



SECTION 1040

GUARDRAIL, END TERMINALS, ONE-STRAND ACCESS RESTRAINT CABLE AND THREE-STRAND GUARD CABLE MATERIAL

1040.1 Scope. This specification covers guardrail, end terminals, one-strand access restraint cable, three-strand guard cable, and all appurtenances required for installation.

1040.2 Posts and Blocks. The same type of posts and blocks shall be used in a given run, except as shown on the plans or as approved by the engineer.

1040.2.1 Wood Posts and Blocks. Wood posts and blocks for guardrail and one-strand access restraint cable shall be in accordance with [Sec 1050](#).

1040.2.2 Steel Posts, Plates and Rails. Steel posts, anchor plates, bearing plates, soil plates, plate washers and channel rail shall be structural steel in accordance with AASHTO M 270, Grade 36, shall be of the dimensions and weights shown on the plans and shall be galvanized in accordance with AASHTO M 111. Bolts, nuts and washers shall be in accordance with the dimensions shown on the plans and shall be galvanized in accordance with AASHTO M 232, or may be mechanically galvanized. If mechanically galvanized, the coating thickness, adherence and quality requirements shall be in accordance with AASHTO M 232, Class C. Any dimensional defects and structural discontinuities will be cause for rejection. The material to be welded shall be preheated in accordance with good welding practice, and welds shall be full-section and sound throughout. All welds shall be mechanically cleaned before galvanizing. No punching, drilling, cutting or welding will be permitted after galvanizing.

1040.2.3 Plastic Blocks. Plastic guardrail blocks shall meet the dimensional requirements shown on the plans. The blocks shall be a homogeneous product with a uniform texture, and shall have no cracking, chipping, flaking, peeling or splintering after fabrication. The blocks will not be considered homogeneous if there are more than five voids larger than 5/8 inch or any voids larger than 3/4 inch on any cut face. The blocks shall be of new stock, shall meet all applicable requirements of NCHRP 350, and shall meet the approval of Construction and Materials.

1040.2.3.1 Approval. Prior to approval and use of the plastic guardrail blocks, the manufacturer shall submit to Construction and Materials, the manufacturer's name, the product brand name or model number, a copy of the NCHRP 350 test results, a copy of the FHWA acceptance letter, an MSDS and a sample block.

1040.2.3.2 Acceptance. Acceptance of the material will be based on the manufacturer's certification and upon the results of such tests as may be performed by the engineer.

1040.3 Steel Beam Guardrail. Guardrail beams shall be of the class and type shown on the plans. Guardrail beams shall be in accordance with AASHTO M 180, Type 1 or Type 2, except as noted herein. Type 1 material shall be galvanized by the continuous method.

1040.3.1 Test Specimens. Test specimens for mechanical properties shall be prepared and tested in accordance with ASTM A 653.

1040.3.2 End Sections. End sections and terminal connectors shall be of a class and type the same as or superior to that used for the beam to which the end sections and terminal connectors are attached. The physical properties shall be in accordance with AASHTO M 180.

1040.3.3 Fabrication. The beams, end sections and terminal connectors shall be shaped and punched as shown on the plans and ready for assembly when delivered. Only drilling or cutting necessary for special connections and for sampling will be permitted in the field. Warped or deformed beams will be rejected. Beams to be erected on a radius of 150 feet or less shall be shop curved to the approximate curvature of the installation.

1040.3.4 Markings.

1040.3.4.1 Beams. Beam markings shall be in accordance with AASHTO M 180, except the AASHTO specification number may be omitted if another designation for Class and Type is used.

1040.3.4.2 Transition Sections and Terminal Connectors. Transition sections and terminal connectors shall be marked in accordance with [Sec 1040.3.4.1](#), except as follows. Durable tags securely attached to each section or connector may be used. If the transition section or terminal connector is Class B, the Class indicator will not be required. If the transition section or terminal connector is Type 2, the Type indicator will not be required. Heat numbers and coating designations will not be required.

1040.3.4.3 End Sections. No markings or tags will be required for end sections.

1040.3.4.4 Posts. Posts shall be marked such that the marking is exposed after installation, in such a manner as to indicate the manufacturer.

1040.3.5 Brand Registration and Guarantee. The manufacturer shall submit a brand registration and guarantee, and current test results indicating compliance with this specification prior to delivery of any material. Once the brand registration and guarantee is approved, the manufacturer's name will be added to the qualified list of guardrail fabricators. For Type I coated material, the brand registration and guarantee shall certify the material as being produced by the continuous galvanizing method.

1040.3.6 Acceptance. Acceptance will be by brand registration and guarantee, and any sampling deemed necessary by the engineer. The contractor or supplier shall provide equipment and personnel required to obtain samples as directed by the engineer.

1040.4 Crashworthy End Terminals.

1040.4.1 Material. Only new material shall be used in the fabrication of end terminals. The major items of the installations shall be the best standard products of a manufacturer regularly engaged in the production of that type of end terminal and shall be of the manufacturer's latest approved design. After installation, the end terminal shall redirect traffic face side vehicle impacts within the prescribed performance crash test criteria ranges.

1040.4.2 Manufacture's Approval. Prior to approval and use of a end terminal, the manufacturer shall submit to MoDOT the manufacturer's name, the product brand name or model number, a copy of the NCHRP 350 test results, a copy of the FHWA acceptance letter, and shop drawings.

1040.4.3 Acceptance. Acceptance of the material will be based on the manufacturer's certification and upon satisfactory field performance.

1040.4.4 Contractor's Certification. Prior to installation, the contractor shall furnish to the engineer a manufacturer's certification that the units furnished are identical in material and design to approved units.

1040.5 End Anchors and Bridge Anchors.

1040.5.1 Steel Tube and Tube Block. Steel tubes for end anchors shall consist of structural steel tubing in accordance with ASTM A 500, Grade B, or ASTM A 501 and shall be galvanized in accordance with AASHTO M 111. Structural steel tubing blocks for guardrail shall consist of steel tubing in accordance with ASTM A 500, Grade B, and shall be galvanized in accordance with AASHTO M 111.

1040.5.2 Cable. Cable shall be 3/4 inch in diameter, Type II, Class A in accordance with AASHTO M 30.

1040.5.3 Transition Cap Rail. The transition cap rail shall be in accordance with AASHTO M 270, Grade 36.

1040.5.4 Thrie Beam Rail and Transition Section. The thrie beam rail and transition section shall be galvanized in accordance with AASHTO M 180, Type 2.

1040.5.5 Approval. The cable assembly and anchor plate will be subject to approval by the engineer and shall have a minimum breaking strength of 20 tons.

1040.5.6 Markings. Thrie beam rail and transition sections shall be marked in accordance with [Sec 1040.3.4](#).

1040.6 Cable and Fittings.

1040.6.1 One-Strand Access Restraint Cable.

1040.6.1.1 Cable. Cable shall be zinc-coated steel wire strand; 1/2-inch diameter; seven wire strand; Common, Siemens-Martin or High Strength grade; Class A coating; and shall be in accordance with ASTM A 475.

1040.6.1.2 Hardware. Eyebolts, turnbuckles and clips for cable connections and end anchors shall be steel forgings in accordance with AASHTO M 102 or pearlitic malleable iron in accordance with ASTM A 220. All miscellaneous parts, comprising of cable connections, fasteners and end anchors, shall be galvanized in accordance with AASHTO M 232.

1040.6.2 Three-Strand Guard Cable.

1040.6.2.1 Cable and Connecting Hardware. The cable and connecting hardware shall be in accordance with AASHTO M 30 and AASHTO M 269. The wire rope shall be Type 1, 3/4-inch diameter, 3 by 7 construction with a Class A coating. The rope, with connecting hardware, shall develop the breaking strength of a 25,000-pound single cable. Connecting hardware shall be galvanized in accordance with AASHTO M 232 or may be mechanically galvanized. If mechanically galvanized, the coating, thickness, adherence and quality requirements shall be in accordance with AASHTO M 232, Class C. Cast Steel components shall be in accordance with AASHTO M 103, Grade 70-40, Class 1. Malleable iron castings shall be in accordance with ASTM A 47. Compensating devices shall have a spring constant of 0.46 psi, plus or minus 0.06 pound per inch, and permit 6 inches of travel, plus or minus one inch. All threaded parts on compensating cable end assemblies shall be in accordance with ASTM F 568, Class 4.6, 3/4-10 threads. Socket baskets shall be designed for use with

the cable anchor wedge as shown on the plans. Guard cable anchor brackets shall be manufactured from an AASHTO M 270, Grade 250 steel plate, and zinc-coated in accordance with AASHTO M 111. Dimensional tolerances not shown on the plans shall be consistent with the proper functioning of the part, including the part's appearance and accepted manufacturing process.

1040.6.2.2 Cable Brackets. Steel used in the fabrication of the bracket shall be in accordance with ASTM A 36. The bracket shall be galvanized after fabrication in accordance with AASHTO M 111. All fittings, including splices, shall be designed to use the wedge detail, and shall be of such section as to develop the full strength of the 3/4-inch, 25,000-pound round cable. Designs for a combination or single-unit compensating device and turnbuckle assembly shall be submitted for approval. Compensating devices shall have a spring rate of 0.46 ± 0.03 pound per inch, and shall permit 6 inches \pm one inch of travel. All parts, except cable wedge, shall be hot-dip zinc coated in accordance with AASHTO M 232 or AASHTO M 298.

1040.6.2.3 Hook Bolts, Hex Bolts, Nuts and Washers. Hook bolts, hex bolts and washers shall be in accordance with ASTM A 307. Cable hook nuts shall be 5/16-18 threads and in accordance with ASTM A 563. Hook bolts, as installed, shall develop an ultimate pull open strength of 450 to 1,000 pounds applied in a direction normal to the axis of the post. Hooked anchor studs shall be in accordance with AASHTO M 314, except the threads and nominal diameter shall be 3/4-10 and in accordance with ASTM F 568, Class 4.6. All items shall be galvanized in accordance with AASHTO M 232 or may be mechanically galvanized in accordance with AASHTO M 232, Class C.

1040.7 Certification. The contractor shall furnish the manufacturer's certification for all material governed by this specification. Specifically, each certification shall indicate compliance with the requirements of each applicable section and as set forth in Table I.

1040.8 Repair of Galvanizing. Galvanized material shall be handled in a manner to avoid damage to the surface. No field punching, drilling, cutting or welding will be permitted after galvanizing. Any galvanized material on which the spelter coating has been damaged will be rejected or may be repaired in accordance with [Sec 1081](#), with approval from the engineer.

Item	Galvanizing Standard	Steel Grade	Other
Wood Post and Blocks	-	-	a
Steel Posts, Plates and Brackets	AASHTO M 111	AASHTO M 270, Grade 36	b
Plastic Blocks	-	-	g
Guardrail Beam	Sec 1040.3	Sec 1040.3	b, c
Bolts, Nuts and Washers	AASHTO M 232	ASTM A 307	
End Terminals Systems	-	-	f
End Anchors			
- Tubes	AASHTO M 111	ASTM A 500/ASTM A 501	b
- Transition Cap Rail	AASHTO M 111	AASHTO M 270, Grade 36	b
One-Strand Access Restraint Cable			
- Cable	AASHTO M 30	AASHTO M 30	b
- Hardware	AASHTO M 232	AASHTO M 102/ ASTM A 220	b

Three Strand Guard Cable			
- Cable	AASHTO M30	AASHTO M 30 & AASHTO M 269	b
- Hardware	AASHTO M 232	AASHTO M 102/ ASTM A 220	d d
- Cast Steel Components	AASHTO M 232	AASHTO M 103	d
- Malleable Iron Castings	AASHTO M 232	ASTM A 47	e
- Anchor Brackets	AASHTO M 111	AASHTO M 270	
- Cable Brackets	AASHTO M 111	AASHTO M 270, Grade 36	d
- Hook and Hex Bolts	AASHTO M 232	ASTM A 307	
- Hook Nuts	AASHTO M 232	ASTM A 563	
- Hooked Anchor Studs	AASHTO M 232	AASHTO M 314	

(a) Certification shall state that the material is in accordance with [Sec 1050](#) and shall include a listing of the material supplied and a certified test report as detailed in Section 7.2 of AWP, Standard M2, attesting to complete compliance with this specification.

(b) Certification shall include, or have attached, specific results of laboratory tests for physical and chemical properties from samples representative of the material.

(c) Shall have Brand Registration and Guarantee on file, including certification indicating the coating is either Type 1 by Continuous Galvanizing Method or Type 2.

(d) All threaded parts of compensating cable end assemblies and hooked anchor studs shall be in accordance with ASTM F 568.

(e) All fittings for cable bracket, except the cable wedge, shall be in accordance with AASHTO M 232 or AASHTO M 298.

(f) Certification shall state the name of the manufacturer and that the units furnished are identical in material and design as those tested for performance in accordance with [Sec 606.30](#).

(g) Certification shall state that the materials furnished are identical in chemistry, mechanical properties and geometry as those that passed the NCHRP 350 crash test, and as those that were approved by the Missouri Department of Transportation.