MICHIGAN

DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION

FOR

**ORNAMENTAL RAILING**

RSD:JN 1 of 5 APPR:SCK:NAP:11-17-21

**a. Description.** This work consists of furnishing, fabricating, coating, and erecting the ornamental railing as shown on the plans, as specified herein, and in accordance with the Public Rights of Way Accessibility Guidelines. Ensure ornamental railing is the style and finish as indicated in the contract and be similar only in appearance to the model, Aegis II Xtreme Majestic, as manufactured by Ameristar and UARC-200-3R, as manufactured by Ultra, or approved equal.

**b. Design Criteria.** Furnish railing materials in accordance with the following requirements.

1. Wind Load. Design the railing for the wind load specified in *AASHTO Load and Resistance Factor Design (LRFD) Bridge Design Specifications, Ninth Edition*.

2. Live Load.

A. Posts, Base Plates and Anchorage Bolts. Design posts, base plates and base plate anchorage bolts for the concentrated design live load specified in the *AASHTO LRFD Bridge Design Specifications, Ninth Edition, Article 13.8.2*.

B. Top and Bottom Rails. Design both the top and bottom rails for a 50 pound per foot uniform load applied simultaneously vertically and transversely, plus a 200 pound concentrated load applied at the midspan in the directions for both maximum stress and deflection. Design connections between the rails and the post for the same loading as the rails except the 200 pound concentrated load will be applied at the connection.

C. Pickets and Infill Areas. Design the pickets and infill areas for a concentrated 200 pound load applied transversely over an area of 1 square foot.

D. Combination of Loads. Design the railing for load combinations and load factors specified in the *AASHTO LRFD Bridge Design Specifications, Ninth Edition*.

E. Deflection. The rails and posts must meet the following deflection requirements when applying the test load per *ASTM E935*.

(1) When the load is applied at the line of vertical support, the horizontal deflection must not exceed the rail height (h) divided by 12, or h/12, with h being the distance between the surface of the post anchorage and the top of the top rail.

(2) When the load is applied at the midspan of the rail, the horizontal deflection must not exceed the sum of the rail height (h) divided by 24 plus the rail length (l) between the vertical supports divided by 96, or h/24 + l/96.

(3) When the load is applied at the midspan of the rail, the vertical deflection must not exceed the length (l) divided by 96, or l/96.

(4) Residual deflection at the released test load, that is at 50 percent of the preload, must not exceed 20 percent of the deflection permitted in subsections b.2.E.(1) through b.2.E.(3) above, or 1/2 inch (13 mm), whichever is smaller.

**c. Materials.**

1. Steel. Furnish steel meeting the requirements of sections 707, 906, and 908 of the Standard Specifications for Construction. Ensure all steel is cold-formed welded square and rectangular tubing (Fy=50,000 psi).

2. Aluminum. Furnish aluminum extruded pipe and tube meeting the requirements of *ASTM B241/B241M, Alloy 6063-T6*.

3. High Strength Bolts and Anchor Bolts. Furnish high strength bolts, nuts, and washers meeting the requirements of section 906 of the Standard Specifications for Construction. Furnish anchor bolts meeting the requirements of section 908 of the Standard Specifications for Construction.

4. Hardware. Furnish hardware meeting the requirements of subsection 908.09.C of the Standard Specifications for Construction and as stated herein. Furnish all hardware and accessories required to properly and completely execute the installation for this project, including, but not limited to: hangers, bolts, nuts, washers, anchors, and similar items, whether specifically mentioned herein or not. Galvanize hardware in accordance with *ASTM A153/A153M*. Ensure screws meet the requirements of *ASTM A276/A276M, Type 304*.

5. Powder Coating. Use a powder coating system thermally fused and coated bonding process on all structural steel and aluminum parts. Ensure the railing is galvanized, then pretreated with zinc phosphate and powder coated with first an epoxy and followed with black polyester in accordance with the manufacturer’s recommendations. Ensure the epoxy and polyester powder coating are from the same manufacturer.

6. Coating for High Strength Bolts, Anchor Bolts and Hardware. Use a coating system for the bolts, anchor bolts, and related hardware in accordance with section 716 of the Standard Specifications for Construction.

7. Fabrication. Fabricator must possess an AISC – Bridge and Highway Metal Components certification and ensure the work is done in accordance with AWS D1.1 – Structural Welding Code – Steel and AWS D1.2 – Structural Welding Code – Aluminum as required.

**d. Submittals**.

1. Submit shop drawings in Adobe PDF to the Engineer for review and approval prior to the start of fabrication. MDOT will have 14 days to perform each review and multiple review cycles may be necessary. MDOT approval of all shop drawings is a prerequisite to railing fabrication, installation, and acceptance. In addition, submit the following information to the Engineer for approval prior to working drawing submittal:

A. Name, location and contact information where powder coating of railing will be performed.

B. QC program established and followed by the firm performing powder coating operations.

C. Powder coating plan, including identification of the powder coating materials used (and manufacturer), specific cleaning, surface preparation, pre-heating, powder coating application, curing, shop and field coating repair, handling, and storage processes.

D. Product data and material safety data sheet (MSDS) sheets for all powder coating and coating repair materials.

2. Structural Calculations. Ensure structural calculations for the railing are signed and sealed by a Professional Engineer licensed in the State of Michigan by the railing manufacturer and submitted to the Engineer for review and approval.

The calculations must include all design information necessary to determine the structural adequacy of the railing to conform to *AASHTO specifications* using LRFD methodology.

**e. Fabrication**. After fabrication, galvanize structural members and hardware in accordance with subsection 707.03.D.20 of the Standard Specifications for Construction.

After galvanization, pretreat galvanized steel with a zinc phosphate then apply the powder coating with a thickness as recommended by the coating manufacturer. Use a dark bronze top coat standard color as provided by the manufacturer.

Do not store galvanized material outdoors and protect from moisture. Clean and prepare newly galvanized surfaces in accordance with *ASTM D6386* and the powder coating plan approved by the Engineer. Perform surface smoothing and surface cleaning in accordance with *ASTM D6386 Section 5* and prepare surfaces in accordance with *ASTM D6386, Section 5.4.2*.

Notify the Engineer at least 1 week prior to all surface cleaning and preparation activities for powder coating. Provide the Engineer the opportunity to perform QA inspection at the completion of the surface cleaning and preparation activities but prior to beginning the powder coating application.

After surface preparation is completed, apply powder coatings in accordance with the powder coating manufacturer’s recommendations, the approved powder coating plan and as follows:

1. Pre-heat sufficiently to prevent pin holes from forming in the finished coating system.

2. Apply and cure the epoxy coating using the coating manufacturer’s recommendations. Ensure the epoxy coating is applied at a minimum thickness of 2 mils.

3. Apply and cure the polyester coating using the coating manufacturer’s recommendation.

Perform testing in accordance with the approved QC program. Visually inspect powder coating for unacceptable surface imperfections. Verify thorough testing that the epoxy primer coating and polyester finish coating are a minimum 2 mils each in thickness. Verify thorough testing that the finish coat provides a minimum hardness value of H in accordance with *ASTM D3363*. Verify through testing that the adhesion for the complete two component coating system is not less than 400 psi in accordance with *ASTM D4541*. Perform solvent cure test in accordance with the *Powder Coating Institute Test Procedure #8*. Document the results of all testing in a QC report and submit to the Engineer for approval. Provide access to the Engineer to witness testing. Failure to satisfy testing requirements is cause for rejection by the Engineer.

Ensure the polyester coating is in accordance with the requirements in Table 1.

**Table 1: Coating Requirements**

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| Test Property | Test Method | Specification Limits |
| Abrasion | *ASTM D1044* Tabor Abraser CS-10, 1000 gm load*,* 1000 cycles | 100 mg max weight loss |
| Adhesion | *ASTM D3359* Initial & 1000 hr, Method A | Rating 5A |
| Gloss | *ASTM D523* Initial, 500 hr, 1000 hr | 90 percent @ 60 degrees  60 percent @ 60 degrees |
| Hardness | *ASTM D3363* | 2H – No Gouge |
| Impact | *ASTM D2794* | Pass 9 N m |
| Weather Resistance | *ASTM G152* 102 minutes of light followed by 18 minutes light and water spray as Method 1 | No Film Failure |
| Infrared Spectrogram | Equipment Manufacturer’s Procedure | Match Original |
| Flexibility | 6.35 mm Mandrel 180 degrees bend in 1 sec, cured per manufacturer’s recommendations | No breaks, flaking or cracks. Tested with a Q-panel with no cracking |
| Thickness | *ASTM D7091* | 2 mils minimum |
| Humidity | *ASTM D2247* 1000 hr | No blistering |
| ∆ E Color Change | *ASTM D5894* Initial, 1000 hr *ASTM D2244* | <2.0 |

Repair damage to the galvanization and the coating in accordance with subsection 716.03.E of the Standard Specifications for Construction. Cost of the repairs will be borne by the Contractor.

The coating manufacturer will furnish certification and test results that the material and work comply with the applicable specifications.

**f. Construction**.

1. Installation. Install the railing in accordance with the manufacturer’s recommendations and as shown on the plans.

2. Shipping and Handling. Protect components and assemblies from damage in accordance with the manufacturer’s recommendations. Repair damaged components to the satisfaction of the Engineer. If satisfactory repairs cannot be made, replace damaged components. All costs associated with repairing and replacing damaged components will be borne by the Contractor. Do not deliver assemblies or components to the site until the Engineer approves the QC report.

3. Special Warranty. Provide manufacturer’s standard limited warranty that its ornamental railing system is free from defects in material and workmanship including cracking, peeling, blistering and corroding for a period of 10 years from the date of purchase.

**g. Measurement and Payment.** The completed work, as described, will be measured and paid for at the contract unit price using the following pay item:

**Pay Item Pay Unit**

Ornamental Railing Foot

**Ornamental Railing** will be measured by the foot of the length installed. Payment includes all other appurtenances for furnishing and installing **Ornamental Railing** complete and in place as described herein and includes furnishing and installing posts, rails, pickets, braces, hardware, base plates, and anchor bolts.