

SECTION 05500
METAL FABRICATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope

1. Furnish and install all metal fabrications where indicated on the Drawings or specified including
 - a. Items fabricated from metal shapes, plates, sheets, rods, or bars
 - b. Metal specialties as specified herein
 - c. Weld plates for anchoring metal fabrications
 - d. Wrought or cast metal specialties
 - e. All other miscellaneous angles, channels, tubes, and plates not specified elsewhere

B. Additional Requirements Specified Elsewhere

1. Section 01340: Shop Drawings, Product Data and Samples
2. Section 01400: Quality Control
3. Section 01600: Materials and Equipment

C. Related Requirements Specified Elsewhere

1. Section 03300: Cast-in-Place Concrete
2. Section 03420: Structural Precast Concrete
3. Section 03600: Grout
4. Section 05120: Structural Steel
5. Section 09900: Painting
6. Section 11221: Screening Equipment (Manually cleaned bar screen)
7. Section 15070: Pipe Supports
8. Component Parts of Equipment: The individual equipment sections

1.2 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies

1. Handrail and steps shall comply with all applicable provisions of OSHA and the Pikes Peak Regional Building Code, including the latest adopted revisions

B. Reference Standards

1. AISC "Steel Construction Manual"
2. ASTM A36: Structural Steel
3. ASTM A366: Steel, Carbon, Cold-Rolled Sheet, Commercial Quality

4. ASTM A569: Steel, Carbon (0.15 Max, percent), Hot-Rolled Sheet and Strip, Commercial Quality
5. ASTM A307: Carbon Steel Externally Threaded Standard Fasteners
6. FS RR-G-661: Grating, Metal, Bar Type (Floor, except for Naval Vessels)
7. ASTM A48: Gray Iron Castings
8. ASTM A167: Stainless and Heat Resisting Chromium-Nickel Steel Plate, Sheet and Strip
9. ANSI A202: Metal Bar Grating Manual for Steel and Aluminum Gratings and Stair Threads
10. AISC "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings"
11. FS WW-F-461: Floor Plate, Steel, Rolled
12. ASTM A500: Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
13. ASTM A501: Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
14. ASTM A120: Pipe, Steel, Black and Hot-Dipped, Zinc Coated (Galvanized) Welded and Seamless for Ordinary Uses

C. Welder Qualifications: Welding only by AWS Certified Welding Operators

D. Design Criteria

1. Grating and checkered plate shall be capable of carrying 150 psf live load unless otherwise specified

1.3 SUBMITTALS

A. Shop Drawings and Product Data

1. Product data describing each manufactured metal specialty
2. Shop drawings describing and detailing each fabricated item

B. Certifications of Compliance

1. Manufacturer's affidavit of compliance certifying
 - a. All tests have been conducted
 - b. All materials comply with applicable standards
 - c. All materials comply with these Specifications
2. Furnish mill test reports on request

1.4 DELIVERY, STORAGE AND HANDLING

A. Deliver anchor bolts and other anchorage devices which are embedded in cast-in-place concrete or masonry construction to the project site in time to be installed before the start of cast-in-place concrete or masonry operations

1. Provide setting drawings, templates, and directions for the installation of anchor bolts and other devices

B. Storage of Metals

1. Metals which are stored at the project site shall be above ground on platforms, skids, or other supports
2. Protect steel from corrosion
3. Store other materials in a weathertight and dry place
4. Store packaged materials in their original, unbroken package or container
5. Protected from bending under its own weight or superimposed load

PART 2 - PRODUCTS

2.1 MATERIALS

A. Steel

1. Plates and shapes: ASTM A36
2. Sheets: ASTM A366 or A569, zinc coated
3. Pipe: ASTM A120
4. Bolts
 - a. High strength: ASTM A325
 - b. Unfinished: ASTM A307
 - c. Anchor bolts ASTM F1554
 - d. Self-locking nuts: Prevailing torque type; IFI-100, Grade A
 - e. Flat washers: ANSI B27.2
 - f. Lock washers: Spring type, ANSI B27.1
 - g. Beveled washers: Table 1 of Specifications for Structural Joints using ASTM A325 or A490 Bolts, AISC Steel Construction Manual
5. Checkered plate: FS QQ-F-461
6. Structural tubing: ASTM A500 or A501

B. Cast Iron: ASTM A48, Class 25 or better

C. Stainless Steel

1. Type 304 or 316 for non-submerged locations
2. Type 316 as indicated on the Drawings for submerged and other locations
3. Plates: ASTM A167
4. Bolts: IFI-104, Grade 303 or 305

D. Aluminum

1. Sheet and plate: ASTM B209, alloy 6061-T6
2. Rolled sections: ASTM B308, alloy 6061-T6
3. Rod and bar: ASTM B211, alloy 6061-T6 or 2017-T4
4. Extrusions: ASTM B221, alloy 6063-T5 or T6
5. Pipe: ASTM B429, alloy 6061-T6 or 6063-T6
6. Rivets: ASTM B316, alloy 6061-T6
7. Bolts: IFI-104, Grade 24T4
8. Castings: ASTM B26 or B85

9. Grating: ASTM B221, alloy 6063-T6, mechanically locked; McNichols "GIA I-Bar," Klemp "I-Bar," Liskey Aluminum "I-Bar," Reliance "I-Lok," Thelen "Aluminum Grating," or equivalent
 - a. Other specific products are specified on the Drawings for specific installations

E. Brass or Bronze

1. Plate and strip: ASTM B36
2. Castings: ASTM B61 or B143
3. Bolts: ASTM B140

F. Specialty and Accessory Items

1. Grating saddle clips and flange block
 - a. ANSI A202.1
 - b. Aluminum grating: Aluminum or stainless steel clips or blocks
 - c. Clip fasteners: Nelson stud-type bolts, ¼" minimum, galvanized or corrosion resistant alloy
2. Manhole steps: Refer to Section 02709 – Gravity Pipelines and Appurtenances
3. Manhole rings and covers: Refer to Section 02709 – Gravity Pipelines and Appurtenances
4. Chain: FS RR-C-271, Type I, Grade C, Class 5, Style 2, galvanized; welded steel, twist-link style, short link pattern
5. Bird screen: 2 mesh, brass or copper wire cloth, minimum wire diameter 0.063" or as indicated on the Drawings
6. Body solder: Flux-core wire, ASTM B32, Alloy Grade 20B
7. Roadway or trench grate: Neenah Foundry Type A grate or H-20 traffic rated equivalent
 - a. Refer to Drawings for other products required for specific installations
8. Protective bollards: Schedule 80 steel pipe unless otherwise noted on the Drawings

G. Shop Coatings

1. Rust inhibitive shop primer for steel: Tnemec "37H-77 Chem-Prime H.S."
2. Zinc rich primer: Tnemec "H90-97 Tneme-Zinc"
3. Coal tar paint: Tnemec "46-465 H.B. Tnemecol"
4. Galvanizing: Hot-dip process, ASTM A123, A133 and A385
5. Bolt galvanizing
 - a. Zinc: ASTM A164, Type GS
 - b. Cadmium: ASTM A165, Type NS

2.2 FABRICATION AND MANUFACTURE

A. General

1. In accordance with dimensions, arrangement, sizes, and weights or thicknesses indicated on the Drawings or specified
2. All members free of winds, warps, local deformations, or unauthorized bends

3. Make all cuts clean and sharp with wire edges ground smooth
4. Holes and other provisions for field connection accurate and shop checked for proper fit
5. Close exposed ends of steel pipe or tubing with weld caps
6. Mark each piece according to the erection drawings
7. Provide all field connection materials

B. Connections

1. General
 - a. As indicated on the Drawings
 - b. Where welding is permitted or required
 - 1) Butt and miter welds continuous
 - 2) Exposed welds ground smooth
 - 3) Intermittent welds
 - a) 2" minimum effective length
 - b) 6" maximum spacing
2. If not indicated on the Drawings, unfinished bolts with self-locking nuts or lock washers

C. Shop Coating

1. Preparation
 - a. All surfaces to be at the proper temperature, dry, and free of grease, oil, dirt, dust, grit, rust, loose mill scale, weld flux, slag, weld splatter, and other objectionable substances
 - b. Scrape, chip and brush welds as required to remove all splatter
 - c. Dull sharp corners of cut or sheared edges with at least one pass of a power grinder
2. Galvanizing: Apply after fabrication
3. Castings: Hot dip in asphalt varnish or coat with coal tar paint, 6 mils minimum
4. Steel: Unless otherwise indicated or specified, hot-dip galvanizing after fabrication
5. Aluminum: Coat all surfaces to come in contact with concrete, cement, mortar, or dissimilar metals with coal tar epoxy paint, 6 mils minimum
6. Do not shop coat galvanized steel
7. Refer to Section 09900 for field painting requirements
8. Contractor shall verify compatibility of shop coating and field painting materials

D. Checkered Floor Plate

1. Aluminum or galvanized steel as indicated on the Drawings
2. Provided with lifting holes, minimum 4 per plate, one at each corner
3. Shop straighten warped or bent plates to lie perfectly flat
4. Supporting steel members hot-dip galvanized after fabrication
5. Provide a minimum of 2 lifting hooks: 36 inches long
6. Coat underside of plates with coal tar paint
7. In each run, cut plate into near equal size pieces with no piece weighing in excess of sixty pounds

E. Railings

1. Aluminum, unless otherwise noted
2. All railings provided of the same type and design, except as otherwise specified or indicated on Drawings
3. Aluminum
 - a. Mill finish per Section 2.1.D
 - b. Field fabricated from stock pipe lengths with external mechanical connections
 - c. Prefabricated railing with internal mechanical connections and manufacturer's standard finish where noted on Drawings for interior locations, Reynolds Metals "ReynoRail II," Blumerator "5000 Series," or equivalent
 - d. Handrail and posts designed for 200 lb. concentrated load applied in any direction per IBC
 - 1) Supplier shall submit structural design calculations for review
 - 2) Provide insert stiffeners as required to meet design loading
4. Connections
 - a. Hollaender SpeedRail® System or equivalent external mechanical connections for field fabricated railing
 - b. Manufacturer's standard internal mechanical connections for prefabricated railing
 - c. Field welded connections not acceptable
5. Fabrication
 - a. Smooth with all projecting joints and sharp corners ground smooth
 - b. Neatly cope members and connect with mechanical connections at all junctions
6. Sleeves
 - a. Fixed posts with reinforcing insert stiffeners: As detailed on Drawings
7. Safety chain
 - a. Provide where indicated on Drawings and at all openings and offset locations between sections of handrail
 - b. $\frac{3}{8}$ " chain, length as required by opening
 - c. Fastened to one post with cadmium plated or stainless steel eyebolt
 - d. Fastened to other post with $2\frac{1}{2}$ " heavy-duty cadmium plated harness snap engaging a similar eyebolt
8. Toe plates
 - a. Aluminum
 - b. Thickness: $\frac{1}{4}$ "
 - c. Extend 4" above top of walkway or landing

F. Grating and Stair Treads

1. I-bar, pressure locked type
2. Bearing bars: $\frac{3}{16}$ " minimum flat stock or equivalent I-bars at 1- $\frac{3}{16}$ " centers, unless otherwise noted
3. Size as indicated on Drawings
 - a. 150 psf live load
 - b. Maximum deflection less than $\frac{1}{300}$ of span
 - c. Depth: As indicated on the Drawings

4. Comply with ANSI B221
5. Laid out with openings centered on a joint between sections
6. Provide 1/4" thick toe plates around openings extending the full depth and 4" above top of grating
7. 3/16" thick, full depth bands at ends of bearing bars in grating floor sections
8. Cut cross bars flush with outside face of side bars
9. Cutting
 - a. Sawed or sheared
 - b. Clean and smooth without fins, beads, or other projections
10. Fabricate in easily handled panels
11. Maximum panel weight: 75 lbs
12. All edges of each section of grating shall be banded
13. Align cross bars and edge bars of adjacent panels
14. Maximum clearance between panels: 1/4"
15. Make all bearing bars parallel
16. Make all grating flat with no tendency to rock
17. Tolerance
 - a. Length: $\pm 3/16$ "
 - b. Width: $\pm 1/8$ "
 - c. Maximum difference of opposite diagonals: 1/4"
 - d. Bearing bar spacing: $\pm 1/32$ "
 - e. Band and toe plate vertical and horizontal alignment: $\pm 1/8$ "
18. Aluminum stair treads
 - a. Pressure locked type
 - b. Serrated flat stock or striated I-bars
 - c. Skid-resistant abrasive nosing
 - d. Fasten to stringers with galvanized bolts

G. Steel Walkway Grating

1. Location: Aerobic digester and aeration basin walkways
2. Fabrication
 - a. One-piece construction with integral toe plate conforming to OSHA requirements for toe boards on elevated walkways
 - b. Reticulated and formed metal cross struts arranged in a diamond pattern with integrally formed channels at the edges
 - c. Slip-resistant raised serrated surface
 - d. Band random cuts at ends and other exposed edges with minimum 1/8" thick bars equal to the overall grating depth, welded at contact points
3. Material: Galvanized steel, 10 gauge, heavy-duty design
4. Size: 36" width, 12' length with 5" side channel depth
5. Security walkway sections to supporting structure with manufacturer's standard galvanized steel hold-down clips with galvanized bolts, nuts and washers
6. Join abutting walkway sections with manufacturer's standard galvanized steel splice plates
7. Design basis: McNichols Company "Heavy Duty GRIP STRUT® Safety Grating Walkway"

H. Stop Plates and Grooves

1. Plates
 - a. Aluminum
 - b. Size as indicated on the Drawings
 - c. Edges accurately finished
 - d. Provide permanently attached lifting devices and supports as detailed on the Drawings
 - e. Permanently marked to identify tag name and location in the plant
2. Grooves
 - a. Aluminum, stainless steel or FRP
 - b. Groove $\frac{1}{8}$ " wider than thickness of associated plate
 - c. All interior surfaces machined
 - d. Meeting ends of butting surfaces ground smooth
 - e. Replaceable neoprene seals and stainless steel retainer clips as detailed on the Drawings

I. Slide Gates

1. Refer to Section 11280 – Slide Gates

J. Steel Stairways

1. Fabricate from steel plates and shapes to the dimensions and to suit the locations as indicated on the Drawings
2. Design and fabrication shall conform with International Building Code and the Pikes Peak Regional Building Code, including the latest adopted revisions
3. Uniform live load: 150 psf
4. Minimum width: 3'-0"
5. Pitch
 - a. Maximum rise: 7"
 - b. Minimum tread: 11"
6. Stair treads and landing platforms shall be aluminum grating as specified elsewhere in this section
7. Provide aluminum handrail and toe plates as specified elsewhere in the section on open sides of stairs and platforms. Provide single handrail on solid walls
8. Attach to floors and walls with stainless steel anchor bolts as recommended by the stair manufacturer
9. Shop prime and field paint in accordance with Section 09900
10. Provide all necessary structural brackets, anchors and accessories to complete stairs as indicated

K. Aluminum Access Hatches and Frames

1. Frame
 - a. Extruded aluminum channel
 - b. $\frac{1}{4}$ " thick minimum aluminum, welded
 - c. Anchor flange around perimeter with bend down anchor strap
 - d. Apply heavy bituminous coating over entire exterior of frame for casting into concrete

- e. EPDM gasket mechanically attached to frame
- 2. Doors
 - a. Aluminum diamond patten tread plate
 - b. Aluminum stiffeners for 300 psf live load
 - c. Aluminum stiffeners for H-20 traffic load where indicated on Drawings
 - d. Thickness: ¼" minimum
 - e. Size and single-leaf or double-leaf configuration as indicated on the Drawings
 - f. Heavy forged aluminum hinges
 - 1) Bolted to underside of door with stainless steel hardware
 - 2) Compression spring operators for lift assistance
 - 3) Retard downward motion
 - g. Open to 90° and automatically lock in that position
 - 1) Automatic hold open arm
 - 2) Stainless steel handle to release cover for closing
 - h. Provide snap lock with removable handle and removable plug
- 3. Hardware
 - a. Latch: Type 316 stainless steel
 - b. Compression spring tubes: Composite
 - c. Compression springs: Steel with electro-coated acrylic finish
- 4. Repair nicks or other damage to bituminous surface of frame prior to installation
- 5. Install per Drawings and per manufacturer's recommendations
- 6. Lubricate and adjust for proper operation
- 7. Drainage type frame in exterior locations and where indicated on the Drawings for wet interior locations
 - a. Bilco type J-AL and JD-AL
 - b. Nystrom model FGA
- 8. Non-drainage type frame for interior locations
 - a. Bilco type K and K-D
 - b. Nystrom model FHA

L. Pipe Sleeves

1. Openings for the passage of pipes through floors and walls shall be formed of sleeves of standard-weight, galvanized steel pipe, unless otherwise indicated on the Drawings or specified
2. Sleeves shall be of ample diameter to accommodate the pipe and modular seal, and to permit such expansion as may occur
3. Sleeves shall be of sufficient length to be flush at the walls and the bottom of slabs and to project 1" above the finished floor surface unless indicated otherwise
4. Threaded nipples shall not be used as sleeves
5. Sleeves shall have a 2" annular fin of ⅛" plate welded with a continuous weld completely around the sleeve at about mid-length
6. Sleeves shall be galvanized after the fins are attached
7. Sleeves shall be set accurately before concrete is poured

M. Monorail Beams

1. Steel beams used as hoist runways to be straight and level

2. Upper surface of lower flange to be smooth with all projections ground off
3. If provided in sections, joints to be close fitting and free from unevenness
 - a. Continuous beams spanning from wall to wall are preferred
4. Beams to be rigidly supported in exact alignment

N. Trolley Stops

1. Fabricated for angles and bolted or welded in place
 - a. Minimum size is 3"x2½"x¼"x6" long unless otherwise noted on the Drawings
 - b. One angle required on each side of beam
 - c. Attach 3" leg to monorail beam
 - d. Bolted connections require two (2) ½" diameter bolts
2. To be installed on each end of each monorail beam to limit travel of hoist
3. Stops to be located as indicated on the Drawings or as directed by the Engineer
 - a. Located so that no part of hoist assembly comes in contact with any part of the structure, supports or piping

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before assembly, thoroughly clean all parts which will be in contact with each other or other materials

3.2 ERECTION AND INSTALLATION

A. General

1. Assemble all parts accurately as indicated on the Drawings
2. Set base plates level and grout in place

B. Connections

1. General

- a. As indicated on the Drawings
- b. Where welding is permitted or required
 - 1) Butt and miter welds continuous
 - 2) Exposed welds ground smooth
 - 3) Intermittent welds
 - a) Minimum effective length: 2 inches
 - b) Maximum spacing: 6 inches
- c. Light drifting is permitted to draw parts together
- d. No drifting to match unfair holes
- e. Enlarge holes, if necessary, by reaming with twist drills
- f. No burning to enlarge holes
- g. No field welding except as indicated on the Drawings

C. Grating

1. Do not damage during installation
2. Anchorage
 - a. Unanchored where installed in recessed openings to hold grating panels in place, unless otherwise indicated on the Drawings or directed by the Engineer
 - b. Other locations
 - 1) Securely anchor in place, unless otherwise indicated on the Drawings or directed by the Engineer
 - 2) Fasten with saddle clips or flange blocks in accordance with ANSI B221

D. Handrails

1. Install with posts plumb and longitudinal members parallel to each other and to floor or slope of stairs
2. All members in a section in true alignment in the same vertical plane
3. Provide wall brackets where indicated or required, anchored with stainless steel bolts and anchors
4. Rigidly attach fixed handrail posts to supporting structure
 - a. Attach to concrete structure by setting in floor or wall flanges with reinforcing inserts, except as otherwise indicated
 - b. Where indicated, attach to structure with special attachments or anchorages
5. Set removable sections in double sleeves
 - a. Set inner sleeve in outer sleeve as specified for fixed posts
 - b. Take special care that inner sleeves are accurately spaced and plumb so handrail sections will stand in proper alignment and be removable without binding
6. Field connections: Locking mechanical fittings, SpeedRail® or equal
7. Slip joints for expansion and contraction
 - a. Provide at 30' maximum intervals
 - b. Gap: Between 1/8" and 3/8"
8. Post spacing
 - a. Aluminum: 6' maximum
 - 1) Conform to requirements of applicable building code. Refer to Section 2.2.E.3.
 - b. Equally spaced unless otherwise indicated
9. Provide safety chain across each opening in the railings, at post offset locations and elsewhere as indicated on the Drawings
 - a. Fastened to one railing post or wall be cadmium plated or stainless steel eyebolt
 - b. Engage a similar eyebolt on the opposite post by means of a 2½" heavy duty cadmium plated harness snap
 - c. Chain length as required by width of opening
 - d. Maximum sag: 1" per foot of horizontal length and/or span
10. Install toe plate per details on Drawings

E. Stop Plates and Grooves

1. Field connect sections to form a completed frame prior to installation in forms
2. Install plumb and straight to within 3/32"
3. Align opposite sides and bottom in a single plane to prevent binding
4. If necessary, box out a space for grooves and grout into place later

F. Monorail Beams

1. Install level and in accurate alignment to form a continuous, straight, smooth track

G. Steel Stairways

1. Erect true to line and slope
2. Support rigidly and brace and tighten to resist movement
 - a. Rigid with no noticeable sway or deflections under ordinary foot traffic
 - b. If necessary, provide additional supports and bracing to prevent noticeable movement
3. Install treads level and to exact alignment and spacing
4. Attach handrails rigidly and in exact alignment

3.3 FIELD QUALITY CONTROL

A. Handrail

1. Check final alignment with a tightly drawn reference wire
2. Maximum misalignment allowed: 1/8"
3. Replace bent, damaged or deformed railings or posts

END OF SECTION