



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 Basis of Acceptance. The basis of acceptance will be in accordance with specification compliance and from an approved qualified plant and accepted based on certification, quality control documentation, and tests on samples required by the engineer.

1040.2.1 Sampling, Testing and Acceptance Procedures. All suppliers furnishing components for MoDOT projects shall be qualified as herein described. All components will be subject to inspection by the engineer at the source, intermediate shipping terminal, or at destination. The engineer shall be allowed unlimited access to all facilities and records as required to conduct inspection and sampling in accordance with [Sec 106](#) unless specified below.

1040.2.2 Application for Placement on Qualified List. To become qualified, a written request shall be sent by the supplier to Construction and Materials. The request shall include a "Pre-Qualified Section 1040, 1043, and 1044 Supplier Inclusion Certificate and Guarantee Statement" and a guarantee that all material to be used in fabrication will be in accordance with MoDOT specifications and pre-approval for any source of material will be received prior to use.

1040.2.3 Maintaining Qualification. To maintain qualification, the supplier shall maintain quality control documentation. The required documentation for each shipment of material used in production shall be kept on file for three years. The supplier shall notify Construction and Materials at least 24 hours prior to each shipment.

1040.2.4 Disqualification of a Supplier. A supplier may be disqualified to provide components for use on MoDOT projects based on the discretion of Construction and Materials, for reasons including, but not limited to, not maintaining required documentation, failure of material to consistently meet specifications, falsification of any documentation, misbranding of components, unsatisfactory performance in the field, or for other reasons indicating lack of consistent material quality.

1040.2.4.1 A supplier will not be considered for reinstatement until after one year from the date of removal for falsification of documents.

1040.2.4.2 Three notices of failure to meet specification requirements within a 12-month period will be cause for disqualification of the supplier for one year, effective from the date of the third notice.

1040.2.4.3 A supplier disqualified within one year of the end of a disqualification may be subject to permanent removal, with no application for reinstatement accepted for a period of three years.

1040.2.5 Reinstatement of a Supplier. Consideration of reinstatement of a supplier once disqualified will be no sooner than specified in [Sec 1040.2.4](#), will require a written document from the supplier stating the reasons for disqualification and the action taken to correct those deficiencies, written concurrence from Construction and Materials that the problem has been suitably addressed, and followed by an application in accordance with [Sec 1040.2.2](#).

1040.2.6 Sampling of Material. Random sampling of the material used in production will be conducted by the engineer to verify the material is in compliance with applicable specifications. Sampling size and frequency will be at the discretion of the engineer.

1040.2.7 MoDOT Identification Number. When the supplier contacts the engineer in accordance with [Sec 1040.2.3](#), the engineer will assign a specific MoDOT identification number for each component. A Shippers form must accompany the products to the job site.

1040.3 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.

1040.3.1 Wood Posts and Blocks. Wood posts and blocks for guardrail and one-strand access restraint cable shall be in accordance with [Sec 1050](#).

1040.3.2 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.

1040.3.3 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 for NCHRP 350 compliant installations or MASH for MASH complaint installations, and shall meet the approval of Construction and Materials.

1040.3.3.1 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 or MASH test results, a copy of the FHWA eligibility letter, an MSDS and a sample block.

1040.3.3.2 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.

1040.4 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.

1040.4.1 Test Specimens. Test specimens for mechanical properties, irrespective of the galvanization method, shall be prepared and tested in accordance with ASTM A 653.

1040.4.2 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.

1040.4.3 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.

1040.4.4 Markings.

1040.4.4.1 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.

1040.4.4.2 Transition Sections and Terminal Connectors. Transition sections and terminal connectors shall be marked in accordance with [Sec 1040.4.4.1](#), 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.

1040.4.4.3 End Sections. No markings or tags will be required for end sections.

1040.4.4.4 Posts. Posts shall be marked such that the marking is exposed after installation, in such a manner as to indicate the manufacturer.

1040.4.5 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.

1040.4.6 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.

1040.5 Crashworthy End Terminals.

1040.5.1 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.

1040.5.2 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 MASH test results, a copy of the FHWA eligibility letter, and shop drawings.

1040.5.3 Acceptance. Acceptance of the material will be based on the manufacturer's certification and upon satisfactory field performance.

1040.5.4 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 successfully tested units.

1040.6 End Anchors, Bridge Anchors, and Approach Transitions.

1040.6.1 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.

1040.6.2 Cable. Cable shall be 3/4 inch in diameter, Type II, Class A in accordance with AASHTO M 30.

1040.6.3 Transition Cap Rail. The transition cap rail shall be in accordance with AASHTO M 270, Grade 36.

1040.6.4 Thrie Beam Rail and Transition Section. The thrie beam rail and transition section shall be galvanized in accordance with AASHTO M 180, Type 2.

1040.6.5 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.

1040.6.6 Markings. Thrie beam rail and transition sections shall be marked in accordance with [Sec 1040.4.4](#).

1040.7 Cable and Fittings.

1040.7.1 One-Strand Access Restraint Cable.

1040.7.1.1 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.

1040.7.1.2 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.

1040.7.2 Three-Strand Guard Cable.

1040.7.2.1 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.

1040.7.2.2 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.

1040.7.2.3 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.

1040.8 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.

1040.9 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 1040.4	Sec 1040.4	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.