

IOWA DEPARTMENT OF NATURAL RESOURCES

**DIVISION II**

**Technical Specifications**

IOWA DEPARTMENT OF NATURAL RESOURCES  
ENGINEERING AND REALTY SERVICES BUREAU  
WALLACE STATE OFFICE BUILDING  
DES MOINES, IA 50319-0034



PART 1 - GENERAL

1.01 SUMMARY:

- A. Section Includes: All labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for and incidental to performing all operations of the work of this section, complete, as shown on the drawings or specified herein. Work includes but is not necessarily limited to the following:
1. Examine all other sections for work related to those other sections and required to be included as work under this section.
  2. Submittals.
  3. Steel girders, beams, purlins, columns, and all other fabricated and rolled shapes shown on structural drawings.
  4. Bolting and welding.
  5. Base and bearing plates, shims and wedges.
  6. Fabrication for attachment of work of other trades.
  7. Provide steel around openings as required by Drawings.
- B. Related Sections: Drawings, general & supplementary provisions and clauses of the Contract, and Division 1 Specification sections, apply to work of this section as well as, but not necessarily limited to, the following:
- Section 01400 Quality Control  
Section 05500 Metal Fabrications  
Section 05510 Metal Stairs

1.02 SUBMITTALS

- A. Provide submittals in accordance with Section 01300.
- B. Submit shop Drawings including complete details and schedules for fabrication and shop assembly of members. Include details of cuts, connections, camber, holes, and other pertinent data. Indicate welds by AWS symbols, and show size, length, and type of weld. Provide setting drawings, templates, and directions for installation of anchor bolts and other anchorages. Identify details by reference to sheet and detail number on the Drawings.
1. Submit the entire structural steel submittal package at one time. Exceptions can be requested by the contractor prior to the first submittal to expedite the construction schedule by subdividing the submittal package into the following order and categories:
    - a. All base plates, anchors, templates, and plans showing their locations and all

related details.

- b. All columns, beams, and plans showing their location and all related details.
- c. Section 05300: All metal deck information, closure plates, shear connectors, bracing, and plans showing their location, and any miscellaneous structural steel items and all related details.
- d. Section 05510: All stairs and related details.
- e. Certification of Materials: Identify all structural steel by heat or melt number and accompany with mill analysis and test reports. Furnish evidence to the Architect that the materials conform with the requirements of these specifications.

#### 1.03 CLEANUP

- A. During the progress of the work, the premises shall be kept free of debris and waste resulting from the work in this section. Upon completion, all surplus material and debris shall be removed from the site.

#### 1.04 QUALITY ASSURANCE

- A. Fabrication and Erection:
  - 1. Perform all work in accordance with the applicable provisions of the AISC "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings," and AWS "Structural Welding Code", latest approved edition.
  - 2. All structural steel, both in the shop and in field shall be transported and handled and erected in such manner as will preclude any injury thereto and in no case shall the material be subjected to any undue stresses in any part of connection or member.
- B. Cooperation: Coordinate the work in the structural steel section with that of all other sections. Provide all punchings and drilling or other fabrication indicated on the drawings, or required for the attachment of their work to the structural steel framing for pipe and duct supports, anchors, aluminum sash, doors and similar work.
- C. Field Measurements: Before starting work, secure all field measurements pertaining to or affecting the work of this section and verify the locations and exact position of all anchor bolts occurring therein.

#### 1.05 TESTING

- A. Tests and inspections shall be as follows:
- B. Testing Laboratory: A qualified testing laboratory, meeting requirements of ASTM E329, shall be as approved by the Architect. Testing and inspection shall be as required by the Drawings and these Specifications.

- C. Tests for Structural Steel shall be made and reports furnished by the Testing Laboratory in accordance with the following requirements:
1. Perform all testing of structural steel in accordance with the requirements of "Standard Methods and Definitions for Mechanical Testing of Steel Products," ASTM A370.
- D. Mill Tests and Inspection of Structural Steel:
1. Tests of Mill Order A36 and A992 Steel: Where steel, ordered from the mill, cut to lengths, is identified by heat or melt numbers and is accompanied by mill analysis test reports, material shall be used without further local tests, provided an affidavit is given that materials conform with requirements. In case of controversy, tension and bend tests of materials, either locally or at mill, as required for local stock will be required.
  2. Test of Unidentified Steel: In the event structural steel cannot be identified by heat or melt numbers and is accompanied by mill analysis and test report, such stock may be used, provided 1 tension and 1 bend test is made for each 50 tons or fractional part, of stock as may be used in work. Complete 4 sided surface inspection may be required for materials. Each piece of high-strength local stock steel shall be tested and stamped.
- E. Any steel that cannot be identified or whose source is questionable shall be rejected and removed from the job site.
- F. Steel pipe shall have one tension, one bend and one flattening test for each lot of 500 lengths or fraction thereof of each size.
- G. Inspection of the structural steel will be performed in the mill, shop and field but such inspections or tests shall not relieve the Contractor of his responsibility to furnish satisfactory materials. The Architect shall have the right to inspect and reject faulty materials or workmanship at any time prior to the final acceptance of the erected structural steel.
- H. Tests of Welding and Bolting: Testing Laboratory shall inspect shop and field welding and high tensile bolting. Testing laboratory shall comply with regulations of the applicable Building Department and shall certify in writing, upon completion of work, that welding and high tensile bolting has been performed in accordance with the Drawings and Specifications and applicable city ordinances.
- I. Continuous Inspection High Tensile Bolts: The Testing Laboratory shall check bolt tightness on not less than 10% of bolts selected at random in each high strength bolt connection with a minimum of two bolts per connection. If the tension in any bolt tested falls below the proper value then all bolts in that connection shall be tested. Inspection procedure shall be as described in the "Specification for Structural Joints Using ASTM A325 or A490 Bolts": by the Research Council on Riveted and Bolted Structural Joints.
- J. Continuous Inspection of Butt or Groove Welds: The Testing Laboratory shall inspect welded connections of column to column, column to girder, or girder to girder and perform testing by ultrasonic or other approved non-destructive tests.

## PART 2 - PRODUCTS

### 2.01 MATERIALS

- A. All materials shall conform with the following requirements and shall be free from scale, defects and imperfections, of recent manufacture and unused. Where two or more identical articles or pieces of equipment are required, they shall be of the same manufacture.
- B. Structural Steel "W" Shapes: ASTM A992.
- C. Other structural steel shall conform with ASTM A36 for shapes, plates and bars unless noted otherwise.
- D. Welding electrodes shall conform with AWS D1.1, E70, series. Electrodes for welding reinforcing steel in to be low hydrogen electrodes.
- E. Anchor bolts shall conform with ASTM A307 and ASTM A325.
- F. High strength bolts shall conform to ASTM A325 bolts for structural steel joints.
- G. Direct Tension Indicators: ASTM A959.
- H. Headed Welded Studs: Nelson "Granular Flux-Filled Shear Connector and Anchor Studs", - "KSM Shear Connector Studs" or approved equivalent manufactured of C1015, 1010, 1017, or 1020 cold-rolled steel conforming to ASTM A108.
- I. Pipe columns shall be ASTM A53, Grade B.
- J. Tube steel shall be ASTM A500, Grade B, 46 ksi.
- K. Galvanizing shall conform with ASTM A123.

## PART 3 - EXECUTION

### 3.01 WELDING

- A. Structural welding shall be done by the electric submerged or shielded metal arc process and shall have inspection by the laboratory of record. Operators shall be thoroughly trained and experienced in arc welding of structures, capable of making uniformly reliable butt, groove and fillet welds in flat, vertical and overhead positions and by producing neat and consistent work in actual operation. Each operator shall have passed all welding tests of the American Welding Society.
- B. Surfaces to be welded shall be free of any paint, grease, loose scale and foreign matter. Clean welds each time the electrode is changed and chip clean all burned or flame-cut edges before welds are deposited thereon. The same electrode may be used with various thicknesses of plate, but change current used and number of passes made proportionately.
- C. After being deposited, brush welds with wire brushes. Welds shall exhibit uniform section, smoothness of welded metal, feathered edges without undercuts or overlays, and freedom

from porosity and clinkers. Visual inspection at edges and ends of fillet and butt joint welds shall indicate a good fusion with penetration into base metal.

- D. During assembly and welding, hold component part of a built-up member with sufficient clamps or other adequate means to keep the parts straight and in close contact. In welding, precautions shall be taken to minimize "lockup" stresses and distortion due to heat. No welding shall be done under windy conditions until adequate wind protection screening has been provided. Any welds or parts of welds which are found to be defective should be cut out with a chisel and replaced.
- E. The maximum space between members to be butt or groove welded shall not exceed 1/4". Bevel all pieces or members up to 1/8" thickness to form a single or double "vee" before being welded. Bevel welds over 3/8" in thickness to form a double "vee" wherever possible.
- F. Lay fillet welds in the position indicated on the drawings and to the sizes shown. In measuring fillet welds, consider only the effective portion. The maximum space between pieces for members to be fillet welded shall not exceed 1/16".

### 3.02 ERECTION

- A. Erect all structural steel with qualified riggers and carefully plan and lay out so that minimum of cutting shall be required. Erect work plumb, square and true to line and level, and in precise position, as indicated. Provide temporary bracing and guys, wherever necessary, to provide for the loads and stresses to which the structure may be subjected, including those due to erection equipment and their operation, and leave in place as long as it may be required for safeguarding all parts of the work.
- B. As erection progresses, securely bolt up work as required to maintain the steel in proper position while field bolting and welding is being done and as required to take care of all deadloads, wind and erection stresses. No field bolting or welding shall be done until the work has been properly aligned, plumbed and leveled.
- C. Set each column base plate in exact position as to alignment, plumb and height. The center of each base shall be true to the column center within a tolerance of 1/16", and its height shall be adjusted in exact position. Maintain all bases at the exact position and level while they are being grouted.
- D. Carry out erection of structural steel work in proper sequence with the work of other trades, and frame, bed and anchor to concrete and related work in strict accordance with the detail drawings and approved setting drawings.
- E. Field Modification: Written acceptance from the Architect/Engineer must be obtained before using cutting torch for field modification or refabrication of structural steel. The structural steel fabricator shall be responsible for errors in fabrication and for correct fit in the field.
- F. Allowable Tolerances: Comply with requirements of AISC Code of Standard Practice. Bases of all columns shall be located on the established column lines within plus or minus 1/8". All leveling and plumbing shall be based on a mean temperature of 70 degrees F. Compensate for difference in temperature at time of erections.
- G. Verification of Erection Tolerances: An accurate survey shall be made by surveyor with prior experience on similar projects, employed by the General Contractor and approved by

the Architect and Owner, of actual column location immediately upon the completion of every third tier of steel. Reports of such survey shall be submitted to the Owner and Architect within 24 hours after recording the data. Survey shall include a survey of the tier below. Should column locations vary beyond allowable tolerances, take necessary corrective measures and modify details and/or procedures as required.

### 3.03 CONNECTIONS

- A. Unfinished bolts: Make field connections with unfinished bolts only where indicated.
- B. High Strength Steel Boltings: Where structural joints are made using high strength bolts, hardened washers and nuts tightened to a high tension, the materials, method of installation and tension control, types of wrenches to be used, and inspection methods shall conform to Specification for Structural Joints using ASTM A325 or A490 bolts, established by the Research Council on Structural Connection of the Engineering Foundation, August 14, 1980.
  - 1. High strength bolts used shall have a suitable identifying mark placed on top of the head before leaving the factory.
  - 2. Bolts that have been completely tightened shall be marked with identifying symbol.
  - 3. Hardened washers shall be installed as per AISC Specifications.
  - 4. Contact bearing surfaces of bolted parts shall be free of scale, slag, burrs, and pits, or dirt, paint, or other foreign material and/or any defects which would prevent solid seating of parts.

### 3.04 HEADED WELDED STUDS

- A. Perform inspection of all shop and field welding. Type and capacity of welding equipment shall be checked and approved by Welding Inspector. Studs shall be subjected to 90 degree bend test by striking them with heavy hammer. After test, weld section shall not exhibit any tearing out or cracking. Any studs exhibiting fatigue or failure shall be replaced.

### 3.05 ANCHOR BOLTS

- A. Inspect the installation of anchor bolts, make all necessary field measurements and, if necessary, furnish templates to insure that all structural steel will fit the job conditions. Locate all columns as indicated on the drawings. Setting of anchor bolts in hardened or existing concrete, which may be necessary because of error or oversight, shall be made in suitable drilled holes and solidly grouted in place, under the direction of the Architect.

### 3.06 FINISH

- A. Clean all steel of any grease, rust, mill scale or other foreign matter. Material to be embedded in concrete and shall not be primed.

END OF SECTION 05100

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes furnishing and installation of all structural steel work, loose steel lintels, ladders, pipe or tube handrails, gratings, trash racks, aluminum items, louvers, anchor bolts, water control structures, and miscellaneous embedded and non-embedded metal work all as specified herein or 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.

1.02 SUBMITTALS

- A. Provide submittals in accordance with Section 01300.

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. Do not delay job progress; allow for trimming and fitting where taking field measurements before fabrication might delay work.
- D. Shop Assembly: Pre-assemble items in shop to greatest extent possible to minimize field splicing. Disassemble units only as necessary for shipping and handling limitations. 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/or replacements necessary to the approval of the IDNR Construction Inspector and at no additional cost to the IDNR.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. 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 A501.
  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. Aluminum sheets: ASTM B209-96.
  10. Stainless steel sheets: AISI type 302 or 304, 24 gauge, with number 4 finish.
  11. Malleable iron castings: ASTM A47, grade as selected by the fabricator.
  12. Steel pipe: ASTM A53, type as selected, Grade A, black finish unless galvanizing is required, standard weight (Schedule 40), unless otherwise indicated.
  13. Concrete inserts: Threaded or wedge type, stainless steel. Provide bolts, washers, and shims as required, stainless steel, conforming to ASTM A167, ASTM A276, or ASTM A666 for type of approved stainless steel shall be Type 304 or 316.
- C. Grout: Nonshrink Nonmetallic Grout: Premixed, factory-packaged, non-staining, non-corrosive, nongaseous grout complying with CE CRD-C588. 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. Select fasteners for the type, grade and class required complying with:
1. Bolts and Nuts: Regular hexagon head type, ASTM A307, 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: N/A
- 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 IDNR Construction Inspector.

## 2.02 MANUFACTURED UNITS

- A. Fabricate items to sizes, shapes and dimensions required. Furnish malleable iron washers for heads and nuts that 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, iron or aluminum shapes as required for framing and supporting work, and for anchoring or securing work to concrete or other structures.
- C. Loose Steel Lintels: Provide loose structural steel lintels for openings and recesses in masonry walls and partitions as shown. Weld adjoining members together to form a single unit where indicated. Provide not less than 8 inch bearing at each side of openings, unless otherwise indicated.
- D. Loose Bearing and Leveling Plates: Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction, made flat, free from warps or twists, and of required thickness and bearing area. Drill plates to receive anchor bolts and for grouting as required.
- E. 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. Work to dimensions shown or accepted on shop drawings, using proven details of fabrication and support. Use type of materials shown or specified for various components of work.
  - 1. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges. Ease exposed edges to a radius of approximately 1/32 inch unless otherwise shown. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
  - 2. Weld corners and seams continuously, complying with AWS recommendations. At exposed connections, grind exposed welds smooth and flush to match and blend with adjoining surfaces.
  - 3. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of type shown or, if not shown, Phillips flat head (countersunk) screws or bolts.
  - 4. Provide for anchorage of type shown, coordinated with supporting structure. Fabricate and space anchoring devices to provide adequate support for intended use.
  - 5. 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 bituminous coated or field welded, and galvanized or aluminum surfaces, unless otherwise indicated, with a metal primer meeting the requirements of AASHTO M 229,

Type II. It is intended as a primer over ferrous metal surfaces, and may be applied by spray, brush, or roller.

1. Remove scale, rust and other deleterious materials before applying shop coat. 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. Use painting methods that will result in full coverage of joints, corners, edges and exposed surfaces. Primer coat will not be required for galvanized corrugated metal pipes and assemblies that are to receive bituminous coating.
4. Apply two shop coats of primer to fabricated metal items, including surfaces inaccessible after assembly or erection. 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. Do not proceed until unsatisfactory 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. 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 and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws and other connectors as required.
- B. Field Assembly: Fit exposed connections accurately together to form tight hairline joints. Weld connections that are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations. Grind exposed joints smooth and touch-up shop paint coat. 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.
- C. 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.

- D. Setting Loose Plates:
1. Clean concrete and masonry bearing surfaces of any bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of bearing plates.
  2. Set loose leveling and bearing plates on wedges, or other adjustable devices. After the bearing members have been positioned and plumbed, tighten the anchor bolts. Do not remove wedges or shims, but if protruding, cut-off flush with the edge of the bearing plate before packing with grout. Use metallic nonshrink grout in concealed locations where not exposed to moisture; use nonmetallic nonshrink grout in exposed locations, unless otherwise indicated.
  3. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.
- E. 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 formwork for items that 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. 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 that are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations.
- F. Final Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint or bituminous coating, and paint exposed areas in accordance with Section 09900.

END OF SECTION 05500



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.
  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. Where items or surfaces are not specifically mentioned, paint same as adjacent similar materials or areas. If color or finish is not designated, Project Engineer 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. 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 as well as, but not necessarily limited to, the following:

Section 09800 - Special Coatings

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. Exterior Paint System (EPS): Provide following exterior paint systems for various substrates, as indicated.

1. EPS-1: Exterior Acrylic Masonry Water Repellent
2. EPS-2: Exterior Acrylic Emulsion - Concrete Masonry
3. EPS-3: Exterior Oil Stain - Wood Trim and Siding
4. EPS-4: Exterior Acrylic Emulsion - Wood Trim and Siding
5. EPS-5: Exterior Alkyd Enamel - Ferrous Metal
6. EPS-6: Exterior Alkyd Enamel - Galvanized and Aluminum Metals

- B. Interior Paint System (IPS): Provide following interior paint systems for various substrates, as indicated:

1. IPS-1: Interior Acrylic Masonry Water Repellent
2. IPS-2: Interior Latex Emulsion - Concrete Masonry Wallboard
4. IPS-4: Interior Latex Emulsion (Semi-Gloss) - Gypsum Wallboard
5. IPS-5: Interior Alkyd Enamel - Woodwork
6. IPS-6: Interior Urethane Varnish - Protected Wood
7. IPS-7: Interior "Tile Like" Epoxy Finish - Concrete Masonry and Ferrous Metals

1.04 SUBMITTALS:

- A. Provide submittals in accordance with Section 01300, if applicable.
- 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 Project Engineer's review of color and texture only. Provide a listing of material and application for each coat of each finish sample.

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 Project Engineer.

- 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 Project Engineer 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 50øF. (10øC) and 90øF. (32øC), 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 45øF. (7øC) and 95øF. (35øC), 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. Coordinate 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.

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. Glidden Coatings and Resins, 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

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. 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. Upon request from other trades, furnish information on characteristics of finish materials proposed for use, to ensure compatible prime coats are used. Provide barrier coats over incompatible primers or remove and re-prime as required. Notify Project Engineer in writing of any anticipated problems using specified coating systems with substrates primed by others.
- D. Color Pigments: Pure, non-fading, 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 Section 3.06 of this specification. 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 Project Engineer. Furnish material data and manufacturer's certificate of performance to Project Engineer 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. 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. Remove, if necessary, for complete painting of items and adjacent surfaces. 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. Program cleaning and painting so that contaminants from cleaning process will not fall onto wet, newly painted surfaces.
- D. Cementitious Materials: Prepare cementitious surfaces of concrete, concrete block, cement plaster and cement-asbestos board to be painted by removing efflorescence, chalk, dust, dirt, grease, oils, and by roughening as required to remove glaze.
- E. Determine alkalinity and moisture content of surfaces to be painted by performing appropriate tests. If surfaces are found to be sufficiently alkaline to cause blistering and burning of finish paint, correct this condition before application of paint. Do not paint over surfaces where moisture content exceeds that permitted in manufacturer's printed directions.
- F. Clean concrete floor surfaces scheduled to be painted with a commercial solution of muriatic acid, or other etching cleaner. Flush floor with clean water to neutralize acid, and allow to dry before painting.
- G. Wood: Clean wood surfaces to be painted of dirt, oil, or other foreign substances with scrapers, mineral spirits, and sandpaper, as required. 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. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood-filler. Sandpaper smooth when dried.
- H. 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.
- I. When transparent finish is required, use spar varnish for backpriming.
- J. Backprime paneling on interior partitions only where masonry, plaster, or other wet wall construction occurs on backside.
- K. Seal tops, bottoms, and cut-outs of unprimed wood doors with a heavy coat of varnish or equivalent sealer immediately upon delivery to job.
- L. 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. Clean and touch-up with same type of shop primer.
- M. Galvanized Surfaces: Clean free of oil and surface contaminants with non-petroleum based solvent.
- N. Material:
1. Mix and prepare painting materials in accordance with manufacturer's directions.
  2. Store materials not in actual use in tightly covered containers. Maintain containers used in storage, mixing and application of paint in a clean condition, free of foreign materials and residue.
  3. Stir materials before application to produce a mixture of uniform density, and stir as required during application. 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. 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. 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. 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. Do not re-coat 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. 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 work day.
- B. Upon completion of painting work, clean window glass and other paint-spattered surfaces. 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. Correct any damage by cleaning, repairing or replacing, and repainting as acceptable to Project Engineer.
- B. Provide "Wet Paint" signs as required to protect newly painted finishes. 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 Glidden Coatings and Resins or other manufacturers of equal products as specified herein.

F. Exterior Alkyd Enamel - Ferrous Metal, Stair Handrails:

1st Coat - Alkyd Metal Primer No. 5210	Glid-Guard
2nd Coat - Alkyd Gloss Enamel	Glid-Guard No. 4550 Series, Color Forest Green
3rd Coat - Alkyd Gloss Enamel	Glid-Guard No. 4550 Series, Color Forest Green

END OF SECTION 09900



PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Pipe, fittings, valves, and accessories for process piping systems.
- B. Equipment vents and drains.
- C. Connections to metering instruments and regulating devices.
- D. Cleaning, testing, and disinfection of piping systems.

1.02 RELATED SECTIONS

- A. Section 01300 - Submittals.
- B. Section 01730 - Operation and Maintenance Data.
- C. Section 02316 - Trenching, Backfilling, and Compacting.
- D. Division 15061 – Supports and Anchors – Process Piping.

1.03 DESIGN REQUIREMENTS

- A. Valves shall be type shown on Drawings and as specified herein.
- B. Pressure class, body material, bonnet-type, and trim material: As shown in the Standards and as specified. Unless specified elsewhere, valves shall be designed for a working pressure of not less than 150 psig.
- C. Laying dimensions of flanged valves: In accordance with ANSI B16.10.
- D. Valves shall open by turning operator in a counter-clockwise direction.
- E. Provide valves with manufacturer's name and pressure rating clearly marked on outside of body.
- F. All valves shall be manufacturer's standard design unless otherwise specified and shall be furnished with operating wheel, wrench nut or lever. Unless otherwise indicated, the direction of rotation of the wheel, wrench nut or lever to open the valve shall be on the left (counter-clockwise). Each valve body or operator shall have cast thereon the word "OPEN" and an arrow indicating the direction to open. A union flanged or shouldered type connection shall be provided within 2 feet of each threaded end valve unless the valve can be otherwise easily removed.
- G. All valves of the same type shall be from a single manufacturer, except as noted.
- H. Unless otherwise specifically noted in these specifications or on the Drawings, all valves in

contact with fish process water shall have only iron, stainless steel, Buna N or plastic for bodies and trim. No bronze trim will be allowed. Exceptions to this requirement are locations where a bronze body ball valve may be used to isolate gauges on process water piping and air release valves.

#### 1.04 SUBMITTALS

- A. Submit the following as appropriate for each piece of equipment, material, piping, and valve provided.
  - 1. Outline and installation drawings for equipment furnished.
  - 2. Equipment performance data and operating characteristics.
  - 3. Manufacturers' catalog data, marked to indicate materials being furnished, on standard equipment, piping, valves, specialties, and accessories.
  - 4. Shop Drawings on shop-fabricated piping systems.
  - 5. Drawings showing arrangement of piping, controls, and accessory equipment furnished.

#### 1.05 QUALITY ASSURANCE

- A. Insofar as practicable, use valves of only one manufacturer for each type of valve.
- B. Welding materials and procedures: Conform to ASME Code. Employ certified welders in accordance with ASME Code Section IX.
- C. Contract drawings indicate the general arrangement and location of pipe and fittings. It is desired that the indicated layout be followed as closely as possible. The exact location of the various items (even those dimensioned) is subject to actual construction, and the actual equipment furnished by the CONTRACTOR. CONTRACTOR shall verify the location of all items furnished, installed, or connected to by him.
- D. Should interference's or discrepancies prevent the installation of any part of the work, the IDNR Construction Inspector shall be notified and will determine the steps necessary to complete the true development of the intent of the Drawings and specifications.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Delivery:
  - 1. Arrange delivery of products in accordance with construction schedules and to allow inspection prior to installation.
  - 2. Coordinate deliveries to avoid conflict with conditions at site.
  - 3. Deliver products in undamaged condition in original containers or packaging, with identifying labels intact and legible.
  - 4. Clearly mark identity of partial deliveries of component parts to facilitate assembly.
- B. Storage:
  - 1. Store products immediately on delivery and protect until installed. Store in accordance with manufacturer's instructions, with seals and labels intact and legible.

2. Provide platforms, blocking or skids, or coverings required to protect products from deterioration or damage.
3. Arrange storage in manner to provide easy access for inspection.
4. Maintain storage conditions to prevent deterioration or damage.
5. Protect products after installation to prevent damage from subsequent operations. Remove when no longer needed.

C. Handling:

1. Provide equipment and personnel necessary to handle products by methods to prevent damage to products or packaging.
2. Handle products by methods to prevent bending or overstressing.

1.07 MAINTENANCE

- A. Provide special tools required for repacking and disassembling valves provided.

PART 2 - MATERIALS

2.01 DUCTILE-IRON PIPE

- A. Service: Process water; Pond water supply piping; Kettle piping 6 inches in diameter and larger; Kettle piping less than 6 inches in diameter (alternate).

- B. Design: AWWA C150; Manufacture AWWA C151.

C. Buried pipe thickness:

1. 4 through 12 inch: Pressure Class 350.
2. 14 through 20 inch: Pressure Class 250.
3. 24 through 64 inch: Pressure Class 200.
4. Use Class 52 pipe at locations requiring "Field-Lok" gaskets.

- D. Exposed (flanged) pipe: AWWA C115 Class 53.

E. Fittings:

1. Buried piping: Mechanical or push-on joints:
  - a. 3 through 24 and 54 through 64 inch; AWWA C153.
  - b. 30 through 48 inch: AWWA C110; rated working pressure; 150.
2. Exposed piping: Flanged:
  - a. 3 through 48 inch: AWWA C110; rated working pressure; 150.
  - b. 54 through 64 inch: AWWA C153; rated working pressure 150 psi.

F. Joints:

1. Buried piping: Mechanical or push-on joints, AWWA C111.

2. Exposed piping: Flanged, AWWA C111.
  3. Gasket: Styrene-butadiene rubber.
  4. Fitting joints: Type similar to that used for piping, AWWA C110, C111, C115, or C153.
  5. Restrained joints: Use manufacturer's standard restrained joints or restraining gaskets rated at specified test pressure for buried piping lengths shown on Drawings.
- G. Include gaskets, glands, bolts, and nuts required for complete installation.
- H. Mark each length of pipe with manufacturer's name and thickness class.
- I. Coating and lining:
1. Bituminous coating: AWWA C151.
  2. Cement lining: AWWA C104; standard thickness with bituminous seal coat.
- J. Polyethylene encasement: Polyethylene film, AWWA C105 for buried pipe.

## 2.02 STEEL PIPE

- A. Service: Low pressure air piping within 25 feet of the blowers; Kettle piping 3 and 4 inch diameter (alternate).
- B. Steel Pipe 6 Inches and Larger:
1. Steel pipe 6 inches and larger in diameter shall be in accordance with AWWA C200. Pipe diameter shown on Drawings shall be nominal diameter of pipe. Wall thickness shall be 1/4-inch. Outside diameter shall be "standard" unless indicated otherwise.
  2. Buried pipe joints shall be one of the following with provisions for thrust restraint where required.
    - a. Push joint, bell & spigot ends with rubber O-ring seal.
    - b. Welded joint.
    - c. Flanged joint.
    - d. Flexible coupling joint where required for assembly and disassembly.
  3. Exposed pipe shall have welded joints unless flanged ends or plain ends for flexible couplings are shown on the Drawings or required for assembly or disassembly. Flanged ends shall conform to AWWA C207 Class B, with rubber gasket.
  4. Fittings shall be in accordance with AWWA C200 and C208. Smooth 90 degree elbows shall be used for sizes 6 to 12 inches in diameter. Joint type shall be as described above for buried or exposed pipe.
  5. All exposed shall be interior lined and exterior painted. All buried pipe shall be interior lined and exterior coated.
  6. Lining for piping and fittings, shall be coal tar epoxy per AWWA C213. All lining shall be suitable for portable water service.

7. Coatings for buried pipe fittings shall be hot coal tar epoxy per AWWA C210 or fusion epoxy coating per AWWA C213. Exposed pipe and fittings shall be factory cleaned and primed and field painted.
8. All field repair work shall conform to one of the following as applicable. Welding per AWWA C206, and cold applied coal tar coating per AWWA C209.

C. Steel Pipe Less than 6 inches:

1. Steel pipe less than 6 inches in diameter shall be in accordance with ASTM A53 or A120. Minimum wall thickness shall be Schedule 40.
2. Buried pipe shall have plain ends for flexible couplings in straight runs or threaded ends to match fittings where required.
3. Exposed pipe shall have grooved end joints complying with AWWA C606, welded joints, threaded joint or flanged joints. Threaded joints shall match fittings and flanges shall be per ANSI B16.1, Class 125.
4. Fittings shall be malleable iron conforming to ASTM A47 and ANSI B16.3, 150 pound.
5. Pipe and fittings shall be black steel unless galvanizing is indicated herein.
6. Coating for buried black steel pipe less than 2 1/2 inch diameter shall be hot applied coal tar - one coat of coal tar primer and two coats of coal tar enamel per AWWA C203. Buried steel pipe 2 1/2 to 6 inches in diameter shall be as Paragraph 2.02.A.7 above.
7. Lining is not required for pipe under 6 inches in diameter.

2.03 POLYVINYL CHLORIDE (PVC) PIPE

A. Polyvinyl Chloride (PVC) Pressure Liquid Handling Pipe:

1. PVC underground pressure pipe up to 3-inch diameter shall be in accordance with ASTM D2241. Minimum wall thickness shall be DR26 with 160 psi minimum pressure rating at 37 degrees F, and shall bear the NSF seal of approval. Joints shall be rubber O-ring or solvent weld.
2. PVC underground pressure pipe 4 to 12-inch diameter shall be in accordance with ASTM D2241, 160 psi rating or in accordance with AWWA C900, 150 psi rating. All pipe must bear the NSF seal for potable water pipe. Joints shall be rubber ring in an integral pipe bell complying with ASTM D3139.
3. PVC underground pipe 14 inch diameter and larger shall be in accordance with ASTM 2241 and AWWA C-905, 150 psi min. rating. Pipe shall bear NSF Seal for potable water. Joints shall be rubber ring in an integral pipe bell.
4. Fittings 4 inches and smaller shall be of same material and joint type to match pipe. Larger than 4 inches shall be gasketed factory fabricated PVC rated at not less than 150 psi or ductile-iron (or cast iron) mechanical joint complying with AWWA C110 or C153 and having transition gasket manufactured specifically for PVC pressure pipe. Lining and coating for ductile iron fittings shall be same as that specified in for Ductile Iron pipe.
5. Wherever CONTRACTOR uses both IPS and cast iron O.D. dimension piping, CONTRACTOR shall provide pressure rated transition fittings and gaskets where the two types are joined.
6. Piping connected to buried valves shall have cast iron O.D.

7. PVC pressure pipe above ground shall be with solvent welded joints in accordance with ASTM D1785. Minimum wall thickness shall be Schedule 40 for solvent weld joints; provide Schedule 80 with threaded joints where indicated. Material shall be Type 1, Grade 1, and shall bear NSF seal of approval. Fittings shall be in accordance with ASTM D2466.

B. Polyvinyl Chloride (PVC) Low Pressure Air Pipe:

1. Service: Air lift pipes; exposed low pressure air piping at kettles, buried low pressure air piping (except within 25 feet of the blowers).
2. PVC shall be with solvent welded joints in accordance with ASTM D1785. Minimum wall thickness shall be Schedule 40 for solvent weld joints. Material shall be Type 1, Grade 1, and shall bear NSF seal of approval. Fittings shall be in accordance with ASTM D2466.

C. Polyvinyl Chloride (PVC) Gravity Drain Pipe:

1. PVC underground gravity drain pipe and fittings 4 to 15 inch diameter shall be in accordance with ASTM D3034 and ASTM F679 for 18 inch diameter and greater. Minimum wall thickness shall be DR 35. Joints shall be bell and spigot with rubber gaskets per ASTM D3212 or solvent weld except solvent weld joints may be used only where indicated on the drawings. Whole wye fittings shall be used at all connections to the system. Saddle type wyes will not be allowed. Tees will not be allowed in lieu of wye fittings.

## 2.04 POLYETHYLENE PIPE

A. Perforated Polyethylene Pipe:

1. Polyethylene underground drainpipe 4 through 30-inch diameter shall be high-density perforated polyethylene with a sock and corrugated exterior and interior. Manufacture and install per the following standards:
  - a. ASTM F 405, Standard Specification for Corrugated Polyethylene Pipe and Fittings.
  - b. AASHTO M 252, Standard Specification for Polyethylene Pipe and Fittings.
  - c. ASTM D 2321.
2. Polyethylene pipe shall be jointed with full sized factory fabricated couplings. Fittings shall be approved by pipe manufacturer for use with manufacturer's pipe.
3. Polyethylene pipe shall be jointed to other piping with transition couplings.
4. Pipe shall be suitable for trench and backfill depths and conditions as indicated in the Drawings and Section 02316.

B. Non-Perforated Polyethylene Pipe:

1. Polyethylene pipe larger than 27-inch diameter shall have corrugated exterior and smooth interior manufactured per ASSHTO M294 Type S specifications. Joints



1. Provide valves suitable to connect to adjoining piping as specified for pipe joints. Use pipe size valves.
2. Threaded for pipe sizes 2 inch and smaller.
  3. Flanged for exposed pipe sizes 2-1/2 inches and larger.
  4. Mechanical joint for buried pipe 3 inch and larger.
  5. Solder or screw to solder adapters for copper tubing.

B. Resilient Seated Gate Valves:

1. Conform to AWWA C509.
2. Use valves of one manufacturer insofar as practicable.
3. Pressure rating: AWWA 200 psi, except 16 and 20 inch AWWA C509 valves shall be 150 psi.
4. Body and gate material: Ductile or cast iron.
5. Bonnet: Bolted.
6. Stem and trim: Bronze.
7. Use type permitting repacking under pressure when wide open.
8. Packing: O-ring.
9. Stem arrangement: Non-rising stem with 2-inch operating nut for mechanical joint end valves; non-rising stem for flanged end valves.
10. Resilient seat: Applied to body or gate.
11. Direction of opening: Turn left to open.
12. Joint: Mechanical joint or flanged as specified for adjacent piping.
13. Lining: Epoxy-lined in accordance with AWWA C550.
14. Provide handwheel operator on exposed valves. Provide valve box for buried valves. Valves positioned 7 feet or more above floor level shall be equipped with chain-wheel with chain extending to 3 feet above floor.
15. Quality standard: Clow; Mueller; or equal.

C. Bronze Gate Valves:

1. Steel pipe systems:
  - a. Material: Bronze.
  - b. Material: Bronze.
  - c. Pressure class: 150.

D. Check Valves, Silent Type:

1. Globe style, flanged ends with full flow area greater than pipe size.
  2. Materials: Ductile or cast iron body, bronze trim, stainless steel spring and resilient seating.
  3. Manufacturer: APCO Series 600, or equal.

E. Combination Air Valves:

1. Function: Releases air accumulating at high point in water piping under pressure, and able to vent large volumes of air for filling and draining pipelines.

2. Working pressure: 150 psi maximum.
3. Connection sizes:
  - a. Inlet: 1 inch.
  - b. Outlet: 1 inch.
4. Orifice size: Size by manufacturer for individual application.
5. Materials:
  - a. Body: Cast iron.
  - b. Trim: Stainless steel.
6. Accessories:
  1. Isolating and drain valves: 150 lb globe valve with bronze body and Teflon disc and packing.
  2. Connecting pipe and union: Bronze, Schedule 40 threaded-type.
7. Manufacturer: APCO; ValMatic; or equal.
- F. Butterfly Valves:
  1. Type: Resilient seated, tight-closing, satisfactory for applications involving throttling service and long periods of inactivity.
  2. Valve bodies:
    - a. 3 through 18 inch: Cast iron or ductile iron conforming to requirements of AWWA C504, ASTM A126, Class B for flanged valves or ASTM A48, Class 40 for wafer style. Flanges valves shall be fully faced and drilled conforming to ANSI B16.1.
    - b. 24 through 72 inch: Cast iron ASTM A126, Class B, narrow body design, AWWA C504.
  3. Valve seats:
    - a. Water or wastewater: Buna N; thickness shall meet or exceed requirements of AWWA C504.
    - b. Air service: EPDM.
  4. Valve discs:
    - a. 3 through 18 inch: Disc shall be a lens-shaped design to afford minimal pressure drop and line turbulence. ASTM A126, Class B cast iron disc with a stainless steel type 316 edge. Discs shall be retained by stainless steel pins, which extend through the full diameter of the shaft to withstand the specified line pressure up to valve rating and the torque required to operate the valve.
    - b. 24 through 72 inch: Valve discs shall be constructed of either cast iron ASTM A48, Class 40 with a stainless steel seating edge or ductile iron

ASTM A536 with a stainless steel seating edge. Disc shall not have any hollow chambers that can entrap water. Disc and shaft connection shall be made with stainless steel pins.

5. Valve shafts:

- a. 3 through 18 inch: Valve shafts shall be of stainless steel type 304. At the operator end of the valve shaft, a packing gland utilizing "V" type chevron packing shall be utilized.
- b. 24 through 72 inch: All shafts shall be turned, ground, polished and constructed of 18-8 Type 304 or Type 316 stainless steel. Shafts shall be two-piece, stub type and keyed for actuator connection. Shaft diameters shall meet minimum requirements established by the latest revision of AWWA Standard C504 for their class, where applicable.

6. Valve bearings:

- a. 3 through 18 inch: Valve bearings shall be of a self-lubricating, non-metallic material to effectively isolate the disc-shaft assembly from the valve body. Metal-to-metal thrust bearings in the flow stream are not allowed.
- b. 24 through 72 inch: Valves shall be fitted with sleeve-type bearings. Bearings shall be corrosion resistant and self-lubricating. Bearing load shall not exceed 1/5 of the compressible strength of the bearing or shaft material.

7. Valve operators:

- a. Operating devices shall conform to requirements of AWWA C504.
- b. Operators shall be equipped with adjustable stop-limiting devices for both open and closed position.
- c. Valves positioned 7 feet or more above floor level shall be equipped with chain-wheel with chain extending to 3 feet above floor.

8. Hand lever operators:

- a. Levers shall be directly connected to valve shaft to provide full rotation from full-open to full-closed position.
- b. Levers shall be provided with a locking device to provide positive locking of disc in at least six positions.
- c. Operator shall include a position indicator.

9. Manual gear reduction type operators:

- a. Type: Worm gear or screw and traveling nut. Operating mechanism shall be totally enclosed, watertight, and gearing shall run in oil.
- b. Gearing and material requirements: Conform to requirements of AWWA C504.
- c. Operators: Self-locking to hold in any position.
- d. Handwheels or chain-wheels: Adequate size to require an operating force of

- e. 40 lb or less.  
Provide indicator to show position of valve disc.

10. Electric actuators:

- a. Locations: Intake water supply pipe; Research pump station supply pipe.
- b. Electrical: 460 volt, 3 phase.
- c. Enclosure: NEMA 4X, TENV.
- d. Motor Insulation: Class F.
- e. Gearing: Worm gear, quarter turn.
- f. Torque switches: Both ends of travel adjustable.
- g. Limit switches: 4 gear train, 16 contacts.
- h. Contact ratings: 5A.
- i. Local controls:

- 1) 3 push buttons: open, stop, close.
- 2) 2 indicating lights: open, close.
- 3) Local-off-remote selector switch with auxiliary contact for remote station.

j. Remote control station:

- 1) 3 push buttons: open, stop, close.
- 2) 2 indicating lights: open, close.

k. Remote access and monitoring from PLC:

- 1) 4-20 mA positioning signal.
- 2) 4-20 mA position feedback signal.

l. Manufacturer: Auma, or equal.

11. Design water service butterfly valves for maximum working pressure of 150 psi. Air service valves shall be designed for 250 degree F operating temperature and 20-psi minimum working pressure.

12. Manufacturer: DeZurik; Pratt; or equal.

G. Plug Valves:

- 1. Non-lubricated design with bolted bonnets; valve shall have full pressure rating both directions.
  - 2. Plug: Eccentric, resilient-faced plug.
  - 3. Bushings: Stainless steel upper and lower bushings.
  - 4. Seat: 90 percent nickel chrome raised seat welded in body.
  - 5. Body: Cast iron (semi-steel) conforming to ASTM A126 Class B.
  - 6. Packing:
    - a. Type permitting repacking without removing bonnet.

- b. Adjustable without disassembly of valve or actuator.
  - 7. End connections: 125 lb flanged.
  - 8. Operator:
    - a. 3-inch and less: Lever; provide extended stem where shown.
    - b. 4-inch and larger: Worm gear actuator suitable for 125-psi pressure. Valves positioned 7 feet or more above floor level shall be equipped with chain-wheel with chain extending to 3 feet above floor.
    - c. Provide buried valves with valve box, cover, and required adapters.
  - 9. Manufacturer: DeZurik; Clow; or equal.
- H. Ball Valves, PVC Piping:
- 1. Type: Full port, double-union, socket end connections except flanged or single-union where shown on Drawings.
  - 2. Material: PVC.
  - 3. Working pressure: Not less than 150 psi.
  - 4. Manufacturer: Nibco "Chemtrol;" or equal.
- I. Ball Valves, Metal Piping:
- 1. Type: Full port, double union.
  - 2. Materials:
    - a. Body and ball:
      - 1) Copper piping: Use oxygen shut-off valve, specified in 2.20.
      - 2) Stainless steel piping: Stainless steel.
    - b. O-rings, seals, packing: Teflon or Viton.
  - 3. Finish: All oxygen service valves shall be cleaned for oxygen.
- J. Oxygen Shut-off Valves:
- 1. Type: Quarter-turn, zero leakage, plug type.
  - 2. Materials:
    - a. Body and stem: Brass.
    - b. Seals: Teflon or Viton.
  - 3. Finish: Cleaned for oxygen.
  - 4. Generant Series SOV; or equal.
- K. Oxygen Solenoid Valves:
- A.
    - 1. Type: Normally closed, energize to open.

2. Materials:
  - a. Body: Bronze.
  - b. Seals: Viton.
- B. 3. Working pressure: 30 psig.
4. Cleaned for oxygen service.
- C. 5. Electrical:
  - a. NEMA 4 housing.
  - b. 120 volt ac.
6. Manufacturer: J.D. Gould Co. Model Q-3V-V, or equal.
- L. Needle Valves:
  1. Materials:
    - a. Body, stem, and knob: Brass.
    - b. Seals and packing: Teflon or Viton.
  2. Configuration: In-line.
  3. Adjustment: 32 threads per inch.
  4. Finish: Cleaned for oxygen.
  5. Generant Series 3000; or equal.
- M. Angle Type Float Valve:
  1. Service: Aerated and screened lake water.
  2. Function: Maintain water level within range of the float switch within service pump sump.
  - B. 3. Type: Hydraulically operated, pilot and float controlled, diaphragm-type angle valve with removable seat.
  4. Materials:
    - a. Main valve body and cover: Ductile iron.
    - b. Main valve trim: Bronze or stainless steel.
    - c. Pilot control system: Cast bronze with stainless steel trim, bronze fittings, copper tubing.
  5. Requirements:
    - a. Pressure class: 125 lb.
    - b. Ends: Flanged.
    - c. Valve closing on rising water level.
  6. Accessories:
    - a. Ejector pilot.

- b. Float control.
- c. Strainer on pilot supply line.
- d. Isolation valves on pilot lines.
- e. Pressure regulator and pressure gage on pilot supply line.

7. Manufacturer: Cla-Val Co. Model 129-01; or equal.

N. Back Pressure Valves:

- 1. Type: Diaphragm.
- 2. Materials:

- a. Body: PVC.
- b. Diaphragm: EPDM.
- c. Seals: EPDM.

3. Back pressure: Factory set to 5 psig.

- 4. Valve shall be adjustable by screw and spring.
- 5. Manufacturer: George Fischer Type V86, or equal.

O. Pressure Relief Valves:

- 1. Service: Water.
- 2. Function: Open upon an increase in pipeline pressure above a set pressure level.
- 3. Type: Hydraulically operated, pilot controlled, diaphragm-type globe-style valve with removable seat.
- 4. Materials:
  - a. Main valve body and trim: Ductile-iron.
  - b. Main valve trim: Bronze or stainless steel.
  - c. Pilot control system: Cast bronze with stainless steel trim, bronze fittings, copper tubing.
- 5. Requirements:
  - a. Pressure class: 125 lb.
  - b. Ends: Flanged.
  - c. Valve opens on high pressure, factory set pilot to 65 psig.
- 6. Accessories:
  - a. Pilot.
  - b. Strainer on pilot supply line.
  - c. Opening speed control.
- 7. Manufacturer: Cla-Val Co. Model 50-01; or equal.

2.08 PIPING APPURTENANCES

A. Hose Bibbs:

1. Location: Research Building service water system.
2. Provide with wheel handle and rough brass finish.
3. Mounting height: 18" above finish floor.
4. Provide vacuum breaker for each hose bibb.
5. Manufacturer: Nibco Co. Model No. 73CL, or equal.

B. Unions:

1. Provide for pipe assembly and to allow removal of connecting equipment.
2. Use: Pipe 2-inch and smaller; for larger piping use flanges or flexible couplings as specified or shown.
3. Oxygen service: Brass with viton seals, cleaned for oxygen service.

C. Pressure Regulators:

1. Location: Oxygen service.
2. Type: Venturi and spring design.
3. Materials:
  - a. Body and spring chamber: Brass.
  - b. Adjustment spring: Chrome vanadium.
  - c. Valve spring: Type 302 stainless steel.
  - d. Flange screws and locking nut: Stainless steel.
  - e. Seals: Viton.
  - f. Diaphragm: Viton on Nomex.
4. Inlet pressure rating: 400 psig.
5. Outlet pressure range: 0-55 psig, factory set for 30 psig.
6. Finish: Cleaned for oxygen service.
  7. Ports:
    - a. Inlet.
    - b. Outlet.
    - c. Inlet pressure gage.
    - d. Outlet pressure gage.
    - e. Provide pressure gages on inlet and outlet pressure gage ports.
8. Generant Series GDR; or equal.

D. Strainers:

1. Type: Oxygen service:
2. Screen size: 40 mesh.
3. Materials:
  - a. Screen: Monel.
  - b. Body: Bronze.

4. Orientation: Vertical.
5. Finish: Cleaned for oxygen service.
6. Hayward Model 85; or equal.

E. Orifice Meters:

1. Service: Oxygen gas:
  - a. Inlet pressure: 30 psig.
  - b. Temperature:
2. Type: Self-contained, orifice meter.
3. Materials:
  - a. Body: Bronze.
  - b. Seals: Viton.
4. Orientation: Flow vertically up, gage on right.
5. Gage:
  - a. Dial size: 3-1/2 inch diameter.
  - b. Units: SCFH.
  - c. Range: Low flow rate, 0-100 SCFH.
  - d. Mark gage with type of gas, specific gravity, line pressure, and temperature.
  - e. Provide correction charts for operating at other temperatures and pressures.
6. Finish: Cleaned for oxygen.
7. RCM Industries "Flo-Gage;" or equal.

F. Sleeve Couplings:

1. Construction: Steel middle ring, without pipe stop, 2 steel followers, 2 rubber compound wedge section gaskets suitable for maximum temperature of 240 degrees F, and required number of track-head steel bolts to properly compress gaskets.
2. Harness-type lugs, tie rods, and nuts shall be furnished and installed where shown on Drawings. Harness-type connections shall be capable of withstanding working pressure of 100 psi.
3. Provide gap of not less than 1 or more than 2 inches between ends of pipe.

G. PVC Tapping Saddles:

- A. 1. Location: Where tapping existing PVC pipe for heated water system.
- B. 2. Type: 4-bolt tapping saddle.
- C. 3. Materials:
  - a. Saddle: Schedule 80 PVC.
  - b. O-rings: EPDM.
  - c. Nuts, bolts, washers: Stainless steel.

4. Pressure rating: 200 psi.
5. Threaded connections shall be reinforced with stainless steel.
6. Piloted saddle to engage hole.

H. Tie Rods:

1. Tie rod assemblies shall conform to details shown on Drawings.
2. Steel plates and rods: ASTM A36.
3. Steel bolts: ASTM A325.
4. Welded lugs: Conform to requirements for welding as specified in ANSI B36.10.

I. Wall sleeves and mechanical seals:

1. Use wall sleeves on new construction where shown for pipes passing through floors, walls, or roof slabs. Core drill holes in existing concrete construction for pipes passing through floors, walls or slabs.
2. Materials: Cast iron or polyethylene with intermediate flange on piping 3 inches and larger; galvanized stainless steel pipe with anchor ring or lugs on piping smaller than 3 inch.
3. Sleeve length: Extend 2 inch above floors, flush with other surfaces.
4. Clearance: As recommended by seal manufacturer.
5. Seal: Mechanical, link-type, modular, field- assembled, insulating, positive-sealing; Thunderline/Leak Seal "Link-Seal," Advance Product & Systems, Inc.; or equal.
6. After seal is installed, place non-shrink grout over bolts in annular space between pipe and wall sleeve.

J. Pressure Gauges:

1. Liquid filled.
2. Materials:
  - a. Case and movement: Stainless steel.
  - b. Bourdon tube:
    - 1) Water service: Stainless steel.
    - 2) Oxygen service: Bronze, brass, or copper.
3. Minimum face diameter: 3-1/2-inches.
4. Accuracy to one percent of span.
5. Gages to read in feet (or psi) for water service and psi for oxygen service.
6. Series 540 Liquid-Filled Gauges, US Gauge Division, Ametek; or equal.
7. Gauges shall be resistant to the liquids carried by the pipelines on which they are mounted.
8. All gauges shall be installed with a restricting device to dampen the effects of rapid pressure fluctuations. A stainless steel or bronze filter type pressure snubber shall be installed between the gauge and the ball valve, which is installed to isolate the gauge should repairs be required.

- K. Valve Boxes:
1. Provide valve box for each buried valve.
  2. Valve box shall be complete, assembled unit consisting of adjustable box and extension stem with 2 inch square operating nut.
  3. Box section: Hand-adjustable to required depth through coupling gland with O-ring seal.
  4. Stem assembly: Telescoping design with torque capacity of 1,000 ft-lb.
  5. Equip lower end of box with self-centering alignment ring to center box over valve nut.
  6. Lid shall drop into valve box top, rotate 90 degrees to retain, and lock in place with single bolt.
  7. Arrange entire assembly to prevent dirt and grit from entering valve box assembly.
  8. Lid shall be marked "Water" or "Sewer," as appropriate, and have directional arrow for open rotation.
  9. Materials:
    - a. Valve box, base, alignment ring, and top: High-density polyethylene.
    - b. Extension steel: Galvanized steel tubing.
    - c. Bolts and screens: Stainless steel.
    - d. Lid: Cast iron.
10. Manufacturer: American Flow Control "Trench Adapter," or equal.
- L. Thrust Restraint: All caps, tees and bends in water supply pipe of buried steel, ductile-iron or PVC piping having a deflection of 11-1/4 degrees or greater shall be provided with thrust restraint. Restraint may be provided thru the type of joint, restraint rods or thrust blocks and shall be capable of sustaining the test and operating pressures of the piping system plus 50 percent.
- M. Tracer Tape and Identification Tape: All buried nonferrous piping shall be laid with detectable tracer tapes. All buried ferrous metal piping shall be laid with plastic identification tape. Tapes shall be buried above and parallel to the pipe throughout its buried length. Tape shall be continuous and be located on the centerline 12 inches above the top of the pipe or as recommended by the manufacturer, and shall be labeled the same as the piping system.
- N. Flexible Couplings (For Gravity Drain Pipe Larger Than 12-inch diameter): Flexible couplings for jointing gravity drain pipe larger than 12-inch diameter to pressure pipe sizes shall be elastomeric PVC with stainless steel bands and screws.

## PART 3 - EXECUTION

### 3.01 PREPARATION

- A. Verification of measurements:
1. Before fabrication, verify measurements at Site, including actual location of existing piping and equipment connections and verification of flange facings and drillings to which piping connects.
  2. Make field measurements necessary to accurately determine piping make-up lengths

or closures and to permit working piping into place without forcing or springing.

- B. Adequately protect surrounding work so as to prevent damage during installation.

### 3.02 BURIED PIPE INSTALLATION

- A. Prepare trench in accordance with Section 02316.
- B. Minimum earth cover: 5 feet, unless shown otherwise.
- C. Clean pipe interior of foreign material before lowering into trench; keep clean at all times by securely closing open ends of pipe and fittings.
- D. Lay pipe in the dry.
- E. Handle pipe and accessories in manner to ensure delivery to trench in sound, undamaged condition; take particular care not to injure pipe coating or cement lining.
- F. Cut pipe using tools and methods which do not damage pipe ends.
- G. Carefully protect joint material from injury while handling and storing pipe; keep weight off joint material on spigot; use no pipe with joints deformed, gouged, or otherwise impaired.
- H. Pipe damaged or unsound will be rejected; before installation of ductile iron pipe, tap with light hammer to detect cracks.
- I. Use suitable fittings where grade or alignment requires offsets greater than manufacturer's recommended joint deflections.
- J. Plug or cap and block pipe ends or fittings left for future connections.
- K. Uncover existing pipe, to which connections are to be made, sufficiently ahead of pipe laying operations to determine fittings required.
- L. Make connections between existing and new pipe with specials and fittings to suit actual conditions.
- M. Follow recommendations of pipe manufacturer.
- N. Install polyethylene encasement of buried ductile iron pipe in accordance with AWWA C105.

### 3.03 THRUST RESTRAINTS

- A. Provide thrust restraints by restrained joints where buried pressure piping changes direction, changes size, and at deadends.
- B. Install thrust restraint for lengths of pipe shown on Drawings.
- C. Installation methods shall be in accordance with manufacturer's recommendations.

### 3.04 INSTALLATION OF EXPOSED PIPE NOT DETAILED

- A. Install essentially as indicated and required; modify as required to clear building structure and openings, lights, ducts, and other services.
- B. Route parallel to building lines and other piping.
- C. Provide sufficient unions and flanged connections to permit dismantling and removing equipment.
- D. Spacing: Adequate to permit servicing valves and specialties, and replacing sections of pipe.
- E. Grade: Slope to permit complete draining.
- F. Flexibility: Prevent excessive forces or moments on equipment.
- G. Vent and drain valves:
  - 1. Provide vents at high points and drains at low points of water piping.
  - 2. Vent valves: 1/4-inch globe.
  - 3. Drain valves:
    - a. Concealed piping and exposed piping in finished spaces: 1/2-inch hose bibb.
    - b. Piping 2 inches and smaller: 1/2-inch globe.
    - c. Piping 2-1/2 through 5 inches: 3/4-inch globe.
    - d. Piping 6 inch and larger: 1-1/4-inch globe.
  - 4. Route discharge from vent and drain valves, except hose bibbs, to nearest floor or equipment drain.

### 3.05 PIPE JOINTS AND METHODS

- A. Welding:
  - 1. Metallic arc process, in accordance with ANSI/ASME B31.1.
  - 2. Shielded arc or coated electrodes specifically designed for pipe material.
  - 3. Use only 1 welding operator on each joint.
  - 4. Thoroughly grind or wire brush each weld pass and remove welding slag and defective material before next pass is applied.
  - 5. Welds shall be neat; remove excessive spatter by chipping or grinding.
  - 6. Welding operator shall stamp pipe adjacent to weld with its identifying symbol; submit list of symbols used on Project with corresponding operator names.
- B. Threaded Joints:
  - 1. Thread type: ANSI B2.1 taper pipe thread.
  - 2. Clean-cut threads; ream pipe ends and remove burrs.



- A. Refer to Section 15061 for pipe support spacing.
- B. Devices in contact with copper piping shall be copper plated.
- C. Arrange hangers for adjustment of load and pipe elevation after installation.
- D. Furnish and install auxiliary structural steel members required for support of piping.

### 3.09 CLEANING

- A. Remove foreign material from pipe before erection.
- B. Close ends of partially erected systems.
- C. Remove temporary preservative coatings from valves and accessories.
- D. Flush or otherwise clean systems after erection, but before connecting to existing system.
- E. Oxygen system:
  - 1. Flush all lines with water to remove dust, dirt and foreign particles.
  - 2. Flush all lines again with a hot solution of sodium carbonate or trisodium phosphate to remove all oil, grease and other oxidizable materials.
  - 3. Flush thoroughly with clear water.
  - 4. Drain all water and blow clean with dry, compressed nitrogen.

### 3.10 TESTS AND INSPECTIONS

- A. General
  - 1. CONTRACTOR shall notify the IDNR Construction Inspector at least 48 hours prior to testing . The IDNR Construction Inspector must be present at all times.
  - 2. CONTRACTOR shall furnish all labor, tools and equipment for testing, including compressed nitrogen, piping, valves, temporary caps and supports.
  - 3. Pressure gages used shall be graduated in increments not greater than 5 psi and shall have a range of approximately twice the test pressure. Use only recently calibrated gages and instruments.
  - 4. CONTRACTOR shall make all arrangements and pay all costs incidental to furnishing and conveying water for test purposes.
  - 5. CONTRACTOR shall install adequate blocking or other means of resisting test pressure. It shall be the CONTRACTOR's responsibility to adequately block or otherwise support all factory-attached caps. Any damage resulting from or caused by these tests shall be repaired at the CONTRACTOR's expense.
  - 6. Under no condition shall air be allowed to be pumped into the line to bring up to test pressure.
  - 7. Prior to testing, remove from systems all equipment that would be damaged by test pressure. Replace removed equipment after testing. Systems may be tested in sections as work progresses; however, any previously tested portion shall become a part of any later test of the composite system if so directed by the IDNR. Using approved methods, correct leaks by remaking joints with new material. Test time

will be accrued only while full test pressure is on system.

8. Testing of pipelines shall be done as nearly as possible in completed runs, or to a convenient cut off, to enable all outlets of the run to be plugged or capped.
9. Selection of test runs shall be reviewed by the IDNR Construction Inspector to assure that the desired test coverage can be obtained.
10. All leaks shall be repaired or defective material replaced and the test repeated.
11. Complete all testing and secure approval of the IDNR Construction Inspector before backfilling or concealing lines.

B. Exposed ductile iron, PVC, copper and steel piping:

1. Remove air before tests; insert taps if necessary.
2. Plug or cap openings.
3. Test hydrostatically at pressures specified.
4. Duration of test: 1 hour.
5. Maximum allowable pressure drop during test period: 5 psi or 10 percent of test pressure whichever is smaller.

C. Buried ductile iron piping: Test in accordance with AWWA C600.

D. Gravity drain lines: Plug lower end of section to be tested and all trench drains. Then apply a 4-foot static head measured at the highest point to the test section for a period of 2 hours. There shall be zero leakage. Where any leakage is discovered before completion and acceptance of the line, repair, and, if necessary, re-lay the line until the leakage is reduced to a quantity within the specified amount. If the leakage is less than the specified amount, stop any visible leaks.

E. Low pressure buried process water supply lines:

1. Fill line with water. Eliminate all air.
2. Maintain pressure of 25 psi on the portion being tested for a minimum period of 2 hours with zero loss of pressure, after the section has been filled with water for a period of at least 24 hours. Maintain pressure by either hydraulic or pneumatic means. Visible leakage, other than a minor amount of sweating, shall require immediate stoppage of the test and repair of the joints so when pressure is again put on the system, there shall be no leakage.
3. Do not use paints, asphalts, tars, or other types of pipe compounds to eliminate leaks.
4. Replace leaking fittings, valves, nipples, or lengths of pipe.

F. Air piping: Test pneumatically, in accordance with ANSI B31.1.

G. Oxygen piping: Test entire system to 75 psi for 2 hours with no pressure drop. All testing shall be done with compressed nitrogen.

H. Other piping: Test hydrostatically, in accordance with ANSI B31.1.

I. Provide pumps, compressors, meters, gages, piping, fittings, accessories, and labor required to conduct tests.

- J. Isolate equipment that would be damaged by test pressure.
- K. Refit joints indicating leakage.
- L. Replace defective pipe, fittings, and accessories.
- M. Conduct test in presence of IDNR Construction Inspector.
- N. Piping shall be anchored sufficiently to withstand test pressure.

3.11 DISINFECTION

- A. Disinfect potable water piping and equipment containing potable water.
- B. Disinfect by injecting solution of calcium hypochlorite and water at slow rate; concentration of solution shall provide minimum residual chlorine content of 25 ppm. System shall stand full of solution for not less than 24 hours.
- C. Minimum chlorine residual at pipe extremities: 10 ppm at end of disinfection period.
- D. Operate valves in line to assure full disinfection.
- E. Repeat disinfection procedure if test indicates less than required residual.
- F. Thoroughly flush lines after disinfection until extremities indicate same chlorine residual as supply water.
- G. CONTRACTOR shall submit 2 bacteriological samples on 2 consecutive days to approved laboratory. Do not put system into operation until results of tests are satisfactory.

3.12 PROTECTION

- A. Provide adequate protection for completed Work prior to acceptance.

END OF SECTION 15220

PART 1 - GENERAL

1.01 SECTION INCLUDES:

- A. Metal ductwork.

1.02 REFERENCES:

- A. ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2002a.
- B. SMACNA (DCS) - HVAC Duct Construction Standards - Metal and Flexible; Sheet Metal and Air Conditioning Contractors' National Association; 1995, Second Edition with Addendum No. 1.

1.03 PERFORMANCE REQUIREMENTS:

- A. No variation of duct configuration or sizes permitted except by written permission. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts.

1.04 SUBMITTALS:

- A. Shop Drawings: Indicate duct fittings, particulars such as gages, sizes, welds, and configuration prior to start of work for 1.0 pressure class and higher systems.
- B. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Galvanized Steel Ducts: Hot-dipped galvanized steel sheet, ASTM A 653/A 653M FS Type B, with G90/Z275 coating.
- B. Insulated Flexible Ducts:
  - 1. Two ply vinyl film supported by helically wound spring steel wire; fiberglass insulation; polyethylene vapor barrier film.
    - a. Pressure Rating: 10 inches WG positive and 1.0 inches WG negative. b. Maximum Velocity: 4000 fpm.
    - c. Temperature Range: -10 degrees F to 160 degrees F.

2.02 DUCTWORK FABRICATION:

- A. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- B. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows must be used, provide air foil turning vanes. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fiber insulation.
- C. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- D. Fabricate continuously welded round and oval duct fittings two gages heavier than duct gages indicated in SMACNA Standard. Joints shall be minimum 4 inch cemented slip joint, brazed or electric welded. Prime coat welded joints.
- E. Provide standard 45 degree lateral wye takeoffs unless otherwise indicated where 90 degree conical tee connections may be used.
- F. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide blank-out panels sealing louver area around duct. Use same material as duct, painted black on exterior side; seal to louver frame and duct.

2.03 DUCT MANUFACTURERS:

- A. Metal-Fab, Inc: [www.metal-fabinc.com](http://www.metal-fabinc.com).
- B. SEMCO Incorporated: [www.semcoinc.com](http://www.semcoinc.com).
- C. United McGill Corporation: [www.unitedmcgill.com](http://www.unitedmcgill.com).

2.04 MANUFACTURED METAL DUCTWORK AND FITTINGS:

- A. Manufacture in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- B. Double Wall Insulated Round Ducts: Round spiral lockseam duct with galvanized steel outer wall, 1 inch thick fiberglass insulation, perforated galvanized steel inner wall; fitting with solid inner wall.

PART 3 - EXECUTION

3.01 INSTALLATION:

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

- B. Duct sizes indicated are actual sheetmetal sizes.
- C. Install and seal metal and flexible ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- D. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- E. Use double nuts and lock washers on threaded rod supports.
- F. Connect terminal units to supply ducts with one foot maximum length of flexible duct. Do not use flexible duct to change direction.
- G. Connect diffusers or light troffer boots to low pressure ducts with 5 feet maximum length of flexible duct held in place with strap or clamp.
- H. Connect flexible ducts to metal ducts with draw bands.
- I. Provide residue traps in kitchen hood exhaust ducts at base of vertical risers with provisions for clean out.
- J. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

3.02 SCHEDULES:

- A. Ductwork Material:
  - 1. Low Pressure Supply (Heating Systems): Galv. Steel.
  - 2. General Exhaust: Galv. Steel, Aluminum.
  - 3. Outside Air Intake: Galv. Steel.
- B. Ductwork Pressure Class:
  - 1. Supply (Heating Systems): 1 inch
  - 2. General Exhaust: 1 inch.
  - 3. Outside Air Intake: 1 inch.

END OF SECTION 233113

