

SECTION 05500

METAL CASTINGS AND FABRICATIONS

PART 1 GENERAL

1.01 SUMMARY

- A. This section addresses the acceptable products, materials, manufacture, fabrication and installation of metal castings and metal fabrications for use in the storm sewer collection systems and includes but is not limited to the following:
1. Cast manhole frames, rings, and covers
 2. Cast frames and grates for curb inlets, other inlets, and catch basins.
 3. Fabricated, welded, metal frames, covers, and grates.
 4. Fabricated, welded, trash racks for openings and end sections.
 5. Safety grates.
 6. Ladders
 7. Stop logs and stop log slots.
 8. Pipe railings and guard rails.
 9. Miscellaneous fabricated metal inserts and assemblies for storm water treatment, inlet and outlet structures.
- B. Related work specified elsewhere:
1. Reinforced Concrete Pipe for Storm Sewers: Section 02615.
 2. High Density Polyethylene (HDPE) Pipe for Storm Sewers: Section 02622.
 3. Polyvinyl Chloride (PVC) Pipe for Storm Sewers: Section 02622.
 4. Trenching, Bedding, Backfilling and Compacting: Section 02221.
 5. Testing of the Storm Sewer System: Section 01666.
 6. Manholes: Section 02605.
 7. Cast-in-place Concrete: Section 03300.
 8. Precast Concrete: Section 03400.
 9. Storm Sewer Collection Systems: Section 02722.
 10. Manhole steps: Section 02605
- C. Measurement and Payment Procedures.
1. For public funded capital improvement projects measurement and payment procedure will be determined on a project by project basis.
 2. For privately funded development projects, Owner will determine measurement and payment requirements.

1.02 REFERENCES

- A. Aluminum Association
1. AA SAS-30 Aluminum Structures Construction Manual Series – Section 1 Specifications for Aluminum Structures.
- B. AMERICAN NATIONAL STANDARDS INSTUTUE (ANSI)
1. ANSI A 14.3 Ladders – Fixed – Safety Requirements.
 2. ANSI MBG 531 Metal Bar Grating Manual.

C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

1. ASTM A 6 General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use.
2. ASTM A 36 Carbon Structural Steel
3. ASTM A 48/A 48M Specification for Gray Iron Castings.
4. ASTM A 53 Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
5. ASTM A 123 Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
6. ASTM A 153 Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
7. ASTM A 276 Stainless and Heat-Resisting Steel Bars and Shapes.
8. ASTM A 307 Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
9. ASTM A 325 Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
10. ASTM A 380 Cleaning and Descaling Stainless Steel Parts, Equipment, and Systems.
11. ASTM A 500 Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
12. ASTM A 536 Specification for Ductile Iron Castings.
13. ASTM A 563 Specification for Carbon and Alloy Steel Nuts.
14. ASTM A 564 Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes.
15. ASTM A 569 Specification for Steel, Carbon (o.15 Maximum, Percent), Hot-Rolled Sheets and Strip Commercial Quality.
16. ASTM A 572 Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
17. ASTM A 1011 Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
18. ASTM B 26/B 26M Specification for Aluminum-Alloy Sand Castings.
19. ASTM B 221 Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes
20. ASTM B 308 Aluminum-Alloy 6061-T6 Standard Structural Shapes.
21. ASTM F 593 Stainless Steel Bolts, Hex Cap Screws, and Studs.
22. ASTM F 594 Stainless Steel Nuts
23. ASTM B 429 Aluminum-Alloy Extruded Structural Pipe and Tube.
24. ASTM A 780 Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
25. ASTM E 32 Practices for Sampling Ferrous Alloys and Steel Additives for Determination of Chemical Composition.
26. ASTM F 436 Specification for Hardened Steel Washers.

D. ASME INTERNATIONAL (ASME)

1. ASME B 18.2.2 Square and Hex Nuts (Inch Series).
2. ASME B 18.6.3 Machine Screws and Machine Screw Nuts.
3. ASME B 18.21.1 Lock Washers (Inch Series).
4. ASME B 18.22.1 Plain Washers.

E. NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

1. NAAMM MBG 531 Metal Bar Grating Manual.
2. NAAMM MBG 532 Heavy Duty Metal Bar Grating Manual.

F. AMERICAN WELDING SOCIETY (AWS)

1. AWS C 5.5 Recommended Practices for Gas Tungsten Arc Welding.
2. AWS D 1.1 Structural Welding Code-Steel.
3. AWS D 1.2 Structural Welding Code-Aluminum.

- G. U.S. DEPARTMENT OF LABOR, OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA).
 - 1. OSHA 29 CFR 1910 OSHA Safety and Health Standard for General Industry.
- H. Where reference is made to one of the above standards, the latest revision shall apply.

1.03 PERFORMANCE REQUIREMENTS

- A. Structural Performance for handrails, guardrails and nontraffic hatches and hinges. Provide items capable of withstanding the effects of gravity loads and stresses within limits and under conditions indicated:
 - a. Meet requirements of OSHA Standard 1910.23.
 - b. Uniform load of 50 lbf. /ft. applied in any direction.
 - c. Concentrated load of 200 lbf. applied in any direction.
 - d. Uniform and concentrated loads need not be assumed to act concurrently.
- B. Structural Performance of all manhole rings and covers, inlet rings and grates, catch basin frames and grates and hatches and hinges subjected to street, highway or maintenance vehicles shall be capable of withstanding a HS20 wheel load.
- C. Trash racks, safety grates and other metal drainage fabrication and assemblies shall be capable of withstanding all anticipated and design loads without failure or excessive deflection that would impare operation or safety.
- D. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.04 SUBMITTALS

- A. Detail drawings for castings, grates, fabrications, metalwork and machine work shall be submitted and approved prior to fabrication.
- B. Materials list for castings and fabricated items shall be submitted at the time of submittal of detail drawings.
- C. Schedules of welding procedures shall be submitted and approved prior to commencing fabrication.
- D. Certified test reports for materials shall be submitted prior to material delivered to the site.
- E. Certifications for welders and welding operators shall be submitted prior to commencing fabrication.

1.05 METALWORK AND MACHINE WORK DETAIL DRAWINGS

- A. Detail drawings for castings, fabrications, metalwork and machine work shall include catalog cuts, templates, fabrication and assembly details and type, grade and class of material as appropriate. Detail drawings shall show maximum allowable imposed loads and design capacities of each casting or fabrication. Elements of fabricated items inadvertently omitted on contract drawings shall be detailed by the fabricator and indicated on the detail drawings.

1.06 QUALIFICATION OF WELDERS AND WELDING OPERATORS

- A. The Contractor shall certify that the qualification of welders and welding operators and tack welders who will perform welding have been qualified for the particular type of work to be done in accordance with the requirements of AWS D 1.1 and AWS D 1.2.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Items shall be stored in a dry location with spacers to separate the pieces from the ground and each other and in a manner to prevent damage.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Miscellaneous Metals and Standard Articles
 - 1. Structural Steel.
 - a. ASTM A 36, or ASTM, A 572, Grade 50, as indicated. Galvanized after fabrication.
 - 2. Steel Tubing.
 - a. ASTM A 500, Grade B, welded, outside dimensions and nominal wall thickness as shown. Galvanized after fabrication.
 - 3. Steel Pipe and Pipe Fittings.
 - a. ASTM A 53, Type E, Grade B, electric-resistance welded, galvanized, nominal size and weight class or outside diameter and nominal wall thickness as shown with plain ends.
 - 4. Bars and Shapes
 - a. Stainless steel bars and shapes shall conform to the following as specified or shown:
 - 1) ASTM A 276, UNS S30400, Condition A, hot-finished or cold-finished. Class C.
 - 2) ASTM A 564, UNS S17400 OR S45000, age-hardened heat treatment condition, hot-finished or cold-finished, Class C.
 - 5. Bolts, Nuts, and Washers
 - a. Bolts, nuts, and washers shall be of the material, grade, type, class, style and finish indicated or best suited for intended use.
 - 1) High-Strength Bolts, Nuts, and Washers. Bolts: ASTM A 325, Type 1, hot-dip galvanized. Nuts: ASTM A 563, hot-dip galvanized.
 - b. Bolts, Nuts, and Washers (Other than High-Strength)
 - 1) Bolts and Nuts: ASTM A 307, Grade A, hot-dip galvanized.
 - 2) Bolts: ASME B 18.2.1, or where shown stainless steel ASTM F 593.
 - 3) Nuts: ASME B 18.2.2, or where shown stainless steel ASTM F 594.
 - 4) Washers
 - a) Plain Washers: ASME B 18.22.1, Type B
 - b) Lock Washer: ASME B 18.21.1.
 - c) Beveled Washers: ASTM F 436, Beveled.
 - 6. Screws
 - a. Screws shall be of the material, grade, type, style, and finish indicated or best suited for use intended.
 - 1) Machine Screws
 - a) ASME B 18.6.3.
 - 7. Welded Shear Studs
 - a. ASTM E 32, minimum yield strength of 50 ksi, minimum ultimate strength of 55 ksi.
 - 8. Welding Electrodes

- a. AWS D 1.1, E 70 Series or as required by AWS Specifications.
 9. Aluminum
 - a. ASTM B 308 Alloy 6061-T 6, 20,000 psi tensile yield strength minimum.
 - b. ASTM B 221 and ASTM B 429 for bars, rods, wires, pipes and tubes. Electrodes for welding aluminum: AWS D 1.2, filler alloy 4043 or 5356.
 10. Embedded Anchor Bolts, Expansion Anchor Bolts, Adhesive Anchor
 - a. Material: ASTM F 593 Stainless steel, Type 304 or 316. Provide Type 316 unless noted otherwise. Provide minimum edge distance cover and spacing as recommended by manufacturer, or as indicated on Drawings whichever is larger. Depth of embedment: minimum embedment as recommended by manufacturer or nine diameters of bolt, whichever is larger. Follow manufacturer's recommendations for installation, torque, and capacity. Submit manufacturer's load test data to verify the anchor bolt capacities at various embedment depths.
 11. Galvanizing Repair Paint
 - a. High zinc dust content paint for regalvanizing welds and abrasions. Dried film shall contain not less than 83 percent zinc dust by weight.
- B. Cast Rings, Frames, Covers and Grates
1. Castings shall be cast gray iron, ASTM, A/48 M, Class 35 B; cast ductile iron, ASTM A 536, Grade 65-45-12; or cast aluminum, ASTM B 26, Alloy 356.0T6. Model and material shall be as indicated on the Drawings.
 2. Minimum weight of ring and cover shall be 350 pounds with a 22 inch minimum clear opening.
 3. Provide machined, non-rocking bearing surfaces between rings and covers or grates.
 4. Solid covers should be consistent with City of Loveland detail SW-6B.
 5. Only one pick hole vent on a cover.
 6. Openings in grates shall be sized to prevent a safety hazard to bicycle and pedestrian traffic.
 7. Total area of openings in grates shall be sized to meet design capacity and head requirements in accordance with current Drainage Criteria.
- C. Manufactured Units
1. Steel Grating, Trash Rocks, and Safety Grates.
 - a. ANSI MBAG 531, NAAMM MBG 531, or NAAMM MBG 523 as required by required load carrying capacity. Grating Cross bars: Welded, swagged or pressure locked to bearing beam, maximum spacing 4 inches on center. Top edges of bars: Smooth unless shown otherwise on the Drawings. Individual grating sections: not wider than 3 feet. Finish: Hot-dip galvanized. Clips and bolts: Stainless steel or hot-dip galvanized, minimum 4 per grate section. Ends and perimeter edges: No banding required except where shown on the Drawings. Openings through grating: Reinforced to provide required load carrying capacity.
 2. Stoplogs
 - a. Stoplogs shall be fabricated from aluminum tubes to the dimensions indicated on the drawings. Rubber seals shall be bonded to the stoplogs as indicated on the drawings with an adhesive recommended by the manufacturer of the seal material, and as approved, and suited to the use intended. The pads shall also be attached with screws to the stoplogs as indicated on the drawings.
 3. Ladders
 - a. As specified in ANSI A 14.3 and OSHA Standard 1910.23.
 - b. Ladders and inserts shall be galvanized after fabrication.
 - c. Install only in locations accepted by the Stormwater Utility in manholes 12 feet or greater in depth.

2.02 FABRICATION

- A. Pipe Railings, Guard Rails, Trash Rocks, Safety Grates and other Pipe and Tube Fabricated Items.
 - 1. General: Fabricate to comply with design, dimensions, and details indicated.
 - 2. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
 - 3. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings.
 - 4. Form changes in direction by bending, or by inserting prefabricated elbow fittings.
 - 5. Form curves by bending in jigs to produce uniform curvature; maintain cross section of member throughout bend without cracking or otherwise deforming exposed surfaces.
 - 6. Close exposed ends of members with prefabricated end fittings.
 - 7. Provide wall returns at ends of wall-mounted handrails, unless otherwise indicated.
 - 8. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect members to other work, unless otherwise indicated.

- B. Drainage Grates, Trash Racks, Safety Grates, Ladders and other bar or Structural Fabricated Items.
 - 1. Preassemble items in the shop to greatest extent possible. Use connections that maintain structural value of joined pieces.
 - 2. Cut, drill and punch metals cleanly and accurately. Remove burrs and ease edges. Remove sharp or rough areas on exposed surfaces.
 - 3. Weld corners and seams continuously. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals. Obtain fusion without undercut or overlap. Remove welding flux immediately. Finish exposed welds smooth and blended.
 - 4. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Locate joints where least conspicuous.
 - 5. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
 - 6. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, not less than 24 inches o.c.

- C. Miscellaneous Framing and Supports
 - 1. Provide steel framing and supports not specified in other Sections as needed to complete the Work. Fabricate units from steel shapes, plates, and bars of welded construction. Cut, drill, and tap units to receive hardware, hangers, and similar items.
 - a. Fabricate steel girders, and beams from continuous steel shapes.
 - b. Fabricate steel pipe columns with steel baseplates and top plates welded to pipe with fillet welds the same size as pipe wall thickness.
 - c. Provide framing and supports of size needed to support imposed loads without excessive deflection to impede intended function, safety or cause failure.

- D. Stoplog Grooves and Sill
 - 1. Extra care shall be taken in the fabrication and installation of the stoplog grooves and sills to ensure that leakage is kept to a minimum. If leakage is excessive and misalignment of the grooves and/or sills, or their component parts, is a contributing factor to the leakage, the Contractor shall propose corrective measures and shall implement corrective measures at no additional cost to the Government. Stoplog groove and end sill surfaces in contact with concrete shall be coated with a bonding agent equal to Sika Armatec 110.

- E. Welding of Steel
 - 1. Welding Procedures for steel shall be as described in AWS D 1.1. The welding schedule shall conform to the requirements specified in the provisions AWS D 1.1.

2. Welding Process – Welding of steel shall be by an electric arc welding process using a method which excludes the atmosphere from the molten metal and shall conform to the applicable provisions of AWS D 1.1. Welding shall be such as to minimize residual stresses, distortion and shrinkage.
 3. Welding Technique and Workmanship
 - a. Filler Metal – The electrode, electrode-flux combination and grade of weld metal shall conform to the appropriate AWS specification for the base metal and welding process being used or shall be as shown where a specific choice of AWS specification allowables is required.
 - b. Preheat and Interpass Temperature – Preheating shall be performed as required by AWS D 1.1.
 - c. Stress – Relief Heat Treatment – Where stress relief heat treatment is specified or shown, it shall be in accordance with the requirements of AWS D 1.1.
 - d. Workmanship for welding shall be in accordance with AWS D 1.1.
- F. Welding of Aluminum
1. Welding of aluminum shall conform to AA SAS – 30 or AWS D 1.2. The welding process and welding operators shall be prequalified as required by AWS D 1.2. A complete schedule of the welding process for each aluminum fabrication to be welded shall be furnished for approval.
- G. Bolted Steel Connections
1. Bolt Holes – Bolt holes shall be accurately located, smooth, perpendicular to the member and cylindrical. Do not make or enlarge holes by burning.
 - a. Holes for bolts shall be drilled or subdrilled and reamed in the shop and shall not be more than 1/16 inch larger than the diameter of the bolt.
 - b. Poor matching of holes will be cause for rejection. Drifting occurring during assembly shall not distort the metal or enlarge the holes. Reaming to a larger diameter of the next standard size bolt will be allowed for slight mismatching.
- H. Bolted Aluminum Connections
1. Punching, drilling, reaming and bolting for bolted aluminum connections shall conform to the requirements of AA SAS – 30, Section 6.
- I. Unfinished Surfaces
1. All work shall be laid out to secure proper matching of adjoining unfinished surfaces unless otherwise directed. Where there is a large discrepancy between adjoining unfinished surfaces they shall be chipped and ground smooth or machined to secure proper alignment. Unfinished surfaces shall be true to the lines and dimensions shown and shall be chipped or ground free of all projections and rough spots. Depressions or holes not affecting the strength or usefulness of the parts shall be filled in an approved manner.
- J. Metallic Coatings
1. Zinc Coatings – Zinc coatings shall be applied after fabrication in a manner and of a thickness and quality conforming to ASTM A 123 or ASTM A 153. Where zinc coatings are destroyed by cutting, welding or other causes the affected areas shall be regalvanized. Coatings 2 ounces or heavier shall be regalvanized with a suitable low-melting zinc base alloy similar to the recommendations of the American Hot-Dip Galvanizers Association to the thickness and quality specified for the original zinc coating. Coatings less than 2 ounces shall be repaired in accordance with ASTM A 780.
- K. Shop Assembly
1. Each unit furnished shall be assembled in the shop to determine the correctness of the fabrication and matching of the component parts unless otherwise specified. Tolerances shall not exceed those shown.

2.03 INSPECTIONS, AND VERIFICATIONS

- A. The Contractor shall submit certifications by an approved laboratory to demonstrate that materials are in conformity with the specifications. These certifications shall be at the Contractor's expense.
- B. Visual Examination
 - 1. Completed welds shall be cleaned and carefully examined for insufficient throat or leg sizes, cracks, undercutting, overlap, excessive convexity or reinforcement and other surface defects to ensure compliance with the requirements of AWS D 1.1.
- C. Welding Repairs
 - 1. Defective welds in the steel welding shall be repaired in accordance with AWS D 1.1. Costs of the repairs shall be borne by the Contractor.

PART 3 EXECUTION

3.01 INSTALLATION

- A. General: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, with edges and surfaces level, plumb, and true.
 - 1. Fit exposed connections accurately together. Weld connections that are not to be left as exposed joints but cannot be shop welded. Do not weld, cut or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication.
 - 2. Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction.
 - 3. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- B. Set bearing and leveling plates on cleaned surfaces using wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts and pack solidly with nonshrink, nonmetallic grout.
- C. Alignment and Setting
 - 1. Each unit shall be accurately aligned by the use of steel shims or other approved methods so that no binding or distortion of any member occurs before it is fastened in place. The alignment of all parts with respect to each other shall be true within the respective tolerances required.
- D. Blocking and Wedges
 - 1. All blocking and wedges used during installation for the support of parts to be grouted in foundations shall be removed before final grouting unless otherwise directed. Blocking and wedges left in the foundations with approval shall be of steel or iron.
- E. Expansion Anchor Bolts and Adhesive Anchor Bolts
 - 1. Install in strict accordance with manufacturer's instructions for hole size, hole cleaning, installation, torque requirements substrate temperature and curing. Use only carbide-tipped drilling equipment.
- F. Steel Grating
 - 1. Attach grating to end and intermediate supports with grating saddle clips and bolts. Maximum spacing: at 2 Feet on-centers with a minimum of two per side. Attach individual units of grating together with clips at 2 feet on centers maximum with a minimum of two clips per side.

3.02 PROTECTION OF FINISHED WORK

A. Cleaning

1. Surfaces shall be thoroughly cleaned of foreign matter. All finished surfaces shall be protected by suitable means.

B. Galvanized Surfaces

1. Repair damaged galvanized surfaces in accordance with ASTM A 780. Prepare damaged surfaces by abrasive blasting or power sanding. Apply galvanizing repair paint in accordance with manufacturer's instructions. Minimum thickness: larger of 6 mils DFT or manufacturer's standard.

3.03 TESTS

A. Workmanship

1. Workmanship shall be of the highest grade and in accordance with the best modern practices to conform with the specifications for the item of work being furnished.

B. Welding

1. Production welding shall conform to the requirements of AWS D 1.1D or AWS D 1.2 as applicable.

END OF SECTION