

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:

<u>Sieve Size</u>	<u>Percentage By Weight Passing</u>
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 AASHTO 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

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 in 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 particles produced by crushing ledge rock, predominantly 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 tested with section 4109 of IDOT Standard Specifications, as follows:

<u>Percent</u>	<u>Sieve Size</u>
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: The work covered by this section consists of furnishing all materials, labor, and equipment necessary or required to do the grading, placing, and compacting of fill materials and surfacing parking area and walk 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

C. Measurement: Measure the quantity of material installed, to the nearest ton.

D. Method of Payment:

1. Contract Unit Price: When payment for the work of this section is so designated, the contractor will be paid the Contract Unit price per ton.
 - a. In the event that the estimated quantity is larger than the quantity provided, pay the Owner a deduct for the difference in cost for both quantity and labor.
 - b. 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 conditions, as determined by the Project Engineer, in accordance with the provisions of the General Conditions of the Contract.
3. The Owner will make no additional payments for additional material or labor to correct deficiencies, shortages, or mistakes by the Contractor.

1.02 REFERENCES:

A. Standards of materials and construction shall conform with the Standard Specifications for Highway and Bridge Construction, Series of 2009, of the Iowa Department of Transportation.

1.03 DELIVERY, STORAGE, AND HANDLING:

- A. General: Use only materials as specified for this section as tested and approved for use by the DNR Construction Inspector in accordance with the applicable portions of 2009 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 2009 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 2009 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: Review job conditions prior to commencing work. Bring any discrepancies of existing work with the Drawings and Specifications to the attention of the DNR Construction Inspector.
- C. If paving work cannot be completed because of weather conditions, then place base course and delay wearing course to be placed when directed by the DNR Construction Inspector. Fill any ruts, depressions, washouts, etc. in the base course and bring to grade prior to placing wearing course as directed by the DNR Construction Inspector.

PART 2 - PRODUCTS

2.01 ASPHALTIC CONCRETE PAVING MATERIAL:

- A. Provide materials in accordance with 2009 Series, I.D.O.T. Section 2203 and Section 2303.

2.02 CONCRETE WALK AND SLAB MATERIALS:

- A. Provide materials in accordance with Section 03300.

2.03 REINFORCING STEEL:

- A. Provide reinforcing steel in accordance with Section 03200.

2.04 EXPANSION JOINT FILLER:

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

2.05 EXPANSION JOINT SEALER:

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

2.06 CONCRETE MIX DESIGN:

- A. Air entrained, 3,500 PSI, compressive strength as specified in Section 03300 with slump of two inches to four inches.

2.07 WHEEL STOPS:

- A. Provide precast concrete wheel stops or curb, 3500 psi, fully reinforced complete with suitable anchorage device as required for positive and permanent attachments to parking surfaces.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Preparation of Subgrade: Conform to 2009 Series, I.D.O.T. Section 2109. 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. 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.
- C. Asphaltic Concrete and Paving:
 - 1. General: Plant mix asphaltic concrete in accordance with the material and placing method requirements of 2009 Series, IDOT Section 2303 for Type A and/or Type B Asphalt Cement Concrete.
 - 2. Asphaltic Concrete Paving: Use asphaltic concrete paving on all roadway, service and parking areas except those specifically designated as walkways.

3. Design Mixes: Type "A" asphaltic concrete mixture size shall be 1/2", and Type "B" asphaltic concrete mixture size shall be 3/4". Contractor to submit asphalt mix design to Project Engineer for approval prior to commencing work on the project.
- D. Installation of Wheel Barrier: Construct wheel barriers where shown on the Drawings. Units shall be set in one-half inch nominal cement grout. If modular units are used, install with open joints between blocks.
- E. Concrete Curbing: Place curbing where shown on the Drawings. Construct in accordance with I.D.O.T. Section 2512 Portland Cement Concrete Curb and Gutter. Coordinate efforts with those installing catch basins and curb inlets as shown on the Drawings.
- F. Concrete Walks and Aprons:
1. Concrete Surfacing: Construct exterior concrete walks and aprons where shown on the Drawings. Construct in accordance with the applicable portions of the I.D.O.T. Portland Cement Concrete Sidewalks, Section 2511. Install expansion joints at transitions of walks and aprons in addition to those locations specified in I.D.O.T. Section 2511. Dowel drivable apron slabs into interior slabs as shown on the Drawings.
 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: Ambient air temperature shall be between 40 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 Project Engineer. Erect tight and plumb bulkheads, when stopping placement and when forming construction joints. Brush on new cement when pouring against hardened concrete.
 4. Concrete Apron: 6" thick minimum.
 5. 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 shall be full slab depth.

6. 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.
 7. Finishing: Finish apron with fiber broom after leveling and floating. Tool expansion and control joint edges to one-fourth inch (1/4") radius.
 8. Do not overwork concrete. Do not allow coarse aggregate to be visible in the final finish.
 9. 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.
- K. Parking Stall Lines: Paint parking stall and directional lines on roadway and parking areas on the paving surface with traffic signal and striping paint. Conform with manufacturer's specification and recommendations for surface cleaning and paint application. Color of pavement markings to be as shown on the Plans

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 50 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:

1. Furnishing all labor, materials, tools, equipment, and services for the installation of new fences and gates as well as the relocation of existing ones as indicated, in accordance with provisions of contract document.
2. Site information indicated on the Drawings regarding existing condition of fences and gates is of a general nature. Visit the site and become familiar with existing conditions.
3. Completely coordinate with all work from other sections in this as well as any other contracts involved in concurrent construction operations.
4. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.

B. Related Sections. Drawings and General Provisions of the Contract, including the General Covenants and Provisions, Supplementary Covenants and Provisions and General Requirements.

C. Method of Payment:

1. Fence will be measured by the linear foot, complete in place. Measurement will be along the top of the fence from outside to outside of end posts, exclusive of gates and other openings.
2. Gates will be measured as complete units of the size and type specified.
3. Electrical grounds required by the specifications or the plans will not be paid for separately. Additional electrical grounds required by the DNR Construction Inspector will be paid for as extra work.

1.02 SUBMITTALS:

A. Provide submittals in accordance with Section 01300.

B. Product Data: Within 30 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:

1. Materials list of items proposed to be provided under this section.
2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.

3. Shop Drawings in sufficient detail to show fabrication, installation, anchorage, and interface of the work of this section with the work of adjacent trades.
 4. Manufacturer's recommended installation procedures which, when approved by the Project Engineer, will become the basis for accepting or rejecting actual installation procedures used on the work.
- B. Submit to the Project Engineer a manufacturer's certification showing that the posts, top rail and fabric for the project have been tested under the latest ASTM designation and does comply with the specifications.
- C. All materials may be subject to site testing for compliance to the above specifications with applicable standard tolerance.

1.03 QUALITY ASSURANCE:

- A. Material Standards: Chain Link Manufacturers Institute "Galvanized Steel Chain Link Fence Fabric" and "Industrial Steel Specifications for Fence Posts, Gates and Accessories."
- B. Test of Galvanized Coating: ASTM A239, 12 one-minute immersions.
- C. Installer Qualifications: Skilled and experienced mechanics.

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. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Project Engineer and at no additional cost to the Owner.

1.05 PROJECT/SITE CONDITIONS:

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

1.06 WARRANTY:

- A. The material specified to be provided under this Section shall be covered by the manufacturer's standard warranty or guarantee on the new material, except that it shall be guaranteed for a minimum of one year from the date of final acceptance of the project.
- B. Guaranty the entire installation, including every part and every specialized system, from the standpoint of workmanship and material, for one year after formal acceptance by the Project Engineer/DNR Construction Inspector.

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. Allied Tube and Conduit Corp.
 2. American Fence Corp.
 3. Anchor Fence, Inc.
 4. Chain Link Fence Company of Pennsylvania
 5. Colorguard Corp.
 6. Century Fence Company
 7. United States Steel Cyclone Fence
- B. Manufacturer: Same for all components.

2.02 MATERIALS:

- A. General:
1. Pipe sizes indicated are commercial pipe sizes.
 2. Tube sizes indicated are nominal flange dimensions.
 3. Roll form section sizes are nominal outside dimensions.
 4. Open seam material not allowed.
 5. Hot-dip galvanizing for iron and steel components:
 - a. On pipe: ASTM, A120, 2OZ/SF.
 - b. On square tubing: ASTM A123, 2 OZ/SF.
 - c. On roll formed sections: ASTM A120.
 - d. On hardware and accessories: ASTM A153.
 - e. On fabric: ASTM A392, Class II, 2.0 OZ/SF, and withstand test of coating, as specified.
 - f. On miscellaneous items: ASTM A120, 2 OZ/SF.
- B. Fence Height: as shown on the Drawings, nominal.
- C. Chain Link Fabric: Woven 2 inch mesh of 9 gauge wire.
1. Copper-bearing steel wire; minimum tensile strength after coating: 90,000 PSI.
 2. Galvanized after fabrication.

3. Fabric:
 - a. Over 72 inches in height provide with selvages twisted and barbed top and bottom.
 - b. Under 72 inches in height provide with selvages knuckled top and bottom.
 4. One piece fabric.
- D. Line Posts: Space 10' o.c. maximum, unless otherwise indicated, of following minimum sizes and weights.
1. Up to 6 feet fabric height, 1.90" OD steel pipe, 2.70 lbs. per lineal foot or 1.875" x 1.625" C-sections, 2.28 lbs. per lineal foot.
 2. Six feet to 8 feet fabric height, 2.375" OD steel pipe, 3.65 lbs. per lineal foot or 2.25" x 1.95" H-sections, 4.10 lbs. per lineal foot.
 3. Over 8 feet fabric height, 2.875" OD steel pipe, 5.79 lbs. per lineal foot, or 2.25 x 1.875" H-sections, 3.26 lbs. per lineal foot.
- E. Terminal, End, and Corner Posts:
1. Up to 4 feet, 2.50" OD steel pipe, 3.65 lbs. per lineal foot.
 2. Four feet to 12 feet, 2.875" OD STEEL PIPE, 5.79 lbs. per lineal foot, or 2.50" square steel pipe, 5.70 lbs. per lineal foot.
 3. Over 12 feet, 4.00" OD steel pipe, 9.10 lbs. per lineal foot.
- F. Gate Posts: Furnish posts for supporting single gate leaf, or one leaf of a double gate installation, for nominal gate widths as follows:
- | <u>Leaf Width</u> | <u>Gate Post</u> | <u>Lbs/Lin. Ft.</u> |
|--------------------|---------------------------|---------------------|
| 1. Up to 6' | 2.5" x 2.5" square | 5.10 |
| | section or 2.875" OD pipe | 5.79 |
| 2. Over 6' to 13' | 3.0" x 3.0" square | 9.10 |
| | section or 4.000" OD pipe | 9.11 |
| 3. Over 13' to 18' | 6.625" OD pipe | 18.97 |
| 4. Over 18' | 8.625" OD pipe | 24.70 |
- G. Top, Center, and Bottom Rails: Manufacturer's longest lengths, with expansion type couplings, approximately 6" long, for each joint. Provide means for attaching top rail securely to each gate corner, pull and end post.
1. Top rails continuous for full length of fence.

2. Top rails shall be furnished in lengths not less than 18 feet.
- H. Tension Wire: 7 gauge, coated coil spring wire, metal and finish to match fabric.
1. Locate at bottom of fabric.
- I. Post Brace Assembly: Manufacturer's standard adjustable brace at end and gate posts and at both sides of corner and pull posts, with horizontal brace located at mid-height of fabric.
1. Use same material as top rail for brace, and truss to line posts with 0.375" diameter rod and adjustable tightener.
- J. Post Tops: Weather-tight closure cap (for tubular posts), one cap for each post.
1. Furnish caps with openings to allow passage of top rail.
- K. Barbed Wire Supporting Arms: Manufacturer's standard barbed wire supporting arms, metal and finish to match framework, with provision for anchorage to posts and attaching 3 rows of barbed wire to each arm.
- 1 Supporting arms may be either attached to posts or integral with post top weather cap and must be capable of withstanding 250 lbs. downward pull at outermost end. Provide following type:
 2. Vee-type with 2 arms at 45° to vertical, one for each post.
- L. Barbed Wire: 2 strand, 12-1/2 gauge wire with 14 gauge 4-point barbs spaced not more than 5" o.c.; metal and finish to match fabric.
- M. Stretcher Bars: One piece lengths equal to full height of fabric, with minimum cross-section of 3/16" x 3/4".
1. Provide one stretcher bar for each gate and end post, and 2 for each corner and pull post, except where fabric is integrally woven into post.
- N. Stretcher Bar Bands: Space not over 15" o.c., to secure stretcher bars to end, corner, pull, and gate posts.

2.03 MANUFACTURED UNITS:

- A. Gates, General:
1. Fabricate gate perimeter frames of tubular members.
 2. Provide additional horizontal and vertical members to assure proper operation of the gate, and for attachment of fabric, hardware, and accessories.
 3. Space so frame members are not more than 8 feet apart.
 4. Fabricate gate frames from:

	<u>Materials and Dimension</u>	<u>Lbs Per Lin Ft.</u>
a.	For swing gates Pipe 1.90" Tubing, 2" square	2.72 2.60
b.	For slide gates Top and bottom members Pipe 2.375" OD	3.65
c.	End members Pipe 1.90" OD	2.72
d.	Diagonal members Pipe 1.660" OD	1.816
e.	Support posts Pipe 4.0" OD	9.11

B. Gates, Fabrication:

1. Weld gate frames with special malleable or pressed steel fittings and rivets for rigid connections.
2. Use same fabric as used in the fence.
3. Install fabric with stretcher bars at vertical edges as a minimum.
4. Attach stretchers to gate frame at not more than 15" on centers.
5. Attach hardware with rivets or by other means which will provide security against removal and breakage.
6. Provide diagonal cross-bracing consisting of 3/8" diameter adjustable length truss rods on gates where required to provide frame rigidity without sag or twist.

C. Gates, Hardware: Provide the following for each swing gate:

1. Hinges:
 - a. Pressed or forged steel, or malleable iron, to suit the gate size; non-lift-off type, offset to permit 180 degree opening, non-liftoff type.
 - b. Provide 1-1/2 pair of hinges for each leaf over 6 feet in nominal height.
2. Latches:
 - a. Provide forked type or plunger-bar type to permit operation from either side of the gate.
 - b. Provide padlock eye as integral part of latch.

3. Keeper: Provide keeper for vehicle gates, which engages automatically the gate leaf and holds it in the open position until manually released.
 4. Double gates:
 - a. Provide gate stops for double gates consisting of mushroom or flush plate, with anchors.
 - b. Set in concrete to engage the center drop rod or plunger bar.
 - c. Provide locking device and padlock eyes as an integral part of the latch, requiring one padlock for locking both gate leaves.
- D. Gate Hardware: All items to suit gate and post sizes. Provide the following for each sliding gate:
1. Provide manufacturer's standard heavy-duty track, ball-bearing hanger sheaves, overhead framing and supports, guides, stays, bracing, and accessories as required.
 2. Latches and Catches:
 - a. Manufacturer's standard heavy duty latches to permit operation from either side.
 - b. Provide padlock eye as integral part of latch.

2.04 ACCESSORIES:

- A. Wire Ties:
1. For tying fabric to line posts, use number 9 gauge wire ties spaced 12" on centers.
 2. For tying fabric to rails and braces, use number 9 gauge wire ties spaced 24" on centers.
 3. For tying fabric to tension wire, use number 11 gauge hog rings spaced 24" on centers.
 4. Manufacturer's standard wire ties will be acceptable if of equal strength and durability.
- B. Miscellaneous Items and Materials: Consistent in quality with materials listed above.
1. Provide as required to complete fence installation.
- C. Provide concrete consisting of portland cement, ASTM C 150, aggregates ASTM C 33, and clean water.
1. Mix materials to obtain concrete with a minimum 28-day compressive strength of 2,500 psi using at least 4 sacks of cement per cubic yard, 1" maximum size aggregate, maximum 3" slump, and 2% to 4% entrained air.

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.
- D. Verify suitability of areas to accept installation.
- E. Installation constitutes acceptance of responsibility for performance.

3.02 PREPARATION:

- A. Do not begin installation and erection before final grading is completed, unless otherwise permitted.

3.03 INSTALLATION:

A. Excavating:

- 1. Drill holes for post footings in firm, undisturbed or compacted soil, strictly adhering to the dimensions and spacing shown.
- 2. Post hole dimensions:
 - a. Provide 42" deep by 8" diameter foundations for line posts for 5 foot fabric height and less.
 - b. Provide 42" deep by 10" diameter foundations for line posts for fabric heights exceeding 5 feet.
 - c. Provide 46" deep by 12" diameter foundations for all other posts.
- 3. Spread soil from excavations uniformly adjacent to the fence line, or on adjacent areas of the site if so directed.
- 4. When solid rock is encountered near the surface, drill into rock at least 12" for line posts and at least 18" for end, pull, gate, and corner posts. Drill hole at least 1" greater diameter than the largest dimension of the post to be placed.
- 5. If solid rock is below soil overburden, drill to full depth required, except penetration into rock need not exceed minimum depths specified above.

B. Setting Posts:

- 1. Remove loose and foreign materials from sides and bottoms of holes, and moisten soil prior to placing concrete.

2. Center and align posts in holes.
3. Place concrete around posts in a continuous pour, and vibrate or tamp for consolidation.
4. Check each post for vertical and top alignment, and hold in position during placement and finishing operations.
5. Trowel tops of footings, and slope or dome to direct water away from posts.
6. Extend footings for gate posts to the underside of bottom hinge.
7. Set keeps, stops, sleeves, and other accessories into concrete as required.
8. Keep exposed concrete surfaces moist for at least seven days after placement, or cure with membrane curing material or other method approved by the Project Engineer.
9. Grout-in those posts which are set into sleeved holes, concrete constructions, or rock excavations, using nonshrink portland cement grout or other grouting material approved by the Project Engineer.

C. Concrete Strength:

1. Allow concrete to attain at least 75% of its minimum 28-day strength before rails, tension wires, and/or fabric is installed.
2. Do not, in any case, install such items in less than seven days after placement of concrete.
3. Do not stretch and tension fabric and wire, and do not hang gates, until concrete has attained its full design strength.

D. Rails and Bracing:

1. Install fence with a top rail and bottom tension wire.
2. Install top rails continuously through post caps or extension arms, bending to radius for curved runs.
3. Provide expansion couplings as recommended by the fencing manufacturer.
4. Provide bracing to the midpoint of the nearest line post or posts at all end, corner, slope, pull, and gate posts.
5. Install tension wires parallel to the line of fabric by weaving through the fabric, and tying to each post with not less than number 6 gauge galvanized wire, or by securing the wire to the fabric.

E. Installing Fabric:

1. Leave approximately 2" between finish grade and bottom selvage.

2. Excavate high points in the ground to clear the bottom of the fence.
3. Place and compact fill to within 1" of the bottom of the fabric in depressions.
4. Pull fabric taut and tie to posts, rails, and tension wires.
5. Install fabric on outward side facing side of fence, and anchor to framework so that the fabric remains in tension after pulling force is removed.
6. Install stretcher bars by threading through or clamping to fabric on 4" centers, and secure to posts with metal bands spaced 15" on centers.

F. Installing Gates:

1. Install gates plumb, level, and secure for full opening without interference.
2. Install ground-set items in concrete for anchorage in accordance with the fence manufacturer's recommendations as approved by the Project Engineer.
3. Lubricate and adjust the hardware for smooth operation.

G. Miscellaneous:

1. Use U-shaped tie wires, conforming to diameter of pipe to which attached, clasping pipe and fabric firmly with ends twisted at least two full turns.
2. Bend ends of wire to minimize hazards to persons and clothing.
3. Fasteners:
 - a. Install nuts for tension band and hardware bolts on side of fence opposite fabric side.
 - b. Peen the ends of bolts to prevent removal of nuts.
4. Repair coatings damaged in the shop or field erection, using hot-applied repair compound applied in accordance with its manufacturer's recommendations as approved by the Project Engineer.

H. Barbed Wire: Pull wire taut and fasten securely to extension arms in accordance with manufacturer's instructions.

3.04 ELECTRICAL GROUNDS:

- A. Properly ground chain-link fences which cross beneath primary electrical power transmission lines, other than a secondary feeder line for individual customer service.
1. Unless otherwise designated on the plans, such grounding shall consist of placing one ground rod at the point of crossing and one at the distance of 25 to 50 feet in each direction from the crossings.

- B. Chain-link fence erected adjacent to and within 50 feet of a primary power line shall be grounded by placing ground rods at not more than 500-foot intervals.
- C. Each applicable straight section of fence shall have at least one ground. The Project Engineer may require the installation of an additional ground at the terminus of a section of fence or at other locations near areas of pedestrian traffic.
- D. Connect ground rod to the fence as shown on the Drawings.

END OF SECTION 02830

PART 1 - GENERAL

1.01 SUMMARY:

- A. Section Includes: Seedbed preparation and application of seed mixtures and fertilizer to all areas designated on the Drawings or all areas within the boundaries of this project having been disturbed by works of this project and not receiving finished surfacing, as determined by the DNR Construction Inspector and as specified herein.
- B. All areas disturbed by contractor shall be seeded in addition to what is shown on the plans. Iowa DNR Engineering Inspector shall determine extent of seeding.
- C. 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 02506 – Crushed Stone Paving

1.02 REFERENCES:

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

1.03 QUALITY ASSURANCE:

- A. Codes and Standards: Perform all work of this section in accordance with the requirements of the "Standard Specifications" I.D.O.T. Section 2601.

1.04 PROJECT/SITE CONDITIONS:

- A. Environmental Requirement:
 - 1. Weather conditions shall be observed.
 - 2. Seeding shall be performed only during normal application periods, optimum temperature, moisture and climatic condition to promote germination and plan growth.
 - 3. Normal application periods are between March 1 and May 31 and between August 10 and September 30.
- B. Existing Conditions:
 - 1. 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.
 - 2. Connections to existing facilities shall be made in accordance with the obvious intent of Drawings and Specifications.

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

1.05 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 trades has been completed unless otherwise approved by the DNR Construction Inspector.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. All topsoil used for seedbed shall be in accordance with Section 02200.
- B. All seeds shall be "redtag" quality or better supplied from the latest available crop, free of noxious weed seed and supplied in the following varieties and percentages of weight.
- C. Provide mixture of types and quantities as specified herein for seeding of areas designated by the Architect/DNR Construction Inspector as indicated on the Drawings, and as specified herein.

1. Class "A" Mixture: For areas to remain in semi-natural state where mowing is required only as a temporary control measure.

Fescue, Kentucky 31	25 lbs. per acre
Switchgrass (Blackwell)	8 lbs. per acre
Alfalfa (Northern Grown)	5 lbs. per acre
Birdfoot Trefoil (Empire)	4 lbs. per acre
Alsike Clover	4 lbs. per acre

2. Class "B" Mixture: For same situation as where Class "A" mixture is used but where a lighter mix is preferable.

Fescue, Kentucky 31	20 lbs. per acre
Switchgrass (Blackwell)	3 lbs. per acre
Alfalfa (Northern Grown)	4 lbs. per acre
Birdfoot Trefoil (Empire)	4 lbs. per acre
Alsike Clover	4 lbs. per acre

3. Class "C" Mixture: For area designated as fine seeded, lawns or other mowed grass areas.

Bluegrass, Kentucky	70%
Ryegrass, Perennial, Fineleaf	10%
Fescue Creeping Red	20%

4. Class "D" Mixture: For all areas, unless otherwise specified, where a prairie grass in natural state is required.

Perennial Ryegrass, Fineleaf	30 lbs. per acre
Switchgrass (Blackwell)	5 lbs. per acre
Sideoats Grama	5 lbs. per acre
Little Bluestem	5 lbs. per acre
Sand Reedgrass	5 lbs. per acre

- D. Seed will be delivered on site in separate packaging for each individual type of seed within each mixture and mixed in the presence of the DNR Construction Inspector if required.
- E. Commercial mixture in the quantities as specified will be acceptable at the discretion of the DNR Construction Inspector if these quantities are verifiable.

2.02 FERTILIZER:

- A. When not otherwise specified, apply fertilizer of type and weight in accordance with I.D.O.T. Standard Specification 2601, and as specified within.

2.03 FUNGICIDE:

- A. All seeds for permanent seeding shall be treated with a nonmercurial fungicide (75% concentration or equivalent) at the rate of 5-1/2 ounces per 100 pounds of seed.

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 SEEDBED PREPARATION:

- A. The area to be seeded shall be raked or graded to fill washes or gullies.
- B. Pick up and dispose of all debris, including stones, boulders, logs, stumps, or other foreign material that will interfere with the seeding operation.

3.03 FERTILIZER APPLICATION:

- A. Spread fertilizer over the area at the rate designated on the Drawings or as specified herein.
- B. Unless otherwise indicated, spread all fertilizer with a mechanical spreader which will secure a uniform rate of application.
- C. Spread fertilizer after the preliminary preparation of seedbed and prior to the sowing of any seeds.
- D. Disk the fertilizer and roll the area prior to seeding.

- E. On area inaccessible to field machinery, spread fertilizer after preparation of the seedbed and thoroughly rake into the soil.
- F. Application of fertilizer in combination with seeding by hydraulic seeder as specified in I.D.O.T. Section 2601.04H will be acceptable at the discretion of the DNR Construction Inspector.

3.04 SEED APPLICATION:

- A. Preparation: Mix all seeds specified for this project thoroughly at the project site prior to placing in spreading equipment.
- B. On all areas accessible to field machinery, all grass seeds may be sown with a gravity, cyclone or hydraulic seeder as specified herein.
 - 1. On areas inaccessible to field machinery, the use of hand-cyclone seeder will be permitted.
- C. Apply seed mixture at a rate of four pounds per 1,000 square feet, unless otherwise indicated during fair, calm weather.
 - 1. One half of the seed mixture shall be sown in one direction and the remainder at right angles to the first sowing.

3.05 SEED APPLICATION IN MAINTAINED LAWNS:

- A. For maintained lawns to be seeded as part of this project, apply fertilizer prior to preparation of the seedbed.
- B. A rotary tiller will be required for preparation of the seedbed.
 - 1. The seedbed after tilling will be raked firm, smooth and free of clods, rocks and other debris.
- C. Roll the seedbed shall both before and after the application of seeds.
 - 1. Apply seeds over damp soil by broadcast seeding.
- D. Roll, seed, and fertilize by hand or with hand operated equipment areas inaccessible to field equipment.

3.06 SPRING OVERSEEDING:

- A. Seedbed preparation will not be required provided the overseeding is applied when the ground is free from frost action after March 1 and before April 1 or as directed by the DNR Construction Inspector.

3.07 MOWING:

- A. When requested by the DNR Construction Inspector, mowing may be returned prior to permanent seeding or anytime during the growing season.

END OF SECTION 02930

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 elsewhere, reinforce all slabs 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 in 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, 15 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 not 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 has 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

**SECTION 03350
CONCRETE FINISHING**

PART 1 - GENERAL

1.01 SUMMARY:

- A. Section Includes: Provisions for all labor, materials and equipment required to provide stamped, textured and colored concrete 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 31000 - Earthwork
 - Section 03100 - Concrete Formwork
 - Section 03200 - Concrete Reinforcement

1.02 SUBMITTALS:

- A. Comply with pertinent provisions of Section 01300 - Submittals Procedures.
 - 1. Provide submittals for approval of color and texture.
- B. Test panel:
 - 1. At a location approved by the Architect, provide an 8' x 8' test panel prior to start of other work of this Section.
 - 2. Demonstrate in the test panel the pattern and finish proposed to be provided. Adjust as necessary to secure the Architect's approval.
 - 3. Provide the work of this Section in accordance with the approved test panel.

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 of this Section.
- B. Use a subcontractor who regularly has been engaged in the placement of stamped concrete for not less than two years immediately preceding this Work, and who has a record of successful installations and a certificate of training from the finishing system manufacturer acceptable to the Architect.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Provide the following materials as required:
 - 1. Wire fabric: Comply with ASTM A185, welded steel.
 - 2. Portland cement: Comply with ASTM C150, type I or II, low alkali.
 - 3. Aggregate: Comply with ASTM C33, using aggregate of less than 3/8" dimension.
- B. Provide a minimum compressive strength at 28 days of 3000 psi, and provide advance evidence satisfactory to the Architect that this strength will be achieved.

2.02 OTHER 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 SURFACE CONDITIONS:

- 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 INSTALLATION:

A. General:

1. Place the welded wire fabric.
2. Place and screed the concrete mix to proper grade; wood float to a uniform surface.
3. Apply colored hardener evenly to the plastic surface by the dry-shake method, using a minimum of 60 LB per 100 sq Ft.
 - a. Apply in two shakes; wood float after each; and trowel only after final floating.
4. While concrete is still in the plastic stage of set, apply the forming tools to make the pattern called for on the Drawings.
5. Cut control joints no later than 12 hours after concrete has been placed.
6. Remove excess release agent in accordance with manufacturer's specifications.
7. Seal with a minimum of one coat of specified sealer in accordance with product manufacturer's instructions.
8. Polish the sealed surface with a fine brush, and remove residual dust and grout from the surface.

B. Protection:

1. Immediately upon completion of installation, install adequate protection.
2. Maintain protection in place until acceptance of this portion of the Work by the Owner.

END OF SECTION 03500

PART 1 – GENERAL

1.1 SUMMARY

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to Work of this Section.
- B. Section Includes:
 - 1. Dye stained concrete interior office floor slabs as noted on page A-600.
 - 2. Grinding and polishing concrete surfaces.
- C. Related Sections:
 - 1. Division 3 Section “Cast-In-Place Concrete” for general applications of concrete and coordination of sample submittal and color selection.
 - 2. Division 7 Section “Joint Sealants” for colored sealant for joints.

1.2 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM C309 “Liquid Membrane-Forming Compounds for Curing Concrete.”
 - 2. ASTM C494 “Standard Specification for Chemical Admixtures for Concrete.”

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer’s complete technical data sheets for the following:
 - 1. Concrete dye stain.
 - 2. Chemical lithium hardener
 - 3. Final finish
- B. Samples for Initial Selection: Manufacturer's color charts showing full range of colors available.
- C. Qualification Data: For firms indicated in “Quality Assurance” Article, including list of completed projects.
- D. Submit the following in accordance with Division 1300 Section “Submittal Procedures.”
- E. Product data for each grinding machine, including all types of grinding heads, dust extraction system, joint filler, concrete densifying impregnator, penetrating sealer, and any other chemicals used in the process.

- F. Applicators must submit a copy of their attendance to the manufacture's Polished Concrete Certified Training Program. .

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer with experience in the production of specified products.
- B. Installer Qualifications: An installer with 5 years experience with work of similar scope and quality.
- C. Obtain each specified material from same source and maintain high degree of consistency in workmanship throughout Project.
- D. Notification of manufacturer's authorized representative shall be given at least 1-week before start of Work.
- E. Certified Applicators:
 - 1. Consult Scofield for a list of Certified Applicators in your area.
- G. Installer/Applicator shall be certified by chemical manufacturer and shall provide adequate number of skilled workmen who are thoroughly trained and experienced in the necessary craft.
- H. Manufacturer's Certification: Provide a letter of acknowledgement from both the equipment and chemical manufacturer stating that the installer is a trained applicator and is familiar with proper procedures and installation requirements recommended by the manufacturer.
- K. Environmental Limitations:
 - 1. Comply with manufacturer's written instructions for substrate temperature and moisture content, ambient temperature and humidity, ventilation and other conditions affecting chemical performance.
 - 2. Application of finish and dye system shall take place a minimum of 21 days prior to fixture and trim installation and/or substantial completion.
 - 3. Finish concrete area shall be closed to traffic during finish floor application and after application for the time as recommended by the manufacturer.

1.5 DELIVERY, STORAGE AND HANDLING

- A. All chemicals: Comply with manufacturer's instructions. Deliver in original, unopened packaging. Store in dry conditions.

1.6 PROJECT CONDITIONS

- A. Dye Stained Concrete Environmental Requirements:
 - 1. Schedule placement to minimize exposure to wind and hot sun before material has cured.

1.7 PRE-JOB CONFERENCE

- A. One week prior to placement of concrete a meeting will be held to discuss the Project and application materials.
- B. It is suggested that the Architect, Inspector, General Contractor, Subcontractor be present.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURER

- A. L. M. SCOFIELD COMPANY, Douglasville, Georgia 1-800-800-9900.

2.2 MATERIALS

- A. Solvent based color liquid dye concentrate: by L. M. SCOFIELD COMPANY.
- C. Provide manufacturer's companion Lithium Densifier and final finish product to help ensure color and protection.
- D. Acceptable product:
 - 1. SCOFIELD[®] Formula One™ Liquid Dye Concentrate by L. M. SCOFIELD COMPANY.
 - 2. SCOFIELD[®] Formula One™ Lithium Densifier MP by L. M. SCOFIELD COMPANY.
 - 3. SCOFIELD[®] Formula One™ Guard-W by L. M. SCOFIELD COMPANY.
- E. Chemical Hardener/Densifiers Manufactured by L. M. SCOFIELD COMPANY:
 - 1. Materials:
 - a. SCOFIELD[®] Formula One™-LD MP is a high performing hardening and dust proofing compound that is chemically reactive and permanently bonds to

- concrete formulated to be used in conjunction with integrally colored concrete as well as uncolored concrete.
- b. SCOFIELD[®] Formula One™ Guard-W is water-borne acrylic penetrating material formulated to protect polished concrete from normal staining and to enhance gloss.
2. Planetary grinding equipment must be capable of providing a multiple step process starting with course metal bond diamonds and ending with fine resin bond diamonds.
- F. SUBSTITUTIONS: The use of products other than those specified will be considered providing that the Contractor requests its use in writing within 14-days prior to bid date. This request shall be accompanied by the following:
1. A certificate of compliance from material manufacturer stating that proposed products meet or exceed requirements of this Section.
 2. Documented proof that proposed materials have a 5-year proven record of performance, confirmed by at least 5 local projects.

2.3 COLORS

- A. Concrete Dye Stain[s]:
1. Liquid Dye Concentrate by L. M. SCOFIELD COMPANY.
 - a. color to be determined

PART 3 – EXECUTION

3.1 POLISHED CONCRETE APPLICATION

- A. Applicator shall examine the areas and conditions under which work of this section will be provided and the General Contractor shall correct conditions detrimental to the timely and proper completion of the work and the Applicator shall not proceed until unsatisfactory conditions are resolved. Unless determined prior to bid, the condition of the floor before the polishing process is the responsibility of the General Contractor. The floor must be protected from damage during general construction.
- B. Grind the concrete floor with metal bond diamonds removing construction debris until the specified Grade is obtained. The first cut must be performed with a metal bond diamond.
- C. After the 400 grit resin bond diamond has been used apply liquid dye and liquid hardener according to the manufacturer's current literature. Allow 12 hours to cure before continuing.
- D. Finish honing and polishing the floor to desired Class.
- E. After the polishing process has been completed apply protection guard material according to the products current technical bulletin. Allow to cure for 2-4 hours.

- F. Using a high-speed burnishing machine and diamond impregnated pads, burnish the surface to the desired gloss level.
- G. Upon completion, the work shall be ready for final inspection and acceptance by the customer.

3.2 PROTECTION

- A. The General Contractor is responsible for using Temporary Floor Protection throughout the project to safeguard the surface quality of concrete slabs before and after application of decorative finishes or installations of other materials.
- B. All concrete floors that will be not be covered by other materials will be protected throughout the project. The concrete slab must be treated as a finished floor at all times during construction.
- C. Temporary Floor Protection will be removed only while finish work to the concrete is being performed and will be replaced after the final finish has cured sufficiently.
- D. Temporary Floor Protection will be Proguard Duracover as manufactured by L. M. Scofield Company, Douglasville, GA (800-800-9900). Seaming of the temporary floor protection will be performed with Scofield Proguard Heavy Duty Seaming Tape. Both products will be installed following the manufacturer's published installation procedures.
- E. DO NOT APPLY THE HEAVY DUTY SEAMING TAPE TO BARE OR FINISHED FLOORS OR WALL SURFACES AT ANY TIME. IT WILL PERMANENTLY DAMAGE THE FLOOR
- F. No substitutions will be allowed.

3.3 CLEANING

- A. The work area shall be kept clean and free of debris at all times.
- B. Remove slurry and dust from adjoining surfaces as necessary.
- C. Dispose of material containers in accordance with local regulations.
- D. Protect finished work until fully cured per manufacturer's recommendations.

3.4 APPLICATORS

- A. For a list of Certified Applicators, contact Scofield at 1-800-800-9900.

PART 4 – SCHEDULES

4.1 CUT AND SHINE LEVELS

- A. Cut Level (Depth of cut)
 - 1. Grade 2-3
- B. Shine Level (Gloss level)
 - 1. Class 1

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY:

- A. Section Includes: Provide all material, labor equipment and services necessary for the installation of the stone veneer 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
Section 02150 – Concrete Sidewalks and Aprons paving
Section 03300 - Cast-In-Place Concrete
Section 05500 - Metal Fabrications
Section 06100 - Rough Carpentry
Section 06200 - Finish Carpentry
Section 07900 - Joint Sealer

1.02 SUBMITTALS:

- A. Submit representative samples of stone for approval.
- B. See Section 01300 for additional requirements concerning submittals.

1.03 QUALITY ASSURANCE:

- A. 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.

1.04 DELIVERY, STORAGE AND HANDLING:

- A. Protect materials during storage and construction from wetting by rain, snow, or ground water and from soilage or intermixture with earth or other materials.
 - 1. Mortar material: Deliver in unbroken original containers, and place in off-ground storage, adequately covered and protected.
 - 2. Masonry sand: Store in a manner approved to prevent inclusion of contaminants or foreign matter.
- B. Prevent grout or mortar from staining the face of veneer to be left exposed.
 - 1. Remove immediately grout or mortar in contact with such surfaces.
- C. Protect floors from droppings of mortar.

- D. Protect partially completed walls against weather, when work is not in progress, by covering top of walls with strong, waterproof, nonstaining membrane.
 - 1. Extend membrane at least two feet down both sides of walls and anchor securely in place.
- E. Protect stone against freezing when the temperature of the surrounding air is 40°F and falling.
 - 1. Heat materials and provide temporary protection of completed portions of veneer work.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Stone Wall Facing:
 - 1. Obtain masonry stone, from one supplier, of uniform texture for each type required, for each continuous area and visually related.
 - 2. Wall facing: Random size buff colored limestone, varying from 3 1/2" to 4 1/2" in depth. Submit samples to architect.
 - 3. Pattern: As approved from patterns selected by masonry contractor
 - a. Mortar joints thickness and variances to match stone pattern.
- B. Mortar and Anchors:
 - 1. Portland cement: Comply with ASTM C150, type II, low alkali.
 - 2. Sand: Comply with ASTM C144, with no less than 5% passing the No. 100 sieve.
 - 3. Hydrated lime: Comply with ASTM C207, type S, unless otherwise approved by the Architect.
 - 4. Water: Provide clean, potable, and free of organic material.
 - 5. Dovetail anchor slots: Provide dovetail anchor slots and ties manufactured by Burke Concrete Accessories, concrete ties, or equal.
 - a. Use 22 gage galvanized steel for spacing at 24" on center.
 - b. Use 16 gage corrugated galvanized steel anchor ties mated to slots, with 3/16" raised spur for retaining wire. Comply with ASTM A82 for 9 gage galvanized wire.
 - 6. Provide other material, not specifically described herein but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Architect/DNR Construction Inspector.

PART 3 - EXECUTION

3.01 INSPECTION:

- A. Installer must examine the areas and conditions under which stone work is to be installed and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work.
- B. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to installer.

3.02 INSTALLATION - GENERAL:

- A. Build walls to the dimensions shown on the Drawings.
- B. Leave openings for equipment to be installed before completion of stone work.
 - 1. After installation of equipment, complete masonry work to match work immediately adjacent to opening.
- C. Mortar:
 - 1. Provide mortar consisting of one part portland cement, from 1/4 to 1/2 part hydrated lime, and clean well graded sand in the proportion of three times the sum of the cementitious material.
 - 2. Mix in a batch mixer for not less than five minutes, and long enough for thorough intimate mixing of all ingredients.
 - 3. Retempering:
 - a. Retemper on mortar boards by adding water within a basin formed with the mortar, and working the mortar into the water.
 - b. Do not dash or pour water over the mortar.
 - c. Do not use or retemper harsh nonplastic mortar.
- D. Grout:
 - 1. Provide mortar as specified above, with sufficient water added to make a pourable consistency; or
 - 2. Provide a 1:3:2 cement, sand, pea gravel mix.
- E. Verify that dovetail anchor slots, if required, are installed in a manner to provide not less than the support shown on the Drawings, and in such a manner as to permit proper installation of ties, wires, mortar, and stone.

- F. Setting: Before setting, stone shall be brushed free of dust or other foreign matter and wetted sufficiently to take up surface absorption. No stone shall be set with a film of water or frost on the surface.
1. All joints shall be uniform in depth and width. If necessary, to prevent displacement of mortar, plastic, or lead spacers may be used.
 2. After setting, excess mortar shall be removed with a minimum of hand tooling.
 3. The stone shall be sponged completely free of mortar immediately after setting.
- G. Lay stone with not less than 1/2" nor more than 1" of the specified mortar between stone and the backing wall, and in accordance with the approved mock-up.
1. Cut, trim, fit, and balance the stone so it is at rest in its final position before mortar or grout is applied.
 2. When dovetail anchors are used, place anchor ties in the anchor slots at not more than 12" on centers.
 3. Loop the horizontal joint reinforcement wire through the supporting anchors:
 - a. Provide loops having legs not less than 15" long, so bent that each leg will lay in the mortar joint.
 - b. Bend the last 2" of each wire leg at right angle.
 - c. Conceal all wire within the mortar.
 4. Unless specifically otherwise approved by the Architect, do not install stone in thickness exceeding 7" from the backing wall to the outside face of the stone.

3.03 CLEANING:

- A. Stonework shall be kept as clean as possible as work progresses.
1. Use clean water and clean brushes or cloth and remove all mortar stains as the work progresses.
- B. Upon completion, stone shall be thoroughly cleaned with soap and water and completely rinsed after scrubbing with fiber brushes.
- C. If necessary, fine white sand may be added to water to aid in cleaning.
- D. The use of acids or wire brushes will not be permitted.

END OF SECTION 04480

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

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pressure preservative treatment for wood products specified elsewhere; provide preservative treated wood for the following applications:
 - 1. Roof decks and sheathing.
 - 2. Sill plates as directed by building manufacturer

1.2 RELATED SECTIONS

- A. Section 06100 - Rough Carpentry: Additional product requirements for wood to be treated.

1.3 REFERENCES

- A. AWPA C9 - Plywood - Preservative Treatment by Pressure Treatment; 2000.
- B. AWPA C31 - Lumber Used Out of Contact with the Ground and Continuously Protected From Liquid Water - Treatment by Pressure Processes; 1999.
- C. AWPA P5 - Standard for Waterborne Preservatives; 2000.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Manufacturer qualifications, as specified.
- C. Product Data: Manufacturer's product data, showing compliance with specifications.
- D. Warranty.

1.5 QUALITY ASSURANCE

- A. Treated Wood Manufacturer Qualifications: Experienced wood treatment firm, specialized in treatment of wood similar to that required for project, licensed by preservative manufacturer, and able to submit test reports showing successful treatment to retention level specified and evidence of ongoing independent third party inspection for products specified.

1.6 DELIVERY, STORAGE & HANDLING

- A. Prevent exposure to precipitation during shipping, storage or installation.
- B. Store material off ground and under cover.

- C. Allow materials exposed to incidental moisture to dry thoroughly prior to covering with vapor or moisture retarding finish materials.

1.7 WARRANTY

- A. Manufacturer's Warranty: Provide manufacturer's 20-year residential limited warranty against structural damage due to termites, carpenter ants, and fungal decay. Furnish warranty document executed by authorized company official. This 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. Acceptable Manufacturer: Licensee of Osmose, Inc; Wood Preserving Group, PO Drawer 0, Griffin, GA 30224-0249. ASD. Tel: (800) 241-0240 or (770) 233-4200. Fax: (770) 229-5225. E-mail: treatedwood@osmose.com. www.osmose.com or www.timberspecialties.com.
- B. Obtain all preservative treated wood products from single source.
- C. Substitutions: UPON SUBSTITUTION ACCEPTANCE BY ARCHITECT
- D. Requests for substitutions will be considered in accordance with provisions of Section 01600.

2.2 MATERIALS

- A. Preservative Treated Wood: Osmose Advance Guard(r) Pressure Treated Wood Products, for use above ground and continuously protected from liquid water, dried after treatment, and having the following minimum characteristics:
 - 1. Species and Grades: As specified in Section 06100.
 - 2. Lumber Species: Douglas Fir, Hem-Fir, Southern Pine or Spruce-Pine-Fir.
 - 3. Plywood Species: Southern Yellow Pine or Douglas Fir.
 - 4. Preservative Treatment: Borate; AWPA P5 SBX (inorganic boron); disodium octoborate tetrahydrate (DOT) treatment for insect and decay protective pressure treatment of wood; EPA-registered; Tim-bor(tm) Industrial.
 - 5. Preservative Treatment for Sill Plates: AWPA P5 CCA, chromated copper arsenate.
 - 6. Structural Lumber: Comply with AWPA C31; dried after treatment to maximum 19 percent moisture content.

7. Plywood: Comply with AWPA C9; dried after treatment to maximum 18 percent moisture content.
 8. Treatment Level: Provide retention level recommended by manufacturer to provide protection against North American subterranean termites, decay and insects; 0.25 pcf (4 kg/cu m) DOT retention, 0.17 pcf (2.7 kg/cu m) minimum borate retention.
 9. Bearing the wood treatment plant's permanent ink stamp quality mark, indicating:
 - a. Manufacturer's name.
 - b. Treatment plant name.
 - c. Identification of independent inspection agency.
 - d. Identification of preservative used, preservative retention level, and date of treatment.
 - e. Applicable treatment standard, wood species, and limitations on use, if any.
- B. Preservative for Field Application to Cut Surfaces of Spruce-Pine-Fir (SPF) and Douglas Fir (DF): Preservative solution approved by preservative treated wood manufacturer for application; one of the following:
1. Tim-bor brand disodium octaborate tetrahydrate (DOT), 10 percent solution.
 2. Copper naphthenate, 2 percent solution, copper metal basis.
 3. Other preservative approved by preservative treated wood manufacturer.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Comply with requirements of other sections governing products made of wood, applicable codes, and manufacturer's installation instructions.
 1. Use member sizes and grades as specified.
 2. Comply with manufacturer's safety recommendations.
 3. Avoid milling operations that could adversely affect preservative characteristics.
 4. Spruce-Pine-Fir (SPF) and Douglas Fir (DF): Prior to installation, treat cut ends and other machined surfaces with specified field applied preservative.
- B. Provide ventilation of building cavities as required by code.
- C. Install using fasteners required by applicable code for use with untreated lumber and plywood.

3.2 PROTECTION

- A. Protect from damage during construction.
- B. Protect from moisture prior to installation of finishes.

END OF SECTION

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:

	<u>ITEM</u>	<u>SPECIES</u>	<u>GRADE</u>
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 AWPB 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, heating, 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 45° 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

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 00812 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

2.1 MANUFACTURERS

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

B. Substitutions: Approval by architect

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: WWP No. 2.

D. Panel Finish: Prefinished steel sheet, 24 gauge thickness – Kynar 500 finish, Color TBD – submit samples – or otherwise noted on drawings

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

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

PART 1 - GENERAL

1.01 SUMMARY:

- A. Section Includes: Provide all labor, materials, equipment, and related services necessary to furnish and install all architectural casework 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 06200 Finish Carpentry

1.02 REFERENCES:

- A. Lumber grading rules and species shall be in conformance with Voluntary Products Standard PS 20-70. Grading rules of the following associations apply to materials furnished.
 - 1. WWPA - Western Wood Products Association
 - 2. WCLIP - West Coast Lumber Inspection Bureau
 - 3. SPIB - Southern Pine Inspection Bureau
 - 4. NLGA - National Lumber Grades Authority
 - 5. RIS - Redwood Inspection Service
- B. Plywood Grading Rules and Recommendations:
 - 1. PS 1-74 - For Soft Plywood
 - 2. PS 51-71 - For Hard Plywood
 - 3. APA - American Plywood Association
- C. Requirements of Regulatory Agencies:
 - 1. AWPB - American Wood Preservers Bureau
 - 2. ALSL - American Lumber Standards Committee
 - 3. FS - Federal Specifications
 - 4. NEMA - National Electrical Manufacturer Association
- D. In addition to complying with pertinent codes and regulations of governmental agencies having jurisdiction, comply with applicable standards of the Architectural Woodwork Institute.

1.03 SUBMITTALS:

- A. Provide submittals in accordance with this Section and 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. Do not purchase or install 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. Include plans, elevation, details of sections and connections.
1. Show anchorage and accessory items.
 2. Provide templates for anchor and bolt installation.
 3. Review shop drawings requirements with DNR Construction Inspector before ordering shop drawings.
- 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.

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.
- B. Provide one skilled individual who shall be present at all times during execution of this portion of the work and who shall personally direct all work performed under this section.

1.05 DELIVERY, STORAGE, AND HANDLING:

- A. Except as otherwise approved by the Architect, determine and comply with manufacturer's recommendations on product handling, storage and protection.
- B. Protect materials during transit, delivery, storage and handling to prevent damage, soiling and deterioration.
- C. Do not deliver materials of this section until painting, wet work, grinding and similar operations of other trades, which could damage, soil or deteriorate casework, have been completed in installation area.
- D. In the event of damage, promptly remove damaged material and unsuitable items from the job site.
 1. Immediately make all repairs and replacement necessary to the approval of the Architect/DNR Construction Inspector with materials meeting the specified requirements at no additional cost to the Owner.

- E. Additional time required to secure replacements and to make repairs will not be considered to justify an extension in the Contract time of completion.

1.06 PROJECT/SITE CONDITIONS:

- A. Conditioning: Installer shall advise Contractor of temperature and humidity requirements for casework installation areas.
 - 1. Do not install finish casework 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 casework within a 1.0 percent tolerance of optimum moisture content, from date of installation through remainder of construction period.
 - 1. The fabricator of casework shall determine optimum moisture content and required temperature and humidity conditions.
- C. Field Measurements: 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.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. General: Fabricate architectural casework to "Premium Grade" standard of the "Architectural Woodwork Institute."
- B. Cabinets and Shelves: Fabricate flush face-type cabinets on site or mill in accordance with approved shop drawings, the Architect's Drawings, and as specified herein.
 - 1. Top, bottom, ends, doors, drawer front: 3/4" thick plywood overlaid with plastic laminate.
 - 2. Drawers: 1/2" hardwood or particleboard and cabinet liner sides, 3/4" plywood front overlaid with plastic laminate on exposed sides, and 1/4" bottom.
- C. Countertops: Shop fabricate countertop and splashes to type and dimensions shown on the Drawings.
 - 1. Where splashes are called for, provide 4" high cover splash and no drip leading edge.
- D. Laminated Plastic:
 - 1. Quantities and Types: Provide general purpose type, 0.050" thick plastic laminate, complying with NEMA LD3.

2. Colors and Pattern: Provide "solid colors, textured finish" selected by the Architect from standard colors and finishes of the approved manufacturer. The following color numbers from Formica are used for control and selection and do not imply that laminates from other manufacturers could not be installed as equals.
 - a. Countertop: TBD.
 - b. Front side and Shelves: TBD.
 - c. Inside back and Sides: Melamine, white.
- E. Adhesives: For installation of laminated plastic, use only low-VOC adhesives with NO Added Urea Formaldehyde (NAUF).
 1. Do not use so called "contact" adhesive.
- F. Hardware: Unless provided as part of prefabricated casework, install hardware as specified herein and in Section 8700 of these specifications.
 1. Provide drawer guides, recessed hinges, pulls, shelf supports, magnetic or mechanical catches as shown, or if not shown, as selected by the Contractor subject to the approval of the Architect/DNR Construction Inspector.
- G. Color and Finishes: As indicated, or if not indicated, as selected by the Architect from manufacturer's standard.
- H. 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 INSTALLATION:

- A. Fabricate and install the work of this section in accordance with the approved shop drawings and the referenced standards.
- B. All workmanship shall be of the highest grade, put together with concealed fasteners or interlocking joints and glued under pressure so as not to show shrinkage, slips or open joints.
- C. 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 manufacture with respect to surfaces, sizes or patterns.

- D. Install the work plumb, level, true and straight with no distortions.
 - 1. Shim as required using concealed shims.
 - 2. 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.
- E. Scribe and cut work to fit adjoining work, and refinish cut surfaces or repair damaged finish at cuts.
- F. No exposed fasteners will be permitted except screws for hardware.
- G. Cut openings for sinks, ranges, etc. in countertops for fixtures to be installed by the Mechanical Contractor.
 - 1. Verify dimensions prior to fabrication of cabinet work.

3.03 ADJUSTING:

- A. Repair damaged and defective casework wherever possible to eliminate defects functionally and visually; where not possible to repair properly, replace casework.
 - 1. Adjust joinery for uniform appearance.

3.04 CLEANING:

- A. Clean finish casework on exposed and semi-exposed surfaces.
- B. Touch-up shop-applied finishes to restore damaged or soiled areas.

3.05 PROTECTION:

- A. Installer of casework 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 06410

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.

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

Install insulation per R-values shown on drawings.

A. Extruded Polystyrene Board Insulation: Rigid, closed-cell, density skin; complying with FS HH-1-524C, Type IV, min. 40 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 binders 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 wool units which have been tested and rated as required for the indicated assembly.

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

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Blowing Insulation
- B. Acoustic Insulation
- C. Vapor Retarder

1.2 RELATED SECTIONS

- A. Section 07100 - Dampproofing and Waterproofing: Insulation installed with waterproofing systems.
- B. Section 07260 - Vapor Retarders: Vapor retarder materials to adjacent insulation.
- C. Section 07270 - Air Barriers: Air seal materials to adjacent insulation.
- D. Section 07810 - Fire and Smoke Protection: Insulation installed in conjunction with firestopping or smoke containment systems.
- E. Section 09200 - Plaster and Gypsum Board: Insulation installed in conjunction with interior wall and ceiling finish systems.
- F. Section 15810 - Ducts: Insulation to surround HVAC ductwork.

1.3 REFERENCES

- A. ASTM C 423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
- B. ASTM C 518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
- C. ASTM C 553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
- D. ASTM C 612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
- E. ASTM C 665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
- F. ASTM C 764 - Standard. Specification for Mineral Fiber. Loose-Fill Thermal Insulation.
- G. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- H. ASTM E 96 - Standard Test Methods for Water Vapor Transmission of Materials.
- I. ASTM E 119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
- J. ASTM E 136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 Degrees C.

- K. ASTM E 814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
- L. Federal Specification HH-I-521F: Insulation Blankets, Thermal (Mineral Fiber, For Ambient Temperatures).
- M. Federal Specification HH-I-558B: Insulation, Blocks, Blankets, Felts, Sleeving (Pipe and Tube Covering), and Pipe fitting Covering, Thermal (Mineral Fiber, Industrial Type)
- N. National Fire Protection Association (NFPA) Life Safety Code
- O. Underwriters Laboratories (UL) - UL 2079 Standard test method for fire resistance of Building Joint Systems.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- C. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer with a minimum of ten years experience manufacturing products in this section shall provide all products listed.
- B. Installer Qualifications: Products listed in this section shall be installed by a single organization with at least five years experience successfully installing insulation on projects of similar type and scope as specified in this section.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store products in manufacturer's unopened packaging bearing the brand name and manufacturer's identification until ready for installation.
- B. Storage: Store materials in dry locations with adequate ventilation, free from water, and in such a manner to permit easy access for inspection and handling.
- C. Handling: Handle materials to avoid damage.

1.7 SEQUENCING

- A. Coordinate with the installation of vapor retarders and air seal materials specified in Section 07260 and Section 07270.
- B. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.8 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: CertainTeed Corp., Insulation Group, which is located at: 750 E. Swedesford Rd. P. O. Box 860 ; Valley Forge, PA 19482-0860; Toll Free Tel: 800-233-8990; Fax: 610-341-7940; Email: [request info](mailto:requestinfo@certainteed.com); Web: certainteed.com/CertainTeed/Pro/Design+Professional/Insulation
- B. Substitutions: Submit for approval by architect
- C. Requests for substitutions will be considered in accordance with provisions of Section 01600.

2.2 APPLICATIONS

- A. Acoustical/Thermal Insulation: Certainteed Acoustical Ceiling NoiseReducer Batts. Fiber glass acoustical insulation for ceilings. Complies with ASTM C 665; preformed glass fiber batt insulation:
 - 1. Facing: ASTM C 665, Type 1, Unfaced.
 - a. Fire Hazard Classification: ASTM E 84:
 - 1) Maximum Flame Spread Index; 25.
 - 2) Maximum Smoke Developed Index; 50.
 - b. Noncombustibility: ASTM E 136, passes.
 - c. Thermal Resistance: R of 11 (RSI 1.9).
 - 1) Thickness: 3-1/2 inches (89 mm).
 - 2) Width: 24 inches (610 mm).
- B. Thermal Blowing Insulation: Certainteed InsulSAFE SP Fiber Glass Blowing Insulation. Fiber glass blowing insulation for open attics, enclosed walls, and floor/ceilings assemblies. Complies with ASTM C 764; mineral fiber loose fill insulation Type 1, Pneumatic application:
 - 1. Fire Hazard Classification: ASTM E 84:
 - a. Maximum Flame Spread Index; 5.
 - b. Maximum Smoke Developed Index; 5.
 - 2. Noncombustibility: ASTM E 136, passes.
 - 3. Open Attic Application:
 - a. Thermal Resistance: R of 49. Minimum Installed Thickness: 18.50 inches.

2.3 VAPOR RETARDER

- A. Sheet Retarder: Certainteed MemBrain, The SMART Vapor Retarder. Polyimide film vapor retarder for use with unfaced, vapor permeable glass fiber and mineral wool insulation in wall and ceiling cavities. Material has a permeance of 1 perm or less when tested to ASTM E 86, dry cup method and increases to greater than 10 perms using the wet cup method.
 - 1. Water Vapor Permeance:
 - a. ASTM E 86, dry cup method: 1.0 perms (57ng/Pa*s*m2).
 - b. ASTM E 86, wet cup method: 10.0 perms (1144ng/Pa*s*m2).
 - 2. Fire Hazard Classification: ASTM E 84:
 - a. Maximum Flame Spread Index; 20.
 - b. Maximum Smoke Developed Index; 55.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. Verify that all exterior and interior wall, partition, and floor/ceiling assembly construction has been completed to the point where the insulation may correctly be installed.
- C. Verify that mechanical and electrical services in ceilings, walls and floors have been installed and tested and, if appropriate, verify that adjacent materials are dry and ready to receive insulation.
- D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in exterior spaces without gaps or voids. Do not compress insulation.
- C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- D. Fit insulation tight in spaces and tight to exterior side of mechanical and electrical services within plane of insulation.
- E. Install insulation with vapor barrier installed facing the warm side. Seal or tape joints as required.

3.4 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

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 or 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

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Siding panels.
- B. Soffit panels.
- C. Accessories and trim.

1.2 RELATED SECTIONS

- A. Section 06100 - Rough Carpentry: Framing and Sheathing.
- B. Section 07900 - Joint Sealers.

1.3 REFERENCES

- A. ASTM C 920 - Standard Specification for Elastomeric Joint Sealants; 1998.
- B. ASTM C 1185 - Standard Test Methods for Sampling and Testing Non-Asbestos Fiber-Cement Flat Sheet, Roofing and Siding Shingles, and Clapboards; 1999.
- C. ASTM C 1186 - Standard Specification for Flat Non-Asbestos Fiber Cement Sheets; 1999.
- D. ASTM E 72 - Standard Test Methods of Conducting Strength Tests of Panels for Building Construction; 1998.
- E. ASTM E 84 -- Standard Test Method for Surface Burning Characteristics of Building Materials; 1999.
- F. ASTM E 96 - Standard Test Methods for Water Vapor Transmission of Materials; 1995.
- G. ASTM E 136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace At 750 Degrees C; 1999.
- H. ASTM E 228 - Standard Test Method for Linear Thermal Expansion of Solid Materials With a Vitreous Silica Dilatometer; 1995.
- I. ASTM G 26 - Standard Practice for Operating Light-Exposure Apparatus (Xenon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials; 1996.

1.4 SUBMITTALS

- A. Make submittals under provisions of Section 01300.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.

2. Storage and handling requirements and recommendations.
 3. Installation methods, including nailing patterns.
 4. Applicable model code authority evaluation report (ICC, CCMC, etc.)
- A. Siding manufacturer's requirements for vapor retarders, primer, paint, etc., to be installed by others.
 - C. Maintenance and periodic inspection recommendations.
 - D. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Provide installer with not less than three years of experience with products similar to those specified.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store products off the ground, on a flat surface, and under a roof or separate waterproof covering.

1.7 WARRANTY

- A. Provide WeatherBoards 50 year limited siding warranty.
- B. CertainTeed ColorMax Finish – provide 15 year limited paint warranty
- C. CertainTeed Premium Stain Finish – provide 12 year limited coating warranty
- D. Register manufacturer's warranty, made out in Owner's name, with copy to Owner.

PART 2 PRODUCTS

2.1 MANUFACTURER

- A. CertainTeed Corporation, Siding Products Group, P.O. Box 860, Valley Forge, Pennsylvania 19482. ASD. Tel: (800) 233-8990 (professional) or (800) 782-8777 (consumer).
www.certainteed.com.
- B. Substitutions: Not permitted.

2.2 PANELS

- A. Fiber Cement Board Panels - General: CertainTeed Fiber Cement Board Panels consist of cement, fly ash and cellulose fiber formed under high pressure into boards with integral surface texture; complying with ASTM C 1186 Type A Grade II; machined edges; for nail attachment.
 1. Surface Burning Characteristics: Flame spread index of 0, smoke developed index of 5, maximum; when tested in accordance with ASTM E 84 (Class I/A).
 2. Flammability: Noncombustible, when tested in accordance with ASTM E 136.

3. Flexural Strength: At least 1450 psi (10 MPa) when in equilibrium condition, and at least 1015 psi (7 MPa) when in wet condition, tested in accordance with ASTM C 1185.
 4. Coefficient of Thermal Expansion: Less than 1×10^{-5} /inch/inch/degree F (0.5×10^{-5} /degree C), when tested in accordance with ASTM E 228.
 5. Freeze Thaw Resistance: At least 80 percent flexural strength retained, when tested in accordance with ASTM C 1185.
 6. UV Resistance: No cracking, checking, or erosion, when tested for 2000 hours in accordance with ASTM G 26.
 7. Water Tightness: No water droplets on underside, when tested in accordance with ASTM C 1185.
- B. Horizontal Siding: CertainTeed WeatherBoards – Cedar Lap Siding.
1. Thickness: 5/16 inch (7.9 mm), plus or minus .04 inch (1 mm).
 2. Length: 12 feet (3657 mm), plus 0, minus 1/8 inch (3 mm).
 3. Style: Cedar lap siding.
 - a. Width: 8-1/4 inches (210 mm) wide.
 4. Factory Stain Finish: Factory applied CertainTeed Fiber Cement Siding Premium Stain color as follows: TBD – Submit Samples
- C. Soffit: CertainTeed WeatherBoards Soffit, ventilated and non-ventilated.
1. Thickness: 1/4 inch (6.35 mm), plus or minus 1/32 inch (0.8 mm).
 2. Style: Cedar texture, 24 inches (610 mm) wide.
 3. Ventilated soffit.
 4. Factory Stain Finish: Factory applied CertainTeed Fiber Cement Siding Premium Stain color as follows: TBD – Submit Samples

2.3 ACCESSORIES

- A. Trim: CertainTeed WeatherBoards Trim
1. Size:
 - a. Thickness 7/16 inch (11 mm) plus or minus (1 mm).
 - b. Width:
 - 1) 5-1/2 inch (140 mm).
 - c. Length: 12 feet (3.657 m) plus or minus 1/8 inch (3.17 mm).
 2. Sealant/Primer: FiberTect Sealant/Primer.
- B. Provide the following trim:
1. Starter strip for lap siding.
 2. Outside corners, butted to siding.
 3. Outside corners, overlapping siding.
 4. Fascia board.
 5. Exterior Window/Door Trim.
- C. Sealant: Paintable, 100 percent acrylic latex caulk complying with ASTM C 920.
- D. Sheet Metal Flashing: Minimum 26 gauge hot-dipped galvanized steel sheet, or coated aluminum.

- E. Nails: Length as required to penetrate minimum 1-1/4 inch (32mm) into solid backing; hot-dipped galvanized or stainless steel.
- F. Building Paper: Kraft or bituminous paper; not polyethylene or foil.
- G. Field Finish Paint: 100 percent acrylic latex as specified in Section 099000: Color TBD

PART 3 EXECUTION

3.1 EXAMINATION

- A. Prior to commencing installation, verify governing dimensions of building and condition of substrate.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Examine, clean, and repair as necessary any substrate conditions that would be detrimental to proper installation.
- B. Do not begin installation until unacceptable conditions have been corrected.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions and Drawing details.
 - 1. Read warranty and comply with all terms necessary to maintain warranty coverage.
 - 2. Install in accordance with conditions stated in model code evaluation report applicable to location of project.
 - 3. Use trim details indicated on drawings.
 - 4. Touch up all field cut edges before installing.
 - 5. Pre-drill nail holes if necessary to prevent breakage.
- B. Allow space between both ends of siding panels that butt against trim for thermal movement; seal joint between panel and trim with exterior grade sealant.
- C. Joints in Horizontal Siding: Avoid joints in lap siding except at corners; where joints are inevitable stagger joints between successive courses.
- D. Joints in Vertical Siding: Install Z-flashing in horizontal joints between successive courses of vertical siding.
- E. Furred Installation: Leave space at top and bottom open; top may be behind soffit; at bottom install insect screen over opening by wrapping a strip of screen over bottom ends of vertical furring strips.
- F. Install sheet metal flashing above door and window casings and horizontal trim in field of siding.

- G. Do not install siding less than 6 inches (150 mm) from surface of ground nor closer than 1 inch (25 mm) to roofs, patios, porches, and other surfaces where water may collect.
- H. After installation, seal all joints except lap joints of lap siding. Seal around all penetrations. Paint all exposed cut edges.

3.4 CLEANING

- A. At completion of work, remove debris caused by siding installation from project site.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY:

- A. Section Includes:
1. The extent of each type of flashing and sheet metal work is indicated on the Drawings and by provisions of this section.
 2. The types of work specified in this section may include but is not necessarily limited to, the following:
 - a. Metal counter flashing; and base flashing (if any).
 - b. Metal wall flashing and expansion joints.
 - c. Built-in metal gutters and scuppers.
 - d. Gutters and downspouts (rain drainage).
 - e. Miscellaneous sheet metal accessories.
 - f. Integral masonry flashings are specified as masonry work in sections of Division 4.
 - g. Roofing accessories, not including roof accessories, are specified in roofing system sections as roofing work.
- 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 07310 Asphalt Shingles
Section 07900 Joint Sealers
Section 15400 Plumbing
- C. Roof accessories and skylights are specified elsewhere, in division 7.

1.02 REFERENCES:

- A. Standards: Comply with standards specified in this section and the provisions of SMACNA "Architectural Sheet Metal Manual."

1.03 SUBMITTALS:

- A. Provide submittals in accordance with Section 01300.

- B. Product Data: Submit manufacturer's product specifications, installation instructions and general recommendations for each specified sheet material and fabricated product.
- C. Samples: Submit two (2), eight-inch (8") square samples of specified sheet materials to be exposed as finished surfaces.
 - 1. Submit two (2), twelve-inch (12") long completely finished units of specified factory-fabricated products exposed as finished work.
- D. Shop Drawings: Submit shop drawings showing layout, joining, profiles, and anchorages of fabricated work, including major counter flashings, trim/fiscia units, gutters, downspouts, scuppers and expansion joint systems; layouts at one-quarter (1/4") scale, details at three-inch (3") scale.

1.04 QUALITY ASSURANCE:

- A. Qualifications of Installers: 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.

1.05 PROJECT/SITE CONDITIONS:

- A. Coordinate work of this section with interfacing and adjoining work for proper sequencing of each installation. Ensure best possible weather resistance and durability of the work and protection of materials and finishes.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Sheet Metal Flashing/Trim:
 - 1. Zinc-Coated Steel: Commercial quality with 1.20 percent galvanized, mill phosphatized where indicated for painting (Pnt); 0.0359" thick (20 gauge) except as otherwise indicated.
 - 2. Copper: ASTM B 370, cold-rolled except where soft temper is required for forming; 16 oz. (0.0216" thick) except as otherwise indicated.
- B. Miscellaneous Materials and Accessories:
 - 1. Solder: For use with steel or copper, provide 50-50 tin/lead solder (ASTM B 32), with rosin flux.
 - 2. Fasteners: Same metal as flashing/sheet metal or, other noncorrosive metal as recommended by sheet manufacturer.
 - a. Match finish of exposed heads with material being fastened.
 - 3. Mastic Sealant: Polyisobutylene; nonhardening, nonskinning, nondrying, nonmigrating sealant.

4. Adhesives: Type recommended by flashing sheet manufacturer for waterproof/weather-resistant seaming and adhesive application of flashing sheet.
5. Metal Accessories: Provide sheet metal clips, straps, anchoring devices and similar accessory units as required for installation of work, matching or compatible with material being installed, noncorrosive, size and gauge required for performance.
6. Roof Cement: ASTM D 2822, asphaltic.
7. Reglets: Metal of type and profile indicated, compatible with flashing indicated, size and gauge required for performance.

2.02 MANUFACTURED UNITS:

- A. Gutters: "K" style 2 3/8" x 4«" seamless, continuous, preprimed, aluminum, .032" thick.
- B. Downspouts: Corrugated, preprimed, rectangular shape aluminum, .025" thick.
- C. Drip Edge: Preprimed, preshaped aluminum.

2.03 FABRICATION:

- A. Shop-fabricate work to greatest extent possible. Comply with details shown, and with applicable requirements of SMACNA "Architectural Sheet Metal Manual" and other recognized industry practices. Fabricate for waterproof and weather-resistant performance; with expansion provisions for running work, sufficient to permanently prevent leakage, damage or deterioration of the work.
 1. Form work to fit substrates.
 2. Comply with material manufacturer instruction and recommendations.
 3. Form exposed sheet metal work without excessive oil-canning, buckling and tool marks, true to line and levels as indicated, with exposed edges folded back to form hems.
- B. Seams: Fabricate nonmoving seams in sheet metal with flat-lock seams.
 1. For metal other than aluminum, tin edges to be seamed, form seams, and solder.
 2. Form aluminum seams with epoxy seam sealer; rivet joints for additional strength where required.
- C. Expansion Provisions: Where lapped or bayonet-type expansion provisions in work cannot be used, or would not be sufficiently water/weatherproof, form expansion joints of intermeshing hooked flanges, not less than one-inch (1") deep, filled with mastic sealant (concealed within joints).
- D. Sealant Joints: Where movable, nonexpansion-type joints are indicated or required for proper performance of work, form metal to provide for proper installation of elastomeric sealant, in compliance with industry standards.

- E. Separations: Provide for separation of metal from noncompatible metal or corrosive substrates by coating concealed surfaces at locations of contact, with bituminous coating or other permanent separation as recommended by manufacturer/fabricator.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine the areas and conditions under which work of this section will be installed.
- 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 INSTALLATION:

- A. General: Except as otherwise indicated, comply with manufacturer's installation instructions and recommendations, and with SMACNA "Architectural Sheet Metal Manual." Anchor units of work securely in place by methods indicated, providing for thermal expansion of metal units; conceal fasteners where possible, and set units true to line and level as indicated.
 - 1. Install work with laps, joints and seams which will be permanently watertight and weatherproof.
- B. Form all sheet metal accurately and to the dimensions and shapes required, finishing all molded and broken surfaces with true, sharp, and straight lines and angles and, where intercepting other members, coping to an accurate fit, soldering securely.
- C. Expansion: Form, fabricate, and install all sheet metal so as to adequately provide for expansion and contraction in the finished work.
- D. Underlayment: Where stainless steel or aluminum is to be installed directly on cementitious or wood substrates, install a course of paper slip sheet and a course of polyethylene underlayment.
- E. Bed flanges of work in a thick coat of bituminous roofing cement where required for waterproof performance.
- F. Install reglets to receive counter flashing in manner and by methods indicated.
 - 1. Where shown in concrete, furnish reglets to trades of concrete work for installation as work of Division 3 sections.
 - 2. Where shown in masonry, furnish reglets to trades of masonry work, for installation as work of Division 4 sections.
 - 3. Install counterflashing in reglets, either by snap-in seal arrangement, or by wedging in place for anchorage and filling reglet with mastic or elastomeric sealant, as indicated and depending on degree of sealant exposure.
- G. Weatherproofing:
 - 1. Finish watertight and weathertight where so required.
 - 2. Make all lock seam work flat and true to line, sweating full of solder.
 - 3. Make all lock seams and lap seams, when soldered, at least one-half inch (1/2") wide.
 - 4. Where lap seams are not soldered, lap according to pitch but in no case less than three inches (3").
 - 5. Make all flat and lap seams in direction of flow.
- H. Nailing:

1. Whenever possible, secure metal by means of clips or cleats without nailing through the metal.
 2. In general, space all nails, rivets, and screws not more than 20 cm (8") apart and, where exposed to the weather, use lead washers.
 3. For nailing into wood, use barbed roofing nails 32 mm (1-1/2") long by 11 gauge.
 4. For nailing into concrete, use drilled plugholes and plugs.
- I. Install continuous gutter guards on gutters, arranged as hinged units to swing open for cleaning gutters.
1. Install beehive-type strainer-guard at conductor heads, removable for cleaning downspouts.
- J. Embedment: Embed all metal in connection with roofs in a solid bed of sealant using materials and methods approved in advance by the Architect or DNR Construction Inspector.
- K. Soldering:
1. Thoroughly clean and tin all joint materials prior to soldering.
 2. Perform all soldering slowly with a well-heated copper in order to heat the seams thoroughly and to completely fill them with solder.
 3. Perform all soldering with a heavy soldering copper of blunt design, properly tinned for use.
 4. Make all exposed soldering on finished surfaces neat, full flowing, and smooth.
 5. After soldering, thoroughly wash acid flux with a soda solution.
 6. Upon request of the DNR Construction Inspector, demonstrate by hose or standing water that all flashing and sheet metal is completely watertight.

3.03 CLEANING:

- A. Clean exposed metal surfaces, removing substances which might cause corrosion of metal or deterioration of finishes.

3.04 PROTECTION:

- A. Installer shall advise Contractor of required procedures for surveillance and protection of flashings and sheet metal work during construction to ensure that work will be without damage or deterioration, other than natural weathering, at time of substantial completion.

END OF SECTION 07600

**SECTION 07712
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's standard guarantees, provide the manufacturer's 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's standard colors matching roofing system.
- B. Downspouts: Corrugated, prepainted, rectangular shape aluminum, .025" thick (minimum).
 1. Finish: Baked-on enamel.
 2. Color: As selected by the Architect from manufacturer's standard colors.
- C. Manufacturer; Provide units with leaf protection such as Englert Leafguard. 1200 Amboy Avenue, Perth Amboy, NJ 08861, 1-800- LEAFGUARD, www.leafguard.com .
- D. Local Dealers/Contractor: Leafguard of Central Iowa, Inc. 1814 Main St, P.O. Box 542, Granger, IA 50109, Phone: (515)999-2896, Toll Free: (800)532-3482 Fax: (515)999-2904 central_iowa@leafguard.com

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

PART 1 – GENERAL

1.1 SUMMARY:

A. WORK INCLUDES:

1. Snow retention system that clamps directly to the standing seams without penetrating the roof system. Screw-down mounted ColorBrackets are used for mechanically fastened roofs.
2. Coordinate with the installation of the metal roofing system to assure the proper fastening of the metal roof to the substructure.
3. Provide all necessary components: Clamps/ColorBrackets, Bars, Set Screws, Tek Screws, End Caps and optional IceStoppers.

B. RELATED SECTIONS:

1. Section 07600: Flashing and Sheet Metal
2. Section 07400: Metal Roof Panels

1.2 SYSTEM DESCRIPTION:

A. COMPONENTS:

1. SnoBar System consisting of 12 Ga. stainless steel, one piece, top loading, non-penetrating clamps and 16 Ga. Galvanized Steel.
2. Set screws to be "cup tipped", Stainless Steel, 3/8" diameter, torqued to 90 in/lbs.
3. Bar to be attached to clamp with two (2) corrosion protected #10 tek screws. Screw-down mounted ColorBrackets are used for mechanically fastened roofs.
4. Plastic end caps to be installed in each end of bar.
5. Aluminum "Ice Stopper" centered on panel and mounted perpendicular to roof panel to prevent sliding ice. Use over pedestrian areas or on areas needing additional protection.

B. DESIGN REQUIREMENTS:

1. Clamps must be used at every roof seam.
2. Snow retention system should have a minimum performance of 500# per linear foot of bar without deflection and 500# per clamp without significantly damaging the roof panel.
3. Based on snow load, climatic conditions, length of roof panel and width of panel; multiple rows of SnoBar may be needed.
4. Provides attachment without voiding roof panel warranty.

C. METAL ROOFING AND SUBSTRATE CRITERIA:

1. Metal roofing must be a minimum of 24 Ga. Steel.
2. All loads incurred by the SnoBar will be transferred to the panels; therefore proper panel attachment to substrate/structure is necessary to prevent roof panels from sliding under snow load. It is important to design new structures or assess the existing structure to make sure it can withstand retained snow loads. (*Architect Note: Add this requirement to Metal Roofing Section*)

- 1.2 SUBMITTAL: – Submit Manufacturer's specifications, standard detail drawings and installation instructions.

1.4 QUALITY ASSURANCE: – Installer to be experienced in the installation of metal roofing and snow retention systems for a period of not less than 5 years in the area of the project.

1.5 DELIVERY/STORAGE/HANDLING: – Inspect material upon delivery and order replacements for any missing or defective items. Keep material dry, covered and off the ground until installed.

PART 2 – PRODUCTS

2.1 MANUFACTURER:

A. SnoBar by Action Manufacturing exclusively distributed by Snoblox-Snojax, Lemoyne, PA (800) 766-5291 www.snobarcolorbar.com

Substitutions: Upon approval by architect

2.2 MATERIALS:

A. Clamps: 12 Ga. one-piece stainless steel clamps with 2 "cup tipped" stainless steel set screws used at every roof seam.

B. Bars: Specify a 16 Ga. Galvanized Steel Bar

2.3 FINISH: – (pick one of the following finishes)

A. Powder Coat – Color to match or be similar to metal roof or as selected by architect

PART 3 – EXECUTION:

3.1 EXAMINATION:

A. Substrate: Inspect roof system to be properly attached and installed to withstand additional loadings incurred.

Notify General Contractor of any deficiencies before installing SnoBar

3.2 INSTALLATION:

A. Comply with architectural drawings for location and with Manufacturer's instructions for assembly, installation and erection.

B. Clamps must be used at every roof seam in straight rows.

C. All Set Screws torqued to 90 in/lbs. and rechecked annually.

E. Refer to manufacturer's installation instructions <http://www.SnobarColorBar.com/installation-instructions/>.

3.3 WARRANTY

A. SnoBar systems shall include free limited lifetime warranty on parts and finish for all systems following manufacturer's spacing/ installation recommendations.

END OF SECTION

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

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. Weyerhaeuser 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 these specifications 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 Includes: 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 minimum
- 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

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fiberglass double-hung windows.

1.2 RELATED SECTIONS

- A. Section 07920 (079200) - Joint Sealants: Sealants and caulking.

1.3 REFERENCES

- A. American Architectural Manufacturers Association (AAMA):
 1. AAMA 502 - Voluntary Specification for Field Testing of Windows and Sliding Doors.
 2. AAMA 613 - Voluntary Performance Requirements and Test Procedures for Organic Coatings on Plastic Profiles.
- B. American Society for Testing and Materials (ASTM):
 1. ASTM C 1036 - Flat Glass.
 2. ASTM C 1048 - Heat-Treated Flat Glass--Kind HS, Kind FT Coated and Uncoated Glass.
 3. ASTM D 3656 - Insect Screening and Louver Cloth Woven from Vinyl-Coated Glass Yarns.
 4. ASTM E 283 - Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors Under Specified Pressure Difference Across the Specimen.
 5. ASTM E 547 - Water Penetration of Exterior Windows, Curtain Walls and Doors by Cyclic Static Air Pressure Differential.
- C. Screen Manufacturers Association (SMA):
 1. SMA 1201 - Specifications for Insect Screens for Windows, Sliding Doors and Swinging Doors.
- D. Window and Door Manufacturers Association (WDMA):
 1. ANSI/AAMA/NWDA 101/I.S.2 - Voluntary Specifications for Aluminum, Vinyl (PVC) and Wood Windows and Glass Doors.

1.4 PERFORMANCE REQUIREMENTS

- A. Windows shall meet Rating specifications in accordance with ANSI/AAMA/NWDA 101/I.S.2.
- B. Window Air Leakage, ASTM E 283: Window air leakage when tested at 1.57 psf (25 mph) shall be 0.25 cfm/ft² of frame or less.
- C. Window Water Penetration, ASTM E 547: No water penetration through window when tested under static pressure of 4.5 psf (42 mph) after 4 cycles of 5 minutes each, with water being applied at a rate of 8 gallons per hour per square foot.

1.5 SUBMITTALS

- A. Submit in accordance with Division 1 requirements.

- B. Product Data: Submit manufacturer's product data, including installation instructions.
- C. Shop Drawings: Submit manufacturer's shop drawings, indicating dimensions, construction, component connections and locations, anchorage methods and locations, hardware locations, and installation details.

1.6 QUALITY ASSURANCE

- A. Mockup:
 - 1. Provide sample installation for field testing window performance requirements and to determine acceptability of window installation methods.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to site undamaged in manufacturer's or sales branch's original, unopened containers and packaging, with labels clearly identifying manufacturer and product name. Include installation instructions.
- B. Storage:
 - 1. Store materials in accordance with manufacturer's instructions.
 - 2. Store materials off ground and under cover.
 - 3. Protect materials from weather, direct sunlight, and construction activities.
- C. Handling: Protect materials and finish during handling and installation to prevent damage.

PART 2 PRODUCTS

2.1 MANUFACTURER

- A. Basis of Design: Pella Corporation, 102 Main Street, Pella, Iowa 50219. Toll Free (800) 54-PELLA. Phone (641) 621-1000. Website www.pella.com.

2.2 FIBERGLASS DOUBLE-HUNG WINDOWS

- A. Double-Hung Windows: Pella Impervia.
 - 1. Factory-assembled window with sash installed in frame.
 - 2. Frame and Sash Material: Duracast. 5-layer, pultruded-fiberglass material, reinforced with interlocking mat.
- B. Sliding Windows: Pella Impervia.
 - 1. Factory-assembled window with sash installed in frame.
 - 2. Frame and Sash Material: Duracast. 5-layer, pultruded-fiberglass material, reinforced with interlocking mat.
- C. Frame:
 - 1. Type: New construction frame
 - 2. Overall Frame Depth: 3 inches for Block frame and New Construction frame; 3-1/4 inches for Precision Fit frame.
 - 3. Nominal Wall Thickness of Fiberglass Members: 0.050 inch to 0.070 inch.
 - 4. Frame Corners:
 - a. Mitered at head and jamb on 10 degree sill.

- b. Joined and bonded with nylon corner lock, with thermoset polyurethane adhesive and mechanically fastened.
- 6. Jamb: Factory-drilled, counter-bored, installation screw holes.

D. Sash:

- 1. Lower Sash: Lower sash vent, tilts for cleaning exterior glass.
- 2. Upper Sash: Upper sash vent, tilts for cleaning exterior glass.
- 3. Sash Corners:
 - a. Mitered.
 - b. Bonded and sealed with injected thermoset polyurethane adhesive.

E. Glazing:

- 1. Float Glass: ASTM C 1036, Quality 1.
- 2. Type: Tape-glazed, 11/16-inch thick, insulating glass, multi-layer Low-E coated with argon.

F. Weather Stripping:

- 1. Vent Upper Sash: Fin-type pile on jamb, top rail and stile.
- 2. Vent Lower Sash: Vinyl-wrapped foam at sill on frame and bottom rail.

2.3 OPTIONS

Specifier Notes: The following paragraphs specify optional products. Specify required options. Consult your local Pella representative for more information.

A. Grilles:

- 1. Insulating Glass: Contain 3/4-inch, contoured, aluminum grilles between the glass.
- 2. Finish: Factory-finished. Match window frame.

Specifier Notes: If insect screens are not specified, delete ASTM D 3656 and SMA 1201 from Article 1.3 References in this section.

B. Insect Screens:

- 1. Compliance: ASTM D 3656 and SMA 1201.
- 2. Screen Cloth: Half- or full-size with black, vinyl-coated, 18/16 mesh, fiberglass screen cloth set in aluminum frame fitted to outside of window.
- 3. Complete with necessary hardware.
- 4. Screen Frame Finish: Baked enamel.
 - a. Color: Match window exterior.

2.4 HARDWARE

A. Balances: Galvanized steel block-and-tackle balances.

B. Lock:

- 1. Type: Self-aligning, cam-action lock.
- 2. Windows 37 Inches Wide or Greater: 2 locks.
- 3. Finish: oil-rubbed bronze.

C. Tilt Latches:

1. Glass reinforced Nylon 6
2. Integrated into sash corner
3. Finish is matte gray

D. Lower Sash Lift: Integrated into Duracast checkrail.

E. Upper Sash Lift: Color-in ABS Resin.

2.5 TOLERANCES

- A. Windows shall accommodate the following opening tolerances:
1. Vertical Dimensions Between High and Low Points: Plus 1/4-inch, minus 0 inch.
 2. Width Dimensions: Plus 1/4-inch, minus 0 inch.
 3. Building Columns or Masonry Openings: Plus or minus 1/4-inch from plumb.

2.6 FINISH

- A. Exterior and Interior Duracast Finish: Factory-applied powder-coat paint, comply with AAMA 613.
1. Color: TBD.

2.7 INSTALLATION ACCESSORIES

- A. Flashing/Sealant Tape: Pella SmartFlash.
1. Aluminum-foil-backed butyl window and door flashing tape.
 2. Maximum Total Thickness: 0.013 inch.
 3. UV resistant.
 4. Verify sealant compatibility with sealant manufacturer.
- B. Exterior Perimeter Sealant: Geocel Proflex Tripolymer Sealant.
- C. Insulating-Foam Sealant: Dow Chemical Great Stuff Window and Door Insulating Foam Sealant.
1. Low-pressure, polyurethane window and door insulating-foam sealant.

2.8 SOURCE QUALITY CONTROL

- A. Factory Testing: Factory test individual standard operable windows for air infiltration in accordance with ASTM E 283, to ensure compliance with this specification.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive windows. Notify Architect of conditions that would adversely affect installation or subsequent use. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Install windows in accordance with manufacturer's instructions.

- B. Install windows to be weather-tight and freely operating.
- C. Maintain alignment with adjacent work.
- D. Secure assembly to framed openings, plumb and square, without distortion.
- E. Integrate window system installation with exterior water-resistant barrier using flashing/sealant tape. Apply and integrate flashing/sealant tape with water-resistant barrier using watershed principles in accordance with window manufacturer's instructions.
- F. Place interior seal around window perimeter to maintain continuity of building thermal and air barrier using insulating-foam sealant.
- G. Seal window to exterior wall cladding with sealant and related backing materials at perimeter of assembly.
- H. Leave windows closed and locked.

3.3 FIELD QUALITY CONTROL

- A. Field Testing: Field-test windows in accordance with AAMA 502, Test Method A.

3.4 CLEANING

- A. Clean window frames and glass in accordance with Division 1 requirements.
- B. Do not use harsh cleaning materials or methods that would damage finish or glass.
- C. Remove labels and visible markings.

3.5 PROTECTION

- A. Protect installed windows to ensure that, except for normal weathering, windows will be without damage or deterioration at time of substantial completion.

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 A156.14 (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, unless 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

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 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
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H. IPS-4: Interior Alkyd Enamel - Galvanized and Aluminum Metals:

1st Coat -	Alkyd Metal Primer	Devoe DevGuard No. 4129
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2nd Coat -	Alkyd Gloss Enamel	Devoe DevGuard No. 4308
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3rd Coat -	Alkyd Gloss Enamel	Devoe DevGuard No. 4308
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I. IPS-5: Interior Urethane Varnish (satin Sheen) - Protected Wood:

1st Coat -	Oil Stain Semi-Transp.	Woodpride No. 1700
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2nd Coat -	Urethane Alkyd	Woodpride No. 1902
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3rd Coat -	Urethane Alkyd	Woodpride No. 1902
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END OF SECTION 09900

SECTION 10522
FIRE EXTINGUISHERS, CABINETS, AND ACCESSORIES

PART 1 - GENERAL

1.01 SUMMARY:

- A. Section Includes: The work consists of furnishing all labor, material and equipment for the installation of fire extinguishers, fire hoses, cabinets and accessories as described herein and as indicated on the drawings.
- B. Products Supplied But Not Installed Under This Section:
- C. Products Installed But Not Supplied Under this Section:
- D. 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
Section
- E. Allowances:
- F. Unit Prices:
- G. Measurement Procedures:
- H. Payment Procedures:
- I. Alternates/Alternatives:

1.02 SUBMITTALS:

- A. Submit shop drawings showing cabinet, cabinet installation details, extinguishers and fire hoses.
- B. See Section 01300 for additional requirements concerning submittals.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. Extinguishers and cabinets shall be one of the following products and manufacturers or an equal approved in advance:

1. Model MPI0/R-2409, manufactured by Larsen's Manufacturing Company, Minneapolis, Minnesota.

2.02 MATERIALS:

A. Extinguishers:

1. Multipurpose dry chemical (A, B, C Type) in heavy duty steel cylinder with epoxy finish.

B. Cabinets:

1. Tub of white baked acrylic enamel cold rolled steel.
2. Flat trim of cold rolled steel trim- baked acrylic enamel.
3. Door shall have bronze acrylic front.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Install as shown on the drawings and per individual manufacturer's specifications and recommendations.

END OF SECTION 10522

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 water piping within the building. Insulate all piping as specified.
 - e. Furnish and install propane piping system.
 - f. Furnish and install water heater and flue.
 - 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. Air Conditioning and Ventilating Work shall include, but is not necessarily limited to:
 - a. Furnish and install a furnace unit complete with filters, coils, dampers, actuators, controls, fans, and motor.
 - b. Furnish and install air-cooled condensing units.
 - c. Furnish and install refrigerant piping, accessories, and final charge of refrigerant.
 - d. Furnish and install complete supply air ductwork systems including all fittings, insulation, and outlets.
 - e. Furnish and install complete return air ductwork systems including all fittings, insulation, and inlets.
 - f. Furnish and install complete exhaust ductwork systems including all fittings, insulation, inlets, and fans.
 - g. Furnish and install furnace flues.
 - h. Furnish and install all temperature control systems.
 - i. This Contractor is responsible for coordinating utilities with all other contractors.
3. 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, 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. Air Conditioning and Ventilating Contractor.
 - c. 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 thermostats, 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 motorized damper, 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 dampers, 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. Sheet metal.
 - d. Other piping.
 - e. 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. Furnace and condensing unit.
 - b. Radiant heater burner assemblies.
2. Assumes all responsibility for the Temperature Control wiring.
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 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.

1.6 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
Refer to drawings	Plumbing Material List Items
15540	Fuel-Fired Radiant Heaters
15623	Furnaces and Condensing Units
15835	Terminal Heat Transfer Units
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 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.

1.7 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.

1.8 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.

1.9 INSURANCE

- A. Contractor shall maintain insurance coverage as set forth in Division 0 of these specifications.

1.10 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 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 PROJECT CLOSEOUT

- A. The following paragraphs supplement the requirements of Division 1.
- B. 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.

3.4 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.

3.5 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 furnace and fan systems and radiant heaters.
 - 2. Temperature control system operation including calibration, adjustment and proper operating conditions of all sensors.
 - 3. Maintenance of equipment.
 - 4. Start-up procedures for all major equipment.
 - 5. 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.
 - 3. Fuel-fired Radiant Heaters - 0.5 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.

3.6 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.

3.7 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.

3.8 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.

3.9 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

PART 1 - GENERAL

1.01 SUMMARY:

- A. Provide material, labor, and supervision necessary to install propane gas piping as required by the Drawings and this Section.
- B. Products Supplied But Not Installed Under This Section:
- C. Products Installed But Not Supplied Under this Section:
- D. 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
Section
- E. Allowances:
- F. Unit Prices:
- G. Measurement Procedures:
- H. Payment Procedures:
- I. Alternates/Alternatives:

1.02 REFERENCES:

- A. Gas piping and connections to equipment shall be in accordance with NFPA-58, ANSI Z 223.1, National Fuel Gas Code, and local county and/or governing municipality code and guidelines.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Provide plug valves in accordance with Section 15100.
- B. Provide piping in accordance with Section 15060.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. Install piping and make service connection to existing piping as indicated on the Drawings.
- B. Pipe size 2 in. and larger shall have welded joints; pipe less than 2 in. shall have threaded joints made up with gas resistant joint compound.
- C. Install gas shutoff plug valve in main, in each branch line and at each appliance.
- D. Install service plug valve at each outlet.
- E. General: Comply with requirements of basic piping material sections for installation of piping materials.
 - 1. Install piping products in accordance with manufacturer's written instructions, with applicable installation requirements of ANSI Z 223.1, and in accordance with recognized industry practices to insure that products serve intended functions.
- F. Use sealant on metal gas piping threads which are chemically resistant to LP gas. Use sealant sparingly and apply to only male threads of metal joints.
- G. Remove cutting and threading burrs before assembling piping.
- H. Do not install defective piping or fittings. Do not use pipe with threads which are chipped, stripped or damaged.
- I. Plug each gas outlet, including valves with a threaded plug or cap, immediately after installation, and retain until continuing piping or equipment connections are completed.
- J. Install drip-legs in gas piping.
- K. Install Tee fittings with bottom outlet plugged, or capped, at bottom of pipe risers.

3.02 FIELD QUALITY CONTROL:

- A. Equipment Connections Tests:
 - 1. Fuel Gas Piping Tightness Test: Prior to initial operation, test and purge fuel gas piping in accordance with ANSI Z 223.1, National Fuel Gas Code.
 - 2. Repair or replace fuel gas piping as required to eliminate leaks, and re-test as specified to demonstrate compliance.

END OF SECTION 15071

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"	N/A
4"	5/8"	N/A

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 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. 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.
- F. Unless otherwise indicated, hangers shall be as follows:

1. Clevis Type:

- Service: Bare Metal Pipe
 Insulated Cold Pipe
 Insulated Hot Pipe

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

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

- G. 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 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.

H. 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

- 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	

I. Unless otherwise shown, upper attachments for hanger rods or support struts shall be as follows:

1. Beam Clamps:

<u>Acceptable Products:</u>	
Anvil	Fig. 228, 292
Cooper/B-Line	Fig. B3054
Erico	Model 360
Nibco/Tolco	Fig. 329

J. 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.

<u>Acceptable Products:</u>	
Erico/M-Co	Model #456
B-Line	Fig. 3198HCT
Anvil	Fig. CT138R
Nibco/Tolco	Fig. 301CT

K. 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 150°F 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 60°F and 150°F. 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. Sleeves shall not penetrate structural members without approval from the Structural Engineer. Sleeves shall then comply with the Engineer's design.
- D. 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.
- E. 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.
- F. 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.

2.7 ESCUTCHEON PLATES AND TRIM

- A. Fit escutcheons to all insulated or uninsulated exposed pipes passing through walls 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. 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.
- N. Do not exceed the manufacturer's recommended maximum load for any hanger or support.
- O. Provide additional supports where pipe changes direction, adjacent to flanged valves and strainers, at equipment connections and heavy fittings.
- P. Provide at least one hanger adjacent to each joint in cast iron soil pipe.
- Q. Spacing of Hangers shall not exceed the compressive strength of the insulation inserts, and in no case shall exceed the following:

<u>Pipe Material</u>	<u>Maximum Spacing</u>
1. Steel (Std. Weight or Heavier – Liquid Service):	
1-1/4" & under	7'-0"
2. Steel (Std. Weight or Heavier – Vapor Service):	
1-1/4" and under	9'-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"

	<u>Pipe Material</u>	<u>Maximum Spacing</u>
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 15170
MOTORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Single 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/NEMA MG 1 - Motors and Generators.
- D. 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 motor data with equipment when motor is installed by the manufacturer at the factory.
- C. 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 40°C 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 shall be single phase, 60 hertz, open drip-proof or totally enclosed fan-cooled type.
- F. Each contractor shall set all motors furnished by him.
- G. All motors shall have a minimum service factor of 1.15.
- H. 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.
- I. Bearings shall be sealed type.

2.2 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:

<u>O.D. of Pipe or insulation</u>	<u>Marker Length</u>	<u>Size of Letters</u>
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. Secure tags with heavy duty key chain and brass "S" link or with mechanically fastened plastic straps.
 - 3. Attach to handwheel or around valve stem. On lever operated valves, drill the lever to attach tags.
 - 4. Number all tags and show the service of the pipe.
 - 5. 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 leg of each "T" joint.
 - e. At least once in every room.
 - 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 furnaces, condensing 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.

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	Black	Yellow
Sanitary Sewer	Black	Yellow
Vent	Black	Yellow
Propane	Varies	Varies
All Underground Pipes		

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 C533 - Calcium Silicate Block and Pipe Thermal Insulation.
- B. ANSI/ASTM C534 - Elastomeric Foam Insulation.
- C. ANSI/ASTM C552 - Cellular Glass Block and Pipe Thermal Insulation.
- D. ASTM E84 - Surface Burning Characteristics of Building Materials.
- E. NFPA 255 - Surface Burning Characteristics of Building Materials.
- F. UL 723 - Surface Burning Characteristics of Building Materials.
- G. 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 75°F; 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 75°F, 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 75°F; moisture resistant, non-combustible; suitable for -100°F to +900°F. 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 300°F; 1200°F 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 -40°F to 150°F. 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 60°F, insulate fittings, valves, unions, flanges, strainers, flexible connections, flexible hoses, and expansion joints. Seal all penetrations of vapor barrier.
- E. On piping operating below 60°F in locations that are not mechanically cooled (e.g., mechanical rooms, etc.), Type B insulation shall be used.
- F. On insulated piping operating between 60°F and 140°F, 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. 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. 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.
- N. 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. 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 60°F, 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 170°F.

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 - 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. ASTM E84 - Surface Burning Characteristics of Building Materials.
- B. ASTM E136 - Standard Test Method for the Behavior of Materials in a Vertical Tube Furnace at 750°C.
- C. National Commercial & Industrial Insulation Standards - 1999 Edition - as published by Midwest Insulation Contractors Association and endorsed by National Insulation Contractors Association.
- D. NFPA 255 - Surface Burning Characteristics of Building Materials.
- E. UL 263 - Full Scale External Fire Tests with Hose Stream.
- F. 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. 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 C564 - Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- N. ASTM C1540 - Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings.
- O. AWWA C651 - Disinfecting Water Mains.
- P. CISPI 301 - Cast Iron Soil Pipe and Fittings for Hubless Cast Iron Sanitary Systems.
- Q. CISPI 310 - Joints for Hubless Cast Iron Sanitary Systems.
- R. FM 1680 - Couplings Used in Hubless Cast Iron Systems.

- S. NFPA 54 - National Fuel Gas Code.
- T. NFPA 58 - Storage and Handling of Liquefied Petroleum Gases.
- U. 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 @ 406°F, 200# CWP @ 150°F, 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: 150°F.

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.
4. 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: 350°F
- B. Piping - 2" and Under:
 - 1. Pipe: Standard weight steel, threaded and coupled, ASTM A53.
 - 2. Joints: Screwed.
 - 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. Shut-Off Valves/Throttling Valves:
 - 1. PL-1: 2" and under, 125# steam @ 450°F, 175# CWP @ 180°F, 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: 180°F
- 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: 180°F
- 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.

2.6 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.

2.7 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.

2.8 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.

2.9 STRAINERS

- A. Unless otherwise indicated, strainers shall be Y-pattern and have stainless steel screens with perforations as follows:

Pipe Size	1/4" - 2"
Water	3/64"

- 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.

2.10 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.

2.11 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.

2.12 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.
- 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:

<u>Pipe Size</u>	<u>Minimum Slope</u>
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. 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.
- W. 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.
- X. 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 45° or 90° 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 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 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 500°F 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 180° 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 250°F):	Red Rubber, Heavy Duty Type
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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 470°F melting point solder. Remove discs and seals during soldering if they are not suitable for 470°F.

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. Elastomeric Gaskets (Sanitary Pipe):

1. Hub and spigot pipe joints with elastomeric gaskets shall be made in accordance with the manufacturer's installation instructions.

- H. 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 below grade.
- 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 -100°F and 300°F 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 inside the building.
2. Extend cleanouts to the floor with long sweep elbows.
3. Install a full size cleanout within 5 feet of the foundation inside or outside of building.
4. 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.
5. 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. 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 A112.19.2M - Vitreous China Plumbing Fixtures.
- D. ANSI A112.19.5 - Trim for Water-Closet Bowls, Tanks, and Urinals.
- E. ASSE 1002 - Water Closet Flush Tank Ball Cocks.
- F. 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 15540
FUEL-FIRED RADIANT HEATERS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes fuel fired low intensity radiant heat.

1.2 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories.
- B. Shop Drawings: Submit manufacturer's specification for equipment showing dimensions, weights, capacities, ratings, motor electrical characteristics, gauges, and finishes of materials. Submit manufacturer's operation and maintenance data.
- C. The Engineer reserves the right to require the Contractor to remove and replace any material or equipment that does not meet specifications or does not have prior approval as a substitute item. Removal of non-compliant material or equipment will be completed immediately without cost or inconvenience to the Owner or any other trades.

1.3 QUALITY ASSURANCE

- A. American National Standard/CSA Standard: Construct and certify gas fired infrared heaters in accordance with latest edition ANSI Z83.20/CSA 2.34 "Gas-Fired Low Intensity Infrared Heaters."

1.4 WARRANTY

- A. Manufacturer's standard form in which manufacturer agrees to repair or replace heat exchanger, couplings, burner, burner head, electronics of fuel-fired radiant heater that fail in materials and workmanship within three years from date of Substantial Completion.

1.5 MANUFACTURERS

- A. Provide: positive pressure modulating low intensity infrared heaters from Roberts Gordon, Inc.
- B. Other modulating low intensity radiant heaters with the same or lower burner firing rate capacity may be acceptable provided they meet the intent of these specifications and prior approval in writing is obtained from the Engineer at least (10) days prior to bid. Two-stage or multi-stage positive pressure heaters shall not qualify as modulating heaters.
- C. Approved Equal: Detroit Radiant.

PART 2 - PRODUCTS

2.1 POSITIVE PRESSURE INFRARED HEATER – MODULATING HEAT

- A. LP model, burner box design with silicone gasketed doors, internally mounted blower (permanently lubricated), nickel plated burner cup, hot surface ignition, interlock safety switch, spot welded construction, and mica flame observation window. Burner assembly shall be epoxy polyester powder painted for corrosion resistance.
- B. Gravity vented power burner, with the following features:
 - 1. Modulation controls: Units shall be equipped with a control board to modulate both gas input and combustion air simultaneously. Heater input shall modulate continuously throughout input range (not staged): from minimum rated input, 66% of total input, to maximum rated input – 100% of total input. Controls shall be configurable for modulating burner input by: zone sensor inputs, direct or remote analog signal, or manual potentiometer.
 - 2. Comprehensive Diagnostic Capability: 17 unique conditions – including but not limited to: air pressure, flame sensor, cabinet pressure, gas valve, and control board.
 - 3. Burner/Ignition: Power gas burner with hot surface ignition electronic flame safety. The ignition sequence shall have prepurge and timed trial for ignition with multiple ignition trial before lockout occurs. The heater shall be capable of a minimum of four (4) trials for ignition to provide maximum reliability.

2.2 HEAT EXCHANGER AND REFLECTORS

- A. Heat Exchanger: Provide emitter tube constructed of 4" O.D. 16 gauge heat treated aluminized tube.
- B. Reflector: Provide aluminum reflector installed to provide continuous coverage of heat exchanger. To maximize radiant output and minimize convection losses, reflectors are to extend below the bottom of the heat exchanger pipe and have an engineered parabolic design of no less than seven (7) bends in usable field of Infrared waves.
 - 1. Overlap of reflectors, 12" for expansion and contraction of system, shall be connected to lower reflector lip and provide connection point for Perimeter Reflector/Side Shield.
 - 2. Perimeter Reflector/Side Shield: Same material as standard reflector. Clearance to Combustible to be a maximum of 9" from edge of tube to combustible being protected. Tilting of reflectors is not allowed.
 - 3. End Caps: Same material as reflector. Each end and transition to have end caps as required to complete the encapsulation of tubing and prevent unnecessary convective losses.

2.3 CONTROLS

- A. Controls – Modulating Burners:
 - 1. Zone temperature sensor: Shall include 40-75°F set point adjustability and low voltage ON/OFF switch as available from radiant heater manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install radiant heaters level and plumb.
- B. Install and connect gas-fired radiant heaters, associated fuel, vent features, and systems according to NFPA 54, applicable local codes and regulations, and manufacturer's written installation instructions.

3.2 CONNECTIONS

- A. Support: Suspend heater, burner, gas piping, electrical, and venting from building substrate as indicated, or in manner to provide durable and safe installation and in accordance with manufacturer's installation instructions.
- B. Gas Piping: Comply with applicable requirements in Division 15 Section "Fuel Gas Piping." Connect gas piping to gas train inlet; provide union with enough clearance for burner removal and service. Provide AGA-approved flexible units. Gas piping by Plumbing Contractor. Provide gas pressure regulator valve to Plumbing Contractor for installation.
- C. Connect vents according to Division 15, Section "Breechings, Chimneys, and Stacks."
- D. Electrical: Comply with applicable requirements in Division 16 Sections.
 - 1. Install electrical devices furnished with heaters, but not specified to be factory mounted.
- E. Ground equipment according to Division 16 Section "Grounding and Bonding."

3.3 FIELD QUALITY CONTROL

- A. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fuel-fired radiant heaters.

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, dampers, 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 HEATING 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, CPVC outlet piping, and concentric vent kit.
- 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. 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 30°F.

2.9 COOLING 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 pre-manufactured cement pad.

END OF SECTION

SECTION 15835
TERMINAL HEAT TRANSFER UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Electric Radiant Ceiling Panel Heaters.
- B. Electric Cabinet Heaters.

1.2 REFERENCES

- A. ANSI/ASHRAE 90.1-2010 - Energy Standard for Buildings Except Low-Rise Residential Buildings.
- B. ANSI/NFPA 70 - National Electrical Code.

1.3 QUALITY ASSURANCE

- A. All electrical equipment shall have a UL label.
- B. 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 90.1-2010.

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 ELECTRIC RADIANT CEILING PANEL RADIANT HEATERS

- A. Assembly: UL listed and labeled, with controls and terminal box with cover.
- B. Heating Elements: Enclosed copper tube element of coiled nickel-chrome resistance wire centered in tubes and embedded in refractory material, bonded to ceiling panel.
- C. Ceiling Panels: 24" x 48" aluminum pans with silkscreened pattern matching ceiling tile.
- D. Acceptable Manufacturers: Indeeco, Berko, Markel.

2.2 ELECTRIC CABINET HEATERS

- A. Forced air ceiling mounted heaters shall include cabinet, fan, motor, coil, inlet grille and discharge grille.
- B. Coil: Electric dual element with finned steel sheaths.
- C. Blower shall have a two-speed split capacitor motor and a concealed unit mounted "Off-Low-High" fan speed switch.
- D. Power connections, circuit breaker, or disconnect shall be provided by the E.C.
- E. Units shall have 1" disposable filters ahead of all coils.
- F. Cabinets shall have 16 gauge exposed surfaces, 18 gauge concealed surfaces, and no exposed plastic parts.
- G. Baked enamel finish. Color selected by Architect/Engineer.
- H. Acceptable Manufacturers: Indeeco, Trane, Berko.

PART 3 - EXECUTION

NOT USED

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. 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. 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/ft²/°F. Temperature range of at least 0-180°F. 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 not 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 25 feet above the electrical equipment. Unless intended to serve these rooms, do not install any ductwork or equipment in electrical rooms, transformer rooms, or electrical closets.
- 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	PRESSUR E 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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ELECTRONIC FILE TRANSMITTAL - CONTRACTOR

KJWW #: 10.0319.08

DATE:

PROJECT NAME: Lake of Three Fires State Park

SOFTWARE/RELEASE:

LOCATION: Bedford, Iowa

FILE NAME:

ENGINEER: Blake O'Brien

TRANSFER METHOD:

TERMS AND CONDITIONS FOR USE:

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Accepted by: _____ Title: _____

Company: _____ Phone: _____

Address: _____ E-mail: _____

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 full duct size.
- 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.

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.

1.2 REFERENCES

- A. ASME B40.1 - Gauges - Pressure Indicating Dial Type - Elastic Element.
- B. 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.

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. Install gauges and thermometers in locations where they are easily read from normal operating level.
- F. 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. 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.
- 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 $\pm 10\%$ of scheduled 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.

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. Filter pressure drop: specified and actual.
7. Total static pressure: specified and actual. (Indicate if across fan or external to unit).
8. Inlet pressure.
9. Discharge pressure.
10. Fan RPM.
11. 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.

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 of equipment furnished by others.
- D. Work Not Included:
 - 1. Temperature control wiring for plumbing and HVAC equipment (unless otherwise indicated) will be by other Contractors.

1.3 OWNER FURNISHED PRODUCTS

- A. The Owner will supply manufacturer's installation data for new equipment purchased by him for this project.
- B. This Contractor shall make all electrical system connections shown on the drawings or required for fully functional units.
- C. This Contractor is responsible for all damage to Owner furnished equipment caused during installation.

1.4 WORK SEQUENCE

- A. All work that will produce excessive noise or interference with normal building operations, as determined by the Owner, shall be scheduled with the Owner. It may be necessary to schedule such work during unoccupied hours. The Owner reserves the right to determine when restricted construction hours are required.
- B. Itemize all work and list associated hours and pay scale for each item.

1.5 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. 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.

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. Other piping.
- d. 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. 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. 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. Furnishes and installs motor control and temperature control wiring, when noted on the drawings.
- 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.

1.6 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 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 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 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 City of Polk City, Iowa 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 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. 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.

F. 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.

G. Field Measurements:

1. Verify all pertinent dimensions at the job site before ordering any conduit, conductors, fittings, etc.

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	Submittal Item
<u>Section</u>	<u>Submittal Item</u>
16440	Disconnect Switches
16510	Lighting
16535	Emergency Lighting Equipment
16570	Lighting Control Systems

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 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. Shop drawings that are larger than 11" x 17" or are plan size layout or erection drawings such as cable tray or busduct drawings, shall be submitted on reproducible media. Submit one reproducible and one print of each drawing or plan. All Contractor approval stamps shall be on the reproducible.
5. The Contractor shall thoroughly review and approve all shop drawings before submitting them to the 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.**
6. 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.
7. 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.
8. 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.
9. Bind each set in a manufacturer's folder or inside of a manila file folder.
10. 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.
11. 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.
12. Failure to comply with the above shall be reason to resubmit all shop drawings.
13. 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.

1.8 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.

1.9 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 Engineer.

1.10 INSURANCE

- A. This Contractor shall maintain insurance coverage as set forth in Division 1 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 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 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 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 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 48 hours prior to installation of ceilings or lay-in ceiling tiles.
- C. The following must be submitted before 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.

3.3 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 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.

3.4 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 make a video recording of 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.
- E. Notify the 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.

3.5 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 Engineer for all costs to develop record documents that comply with this requirement. Reimbursement shall be made at the Engineer's hourly rates in effect at the time of work.
- D. Record changes daily and keep the marked drawings available for the 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 Engineer.

3.6 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 Engineer his color preference before ordering.
- E. Do NOT paint electric conduits in crawl spaces, tunnels, or spaces above suspended ceilings except that where conduit is in a damp location give exposed threads at joints two coats of sealer after joint is made up.

3.7 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.

3.8 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 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 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 Engineer.

4. Before final payment is made to the Contractor submit a written report to the 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 Engineer or authority having jurisdiction deem necessary.

END OF SECTION

SECTION 16111
CONDUIT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Electrical metallic tubing and fittings
- B. Flexible metallic conduit and fittings
- C. High density polyethylene conduit and fittings

1.2 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. ANSI C80.3 - Electrical Metallic Tubing, Zinc-Coated and Fittings
 - 2. ANSI C80.4 - Fittings for Rigid Metal Conduit and Electrical Metallic Tubing
- 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. TC 2 – Electrical Polyvinyl Chloride (PVC) Conduit
 - 3. TC 9 – Fittings for PVC Plastic Utilities Duct for Underground Installation
- 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. UL514-B – Conduit Tubing and Cable Fittings
 - 3. UL797 – Electrical Metal Tubing
 - 4. UL651-A – Type EB and a PVC Conduit and HDPE Conduit
 - 5. UL651-B – Continuous Length HDPE 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.

PART 2 - PRODUCTS

2.1 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 type of steel designed for their specific application.
2. Larger than 2": Compression 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.

2.2 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.
 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.

2.3 HIGH DENSITY POLYETHYLENE

- A. Minimum Size: 2 inch, unless noted otherwise.
- B. Acceptable Manufacturers: Carlon, Chevron Phillips Chemical Company, or approved equal.
- C. Materials used for the manufacture of polyethylene pipe and fittings shall be extra high molecular weight, high-density polyethylene resin. The material shall be listed by PPI (Plastic Pipe Institute) and shall meet the following resin properties:

ASTM Test	Description	Values HDPE
D-1505	Density g/CM 3	< .941
D-1238	Melt Index, g/10 min Condition E	> .55 grams/10 min.
D-638	Tensile Strength at yield (psi)	3000 min.
D-1693	Environmental Stress Crack Resistance Condition B, F 20	96 hrs.

ASTM Test	Description	Values HDPE
D-790	Flexural Modulus, MPa (psi)	< 80,000
D-746	Brittleness Temperature	-75°C Max

- D. The pipe shall contain no recycled compound except that generated in the manufacturer's own plant from resin of the same raw material, including both the base resin and coextruded resin. The pipe shall be homogeneous throughout and free of visible cracks, holes, voids, foreign inclusions, or other defects that may affect the wall integrity.
- E. Fitting and Conduit Bodies:
1. Directional Bore and Plow Type Installation: Electrofusion or Universal Aluminum threaded couplings. Tensile strength of coupled pipe must be greater than 2,000 lbs.
 2. For all other type of installation: Coupler must provide a water tight connection. The tensile strength of coupled pipe must be greater than 1,000 lbs.
 3. E-loc type couplings are not acceptable in any situations.
 4. Acceptable Manufacturers: ARCON, Carlon, or approved equal.

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.)
- 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 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 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 shall not be supported from non-structural members, unless approved by the Engineer. All supports shall be from structural slabs, walls, structural members, and bar joists, and coordinated with all other applicable contractors, unless noted otherwise.
- B. 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.
- C. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps.
- D. Spring-steel conduit clips specifically designed for supporting single conduits or tubing may be used in lieu of malleable-iron hangers for 1" and smaller raceways serving lighting and receptacle branch circuits above accessible ceilings and for securing raceways to slotted channel and angle supports.
- E. 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.
- F. 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.
- G. 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.
- H. 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.

- I. 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.
- J. 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.
- K. 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. 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.
 - 3. 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. No conduits are allowed in concrete on metal deck unless expressly approved in writing by the Structural Engineer.
11. Do not route conduits across each other in slabs on grade.

12. 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.
13. Contractor shall provide a polypropylene pull cord with 2000 lbs. tensile strength in each empty conduit (indoor and outdoor), except in sleeves and nipples.

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. 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.

C. Conduit Elbows (vertical):

1. Minimum metal or RTRC 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.

2. 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).

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 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.
 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.
 - b. Concealed: EMT
 2. Interior Locations:
 - a. Exposed: EMT.
 - b. Concealed: EMT.
 3. Exterior Locations
 - a. Underground: PVC.

END OF SECTION

SECTION 16120
WIRE AND CABLE

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Building wire

1.2 REFERENCES

- A. NEMA WC 70 - Power Cables Rated 2,000V or Less for the Distribution of Electrical Energy
- B. UL 44 – Thermoset-Insulated Wires and Cables
- C. UL 83 – Thermoplastic-Insulated Wires and Cables
- D. UL 854 – Service-Entrance Cables
- E. UL 1581 – Standard for Electrical Wires, Cables, and Flexible Cords

PART 2 - PRODUCTS

2.1 BUILDING WIRE

- A. Feeders and Branch Circuits Larger Than 6 AWG: Copper, stranded conductor, 600 volt insulation, THHN/THWN.
- B. 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.
- C. 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.
- D. Control Circuits: Copper, stranded conductor 600 volt insulation, THHN/THWN.
- E. Aluminum conductors are not to be used for feeds to motor loads.

PART 3 - EXECUTION

3.1 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) may 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.

3.2 CONTRACTOR CHANGES

- A. 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.
- B. Record drawing shall include the calculations and sketches.

3.3 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.

3.4 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 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:
 - 1. Facing the front and operating side of the equipment, the phase identification shall be:
 - a. Left to Right - A-B-C
 - b. 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.

3.6 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 manufacturers’ recommended values.
- E. Perform continuity test on all power and equipment branch circuit conductors. Verify proper phasing connections.

END OF SECTION

SECTION 16130
BOXES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Wall and ceiling outlet boxes
- B. Pull and junction boxes
- C. 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 ferrous alloy, 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 and weather resistant
- C. Device plates and box covers

1.2 REFERENCES

- A. DSCC W-C-896F – General Specification for Electrical Power Connector
- B. FS W-C-596 - Electrical Power Connector, Plug, Receptacle, and Cable Outlet
- C. FS W-S-896 - Switch, Toggle
- D. NEMA WD 1 – General Color Requirements for Wiring Devices
- E. NEMA WD 6 – Wiring Devices – Dimensional Requirements
- F. UL 498 – Standard for Attachment Plugs and Receptacles
- G. UL 943 – Standard for Ground Fault Circuit Interrupters

1.3 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.

1.4 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. Isolated ground receptacles shall have the equipment ground contacts connected only to the green grounding screw terminal of the device with inherent electrical isolation from the mounting strap.
- F. Receptacles with integral surge suppression shall comply with the following:
 - 1. Category A3 listed.
 - 2. Line to ground, line to neutral, and neutral to ground modes.
 - 3. Metal-oxide varistors with a nominal clamp level rating of 500 volts and minimum single transient pulse energy dissipation of 210 joules per mode.
 - 4. Status indication: Light visible in the face of the device and audible alarm to indicate device is no longer active or in service.
 - 5. Distinctive symbol on device face to denote SPD-type device.
- G. Receptacles with modular wiring type quick connectors shall comply with the following in addition to the above:
 - 1. Wired with #12 THHN Cu, stranded or solid, 3 or 4 wire as required for device, minimum 6" lead length.
 - 2. Connector contacts shall be crimped or welded.
 - 3. Modular connector shall be flush with back of device when fully inserted.

2.3 WALL PLATES

- A. Decorative coverplate shall be as shown on the drawings. Verify color with Owner.
- B. Weatherproof coverplates shall be as shown on the drawings. Verify color with Owner.
- 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 and convenience receptacles at standard 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 device rough-ins.
- C. Install receptacles vertically with ground slot up or where indicated on the drawings, horizontally with ground slot to the left.
- D. Install decorative plates on switch, receptacle, and blank outlets in finished areas, using jumbo size plates for outlets installed in masonry walls.
- E. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface-mounted outlets.
- F. Install devices and wall plates flush and level.
- G. Install nameplate identification to receptacle cover plates indicated. Identification shall identify panel name and circuit number. Refer to Specification Section 16195 - Electrical Identification.
- H. Test receptacles for proper polarity, ground continuity and compliance with requirements.

END OF SECTION

SECTION 16195
ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Nameplates and tape labels
- B. Conductor color coding
- C. Electrical gear labeling
- D. Power distribution equipment labeling
- E. 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 NAMEPLATES AND SIGNS

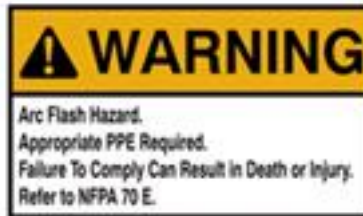
- A. Engraved, Plastic-Laminated Labels, Signs and Instruction Plates: Engraving stock melamine plastic laminate, 1/16-inch minimum thick for signs up to 20 square inches, or 8 inches in length; 1/8 inch thick for larger sizes. Labels shall be punched for mechanical fasteners. Engraving legend shall be as follows:
 - 1. Black letters on white face for normal power.
- 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: Labeling shall be 3/8-inch Kroy tape or Brother self-laminating vinyl label, color-coded same as conduits or 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. Install ARC FLASH WARNING signs on all panelboards. Sign at a minimum shall contain:



3.2 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, N1-3,5,7”).

3.3 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

3.4 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.

3.5 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 16440
DISCONNECT SWITCHES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Manual switches
- B. Non-fusible switches
- C. Motor disconnect switches
- D. 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 MANUAL SWITCHES

- A. Manual Switch Assemblies: NEMA KS 1; as indicated on the disconnect schedule.
- B. Enclosures: As indicated on the disconnect schedule.
- C. Accessories: As indicated on the disconnect schedule.

2.2 NON-FUSIBLE SWITCHES

- A. 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.
- B. Enclosures: Type as indicated on the disconnect schedule.
- C. Accessories: As indicated on the disconnect schedule.

2.3 MOTOR DISCONNECT SWITCHES

- A. Rotary Switch Assemblies: Rated for making and breaking loads, rotary type enclosed switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position.
- B. Enclosures: Type as indicated on the Disconnect Schedule.
- C. Ground lug connection provided in enclosure.
- D. Accessories: As indicated on the Disconnect Schedule.
- E. Listed UL 508 suitable for motor control.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install disconnect and manual switches where indicated on the drawings.

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 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Testing agency as defined by OSHA in 29 CFR 1910.7 or a member company of the International Electrical Testing Association and that is acceptable to authorities having jurisdiction.
- B. Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association to supervise on-site testing specified in Part 3.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with UL 467 Grounding and Bonding Equipment.
- E. Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system.
- F. 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: Copper.
- C. Equipment Grounding Conductors: Insulated with green-colored insulation.
- D. Grounding Electrode Conductors: Stranded cable.
- E. Underground Conductors: Bare, tinned, stranded, unless otherwise indicated.
- F. Sizes and types below are typical. Adjust to suit Project conditions and requirements.

G. Copper Bonding Conductors: As follows:

1. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG copper conductor, 1/4 inch in diameter.
2. Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor.
3. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
4. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

H. 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, 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. Chemical Electrodes: Copper tube, straight or L-shaped, filled with nonhazardous chemical salts, terminated with a 4/0 bare conductor. Provide backfill material recommended by manufacturer.

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. 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.
 - 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. Hydraulic compression connection. Use for underground connections, except those at test wells.
 - 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.
 - G. 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. Each grounding conductor that passes through a below grade wall must be provided with a waterstop.
- C. Grounding electrode conductor (GEC) shall be protected from physical damage by rigid polyvinyl chloride conduit (PVC) in exposed locations.
- D. 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.

- E. In raceways, use insulated equipment grounding conductors.
- F. 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.
- 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.

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.

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. Exterior Metallic Pull and Junction Box Covers, Metallic Hand Rails: Bond to grounding system using flexible grounding conductors.
- C. 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.
- D. 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.
- E. 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.
- F. 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.
- G. Telecom Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch grounding bar.

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.

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.

3.7 GRADING AND PLANTING

- A. Restore surface features, including vegetation, at areas disturbed by Work of this Section. Reestablish original grades, unless otherwise indicated. If sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other activities to their original condition. Include application of topsoil, fertilizer, lime, seed, sod, sprig, and mulch. Comply with Division 2. Maintain restored surfaces. Restore disturbed paving.

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 KS 1 - Enclosed Switches
- C. NEMA PB 1 - Panelboards
- D. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less
- E. NEMA PB 1.2 - Application Guide for Ground-fault Protective Devices for Equipment
- F. UL 67 - Panelboards

1.3 SPARE PARTS

- A. Keys: Furnish four (4) each to the Owner.

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 door-in-door construction. 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.

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 16510
LIGHTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Interior luminaires and accessories
- B. Exterior luminaires and accessories
- C. Lamps

1.2 REFERENCES

- A. ANSI C82.77-2002 – Standard for Harmonic Emission Limits and Related Power Quality Requirements for Lighting Equipment
- B. IEEE C2 - National Electrical Safety Code
- C. 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. 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.

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.

1.5 EXTRA STOCK

- A. Provide extra stock under provisions of Section 16010.
- B. Fluorescent Lamps: Five (5) percent of quantity installed. Minimum of two (2) of each size and type, and maximum of one (1) case (30 lamps).
- C. Other Lamps: Five (5) percent of quantity installed. Minimum of two (2) of each size and type, and maximum of one (1) case (20 lamps).
- D. Lenses: Three (3) percent of quantity installed, minimum of one (1) of each size and type.

1.6 WARRANTY

- A. Fluorescent ballasts shall carry a three-year warranty from date of Substantial Completion.
- B. Fluorescent lamps shall carry a two-year warranty from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 INTERIOR LUMINAIRES AND ACCESSORIES - GENERAL

- A. Exposed Ceiling Luminaires: Confirm ceiling type and furnish trim and accessories necessary to permit proper installation in each ceiling system.
- B. Self-Powered Exit Signs: Stencil face, 6 inch high letters, directional arrows as indicated, universal mounting type as indicated on the drawings. One-piece, self-contained unit with sealed, maintenance-free nickel cadmium battery, automatic charger and electronic circuitry. Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
- C. Self-Powered Emergency Lighting Units: One-piece, self-contained unit with sealed, maintenance-free nickel cadmium battery, automatic charger and electronic circuitry. Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
- D. Painted reflector surfaces shall have a minimum reflectance of 90%.

2.2 EXTERIOR LUMINAIRES AND ACCESSORIES - GENERAL

- A. Listed for wet or damp location as scheduled.
- B. Provide low temperature ballasts or LED drivers, with reliable starting to -20°F.

2.3 ACCEPTABLE MANUFACTURERS – LAMPS

MANUFACTURER	INCAND. HALOGEN	FLUORESCENT
Philips Lighting Company	X	X
Osram Sylvania	X	X
GE Lighting	X	X

2.4 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.

2.5 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.

2.6 ACCEPTABLE MANUFACTURERS - FLUORESCENT ELECTRONIC BALLASTS

MANUFACTURER		PRS
A.	Advance	IOP
B.	GE	UltraStart
D.	Osram/Sylvania	QuickTronic

2.7 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: ≥ 88 MLPW(T8)
- 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%).

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.

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 ft²) 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.

3.2 LAMP SEASONING

- A. Operate all fluorescent for 100 hours prior to requesting final observation. 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 with self-test capability
- B. Emergency exit signs with self-test capability

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 and exit signs.

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. Unit Voltage: 120 volts, AC.
- J. Unit shall be self-diagnostic with continuous monitoring of charger performance and battery voltage. Any malfunction of battery, charger, transfer circuit or emergency lamps shall be detected and visually indicated.
- K. Unit shall be programmed to exercise the battery and test emergency operation by performing a five minute discharge/diagnostic cycle every 6 months. A manual test switch shall allow a five minute discharge/diagnostic test at any time.
- L. 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.
- D. Unit shall be self-diagnostic with continuous monitoring of charger performance and battery voltage. Any malfunction of battery, charger, transfer circuit or emergency lamps shall be detected and visually indicated.
- E. Unit shall be programmed to exercise the battery and test emergency operation by performing a five minute discharge/diagnostic cycle every 6 months. A manual test switch shall allow a five minute discharge/diagnostic test at any time.

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. 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 control riser diagram of the specific project system configuration.
- D. 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.
- E. Submit manufacturer sensor coverage patterns applicable to this project. For areas requiring multiple sensor devices for appropriate coverage, submit specific manufacturer approved sensor layout as an overlay directly on the project drawings, either in print or approved electronic form.

1.4 EXTRA STOCK

- A. Provide extra stock under provisions of Section 16010.
- B. Relays and Dimmer Modules: Five (5) percent of quantity installed. Minimum of two (2) of each size and type.
- C. Daylight Sensors and Photocells: One (1) of each configuration and type.
- D. Occupancy Sensors and Power Supply/Relay: Five (5) percent of quantity installed. Minimum of two (2) of each configuration and type.

1.5 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. Comply with applicable portions of NEMA standards pertaining to types of electrical equipment and enclosures.
- C. 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.
- D. All assemblies are to be in compliance with FCC emissions standards specified in Part 15 Subpart J for Class A applications.

1.6 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 and daylight sensor.

2.2 LOCAL DAYLIGHTING CONTROLS

- A. Indoor Daylight Controller:
 - 1. Daylight controller shall provide three (3) channels 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, dimming response, fade rate, ramp rate 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.

2.3 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.

2.4 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.

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.
- 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, lighting levels and sensor settings shall be performed by a factory-authorized technician. 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.

END OF SECTION