the drawings as closely as possible. If routing is not illustrated then the Contractor shall choose his own routing, but in any case it shall be run in a manner previously stated.

D. Open cable shall be supported by the appropriate size bridle rings or other means if called for on the drawings. Wire and cable from different systems shall not be installed in the same bridle rings.

E. Open cable installed above suspended ceilings shall not rest on the suspended ceiling construction, nor utilize the ceiling support system for wire and cable support.

F. Where open cables are grouped, they shall be neatly bundled and held together with nylon tie wraps placed every 2.5 ft. on the bundle. Where tie bundle passes through a bridle ring it shall be fastened to the ring with a tie wrap.

G. Bridle ring supports shall be installed at five foot (5') intervals. All rings shall be installed where completely accessible and not blocked by piping, ductwork, inaccessible ceilings, etc.

H. Open cable shall only be installed where specifically shown on the drawings, or permitted in these specifications.

3.5 MC CABLE INSTALLATION

A. Cable shall be supported by an approved means every 4 ½’ and within 12” of outlet boxes, junction boxes, cabinets, or fittings.

B. Cable may be unsupported in the following conditions:

1. Cable is not longer than 2’ in length at terminals where flexibility is necessary.
2. Cable is not more than 6’ from the last point of support for connections within an accessible ceiling to light fixtures or equipment.

C. Conductor ampacity shall be derated as required by the NEC where more than three current carrying conductors are used.

D. Cables shall be cut using a rotary cutter as recommended by the manufacturer to eliminate nicking and cutting of the conductors.

E. Bending radius shall comply with the requirements listed in the NEC for the type and size of cable being installed, but shall not be less than 5-times the diameter of the cable in any case.

F. At cable terminations, a fitting shall be provided to protect wires from abrasion, unless the design of the outlet boxes or fittings is such as to afford equivalent protection, and, in addition, an insulating bushing or its equivalent protection shall be provided between the conductors and the armor.

3.6 WIRING CONNECTIONS AND TERMINATIONS

A. Splice and tap only in accessible junction boxes.

B. Use solderless, tin-plated copper, compression terminals (lugs) applied with circumferential crimp for copper conductor terminations, 8 AWG and larger.

C. Use solderless, tin-plated, compression terminals (lugs) applied with indenter crimp for copper conductor terminations, 10 AWG and smaller.

D. Use solderless pressure connectors with insulating covers for copper wire splices and taps, 8 AWG and smaller. For 10 AWG and smaller, use insulated spring wire connectors with plastic caps.

E. Use copper, compression connectors applied with circumferential crimp for copper wire splices and taps, 6 AWG and larger. Tape uninsulated conductors and connectors with electrical tape to 150 percent of the insulation value of conductor.

F. Thoroughly clean wires before installing lugs and connectors.

G. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.

H. Terminate spare conductors with electrical tape, unless otherwise indicated on the drawings.

I. Phase Sequence: All apparatus shall be connected to operate in the phase sequence A-B-C representing the time sequence in which the phase conductors so identified reach positive maximum voltage.

J. As a general rule, applicable to switches, circuit breakers, starters, panelboards, switchgear and the like, the connections to phase conductors are intended thus:

Facing the front and operating side of the equipment, the phase identification shall be:

Left to Right - A-B-C
Top to Bottom - A-B-C

K. Connection revisions as required to achieve correct rotation of motors shall be made at the load terminals of the starters or disconnect switches.

L. Use antioxidant joint compound on all aluminum conductor terminations. Apply antioxidant joint compound per manufacturer’s recommendations.

3.7 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of Division 1.

B. Cable Testing: Test shall be made by means of an insulation testing device such as a “Megger” using not less than 500 volts D.C. test potential.

C. Inspect wire and cable for physical damage and proper connection.

D. Torque test conductor connections and terminations to manufacturer's recommended values.

E. Perform continuity test on all power and equipment branch circuit conductors. Verify proper phasing connections.

F. Provide documentation of the manufacturer's recommended lug torque value for aluminum conductors, the date the lugs were torqued, and installed torque readings.

3.8 WIRE AND CABLE INSTALLATION SCHEDULE

A. Concealed Interior Locations: Building wire in raceways.

B. Exposed Interior Locations: Building wire in raceways.

C. Above Accessible Ceilings: Building wire in raceways. Low voltage (less than 110 volts) shall be installed without conduit.

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. Below Accessible Floor: Building wire in raceways.

END OF SECTION

SECTION 16130
BOXES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Wall and ceiling outlet boxes
B. Floor boxes
C. Pull and junction boxes
D. Accessories

1.2 REFERENCES

A. ANSI/NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers and Box Supports

B. ANSI/NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports

C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum)

D. Federal Specification A–A–50563 – Conduit Outlet Boxes, Bodies, and Entrance Caps, Electrical Cast Metal

PART 2 - PRODUCTS

2.1 OUTLET BOXES

A. Sheet Metal Outlet Boxes: ANSI/NEMA OS 1; galvanized steel, minimum of 14 gauge, with 1/2 inch male fixture studs where required.

B. Nonmetallic Outlet Boxes: ANSI/NEMA OS 2.

C. Cast Boxes: NEMA FB1, Type FD, Aluminum or cast feralloy, deep type, gasketed cover, threaded hubs.

D. Outlet boxes for light fixtures to be 4" octagon box not less than 1-1/2" deep, deeper if required by the number of wires or construction.

E. Switch outlet boxes for local light control switches shall be 4 inches square by 1-1/2 inches deep, with raised cover to fit flush with finish wall line. Multiple gang switch outlets shall consist of the required number of gang boxes appropriate to the quantity of switches comprising the gang. Where walls are plastered, provide a plaster raised cover. Where switch outlet boxes occur in exposed concrete block walls, boxes shall be installed in the block cavity with a raised square edge tile cover of sufficient depth to extend out to face of block or masonry boxes.

F. Outlet boxes for telephone substations in walls and columns shall be 4 inches square and 2-1/8 inches deep with single gang raised cover to fit flush with finished wall line equipped with flush telephone plate.

G. Wall or column receptacle outlet boxes shall be 4 inches square with raised cover to fit flush with finished wall line. Boxes in concrete block walls shall be installed the same as for switch boxes in block walls.

2.2 PULL AND JUNCTION BOXES

A. Sheet Metal Boxes: ANSI/NEMA OS 1; galvanized steel.

B. Sheet metal boxes larger than 12 inches in any dimension that contain terminations or components: Continuous hinged enclosure with 1/4 turn latch and white back panel for mounting terminal blocks and electrical components.

C. Cast Metal Boxes for Outdoor and Wet Location Installations: NEMA 250; Type 4 and Type 6, flat-flanged, surface-mounted junction box, UL listed as raintight. Galvanized cast iron box and cover with ground flange, neoprene gasket, and stainless steel cover screws.

D. Cast Metal Boxes for Underground Installations: NEMA 250; Type 4, inside flanged, recessed cover box for flush mounting, UL listed as raintight. Galvanized cast iron box and plain cover with neoprene gasket and stainless steel cover screws.

E. Handholes for Underground Installations: Precast composite polymer concrete stackable body with conduit entry holes at center bottom of each side; composite polymer concrete cover with logo and skid resistant surface and stainless steel bolts.

F. Flanged type boxes shall be used where installed flush in wall.

PART 3 - EXECUTION

3.1 BOX INSTALLATION SCHEDULE

A. Galvanized steel boxes may be used in:

1. Concealed interior locations above ceilings and in hollow studded partitions.

2. Exposed interior locations in mechanical rooms and in rooms without ceilings; higher than 8’ above the highest platform level.

3. Direct contact with concrete except slab on grade.

4. Recessed in stud wall of kitchens and laundries.

B. Cast boxes shall be used in:

1. Exterior locations.

2. Hazardous locations.

3. Exposed interior locations within 8’ of the highest platform level.

4. Direct contact with earth.

5. Direct contact with concrete in slab on grade.

6. Wet locations.

7. Kitchens and laundries when exposed on wall surface.

3.2 COORDINATION OF BOX LOCATIONS

A. Provide electrical boxes as shown on the drawings, and as required for splices, taps, wire pulling, equipment connections, and code compliance.

B. Electrical box locations shown on the Contract Drawings are approximate, unless dimensioned. Verify location of floor boxes and outlets in offices and work areas prior to rough-in.

C. Locate and install boxes to allow access. Avoid interferences with ductwork, piping, structure, equipment, etc. Where installation is inaccessible, provide access doors. Coordinate locations and sizes of required access doors with the Architect and General Contractor.

D. Locate and install to maintain headroom and to present a neat appearance.

E. Coordinate locations with Heating Contractor to avoid baseboard radiation cabinets.

3.3 OUTLET BOX INSTALLATION

A. Do not install boxes back-to-back in walls. Provide a minimum horizontal offset of 24 inches between boxes installed on opposite sides of stud walls.

B. The Contractor shall anchor switch and outlet box to wall construction so that it is flush with the finished masonry, paneling, drywall, plaster, etc. The Contractor shall check the boxes as the finish wall surface is being installed to assure that the box is flush. (Provide plaster rings as necessary.)

C. Mount at heights shown or noted on the drawings or as generally accepted if not specifically noted.

D. Locate boxes in masonry walls to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat openings for boxes.

E. Provide knockout closures for unused openings.

F. Support boxes independently of conduit.

G. Use multiple-gang boxes where more than one device are mounted together; do not use sectional boxes. Provide barriers to separate wiring of different voltage systems.

H. Install boxes in walls without damaging wall insulation.

I. Coordinate mounting heights and locations of outlets mounted above counters, benches, backsplashes, and below baseboard radiation.

J. Position outlets to locate luminaires as shown on reflected ceiling drawings.

K. In inaccessible ceiling areas, position outlets and junction boxes within 6 inches of recessed luminaire, to be accessible through luminaire ceiling opening.

L. Provide recessed outlet boxes in finished areas; secure boxes to interior wall and partition studs, accurately positioned to allow for surface finish thickness. Use stamped steel stud bridges for flush outlets in hollow stud wall, and adjustable steel channel fasteners for flush ceiling outlet boxes.

M. Align wall-mounted outlet boxes for switches, thermostats, and similar devices.

N. Provide cast outlet boxes in exterior locations and wet locations, and where exposed rigid or intermediate conduit is used.

3.4 PULL AND JUNCTION BOX INSTALLATION

A. Locate pull boxes and junction boxes above accessible ceilings or in unfinished areas.

B. Support pull and junction boxes independent of conduit.

C. Do not install back-to-back boxes in walls. Provide a minimum horizontal offset of 24 inches between boxes installed on opposite sides of stud walls.

3.5 EXPOSED BOX INSTALLATION

A. Boxes shall be secured to the building structure with proper size screws, bolts, hanger rods, or structural steel elements.

B. On brick, block and concrete walls or ceilings, exposed boxes shall be supported with no less than two (2) Ackerman-Johnson, Paine, Phillips, or approved equal screw anchors or expansion shields and round head machine screws. Cast boxes shall not be drilled.

C. On steel structures, exposed boxes shall be supported to the steel member by drilling and tapping the member and fastening the boxes by means of round head machine screws.

D. Boxes may be supported on steel members by APPROVED beam clamps if conduit is supported by beam clamps.

E. Boxes shall be fastened to wood structures by means of a minimum of two (2) wood screws adequately large and long to properly support. (Quantity depends on size of box.)

F. Wood, plastic, or fiber plugs shall not be used for fastenings.

G. Explosive devices shall not be used unless specifically allowed.

END OF SECTION

SECTION 16141
WIRING DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Wall switches
B. Receptacles including GFCI
C. Floor mounted service fittings
D. Device plates and box covers

1.2 REFERENCES

A. FS W-C-596 - Electrical Power Connector, Plug, Receptacle, and Cable Outlet

B. FS W-S-896 - Switch, Toggle

C. NEMA WD 1 – General Color Requirements for Wiring Devices

D. NEMA WD 6 – Wiring Devices – Dimensional Requirements

E. U.L. 1472 – Solid-State Dimming Controls

F. U.L. 943 – Standard for Ground Fault Circuit Interrupters

G. U.L. 498 – Standard for Attachment Plugs and Receptacles

H. U.L. 20 – Standard for General Use Snap Switches

I. DSCC W-C-896F – General Specification for Electrical Power Connector

1.3 SUBMITTALS

A. Submit product data under provisions of Section 16010.

B. Provide product data showing configurations, finishes, dimensions, and manufacturer's instructions.

1.4 QUALITY ASSURANCE

A. Provide similar devices from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency to Authorities Having Jurisdiction and marked for intended use.

C. Comply with NFPA 70.

1.5 COORDINATION

A. Receptacles for Owner Furnished Equipment: Match plug configurations.

B. Cord and Plug Sets: Match equipment requirements.

PART 2 - PRODUCTS

2.1 WALL SWITCHES

A. Refer to General Electrical Equipment Schedule for configuration and ratings.

2.2 RECEPTACLES

A. Refer to General Electrical Equipment Schedule for configuration and ratings.

B. Back wired devices shall be complete with eight holes that are screw activated with metal clamps for connection to #12 or #10 copper conductors.

C. Side wired devices shall have four binding screws that are undercut for positive wire retention.

D. Ground Fault Circuit Interrupter (GFCI) receptacles shall comply with the 2006 edition of U.L. 943 requiring increased surge immunity, improved corrosion resistance, improved resistance to false tripping and diagnostic indication for miswiring if the line and load conductors are reversed during installation.

E. Industrial heavy-duty pin and sleeve devices shall comply with IEC 309-1.

F. Hazardous (Classified) location receptacles shall comply with NEMA FB 11.

2.3 CORD AND PLUG SETS

A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.

1. Cord: Rubber-insulated, stranded copper conductors, with Type SOW-A jacket; with green insulated grounding conductor and equipment rating ampacity plus a minimum of 30 percent.

2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.4 FLOOR MOUNTED SERVICE FITTINGS

A. Refer to General Electrical Equipment Schedule for configuration and required services.

2.5 WALL PLATES

A. Decorative coverplate shall be as shown on the drawings.

B. Weatherproof coverplates shall be as shown on the drawings.

C. Plate securing screws shall be metal with head color matching the wall plate finish.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install light switches, dimmers, and convenience receptacles at elevations indicated in the General Installation Notes on the contract drawings.

B. Install specific-use receptacles at heights shown on the contract drawings. Install devices level, plumb, and square with building lines. Coordinate installation of adjacent devices of separate systems with common mounting heights, including lighting, power, systems, technology, and temperature rough-ins.

C. Drill opening for poke-through fitting installation in accordance with manufacturer's instructions.

D. Install receptacles vertically with ground slot up or where indicated on the drawings, horizontally with ground slot to the left.

E. Install decorative plates on switch, receptacle, and blank outlets in finished areas, using jumbo size plates for outlets installed in masonry walls.

F. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface-mounted outlets.

G. Install devices and wall plates flush and level.

H. Contractor to verify that wall dimmer ratings are achieved where a ganged installation is used.

I. Install nameplate identification to receptacle cover plates indicated. Identification shall identify panel name and circuit number. Refer to Specification Section 16195 - Electrical Identification.

J. Test receptacles for proper polarity, ground continuity and compliance with requirements.

END OF SECTION

SECTION 16190
SUPPORTING DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Conduit and equipment supports
B. Fastening hardware

1.2 COORDINATION

A. Coordinate size, shape and location of concrete pads with Section on Cast-in-Place Concrete or Concrete Topping.

1.3 QUALITY ASSURANCE

A. Support systems shall be adequate for weight of equipment and conduit, including wiring, which they carry.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Allied Support Systems
B. Cooper B-Line
C. Erico, Inc.
D. Hilti
E. Power Fasteners

2.2 MATERIAL

A. Support Channel: Painted steel.

B. Hardware: Corrosion resistant.

C. Anchorage and Structural Attachment Components:

1. Strength: Defined in reports by ICBO Evaluation Service or another agency acceptable to Authorities Having Jurisdiction.

   a. Structural Safety Factor: Strength in tension and shear of components used shall be at least two times the maximum seismic forces to which they will be subjected.

2. Through Bolts: Structural type, hex head, high strength. Comply with ASTM A 325.

3. Welding Lugs: Comply with MSS-SP-69, Type 57.

4. Beam clamps for Steel Beams and Joists: Double sided. Single-sided type is not acceptable.

5. Bushings for Floor-Mounted Equipment Anchors: Neoprene units designed for seismically rated rigid equipment mountings, and matched to the type and size of anchor bolts and studs used.

6. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for seismically rated rigid equipment mountings, and matched to the type and size of attachment devices used.

7. Concrete Anchors: Fasten to concrete using cast-in or post-installed anchors designed per the requirements of Appendix D of ACI 318-08. Post-installed anchors shall be qualified for use in cracked concrete by ACI-355.2.

8. Masonry Anchors: Fasten to concrete masonry units with expansion anchors or self-tapping masonry screws. For expansion anchors into hollow concrete block, use sleeve-type anchors designed for the specific application. Do not fasten in masonry joints. Do not use powder actuated fasteners, wooden plugs, or plastic inserts.

D. Conduit Sleeves and Lintels:

1. Each Contractor shall provide, to the General Contractor for installation, lintels for all openings required for the Contractor's work in masonry walls and conduit sleeves for floors, unless specifically shown as being by others.

2. Refer to Structural plans and specifications for lintel requirements and sizes.

3. Fabricate all lintels from structural steel shapes or as indicated on the drawings. All lintels and grouped wall openings shall be approved by the Architect or Structural Engineer.

4. Fabricate all sleeves from standard weight black steel pipe. Provide continuous sleeve. Cut or split sleeves are not acceptable.

5. Sleeves through the floors on exposed risers shall be flush with the ceiling, with planed squared ends extending 1" above the floor in unfinished areas, and flush with the floor in finished areas, to accept spring closing floor plates.

6. Sleeves shall not penetrate structural members without approval from the Structural Engineer.

7. Openings through unexcavated floors and/or foundation walls below the floor shall have a smooth finish with sufficient annular space around material passing through opening so slight settling will not place stress on the material or building structure.

8. Install all sleeves concentric with conduits. Secure sleeves in concrete to wood forms. This Contractor is responsible for sleeves dislodged or moved when pouring concrete.

9. Where conduits rise through concrete floors that are on earthen grade, provide 3/4" resilient expansion joint material (asphalt and cork) wrapped around the pipe, the full depth of concrete, at the point of penetration. Secure to prevent shifting during concrete placement and finishing.

10. Size sleeves large enough to allow expansion and contraction movement.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure using expansion anchors in concrete and beam clamps on structural steel.

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 ceiling systems, piping, ductwork, mechanical equipment, or conduit, unless otherwise noted.

D. Do not use powder-actuated anchors without specific permission.

E. Do not drill structural steel members.

F. 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.

G. In wet locations and on all building floors below exterior earth grade install free-standing electrical equipment on concrete pads.

H. Install surface-mounted cabinets and panelboards with minimum of four anchors. Provide steel channel supports to stand cabinet one inch off wall.

I. Bridge studs top and bottom with channels to support flush-mounted cabinets and panelboards in stud walls.

J. Do not exceed 25 lbs. per hanger and a minimum spacing of 2’-0” on center when attaching to metal roof decking (excludes concrete on metal deck). This 25 lbs. load and 2’-0” spacing include adjacent electrical and mechanical items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off steel framing will need to be added.

K. Refer to Section 16111 for special conduit supporting requirements.

3.2 FINISH

A. Prime coat exposed steel hangers and supports. Hangers and supports in crawl spaces, pipe shafts, and above suspended ceiling spaces are not considered exposed.

B. Trim all ends of exposed field fabricated steel hangers, slotted channel and threaded rod to within 1” of support or fastener to eliminate potential injury to personnel unless shown otherwise on the drawings. Smooth ends and install elastomeric insulation with two coats of latex paint if exposed steel is within 6’-6” of finish floor and presents potential injury to personnel.

END OF SECTION

SECTION 16195
ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Nameplates and tape labels
B. Wire and cable markers
C. Conduit labeling
D. Conductor color coding
E. Electrical gear labeling
F. Power distribution equipment labeling
G. Series rating identification

1.2 REFERENCES

A. ANSI C2 – National Electrical Safety Code

B. NFPA 70 – National Electrical Code

C. ANSI A13.1 – Standard for Pipe Identification

D. ANSI Z535.4 – Standard for Product Safety Signs and Labels

PART 2 - PRODUCTS

2.1 ELECTRICAL IDENTIFICATION PRODUCTS

A. Colored Adhesive Marking Tape for banding Raceways, Wires, and Cables: Self-adhesive vinyl tape not less than 3 mils thick by 1 inch to 2 inches in width.

B. Pretensioned Flexible Wraparound Colored Plastic Sleeves for Cable Identification: flexible acrylic bands sized to suit the cable diameter and arranged to stay in place by pre-tensioned gripping action when coiled around the cable.

C. Wire/Cable Designation Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound, cable/conductor markers with preprinted numbers and letter.

D. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking nylon cable ties, 0.18-inch minimum width, 50-lb minimum tensile strength, and suitable for a temperature range from minus 50°F to 350°F. Provide ties in specified colors when used for color coding.

E. Underground Plastic Markers: Bright colored continuously printed plastic ribbon tape of not less than 6 inches wide by 4 mil thick, printed legend indicating type of underground line, manufactured for direct burial service. Tape shall contain a continuous metallic wire to allow location with a metal detector.

F. Aluminum, Wraparound Marker Bands: 1" in width, .014 inch thick aluminum bands with stamped or embossed legend, and fitted with slots or ears for permanently securing around wire or cable jacket or around groups of conductors.

G. Brass or aluminum Tags: 2" by 2" by .05-inch metal tags with stamped legend, punched for fastener.

H. Indoor/Outdoor Number and Letters: Outdoor grade vinyl label, minimum of 3/4” high x 9/16” wide, with acrylic adhesive designed for permanent application in severe indoor and outdoor environments.

2.2 NAMEPLATES AND SIGNS

A. Engraved, Plastic-Laminated Labels, Signs and Instruction Plates: Engraving stock melamine plastic laminate, 1/16-inch minimum thick for signs up to 20 square inches, or 8 inches in length; 1/8 inch thick for larger sizes. Labels shall be punched for mechanical fasteners. Engraving legend shall be as follows:

1. Black letters on white face for normal power.

2. White letters on red face for emergency power.

3. White letters on green face for grounding.

4. Black letter on yellow face for Caution or UPS.

B. Baked–Enamel Signs for interior Use: Preprinted aluminum signs, punched, or drilled for fasteners, with colors, legend, and size required for application. Mounting ¼" grommets in corners.

C. Exterior, Metal-Backed, Butyrate Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with .0396 inch galvanized-steel backing: and with colors, legend, and size required for application. Mounting ¼" grommets in corners.

D. Safety Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145.

E. Fasteners for Plastic-Laminated Signs; Self-tapping stainless steel screws or number 10/32 stainless steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Lettering and Graphics: Coordinate names, abbreviations, colors, and other designations used in electrical identification work with corresponding designations specified or indicated. Install numbers, lettering, and colors as required by code.

B. Install identification devices in accordance with manufacturer’s written instruction and requirements of NEC.

C. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work. All mounting surfaces shall be cleaned and degreased prior to identification installation.

D. Identify Junction, Pull and Connection Boxes: Permanent magic marker (color coded), neatly hand printed. In rooms that are painted out, provide labeling on inside of cover.

E. Circuit Identification: Tag or label conductors as follows:

1. Multiple Power or Lighting Circuits in Same Enclosure: Where multiple branch circuits are terminated or spliced in a box or enclosure, label each conductor with source and circuit number.

2. Multiple Control Wiring and Communication/Signal Circuits in Same Enclosure: For control and communications/signal wiring, use wire/cable marking tape at terminations in wiring boxes, troughs, and control cabinets. Use consistent letter/number conductor designations throughout on wire/cable marking tape.

3. Match identification markings with designations used in panelboards shop drawings, Contract Documents, and similar previously established identification schemes for the facility's electrical installations.

F. Apply warning, caution and instruction signs as follows:

1. Install warning, caution or instruction signs where required by NEC, where indicated, or where reasonably required to assure safe operation and maintenance of electrical systems and of the items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.

G. Apply circuit/control/item designation labels of engraved plastic laminate for pushbuttons, pilot lights, alarm/signal components, and similar items, except where labeling is specified elsewhere.

H. Install labels parallel to equipment lines at locations as required and at locations for best convenience of viewing without interference with operation and maintenance of equipment.

I. Install ARC FLASH WARNING signs on all switchboards, panelboards, industrial control panels, and motor control centers. Sign at a minimum shall contain:

J. Circuits with more than 600V: Identify raceway and cable with "DANGER—HIGH VOLTAGE" in black letters 2 inches high on orange background at 10'-0 foot intervals.

1. Entire floor area directly above conduits running beneath and within 12 inches of a basement or ground floor that is in contact with earth or is framed above unexcavated space.

2. Wall surfaces directly external to conduits concealed within wall.

3. All accessible surfaces of concrete envelope around conduits in vertical shafts, exposed in building, or concealed above suspended ceilings.

K. Underground Electrical Lines: For exterior underground power, control, signal, and communication lines, install continuous underground plastic line marker located directly above line at 6 to 8 inches below grade. Where width of multiple lines installed in a common trench or concrete envelope does not exceed 16 inches overall, use a single marker. Install line marker for underground wiring, both direct-buried cables and cables in raceway.

3.2 RECEPTACLE COVER PLATES

A. Provide identification on all receptacle cover plates indicated. Identification shall indicate source and circuit number serving the device (i.e. "C1A #24").

B. Identification material to be a clear, 3/8-inch Kroy tape or Brother self-laminating vinyl label with black letters in normal size "Swis 721 Bold" font. Letter and number size to 3/16-inch high. Embossed Dymo-Tape labels are not acceptable. Permanently affix identification label to cover plates, centered above the receptacle openings.

3.3 BOX LABELING

A. All junction, pull, and connection boxes shall be identified as follows:

1. For power and lighting circuits, indicate system voltage and identity of contained circuits ("120V, 1LA1-3,5,7").

3.4 CONDUCTOR COLOR CODING

A. Color coding shall be applied at all panels, switches, junction boxes, pull boxes, vaults, manholes etc., where the wires and cables are visible and terminations are made. The same color coding shall be used throughout the entire electrical system, therefore maintaining proper phasing throughout the entire project.

B. All wires and cables, 6 AWG or larger, used in motor circuits, main feeders, sub-main feeders and branch circuits, shall be coded by the application of plastic tape. The tape shall be 3-M, Plymouth or Permacel, in colors specified below. The tape shall be applied at each conductor termination with two 1-inch tape bands at 6-inch centers. Contractor option to use colored cabling in lieu of the tape at each end for conductor 6 AWG to 500 KCM.

C. Wire and cables smaller than 6 AWG shall be color coded by the manufacturer.

D. Colored cable ties shall be applied in groups of three ties of specified color to each conductor at each terminal or splice point starting 3 inches from the termination and spaced at 3- inches centers. Tighten to a snug fit, and cut off excess length.

E. Where more than one nominal voltage system exists in a building or facility, each ungrounded conductor of a multi-wire branch circuit, where accessible, shall be identified by phase and system.

F. Conductors shall be color coded as follows:

1. 120/240 Volt, 3-Wire:

a. A-Phase – Black
b. B-Phase – Red
c. Neutral – White
d. Ground Bond – Green

3.5 ELECTRICAL GEAR LABELING

A. Exterior electrical gear shall be identified with vinyl label names and numbers to be visible on the exterior of the gear. The labels shall correspond to the 1-line nomenclature and identify each cubicle of multi-section gear.

3.6 CONTROL EQUIPMENT IDENTIFICATION

A. Provide identification on the front of all control equipment, such as disconnect switches, starters, VFDs, contactors, motor control centers, etc. Nameplate text shall be a minimum of 1/4" high.

B. Labeling shall include:

1. Equipment type and contract documents designation of equipment being served.
2. Location of equipment being served if it is not located within sight.
3. Voltage and phase of circuit(s).
4. Panel and circuit number(s) serving the equipment.

EXHAUST FAN EF-1 ("LOCATED ON ROOF")
480V, 3-PHASE
FED FROM "1HA1-1"

3.7 POWER DISTRIBUTION EQUIPMENT IDENTIFICATION

A. Provide identification on the front of all power distribution equipment, such as panelboards, switchboards, etc. The identification material shall be engraved plastic-laminated labels. Text shall be a minimum of 1/4" high, Swiss 721 Bold.

B. Labeling shall include:

1. Equipment type and contract documents designation of equipment.
2. Voltage of the equipment.
3. Name of the upstream equipment and location of the upstream equipment if it is not located within sight.

DISTRIBUTION PANEL DP-H1
480Y/277V
FED FROM SWITCHBOARD "SB-1" (LOCATED IN MAIN ELECTRIC ROOM)

C. A separate nameplate for the service entrance equipment shall be labeled with the MAXIMUM AVAILABLE FAULT CURRENT and DATE of calculation given on the one-

line diagram.

D. Distribution panelboards and switchboards shall have each overcurrent protection device identified with name and location of the load being served ("AHU-1 LOCATED IN PENTHOUSE 1").

E. Branch panelboards shall be provided with typed panel schedules upon completion of the project. Existing panelboards shall have their existing panel schedules typed, with all circuit changes, additions or deletions also typed on the panel schedules. A copy of all panel schedules for the project shall be turned over as part of the O&M Manuals. Refer to 16010 for other requirements.

3.8 SERIES RATING IDENTIFICATION

A. Upstream devices of series rated components not enclosed in a single NEMA type enclosure shall be identified with a nameplate using 1/8-inch lettering height reading "CAUTION - SERIES RATED SYSTEM - IDENTICAL COMPONENT REPLACEMENT REQUIRED".

B. Downstream devices of series rated components not enclosed in a single NEMA type enclosure shall be identified with a nameplate using 1/8-inch lettering height reading "CAUTION - SERIES RATED SYSTEM - ADDITIONAL SERIES COMBINATION RATING: XX,XXX RMS SYMMETRICAL AMPERES" where XX,XXX shall be the series combination rating.

END OF SECTION

SECTION 16412
SURGE PROTECTION DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This section describes materials and installation requirements for low voltage surge protection devices (SPD) for the protection of all AC electrical circuits. SPD equipment to be installed at designated service entrance equipment.

1.2 REFERENCES

A. ANSI/IEEE C62.33 – IEEE Guide on Testing of MOV components

B. ANSI/IEEE C62.35 – IEEE Guide on Testing of SAD components

C. ANSI/IEEE C62.41 - IEEE Recommended Practice on Surge Voltage in Low Voltage AC Power Circuits

D. ANSI/IEEE C62.45 - IEEE Guide on Surge Testing for Equipment Connected to Low Voltage AC Power Circuits

E. ANSI/UL 1449 Third Edition (Version 3.0) - UL Standard for Safety for Surge Protective Devices

F. CBEMA – Computer Business Equipment Manufacturers Association

G. IEC 664 – International Engineering Consortium, Standard for Clamping Voltage

H. National Electrical Code 285 - Surge Protection Devices

I. NFPA 70 - National Electrical Code

J. UL 67 – Listed for Internal Panelboard Transient Voltage Surge Suppressors

K. UL 96A – Devices listed as approved for secondary surge arrestors (VZCA)

L. UL 248-1 - Fusing

M. UL 1283 – Electromagnetic Interference Filters, Fifth Edition

1.3 QUALITY ASSURANCE

A. The specified unit shall be designed, manufactured, tested and installed in compliance with the above references. The unit shall be “Listed by Underwriters Laboratories” to UL 1449.

B. Each unit shall be designed and manufactured by a qualified manufacturer of power conditioning equipment. The qualified manufacturer must have been engaged in the design and manufacturer of such products for a minimum of five years.

1.4 SUBMITTALS

A. Shop Drawings: Should include device dimensions, mounting requirements including wire size and over-current protection device rating, nameplate nomenclature, electrical ratings, short circuit current rating, and test results as indicated below under “Testing, Warranty and Life Expectancy” as provided by an independent test lab or a UL certified test lab for the category of suppression device specified using the appropriate IEEE test wave. Product data sheets with installation instructions for each size and type of device are required. Shop drawings submitted without the testing data as required by section this section will be rejected.

B. Fuse information: Provide fuse information if required for operation. Include size, manufacturer, time-current chart responses to UL 1449 testing requirements, maximum surge protection capability per mode and phase as limited by the fuse, and verification of repetitive surge protection device operation without system degeneration greater than 10%.

1.5 TESTING, WARRANTY AND LIFE EXPECTANCY

A. Manufacturer must provide independent testing on repetitive capability and maximum surge current rating of service entrance suppressor units. This shall be performed at a nationally recognized lab not affiliated with the manufacturer.

1. Single pulse surge current capacity: Single pulse surge current tested in a mode at rated surge currents.

2. Single pulse surge current capacity test: An initial UL 1449 defined 1.2 x 50µs, 6000V open circuit voltage waveform and an 8 x 20µs, 500A and 3kA short circuit current waveform shall be applied to benchmark the unit’s suppression voltage (VPR).

3. A single 8 x 20µs waveform pulse of maximum rated surge current per mode shall then be applied. To complete the test, another UL 1449 surge shall be applied to verify the unit’s survival. Survival is achieved if the suppression voltage measured from the two UL1449 surges does not vary by more than 10%.

B. Minimum Repetitive Surge Current Capacity:

1. Service entrance suppressor units should be tested repetitively at an independent lab to verify repetitive capacity.

2. Minimum Repetitive Surge Current Capacity Test:

a. An initial UL 1449 surge defined as 1.2 x 50µs, 6000V open circuit voltage waveform and an 8 x 20µs, 500A and 3kA short circuit current waveform shall be applied to benchmark the unit’s suppression voltage.

b. A repetitive number of ANSI/IEEE C62.41.2-2002 (Category C3) surges, defined as a 1.2 x 50µs 10kV or 20kV open circuit voltage waveform and an 8 x 20µs 10,000A short circuit current waveform, shall then be applied at one-minute intervals.

c. To complete the test, another UL 1449 surge shall be applied to verify the unit's survival.

3. Survival is achieved if the suppression voltage (VPR) does not vary by more than 10%.

4. Proof of such testing shall be the test log generated by the surge generator.

C. Provide UL 1449 classification white sheet pages indicating the VPR (voltage protection rating) for each SPD unit submitted for this product using the 6kV/3kA combination wave surge.

D. Warranty: Ten (10) years. Includes workmanship, installation and programming.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS – REFER TO GENERAL ELECTRICAL EQUIPMENT SCHEDULE ON DRAWINGS

2.2 DESCRIPTION

A. General: The unit shall provide transient voltage suppression, surge current diversion and high-frequency noise attenuation, when connected in parallel to the facilities distribution system. The unit MCOV shall not be less than 115% of the nominal system voltage. Operating frequency shall be for a 60 Hz system. The unit shall provide protection in all normal modes for "wye" and "delta" systems. The short circuit current rating shall be the larger of the listed value on the drawings or as required by the equipment protected.

2.3 RATINGS

A. Service Entrance Suppressors – NonModular:

1. For 120/240 volt, 1 phase, 3 wire, type 2, category C3 unit.

a. Surge current capacity: 80,000/160,000 amps per protection mode/phase

b. Nominal Discharge Current: 20 kA.

c. Mounting: Refer to the drawings.

d. Voltage Protection Rating: Refer to requirements below.

e. Components: Minimum component size of 20mm metal oxide varistors (MOV).

B. Voltage Protection Rating:

1. Protection modes and UL 1449 voltage protection rating for surge suppression units per each mode (L-N, L-L, L-G, and N-G as appropriate).

a. 240 Volt, 1 phase, 3 wire. 1200 Volt L-N, L-L

C. Indication:

1. Each unit shall include solid-state indicators with externally mounted LED visual status indicators that indicate on-line status of each protection mode of the unit.

2. Each unit shall include an audible alarm with silencing switch to indicate when protection has failed.

3. Provide each type unit with a transient counter.

4. Each unit shall contain form “C” contacts for remote indication of an alarm status.

D. Fuses:

1. Use fuses recommended by the manufacturer to satisfy repetitive UL 1449 operation of the surge suppression unit.

2. Fuses shall be rated 200, 000 AIC minimum interrupting capacity.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine equipment for size and type of surge protection device to be used to ensure physical compatibility.

B. Inspect surge protection device for any signs of physical damage due to shipping or handling before installing surge protection device.

3.2 INSTALLATION

A. Mounting Location:

1. The unit shall be installed as close as practical to the panel secondary lugs in accordance with applicable national/Local Electrical Codes and the manufacturer’s recommended installation instructions. Connect the unit to the panel using a conduit nipple. Flush mount the unit in the front of the switchboard. Mount unit directly across from the breaker or disconnect serving it.

B. Connections:

1. Conductors from the protected bus to the unit shall not be any longer than necessary avoiding unnecessary bends. The conductor leads shall be twisted together and as short as possible. Connection shall be with mechanical lugs for each phase, neutral, and ground if applicable. Contractor shall provide wire and circuit breakers sized per the approved manufacturer’s requirements. Maximum lead length from protected bus to surge protection device shall be per manufacturer’s requirements, but no greater than 5’-0”.

2. The surge protection unit shall be isolatable from the electrical distribution system via 3 pole circuit breaker mounted in the switchboard/panelboard. Single phase 120 volt units shall be hardwired without a disconnecting means.

3. Neutral and ground shall not be bonded together at secondary panelboard locations.

C. General:

1. Check unit for proper operation of protection and indication under start-up.

2. Check unit to ensure all MOVs for each mode of protection are operational. Verify integral fuse links are operational and have not melted.

3. Surge suppression devices shall not be installed ahead of the main service disconnect(s).

4. Install fuses in all fuse holders and fused disconnects internal to the surge protection unit. Use fuses recommended by the manufacturer to satisfy repetitive UL 1449 operation of the surge suppression unit. External fusing of the surge protection device is not allowed.

5. Coordinate location of surge protection device to allow adequate clearances for maintenance.

END OF SECTION

SECTION 16420
SERVICE ENTRANCE

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Arrangement with Utility Company for permanent electric service
B. Underground service entrance

1.2 SYSTEM DESCRIPTION

A. System Voltage: 240/120, one phase, three-wire, 60 Hertz.

1.3 QUALITY ASSURANCE

A. Install service entrance in accordance with Utility Company's rules and regulations.

1.4 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 16010.

B. Submit Utility Company prepared drawings (if applicable).

PART 2 - PRODUCTS

2.1 METERING EQUIPMENT

A. Meter: Furnished by the Utility Company.

B. Meter Base: Furnished by the Contractor, as approved by the Utility Company. (Manufacturers: Milbank, Superior, Duncan, or Anchor).

C. Exterior Mounted Metering Cabinets: Furnished and installed by the Contractor to Utility Company's specifications. Conduit and conductors between metering cabinets and instrumentation shall be by the Contractor. Connections as required by the Utility Company.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Make arrangements with Utility Company to obtain permanent electric service to the Project.

B. Primary distribution equipment and pad-mounted transformers shall be furnished and installed by the Utility Company.

C. Primary conductors shall be furnished, installed, and terminated by the Utility Company. Primary conduit shall be furnished and installed by the Contractor, as shown on the drawings, to the Utility Company's requirements.

D. Underground: Install service entrance conduits in concrete envelope from Utility Company's pad mounted transformer to building service entrance equipment. Utility Company will connect service conductors to transformer secondary lugs.

E. Concrete Pad for Transformer: Furnished and installed by the Contractor to Utility Company's specifications.

END OF SECTION

SECTION 16440
DISCONNECT SWITCHES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Fusible switches
B. Nonfusible switches
C. Molded-case circuit switches
D. Molded-case switches
E. Enclosures

1.2 REFERENCES

A. NEMA KS 1 - Enclosed Switches

1.3 SUBMITTALS

A. Submit product data under provisions of Section 16010.

B. Product Data: For each type of enclosed switch, circuit breaker, accessory and component indicated, include dimensions, weights, and manufacturer's technical data on features, performance, and ratings.

C. Electrical Characteristics: For each type of enclosed switch, enclosure types, current and voltage ratings, short-circuit current ratings, UL listing for series rating of installed devices, features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

1.4 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 FUSIBLE AND NONFUSIBLE SWITCHES

A. Fusible Switch Assemblies: NEMA KS 1; Type heavy duty, quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse Clips: Class 'R' fuse clips only, unless indicated otherwise on the drawings.

B. Non-fusible Switch Assemblies: NEMA KS 1; Type heavy duty, quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position.

C. Enclosures: Type as indicated on the disconnect schedule.

D. Accessories: As indicated on the disconnect schedule.

2.2 MOLDED-CASE CIRCUIT BREAKERS AND SWITCHES

A. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

B. Molded-Case Switches: Molded-case circuit breaker with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install disconnect switches where indicated on the drawings.

B. Install fuses in fusible disconnect switches.

C. Provide adhesive label on inside door of each switch indicating UL fuse class and size for replacement.

END OF SECTION

SECTION 16450
GROUNDING AND BONDING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Equipment grounding system
B. Bonding system
C. Grounding electrode system

1.2 SUMMARY

A. This section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

1.3 SUBMITTALS

A. Submit shop drawings under provisions of Section 16010.

B. Product Data: For the following:

1. Ground rods.

C. Field Test Reports: Submit written test reports to include 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. Indicate layout of ground field, location of system grounding electrode connections, and routing of grounding electrode conductor and ground ring.

1.4 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 UL 467 Grounding and Bonding Equipment.

C. Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system.

D. Comply with NFPA 70; for overhead-line construction and medium-voltage underground construction, comply with IEEE/ANSI C2 National Electrical Safety Code (NESC).

PART 2 - PRODUCTS

2.1 GROUNDING CONDUCTORS

A. For insulated conductors, comply with Division 16 Section 16120 "Wire and Cable".

B. Material: Aluminum.

C. Equipment Grounding Conductors: Insulated with green-colored insulation.

D. Isolated Ground Conductors: Insulated with green-colored insulation with yellow stripe. On feeders with isolated ground, use colored tape, alternating bands of green and yellow tape to provide a minimum of three bands of green and two bands of yellow.

E. Grounding Electrode Conductors: Stranded cable.

F. Underground Conductors: Bare, tinned, stranded, unless otherwise indicated.

G. Sizes and types below are typical. Adjust to suit Project conditions and requirements.

H. Aluminum Bonding Conductors: As follows:

1. Bonding Cable: 10 strands of No. 14 AWG aluminum conductor, 1/4 inch in diameter.

2. Bonding Conductor: No. 4 or No. 6 AWG, stranded aluminum conductor.

3. Bonding Jumper: Aluminum tape, braided bare aluminum conductors, terminated with aluminum ferrules; 1-5/8 inches wide and 1/16 inch thick.

I. Grounding Bus: Bare, annealed copper bars of rectangular cross section, with insulators.

2.2 CONNECTOR PRODUCTS

A. Comply with UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.

B. Connectors: Hydraulic compression type or Exothermic-welded type, in kit form, and selected per manufacturer’s written instructions.

C. Bolted Connectors: Bolted-pressure-type connectors.

2.3 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel.

B. Concrete-Encased Grounding Electrode (Ufer): Fabricate according to NFPA 70, Paragraph 52-(3), using a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG or 20 feet (6.0 m) of 1/2” (13mm) steel reinforcing bar.

PART 3 - EXECUTION

3.1 CONNECTIONS

A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.

2. Make connections with clean, bare metal at points of contact.

3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.

4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.

5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

B. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

C. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.

D. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically non-continuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.

E. Connections at Test Wells: Use compression-type connectors on conductors and make bolted- and clamped-type connections between conductors and ground rods.

F. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

G. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.

H. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.2 INSTALLATION

A. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.

B. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

C. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then use a bolted clamp. Bond straps directly to the basic structure, taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.

D. In raceways, use insulated equipment grounding conductors.

E. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections, except those at test wells.

F. Equipment Grounding Conductor Terminations: Use bolted pressure clamps.

G. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, below access floors, and elsewhere as indicated, with bolted connections to form a continuous ground path.

H. Underground Grounding Conductors: Use copper conductor, No. 2/0 AWG minimum. Bury at least 24 inches below grade or bury 12 inches above duct bank when installed as part of the duct bank.

I. Grounding electrode conductor shall be protected from physical damage by rigid polyvinyl chloride conduit (PVC).

J. Each grounding conductor that passes through a basement wall must be provided with a waterstop.

3.3 EQUIPMENT GROUNDING SYSTEM

A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.

B. Install equipment grounding conductors in all feeders and circuits. Terminate each end on a grounding lug or bus.

C. Install insulated equipment grounding conductor with circuit conductors for the following items, in addition to those required by NEC:

1. Lighting and receptacle circuits. Terminate each end on a grounding lug or bus.
2. Single-phase and three-phase motor and appliance branch circuits.
3. Flexible raceway runs, including FMC and LFMC.
4. Armored and metal-clad cable runs.

D. Busway Supply Circuits: Install insulated equipment grounding conductor from the grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.

E. Computer Outlet Circuits: Install insulated equipment grounding conductor in branch-circuit runs from computer-area power panels or power-distribution units.

F. X-Ray Equipment Circuits: Install insulated equipment grounding conductor in circuits supplying x-ray equipment.

G. Isolated Grounding Circuits: Install an insulated equipment grounding conductor connected to the receptacle or equipment grounding terminal. Isolate grounding conductor from raceway and from panelboard grounding terminals. Terminate at isolated equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.

H. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.

3.4 BONDING SYSTEM

A. At building expansion joints, provide flexible bonding jumpers to connect to columns or beams on each side of the expansion joint.

B. Isolated Equipment Enclosure: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate equipment bonding conductor.

C. Exterior Metallic Pull and Junction Box Covers, Metallic Hand Rails: Bond to grounding system using flexible grounding conductors.

D. Equipment Circuits: Install a bonding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners and heaters. Bond conductor to each unit and to air duct. Bond interior metal piping systems and metal air ducts to equipment grounding conductors of associated pumps, fans, blowers, electric heaters, and air cleaners. Use braided-type bonding straps.

E. Water Heater, Heat-Tracing, Metal Well Casing, and Heating Cables: Install a separate equipment grounding conductor to each electric water heater, heat-tracing, and anti-frost heating cable. Bond conductor to heater units, piping, well casing, connected equipment, and components.

F. Connect bonding conductors to metal water pipe using a suitable ground clamp. Make connections to flanged piping at street side of flange. Provide bonding jumper around water meter.

G. Signal and Communication Systems: For telephone, alarm, voice and data, and other communication systems, provide No. 6 AWG minimum insulated bonding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location. Leave 10 feet of slack conductor at terminal board.

H. Telecom Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch grounding bar.

I. Terminal Cabinets: Terminate bonding conductor on cabinet grounding terminal.

J. Remote control, signaling, and fire alarm circuits shall be bonded in accordance with the most recent version of the National Electric Code.

3.5 GROUNDING ELECTRODE SYSTEM

A. Supplementary Grounding Electrode: Use driven ground rod on exterior of building.

B. Provide bonding at Utility Company's metering equipment and pad mounted transformer.

C. Ground Rods: Install at least two rods spaced at least 20 feet from each other and located at least the same distance from other grounding electrodes.

1. Drive ground rods until tops are 12 inches below finished floor or final grade, unless otherwise indicated.

2. Interconnect ground rods with grounding electrode conductors. Use exothermic welds, except at test wells and as otherwise indicated. Make connections without exposing steel or damaging copper coating.

D. Metal Water Service Pipe: Provide insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes by grounding clamp connectors. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

E. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding clamp connectors.

F. Bond each aboveground portion of natural gas metallic piping system at equipment locations. The equipment grounding conductor may serve as the bonding means.

G. Concrete-Encased Grounding Electrode (Ufer): Install concrete-encased grounding electrode encased in at least 2 inches (50mm) of concrete horizontally within the foundation that is in contact with the earth. If concrete foundation is less than 20 feet long, coil excess conductor within the base of the foundation. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building grounding grid or to a grounding electrode external to concrete.

3.6 FIELD QUALITY CONTROL

A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.

1. Measure ground resistance from system neutral connection at service entrance to convenient ground reference points using suitable ground testing equipment. Resistance shall not exceed 5 ohms.

2. Testing: Perform the following field quality-control testing:

   a. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.

   b. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells. Measure ground resistance not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests, by the fall-of-potential method according to IEEE 81.

   c. Provide drawings locating each ground rod and ground rod assembly and other grounding electrodes, identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

      1) Equipment Rated 500 kVA and Less: 10 ohms.
      2) Equipment Rated 500 to 1000 kVA: 5 ohms.
      3) Equipment Rated More Than 1000 kVA: 3 ohms.
      4) Substations and Pad-Mounted Switching Equipment: 5 ohms.
      5) Manhole Grounds: 10 ohms.

   d. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION

SECTION 16470
PANELBOARDS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Lighting and appliance branch circuit panelboards

1.2 REFERENCES

A. NEMA AB 1 - Molded Case Circuit Breakers

B. NEMA FU 1 – Low voltage cartridge fuses

C. NEMA KS 1 - Enclosed Switches

D. NEMA PB 1 - Panelboards

E. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less

F. NEMA PB 1.2 - Application Guide for Ground-fault Protective Devices for Equipment

G. UL 67 - Panelboards

1.3 SUBMITTALS

A. Submit shop drawings for equipment and component devices under provisions of Section 16010.

B. Include outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.

PART 2 - PRODUCTS

2.1 RATINGS

A. Definitions:

1. Series rated equipment shall be defined as equipment that can achieve a required UL AIC rating with an upstream device such as a main breaker or a combination of devices to meet or exceed a required UL AIC rating. All series rated equipment shall have a permanently attached nameplate indicating that device rating must be maintained. See Section 16195 for additional requirements.

2. Fully rated equipment shall be defined as equipment where all devices in that equipment shall carry a minimum of the AIC rating that is specified.

B. The panelboards for this project shall be fully rated unless otherwise specifically noted in the Drawings or Specifications.

2.2 BRANCH CIRCUIT PANELBOARDS

A. Lighting and Appliance Branch Circuit Panelboards: NEMA PB 1; circuit breaker type.

B. Enclosure: NEMA PB 1; Type 1.

C. Provide cabinet front with concealed hinge. Finish in manufacturer's standard gray enamel.

D. Provide panelboards with copper bus, ratings as scheduled on the drawings. Provide copper ground bus in all panelboards.

E. All multiple-section panelboards shall have the same dimensional back box and cabinet front size.

F. Minimum Integrated Short Circuit Rating: As shown on the drawings.

G. Molded Case Circuit Breakers: Bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles. Provide circuit breakers UL listed as Type SWD for lighting circuits. Provide UL Class A ground fault interrupter circuit breakers where scheduled on the drawings. Do not use tandem circuit breakers.

H. Current Limiting Molded Case Circuit Breakers: Provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole. Interrupting rating 100,000 symmetrical amperes, let-through current and energy level less than permitted for same size Class RK-5 fuse.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install panelboards plumb as indicated on the drawings in conformance with NEMA PB 1.1.

B. Height: 6 feet to handle of highest device.

C. Provide filler plates for unused spaces in panelboards.

D. Provide typed circuit directory for each branch circuit panelboard. Label each circuit with the type of load and the name and number of the area served. Revise directory to reflect circuit changes required to balance phase loads.

E. Stub five (5) empty one inch conduits to accessible location above ceiling out of each recessed panelboard.

F. Install fuses in fusible switch assemblies.

3.2 FIELD QUALITY CONTROL

A. Measure steady state load currents at each panelboard feeder. Should the difference at any panelboard between phases exceed 20 percent, rearrange circuits in the panelboard to balance the phase loads within 20 percent. Take care to maintain proper phasing for multi-wire branch circuits.

B. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers, fusible switches, and fuses.

END OF SECTION

SECTION 16477
FUSES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Fuses
B. Spare Fuse Cabinet

1.2 REFERENCES

A. UL 198C - High-Interrupting Capacity Fuses; Current Limiting Types

B. UL 198E - Class R Fuses

C. FS W-F-870 - Fuseholders (For Plug and Enclosed Cartridge Fuses)

D. NEMA FU 1 - Low Voltage Cartridge Fuses

E. NFPA 70 – National Electrical Code

1.3 SUBMITTALS

A. Submit product data under provisions of Section 16010.

1.4 PROJECT CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40°F (5°C) or more than 100°F (38°C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.5 EXTRA MATERIALS

A. Provide two fuse pullers.

B. Provide three of each size and type of fuse installed.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS – FUSES

A. Cooper Bussman
B. Eagle Electric Mfg. Co.; Cooper Industries
C. Mersen
D. Tracor; Littelfuse Subsidiary

2.2 FUSES

A. Dimensions and Performance: NEMA FU 1, Class as specified or indicated.

B. Voltage: Provide fuses with voltage rating suitable for circuit phase-to-phase voltage.

C. Fuses with ratings larger than 600 amperes: Class L (time delay), unless otherwise noted on the drawings.

D. Fuses with ratings larger than 200 amperes but equal to or less than 600 amperes: Class RK-1 (time delay), unless otherwise noted on the drawings.

E. Fuses with ratings less than or equal to 200 amperes (not including control transformer fuses): Class RK-5, unless otherwise noted on the drawings.

F. Control transformer fuses: Class CC (time delay).

G. Fuses for packaged equipment: Size and type as recommended by equipment manufacturer.

2.3 SPARE FUSE CABINET

A. Cabinet: Wall-mounted, 0.05-inch- (1.27-mm-) thick steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.

1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
2. Finish: Gray, baked enamel.
3. Identification: "SPARE FUSES" in 1-1/2-inch- (38-mm-) high letters on exterior of door.
4. Fuse Pullers: For each size of fuse.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fuses where indicated on the drawings and specifications.

B. Install fuses in accordance with manufacturer's instruction.

C. Install fuses in packaged equipment as required by equipment manufacturer.

D. Install fuse with label oriented such that manufacturer, type, and size are easily read.

END OF SECTION

SECTION 16480
MOTOR CONTROL

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Manual motor starters
B. Magnetic motor starters
C. Combination magnetic motor starters

1.2 REFERENCES

A. NEMA ICS 6 - Enclosures for Industrial Controls and Systems

B. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service

C. FS W-P-115 - Power Distribution Panel

D. FS W-F-870 - Fuseholders (For Plug and Enclosed Cartridge Fuses)

E. FS W-S-865 - Switch, Box, (Enclosed), Surface-Mounted

F. NEMA AB 1 - Molded Case Circuit Breakers

G. NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies

H. NEMA KS 1 - Enclosed Switches

I. NEMA PB 1 - Panelboards

J. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or less

K. ANSI/UL Standard 508. Standard for Industrial Control Equipment

L. IEEE Standard 519-1981 - Guide for Harmonic Control and Reactive Compensation of Static Power Converters

M. FCC Rules and Regulations, Part 15, Subpart J- Radio Frequency Interference

1.3 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 16010.

B. Indicate on shop drawings, front and side views of motor control center enclosures with overall dimensions. Include conduit entrance locations and requirements; wiring diagrams that differentiate between manufacturer-installed and field-installed wiring; nameplate legends; size and number of bus bars per phase, and ground; electrical characteristics including voltage, frame size and trip ratings, withstand ratings, and time-current curves of all equipment and components.

C. Provide product data on motor starters and combination motor starters, relays, pilot devices, and switching and over-current protective devices.

D. Submit manufacturer's instructions under provisions of Section 16010.

1.4 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Section 16010.

B. Include spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Section 16010.

B. Deliver in 60 inch maximum width shipping splits, individually wrapped for protection, and mounted on shipping skids.

C. Store and protect products under provisions of Section 16010.

D. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from fumes, dirt, water, construction debris, traffic, and physical damage.

E. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to motor control center components, enclosure, and finish.

1.6 SPARE PARTS

A. Keys: Furnish four (4) each to the Owner.

B. Fuses: Furnish three (3) spare fuses of each type and rating installed to the Owner.

C. Fuse Pullers: Furnish one (1) fuse puller to the Owner.

PART 2 - PRODUCTS

2.1 MANUAL MOTOR STARTERS

A. Manual Motor Starter: NEMA ICS 2; AC general-purpose Class A manually operated non-reversing full-voltage controller for induction motors rated in horsepower, with overload relay, and toggle operator.

B. Fractional Horsepower Manual Starter: NEMA ICS 2; AC general-purpose Class A manually operated, full-voltage controller for fractional horsepower induction motors, with thermal overload unit, and toggle operator.

C. Motor Starting Switch: NEMA ICS 2; AC general-purpose Class A manually operated, full-voltage controller for fractional horsepower induction motors, without thermal overload unit, and toggle operator.

D. Enclosure: NEMA ICS 6; Type 1.

2.2 MAGNETIC MOTOR STARTERS

A. Magnetic Motor Starters: NEMA ICS 2; AC general-purpose Class A magnetic controller for induction motors rated in horsepower.

B. Full Voltage Starting: Non-reversing type, unless otherwise indicated.

C. Coil Operating Voltage: 120 volts, 60 Hertz, obtained from integral control power transformer of sufficient capacity to operate connected pilot, indicating, and control devices, plus 100% spare capacity.

D. Size: NEMA ICS 2; size as shown on the drawings.

E. Overload Relay:

1. Overload Relay: Ambient-compensated type with inverse-time-current characteristic and NEMA ICS 2, Class 10 tripping characteristic. Provide with heaters or sensors in each phase matched to nameplate full-load current of specific motor to which they connect and with appropriate adjustment for duty cycle.

F. Enclosure: NEMA ICS 6; Type 1.

G. Combination Motor Starters: Combine motor starters with disconnect switch in common enclosure. Provide with disconnecting means as indicated on drawings.

H. Auxiliary Contacts: NEMA ICS 2; two normally open, field convertible contacts in addition to seal-in contact.

I. Pushbuttons: NEMA ICS 2; START/STOP in front cover.

J. Indicating Lights: NEMA ICS 2; RUN: red in front cover.

K. Selector Switches: NEMA ICS 2; HAND/OFF/AUTO, in front cover.

L. Relays: NEMA ICS 2.

M. Control Power Transformers: 120 volt fused secondary, fused primary, minimum VA as scheduled:

Size 1 - 100 VA
Size 2 - 100 VA
Size 3 - 150 VA
Size 4 - 300 VA
Size 5 - 300 VA
Size 6 - 300 VA

N. Provide phase loss protection relay with contacts to de-energize the starter for each starter serving motors 5 HP or greater.

2.3 CONTROLLER OVER-CURRENT PROTECTION AND DISCONNECTING MEANS

A. Molded Case Thermal-Magnetic Circuit Breakers: Circuit breakers with integral thermal and instantaneous magnetic trip in each pole. NEMA AB 1, motor-circuit protector with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.

B. Non-fusible Switch Assemblies: Quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle. Provide interlock to prevent opening front cover with switch in ON position. Handle lockable in OFF position.

C. Fusible Switch Assemblies: NEMA KS 1, quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle. Provide interlock to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse Clips: Provide with Class' R' rejection clips. Select and size fuses to provide Type 2 protection according to IEC 947-4-1, as certified by a nationally recognized testing laboratory.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install motor control equipment in accordance with manufacturer's instructions on concrete bases.

B. Motor Starter Panelboard Installation: In conformance with NEMA PB 1.1.

C. Install fuses in fusible switches.

D. Select and install heater elements in motor starters to match installed motor characteristics.

E. Set field-adjustable switches and circuit-breaker trip ranges.

F. Motor Data: Provide neatly typed label inside each motor starter enclosure door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating.

END OF SECTION

SECTION 16510
LIGHTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Interior luminaires and accessories
B. Exterior luminaires and accessories
C. Lamps
D. Ballasts
E. Poles

1.2 REFERENCES

A. ANSI C78.377-2008 – Specifications for the Chromaticity of Solid State Lighting Products

B. ANSI C82.4 - High-Intensity Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type)

C. ANSI C82.6 - Ballasts for HID Lamps - Method Measurement

D. ANSI C82.11 - High Frequency Fluorescent Lamp Ballasts

E. ANSI C82.77-2002 – Standard for Harmonic Emission Limits and Related Power Quality Requirements for Lighting Equipment

F. IEEE C2 - National Electrical Safety Code

G. NEMA LE 2 - H-I-D Lighting System Noise Criterion (LS-NC) Ratings

H. UL 935 – Standard for Fluorescent Lamp Ballasts

1.3 SUBMITTALS

A. Submit product data under provisions of Section 16010.

B. Submit product data sheets for luminaires, lamps, ballasts, drivers and poles. Include complete product model number with all options as specified.

C. Submit lens product data, dimensions and weights if not included in product data sheet submittal.

D. Include outline drawings, support points, weights, and accessory information for each luminaire type.

E. Submit utility rebate forms, where offered at project location, with rebate items completed.

F. LED luminaire submittals shall include photometric report per IESNA LM-79-08 for the latest generation system being furnished, including independent testing laboratory name, report number, date, luminaire model number, input wattage, luminaire, and light source specifications. Manufacturer origin of LED chipset and driver shall be submitted.

G. For all LED luminaires specified as dimmer controlled, submit dimmer device data that is approved by manufacturer of submitted luminaire and that Contractor proposes to furnish and install. Contractor is responsible for verifying that installed dimming controls are compatible with and approved by the luminaire manufacturer.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site. Store and protect under provisions of Section 16010.

B. Protect luminaire finishes, lenses, and trims from damage during storage and installation. Do not remove protective films until construction cleanup within each area is complete.

C. Handle site lighting poles carefully to prevent breakage and damage to finish.

1.5 WARRANTY

A. Fluorescent ballasts shall carry a three-year warranty from date of Substantial Completion. HID ballasts shall carry a two-year warranty from date of Substantial Completion. Dimming electronic ballasts shall have a five year warranty.

B. Fluorescent lamps shall carry a two-year warranty from date of Substantial Completion.

C. HID lamps shall carry a one-year warranty from date of Substantial Completion.

D. Light emitting diode (LED) light engines and drivers shall have a five-year warranty from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 INTERIOR LUMINAIRES AND ACCESSORIES - GENERAL

A. Lensed Fluorescent Troffers: Provide hinged frames with latches and 0.125 inch thick virgin acrylic lenses. Prismatic lenses shall have depth of no less than 0.080", KSH12 or equal. Other lenses as scheduled.

B. Recessed Ceiling Luminaires: Confirm ceiling type and furnish trim and accessories necessary to permit proper installation in each ceiling system. Where fire-rated ceiling assemblies are specified, furnish and install listed enclosures around luminaires that maintain the system rating.

C. Parabolic Luminaires: Louvers shall be anodized low iridescent specular aluminum with mitered corners and interlocking construction. Provide ballast covers to separate inboard/outboard lamps when multi-level switching is indicated, so light does not spill into unlit cells.

D. Suspended Luminaires: Coordinate power feed and suspension canopies with ceiling type and architectural RCP for proper fit and location. Ensure finished installations are plumb and level at elevations specified.

E. HID Luminaires: Pre-wired, with integral ballast.

F. Painted reflector surfaces shall have a minimum reflectance of 90% after fabrication.

2.2 EXTERIOR LUMINAIRES AND ACCESSORIES - GENERAL

A. Listed for wet or damp location as scheduled. Fountain and pool luminaires shall be listed for submersible location to meet depth specified.

B. Provide low temperature ballasts or LED drivers, with reliable starting to -20°F.

2.3 LIGHT EMITTING DIODE (LED) LUMINAIRE SYSTEMS

A. Light emitting diodes used in interior applications shall have a minimum color rendering index (CRI) of 80. Light emitting diodes used in exterior applications shall have a minimum color rendering index (CRI) of 70. Color temperature of the luminaires shall be as noted on the luminaire schedule.

B. LED chip arrays specified as color changing shall have chip colors as noted on the luminaire schedule.

C. LED chips shall be wired so that failure of one chip does not prohibit operation of the remainder of the chip array.

D. LED Driver:

1. Solid state driver with integral heat sink. Driver shall have overheat, short-circuit and overload protection, power factor 0.90 or above and maximum total harmonic distortion of 20%. Surge suppression device for all exterior luminaires.

2. Drivers shall have dimming capabilities as outlined in the luminaire schedule for each luminaire type.

3. Driver shall have a minimum of 50,000 hours rated life.

2.4 ACCEPTABLE MANUFACTURERS – LAMPS

MANUFACTURER	INCAND. HALOGEN	FLUORESCENT	COMPACT FLUOR.	INDUCTION	HID
Philips Lighting Company	**X**	**X**	**X**	**X**	**X**
Osram Sylvania	**X**	**X**	**X**	**X**	**X**
Venture Lighting International Inc.					**X**
GE Lighting	**X**	**X**	**X**		**X**
USHIO America, Inc.	**X**	**X**	**X**		**X**

A. Lamps used with dimming shall be verified for compatibility with dimmer manufacturer prior to ordering.

2.5 FLUORESCENT LAMPS

A. T-8 Type: Correlated color temperature (CCT) and Color Rendering Index (CRI) as scheduled on the drawings. Lamps shall be reduced mercury type having credentials that pass the EPA 1990 Toxic Characteristics. Four-foot, 32-watt lamps shall be 3100 lumen extended performance type, with minimum 30,000-hour lamp life at three-hour starts.

B. Compact Fluorescent: Correlated Color Temperature (CCT) and a Color Rendering Index (CRI) as scheduled on the drawings.

C. Other Types: Correlated Color Temperature (CCT) and Color Rendering Index (CRI) as scheduled on the drawings.

2.6 HID LAMPS

A. Metal Halide HID Lamps: Clear, suitable for all burning positions. Pulse start lamps shall have a lumen maintenance factor of .75 or greater and a CRI of 65 or greater with color stability of +/- 100°K. Correlated Color Temperature (CCT) as scheduled on the drawings.

2.7 FLUORESCENT BALLASTS - GENERAL

A. All ballasts shall have a Class A sound rating, or better.

B. Ballast shall comply with EMI and RFI limits set by FCC (CFR 47 Part 18).

C. Linear fluorescent ballasts shall operate parallel circuit lamps that allow remaining lamps to maintain full output if companion lamps fail.

D. All fluorescent ballasts designed for operation of double-ended lamps or integral to a luminaire supplied by multi-wire branch circuits shall comply with disconnecting means as specified in NEC Article 410 and amendments thereto.

2.8 ACCEPTABLE MANUFACTURERS - FLUORESCENT ELECTRONIC BALLASTS

MANUFACTURER		PRS	IS-10%THD
A.	Advance	IOP	IOP, RCN, VCN
B.	GE	UltraStart	UltraMax
C.	MagnaTek/Universal	AccuStart Ultim8	Ultim8
D.	Osram/Sylvania	QuickTronic	QuickTronic

2.9 FLUORESCENT ELECTRONIC BALLAST

A. Fluorescent Ballast: Shall meet UL Standard 935. Ballasts shall be PROGRAM RAPID START (PRS) type.

B. Ballasts operated by occupancy sensors shall be program rapid start type.

C. Ballasts shall meet applicable ANSI and IEEE standards regarding harmonic distortion and surge protection. The input current 3rd harmonic content shall not exceed 13% of the input current. The total harmonic distortion shall not exceed 10%.

D. Fluorescent ballasts shall conform to the performance criteria listed below:

1. Ballast factor as indicated on luminaire schedule.

2. Mean System Efficacy:

a. Program Start: $\geq$ 88 MLPW(T8); $\geq$87 MLPW(T5); $\geq$ 85 MLPW(T5HO)

E. Luminaires designed as multi-level switching shall have combination of 1, 2 or 3 lamp ballasts configured to allow switching of all inboard lamps as a group separate from outboard lamps in the room. Master/slave luminaire arrangement is preferred where practical. The Contractor shall verify ballast configuration to achieve switching shown.

F. The ballast must maintain constant high output through input voltage ranges of 90 to 145 volts for a 120V ballast (+/- 25%) and 200 to 320 volt for a 277V ballast (+/- 28%).

G. Ballast Requirements:

1. Current crest factor shall be no greater than 1.8 for F40 lamps and 1.7 for all other lamps.

2. The operating ambient temperature range shall be 50°F to 105°F.

3. Fluorescent ballasts shall operate at 20KHZ or higher, with no detectable lamp flicker.

4. Ballasts shall not be affected by lamp failure and shall yield normal lamp life.

5. Ballast power factor shall be greater than 90%.

6. Ballast shall be rated Class P and shall be thermally protected.

7. Program rapid start ballasts shall heat the filament prior to applying the starting voltage to the lamp, then remove lamp cathode heat in a sequence consistent with ANSI standard C82.11.

8. Cold weather ballast(s) must reliably start and operate lamps in ambient temperatures down to 0°F for the rated life of the lamps.

2.10 COMPACT FLUORESCENT BALLASTS

A. Fluorescent Ballast: ANSI C82.1; high power factor type, Class P with voltage rating matching branch circuit voltage. Ballast factor shall be .85 or greater.

B. Current crest factor shall be no greater than 1.7. Ballast shall have a Class A sound rating.

C. Ballast shall meet applicable ANSI and IEEE standards regarding harmonic distortion and surge protection. The total harmonic distortion for lamp wattage <26 watts shall not exceed 33%; all others shall not exceed 10%.

D. Ballast shall have lamp fault shut off circuitry to prevent starting of a faulty lamp.

E. Cold weather ballast must reliably start and operate the lamp in ambient temperatures down to 0°F for the rated life of the lamp.

F. Manufacturer shall be one of the listed fluorescent electronic ballast acceptable manufacturers.

2.11 HIGH INTENSITY DISCHARGE BALLASTS

A. HID Ballasts:

1. Comply with ANSI C82.4, C82.6 and C92.1.

2. Metal Halide Pulse Start: Super constant wattage auto-transformer with igniter and a maximum crest factor of 1.6.

3. The ballast design center shall not vary more than ±5% from rated lamp watts for nominal line voltage and nominal lamp voltage.

4. With a nominal voltage "reference" lamp, the wattage regulation spread shall not exceed 20% for ±5% line voltage variation for high reactance auto-transformer - high power factor ballasts and 30% for ±10% line voltage variation for high power factor auto-regulator ballast.

5. Ballasts must reliably start and operate the lamp in ambient temperatures down to -20°F for the rated life of the lamp. The ballast primary current during starting for high reactance auto-transformer type ballasts may exceed the normal operating current by a factor of 1.5, for 250-1000 watt lamps. Auto-regulating type ballasts shall not exceed normal operating current.

6. High reactance autotransformer - high power factor ballasts shall be capable of sustaining lamp operation with a line voltage dip or sag of 20% for up to 4 seconds when operating a nominal voltage lamp with nominal line voltage applied to the ballast primary.

7. Auto-regulating high power factor ballasts shall be capable of sustaining lamp operation with a line voltage dip or sag of 40% for up to 4 seconds when operating a nominal voltage lamp with nominal line voltage applied to the ballast primary.

8. For high reactance auto-transformer - high power factor ballasts, the current crest factor shall not exceed 1.6 for ±5% line voltage variation, including lamp starting or from nominal lamp voltage through rated end of life lamp voltage.

9. For auto-regulating high power factor ballasts, the current crest factor shall not exceed 1.8 for ±10% line voltage variation, including lamp starting or from nominal lamp voltage through rate end of life lamp voltage.

10. For high reactance auto-transformer - high power factor ballasts, the line power factor of the lamp/ballast system shall not be below 90% for ±5% line voltage variation.

11. For auto-regulating high power factor ballasts, the line power factor of the lamp/ballast system shall not be below 90% for ±10% line voltage variation.

12. LS-NC Rating: NEMA LE 2; equal to or less than ratings listed in Table C-1.

2.12 ACCEPTABLE MANUFACTURERS - POLES

A. Manufacturer of Luminaire.
B. Valmont Poles.
C. U. S. Pole Company.
D. KW Industries

2.13 LIGHTING POLES

A. Metal Poles: Round straight steel lighting pole with anchor base.

B. Wind Load: 100 MPH velocity, with 1.3 gust factor with luminaires and brackets mounted.

C. Hand Hole: 2 x 4 inches with removable weatherproof cover installed at manufacturer's standard location. Provide matching gasketed cover plate.

D. Pole Top: Provide mast arm(s) in array as indicated.

E. Anchor Bolts: As recommended by pole manufacturer. Provide template, flat washers, lock washers, and hex nuts for each pole. Grout between anchor plate and concrete base with non-shrink grout after pole is plumbed.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Securely fasten luminaires to the ceiling framing member by mechanical means such as bolts, screws, rivets or listed clips identified for use with the type of ceiling framing members.

B. Install lamps in lamp holders of luminaires.

C. Support surface-mounted luminaires directly from building structure. Install luminaires larger than eight square feet (8 ft^2) or weighing more than 30 pounds independent of ceiling framing.

D. Support suspended or pendant mounted luminaires independent of ceiling grid with a minimum of two #12 gauge wires. Suspension assembly and anchors shall be capable of supporting 300 pounds dead load at each suspension point.

E. Install recessed luminaires to permit removal from below. Use plaster frames or install grid clips. Support luminaires independent of ceiling grid with a minimum of two (2) #12 gauge wires located on diagonal corners.

F. Adjust aimable luminaires to obtain lighting levels on objects and areas as directed to obtain desired lighting levels.

G. Parabolic louvers and other optical accessories shall remain in protective wraps or films until construction in area is complete and area has been cleaned.

H. Luminaire Pole Bases: Sized and constructed as indicated on the drawings. Project anchor bolts 2 inches minimum above base. Install poles plumb with double nuts for adjustment. Grout around pole anchor base.

I. Use belt slings or non-chafing ropes to raise and set pre-finished luminaire poles.

3.2 LAMP SEASONING

A. Operate all fluorescent and HID lamps for 100 hours prior to requesting final observation. Operate dimming fluorescent lamps at 100% output during seasoning. Operate lamps for minimum 8 hour intervals during seasoning.

3.3 RELAMPING

A. Replace failed lamps at completion of work. Replacement of incandescent and other lamp burnouts after the warranty period starts shall be the responsibility of the final user.

3.4 ADJUSTING AND CLEANING

A. Align luminaires and clean lenses and diffusers at completion of work. Clean paint splatters, dirt, and debris from installed luminaires.

B. Touch up luminaire and pole finish at completion of work.

3.5 LUMINAIRE SCHEDULE

A. As shown on the drawings.

END OF SECTION

SECTION 16535
EMERGENCY LIGHTING EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Emergency lighting units
B. Emergency exit signs

1.2 REFERENCES

A. FS W-L-305 - Light Set, General Illumination (Emergency or Auxiliary)

B. NFPA 101 - Code for Safety to Life from Fire in Buildings and Structures

C. UL 924 – Emergency Lighting and Power Equipment

1.3 REGULATORY REQUIREMENTS

A. Conform to NFPA 101 for installation requirements.

1.4 SUBMITTALS

A. Submit shop drawings under provisions of Section 16010.

B. Provide product data on emergency lighting units, exit signs, emergency inverters, and emergency fluorescent lamp power supply units.

PART 2 - PRODUCTS

2.1 INCANDESCENT EMERGENCY LIGHTING UNITS

A. Emergency Lighting Unit: Self-contained unit with rechargeable storage batteries, charger, and lamps.

B. Battery: Maintenance free lead calcium type, with 1.5 hour capacity to supply the connected lamp load.

C. Charger: Dual-rate solid state charger, capable of maintaining the battery in a full-charge state during normal conditions, and capable of recharging discharged battery to full charged within 168 hours. Low voltage disconnect to prevent deep discharge of battery.

D. Lamps: As scheduled on luminaire schedule.

E. Remote Lamps: Match lamps on unit.

F. Indicators: Provide lamps to indicate AC ON and RECHARGING.

G. Provide test switch to transfer unit from normal supply to battery supply.

H. Electrical Connection: Knockout for conduit connection.

I. Warranty: Emergency lighting unit shall have a full three (3) year, non-prorated warranty.

2.2 SELF-CONTAINED EMERGENCY POWER EXIT SIGNS

A. Type: Exit signs with integral battery-operated emergency power supply, including power failure relay, test switch, AC ON pilot light, battery, and fully-automatic two-rate charger.

B. Battery: Sealed lead acid or lead calcium cell, requiring no maintenance or replacement for 10 years under normal conditions.

C. Directional Indicators: The directional indicator for exit signage shall be of a chevron type meeting all requirements of NFPA 101.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units plumb and level.

B. Aim directional lampheads as directed.

C. Test emergency lighting equipment for 60 minutes to determine proper operation, prior to substantial completion. Provide typewritten periodic test log form to Owner's representative. Explain and instruct Owner's representative of requirements for testing and maintenance.

END OF SECTION

SECTION 16570
LIGHTING CONTROL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Lighting control panels, control station and programming software.
B. Line and low voltage, occupancy sensors, photo sensors and related power supplies.

1.2 REFERENCES

A. ANSI/NFPA 70 - National Electrical Code
B. FCC Rules and Regulations, Part 15, Subpart J - Radio Frequency Interference
C. UL Standard 916 Energy Management Equipment

1.3 SUBMITTALS

A. Submit product data under provisions of Section 16010.

B. Submit product data showing dimensions and ratings for relays, dimmers, power supplies, control stations, sensors, and accessory modules.

C. Submit typical wiring diagrams for all components including, but not limited to, dimmer panels, dimmers, relay panels, relays, low voltage switches, occupancy sensors, control stations, and communication interfaces.

1.4 PROJECT RECORD DOCUMENTS

A. Submit project record documents under provisions of Section 16010.

B. Accurately record location of control panels, stations, switches, power supplies, and control enclosures. Include description of switching and circuiting arrangements.

1.5 OPERATION AND MAINTENANCE DATA

A. Submit emergency, operation, and maintenance data under provisions of Section 16010. Data shall also include the following:

1. Schedule for routine maintenance, inspection, and calibration of all lighting control devices and system components.

2. Complete narrative describing intended operation and sequence for each control scenario and system component, updated to reflect all changes resulting from commissioning of systems. Narrative shall indicate recommended settings for devices where applicable.

3. Replacement part numbers for all system components.

B. Identify installed location and labeling for each luminaire controlled by automated lighting controls.

C. Submit software operating and maintenance manuals, program software backup on compact disc or compatible media with data files, device address list, and a printout of software application and graphic screens, where applicable.

1.6 QUALITY ASSURANCE

A. Manufacturers shall be regularly engaged in the manufacture of lighting control equipment and ancillary equipment, of types and capacities required, whose products have been in satisfactory use in similar service for not less than five (5) years.

B. All components and assemblies are to be factory pre-tested prior to delivery and installation.

C. Comply with NEC as applicable to electrical wiring work.

D. Comply with applicable portions of NEMA standards pertaining to types of electrical equipment and enclosures.

E. Panels and accessory devices are to be UL listed under UL 916 Energy Management Equipment. Panels and accessories used for control of life safety and critical branch circuits shall be listed under UL 924 Emergency Lighting and Power Equipment.

F. All assemblies are to be in compliance with FCC emissions standards specified in Part 15 Subpart J for Class A applications.

1.7 WARRANTY

A. Manufacturer shall warrant products under normal use and service to be free from defects in materials and workmanship for a period of two (2) years from date of commissioning.

B. Occupancy, vacancy, daylight sensors and controls shall have a five (5) year warranty from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CENTRAL LIGHTING CONTROL FEATURES AND FUNCTIONS

A. Lighting control system shall be designed to allow control of lighting and associated systems via switches, occupancy sensors, daylight sensor, and astronomical/time-of-day scheduling controls.

B. Clock events shall be activated by calendar schedule, by day type and/or specific day programming, including everyday, weekday, weekend, S, M, T, W, H, F, S, Holiday. Clock events shall also be activated by astronomical events, which will compensate for daylight savings time and will have programmable setback periods relative to sunrise and sunset.

C. System shall accept any type of switch input, including momentary or maintained.

D. System shall support by relay or zone the "blink warning" function. System shall be capable of flashing lights Off/On prior to the lights being turned Off. The warning interval time between the flash and the final lights off signal shall be definable for each zone. Occupant shall be able to override any scheduled Off sweep using local wall switches within the

occupied space. Occupant override time shall be locally and remotely programmable and shall not exceed two (2) hours.

E. System shall provide temporary override conditions for each relay or dimmer so that lights can always be turned on.

F. All programs, schedules, time of day, etc, shall be held in non-volatile memory for a minimum of two (2) years at power failure. At restoration of power, lighting control system shall implement programs required by current time and date.

2.2 COMPONENTS

A. Lighting Control Panels:

1. Cabinets and Enclosures: NEMA 1 enclosure sized to accept required relays and dimmers. Surface-mounted cover as required, with captive screws in a hinged, lockable configuration.

2. Interior: Interiors shall be provided with installed and tested relays.

3. Power Supply: Transformer assembly including internal overcurrent protection with automatic reset and metal oxide varistor protection against power line spikes.

4. Panel shall be provided with expansion space for ease of installation of other system components (e.g., timeclock and/or photocell controller). Terminals shall be included in the interior to accept a communication line for the connection of communication line switches to the system, or to allow a communication line to be run between multiple panels for network communications.

B. Switch Interface: Control panels shall be designed to provide eight(8) dry maintained or momentary contact input or output signals for interface to fire alarm, security, building controls and other associated systems.

C. Relays: Momentary-pulsed mechanically latching contactors with plug-in connector. Relays shall have mechanically latching contacts with single moving part design for improved reliability. Relays shall have the following characteristics:

1. Coil:

a. Magnetically held, momentary coil activation (50 milliseconds).
b. 2.2 VA max per relay to allow up to 20 relays to be controlled in parallel using class 2 wiring.
c. Split coil - 1/2 for ON, 1/2 for OFF.

2. Power Contacts:

a. 20 amp tungsten and NEMA electronic ballast rated.
b. Rated for 50,000 ON/OFF cycles at full load.
c. Support #10 - #14 AWG solid or stranded wire.
d. 120 and 277 volt rated.
e. 30 VAC Isolated contacts for status feedback and pilot light indication.
f. FCC approved for commercial and residential use.

2.3 LOCAL DAYLIGHTING CONTROLS

A. Standalone Interior Photo Sensors:

1. Sensor shall detect changes in ambient light level and provide triggering of lighting groups in area based on sequence of operation.

2. Sensor shall be configurable via DIP switches at device or via handheld wireless remote programming unit. Settings shall include:

   a. Ambient sensitivity range between 1 and 1,000 foot-candles.
   b. Time delay of 5 to 300 seconds.
   c. Trigger setpoints with deadband adjustment.

3. Sensor shall provide on/off setpoints in quantity as specified on drawings, and as shown in the sequence of operation.

4. Sensor shall be ceiling- or wall-mounted for range and viewing angle meeting application requirements as outlined in the sequence of operation.

5. Output signal from sensor shall be linear with light level.

B. Indoor Daylight Controller:

1. Daylight controller shall provide one channel of switching open loop control.

2. Daylight sensor shall have with range and viewing angle to meet requirements of sequence of operation and construction documents.

3. Provide separate adjustable setting for each channel. Each channel shall have its own adjustable setpoint, maximum and minimum output, setpoint and cutoff time adjustable setpoint, deadband, ON delay, OFF delay, and load shed point.

4. The controller shall interface to occupancy sensors, energy management systems and low voltage wall switches where indicated.

C. Standalone Exterior Photo Sensors:

1. Sensor shall be within a weatherproof enclosure, with design operation in temperatures of -30°F to +130°F. Sensor shall have threaded stem for box mounting, with knuckle to permit aiming of receptor after installation.

2. Sensor shall contain an integral switching contactor rated for 277 volt operation, with loads of up to 1,800 VA. Contacts shall be configured for zero-crossing closure to provide 100,000 cycle minimum operation.

3. Sensor shall detect changes in daylight levels to provide triggering of exterior lighting equipment based on the sequence of operation.

4. Sensor shall be field configurable at the device or via handheld wireless remote controller. Configurable settings shall include:

   a. Ambient sensitivity range of 5 to 1,500 foot-candles.
   b. Adjustable setpoint.
   c. Deadband adjustment by percentage of setpoint.
   d. Time delay of up to five minutes.

5. Sensor shall be equipped with a lens cover that can be applied for system testing during daylight conditions.

2.4 INDOOR OCCUPANCY AND VACANCY SENSORS

A. General Description: Wall- or ceiling-mounting, solid-state units with a separate power supply/relay unit.

1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied, with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes. Vacancy sensors require a manual switch operation to turn lights on and off, with a time delay for turning lights off when unoccupied.

2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.

3. Relay Unit: Dry contacts rated for 20 A ballast load at 120 and 277 VAC, for 13 amp tungsten at 120 VAC, and for 1 hp at 120 VAC. Power supply to sensor shall be 24 V dc, 150-mA, Class 2 power source as defined by NFPA 70.

4. Mounting:

   a. Sensor: Suitable for mounting in any position on a standard outlet box.

   b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure. Mount relay above ceiling near entry door to room or area.

   c. Time Delay and Sensitivity Adjustments: Recessed and concealed.

5. Indicator: LED to show when motion is being detected during testing and normal operation of the sensor.

6. Bypass Switch: Override the on function in case of sensor failure.

B. PIR Type: Ceiling mounting; detect occupancy by sensing a combination of heat and movement in area of coverage.

1. With daylight filter and lens to afford coverage applicable to space to be controlled.

2. Detection Coverage (Room): Detect occupancy anywhere in an area based on hand motion.

3. Detection Coverage (Corridor): Detect occupancy based on a half-step motion.

C. Ultrasonic Type: Ceiling mounting. Detect occupancy by sensing a change in pattern of reflected ultrasonic energy in area of coverage.

1. Crystal controlled with circuitry that causes no detection interference between adjacent sensors.

2. Detection Coverage (Room): Detect occupancy anywhere in an area based on hand motion.

3. Detection Coverage (Corridor): Detect occupancy based on a half-step motion.

D. Dual-Technology Type: Ceiling mounted. Detect occupancy by using a combination of PIR and ultrasonic or acoustic detection methods in area of coverage. Particular technology or combination of technologies that controls on and off functions shall be selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.

2. Detection Coverage:

a. Task Areas: Detect occupancy anywhere in an area based on hand motion.

b. Circulation Areas: Detect occupancy anywhere in an area based upon half-step walking motion.

E. Mask sensors where necessary to prevent nuisance switching from adjacent areas.

2.5 CONDUCTORS AND CABLES

A. Control Wiring:

1. Where installed with the line-voltage wiring, control wiring shall be copper conductors not smaller than No. 16 AWG with insulation voltage rating and temperature rating equal to that of the line-voltage wiring, complying with Division 16 Section 16120 "Wire and Cable."

2. Tap conductors to switches or relays: Stranded copper conductors of 16 AWG or solid 16 or 18 AWG with insulation rating equal to that of the line-voltage wiring.

3. Tap conductors to dimming ballasts: Solid copper conductors of 18 AWG with insulation voltage rating equal to that of the line-voltage wiring and insulation temperature rating not less than 90°C.

4. Network cabling as required by manufacturer.

B. Splices and Taps:

1. Tapping or wire trap connectors shall be used to splice all Class 1 and Class 2 control wiring. Twist-on, wire-nut type connectors are not allowed.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are ready to receive work.

B. Verify field dimensions and coordinate physical size of all equipment with the architectural requirements of the spaces into which they are to be installed. Allow space for adequate ventilation and circulation of air.

C. Verify that required utilities are available, in proper location, and ready for use.

D. Beginning of installation means installer accepts existing conditions.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions and approved shop drawings.

B. All wiring shall be installed in conduit. Class II low voltage control wiring may be open wiring and shall maintain 150 mm (6 inch) spacing from electronic ballast and other RFI/EMI sources.

C. All branch load circuits shall be live tested before connecting the loads to the lighting control panel.

3.3 SUPPORT SERVICES

A. System Startup:

1. Manufacturer shall provide factory authorized technician to confirm proper installation and operation of all system components.

B. Testing:

1. System shall be completely functional tested by a factory-authorized technician. All loads shall be tested live for continuity and freedom from defects, and all control wiring shall be tested for continuity and connections prior to energizing the system components.

2. Programming of initial zones, schedules, lighting levels, control station groups, and sensor settings shall be performed by a factory-authorized technician. Lighting Control Matrices shown on drawings shall serve as a basis for programming, However, all final decisions regarding groups and schedules shall be at the direction of the Owner. The following procedures shall be performed at a minimum:

a. Confirm occupancy sensor placement, sensitivity, and time delay settings to meet specified performance criteria.

b. Confirm daylight sensor placement, sensitivity, deadband, and delay settings to meet specified performance criteria.

c. Confirm that schedules and time controls are configured to meet specified performance criteria and Owner’s operating requirements.

C. Training:

1. Manufacturer shall provide competent factory-authorized technician to train Owner personnel in the operation, maintenance and programming of the lighting control system. Submit training plan with notification seven (7) days prior to proposed training dates.

2. Training duration shall be no less than four hours.

D. Documentation:

1. Manufacturer shall provide system documentation including:

a. System one-line showing all panels, number and type of control stations and sensors, communication line, and network or BMS/BAS interface unit.

b. Drawings for each panel showing hardware configuration and numbering.

c. Panel wiring schedules.

d. Typical diagrams for each component.

END OF SECTION

SECTION 17010
BASIC COMMUNICATIONS SYSTEMS REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Basic Communications Systems Requirements specifically applicable to Division 17 sections, in addition to Division 1 - General Requirements.

1.2 SCOPE OF WORK

A. This Specification and the accompanying drawings govern the work involved in furnishing, installing, testing and placing into satisfactory operation the Communications Systems as shown on the drawings and specified herein.

B. Each Contractor shall provide all new materials as indicated in the schedules on the drawings, and/or in these specifications, and all items required to make their portion of the Communications Systems a finished and working system.

C. Description of Systems include but are not limited to the following:

1. Complete Structured Cabling System including, but not limited to:

a. Voice and data horizontal cabling and terminations.
b. Information outlets (IO's) including faceplates, jacks, and labeling.
c. Equipment racks, cabinets, cable management, and equipment.
d. Telecommunication Room equipment including patch panels and termination blocks.
e. Cabling pathways.
f. Grounding and bonding.
g. Testing.

2. Low Voltage Communications Wiring (less than +120VAC) as specified and required for proper system control and communications.

3. All associated electrical backboxes, conduit, miscellaneous cabling, and power supplies required for proper system installation and operation as defined in the "Suggested Matrix of Scope Responsibility".

4. Firestopping of penetrations as described in Section 16080.

1.3 DIVISION OF WORK BETWEEN ELECTRICAL AND COMMUNICATIONS CONTRACTORS

A. Division of work is the responsibility of the Prime Contractor. Any scope of work described in the contract document shall be sufficient for including said requirement in the project. The Prime Contractor shall be solely responsible for determining the appropriate subcontractor for the described scope. In no case shall the project be assessed an additional cost for scope that is described in the contract documents. The following division of responsibility is a guideline based on typical industry practice.

B. Definitions:

1. "Electrical Contractor" as referred to herein refers to the Contractors listed in Division 16 of this Specification.

2. “Electrical Contractor” shall also refer to the Contractor listed in Division 17 of this specification when the “Suggested Matrix of Scope Responsibility” indicates the work shall be provided by the EC. Refer to the Contract Documents for the “Suggested Matrix of Scope Responsibility”.

3. “Communications Contractor” as referred to herein refers to the Contractors listed in Division 17 of this Specification.

4. Low Voltage Communications Wiring: The wiring (less than 120VAC) associated with the Communications Systems, used for analog and/or digital signals between equipment.

5. Telecommunications Rough-in: Relates specifically to the backboxes, necessary plaster rings and other miscellaneous hardware required for the installation and mounting of the telecommunications information outlet. Rough-in shall include conduit from the information outlet backbox to above the lay-in ceiling. Where surface mounted backboxes are required, conduit shall be routed to above the lay-in ceiling.

C. General:

1. The purpose of these Specifications is to outline typical Electrical and Communications Contractor's work responsibilities as related to Communications Systems including Telecommunications rough-in, conduit, power wiring and Low Voltage Communications Wiring. The prime contractor is responsible for all divisions of work.

2. The exact wiring requirements for much of the equipment cannot be determined until the systems have been purchased and submittals are approved. Therefore, only known wiring, conduits, raceways, and electrical power as related to such items, is shown on the Communications Drawings. Other wiring, conduits, raceways, junction boxes, and electrical power not shown on the Communications Drawings but required for the successful operation of the systems shall be the responsibility of the Communications Contractor and included in the Contractor’s bid.

3. Where the Electrical Contractor is required to install conduit, conduit sleeves and/or power connections in support of Communications systems, the final installation shall not begin until a coordination meeting between the Electrical Contractor and the Communications Contractor has convened to determine the exact location and requirements of the installation.

4. Where the Electrical Contractor is required to install cable tray that will contain Low Voltage Communications Wiring, the installation shall not begin until the Communications Contractor has completed a coordination review of the cable tray shop drawing.

5. This Contractor shall establish Electrical and Communications utility elevations prior to fabrication and installation. The Communications Contractor shall cooperate with the Electrical Contractor and the determined elevations in accordance with the guidelines below. This Contractor shall coordinate utility elevations with other trades. When a conflict arises, priority shall be as follows:

    a. Lighting Fixtures
    b. Gravity Flow Piping, including Steam and Condensate
    c. Sheet Metal
    d. Electrical Busduct
    e. Cable Trays, including 12" access space
    f. Sprinkler Piping and other Piping
    g. Conduit and Wireway
    h. Open Cabling

D. Electrical Contractor's Responsibility:

1. Responsible for Communications Systems grounding and bonding.

2. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

E. Communications Contractor's Responsibility:

1. Assumes all responsibility for the Low Voltage Communications Wiring of all systems, including cable support where open cable is specified.

2. Assumes all responsibility for providing and installing all ladder rack and other cable management hardware (as defined in here-in).

3. Responsible for providing the Electrical Contractor with the required grounding lugs or other hardware for each piece of Communications equipment which is required to be bonded to the Communications ground system.

4. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

1.4 COORDINATION DRAWINGS

A. Definitions:

1. Coordination Drawings: A compilation of the pertinent layout and system drawings that show the sizes and locations, including elevations, of system components and required access areas to ensure that no two objects will occupy the same space.

    a. Mechanical trades shall include, but are not limited to, mechanical equipment, ductwork, fire protection systems, plumbing piping, medical gas systems, hydronic piping, steam and steam condensate piping, and any item that may impact coordination with other disciplines.

b. Electrical trades shall include, but are not limited to, electrical equipment, conduit 1.5” and larger, conduit racks, cable trays, pull boxes, transformers, raceway, busway, lighting, ceiling-mounted devices, and any item that may impact coordination with other disciplines.

c. Technology trades shall include, but are not limited to, technology equipment, racks, conduit 1.5” and larger, conduit racks, cable trays, ladder rack, pull boxes, raceway, ceiling-mounted devices, and any item that may impact coordination with other disciplines.

d. Maintenance clearances and code-required dedicated space shall be included.

e. The coordination drawings shall include all underground, underfloor, in-floor, in chase, and vertical trade items.

2. The contractors shall use the coordination process to identify the proper sequence of installation of all utilities above ceilings and in other congested areas, to ensure an orderly and coordinated end result, and to provide adequate access for service and maintenance.

B. Participation:

1. The contractors and subcontractors responsible for work defined above shall participate in the coordination drawing process.

2. One contractor shall be designated as the Coordinating Contractor for purposes of preparing a complete set of composite electronic CAD coordination drawings that include all applicable trades, and for coordinating the activities related to this process. The Coordinating Contractor for this project shall be the Mechanical Contractor.

a. The Coordinating Contractor shall utilize personnel familiar with requirements of this project and skilled as draftspersons/CAD operators, competent to prepare the required coordination drawings.

3. Electronic CAD drawings shall be submitted to the Coordinating Contractor for addition of work by other trades. KJWW will provide electronic file copies of ventilation drawings for contractor’s use if the contractor signs and returns an “Electronic File Transfer” waiver provided by KJWW. KJWW will not consider blatant reproductions of original file copies an acceptable alternative for coordination drawings.

C. Drawing Requirements:

1. The file format and file naming convention shall be coordinated with and agreed to by all contractors participating in the coordination process and the Owner.

a. Scale of drawings:

1) General plans: 1/4 Inch = 1 '-0" (minimum).

2) Mechanical, electrical, communication rooms, and including the surrounding areas within 10 feet: 1/2 Inch = 1'-0" (minimum).

3) Shafts and risers: 1/2 Inch = 1'-0" (minimum).

4) Sections of shafts and mechanical and electrical equipment rooms: 1/4 Inch = 1 '-0" (minimum).

5) Sections of congested areas: 1/2 Inch = 1'-0" (minimum).

2. Ductwork layout drawings shall be the baseline system for other components. Ductwork layout drawings shall be modified to accommodate other components as the coordination process progresses.

3. There may be more drawings required for risers, top and bottom levels of mechanical rooms, and shafts.

4. The minimum quantity of drawings will be established at the first coordination meeting and sent to the A/E for review. Additional drawings may be required if other areas of congestion are discovered during the coordination process.

D. General:

1. Coordination drawing files shall be made available to the A/E and Owner's Representative. The A/E will only review identified conflicts and give an opinion, but will not perform as a coordinator.

2. A plotted set of coordination drawings shall be available at the project site.

3. Coordination drawings are not shop drawings and shall not be submitted as such.

4. The contract drawings are schematic in nature and do not show every fitting and appurtenance for each utility. Each contractor is expected to have included in his/her bid sufficient fittings, material, and labor to allow for adjustments in routing of utilities made necessary by the coordination process and to provide a complete and functional system.

5. The contractors will not be allowed additional costs or time extensions due to participation in the coordination process.

6. The contractors will not be allowed additional costs or time extensions for additional fittings, reroutings or changes of duct size, that are essentially equivalent sizes to those shown on the drawings and determined necessary through the coordination process.

7. The A/E reserves the right to determine space priority of equipment in the event of spatial conflicts or interference between equipment, piping, conduit, ducts, and equipment provided by the trades.

8. Changes to the contract documents that are necessary for systems installation and coordination shall be brought to the attention of the A/E.

9. Access panels shall preferably occur only in gypsum board walls or plaster ceilings where indicated on the drawings.

    a. Access to mechanical, electrical, technology, and other items located above the ceiling shall be through accessible lay-in ceiling tile areas.

    b. Potential layout changes shall be made to avoid additional access panels.

    c. Additional access panels shall not be allowed without written approval from the A/E at the coordination drawing stage.

    d. Providing additional access panels shall be considered after other alternatives are reviewed and discarded by the A/E and the Owner's Representative.

    e. When additional access panels are required, they shall be provided without additional cost to the Owner.

10. Complete the coordination drawing process and obtain sign off of the drawings by all contractors prior to installing any of the components.

11. Conflicts that result after the coordination drawings are signed off shall be the responsibility of the contractor or subcontractor who did not properly identify their work requirements, or installed their work without proper coordination.

12. Updated coordination drawings that reflect as-built conditions may be used as record documents.

1.5 QUALITY ASSURANCE

A. Telecommunications Structured Cabling System Standards:

1. All work and equipment shall conform to the most current ratified version of the following published standards unless otherwise indicated that draft standards are to be followed:

    a. TIA/EIA 569-A – Commercial Building Standard for Telecommunications Pathways and Spaces.

    b. TIA/EIA 606 – Administration Standards for the Telecommunications Infrastructure of Commercial Buildings.

    c. TIA/EIA 607 – Commercial Building Grounding and Bonding Requirements for Telecommunications.

    d. ANSI/NECA 568 – Standard for Installing Commercial Building Telecommunications Cabling.

    e. TIA/EIA 568-B – Commercial Building Telecommunications Cabling Standard

        1) B.1 – Part 1: General Requirements

2) B.1-1 – Addendum 1: Minimum 4-Pair UTP and 4-Pair ScTP Patch Cable Bend Radius.

3) B.2 – Part 2: Balanced Twisted Pair Cabling Components.

4) B.2-1-2002– Addendum 1: Transmission Performance Specifications for 4-Pair 100 Ohm Category 6 Cabling.

5) B.3 – Optical Fiber Cabling Components Standard.

f. TIA/EIA TSB-72 – Centralized Optical Fiber Cabling Guidelines.

g. ANSI FDDI Standard – Fiber Distribution Data Interface.

h. UL 444 – Standard for Safety for Communications Cable.

i. NFPA 70 (NEC) – National Electrical Code.

B. Refer to individual sections for additional Quality Assurance requirements.

C. Qualifications:

1. Only products of reputable manufacturers as determined by the Engineer will be acceptable.

2. The installing Contractor shall be certified by the manufacturer of the structured cabling system. Certification of Contractor shall have been in place for a minimum of one (1) year prior to bidding this project. Documentation of certification is required at the time of bid. Shop drawings will not be approved until proof of certification is submitted. Refer to the end of this specification section for certification documentation requirements.

3. Each Contractor and their subcontractors shall employ only workers who are skilled in their respective trades and fully trained. All workers involved in the termination of cabling shall be individually certified by the manufacturer.

4. The Contractor shall be experienced in all aspects of this work and shall be required to demonstrate direct experience on recent systems of similar type and size.

5. The Contractor shall own and maintain tools and equipment necessary for successful installation and testing of optical and copper structured cabling systems and have personnel adequately trained in the use of such tools and equipment.

6. The Contractor shall have certified BICSI installation technicians on staff to perform the following tasks on the project:

a. Act as the field superintendent or job foreman with the responsibility of monitoring the daily work of each technician.

b. Oversee all testing and termination of cabling.

7. A resume of qualification shall be submitted with the Contractor's bid indicating the following:

   a. Documentation of certification of This Contractor by the proposed structured cabling system manufacturer as required at the end of this specification section.

   b. A list of test equipment proposed for use in verifying the installed integrity of copper systems on the project.

   c. A technical resume of experience for the Contractor's project manager and on-site installation supervisor assigned to this project.

   d. Resume and certification of the BICSI installation technician for the project.

D. Compliance with Codes, Laws, Ordinances:

1. This Contractor shall conform to all requirements of the State of Iowa's Codes, Laws, Ordinances and other regulations having jurisdiction over this installation.

2. In the event there are no local codes having jurisdiction over this job, the current issue of the National Electrical Code shall be followed.

3. If there is a discrepancy between the codes and regulations having jurisdiction over this installation, and these specifications, the codes and regulations shall determine the method or equipment used.

4. If the Contractor notes, at the time of bidding, any parts of the drawings and specifications which are not in accordance with the applicable codes or regulations, he shall inform the Architect/Engineer in writing, requesting a clarification. If there is insufficient time to follow this procedure, he shall submit with the proposal, a separate price required to make the system shown on the drawings comply with the codes and regulations.

5. All changes to the system made after the letting of the contract, in order to comply with the applicable codes or the requirements of the Inspector, shall be made by the Contractor without cost to the Owner.

E. Permits, Fees, Taxes, Inspections:

1. Procure all applicable permits and licenses.

2. Abide by all applicable laws, regulations, ordinances, and other rules of the State or Political Subdivision wherein the work is done, or as required by any duly constituted public authority.

3. Pay all applicable charges for such permits or licenses that may be required.

4. Pay all applicable fees and taxes imposed by the State, Municipal and/or other regulatory bodies.

5. Pay all charges arising out of required inspections due to codes, permits, licenses or as otherwise may be required by an authorized body.

6. Pay all charges arising out of required contract document reviews associated with the project and as initiated by the Owner or authorized independent agency/consultant.

7. Pay any charges by the service provider related to the service or change in service to the project.

8. All equipment and materials shall be as approved or listed by the following (unless approval or listing is not applicable to an item by all acceptable manufacturers):

   a. Factory Mutual
   b. Underwriters' Laboratories, Inc.

F. Examination of Drawings:

1. The drawings for the Communications Systems work are diagrammatic, intended to convey the scope of the work and to indicate the general arrangements and locations of equipment etc., and the approximate sizes of equipment.

2. Contractor shall determine the exact locations of equipment and the exact routing of cabling so as to best fit the layout of the job. Scaling of the drawings will not be sufficient or accurate for determining this layout. Where a specific route is required, such route will be indicated on the drawings.

3. Where job conditions require reasonable changes in indicated arrangements and locations, such changes shall be made by the Contractor at no additional cost to the Owner.

4. If an item is either shown on the drawings, called for in the specifications or required for proper operation of the system, it shall be considered sufficient for including same in this contract.

5. The determination of quantities of material and equipment required shall be made by the Contractor from the drawings. Schedules on the drawings and in the specifications are completed as an aid to the Contractor but where discrepancies arise, the greater number shall govern.

6. Where words "provide", "install", or "furnish" are used on the drawings or in the specifications, it shall be taken to mean, to furnish, install and terminate completely ready for operation, the items mentioned.

G. Electronic Media/Files:

1. Construction drawings for this project have been prepared utilizing AutoCAD MEP.

2. Contractors and Subcontractors may request electronic media files of the contract drawings and/or copies of the specifications. Specifications will be provided in PDF format.

3. Upon request for electronic media, the Contractor shall complete and return a signed “Electronic File Transmittal” form provided by KJWW.

4. If the information requested includes floor plans prepared by others, the Contractor will be responsible for obtaining approval from the appropriate Design Professional for use of that part of the document.

5. The electronic contract documents can be used for preparation of shop drawings and as-built drawings only. The information may not be used in whole or in part for any other project.

6. The drawings prepared by KJWW for bidding purposes may not be used directly for ductwork layout drawings or coordination drawings.

7. The use of these CAD documents by the Contractor does not relieve them from their responsibility for coordination of work with other trades and verification of space available for the installation.

8. The information is provided to expedite the project and assist the Contractor with no guarantee by KJWW as to the accuracy or correctness of the information provided. KJWW accepts no responsibility or liability for the Contractor's use of these documents.

H. Field Measurements:

1. Before ordering any materials, this Contractor shall verify all pertinent dimensions at the job site and be responsible for their accuracy.

2. Field conditions that will result in telecommunications drops that exceed the length limitations identified in the contract documents shall be brought to the attention of the Engineer prior to installation. The cost of reworking cabling that is too long, that was not brought to the written attention of the Engineer will be borne entirely by the Contractor.

3. This Contractor shall provide the Engineer with written documentation of any cabling drops that will not be able to use the cable tray (where cable tray is available) due to the resulting cabling lengths. This documentation shall be submitted prior to installation and installation shall not commence until approved by the Engineer.

1.6 SUBMITTALS

A. Submittals shall be required for the following items, and for additional items where required elsewhere in the specifications or on the drawings.

1. Submittals list:

Referenced Specification Section	**Submittal Item**
17050	Communications Bonding
17110	Communication Equipment Rooms
17130	Interior Communications Pathways
17160	Horizontal Cabling Requirements
17170	Identification and Administration
17171	Testing

B. In addition to the provisions of Division 1, the following is required:

1. Submittals shall include all layout drawings; manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures; performance and test data; wiring diagrams; and all other drawings and descriptive data of materials of construction as may be required to show that the materials, equipment or systems and the location thereof conform to the requirements of the contract documents.

2. The Contractor shall submit seven (7) copies of each shop drawing for review by the Architect/Engineer BEFORE releasing any equipment for manufacture or shipment.

3. Shop drawings which are larger than 11" x 17" or are plan size layout drawings such as wiring diagrams and cable tray drawings, shall be submitted on reproducible media. Submit one reproducible and one print of each drawing or plan. All Contractor approval stamps shall be made on the reproducible. The Architect/Engineer will return the reproducible copy of the shop drawings, complete with comments. This Contractor shall copy and distribute these reviewed shop drawings as required. All costs for copying and distribution of reproducible shop drawings shall be included by This Contractor in their bid.

4. The Contractor shall thoroughly review and approve all shop drawings before submitting them to the Architect/Engineer. CONTRACTOR'S APPROVAL STAMP IS REQUIRED ON ALL SUBMITTALS. APPROVAL WILL INDICATE THE CONTRACTOR'S REVIEW of all material and a COMPLETE UNDERSTANDING OF EXACTLY WHAT IS TO BE FURNISHED. Contractor shall clearly mark all deviations from the contract documents on all submittals. IF DEVIATIONS ARE NOT MARKED BY THE CONTRACTOR, THEN THE ITEM SHALL BE REQUIRED TO MEET ALL DRAWING AND SPECIFICATION REQUIREMENTS.

5. The Contractor shall clearly mark each item with the same nomenclature applied on the drawings or in the specifications.

6. The Contractor shall clearly indicate the size, finish, material, etc.

7. All submittals shall be assembled in sets by system.

8. Each set shall be bound in a manufacturer's folder or inside of a manila file folder.

9. Each set shall contain an index of the items enclosed with a general topic description on the cover.

10. Where more than one model is shown on a manufacturer's sheet, the Contractor shall clearly indicate exactly which item and which data is relevant to the work.

11. Failure to comply with the above shall be reason to resubmit all shop drawing submittals.

12. The Engineer's responsibility shall be to review one set of shop drawing submittals for each product. If the first submittal is incomplete or does not comply with the drawings and/or specifications, the Contractor shall be responsible to bear the cost for the Engineer to recheck and handle the additional shop drawing submittals.

13. Provide documentation of all warranties required by the contract documents.

14. Submit copy of the Contractor certification form contained at the end of specification section.

C. Provide Schedule of Values for Technology Work:

1. Application forms: Use AIA Document Continuation Sheets G703 (or similar) as the form for application.

2. Provide line items on the Schedule of Values including:

a. Structured Cabling

3. Change orders shall have schedule of values broken out as listed above submitted with each change order.

4. Coordinate with the Project Engineer the items included in the Schedule of Values. The intent is to not create schedules in addition to those the Technology Contractor normally submits to the General Contractor for payment.

1.7 EQUIPMENT SUPPLIERS' INSPECTION

A. The following equipment shall not be placed in operation until a representative of the manufacturer has inspected the installation and certified that the equipment is properly installed and that the equipment is ready for operation:

1. Firestopping, including mechanical firestop systems.

1.8 PRODUCT DELIVERY, STORAGE, HANDLING & MAINTENANCE

A. Exercise care in transporting and handling to prevent damage to fixtures, equipment and materials.

B. Store materials on the site so as to prevent damage.

C. Keep fixtures, equipment and materials clean, dry and free from deleterious conditions.

1.9 WARRANTY

A. At a minimum, provide a one (1) year warranty for all equipment, materials, and workmanship. Individual specifications sections within Division 17 may require additional warranty requirements for specific equipment or systems.

B. The warranty period for the entire installation described in this Division of the specifications shall commence on the date of substantial completion unless a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization. In this instance, the warranty

period shall commence on the date when such whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the Owner or their representative.

C. Warranty requirements shall extend to correction, without cost to the final user, of all work and/or equipment found to be defective or nonconforming to the contract documents. The Contractor shall bear the cost of correcting all damage resulting from such defects or nonconformance with contract documents exclusive of repairs required as a result of improper maintenance or operation, or of normal wear as determined by the Architect/Engineer.

1.10 INSURANCE

A. This Contractor shall maintain insurance coverage as set forth in Division 1 of these specifications.

1.11 MATERIAL

A. Where several manufacturers' names are given, the first named manufacturer constitutes the basis for job design and establishes the equipment quality required to be used in this contract.

B. Equivalent equipment manufactured by the other named manufacturers may be used. Contractor shall ensure that all items submitted by these other manufacturers meets all requirements of the drawings and specifications and fits in the allocated space. The Engineer shall make the final determination of whether a product is equivalent.

C. Any material, article or equipment of other unnamed manufacturers which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured **in writing** from the Architect/Engineer not later than ten (10) days prior to the bid opening date. The Contractor bears full responsibility for the unnamed manufacturers equipment adequately meeting the intent of design. The Architect/Engineer may reject manufacturer at time of shop drawing submittal. The Contractor assumes all costs incurred by other trades on the project as a result of changes necessary to accommodate the offered material, equipment or installation method.

D. Should this Contractor be unable to secure approval from the Architect/Engineer for other unnamed manufacturers as outlined above, this Contractor may list voluntary add or deduct prices for alternate materials on the bid form. These items will not be used in determining the low bidder. Should a voluntary alternate material be accepted, This Contractor shall assume all costs that may be incurred as a result of using the offered material, article or equipment necessitating extra expense on This Contractor or on the part of other Contractors whose work is affected.

PART 2 - PRODUCTS

2.1 REFER TO INDIVIDUAL SECTIONS

PART 3 - EXECUTION

3.1 JOBSITE SAFETY

A. Neither the professional activities of the Engineer, nor the presence of the Engineer or his or her employees and subconsultants at a construction site, shall relieve the Contractor and any other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Engineer and his or her personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The Engineer and the Engineer's consultants shall be indemnified and shall be made additional insureds under the Contractor's general liability insurance policy.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Installation of all conduit and cabling shall comply with Sections 16111 and 16120. Additional conduit requirements described within this Division shall be supplemental to the requirement described in Section 16111. Should conflicts exist between the two Divisions the more stringent (more expensive material and labor) condition shall prevail until bidding addendum or construction clarification or RFI can be submitted and responded to. In no case shall the Contractor carry the least stringent condition in the pricing.

B. It is the Contractor's responsibility to survey the site and include all necessary costs to perform the installation as specified.

3.3 FIELD QUALITY CONTROL

A. General:

1. Refer to specific Division 17 sections for further requirements.

2. The Contractor shall conduct all tests required and applicable to the work both during and after construction of the work.

3. The necessary instruments and materials required to conduct or make the tests shall be supplied by the Contractor who shall also supply competent personnel for making the tests who has been schooled in the proper testing techniques.

4. In the event the results obtained in the tests are not satisfactory, This Contractor shall make such adjustments, replacements and changes as are necessary and shall then repeat the test or tests which disclose faulty or defective work or equipment, and shall make such additional tests as the Architect/Engineer or code enforcing agency deems necessary.

5. All telecommunications tests that fail, including those due to excessive cabling lengths, shall be remedied by the Contractor without cost to the project.

B. Protection of cable from foreign materials:

1. It is the Contractor's responsibility to provide adequate physical protection to prevent foreign material application or contact with any cable type. Foreign material is defined as any material that would negatively impact the validity of the manufacturer's performance warranty. This includes, but is not limited, to overspray of paint (accidental or otherwise), drywall compound, or any other surface chemical, liquid or compound that could come in contact with the cable, cable jacket or cable termination components.

2. Overspray of paint on any cable, cable jacket or cable termination component will not be accepted. It shall be the Contractor's responsibility to replace any component containing overspray, in its entirety, at no additional cost to the project. Cleaning of the cables with harsh chemicals is not allowed. This requirement is regardless of the PASS/FAIL test results of the cable containing overspray. Should the manufacturer and warrantor of the structured cabling system desire to physically inspect the installed condition and certify the validity of the structured cabling system (via a signed and dated statement by an authorized representative of the structured cabling manufacturer), the Owner may, at their sole discretion, agree to accept said warranty in lieu of having the affected cables replaced. In the case of plenum cabling, in addition to the statement from the manufacturer, the Contractor shall also present to the Owner a letter from the local Authority Having Jurisdiction stating that they consider the plenum rating of the cable to be intact and acceptable.

3.4 PROJECT CLOSEOUT

A. Refer to the Division 1 Section: PROJECT CLOSEOUT for requirements. The following paragraphs supplement the requirements of Division 1.

B. Final Jobsite Observation:

1. The Engineer will not perform a final jobsite observation until the project is ready. This is not dictated by schedule, but rather by completeness of the project.

2. Refer to the end of this specification section for a "STATEMENT INDICATING READINESS FOR FINAL JOBSITE OBSERVATION."

3. The Contractor shall sign this form and return it to the Engineer so that the final observation can commence.

C. Before final payment will be authorized, this Contractor must have completed the following:

1. Submitted operation and maintenance manuals to the Architect/Engineer for review.

2. Submitted bound copies of approved shop drawings.

3. Record documents including edited drawings and specifications accurately reflecting field conditions, **inclusive** of all project revisions, change orders, and modifications.

4. Submitted a report stating the instructions given to the Owner's representative complete with the number of hours spent in the instruction. The report shall bear the signature of an authorized agent of This Contractor and shall be signed by the Owner's representative as having received the instructions.

5. Submitted testing reports for all systems requiring final testing as described herein.

6. Submitted start-up reports on all equipment requiring a factory installation inspection and/or start.

7. Provide spare parts, maintenance, and extra materials in quantities specified in individual specification sections. Deliver to project site; submit receipt to Architect/Engineer prior to final payment being approved.

8. Provide System Assurance Warranty certificate for the telecommunications system.

3.5 OPERATION AND MAINTENANCE INSTRUCTIONS

A. Submit three (3) properly indexed and bound copies, in "D" ring style notebooks, of the Operations and Maintenance Instructions to the Architect/Engineer for approval. Make all corrections or additions required.

B. Operation and Maintenance Instructions shall include:

1. Notebooks shall be heavy duty locking three ring binders and incorporate clear vinyl sheet sleeves on the front cover and spine for slip-in labeling. "Peel and stick" labels are **not** acceptable. Sheet lifters shall be supplied at the front of each notebook. Provide "Wilson-Jones" or equal, color black. Size notebooks a minimum of 1/2" thicker than material for future inserts. Label the spine and front cover of each notebook. If more than one notebook is required, label in consecutive order. For example; 1 of 2, 2 of 2. No other forms of binding will be acceptable.

2. Prepare binder covers (front and spine) with printed title "Operation and Maintenance Instructions", title of project, and subject matter of binder when multiple binders are required.

3. Title page with project title, Architect, Engineer, Contractor, and Subcontractor with addresses, telephone numbers, and contacts.

4. Table of Contents describing all index tabs.

5. Listing of all Subcontractors and major equipment suppliers with addresses, telephone numbers, and contacts.

6. Index tabs dividing information by specification section, major equipment, or systems. All tab titles shall be clearly printed under reinforced plastic tags.

7. Copies of warranties.

8. Copies of all final approved shop drawings and submittals.

9. Copies of all factory inspection and/or equipment start-up reports.

C. Operation and maintenance data shall consist of written instructions for the care, maintenance, and operation of the equipment and systems. Instruction books, cards, manuals furnished with the equipment shall be included.

3.6 INSTRUCTING THE OWNER'S REPRESENTATIVE

A. Adequately instruct the Owner's designated representative or representatives in the maintenance, care, and operation of the complete systems installed under this contract.

B. Provide verbal and written instructions to the Owner's representative or representatives by FACTORY PERSONNEL in the care, maintenance, and operation of the equipment and systems.

C. The Owner has the option to video tape the instructions to the Owner. Coordinate schedule of instructions to facilitate this recording.

D. The Architect/Engineer shall be notified of the time and place for the verbal instructions to be given to the Owner's representative so that their representative can be present if desirable.

E. Refer to the individual specification sections for minimum hours of instruction time for each system.

F. Operating Instructions:

1. The Contractor is responsible for all instructions to the Owner and/or Owner’s operating staff on the Communications Systems.

2. If the Contractor does not have Engineers and/or Technicians on staff that can adequately provide the required instructions on system operation, performance, troubleshooting, care and maintenance, they shall include in the bid an adequate amount to reimburse the Owner for the Engineer to perform these services.

3.7 SYSTEM COMMISSIONING

A. The Communications Systems included in the construction documents are to be complete and operating systems. The Architect/Engineer will make periodic job site observations during the construction period. The system start-up, testing, configuration, and satisfactory system performance is the responsibility of the Contractor. This shall include all calibration and adjustments of electrical equipment controls, equipment settings, software configuration, troubleshooting and verification of software, and final adjustments that may be required.

B. All operating conditions and control sequences shall be simulated and tested during the start-up period.

C. The Contractor, subcontractors, and equipment suppliers are expected to have skilled technicians to insure that the system performs as designed. If the Architect/Engineer is requested to visit the job site for the purpose of trouble shooting, assisting in the satisfactory start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period through no fault of the design; the Contractor shall reimburse the Owner on a time and material basis for services rendered at the Architect/Engineer's standard hourly rates in effect at the time the services are requested. The

Contractor shall be responsible for making payment to the Owner for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

3.8 RECORD DOCUMENTS

A. Refer to the Division 1 Section: PROJECT CLOSEOUT for requirements. The following paragraphs supplement the requirements of Division 1.

B. Mark specifications to indicate approved substitutions, change orders, and actual equipment and materials used.

C. This Contractor shall maintain at the job site, a separate and complete set of Communications Drawings which shall be clearly and permanently marked and noted in complete detail any changes made to the location and arrangement of equipment or made to the Communications Systems and wiring as a result of building construction conditions or as a result of instructions from the Architect or Engineer. All Change Orders, RFI responses, Clarifications and other supplemental instructions shall be marked on the documents. Record documents that merely reference the existence of the above items are not acceptable. Should This Contractor fail to complete Record Documents as required by this contract, This Contractor shall reimburse Architect/Engineer for all costs to develop record documents that comply with this requirement. Reimbursement shall be made at the Architect/Engineer's hourly rates in effect at the time of work.

D. The above record of changes shall be made available for the Architect and Engineer's examination during any regular work time.

E. Upon completion of the job, and before final payment is made, This Contractor shall give the marked-up drawings to the Architect/Engineer.

3.9 ADJUST AND CLEAN

A. Contractor shall thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project.

B. Contractor shall clean all foreign paint, grease, oil, dirt, labels, stickers, and other foreign material from equipment.

C. Contractor shall remove all rubbish, debris, etc., accumulated during the Contractor's operations from the premises.

END OF SECTION

STATEMENT INDICATING READINESS FOR FINAL JOBSITE OBSERVATION

In order to assist the contractor in a timely close-out of the project, it is crucial that the final jobsite observation is not conducted prior to the project being ready. The contractor is required to review the completion status of the project at the time the observation is scheduled. This review, and the subsequent submittal of this form to the Engineer, shall indicate the contractor's agreement that the area of the project being requested for final observation is ready as defined below. The following list represents the degree of completeness required prior to requesting a final observation:

1. All cabling pathways (cable tray, ladder rack, conduit sleeves, etc) are installed and all cabling has been pulled through them.
2. All mechanical firestop products are installed and all other penetrations have been sealed.
3. All telecommunications jacks are installed in the faceplates.
4. All telecommunications cabling is pulled and at least 75% of all jacks have been terminated at the jack and at the telecom room.
5. Telecommunications testing is in progress and at least 25% of testing has been completed.
6. Telecommunications labeling has been provided on at least 25% of each type of component requiring a label.
7. All telecommunications related grounding is complete.

The project will be ready for final jobsite observation prior to the requested date of the observation, according to the above list of requirement.

Prime Contractor: _____ By: _____

Requested Observation Date _____ Today's Date: _____

Contractor shall sign this readiness statement and transmit to Engineer at least 10 days prior to the requested date of observation.
It is understood that if the Engineer finds that the project is not complete as defined above and that the final jobsite observation cannot be completed on the requested date, the Engineer will return to the site at a later date. All additional visits to the site for the purposes of completing the final observation will be billed T&M to the Contractor at our standard hourly rates, including travel expenses or the contractor's retainage may be deducted for the same amount.

SECTION 17050
COMMUNICATIONS BONDING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Bonding Conductors
B. Bonding Connectors
C. Grounding Busbar (TMGB and TGB)
D. Rack-mount Telecommunications Grounding Busbar

1.2 REFERENCES

A. ANSI/IEEE 1100 – Recommended Practice for Power and Grounding Sensitive Electronic Equipment in Industrial and Commercial Power Systems

B. ANSI/TIA/EIA 568-B.1-B.3 – Commercial Building Telecommunications Cabling Standard

C. ANSI/TIA/EIA 569-A – Commercial Building Standard for Telecommunications Pathways and Spaces

D. ANSI/TIA/EIA 606 – Administration Standard for the Telecommunications Infrastructure of Commercial Buildings

E. ANSI/TIA/EIA 758 – Customer Owned Outside Plant

F. ANSI-J-STD-607-A – Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications

G. IEEE 81 – IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System Part 1: Normal Measurements

H. IEEE 837 – IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding

I. NFPA 70 – National Electrical Code

J. NFPA 780 – Standard for the Installation of Lightning Protection Systems

K. UL 96 – Lightning Protection Components

L. UL 96A – Installation Requirements for Lightning Protection Systems

M. UL 467 – Grounding and Bonding Equipment

1.3 RELATED SECTIONS

A. Section 16111 – Conduit
B. Section 16120 – Wire and Cable
C. Section 16450 – Grounding and Bonding
D. Section 16670 – Lightning Protection Systems

E. Section 17010 – Basic Communications Systems Requirements
F. Section 17110 – Communication Equipment Rooms
G. Section 17130 – Interior Communication Pathways
H. Section 17170 – Identification and Administration

1.4 SYSTEM DESCRIPTION

A. This section describes the requirements for the furnishing, installation, adjusting, and testing of a complete turnkey communications bonding system, including connection to the electrical ground grid.

B. Performance Statement: This specification section and the accompanying drawings are performance based, describing the minimum material quality, required features, operational requirements, and performance of the system. These documents do not convey every wire that must be installed, every equipment connection that must be made, or every feature and function that must be configured. Based on the equipment constraints described and the performance required of the system as presented in these documents, the Contractor is solely responsible for determining all components, devices, equipment, wiring, connections, and terminations required for a complete and operational system that provides the required performance.

C. This document describes the major components of the system. All additional hardware, subassemblies, supporting equipment, and other miscellaneous equipment required for complete, proper system installation and operation shall be provided by the Contractor.

D. Basic System Requirements:

1. A complete communications bonding infrastructure is required for this project. Refer to the drawings and the requirements of ANSI-J-STD-607-A and NFPA 70 for complete information.

2. The bonding system shall include, but not be limited to, the following major components:

a. Bonding Conductor for Telecommunications (BCT)
b. Telecommunications Main Grounding Busbar (TMGB)
c. Telecommunications Bonding Backbone (TBB)
d. Telecommunications Grounding Busbar(s) (TGB)
e. Rack mount Telecommunications Grounding Busbar(s)
f. Bonding Conductor(s) (BC)
g. Bonding Connectors
h. Bonding system labeling and administration as defined in Section 17170.

1.5 QUALITY ASSURANCE

A. Refer to Section 17010 for relevant standards.

B. Communications bonding system component, device, equipment, and material manufacturer(s) shall have a minimum of five (5) years documented experience in the manufacture of communications bonding products.

C. The entire installation shall comply with all applicable electrical codes, safety codes, and standards. All applicable components, devices, equipment, and material shall be listed by Underwriters' Laboratories, Inc.

1.6 SUBMITTALS

A. Submit product data and shop drawings under provisions of Section 17010 and Division 1.

B. Provide manufacturer's technical product specification sheet for each individual component type. Submitted data shall show the following:

1. Compliance with each requirement of these documents. The submittal shall acknowledge each requirement of this section, item-by-item, including construction, materials, ratings, and all other parameters identified in Part 2 - Products.

2. Manufacturer's installation instructions indicating application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

C. Provide CAD-generated, project-specific system shop drawings as follows:

1. Provide a system block diagram indicating system configuration, system components, interconnection between components, and conductor routing. The diagram shall clearly indicate all wiring and connections required in the system. When multiple devices or pieces of equipment are required in the exact same configuration (e.g., multiple identical equipment racks or sections of ladder tray), the diagram may show one device and refer to the others as "typical" of the device shown. The diagram shall list room numbers where system equipment will be located.

2. Installation details for all system components.

D. Provide system checkout test procedure to be performed at acceptance.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the site under the provisions of Section 17010.

B. Store and protect products under the provisions of Section 17010.

C. Contractor shall exercise care to prevent corrosion of any products prior to installation. Corroded products shall not be acceptable for use on this project.

1.8 PROJECT RECORD DOCUMENTS

A. Submit documents under the provisions of Section 17010.

B. Provide final system block diagram showing any deviations from approved shop drawing submittal.

C. Provide floor plans that document the following:

1. Actual locations of system components, devices, and equipment.
2. Actual conductor routing.
3. Actual system component, device, equipment, and conductor labels.

D. Provide statement that system checkout test, as outlined in the approved shop drawing submittal, is complete and test results were satisfactory.

E. Complete all operation and maintenance manuals as described below.

1.9 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 17010.

B. Submitted data shall include:

1. Approved shop drawings.

2. Descriptions of recommended system maintenance procedures, including:

a. Inspection
b. Periodic preventive maintenance
c. Fault diagnosis
d. Repair or replacement of defective components

PART 2 - PRODUCTS

2.1 BONDING CONDUCTORS

A. Bare Copper:

1. Annealed uncoated stranded conductor.
2. Minimum size 6 AWG.

B. Insulated Copper:

1. Annealed uncoated stranded conductor.

2. Insulation:

a. PVC insulation with nylon outer jacket.
b. Rated $\geq$ 600 volts.
c. Green.

3. Minimum size 6 AWG.

C. All bonding conductors shall be listed and recognized by a nationally recognized testing laboratory as being suitable for the intended purpose and for installation in the space in which they are installed.

D. Bonding Conductor Sizing

1. All Communications bonding system conductors shall be sized by length as follows:

Length Linear ft (m)	Size (AWG)
Less than 13 (4)	6
14 - 20 (4 - 6)	4
21 - 26 (6 - 8)	3
27 - 33 (8 - 10)	2
34 - 41 (10 - 13)	1
42 - 52 (13 - 16)	1/0
53 - 66 (16 - 20)	2/0
Greater than 66 (20)	3/0

2. The BCT shall be the same size as the TBB or larger.

2.2 BONDING CONNECTORS

A. Acceptable Types:

1. Two-hole compression lug
2. Exothermic weld
3. Irreversible compression

B. Connectors shall be provided in kit form and selected per manufacturer's written instructions.

C. Connectors shall comply with IEEE 837 and UL 467 and be listed for use for specific types, sizes, and combinations of conductors and connected items.

2.3 GROUNDING BUSBAR (TMGB AND TGB)

A. Features:

1. Wall-mount configuration.
2. Listed and recognized by a nationally recognized testing laboratory as being suitable for intended purpose.
3. Hole patterns compliant with BICSI recommendations and ANSI-J-STD-607-A standards.
4. Predrilled holes.
5. Integral insulators.
6. Stainless steel offset mounting brackets.

B. Specifications:

1. Material: Electrolytic tough pitch copper bar.

2. Minimum Dimensions: 1/4" thick x 4" high x 12" long.

a. Increase dimensions and/or quantity furnished and installed as required to accommodate all terminations required by the project, plus 20% spare capacity.

3. Hole pattern shall include:

a. A minimum of 15 sets of 5/16” holes, 5/8” on center, to accommodate “A” spaced 2-hole compression lugs.

b. A minimum of three (3) sets of 7/16” holes, 1” on center, to accommodate “C” spaced 2-hole compression lugs.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General Bonding Requirements:

1. The communications bonding system shall be a complete system. Contractor shall furnish and install all necessary miscellaneous components, devices, equipment, material, and hardware, including, but not limited to, lock washers, paint-piercing washers, hex nuts, compression lugs, insulators, mounting screws, lugs, etc., to provide a complete system.

2. A licensed electrician shall perform all bonding.

3. Comply with the manufacturer’s instructions and recommendations for installation of all products.

B. Main Cross Connect and Service Entrance Room Bonding Requirements:

1. Locate the TMGB in the service entrance room unless otherwise noted on the drawings.

2. The location of the TMGB shall be the shortest practical distance from the telecommunications primary lightning protection devices.

3. Bond the telecommunications primary protectors to the TMGB. Maintain a minimum 1 foot (300 mm) separation of the bonding conductor from all DC power cables, switchboard cable, and high frequency cable.

C. Telecommunications Main Ground Bar (TMGB) Requirements:

1. Install TMGB such that it is insulated from its support with a minimum 2” standoff.

2. Bond the TMGB to the electrical service ground via the BCT.

a. A minimum of 1 foot (300 mm) separation shall be maintained between the BCT and any DC power cables, switchboard cable, or high frequency cables.

3. TMGB shall be bonded to all electrical panels located in the same room or space as the TMGB or in an immediately adjacent space within 20 linear feet of the TMGB. TMGB shall be bonded to all electrical panels providing electrical power to communications equipment located in the same room or space as the TMGB.

4. TMGB shall be bonded to accessible metallic building structure located within the same room or space as the TMGB.

5. All metallic continuous cable pathways, including, but not limited to, cable trays, basket trays, ladder racks, raceways, conduits, conduit sleeves, and fire-rated cable pathway devices, located within the same room or space as the TMGB, shall be bonded to the TMGB.

6. All metallic communications equipment, including, but not limited to, cable pair protectors, surge suppressors, cross-connect frames, patch panels, equipment cabinets, etc., located within the same room or space as the TMGB, shall be bonded to the TMGB.

D. Telecommunications Ground Bar (TGB) Requirements:

1. Provide a TGB in each telecommunications equipment room.

2. Install TGB such that it is insulated from its support with a minimum 2" standoff.

3. Bond each TGB to the TMGB via the TBB.

a. A minimum of 1 foot (300 mm) separation shall be maintained between the TBB and any DC power cables, switchboard cable, or high frequency cables.

b. The TBB may be routed from TGB to TGB or as a radial feed to each TGB as the layout requires.

4. When there are multiple telecommunications equipment rooms on each floor in buildings containing more than five stories, the TGBs on the same floor shall be bonded together horizontally using a grounding equalizer (GE) on the first, last, and every third intermediate floor. GE conductors shall be the same size as the TBB.

5. If more than one (1) TGB is provided within the same room or space, they shall all be bonded together via a BC the same size as the TBB.

6. TGBs shall be bonded to accessible metallic building structure located within the same room or space as the TGBs.

7. TGBs shall be bonded to all electrical panels located in the same room or space as the TGB or in an immediately adjacent space within 20 linear feet of the TGB. TGBs shall be bonded to all electrical panels providing electrical power to communications equipment located in the same room or space as the TGB.

8. All metallic continuous cable pathways, including, but not limited to, cable trays, basket trays, ladder racks, raceways, conduits, conduit sleeves, and fire-rated cable pathway devices, located within the same room or space as the TGB, shall be bonded to the TGB.

9. All metallic communications equipment, including, but not limited to, cable pair protectors, surge suppressors, cross-connect frames, patch panels, equipment cabinets, etc., located within the same room or space as the TGB, shall be bonded to the TGB.

E. Metallic Interior Communication Pathway Bonding Requirements:

1. All metallic interior continuous communication cable pathways, including, but not limited to, conduit, conduit sleeves, fire-rated cable pathway devices, cable tray, basket tray, and ladder rack, shall be bonded to the communications bonding system.

F. Bonding Conductor Requirements:

1. Bonding conductors shall be green or marked with a distinctive green color.

2. Bonding conductors shall be routed parallel and perpendicular to building structure along shortest and straightest paths possible. Number of bends and changes in direction should be minimized. Install and secure conductors in a manner that protects the conductors from impact and from physical or mechanical strain or damage.

3. Bonding conductors shall not be installed in metallic conduit.

4. All conductors, including, but not limited, to the BCT, TBB, GE(s), and BC(s), shall be installed splice-free. If the Contractor believes that site conditions do not allow a splice-free installation, the Contractor may request permission from the Engineer to splice a specific communications bonding system conductor.

   a. Where documented permission to splice a conductor is granted:

      1) The number of splices shall be limited to as few as possible.

      2) Splices shall be made using exothermic welding or irreversible compression-type connections only. Splice hardware shall be listed for grounding and bonding. Solder is not an acceptable means of splicing conductors.

      3) Splices shall be made in telecommunications spaces in accessible locations to facilitate future inspection and maintenance.

      4) Splices shall be adequately supported and protected from impact and from physical or mechanical strain or damage.

5. All bonding conductors shall be labeled in accordance with the requirements of Section 17170. In addition to the requirements of Section 17170:

   a. Labels shall be nonmetallic.

   b. Labels shall be printer-generated.

   c. Labels shall be located on conductors as close as is practical to their point of termination in a readable position.

   d. Additionally, conductors shall be labeled as follows:

      1) "IF THIS CONNECTOR OR CABLE IS LOOSE OR MUST BE REMOVED, PLEASE CALL THE BUILDING TELECOMMUNICATIONS MANAGER."

6. Interior water piping is not acceptable for use as a communications bonding system bonding conductor.

7. Metallic cable shields are not acceptable for use as communications bonding system bonding conductors.

G. Bonding Connection Requirements:

1. Make all connections in accessible locations to facilitate future inspection and maintenance.

2. Communications bonding system connections shall be made using exothermic welding, two-hole compression lugs, or other irreversible compression-type connections. The use of 1-hole lugs is prohibited, except for connections to a rack-mount telecommunications ground bar. Connection hardware shall be listed for grounding and bonding. Sheet metal screws shall not be used to make communications bonding system connections.

3. Thoroughly clean conductors before installing lugs and connectors.

4. Install and tighten all connectors in accordance with manufacturer's instructions, using the appropriate purpose-designed tool(s) recommended by the manufacturer for that purpose. Exercise care not to tighten connectors beyond manufacturer's recommendations.

5. Where necessary, remove paint and/or use paint-piercing washers to provide proper electrical bond at all connections.

6. All bonding connections shall be coated in anti-oxidant joint compound that is purpose-designed and purpose-manufactured for that use. Anti-oxidant joint compound shall be applied in accordance with manufacturer's recommendations and instructions.

7. All installed connectors on conductors installed in damp locations shall be sealed with dielectric grease and then covered with heat shrink tubing to protect against moisture ingress. Applied heat shrink tubing shall overlap conductor's outer jacket a minimum of four (4) inches past connector and be installed in accordance with manufacturer's recommendations and instructions.

3.2 FIELD QUALITY CONTROL

A. Field inspection and testing shall be performed under provisions of Section 17010.

B. Where these specifications require a product or assembly without the use of a brand or trade name, provide a product from a reputable manufacturer that meets the requirements of the specifications.

C. Periodic observations will be performed during construction to verify compliance with the requirements of the specifications. These services do not relieve the Contractor of responsibility for compliance with the contract documents.

3.3 ADJUSTING

A. Adjust work under provisions of Section 17010.

B. Contractor shall make any and all adjustments to the communications bonding system necessary to ensure that the installed system meets all requirements listed herein. Modifications necessary to comply with listed requirements or to provide specified performance shall be completed by the Contractor at no additional cost to the Owner.

3.4 TESTING

A. Test installed system under provisions of Section 17171.

B. Measure and document resistance to ground at TMGB, each TGB, each RTGB, and each electrical distribution panel bonded to the TMGB or a TGB.

1. Measurements shall be made not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage, and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests by the fall-of-potential method according to IEEE 81.

2. Measured resistance to ground at TMGB, each TGB, and each RTGB must not exceed 5 ohms.

3. Under no circumstances shall any point in the communications bonding system have a lower resistance to ground than that of nearby electrical distribution system components that it is bonded to.

C. Include measurement documentation in test data submitted at completion of project under provisions of Section 17171.

3.5 SYSTEM TRAINING

A. All labor and materials required for on-site system training shall be provided. Training shall be conducted at the project site using the project equipment.

1. Provide two week's advanced notice of training to the Owner and Engineer.

2. The Engineer shall be presented with the option to attend the training.

3. Provide a training outline agenda describing the subject matter and the recommended audience for each topic.

B. At a minimum, the following training shall be conducted:

1. A course detailing the system functions and operations that a technical user will encounter. Provide training on all aspects of using the system, including making new bonding connections to the TMGB, TGB, or RTGB. Provide training on all recommended inspection, maintenance, and repair procedures for the system.

C. Minimum on-site training times shall be:

1. Technical user: Four hours.

END OF SECTION

SECTION 17110
COMMUNICATION EQUIPMENT ROOMS (CER)

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This section describes the products and execution requirements related to furnishing and installing equipment for Communication Equipment Rooms. Communication Equipment Rooms include rooms for the Main Cross Connect (MC), Intermediate Cross Connect (IC), Horizontal Cross Connect (HC), Service Entrance Room (SER) and Equipment Room (ER) (such as data centers and main computer rooms housing servers, mainframes and other central equipment).

B. Definitions:

1. Main Cross Connect (MC): Allows single point administration of technology components for cross-connect of first level backbone cables, entrance cables and equipment cables.

2. Intermediate Cross Connect (IC): Cross connect location between a backbone cable extending from the main cross connect (first level backbone) and the backbone cable from the horizontal cross connect (second level backbone).

3. Horizontal Cross Connect (HC): Cross connect location between the horizontal cabling and the backbone cabling.

4. Service Entrance Room: Accommodates a single location for incoming services to terminate and indicates an interface point and division of responsibility between the building cabling system and the service provider (herein referred to as the demarc).

C. Refer to Specification Section 17130 for cable pathway and support requirements.

1.2 RELATED SECTIONS

A. Section 17010 - Basic Communications Systems Requirements
B. Section 17050 - Communications Bonding
C. Section 17130 - Interior Communication Pathways
D. Section 17160 - Horizontal Cabling Requirements

1.3 QUALITY ASSURANCE

A. Refer to Section 17010 for applicable standards.

1.4 SUBMITTALS

A. Under the provisions of Section 17010 and Division 1, prior to the start of work the Contractor shall submit:

1. Manufacturer's data covering all products including construction, materials, ratings and all other parameters identified in Part 2 - Products, below.

2. Manufacturer's installation instructions.

B. Coordination Drawings:

1. Include ladder racking, equipment racks, cable tray and conduit sleeve layout in composite electronic coordination files. Refer to Section 17010 for coordination drawing requirements.

PART 2 - PRODUCTS

2.1 EQUIPMENT GROUNDING

A. Refer to specification section 17050 for grounding requirements.

B. All equipment required to be grounded shall be provided with a grounding lug suitable for termination of the specified size electrode conductor.

2.2 EQUIPMENT RACKS AND CABINETS

A. Where identified on the drawings in Communication Equipment Rooms, equipment racks and/or equipment cabinets shall be furnished and installed by the Contractor to house cable termination components (e.g., copper, optical fiber, coax) and network electronics.

1. Swing Gate TIA/EIA 19" Wall Rack:

a. Equipment rack shall be 35" in height and provide a useable mounting height of 20 RU. Rack shall be a minimum of 18" deep.

b. Wall-mounted equipment racks shall be provided with a swing-gate assembly to allow rear access of rack-mounted equipment.

c. Equipment rack shall support up to 100 lbs. when securely mounted to a wall or backboard.

d. Provide all mounting hardware and accessories as required for a complete installation.

2.3 CABLE MANAGEMENT – HORIZONTAL

A. Equipment Racks:

1. Equipment racks shall be equipped with horizontal cable management hardware in the form of rings and guides. Racks shall incorporate horizontal covers, to allow an orderly, hidden, routing of copper, optical fiber, and coax jumpers from the modular

patch panels and/or 110-type termination blocks to the customer provided network electronics. Horizontal cable management hardware shall be as follows:

a. Horizontal cable management hardware shall be painted steel (3.5" panel), have a minimum of five (5) jumper distribution rings (1.75" x 3.75" minimum dimension) and incorporate jumper routing clips (plastic) for individual jumpers. Provide with cover designed to conceal and protect cable.

b. At a minimum, horizontal cable management hardware shall be positioned above and below (a) each grouping of two rows of jacks on modular patch panels, and (b) above and below each optical fiber patch panel and (c) each grouping of two rows of F-type connectors on coax patch panels.

2. Each equipment rack shall be supplied with a minimum of 12 releasable (e.g., "hook and loop") cable support ties.

3. Where cable termination hardware is wall-mounted, the Contractor shall be responsible for establishing a cable pathway for jumpers routed from the equipment rack(s) to the wall. This shall be in the form of slotted ducts or troughs. Routing of jumpers via the overhead cable tray or ladder rack system is NOT acceptable. The proposed method shall be included in the submittals required by this document and shall be approved by the Engineer prior to installation.

B. Equipment Cabinets

1. Equipment cabinets shall be equipped with vertical and horizontal cable management hardware, in the form of rings and guides, to allow an orderly routing of optical fiber and copper jumpers from the modular patch panel and/or 110-type termination blocks to the customer provided network electronics. At a minimum, one such horizontal cable management panel shall be provided with each equipment cabinet. Horizontal cable management panels shall be 3.5" in height and have a minimum of five (5) jumper distribution rings.

C. 110-type Termination Blocks:

1. Horizontal troughs incorporating plastic distribution rings shall be provided by the Contractor to accommodate routing of jumpers. Horizontal troughs shall be positioned at the top of each column of 110-type termination blocks and between each 100-pair 110-type termination block.

2. Vertical troughs incorporating metal distribution rings shall be provided for vertical routing of jumper and/or cross-connect wire.

2.4 PATCH PANELS

A. Where identified on the drawings in Communication Equipment Rooms, modular patch panels shall be furnished and installed by the Contractor for termination of copper cable.

B. Copper cabling shall be terminated in Communication Equipment Rooms on modular patch panels consisting of a modular connector system incorporating modular jacks meeting the specifications for the jacks detailed in Section 17160.

C. The largest single modular patch panel configuration shall not exceed 48-Ports. Modular patch panels shall be fully populated (all ports occupied by jacks) and be provided in increments of no less than 12 jacks. High-density modular patch panels will not be accepted.

D. The modular patch panel blocks shall have the ability to seat and cut eight (8) conductors (4 pairs) at a time and shall have the ability of terminating 22- through 26-gauge plastic insulated, solid and stranded copper conductors. Modular patch panel blocks shall be designed to maintain the cables' pair twists as closely as possible to the point of mechanical termination.

E. Modular patch panels shall incorporate cable support and/or strain relief mechanisms to secure the horizontal cables at the termination block and to ensure that all manufacturers minimum bend radius specifications are adhered to.

2.5 TERMINATION BLOCKS

A. Where identified on the drawings in Communication Equipment Rooms, 110-type termination blocks shall be furnished and installed by the Contractor for termination of copper cable.

B. Each horizontal row of the 110-type termination block must be capable of terminating one (1) 25-pair binder group (backbone cables).

C. The Mechanical Termination Shall:

1. Have the ability of terminating 22 - 26 AWG plastic insulated, solid and stranded copper conductors.

2. Provide a direct connection between the cable and jumper wires.

3. Have less than 0.2 dB of attenuation from 1-16 MHz.

4. Have less than 100 mW of DC resistance.

5. Have less than 5 mw of resistance imbalance.

6. Have minimal signal impairments at all frequencies up to 16 MHz.

D. The 110-type termination block shall identify pair position by a color designation - Blue, Orange, Green, Brown and Slate (backbone only).

E. The 110-type termination block shall be designed to maintain the cables' pair twists as closely as possible to the point of mechanical termination.

2.6 LADDER RACK

A. Provide complete ladder rack system including metallic ladder rack, splice connectors, fastening hardware and other miscellaneous materials as required for a complete installation per manufacturer's recommendations.

B. Steel C-Channel Stringer Style Ladder Rack:

1. Rolled steel siderail stringer, 2” stringer height, 9” spaced welded rungs.

2. Steel shall meet the requirements of ASTM A1011 SS Grade 33.

3. Loading limits shall be 292 lbs/ft for 4 ft spans.

C. Ladder rack finish shall be flat black powder coat.

2.7 D-RINGS

A. Rounded edge D-rings for support of cabling in vertical and horizontal configurations.

B. EIA 310D compliant, manufactured from materials meeting UL94-V0 specifications.

C. Provide ¼” screw holes for wall mounting.

2.8 POWER STRIPS

A. Provide power strips on all equipment racks, unless noted otherwise. These power strips shall have the following characteristics:

1. Standard Rack Mount:

a. TIA/EIA 19” equipment rack mountable.

b. Compliant with UL-1449 Second Edition and UL-497A.

c. Provide transient suppression to 13,000-A. Protection shall be in all three modes (line-neutral, line-ground and neutral-ground).

d. Shall meet or exceed ANSI C62 Category A3 requirements.

e. Provide high-frequency noise suppression as follows:

>20-dB @ 50 kHz
>40-dB @ 150 kHz
>80-dB @ 1 MHz
>30-dB @ 6 to 1000 MHz

f. Provide a minimum of 320 joules of AC energy absorption.

g. Be equipped with a 10-foot power cord.

2.9 COPPER PATCH CORDS

A. 110-type Termination Block:

1. Provide Category 3 copper patch cords for each assigned voice port on the 110-type termination block. These patch cords shall be the cross-connect between the copper backbone 110-type termination block and the horizontal RJ-45 modular patch panel. Copper patch cords shall be equipped with a 1-pair 110-type connector on the

backbone end and a RJ-45 connector 1-pair 110-type connector on the horizontal cable end. Provide lengths as required by the layout of the room.

2. Refer to Section 17160 for cable and connector performance requirements.

3. Patch cords shall not be made-up in the field.

4. Basis of Design (Refer to 17190 for Acceptable Manufacturers):

a. Panduit GPC Plus series

B. Modular Patch Panel:

1. Provide Category 5E copper patch cords for 50% of all assigned ports on the modular patch panel. Of these cords, 60% shall be 2' in length and 40% shall be 3' in length. These patch cords shall be the cross-connect between the network electronics and the horizontal RJ-45 modular patch panel. Copper patch cords shall be equipped with a 4-pair RJ-45 connector on each end.

2. Refer to Section 17160 for cable and connector performance requirements.

3. Patch cords shall not be made-up in the field.

4. Basis of Design (Refer to 17190 for Acceptable Manufacturers):

a. Panduit TX5e UTP series.

2.10 DEMARCATION REQUIREMENTS

A. Contractor shall coordinate all requirements for the demarcation point with the owner's selected service provider.

B. The Contractor shall not proceed with any installation without written communication with the Engineer should the service provider's requirements differ from the work shown on the contract documents.

C. Refer to the drawings for further requirements.

PART 3 - EXECUTION

3.1 EQUIPMENT RACKS

A. Equipment racks shall be furnished and installed as shown on the drawings.

B. The Contractor shall bolt the rack to the floor as recommended by the manufacturer. Multiple racks shall be joined and the ground made common on each. The rack shall be stabilized by extending a brace to the wall. Alternately, overhead ladder rack by which the cabling accesses the equipment rack(s) may provide this function.

C. A space between the rack upright and the wall (approximately 4") should be provided to allow for cabling in that area. The rear of the rack should be approximately 40" from the wall to allow for access by maintenance personnel. In all cases, a minimum of 40" workspace in front of the rack is also required. Locations where these guidelines cannot be followed should be brought to the attention of the Engineer for resolution prior to installation.

D. All hardware and equipment is to be mounted between 18" and 79" above floor level. This is to afford easy access and, in the case of the lower limit, prevent damage to the components. Positioning of hardware should be reviewed and approved by the Engineer and Site Coordinator(s) prior to installation.

E. Equipment racks shall be equipped with cable management hardware as to allow an orderly and secure routing of optical fiber and/or copper cabling to the optical fiber distribution cabinets and/or modular patch panels. At minimum, one such horizontal jumper management panel shall be placed below each optical fiber distribution cabinet installed by the Contractor. Additional Jumper Management panels may be required pending installation of other cable types on the equipment rack.

F. Each rack shall be grounded to the Telecommunications Ground Bar (GND) using a #6 AWG (or larger) insulated stranded copper conductor (GREEN jacket) directly or via an adjacent grounded equipment rack. Refer to grounding requirements below.

3.2 LADDER RACK

A. Provide support for ladder rack on 4 ft centers.

B. Maintain a 1.5 safety factor on all load limits specified herein.

C. Ladder rack support shall be by 5/8” diameter threaded rod when ceiling mounted. Ladder rack requiring wall mounting shall utilize accessories supplied by the ladder rack manufacturer specifically for the purpose of wall mounting ladder rack.

3.3 D-RINGS

A. Provide D-rings for cable routing and management in all areas where open cabling is routed along the wall in an Equipment Room.

B. Locate D-rings on 24” centers vertically and horizontally.

C. Securely attach D-rings to the wall as required by the manufacturer.

3.4 GROUNDING

A. Provide a complete grounding system in accordance with the requirements of Section 17050.

3.5 CROSS CONNECT INSTALLATION

A. Bend radius of cable shall not exceed 4 times the outside cable diameter or manufacturer’s recommendation, whichever is less.

B. Cables shall be neatly bundled and dressed to their respective panels and/or blocks. Each shall be fed by an individual bundle separated and dressed to the point of cable entrance into the rack and/or frame.

C. The cable jacket shall be maintained as close as possible to the termination point.

D. Each cable shall be clearly labeled on the cable jacket behind the patch panel at a location that is visible without removing the bundle support.

3.6 CONDUITS AND CABLE ROUTING

A. Refer to Section 16111 for additional requirements.

B. Where conduits enter a telecommunications room, conduits shall be terminated on the wall where shown on the contract documents. Conduits entering the room from the floor shall extend 3” above the floor slab.

C. Where cabling rises vertically in a telecommunications rooms, provide vertical cable management to support the cabling from floor to ceiling level.

D. All conduits shall be reamed and shall be installed with a nylon bushing.

E. Maintain appropriate conduit bend radius at all times. For conduits with an internal diameter of 2” or less, maintain a bend radius of at least 6 times the internal diameter. For conduits with an internal diameter greater than 2”, maintain a bend radius of at least 10 times the internal diameter.

END OF SECTION

SECTION 17130
INTERIOR COMMUNICATION PATHWAYS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. The work covered under this section consists of the furnishing of all necessary labor, supervision, materials, equipment, tests and services to install complete support systems, conduits, sleeves, innerduct, etc. for an interior cabling plant as shown on the drawings.

1.2 RELATED SECTIONS

A. Section 16111 - Conduit
B. Section 17010 - Basic Communications Systems Requirements
C. Section 17050 - Communications Bonding

1.3 REFERENCES

A. ANSI/NFPA 70 - National Electrical Code

1.4 DRAWINGS

A. The drawings, which constitute a part of these specifications, indicate the general route of the conduit, sleeves, etc. Data presented on these drawings is as accurate as preliminary surveys and planning can determine until final equipment selection is made. Accuracy is not guaranteed and field verification of all dimensions, routing, etc., is required.

1.5 SUBMITTALS

A. Under the provisions of Section 17010 and Division 1, prior to the start of work the Contractor shall submit:

1. Manufacturer’s data covering all products proposed, including construction, materials, ratings and all other parameters identified in Part 2 - Products, below.

2. Manufacturer’s installation instructions.

B. Coordination Drawings:

1. Include conduit sleeve layout in composite electronic coordination files. Refer to Section 17010 for coordination drawing requirements.

1.6 QUALITY ASSURANCE

A. Refer to Section 17010 for requirements.

PART 2 - PRODUCTS

2.1 CONDUIT

A. Refer to Section 16111 for conduit requirements for this project.

2.2 CABLE HANGERS AND SUPPORTS

A. Provide a non-continuous cable support system suitable for use with open cable.

B. Cable Hooks:

1. Construction: Flat bottom design with a minimum cable bearing surface of 1-5/8". Hooks shall have 90-degree radius edges.

2. All cable hook mounting hardware shall be recessed to prevent damage to cable during installation. Installed cabling shall be secured using a cable latch retainer that shall be removable and reusable.

3. Finish: Pre-galvanized steel, ASTM A653 suitable for general duty use.

C. Cable Hangers:

1. Adjustable, non-continuous cable support slings for use with low voltage cabling.

2. Steel and woven laminate construction, rated for indoor non-corrosive use. Laminate material shall be suitable for use in plenum environments.

3. Sling length shall be adjustable to a capacity of 425 4-pair UTP cables.

4. Cabling hanger load limit shall be 100 lbs per foot.

5. Manufacturer: Erico Caddy CableCat CAT425, Arlington Fittings Tl Series or approved equal.

PART 3 - EXECUTION

3.1 CABLE HOOK SUPPORT SYSTEM

A. In areas where cabling is not supported by cable tray, ladder rack, enclosed wireway or installed in conduit, such cabling shall be supported by an approved cable hook support system.

B. Refer to manufacturer's requirements for allowable fill capacity for selected cable hook. In no case shall a 40% fill capacity be exceeded.

C. Cable hooks shall be securely mounted per manufacturer's instructions. In no case shall the side-to-side travel of any cable hook exceed 6".

D. Cable hooks shall be selected based on the contractors cable routing. Hooks shall be capable of supporting a minimum of 30 pounds with a safety factor of 3.

E. Support spans shall be based on the manufacturer's load ratings. In no case shall a 5 foot span be exceeded.

F. The resting and supporting of cabling on structural members shall not meet the requirements for cabling support specified herein.

G. The use of tie-wraps or hook and loop type fasteners is specifically prohibited as a substitute for cable hooks specified herein.

3.2 CONDUIT AND CABLE ROUTING

A. Refer to specification section 16111 for additional requirements.

B. All conduits shall be reamed and shall be installed with a nylon bushing.

C. Maintain appropriate conduit bend radius at all times. For conduits with an internal diameter of 2" or less, maintain a bend radius of at least 6 times the internal diameter. For conduits with an internal diameter greater than 2", maintain a bend radius of at least 10 times the internal diameter.

D. No conduit or sleeve containing more than two (2) cables shall exceed 40% fill ratio, regardless of length.

E. Any conduit exceeding 90' in length or containing more than three (3) 90-degree bends shall contain a pull box sized per ANSI/TIA/EIA 569 requirements.

1. A separate pull box is required for each 90' (or greater) length section.

2. A separate pull box is required after any three (3) consecutive 90-degree bends.

3. Pull box shall be located in an area that maintains accessibility of box, including the ability to remove box lid without removal or relocation of any other materials.

F. Any conduit with bends totaling 90 degrees or more shall have the fill capacity derated by 15% for each 90 degrees of cumulative bend.

G. Cables installed in any conduits that do not meet the above requirements shall be replaced at the Contractor's expense, after the conduit condition has been remedied.

3.3 ATTACHMENT TO METAL DECKING

A. Where supports for cable hook systems attach to metal roof decking, excluding concrete on metal decking, do not exceed 25 lbs. per hangar and a minimum spacing of 2'-0" on center. This 25 lb. load and 2'-0" spacing include adjacent electrical and mechanical items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off steel framing will need to be added.

END OF SECTION

SECTION 17160
HORIZONTAL CABLING REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This section describes the products and execution requirements relating to furnishing and installing horizontal communications cabling and termination components and related subsystems as part of a cabling plant. The cabling plant consists of copper cabling.

1.2 RELATED SECTIONS

A. Section 17010 - Basic Communications Systems Requirements

1.3 QUALITY ASSURANCE

A. Refer to Section 17010 for relevant standards.

B. The channel shall be required to meet the performance requirements indicated herein. The manufacturer shall warranty the performance of their system to the required performance (and not just to the Standard, should the required performance exceed the Standard).

C. Specific components of the channel shall be required, at a minimum, to meet the Standard component requirements for that particular component.

D. The installing contractor must be certified by the manufacturer of the structured cabling system.

1.4 SUBMITTALS

A. Under the provisions of Section 17010 and Division 1, prior to the start of work the Contractor shall submit:

1. Manufacturer’s data covering all products proposed, including construction, materials, ratings and all other parameters identified in Part 2 - Products, below.

2. Manufacturer’s installation instructions.

PART 2 - PRODUCTS

2.1 HORIZONTAL CABLE

A. CAT 5E Plenum Cable:

1. The horizontal cable requirements must be met as well as the following channel requirements.

2. CAT 5E cable shall terminate on patch panels in their respective Communication Equipment Room as indicated on the drawings.

3. Performance tests shall be conducted at a maximum test frequency of 100 MHz for the cable and 100 MHz for the channel. All numbers given are dB per 100 meters.

4. Cable Requirements:

Test Parameter	**100 MHz**
Attenuation:	22.0 dB
NEXT:	35.3 dB
PS NEXT:	32.3 dB
ACR:	13.3 dB
PS ACR:	N/A
ELFEXT:	23.8 dB
PS ELFEXT:	20.8 dB
Return Loss:	20.1 dB
Propagation Delay:	548 ns
Delay Skew:	50 ns

5. Channel Requirements:

Test Parameter	**100 MHz**
Attenuation:	24.0 dB
NEXT:	30.1 dB
PS NEXT:	27.1 dB
ACR:	6.1 dB
PS ACR:	3.1 dB
ELFEXT:	17.4 dB
PS ELFEXT:	14.4 dB
Return Loss:	10.0 dB

6. The jacket color for CAT 5E cable shall be white for voice applications and blue for data applications.

7. Basis of Design:

   a. Panduit PUP 5504 CMP

2.2 FACEPLATES/JACKS

A. CAT 5E Jacks:

1. CAT 5E horizontal cable shall each be terminated at their designated work area location on RJ-45 modular jacks. These modular jack assemblies shall snap into a modular mounting frame. The combined modular jack assembly is referred to as an information outlet.

2. The same orientation and positioning of modular jacks shall be utilized throughout the installation. Prior to installation, the Contractor shall submit the proposed configuration for each information outlet type for review by the Engineer.

3. Information outlet faceplates shall incorporate recessed designation strips at the top and bottom of the frame for identifying labels. Designation strips shall be fitted with clear plastic covers.

4. Where standalone CAT 5E only modular jacks are identified, the information outlet faceplate shall be configured as to allow for the addition of one (1) additional modular jack (CAT 3, CAT 5E, or CAT 6) to be installed to supplement each such modular jack as defined by this project. The installation of these supplemental modular jacks is NOT part of this project.

5. Any unused modular jack positions on an information outlet faceplate shall be fitted with a removable blank inserted into the opening.

6. The information outlet faceplate shall be constructed of high impact plastic (except where noted otherwise). The information outlet faceplate color shall (1) match the faceplate color used for other utilities in the building or (2) when installed in surface raceway (if applicable), match the color of that raceway.

7. Different faceplate and frame designs for locations, which include optical fiber cabling relative to those, that terminate only copper cabling are acceptable. Information outlets that incorporate optical fiber shall be compliant with the above requirements plus:

    a. Be a low-profile assembly.

    b. Incorporate a mechanism for storage of cable and fiber slack needed for termination.

    c. Position the optical fiber couplings to face downward or at a downward angle to prevent contamination.

    d. Incorporate a shroud that protects the optical fiber couplings from impact damage.

8. All information outlets and the associated modular jacks shall be of the same manufacturer throughout the project.

9. The CAT 5E modular jacks shall be non-keyed 8-pin modular jacks.

10. The interface between the modular jack and the horizontal cable shall be a 110-type termination block or insulation displacement type contact. Termination components shall be designed to maintain the horizontal cable's pair twists as closely as possible to the point of mechanical termination.

11. CAT 5E modular jacks shall be pinned per TIA-568B.

12. CAT 5E termination hardware shall, as a minimum, meet all of the mechanical and electrical performance requirements of the following standards:

    a. ANSI/TIA/EIA-568-A-5
    b. ANSI/TIA/EIA-568A
    c. ISO/IEC 11801
    d. IEC 603-7
    e. FCC PART 68 SUBPART F

13. The color for CAT 5E jacks shall be white for voice applications and blue for data applications. Alternately, a color-coded bezel or icon may be used to identify the CAT 5E modular jack.

2.3 COPPER WORK AREA CORDS

A. RJ-45:

1. Provide the same quantity of Category 5E copper work area cords as copper patch panel cords specified in Section 17110. Copper work area cords shall be equipped with an 8-pin modular RJ-45 connector on each end.

2. Work area cords shall be 10’ in length.

3. Manufacturer of copper patch cable shall be the same as the manufacturer of the horizontal copper cable.

PART 3 - EXECUTION

3.1 CABLE INSTALLATION REQUIREMENTS

A. Horizontal Cabling:

1. The maximum horizontal cable drop length for Data UTP shall not exceed 295 feet (90 meters) in order to meet data communications performance specifications. This length is measured from the termination panel in the wiring closet to the outlet and must include any slack required for the installation and termination. The Contractor is responsible for installing horizontal cabling in a fashion so as to avoid unnecessarily long runs. Any area that cannot be reached within the above constraints should be identified and reported to the Engineer prior to installation. Changes to the contract documents shall be approved by the Engineer.

2. All cable shall be free of tension at both ends. In cases where the cable must bear some stress, Kellum grips may be used to spread the strain over a longer length of cable.

3. Manufacturer’s minimum bend radius specifications shall be observed in all instances.

4. Horizontal cabling installed as open cabling shall be supported at a maximum of 5’ between supports. Refer to the specifications for required cable supports.

5. Horizontal cabling installed as open cable or in cable tray shall be bundled at not less than 10' intervals with hook-and-loop tie wraps. The use of plastic cable ties is strictly prohibited.

6. The maximum conduit fill for horizontal cabling shall not exceed 40% regardless of conduit length.

7. Cable sheaths shall be protected from damage from sharp edges. Where a cable passes over a sharp edge, a bushing or grommet shall be used to protect the cable.

8. A coil of 3 feet in each cable shall be placed in the ceiling at the last support (e.g., J-hook, bridle ring, etc.) before the cables enter a fishable wall, conduit, surface raceway or box. At any location where cables are installed into movable partition walls or modular furniture via a service pole, approximately 15-feet of slack shall be left in each horizontal cable under 250 feet in length to allow for change in the office layout without re-cabling. These "service loops" shall be secured at the last cable support before the cable leaves the ceiling and shall be coiled from 100% to 200% of the cable recommended minimum bend radius.

9. To reduce or eliminate EMI, the following minimum separation distances from 480V power lines shall be adhered to:

   a. Twelve (12) inches from power lines of <5-kVa.
   b. Eighteen (18) inches from high-voltage lighting (including fluorescent).
   c. Thirty-nine (39) inches from power lines of 5-kVa or greater.
   d. Thirty-nine (39) inches from transformers and motors.

10. Information outlets shown on floor plans with the subscript "W" are intended to be used for wall mounted telephones. Back boxes for wall mounted telephones shall not be located within 12" vertically, or horizontally, from any light switches, power receptacles, nurse call devices, thermostats, or any other architectural element that would otherwise prevent the installation of a wall mounted telephone on the mating lugs.

B. Horizontal Cabling in Modular Furniture:

1. This Contractor shall be responsible for providing and installing cable completely to the information outlet in the furniture. This Contractor's responsibility does not end at the furniture feed point.

2. Where furniture panels are installed to include contact with a wall, cabling shall be fed to the furniture panels via conduit.

3. Where modular furniture is installed without wall contact, the Contractor shall install cabling through floor fittings as shown on the drawings.

4. Cabling shall be protected in the transition from the floor or wall fittings to the modular furniture via a length of flexible plastic conduit or other approved protective means. Conduit fittings shall be compatible with the Floor and Wall Fittings proposed. There shall be no exposed cable in the transition to the modular furniture. Fill ratio (cable area vs. conduit area) in each feed shall not exceed 40%.

5. For purposes of bidding, it is to be assumed that the cable pathway shall be limited to the bottom panel of the modular furniture only. Communications cables would be run through these channels to the jack location.

6. For purposes of bidding, it is to be assumed that it will be the responsibility of the Contractor to punch and reinstall the bottom molding panels on the modular furniture as required to accommodate the communications cabling and information outlets. The panels shall be marked prior to installation by the Owner to identify the desired location of the information outlets.

7. The information outlet shall be secured to the panel via mounting tabs, pop-rivets, screws or other approved method. Use of adhesive tape is not acceptable. The method of securing the information outlet to the panel shall not result in sharp protrusions (e.g., sheet metal screw tip) into the channel behind the panel.

3.2 CABLE TERMINATION REQUIREMENTS

A. Cable Terminations - Data UTP:

1. Modular patch panels shall be designed and installed in a fashion as to allow future horizontal cabling to be terminated on the panel without disruption to existing connections.

2. If the “last” patch (per rack) is greater than 50% utilized, one additional patch panel shall be provided for future use.

3. At information outlets and modular patch panels, the Contractor shall ensure that the twists in each cable pair are preserved to within 0.5-inch of the termination for data cables. The cable jacket shall be removed only to the extent required to make the termination.

END OF SECTION

SECTION 17170
IDENTIFICATION AND ADMINISTRATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This section describes the execution and administration requirements relating to the structured cabling system and its termination components and related subsystems.

B. Identification and labeling.

1.2 RELATED SECTIONS

A. Section 17010 – Basic Communications Systems Requirements

1.3 QUALITY ASSURANCE

A. Refer to section 17010 for relevant standards.

1.4 SUBMITTALS

A. Under the provisions of Section 17010 and Division 1, prior to the start of work the Contractor shall submit:

1. Documentation of labeling scheme.

PART 2 - PRODUCTS

2.1 LABELING

A. Adhesive labels shall meet the requirements of UL 969 (Ref D-16) for legibility, defacement and adhesion. Exposure requirements of UL 969 for indoor and outdoor (as applicable) use shall be met.

B. Insert labels shall meet the requirements of UL 969 for legibility, defacement and general exposure.

C. Labeling shall be consistent for all common elements in the project. This consistency shall include label size, color, typeface an attachment method.

D. Labels incorporating bar codes shall be either Code 39 conforming to USS-39 or Code 128 conforming to USS-128.

1. All Code 39 bar codes shall have a ratio between 2.5:1 and 3.0:1. Provide a minimum “quite zone” of 0.25” on each side of the bar code.

2. A descriptive label for reading by personnel shall be provided with any bar code. Bar codes by themselves are not acceptable.

E. Color Code: Observe the following requirements for color coding:

1. Labels on each end of a cable shall be the same color for each termination.

2. Labels for cross-connects shall be two different colors at each termination fields, representative of the color of that field.

3. Orange (Pantone 15C) shall be used for the demarcation point.

4. Green (Pantone 353C) shall be used for the termination point of network connection on the facility side of the demarc.

5. Purple (Pantone 264C) shall be used to identify the termination of cables from common equipment (PBX, computers, LANS, etc.)

6. White shall be used to identify the first-level backbone termination in the main cross-connect.

7. Gray (Pantone 422C) shall be used to identify the second-level backbone termination in the main cross-connect.

8. Blue (Pantone 291C) shall be used to identify the termination of station cabling at the telecommunications closet and/or equipment room end of the cable.

9. Brown (Pantone 465C) shall be used to identify the termination of the interbuilding backbone cable terminations.

10. Yellow (Pantone 101C) shall be used to identify the termination of auxiliary circuits, alarms, maintenance, security, etc.

11. Red (Pantone 184C) shall be used to identify the termination of key telephone systems.

12. In facilities that do not contain a main cross-connect, the color white may be used to identify second-level backbone terminations.

F. Tag all CAT 3, CAT 5E, CAT 6, and optical fiber cables at both the Communications Equipment Room and the information outlets using the following alphanumeric labeling system:

1. (Room Number) - (Outlet Number) - (Jack Number) - (Use).

2. “Outlet Number” shall start with 1 in each room, with additional outlets in each room numbered sequentially.

3. “Jack Number” shall start with 1 for the upper left jack in each outlet, increasing sequentially from left to right and top to bottom across the outlet face.

4. "Use" shall be designated by the following:

   a. "V" for voice (RJ-45)
   b. "D" for data (RJ-45)
   c. "C" for video (coax)
   d. "M" for multimedia retrieval (coax)
   e. "S" for speaker (RCA)

5. Example #1: "106-1-1-V" indicates the top left voice jack in outlet #1 in Room 106.

6. Example #2: "109-3-4-D" indicates the bottom right data jack (assuming a 4-port faceplate) in outlet #3 in Room 109.

2.2 DOCUMENTATION/AS-BUILTS/RECORDS

A. General:

1. Upon completion of the installation, the Contractor shall submit as-builts per the requirements of Section 17010 and Division 1. Documentation shall include the items detailed in the subsections below.

2. All documentation, including hard copy and electronic forms shall become the property of the Owner.

B. Record Drawings:

1. The drawings are to include cable routes and outlet locations. Outlet locations shall be identified by their sequential number as defined elsewhere in this document. Numbering, icons and drawing conventions used shall be consistent throughout all documentation provided.

PART 3 - EXECUTION

3.1 IDENTIFICATION AND LABELING

A. Cable Labeling: Horizontal cables shall be labeled at each end.

1. Provide additional cable labeling at each manhole and pull box.

2. Cables that are routed through multiple pathway segments shall contain reference to all pathway segments in the pathway linkage field.

3. Cables that differ only by performance class shall have a suitable marking or label to indicate the higher performance class. For example, station cabling utilizing the blue color, may include blue with a white stripe to indicate the higher performance class station cabling.

B. Information Outlet Labeling: Tag all voice and data jacks as defined herein.

C. Termination Hardware Labeling:

1. An identifier shall be provided at each termination hardware location or its label.

D. Grounding/Bonding Labeling:

1. The TMGB shall be labeled “TMGB.” There shall be only one TMGB in the facility.

2. Label all TBB conductors connecting to the TMGB with a unique label, located at both ends of the TBB.

3. Each TGB shall be labeled with a unique label.

4. All TBB conductors connecting to the TGB shall be labeled uniquely at each end of the cable.

END OF SECTION

SECTION 17171
TESTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This section describes the testing requirements relating to the structured cabling system and its termination components and related subsystems.

1.2 RELATED SECTIONS

A. Section 17010 – Basic Communications Systems Requirements

1.3 QUALITY ASSURANCE

A. Refer to Section 17010 for relevant standards.

1.4 SUBMITTALS

A. Under the provisions of Section 17010 and Division 1, prior to the start of work, the Contractor shall submit:

1. Complete information on testing procedure as described herein.

PART 2 - PRODUCTS

2.1 TESTING COPPER

A. General Requirements:

1. The Contractor is responsible to perform acceptance tests as indicated below for each sub-system (e.g., backbone, horizontal, etc.) as it is completed.

2. The Contractor is responsible for supplying all equipment and personnel necessary to conduct the acceptance tests. Prior to testing, the Contractor should provide a summary of the proposed test plan for each cable type including equipment to use used, setup, test frequencies or wavelengths, results format, etc. The method of testing shall be approved by the Engineer.

3. The Contractor shall visually inspect all cabling and termination points to ensure that they are complete and conform to the wiring pattern defined herein. The Contractor shall provide the Engineer with a written certification that this inspection has been made.

4. The Contractor shall conduct acceptance testing according to a schedule coordinated with the Owner/Engineer. Representatives of the Owner may be in attendance to witness the test procedures. The Contractor shall provide a minimum of one (1) week’s advance notice to the Engineer to allow for such participation. The notification shall include a written description of the proposed conduct of the tests, including copies of blank test result sheets to be used.

5. Tests related to connected equipment of others shall only be done with the permission and presence of the Contractor involved. The Contractor shall ascertain that testing only is required to prove the wiring connections are correct.

6. The Contractor shall provide test results and describe the conduct of the tests including the date of the tests, the equipment used and the procedures followed. At the request of the Engineer, the Contractor shall provide copies of the original test results.

7. All cabling shall be 100% fault-free unless noted otherwise. If any cable is found to be outside the specification defined herein, that cable and the associated termination(s) shall be replaced at the expense of the Contractor. The applicable tests shall then be repeated.

8. Should it be found by the Engineer that the materials or any portion thereof furnished and installed under this Contract fail to comply with the specifications and drawings, with respect or regard to the quality, amount or value of materials, appliances or labor used in the work, it shall be rejected and replaced by the Contractor and all work disturbed by changes necessitated in consequence of said defects or imperfections shall be made good at the Contractor's expense.

   a. CAT 5E Cable:

      1) Testing shall be from the modular jack at the information outlet to the modular patch panel in the communication equipment room.

      2) Horizontal cable shall be free of shorts within the pairs, and be verified for continuity, pair validity and polarity, and conductor position on the modular jack (e.g., wire map). Any defective, split or mis-positioned pairs must be identified and corrected.

      3) CAT 5E horizontal cable shall also be tested to 100 250 MHz as defined by TIA/EIA-568-A. Measurements shall be of the "Basic Link" including cabling and modular jacks at the information outlet and modular patch panel. Parameters to be tested must include:

         a) Wire Map
         b) Length
         c) NEXT Loss (Pair-to-Pair)
         d) NEXT (Power Sum)
         e) ELFEXT (Pair-to-Pair)
         f) ELFEXT (Power Sum)
         g) Return Loss
         h) Attenuation
         i) Propagation Delay
         j) Delay Skew

      4) The maximum length of horizontal cable shall not exceed 295 feet (90m), which allows 33 feet (10 m) for technology equipment and modular patch cords.

5) To establish testing baselines, cable samples of known length and of the cable type and lot installed shall be tested. The cable may be terminated with an eight-position CAT 5E or CAT 6 modular connector (8-pin) to facilitate testing. Net Propagation Velocity (NPV) and nominal attenuation values shall be calculated based on this test and be utilized during the testing of the installed cable plant. This requirement can be waived if NPV data is available from the cable manufacturer for the exact cable type under test.

6) CAT 5E horizontal cable testing shall be performed using a test instrument designed for testing to 100 MHz or higher. Test records shall verify, "PASS" on each cable and display the specified parameters, comparing test values with standards based "templates" integral to the unit. Field testers that report a PASS*, FAIL*, or FAIL result for any of the parameters will not be accepted.

7) In the event results of the tests are not satisfactory, the Contractor shall make adjustments, replacement and changes as necessary and shall then repeat the test or tests that disclosed faulty or defective material, equipment or installation method, and shall make additional tests as the Engineer deems necessary at no additional expense to the project or user agency.

2.2 DOCUMENTATION/AS-BUILTS/RECORDS

A. General:

1. Upon completion of the installation, the Contractor shall submit as-builts per the requirements of Section 17010 and Division 1. Documentation shall include the items detailed in the subsections below.

2. All documentation, including hard copy and electronic forms shall become the property of the Owner.

3. The Engineer may request that a 10% random field retest be conducted on the cable system at no additional cost to verify documented findings. Tests shall be a repeat of those defined above. If findings contradict the documentation submitted by the Contractor, additional testing can be requested to the extent determined necessary by the Engineer, including a 100% retest. This retest shall be at no additional cost to the Owner.

B. Copper Media Test Data:

1. Test results shall include a record of test frequencies, cable type, conductor pair and cable (or Outlet) I.D., measurement direction, test equipment type, model and serial number, date, reference setup, and crew member name(s).

2. Printouts generated for each cable by the wire test instrument shall be submitted as part of the documentation package. The Contractor shall furnish this information in electronic form (CD-ROM). The CD-ROM shall contain the electronic equivalent of the test results as defined by the bid specification and be of a format readable by Microsoft Word (Version 6.0 or newer). The Contractor shall provide a licensed copy

of the software required to view and print the data that is provided in a proprietary format. The Contractor shall furnish one (1) copy of the Data and Display (if applicable) software.

C. Record Drawings:

1. The drawings are to include cable routes and outlet locations. Outlet locations shall be identified by their sequential number as defined elsewhere in this document. Numbering, icons and drawing conventions used shall be consistent throughout all documentation provided.

PART 3 - EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 17190
SUPPORT AND WARRANTY

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This section describes support and warranty requirements relating to the structured cabling system and related subsystems.

1.2 RELATED SECTIONS

A. Section 17010 – Basic Technology Systems Requirements.

1.3 QUALITY ASSURANCE

A. Refer to Section 17010 for relevant standards.

PART 2 - PRODUCTS

2.1 MANUFACTURER REQUIREMENTS

A. The Basis of Design for all structured cabling components is listed in the individual Division 17 sections. Alternative acceptable manufacturers will be accepted for this project.

B. Additional acceptable manufacturers for horizontal cabling:

1. Panduit
2. Belden/CDT
3. Commscope/Uniprise
4. Siemon
5. Hubbell
6. Berk-Tek Ortronics
7. Molex

2.2 WARRANTY

A. A twenty-five (25) year Product Installation Warranty shall be provided for the structured cabling system as described in the contract documents.

B. The Product Installation Warranty shall cover the replacement or repair of the defective product(s) and labor for the replacement or repair of such defective product(s).

C. Upon successful completion of the installation and subsequent inspection, the Owner shall be provided with a numbered certificate from the manufacturing company registering the installation.

PART 3 - EXECUTION

NOT APPLICABLE

END OF SECTION