SECTION 710 – GUARDRAIL MATERIALS

710.01 General. Metal beam rails, guardrail posts, and guardrail hardware shall conform to AASHTO-AGC-ARTBA Joint Committee, Task Force 13 Report, *A Guide To Standardized Highway Barrier Hardware* and this section.

710.02 (Unassigned)

710.03 (Unassigned)

710.04 Metal Beam Rails.

(A) Steel Rail. Metal beam rails shall be corrugated sheet steel beams conforming to AASHTO M 180 and shall be zinc coated after fabrication in accordance with ASTM A 653. Unless otherwise indicated in the contract documents, punching, drilling, and cutting will not be allowed after application of zinc coating. Edges, bolt holes, and surfaces shall be free of torn metal, burrs, sharp edges, and protrusions.

(B) Certificate of Compliance. Certified inspection reports with test results certifying compliance of metal beam rails shall be submitted before railing installation.

710.05 (Unassigned)

710.06 (Unassigned)

710.07 Guardrail Posts. Unless otherwise indicated in the contract documents, guardrail posts shall be steel conforming to AASHTO M 270 and shall be zinc coated after fabrication in accordance with AASHTO M 111.

710.08 Guardrail Hardware. Unless otherwise indicated in the contract documents, metal fittings, bolts, nuts, washers, and accessories shall conform to AASHTO M 180 and be zinc coated after fabrication in accordance with AASHTO M 232, Class C.

(A) Offset Brackets. Offset brackets (or spacer blocks) shall conform to the following:

(1) Metal Offset Brackets. Metal offset brackets shall be of same material required for steel posts, in accordance with Subsection 710.07 - Guardrail Posts.

(2) Recycled Plastic Offset Brackets. Recycled plastic offset brackets (spacer blocks) shall conform to the following:
(a) Contain minimum 70 percent, by weight, of recycled plastic.

(b) Be uniform in composition throughout product.

(c) Be free of burns, discoloration, contamination, and other objectionable marks or defects that would affect appearance or serviceability.

(d) Have minimum service life of 35 years and contain chemicals, including fillers and colorants, designed to inhibit ultraviolet degradation, biological or biochemical decomposition, or both, insect infestation, and burning.

(e) When tested in accordance with ASTM D 1603, contain at least 2.5 percent and not more than 3.5 percent carbon black.

(f) When tested in accordance with ASTM D 570, exhibit water absorption not more than 0.03 percent.

(g) Include branded information on each block, including manufacturer’s name and date that block was manufactured.

(B) Splices and End Connections. Splices and end connections shall develop full design strength of rail elements.

End sections and terminal connectors shall conform to AASHTO M 180, Class B, Type II.

(C) End Anchor Rods and Accessories. End anchor rods and accessories shall be of such size and strength to develop the full design strength of the rail elements.

(D) Bolts and nuts. Standard bolts and nuts shall conform to ASTM A 307 and AASHTO M 291, Grade A, respectively, or better.

High strength bolts shall conform to AASHTO M 164 or ASTM A 449.

710.09 Aluminum Bridge Railing.


(1) Chemical Properties. Chemical composition shall conform to limits shown in Table 710.09-1 - Composition Limits (Percent).
TABLE 710.09-1 - COMPOSITION LIMITS (PERCENT)

<table>
<thead>
<tr>
<th></th>
<th>Cu</th>
<th>Fe</th>
<th>Si</th>
<th>Mn</th>
<th>Mg</th>
<th>Zn</th>
<th>Ti</th>
<th>Other (Each)</th>
<th>Other (Total)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.10</td>
<td>0.20</td>
<td>6.5-7.5</td>
<td>0.10</td>
<td>0.05</td>
<td>0.10</td>
<td>0.20</td>
<td>0.05</td>
<td>0.15</td>
</tr>
</tbody>
</table>

NOTE: Values are maximums unless shown as range.

(2) Mechanical Properties. Minimum mechanical properties of test bars machined vertically or horizontally from highly stressed area of post tension flange (lower 14 inches), but not at junction of rib and tension flange, shall conform to Table 710.09-2 - Mechanical Properties of Casting Tension Flange.

TABLE 710.09-2 - MECHANICAL PROPERTIES OF CASTING TENSION FLANGE

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ultimate Tensile Strength (psi)</td>
<td>20,000</td>
</tr>
<tr>
<td>Elongation (percent in 2 inches or 4D)</td>
<td>20</td>
</tr>
</tbody>
</table>

(3) Lot. Lot, as applied to castings, shall consist of not more than 1,000 pounds of trimmed castings produced by batch-type furnaces, and not more than 2,000 pounds of trimmed castings produced by continuous furnaces running maximum of eight consecutive hours.

(4) Chemical Analysis. At least one sample from each lot of castings shall be analyzed by an independent testing laboratory to determine conformance to requirements of Table 710.09-1 - Composition Limits (Percent).

(5) Mechanical Property Tests. One tensile specimen shall be machined from area of tension flange described in Subsection 710.09(A)(2) - Mechanical Properties. Tensile specimen shall be tested by an independent testing laboratory for conformance to Table 710.09-2 - Mechanical Properties of Casting Tension Flange. One tensile specimen from each casting lot shall be provided for testing.

Specimens machined from castings shall be Type R1, R2, R3, F2, or other sheet-type specimen as described in FED-STD-151a, Method 211.1. The largest possible round specimen shall be provided.
for testing. Flat, sheet-type specimens shall be tested only if casting thickness does not permit extraction of at least one R3 specimen.

Testing shall be performed in accordance with FED-STD-151a, Method 211.1. An independent laboratory shall perform tests and certify test results.

(6) Retesting. If test specimen fails to meet Table 710.09-2 - Mechanical Properties of Casting Tension Flange, two additional specimens shall be provided to replace each failed specimen. Replacements shall be tested for conformance to Table 710.09-2 - Mechanical Properties of Casting Tension Flange. If requirements are not met after retesting, the entire lot will be rejected.

(7) Heat Treatment. Entire casting shall be heat-treated to produce material of highest uniformity and conformance to specified properties.

(8) Quality Requirements. Castings shall be uniform in quality and condition, and free from cracks, shrinkage, porosity, blowholes, and other defects that due to their nature or extent will be detrimental to their intended use. Castings shall be smoothed and cleaned before inspection.

Castings shall be produced under radiographic control as follows:

(a) All castings shall be inspected by X-ray until foundry technique has been established for each mold that will ensure production of castings that are of commercial quality and free from harmful defects.

(b) Each production lot of castings shall be X-rayed in accordance with Special Level S-2, AQL 6.5 percent, of MIL-STD-105D.

(c) Bottom 14 inches of tension and compression flanges, and casting base shall be inspected. Non-critical areas do not require production X-rays.

(d) Single X-ray to cover tension flange and compression flanges, and casting base is acceptable.

Radiographic acceptance of critical areas shall be based on ASTM E 155 and Table 710.09-3 - Radiographic Acceptance Standards.
TABLE 710.09-3 - RADIOGRAPHIC ACCEPTANCE STANDARDS

<table>
<thead>
<tr>
<th>Type of Defect</th>
<th>Reference Radiograph</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1/4 Inch</td>
</tr>
<tr>
<td>Gas Holes</td>
<td>1.10</td>
<td>2</td>
</tr>
<tr>
<td>Gas Porosity (round)</td>
<td>1.21</td>
<td>3</td>
</tr>
<tr>
<td>Gas Porosity (elongated)</td>
<td>1.22</td>
<td>---</td>
</tr>
<tr>
<td>Shrinkage Cavity</td>
<td>2.10</td>
<td>2</td>
</tr>
<tr>
<td>Shrinkage – Sponge</td>
<td>2.20</td>
<td>2</td>
</tr>
<tr>
<td>Foreign Material (less dense)</td>
<td>3.11</td>
<td>3</td>
</tr>
<tr>
<td>Foreign Material (more dense)</td>
<td>3.12</td>
<td>2</td>
</tr>
</tbody>
</table>

Casting with one or more defects greater than indicated in Table 709.10-3 - Radiographic Acceptance Standards shall be rejected.

Defects equal to but not greater than indicated in Table 709.10-3 - Radiographic Acceptance Standards shall be limited to two defects per type, or total of three defects if all are same type.

(9) **Post Finish.** Standard scratch brush finish shall be applied to front, top, and rear face of posts.

(10) **Material Inspection.** Material shall be inspected at place of delivery.

Castings shall be visually checked for conformance to Subsection 710.09(A)(8) – Quality Requirements.

(11) **Reports.** Inspection reports shall be submitted certifying compliance of castings with requirements of this subsection for each casting shipment.
(B) 5/16-Inch Toggle Bolt Assembly.

(1) **Toggle Bolt Material.** Toggle bolt material shall be 5/16-inch - 18 NC, SAE 1020 C.R. steel, unannealed after forming.

(2) **Toggle Material.** Toggle material shall be H.R. steel, pickled and oiled.

(3) **Washer.** Washer shall be 1020 C.R. steel.

(4) **Nut.** Nut shall be 5/16-inch - 18 NC, American Standard cold punched 1020 steel.

Steel parts shall have cadmium plating, Class 12, Type II, conforming to ASTM B 766.

(C) 1/2-Inch Toggle Bolt Assembly.

(1) **Toggle Bolt Material.** Toggle bolt material shall be 1/2-Inch - 13 NC, 1335 C.R. steel, heat-treated RC 32038, conforming to ASTM A 354.

(2) **Toggle Material.** Toggle material shall be 1015 H.R. steel, pickled and oiled with rounded edge, conforming to ASTM A 570.

(3) **Washer.** Washer shall be SAE 1020 H.R. steel plate, sharp edged, conforming to ASTM A 283.

(4) **Nut.** Nut shall be 1/2-inch - 13 NC, American Standard hexagon nut, heavy 1035 C.R. steel, heat treated, conforming to AASHTO M 164.

Steel parts shall have cadmium plating, Class 12, Type II, conforming to ASTM B 766.

(D) Steel Anchor Bolt Assemblies. Steel parts of anchor bolt assemblies shall be zinc coated after threading, cutting, drilling, or punching, in accordance with AASHTO M 232.

(1) **Steel Anchor Bolt, Washer, and Nut.** Steel anchor bolt, washer, and nut shall conform to AASHTO M 164, except that Rockwell C hardness of bolts shall not exceed 32 after heat treatment and before zinc coating.

(2) **Anchor Plate.** Anchor plate shall be steel plate conforming to ASTM A 36.
(E) **Extruded Aluminum Tube.** Extruded aluminum tube shall conform to ASTM B 221, Alloy 6061-T6.

(F) **Insulating Material.** Pads for insulating aluminum members from concrete or dissimilar metals shall be of material, shape, and size indicated in the contract documents.

(G) **Compliance Reports.** Certified inspection reports with test results affirming conformance of cast posts, anchor bolts, extruded aluminum tubes, and appurtenances to requirements of this subsection shall be submitted. Certified inspection reports for anchor bolts shall conform to requirements of AASHTO M 164. Certifications shall be submitted before installation of railings.

### 710.10 Steel Bridge Railing

Steel bridge railing shall include metal rails, metal support posts, anchor bolts, hardware, and fittings. Rail assembly shall be zinc coated in accordance with AASHTO M 111 and AASHTO M 232 after fabrication.

Steel rail shall be shop bent to fit horizontal curves indicated in the contract documents.

If horizontal curve has radius 30 feet or less, railing shall be shop bent or fabricated from structural steel posts 1/4 inch thick conforming to ASTM A 36. Fabricated railing shall match seamless tube railing in appearance.

Clear space between rail and sleeve shall not exceed 1/16 inch after zinc coating.

Base of metal post shall be true and flat for uniform bearing on concrete.

Material for rails, posts, rods, bolts, and nuts shall conform to Table 710.10-4 - Material Requirements for Steel Railing.

If required, shims shall be installed with posts and railing for uniform bearing and conformity with horizontal and vertical lines and grades. Shims at steel posts shall be zinc-coated sheet steel conforming to ASTM A 36.

Certified inspection reports with test results affirming conformance of rails, posts, sleeves, anchor bolts, bolts, nuts, and washers to requirements of this subsection shall be submitted before installation of material. Reports for anchor bolts shall conform to AASHTO M 164.
TABLE 710.10-4 – MATERIAL REQUIREMENTS FOR STEEL RAILING

<table>
<thead>
<tr>
<th>Material</th>
<th>ASTM or AASHTO Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel Rail</td>
<td>ASTM A 500, Grade B</td>
</tr>
<tr>
<td>Steel Post</td>
<td>ASTM A 36</td>
</tr>
<tr>
<td>Steel Sleeve For Rail</td>
<td>ASTM A 36</td>
</tr>
<tr>
<td>Steel Bolt</td>
<td>AASHTO M 169, Grades 1015 to 1020</td>
</tr>
<tr>
<td>Anchor Bolt, Bolt, Nut, and Washer</td>
<td>AASHTO M 164, except that Rockwell C hardness of bolt shall not exceed 32 after heat treatment and before zinc coating.</td>
</tr>
</tbody>
</table>

710.11 Steel Pipe for Railing. Steel pipe shall conform to ASTM A 53. Steel pipe shall have 1-1/2 inch inside diameter and shall be zinc coated, standard weight for rails, and extra strong for posts and sleeves. Flanges, bolts, and other appurtenances shall be hot-dip zinc coated.

END OF SECTION 710