

# Resource Charts

FEDERAL HIGHWAY ADMINISTRATION

ROADWAY DEPARTURE TECHNOLOGY TRANSFER

February 1, 2015

## *Purpose*

These charts were developed by KLS Engineering, LLC under the FHWA Contract, DTFH61-10-D-00021, Roadside Safety Systems Inspectors/Maintenance and Designers Mentor Program. The charts feature current safety systems that are eligible for reimbursement under the Federal-Aid Highway Program.

These charts were developed to be used by field and design personnel as a resource or a quick guide in the selection and identification of various systems. The information varies depending on the system and includes Type of System, Performance Characteristics, Distinguishing Characteristics, Test Level, Manufacturer and a link to the Manufacturer's website.

The information on these charts was extracted from the FHWA Eligibility Letters, AASHTO Roadside Design Guide, 2011 and the manufacturer's website. Each of these products or systems was reviewed by FHWA for uniformity and consistency and is not intended to be used as a marketing tool, but to provide the user with basic information at a glance. It is strongly recommended to contact the Manufacturer for more complete detailed product information not provided in this resource. Each chart was also reviewed by the individual Manufacturer to ensure accuracy.

Safety Systems include:

- Work Zone Barrier – Steel (February 1, 2015)
- Aesthetic Barriers (Revised November, 2013)
- Cast-In-Place Concrete Barriers (April 23, 2013)
- Roadside Post and Beam Rail Element (February 2013)
- Roadside Terminals (Revised November 2013)
- Median Terminals (September 2012)
- Crash Cushions (Revised November 2013)
- Cable Barriers (September 2012)

FHWA is currently developing these additional charts:

- Work Zone Barriers – Plastics and Portable Concrete
- Median Post and Rail Element Barriers






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# Work Zone Barrier - Steel

| NAME/MANUFACTURER   | ILLUSTRATION   | TEST LEVEL       |      | SECTION DETAILS  | ANCHORAGE DETAILS   | DISTINGUISHING CHARACTERISTICS  |
|---|--|------------------|------|--|---|---|
|   |  | NCHRP 350        | MASH |  |   |   |
| <b>Vulcan Barrier (B134, A, C, D)</b><br><br>Energy Absorption Systems, Inc.<br><br><a href="http://www.energyabsorption.com/products/PI%20Sheets/Vulcan.pdf">http://www.energyabsorption.com/products/PI%20Sheets/Vulcan.pdf</a> |    | TL-3, TL-4       |      | <u>Section Dimensions:</u><br>Height: 2'-8"<br>Width: 1'-9"<br>4M: Length: 13'-6", Weight: 871 lbs.<br>12M: Length: 38'-6", Weight: 2243 lbs.<br><br><u>Section Connections:</u><br>ASTM A53 Steel pins. | <u>Foundation Type:</u><br>Asphalt and Concrete<br><br><u>Unanchored Installation:</u><br>Must have a minimum of 236' of barrier in advance of the BLON and 236' of barrier at the trailing end of the system.<br><br>BLON (TL-3): At the 24th section (4M Sections)<br>Dynamic Deflection: 13.12'; Test Length: 243'<br><br><u>Anchored Installation:</u><br>Anchor feet installed on the traffic side of the Vulcan.<br>Dynamic Deflection (TL-3): 6.89'; Test Length: 189' (4M Sections)<br>Dynamic Deflection (TL-4): 7.87'; Test Length: 231.3' (4M or 12M Sections Acceptable)<br><br><u>Limited Deflection:</u><br>12M Vulcan Barrier and Vulcan Barrier Anchor System (VAS). The VAS is a steel strap that is placed every 13.1' to reduce deflection.<br>Dynamic Deflection (TL-3): 3" (base), 12" (top); Test Length: 157'. | Consist of standard Thrie-beam guardrail panels at the top and sheet metal rub rails at the bottom.<br><br>5 steel bulkhead tie the sides of the Vulcan together.<br><br>End bulkheads has vertically aligned holes for pinning segments together.<br><br>Center bulkhead incorporates a lifting tabs for assembly and transport.<br><br>A stiffener plate runs the length of the segment.<br><br>For straight section installation an optional steel spacer can be installed to reduce lateral deflection. |
| <b>Vulcan Barrier Transition (B134C - 2007)</b><br><br>Vulcan to GuardGuard CZ  |  | TL-3             |      | <u>Transition Dimensions:</u><br>Height: 2'-7.4"<br>Length: 6'-8"<br>Width: variable   | <u>Foundation Type:</u><br>Asphalt and Concrete<br><br><u>Anchored Installation:</u><br>4 Sections pinned to a Crash Cushion end anchorage.<br><br>Dynamic Deflection: 2'-4"  | Transition incorporates a lower steel mounting plate with twelve mounting holes for anchoring transition to a rigid foundation.   |
| <b>Vulcan Gate System (B201)</b>  |  | TL-2, TL-3, TL-4 |      | <u>Section Dimensions:</u><br>Height: 2'-8"<br>Width: 1'-9.5"<br>Weight: 1080 lbs.<br>Min. Installation Length: 30 ft.<br>Max. Installation Length: Unlimited.   | <u>Unanchored Hinge</u><br>Connected to the end transitions and the Vulcan.<br><br>4" diameter steel pins   | Consists of two steel transitions, two hinges and at least one section length of Vulcan Steel Barrier (either 13.5 ft or 40 ft) equipped with wheels and jacks.   |

RELATED SYSTEMS






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# Work Zone Barrier - Steel

| NAME/MANUFACTURER   | ILLUSTRATION   | TEST LEVEL |      | SECTION DETAILS   | ANCHORAGE DETAILS   | DISTINGUISHING CHARACTERISTICS   |
|---|--|------------|------|---|---|--|
|   |  | NCHRP 350  | MASH |   |   |  |
| <p><b>BarrierGuard 800 (B131, B158)</b></p> <p>Highway Care, USA</p> <p><a href="http://www.highwaycareusa.com/traffic.php?page=barrierguard800">http://www.highwaycareusa.com/traffic.php?page=barrierguard800</a></p> |    | TL-3, TL-4 |      | <p><u>Section Dimensions:</u></p> <p>Height: 2'-7.5"</p> <p>Width: 1'-10" (base), 9" (top)</p> <p>Length: 19.7', Weight: 1,182 lbs.</p> <p>Length: 39.4', Weight: 2,381 lbs.</p> <p><u>Section Connections:</u></p> <p>Quick-link Connection</p> <p><u>Section Dimensions w T-top:</u></p> <p>Height: 3'-1/16"</p> <p>Width: 1'-10" (base), 1'-7" (top)</p> <p>Length: 19.7', Weight: 1,800 lbs.</p> <p>Length: 39.4', Weight: 3,600 lbs.</p> | <p><u>Foundation Type:</u></p> <p>Asphalt</p> <p><u>Standard Anchored Installation:</u></p> <p>Anchored each end with 8 threaded steel rods (4 rods at each end anchor location) and 4 threaded rods (2 at each anchor location) 19.7 ft from terminal end.</p> <p>Dynamic Deflection (TL-4): 4.9'; Test Length: 236'</p> <p><u>Minimum Deflection System:</u></p> <p>Barrier is anchored every 20 ft. with either joint anchors or intermediate anchors.</p> <p>Barrier is fitted with a T-top attachment to aid in the redirection and stability of the vehicle after impact.</p> <p>Dynamic Deflection (TL-3): 12"(top), 3"(base); Test Length: 157'</p> | <p>BarrierGuard 800 has a "step profile" face, which begins 10" above the ground.</p>  |
| <p><b>BarrierGuard 800 Gate (B159)</b></p>  |   | TL-3       |      | <p><u>Section Dimensions:</u></p> <p>Height: 2'-7.5"</p> <p>Width: 1'-10" (base), 1'-7" (top)</p> <p>Length: 20' (min), 40'(max)</p>  | <p><u>Anchor Installation:</u></p> <p>Two types: asphalt anchors (upstream end) and soil anchors (downstream end) of test installation.</p> <p>Gate install is anchored.</p> <p>Dynamic Deflection: 3.81'; Test Length: 256'.</p>   | <p>BarrierGuard Gate can be unpinned and swung open from either end to allow vehicle or pedestrian passage.</p> <p>The gate is positioned between two (20 ft) gate post connecting systems, making a total length of the basic gate system 60 ft. Larger gate sections in 20 ft increments are available.</p> <p>Standard 20' or 40' section of BarrierGuard can be inserted into the center section of gate.</p>                  |
| <p><b>BarrierGuard 800 Variable Length (B160)</b></p>   |  | TL-3       |      | <p><u>Section Dimensions:</u></p> <p>Height: 2'-7.5"</p> <p>Width: 1'-10" (base), 9" (top)</p> <p>Length: 5'-3" (nominal)</p>   | <p><u>Unanchored Installation:</u></p> <p>No anchors within 20 ft of the either end of units.</p> <p>T-top attachment should be used for 39.4' on either side of the BGVLB and terminate with a 9.85' transition section.</p>   | <p>The Variable Length Barrier (VLB) is designed to provide clearance and flexibility for expansion joints on bridges, overpasses, and roadways.</p> <p>It allows movement of up to 7" expansion and 7" contraction for a total 14" slow relative movement for conditions such as thermal expansion/contraction, bridge joint movement, etc., but hydraulically locks when the movement is fast, such as an impacting vehicle.</p> |

RELATED SYSTEMS



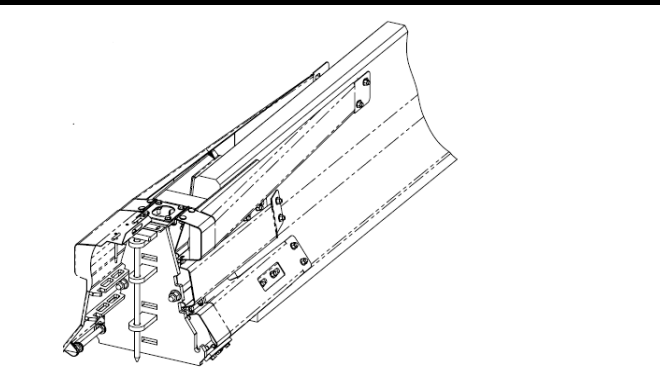


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## Work Zone Barrier - Steel

| NAME/MANUFACTURER  | ILLUSTRATION   | TEST LEVEL |      | SECTION DETAILS  | ANCHORAGE DETAILS   | DISTINGUISHING CHARACTERISTICS  |
|--|--|------------|------|--|---|---|
|  |  | NCHRP 350  | MASH |  |   |   |
| <b>ArmorGuard™ Barrier (B108)</b><br>(formerly named SafeGuard Link System)<br><br>Lindsay Transportation Solutions<br><br><a href="http://www.barriersystemsinc.com/movable-workzone-barrier">http://www.barriersystemsinc.com/movable-workzone-barrier</a> |    | TL-2, TL-3 |      | <u>Section Dimensions:</u><br>Height: 2'-9"<br>Width: 2'-4" (base), 1'-8" (top)<br>Length: 28'<br>Weight: 3,362 lbs.<br><u>Section Connections:</u><br>The barrier sections are pinned together with a hinge and pin assembly. | The ArmorGuard Barrier is designed to be a portable freestanding longitudinal barrier. Multiple barriers can be pinned together to form on continuous run of barriers or the barrier can be used as a gate between openings in both permanent or temporary concrete barrier.<br><br><u>TL-2 Condition:</u><br>BLON: At 4th Section (112 ft)<br>Dynamic Deflection: 3.41'; Test length: 223'.<br><br><u>TL-3 Condition:</u><br>BLON: At 8th Section (224 ft)<br>Dynamic Deflection: 6.3'; Test length: 223'. | The ArmorGuard Barrier is designed for short term durations work zones. The barrier sections are easily raised and lowered manually or with optional compressed air. Sections can be moved, by hand, a forklift or pickup truck. Sections can also be attached or joined to create controlled access gates. |
| <b>SafeGuard Gate System (B87)</b>   |   | TL-3       |      | <u>Section Dimensions:</u><br>Height: 2'-9"<br>Width: 2'-4" (base), 1'-8" (top)<br>Length: 13.12'<br>Weight: 1488 lbs.<br><u>Section Connections:</u><br>Hinge assembly.   | The ArmorGuard Barrier Gate attaches to concrete barrier with the use of a special transition section.  | The ArmorGuard Barrier Gate is designed to be used between openings in both permanent or temporary concrete barrier to create controlled access gates.  |
| <b>Alternative Universal Transition (B173)</b>   |  | TL-3       |      | <u>Section Dimensions:</u><br>Height: 2'-8"<br>Width: 2'-4" (base), 1'-8" (top)<br>Length: 3'-4" (base), 7'-1" (top)   | There are two types of transitions, temporary and permanent. For short term projects, temporary transitions do not require anchoring to a foundation only to the concrete barrier that is it being attached to. For permanent applications, the permanent transitions require anchoring to a foundation and barrier.  | The transitions are designed to fit standard New Jersey style barrier. For alternate barrier types please contact manufacturer.   |

RELATED SYSTEMS





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## Work Zone Barrier - Steel

| NAME/MANUFACTURER  | ILLUSTRATION  | TEST LEVEL  |      | SECTION DETAILS  | ANCHORAGE DETAILS   | DISTINGUISHING CHARACTERISTICS  |
|--|---|---|------|--|---|---|
|  |   | NCHRP 350   | MASH |  |   |   |
| <p><b>Armorflex ORION™ (B217)</b></p> <p>Lindsay Transportation Solutions</p> <p><a href="http://www.barriersystemsinc.com/orion-portable-steel-barrier">http://www.barriersystemsinc.com/orion-portable-steel-barrier</a></p> |   | TL-3  |      | <p><u>Section Dimensions:</u></p> <p>Height: 2'-10"</p> <p>Width: 1'-6" (effective), 2' (total)</p> <p>Length: 39'-2"</p> <p>Weight: 1985 lbs.</p> <p><u>Section Connections:</u></p> <p>Twin-pin steel connectors</p>   | <p><u>Foundation Type:</u></p> <p>Asphalt or Concrete</p> <p>Hold-down Pins: Threaded rods epoxied in place.</p> <p><u>Standard Anchored Installation:</u></p> <p>Barrier end segments anchored using eight (8) hold-down pins at each end segment.</p> <p>Dynamic Deflection: 6.07'; Test Length: 161.7'</p> <p><u>Low Deflection Anchored Installation:</u></p> <p>First and last barrier segments anchored using eight (8) hold down pins. Additionally, barrier should be anchored every 12.5 ft. on the traffic face only.</p> <p>Dynamic Deflection: 3.15'; Test Length: 154'</p> | <p>The Orion Steel Barrier consists of a standard 8-space three-beam guardrail and standard w-beam guardrail connected to internal bulkheads using standard guardrail splice bolts. The internal bulkhead (framework) are unique to the Orion and can be obtained separately.</p> |
| <p><b>MDS Temporary Barrier (B165)</b></p> <p>MDS, LLC</p> <p><a href="http://mds.roadsafellc.com">http://mds.roadsafellc.com</a></p>  |  | TL-4 (EN1317 test TB51),<br>TL-5 (EN1317 test TB81) |      | <p><u>Section Dimensions:</u></p> <p>Height: 4.04' (TL-4), 5.22' (TL-5)</p> <p>Width: 1.60' (TL-4, TL-5)</p> <p>Length: 19.7' (TL-4, TL-5)</p> <p>Weight: 1023 lbs. (TL-4); 1594 lbs. (TL-5)</p> <p><u>Section Connections:</u></p> <p>Panel hinges.</p> <p>Base plates.</p> | <p><u>Foundation Type:</u></p> <p>Concrete</p> <p><u>Anchored:</u></p> <p>Base plate is attached to the deck using four anchor bolts.</p> <p>Anchor bolts can be drilled through the deck or epoxied into the deck.</p> <p>Dynamic Deflection (TL-4): 1.62' ; Test Length: 19.7'</p> <p>Dynamic Deflection (TL-5): 1.38'; Test Length: 19.7'</p>  | <p>Barrier has a unique sliding base assembly that is bolted directly to the bridge deck.</p>   |






## Work Zone Barrier - Steel




| NAME/MANUFACTURER      | ILLUSTRATION  | TEST LEVEL |      | SECTION DETAILS   | ANCHORAGE DETAILS  | DISTINGUISHING CHARACTERISTICS   |
|------------------------|---|------------|------|---|--|--|
|                        |   | NCHRP 350  | MASH |   |  |  |
| <b>RELATED SYSTEMS</b> | <p><b>ZoneGuard (B176, B176A)</b></p> <p>Hill and Smith, Inc.</p> <p><a href="http://hshighway.com/products/zoneguard">http://hshighway.com/products/zoneguard</a></p>  | TL-3, TL-4 | TL-3 | <p><u>Section Dimensions:</u></p> <p>Height: 2'-8"</p> <p>Width: 2'-3-9/16" (base), 6 3/16" (top)</p> <p>Length: 50'</p> <p>Weight: 3,097 lbs.</p> <p><u>Section Connections:</u></p> <p>Speed Joints: The end of each section slides over the other and are connected together and are held together via a latching mechanism.</p> | <p><u>Foundation Type:</u></p> <p>Concrete</p> <p><u>Standard Anchored Installation:</u></p> <p>First and last sections anchored at 1.64' and 16.67' (4 anchors steel rods)</p> <p>Dynamic Deflection (TL-3, 350): 6' (Top), 5.44' (Base), ; Test Length: 250'</p> <p>Dynamic Deflection (TL-3, MASH): 6.33' (Top), 6.17' (Base); Test Length: 250'</p> <p>Dynamic Deflection (TL-4, 350): 4.75' (Top), 4.17' (Base); Test Length: 250'</p> <p><u>Minimum Deflection Installation:</u></p> <p>First and last sections anchored at 1.64' and 16.67' (4 anchors</p> <p>Dynamic Deflection (TL-3, 350): 12" (Top), 2" (Base); Test Length: 250'</p> <p>Dynamic Deflection (TL-3 MASH): 16" (Top), 5"(Base); Test Length: 250'</p> | <p>Comprises of eight-gauge, (0.165 in thick) galvanized steel panels.</p> <p>Each section has a 0.5 ft wide step on each side just above surface level, which slopes upward to meet the upper beam section.</p> <p>The base of each section has a 12 rubber feet, which are fixed using an adhesive compound.</p> |
|                        | <p><b>Expansion Joints (B220)</b></p>    | TL-3       |      | <p><u>Section Dimensions:</u></p> <p>Height: 2'-8"</p> <p>Length: 46'-5.5"</p>  | <p><u>Anchored:</u></p> <p>Anchored similar to above.</p> <p>Dynamic Deflection (TL-3): 3.18 ft.</p>   | <p>Three part expansion joint with longitudinal expansion provided by eight sleeved tubes.</p>   |



# Aesthetic Barrier




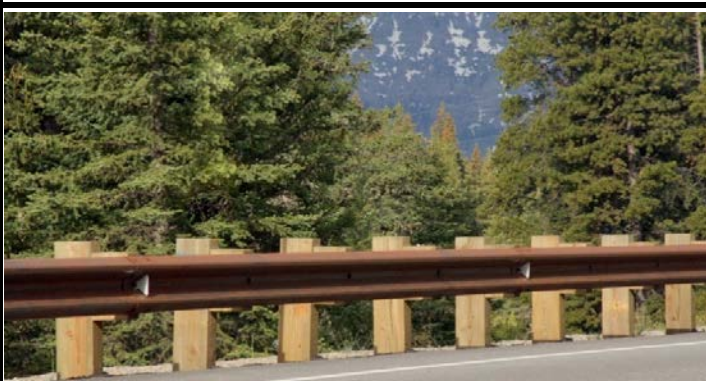
| NAME   | MANUFACTURER   | TEST LEVEL    |      | POST AND BLOCKOUT   | RAIL   | DISTINGUISHING CHARACTERISTICS  |
|--|--|---------------|------|---|--|---|
|  |  | NCHRP 350     | MASH |   |  |   |
| <b>FLEXIBLE SYSTEMS</b>  |  |               |      |   |  |   |
| <b>NatureRail</b><br>Gregory Highway Products<br><a href="http://www.gregorycorp.com/highway_nature_rail.cfm">http://www.gregorycorp.com/highway_nature_rail.cfm</a>   |    | TL-2          |      | 6" diameter Wood-clad steel post.<br>NatureRail 2m - 5'-11 7/8" post, 6'-6 3/4" post spacing<br>NatureRail 4m - 5'-11 7/8" post, 13'-1 1/2" post spacing<br>Steel spacer unit separates the post from the rail.<br>No blockout. | Composite rail:<br>2m: Modified 7" diameter log and 3 15/16" x 3/16" x 13'-1 1/16" steel rail internally located in slotted wood rail with no exterior steel rail.<br>4m: Modified 7" diameter log and 3 15/16" x 3/16" x 13'-1 1/16" steel rail internally located in slotted wood rail with an additional steel rail mounted to the back of the wood rail. | Rail height 2'-3 1/2"<br>All wood appearance blends into the surrounding environment.<br>Dynamic Deflection 2m: 4'-7" and 4m - 6'-2".<br>Use along edge of roadway.<br>No crashworthy end terminal is currently available; acceptable end treatments include anchoring in a backslope or flaring the barrier to the edge of the clear zone.   |
| <b>Ironwood Aesthetic Barrier</b><br>West - East Partners, LLC<br><a href="http://www.west-eastpartners.com/">http://www.west-eastpartners.com/</a>  |   | TL-3          |      | S3 x 5.7, 5'-3" long steel post, with a 8" x 2' steel soil plate<br>Steel post encased by a 6 3/4" diameter wood sleeve.<br>Post Spacing 6'-6".   | Composite rail: 8" diameter routed wood beams and 1/4" thick steel channel embedded in and bolted to the timber rail.<br>8" x 7" rectangular timber rail - alternate design  | Rail height 2'-2"<br>All wood appearance blends into the surrounding environment.<br>Dynamic deflection 5'-4 1/2"<br>No crashworthy end terminal is currently available; acceptable end treatments include anchoring in a backslope or flaring the barrier to the edge of the clear zone.   |
| <b>High Tension Cable Barrier</b><br>Brifen (WRSF)<br><a href="http://www.brifenus.com">http://www.brifenus.com</a><br>Gibraltar<br><a href="http://gibraltartx.com">http://gibraltartx.com</a><br>Gregory Highway Products<br><a href="http://www.gregorycorp.com/highway_safety_fence.cfm">http://www.gregorycorp.com/highway_safety_fence.cfm</a><br>Nucor Steel Marion<br><a href="http://nucorhighway.com/nu-cable.html">http://nucorhighway.com/nu-cable.html</a><br>Trinity Highway Products<br><a href="http://www.highwayguardrail.com/products/cb.html">http://www.highwayguardrail.com/products/cb.html</a> |  | TL-3 and TL-4 |      | Sizes and post spacing designs vary.<br>Refer to manufacturer's specifications.   | Three and four cable designs available.  | All systems are propriety.<br>Blends in with surrounding environment, and reduces visual impairment.<br>Refer to manufacturer's specifications for distance from post to embankment hinge point.<br>Refer to manufacturer's specifications for availability of end treatments.<br>Steel posts are typically galvanized. Coating alternatives are available to enhance aesthetic appearance.<br>Use in medians and along edge of roadways. |
|  |  |               |      | <p><b>For details on a specific system please go to manufacturer's website. For a comparisons of all systems, please refer to FHWA Cable Barrier Chart</b></p>  |  |   |

# Aesthetic Barrier




| NAME  | MANUFACTURER   | TEST LEVEL |      | POST AND BLOCKOUT  | RAIL   | DISTINGUISHING CHARACTERISTICS   |
|---|--|------------|------|--|--|--|
|   |  | NCHRP 350  | MASH |  |  |  |
| <b>SEMI-RIGID SYSTEM</b>  |  |            |      |  |  |  |
| <b>Deception Pass Log Rail</b><br><a href="http://www.wsdot.wa.gov/Research/Reports/600/642.1.htm">http://www.wsdot.wa.gov/Research/Reports/600/642.1.htm</a>   |    | TL-2       |      | Reinforced concrete, rock and mortar, bollard posts designed to replicate the historic Civilian Conservation Corp construction.<br><br>18' bollard spacing<br><br>Intermediate spacing of 6" diameter steel posts.<br><br>No blackout. | Composite rail: Modified 12" diameter log and 6" x 6" x 3/8" steel plate embedded into the log rail. | Rail height 2'-3"<br><br>Wood and rock appearance blends into the surrounding environment.<br><br>Design reduces visual impairment of the environment.<br><br>No crashworthy end terminal is currently available; acceptable end treatments include anchoring in a backslope or flaring the barrier to the edge of the clear zone.   |
| <b>TimBarrier StreetGuard Plus</b><br><br>S.I. Storey Lumber Co.<br><br><a href="http://www.sistoreylumber.com/pdf/StreetGuardPlusFlyer.pdf">http://www.sistoreylumber.com/pdf/StreetGuardPlusFlyer.pdf</a> |   | TL-2       |      | 6" x 8" x 6' long timber post<br><br>Wood blockouts 6" x 8" x 10"<br><br>Post spacing 8'   | Composite rail: 4" x 12" x 7'-11" long timber rail backed by 1/4" x 6" x 7'-6" long steel plates.    | Rail height 2'-5"<br><br>All wood appearance blends into the surrounding environment.<br><br>Use along edge of roadway.<br><br>No crashworthy end terminal is currently available; acceptable end treatments include anchoring in a backslope or flaring the barrier to the edge of the clear zone.<br><br>Dynamic deflection 4'-4". |
| <b>Steel-Backed Log Rail</b><br><br><a href="http://flh.fhwa.dot.gov/resources/pse/standard/#fp617">http://flh.fhwa.dot.gov/resources/pse/standard/#fp617</a>   |  | TL-2       |      | 12" diameter x 7' log post<br><br>Wood blockouts 8" x 6" x 8" notched into log post<br><br>Post spacing 10'.   | Composite rail: Modified 10" diameter log rail, backed with 6" x 3/8" thick steel plate.             | Rail height 2'-7"<br><br>Wood appearance blends into the surrounding environment.<br><br>No crashworthy end terminal is currently available; acceptable end treatments include anchoring in a backslope or flaring the barrier to the edge of the clear zone.<br><br>Dynamic deflection 4"   |






# Aesthetic Barrier

| NAME   | MANUFACTURER   | TEST LEVEL            |      | POST AND BLOCKOUT  | RAIL  | DISTINGUISHING CHARACTERISTICS   |
|--|--|-----------------------|------|--|---|--|
|  |  | NCHRP 350             | MASH |  |   |  |
| <b>SEMI-RIGID SYSTEM</b>                               |  |                       |      |  |   |  |
| Steel-Backed Timber Guardrail                          |    | TL-3 (with blockouts) |      | 10" x 12" x 7' long timber post.<br>Post spacing 5'.   | Composite Rail: 6" x 10" wood rail backed with a 3/8" thick steel plate.  | Rail height 2'-3"<br>All wood appearance blends into the surrounding environment.<br>System can connect to Straight and Curved Stone Masonry Guardwall.<br>Dynamic deflection 1'-11" with blockout   |
|  |  | TL-2 (no blockouts)   |      | Wood blockouts 4" x 9" x 12"   |   |  |
| Steel Backed Timber Guardrail Tangent End Terminal     |    | TL-2                  |      | The SBT end terminal is 40'-9" long and is designed to collapse when hit end-on.<br>9 - 6" x 10" weakened wood posts.<br>9 - 6" x 10" rail segment with angled ends and special attachment hardware. |   |  |
| Merritt Parkway Aesthetic Guardrail<br>Connecticut DOT |   | TL-3                  |      | W6 x 15 X 6' - 6" steel post<br>Post below ground is galvanized.<br>Post Spacing 9'-6".<br>Wood blockout 4" x 8" x 11"   | Composite Rail: 6" x 12" timber beams backed with 6" x 3/8" steel plates and splices to provide tensile continuity. | Rail Height 2'-6"<br>All wood appearance blends into the surrounding environment.<br>No crashworthy end terminal was developed for this system; acceptable end treatments include anchoring in a backslope or flaring the barrier to the edge of the clear zone.<br>A granite transition curbing is required at transition to a bridge parapet.<br>Dynamic deflection 3'-10" without a curb and 3'-4" when installed 12" behind a 4" sloped face curb. |
| Rustic-appearance Metal Beam Guardrail                 |  | TL-3                  |      | Uses wood or steel posts.  | Standard metal beam guardrail   | Blends in with the surrounding environment   |
|  |  |                       |      | <b>For a complete comparisons of these systems, please refer to FHWA Roadside Post and Beam Chart</b>  |   |  |



# Aesthetic Barrier

| NAME  | MANUFACTURER   | TEST LEVEL |      | COMPONENTS   | CHARACTERISTICS   |
|---|--|------------|------|--|---|
|   |  | NCHRP 350  | MASH |  |   |
| <b>RIGID SYSTEM</b>   |  |            |      |  |   |
| <b>Random Rubble Cavity Wall</b><br><br><a href="http://www.efl.fhwa.dot.gov/files/technology/abs/Random-rubble/B181RubbleGuardwall-WFLHD-FIN.pdf">http://www.efl.fhwa.dot.gov/files/technology/abs/Random-rubble/B181RubbleGuardwall-WFLHD-FIN.pdf</a> |    | TL-1       |      | Wall width 1'-6"<br><br>Composed of alternating height sections:<br>Section 1 is 1'-6" tall x 12' long<br>Section 2 is 2' tall x 5'-6" long.<br><br>Reinforced concrete footings and core wall are poured and stone placed prior to filling the cavity with concrete.<br><br>Rock size is between 12" and 1'-6" with smaller rocks and masonry mortar.   | Wall height: 1'-6" and 2' alternating height sections<br><br>Stone facing blends into the surrounding environment.<br><br>No crashworthy end terminal is currently available; acceptable end treatments include anchoring in a backslope or flaring the barrier to the edge of the clear zone.        |
| <b>Rough Stone Masonry Guardwall</b><br><br><a href="http://safety.fhwa.dot.gov/roadway_dept/policy_guide/road_hardware/barriers/pdf/b202.cfm">http://safety.fhwa.dot.gov/roadway_dept/policy_guide/road_hardware/barriers/pdf/b202.cfm</a>             |   | TL-2       |      | Wall width: 2' single or 2'-3" double faced.<br><br>Three main components: reinforced concrete foundation slab, inner reinforced concrete core wall and rough stone masonry face with an attachment system.<br><br>Masonry face can have the projections a maximum of 1-1/2" beyond the working line. Avoid projections oriented toward oncoming traffic. Rake joints can be up to 2" deep, and mortar beds can be 2" - 3" thick.    | Wall height: 1'-10"<br><br>Stone facing blends into the surrounding environment.<br><br>No crashworthy end terminal is currently available; acceptable end treatments include anchoring in a backslope or flaring the barrier to the edge of the clear zone.  |
| <b>Rough Stone Masonry Guardwall</b><br><br><a href="http://safety.fhwa.dot.gov/roadway_dept/policy_guide/road_hardware/barriers/pdf/b64d.pdf">http://safety.fhwa.dot.gov/roadway_dept/policy_guide/road_hardware/barriers/pdf/b64d.pdf</a>             |  | TL-3       |      | Wall width: 2' single or double faced.<br><br>Three main components: reinforced concrete foundation slab, inner reinforced concrete core wall and rough stone masonry facing with an anchor attachment system.<br><br>Masonry face can have the projections a maximum of 1-1/2" beyond the working line. Avoid projections oriented toward oncoming traffic. Rake joints can be up to 2" deep, and mortar beds can be 2" - 3" thick. | Wall height: 2'-3"<br><br>Stone facing blends into the surrounding environment.<br><br>Used in medians when double-faced.<br><br>No crashworthy end terminal is currently available; acceptable end treatments include anchoring in a backslope or flaring the barrier to the edge of the clear zone. |

# Aesthetic Barrier

| NAME   | MANUFACTURER   | TEST LEVEL |      | COMPONENTS  | CHARACTERISTICS  |
|--|--|------------|------|---|--|
|  |  | NCHRP 350  | MASH |   |  |
| <b>RIGID SYSTEM</b>  |  |            |      |   |  |
| <b>Smooth Stone Masonry Guardwall</b><br><br><a href="http://flh.fhwa.dot.gov/resources/pse/standard/#fp620">http://flh.fhwa.dot.gov/resources/pse/standard/#fp620</a>   |    | TL-3       |      | Wall width: 2' single or double faced.<br><br>Three main components: reinforced concrete foundation slab, inner reinforced concrete core wall and rough stone masonry face with an attachment system.<br><br>Masonry face can have the projections a maximum of 1-1/2" beyond the working line. Avoid projections oriented toward oncoming traffic. Rake joints can be up to 2" deep, and mortar beds can be 2" - 3" thick. | Wall height: 2'-3" with 3" crenulations above primary height.<br><br>Stone facing blends into the surrounding environment.<br><br>No crashworthy end terminal is currently available; acceptable end treatments include anchoring in a backslope or flaring the barrier to the edge of the clear zone.   |
| <b>Precast Concrete Guardwall</b><br><br><a href="http://flh.fhwa.dot.gov/resources/pse/standard/#fp618">http://flh.fhwa.dot.gov/resources/pse/standard/#fp618</a>   |   | TL-3       |      | Wall width 2'-2"<br><br>10-ft long pre-cast units include 12 inch deep footings.<br><br>Foundation, core, and concrete stone facing are precast as a single unit.   | Wall height: 2'-3-1/2"<br><br>Precast concrete stone facing and capstone blend into the surrounding environment.<br><br>Use in medians if double-faced or along edge of roadway.<br><br>Approved for use with 4" mountable curb at any offset.<br><br>No crashworthy end terminal is currently available; acceptable end treatments include anchoring in a backslope or flaring the barrier to the edge of the clear zone. |
| <b>Stone Cast Barrier</b><br><br>Stone Cast, Inc.<br><br><a href="http://safety.fhwa.dot.gov/roadway_dept/policy_guide/road_hardware/barriers/pdf/b-73.pdf">http://safety.fhwa.dot.gov/roadway_dept/policy_guide/road_hardware/barriers/pdf/b-73.pdf</a> |  | TL-3       |      | Unit dimension: 2'-7" tall; 1'-7" width at top and 2' at bottom.<br><br>Unit footing: 1' deep x 4' wide, cast integrally with its stem.<br><br>Foundation, stem, and stone veneer cast integrally as a single unit.<br><br>Units can be made in 5', 10' or 20' long segments, and can be curved to fit a specified radius   | Wall height: 2'-7"<br><br>No crashworthy end terminal is currently available; acceptable end treatments include anchoring in a backslope or flaring the barrier to the edge of the clear zone.   |

# Aesthetic Barrier

| NAME  | MANUFACTURER  | TEST LEVEL |      | COMPONENTS   | CHARACTERISTICS   |
|---|---|------------|------|--|---|
|   |   | NCHRP 350  | MASH |  |   |
| <b>RIGID SYSTEM</b>   |   |            |      |  |   |
| <p><b>California's Type 60 Concrete Barrier</b></p> <p>e.g.: Mission Arch, Deep Cobblestone Reveal, Dry stack, Fracture Granite</p> | <br> | TL-3       |      | <p>Barrier has a constant single slope approximately 9 degs from the vertical.</p> <p>General texture guidelines:</p> <ol style="list-style-type: none"> <li>1. Sandblast textures with a maximum relief of 1/5".</li> <li>2. Images or geometric patterns inset into the face of the barrier 1" or less and having 45-deg or flatter chamfered or beveled edges.</li> <li>3. Textures or patterns of any shape and length inset into the face of the barrier up to the 1/2" deep and 1" width.</li> <li>4. Any pattern or texture with gradual undulations that have a maximum relief of 3/4" over a distance of 1'.</li> <li>5. Gaps, slots, grooves or joints of any depth with a maximum width of 3/4" and a maximum surface differential across these features of 1/5" or less.</li> <li>6. Any pattern or texture with a maximum relief of 2-1/2", if such pattern begins 2' or higher above the base of the barrier and all leading edges are rounded or sloped. No part of this pattern or texture should protrude above the plane of the lower, untextured portion of the barrier.</li> </ol> | <p>Wall height: 2'-3" (vertical wall) to 2'-8" (single-slope barrier)</p> <p>No crashworthy end terminal is currently available; acceptable end treatments include anchoring in a backslope or flaring the barrier to the edge of the clear zone.</p> |


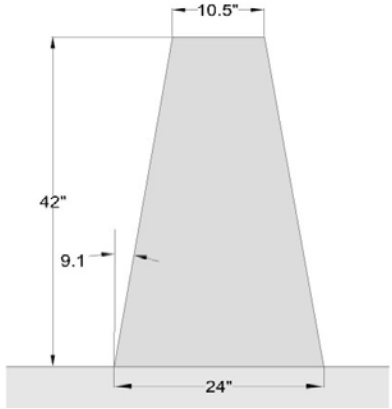

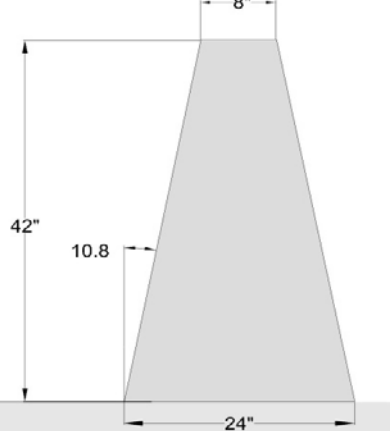

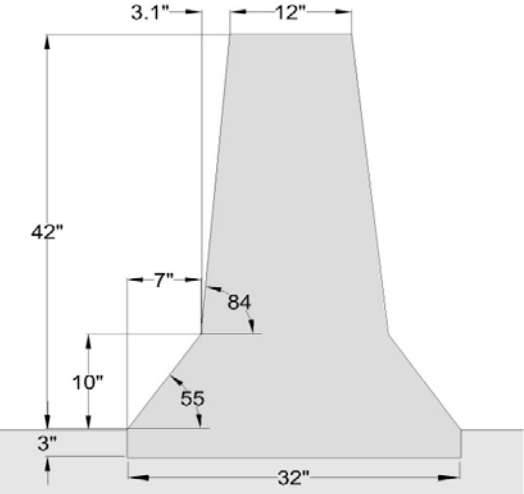
# Cast-In-Place Concrete Barriers

NOTE: Reinforcing steel in each of these barrier may vary and have been omitted from the drawings for clarity, only the Ontario Tall Wall is unreinforced.

| NAME/MANUFACTURER   | ILLUSTRATION | TEST LEVEL                               |      | PROFILE GEOMETRIC DIMENSIONS | CHARACTERISTICS   |
|---|--------------|--|------|------------------------------|---|
|   |              | NCHRP 350                                | MASH |                              |   |
| <b>New Jersey Safety-Shape Barrier</b><br><br><a href="https://www.aashtotf13.org/Files/Drawings/sgm11a_b.pdf">https://www.aashtotf13.org/Files/Drawings/sgm11a_b.pdf</a> |              | TL-4<br>32" Tall<br><br>TL-5<br>42" Tall |      |                              | The New Jersey Barrier was the most widely used safety shape concrete barrier prior to the introduction of the F-shape. As shown, the "break-point" between the 55 deg and 84 deg slope is 13 inches above the pavement, including the 3 inch vertical reveal. The flatter lower slope is intended to redirect vehicles impacting at shallow angles with little sheet metal damage, but can cause significant instability to vehicles impacting at high speeds and angles.                            |
| <b>F-shape Barrier</b><br><br><a href="https://www.aashtotf13.org/Files/Drawings/sgm10a_b.pdf">https://www.aashtotf13.org/Files/Drawings/sgm10a_b.pdf</a>                 |              | TL-4<br>32" Tall<br><br>TL-5<br>42" Tall |      |                              | The F-shape has the same basic geometry as the New Jersey barrier, but the "break-point" between the lower and upper slopes is 10 inches above the pavement. This modification results in less vehicle climb in severe impacts and improved post-crash trajectories. The 7.5 inch horizontal distance from the toe of the F-shape to its top corner also reduces the roll angle of impacting trucks and other vehicles with high centers-of-gravity.<br><br>NOTE: 8" top width minimum is acceptable. |
| <b>Vertical Concrete Barrier</b>  |              | TL-4<br>32" Tall<br><br>TL-5<br>42" Tall |      |                              | A vertical concrete barrier may be a good choice where vehicle roll must be minimized, such as when shielding a bridge pier. This shape offers the best post-crash trajectories with only slight roll, pitch, and yaw angles. Lateral deceleration forces may be somewhat higher than with a safety shape design.   |


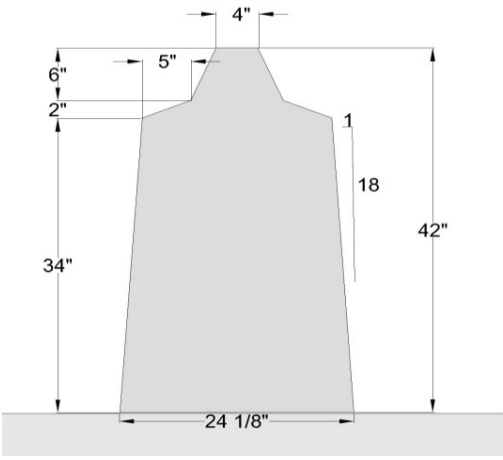

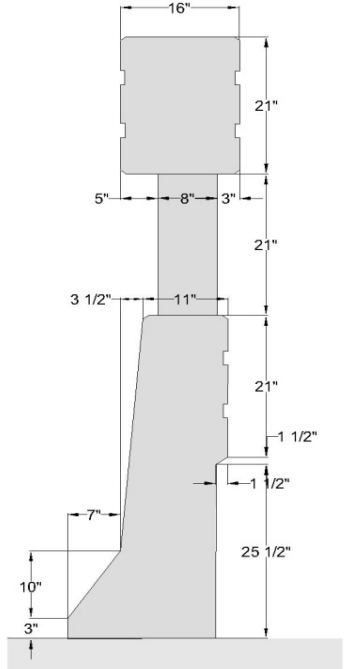
# Cast-In-Place Concrete Barriers

NOTE: Reinforcing steel in each of these barrier may vary and have been omitted from the drawings for clarity, only the Ontario Tall Wall is unreinforced.

| NAME/MANUFACTURER   | ILLUSTRATION   | TEST LEVEL       |      | PROFILE GEOMETRIC DIMENSIONS  | CHARACTERISTICS  |
|---|--|------------------|------|---|--|
|   |  | NCHRP 350        | MASH |   |  |
| Single Slope Barrier  |    | TL-4<br>32" Tall |      |    | The 9.1 degree single-slope barrier, developed in California, performs comparably to the F-shape barrier, with good post-impact vehicle trajectories.  |
| Constant Slope Barrier  |   | TL-4<br>32" Tall |      |   | The 10.8 degree single-slope barrier, developed in Texas, performs comparably to the New Jersey barrier.   |
| Ontario Tall Wall Median Barrier<br><a href="https://www.aashtotf13.org/Files/Drawings/sgm12.pdf">https://www.aashtotf13.org/Files/Drawings/sgm12.pdf</a> |  | TL-5<br>42" Tall |      |  | The lower portion of the barrier is very similar to the F shape barrier with its slope "break-point" 10 inches above the pavement. However this barrier is taller and has a larger footprint (32" vs. 24") than the standard F-shape and has no reinforcing steel. |

# Cast-In-Place Concrete Barriers




NOTE: Reinforcing steel in each of these barrier may vary and have been omitted from the drawings for clarity, only the Ontario Tall Wall is unreinforced.

| NAME/MANUFACTURER   | ILLUSTRATION  | TEST LEVEL       |      | PROFILE GEOMETRIC DIMENSIONS   | CHARACTERISTICS   |
|---|---|------------------|------|--|---|
|   |   | NCHRP 350        | MASH |  |   |
| Vertical Faced Concrete Median Barrier Incorporating Head Ejection Criteria |   | TL-5<br>42" Tall | TL-5 |   | <p>This concrete median barrier was developed to redirect vehicles ranging from small cars to fully-loaded tractor trailers, while safely</p> <ul style="list-style-type: none"> <li>maximizing stability in passenger vehicles by limiting wheel climb and roll.</li> <li>addressing occupant safety by limiting peak impact forces</li> <li>preventing "head slap"</li> <li>providing an economical alternative to existing concrete barrier design.</li> </ul> |
| Tank Truck Barrier Wall   |  | TL-6<br>90" Tall |      |  | <p>This barrier was developed as a TL-6 design to contain and redirect vehicles up to an 80,000 lb. tractor tanker. The base is essentially a New Jersey barrier slope, followed by an open "window" design, and topped by a continuous reinforced concrete beam 21 inches high and 16 inches deep. It has been used in the US as a bridge railing, a median barrier and as a roadside barrier.</p>   |

# Roadside Post and Beam Rail Element

NOTE: No barriers should be placed on any slope steeper than 1V:6H, unless it has been crash tested in accordance with NCHRP 350 or MASH evaluation criteria.

If a barrier is to be placed on a slope steeper than 1V:10H, a flexible or semi-rigid type should be used.




| NAME  | ILLUSTRATION  | TEST LEVEL   |  | POST  | BLOCKOUT   | DISTINGUISHING CHARACTERISTICS  |
|---|---|--|--|---|--|---|
|   |   | NCHRP 350  | MASH   |   |  |   |
| <b>SEMI-RIGID SYSTEMS</b>   |   |  |  |   |  |   |
| <b>W-beam (strong post)</b><br><br><a href="https://www.aashtotf13.org/Files/Drawings/sgr04a-c.pdf">https://www.aashtotf13.org/Files/Drawings/sgr04a-c.pdf</a><br><br>Generic   |   | TL-3<br><br><br><br><br><br><br><br><br><br><br>TL-2 | TL-3<br><br><br><br><br><br><br><br><br><br><br> | W6 x 9 or W6 x 8.5 x 6 ft. Steel post.<br><br>Timber post 5 ft. 4 in. or 6 ft.<br><br>Post spacing 6 ft. 3 in.  | 6 in. wide x 8 in. x 14 in. blockouts<br><br>Routed (w/steel posts) timber or composite blockout<br><br>Double blockouts can be used                                       | Top height of rail 27.75 in. FHWA recommends new applications to have 29 in. +/- 1 in. rail height.<br><br>Strong post barrier systems usually remain functional after moderate to low speed impact, thereby minimizing the need for immediate repair<br><br>Dynamic lateral deflection 2.6 ft. (wood post), 3.3 ft. (steel post) for NCHRP 350 impact condition<br><br>Dynamic lateral deflection 3.9 ft. MASH<br><br>Uses 12-gauge panels. Specific applications may use 10-gauge panels.   |
| <b>Nu-Guard 27</b><br><br><a href="http://nucorhighway.com/nu-guard-27.html">http://nucorhighway.com/nu-guard-27.html</a><br><br>Nucor Steel Marion, Inc.   |   | TL-3   |  | 6 ft. 6 in. RIB-BAK U-channel 2 in. deep and 3-1/2" wide<br><br>Post weight 5 lbs. per foot<br><br>3/4-in. wide x 7 in. long slot is located 1 in. down from the top of the posts in the middle cross section<br><br>Post spacing 6 ft. 3 in. | 3-5/8 in. x 8 in. x 14 in. plastic blockouts<br><br>W-beam is held with 5/8"x 12" post bolt and standard guardrail splice nut  | Top rail height 27 in to 31 in.<br><br>Uses standard 12-gauge panels<br><br>Can be used to repair sections within an existing run of wood or I-beam posts<br><br>Dynamic lateral deflection 3.8 ft.   |
| <b>Midwest Guardrail System (MGS)</b><br><br><a href="http://engineering.unl.edu/specialty-units/mwrsf/Newsletter-MidwestGuardrail.shtml">http://engineering.unl.edu/specialty-units/mwrsf/Newsletter-MidwestGuardrail.shtml</a><br><br>Generic |  | TL-3   | TL-3   | W6 x 9 or W6 x 8.5 x 6-ft long steel posts<br><br>Post spacing 6 ft. 3 in.<br><br>Rectangular or round timber posts allowable   | 12" (recommended), 8", or no block. Backup plate needed with non-blocked option.<br><br>When steel posts are used, timber or plastic blockouts may be routed or toenailed. | Top height of rail between 27-3/4" and 32 in.<br><br>Uses standard 12-gauge panels.<br><br>One-half and one-quarter standard post spacing allowable<br><br>Rail splices are located at midspan between adjacent posts<br><br>Dynamic lateral deflection 3 ft. 7 in. (NCHRP 350) and 3 ft. 8 in. (MASH)<br><br>Long-span (25 ft.) installation without intermediate post to conflict with underground structures allowable<br><br><b>Applications:</b> use on curbs, over long span culvert, at slope break point, approach to slopes, varying flare rates, with 8 in. blockouts, at wire-faced MSE wall, without a blockout, approach transition. Deflection values varies by applications. |



# Roadside Post and Beam Rail Element

NOTE: No barriers should be placed on any slope steeper than 1V:6H, unless it has been crash tested in accordance with NCHRP 350 or MASH evaluation criteria.





If a barrier is to be placed on a slope steeper than 1V:10H, a flexible or semi-rigid type should be used.

| NAME   | ILLUSTRATION   | TEST LEVEL |      | POST   | BLOCKOUT   | DISTINGUISHING CHARACTERISTICS  |
|--|--|------------|------|--|--|---|
|  |  | NCHRP 350  | MASH |  |  |   |
| <p><b>Gregory Mini Spacer (GMS)</b><br/> <a href="http://www.gregorycorp.com/highway_gms.cfm">http://www.gregorycorp.com/highway_gms.cfm</a><br/>                     Gregory Highway Products</p>                       |     | TL-3       | TL-3 | <p>W6 x 9 or W6 x 8.5 x 6-ft Steel posts</p> <p>6 x 8 in. rectangular or 7 in diameter round timber posts</p> <p>Post spacing 6 ft. 3 in. or 12 ft. 6 in. or 3 ft. 1.5 in.</p>   | <p>No blockouts or backup plates</p> <p>Rail is attached to post using a 5/16-in diameter standard hex head bolt incorporated with the GMS</p>   | <p>Top height of rail between 27 and 32 inches</p> <p>Splices can be at mid span or at the post</p> <p>Uses standard 12-gauge or 10-gauge panels and standard post.</p> <p>Can be used with Thrie-beam at 39 in. tall</p> <p>GMS fastener may be used in place of a standard guardrail bolt on any non-proprietary strong or weak post W-beam guardrail design</p> <p>Dynamic lateral deflection 2.9 ft. (6ft 3in spacing); 5ft (12ft 6 in spacing) MASH.</p> |
| <p><b>Nu-Guard 31</b><br/> <a href="http://nucorhighway.com/nu-guard-31.html">http://nucorhighway.com/nu-guard-31.html</a><br/>                     Nucor Steel Marion, Inc.</p>   |   | TL-4       | TL-3 | <p>6 ft. 6 in. RIB-BAK U-channel 2 in. deep and 3.5 in. wide</p> <p>Post weight 5 lbs.per foot</p> <p>3/4-in. wide x 7 in. long slot is located 1 in. down from the top of the posts in the middle cross section</p> <p>Post spacing 6 ft. 3 in.</p> | <p>No blockouts</p> <p>Round spacer washers are installed between the guardrail and the legs of the posts</p> <p>Spacers are 3.5 in outer diameter, with a 1 in diameter hole</p> <p>Washer is placed with 5/8 in. x 3.5 in. post bolt and standard guardrail splice nut</p> | <p>Top height of rail 31 in.</p> <p>Uses standard 12-gauge panels</p> <p>Dynamic lateral deflection TL-3: 3.4 ft.</p> <p>Dynamic lateral deflection TL-4: 4 ft. (NCHRP 350)</p>   |
| <p><b>Trinity T-31 Guardrail System</b><br/> <a href="http://www.highwayguardrail.com/products/grT31.html">http://www.highwayguardrail.com/products/grT31.html</a><br/>                     Trinity Highway Products</p> |  | TL-3       | TL-3 | <p>W6 x 9 or W6 x 8.5 x 6 ft. Steel post</p> <p>6 ft. long Steel Yielding Line Posts (SYLP)</p> <p>Each post has four 13/16-in. diameter holes in the flanges at ground line</p> <p>Post spaced at 6 ft. 3 in.</p>                                   | <p>No Blockouts</p> <p>Uses a 6-inch long flange protector at each post (W-beam)</p>   | <p>Top of rail height 31 in.</p> <p>Rail is attached to the post using a 5/8 in. diameter x 1.75 in. long special bolt with a slotted countersunk head</p> <p>Uses standard 12-gauge panels</p> <p>All splices in the W-beam rail element fall midspan, between adjacent posts</p> <p>Dynamic lateral deflection 3.2 ft. (NCHRP 350) and 3.4 ft. MASH</p>   |

# Roadside Post and Beam Rail Element

NOTE: No barriers should be placed on any slope steeper than 1V:6H, unless it has been crash tested in accordance with NCHRP 350 or MASH evaluation criteria.





If a barrier is to be placed on a slope steeper than 1V:10H, a flexible or semi-rigid type should be used.

| NAME  | ILLUSTRATION   | TEST LEVEL    |      | POST   | BLOCKOUT   | DISTINGUISHING CHARACTERISTICS  |
|---|--|---------------|------|--|--|---|
|   |  | NCHRP 350     | MASH |  |  |   |
| <b>Thrie-Beam</b><br><a href="https://www.aashtotf13.org/guide_display.php">https://www.aashtotf13.org/guide_display.php</a><br><br>Generic                                       |     | TL-3          |      | Wood or steel strong post<br><br>W6 x 9 or W6 x 8.5 x 6 ft. 6 in. Steel post<br><br>Post spacing 6 ft. 3 in.   | 6 in. wide x 8 in. x 21.75 in. blockouts<br><br>Wood or composite routed blocks with steel posts.  | Mounting height 32 in.<br><br>Stronger version of the blocked-out W-beam barrier<br><br>Additional corrugation in the Thrie-beam rail element stiffens the system<br><br>Dynamic lateral deflection 2.2 ft. wood post and blockouts<br><br>Dynamic lateral deflection 1.9 ft. steel post and routed timber or composite blockouts.  |
| <b>Modified Thrie-beam</b><br><a href="https://www.aashtotf13.org/guide_display.php">https://www.aashtotf13.org/guide_display.php</a><br><br>Generic                              |    | TL-3 and TL-4 |      | W6 x 9 or W6 x 8.5 x 6 ft. 9 in. Steel post.<br><br>Post spaced at 6 ft. 3 in.   | Steel block with a triangular notch cut from its web<br><br>W14x22x17" long steel block  | Mounting height 34 in.<br><br>Dynamic deflection TL-4: 3 ft., TL-3: 2 ft.<br><br>Requires a backup plate at non-spliced post.   |
| <b>Trinity T-39 (Thrie-beam)</b><br><a href="http://highwayguardrail.com/products/grT39.html">http://highwayguardrail.com/products/grT39.html</a><br><br>Trinity Highway Products |  | TL-4          | TL-3 | W6 x 9 or W6 x 8.5 x 6 ft. Steel post.<br>6 ft. long Steel Yielding Line Posts (SYLP)<br><br>Each post has four 13/16-in. diameter holes in the flanges at ground line<br><br>Post spacing 6 ft. 3 in. | No Blockouts<br><br>Uses a 6 in. long flange protector at each post (W-beam)   | Mounting height 39 in.<br><br>Uses 12-gauge panels<br><br>Rail is attached to the post using a 5/8 in. diameter x 1.75 in. long special bolt with a slotted countersunk head<br><br>Rail splices are located at midspan between adjacent posts<br><br>Dynamic lateral deflection TL-3: 2.1 ft. (MASH) and TL-4: 2.6 ft. (NCHRP 350) |
| <b>Gregory Mini Spacer (GMS-TB)</b><br><a href="http://www.gregorycorp.com/highway_gms.cfm">http://www.gregorycorp.com/highway_gms.cfm</a><br><br>Gregory Highway Products        |   | TL-3          |      | W6 x 9 or W6 x 8.5 x 6 ft. Steel post.<br><br>Post spacing 6 ft. 3 in.   | No blockouts or backup plates<br><br>Thrie-beam is attached with the GMS fastener at each post, attached to the lower post-bolt slot of the Thrie-beam | Top height of rail 39 in.<br><br>Uses standard 12-gauge or 10-gauge panels and standard post. The rail is mounted with the top corrugation protruding above the post and only one post bolt is used per post<br><br>All splices are at the post<br><br>Dynamic lateral deflection 4.33 ft.  |

# Roadside Post and Beam Rail Element







NOTE: No barriers should be placed on any slope steeper than 1V:6H, unless it has been crash tested in accordance with NCHRP 350 or MASH evaluation criteria.

If a barrier is to be placed on a slope steeper than 1V:10H, a flexible or semi-rigid type should be used.

| NAME   | ILLUSTRATION  | TEST LEVEL |      | POST  | BLOCKOUT                                       | DISTINGUISHING CHARACTERISTICS  |
|--|---|------------|------|---|--|---|
|  |   | NCHRP 350  | MASH |   |  |   |
| <b>Box Beam weak Post</b><br><a href="https://www.aashtotf13.org/Files/Drawings/sgr03.pdf">https://www.aashtotf13.org/Files/Drawings/sgr03.pdf</a><br>Generic                        |    | TL-3       | TL-3 | S3 x 5.7 post 5 ft. 3 in. long with soil plate<br><br>Post spacing 6 ft.        | No blockouts                                   | Top height of rail 27 in.<br><br>Post near the point of impact are designed to break or tear away, distributing impact forces to adjacent post<br><br>Dynamic lateral deflection 3.75 ft. (NCHRP 350)<br>Dynamic lateral deflection 4.8 ft. (MASH)                                    |
| <b>Trinity Guardrail System (TGS)</b><br><a href="http://www.highwayguardrail.com/products/gr.html">http://www.highwayguardrail.com/products/gr.html</a><br>Trinity Highway Products |    | TL-3       | TL-3 | W6 x 9 or W6x8.5 x 6ft Steel post.<br><br>Post spacing 6'-3"                    | No blockouts                                   | Mounting height 31"<br><br>Uses standard 12 gauge W-beam panels and standard post.<br>Rail is attached to the post using a 5/8 in. diameter x 1.75 in. long special bolt with a slotted countersunk head<br><br>Dynamic lateral deflection 3.2 ft. (MASH); 2000P Test not run (NCHRP) |
| <b>FLEXIBLE SYSTEMS</b>  |   |            |      |   |  |   |
| <b>W-beam (weak post)</b><br><a href="https://www.aashtotf13.org/Files/Drawings/sgr02a.pdf">https://www.aashtotf13.org/Files/Drawings/sgr02a.pdf</a><br>Generic                      |  | TL-2       |      | S3 x 5.7 post 5 ft. 3 in. long with soil plate<br><br>Post spacing 12 ft. 6 in. | No blockouts                                   | Mounting height 28 in.<br><br>Dynamic lateral deflection 4 ft.7 in. for TL-2<br><br>System was redesigned for TL-3 as shown below and called "Modified W-beam (weak post)"  |
| <b>Modified W-beam (weak post)</b><br><a href="https://www.aashtotf13.org/guide_display.php">https://www.aashtotf13.org/guide_display.php</a><br>Generic                             |  | TL-3       | TL-3 | S3 x 5.7 post 5 ft. 5 in. long with soil plate<br><br>Post spacing 12 ft. 6 in. | No blockouts<br><br>Backup plates at each post | Mounting height 32.3 in.<br><br>Rail splices are centered mid-span between posts<br><br>Dynamic lateral deflection 7 ft. (NCHRP 350)<br><br>Dynamic lateral deflection 8.6 ft. (MASH)   |




# Roadside Terminals

Proper grading in advance of the system and a traversable runout area beyond the beginning of the system is required for all terminals. When the unshielded upstream roadside is similar to the area downstream of the terminal and it is impractical to extend the barrier, a lesser runout area may be permissible. Refer to AASHTO Roadside Design Guide

| NAME                                      | MANUFACTURER  | PERFORMANCE CHARACTERISTICS |                      | TEST LEVEL             |      | FLARED | TANGENT | 31-inch Height (option) | DISTINGUISHING CHARACTERISTICS  | LOCATIONS CAN BE USED  |
|---|---|-----------------------------|----------------------|------------------------|------|--------|---------|-------------------------|---|--|
|   |   | Energy Absorbing            | Non Energy Absorbing | NCHRP 350              | MASH |        |         |                         |   |  |
| Breakaway Cable Terminal (BCT)            |    | Generic                     | X                    | Does not meet Criteria |      | X      |         |                         | No impact head or ground strut between the two end posts.<br>Should have a parabolic flare with a 4-ft offset at first post.<br>Only two weakened posts.  | Should not be used for new installations. (Shown on charts for identification purposes only)   |
| Vermont G1-d                              |    | Generic                     | X                    | TL-2                   |      | X      |         |                         | No impact head.<br>Shop-bent w-beam 5 ft flare.<br>Concrete anchor block with steel rod connecting at post 3.   | Driveway turnouts  |
| Modified Eccentric Loader Terminal (MELT) |    | Generic                     | X                    | TL-2                   |      | X      |         |                         | No impact head. Rail installed on parabolic curve.<br>Strut between the steel tube foundation for the two end posts to act together to resist the cable loads.<br>All wood posts.   | Should be installed at locations where runout area exists behind and downstream of the terminal.<br><br>End of W-beam rail with offset of 4'-0". |
| Buried-in-Backslope Terminal              |   | Generic                     | X                    | TL-3                   |      | X      |         |                         | No impact head.<br>Height of W-beam rail should be held constant in relation to the roadway shoulder elevation until barrier crosses the ditch bottom.<br>Rubrail should be added below the w-beam.   | Cut sections of a roadway<br><br>When the road transitions from a cut to a fill.   |
| Regent-C                                  |  | Energy Absorption Systems   | X                    | TL-3                   |      | X      |         |                         | No impact head.<br>Modified w-beam panels containing slots and includes a 1/2" diameter 6 x 9 wire rope nested into the traffic -face of the w-beam.<br>Uses a standard strut and cable end anchorage and seven weakened wood post to support the rail. | Should be installed at locations where runout area exists behind and downstream of the terminal.<br><br>End of W-beam rail with offset of 4'-0". |
| Eccentric Loader Terminal (ELT)           |  | Generic                     | X                    | TL-3                   |      | X      |         |                         | End consists of a fabricated steel element inside a section of corrugated steel pipe. Rail installed on parabolic curve.<br>Strut between the steel tube foundation for the two end posts to act together to resist the cable loads.<br>All wood posts. | Should be installed at locations where runout area exists behind and downstream of the terminal.<br><br>End of W-beam rail with offset of 4'-0". |





# Roadside Terminals

Proper grading in advance of the system and a traversable runout area beyond the beginning of the system is required for all terminals. When the unshielded upstream roadside is similar to the area downstream of the terminal and it is impractical to extend the barrier, a lesser runout area may be permissible. Refer to AASHTO Roadside Design Guide

| NAME   | MANUFACTURER   | PERFORMANCE CHARACTERISTICS |                      | TEST LEVEL |      | FLARED | TANGENT | 31-inch Height (option) | DISTINGUISHING CHARACTERISTICS  | LOCATIONS CAN BE USED   |
|--|--|-----------------------------|----------------------|------------|------|--------|---------|-------------------------|---|---|
|  |  | Energy Absorbing            | Non Energy Absorbing | NCHRP 350  | MASH |        |         |                         |   |   |
| Slotted Rail Terminal (SRT-350)<br><br><a href="http://www.highwayguardrail.com/products/et-srt350.html">http://www.highwayguardrail.com/products/et-srt350.html</a> | <br><br>Trinity Highway Products, LLC   |                             | X                    | TL-3       |      | X      |         | X                       | No impact head.<br><br>Longitudinal slots on W-beam rail element.<br><br>Strut and cable anchor bracket between post 1 and 2 act together to resist the cable loads.<br><br>Slot Guards on downstream end of slots.<br><br>Steel and wood post options available.<br><br>Parabolic flare on wood post.<br><br>Straight line flare on all SYTP steel post version and HBA steel/wood post version.   | Should be installed at locations where runout area exists behind and downstream of the terminal.<br><br>End of W-beam rail with offset of 4'-0".<br><br>Wood post option has 3'-0" to 4'-0" offset. |
| Flared Energy-Absorbing Terminal (FLEAT)<br><br><a href="http://roadsystems.com/fleat.html">http://roadsystems.com/fleat.html</a>                                    | <br><br>Road Systems, Inc.             | X                           |                      | TL-2, TL-3 |      | X      |         | X                       | Rectangular impact front face, with steel tube on top.<br><br>Rail has 5 slots (1/2"x4" long) on both the top and bottom corrugations of the w-beam section.<br><br>There may also be 3 additional (1/2"x4" long) slots in the valley of the rail which makes it interchangeable with the first SKT section.<br><br>Breakaway steel end posts #1 and #2, standard steel guardrail post #3 and beyond.<br><br>Cable anchor bracket is fully seated on the shoulder portion of the cable anchor bolts.<br><br>All hinge steel post, plug weld steel posts, or wood posts available. | End of W-beam rail with offset of 2'-6" to 4'-0".   |
| TREND 350 Flared<br><br><a href="http://www.highwayguardrail.com/products/flared.html">http://www.highwayguardrail.com/products/flared.html</a>                      | <br><br>Trinity Highway Products, LLC | X                           |                      | TL-3       |      | X      |         | X                       | Rectangular Impact Face<br><br>All steel driven posts.<br><br>Breakaway steel posts at #1 and #2, standard steel guardrail posts #3 and beyond.<br><br>Steel Strut between posts #1 and #2.<br><br>During head on impacts the system telescopes rearward, using friction between the guardrail panels and deformation of the rail sections to decelerate the vehicle.   | End of W-Beam rail with offset of 1' to 4'0"  |




# Roadside Terminals

Proper grading in advance of the system and a traversable runout area beyond the beginning of the system is required for all terminals. When the unshielded upstream roadside is similar to the area downstream of the terminal and it is impractical to extend the barrier, a lesser runout area may be permissible. Refer to AASHTO Roadside Design Guide





| NAME  | MANUFACTURER   | PERFORMANCE CHARACTERISTICS |                      | TEST LEVEL |      | FLARED | TANGENT | 31-inch Height (option) | DISTINGUISHING CHARACTERISTICS  | LOCATIONS CAN BE USED                         |
|---|--|-----------------------------|----------------------|------------|------|--------|---------|-------------------------|---|---|
|   |  | Energy Absorbing            | Non Energy Absorbing | NCHRP 350  | MASH |        |         |                         |   |   |
| Sequential Kinking Terminal (SKT)<br><a href="http://roadsystems.com/skt.html">http://roadsystems.com/skt.html</a>  | <br>Road Systems, Inc.              | X                           |                      | TL-2, TL-3 |      |        | X       | X                       | Square Impact Face.<br>Has a feeder chute (channel section that surrounds the rail) that gets wider at the downstream end.<br>Breakaway steel end posts #1 and #2 and standard steel guardrail posts #3 and beyond.<br>Rail has 3 (1/2"x4" long) slots in the valley of the rail.<br>There may also be an additional 5 slots (1/2"x4" long) on both the top and bottom corrugations of the w-beam section, which makes it interchangeable with the FLEAT section.<br>Cable anchor bracket is fully seated on the shoulder portion of the cable anchor bolts.<br>All hinge steel post, plug weld steel posts, or wood posts available. | End of W-beam rail with offset of 0 to 2'-0". |
| Extruder Terminal (ET-Plus)<br><a href="http://www.highwayguardrail.com/products/etplus.html">http://www.highwayguardrail.com/products/etplus.html</a>                                | <br>Trinity Highway Products, LLC  | X                           |                      | TL-2, TL-3 |      |        | X       | X                       | Rectangular Impact Front Face (Extruder Head).<br>Rectangular holes in 1st rail support the tabs of the cable anchor bracket.<br>Steel HBA and SYTP and wood post options are available.<br>SYTP Retrofit in tube sleeve option available.  | End of W-beam rail with offset of 0 to 2'-0". |
| SoftStop<br><a href="http://www.highwayguardrail.com/products/SoftStop.html">http://www.highwayguardrail.com/products/SoftStop.html</a>   | <br>Trinity Highway Products, LLC | X                           |                      |            | TL-3 |        | X       | X (Only)                | Rectangular Impact Face.<br>Breakaway steel posts at #1 and #2, standard posts 3 and beyond.  | End of W-Beam rail with offset of 0' to 2'0"  |
| X-Tension Guardrail End Terminal<br><a href="http://www.barriersystemsinc.com/xtension-guardrail-end-treatment">http://www.barriersystemsinc.com/xtension-guardrail-end-treatment</a> | <br>Barrier Systems, Inc.         | X                           |                      | TL-3       |      | X      | X       | X                       | Impact head with locking bar to lock cables into place.<br>Strut between the first post and a front anchor post.<br>Steel and wood post options available.<br>Tension Cable Based Energy Absorber.<br>Two cables attached to soil anchor extend the entire length of the terminal.  | End of W-beam rail with offset of 0 to 4'-0". |

# Roadside Terminals

Proper grading in advance of the system and a traversable runout area beyond the beginning of the system is required for all terminals. When the unshielded upstream roadside is similar to the area downstream of the terminal and it is impractical to extend the barrier, a lesser runout area may be permissible. Refer to AASHTO Roadside Design Guide




| NAME  | MANUFACTURER  | PERFORMANCE CHARACTERISTICS |                      | TEST LEVEL |      | FLARED | TANGENT | 31-inch Height (option) | DISTINGUISHING CHARACTERISTICS  | LOCATIONS CAN BE USED   |
|---|---|-----------------------------|----------------------|------------|------|--------|---------|-------------------------|---|---|
|   |   | Energy Absorbing            | Non Energy Absorbing | NCHRP 350  | MASH |        |         |                         |   |   |
| X-Lite Terminal<br><a href="http://www.barriersystemsinc.com/xlite-end-terminal">http://www.barriersystemsinc.com/xlite-end-terminal</a>                              | <br>Barrier Systems, Inc.          | X                           |                      | TL-3       |      | X      | X       | X                       | Only approved with steel post.<br>Uses a slider mechanism between post 1 and 2 that gathers and retains the rail when hit.<br>The anchor consists of posts #1 and #2 connected by tension struts and a soil plate below grade on post #2.<br>Tangent systems uses 3 modified crimped posts and special shear bolts at second and third splice location.<br>Flared layout uses 6 modified crimped posts and special shear bolts at second splice location.<br>Flared layout uses blackout at post #2 where tangent does not. | End of W-Beam rail at tangent locations or at flared locations with a 4-ft offset |
| Wyoming Box-Beam End Terminal (WY-BET)<br><a href="http://www.highwayguardrail.com/products/et-wybet.html">http://www.highwayguardrail.com/products/et-wybet.html</a> | <br>Trinity Highway Products, LLC | X                           |                      | TL-3       |      |        | X       | N/A                     | Square Impact Face.<br>Nose plate welded and insert into box beam and held in place by an end wood post.<br>Energy absorbing material inside the tubing crushes as the rails telescope. Uses an oversized outer tube that telescopes over the downstream tube.<br>There is a strut between the first post and a second tube that has no post.   | End of 6" x 6" box beam.  |
| Bursting Energy Absorbing Terminal (BEAT)<br><a href="http://roadsystems.com/beat-beat-mt.html">http://roadsystems.com/beat-beat-mt.html</a>                          | <br>Road Systems, Inc.           | X                           |                      | TL-3       |      |        | X       | N/A                     | Square Impact Face.<br>The unique components of the terminal attach directly to standard box beam allowing part of box beam barrier to function as part of the terminal.<br>Breakaway steel end post and a cable anchor system.<br>Mandrel section of the impact head bursts the tubing to absorb the impact energy.<br>End tube is 1/8". Remaining tubes are 3/16".  | End of 6" x 6" box beam.  |

# Median Terminals

| NAME   | MANUFACTURER   | PERFORMANCE CHARACTERISTICS |                      | TEST LEVEL |      | 31-inch Height (option) | DISTINGUISHING CHARACTERISTICS  | HOW IT WORKS  | LOCATIONS CAN BE USED  |
|--|--|-----------------------------|----------------------|------------|------|-------------------------|---|---|--|
|  |  | Energy Absorbing            | Non-Energy Absorbing | NCHRP 350  | MASH |                         |   |   |  |
| Brakemaster 350<br><a href="http://www.energyabsorption.com/products/products_brakemaster350_crash.asp">http://www.energyabsorption.com/products/products_brakemaster350_crash.asp</a> | <br>Energy Absorption Systems, Inc. | X                           |                      | TL-3       |      |                         | Steel posts are not embedded.<br>Break Tension System at post #1.<br>Short W-Beam rail sections that translate over each other.   | During head-on impacts, the system telescopes rearward, using friction technology to decelerate the vehicle.                                      | Low frequency impact areas.<br>In the median with 1-way or 2-way traffic.  |
| Crash Cushion Attenuating Terminal (CAT-350)<br><a href="http://www.highwayguardrail.com/products/cat350.html">http://www.highwayguardrail.com/products/cat350.html</a>                | <br>Trinity Highway Products, LLC   | X                           |                      | TL-3       |      |                         | Breakaway wood posts and a cable anchorage system.<br>The beam elements are slotted W-beam rail sections.<br>Nose is 10 gauge And first set of rails are 12 gauge and second set of rails are heavier 10 gauge. | During head-on impacts, the system telescopes rearward, shearing out tabs between the slots to decelerate the vehicle.                            | Low frequency impact areas.<br>Attached directly to a W-Beam median barrier, or to a Thrie-Beam median barrier using the standard W-Beam to Thrie-Beam transition section. |
| TREND 350 Median<br><a href="http://www.highwayguardrail.com/products/et.html">http://www.highwayguardrail.com/products/et.html</a>  | <br>Trinity Highway Products, LLC  | X                           |                      | TL-3       |      | X                       | Square Impact Face.<br>All steel driven posts.<br>Breakaway steel posts at #1 and #2, standard steel guardrail posts #3 and beyond.<br>Steel Strut between posts #1 and #2.                                     | During head on impacts the system telescopes rearward, using between the system rails and the deformation of the rails to decelerate the vehicle. | Low Frequency impact areas.<br>Attached directly to a W-Beam Median Barrier, or to a Thrie-Beam median barrier using the standard W-Beam to Thrie-Beam transition section. |
| FLEAT Median Terminal (FLEAT-MT)<br><a href="http://www.roadsystems.com/fleat-mt.html">http://www.roadsystems.com/fleat-mt.html</a>  | <br>Road Systems, Inc.            | X                           |                      | TL-3       |      | X                       | Two impact heads, two modified W-beam rails, standard W-beam rails, two breakaway cable anchor assemblies and weakened steel or wood posts.<br>Uses many of the same components as the roadside FLEAT terminal. | During head-on impacts, the impact head translates down the rail kinking the rail to decelerate the vehicle.                                      | Low frequency impact areas.<br>Attached directly to a W-Beam median barrier, or to a Thrie-Beam median barrier using the standard W-Beam to Thrie-Beam transition section. |








# Median Terminals

| NAME  | MANUFACTURER   | PERFORMANCE CHARACTERISTICS |                      | TEST LEVEL |      | 31-inch Height (option) | DISTINGUISHING CHARACTERISTICS  | HOW IT WORKS  | LOCATIONS CAN BE USED  |
|---|--|-----------------------------|----------------------|------------|------|-------------------------|---|---|--|
|   |  | Energy Absorbing            | Non-Energy Absorbing | NCHRP 350  | MASH |                         |   |   |  |
| X-Tension Median Attenuator System (X-MAS)<br><a href="http://www.barriersystemsinc.com/#/x-tension-median">http://www.barriersystemsinc.com/#/x-tension-median</a>   | <br>Barrier Systems, Inc.         | X                           |                      | TL-3       |      | X                       | Impact head with locking bar to lock cables into place.<br><br>Two cables attached to soil anchor extend the entire length of the terminal.<br><br>Only available with steel posts.       | During head on impacts, X-Tension is energy absorbing with resistance at the impact head. As the head is pushed down the two cables, the cables are pulled through the cable friction plate in a twisting path which dissipates the energy. | Low frequency impact areas.<br><br>Attached directly to a W-Beam median barrier, or to a Thrie-Beam median barrier using the standard W-Beam to Thrie-Beam transition section. |
| Wyoming Box-Beam End Terminal (WY-BET)<br><a href="http://www.highwayguardrail.com/products/et-wybet.html">http://www.highwayguardrail.com/products/et-wybet.html</a> | <br>Trinity Highway Products, LLC | X                           |                      | TL-3       |      | N/A                     | Square Impact Face.<br><br>Nose plate welded and insert into box beam and held in place by a wood post<br><br>There is a strut between the first post and a second tube that has no post. | Energy absorbing material inside the tubing crushes as the rails telescope.<br><br>Uses an oversized outer tube that telescopes over the downstream tube.   | End of 6" x 8" box beam.   |
| Bursting Energy Absorbing Terminal-Median Terminal (BEAT-MT)<br><a href="http://roadsystems.com/beat-beat-mt.html">http://roadsystems.com/beat-beat-mt.html</a>       | <br>Road Systems, Inc.          | X                           |                      | TL-3       |      | N/A                     | Square Impact Face.<br><br>Attached directly to box beam rail end section.<br><br>Breakaway steel post and a cable anchor system.<br><br>End tube is 1/8". Remaining tubes are 3/16".     | Mandrel section of the impact head bursts the tubing to absorb the impact energy.   | End of 6" x 8" box beam.   |






# Crash Cushions






| NAME   | MANUFACTURER  | PERFORMANCE CHARACTERISTICS |                     |                         | TEST LEVEL |            | DIMENSIONS                  |                    |                         | LOCATIONS  |           | HOW IT WORKS | LOCATIONS CAN BE USED   | MAINTENANCE CHARACTERISTICS (per AASHTO RDG)   |             |
|--|---|-----------------------------|---------------------|-------------------------|------------|------------|-----------------------------|--------------------|-------------------------|------------|-----------|--------------|---|--|-------------|
|  |   | Non-Redirective, Gating     | Redirective, Gating | Redirective, Non-gating | NCHRP 350  | MASH       | WIDTH (without transitions) | LENGTH             | HEIGHT                  | PERMENANT  | TEMPORARY |              |   |  |             |
| Energite<br><a href="http://www.energyabsorption.com/products/products_energite_iii.asp">http://www.energyabsorption.com/products/products_energite_iii.asp</a>                      |    | Energy Absorption Systems   | X                   |                         |            | TL-2, TL-3 |                             | Varies to fit site | VARIABLE (30 to 65 mph) | 32" to 36" | X         | X            | Sand-filled plastic barrels dissipate the kinetic energy of an impacting vehicle by transferring the vehicle's momentum to the variable masses of sand in the barrels that are hit. | Temporary Construction Worksites i.e. Ends of Concrete Barriers; Gore Two sided Protection; Wide Medians; Bridge Piers | Sacrificial |
| Fitch<br><a href="http://www.energyabsorption.com/products/products_universal_barrels.asp">http://www.energyabsorption.com/products/products_universal_barrels.asp</a>               |    | Energy Absorption Systems   | X                   |                         |            | TL-2, TL-3 |                             | Varies to fit site | VARIABLE (30 to 65 mph) | 33"        | X         | X            | Sand-filled plastic barrels dissipate the kinetic energy of an impacting vehicle by transferring the vehicle's momentum to the variable masses of sand in the barrels that are hit. | Temporary Construction Worksites i.e. Ends of Concrete Barriers; Gore Two sided Protection; Wide Medians; Bridge Piers | Sacrificial |
| Big Sandy<br><a href="http://www.traffixdevices.com/cgi-local/SoftCart.exe/big sandy.htm?E+scstore">http://www.traffixdevices.com/cgi-local/SoftCart.exe/big sandy.htm?E+scstore</a> |   | Traffix Devices             | X                   |                         |            | TL-2, TL-3 |                             | Varies to fit site | VARIABLE (30 to 65 mph) | 35" to 47" | X         | X            | Sand-filled plastic barrels dissipate the kinetic energy of an impacting vehicle by transferring the vehicle's momentum to the variable masses of sand in the barrels that are hit. | Temporary Construction Worksites i.e. Ends of Concrete Barriers; Gore Two sided Protection; Wide Medians; Bridge Piers | Sacrificial |
| CrashGard<br><a href="http://www.plasticsafety.com/crash-cushions-sand-barrels">http://www.plasticsafety.com/crash-cushions-sand-barrels</a>   |  | Plastic Safety Systems      | X                   |                         |            | TL-2, TL-3 |                             | Varies to fit site | VARIABLE (25 to 70 mph) | 53"        | X         | X            | Sand-filled plastic barrels dissipate the kinetic energy of an impacting vehicle by transferring the vehicle's momentum to the variable masses of sand in the barrels that are hit. | Temporary Construction Worksites i.e. Ends of Concrete Barriers; Gore Two sided Protection; Wide Medians; Bridge Piers | Sacrificial |
| RAPTOR<br><a href="http://www.barriersales.com/products/raptor/">http://www.barriersales.com/products/raptor/</a>  |  | Barrier Systems, Inc.       | X                   |                         |            | TL-1       |                             | 45"                | 8'-0" and 9'-0"         | 41"        | X         |              | Enclosed energy absorbing material crushes on impact.   | Poles/trees located close to the road.   | Sacrificial |







# Crash Cushions

| NAME  | MANUFACTURER  | PERFORMANCE CHARACTERISTICS |                     |                         | TEST LEVEL |      | DIMENSIONS                  |  |        | LOCATIONS |           | HOW IT WORKS   | LOCATIONS CAN BE USED  | MAINTENANCE CHARACTERISTICS (per AASHTO RDG) |
|---|---|-----------------------------|---------------------|-------------------------|------------|------|-----------------------------|--|--------|-----------|-----------|--|--|--|
|   |   | Non-Redirective, Gating     | Redirective, Gating | Redirective, Non-gating | NCHRP 350  | MASH | WIDTH (without transitions) | LENGTH   | HEIGHT | PERMENANT | TEMPORARY |  |  |  |
| Absorb 350<br><a href="http://www.barriersystemsinc.com/#/absorb-350">http://www.barriersystemsinc.com/#/absorb-350</a>   | <br>Barrier Systems, Inc.      | X                           |                     |                         | TL-2, TL-3 |      | 24"                         | VARIABLE<br>19'-4"<br>(45 mph)<br>to<br>32'-0"<br>(60 mph) | 32"    | X         | X         | Plastic waterfilled elements allow vehicles to be decelerated. | Temporary Construction worksite.<br>Narrow spaces<br>Roadsides, exits and wide medians.<br>Any locations where it is safe for the post impact trajectories to be on the back side of the system. | Sacrificial                                  |
| ACZ350<br><a href="http://www.energyabsorption.com/products/products_acz.asp">http://www.energyabsorption.com/products/products_acz.asp</a>   | <br>Energy Absorption Systems | X                           |                     |                         | TL-2, TL-3 |      | 20"                         | 31'-7"   | 33"    |           | X         | Plastic waterfilled elements allow vehicles to be decelerated. | Temporary Construction worksite.<br>Narrow spaces<br>Roadsides, exits and wide medians.<br>Any locations where it is safe for the post impact trajectories to be on the back side of the system. | Sacrificial                                  |
| SLED<br><a href="http://traffixdevices.com/cgi-local/SoftCart.exe/newproducts.htm?L+scstore+tsjv8007ff838f8+1364541558">http://traffixdevices.com/cgi-local/SoftCart.exe/newproducts.htm?L+scstore+tsjv8007ff838f8+1364541558</a> | <br>Traffix Devices          | X                           |                     |                         | TL-2, TL-3 |      | 24"                         | 18'-11"<br>(45 mph)<br>and<br>26'-0"<br>(60 mph)           | 46"    |           | X         | Plastic waterfilled elements allow vehicles to be decelerated. | Temporary Construction worksite.<br>Narrow spaces<br>Roadsides, exits and wide medians.<br>Any locations where it is safe for the post impact trajectories to be on the back side of the system. | Sacrificial                                  |



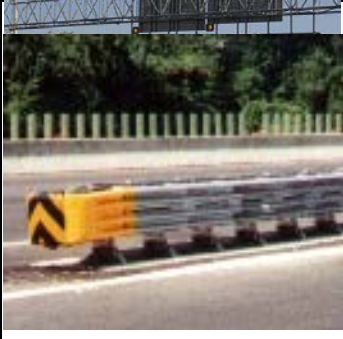
# Crash Cushions

| NAME  | MANUFACTURER  | PERFORMANCE CHARACTERISTICS |                     |                         | TEST LEVEL |      | DIMENSIONS                  |                     |                    | LOCATIONS |           | HOW IT WORKS | LOCATIONS CAN BE USED  | MAINTENANCE CHARACTERISTICS (per AASHTO RDG)  |             |
|---|---|-----------------------------|---------------------|-------------------------|------------|------|-----------------------------|---------------------|--------------------|-----------|-----------|--------------|--|---|-------------|
|   |   | Non-Redirective, Gating     | Redirective, Gating | Redirective, Non-gating | NCHRP 350  | MASH | WIDTH (without transitions) | LENGTH              | HEIGHT             | PERMENANT | TEMPORARY |              |  |   |             |
| NEAT<br><a href="http://www.energyabsorption.com/products/products_neat_crash.asp">http://www.energyabsorption.com/products/products_neat_crash.asp</a>   |    | Energy Absorption Systems   | X                   |                         |            | TL-2 |                             | 22.5"               | 10'-0"             | 32"       |           | X            | Energy absorbing hex foam surrounded by aluminum sheeting is crushed upon impact.  | Temporary Construction Worksite.<br><br>Any locations where it is safe for the post impact trajectories to be on the back side of the system. | Sacrificial |
| Thrie-Beam Bullnose Guardrail System<br><a href="http://www.fhwa.dot.gov/publications/publicroads/99janfeb/jungle.cfm">http://www.fhwa.dot.gov/publications/publicroads/99janfeb/jungle.cfm</a> |    | Generic                     |                     | X                       |            | TL-3 |                             | 14'-9" but can vary | Varies 50' minimum | 31.6"     |           | X            | Breakaway posts and slots in thrie-beam rail weaken the system allowing rail to collapse. Cables inside rail help to capture vehicle.                      | Wide medians, connections at bridge openings, bridge piers.   | Sacrificial |
| CIAS Connecticut Impact Attenuating System<br><a href="http://www.ct.gov/dot/cwp/view.asp?a=1387&amp;q=259608">http://www.ct.gov/dot/cwp/view.asp?a=1387&amp;q=259608</a>                       |   | Generic                     |                     | X                       |            | TL-3 |                             | 144"                | 25'-6"             | 48"       |           | X            | Hollow steel cylinders, some reinforced, crush upon impact. Total 14 cylinders.<br><br>Requires Paved Pad.   | Shield ends of wide hazards.  | Sacrificial |
| NCIAS Narrow Connecticut Impact Attenuating System<br><a href="http://www.ct.gov/dot/cwp/view.asp?a=1387&amp;q=259626">http://www.ct.gov/dot/cwp/view.asp?a=1387&amp;q=259626</a>               |  | Generic                     |                     | X                       |            | TL-3 |                             | 36"                 | 24'-0"             | 48"       |           | X            | Hollow steel cylinders, some reinforced, crush upon impact. Cables on the side are for traffic face impacts. Total 8 cylinders.<br><br>Requires Paved Pad. | Shield ends of narrow hazards.  | Sacrificial |
| Advanced Dynamic Impact Extension Module (ADIEM)<br><a href="http://www.highwayguardrail.com/products/adiem.html">http://www.highwayguardrail.com/products/adiem.html</a>                       |  | Trinity Highway Products    |                     | X                       |            | TL-3 |                             | 20"                 | 30'-0"             | Varies    |           | X            | Lightweight crushable concrete allows vehicles to be decelerated. The modules are placed on a high-strength tapered concrete base.                         | Wide median protection. Because of durability of concrete modules, system is more suited for temporary applications.                          | Sacrificial |

# Crash Cushions





| NAME   | MANUFACTURER  | PERFORMANCE CHARACTERISTICS |                     |                         | TEST LEVEL |      | DIMENSIONS                        |  |        | LOCATIONS |           | HOW IT WORKS  | LOCATIONS CAN BE USED  | MAINTENANCE CHARACTERISTICS (per AASHTO RDG) |
|--|---|-----------------------------|---------------------|-------------------------|------------|------|-----------------------------------|--|--------|-----------|-----------|---|--|--|
|  |   | Non-Redirective, Gating     | Redirective, Gating | Redirective, Non-gating | NCHRP 350  | MASH | WIDTH (without transitions)       | LENGTH   | HEIGHT | PERMENANT | TEMPORARY |   |  |  |
| BEAT-SSCC Single Sided Crash Cushion<br><a href="http://www.roadsystems.com/beat-sscc.html">http://www.roadsystems.com/beat-sscc.html</a>                                | <br>Road Systems, Inc.         |                             | X                   |                         | TL-3       |      | 24"                               | 28'-0" standard but available in lengths of 32', 36', 40', 44'   | 28"    | X         |           | Mandrel section of the impact head bursts the tubing to absorb the impact energy.<br><br>Attaches directly to rigid barriers, bridge rails and abutments.   | Shoulder Protection<br><br>Ground mounted or surface mounted post on a concrete pad. | Sacrificial                                  |
| BEAT-BP Bridge Pier System<br><a href="http://www.roadsystems.com/beat-bp.html">http://www.roadsystems.com/beat-bp.html</a>  | <br>Road Systems, Inc.         |                             | X                   |                         | TL-3       |      | Variable to adjust to pier widths | Variable to adjust to number of piers and pier spacing. i.e.<br>1 pier = 79',<br>2 pier = 103',<br>3 pier = 115',<br>4 pier = 151' | 28"    | X         |           | Mandrel section of the impact head bursts the tubing to absorb the impact energy.<br><br>System completely surrounds piers and has attenuator at both approach ends.  | Median protection at bridge piers.   | Sacrificial                                  |
| Quadtrend<br><a href="http://www.energyabsorption.com/products/products_quadtrend350_end.asp">http://www.energyabsorption.com/products/products_quadtrend350_end.asp</a> | <br>Energy Absorption Systems |                             | X                   |                         | TL-3       |      | 15"                               | 20'-0"   | 32"    | X         |           | Quadbeam rail sections translate downstream while sand filled containers are crushed.<br><br>Attaches directly to rigid barriers, bridge rails and abutments.<br><br>Requires redirecting cable on backside of system to direct the rail sections away from traffic.<br><br>Requires Paved Pad. | Shoulder protection at the end of rigid barriers                                     | Sacrificial                                  |
| X-TENUator<br><a href="http://www.barriersystemsinc.com/#/x-tenuator">http://www.barriersystemsinc.com/#/x-tenuator</a>  | <br>Barrier Systems, Inc.    |                             |                     | X                       | TL-3       |      | 21"                               | 24'-9"   | 27.75" | X         | X         | Impact head has locking bar to lock cables into place. The friction between the cables and the impact head dissipates crash energy.   | Median or shoulder Protection<br><br>Gore Two-side Protection                        | Sacrificial                                  |

# Crash Cushions

| NAME  | MANUFACTURER  | PERFORMANCE CHARACTERISTICS |                     |                         | TEST LEVEL |            | DIMENSIONS                  |  |   | LOCATIONS |           | HOW IT WORKS | LOCATIONS CAN BE USED   | MAINTENANCE CHARACTERISTICS (per AASHTO RDG)                  |                       |
|---|---|-----------------------------|---------------------|-------------------------|------------|------------|-----------------------------|--|---|-----------|-----------|--------------|---|---|-----------------------|
|   |   | Non-Redirective, Gating     | Redirective, Gating | Redirective, Non-gating | NCHRP 350  | MASH       | WIDTH (without transitions) | LENGTH   | HEIGHT  | PERMENANT | TEMPORARY |              |   |   |                       |
| QUEST<br><br><a href="http://www.energyabsorption.com/products/products_questimpact.asp">http://www.energyabsorption.com/products/products_questimpact.asp</a>  |    | Energy Absorption Systems   |                     |                         | X          | TL-2, TL-3 |                             | 24"<br><br>30"<br><br>36"  | 22'-0"<br>(45 mph or less)<br><br>28'-0"<br>(50 mph or greater)<br><br>34'-0"<br>(70 mph)   | 31"       | X         |              | Consists of a series of W-Beam fender panels supported by diaphragms with a trigger mechanism at the nose that releases the front assembly.<br><br>Requires Paved Pad.  | Median or shoulder Protection<br><br>Gore Two-side Protection | Refer to Manufacturer |
| Trinity Attenuating Crash Cushion (TRACC) Family<br><br><a href="http://www.highwayguardrail.com/products/tracc.html">http://www.highwayguardrail.com/products/tracc.html</a>   |    | Trinity Highway Products    |                     |                         | X          | TL-2, TL-3 |                             | FASTRACC: 24"<br><br>TRACC: 24"<br><br>SHORTRACC: 24"<br><br>WIDEFAC TRACC: 71"-139"<br><br>WIDETRACC: 58"-127"<br><br>WIDESHORT: 39"-108" | 25'-9"<br>(70 mph)<br><br>21'-3"<br>(50 mph or greater)<br><br>14'-3"<br>(45 mph or less)<br><br>25'-8" to 48'-10"<br>(70 mph)<br><br>21'-0" to 44'-2"<br>(50 mph or greater)<br><br>14'-1" to 37'-3"<br>(45 mph or less) | 32"       | X         | X            | Metal is sheared at the base and double sets of W-Beam rails translate.<br><br>Requires Paved Pad.  | Median or shoulder Protection<br><br>Gore Two-side Protection | Refer to Manufacturer |
| QuadGuard Family<br>QuadGuard, QuadGuard-II, QuadGuard M-10 (MASH)<br><br><a href="http://www.energyabsorption.com/products/products_quadguard2_crash.asp">http://www.energyabsorption.com/products/products_quadguard2_crash.asp</a> |  | Energy Absorption Systems   |                     |                         | X          | TL-2, TL-3 | TL-2, TL-3                  | NARROW: 24", 30" and 36"<br><br><br>WIDE: 69" or 90"   | VARIABLE 9'-0"<br>(45 mph) to 27'-0"<br>(70 mph)<br><br>VARIABLE 12'-0"<br>(50 mph) to 27'-0"<br>(70 mph)   | 32"       | X         | X            | Hex-foam cartridges crush upon impact. Specially fabricated side panels having four corrugations slide back on a single track when struck head-on.<br><br>Energy absorbing cartridges in each bay need to be replaced after a crash.<br><br>Requires Paved Pad.<br><br>Using a transition can be directly attached to a W-beam or thrie beam median barrier or concrete safety shape. | Median or shoulder Protection<br><br>Gore Two-side Protection | Reusable              |






# Crash Cushions

| NAME  | MANUFACTURER  | PERFORMANCE CHARACTERISTICS |                     |                         | TEST LEVEL |      | DIMENSIONS   |  |        | LOCATIONS |           | HOW IT WORKS  | LOCATIONS CAN BE USED   | MAINTENANCE CHARACTERISTICS (per AASHTO RDG) |
|---|---|-----------------------------|---------------------|-------------------------|------------|------|--|--|--------|-----------|-----------|---|---|--|
|   |   | Non-Redirective, Gating     | Redirective, Gating | Redirective, Non-gating | NCHRP 350  | MASH | WIDTH (without transitions)  | LENGTH   | HEIGHT | PERMENANT | TEMPORARY |   |   |  |
| Universal TAU II Family<br><br><a href="http://www.barriersystemsinc.com/#/tau-ii">http://www.barriersystemsinc.com/#/tau-ii</a>  | <br>Barrier Systems, Inc.      |                             |                     | X                       |            |      | NARROW:<br>Up to 36"<br><br>WIDE:<br>42" up to 102"<br>in 6"<br>increments | VARIABLE<br>8'-6"<br>(30 mph) to<br>37'-0"<br>(75 mph)<br><br>VARIABLE<br>8'-8"<br>(30 mph) to<br>31'-6"<br>(70 mph) | 32"    | X         | X         | Energy absorbing cartridges crush upon impact. Thrie beam panels slide back when struck head-on. Anchored at the front and rear of system.<br><br>Width and lengths are variable depending on hazards, site conditions and design speed.<br><br>Energy absorbing cartridges in each bay need to be replaced after a crash.<br><br>Requires Paved Pad. | Median or shoulder Protection<br><br>Gore Two-side Protection | Reusable                                     |
| EASI-CELL<br><br><a href="http://www.energyabsorption.com/products/products_easi-cell_cluster.asp">http://www.energyabsorption.com/products/products_easi-cell_cluster.asp</a>  | <br>Energy Absorption Systems | X                           |                     |                         |            |      | 51"<br>but can vary  | 8'-6"<br>but can vary  | 39"    | X         |           | Clusters of high molecular weight, high density polyethylene collapse to absorb energy of impacting vehicle.  | Low Speed, High frequency impact sites.                       | Low-Maintenance                              |
| TAU II R<br><br><a href="http://www.barriersystemsinc.com/#/restorable-crash-cushion-tau-ii-r-barrier-systems-inc">http://www.barriersystemsinc.com/#/restorable-crash-cushion-tau-ii-r-barrier-systems-inc</a>                           | <br>Barrier Systems, Inc.    |                             |                     | X                       |            |      | NARROW:<br>Up to 36"<br><br>WIDE:<br>42" up to 102"<br>in 6"<br>increments | VARIABLE<br>8'-6"<br>(30 mph) to<br>37'-0"<br>(75 mph)<br><br>VARIABLE<br>8'-8"<br>(30 mph) to<br>31'-6"<br>(70 mph) | 32"    | X         | X         | Hyperelastic modules crush upon impact. Thrie beam panels slide back when struck head-on. Anchored at the front and rear of system.<br><br>Width and lengths are variable depends on hazards, site conditions and design speed.<br><br>Requires Paved Pad.  | Median or shoulder Protection<br><br>Gore Two-Side Protection | Low-Maintenance                              |
| Compressor<br><br><a href="http://traffixdevices.com/cgi-local/SoftCart.exe/compressor.htm?L+scstore+tsjv8007ff838f8+1360807249">http://traffixdevices.com/cgi-local/SoftCart.exe/compressor.htm?L+scstore+tsjv8007ff838f8+1360807249</a> | <br>Traffix Devices          |                             |                     | X                       |            |      | 48.7"  | 21'-3"   | 53.5"  | X         |           | Modules molded from High Density Polyethylene absorb the impact energy. Steel side panel translate during end-on impacts. The assembly is combined with Uni-Base.<br><br>Requires Paved Pad.  | Median or shoulder Protection<br><br>Gore Two-Side Protection | Low-Maintenance                              |





# Crash Cushions

| NAME   | MANUFACTURER   | PERFORMANCE CHARACTERISTICS |                     |                         | TEST LEVEL |      | DIMENSIONS   |  |                  | LOCATIONS |           | HOW IT WORKS  | LOCATIONS CAN BE USED   | MAINTENANCE CHARACTERISTICS (per AASHTO RDG) |
|--|--|-----------------------------|---------------------|-------------------------|------------|------|--|--|------------------|-----------|-----------|---|---|--|
|  |  | Non-Redirective, Gating     | Redirective, Gating | Redirective, Non-gating | NCHRP 350  | MASH | WIDTH (without transitions)                              | LENGTH   | HEIGHT           | PERMENANT | TEMPORARY |   |   |  |
| Hybrid Energy Absorption Reusable Terminal (HEART)<br><br><a href="http://www.highwayguardrail.com/products/heart.html">http://www.highwayguardrail.com/products/heart.html</a>  | <br>Trinity Highway Products    |                             |                     | X                       |            |      |  | 15'-9 1/2" (45 mph or less)<br><br>28"<br><br>28'-3" (50 mph or greater)<br><br>30'-9" (70 mph)  | 32.2"            | X         | X         | High Molecular Weight / High Density Polyethylene side panels connected to steel diaphragms mounted on tubular steel tracks and compress upon impact.<br><br>Requires Paved Pad.                                    | Median or shoulder Protection<br><br>Gore Two-side Protection | Low-Maintenance                              |
| QuadGuard Elite and QuadGuard Elite M10 (MASH)<br><br><a href="http://www.energyabsorption.com/products/products_quadguard_elite.asp">http://www.energyabsorption.com/products/products_quadguard_elite.asp</a>                    | <br>Energy Absorption Systems   |                             |                     | X                       |            |      | NARROW: 24" to 36"<br><br>WIDE: 69" or 90"               | 5 Bay - 18'-0" (45 mph or less)<br><br>8 Bay - 27'-0" (50 mph or greater)<br><br>11 Bay - 36'-0" (70 mph)<br><br>7 Bay - 18'-0" (45 mph or less)<br><br>8 Bay - 27'-1" (50 mph or greater)<br><br>11 Bay - 36'-0" (70 mph) | 32"              | X         | X         | High Density Polyethylene cylinders and flex-belt nose collapse upon impact. Specially fabricated side panels having four corrugations slide back on a single track when struck head-on.<br><br>Requires Paved Pad. | Median or shoulder Protection<br><br>Gore Two-side Protection | Low-Maintenance                              |
| Reusable Energy Absorbing Crash Terminal REACT 350 & REACT 350 II<br><br><a href="http://www.energyabsorption.com/products/products_react350_impact.asp">http://www.energyabsorption.com/products/products_react350_impact.asp</a> | <br>Energy Absorption Systems |                             |                     | X                       |            |      | NARROW: 30"-36"<br><br>WIDE 60"<br>WIDE 96"<br>WIDE 120" | 13'-9" and 15'-3" (45 mph)<br><br>19'-5" and 21'-3" (62 mph) REACT II<br><br>26'-9" and 30'-7" (70mph)<br><br>30'-10"<br>34'-9"<br>33'-10"   | 51.5"<br><br>46" | X         | X         | Hollow high molecular weight, high density polyethylene cylinders crush upon impact.<br><br>Cables on the side are for side impacts.<br><br>Requires Paved Pad.   | Median or shoulder Protection<br><br>Gore Two-side Protection | Low-Maintenance                              |









# Crash Cushions

| NAME   | MANUFACTURER   | PERFORMANCE CHARACTERISTICS |                     |                         | TEST LEVEL |            | DIMENSIONS                  |   |  | LOCATIONS |           | HOW IT WORKS  | LOCATIONS CAN BE USED  | MAINTENANCE CHARACTERISTICS (per AASHTO RDG)                  |                 |
|--|--|-----------------------------|---------------------|-------------------------|------------|------------|-----------------------------|---|--|-----------|-----------|---|--|---|-----------------|
|  |  | Non-Redirective, Gating     | Redirective, Gating | Redirective, Non-gating | NCHRP 350  | MASH       | WIDTH (without transitions) | LENGTH  | HEIGHT   | PERMENANT | TEMPORARY |   |  |   |                 |
| QuadGuard LMC<br><br><a href="http://www.energyabsorption.com/products/products_quadguard_lmc.asp">http://www.energyabsorption.com/products/products_quadguard_lmc.asp</a> | <br>Energy Absorption Systems |                             |                     | X                       |            | TL-3       |                             | NARROW:<br>36"<br><br>WIDE:<br>69" or 90"                           | 5 Bay - 18'-0"<br>(45 mph or less)<br>8 Bay - 27'-0"<br>(50 mph or greater)<br>11 Bay - 36'-0"<br>(70 mph)<br><br>7 Bay - 18'-0"<br>(45 mph or less)<br>8 Bay - 27'-1"<br>(50 mph or greater)<br>11 Bay - 36'-0"<br>(70 mph) | 32"       | X         | X   | Elastic cylinders collapse upon impact. Specially fabricated side panels having four corrugations slide back on a single track when struck head-on.<br><br>Requires Paved Pad. | Median or shoulder Protection<br><br>Gore Two-side Protection | Low-Maintenance |
| Smart Cushion Innovations (SCI)<br><br><a href="http://www.workareaprotection.com/attenuator.htm">http://www.workareaprotection.com/attenuator.htm</a>                     | <br>SCI Products            |                             |                     | X                       |            | TL-2, TL-3 | 24"                         | 13'-8"<br>(45 mph or less)<br><br>21'-8 1/4"<br>(60 mph or greater) | 33.4"  | X         | X         | Hydraulic cylinders in the attenuator provides resistance used to stop the vehicle before it reaches the end of the cushion's usable length.<br><br>Requires Paved Pad. | Median or shoulder Protection<br><br>Gore Two-side Protection  | Low-Maintenance   |                 |

# Cable Barriers

\* Systems can be installed on 1V:6H and 1V:4H slopes, but cable configuration and offsets from the roadway edge and from the ditch bottom must be in accordance with test results and manufacturers' recommendations.

| NAME   | MANUFACTURER  | TEST LEVEL                    |              | POST TYPE | CABLE  | DISTINGUISHING CHARACTERISTICS   |  |
|--|---|-------------------------------|--------------|-----------|--|--|--|
|  |   | NCHRP 350                     | MASH         |           |  |  |  |
| Generic Weak-post Cable Guardrail<br>(Low Tension)   |    | Generic                       | TL-3         |           | I-Beam Post<br>Flanged steel U-Channel Post<br>Weakened rounded Timber Posts | 3 cable configuration.<br>Cables placed on one side of post; the side closer to the road - Roadside Application.<br>Two cables are placed on one side of the post and the other cable is placed on the opposite side - Median Application. | Cables are attached with hook bolts.<br>Uses a crashworthy generic terminals.<br>Typical Post Spacing 4 ft to 16 ft.   |
| Brifen Wire Rope Safety Fence (WRSF)<br><a href="http://www.brifenus.com">http://www.brifenus.com</a>                              |    | Brifen                        | TL-3<br>TL-4 |           | Z Shaped Posts   | 3 and 4 cable configuration.<br>Interweaving of cables between adjacent post.  | Top cable is placed in a slot at the center of the post.<br>Other 2 or 3 cables are weaved around post.<br>Uses proprietary terminal.<br>Posts can be driven or socketed.<br>Typical Post spacing 10.5 ft to 21 ft.  |
| Gibraltar<br><a href="http://gibraltartx.com">http://gibraltartx.com</a>   |   | Gibraltar                     | TL-3<br>TL-4 |           | C Channel Posts  | 3 and 4 cable configuration.<br>Pre-stretched or Non-pre-stretched.  | Cables are attached using a single steel hair pin.<br>Posts are placed such that adjacent post are on opposite sides of the cable.<br>Uses proprietary terminal.<br>Posts can be driven or socketed.<br>Typical Post spacing 10 ft to 30 ft.   |
| Nucor Steel Marion Cable Barrier System<br><a href="http://nucorhighway.com/nucable.html">http://nucorhighway.com/nucable.html</a> |  | Nucor Steel Marion            | TL-3<br>TL-4 |           | U Channel Posts  | 3 and 4 cable configuration.<br>Pre-stretched or Non-pre-stretched.  | Cables are attached using locking hook bolts or hook bolts and a strap.<br>2 of 4 cable are placed on one side of post and the other two are placed on the opposite side.<br>Uses proprietary terminal.<br>Posts can be driven or socketed.<br>Typical Post spacing 6.6 ft. to 20 ft.          |
| Safence<br><a href="http://www.gregorycorp.com/highway/safence.cfm">http://www.gregorycorp.com/highway/safence.cfm</a>             |  | Gregory Highway Products      | TL-3<br>TL-4 |           | C-shaped Posts   | 3 and 4 cable configuration.   | All cables are inserted in a slot at the center of the post and separated by plastic spacers.<br>Uses proprietary terminal.<br>Posts can be driven or socketed.<br>Typical Post spacing 6.5 ft to 33.2 ft.   |
| CASS<br><a href="http://www.highwayguardrail.com/products/cb.html">http://www.highwayguardrail.com/products/cb.html</a>            |  | Trinity Highway Products, LLC | TL-3<br>TL-4 |           | C-shaped and I-Beam Post (S3 & S4)   | 3 and 4 cable configuration.<br>Pre-stretched or Non-pre-stretched configuration.  | Cables are placed in a wave-shaped slot at the center of the post and separated by plastic spacers. Some versions also have cables that are supported on the flanges of the post.<br>Uses proprietary terminal.<br>Posts can be driven or socketed.<br>Typical Post spacing 6.5 ft to 32.5 ft. |