

MAPA Meeting – May 7, 2024

Recent and Upcoming Policy Changes

1. Standard Specification Changes

a. Std. Spec 109 Price Adjustments for Fuel – Updates to Fuel Index

109.14 Price Adjustment for Fuel. If the contractor accepts the option for fuel adjustment in the bid proposal, the method of price adjustment for the fuel used on the items of work specified herein will be based on "Fuel Usage Factors" and the Monthly Fuel Index. The following table specifies the fuel usage factors for Production and On-Road Hauling. The On-Road Hauling Factor is based on an average 30-mile round trip and will be used regardless of the actual haul distance. Price adjustment for fuel does not apply to fixed-cost items listed in Job Order Contracts. Price adjustment for fuel shall only apply to items that are defined in the table below and listed in the Listing of Bid Items for Highway Construction at the time of bid. Non-standard bid items shall not be subject to price adjustment for fuel unless specified elsewhere in the contract.

~~109.14.1 The first day of each month (excluding Saturdays, Sundays, and holidays) in which the project is bid will be used to establish the "Starting Fuel Index" for the duration of the project. The "Starting Fuel Index" will be the average of the values given for No. 2 fuel as reported by Platt's Oilgram – PAD 2 – St. Louis Area.~~

~~109.14.2 The pay items and unit prices in the contract will not change. The Commission will, on the first day of each month (excluding Saturdays, Sundays and holidays), determine the "Monthly Fuel Index" of No. 2 fuel from the price index as reported by Platt's Oilgram – PAD 2 – St. Louis Area, which will apply to all payment estimates during that month regardless of the type fuel used.~~

~~109.14.3 The quantities of completed work for the payment period will be determined by the engineer and included in the payment estimate. These same quantities will be used to determine the fuel usage for any price adjustment.~~

~~109.14.4 The difference (±) between the "Monthly Fuel Index" and the "Starting Fuel Index" will be the "Monthly Fuel Index Adjustment Factor". This "Monthly Fuel Index Adjustment Factor", along with the "Fuel Usage Factor" and quantities of completed work for which payment is made will determine the fuel adjustment payment or deduction.~~

~~109.14.5 If adjustments are made in the contract quantities, the contractor shall accept the fuel adjustment as full compensation for increases or decreases in the price of fuel regardless of the amounts of overrun or underrun.~~

~~109.14.6 The fuel adjustment will be computed each pay period work is performed, for the usage of fuel by the following procedure:~~

$$\text{Fuel Adjustment} = \frac{(\text{Fuel Usage Factor}) \times (\text{Monthly Fuel Index Adjustment Factor})}{\text{Units of Work included in the payment estimate}}$$

~~109.14.7 Payments or deductions for the fuel adjustments on the various items of work will be made on the estimate as one "Fuel Adjustment". No change order will be required.~~

~~109.14.8 If the bidder wishes to be bound by these specifications, the bidder shall execute the acceptance form in the proposal. Failure by the bidder to execute the acceptance form will be interpreted to mean election to not participate in the price adjustment for fuel.~~

~~109.14.1 Monthly Fuel Index. Each month, the Monthly Fuel Index will be established as the average retail price per gallon for Ultra Low Sulfur Diesel for the Midwest (PADD 2) area as posted on the first Monday of the month by the U.S. Energy Information Administration (EIA). Should the posted price not be available for any reason, the MoDOT State Construction & Materials Engineer will use reasonable methods, at their sole discretion, to establish the Monthly Fuel Index on an interim basis until the EIA resumes its publication.~~

109.14.2 Fuel Adjustment Calculation.

~~B = Base Fuel Index = Monthly Fuel Index in the month in which the project was let
C = Current Index = Monthly Fuel Index in the month in which the work was performed
U = Units of work performed within the current pay estimate period (applicable pay units)
F = Total Fuel Usage Factor (gal/applicable pay units)~~

$$\text{Fuel Adjustment (Dollars)} = (C - B) \times U \times F$$

~~109.14.3 Each pay estimate period, a fuel adjustment payment or deduction will be applied for the quantity of work performed that period on each qualifying pay item. For calculation of the fuel adjustment, work performed on the first day of a month will generally be included with the second estimate in the previous month to keep fuel adjustments in sync with MoDOT's normal payment estimate period schedule. The Commission reserves the right to include work performed on the first day of the month with the current month to accommodate financial accounting termini, such as the beginning of the state and federal fiscal years (July 1 and October 1).~~

~~109.14.4 If the bidder wishes to be bound by these specifications, the bidder shall execute the acceptance form in the proposal. Failure by the bidder to execute the acceptance form will be interpreted to mean election to not participate in the price adjustment for fuel.~~

- b. **Std. Spec 606 Guardrail, Crashworthy End Terminals, One-Strand Access Restraint Cable and High-Tension Guard Cable** – Updates to MoDOT’s Guard Cable Requirements that include splicing guidance, and all new installations will be high-tension. (July 1)

SECTION 606

GUARDRAIL, CRASHWORTHY END TERMINALS, ONE-STRAND ACCESS RESTRAINT CABLE AND ~~HIGH-TENSION THREE-STRAND~~ GUARD CABLE

606.1 Description. This work shall consist of furnishing and installing guardrail, crashworthy end terminals, one-strand access restraint cable or ~~high-tension three-strand~~ guard cable as shown on the plans or as directed by the engineer.

606.2 Material. All material shall be in accordance with Division 1000, Material Details, and specifically as follows:

Item	Section
Concrete	501
Guardrail, End Terminals, Crash Cushions, One-Strand Access Restraint Cable and Three-Strand High-Tension Guard Cable	1040

606.2.1 Concrete. Concrete shall be placed, finished and cured in accordance with [Sec 703](#).

606.2.2 Cold Weather. During cold weather, the weather limitations of [Sec 502](#) will apply to concrete work.

606.2.3 Aesthetic Guardrail. When specified, aesthetic guardrail shall be in accordance with [NCHRP-350MASH -16](#), Test Level 3 criteria and shall be of new stock. End terminals and crash cushions for aesthetic guardrail shall be fabricated and installed in accordance with [Sec 606.30.3](#).

606.3 Construction Requirements.

606.3.1 General. Work on guardrail or guard cable removal and replacement when the adjacent travel or auxiliary lane is open to traffic during non-working hours shall adhere to the following requirements:

- (a) The contractor shall provide a schedule of work prior to the beginning of work.
- (b) Remove no more guardrail or guard cable than can be replaced in the same day.
- (c) Schedule guardrail and guard cable installation to ensure guardrail beam or guard cable is properly attached to all installed posts at the end of each [work day](#).
- (d) Ensure end sections or terminals exposed to traffic meet current standards.
- (e) Notify the engineer prior to delivery of the material to the project.

606.3.1.1 If guardrail or ~~three-strand~~high-tension guard cable cannot be replaced the same day as removal, traffic control measures meeting the approval of the engineer shall be provided. The contractor will not be compensated for any additional traffic control items required to perform

606.40.2 Construction Requirements. The cable shall be strung directly from the reel and pulled tight after the initial anchoring. The cable shall then be attached to the second anchor assembly with all turnbuckles fully opened. The cable shall be completely anchored before attaching to the line posts. ~~Only one splice will be permitted between anchors, located between the line posts. Splices will not be permitted in spans adjacent to the anchor and cable end assemblies.~~

606.40.2.1 Line Posts. Posts shall be installed in accordance with Sec 606.3.3. All posts shall be aligned to a tolerance of 1/4 inch for plumb and grade line.

606.40.2.2 Anchor Assemblies. The specified type of anchor assembly shall be constructed at each end of a run of guard cable. ~~If intermediate end anchors are required, the cable assembly shall be overlapped as shown on the plans. The location of all intermediate anchor assemblies shall be determined by the contractor and approved by the engineer. Backfill shall be brought up level with the finished grade line.~~

606.40.3 Method of Measurement. Measurement of one-strand access restraint cable will be made to the nearest 1/2 linear foot for each increment, from center of end post to center of end post, and totaled to the nearest linear foot for the sum of the increments on the project.

606.40.4 Basis of Payment. The accepted quantities of one-strand access restraint cable, end anchors, posts and hardware, complete in place, will be paid for at the contract unit price for each of the pay items included in the contract.

SECTION 606.50 ~~HIGH-TENSION~~THREE-STRAND GUARD CABLE.

606.50.1 Description. This work shall consist of furnishing and installing ~~three-strand high-tension~~ guard cable, including all hardware, appurtenances and aggregate bedding, as shown on the plans or as directed by the engineer. ~~High-tension guard cable systems shall be fabricated and installed in accordance with the manufacturer's approved shop drawings, recommendations and as shown on the plans, or as directed by the engineer.~~

606.50.2 Construction Requirements.

606.50.2.1 Line Posts. ~~All posts shall be driven unless otherwise directed by the engineer. Driving shall be accomplished with approved equipment and methods that will leave the posts in the final position, free from any distortion, burring or other damage. All posts shall be aligned to a tolerance of 1/4 inch for plumb and grade line. If rock is encountered when setting line posts, the contractor may set line posts with or without a soil plate. Line posts set with a soil plate shall be installed by digging or boring a hole into the rock to the required depth and of sufficient size for the post to be set with the soil plate attached. Line posts set without the soil plate shall be installed by drilling a hole to the required depth not to exceed 5 inches in diameter. Following placement of the post, the hole shall be backfilled with a cohesive soil or sand in accordance with Sec 1005.3, and thoroughly tamped.~~

606.50.2.2 Anchor Assemblies. ~~The specified type of anchor assembly shall be constructed at each end of a run of guard cable. If intermediate end anchors are required, the cable assembly shall be overlapped as shown on the plans. The location of all intermediate anchor assemblies shall be determined by the contractor and approved by the engineer. The concrete anchor shall be cast in place with the centerline normal to the line of the guard cable. The top 12 inches of the anchor below finished ground line shall be formed, unless the engineer determines soil conditions permit excavation to be made to the neat lines of the anchor and the anchor cast against the undisturbed vertical soil face. Anchors shall be constructed on firm, stable, undisturbed soil to the minimum dimensions shown on the plans. Anchor bolts and anchor post slip bases shall be firmly held in the proper position supported at the top by a template during~~

concrete placement. Backfill shall be thoroughly compacted with mechanical tampers with care taken to prevent damage to the finished concrete. Backfill shall be brought up level with the finished grade line. The anchor may be cast in place or precast as either one or two units.

~~606.50.2.3 Cables. Cables shall be attached to the line posts, anchor posts, cable transition brackets and anchor brackets as shown on the plans. Where compensating devices or turnbuckles are required, the cables shall be attached to the end anchor with turnbuckles fully opened. Compensating devices and turnbuckles shall be installed such that no interference with the functions of any other part of the system occurs. Individual cables may be spliced with a device approved by the engineer. Each cable shall be stretched taut by mechanical means to eliminate sag between the posts. The contractor may tighten cable hook bolts after final cable tensioning is complete to allow cable slack to be adequately taken up. Prior to final acceptance, the cables shall be tensioned in accordance with the temperature and spring compression table shown on the plans and all cable hook bolts tightened.~~

~~606.50.2.4 Aggregate Bedding. Material for aggregate bedding shall consist of a durable crushed stone, shot rock or broken concrete with approximately 20 percent of the pieces being between 1 inch and 3 inches in diameter but none greater than 3 inches. The remainder of the material shall be such that provides a uniform, angular appearance. Acceptance by the engineer will be made by visual inspection.~~

~~606.50.2.5 Delineators. Delineator spacing and reflector colors shall be in accordance with Sec 606.10.~~

~~606.50.3 Method of Measurement.~~

~~606.50.3.1 Three Strand Guard Cable. Measurement of three strand guard cable will be made from center of line post to center of line post, totaled to the nearest linear foot.~~

~~606.50.3.2 Anchor Assemblies. Measurement of anchor assemblies will be made per each.~~

~~606.50.3.3 Aggregate Bedding. Aggregate bedding material will be measured to the nearest cubic yard of material.~~

~~606.50.4 Basis of Payment. The accepted quantities of three strand guard cable, end anchors, posts, hardware and aggregate bedding will be paid for at the contract unit price for each of the pay items included in the contract. No direct payment will be made for setting posts in rock. No direct payment will be made for guard cable delineators provided on new guard cable. Delineators specified for installation on existing guard cable will be measured and paid for per each.~~

c. **Std. Spec 610 Pavement Smoothness – Update to Inertial Profiler Certification and Dispute Resolution Requirements. (July 1)**

610.3 Certification. All inertial profilers used to collect data on MoDOT projects shall be annually certified at a MoDOT approved the MoDOT-certification site in accordance with ~~TM-59~~. The operator of the IP shall be certified through the MoDOT technician certification program or an approved technician certification program.

610.5.5 Dispute Resolution. Any dispute between the engineer and contractor regarding IRI QC/QA comparisons that cannot be settled at the project office level shall be arbitrated-resolved with the MoDOT reference profiler per the test procedure in ~~TM-59~~ with Third Party resolution in accordance with Sec 403 or Sec 502. The Third Party shall be independent of the contractor, MoDOT consultants and all project subcontractors or suppliers on each specific project. The Third Party shall have properly calibrated and annually certified profiler equipment that meets AASHTO R 56 requirements and the operator has completed profiler certification training through an approved MoDOT Technician Certification Program. The Third Party for smoothness testing shall be listed on the Quality Control Plan in accordance with Sec 403.17.2 or Sec 502.11.1. The results of the reference profiler shall be binding for the engineer and contractor. The QC and QA average IRI profiles will be compared to the Third Party's average IRI profile, whichever of the average QC/QA IRI profiles is closer to the ~~arbitration-Third Party's~~ average IRI profile shall be the binding profile for the purpose of construction acceptance.

d. **Std. Spec 1040 Guardrail, End Terminals, One-Strand Access Restraint Cable and Guard Cable Material – Updates to MoDOT's Guard Cable Requirements that include splicing guidance and all new installations will be high-tension. (July 1)**

SECTION 1040

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

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

1040.5.2 Manufacturer's Approval. Prior to approval and use of an end terminal, the contractor manufacturer shall submit to MoDOT the manufacturer's name, the product brand name or model number, a copy of the MASH 2016 test results, a copy of the FHWA eligibility letter, and shop drawings.

1040.7.2 Three-Strand-Guard Cable.

1040.7.2.1 Cable and Connecting Hardware. The cable and connecting hardware shall be in accordance with AASHTO M 30 and AASHTO M 269. The wire rope shall be Type 1, 3/4-inch diameter, 3 by 7 construction with a Class A coating. The rope, with connecting hardware, shall develop the breaking strength at a minimum of a 25,000-pound single cable. Connecting hardware shall be galvanized in accordance with AASHTO M 232 or may be mechanically galvanized. If mechanically galvanized, the coating, thickness, adherence and quality requirements shall be in accordance with AASHTO M 232, Class C. Cast Steel components shall be in accordance with AASHTO M 103, Grade 70-40, Class 1. Malleable iron castings shall be in accordance with ASTM A47. Compensating devices shall have a spring constant of 0.46 psi, plus or minus 0.06 pound per inch, and permit 6 inches of travel, plus or minus one inch. All threaded parts on compensating cable end assemblies shall be in accordance with ASTM F568, Class 4.6, 3/4-10 threads. Socket baskets shall be designed for use with the cable anchor wedge as shown on the plans. Guard cable anchor brackets shall be manufactured

1040.7.2.2 Cable Brackets. Steel used in the fabrication of the bracket shall be in accordance with ASTM A36. The bracket shall be galvanized after fabrication in accordance with AASHTO M 111. All fittings, including splices, shall be designed to use the wedge detail, and shall be of such section as to develop the full strength of the 3/4-inch, at a minimum of 25,000-pound round cable. Designs for a combination or single-unit compensating device and turnbuckle assembly shall be submitted for approval. Compensating devices shall have a spring rate of 0.46 ± 0.03 pound per inch, and shall permit 6 inches ± one inch of travel. All parts, except cable wedge, shall be hot-dip zinc coated in accordance with AASHTO M 232 or AASHTO M 298.

1040.8.1 Manufacturer's Approval. Prior to a new installation of an approved high-tension guard cable system, the contractor shall submit to MoDOT the manufacturer's name, the product brand name or model number, a copy of the MASH 2016 test results, a copy of the FHWA eligibility letter, and shop drawings.

Three-Strand-Guard Cable				b
- Cable	AASHTO M30	AASHTO M 30 & AASHTO M 269		d
- Hardware	AASHTO M 232	AASHTO M 102/ ASTM A220		d
- Cast Steel Components	AASHTO M 232	AASHTO M 103		e
- Malleable Iron Castings	AASHTO M 232	ASTM A47		
- Anchor Brackets	AASHTO M 111	AASHTO M 270		d
- Cable Brackets	AASHTO M 111	AASHTO M 270, Grade 36		
- Hook and Hex Bolts	AASHTO M 232	ASTM A307		
- Hook Nuts	AASHTO M 232	ASTM A563		
- Hooked Anchor Studs	AASHTO M 232	AASHTO M 314		

(g) Certification shall state that the materials furnished are identical in chemistry, mechanical properties and geometry as those that passed the NCHRP 350 or MASH 2016 crash test, and as those that were approved by the Missouri Department of Transportation.

2. Standard Plan Changes

- a. **D-29** – Clarifies post stub payment.(July 1)

SIGNS				CONCRETE FOOTINGS EMBEDDED	STRUCTURAL STEEL POSTS * AND STUB				PIPE POSTS * AND STUB				BACKING BARS **			U-CHANNEL POST							
SIGN NO.	SIGN SIZE	STATION	HORZ CLEAR IF NOT STD	LOCATION	SIGN DTL. SHET. NO.	ITEM NO. 9031210	POST DES NO.	POST NO. 1	POST NO. 2	POST NO. 3	LBS PER FT	TOTAL LBS	PIPE SIZE	POST NO. 1	POST NO. 2	LBS PER FT	TOTAL LBS	2" x 1/4" BARS @ 2.55 LBS PER FT	NO.	LGTH	TOTAL	ITEM NO. 9031250A	
						CF		LF	LF	LF			IN.	LF	LF					IN.	LF	LBS	LF
902 SIGNAL SIGNS TABULATED ON D-37A SHEET																							

- b. **Standard Plan 606.41N** – Renamed and added clarifications to reflect Low-Tension Guard Cable is for repair only. (July 1)
- c. **Standard Plan 606.42** – New Standard Plan for “High-Tension Guard Cable” (July 1)
- d. **Standard Plan 606.50F** – Added sheet for MGS on Concrete Box Culvert (July 1)
- e. **Standard Plan 616 BE, 616.20C, D-2BS** – Removed “Rate our Work Zone” signing.

3. EPG

- a. **EPG 106.3.2.41 TM-41, Density Testing of Bituminous Mixtures with Nuclear Gauges** – Revised test method for correlating nuclear gauges to asphalt density. (July 1)
- b. **EPG 106.3.2.59 TM-59** – Profiler certification requirements have changed. Smoothness dispute resolutions non longer settled by the MoDOT SupPro and will require a Third Party.
- c. **EPG 231.1.2 Barrier Types** – Updated to reflect new guard cable installations will be High-Tension
- d. **EPG 501.1.10 2AA Sheet for Concrete Pavement** – Updated to reflect “exceed one-half mile” requirements.
- e. **EPG 612 Impact Attenuators** – Updated to align with current TA guidance. (July 1)

Category:612 Impact Attenuators



The traffic control guidance of the EPG serves as MoDOT's Manual on Uniform Traffic Control Devices (MUTCD) and should be used as the primary document when applying traffic control guidance to MoDOT's roadways. Per federal regulations, MoDOT's traffic control policies are required to be in substantial conformance with the MUTCD. There are occasions in the MUTCD where more than one traffic control device can be applied, but the EPG guidance typically selects the most applicable option for use on MoDOT roadways. The EPG also omits content from the MUTCD which doesn't apply to Missouri.

Like the MUTCD, the MoDOT's traffic control guidance of the EPG is permissive guidance, meaning this guidance outlines what is permissible allowed in regard to regarding applying traffic control devices to MoDOT roadways. When a nontypical situation specific traffic control guidance is not found refer to the in the Manual on Uniform Traffic Control Devices (MUTCD) or in the EPG, contact the District Work Zone Coordinator or MoDOT Central Office Highway Safety and Traffic Division office for assistance. The Division office can obtain assistance from FHWA, research facilities and other states for possible solutions that are MUTCD compliant. If these solutions have the possibility of being applicable to more than one site, consideration will be made to include the solution into the standard guidance found in the EPG as a standard.

This article provides information for the use of protective vehicles and three primary types of impact attenuators: truck-mounted attenuators, trailer-mounted attenuators (TMA) and freestanding impact attenuators (sand barrels). Impact attenuators are designed to absorb energy of an impacting vehicle and reduce the force on a passenger to an acceptable level. Types of impact attenuators include: truck-mounted attenuators (TMA), freestanding impact attenuators (sand barrels), and work zone crash cushions.

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612.1 Protective Vehicles/TMAs (MUTCD "Shadow Vehicle")

Protective vehicles/TMAs are used to safeguard the workspace from errant vehicles. In some operations, these devices also serve as platforms for signs and other devices used to warn traffic of upcoming conditions or inform them of needed actions. For increased motorist, driver and worker safety, the protective vehicle may be equipped with a truck-mounted attenuator (TMA).

Protective vehicle can be any MoDOT fleet vehicle except for a tractor.

Proper positioning of the protective vehicle/TMA vehicle within the work zone is critical to its effectiveness. The operator will refer to the appropriate typical application for guidance and placement of the protective vehicle. It is the operator's responsibility to make sure that the protective vehicle/TMA is in the proper position to protect the crew, to provide ample roll-ahead distance, and to provide adequate warning to your co-workers and traveling public.

†

Pros and Cons of Truck- and Trailer-Mounted TMAs			
Truck-Mounted TMA Host Vehicle 16,000 lbs GVWR		Trailer-Mounted TMA Host Vehicle 10,000 lbs GVWR	
Pros	Cons	Pros	Cons
Cost and Maintenance		Cost and Maintenance	
After an impact the TMA is easily secured to the host truck, for transport to shop. (Ex: no need for a tow truck)	After impact, damage to host truck is common and extended down-time of truck is possible. This may be an issue if the vehicle fleet in an area is low.	For the "boat" trailer style, the TMA normally has less parts, maintenance cost, and assembly cost.	Tire issues can cause down time
No tire maintenance or down-time due to tire issues	Maintenance can be costly and timely	-	-
-	TMA must be removed prior to Arrow Board maintenance or repairs	-	-
Operations		Operations	
Follows directly behind truck. (Ex: Will not track paint from striping operations)	Difficult to remove and install. (Ex: Truck cannot be quickly used for other applications)	Trailer TMA are usually easier to install and remove from the truck hitches.	The driver may have difficulties backing, a spotter is recommended. (Ex: Backing up to pick up channelizers within a work zone and keeping the trailer out of the travel lane)
Easy Backing when spotter not available. (Ex: During work zone removal)	Difficult to access plugs, wires and lighting connections during installation and removal	After an impact, the trailer is removed from host vehicle and the truck is usually still serviceable.	After an impact, the trailer needs towing by flat bed back to shop for repairs based on manufacturer recommendations

Easy Maneuvering	Truck may not have hitch. This may limit the number of applications of the truck.	-	During operations such as striping, tires can track paint
-	When in the down position, the TMA will swing in to adjacent lane	-	Finding a location to turn around can be difficult (Ex: Rural areas with narrow lanes, small entrances, etc.)
Other Considerations		Other Considerations	
-	Overhead hazards become an issue when the TMA is in the Up position, which reaches 13'6".	When the TMA is not deployed as a protective truck, the tailgate can be left attached for cargo/material hauling.	Depending on the TMA, the unit may rotate into an adjacent lane upon a side impact.
-	Due to added weight of the TMA on rear of the truck, the ride is rough and is tough on truck suspension.	The TMA can be used with different host vehicles and is not dedicated to one vehicle.	Some trailer TMAs look similar to "boat" trailers, which give a perception the TMA units are not safe.
-	Due to the over swing and lowering of the TMA, the area behind the truck should be clear of personnel and vehicles.	-	-

612.1.1 ~~Truck- and or Trailer Mounted Attenuators~~

~~Truck or Trailer-mounted attenuators (TMAs) are energy-absorbing devices attached to the rear of the trucks and used as appropriate protective vehicles, thus protecting the motorist and the protective vehicle's driver/operator upon impact. The MODOT TA article 616.8 expands upon which work locations require the use of a TMA attached to a protective vehicle. The protective vehicle that supports the TMA must meet manufacturer specifications.~~

The National Cooperative Highway Research Project 350 (NCHRP 350) and the 2016 AASHTO Manual for Assessing Safety Hardware (MASH 2016) set the crash criteria for TMAs. ~~TMAs purchased by MoDOT meet these requirements. Non MASH 2016 impact attenuators manufactured prior to January 1, 2023 may be used until January 1, 2030. All impact attenuators manufactured after January 1, 2023 shall meet MASH 2016 Test Level 3 crash test requirements.~~

~~Damaged TMAs are to be removed from service and either repaired or replaced. Articles on MoDOT's are available upon request.~~

~~NCHRP 350 and MASH 2016 crash tests straight-on and offset collisions, not side impacts. TMAs are not designed for side impacts.~~

~~Articles on MoDOT's Maintenance Planning Guidelines for Impact Attenuators are available upon request.~~

612.1.2.1 ~~MoDOT Protective Vehicle/TMA Marking and Emergency Alert Lights~~ Lighting, and Audible Alert System

~~While in the operating position, the rear facing of the TMA shall be marked with alternating 8-inch yellow and 8-inch black retroreflective sheeting forming an inverted "V" at the center and slope downward at an angle of 45 degrees toward each side of the unit or a checkered board pattern consisting of 12-inch square red and 12-inch square white retroreflective sheeting. The TMA may be marked with the same operating pattern or red and white DOT conspicuity tape to simulate the looks of a standard van body trailer when traveling.~~

~~For future installations beginning July 1, 2023, use Emergency Alert Lights (EALs) and Audible Alert systems on all MoDOT MASH 2016 tested TMAs are used in accordance with typical applications. Install EALs below the flashing arrow panel.~~

~~All lighting should be appropriately set, depending on the day or nighttime conditions.~~

~~If an approaching vehicle is observed driving in the occupied moving work zone lane, the TMA driver should activate the EALs by pushing the switch for a short duration. It is not recommended to leave the lights on very long because continuous or long term use may reduce the effectiveness of the EALs.~~

612.1.3 ~~Protective Vehicle/TMA Expectations for Operations~~

when exiting their vehicle. The vehicle should maintain a minimum of 150 feet roll ahead distance to the work activity space, be parallel to traffic, and have its wheels aligned to stay within the lane if struck. If the operator of the protective vehicle/TMA closest to the work activity feels he/she is about to be struck by an oncoming vehicle, the operator may take preventive action if the roll-ahead distance is greater than 150 feet.

For protective vehicle/TMA#2 during short duration/mobile operations, if the operator feels he/she is about to be struck by an oncoming vehicle, the operators may take preventive action to lessen the impact. However, the operator shall maintain a minimum of 150 feet of roll ahead distance to the next protective vehicle/TMA, be parallel to traffic, and have its wheels aligned to stay within the lane if struck.

For additional guidance for protective vehicle/TMA use within work zones, refer to the typical applications in [EPG 616.8 Typical Applications](#).

612.1.4 MoDOT Equipment/Materials Stored in Bed of Protective Vehicle Guidelines

Protective vehicles may carry loads or cargo, such as sign posts or tools, in the bed of the protective vehicle. When the protective vehicle is being deployed for protection or has the possibility of deployment prior to getting to the work area space, loads or cargo shall be properly secured. Loads or cargo are not allowed to be carried on TMAs.

Truck beds may be secured to the truck frame to maximize stability during impact. Steel plates and/or containers, secured by approved methods, may be used for ballast or weight to keep the dump bed against the host vehicle frame and may remain in the vehicle while the protective vehicle/TMA is ~~deployed~~

The term "protective vehicle" represents the use of the protective vehicle within operations. The term TMA represents a truck or trailer-mounted attenuator. For the usage of specific protective vehicles within each work space, refer to the [link to TAs](#)

The flashing arrow panel and warning lights shall not be active when the Protective Vehicle/TMA is traveling from the home domicile to the staging area/desired lane/work location. Once the Protective Vehicle/TMA has reached the staging area/desired lane/work location, the appropriate operating mode shall be displayed and turned on. If the Protective Vehicle/TMA leaves the staging area/desired lane/work location and travels to another staging area/desired lane/work location, the flashing arrow panel and warning lights shall not be active.

612.1.3.1.2 TMA Typical Operations

612.1.3.1.2.1 Stationary Operations Construction Projects

For construction projects, the use of a stationary TMA may be required on the temporary traffic control plans above and beyond the requirements of the MUTCD. If the use of a stationary TMA is required, the stationary TMA but should be included on the temporary traffic control plans, contain the appropriate bid item as well as the applicable ISP for Stationary Truck or Trailer Mounted Attenuator for Stationary Activities.

For ~~contract~~ construction projects, TMAs required for mobile operations, such as striping, are considered incidental per [Sec 612.5](#).

For additional guidance for protective vehicle/TMA use within work zones, refer to the typical applications in [EPG 616.8 Typical Applications](#).

612.1.3.1.2.2 Short Duration and Mobile MoDOT Operations

For contract projects, TMAs required for mobile operations, such as striping, are considered incidental per [Sec 612.5](#).

During MoDOT stationary operations, all protective vehicle/TMA vehicles shall be parked with the transmission in neutral and the parking brake engaged. The vehicle shall maintain a minimum of 150 feet of roll ahead distance to the next vehicle or work activity, be parallel to traffic, and have its wheels aligned with the striping and lane to maintain lane discipline and try to stay within the lane if struck. ~~It is recommended~~ the operator shall not wait inside or near the protective vehicle/TMA vehicle. The employee should proceed to the Work Space to assist other employees and wait for instructions.

During MoDOT short duration and mobile operations, protective vehicle/TMA operators are allowed to take preventive action by rolling ahead, when they perceive possible interaction with an errant vehicle. All TMAs, except TMA#1 are allowed take preventive action. Preventive action includes moving the protective vehicle/TMA forward to lessen impact. If the operator takes preventive action, they should be observant of all crew workers and equipment to maintain a minimum of 150 feet roll ahead distance and stay in the closed lane. In instances where you do not have the recommended 150 ft. of roll-ahead distance, DO NOT roll forward to lessen the impact and, if possible, engage the parking brake.

During short duration/mobile operations, if any employees exit their vehicles in the work activity space, the protective vehicle/TMA#1 operator closest to work activity space shall engage the parking brake

Stage 1—Classroom General Knowledge Training

Stage 2—OJT (On the Job) Training and Skills Assessment

612.2 Sand-Filled Impact Attenuators Array (Sand Barrels)



Sand Barrels

An Impact Attenuator Array (Sand Barrels) is most often used to shield fixed objects that cannot be removed or relocated, when posted speeds are greater than 35 mph. These devices are recommended for temporary usage such as in work zones. A benefit/cost analysis is to be conducted before sand barrels are used in a permanent application.

This system An Impact Attenuator Array (Sand Barrels) consists of a group of freestanding plastic barrels configured in an array of increasing weights from the impact point toward the object. Such an array transfers the vehicle's momentum to the increasing masses of sand in the barrels and provides a gradual deceleration. Each barrel is designed with a specific weight of sand to absorb the energy of an errant vehicle. The sand barrel array's "footprint" length and width and the number of barrels will change based upon the permanent posted speed limit of the roadway. For the correct setup and array of sand barrel impact attenuators, refer to the manufacturer's recommendations. For more information about manufacturer's recommendations, see [End Terminals, Crash Cushions and Barrier Systems](#).

The pay item will be based on the posted speed limit for the location the sand barrels will be used. Each Impact Attenuator XX mph (Sand Barrel Array) will be paid for per each, as a unit including the number of barrels and weight of sand in each barrel, as required by the manufacturer. For one (1) sand barrel impact attenuator array will include the number of sand barrels the manufacturer requires for the posted speed limit and will be paid for each array. If it is anticipated that the sand barrel array will be relocated during staged construction, the entire array will be relocated and paid for by the pay item Impact Attenuator (Relocation) each time the sand barrel array is relocated. The relocated array should be used in an area with the same posted speed limit, or another pay item will need to be used. An estimate for replacement barrels needs to be included as a separate pay item, typically calculated as one for each sand barrel array. No direct payment is made for the Type 1 object marker on the lead sand barrel in the array.

Sand barrels are most often used to shield fixed objects that cannot be removed or relocated. Sand barrels are recommended for temporary usage such as in work zones. A benefit/cost analysis is to be conducted before sand barrels are used in a permanent application.

An approved sand-filled impact attenuator may be installed on the exposed end of the barrier where the posted speed prior to construction on an existing facility or the anticipated posted speed of a temporary facility is greater than 35 mph.

612.3 Work Zone Crash Cushion

Work Zone Crash Cushions are used to protect traffic from the blunt end of temporary barrier curb. A crash cushion will be required on the upstream end of barrier curb for divided facilities, and on both ends for all two-way facilities. When space allows, sand barrel impact attenuators are the preferred choice for temporary protection. However, in the event that sand barrels cannot be used (for example, insufficient width), work zone crash cushions may be used instead. Work zone crash cushions provide a narrower option than sand barrels, but still perform the same function. Work zone crash cushions are discussed in [EPG 617.1.3.3 Crash Cushion](#). Applicable pay items are included in the plans.

612.34 Construction Inspection Guidelines

Material (for Sec 612.2) Certifications are to be collected on both the sand and retroreflective sheeting and any other product specified in Sec 1063, used in or on the sand-filled impact attenuators.

Safety Requirements (for Sec 612.3) The inspector is to request a copy of the manufacturer's certification that states the units comply with the crash test requirements of NCHRP 350 or MASH 2016, Test Level 3. This information is to be kept in the project files.

Truck-Mounted Attenuator (for Sec 612.4.1) TMAs are to be inspected to make sure they are structurally sound, the frames are not bent and that they appear to be in good working order. In some cases, the contractor may elect to add TMAs when TMAs are not required. Elective TMAs need to be NCHRP 350 or MASH 2016, Test Level 3 compliant and therefore the certification still needs to be collected. Typically, TMAs are only required and paid for under conditions where the contractor is operating without a lane drop set up (cones, channelizers, etc.). TMAs the contractor voluntarily adds to an operation are typically not paid for.

Sand-Filled Impact Attenuator Array (for Sec 612.4.2) The inspector is to request a copy of the manufacturer's installation instructions for the particular brand of sand-filled impact attenuator the contractor is using. The use of more than one manufacturer's sand barrels in an array is not allowed. When inspecting the sand-filled impact attenuator arrays, make sure that the array is in the location as shown in the temporary traffic control plans, and set up and filled in accordance with the manufacturer's recommendations. All lids are to be on and secured. In order to prevent the sand inside

~~the barrels from freezing in cold weather, the sand shall have a maximum moisture content and rock salt added, according to Sec 612.4.2.1. MoDOT requires rock salt intermixed with the sand so that any water that gets into the barrels will not freeze and create a safety hazard. The contractor should provide the calculations for moisture content and rock salt content for each barrel, so the specification requirements can be verified.~~ When checking the contents of the barrels, rock salt should be visible in the sand mix, ~~to verify uniform dispersion in the sand.~~ During periods of extended cold weather, the sand should be checked periodically to make sure it has not frozen because the salt content has been exhausted. If this condition is found, the contractor will need to add more salt or replace the sand/salt mixture.

Work Zone Crash Cushions (for Sec 612.4.3). The inspector is to request a copy of the manufacturer's installation instructions for the particular brand of crash cushion the contractor is using. When inspecting the work zone crash cushion, make sure that the crash cushion is in the location as shown on the temporary traffic control plans and set up in accordance with the manufacturer's recommendations. If the crash cushion is water-filled, MoDOT requires a mixture content per manufacturer's recommendations so that the crash cushion will not freeze and create a safety hazard. During periods of extended cold weather, the crash cushion(s) should be checked periodically to make sure it has not frozen. If this condition is found, the contractor will need to correct and/or replace the mixture. In the event the work zone crash cushion is damaged and needs to be replaced, it is considered incidental and replaced at no cost to the Commission.

Articles in "612 Impact Attenuators"

This category contains only the following page.

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~~612.4 Maintenance Planning Guidelines for Impact Attenuators~~

~~612.1.51.3~~ MoDOT **Protective Vehicle/TMA Operator's Training**

~~MoDOT operators are required complete MoDOT's Truck-Trailer Mounted Attenuator (TMA) Protective Vehicle training (both classroom and On The Job training) in advance operating a TMA. Training is conducted in two stages:~~

~~when exiting their vehicle. The vehicle should maintain a minimum of 150 feet roll ahead distance to the work activity space, be parallel to traffic, and have its wheels aligned to stay within the lane if struck. If the operator of the protective vehicle/TMA closest to the work activity feels he/she is about to be struck by an oncoming vehicle, the operator may take preventive action if the roll-ahead distance is greater than 150 feet.~~

~~For protective vehicle/TMA#2 during short duration/mobile operations, if the operator feels he/she is about to be struck by an oncoming vehicle, the operators may take preventive action to lessen the impact. However, the operator shall maintain a minimum of 150 feet of roll ahead distance to the next protective vehicle/TMA, be parallel to traffic, and have its wheels aligned to stay within the lane if struck.~~

~~For additional guidance for protective vehicle/TMA use within work zones, refer to the typical applications in EPG 616.8 Typical Applications.~~

~~612.1.4~~ MoDOT **Equipment/Materials Stored in Bed of Protective Vehicle Guidelines**

~~Protective vehicles may carry loads or cargo, such as sign posts or tools, in the bed of the protective vehicle. When the protective vehicle is being deployed for protection or has the possibility of deployment prior to getting to the work area space, loads or cargo shall be properly secured. Loads or cargo are not allowed to be carried on TMAs.~~

~~Truck beds may be secured to the truck frame to maximize stability during impact. Steel plates and/or containers, secured by approved methods, may be used for ballast or weight to keep the dump bed against the host vehicle frame and may remain in the vehicle while the protective vehicle/TMA is deployed.~~

- f. **EPG 606.2 Guard Cable** – Updates to MoDOT's Guard Cable Requirements that include splicing guidance, and all new installations will be high-tension. (July 1).
- g. **EPG 612.4 Maintenance Planning Guidelines for Impact Attenuators** – This article is being removed. (July 1)
- h. **EPG 616.23.5.11 Protective Vehicles** – Updated to align with current TA guidance. (July 1)

616.23.2.5.11 Protective Vehicles

Protective vehicles are used to safeguard the workspace from errant vehicles. In some operations, these devices also serve as platforms for signs and other devices used to warn traffic of upcoming conditions or inform them of needed actions. For increased motorist, driver and worker safety, the protective vehicle may be equipped with a [truck-mounted attenuator](#). (See [EPG 612.1 Protective Vehicles](#) for additional guidance).

[MoDOT Protective Vehicles](#) can be any MoDOT fleet vehicle appropriate for the operation.

[Positioning of the protective vehicle within the work zone is critical to its effectiveness. The operator will refer to the appropriate typical application for guidance and placement of the protective vehicle.](#)

616.23.2.5.11.1 Equipment/Materials Stored in Bed of Protective Vehicle Guidelines

[Protective vehicles may carry loads or cargo, such as sign posts or tools, in the bed of the protective vehicle. When the protective vehicle is being deployed for protection or has the possibility of deployment prior to getting to the work space, loads or cargo shall be properly secured. Loads or cargo are not allowed to be carried on TMAs.](#)

- i. **EPG 616 Work Zone Safety and Mobility Policy Resources** – This article is being removed (July 1)
- j. **EPG 616.19 Quality Standards for Temporary Traffic Control Devices** – Revised language to be consistent with current policy and updated to follow order of appearance in a work zone. (July 1)
- k. **EPG 617 Traffic Barrier** - Updates to MoDOT’s Guard Cable Requirements that include splicing guidance, and all new installations will be high-tension. (July 1).
- l. **EPG 751.1 Preliminary Design and 751.36 Driven Piles** – Clarify guidance for field verification of pile driving which affects design and construction.
- m. **EPG 751.5.9.2.1.2 Bend Shapes** – New article under the general information for reinforcing steel explaining MoDOT’s bent bar shapes used in structures.
- n. **EPG 751.5.9.2.7 Length Calculations** – Clarified calculations for hook dimensions and bend deductions
- o. **EPG 751.11.3.5 Anchor Bolts, 751.12.1.3-6 Barrier Types, 751.22.3.4.1 Reinforcing Details, 751.31,32, & 35 Bent Types**– Revised references to stirrup pin bend shapes. Revised bar shape dimensions or shape numbers in accordance with revisions to the bill of reinforcing standard drawing.
- p. **EPG 751.50 Standard Detailing Notes** – Updates standard notes providing a MASH TL-4 steel barrier alternate for bridges.
- q. **EPG 902.5.23 Signal Indications for Left-Turn Movements** – Updates due to new guidelines for Protected Only Left Turns.
- r. **EPG 903.6.59 Vehicle Speed Feedback Plaque** – Updating guidance to match MUTCD.

903.6.59 Vehicle Speed Feedback Plaque (W13-20aP) (MUTCD Section 2C.13)



W13-20aP

Option: A Vehicle Speed Feedback (W13-20aP) plaque that displays the speed of an approaching vehicle to the vehicle operator may be used to provide warning to drivers of their speed in relation to a speed limit sign.

Standard: When used to display the speed of an approaching vehicle in relation to the posted speed limit, the Vehicle Speed Feedback (W13-20aP) plaque shall be mounted below a Speed Limit (R2-1) sign. The speed limit sign shall be a minimum of 30"x36" on conventional roads and a minimum of 36"x48" on freeways and expressways. The Vehicle Speed Feedback assembly shall not be installed at a location where the posted speed limit on the route changes. Vehicle Speed Feedback assemblies shall be placed anywhere downstream of a speed limit change but shall be a minimum of 200 feet down stream of a speed limit change on conventional routes and a minimum of 400 feet down stream of a speed limit change on expressways of freeways. Vehicle Speed Feedback assemblies shall be installed in accordance with the [Vehicle Speed Feedback Assembly Typical Application](#).

The legend YOUR SPEED shall be a black legend on a yellow retroreflective background with the YOUR SPEED text on one line. The changeable legend displaying the speed of the approaching vehicle shall be a yellow luminous legend on a black opaque background. The vehicle speed displayed on the changeable portion of the sign shall be displayed as an integer. The Vehicle Speed Feedback sign and plaque shall not flash, strobe, change color, or use other animated elements integrated into the changeable legend display. When no vehicles are approaching, the changeable display shall not display a legend.

No Speed Sign shall have the capability to collect, store or transmit data of any type.

Guidance: The changeable portion of the Vehicle Speed Feedback legend should be approximately the same height, width, and stroke of those on the Speed Limit sign it supplements or is mounted below.

The W13-20aP should be approximately the same width of the Speed Limit sign it is mounted below.

s. EPG 941.10.2.2 LPR and PTZ Permanent Installations – Adds Flock Safety Breakaway A as an option. t.

941.10.2.2 LPR and PTZ Permanent Installations

To assure LPR and PTZ devices do not represent an added risk to the traveling public, there are defined installation locations which are acceptable on Commission right of way. Acceptable installation locations include:

- Only deployed on the right side of the roadway outside of the shoulder.
- On MoDOT traffic signal upright poles, except in instances where deployment will interfere with other devices already attached to the pole.
- On MoDOT overhead sign truss upright poles.
- On independent signal pedestal base poles **behind barrier** (installed and maintained by requesting agency or their LPR vendor). **in accordance with the LPR Independent Installation Typical Application**
- **On independent breakaway support that has been crash tested and approved by MoDOT, in accordance with the following (or in the future if we have more approved "one of the following") approved system(s) Flock Safety Breakaway TA**
- On any non-breakaway structure owned by a third party, with the written permission of the third party.

Locations where LPR and PTZ devices shall not be installed include, but are not limited to:

- Any installation in the median / left side of a divided highway.
- Any overhead location.
- On any existing structure on right of way which has a breakaway design, whether it is owned by the Commission or a third party.
- Any bridge structure.
- Any location that already has a device installed.
- Any location that may interfere with MoDOT's ability to manage the transportation system.

MoDOT does not allow the deployment of LPR and PTZ devices overhead or in the median as these locations would result in increased impact on the safety and mobility of the traveling public when performing installation and maintenance activities. LPR and PTZ

devices are not permitted on any existing structure which is designed as a breakaway device on Commission right of way, regardless of ownership, as the addition of these devices could negatively impact the performance and safety of the breakaway structure.

There are three methods identified for deploying LPR and PTZ devices on Commission right of way, all of which must be approved by MoDOT and installed under a MoDOT permit:

- LPRs and PTZs installed on MoDOT structures.
- LPRs and PTZs installed on new stand-alone structures - installed and maintained by the requesting agency or their vendor in accordance with the [LPR Independent Installation Typical Application](#)- or [Flock Safety Breakaway TA](#).
- LPRs and PTZs installed on non-MoDOT structures - with the written permission of the structure owner.

941.10.2.2.3 LPRs and PTZs Installed on New Stand-Alone Structures

To limit the number of structures on Commission right of way, opportunities to locate the LPRs and PTZs off of right of way is the preferred option, followed by an installation location on an existing structure already on right of way. If it is determined a new stand-alone structure is required to facilitate the LPR and PTZ deployment, the following guidance shall be followed:

- The district shall work with the local agency to find a location which meets the requirements outlined on the [MoDOT License Plate Reader Independent Installation Typical Application](#) or [Flock Safety Breakaway TA](#).
- Stand-Alone LPR and PTZ structures shall be properly spaced away from other traffic control devices, which can include but are not limited to highway signs, traffic signal, roadway lighting poles, etc.:
- No closer than 200 feet upstream of a traffic control device.
- No closer than 50 feet downstream of a traffic control device.
- Installation and maintenance access should be via adjacent private property or secondary roadways for divided highway, unless physically impossible.

4. General Provisions

- a. **Covid-19 Safety** –Removes reference to pandemic levels.
- b. **Anti-Discrimination Against Israel Certification** – Removed from Supplemental Revisions JSP and added as a new section.
- c. **Ground Tire Rubber (GTR) Dry Process Modification of Bituminous Pavement Material** – Removed from Supplemental Revisions JSP and added as a new section.
- d. **Disposal of Blast Media and Paint Residue** – Removed from Supplemental Revisions JSP and added as a new section.

5. Upcoming/Future Revisions

- a. Additional changes to Buy America. – We were asked for comments on the Manufacturing Waiver and have provided those comments along with some specific examples of products that are not always available without those waivers or have limited suppliers. A couple of examples of these include many items needed for utilities and glass beads.