

ATTACHMENT 10

TECHNICAL SPECIFICATIONS

for

**Safety Equipment & Products for Transportation & Public Works
– Comprehensive Crash Mitigation (including Attenuators,
Barricades, Bridge Rails, Crash Cushions and Guide Rails)
(Statewide)**

IFB # 23244

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GENERAL

The purpose of this Solicitation, and the resulting centralized contract(s), is to provide Authorized Users with a means of acquiring traffic safety and crash mitigation equipment, associated accessories, parts and products manufactured and sold in the transportation and public safety industries to be primarily used by State Agencies, State Authorities, State and Local Parks, Counties, Municipalities, Educational Organizations and Facilities and other eligible Authorized Users.

Products and systems include, but are not limited to, traffic safety and crash mitigation, including Attenuators, Barricades, Bridge Rail, Crash Cushions and Guide Rails, as shown in the Specification Reference Chart below:

NOTE: Should updates be made to specifications by the State during the course of the contract term, contractors are expected to update products as soon as possible in accordance with the provisions of the Solicitation. No changes or substitution of products or pricing is permitted without the express approval of OGS Procurement Services.

Specification Reference Chart	
Type 1 - Galvanized Steel Posts	Section 710-14, Section 710-13, , Section 710-17, Section 710-18, Section 710-19, Section 710-20, Section 710-21, Section 710-22, Section 710-23, Section 710-26
Type 1 - Box Beam Guide Rail	Section 710-21, Section 710-24
Type 1 - Corrugated Beam Guide Rail	Section 710-17, Section 710-18, Section 710-19, Section 710-20
Type 1 - Cable Guide Rail	Section 710-22
Road Systems Inc. (RSI) BEAT System Series Products	Section 710-24 & Manufacturer’s Information
Road Systems Inc. (RSI) SKT Series Products	Section 710-17, Section 710-18, Section 710-19, & Manufacturer’s Information
Trinity Highway Systems Products	Section 710-17, Section 710-18, Sections 710-19, Section 710-26, Section 712-06, Section 729-10, Section 729-11, & Manufacturer’s Information
Concrete Barriers	Section 704
Energy Absorption Systems Inc. Products	Section 712-06, Section 712-07,Section 712-08, Section 729-10, Section 729-11, Section 729-12, & Manufacturer’s Information
Barrier Systems Inc. Products	Section 710-17, Section 710-18, Section 712-06, Section 729-10, Section 729-11, Section 729-12, & Manufacturer’s Information
SCI System Products	Section 712-06, Section 729-10, & Manufacturer’s Information
Renco System Products	Section 729-12, & Manufacturer’s Information
Scorpion Attenuator System Products	Section 729-12, & Manufacturer’s Information
General Purpose Barricades, Parts & Accessories	Section 729-06, Section 729-07, Section 729-08, Section 729-18 & Section 730-05
Gregory Highway Products Attenuators	Section 729-12, & Manufacturer’s Information

TECHNICAL SPECIFICATION WEBLINKS:

The complete NYS Department of Transportation Standard Specification (May 2021) may be found at https://www.dot.ny.gov/main/business-center/engineering/specifications/english-spec-repository/espec1-9-14english_0.pdf.

Many entries found herein are excerpted and adapted from this document. Users shall note that while the NYSDOT document is the guiding technical specification steering this procurement, these specifications herein may not be verbatim and the terms and conditions of both the main Solicitation, these specifications and any subsequent contract award supersedes all administrative guidelines that are contained within the NYSDOT Standard Specification publication.













Specifications regarding applied reflected sheet are herein amended universally to exclude Engineering Grade materials, limiting offerings requiring reflective material to Hi-Intensity or Diamond, Super, Ultra-High Intensity grade material or above, or equal.

Links containing the standard sheets as well as the supporting Engineering Bulletins (EB) under which they were issued for Guide and Bridge Rail and Bridge Details as well as Concrete Barriers are available on the NYSDOT Web at: <https://www.dot.ny.gov/main/business-center/engineering/cadd-info/drawings/standard-sheets-us/606> and <https://www.dot.ny.gov/main/business-center/engineering/cadd-info/drawings/bridge-detail-sheets-usc> - under the Group Identification Codes beginning with the letter “R”.

These EB’s and sheets contain the complete technical specifications for Type 1 Galvanized Steel Posts, Type 1 Box Beam Guide Rail, Type 1 Corrugated Beam Guide Rail, Type 1 Cable Guide Rail 5 in this procurement

Links listing some of the proprietary needs for the procurement may be found on the NYSDOT Web at: <https://www.dot.ny.gov/main/business-center/engineering/specifications/details-of-proprietary-attenuators>

TABLE 1: ENERGY ABSORBING END ASSEMBLIES

Name	Preferred Attachment	Manufacturer
BEAT 	Box Beam	Road Systems
ET 2000/2000+ 	HPBO (parallel or flare)	Trinity Industries
SKT 350 	HPBO (parallel or flare)	Road Systems
CAT 350 	HPBO Median	Trinity Industries
Brakemaster 350 	HPBO Median +	Energy Absorption Systems
REACT 350 	Concrete	Energy Absorption Systems
TRACC 	Concrete+	Trinity Industries
ADIEM II 	Concrete+	Trinity Industries
Multipurpose Attenuators		
TAU-II 	Wide and Narrow Objects	Barrier Systems /Lindsay Corporation
QuadGuard Permanent 	Wide and Narrow Objects	Energy Absorption Systems
SCI-GM 	Wide and Narrow Objects	Work Area Protection
Energite III 	Sand Barrels	Energy Absorption Systems
MAX-Tension	HPBO	Lindsay Transportation Solutions
MSKT-MASH	HPBO	Road Systems
SoftStop	HPBO	Trinity Highway Products
X-MAS	HPBO Median	Lindsay Transportation Solutions
MAX-Tension Median	HPBO Median	Lindsay Transportation Solutions

SECTION 704 – MASONRY UNITS

This procurement seeks Concrete Barriers, temporary and permanent as drawn in standard sheet USC 606-36, and addressed by chapter 5 of Section 704 of the general specifications.

704-05 - PRECAST CONCRETE BARRIER

SCOPE. This specification covers the material and quality requirements for precast concrete barrier used in highway applications, precast concrete barrier for structures, and precast temporary concrete barrier.

MATERIAL REQUIREMENTS. The Material Requirements contained in 704-03 Precast Concrete - General shall apply except as noted herein.

Concrete mixtures used under this specification shall have a maximum cement content of 750 lbs per cubic yard. Unless noted otherwise in the contract documents or approved fabrication drawings, the compressive strength of concrete used in precast concrete barrier shall be as follows:

Concrete Barrier	3,000 psi (minimum) @ 28 days
Concrete Barrier for Structures	5,000 psi (minimum) @ 28 days
Temporary Concrete Barrier	3,000 psi (minimum) @ 28 days

All reinforcing steel for Concrete Barrier and Concrete Barrier For Structures shall be epoxy coated meeting the requirements of 709-04 Epoxy Coated Bar Reinforcement, Grade 60. All reinforcing steel for Temporary Concrete Barrier shall meet the requirements of 709-01 Bar Reinforcement, Grade 60.

DRAWINGS. The drawing requirements contained in 704-03 Precast Concrete - General shall apply except as noted herein.

Concrete Barrier and Temporary Concrete Barrier shall use dimensions as shown on the Standard Sheets. Concrete Barrier for Structures shall use dimensions as shown on the Bridge Design (BD) Sheets.

FABRICATION. The fabrication requirements contained in 704-03 Precast Concrete - General, as well as the following shall apply.

- Cross-sectional dimensions shall not vary from the dimensions shown by more than 1/4 inch.
- Barrier shall not be out of plumb by more than 1/4 inch.
- Longitudinal dimensions shall not vary from the dimensions shown by more than 1/4 inch per 10 feet of barrier.
- When checked with a 10 foot straight edge, irregularities shall not exceed 1/4 inch.

SAMPLING AND TESTING. The Sampling and Testing requirements contained in 704-03 Precast Concrete - General shall apply.

MARKING. The Marking requirements contained in 704-03 Precast Concrete - General shall apply except as noted herein.

Concrete Barrier and Concrete Barrier For Structures shall be marked on one end of each barrier segment such that they will not be exposed to view after installation.

Temporary Concrete Barrier shall be marked with “NYSDOT” in place of a Department contract number. In addition, each Temporary Concrete Barrier segment shall be permanently marked with a manufacturer’s identification and a date of manufacture in a manner that will remain legible throughout its service life. The date, at a minimum, shall contain the month and year. Permanent markings shall be placed in a consistent location on the top, bottom, or one end of each segment. Imprinting the required information, a minimum of 1/4 inch into the concrete surface will be considered an acceptable permanent marking. Paint will not be considered a permanent marking. If permanent markings are located on the bottom of the segment, paint markings matching the permanent markings shall be placed on one end of each segment to facilitate field inspection.

FINAL PRODUCTION INSPECTION. The Final Production Inspection requirements contained in 704-03 Precast Concrete - General shall apply.

SHIPPING. The Shipping requirements in 704-03 Precast Concrete - General shall apply.

BASIS OF APPROVAL. Designs for permanent, standard Concrete Barrier other than those shown on the Standard Sheets will not be approved.

Concrete Barrier for Structures designs may be proposed, and if found acceptable, will be placed on the Approved List. Evidence shall be provided that the proposed anchorage system has been successfully tested in accordance with the procedural directives issued by the DCES.

Temporary Concrete Barrier designs other than those shown on the Standard Sheets may be proposed, and if found acceptable, will be placed on the appropriate Approved List based on their deflection and

SECTION 710 - FENCE AND GUIDE RAIL

NOTE: Guide and Bridge Rail are covered under this procurement. Fencing by design is a form of barricade, which is covered under the scope of the procurement. Fencing, its component and accessory parts may be included in a submitted price list.

All material must be shipped secure and furnished in a clean condition, free of all foreign material including oil, dust, film, etc. and must have a material certification as meeting or exceeding these specifications. Buy America requirements apply to all metal fencing.

710-01 ALUMINUM FENCE FABRIC

SCOPE. This specification covers the requirements for aluminum alloy, chain link fence fabric.

MATERIAL REQUIREMENTS. Aluminum chain link fence fabric shall conform to the requirements of AASHTO M181, Chain Link Fence, Type III, except as modified herein.

- A. Wire.** The aluminum alloy wire shall be 6061-T94 conforming to the applicable chemical composition limits of ASTM B211.
- B. Mesh Size and Wire Diameter.** The size of the mesh and the wire diameter shall be 2 inches and 9 gage (0.148 inch) respectively unless otherwise specified in the plans or proposal.

SHIPPING. Fabric shall be furnished in a clean condition free of all foreign material, including oil, dust, film, etc.

BASIS OF ACCEPTANCE. Aluminum fence fabric will be accepted on the basis of a material certification that specifies the product conforms to this specification.

710-02 GALVANIZED STEEL FENCE FABRIC

SCOPE. This specification covers the requirements for galvanized steel chain link fence fabric.

MATERIALS REQUIREMENTS. Galvanized steel chain link fence fabric shall conform to the requirements of AASHTO M181, Chain Link Fence, Type I, except as modified herein.

- A. Mesh Size Coated Wire Diameter.** The size of the mesh and the coated wire diameter shall be 2 inches and 9 gage (0.148 inch) respectively unless otherwise specified in the plans or proposal.
- B. Zinc-Coating.** The 2 inch mesh shall be galvanized with a Class D coating (2 oz/sf) by the hot-dip process after weaving. When 1 inch mesh is specified, it shall be galvanized with Class D Coating (2 oz/sf) before weaving by the electrolytic process.

SHIPPING. Fabric shall be furnished in a clean condition free of all foreign material, including oil, dust, film, etc.

BASIS OF ACCEPTANCE. Galvanized steel fence fabric will be accepted on the basis of a material certification that specifies the product conforms to this specification. *Buy America requirements apply.*

710-03 VINYL COATED STEEL FENCE FABRIC

SCOPE. This specification covers the material requirements for Class A-Extruded Polyvinyl Chloride (PVC)-Coated Steel Fence Fabric, and Class B-Bonded Polyvinyl Chloride (PVC)-Coated Steel Fence Fabric.

MATERIAL REQUIREMENTS. Vinyl coated steel chain link fence fabric shall conform to the requirements of AASHTO M181, Chain Link Fence, Type IV, except as modified herein.

- A. Mesh Size.** The size of the mesh shall be 2 inches unless otherwise specified in the contract documents.
- B. Wire Diameter.** The wire diameter shall be as follows unless specified otherwise in the contract documents:
 - 1. Class A-** Extruded Polyvinyl Chloride (PVC)-Coated Steel shall have a 9-gage (0.148 inch) metallic coated core wire.
 - 2. Class B-** Bonded Polyvinyl Chloride (PVC)-Coated Steel shall have an 11-gage (0.12 inch) metallic coated core wire.
- C. Vinyl Coating.** The color of the vinyl coating shall be dark green unless shown otherwise in the contract documents. The Engineer shall have the option of approving an alternate color if the specified color is unavailable. An adhesion test is not required for coatings which are extruded or extruded and bonded.

SHIPPING. Fabric shall be furnished in a clean condition, free of all foreign material, including oil, dust, film, etc.

BASIS OF ACCEPTANCE. Vinyl-coated steel fence fabric will be accepted on the basis of a material certification that specifies the product conforms to this specification. *Buy America requirements apply.*

710-04 ALUMINUM COATED STEEL FENCE FABRIC

SCOPE. This specification covers the requirements for Aluminum Coated Chain Link Fence Fabric.

MATERIAL REQUIREMENTS. Aluminum coated steel fabric shall conform to the requirements of AASHTO M181, Chain Link Fence, Type II, except as modified herein.

Mesh Size and Coated Wire Diameter. The size of the mesh and the coated wire diameter shall be 2 inches and 9 gage (0.148 inch) respectively unless otherwise specified in the contract documents.

SHIPPING. Fabric shall be furnished in a clean condition free of foreign material including oil, dust, film, etc. except that a methacrylate lacquer may be used to protect it under storage conditions.

BASIS OF ACCEPTANCE. Aluminum-coated steel fence fabric will be accepted on the basis of a material certification that specifies the product conforms to this specification. *Buy America requirements apply.*

710-05 COATED STEEL FENCE FABRIC, (95% ZINC 5% ALUMINUM – MISCHMETAL ALLOY)

SCOPE. This specification covers the requirements for coated steel fence fabric (95% zinc 5% aluminum - mischmetal alloy).

MATERIAL REQUIREMENTS. Coated steel fence fabric (95% zinc 5% aluminum – mischmetal alloy) shall conform to the dimensional and strength requirements of AASHTO M 181 Chain Link Fence Type I, except as modified herein.

- A. Mesh Size.** The size of the mesh shall be 2 inches unless otherwise specified in the contract documents.
- B. Coated Wire Diameter.** The size of the coated wire diameter shall be 9 gage (0.148 inch) unless otherwise specified in the contract documents.
- C. Coating.** The coating shall meet the requirements of ASTM F1345 Class 2 (1 oz/sf).

SHIPPING. Fabric shall be furnished in a clean condition, free of all foreign material including oil, dust, film, etc.

BASIS OF ACCEPTANCE. Coated steel fence fabric will be accepted on the basis of a material certification that specifies the product conforms to this specification. *Buy America requirements apply.*

710-06 ROCK SLOPE NET AND WIRE MESH ASSEMBLIES

SCOPE. This specification covers the material requirements for the components for assembling a net or wire mesh used as part of a rock catchment system. The following materials are evaluated in this specification:

- 710.0601 – Rock Slope Net Assembly.
- 710.0602 – Rock Slope Wire Mesh Assembly.
- 710.0603 – Rock Slope Wire Mesh Drape Assembly.

MATERIAL REQUIREMENTS.

- A. Rock Slope Net Assembly.** Provide a fence consisting of a net fabricated from wire rope meeting the requirements of §710-27 *Rock Slope Wire Ropes, Seam Rope for Wire Rope Rock Catchment Fence*. The border rope of the net shall meet the requirements of §710-27 *Rock Slope Wire Ropes, Net Supporting Wire Rope for Wire Rope Rock Catchment Fence*. The mesh size of the net shall be 8 in. by 8 in. The net shall be diagonally woven.
- B. Rock Slope Wire Mesh.** Provide 11 gauge (1/8 in. diameter), single twisted, coated steel wire mesh, with Class 1 (Zn-5Al) coating conforming to ASTM F1345. The steel wire composing the mesh shall have a minimum tensile strength conforming to ASTM A817.
- C. Rock Slope Wire Mesh Drape.** Provide 11 gauge (1/8 in. diameter), 8 by 10 mesh type having a nominal mesh opening of 3 ¼ in. x 4 ½ in., galvanized steel wire mesh, conforming to ASTM A975, Style 1.

BASIS OF ACCEPTANCE. The Rock Slope Net Assembly will be accepted on the basis of a material certification that the product conforms to this specification. The Rock Slope Wire Mesh will be accepted on the basis of a material certification that the product conforms to this specification. The Rock Slope Wire Mesh Drape will be accepted on the basis of a material certification that the product conforms to this specification.

710-10 STEEL AND IRON POSTS, RAILS, BRACES, AND FITTINGS FOR CHAIN LINK FENCE

SCOPE. This specification covers the requirements for steel and iron posts, rails, braces and fittings used in erecting chain link fence. The contractor shall have the option of supplying any one of the post sections shown on the Standard Sheets.

MATERIALS REQUIREMENTS. The following specifications cover the material requirements for each of the sections, fittings, and tension wires shown in the Post and Rail schedule on the Standard Sheets for Chain Link Fence:

- A. Class A, Schedule 40 Pipe.** Posts, rails and braces shall be standard weight Schedule 40 Pipe, manufactured in accordance with ASTM F1083, except that the protective coating system shall be as specified herein.
- B. Class B, Steel Tubing.** Posts, rails and braces shall be manufactured by one of the following methods with the steel conforming to ASTM A1011 or ASTM A1008 and A1011/A1011M with a minimum yield strength of 50,000 psi:
 - Furnace butt welded, continuous welded
 - Cold rolled and electric resistance welded
 - Seamless

The tubing shall conform to the following dimensions:

Nominal Size (inches)	Outside Diameter, inches	Minimum Wall Thickness, inches	Weight lb/ft
1 ¼	1.660	0.111	1.836
1 ½	1.900	0.120	2.281
2	2.375	0.130	3.117
2 ½	2.875	0.160	4.639

- C. Class C, Rolled-Formed Shapes.** Posts, rails and braces shall be roll formed shapes which meet the requirements of ASTM F1043.
- D. H-Posts.** H Posts shall be fabricated from hot-rolled steel sections which meet the requirements of ASTM F1043.
- E. Fittings.** Fittings shall be manufactured of weldable steel, malleable iron, cast steel, cast iron, or aluminum alloy.
 - 1. Weldable Steel.** Weldable steel shall be commercial quality or better, produced by one of the following processes: Open-Hearth, Electric Furnace, or Basic Oxygen.
 - 2. Malleable Iron.** Malleable Iron shall conform to the requirements of '715-09.
 - 3. Cast Iron.** Cast iron shall conform to the requirements of '715-05.
 - 4. Cast Steel.** Cast steel shall conform to the requirements of '715-02.
 - 5. Aluminum Alloy.** Aluminum alloy shall meet the material requirements of '710-11.

Fittings other than aluminum fittings in contact with galvanized surfaces shall be galvanized in accordance with '719-01, Type II. Fittings in contact with aluminum surfaces shall be made of aluminum alloy or be aluminum coated in accordance with '719-03.

- F. Tension Wire.** Tension wire shall meet the requirements of ASTM A641M, as modified herein. The wire shall be a no. 7 gage minimum 0.177 ± 0.004 inch in diameter, having a minimum tensile strength of 80,000 psi, with a minimum galvanized coating of 0.7 oz/sf or a minimum aluminum coating of 0.3 oz/sf.

Protective Coating Systems. Posts, rails and braces shall be coated with a protective coating system conforming to one of the following depending on structural member.

A. Class A Schedule 40 Pipe; Class B Steel Tubing

1. Galvanized Coatings. Galvanized both inside and out in accordance with ASTM F1083.

2. Combined Coatings

a. External surfaces. The external surfaces shall be coated with the following combined coating system:

(1) *Hot Dip Galvanizing.* The external surface shall be hot-dip galvanized with “Special High Grade” or “High Grade” slab zinc conforming to ASTM B6. The weight of the coating shall be a minimum 0.9 oz/sf.

(2) *Chromate Conversion Coating.* Chromate conversion coating shall be specifically designed for use as a pretreatment of galvanized surfaces. The coating shall be applied prior to the application of the thermoplastic acrylic coating at the manufacturer's recommended rate.

(3) *Clear Coating.* A thermoplastic acrylic or cross linked polyester coating shall be applied with a minimum dry film thickness of 0.3 mils.

b. Internal Surfaces. The internal surfaces of the pipe or tubing shall be coated with one of the following:

(1) *Zinc rich coating.* The zinc rich coating shall contain not less than 87% zinc dust by weight and shall be capable of providing galvanic protection. The minimum coating thickness shall be 0.3 mils.

(2) *Cross linked polyester coating containing a corrosion inhibitor*

(3) *Hot-dip galvanized coating.* The hot-dipped galvanized coating shall average not less than 0.35 oz/sf and no single specimen shall show less than 0.25 oz/sf.

B. Class C Roll Formed Shapes and H Posts. All surfaces shall be hot-dip galvanized in accordance with the requirements of '719-01, Type I.

C. Class A Schedule 40 Pipe; Class B Steel Tubing; Class C Roll Formed Shapes, H-Posts.

1. Aluminum with Chromate Coatings. All surfaces shall be given a hot-dipped 99% pure aluminum, Type II coating. The aluminum coating shall average 0.66 oz/sf and no single specimen shall show less than 0.61 oz/sf when tested in accordance with ASTM A428. The coating shall meet the adherence and quality requirements of '719-03. The aluminum coated surfaces shall be given a colorless chromate chemical treatment. The external surfaces shall be given a colorless protective resin coating to protect the material from abrasion in shipment and storage.

2. Mischmetal Alloy Coating (95% Zinc 5% Aluminum). Coating shall meet the requirements of ASTM F1043 Protective Coatings on Steel Framework for Fences Type C, except the coating weight shall be 1.0 oz/sf.

BASIS OF ACCEPTANCE. Steel and iron posts, rails, braces, and fittings for chain link fence will be accepted on the basis of a material certification that specifies the product conforms to this specification. *Buy America requirements apply.*

710-11 ALUMINUM POSTS, RAILS, BRACES AND FITTINGS FOR CHAIN LINK FENCE

SCOPE. This specification covers the requirements for aluminum posts, rails, braces and fittings to be used in erecting chain link fencing.

MATERIAL REQUIREMENTS. Posts, Rails, Braces and Fittings shall conform to the following materials specifications, alloy, temper and dimensional requirements in Table below.

BASIS OF ACCEPTANCE. Aluminum posts, rails, braces and fittings for chain link fence will be accepted on the basis of a material certification that specifies the product conforms to this specification.

Material	Material Spec.	Alloy & Temper	Dimensions
Fabric Ties	715-04	5052-H-38, 1100-H18or 3003-H14	0.144 in. nom. dia. or 1/2 in.wide x 0.06 in. thick
Top & Bottom Tension Wires	715-04	6061-T94	0.192 in. nom. dia.
Hog Rings	715-04	6061-T94	0.110 in. nom. dia.
Stretcher Bars	715-04	6063-T5 or 6063-T6	1/4 x 3/4 in.
Truss Rods	715-04	6061-T6 or 6063-T6	3/8 in. nom. dia.
Cast Tumblers	715-03	356.0-T6	-
Wrought Turnbuckles	715-04	6061-T6 or 6063-T6	-
Brace & Stretcher Bands	715-04	3003-H14 or 6063-T6	1/8 x 7/8 in.
Carriage Bolts	715-04	2024-T4	-
Brace Ends & Rail Ends	715-03	356.0-T6, 360.0, D712.0, or ZG 61A-T5	-
Expansion Sleeves	715-04	6063-T6 or 6063-T832	See Note 1
Nuts	715-04	2024-T4 or 6061-T6	-
Line Posts	715-04	6063-T6	Sched. 40 pipe 2 in. diam.
End, Corner & Intermediate Posts	715-04	6063-T6	Sched. 40 pipe 2 1/2 in.diam.
Post Tops	715-03	356.0-F, 360.0, D712.0,or ZG61A-T5	-
Top Rails	715-04	6063-T6	Sched. 40 pipe 1/4 in. diam.
Brace Rails	715-04	6063-T6	Sched. 40 pipe 1/4 in. diam.

NOTE: 1. Modified Schedule 40 pipe, 1 1/2 in. nom. diam., 1.69 in. Inside Diameter, 0.078 in. Minimum Wall Thickness, 6 in. long.

710-12 PLASTIC COATED POSTS, RAILS, BRACES AND FITTINGS FOR CHAIN LINK FENCE

SCOPE. This specification covers the requirements for plastic coated posts, rails, braces and fittings used for erection of chain link fencing.

MATERIAL REQUIREMENTS. Posts, rails, braces, fittings, and accessories shall comply with the requirements of '710-10, except for the galvanized coatings. Post, rails, braces, fittings and accessories shall be resin-clad with either an epoxy modified ply (vinyl chloride), or a thermoplastic polyester resin. The coating shall have a minimum thickness of 7 mils and shall be of the same color as the fabric.

Fabrication Requirements. The epoxy modified poly (vinyl chloride) coating shall be chemically bonded to heated pipe, fittings, etc., or the fitting and pipe, etc., shall be clad with a heavy molecule, saturated, linear thermoplastic polyester resin applied by electrostatic spray and fusing or equal method. Each length of pipe shall be sealed with two snug-fitting polyethylene plug-type seals to prevent condensation and eliminate internal corrosion.

BASIS OF ACCEPTANCE. Plastic-coated posts, rails, braces, and fittings for chain link fence will be accepted on the basis of a material certification that specifies the product conforms to this specification. *Buy America requirements apply.*

710-13 WOOD AND TIMBER POSTS AND TIMBER BLOCKOUTS

SCOPE. This specification covers wood posts used as witness posts, timber posts, and blockouts used in guiderail construction.

MATERIALS REQUIREMENTS. Wood posts, timber posts, and timber blockouts shall comply with the requirements of ' 712-14, Stress Graded Timber and Lumber, except that not every timber blockout in the lot need be branded, provided that approximately 10% of the blockouts are branded, and that the unbranded blockouts are visually similar, as determined by the engineer, to the branded blockouts. Using the clean wood properties of ASTM D2555, the bending stress (Modulus of Rupture) shall not be less than 4000 psi. They shall be surfaced on four sides and the dimensions shall be actual or nominal as indicated on the plans. If the dimensions are indicated to be nominal, the actual dimensions provided shall be in accordance with current trade practice. Surface dried redwood, red cedar, cypress or black locust may be used untreated. Other lumber including douglas fir, pine, oak, birch, apple, and beech may also be used but shall be pressure treated in accordance with ' 708-31, Wood Preservative-Water Borne after all the holes have been drilled and all other woodworking operations have been performed. Bituminous preservative treatments will not be permitted. Before using, the Contractor shall submit to the Engineer, for approval, information as to the species of timber to be used and method of preservative treatment to be employed.

BASIS OF ACCEPTANCE. Wood and timber posts and timber blockouts will be accepted on the basis of a material certification that specifies the product conforms to this specification.

710-14 GALVANIZED STEEL BARRIER POSTS

SCOPE. This specification covers galvanized steel posts used as guiderail and median barrier posts, Ibeam posts for existing guide railing and median barrier, and required soil plates, Anchor Post Base, and slip impact bases.

MATERIAL REQUIREMENTS. Galvanized steel barrier post shall conform to the following:

Galvanizing	719-01 Galvanized Coatings and Repair Methods, Type I
Steel	ASTM A36

Posts. Steel posts used as guiderail and median barrier posts or I-beam posts for existing guide railing and median barrier, shall be fabricated from steel conforming to the ASTM A36 shape specified on the standard sheet for the guide railing or median barrier being utilized.

Soil Plates, Slip Impact Bases, and Other Post Components. Soil plates, slip impact bases, and other post components shall be fabricated from steel conforming to the dimensions shown on the standard sheet for the guide railing or median barrier being utilized.

FABRICATION. Guiderail and median barrier posts or I-beam posts for existing guide railing and median barrier shall be fabricated with all required welding, punching, drilling, or cutting of the post or any component of the post completed prior to galvanizing. Welding shall be done in accordance with the requirements of the *New York State Steel Construction Manual*, except that radiographic inspection of shop welds will not be required.

BASIS OF ACCEPTANCE. Galvanized steel barrier posts will be accepted on the basis of a material certification that specifies the product conforms to this specification. *Buy America requirements apply.*”

710-17 CORRUGATED BEAM GUIDE RAILING END TERMINAL (ENERGY-ABSORBING)

SCOPE. This specification covers the material and performance requirements for energy-absorbing corrugated beam end terminals.

MATERIALS REQUIREMENTS. All metal components and hardware shall be new and galvanized to meet or exceed the requirements of §719-01 *Galvanized Coatings and Repair Methods, Type I*.

BASIS OF APPROVAL. End Terminal systems tested before December 31, 2010 shall be either NCHRP 350 approved or MASH approved. Systems tested after December 31, 2010 shall be MASH approved. End terminals acceptable at TL-3 will also be acceptable at TL-2. Manufacturers or material suppliers desiring to have products considered for inclusion on the Approved List shall prepare and submit copies of drawings, specifications, test reports, and Federal Acceptance Letters to the Director of the Materials Bureau. Upon approval, the name of the manufacturer and the product will be placed on the Approved List.

BASIS OF ACCEPTANCE. Corrugated Beam End Terminals (Energy-Absorbing) will be accepted at the contract site on the basis of the manufacturer's name and product brand name appearing on the Approved List, conformance to the appropriate Materials Details Sheets, and the manufacturer's certification that the product delivered is in conformance with these specifications.

710-18 HBPO (Mod.) CORRUGATED BEAM GUIDE RAILING END TERMINAL (ENERGY-ABSORBING)

SCOPE. This specification covers the material and performance requirements for HPBO (Mod.) Corrugated Beam Guide Railing End Terminal (Energy-Absorbing).

MATERIALS REQUIREMENTS. All metal components and hardware shall be new and galvanized to meet or exceed the requirements of §719-01 *Galvanized Coatings and Repair Methods, Type I*.

BASIS OF APPROVAL. End Terminal systems tested before December 31, 2010 shall be either NCHRP 350 approved or MASH approved. Systems tested after December 31, 2010 shall be MASH approved. End terminals acceptable at TL-3 will also be acceptable at TL-2. Manufacturers or material suppliers desiring to have products considered for inclusion on the Approved List shall prepare and submit copies of drawings, specifications, test reports, and Federal Acceptance Letters to the Director of the Materials Bureau. Upon approval, the name of the manufacturer and the product will be placed on the Approved List.

BASIS OF ACCEPTANCE. Corrugated Beam End Terminals (Energy-Absorbing) will be accepted at the contract site on the basis of the manufacturer's name and product brand name appearing on the Approved List, conformance to the appropriate Materials Details Sheets, and the manufacturer's certification that the product delivered is in conformance with these specifications.

710-19 HPBO (Mod.) CORRUGATED BEAM MEDIAN BARRIER END TERMINAL (ENERGY-ABSORBING)

SCOPE. This specification covers the material and performance requirements for HPBO (Mod.) Corrugated Beam Median Barrier End Terminal (Energy-Absorbing).

MATERIALS REQUIREMENTS. All metal components and hardware shall be new and be galvanized to meet or exceed the requirements of §719-01 *Galvanized Coatings and Repair Methods, Type I*.

BASIS OF APPROVAL. End Terminal systems tested before December 31, 2010 shall be either NCHRP 350 approved or MASH approved. Systems tested after December 31, 2010 shall be MASH approved. End terminals acceptable at TL-3 will also be acceptable at TL-2. Manufacturers or material suppliers desiring to have products considered for inclusion on the Approved List shall prepare and submit copies of drawings, specifications, test reports, and Federal Acceptance Letters to the Director of the Materials Bureau. Upon approval, the name of the manufacturer and the product will be placed on the Approved List.

BASIS OF ACCEPTANCE. HPBO (Mod.) Corrugated Beam Median Barrier End Terminal (Energy-Absorbing) will be accepted at the contract site on the basis of the manufacturer's name and product brand name appearing on the Approved List, conformance to the appropriate Materials Details Sheets, and the manufacturer's certification that the product delivered is in conformance with these specifications.

710-20 CORRUGATED BEAM GUIDE RAILING AND MEDIAN BARRIER

SCOPE. This specification covers corrugated beam guide railing and median barrier including corrugated beams, posts, anchorage units and accessory hardware.

MATERIAL AND FABRICATION REQUIREMENTS

General: For new installations all components shall be new.

Posts. Posts shall meet the requirements of 710-14 Galvanized Steel Barrier Posts

Beams, Terminal Sections and Hardware. Corrugated beams, terminal sections and all hardware shall be fabricated in accordance with the details shown on the standard sheets. Bolt holes in the beam at the post hole and elsewhere, as necessary, shall be enlarged or slotted to permit expansion and contraction, and to facilitate erection. The beams shall be of uniform section and straight, unless shop curved beams are required by the plans or specifications. The edges shall be rolled to eliminate sharp edges. When shop curving of corrugated beams is required the radius of curvature shall be stamped into the base metal of the beam. The stamping shall be on the back, at or near both ends of the beam, and in a location where it will be visible to a worker after erection.

Beams and terminal sections shall be rolled from 12 gage (nominal thickness 0.105 inches -0.009 inch tolerance) or heavier sheet or coil stock. The sheet or coil stock shall be new billet open hearth, electric furnace, or basic oxygen steel sheet. The minimum yield point and elongation of the steel used in the beam sections shall be 50,000 psi and 12% in 2 inch gage length respectively. Terminal sections, used for finishing-off or ornamental purposes, may be of mild steel, 33,000 psi yield point.

Plates and Anchorage Units. Plates and Anchorage Units shall be as detailed on the standard sheet for corrugated beam type guide railing and median barrier. They shall conform to ASTM A36.

Splices and Post Bolts. Splices and post bolts shall be made with flat, roundheaded, grippable, galvanized bolts, nuts, and washers conforming to the following, unless specified otherwise in the contract documents: Bolts ASTM A307 Grade A, Nuts ASTM A563 Grade A or better, and Washers ASTM F844. They shall be galvanized in accordance with the requirements of §719-01 Galvanized Coatings and Repair Methods, Type II (ASTM A153) unless another coating is specified. Post bolts and the splice bolts shall be as detailed on the Standard Sheets.

Fabrication Welding. Fabrication welding shall be done in accordance with the New York State Steel Construction Manual, except radiographic inspection of shop welds will not be required.

Galvanizing. The rail element shall be galvanized in accordance with 719-01, Galvanized Coatings and Repair Methods, Type I (ASTM A123) or Type IV (ASTM A653/653M) of the standard specifications, except that the minimum check limits for the weight of coating as determined by the triple spot and single spot tests for 719-01, Galvanized Coatings and Repair Methods, Type IV (ASTM A653/653M), shall be 4 oz/ft² and 3 oz/ft² respectively, (total amount both sides of sheet). Posts, plates, and anchorage units shall be galvanized in accordance with 719-01, Galvanized Coatings and Repair Methods, Type I (ASTM A123). Hardware shall be galvanized in accordance with 719-01, Galvanized Coatings and Repair Methods, Type II (ASTM A153). When beams are to be galvanized in accordance with 719-01, Galvanized Coatings and Repair Methods, Type I (ASTM A123), they shall be blanked to the proper shape, fabricated and ready for assembly before galvanizing. No punching, drilling, cutting or welding will be permitted after galvanizing. When galvanizing in accordance with 719-01, Galvanized Coatings and Repair Methods, Type IV (ASTM A653/653M), the beam may be fabricated, cut, punched or drilled from galvanized sheet or coil stock. The exposed edges resulting from this process do not have to be repaired or touched up in any way.

BASIS OF ACCEPTANCE. All components of the corrugated beam type guide railing and median barrier shall be accepted in accordance with directives issued by the Department.

710-21 BOX BEAM GUIDE RAILING AND MEDIAN BARRIER

SCOPE. This specification covers box beam guide railing and median barrier including the guide rail, posts, end assembly units and accessory hardware.

MATERIAL REQUIREMENTS

General: For new installations all components shall be new.

Posts. Posts shall meet the requirements of 710-14 Galvanized Steel Barrier Posts.

Rails. Rails shall be cold-formed welded and seamless structural tubing. The rails shall conform to ASTM A500, Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes, Grade B, except as modified below. Splice plates and plates welded to tubes for splice assemblies shall be Charpy V-Notch tested. Splice tubes need not be tested

All rail shall be tested in accordance with ASTM E436 “Drop-Weight Tear Tests of Ferritic Steels” except as modified below.

The tests shall be done after all galvanizing and associated operations have been performed on the rail.

The testing shall be conducted at a temperature of -0.4oF, without removing the galvanizing, on 2 x 9 inch specimens supported to achieve a 7 inch span.

The percent shear area will be determined by testing nine (9) specimens, three (3) from each of three (3) sides not containing a weld. The shear areas of the three specimens from the side with the lowest average shear area shall be disregarded and the final average based on the remaining six specimens. If the average percent shear area falls below 50, the material represented by these tests shall be rejected.

To facilitate acceptance and rejection of material the manufacturer of the structural shape shall, before galvanizing, identify the product with the steel heat number, or some number which is traceable to the heat number, and its own unique identification code. The identification method shall be such that it can be read after the structural shape is galvanized. The identification information shall be placed on the structural shape at intervals not to exceed 4 feet. When shop curving of box beams is required, the radius of curvature shall be stamped into the base metal of the beam. The stamping shall be the vertical faces, at or near both ends of the beam, and in a location where it will be visible to a worker after erection. No mill transverse welds will be permitted on the rail sections. Longitudinal welds shall be made by the resistance, gas shielded arc, submerged arc or plasma arc welded process; shall be sound, free from defects, and shall not be repaired. The welded joint, in cold-formed welded rail, shall have a minimum tensile strength specified for the railing when tested according to the tensile strap test of ASTM Method E8. All fabrication shall be done in accordance with the requirements of the Steel Construction Manual.

Rails shall be galvanized in accordance with 719-01, Type I, Galvanized Coatings and Repair Methods. Slots and round holes may be subsequently drilled, punched, burned, or cut and regalvanized according to the paragraph below on “Regalvanizing Iron and Steel Using a Flame Sprayed Coating System.” This repair procedure shall also apply to curved rail sections and splice plates as required.

Regalvanizing Iron and Steel Using a Flame Sprayed Coating System. Those areas to be regalvanizing shall be blasted with silica sand or crushed garnet of such gradation that sand shall be mesh size # 20 to # 40 U.S. Standard Sieve with a minimum of 40% retained on a # 30 U.S. Standard Sieve.

Pressure of not less than 75 psi shall be maintained at the blast generator.

A sample steel plate shall be blasted until the surface cannot be further cleaned or roughened. This plate shall be used for visual comparison and any areas that do not meet this standard as to roughness or cleanliness shall be reblasted.

The wire used in spraying shall be 1/8 or 3/16 inch diameter, zinc 99.0% purity. Air pressure at the Air Control Unit shall be 60 psi and there shall be no more than 35 feet of 3/8 inch I.D. hose between the Air Control Unit and the gun.

The metal coating shall be applied at a minimum thickness of 0.0045 inches. At least one coating shall be applied within 4 hours of blasting and the surface shall be completely coated within 8 hours of blasting.

The specified thickness of coating shall be applied in multiple layers and in no case shall less than two passes be made over every part of the surface.

Fasteners. Fasteners shall be galvanized and conform to the following unless specified otherwise in the contract documents. Bolts ASTM A307 Grade A, nuts ASTM A563 Grade A or better, and washers ASTM F844.

FABRICATION. Curved box beam guide rail or median barrier shall be shop bent or shop mitered in accordance with the following. At the fabricator's option, the shop mitering process may be used instead of a shop bending process. However, shop bending may not be used in place of shop mitering.

1. **Shop Bent Box Beam Guide Railing.** Box beam guide rail installed on a curved alignment with a radius above 20 and up to 720 feet shall be shop bent prior to galvanizing. In order to achieve a smooth arc, the bend points shall be placed no farther apart than two feet when the radius is from 20 to 50 feet, no farther apart than three feet when the radius is between 50 and 150 feet, and no farther apart than four feet when the radius is 150 feet or greater.
2. **Shop Mitered Box Beam Guide Railing.** Box beam guide railing installed on a curved alignment with a radius of 20 feet or less shall be miter cut and welded in the shop prior to galvanizing. For radii less than 12 feet, the average spacing of the cuts shall be approximately 18 inches. For radii from 12 feet to 20 feet, the average spacing of the cuts shall not exceed 24 inches. Cut locations shall be adjusted as needed to avoid bolt holes and post brackets. After the miter cuts are completed, backer bars shall be tack welded to one side of the cut and the miter shall be closed to within a quarter of an inch (+ 0", -1/8") and butt welding performed in accordance with AWS D1.1. Section 3.
3. **Shop Bent Median Box Beam Barrier.** Box beam median barrier installed on a curved alignment with a radius above 30 and up to 1525 feet shall be shop bent prior to galvanizing. For radii between 30 and 60 feet, the bending shall be performed prior to cutting the slots for the post support paddles. In order to achieve a smooth arc, the bend points shall be placed no farther apart than 18 inches.
4. **Shop Mitered Box Beam Median Barrier.** Box beam median barrier installed on a curved alignment with a radius of 30 feet or less shall be miter cut and welded in the shop prior to galvanizing. For radii less than 12 feet, the average spacing of the cuts shall be approximately 18 inches. For radii of 12 feet or greater, the average spacing of the cuts shall not exceed 24 inches. Cut locations shall be adjusted as needed to avoid post support slots. After the miter cuts are completed, backer bars shall be tack welded to one side of the cut and the miter shall be closed to within a quarter of an inch (+ 0", -1/8") and butt welding performed in accordance with AWS D1.1. Section 3.

BASIS OF ACCEPTANCE. All components of the box beam guide railing and median barrier shall be accepted in accordance with directives issued by the NYSDOT.

710-22 CABLE GUIDE RAILING

SCOPE. This specification covers cable guide railing including cable, posts, anchorage units, and accessory hardware.

DEFINITIONS. There are two kinds of cable guide rails depending on the amount of tension in the cables –

- A. **Medium-Tension Cable Guide Rail** – When the tension in each of the cables in a cable system is less than 2500 pounds at 72° F.
- B. **High-Tension Cable Guide Rail** – When the tension in each of the cables in a cable system is 2500 pounds or more at 72° F.

MATERIAL REQUIREMENTS.

General. For new installations, all components shall be new.

Cable Guide Railing systems that are listed on the Approved List and are proprietary in nature shall conform to the manufacturer's requirements as indicated in the NYSDOT-approved Materials Details.

Cable Guide Railing meeting the Standard Sheets shall conform to the following:

Posts, Soil Plates	710-14 Galvanized Steel Barrier Posts
Reflectors	730-01 Aluminum Sign Panels
Reflective Sheeting	730-05 Reflective Sheeting
Cable Construction	AASHTO M30 or ASTM A741 Type I Class A
Coating	
Anchor Angle, Anchor Post Base	ASTM A36
Bolts	ASTM A307 Grade A
Nuts	ASTM A563 Grade A
Washers	ASTM F844
Concrete	Class A

Cable End Assemblies. Designs for a steel turnbuckle cable-end assembly or spring cable-end assembly not shown on the standard sheet or detailed in the plans shall be submitted for approval.

Hook Bolts. Hook bolts shall develop an ultimate pull open strength of from 450 lbs to 1000 lbs applied in a direction normal to the longitudinal axis of the post.

Galvanizing. The bolts, including the “J” bolt used to mount the cable, nuts, washers, anchor rods, spring compensator components, steel turnbuckle cable end assembly, and all cast steel or malleable iron hardware, except the wedge shown on the Standard Sheet, shall be galvanized in accordance with the requirements of 719-01 Galvanized Coatings and Repair Methods, Type II, unless another coating is specified. The wedge shown on the Standard Sheet shall be ungalvanized (black).

The anchor angles, and Anchor Post Base shall be galvanized in accordance with the requirements of 719-01 Galvanized Coatings and Repair Methods, Type I.

Welding. Welding shall be performed in accordance with the requirements of the New York State Steel Construction Manual, except radiographic inspection of shop welds will not be required.

BASIS OF APPROVAL. Cable Guide Railing designs other than those shown on the Standard Sheets may be proposed, and if found acceptable, will be placed on the approved list. Evidence shall be provided that the Cable Guide Railing is MASH-16 approved. Systems that have passed MASH-09 only may be accepted on a limited time basis. If approved and as a requirement to be placed on the Approved List, Materials Details of the approved system shall be supplied by the manufacturer to be posted on NYSDOT web site.

BASIS OF ACCEPTANCE. Cable Guide Railing supplied will be accepted based on the following requirements:

1. System supplied meeting the Standard Sheets or
2. The manufacturer’s name appearing on the Approved List and the manufacturer’s certification that the system supplied meets the specifications and the manufacturer’s Materials Details posted with the Department’s Approved List.

710-23 STEEL BRIDGE RAILING

SCOPE. This specification covers the material requirements for Steel Bridge Railing and its component parts.

MATERIAL REQUIREMENTS. Steel Bridge Railing materials shall conform to the following requirements:

<u>Piece</u>	<u>ASTM Designation</u>
Rail Tubes	A500 Grade B
Rail End Caps	A36 (A709 Grade 36)
Base Plates ¹	A572 Grade 50 (A709 grade 50)
Anchor Studs	A325 or A449 Grade 1
Splice Bolts	A325 or A449 Grade 1
Round Head Bolts	A325 or A449 Grade 1
Nuts ²	A563
Washers ²	F436
Lock Washers	High Carbon Heat Treated Spring Steel: ASME B18.2
Anchor Plates	A36 (A709 Grade 36)
Plate Shims	A36 (A709 Grade 36)
Tube Rail Splices	A500 Grade B
Solid Rail Splices	A572 Grade 50 (A709 grade 50)
Angle ¹	A572 Grade 50 (A709 grade 50)
Splice Plates	A572 Grade 50 (A709 grade 50)
Railing Post ¹	A572 Grade 50 (A709 grade 50)
Tubular Posts	A500 Grade B

¹ All post material, including base plates, shall be furnished to minimum Charpy V-notch toughness requirements as required by §715-01, under Charpy V-Notch Impact test.
² Use the following nut and washers for the given bolt class:

Bolt or Stud Class	NUT A563 (Class & Dimension style of nut)	Washer A563 Type
4.6	5 H1	1 or 3
8.8	10S HH	1 or 3

Beveled shims may be machined from the same type of metal as in the post base plates or may be cast from material conforming to the requirements of 715-02, Steel Castings, or 715-09, Malleable Iron Castings.

All rail, except bicycle and pedestrian rail, shall be tested in accordance with ASTM E436 - "Drop-Weight Tear Tests of Ferritic Steels", except as modified below.

The tests shall done after all galvanizing and associated operations have been performed on the rail. The testing shall be conducted at a temperature of 0oF, without removing the galvanizing, on 2 x 9 inch specimens supported to achieve a 7 inch span.

The percent shear will be determined by testing nine (9) specimens, three (3) from each of three (3) sides not containing a weld. The shear areas of the three specimens from the side with the lowest average shear area shall be disregarded and the final average based on the remaining six specimens. If the average percent shear area falls below 50 the material represented by these tests shall be rejected.

Splice plates and plates welded to tubes for splice assemblies shall be Charpy V-notch tested. Splice tubes need not be Charpy V-notch tested.

To facilitate acceptance and rejection of material, the manufacturer of the structural shape shall, before galvanizing, identify the product with the steel heat number, or some number which is traceable to the heat number, and its own unique identification code. The identification method shall be such that it can be read after the structural shape is galvanized. The identification information shall be placed on the structural shape at intervals not to exceed 4 feet.

FABRICATION. Bridge Railing shall be fabricated to the dimensions shown in the contract plans and in compliance with the specifications.

- A. Shop Drawings.** Shop drawings, when required by the contract documents, shall be provided in accordance with the requirements of the S.C.M., except that: 1) the drawings shall be submitted to the Engineer for review and approval and 2) the computed weights need not be shown.
- B. Welding.** Shop welding shall be performed only where specifically noted on the contract documents. Transverse welds shall not be permitted unless directly called for on the contract plans. All welding shall be done in accordance with the requirements of the SCM.
- C. Cutting.** All exposed flame cut surfaces shall have a surface roughness not to exceed 250, as defined by the ANSI standard specification B46.1. Grind all edges of Posts and Post Base Plates so that all sharp edges are removed.
- D. Bending.** Rails for curved structures shall be curved in the shop prior to galvanizing. To facilitate bending, rails may be heated to a temperature not exceeding 1200°F.
- E. Galvanizing.** Galvanizing shall conform to the requirements of 719-01, Galvanized Coatings and Repair Methods, Type I. All components of the railing, including anchor studs, nuts and washers, shall be galvanized. The rails, post assemblies, splices and all hardware shall be fabricated and ready or assembly prior to galvanizing.

All galvanized bolts and galvanized anchor studs shall have a Class 2A Thread. All galvanized nuts shall have a standard oversized tap to allow for the galvanizing on the bolts and nuts.

Shop galvanizing repair of uncoated areas will be permitted on localized areas. Repair of localized areas is limited to a total of 2 square inches on any post or rail. A post or rail which contains galvanizing defects totaling more than 2 square inches shall be stripped and regalvanized.

Shop repair shall be made in accordance with the methods given in 719-01. The following areas will not require galvanizing repair: One 1/8 inch maximum dimension spot of tight flux remaining in the fusion line of any 7 inch length of weld after blast cleaning pickling and galvanizing.

- F. Brown Rail.** When brown rail is specified, all components of the railing system shall be galvanized and then the visible portions of the system shall be painted in accordance with §657 Painting Galvanized and Aluminum Surfaces. Paint color shall be 'Weathered Brown' as defined by 708-05 Standard Paint Colors.

BASIS OF ACCEPTANCE. The manufacturer shall furnish the Department with three (3) certified copies of physical test and chemical analysis of the materials used in the manufacture of the railing. Check analysis may be made by the Department from delivered material.

Inspection will be performed in accordance with the provisions of the SCM, except that mill inspection will not be done.

Materials that do not bear the Inspector's mark of acceptance shall not be accepted at the project site.

710-24 BOX BEAM GUIDE RAIL END ASSEMBLY, TYPE III; AND BOX BEAM MEDIAN BARRIER END ASSEMBLY, TYPE C

SCOPE. This specification covers the material and performance requirements for Box Beam End Assembly Type III and for Box Beam Median Barrier End Assembly, Type C.

MATERIALS REQUIREMENTS. All metal components and hardware shall be new and be galvanized to meet or exceed the requirements of §719-01 Galvanized Coatings and Repair Methods, Type I.

BASIS OF APPROVAL. End Terminal systems shall be MASH approved. End terminals acceptable at TL-3 will also be acceptable at TL-2.

Manufacturers or material suppliers desiring to have products considered for inclusion on the Approved List shall prepare and submit copies of drawings, specifications, test reports, complete crash test videos, installation manuals, and Federal Acceptance Letters to the Director of the Design Quality Assurance Bureau. Upon approval, the name of the manufacturer, the product, and the drawings and installation manual will be placed on the Approved List.

BASIS OF ACCEPTANCE. After May 1, 2021, including on active construction contracts, all Box Beam Guide Rail End Assembly, Type III; and Box Beam Median Barrier End Assembly, Type C will be accepted at the contract site on the basis of the manufacturer's name and product brand name appearing on the Approved List, conformance to the appropriate Materials Details Sheets, and the manufacturer's certification that the product delivered is in conformance with those Materials Details."

710-26 PLASTIC AND SYNTHETIC BLOCK-OUTS FOR HEAVY POST GUIDERAIL SYSTEMS

SCOPE. This specification describes plastic and synthetic material block-outs used to provide uniform offset distance from the corrugated beam rail to the heavy post.

GENERAL. The block-out shall have the same general dimensions as detailed in the Department Standard Sheets. The block-out shall not contain excessive voids that would compromise its physical strength. The material shall be designed for outdoor exposure and shall include chemical additives to resist UV degradation. If the product contains recycled materials, they shall be environmentally friendly and non-hazardous. Blocks shall contain no materials that will negatively affect their field performance, such as materials that absorb moisture.

BASIS OF ACCEPTANCE. Manufacturers or suppliers may submit their product for evaluation to the Director of the Materials Bureau. This submission shall include copies of drawings, specifications, test reports, the quality control procedure and Federal Acceptance Letters. At the Departments discretion, the material will be evaluated for conformance to these specifications, and product samples will be tested in accordance with procedural directives of the Materials Bureau.

The product will be accepted at the job site based on its appearance on the Approved List. In addition, the contractor shall provide manufacturer certification that the supplied product has the same chemical composition, mechanical properties as the product used in the testing accepted for Federal Approval. Modifications to this product are acceptable, provided the resulting product is an equivalent or of higher level of quality, and supporting documentation is provided.

710-27 ROCK SLOPE WIRE ROPES

SCOPE. This specification covers the material requirements for the components for wire ropes generally used in a rock catchment system. The following materials are evaluated in this specification:

- 710.2701 – Rock Slope Wire Ropes, Net Supporting Wire Rope for Wire Rope Rock Catchment Fence.
- 710.2702 – Rock Slope Wire Ropes, Seam Rope for Wire Rope Rock Catchment Fence.
- 710.2703 – Rock Slope Wire Ropes, Tieback Restraining Cable for Wire Rope Rock Catchment Fence.
- 710.2704 – Rock Slope Wire Ropes, Anchor Cable for Wire Rope Rock Catchment Fence.
- 710.2705 – Rock Slope Wire Ropes, Seam Rope for Wire Mesh Slope Protection

MATERIAL REQUIREMENTS. Provide material in accordance with TABLE 710-27A *Rock Slope Wire Ropes*.

TABLE 710-27A ROCK SLOPE WIRE ROPES

Rock Slope	Rope/Cable	Minimum Diameter	Minimum Breaking Strength
Wire Ropes for Wire Rope Rock Catchment Fence	Net Supporting Wire Rope	5/8 in. (6x19 construction)	37 kips
	Seam Rope	5/16 in. (7x7 construction)	9 kips
	Tieback Restraining Cables	5/8 in. (6x19 construction)	37 kips
	Anchor Cables (10 ft. min. length, equipped with heavy duty type thimbles)	3/4 in.	53 kips
Seam Wire for Wire Mesh Slope Protection	Seam Rope	5/16 in. (7 x 19 Galvanized Aircraft Cable)	10 kips

All wire ropes for the wire nets, supporting ropes, seam ropes and anchors shall be composed of steel wires individually galvanized before being woven into the ropes.

BASIS OF ACCEPTANCE. The Wire Ropes for Wire Rope Rock Catchment Fence will be accepted on the basis of a material certification that the product conforms to this specification.

The Seam Wire Rope for Wire Mesh Slope Protection will be accepted on the basis of a material certification that the product conforms to this specification.

710-28 ANCHOR BOLTS FOR GUIDE RAILING AND MEDIAN BARRIER

SCOPE. This specification covers the material requirements for anchor bolts.

MATERIALS REQUIREMENTS. Anchor bolts shall meet the requirements of ASTM A449. A hex nut and flat washer shall be supplied with each anchor bolt and their dimensions shall be as shown on the plans or Standard Sheets. The hex nut and flat washer shall be manufactured in accordance with ASTM A325. The nuts, washers, and the top 12 inches of the anchor bolts shall be galvanized in accordance with the requirements for Type II or Type V galvanizing as stated in section §719-01, Galvanized Coatings and Repair Methods. The anchor bolt, nut and washer dimensions shall be as shown on the plans or Standard Sheets.

SHIPPING. Anchor bolts, hex nuts, and washers shall be shipped to the construction site at a time convenient to the masonry construction.

BASIS OF ACCEPTANCE. Anchor bolts will be accepted upon the manufacturer's certification that they meet the requirements of this section.

710-30 RIGHT-OF-WAY

SCOPE. These specifications cover the material requirements required for the construction of right-of-way fences comprised of (a) galvanized steel or aluminum coated steel fence fabric, and (b) posts, braces and hardware designed to support and retain the fencing.

MATERIAL REQUIREMENTS

Fence Fabric. Right-of-way fencing fabric shall conform to the requirements of ASTM A116 “Zinc Coated (Galvanized) Steel Woven Wire Fence Fabric”. The fabric shall be woven in accordance with Design Number 1047-6-9 or 1047-6-11 as shown in Table 1 of both ASTM A116. The weight of the coating on the Zinc-Coated (Galvanized) Fence Fabric shall conform to the coating weight requirements of Class 3 shown in Table 2 of ASTM A116.

Fence Posts and Braces. Posts and brace sizes shall be as indicated on the Standard Sheets. Steel line posts shall conform to the requirements of ASTM A702. Steel end, corner or intermediate post and braces shall conform to the requirements of Section 6.5 through Section 6.5.4 of ASTM A702; or the requirements for Class A, Schedule 40 Pipe or Class B, Steel Tubing of 710-10.03 of the Standard Specifications. Posts and braces conforming to the requirements of ASTM A702 shall be galvanized in accordance with the requirements of 719-01 Type I. Type A Schedule 40 Pipe and Type B Steel Tubing shall use one of the protective coating system specified in 7A of ' 710-10.03.

Wood posts and braces shall be seasoned southern yellow pine, red (Norway) pine, spruce, douglas fir, hemlock, larch, or redwood. All wood posts and braces shall be pressure treated with a water-borne wood preservative conforming to the requirements of ' 708-31. The wood posts shall be subject to inspection before and during treatment at the option of the Department. They shall be sound, free from loose knots or decay, and with no through checks on tops or butts. Posts shall be machine peeled to a smooth uniform appearance and free from all inner bark. The preservative pressure treatment shall be by the empty cell process in accordance with C5 of the American Wood-Preservers' Association Standards.

Fittings. Fittings shall be manufactured of weldable steel, malleable iron, cast steel, cast iron, or aluminum alloy. Fittings other than aluminum shall be galvanized in accordance with the requirements of 719-01 Type II.

Fasteners. Bolts, nuts, and washers shall conform to the following, unless specified otherwise in the contract documents:

Bolts	ASTM A307
Nuts	ASTM A563 Grade A or better
Washers	ASTM F844

The fasteners shall be galvanized in accordance with the requirements of 719-01 Type II.

Gates. Gates shall be constructed of Class A Schedule 40 Pipe conforming to 710-10 welded at all corners or assembled with corner fittings. The size of the pipe used to fabricate the gate shall be as shown on the Standard Sheets. When corner fittings are used the gates shall have truss rods of minimum 3/8 inch diameter to prevent sag or twist. Gate leaves shall have vertical intermediate bracing so that no vertical members are more than 8 feet apart. Gate leaves over 10 feet shall have a truss rod of 3/8 inch minimum diameter even if the corners are welded. The fence fabric used on the gate shall conform to the fence fabric in the remainder of the fence.

- A. Hinges.** Hinges shall be weldable steel, cast steel, or malleable iron 180o offset industrial type. The hinges shall not twist or turn under the action of the gate. The gate shall be able to be opened by one person. The hinges shall be galvanized in accordance with the requirements of 719-01 Type I.

- B. Latches.** Latches, stops, and keepers shall be provided for all gates. Latches for single leaf gates may be a forked latch type. Double leaf gates shall have a plunger bar type latch arranged to engage a stop. Latches shall be capable of being locked and the Contractor shall provide a lock with triplicate keys for each gate. Keepers shall consist of a mechanical device for securing the free end of a gate when in the full open position.
- C. Gate Posts.** Gate posts shall conform to the dimensions shown on the Standard Sheets. Steel gate posts shall be fabricated from either Class A Schedule 40 Pipe or Class B Steel Tubing conforming to the requirements of 710-10. Wood gate posts shall be made from wood conforming to the requirements for wood posts and braces as specified in “Fence Posts and Braces”.

BASIS OF ACCEPTANCE. Right-of-way fencing will be accepted on the basis of a material certification that specifies the product conforms to this specification. *Buy America requirements apply.*

SECTION 712 – MISCELLANEOUS

712-06 EXPENDABLE IMPACT ATTENUATOR

SCOPE. This specification covers the material and performance requirements for expendable impact attenuators.

MATERIALS REQUIREMENTS. Expendable Impact Attenuator components shall meet the following requirements:

Impact attenuators that use liquid or other materials as a filler or to provide ballast will be evaluated for potential environmental impacts and/or seasonal limitations. Impact attenuators will be approved for use in shielding an object of a maximum width as specified in the Approved List, and specific configurations may be approved for maximum speeds.

Covers shall be provided by the manufacturer for all units where ingress of debris from the top will result in deterioration of performance.

Metal parts shall be fabricated from M1020 Merchant Quality or ASTM A36M steel.

All galvanization shall be in accordance with §719-01 *Galvanized Coatings and Repair Methods, Type I*.

Welding shall be in accordance with the Steel Construction Manual, except radiographic inspection shall not be required.

The size and recommended attachment method for reflective marking shall be specified.

BASIS OF APPROVAL. Impact attenuator systems shall be NCHRP 350 approved. Impact attenuators meeting the requirements of NCHRP 350 TL-2 are acceptable only as TL-2 devices. TL-3 devices are acceptable for TL-3 and TL-2. Manufacturers or material suppliers desiring to have impact attenuators approved shall prepare and submit Materials Details Sheets consisting of copies of drawings, specifications, test reports, and Federal acceptance letters, to the Director of the Materials Bureau. The review process requires a minimum of 45 calendar days.

BASIS OF ACCEPTANCE. Expendable Impact Attenuators will be accepted at the contract site on the basis of the manufacturer's name appearing on the Approved List, conformance to the appropriate Materials Details Sheets, and the manufacturer's certification that the product delivered is in conformance with these specifications.

712-07 INERTIAL BARRIER MODULES

SCOPE. This specification covers the material and performance requirements for sand-filled inertial barrier systems used for site hazard protection.

GENERAL. Modules composing the array shall be free-draining with respect to residual moisture in the fill sand. Their lids shall be such that they divert precipitation and stop moisture from seeping into the shell. Lids shall be fastened with a minimum of six equally spaced pop rivets or secured by other approved fasteners so as to provide a reasonably vandal resistant, closed barrel.

MATERIAL REQUIREMENTS. The modules shall be federal yellow or as shown on the plans. They shall be durable, waterproof, resistant to deterioration from ultra-violet rays, deformation from dynamic loadings due to vibration in the placement area and long-term stresses induced by thermal expansion and contraction and fill settlement.

The fill sand shall conform to the requirements of either 703-06, Cushion Sand, or 703-07, Concrete Sand. Sodium chloride, as dry rock salt, equal to 3-5 percent by weight of the sand, shall be thoroughly mixed into the sand. Sodium chloride shall meet the requirements of 712-03, Sodium Chloride.

TESTS. To determine the crash worthiness of inertial barrier modules not on the NYSDOT's Approved List, an array containing each size module shall be subjected to crash tests to verify that the barrier system can safely decelerate an impacting vehicle. These tests shall be done in accordance with the National Cooperative Highway Research Program Report 350, test numbers, 3-40, 3-41, 3-42, 3-43 and 3-44. Evaluation criteria shall conform to the safety evaluation guidelines found in Table 5.1, as specified in Table 3.2.

Crash cushion arrays shall be designed to conform to the occupant risk values found in NCHRP Report 350, Table 5.1, Criteria D, H and I.

Any values deviating from these shall be justified by site and/or shape limitations, or cost, and approved by the Director, Materials Bureau.

BASIS OF ACCEPTANCE. The Department requires the submission of Materials Details. The manufacturer or supplier shall prepare and submit the appropriate material in accordance with the procedural directives of the Materials Bureau. Upon approval by the Materials Bureau, the name of the product and/or supplier, and the reference number assigned to the approved Materials Details will be placed on the Approved List. Such products shall then be accepted on the basis of their brand and conformance to the approved Materials Details.

712-08 REUSABLE IMPACT ATTENUATORS – NOW VACANT

SECTION 729 – TEMPORARY TRAFFIC CONTROL DEVICES

729-01 DRUMS

SCOPE. This specification covers the material, fabrication, and performance requirements for traffic drums. Drums are defined by FHWA as a Category I device.

MATERIAL REQUIREMENTS. Drums shall meet the requirements of the MUTCD, shall be NCHRP 350 or MASH approved and shall be orange plastic, one-piece or two-piece construction, with a closed top. Drums shall be a minimum of 18 inches in diameter (visible from all directions), a minimum of 36 inches in height. Drums shall have a maximum weight of 75 lbs., including ballast. Two-piece drums shall consist of a base no more than 4 inches in height and an upper section. The base and upper section of two-piece drums shall be designed as a unit. One-piece drums shall include a base ring or elongation designed to hold ballast. The base and/or any nonflexible portion of the drum shall not extend more than 2 inches above the pavement surface.

Drums shall have 4 horizontal circumferential stripes of retroreflective sheeting a minimum of 6 inches wide, of alternating fluorescent orange and white, starting with fluorescent orange on the top. The top edge of the upper band shall be a maximum of 2 inches from the top edge of the drum. The space between stripes shall not exceed 2 inches.

Retroreflective sheeting. Retroreflective sheeting shall be:

- Firmly bonded to the drum with an adhesive; mechanical fasteners will not be allowed.
- Re-boundable and able to resist multiple impacts.

Retroreflective sheeting shall conform to the following sections of AASHTO M268 for White and Fluorescent Orange:

Daytime Luminance Factor: Table 1 - Daytime Luminance Factor (%Y) for Types A, B, C, and D.

Color: Table 2 - Color Specification Limits (Daytime) For Types A, B, C, and D
Table 3 - Color Specification Limits (Nighttime) For Types A, B, C, and D

Initial Retroreflectivity: Table 5 - Minimum Coefficient of Retroreflection (RA) for Type B Sheeting

BASIS OF ACCEPTANCE. Upon request, the Contractor shall provide a material certification that the product conforms to this specification.

729-02 CONES

SCOPE. This specification covers the material, fabrication, and performance requirements for traffic cones. Cones are defined by FHWA as a Category I device.

MATERIAL REQUIREMENTS. Cones shall meet the requirements of the MUTCD, shall be NCHRP 350 or MASH approved and shall be orange rubber or plastic. Cones shall have a maximum weight of 20 lbs, including ballast.

Standard cones shall be approximately 28 inches in height with a minimum conical bottom width of 10 inches. Standard cones shall have two horizontal circumferential stripes of white retroreflective sheeting, the upper a minimum of 6 inches wide, with the upper edge 3 to 4 inches from the top of the cone, and the lower a minimum of 4 inches wide with the upper edge approximately 2 inches below the upper stripe.

Tall cones shall be approximately 36 inches in height with a minimum conical bottom width of 10 inches. Tall cones shall have two horizontal circumferential stripes of white retroreflective sheeting, the upper a minimum of 6 inches wide, with the upper edge 3 to 4 inches from the top of the cone, and the lower a minimum of 4 inches wide with the upper edge approximately 2 inches below the upper stripe.

Extra tall cones shall be a minimum of 42 inches in height with a minimum conical bottom width of 7 inches. Extra tall cones shall have a minimum of four horizontal circumferential stripes of retroreflective sheeting from 4 to 6 inches wide, of alternating orange and white starting with orange on the top. The upper edge of the sheeting shall be 4 inches from the top of the cone. Nonreflective spaces between the stripes shall not exceed 3 inches wide.

Retroreflective sheeting. Retroreflective sheeting shall be:

- Firmly bonded to the cone with an adhesive; mechanical fasteners will not be allowed.
- Re-bondable and able to resist multiple impacts.

Retroreflective sheeting shall conform to the following sections of AASHTO M268 for White:

Daytime Luminance Factor: Table 1 – Daytime Luminance Factor (%Y) for Types A, B, C, and D.

Color: Table 2 - Color Specification Limits (Daytime) For Types A, B, C, and D
Table 3 - Color Specification Limits (Nighttime) For Types A, B, C, and D

Initial Retroreflectivity: Table 5 - Minimum Coefficient of Retroreflection (RA) for Type B Sheeting

BASIS OF ACCEPTANCE. Upon request, the Contractor shall provide a material certification that the product conforms to this specification.

729-04 VERTICAL PANELS

SCOPE. This specification covers the material, fabrication, and performance requirements for vertical panels. Vertical panels are defined by FHWA as a Category II device.

MATERIAL REQUIREMENTS. Vertical panels shall conform to the requirements of the MUTCD, shall be NCHRP 350 or MASH approved and shall be constructed of plastic, aluminum, or other lightweight materials. Vertical panels shall be supported by a base capable of maintaining the panel in an upright position and in the proper position and orientation.

Vertical panels shall have 4 to 6 inch wide diagonal stripes of alternating orange and white reflective sheeting, sloping downward at an angle of 45° toward the side on which traffic is to pass. Vertical panels which are 36 inches and larger shall have 6 inch wide diagonal stripes.

Standard vertical panels shall be a minimum of 24 inches in height and a minimum of 8 inches in width. The top of the panel shall be mounted a maximum of 36 inches high. Support posts for standard vertical panels shall not be located on the traffic face of the panel.

Oversized vertical panels shall be a minimum of 36 inches in height and have a minimum reflective area of 2.0 square feet. Reflective sheeting shall conform to 730-05 *Reflective Sheeting* ASTM Type I (Class A), ASTM Type III (Class B) or higher.

BASIS OF ACCEPTANCE. Upon request, the Contractor shall provide a material certification that the product conforms to this specification.

729-06 TYPE I CONSTRUCTION BARRICADES

SCOPE. This specification covers the material, fabrication, and performance requirements for Type I construction barricades. Type I construction barricades are defined by FHWA as a Category II device.

MATERIAL REQUIREMENTS. Type I construction barricades shall meet the requirements of the MUTCD and shall be NCHRP 350 or MASH approved. Type I construction barricades shall be constructed of an A frame with a single rail panel 8 to 12 inches wide and a minimum of 24 inches long. Rails on barricades used on expressways and other high-speed roadways shall have an area of at least 2.0 square feet. The top of the upper panel shall be mounted at a minimum height of 36 inches. Barricade frames shall be designed to maintain the proper orientation and location of the device during windy conditions. Nonrigid ballast may be placed on the frame, close to the ground, to hold the barricade in position, and shall not obscure the view of the rail panels to approaching traffic.

Barricade rail panels shall have 4 inch wide, retroreflective diagonal stripes sloping at an angle of 45°, alternating orange and white colors.

Retroreflective sheeting. Retroreflective sheeting shall be:

- Firmly bonded to the barricades with an adhesive; mechanical fasteners will not be allowed.
- Re-bondable and able to resist multiple impacts.

Retroreflective sheeting shall conform to the following sections of AASHTO M268 for White and Orange:

Daytime Luminance Factor: Table 1 – Daytime Luminance Factor (%Y) for Types A, B, C, and D.

Color: Table 2 - Color Specification Limits (Daytime) For Types A, B, C, and D
Table 3 - Color Specification Limits (Nighttime) For Types A, B, C, and D

Initial Retroreflectivity: Table 5 - Minimum Coefficient of Retroreflection (RA) for Type B Sheeting

BASIS OF ACCEPTANCE. Upon request, the Contractor shall provide a material certification that the product conforms to this specification.

729-07 TYPE II CONSTRUCTION BARRICADES

SCOPE. This specification covers the material, fabrication, and performance requirements for Type II construction barricades. Type II construction barricades are defined by FHWA as a Category II device.

MATERIAL REQUIREMENTS. Type II construction barricades shall meet the requirements of the MUTCD and shall be NCHRP 350 or MASH approved. Type II construction barricades shall be constructed of a frame with two rail panels 8 to 12 inches wide and a minimum of 24 inches long. Rails on barricades used on expressways and other high-speed roadways shall have an area of at least 2.0 square feet. The top of the upper panel shall be mounted at a minimum height of 36 inches. Barricade frames shall be designed to maintain the proper orientation and location of the device during windy conditions. Non-rigid ballast may be placed on the frame, close to the ground, to hold the barricade in position, and shall not obscure the view of the rail panels to approaching traffic.

Barricade rail panels shall have 4 to 6 inch wide, retroreflective diagonal stripes sloping at an angle of 45°, alternating orange and white colors. Barricade rail panels 36 inches and longer shall have 6 inch wide stripes.

Retroreflective sheeting. Retroreflective sheeting shall be:

- Firmly bonded to the barricades with an adhesive; mechanical fasteners will not be allowed.
- Re-bondable and able to resist multiple impacts.

Retroreflective sheeting shall conform to the following sections of AASHTO M268 for White and Orange:

Daytime Luminance Factor: Table 1 – Daytime Luminance Factor (%Y) for Types A, B, C, and D.

Color: Table 2 - Color Specification Limits (Daytime) For Types A, B, C, and D
Table 3 - Color Specification Limits (Nighttime) For Types A, B, C, and D

Initial Retroreflectivity: Table 5 - Minimum Coefficient of Retroreflection (RA) for Type B Sheeting

BASIS OF ACCEPTANCE. Upon request, the Contractor shall provide a material certification that the product conforms to this specification.

729-08 TYPE III CONSTRUCTION BARRICADES

SCOPE. This specification covers the material, fabrication, and performance requirements for Type III construction barricades. Type III construction barricades are defined by FHWA as a Category II device.

MATERIAL REQUIREMENTS. Type III construction barricades shall meet the requirements of the MUTCD and shall be NCHRP 350 or MASH approved. Type III construction barricades shall be constructed of a frame with three rail panels 8 to 12 inches wide and a minimum of 48 inches long. The top of the upper panel shall be mounted at a minimum height of 60 inches. Barricade frames shall be designed to maintain the proper orientation and location of the device during windy conditions. Nonrigid ballast may be placed on the frame, close to the ground, to hold the barricade in position, and shall not obscure the view of the rail panels to approaching traffic.

Barricade rail panels shall have 6 inch wide retroreflective diagonal stripes, sloping at an angle of 45°, alternating orange and white colors.

Retroreflective sheeting. Retroreflective sheeting shall be:

- Firmly bonded to the barricades with an adhesive; mechanical fasteners will not be allowed.
- Re-bondable and able to resist multiple impacts.

Retroreflective sheeting shall conform to the following sections of AASHTO M268 for White and Orange:

Daytime Luminance Factor: Table 1 – Daytime Luminance Factor (%Y) for Types A, B, C, and D.

Color: Table 2 - Color Specification Limits (Daytime) For Types A, B, C, and D
Table 3 - Color Specification Limits (Nighttime) For Types A, B, C, and D

Initial Retroreflectivity: Table 5 - Minimum Coefficient of Retroreflection (RA) for Type B Sheeting

Warning Lights. Warning lights, when used, shall be securely mounted directly to the barricade frame, above the top rail, using a bolt, nut, and washer of sufficient strength to ensure that the light does not detach if impacted by a vehicle, and no part of the light or wiring shall cover the face of the rail. Batteries shall be placed at ground level, except that integral batteries weighing a maximum of 7 lbs may be mounted on the barricade frame. Warning lights shall not be attached to the barricade rail.

BASIS OF ACCEPTANCE. Upon request, the Contractor shall provide a material certification that the product conforms to this specification.

729-10 TEMPORARY IMPACT ATTENUATORS – REDIRECTIVE

SCOPE. This specification covers the material and performance requirements for temporary impact attenuators. Temporary impact attenuators are defined by FHWA as a Category III device.

MATERIALS REQUIREMENTS. Temporary impact attenuators shall be NCHRP 350 or MASH approved as a redirective, non-gating device. Temporary impact attenuators that use liquid or other materials as a filler or to provide ballast will be evaluated for potential environmental impacts and/or seasonal limitations. Temporary impact attenuators meeting the requirements of NCHRP 350 or MASH Test Level 2 are acceptable only as Test Level 2 devices. A Temporary impact attenuator accepted as a Test Level 3 device is also acceptable as Test Level 2 device. Temporary impact attenuators will be approved for use in shielding an object of a maximum width as specified in the Approved List, and specific configurations may be approved for maximum speeds. Approach ends of Temporary impact attenuators shall have impact attenuator markings in accordance with the MUTCD.

Concrete Grouting Material	701-05
Anchoring Materials - Chemically Curing	701-07

If a temporary foundation slab is required, concrete shall be Class A concrete conforming to Section 501 *Portland Cement Concrete - General*; reinforcing steel shall conform to §709-01 *Bar Reinforcement, Grade 420*.

BASIS OF APPROVAL. Manufacturers or material suppliers desiring to have Test Level 2 or Test Level 3 temporary impact attenuators approved shall prepare and submit copies of drawings, specifications, test reports, and Federal acceptance letters to the Director of the Materials Bureau. The review process requires a minimum of 30 calendar days. Upon approval, the name of the manufacturer and the product will be placed on the Approved List.

BASIS OF ACCEPTANCE. Test Level 2 or Test Level 3 temporary impact attenuators will be accepted on the basis of the product appearing on the Approved List and a material certification that the product is the same as the one appearing on the Approved List and that it conforms to this specification.

729-11 TEMPORARY IMPACT ATTENUATORS – GATING

SCOPE. This specification covers the material and performance requirements for temporary impact attenuators. Temporary impact attenuators are defined by FHWA as a Category III device.

MATERIALS REQUIREMENTS. Temporary impact attenuators shall be NCHRP 350 or MASH approved as a gating device. Temporary impact attenuators that use liquid or other materials as a filler or to provide ballast will be evaluated for potential environmental impacts and/or seasonal limitations. Temporary impact attenuators meeting the requirements of NCHRP 350 or MASH Test Level 2 are acceptable only as Test Level 2 devices. A Temporary impact attenuator accepted as a Test Level 3 device is also acceptable as Test Level 2 device. Temporary impact attenuators will be approved for use in shielding an object of a maximum width as specified in the Approved List, and specific configurations may be approved for maximum speeds. Approach ends of Temporary impact attenuators shall have impact attenuator markings in accordance with the MUTCD.

Concrete Grouting Material	701-05
Anchoring Materials - Chemically Curing	701-07

If a temporary foundation slab is required, concrete shall be Class A concrete conforming to Section 501 *Portland Cement Concrete - General*; reinforcing steel shall conform to §709-01 *Bar Reinforcement, Grade 420*.

BASIS OF APPROVAL. Manufacturers or material suppliers desiring to have Test Level 2 or Test Level 3 temporary impact attenuators approved shall prepare and submit copies of drawings, specifications, test reports, and Federal acceptance letters to the Director of the Materials Bureau. The review process requires a minimum of 30 calendar days. Upon approval, the name of the manufacturer and the product will be placed on the Approved List.

BASIS OF ACCEPTANCE. Test Level 2 or Test Level 3 temporary impact attenuators will be accepted on the basis of the product appearing on the Approved List and a material certification that the product is the same as the one appearing on the Approved List and that it conforms to this specification.

729-12 TRUCK-MOUNTED AND TRAILER

SCOPE. This specification covers the material and performance requirements for truck mounted impact attenuators or trailer mounted impact attenuators (TMIA's) mounted on the rear of work vehicles and barrier trailers. Impact attenuators are defined by FHWA as a Category III device.

MATERIALS REQUIREMENTS. TMIA's shall be NCHRP 350 or MASH approved. TMIA's meeting the requirements of NCHRP 350 or MASH Test Level 3 are also acceptable as a Test Level 2 device. TMIA's meeting the requirements of NCHRP 350 or MASH Test Level 2 are acceptable only as Test Level 2 devices. Approach ends of TMIA's shall have impact attenuator markings in accordance with the MUTCD.

BASIS OF APPROVAL. Manufacturers or material suppliers desiring to have products considered for inclusion on the Approved List shall prepare and submit copies of drawings, specifications, test reports, and Federal Acceptance Letters to the Director of the Materials Bureau. The review process requires a minimum of 30 calendar days. Upon approval, the name of the manufacturer and the product will be placed on the Approved List.

BASIS OF ACCEPTANCE. Test Level 2 or Test Level 3 TMIA's will be accepted on the basis of the product appearing on the Approved List and a material certification that the product is the same as the one appearing on the Approved List and that it conforms to this specification.

729-13 TEMPORARY SAND BARRELS

SCOPE. This specification covers the material and performance requirements for sand barrels. Sand barrels are defined by FHWA as a Category III device.

MATERIAL REQUIREMENTS. Sand barrels of each size module shall be NCHRP 350 or MASH approved. Sand barrels shall be yellow, durable, waterproof, ultraviolet-stable plastic. The first barrel in the array shall have impact attenuator markings in accordance with the MUTCD.

Sand barrels shall resist deformation from dynamic loadings due to vibration in the placement area and long-term stresses induced by thermal expansion/contraction and fill settlement. Sand barrels shall be free draining with respect to residual moisture in the fill sand. Lids shall divert precipitation and prevent moisture from entering the module. Lids shall be fastened or otherwise secured to provide a closed, reasonably vandal-resistant barrel.

The fill sand shall conform to the requirements of either 703-06 *Cushion Sand* or 703-07 *Concrete Sand*. Sodium chloride, as dry rock salt, equal to 3-5 % by weight of the sand, shall be thoroughly mixed into the sand. Sodium chloride shall meet the requirements of 712-03 *Sodium Chloride*.

BASIS OF APPROVAL. Manufacturers or material suppliers desiring to have products considered for inclusion on the Approved List shall prepare and submit copies of drawings, specifications, test reports, and Federal Acceptance Letters to the Director of the Materials Bureau. The review process requires a minimum of 30 calendar days. Upon approval, the name of the manufacturer and the product will be placed on the Approved List.

BASIS OF ACCEPTANCE. Sand barrels will be accepted on the basis of the product appearing on the Approved List and a material certification that the product is the same as the one appearing on the Approved List and that it conforms to this specification.

729-14 VEHICLE-ARRESTING SYSTEMS

SCOPE. This specification covers the material and performance requirements for vehicle-arresting systems. Vehicle-arresting systems are defined by FHWA as a Category III device.

MATERIAL REQUIREMENTS. Vehicle-arresting systems shall be NCHRP 350 or MASH approved.

BASIS OF APPROVAL. Manufacturers or material suppliers desiring to have products considered for inclusion on the Approved List shall prepare and submit copies of drawings, specifications, test reports, and Federal Acceptance Letters to the Director of the Materials Bureau. The review process requires a minimum of 30 calendar days.

BASIS OF ACCEPTANCE. Vehicle-arresting systems will be accepted on the basis of the product appearing on the Approved List and a material certification that the product is the same as the one appearing on the Approved List and that it conforms to this specification.

729-18 WARNING LIGHTS

SCOPE. This specification covers the material and performance requirements for warning lights. Warning lights are not defined separately by FHWA, but rather are considered a system component.

MATERIAL REQUIREMENTS. Warning lights shall be mounted on signs or channelizing devices in a manner that, if hit by an errant vehicle, they will not be likely to penetrate the windshield. Warning lights shall be Type A (low-intensity flashing), Type B (high-intensity flashing), or Type C (steady-burning). Warning lights shall meet the requirements of the MUTCD Section 6F.83 and the ITE *Purchase Specification for Flashing and Steady Burn Warning Lights*. Warning lights shall have a minimum nominal diameter of 7 inches and shall emit yellow light. Flashing warning lights shall flash between 55 and 75 times per minute. Flashing warning lights required to operate 24 hours per day shall be Type B.

Steady-burning warning lights shall operate from one-half hour after sunset to one-half hour before sunrise. Warning lights shall have a minimum mounting height of 30 inches to the bottom of the lens.

Warning lights shall be powered by batteries, line power, or solar cells adequate to maintain the required luminance during all periods of required operation.

BASIS OF ACCEPTANCE. Upon request, the Contractor shall provide a material certification that the product conforms to this specification.

SECTION 730 – SIGNS AND DELINEATORS

730-05 REFLECTIVE SHEETING

SCOPE. These specifications cover reflective sheeting for use in the fabrication of highway and construction signs, delineators and other traffic control devices.

GENERAL. The reflective sheeting supplied shall be colored, flexible, weather resistant, and shall have a smooth outer surface. If the reflective sheeting contains spherical lens elements, the lens elements shall be embedded within a transparent plastic, so as to produce a smooth, flat outer surface. All sheeting shall be of good appearance, free from ragged edges, cracks, scales, blisters, or other defects.

The back of the reflective sheeting shall be protected by a removable liner and shall include a precoated pressure-sensitive or a heat-activated adhesive, either of which may be applied without the necessity of additional adhesive tack coats on the reflective sheeting or application surface.

Reflective sheeting shall be one of the following ASTM D4956 types:

730-05.01 - ASTM Type I (Class A). A medium-intensity reflective sheeting often referred to as engineer grade. It is recommended for highway signs, except where high reflectivity is required, and for construction barricades, panels, and other work zone devices.

730-05.02 - ASTM Type III (Class B). A high-intensity reflective sheeting often referred to as high intensity. It is recommended for highway signs, construction signs, delineators, and other work zone devices.

730-05.03 - ASTM Type V (Class C). A super-high-intensity reflective sheeting recommended for delineators, construction barricades, and vertical panels. This material is not recommended for highway or construction zone sign faces.

730-05.04 - Fluorescent Orange (Class D). A fluorescent orange-colored sheeting with reflective properties similar to Class B high intensity. This sheeting is only recommended for use on orange-colored construction signs, and for the orange portions of construction barricades, vertical panels, and other work zone devices with rigid substrates, when a high level of conspicuity or visibility is needed.

730-05.05 - ASTM Type IX (Class E). A very-high-intensity retroreflective sheeting having highest retroreflective characteristics at short road distances. Recommended for permanent signs, delineators, construction zone devices, and vertical panels, when a high level of conspicuity or visibility is needed.

TABLE 730-05-1 FLUORESCENT SHEETING REQUIREMENTS

Fluorescent Color	Luminance Factor (Y %) Min.		Maximum Spectral Radiance Factor(%)	Color Specification Limits ¹							
				1		2		3		4	
	Y _t	Y _f		x	y	x	y	x	y	x	y
Orange	25	15	110.0	0.583	0.416	0.535	0.400	0.595	0.351	0.645	0.355
Yellow	45	20	-----	0.479	0.520	0.446	0.483	0.512	0.421	0.557	0.442
Yellow Green	60	20	-----	0.387	0.610	0.369	0.546	0.428	0.496	0.460	0.540

NOTE: 1. Four pairs of chromaticity coordinates determine acceptable color in terms of the CIE, 1931 Standard Colorimetric System measured with Standard Illuminant D₆₅.

MATERIAL REQUIREMENTS. Reflective sheeting shall meet the requirements of ASTM D4956 and the following:

1. **Fluorescent Colors.** Shall conform to the requirements of Table 730-05-1.
2. **Fluorescent Orange Class D - 730-05.04.** Class D fluorescent orange reflective sheeting:
 - A. **Coefficient of Retroreflection (RA).** The coefficient of retroreflection shall meet or exceed the reflectivity requirements indicated in Table 730-05-2.

TABLE 730-05-2 FLUORESCENT ORANGE COEFFICIENT OF RETROREFLECTION, R _A		
Observation Angle (°)	Entrance Angle (°)	Minimum R _A (cd/fc/ft ²)
0.2	- 4	100.0
0.2	+ 30	34.0
0.5	- 4	64.0
0.5	+ 30	22.0

- B. **Daytime Color.** The color shall conform to the requirements for luminance factor, maximum spectral radiance factor (peak reflectance), and color specification limits indicated in Table 730-05-1. Color measurements shall be determined in accordance with ASTM E991, using instrumentation which has circumferential viewing (illumination). Calculations shall be performed in accordance with ASTM E308 for the CIE 1931 2 standard observer.
 - C. **Artificial Weathering.** After 1500 hours of artificial weathering performed in accordance with ASTM G 26, Method A, using a Type B weatherometer, the following requirements shall be met:
 - The minimum coefficient of retroreflection shall be 55.0 cd/fc/ft² at 0.2 degree observation angle; - 4 degree entrance angle.
 - The luminance factor (Y Percent) shall be from 20.0 to 45.0.
 - The maximum spectral radiance factor (peak reflectance) shall not be less than 60.0 percent.
 - The color specification limits shall conform to the requirements shown above in Class D, B. *Daytime Color.*
3. **Type IX (Class E) - 730-05.05.** All colors shall conform to the requirements of ASTM D4956, except fluorescent colors. Fluorescent colors shall conform to the requirements of Table 730-05-1 and Table 730-05-3 of this specification.

TABLE 730-05-3 COEFFICIENT OF RETROREFLECTION (R_A) (cd/fc/ft²)

	Entrance Angle (°)	Observation Angle (°)			
		0.1	0.2	0.5	1.0
Fluorescent Orange	- 4	200	115	72	24
	+ 30	110	34	22	14
Fluorescent Yellow	- 4	400	240	165	45
	+ 30	250	150	75	24
Fluorescent Yellow-Green	- 4	540	325	235	65
	+ 30	380	200	105	35

FABRICATION. The reflective sheeting shall be so fabricated as to allow easy cutting to specified sizes and shapes.

The sheeting surface shall be solvent resistant and shall permit solvent cleaning. All solvents used for cleaning operations shall be as recommended by the sheeting manufacturer and shall comply with all Federal, State, and Local air quality regulations.

To ensure uniform appearance and brilliance under both nighttime and daytime conditions, the reflective sheeting shall be cut, matched and positioned on the prepared sign panel or other substrate in strict accordance with the recommendations of the sheeting manufacturer. Backgrounds, characters, delineators, etc., shall be coated and/or edge sealed in accordance with the recommendations of the sheeting manufacturer. When performed, coating operations shall be done in a workmanlike manner so as to create an even, clear, uniform coat which shall be free of streaks, drops or other defects which might affect reflectivity.

Reflective sheeting shall be furnished in both rolls and sheets. Rolls shall be packed individually and contain not more than four splices per 150 feet linear measurement. Cut sheets shall be packaged flat and in such a manner as to minimize any damage or defacement that may occur to the sheeting during shipment or storage. The sheeting surface shall be capable of being readily processed and be compatible with recommended transparent and opaque process inks. The finished sheeting surface shall show no loss of the color with normal handling, cutting and application.

TESTING. Outdoor test specimen panels shall include both unprocessed reflective sheeting and reflective sheeting processed with the manufacturer’s recommended transparent and opaque inks. Type I (Class A), Type III (Class B), and Type IX (Class E), except Type IX fluorescent orange, reflective sheetings shall be exposed outdoors on a test deck for a minimum 3-year continuous time period. Class D and Type IX (Class E) fluorescent orange sheeting shall be exposed outdoors on a test deck for a minimum 1 year continuous time period. Outdoor exposure testing will not be required for Type V (Class C) reflective sheeting.

Outdoor testing shall consist of exposing reflective sheeting test specimen panels, facing south, and inclined at an angle of 45 from a horizontal position. The test deck facility shall be located in a climate similar to that in which the material is intended to be used, or at a site approved by the Materials Bureau. Testing shall be performed by an independent testing agency or in conjunction with the National Transportation Product Evaluation Program (NTPEP).

Following the specified outdoor exposure time period, all weathered test panels of reflective sheeting shall meet the following performance requirements. The sheeting on the test panels shall show no appreciable adhesion loss, cracking, blistering, crazing, dimensional change, or color change. The minimum percent retained coefficient of retroreflection (RA) shall be as specified below when compared to a control unexposed specimen counterpart. The control specimen reflectivity values (RA) shall be measured at the start of outdoor exposure testing. Measurements shall be taken at 0.2 degree observation angle; - 4 degree entrance angle.

TABLE 730-05-4 MINIMUM PERCENT RETAINED COEFFICIENT OF RETROREFLECTION (R_A)	
Type I (Class A) Materials Designation 730-05.01	50%
Type III (Class B) Materials Designation 730-05.02	80%
Class D (Materials Designation 730-05.04)	50%
Type IX (Class E) Materials Designation 730-05.05	60%

BASIS OF ACCEPTANCE. Approvals will be based upon independent laboratory analysis and outdoor exposure testing conducted in accordance with this specification. If the reflective sheeting passes the requirements for laboratory and outdoor exposure testing, the product will then be placed on the Department’s “Approved List” of materials. Detailed requirements and procedures for approval are available from the Materials Bureau.

Contract acceptance of Type I (Class A), Type III (Class B), Type IX (Class E), and Class D reflective sheetings will be based on the inclusion of the sheeting material on the Department’s “Approved List” of reflective sheeting materials and the manufacturer’s certification of compliance with this specification.

Contract acceptance of Type V (Class C) reflective sheeting will be based on the manufacturer’s certification of compliance with this specification.