



Highway Attachment 16 – Caltrans Maintenance Manual Volume 1, Section 3

HWY18FH011

(18 pages)

Section 3 – Safety Devices (Family Problems M6, M7, M8, & M9)

M3.00 Introduction

Safety devices are provided and maintained for the protection and guidance of traffic.

This section includes work in the following Family/Problem areas:

- M5 Roadside Delineator Post
- M6 Guardrail
- M7 Median Barrier
- M8 Vehicle Energy Attenuators (energy dissipaters)
- M9 Out of Control Vehicle Ramps (portion)

Unsatisfactory performance or problems with maintenance of traffic safety devices should be reported to the Division of Maintenance.

Refer to Maintenance Manual Volume 2, for planning, scheduling and administrative procedures connected with the “M” Family.

The following section (M3.01) discusses maintenance levels applicable to work in the “M” Family. Sections M3.02 and M3.03 describe the proper use and general guidelines for the various devices, and discuss installation and maintenance details and checklists.

M3.01 Levels 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. Levels 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 Maintenance Manual Volume 2 for budgeting purposes. Levels may vary depending on overall appropriation of funds by the Legislature.

M3.01.1 Guardrail

Guardrail should be routinely observed for deficiencies. 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 current Standard Plans.

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 the Maintenance Manual Volume 2. Any remaining adjustments to line and grade should be done, when conditions permit, in conjunction with other repair work.

Rail that has previously been painted for delineation should be washed or repainted as needed.

Washing and painting of unpainted rail is not required. End caps on the downstream ends of guardrail adjacent to one way roadways should not be replaced when damaged.

M3.01.2 Median Barriers

For removable panels of glare screen that are missing, or damaged, contact the District Traffic Safety Device 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) Cable Barrier

- (1) The effectiveness of cable barrier is extremely sensitive to the height of the cable.

Make periodic surveillance for structural integrity, height, and alignment.
- (2) When damaged, temporary repairs should be made promptly by propping up the cable to the height of the adjacent cable and cutting off posts that may be considered an obstacle to traffic.

- (3) Damaged posts should be scheduled for replacement at the earliest practical time.

Posts replaced in sleeves in the foundation may be back filled with concrete sand in lieu of paving asphalt.

- (4) 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.
- (5) Reflectors on cable median barrier will not be maintained when the median edge is delineated by striping and/or raised pavement markers.
- (6) Questions concerning the maintenance of cable median barrier not covered here should be referred to the Division of Traffic Operations Liaison.

(C) Concrete Barrier

- (1) Concrete median barriers generally require little maintenance. Surveillance is necessary to ensure prompt repair when the barrier is broken or pre-cast units are toppled over or knocked out of line.
- (2) Concrete barriers 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.

M3.01.3 Crash Cushions

Crash cushions, also known as impact energy attenuators, are intended to protect the motorist from the consequences of collision with a 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.

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 action and impair the functioning of these devices and presents an unsightly appearance.

M3.01.4 Roadside Delineation Posts

Roadside delineation posts should be maintained in an upright position, facing traffic and with reflectors clear of material that obscures them. Any markers or reflectors that are damaged or missing should be replaced to meet current standards. Post mile information (Rte-Co-P.M.) shall not be placed on markers that are not part of the post mile system. Flexible posts are the standard, however metal posts may be used as needed to accommodate driving posts in hard or rocky soil.

M3.01.5 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, or MBMB) are broken or out of alignment with original position by more than 12 inches horizontally.
- Metal sections (MBGR, MBMB, and Thrie) 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 cushions 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 Devices Coordinator in District Traffic Operations to have the location evaluated by an engineer.

M3.02 Uses and General Guidelines

M3.02.1 Guardrail

Guardrail is a safety barrier installed on State highways to reduce the combined effect of severity and frequency of "runoff the road" 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 barrier 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 Department of Transportation Standard Plans. Any deviation to install, delete, or modify must be by prior approval of District Traffic Operations.

The approach ends of most guardrail end treatments are usually turned away from approaching traffic to minimize the probability of an end on collision, depending on the end treatment used. Both ends of guardrail installations are anchored to prevent failure of short sections of guardrail and minimize "pocketing" during a collision.

End caps 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 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 breakaway guardrail terminal is to be made by installing the current standard breakaway terminal as shown in the latest edition of the Standard Plans. Contact the District Traffic Safety Device Coordinators, Headquarters Division of Maintenance, or Headquarters Traffic Operations Liaisons for more information.

- (A) The following guidelines should be used when replacing damaged guardrail:
 - (1) Metal plate (Tuthill) guardrail is no longer appropriate for use on the State highway system. Damaged sections shall be replaced with standard guardrail.

- (2) In all cases when nonstandard guardrail is damaged to the extent that a section or sections must be replaced, District Maintenance will immediately advise District Traffic Operations, and corrective work will be initiated based upon their recommendations. Mixtures of old and new types of guardrail in a run should be avoided.
 - (3) When upgrading guardrail, current standards will apply as to post size and spacing, rail elements, anchorage and positioning. District Traffic Operations personnel will furnish Maintenance forces with the necessary guardrail design information.
- (B) Charges for replacement upgrading of damaged guardrail 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 blanket type improvement E-FIS Project Code to fund this type of work. When possible, upgrading of guardrail should be accomplished by contract.
 - (4)

M3.02.2 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. Although not part of the initial design, it may also prevent the deflection of a vehicle colliding with the barrier back into traffic stream, and decelerate the errant vehicle within tolerable limits. Concrete Type 60 and metal Thrie beam are the most common types of median barriers. Cable systems and W-beam (looks like guardrail, but referred to as metal beam median barrier MBMB) have also been used in median barriers.

See California 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.

(B) Metal Beam Barrier

The top of metal beam median barrier is 30 inches above the ground beneath the rail.

The top of the posts are level with the top of the rail element. The blocks extend approximately 1 inch above the top of the posts and rail elements.

(C) Cable Barrier

Emergency openings in cable barrier must be secured after use. Failure to do so reduces the effectiveness of a substantial length of cable barrier.

Research indicates that consolidated sand is a satisfactory filler material in lieu of asphalt for use in cable barrier post footing sockets. As a result, dry, clean, commercial quality concrete sand may be used as an alternative filler material in "Type B" cable barrier footings. The sand should be consolidated and compacted in the post socket by a minimum of 25 hammer blows to each side of the post.

Questions concerning the maintenance of cable barrier should be referred to the Division of Traffic Operations Liaison.

(D) Concrete 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 Standard Plans indicate the location and amount of steel reinforcement in the barrier. The Type 60 single slope concrete median barrier is the current standard and is being installed throughout the State.

The standard height for the Type 60 barrier is 36 inches, although 32 inch and 56-inch tall barriers may be installed as field conditions dictate. Check the latest Standard Plans for complete details and clarification.

M3.02.3 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 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 water filled plastic tube, and lightweight crushable canister attenuators use overlapping fender panels along the sides of the assembly. These systems are held in position by anchor cables 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 ft. in diameter by 3 ft. 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, is capable of exerting 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. Laboratory tests have shown that sand filled crash cushions will function correctly when "Energite", "Traffix" and "Fitch" sand barrels are mixed, as long as the array position and sand weight are maintained.
4. 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.

M3.02.4 Roadside Markers

Roadside markers comprise the various permanent devices, excluding signs, used off the traveled way to guide the motorist and warn of restricted width and/or identify or mark locations along the highway. Instructions for use of roadside delineators, object markers, and channelizers are included in Part 3 of the California MUTCD.

- (A) Flexible delineators will generally be used for maintenance replacements unless the following conditions are met:
 - (1) Where it is necessary to attach snow poles to posts.

- (2) In rocky areas or hard ground where steel posts have some advantage in driving.

Consideration may be given to the possibility for using a two part, metal base and flexible post system in these areas.

- (3) In protected areas where posts are not exposed to traffic (such as behind guardrails and in front of structures).
- (4) When there is a need to support post mile markers.

Decisions regarding locations on existing roads which warrant the use of flexible delineator posts shall be the responsibility of District Maintenance in consultation with District Traffic Operations. Circumstances of weather, snow removal, difficulty of installation or other special needs will dictate when metal markers are required.

Any widespread district program to upgrade undamaged installations to provide uniformity of appearance is considered "improvement work" and cannot be done using Maintenance funds.

Replacement and salvage of guide markers in good condition is not generally cost effective. An exception may be considered where, after knocked down markers have been replaced, the remaining metal guide markers in good condition on a particular ramp or curve represent 25 percent or less of the total number of delineator posts. In this case, replacement of the remaining metal markers for the sake of uniform delineation treatment may be considered.

Excess markers are a needless expense to install and maintain and should be avoided whenever possible. However, except for culvert markers and clean out markers used by Maintenance, all markers on the system should be maintained unless directed otherwise by the District Traffic Operations.

(B) Delineators

Attention is directed to Standard Plan A73C and Figures 3D-101 through 3D-105 of the CA Supplement. The purpose of delineators is to indicate the roadway alignment and to accent critical locations. Delineators should not be used for other purposes. The practice of using them to mark drainage structures, pull boxes, underground utilities, etc. should be discontinued.

All delineators shall be retroreflectorized. Retroreflective sheeting shall have a minimum dimension of 3 inches in width and 12 inches in height.

Uniformity of type, color, and positioning of reflectors to delineate the roadway is essential. All proposed deviations from the patterns shown in the California MUTCD should be cleared by District Traffic Operations.

The overall line of delineators should parallel the roadway centerline as closely as possible. When possible, delineators should be placed 2- ft. outside the edge of the usable shoulder but not more than 12-ft. from the pavement edge. In curbed sections, the markers will be placed 2- ft. outside the face of the curb.

(C) Clearance Markers

Attention is directed to Standard Plan A73B and Figure 3C-101 of the CA Supplement. Clearance markers are used to indicate obstructions or restrictions in width to the right of traffic, including bridge and culvert rails. They should be placed for all major obstructions in the plane of the roadway and within 4-ft. of the edge of shoulder. On divided highways, clearance markers are also used to the left of traffic for the same purpose. All clearance markers are retroreflectorized for night visibility.

Clearance marker posts are placed on a line with the edge of the obstruction nearest to the pavement. When placed in conjunction with guardrail on bridge approaches, the clearance markers are located immediately behind the guardrail and at sufficient height to make all reflectors visible to approaching traffic.

(D) Culvert Markers

Attention is directed to Chapter 3D of the CA Supplement in section entitled “Culvert Markers.” Culvert markers are placed as a convenience to Maintenance crews in marking locations of culvert openings. Such marking is sometimes necessary to protect culvert ends from damage from adjacent operations as well as to serve as an aid in locating culverts during storm conditions.

Most culverts can be located without the use of markers and in such cases, and if protection is not needed, markers need not be used. When culverts are difficult to locate, markers may be placed on each side of the roadbed, above the culvert. They may be placed either outside or in line with a series of markers.

Culvert markers should not be retroreflectorized except where the marker is well off the traveled way and locating the culvert could be a problem during hours of darkness. The possibility that the culvert marker might be mistaken for a road delineator should be avoided.

Culvert markers are not part of the post mile system for identifying locations and post mile markings (Rte.-Co.-P.M.) are not to be stenciled on replacement culvert markers. If needed for Maintenance identification of a particular culvert, crews should stencil only the numerical value of the post mile (not route and county) on new or replacement markers.

Removal of excess culvert markers may be done at any time as part of routine Maintenance operations. Revision of existing markers to eliminate retroreflectorization and post mile markings, should be performed whenever the marker requires replacement for other purposes.

(E) Emergency Crossover Markers

Attention is directed to Chapter 3D of the CA Supplement in section entitled "Emergency Passageway Marker." Markings for abandoned or obliterated crossovers should be removed.

Use of fencing and or gates at crossover locations to prevent unauthorized use is strongly discouraged, except in the most unusual circumstances. Acceptable locations for the establishment of gated crossovers would be for use for incident management detours or snow removal operations.

(F) Post Mile Markers

Attention is directed to Standard Plan A73B for Highway Post Marker. The post mile marker is an integral part of the post mile system, and is used by traffic officers, Maintenance personnel, and others to locate specific incidents or features on the roadway with respect to the post mile system. Post mile markers should not be used for additional marker functions, and other type markers should not be used as post mile markers. The post mile marker shall indicate the route, county, and post mile of the installation; only post mile markers shall contain the route and county designation.

The lettering size shall be 2½ inch letters for county, route and post mile fraction (hundredths). The post mile numerals shall be 4-inches in height.

Post mile markers shall not be retroreflectorized. When installed behind guardrail, the marker should be placed so that the entire legend is readable from the road.

Stenciling of the post mile on concrete median barriers is permissible in addition to, but not in place of, the regular post mile markers located along the outer shoulder. This is an additional aid for Maintenance and accident investigation forces.

District Traffic Operations shall have the responsibility to verify the accuracy of the placement of post mile markers. All post mile markers should be located to an accuracy of 50 ft. (0.01 mile) on the ground. The value shown on the marker shall be to the nearest 0.01 of a mile, and shall reflect the mile point of the centerline opposite the marker location. If any are found to be more than +/- 0.01 mile from the intended location, they must be relocated.

Periodic field review and inspection should be conducted to locate damaged or illegible markers. Reports of incorrect post mile markers may originate from various sources.

The District Traffic Operations and the Roadway Records unit of Headquarters Division of Traffic Operations must be in agreement as to which field markers will be corrected and which accident records will be relocated before any action is initiated. Care must be taken in replacing damaged markers to assure that the new marker is installed in the same place as the old marker.

(G) Miscellaneous Markers

Roadside markers are sometimes used to mark the location of pull boxes, survey monuments, water line crossings, etc. Where such items are readily visible or can be found easily, marker posts should not be installed. These markers shall not be retroreflectorized. When placed adjacent to the shoulder, the markers should face approaching traffic.

M3.03 Installation/Maintenance Details and Checklists

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

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.

M3.03.1 Metal Beam Guardrail, Thrie and Metal Beam Median Barriers

- (A) Check the plans. Know what the design requires.
- (B) The 6-inch side of 6-inch x 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. The Standard Plans contain some alternatives. Others may be obtained through the Construction Division or District Traffic Operations.

(D) All rail laps should be in the direction of traffic adjacent to the rail.

(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 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. This is especially important where there is pedestrian or bicycle traffic behind the barrier. Excessive bolt length on beam barrier 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.

(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 ¾ inches for metal beam guardrail and 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.

(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 no obvious 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.

(K) Concrete anchors and footings should be built according to dimension shown in the plans. Undersized footings, where soil has caved into the hole before concrete was placed, have been torn out of the ground by impacting vehicles.

- (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. These modifications are made to provide additional lateral support to the posts. Be alert in recognizing these installations 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) Where there is a problem, or if something is not clear, ask questions. If you observe something that does not work the way it should, either in building it, maintaining it, or in expected performance, seek help through your district or Headquarters office.
- (P) Guardrail and barriers do not prevent accidents; they lessen the severity of collision when installed at justified locations.

M3.03.2 Sand Filled Impact Energy Attenuators (Crash Cushions)

- (A) Check the plans. Know what the installation requires.
- (B) Read manufacturer's installation instructions. Changes can occur. There are differences in manufacturer's designs.
- (C) Don't install barrels on soft ground or AC that is not compacted. The barrels will sink in unevenly, distorting the barrel and eventually leading to failure.
- (D) Open bottom (Fitch) barrels should not be installed on bare ground. Rodents can burrow underneath and into the barrel. An AC pad may prevent this. Also, water can more readily soften the ground under such barrels leading to its eventual failure.
- (E) Barrels should not hang over curbs on raised gore surfaces.
- (F) Weight of sand should be painted on pavement under or beside the barrel. This makes repairs easier.
- (G) 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.

- (H) 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.
- (I) 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.
- (J) 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.
- (K) Check the amount of sand in all barrels. Weights should conform to those shown on the plans.
- (L) 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.
- (M) If something is not understood or if you have questions, be sure to ask. Contact the Division of Maintenance or Division of Traffic Operations for questions.
- (N) All approved sand barrels (Energite, Fitch, and Traffix) 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.

M3.04 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.012