SECTION 05 50 00 - METAL FABRICATIONS

Some of the paragraphs may be deleted. When deleting, do not renumber all the paragraphs. Simply leave the section number and title as is, delete the text, and add the words "Not Used".

PART 1 GENERAL

1.1 SUMMARY

A. The extent of metal fabrications work is shown on the Drawings and includes items fabricated from iron, steel, stainless steel and aluminum shapes, plates, bars, sheets, strips, tubes, pipes, and castings which are not a part of structural steel or other metal systems in other sections of these specifications.

B. Section Includes:

Edit list below to fit your project.

1. Shop-fabricated metal items
2. Loose steel lintels
3. Hoist beams and divider beams
4. Bollards
5. Ladders
6. Window security grilles
7. Anchor bolts
8. Stairs
9. Handrails and railings
10. Gratings
11. Roof access hatches
12. Fasteners
13. Miscellaneous fabricated architectural details

C. Related Sections:

Edit list below to fit your project.

1. Section 03 30 00, Cast-In-Place Concrete
2. Section 09 90 00, Painting and Coating
3. Section 33 05 64, Precast Concrete Valve Vaults and Meter Boxes

4. Section 33 16 10, Ground-Level Prestressed Concrete Water Utility Storage Reservoir

1.2 REFERENCE STANDARDS

A. Aluminum Association (AA):

1. AA DAF-45 - Designation System for Aluminum Finishes

B. American Architectural Manufacturers Association (AAMA):

1. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum

2. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels

3. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels

4. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels

C. American National Standards Institute (ANSI):

1. ANSI A14.3 - American National Standard (ASC) for Ladders - Fixed - Safety Requirements

D. American Welding Society (AWS):

1. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination

2. AWS D1.1 - Structural Welding Code - Steel

3. AWS D1.6 - Structural Welding Code - Stainless Steel

E. ASTM International (ASTM):

1. ASTM A6 - Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling

2. ASTM A36 - Standard Specification for Carbon Structural Steel

3. ASTM A47, grade as selected - Malleable Iron Castings

4. ASTM A48, Class 30 - Gray Iron Castings

5. ASTM A53- Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

6. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished

7. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

8. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

9. ASTM A193 - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High-Pressure Service and Other Special Purpose Applications

10. ASTM A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

11. ASTM A269 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service

12. ASTM A283, Grade C - Steel Plates to be Bent or Cold Formed

13. ASTM A276 - Standard Specification for Stainless Steel Bars and Shapes

14. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength

15. ASTM A312 - Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes

16. ASTM A354 - Standard Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners

17. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

18. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing

19. ASTM A513 - Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing

20. ASTM A554 - Standard Specification for Welded Stainless Steel Mechanical Tubing

21. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts

22. ASTM A572 - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel

23. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

24. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar

25. ASTM A780 - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings

26. ASTM A992 - Standard Specification for Structural Steel Shapes

27. ASTM B26 - Standard Specification for Aluminum-Alloy Sand Castings

28. ASTM B85 - Standard Specification for Aluminum-Alloy Die Castings

29. ASTM B177 - Standard Guide for Engineering Chromium Electroplating

30. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

31. ASTM B210 - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes

32. ASTM B211 - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire

33. ASTM B 308, Alloy 6061-T6, Anodic Coating Class I, AA-C22-A41, anodized after fabrication - Structural Aluminum Shapes and Plates

34. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

35. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel

36. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings

37. ASTM E985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings

38. ASTM F3125 - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi and 150 ksi Minimum Tensile Strength

39. ASTM F436 - Standard Specification for Hardened Steel Washers

40. ASTM F844 - Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use

41. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105 ksi Yield Strength

F. Builders Hardware Manufacturers Association (BHMA):

1. ANSI/BHMA A156.20 - American National Standard for Strap and Tee Hinges and Hasps

G. National Ornamental & Miscellaneous Metals Association (NOMMA):

1. NOMMA Guideline 1 - Joint Finishes

The below standards are the most used standards for miscellaneous steel fabrications, but other SSPC standards should be considered for special exposures, such as saltwater or coastal air, industrial applications, water and sewage plants, and the like.

Consult with Technical Lead.

H. SSPC: The Society for Protective Coatings:

1. SSPC - Steel Structures Painting Manual

2. SSPC Paint 15 - Steel Joist Shop Primer/Metal Building Primer

3. SSPC Paint 20 - Zinc-Rich Coating (Type I - Inorganic and Type II - Organic)

4. SSPC SP 1 - Solvent Cleaning

5. SSPC SP-7 Brush-off Blast Cleaning

6. SSPC SP 10 - Near-White Blast Cleaning

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for Submittals.

B. Manufacturer's Data: For information only, submit copies of Manufacturer's specifications, load tables, dimension diagrams, anchor details, and installation instructions for products to be used in miscellaneous metal work, including paint products.

C. Shop Drawings:

1. General: Submit copies of shop drawings for the fabrication and erection of all assemblies of miscellaneous metal work which are not completely shown by the Manufacturer's data sheets.

a. Include plans, elevations, and details of sections and connections and fabricators proposed shop coat paint or galvanizing specifications.

b. Show anchorage and accessory items.

c. Furnish setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, such as concrete inserts, anchor bolts, and miscellaneous items having integral anchors, which are to be embedded in concrete construction.

d. Indicate welded connections using standard AWS A2.4 welding symbols.

e. Indicate net weld lengths.

2. Stairs, Handrails, and Railings:

a. Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.

3. Gratings:

a. Indicate details of gratings, plates, component supports, anchorages, openings, perimeter construction details, and tolerances.

D. Samples:

1. Submit two sets of representative samples of materials, illustrating factory finishes as may be requested by the Engineer.

2. Engineer's review will be for color, texture, style and finish only.

E. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

Include the following Paragraph when the Contractor is responsible for designing products or assemblies; otherwise, delete.

F. Delegated Design Submittals:

1. Submit signed and sealed Shop Drawings from a registered, licensed professional engineer within the State of _____.

2. Include design calculations and assumptions for the following:

Specify product. List affected products Expand list if more than one product.

a. <_____>

G. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

Include the following Paragraph in conjunction with Paragraph F above when the Contractor is responsible for designing products or assemblies; otherwise, delete.

H. Qualifications Statement:

1. Submit qualifications for licensed professional to perform Delegated Design Submittals as noted above.

1.4 MOCKUPS

Use this subsection when full-size erected assemblies required for review of construction, coordination of work of several Sections, testing, or observation of operation. The need for this is rare for our projects. DELETE Article if not needed.

Add Paragraphs to describe additional mockups as needed.

A. Size: Construct mockup for <_____>, <_____> feet by <_____> feet wide, including <_____>.

B. Locate [where directed by Engineer] *or* [where indicated on Drawings].

Use one of the following and delete one not used.

C. Incorporate accepted mockup as part of Work.

OR

D. Remove mockup when directed by Engineer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Transporting, handling, storing, and protecting products shall be in accordance with Manufacturer's requirements.

B. Inspection: Accept metal fabrications on-site in labeled shipments. Inspect for damage.

C. Protect metal fabrications from damage by exposure to weather or by ground contact.

1.6 EXISTING CONDITIONS

A. Field Measurements: Verify field measurements prior to preparation of Shop Drawings and fabrication. Indicate field measurements on Shop Drawings.

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

PART 2 PRODUCTS

2.1 GENERAL

A. For the fabrication of miscellaneous metal work items which will be exposed to view, use only materials which are smooth and free of surface blemishes including pitting, seam marks, roller marks, rolled trade names, roughness and defects which impair strength, durability, and appearance. Remove such blemishes by grinding or by welding and grinding prior to cleaning, treating and application of surface finishes including zinc coatings.

Edit to fit Project or leave heading; remove text and insert "Not Used".

2.2 LINTELS

A. Description:

1. Steel sections

2. Size and Configuration:

a. As indicated on Drawings.

b. Length to allow [8] <___>-inch minimum bearing on both sides of opening.

Edit to fit Project for finish. Galvanized, or Prime-paint, one-coat

3. Exterior Location Shop Finish: <_____>.

4. Interior Location Shop Finish: Prime paint, one coat.

Edit to fit Project or leave heading; remove text and insert "Not Used".

2.3 HOIST BEAMS AND DIVIDER BEAMS

A. Hoist and Divider Beams:

1. Steel, wide-flange sections

2. Shape and Size: As required to support applied loads with maximum deflection of 1/240 of the span.

3. Shop Finish: Prime paint, one coat

Edit to fit Project or leave heading; remove text and insert "Not Used".

2.4 BOLLARDS

A. Description:

1. Steel pipe, concrete filled

2. Crowned cap

3. Size: <_____>-inch diameter, length as indicated on Drawings.

Edit to fit Project for correct material. Galvanized, and Prime-paint, one-coat.

4. Shop Finish: <_____>.

B. Concrete Fill:

1. Minimum Compressive Strength: 3,000 pounds per square inch (psi).

2. As specified in Section 03 30 00, Cast-in-Place Concrete.

C. Anchors: Concealed type as indicated on Drawings.

Edit to fit Project or leave heading; remove text and insert "Not Used".

2.5 LADDERS

If more than one type of ladder copy and modify Paragraph A. for each different ladder type, such as interior reservoir ladder (painted or stainless steel) or roof access ladder (painted or galvanized steel).

Note: aluminum is not to be used within interior of any wetted environment.

A. <_____> Ladder:

1. ANSI A14.3.

Edit to fit Project for correct material. Steel, Aluminum, or Stainless Steel.

2. <_____> welded construction.

3. Siderails:

a. Size: 1/2 by 2 inches

b. Spacing: 20 inches on center

4. Rungs:

a. Solid rod. Hex rod or gnarled rebar

b. Size: 1-inch diameter

c. Spacing: 12 inches on center

5. Mounting:

   a. Space rungs as shown on Drawings, a minimum of 7 inches from wall surface.

   b. Provide steel mounting brackets and attachments per Drawings.

Edit to fit Project for correct finish. Galvanized, Mill finish, Prime paint, one coat, or finish paint.

6. Shop Finish: <_____>.

Safety cages are recommended when ladder height exceeds 20 feet (6 meters).

Rest platforms are required when ladders exceed 30 feet (9.2 meters).

B. Ladder Safety Cage:

Edit to fit Project. Cages can be steel or aluminum construction.

1. <_____> bar sections, as shown on Drawings, minimum 1/4 by 2 inches.

2. Bottom Hoop:

   a. Size: As shown on Drawings, minimum 18-inch radius.

   b. Location: Maximum 74 inches above finished floor or roof.

3. Other Hoops:

   a. Size: As shown on Drawings, minimum 14-inch radius.

   b. Spacing: Maximum 48 inches on center

4. Vertical Bars Spacing: 10 inches on center

5. Finish: Match ladder finish.

C. Ladder Security Enclosure:

1. Description: Formed to enclose ladder siderails and rungs when closed and to swing free of ladder rungs and siderails with minimum 1-1/2-inch clear to siderails in open position.

2. Sheet steel.

3. Thickness: Minimum 16-gauge/0.058-inch formed to enclose ladder siderails and rungs when closed and to swing free of ladder rungs and siderails with minimum 1-1/2-inch clear to siderails in open position.

4. Provide continuous steel hinge full height of enclosure.

5. Provide steel hasp for padlocking in closed and open position.

6. Finish: Match ladder finish.

Edit to fit Project or leave heading; remove text and insert "Not Used".

2.6 WINDOW SECURITY GRILLES

A. Description:

1. Construction: Welded steel; conform to shape of window.
2. Verticals: 1/2-inch diameter solid bar; 4 inches on center
3. Top and Bottom Rail: 1/4-by-1-1/2-inch flat bar; 6 inches from top and bottom.
4. Hinges: Two for each grille; mounted for side swing.
5. Padlock Hasp: Side opposite hinges for securing gates in closed position.
6. Anchors:
   a. Fabricate as required for attachment to existing window jambs within window opening.
   b. Attachment to exterior building façade; overlapping window opening is not permitted.

Edit to fit Project for correct finish. Galvanized, Prime paint, one coat, or powder coat paint finish.

7. Shop Finish: <_____>

Edit to fit Project or leave heading; remove text and insert "Not Used".

2.7 FABRICATED ARCHITECTURAL TRIM

A. Description: Steel sections, size and configuration as indicated on Drawings.

Edit to fit Project for correct finish. Galvanized or Prime paint, one coat.

B. Shop Finish for Exterior Locations: <_____>.

Edit to fit Project or leave heading; remove text and insert "Not Used".

2.8 ANCHORS

A. All anchors shall be epoxy anchors or expansion anchors as shown in the Drawings.

B. Materials:

1. As shown in the Drawings.
2. For direct bury:
   a. Malleable iron complying with ASTM A47
   b. Cast steel complying with ASTM A27
   c. Iron and steel galvanized in compliance with ASTM A153

3. For wetted atmospheric conditions

    a. Type 316 stainless steel

4. Threaded rod, nuts, bolts, and washers:

    a. Material matching anchor insert type

C. Types:

1. Threaded-type Concrete Inserts:

    a. Internally threaded to receive machine bolts

    b. Malleable iron, ASTM A47

    c. Cast steel, ASTM A27

    d. Stainless steel, type 304, ASTM A320

2. Wedge-type Concrete Inserts:

    a. Box-type ferrous castings designed to accept bolts having special wedge-shaped heads.

3. Slotted-type Concrete Inserts:

    a. Box-type welded construction with slot designed to receive square head bolt and with knockout cover.

D. Manufacturers:

1. Hilti, Inc.

2. Simpson Strong-Tie Co., Inc.

3. Proprietary products as named in the Drawings.

Edit to fit Project or leave heading; remove text and insert "Not Used".

2.9 STAIRS

A. Meet all applicable codes and Occupational Safety and Health Administration (OSHA) requirements.

B. Minimum Design Live (Pedestrian) Load: Fabricate stair assembly to support uniform live load of 100 pounds per square foot (psf) and moving concentrated load of 1,000 psf with deflection of stringer or landing framing not to exceed 1/180 of span.

C. Fabricate stair assembly to NAAMM AMP 510, industrial class.

D. Materials: As shown in the Drawings.

Edit to fit Project or leave heading; remove text and insert "Not Used".

2.10 HANDRAILS AND RAILINGS

A. Maximum spacing between members shall be as directed by local code and OSHA requirements unless otherwise noted on the Drawings.

B. Railing assembly, wall rails, and attachments to resist lateral force of 200 pounds at any point without damage or permanent set. Test according to ASTM E935.

C. Construction:

1. Height: 3 foot, 6-inch high.

2. Outside diameter:

a. 2-inch for top and vertical segments.

b. 1-1/2-inch all others.

3. Top corners of handrail are to be bent to the smallest radius possible without causing grain separation or otherwise impairing the work.

4. Radius Sections -- Roll to radii shown on Drawings.

5. Vertical segments of handrail are to be set plumb and mount as shown on Drawings or as otherwise specified.

6. Spacing between vertical segments will be according to Drawings.

D. Welded Connections:

1. Cope intersections of rails and posts, weld joints of tailings or use welding connectors, at fabricator's option.

a. Other methods of welding may be used when acceptable to the Engineer.

2. Weld corners and seams continuously and in accordance with the recommendations of AWS.

3. Grind exposed welds smooth and flush, to match and blend with adjoining surfaces.

4. Discoloration of finished surfaces and sharp edges will not be acceptable.

E. Materials: As shown on the Drawings.

Edit to fit Project or leave heading; remove text and insert "Not Used".

2.11 GRATINGS

A. Meet all applicable codes and Occupational Safety and Health Administration (OSHA) requirements.

B. Minimum Design Live (Pedestrian) Load: Fabricate stair assembly to support uniform live load of 100 psf and moving concentrated load of 1,000 psf with deflection of stringer or landing framing not to exceed 1/120 of span.

C. Layout:

1. Provide removable grating sections with end-banding bars for each panel.

2. Exposed connections shall fit accurately together to form tight hairline joints.

3. Install all gratings with bearing bars spanning the shortest dimension unless shown otherwise on the plans.

4. Provide welded positioning tabs in support angles at each grating section to prevent lateral movement of grating sections.

5. Layout units to allow grating removal without disturbing items penetrating grating.

D. Penetrations:

1. Provide for notched gratings and banding for penetrations as indicated.

2. Provide banding for openings in grating of same material and size as bearing bars unless otherwise indicated.

3. Wherever bar gratings are pierced by pipes, ducts, and structural members, cut openings neatly and accurately to size and weld a strap collar of same material and size as bearing bars to the cut ends of the bars.

4. Divide panels into sections only to the extent required for installation wherever bar grating platforms, runways, etc., are to be placed around previously installed pipes, ducts, and structural members.

E. Materials: As shown on the Drawings.

Edit to fit Project or leave heading; remove text and insert "Not Used".

2.12 ACCESS HATCHES

A. Use materials of the size and thickness shown in Drawings or, if not shown in the Drawings, of the size recommended by Product Manufacturer.

B. Work to the dimension shown in the Drawings or accepted on final shop drawings, using proven details of fabrication and support.

C. Use the type of materials shown or specified for the various components of the Work.

Edit to fit Project: "Reservoir" or "Vault".

D. <_____> Roof Access Hatch:

Edit to fit Project: "Reservoir" or "Vault".

1. Frame opening length x width = <_____>

2. Flush grip handle.

3. Comp. spring lifting mechanism assembly.

4. Heavy duty forged brass hinges with stainless steel pins.

5. Heavy duty automatic lock open arm with red vinyl release grip.

6. Heavy duty check chain.

7. Plate cover reinforced for 300 psf live load.

To be used only with vaults. The following two items are not acceptable for reservoir roof hatches.

8. 1-1/2-inch drain coupling.

9. Channel frame with anchor flange.

The following item is required for reservoir roof hatches.

Commented [KG1]: Division Lead to verify if just #10 for reservoirs or #10-15. Edit instructions to fit.

10. Watertight, “shoe box” style construction. Provide full overlap of hatch curb by a minimum 2 inches.

11. Stainless steel slam-lock with brass spoon handle.

12. All steel plate, sheeting and hardware galvanized, or cadmium plated except as noted above.

13. Shop finish of cover and frame: Mill finish.

14. Recessed hasp for pad lock.

15. Aluminum in contact with concrete or grout shall be coated with epoxy as specified herein.

Edit to fit Project or leave heading; remove text and insert "Not Used".

2.13 ROUGH HARDWARE

A. Furnish bent or otherwise custom fabricated bolts, plates, anchors, hangers, dowels, and other miscellaneous steel and iron shapes as required for framing and supporting systems. Acceptable manufacturers are Simpson or equal.

B. Manufacture or fabricate items of sizes, shapes, and dimensions required. Furnish malleable iron washers for heads and nuts which bear on wood structural connections; elsewhere furnish galvanized steel washers.

Edit to fit Project or leave heading; remove text and insert "Not Used".

2.14 MISCELLANEOUS FABRICATIONS, FRAMING, AND SUPPORTS

A. Provide miscellaneous steel framing and supports required to complete the Work.

B. Fabricate miscellaneous units to the sizes, shapes and profiles shown in the Drawings or, if not shown, of the required dimensions to receive adjacent grating, plates doors, or other work to be retained by the framing.

C. Except as otherwise shown, fabricate from structural steel shapes and plate and steel bars, all welded construction using mitered corners, welded brackets and splice plates and a minimum number of joints for field connection.

D. Cut, drill, and tap units to receive hardware and similar items to be anchored to the work.

E. Equip units with integrally welded anchors for casting into concrete, bolting to structural steel or building into masonry. Furnish inserts if units must be installed after concrete is placed.

F. Galvanize all miscellaneous fabrications unless otherwise noted.

Edit to fit Project or leave heading; remove text and insert "Not Used".

2.15 NON-SHRINK GROUT

A. Where required for anchoring, patching, or sealing, grouting, and sealing compounds shall conform to the requirements of Section 03 60 00, Grouting.

Edit to fit Project or leave heading; remove text and insert "Not Used".

2.16 MATERIALS

A. Materials listed below shall be provided unless otherwise noted in the Drawings or other sections of these specification.

B. Steel:

1. Structural W Shapes: ASTM A992
2. Structural Shapes: ASTM A36
3. Channels and Angles: ASTM A36
4. Steel Plate: ASTM A36
   a. Steel Plate to be Bent or Cold Formed: ASTM A283, Grade C
5. Hollow Structural Sections: ASTM A500, Grade B
6. Structural Pipe: ASTM A53, Grade B, Schedule 40 unless shown otherwise in Drawings
7. Bar: ASTM A36
   a. Cold-Finished Steel Bar: ASTM A108, grade as selected by fabricator
8. Sheet Steel: ASTM A653, Grade 33 Structural Quality
9. Tubing: ASTM A513, Type 5, minimum 50 kilopounds per square inch (ksi) yield strength
10. Standard Bolts: ASTM A307; Grade A

a. Washers: ASTM F844

11. High Strength Bolts: ASTM A325

a. Washers: ASTM F436; Type 1

12. Nuts: ASTM A563; heavy-hex type

13. Welding Materials: AWS D1.1; type required for materials being welded

C. Stainless Steel:

1. Bars and Shapes: ASTM A276; Type 316

2. Tubing: ASTM A269; Type 316

3. Pipe: ASTM A312, seamless; Type 316

4. Plate, Sheet, and Strip: ASTM A666; Type 316

5. Bolts, Nuts, and Washers: ASTM A354; Type 316

6. Welding Materials: AWS D1.6; type required for materials being welded

D. Aluminum:

1. Structural Aluminum Shapes and Plates: ASTM B308, Alloy 6061, Temper T66, Anodic Coating Class I, anodized after fabrication

2. Aluminum-Alloy-Drawn Seamless Tubes: ASTM B210 Alloy 6063, Temper T6

3. Aluminum-Alloy Bars: ASTM B211 Alloy 6063, Temper T6

4. Bolts, Nuts, and Washers: Stainless steel or Steel, galvanized

5. Welding Materials: AWS D1.1; type required for materials being welded

E. Bolts, Nuts, and Washers for Equipment and Piping:

1. Select fasteners for the type, grade, and class required for the installation of miscellaneous metal items.

2. Carbon Steel:

a. General: Zinc-coated, ASTM A153

b. Structural Connections: ASTM A307, Grade 2 (60 ksi), hot-dip galvanized

c. Anchor Bolts: ASTM A307, Grade 2 (60 ksi), hot-dip galvanized

d. Pipe and Equipment Flange Bolts: ASTM A193, Grade B-7

e. High Strength Bolts: ASTM F3125, Heavy Hex Head

3. Stainless Steel: Type 316 stainless steel, Class 2; ASTM A193 for bolts; ASTM A194 for nuts

    a. Where stainless steel bolts are in contact with dissimilar metals, glass epoxy insulating sleeves and washers shall be used to electrically isolate the bolts.

Edit to fit Project or leave heading; remove text and insert "Not Used".

2.17 FABRICATION

A. Workmanship:

1. Use materials of the size and thicknesses shown in the Drawings or, if not shown, of the required size and thickness to produce adequate strength and durability in the finished product for the intended use as approved by the Engineer.

2. Work to the dimensions shown in the Drawings or accepted on Shop Drawings, using proven details of fabrication and support.

3. Use the type of materials shown in the Drawings or specified for the various components of work.

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

5. Ease exposed edges to a radius of approximately 1/32-inch, unless otherwise shown in the Drawings.

6. Form bent-metal corners to the smallest radius possible without causing grain separation or otherwise impairing the Work.

B. Fit and shop-assemble items in largest practical sections for delivery to Site.

C. Fabricate items with joints tightly fitted and secured.

D. Continuously seal join members by means of continuous welds in accordance with the recommendations of AWS, unless otherwise noted or approved.

E. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small, uniform radius.

F. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

G. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

H. Loose Bearing and Leveling Plates:

1. 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.

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

3. Galvanize after fabrication.

I. Miscellaneous Steel Trim:

1. Provide shapes and sizes for profiles shown in the Drawings.

2. Except as otherwise indicated, fabricate units from structural steel shapes and plates and steel bars, with continuously welded joints and smooth exposed edges.

3. Use concealed field splices wherever possible.

4. Provide cutouts, fittings, and anchorages as required for coordination of assembly and installation with other work.

Below are recommended Fabrication Tolerances. If desired, these may be eased or tightened for your project.

J. Fabrication Tolerances:

1. Squareness: [1/16] <___>-inch maximum difference in diagonal measurements.

2. Maximum Offset between Faces: [1/16] <___>-inch.

3. Maximum Misalignment of Adjacent Members: [1/16] <___>-inch.

4. Maximum Bow: [1/16] <___>-inch in [48] <___> inches.

5. Maximum Deviation from Plane: [1/16] <___>-inch in [48] <___> inches.

Edit to fit Project or leave heading; remove text and insert "Not Used".

2.18 FINISHES

A. Steel:

1. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

2. Do not prime surfaces in direct contact with concrete or where field welding is required.

3. Prime-paint items with one coat, except where galvanizing is specified.

4. Coatings as specified per Section 09 90 00, Painting and Coating.

a. Primer paint selected must be compatible with the required finish coats of paint.

b. At locations in contact with potable water, use only primer approved for potable water use.

ASTM A123 (A123M) includes minimum coating thickness grade based on type of material and steel thickness of component.

5. Galvanizing for Rolled, Pressed and Forged Steel Shapes, Plates, Bars and Strips: ASTM A123; hot-dip galvanize after fabrication

6. Galvanizing for Fasteners, Connectors, and Anchors:

    a. Hot-Dip Galvanizing: ASTM A153

    b. Mechanical Galvanizing: ASTM B695; Class 50 minimum

    Insert "satin" or "polished"

7. Chrome Plating: ASTM B177, nickel-chromium alloy, <_____> finish

8. Sheet Steel: Galvanized

9. Bolts: Hot-dip galvanized

10. Nuts: Hot-dip galvanized

11. Washers: Hot-dip galvanized

12. Touchup Primer for Galvanized Surfaces: ASTM A780 (A780M), A1. Repair Using Zinc-Based Alloys (Heat and Stick Method)

B. Stainless Steel:

Varieties of specialty finishes are available for stainless steel, including mechanical, patterned finishes, and chemical coloring. Expand finish descriptions to suit Project conditions.

Refer to NAAMM AMP 503 - Finishes for Stainless Steel for assistance in selecting and specifying finishes.

1. Satin-Polished Finish: Number 4, satin directional polish parallel with long dimension of finished face.

2. Mirror-Polished Finish: Number 8, mirror polish with preliminary directional polish lines removed.

C. Aluminum:

1. Protection of All Aluminum:

    a. Aluminum surfaces in contact with cementitious, masonry or dissimilar materials, apply the following coating system:

        1) One (1) coat of epoxy primer, 1 to 2 mils dry film (D.F.).

        2) Followed by two (2) coats of Bitumastic, 6 to 8 mils D.F.

        3) Followed by two (2) coats of tarset material, 6 to 8 mils D.F.

D. Shop Painting

1. Shop painting of metal fabrications shall be allowed only at the sole discretion of the Engineer.

2. Shop paint miscellaneous metal work in accordance with Section 09 90 00, Painting and Coating, with the following exceptions:

    a. Those members or portions of members to be embedded in concrete or masonry.

    b. Surfaces and edges to be field welded.

    c. Galvanized surfaces.

3. Remove scale, rust, and other deleterious materials before the shop coat of paint is applied.

    a. Clean off heavy rust and loose mill scale in accordance with SSPC SP-7, Brush-off Blast Cleaning.

    b. Remove oil, grease, and similar contaminates in accordance with SSPC SP-1, Solvent Cleaning.

4. Immediately following surface preparation, brush or spray on metal primer paint, applied in accordance with the Manufacturer's instructions or as specified below.

5. Apply one shop coat of metal primer paint to fabricated metal items, except apply two coats of paint to surfaces which will be inaccessible after assembly or erection. Change color of second coat to distinguish it from the first.

E. Touch-up Painting, Pre-painted Items:

1. Immediately after erection, clean field welds, bolted connections, and abraded areas of the shop paint, and paint all exposed areas with the same material as used for shop painting.

2. Apply touch-up coatings by brush or spray to provide a minimum dry film thickness of the original coating thickness.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive Work.

3.2 PREPARATION

A. Clean and strip primed steel items to bare metal and aluminum where Site welding is required.

B. Furnish setting drawings, diagrams, templates, instructions, and directions for the installation of anchorages, such as concrete inserts, anchor bolts, and miscellaneous items having integral anchors. Supply steel items required to be cast into concrete or embedded in masonry with setting templates to appropriate sections. Coordinate delivery of such items to the Project Site.

3.3 INSTALLATION

A. Install items plumb and level, accurately fitted, and free from distortion or defects.

B. Make provisions for erection stresses. Install temporary bracing to maintain alignment until permanent bracing and attachments are installed.

C. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal items 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.

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

E. Grind joints smooth and touch-up shop paint coat.

F. 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.

G. Field-weld components indicated on Drawings and Shop Drawings.

H. Perform field welding according to AWS D1.1 with regards to procedures of manual shielded metal-arc welding, the appearance and quality of welds made, and the methods used in correcting welding work.

I. Obtain approval of Engineer prior to Site cutting or making adjustments not scheduled.

3.4 TOLERANCES

Specify tolerances as required by types of fabricated items.

Recommended minimum tolerances are provided below in highlight.

A. Maximum Variation from Plumb: [**1/4**] <___>-inch per story or for every 12 feet in height, whichever is greater, non-cumulative.

B. Maximum Variation from Level: [**1/16**] <___>-inch in 3 feet and 1/4-inch in 10 feet.

C. Maximum Offset from Alignment: [**1/4**] <___>-inch.

D. Maximum Out-of-Position: [**1/4**] <___>-inch.

3.5 FIELD QUALITY CONTROL

A. Welding: Inspect welds according to AWS D1.1.

B. Replace damaged or improperly functioning hardware.

C. After erection, touch up welds, abrasions, and damaged finishes with prime paint or galvanizing repair paint to match shop finishes.

D. Touch up factory-applied finishes according to Manufacturer-recommended procedures.

3.6 ADJUSTING

A. Adjust operating hardware and lubricate as necessary for smooth operation.

END OF SECTION