

SECTION 710 – GUARDRAIL MATERIALS

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4 **710.01 General.** Metal beam rails, guardrail posts, and guardrail hardware shall
5 conform to AASHTO-AGC-ARTBA Joint Committee, Task Force 13 Report, *A Guide*
6 *To Standardized Highway Barrier Hardware* and this section.

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8 **710.02 (Unassigned)**

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10 **710.03 (Unassigned)**

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12 **710.04 Metal Beam Rails.**

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

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

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25 **710.05 (Unassigned)**

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27 **710.06 (Unassigned)**

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29 **710.07 Guardrail Posts.** Unless otherwise indicated in the contract documents,
30 guardrail posts shall be steel conforming to AASHTO M 270 and shall be zinc
31 coated after fabrication in accordance with AASHTO M 111.

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33 **710.08 Guardrail Hardware.** Unless otherwise indicated in the contract
34 documents, metal fittings, bolts, nuts, washers, and accessories shall conform to
35 AASHTO M 180 and be zinc coated after fabrication in accordance with AASHTO
36 M 232, Class C.

37
38 **(A) Offset Brackets.** Offset brackets (or spacer blocks) shall conform to
39 the following:

40
41 **(1) Metal Offset Brackets.** Metal offset brackets shall be of same
42 material required for steel posts, in accordance with Subsection
43 710.07 - Guardrail Posts.

44
45 **(2) Recycled Plastic Offset Brackets.** Recycled plastic offset
46 brackets (spacer blocks) shall conform to the following:

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- 48 (a) Contain minimum 70 percent, by weight, of recycled
49 plastic.
50
51 (b) Be uniform in composition throughout product.
52
53 (c) Be free of burns, discoloration, contamination, and other
54 objectionable marks or defects that would affect appearance or
55 serviceability.
56
57 (d) Have minimum service life of 35 years and contain
58 chemicals, including fillers and colorants, designed to inhibit
59 ultraviolet degradation, biological or biochemical
60 decomposition, or both, insect infestation, and burning.
61
62 (e) When tested in accordance with ASTM D 1603, contain
63 at least 2.5 percent and not more than 3.5 percent carbon
64 black.
65
66 (f) When tested in accordance with ASTM D 570, exhibit
67 water absorption not more than 0.03 percent.
68
69 (g) Include branded information on each block, including
70 manufacturer's name and date that block was manufactured.
71

72 **(B) Splices and End Connections.** Splices and end connections shall
73 develop full design strength of rail elements.
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75 End sections and terminal connectors shall conform to AASHTO
76 M 180, Class B, Type II.
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78 **(C) End Anchor Rods and Accessories.** End anchor rods and
79 accessories shall be of such size and strength to develop the full design
80 strength of the rail elements.
81

82 **(D) Bolts and nuts.** Standard bolts and nuts shall conform to ASTM
83 A 307 and AASHTO M 291, Grade A, respectively, or better.
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85 High strength bolts shall conform to AASHTO M 164 or ASTM A 449.
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87 710.09 Aluminum Bridge Railing.

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89 **(A) Cast Posts.** Cast posts shall be permanent mold castings conforming
90 to ASTM B 108, Alloy A444.0-T4.
91

92 **(1) Chemical Properties.** Chemical composition shall conform to
93 limits shown in Table 710.09-1 - Composition Limits (Percent).
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TABLE 710.09-1 - COMPOSITION LIMITS (PERCENT)								
Cu	Fe	Si	Mn	Mg	Zn	Ti	Other (Each)	Other (Total)
0.10	0.20	6.5-7.5	0.10	0.05	0.10	0.20	0.05	0.15
NOTE: Values are maximums unless shown as range.								

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(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	
Ultimate Tensile Strength (psi)	20,000
Elongation (percent in 2 inches or 4D)	20

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(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.

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(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

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124 for testing. Flat, sheet-type specimens shall be tested only if casting
125 thickness does not permit extraction of at least one R3 specimen.
126

127 Testing shall be performed in accordance with FED-STD-151a,
128 Method 211.1. An independent laboratory shall perform tests and
129 certify test results.
130

131 **(6) Retesting.** If test specimen fails to meet Table 710.09-2 -
132 Mechanical Properties of Casting Tension Flange, two additional
133 specimens shall be provided to replace each failed specimen.
134 Replacements shall be tested for conformance to Table 710.09-2 -
135 Mechanical Properties of Casting Tension Flange. If requirements are
136 not met after retesting, the entire lot will be rejected
137

138 **(7) Heat Treatment.** Entire casting shall be heat-treated to
139 produce material of highest uniformity and conformance to specified
140 properties.
141

142 **(8) Quality Requirements.** Castings shall be uniform in quality
143 and condition, and free from cracks, shrinkage, porosity, blowholes,
144 and other defects that due to their nature or extent will be detrimental
145 to their intended use. Castings shall be smoothed and cleaned before
146 inspection.
147

148 Castings shall be produced under radiographic control as
149 follows:
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151 **(a)** All castings shall be inspected by X-ray until foundry
152 technique has been established for each mold that will ensure
153 production of castings that are of commercial quality and free
154 from harmful defects.
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156 **(b)** Each production lot of castings shall be X-rayed in
157 accordance with Special Level S-2, AQL 6.5 percent, of
158 MIL-STD-105D.
159

160 **(c)** Bottom 14 inches of tension and compression flanges,
161 and casting base shall be inspected. Non-critical areas do not
162 require production X-rays.
163

164 **(d)** Single X-ray to cover tension flange and compression
165 flanges, and casting base is acceptable.
166

167 Radiographic acceptance of critical areas shall be based on
168 ASTM E 155 and Table 710.09-3 - Radiographic Acceptance
169 Standards.
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TABLE 710.09-3 - RADIOGRAPHIC ACCEPTANCE STANDARDS			
Type of Defect	Reference Radiograph	Thickness	
		1/4 Inch	3/4 Inch
Gas Holes	1.10	2	3
Gas Porosity (round)	1.21	3	2
Gas Porosity (elongated)	1.22	---	---
Shrinkage Cavity	2.10	2	---
Shrinkage – Sponge	2.20	2	2
Foreign Material (less dense)	3.11	3	3
Foreign Material (more dense)	3.12	2	1

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

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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.

- 193 **(B) 5/16-Inch Toggle Bolt Assembly.**
194
195 **(1) Toggle Bolt Material.** Toggle bolt material shall be 5/16-inch
196 - 18 NC, SAE 1020 C.R. steel, unannealed after forming.
197
198 **(2) Toggle Material.** Toggle material shall be H.R. steel, pickled
199 and oiled.
200
201 **(3) Washer.** Washer shall be 1020 C.R. steel.
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203 **(4) Nut.** Nut shall be 5/16-inch - 18 NC, American Standard cold
204 punched 1020 steel.
205

206 Steel parts shall have cadmium plating, Class 12, Type II, conforming
207 to ASTM B 766.
208

- 209 **(C) 1/2-Inch Toggle Bolt Assembly.**
210
211 **(1) Toggle Bolt Material.** Toggle bolt material shall be 1/2-Inch -
212 13 NC, 1335 C.R. steel, heat-treated RC 32038, conforming to
213 ASTM A 354.
214
215 **(2) Toggle Material.** Toggle material shall be 1015 H.R. steel,
216 pickled and oiled with rounded edge, conforming to ASTM A 570.
217
218 **(3) Washer.** Washer shall be SAE 1020 H.R. steel plate, sharp
219 edged, conforming to ASTM A 283.
220
221 **(4) Nut.** Nut shall be 1/2-inch - 13 NC, American Standard
222 hexagon nut, heavy 1035 C.R. steel, heat treated, conforming to
223 AASHTO M 164.
224

225 Steel parts shall have cadmium plating, Class 12, Type II, conforming
226 to ASTM B 766.
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- 228 **(D) Steel Anchor Bolt Assemblies.** Steel parts of anchor bolt
229 assemblies shall be zinc coated after threading, cutting, drilling, or punching,
230 in accordance with AASHTO M 232.
231
232 **(1) Steel Anchor Bolt, Washer, and Nut.** Steel anchor bolt,
233 washer, and nut shall conform to AASHTO M 164, except that
234 Rockwell C hardness of bolts shall not exceed 32 after heat treatment
235 and before zinc coating.
236
237 **(2) Anchor Plate.** Anchor plate shall be steel plate conforming to
238 ASTM A 36.
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240 **(E) Extruded Aluminum Tube.** Extruded aluminum tube shall conform to
241 ASTM B 221, Alloy 6061-T6.

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

246
247 **(G) Compliance Reports.** Certified inspection reports with test results
248 affirming conformance of cast posts, anchor bolts, extruded aluminum tubes,
249 and appurtenances to requirements of this subsection shall be submitted.
250 Certified inspection reports for anchor bolts shall conform to requirements of
251 AASHTO M 164. Certifications shall be submitted before installation of
252 railings.

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254 **710.10 Steel Bridge Railing.** Steel bridge railing shall include metal rails, metal
255 support posts, anchor bolts, hardware, and fittings. Rail assembly shall be zinc
256 coated in accordance with AASHTO M 111 and AASHTO M 232 after fabrication.

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

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

264
265 Clear space between rail and sleeve shall not exceed 1/16 inch after zinc
266 coating.

267
268 Base of metal post shall be true and flat for uniform bearing on concrete.

269
270 Material for rails, posts, rods, bolts, and nuts shall conform to
271 Table 710.10-4 - Material Requirements for Steel Railing.

272
273 If required, shims shall be installed with posts and railing for uniform bearing
274 and conformity with horizontal and vertical lines and grades. Shims at steel posts
275 shall be zinc-coated sheet steel conforming to ASTM A 36

276
277 Certified inspection reports with test results affirming conformance of rails,
278 posts, sleeves, anchor bolts, bolts, nuts, and washers to requirements of this
279 subsection shall be submitted before installation of material. Reports for anchor
280 bolts shall conform to AASHTO M 164.

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TABLE 710.10-4 – MATERIAL REQUIREMENTS FOR STEEL RAILING	
Material	ASTM or AASHTO Designation
Steel Rail	ASTM A 500, Grade B
Steel Post	ASTM A 36
Steel Sleeve For Rail	ASTM A 36
Steel Bolt	AASHTO M 169, Grades 1015 to 1020
Anchor Bolt, Bolt, Nut, and Washer	AASHTO M 164, except that Rockwell C hardness of bolt shall not exceed 32 after heat treatment and before zinc coating.

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284 **710.11 Steel Pipe for Railing.** Steel pipe shall conform to ASTM A 53. Steel
285 pipe shall have 1-1/2 inch inside diameter and shall be zinc coated, standard weight
286 for rails, and extra strong for posts and sleeves. Flanges, bolts, and other
287 appurtenances shall be hot-dip zinc coated.

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END OF SECTION 710