

# CHAPTER M3

## *Traffic Safety Devices*

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## M3.01 Introduction

### M3.01.01 Chapter Content and Resources

#### Roadside Safety Hardware

This chapter contains information relevant to all work performed to replace and maintain roadside safety hardware which includes crash cushions (impact attenuators), guardrail end terminals, anchors and transitions as well as roadside barriers such as W-Beam guardrail (Metal Beam Guardrail (MBGR) and Midwest Guardrail System (MGS), high tension cable barrier, concrete guardrail and concrete barriers on the State Highway System (SHS). Other safety devices that that may be included, but are not limited to:

- Roadside Delineator Posts
- Roadside Safety Hardware Delineation
- Out of Control Vehicle Ramps (portion that may contain a vehicle capture system such as a net or other feature design for truck capture.)

For charging practice instructions, see Volume 2 of the Maintenance Manual.

This chapter provides an overview of policies, expectations, and strategies regarding Safety Devices. For additional information and a complete description of materials, applications, and recommended highway maintenance strategies please see the following references:

Authorized Materials Lists (AML): <https://dot.ca.gov/programs/engineering-services/authorized-materials-lists>

Division of Maintenance, Field Technical Support: [Field Technical Support | Maintenance](#)

Federal Highway Administration (FHWA) W-Beam Guardrail Repair- A Guide for Highway and Street Maintenance Personnel:

[https://safety.fhwa.dot.gov/local\\_rural/training/fhwasa08002/fhwasa08002.pdf](https://safety.fhwa.dot.gov/local_rural/training/fhwasa08002/fhwasa08002.pdf)

Implementation of the Manual for Assessing Safety Hardware (MASH):

<https://dot.ca.gov/programs/safety-programs/mash>

Level of Service Intranet Page: <https://maintenance.onramp.dot.ca.gov/roadsidemgmt/level-service>

Maintenance Memos: <https://maintenance.onramp.dot.ca.gov/maintadmin/maintenance-memos>

Maintenance Program Strategic Plan (2022-2027): [Strategic Plan 2022–2027 \(ca.gov\)](#)

Safety Devices HQ and District Traffic Safety Systems Coordinators:

<https://safetyprograms.onramp.dot.ca.gov/safety-devices-coordinators>

Traffic Operations Headquarters Division:

<https://traffic.onramp.dot.ca.gov/>

M3.01.02 Definitions

AC – Asphalt Concrete  
E-FIS – Enterprise Resource Planning Financial Infrastructure  
FHWA – Federal Highway Administration  
IMMS - Integrated Maintenance Management System  
LOS – Level of Service  
MASH – Manual for Assessing Safety Hardware  
MBGR – Metal Beam Guardrail  
MGS – Midwest Guardrail System  
NCHRP – National Cooperative Highway Research Program  
PCC \_ Portland Cement Concrete  
RESP – Responsive Maintenance  
SCRT – Scheduled/Routine  
SHS – State Highway System

***District Traffic Safety Engineer:*** The District Traffic Safety Engineer, or their designee, ensures compliance with the traffic safety systems policies.

***District Traffic Safety Systems Coordinator:*** The District Traffic Safety Systems Coordinator is the primary contact for inquiries about traffic safety systems in the respective districts. The coordinator provides guidance for use of traffic safety systems and makes recommendations for repair and replacement of safety systems and hardware.

***Energy-Absorbing End Treatment:*** An energy absorbing tangent or flared system. When impacted head on, the vehicle is brought to a controlled stop.

***Flared End Treatment:*** End treatment with an offset of 2 ½ feet to 4 feet from the edge of roadway.

***Tangent (inline) Terminal System:*** A system that is parallel with the edge of roadway.

***Gating End Terminal System:*** A gating guardrail system will bend and ‘gate’ out of the way allowing the impacting vehicle to slow down on some impacts and pass behind the guardrail on others.

***Guardrail:*** Guardrail is a standard guardrail panel used as a longitudinal barrier installed on State Highways to reduce the combined effect of severity and frequency of errant vehicle type crashes. This is accomplished by redirecting a vehicle away from embankment slopes or fixed objects and dissipating the energy of the errant vehicle. The W-Beam channel is the most common barrier used for guardrail applications and is commonly known as Metal Beam Guardrail (MBGR) or Midwest Guardrail System (MGS).

***Thrie-Beam:*** Thrie-Beam rail features a three-wave cross sectional design for added strength and durability. It is essentially two pieces of W-Beam guardrail that have been formed into one single piece.

***MASH:*** A set of current national crash testing criteria that determines crash worthiness of roadside safety hardware.

***Median Barriers:*** Median barrier is a continuous safety barrier placed in medians of all highway types to prevent an errant vehicle from crossing the median and colliding with opposing traffic. Median barriers may be concrete, Thrie-Beam or high-tension cable barrier. Although not part of the initial design, it may also prevent the deflection of a vehicle colliding with the barrier back into the traffic stream and decelerate the errant vehicle within tolerable limits.

***Out of Control Vehicle Ramp:*** Out of Control Vehicle Ramps (portion that may contain a vehicle capture system such as a net or other feature designed for truck capture). Gravel tends to pack with time or repeated traversals by equipment. Thus, the gravel should be loosened up or scarified after each ten uses of the ramp or every six (6) months (Spring and Fall), whichever occurs more frequently. Whenever the gravel is scarified, it should be examined for contamination. Then, if an excessive amount of fine material or other contaminants is noted, immediate provisions should be made to replace or reprocess the aggregate to original specifications.

***Safety Hardware:*** Guardrail, guardrail end treatment, attenuators, crash cushions and medium barriers.

***Vehicle Energy Attenuators-Crash Cushions:*** Crash cushions, also known as impact energy attenuators, are intended to reduce the severity of a collision with a fixed object that cannot be removed or protected by other types of safety hardware or systems.

#### M3.01.03      References and Hyperlinks

Some of the references found in this chapter have hyperlinks that connect to the Department of Transportation (Caltrans) intranet pages which are not displayable to the public. Until such time that the specific reference becomes available on the internet, the user will have to contact their district maintenance engineer or the appropriate Headquarters division to inquire about the availability of the reference.

#### M3.01.04      Chapter Contact

This chapter of the Maintenance Manual is maintained by Division of Maintenance, Office of Maintenance Traffic Guidance and Safety.

### **M3.02      Overview**

#### M3.02.01      What is M3 Family- Roadside Safety Hardware

Roadside Safety Hardware (Safety systems and devices) are provided and maintained for the protection of traffic from more severe impacts with embankments or other fixed highway features.

### **M3.03 M3 Safety Devices Family Types**

This section includes work in the following M Family areas:

- M6 - Guardrail
- M7 - Median Barrier
- M8 - Vehicle Energy Attenuators (energy dissipaters)
- M9 - Out of Control Vehicle Ramps

### **M3.04 Condition Measurement and Inventory**

#### M3.04.01 General

Guardrail is evaluated, and the condition is measured by its ability to withstand impact usable or non-usable condition after impact using guidance from Volume 2 of the Maintenance Manual. There are three (3) types of conditions (Pass, Need 1 and Need 2) as described below:

#### **Conditions:**

##### **Pass:**

No maintenance action needed.

##### **Need 1:**

#### **SCRT – SCHEDULED/ROUTINE**

Scheduled/Routine Maintenance is not inherently time constrained like Responsive Maintenance. It includes any work that occurs on a repetitive basis or frequency.

##### **Need 2:**

#### **RESP – RESPONSIVE MAINTENANCE**

Responsive Maintenance is:

- 1) Work that is due to damage by the public (Examples include, but not limited to: graffiti, guardrail hits, sign knock downs, pole knock downs, etc.)
- 2) An event that causes field maintenance forces to redirect from regularly scheduled work (Examples include, but not limited to accidents, spills, floods, avalanches, etc.)

#### **Measurement and Inventory**

M60 GUARDRAIL Current Standards are measured by FEET.

This item includes all current standard Thrie and W- Beam guardrails. Measurement by feet is the process to inventory the total length of rail. All guardrails not in the current Standard Plans are to be inventoried under this item. The guardrail may be constructed of wood, metal, cable, or any other material.

M61 END TREATMENT Current Standards are measured by EACH.

The length, and vendor of each end treatment may differ, but they will still be measured/counted as each.

M714 BARRIER, PCC Measured by FEET

All PCC barrier constructed for any purpose and placed anywhere within the right-of-way will be inventoried under this item. Include rock walls used as a barrier. This barrier may be with or without light screen.

M724 BARRIER, METAL LINEAR Measured by FEET

All metal barrier rail that has been constructed anywhere within the right-of-way will be inventoried under this item. This rail normally will be constructed in the median but may also be constructed in other places such as the right-hand shoulder between the state highway and a frontage road. Metal barrier may be single or double sided. Barrier that is double sided (sharing a post) should be accounted for in IMMS product unit by single side length of damage rail. Total damage rail length shall be entered as materials used in the comment section.

High Tension Cable Barrier, Measured by FEET.

See Section M3.06.01.2 (B) below for additional information.

M814 ATTENUATOR, All EACH Installation


All Attenuators constructed of any material or design. An entire array of sand barrels is one installation.

#### M3.04.02 Level of Service Survey



For the latest Level of Service (LOS) scores and other information for LOS see Level of Service web page, provided in [Section M3.01.01](#) of this chapter, for further information on how this score is calculated.

In addition, refer to the FHWA W-Beam Guardrail Repair- A Guide for Highway and Street Maintenance Personnel, provided in [Section M3.01.01](#) of this chapter.

The following barrier conditions provide an overview of typical examples of barrier related distresses and expected maintenance.

<b>Condition</b>	<b>Description</b>	<b>Typical Maintenance Activity</b>
<p style="text-align: center;">Pass</p>		<p style="text-align: center;">No Damage</p> <p>Rail is bent/pushed out of line less than 6 inches – rail element is intact (no tears and full splices; guardrail height is minimum 27 <sup>3</sup>/<sub>4</sub> inches for metal-beam guardrail - splices at post, and guardrail height is a minimum of 29 inches for Midwest Guardrail System - splices at midspan off post).</p> <p style="text-align: center;">No Action needed, continue to monitor.</p> <p>If guardrail height is less than 27 <sup>3</sup>/<sub>4</sub> inches for metal-beam guardrail or less than 29 inches for Midwest Guardrail System, consult with District Traffic Safety Systems Coordinator within the District</p>



<p>Need 1</p>		<p>Shall be scheduled for repairs.</p> <p>Rail is bent/pushed out of line less than 12 inches – rail element is intact (no tears and full splices).</p> <p>One or two posts are broken/bent over and separated from the rail – rail element is intact (no tears and full splices).</p>
<p>Need 2</p>		<p>Shall take immediate action to fix damages.</p> <p>Rail is bent/pushed more than 12 inches out of line, and/or became less than 24 inches high.</p> <p>W-Beam element is separated completely.</p> <p>W-Beam element is torn.</p>

Definitions for Asset Condition are determined by-Headquarters managers of the asset families. Evaluation of conditions are based on Federal and State laws, policies, and best practices. Each asset is governed by its activity. These distresses are discussed in more details in Section M3.05 and M3.06 of this Manual.

### **M3.05 Identifying Distresses and Maintenance Needs**

#### M3.05.01 General

The following summaries of common distresses provide an overview of typical examples of *Guardrail and Guardrail End Treatments* related distresses and expected maintenance:

- Anchor cable
- Posts
- Impact head
- W-Beam
- Thrie-Beam
- Grading

The Maintenance Supervisor should periodically review this information with staff to make sure all are aware of what distresses to look for.

Downed rail can be reported by anyone observing it, including CHP, Traffic Operations, Construction and Maintenance Employees.

Strategies for maintaining each type of Guardrail systems are discussed further in Section M3.06 of this chapter.

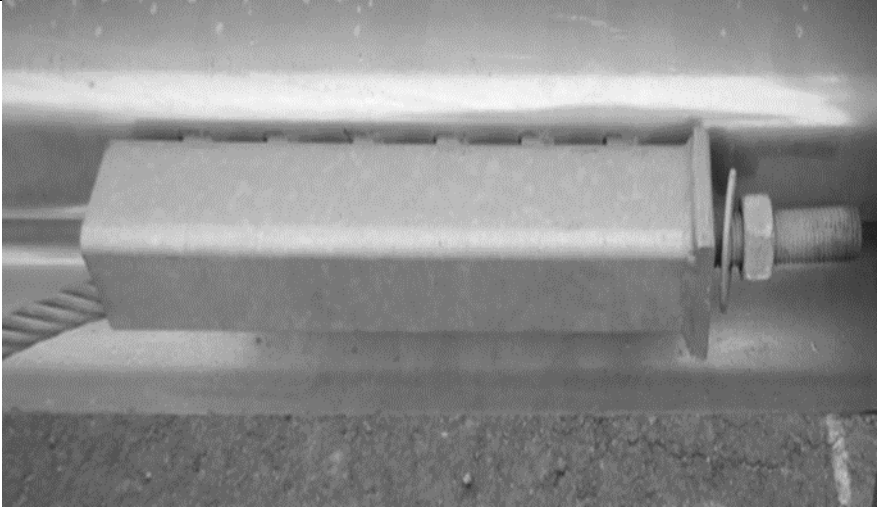

M3.05.02 Identifying Distresses

Following an assessment of a field repair situation, Maintenance personnel may need additional guidance from District Traffic Safety Systems Coordinators.

(A) Examples of Distresses

Description

**Anchor Cables**

	Anchor Cable Bolt Not Properly Tightened
	Anchor Cable Not Attached



Posts

	<p>Split and Broken Posts</p>
	<p>Missing Posts</p>

Impact Heads

	<p>Unleveled Impact Head</p>
	<p>Rail Not Inserted into Impact Head</p>
	<p>Bolting Impact Head to Post</p>

W-Beam and Thrie-Beam

	<p>Rail Damaged From Impact</p>
	<p>Washers Located on Face of Rail</p>

**Grading**

		Insufficient Soil Grading
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(B) Causes

**Anchor Cables**

Cables not attached, or too loose, are identified with a completed checklist. Use the assigned checklist to eliminate repair or replacement errors.

**Posts**

Damaged posts from errant driver impact, cold, heat, rain and rotting.

**Impact head**

Unlevel impact heads from not drilling the leveling holds before bolting the head to the post. This may also cause the head to slide off the rail end.

**W-Beam & Thrie-Beam**

Damage caused by errant drivers. Remove washers on rail-face to bring rail to current standards. Except last 25 feet of metal-beam guardrail, WB and WB-31 transition rails.

### Grading

Due to erosion from rain or other weather conditions grading is lost.

#### (C) Goals

Goals for all traffic roadside safety hardware shall be:

- All repair or replacement of end treatments shall be completed within fourteen (14) business days or put on HOLD with justifiable reasons documented in the IMMS database with the reason that the repair or replacement cannot be completed within the timeframe.
- All mainline guardrail meets current standards.
- All end treatments are in approved working condition and properly documented.

#### (D) Actions

- When guardrails, or guardrail end treatments, that do not meet current policy are damaged or otherwise require replacement, the location shall be reported to the District Traffic Safety Systems Coordinator for written recommendation.
- Deficiencies: true to line, grade, functional height, buildup of pavement or shoulder material, shoulder erosion, fill settlement, or any other cause should be routinely observed so it can be brought back to acceptable original standard.

### M3.06 Maintenance Level of Service Goals and Expectations

The proper maintenance of traffic safety devices is important in maximizing safety and efficiency for the users of the State Highway System. Caltrans Division of Maintenance has established a system performance goal to maintain a statewide level of service score of 90, or greater, for traffic safety devices. As outlined in the Maintenance Program Strategic Plan (2022-2027), provided in [Section M3.01.01](#) of this chapter, the Division of Maintenance priorities focus on safety, people, stewardship, and equity.

#### M3.06.01 Level of Maintenance

The proper maintenance of traffic safety devices is important in providing maximum protection to the traveling public and for general appearance of the roadside. Level of Maintenance, including frequency and priority of action for severe damage (any damage that can affect the ability of the safety device from performing its intended function) are included in Volume 2 of the Maintenance Manual for budgeting purposes.

##### M3.06.01.01 Guardrail

Guardrail must be kept in good working order (near as-built condition) if the systems are to constrain and redirect impacting vehicles. Guardrail should be routinely observed for damages. It should be maintained approximately true to line, grade, and functional height. Timely adjustments should be made to correct guardrail height when the original installation is degraded by the buildup of pavement or shoulder material, shoulder erosion, fill settlement, or any other



cause. Missing anchor cables must be replaced. End treatments should be maintained according to the Approved Caltrans Drawings.

Refer to the implementation of the Manual for Assessing Safety Hardware (MASH) web page, provided in [Section M3.01.01](#) of this chapter, and the Manufacturer's Installation and Repair manual for each specific system.

Some kinds of damage may seriously degrade performance such as those listed below in the Longitudinal Barrier Damage section. Repairs to these types of damage should be given priority. Each identified damaged barrier site must be assessed, prioritized, and scheduled for repairs based upon risk exposure (highway type, extent of barrier/terminal damage, potential for being struck within the repair time window).

#### Longitudinal Barrier Damage

The types of guardrail damage listed below may result in inadequate structural and substandard redirective performance:

- Vertical tears in the W-Beam rail that begin at the top or bottom edge. These are likely to result in rail separation in a subsequent crash.
- Similarly, holes in the rail resulting from damage or deterioration that reaches the top or bottom of a rail or one hole with a section greater than 1 inch or several holes with a dimension less than 1 inch within a 12.5-foot length of rail.
- More than 1 missing or ineffective splice bolts.
- More than 9 inches of lateral deflection over a 25-foot length of rail.
- Rail flattening that increases the W-beam section width from its original 12 inches.

Damaged rails and bent or missing delineators should be temporarily repaired if an obvious hazard exists or if functional integrity is impaired.

Permanent repair or replacement should be scheduled according to the priorities set in Volume 2 of the Maintenance Manual. Any remaining adjustments to line and grade should be done, when conditions permit, in conjunction with other repair work.

End caps on the downstream ends of guardrail adjacent to one-way roadways should not be replaced when damaged.

#### M3.06.01.02 Median Barriers

For removable panels of glare screen that are missing, or damaged, contact the District Traffic Safety Systems Coordinator for recommendation regarding if it should be maintained or replaced.

##### (A) Thrie and Metal Beam Barrier

- (1) Surveillance should be made for structural integrity, height, and alignment.
- (2) Repairs should be made promptly if a traffic hazard exists, or functional integrity

is questionable. Damage not constituting a hazard to traffic or functional integrity should be repaired when the schedule permits.

(B) High Tension Cable Barrier

All high-tension cable barrier should be inspected and re-tensioned annually, as recommended by cable barrier system manufacturers. The inspection shall consist of maintenance personnel walking along the run of barrier, visually observing barrier components to determine any damage exists and the overall condition of the cable barrier. The inspection should also include measuring the tension and re-setting the tension to the recommended requirements per the manufacturer's installation and maintenance repair manual.

- (1) Each manufacturer of proprietary high-tension cable barrier systems has established practices and procedures for maintaining their specific systems.
- (2) The manufacturer's installation and maintenance manual shall be referred to prior to and during all repairs of a proprietary system to ensure that the system is repaired in accordance with the manufacturer's instructions.
- (3) The effectiveness of cable barrier is sensitive to the height of the cable. Make periodic surveillance for structural integrity, height, alignment, and tension.
- (4) When damaged, repairs should be made promptly.
- (5) Damaged posts should be scheduled for replacement at the earliest practical time. Posts should be replaced following the manufacturer's installation and maintenance manual instructions.
- (6) Permanent repairs should be scheduled promptly. Surface irregularities such as berms or windrows resulting from shoulder grading must not be allowed adjacent to cable barriers.
- (7) Reflectors on cable median barrier will be maintained to the condition the cable barrier was when originally constructed with such delineation features or if retrofitted to meet special needs. Missing or damaged retroreflective delineators should be replaced promptly.
- (8) Questions concerning the maintenance of cable median barrier not covered here should be referred to the District Traffic Safety Systems Coordinator and/or product manufacturer of the system.

(C) Concrete Median Barrier and Concrete Guardrail

- (1) Concrete median barriers and concrete guardrails generally require little maintenance. Surveillance is necessary to ensure prompt repair when the barrier is broken, spalled greater than 1 inch in depth, when spalling exposes structural rebar, or when pre-cast units are toppled over or displaced out of line.

- (2) Concrete barriers and guardrail are not to be painted to eliminate tire marks.
- (3) Retroreflective delineators, placed as part of the original installation or retrofitted to meet special needs, should be maintained with the reflectors clear of material that obscures them. Missing or damaged retroreflective delineators should be replaced promptly.

#### M3.06.01.03 Crash Cushions

Crash cushions, also known as impact energy attenuators, are intended to protect the motorist from the consequences of collision with a non-break away fixed object. Routine surveillance should be performed to ensure that these devices remain functional. Detailed inspections should be made to ensure that the components are in satisfactory condition.

Existing NCHRP 350 compliant attenuators may remain in place and repaired. If a system is completely destroyed upon impact, consultation should occur with the District Traffic Safety Systems Coordinator to determine if the location may be viable for an upgrade to a MASH compliant crash cushion.

Several types of crash cushions are placed on the SHS. These are generally quantified as general purpose, severe duty (low maintenance) and sand barrel arrays. All crash cushions require attention after each impact, even those that may be able to sustain a second impact prior to repair.

Repair impact attenuators in accordance with the manufacturer's installation and maintenance manual recommendations. Check for proper restraining cable tightness, anchor bolt tightness, diaphragm damage and that all hardware is in good condition, and fender or transition panels are securely in place.

Sand barrel designs are generally proprietary. Inspect proprietary designs according to manufacturer's installation and Maintenance Manual recommendations. Standard Plans and/or Specifications are also applicable here for layout conditions.

Inspect sand barrels as follows:

- Lids are firmly in place and not dented.
- No visible damage or cracks in the outer shell.
- Each barrel is filled with the correct amount of dry sand. (See original specifications or manufacturer requirements).
- No visible moisture inside the barrels. If the sand is found to contain moisture, remove and replace with manufacturer approved sand.

Damage that impairs the functional integrity of attenuators should be repaired as soon as possible. Less critical damage may be repaired in conjunction with other maintenance operations.

Debris should be periodically removed from under or around attenuators. The accumulation of large amounts of debris can hinder sliding or telescoping action and impair the functionality of these devices and presents an unsightly appearance.

#### M3.06.01.04 Damage Guidelines for Safety Barriers

Severe damage as a result of an impact to a safety barrier (guardrail, median barrier, or crash cushion) is defined as any damage that significantly alters the structural integrity of a barrier and could alter the performance of a barrier during a subsequent impact. Examples of severe damage may be:

- Posts (for MBGR, Thrie-Beam,) are broken or out of alignment with original position by more than 12 inches horizontally.
- Metal sections (MBGR, Thrie-Beam,) are out of alignment with original installation by more than 12 inches horizontally.
- Bolts are missing or have torn through metal sections.
- Metal sections have been split or torn.
- Sections of concrete have been loosened or knocked out of the barrier.
- Cable supports have been knocked down, or the cable is lying on the ground.
- Any end treatment or crash cushion damage.

There may be other examples of severe damage not listed here.

Damage that is not considered severe damage is damage that does not significantly degrade or alter the structural integrity of the barrier and is referred to as minor damage. Rubs and scrapes that do not push a metal barrier out of alignment more than 6 inches, and aesthetic damage, such as tire marks, are examples of minor damage.

When a question arises on a specific location as to the extent of the damage and the impact on structural integrity, or the ability of the device to perform as intended, contact the District Traffic Safety Systems Coordinator in District Traffic Operations to have the location evaluated by an engineer.

#### M3.06.02 Uses and General Guidelines

##### M3.06.02.01 Guardrail

Guardrail is a safety barrier installed on State highways to reduce the combined effect of severity and frequency of errant vehicle type crashes. This is accomplished by redirecting a vehicle away from embankment slopes or fixed objects and dissipating the energy of the errant vehicle. The W-beam channel is the most common barrier used for guardrail applications and is commonly known as metal beam guardrail (MBGR), though concrete and other types of barriers may be used. Guardrail sections also include the end treatments and transitions that are attached.

Existing guardrail is to be maintained in accordance with the Caltrans' Standard Plans. Any deviation to install, delete, or modify existing guardrail must be by prior approval of the District Traffic Safety Systems Coordinator.

End wraps are no longer installed on the trailing end of guardrail adjacent to one-way roadways and are not to be maintained. Existing curved end sections on the trailing end of one-way roadway guardrail may be salvaged for use as needed.

Damaged breakaway terminals must be replaced with acceptable current standard breakaway terminals as approved by the District Traffic Safety Systems Coordinator in the Division of Traffic Operations.

Variable heights of guardrails are readily apparent to motorists, as well as being a potential safety problem and priority should be given to maintaining them to proper levels. Persons responsible for project reviews, construction and maintenance inspections should be alert to the potential need to adjust rail height because of pavement overlays.

Restoration of any damaged MASH guardrail end terminal system is to be made by replacing the system with the same MASH approved guardrail end terminal system. Restoration of any damaged NCHRP 350 flared guardrail end terminal system is to be made by replacing the system with the same NCHRP 350 approved guardrail end terminal system. If the same system is no longer available or approved for use, then a recommendation from the District Traffic Safety Systems Coordinator is required. Restoration of any damaged NCHRP 350 inline guardrail end terminal system requires a review and recommendation from the District Traffic Safety Systems Coordinator. Contact the District Traffic Safety Systems Coordinators or Headquarters Division of Maintenance for more information.

- (A) The following guidelines should be used when replacing damaged guardrail:
  - (1) In all cases when nonstandard guardrail is damaged to the extent that a section or sections must be replaced, District Maintenance will immediately advise the District Traffic Safety Systems Coordinator, and corrective work will be initiated based upon their recommendations. Mixtures of old and new types of guardrails in a run should be avoided.
  - (2) When upgrading guardrail, current standards will apply as to post size and spacing, rail elements, anchorage, and positioning. The District Traffic Safety Systems Coordinator in District Traffic Operations will furnish Maintenance forces with the necessary guardrail design and installation information.
- (B) Charges for replacing damaged non-standard guardrail with guardrail compliant per current standard plans will be apportioned as follows:
  - (1) The cost of "replacement in kind" of the damaged guardrail to be shown on the damage report should be an estimate based on the district's prior charges for similar work.
  - (2) Capital outlay costs (upgrading) will be the actual cost of replacement to current standards, less the amount for "replacement in kind" shown on the damage report.
  - (3) When any upgrading by Maintenance forces is involved in a replacement of damaged guardrail, a specific work order is required incorporating the split-funding provisions. Most districts have a blanket type improvement E-FIS Project Code to fund this type of work. When possible, upgrading of guardrail should be accomplished by contract.

#### M3.06.02.02 Median Barriers

Median barrier is a continuous safety barrier placed in medians of divided highways to prevent an errant vehicle from crossing the median and colliding with opposing traffic. Concrete Type 60 and Type 60M, high tension cable barrier and metal Thrie-Beam barrier are the most common types of median barriers.

See Standard Plans for flares and special conditions covering median barrier installations.

##### (A) Thrie-Beam Barrier

Thrie-beam barrier is a type of metal beam barrier that has rail elements containing 3 ribs that are 20 inches high. There is no channel rail. The top of the rail is 32 inches above the ground. (For further details and dimensions review the current Standard Plans).

##### (B) Concrete Median Barrier

The top of Type 50, concrete median barrier is 32 inches above finished grade. Present design of the barrier does not call for a below ground footing except at ends or joints in the barrier. The minimum height of Type 50 barrier after overlays shall be no less than 29 inches. The Standard Plans indicate the location and amount of steel reinforcement in the barrier.

Type 60M (renamed to Type 60MS in current standard plans) is a single slope concrete median barrier that is 36 inches in height above finished grade. The Type 60M single slope concrete median barrier is the current standard and is being installed throughout the State. This barrier is 42 inches tall and can accommodate pavement overlays of up to 6 inches. The minimum height of this barrier must be maintained at 36 inches or higher.

Review the latest Standard Plans and Revised Standard Plans for complete details and clarification.

#### M3.06.02.03 Crash Cushions

Crash cushions, also known as impact energy attenuators, are intended to reduce the severity of a collision with a fixed object that cannot be removed or protected by other types of protective systems.

Cushions/attenuators are expensive to install and maintain. Special problems or unsatisfactory performance should be immediately brought to the attention of District Traffic Safety Systems Coordinator in District in District Traffic Operations.

Type R chevron markers should be installed on the front of the attenuators whenever traffic may proceed on either side of the installation. The point of the chevron should be at the top of the marker.

(A) Collapsible Units

Present designs of lightweight crushable canister attenuators use overlapping fender panels along the sides of the assembly. These systems are held in position by anchor cables, bolting to a concrete pad, and use a backup structure.

Successful operation of sliding type units depends to a large extent on keeping the area free from objects and debris that can resist movement of the units. Care must be taken in machine sweeping to assure that there is no excessive buildup of debris within the device.

(B) Sand Filled Units

Sand filled plastic barrels are free standing and approximately 3 feet in diameter by 3 feet (Please see the Standard Plans for current standards). These barrels contain specific weights of sand depending upon their location in the installation. Sand filled barrels may "walk" or move downhill when installed on a slope. When this occurs, a stop or restraint is needed for each barrel.

Location of the barrel in the array and weight of sand in the barrel are critical in determining how the unit functions when impacted.

Whenever possible, location and weight of the barrels should be painted on the pavement to facilitate replacement. If this is not possible (e.g., installations in unpaved areas), weights can be marked on a marker Post Plate.

Copies of "As Built" plans can also be used to supply the information. Marking the weight on the sides of barrels, or on the lids, is unsatisfactory since these notations are lost in most impacts. Contact District Traffic Operations when no other information is available.

Sand used in filling barrels must be capable of remaining in a loose condition throughout the expected life of the barrel. Sand that contains clay particles, or is not well graded, can exert excessive stresses during expansion/contraction of the barrels and can cause premature failure of the unit. Cohesive materials can also result in failure of the array to dissipate energy when impacted by a vehicle.

Until further modified by the Engineering Service Center, Office of Materials Engineering and Testing Service, the following recommendations should be followed in filling barrels:

- (1) The sand used to fill modules shall be a clean washed concrete sand of commercial quality conforming to the sieve analysis requirements of ASTM C33- with no more than 1 percent of the sand passing the No. 200 sieve. The sand must not contain clay lumps.
- (2) Bagged sand shall not be used. At the time of placing in the modules, the sand shall not contain more than 7 percent water, as determined by Test Method No.

Calif. 226.

- (3) Lids should be fastened to the sand barrel shell consistent with the manufacturer recommendations. This is to minimize the scattering of debris during an impact. Some sand barrel lids have traveled a considerable distance. The placement of 4 pop-rivets, spaced equal distance, around the barrel are satisfactory.

### M3.06.03 Installation/Maintenance Details and Checklists

Installation standards and drawings for traffic safety systems may change as new materials, equipment, and traffic needs are identified. Be sure that the latest information is used for any new installation.

Each manufacturer of proprietary roadside safety hardware has installation and maintenance checklists that should be reviewed when repairing these systems along with the installation and maintenance manuals.

The District Traffic Safety Systems Coordinator in District Traffic Operations will provide current standards for each installation. Supervisors are responsible to assure that current drawings and standards are available for performance of work.

#### M3.06.03.01 Metal Beam Guardrail, Thrie and Metal Beam Median Barriers

- (A) Check the Standard Plans for the system or barrier type that is installed. Reference older Standard Plans as needed to ensure you are repairing the system to the standard the system was installed. Know what the design requires.
- (B) The 6-inch side of 6-inch by 8-inch timber posts should be next to the rail.
- (C) The posts should be set to the full depth shown on the plans. If this is not possible due to the presence of spread footings or other underground obstruction, some acceptable alternative method of setting the posts securely should be used after consultation with the District Traffic Safety Systems Coordinator. The Standard Plans and Traffic Safety Systems Guidance contain some alternatives. Others may be obtained through the Construction Division or District Traffic Operations.
- (D) All guardrail laps should be in the direction of traffic adjacent to the rail. Proprietary end terminal systems may have configurations that lap the rails differently for performance. Review Caltrans Approved Drawings for each system and specific manufacturer's requirements for each system.
- (E) Splice bolts should be tight with full bearing on the rail and not on bolt shoulders. The recess in the nut should face the bolt shoulder. Otherwise, the splice will not be tight.

Use all the splice bolts the Standard Plans call for.

- (F) Bolts should be long enough, so that nuts, are threaded completely onto the bolt. A one (1) or two (2) thread connection is not satisfactory. This should be checked,



especially at connections to structures.

- (G) Excessive bolt "stick through", exposed threads beyond the nut, more than ½ inch should be cut off to ½ inch. This is especially important where there is pedestrian or bicycle traffic behind the barrier. Excessive bolt length on beam barriers can increase sheet metal damage in otherwise minor collisions by vehicles. Threaded ends of bolts shall not be placed on the traffic side of the rail unless allowed for by the manufacturer of a proprietary system.
- (H) Rail elements should be at the proper height for the type of barrier being installed.  
  
Where the rail element is too low, less than 27<sup>3/4</sup> inches for Metal Beam Guardrail and 30 inches for the Midwest Guardrail System, there is an increased chance that a vehicle may go over the top of the guardrail. Where a metal beam guardrail element is too high, more than 30 inches, and a Midwest Guardrail System element is too high, more than 32 inches, there is an increased chance of a small vehicle snagging on a post below the rail. (Please see the Standard Plans for current standards).
- (I) The area in front of barriers should be flat and smooth, free of berms, dikes, curbs, windrows, watering basins, and ruts.
- (J) Anchor cables should be taunt with not more than 1 inch of movement/slack in the cable. This will ensure that tension is quickly developed in the rail element during a collision and minimize any tendency towards pocketing of the vehicle or failure of the system components.
- (K) Concrete anchors and footings should be built according to dimension shown in the Standard Plans.
- (L) Roadside rails may have longer posts or other design modifications when installed where the ground is loose or where there are steep side slopes. Longer posts shall only be used after consultation with the District Traffic Safety Systems Coordinator. These modifications are made once approved to provide additional lateral support to the posts. Be alert in recognizing these installations when repairing and/or replacing posts so they can be maintained as constructed.
- (M) Where cable clips are used, the saddle of the clip should be on the live or load carrying end of the cable. If not, the cable can slip, the rail will not develop full tension and a vehicle can penetrate the guardrail.
- (N) Avoid, if possible, making "off the cuff" field changes in planned installations. Small changes in an installation can result in greatly different performance during a collision.
- (O) If something is not understood or if you have questions, consult with the District Traffic Safety Systems Coordinator, or contact the Division of Maintenance or Division of Traffic Operations for questions.
- (P) Guardrail and barriers are also fixed objects and do not prevent all crashes, they lessen

the severity of a collision when installed as shown within the Standard Plans and Approved Drawings.

M3.06.03.02 Sand Filled Impact Energy Attenuators (Crash Cushions)

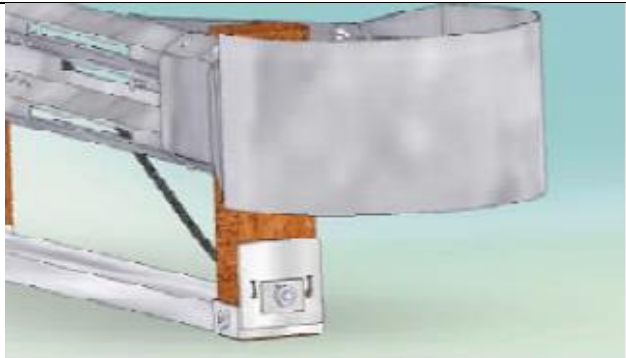
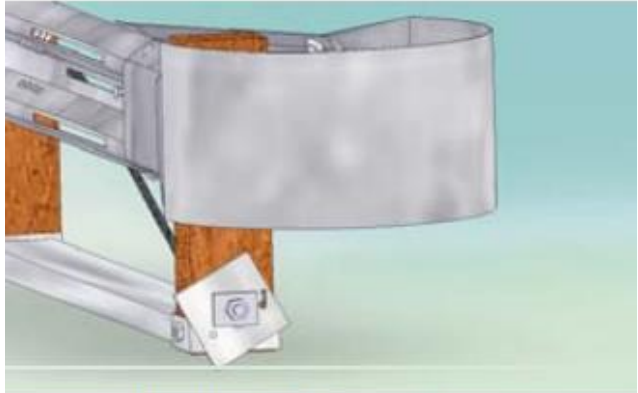
- (A) Check the Standard Plans. Know what the manufacturer installation requires.
- (B) Read manufacturer's installation instructions. Differences can vary by manufacturer. There are differences in manufacturer's designs.
- (C) Don't install barrels on soft or open ground or AC that is not compacted. The barrels will sink in unevenly, distorting the barrel and eventually leading to failure.
- (D) Barrels should not hang over curbs on raised gore surfaces.
- (E) Weight of sand should be painted on pavement under or beside the barrel. This makes repairs easier.
- (F) Maintenance crews responsible for maintaining sand filled cushions should get a set of plans or drawings for each project showing the sand barrel pattern and sand weights in each barrel. This is especially important where sand weights have not or cannot be painted on the ground.
- (G) Lids should be pop-riveted to shells on Fitch barrels to minimize the lids flying about during an impact. The new lids are heavier, weighing 8 pounds to 10 pounds. If it is necessary to secure "Energite" or "Trafix" lids on barrels, they should be pop-riveted.
- (H) Energite Inner Cones and Fitch Sand Support Structures should be installed in accordance with the manufacturer's instructions to ensure proper performance. Sand should be added to the levels indicated on the sides of the barrels.
- (I) Be sure that the sand meets specifications. Cleanliness is most important. Dirty sand can cake and result in split barrels. Very fine sand may slowly leak out. Do not use sand in bags. Use only loose sand.
- (J) Check the amount of sand in all barrels. Weights should conform to those shown on the plans.
- (K) Barrels with cracks through the walls that are permitting sand to leak out should be replaced as soon as possible. This assures the proper performance of the crash cushion.
- (L) If something is not understood or if you have questions, consult with the District Traffic Safety Systems Coordinator, or contact the Division of Maintenance or Division of Traffic Operations for questions.
- (M) All NCHRP 350 approved sand barrels (Energite, Fitch, and Trafix) may be mixed in an approved array, as long as the barrel has the proper sand weight for its array location. Note: the current Standard Plans have the approved arrays shown. MASH

approved sand barrel arrays may not be mixed with NCHRP 350 approved sand barrel arrays.

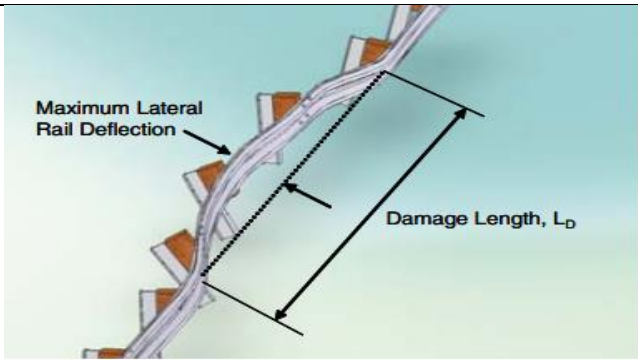
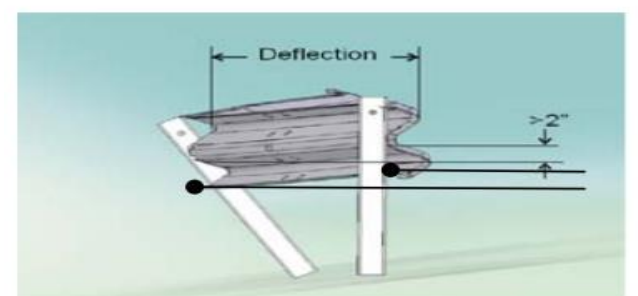
Examples of damaged assets are illustrated below for reference:

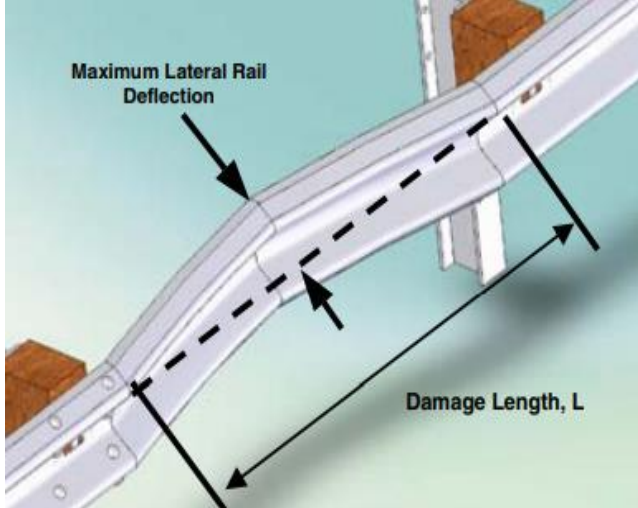
MISALIGNED OR MISSING BEARING PLATES

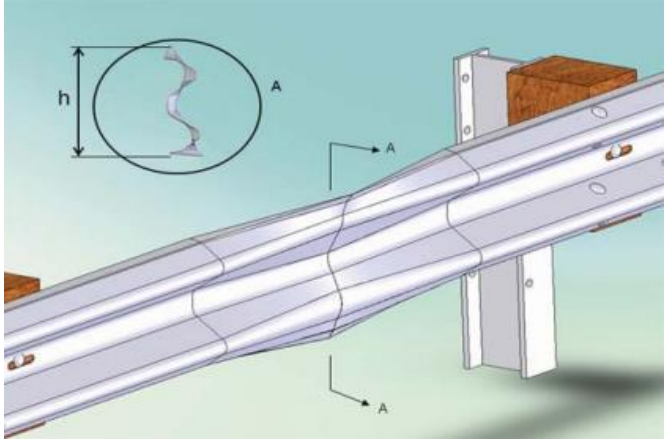


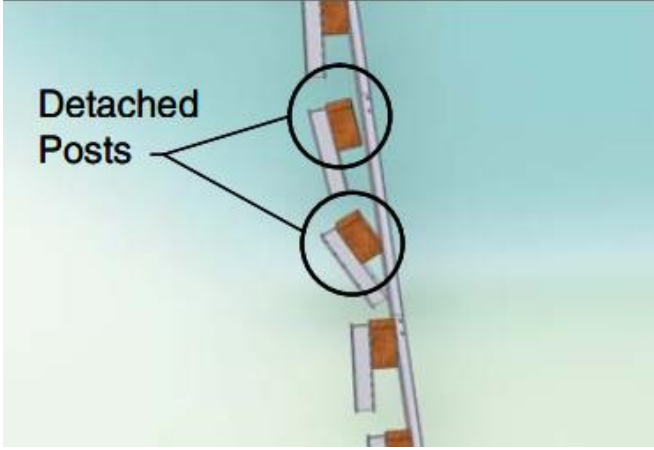
Damage Mode	Repair Threshold	Relative Priority	Measurement
Bearing Plate	Missing bearing plate	High	 <p>(Correct Bearing Plate)</p>  <p>(Misaligned Bearing Plate)</p>
	Loose or misaligned	Medium	

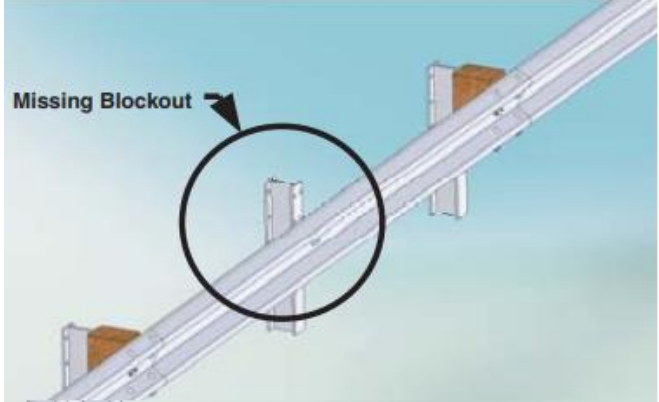
POST AND RAIL DEFLECTION

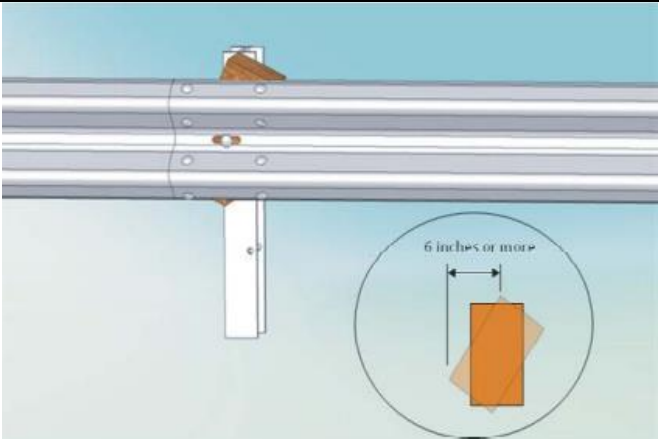
Damage Mode	Repair Threshold	Relative Priority	Measurement
Post and Rail High Deflection	One or more of the following thresholds: More than 9 inches of lateral deflection anywhere over a 25 feet length of rail. Top of rail height 2 or more inches lower than original top of rail height.	High	  <p>(Weak Post W-Beam Shown Only for Clarity. Each measurement taken at the rail's middle fold)</p>
	6 to 9 inches lateral deflection anywhere over a 25-foot length of rail.	Medium	
	Less than 6 inches of lateral deflection over a 25 feet length of rail	Low	

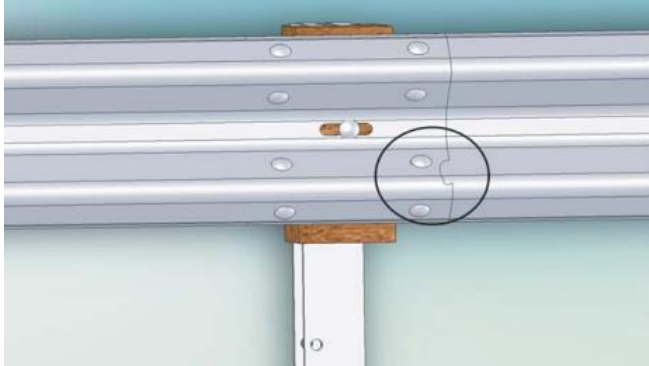
Damage Mode	Repair Threshold	Relative Priority	Measurement
Rail Deflection Only	6 to 9 inches of lateral deflection between any two adjacent posts Note: For deflection over 9 inches, use post/rail deflection guidelines.	Medium	
	Less than 6 inches of lateral deflection between any two adjacent posts	Low	

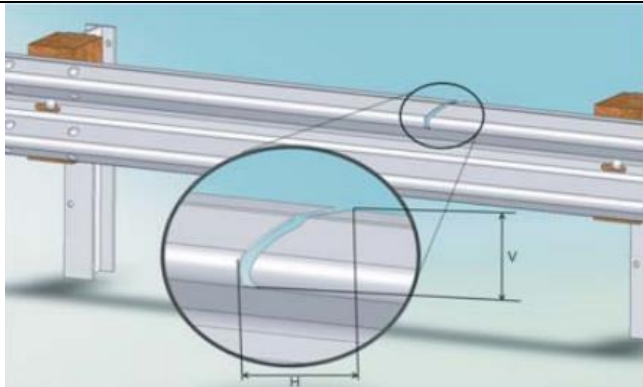
Damage Mode	Repair Threshold	Relative Priority	Measurement
Rail Flattening	One or more of the following thresholds:	Medium	
	Rail cross-section height is more than 17 inches (such as may occur if the rail is flattened)		
	Rail cross-section height is less than 9 inches (such as a dent to the top edge)		
	Rail cross-section height is between 9 and 17 inches.	Low	

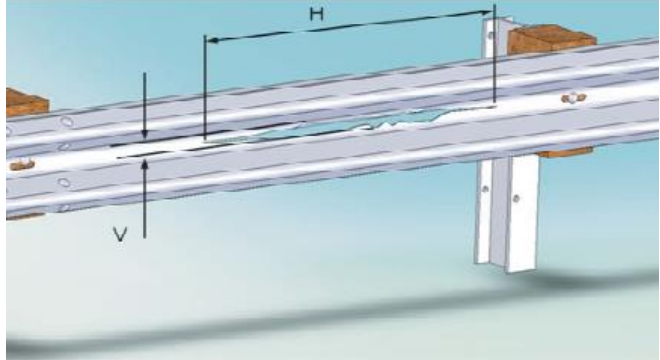
Damage Mode	Repair Threshold	Relative Priority	Measurement
Posts Separated from Rail	2 or more posts with block out attached with a post/rail separation less than 3 inches.	Medium	
	1 or more posts with a post/rail separation which exceeds 3 inches.		
		1 post with block out attached with post/rail separation less than 3 inches.	

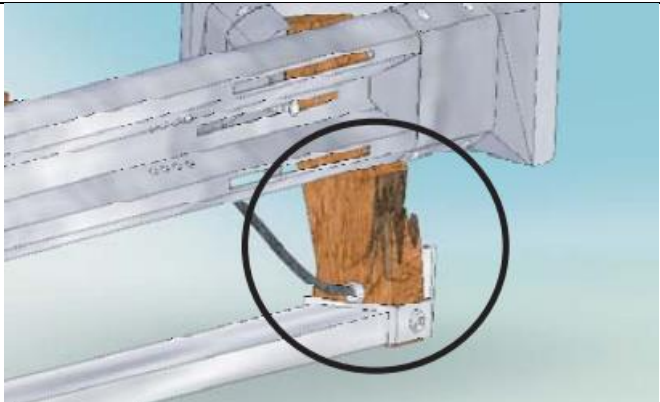
Damage Mode	Repair Threshold	Relative Priority	Measurement
Missing Block out	Any block outs	Medium	
	Missing  Cracked across the grain  Cracked from top or bottom of block out through post bolt hole  Rotted		

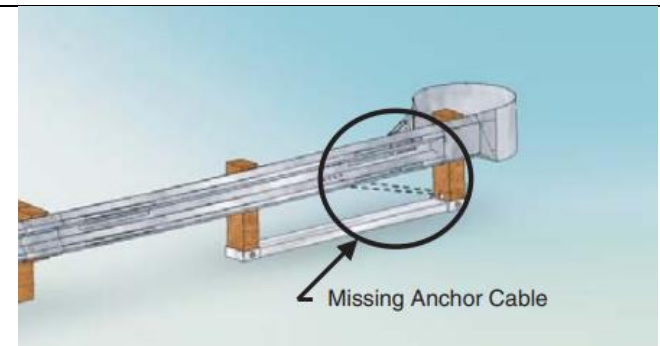
Damage Mode	Repair Threshold	Relative Priority	Measurement
Twisted Block outs	Any misaligned block outs and the top edge of the block is 6 inches or more from the bottom edge	Low	
	Note: Repairs of twisted block out are relatively quick and inexpensive.		

Damage Mode	Repair Threshold	Relative Priority	Measurement
Damage at a rail splice	More than 1 splice bolt Missing Damaged Visibly missing any underlying rail Torn through rail	High	
	1 splice bolt Missing Damaged Visibly missing any underlying rail Torn through rail	Low	


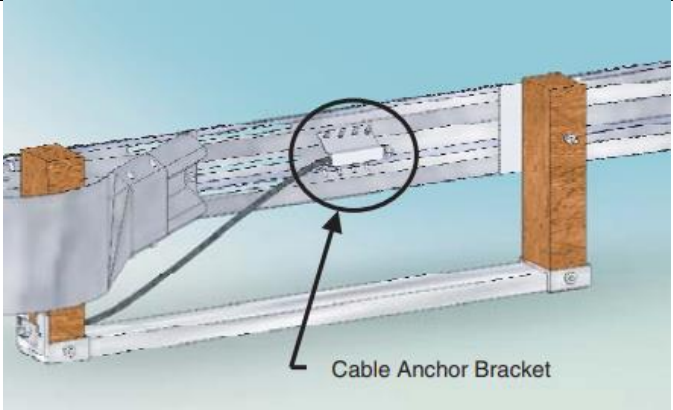
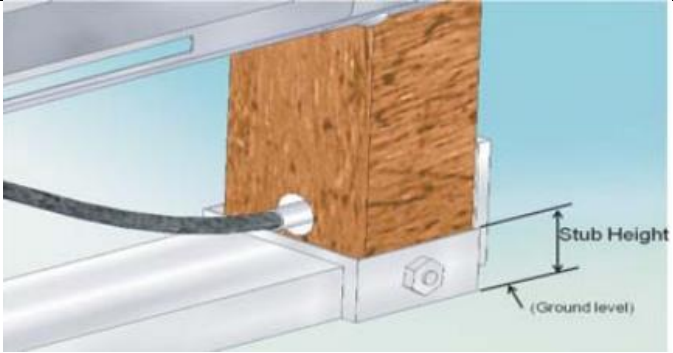
Damage Mode	Repair Threshold	Relative Priority	Measurement
Vertical Tear	Any length vertical (transverse) tear	High	

Damage Mode	Repair Threshold	Relative Priority	Measurement
Horizontal Tear	Horizontal (longitudinal) tears greater than 12 inches long or greater than 0.5 inches wide	Medium	

Damage Mode	Repair Threshold	Relative Priority	Measurement
Damaged End Post	Not functional (sheared, rotted, cracked across the grain)	High	

Damage Mode	Repair Threshold	Relative Priority	Measurement
Anchor Cable	Missing	High	



Damage Mode	Repair Threshold	Relative Priority	Measurement
Anchor Cable	More than 1 inch of movement when pushed down by hand	Medium	 <p>A 3D perspective diagram of a cable anchor bracket mounted on a metal rail. A hand is shown pushing down on the cable, and a vertical double-headed arrow indicates the displacement, labeled '1"'. The rail is supported by a wooden post.</p>
Cable Anchor Bracket	Loose or not firmly seated in rail	Medium	 <p>A 3D perspective diagram of a cable anchor bracket on a rail. A circular callout highlights the bracket's connection to the rail. An arrow points from the text 'Cable Anchor Bracket' to the callout. The rail is supported by a wooden post.</p>
Stub or Soil Foundation Tube Height	Height which exceeds 4 inches.	Medium	 <p>A 3D perspective diagram showing a cable stub protruding from a metal foundation tube. A vertical double-headed arrow measures the height of the stub above the ground level, labeled 'Stub Height' and '(Ground level)'. The foundation tube is supported by a wooden post.</p>

### M3.06.03.03 Out of Control Vehicle Ramps

Arrestor bed escape ramps require smoothing after every entry. An aggregate bed that contains humps and hollows can be very difficult to traverse and may unnecessarily damage the truck. Thus, it is essential that the aggregate bed be reshaped as soon as possible after a vehicle has been removed from the gravel.

Gravel tends to pack with time or repeated traversals by equipment. Thus, the gravel should be loosened up or scarified after each ten uses of the ramp or every six (6) months (Spring and Fall), whichever occurs more frequently. Whenever the gravel is scarified, it should be examined for contamination. Then, if an excessive amount of fine material or other contaminants is noted, immediate provisions should be made to replace or reprocess the aggregate to original specifications. Another indicator that the aggregate is becoming contaminated is when vehicles using the ramp travel increasing distances along the ramp. Use of the proper grade of stone cannot be over emphasized due to the potential liability.

Maintenance of an arrestor bed escape ramp requires adequate equipment. Hand tools are not acceptable. Proper power equipment assures that the ramp will be back in service in a minimum amount of time. It also ensures that Maintenance workers will be minimally exposed to the chance of a runaway truck wanting to use the ramp.

Equipment considerations may include a motor grader with an extension on its blade so the final pass in smoothing the gravel may be made from the service road. Another possibility is using a snow cat or some other light footprint vehicle. Since escape ramps are located in mountainous terrain and their use is more frequent in warm weather, the availability of snow cats is a possibility.

### **M3.07 Non-Motorized Travelers on State Highways**

During lane or shoulder closure for maintenance repair/replacement of Safety Devices, special considerations should be included to accommodate the needs of non-motorized travelers such as pedestrians and bicyclists.

### **M3.08 Other Requirements and Considerations**

Use Standard Plans for current approved safety devices adopted by Caltrans.

See Division of Traffic Operations, Traffic Safety Devices web page for approved list of end treatment products. In addition, refer to the MASH implementation and Authorized Material Lists (AML) web pages provided in [Section M3.01.01](#) of this chapter.

District maintenance forces shall coordinate with their respective District Traffic Safety Devices Coordinator to determine the appropriate written instructions for repair/replacement of damaged end treatment.

M3.08.01 Response Timeline

Timely repairs are critical for the acceptable performance of safety devices. Managers, superintendents and supervisors should make every effort to begin permanent repairs to safety devices as soon as possible. Compliance alert email notification system is in the IMMS to help with timely response to safety devices.

The district (or region) maintenance guardrail crew must respond immediately to all accident or vehicle collisions that involve any safety device. All notifications of damage to a guardrail, guardrail end treatment, median barrier or attenuator will be considered urgent. The responding crew will survey the damage as soon as safely possible. The responding crew must immediately perform necessary temporary repairs to reduce or eliminate obvious hazards.

The response time to complete permanent repairs for guardrail end treatments and attenuators is fourteen (14) business days from first notification. The crew supervisor must notify the area superintendent within (2) two business days if the crew is not able to initiate permanent repairs within the fourteen (14) business days' time frame. The response time to complete permanent repairs for the main run of guardrail or median barrier is thirty (30) business days from first notification. The crew supervisor must notify the area superintendent within (7) seven business days if the crew is not able to initiate permanent repairs. This will allow time to arrange for an on-call service contract to complete repairs within the appropriate time frames.

Agreements (formal or informal) with the California Highway Patrol, local law enforcement, or local emergency response agencies should be created that direct these agencies to notify Caltrans for any accident involving a guardrail, end treatment, median barrier, or crash cushion, no matter how trivial the damage appears to them. What seems like minor damage may actually affect the performance of the device during the next incident. The California Highway Patrol, local law enforcement, or local emergency response agency are not qualified to assess damage to safety devices.

M3.08.02 Integrated Maintenance Management System (IMMS)

All safety device work orders in IMMS must be site/incident specific. IMMS Work Orders that capture work at multiple locations for multiple incidents are not allowed. Caltrans' ability to accurately capture costs for recovery purposes or identify problem locations is reduced when unrelated work over large areas and time frames are included in a single work order.

The Work Order Comments tab must be used to describe the extent of damage and the repairs performed. Comments must fully describe work and identify the exact type of safety device worked on as directed by Volume 2 of the Maintenance Manual.

Work on guardrail and guardrail end treatments require separate work orders, even if the work is a result of the same incident. There are different IMMS activities for these two items. The District Traffic Safety Devices Coordinator can be consulted if there is a question on the dividing point between guardrail and guardrail end treatments, or identification of device type. Work on non-breakaway guardrail anchors on the trailing end of a guardrail run should be included in the guardrail work order, not a separate end treatment work order.

Each end treatment or attenuator work order can have no more than one device on a repair work order, even if the same incident causes damage on more than one device. The production unit for end treatment or attenuator work is one per device, not by length of device.

Production units on guardrails or median barriers must be counted by the lineal foot. Do not double count on two sided guardrails sharing the same posts. Comments on the work order should indicate if the guardrail or barrier is single or double sided and identify type of material (MGBR, MGS, Thrie-Beam, concrete, etc.). Capture all materials used on the material tab of the work order. Every effort needs to be made to identify the location as accurately as possible with the post mile location. If the device is identified in IMMS as an asset or appurtenance, charge the work order to that asset or appurtenance, not the roadway.

#### M3.08.03 Other Documentation and Notification

Proprietary devices like guardrail end treatments and crash cushions have specific instructions from their respective manufacturers. An installation checklist is part of these instructions. Each individual device must have the manufacturer's checklist signed off by the crew supervisor, and superintendent or District Traffic Safety Systems Coordinator after each repair. Each device repaired or installed must have its own separate checklist.

The District Traffic Safety Systems Coordinator must be notified of all attenuator, crash cushion, end treatment repairs. All work orders are to be closed by completion date and a copy of the checklist sent to the District Traffic Safety Systems Coordinator. If there are any discrepancies found by the District Traffic Safety System Coordinator, the work order can be re-opened for further repairs.

The original checklist must be retained by Maintenance and a copy sent to the District Traffic Safety Systems Coordinator monthly. The checklist must be kept on file until the device is repaired or replaced at a later date. These checklists are available in the installation manuals of each proprietary system and are available through the District Traffic Safety Systems Coordinator. Contact the District Traffic Safety Systems Coordinator if these checklists are not readily available.

#### M3.08.04 Quality Assurance/Quality Control

The crew supervisor and area superintendent or District Traffic Safety Systems Coordinator must verify each location using the approved checklist for each device. Inspector's name, title, and signature of each approving person must be on each checklist.

When guardrail repairs are completed, the end treatment(s) and end anchor(s) must be inspected for proper cable tension. This work is minor and can be included in the guardrail work order (IMMS activity M60010) unless the inspection shows additional needed repairs. In that case, a guardrail end treatment work order (IMMS activity M61010) must be completed.

All safety devices in each district will be inspected by qualified maintenance staff or traffic personnel to determine devices are compliant with standards in addition to the normal Level of Service (LOS) review. Copies of annual inspections must be forwarded to the District Traffic Safety Systems Coordinator. Recommendations for repairs or replacement will begin with the

appropriate program. The manufacturer's checklist may be used as a guide for inspection on proprietary devices. Many have an approved inspection checklist that may vary from the repair or replacement checklists.

Maintenance staff will document inspections in IMMS with a yearly generated project code and a completed checklist. The checklist must indicate that it is for inspection, before forwarding to the District Traffic Safety Systems Coordinator.

#### M3.08.05 Training

Prior to repairing or installing attenuators and end treatments, the crew(s) will meet to discuss the work to be completed, particularly the specific details on the device to be repaired or installed. It is recommended that the manufacturer's installation manual and checklist be reviewed as part of this pre-job meeting. Each manufacturer also offers "at will" online training for their MASH approved products. This pre-job meeting must be documented on a tailgate safety meeting form (either form 02-OM-0111 or form PM-S-0110), dated and signed by those in attendance. This form will be attached to and kept with the manufacturer's checklist if used.

All repairs on proprietary devices like end treatments and attenuators will be overseen by staff that has been trained by that manufacturer or employees who have had on the job training on the device. Training can be coordinated by the District Traffic Safety Systems Coordinator, the Division of Traffic Operations, or the Division of Maintenance. Some training may be conducted on an informal basis by the device manufacturers and will not be tracked in the Learning Management System (LMS). If the training is not documented in LMS, the crew supervisor shall keep records that detail the time and date of the training, who received the training, who gave the training, and what devices were reviewed during the training. A copy of these records shall also be given to the area superintendent.

The Division of Maintenance and Division of Safety Programs have developed training courses for all maintenance personnel that oversee the maintenance of safety devices, including but not limited to lead workers, supervisors, superintendents, and regional managers. These formal training courses are tracked in the Learning Management System (LMS).

#### M3.08.06 Material on Hand

The Region Managers and Area Superintendents should verify parts inventories to ensure needed parts are on hand and readily accessible for use.

The Division of Maintenance will work with the Maintenance Warehouse and Division of Procurement and Contracts to ensure that all devices can be acquired when needed. The Division of Maintenance will work with the Division of Traffic Operations to consolidate the list of approved items.

#### M3.08.07 On-Call Service Contract

All districts should have an on-call contract(s) in place to be able to repair guardrails, guardrail end treatments, median barriers, and crash cushions. These contracts will augment Caltrans forces so that necessary repairs are initiated and completed within the prescribed times in the

Maintenance Manual. The Division of Maintenance will have templates for these contracts. The contracts must be comprehensive and include all necessary labor, parts, and traffic control. Existing contracts should be amended to include all devices.

Documentation for service contract work is identical to the documentation for work performed by State forces. A check list for each end treatment repaired/replacement must be completed at the time of work by the contractor and the superintendent or contract manager. A copy of each check list must be forwarded to the District Traffic Safety Systems Coordinator. All sites must be inspected after work is complete. Beginning and completion inspections and contract cost on service contract work must be charged in IMMS on the appropriate repair activity. Work orders for inspections must be site and incident specific, with separate work orders for end treatments and the rest of the guardrail run.

For locations with a high-incidence of impacts to Traffic Safety Systems or Devices, Division of Maintenance will have emergency on-call contract language clause in future on-call contracts to perform permanent repair or replacement of safety devices within 48 hours of notification, when Maintenance personnel cannot immediately respond to high priority locations that have multiple collisions within a short period of time.

Criteria conditions for the use of emergency on-call contractors for high priority locations.

- History or expectation of multiple impacts per year.
- Sites that require short repair times or have repair time limitations, or sites that are difficult to access.
- Sites that require a ramp closure or lane closure to repair.
- Roadways with annual average daily traffic greater than 20,000 where repair activity is impacted by traffic.

#### M3.08.08 Alerts/Reminder Notification System for Traffic Safety Devices

An alerts/reminder system is being implemented in Integrated Maintenance Management System (IMMS) to send email notifications on overdue service requests or work orders related to Traffic Safety Devices repair/replacement.

Instructions and operation of the new alerts/reminder system is explained below:

#### **Service Request & Work Order Safety Device Alerts**

This new alert system will be based off safety device Service Requests (SR) and Work Orders (WO).

The SR alerts are specific to 4 SR Types:

- **ATTDMG** – SAFETY DEVICE ATTENUATOR DAMAGE
- **BARR** – BARRIER DAMAGE, K RAIL, JERSEY WALL, CABLE, THRIE BEAM, ETC.
- **GRAIL** – GUARDRAIL DAMAGE
- **GRETDMG** – SAFETY DEVICE GUARDRAIL END TREATMENT DAMAGE

When a SR for one of the 4 specified types is created and assigned to a supervisor, the clock will start based upon **SR Call Date**, not the date it was created. SRs with no action taken (no associated work order) will produce alerts sent via email on the following schedule:

- To: Supervisor (**CMS**) CC: Superintendent (**CMAS**) – at the time the SR is created
- To: **CMS**, CC: **CMAS** – on the **3rd** day indicating the SR is out of compliance **with no** WO associated
- To: **CMAS**, CC: **CMS** – on the **4th** day indicating the SR is out of compliance **with no** WO associated
- To: Region Manager (**RM**) CC: **CMAS**, **CMS** – on the **5th** day indicating the SR is out of compliance **with no** WO associated
- To: Deputy District Director Maintenance (**DDDM**) CC: **RM**, **CMAS**, **CMS** – on the **6th** day indicating the SR is out of compliance **with no** WO associated
- To: Headquarters Safety Device Program Manager (**HQ**) CC: **DDDM**, **RM**, **CMAS**, **CMS** – on the **7th** day indicating the SR is now **overdue**. Inspection was due [Call Date + 7 days]

**Note:** When a WO with the correct Activity is associated to the SR, the SR alerts will stop. There is a 1 to 1 correlation for the SR Type and WO Activity. You **must** create a work order with the correct activity as outlined below:

- SR Type: **ATDMG** = WO Activity: M80010 – REPAIR/REPLACE ATTENUATOR
- SR Type: **BARR** = WO Activity: M70010 – REPAIR/REPLACE BARRIERS
- SR Type: **GRAIL** = WO Activity: M60010 – REPAIR/REPLACE GUARDRAILS
- SR Type: **GRETDMG** = WO Activity: M61010 – REPAIR/REPLACE GUARDRAIL END TREATMENTS

Once the SR alerts stop due to a WO being associated to the SR, the WO alerts will pick up from there. The WO alerts timing is **still** based on the **SR Call Date**.

Repairs for Guardrail End Treatments and Attenuators are to be completed within **14 days**. WOs that are **not completed** will receive alerts on the following schedule:

- To: **CMS** CC: **CMAS** – on the **3rd** day indicating the WO is not completed
- To: **CMAS** CC: **CMS** – on the **6th** day indicating the WO is not completed
- To: **RM** CC: **CMAS**, **CMS** – on the **9th** day indicating the WO is not completed
- To: **DDDM** CC: **RM**, **CMAS**, **CMS** – on the **12th** day indicating the WO is not completed
- To: **HQ** CC: **DDDM**, **RM**, **CMAS**, **CMS** – on the **14th** day indicating the WO is now out of compliance. Repairs were due [SR Call Date + 14 days]

Repairs for **Guardrail** and **Barriers** are to be completed within **30 days**. WOs that are **not completed** will receive alerts on the following schedule:

- To: **CMAS** CC: **CMS** – on the **10th** day indicating the WO is not completed
- To: **RM** CC: **CMAS**, **CMS** – on the **24th** day indicating the WO is not completed
- To: **DDDM** CC: **RM**, **CMAS**, **CMS** – on the **28th** day indicating the WO is not completed
- To: **HQ** CC: **DDDM**, **RM**, **CMAS**, **CMS** – on the **30th** day indicating the WO is now out of compliance. Repairs were due [SR Call Date + 30 days]

**Note:** The WO alerts can be put on hold for just cause (such as parts not available, etc.). This action can **only** be performed by a Region Manager or District IMMS Coordinator and is accomplished by inserting a Log Type “RMHOLD – REGION MANAGER HOLD” on the Log tab of the WO. The log **must** contain comments and can be created for a **maximum** of **180 days**.

After closing the WO, alerts will stop if all business rules have been followed and the correct activities are assigned to the correct SR's.

All calculations of “**days**” are performed in “**business days**” Monday-Friday with the exclusion of holidays.

**Example 1:** SR call date is on a Friday and SR is created Friday, followed by a holiday on Monday. Tuesday is day 1.

**Example 2:** SR call date is on Monday; SR is created Thursday. Thursday is day 3. This would trigger two email alerts.









**APPENDIX M3**

Traffic Safety Devices

Fact Sheets

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<i>Traffic Safety Devices</i>			
<b>Conditio</b>	<b>Example</b>	<b>Description</b>	<b>Maintenance Actions</b>
Pass		<ul style="list-style-type: none"> <li>• Proper end treatment.</li> </ul>	<ul style="list-style-type: none"> <li>• The guardrail end treatment is in line with roadway, at proper height, rail straight, bolts and nuts are tightened and not missing.</li> <li>• No Action needed, continue to monitor.</li> </ul>
Need 1		<ul style="list-style-type: none"> <li>• Washers on the face of guardrail. It affects the integrity of the guardrail system.</li> </ul>	<ul style="list-style-type: none"> <li>• All washers shall be removed and repair minor damage guardrails except for the transitions to bridge rails (see applicable Standard Plans).</li> <li>• Need 1, shall be schedule for repairs.</li> </ul>
Need 2		<ul style="list-style-type: none"> <li>• Complete damage to end treatment.</li> </ul>	<ul style="list-style-type: none"> <li>• All non-approved end treatments must be immediately referred to the District Traffic Safety System Coordinator. Approved end treatments shall be repaired or replace in-kind within fourteen business days</li> <li>• Need 2, shall take immediate action.</li> </ul>

<i>Traffic Safety Devices - continued</i>			
<b>Condition</b>	<b>Example</b>	<b>Description</b>	<b>Maintenance Actions</b>
Pass		<ul style="list-style-type: none"> <li>• Proper Guardrail.</li> </ul>	<ul style="list-style-type: none"> <li>• Guardrail is up to standard plans, the 31 inches Midwest Guardrail System (MGS) no missing nuts and bolts, rail is straight.</li> <li>• No Action needed, continue to monitor.</li> </ul>
Need 1		<ul style="list-style-type: none"> <li>• Block out of alignment with post</li> </ul>	<ul style="list-style-type: none"> <li>• Post and block should be parallel, and tack with nails to keep block parallel with post.</li> <li>• Need 1, shall be schedule for repairs.</li> </ul>
Need 2		<ul style="list-style-type: none"> <li>• Torn guardrail.</li> </ul>	<ul style="list-style-type: none"> <li>• Torn rail shall be replaced immediately, to ensure structural and functional integrity.</li> <li>• Need 2, shall take immediate action.</li> </ul>