

# HIGHWAY PRODUCTS

**RSI**

Road Systems, Inc.

W-BEAM  
PRODUCTS

**PERFORMANCE  
MAKES THE DIFFERENCE**

BOX BEAM  
PRODUCTS

# SKT

The SKT® (Sequential Kinking Terminal) is a high-performance tangent end terminal.

Because of its unique design, the SKT is activated with lower forces than other tangent end terminal treatments

Thus, impact forces on occupants of errant vehicles are lessened. This also results in an impact head that is much easier to remove from damaged rail compared to competing systems.



SKT



## Additional features:

- Still available: 50' long version w/8 breakaway posts for Test Level 3 design speed
- Still available: SKT®-LITE, 37' 6" long TL-3 version
- Also available: Test Level 2 version in 25-foot length
- Uses standard 12.5-ft. or 25-ft. long guardrail sections
- Available in 2, 4, or 8-foundation tube designs if tubes are desired
- Components interchangeable with FLEAT and FLEAT-MT
- Can be used with **wood or steel breakaway posts**
- Can be installed on a 25:1 straight flare to achieve an offset up to 2 ft. over a 50-ft. length.

# FLEAT

For end-on impacts, the FLEAT is energy-absorbing and controls vehicles in a much more predictable manner. This means less recovery area is needed between the hazard and the end of the terminal. (See  $K.E. = \frac{1}{2}MV^2$  for more information.) Redirection in traffic face impacts is improved by the straight flare.

## Additional features:

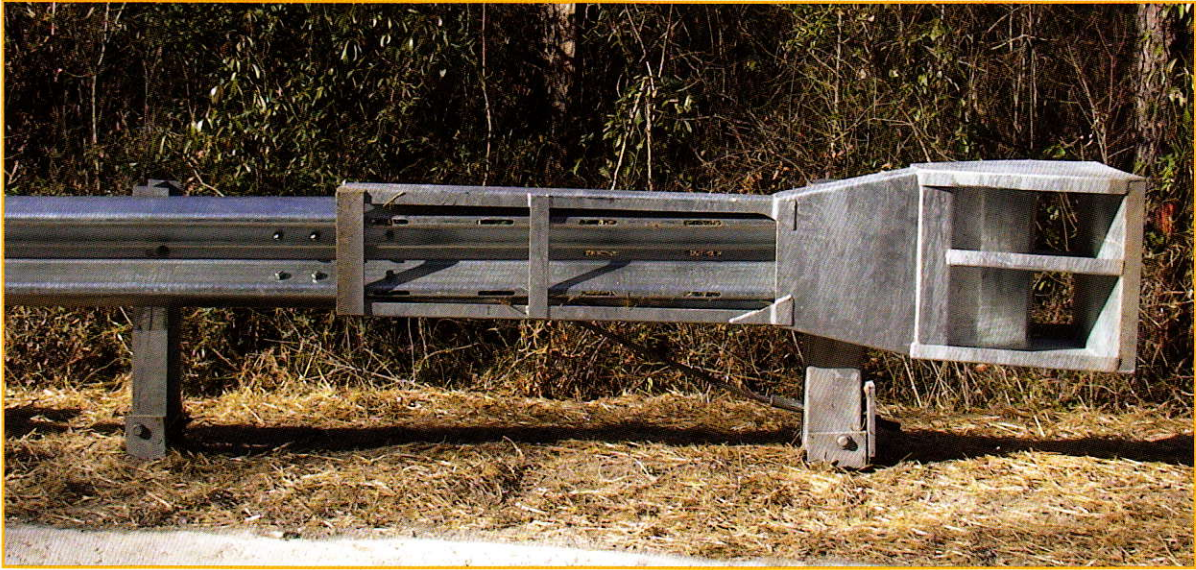
- Still available: 37' 6" long version with 7 breakaway posts for Test Level 3 design speed
- Also available: Test Level 2 version in 25-foot length
- Components interchangeable with SKT and FLEAT®-MT
- Variable offset from 2' 6" to 4' 0" may reduce need for costly site grading
- Uses standard 12.5-ft. or 25-ft. guardrail sections
- Can be used with **wood or steel breakaway posts**

FLEAT

The FLEAT® (FLared Energy-Absorbing Terminal) offers significant safety and economic advantages over parabolic curved flared terminals. The rail is installed at a "straight" flare (with a 2' 6"-4' 0" offset), and thus requires much less layout time than parabolic systems. Installation, maintenance and training requirements are reduced by the interchangeable parts with our other terminal systems and the limited number of small components.



# SKT-SP and FLEAT-SP



The market has embraced RSI's terminals that have only 12.5 ft. of distinct parts for the SKT and FLEAT end terminals.

The SKT®-SP and FLEAT®-SP Standard Post systems feature an enhanced upper and lower hinged Post #1 and a hinged Post #2 with no ground strut.

These models present cost savings, because from Post #3 and beyond, generic standard W6 steel guardrail posts and standard W-Beam rail sections are used.

This greatly reduces the need to keep specialized inventory on hand. Installation and maintenance is also greatly simplified. The SKT-SP and FLEAT-SP are NCHRP 350 tested and approved.



# SKT-MGS and FLEAT-MGS ROADSIDE TERMINALS

## 31" Tall MGS (Midwest Guardrail System) W-Beam and Terminals Have Greater Capacity



Existing W-Beam barriers were developed many years ago when the vehicle fleet was different than it is today. These existing W-Beam barriers measure 27 <sup>3</sup>/<sub>4</sub>" to the top of the rail. Because of the greater capacity and improved performance, recent FHWA Memos have instructed Transportation agencies to consider adopting 31" high guardrail designs instead of the 27 <sup>3</sup>/<sub>4</sub>" high systems for all new installations.

### *Differences between the MGS terminals and the original design terminals:*

- The MGS top-of-rail height is 31" rather than 27 <sup>3</sup>/<sub>4</sub>"
- The MGS blockout is 12" rather than 8"
- The MGS W-Beam rail splices occur mid-span between posts rather than at the post

In 2001–2002, the Midwest States Pooled Fund Program funded by 11 States recognized the need for a new **generic** strong-post W-Beam barrier that would be compatible with the newer higher-center-of-gravity vehicles crash-tested under the update to NCHRP 350 known as MASH. The result was the MGS Barrier and associated terminals.

*The SKT<sup>®</sup>-MGS and FLEAT<sup>®</sup>-MGS were successfully crash-tested in the MGS configuration. Both wood and steel breakaway posts are available.*



$$K.E. = \frac{1}{2} MV^2$$

## Energy-absorbing Terminals vs. Non-energy-absorbing Terminals

There are several models of Roadside W-Beam terminals available today, and they are distinguished by various features. One of the most important, fundamental distinctions to be made between them is whether they are energy-absorbing or non-energy-absorbing.

Although both performances are acceptable within the criteria of NCHRP 350, the FHWA strongly recommends the use of energy-absorbing terminals under certain site conditions — such as when there is a limited run-out area or a second hazard behind the rail. The agency has issued several memos on this subject and even produced a CD with crash test footage to make clear its preference for energy-absorbing terminals under these conditions.

In these cases, energy-absorbing terminals, such as our FLEAT, are superior to non-energy-absorbing terminals because of the proximity of the end terminal to the hazard. Performance truly makes the difference here, and the characteristics of energy-absorbing terminals are proven to outperform their non-energy-absorbing counterparts.

All terminals are gating. All W-beam terminals have a point somewhere along the length of the system where they are redirective when impacted on the traffic face. In the same way, all terminals allow the vehicle to gate through if impacted upstream of that point, which is called the length-of-need. But when impacted end-on, only energy-absorbing terminals have the ability to capture the vehicle and prevent it from traveling hundreds of feet beyond the end of the terminal.

Conditions at the installation site determine which type of terminal is most appropriate. Designers who call for these terminals **MUST** be made aware of these **impact performance differences**.

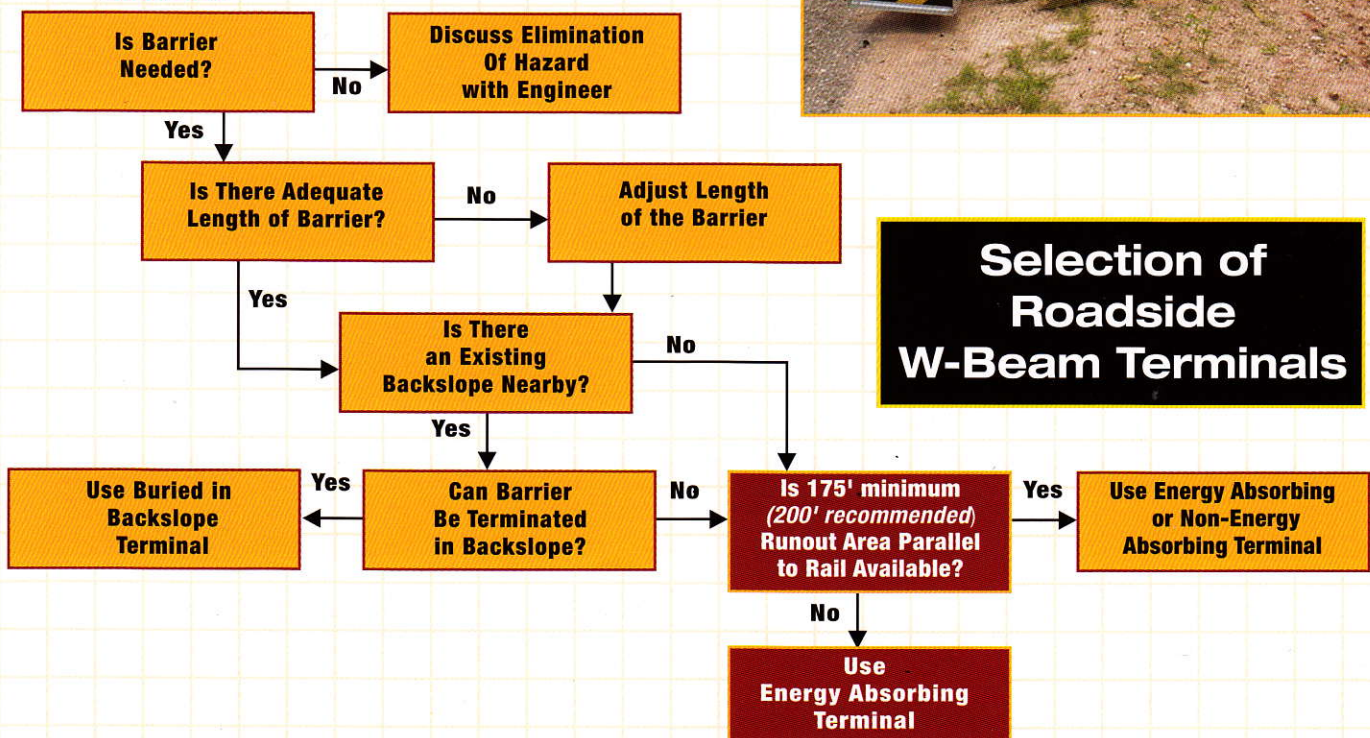
The initial Kinetic Energy (K.E.) of the vehicle is determined by the formula  $K.E. = \frac{1}{2} MV^2$  — where M is the vehicle's mass and V is the vehicle's initial velocity.



Kinetic Energy is absorbed during end-on impacts.



*The first question should be:*



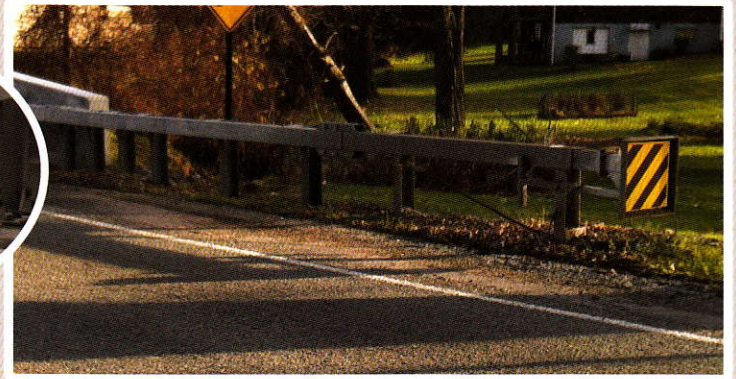
# BEAT-SSCC

The BEAT<sup>®</sup>-SSCC (Single-Sided Crash Cushion) is a revolutionary system that meets a need for which options are limited.

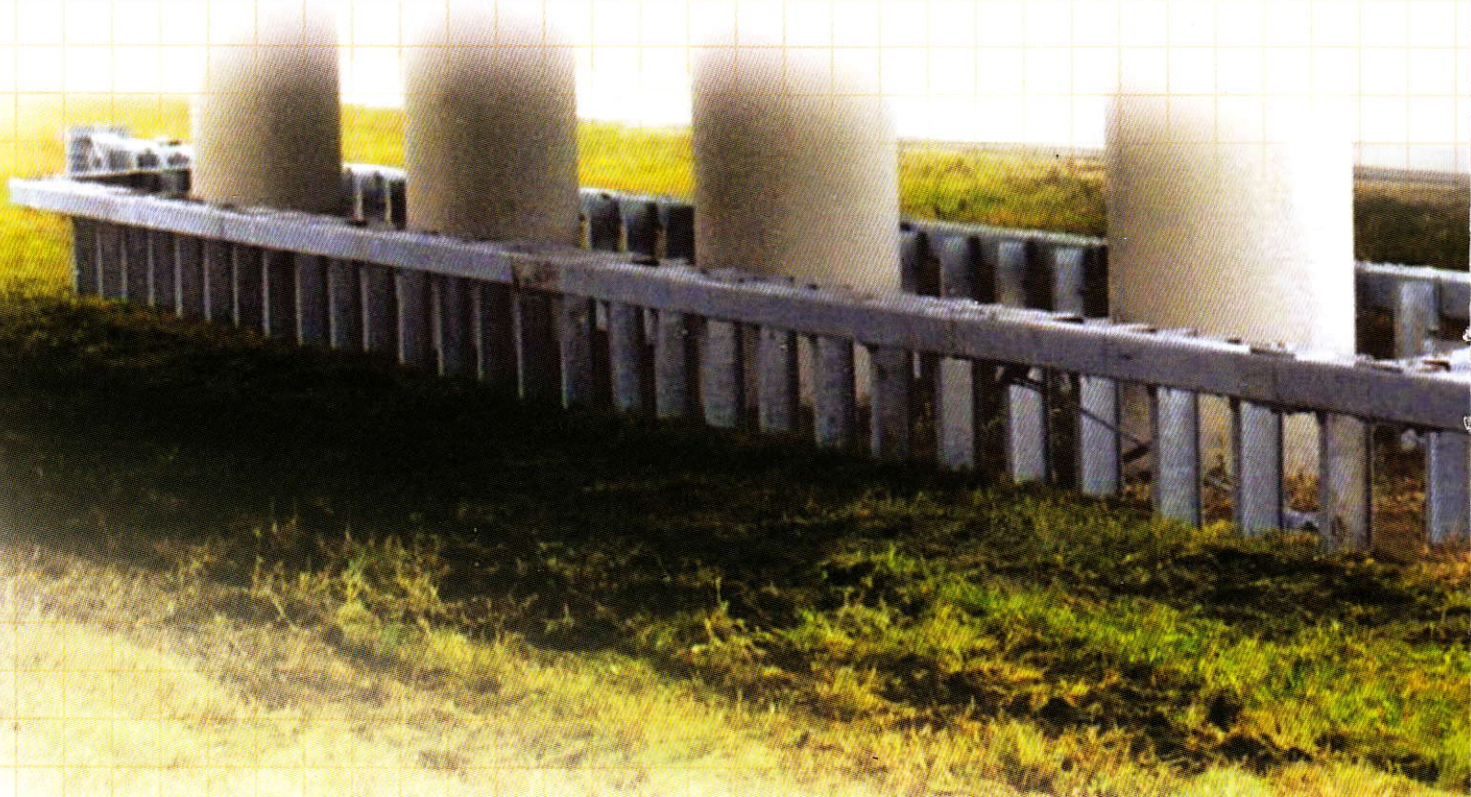
It attaches **directly** to bridge abutments, rigid barrier ends and many bridge rails, offering a low-cost alternative to other crash cushion systems for these and other locations. With its **short length** (25' 6" from post #1 to the end of the rigid hazard), it's ideal for restrictive site conditions often found on **rural roads**.

#### *Additional features:*

- Major components include 6" x 6" box beam, breakaway steel posts, cable assembly and rigid wall attachment
- Many components interchangeable with BEAT, BEAT-MT and BEAT-BP
- Available with surface- or ground-mounted posts
- Easily repaired on site; damaged components easy to identify



**Available in variable lengths:  
28', 32', 36', 40', 44' overall lengths**



# BEAT-BP

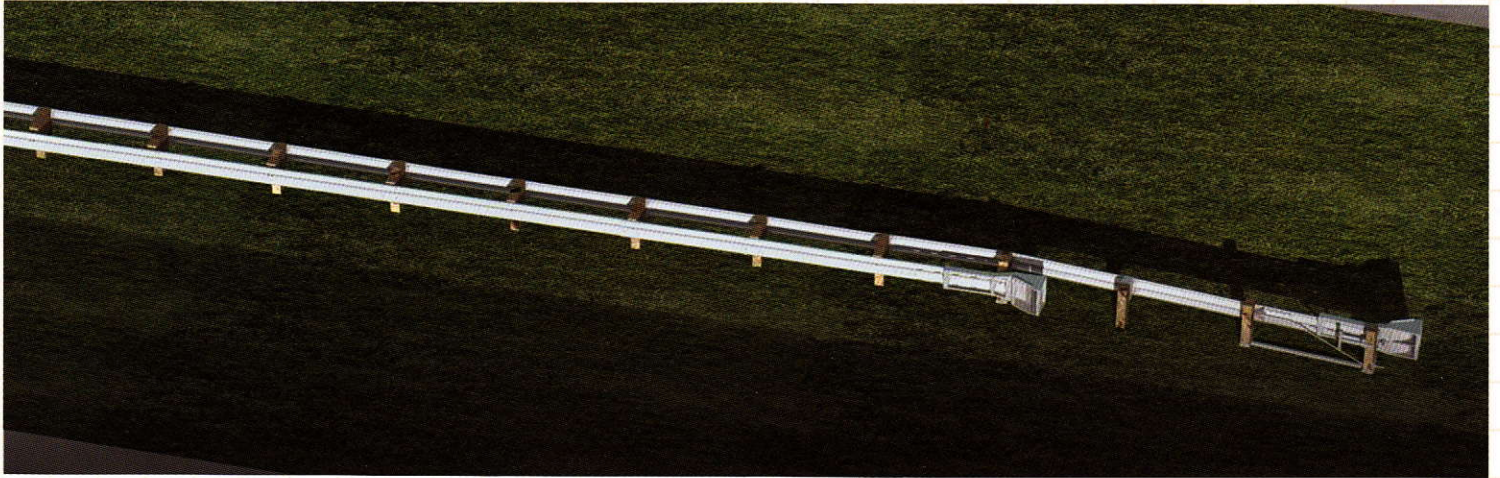
The BEAT®-BP (Bridge Pier) system provides a solution to an old problem: shielding bridge piers from impact.

The BEAT-BP is a revolutionary system that fills an application for which there are few other options. It is lower in cost, more appealing and more effective than other bridge pier protection systems. It also solves the problem of grass mowing and maintenance operations in Bullnose areas.

- Adjustable for pier spacing, pier diameter and for number of piers
- A self-contained system — additional or existing box beam barrier not required
- Major components: 6" x 6" box beam, breakaway steel posts, impact heads, standard steel posts, cable anchor assemblies and associated hardware
- Many components are interchangeable with other RSI products (BEAT, BEAT-MT, BEAT-SSCC)
- The condensed layout reduces exposure area and increases recovery area
- Can significantly reduce grading requirements



# FLEAT-MT



## FLEAT-MT approved in conventional 27<sup>3</sup>/<sub>4</sub>" rail height configuration or in 31" MGS rail height configuration

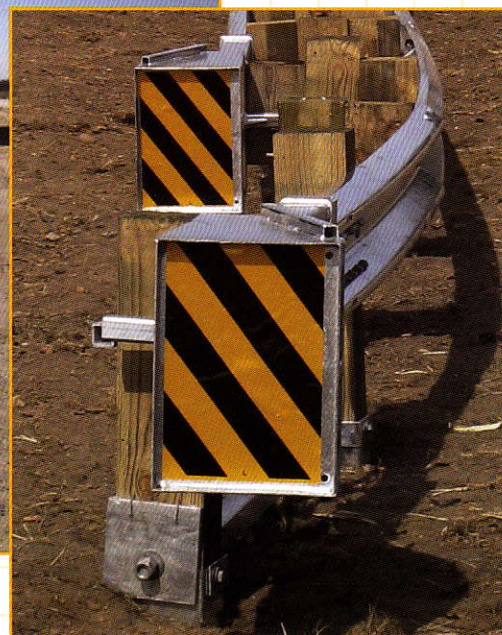
The economical FLEAT<sup>®</sup>-MT (Median Terminal) is designed to lower the cost of median terminals and greatly reduce maintenance inventory.

The FLEAT-MT attaches directly to median double-sided W-Beam rail.

The FLEAT-MT's design allows for fast and easy installation and repair.

### *Additional features:*

- 37' 6" long for Test Level 3 design speed
- Uses standard 12.5-ft. guardrail sections
- Can be used with **wood or steel breakaway posts**
- Components are interchangeable with SKT and FLEAT terminal systems





# BEAT and BEAT-MT

The BEAT® (Box Beam Bursting Energy Absorbing Terminal) provides solutions in box beam barrier protection for the roadside and median.

During end-on impacts, the impact head of the BEAT is forced into the end of the box beam section, causing the tube to burst. This safely decelerates the errant vehicle and brings it to a controlled stop.

The BEAT's short length of 14' makes it ideal for challenging installations. The downstream standard box beam serves as the necessary remaining terminal length.

The Roadside BEAT is designed to shield 6" x 6" tube barriers, while the BEAT®-MT Median Terminal protects 6" x 8" tube barriers. Many components are interchangeable between the two designs.

### *Additional features:*

- Uses many components common to standard box beam barriers
- Significantly fewer components than competing systems
- Much easier to install, maintain and repair than competing systems



BEAT



BEAT-MT



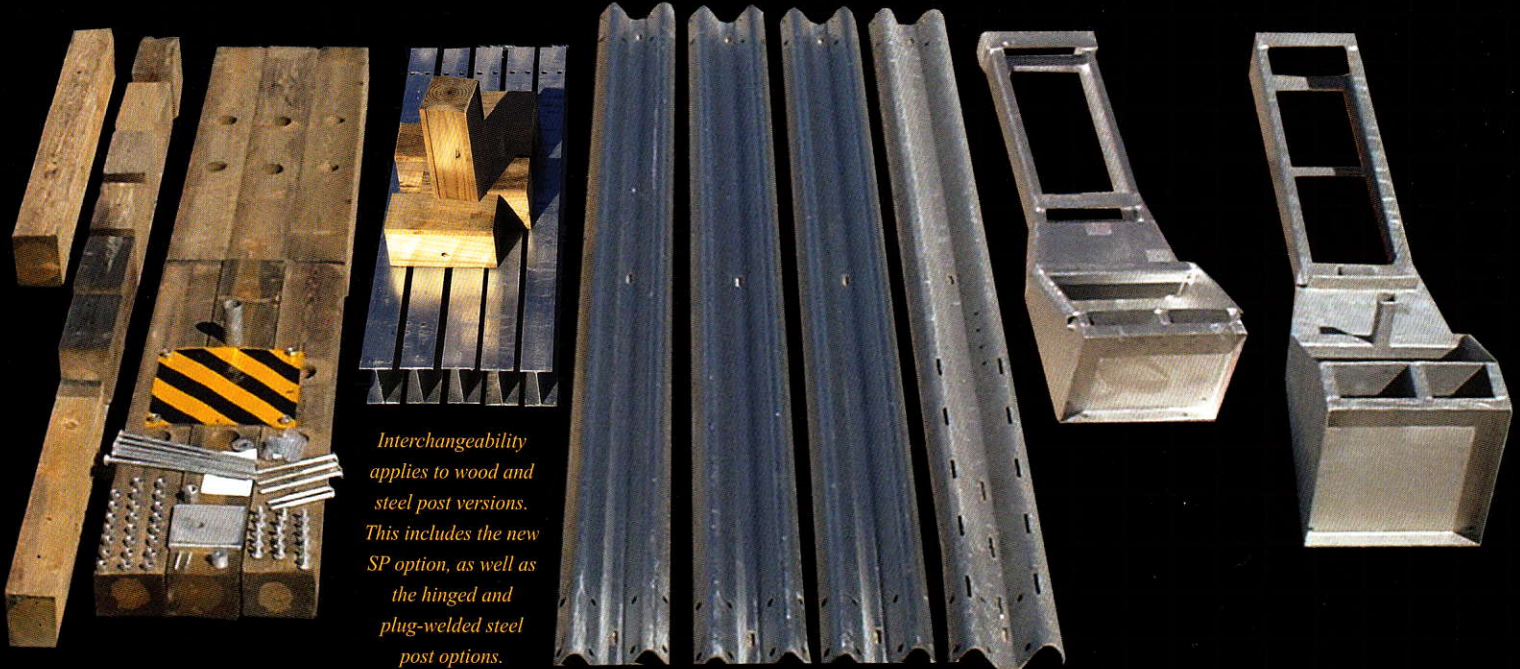
# THE RSI ADVANTAGE – MULTIPLE PRODUCTS, ONE INVENTORY

Think about it: if you're responsible for several different kinds of terminals, each with its own unique components — then you have to keep every single one of those unique components on-hand in inventory for repair and replacement.

But if you install several different kinds of terminals that

use mostly the same components, you can greatly reduce your inventory since most parts will have multiple applications.

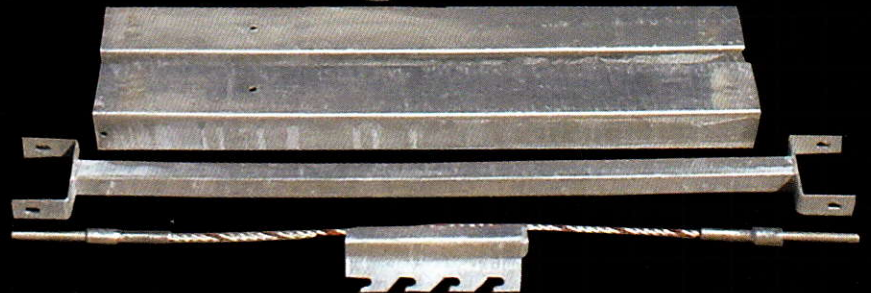
That's the simple philosophy behind RSI's SKT, FLEAT and FLEAT-MT lines: fewer unique components = smaller inventory = cost savings.



There are many different support post options available for the SKT & FLEAT as shown below.

This table is based on a 50'-0" long SKT system and a 37'-6" long FLEAT system.

Post options are available for 27 3/4" height terminals and 31" MGS Terminals.



SKT or FLEAT Support Post Design Options	Number of Bolted Hinged Steel Posts	Number of Standard Steel Guardrail Posts	Number of Plug Weld Steel Posts	Number of Wood BCT Posts 3'-9" long	Number of Wood CRT Posts 6'-0" long	Number of Foundation Tubes
SKT-SP & FLEAT-SP Standard Steel Guardrail Post System	SKT - 2 FLEAT - 2 Post #1 is 6" x 6" Tube w/ W6x15# lower post Post #2 is W6x9# Post w/W6x9# lower post	SKT - 6 FLEAT - 5	-0-	-0-	-0-	-0-
All Hinged Steel Post System	SKT - 2 long, 6 medium FLEAT - 2 long, 5 medium	-0-	-0-	-0-	-0-	-0-
All Plug Weld Steel Post System	-0-	-0-	SKT - 2 short, 6 medium- (or) SKT - 8 short FLEAT - 2 short, 5 medium	-0-	-0-	SKT - 2 (or) SKT - 8 FLEAT - 2
Hinged & Plug Weld Steel Post System	SKT - 2 long FLEAT - 2 long	-0-	SKT - 6 medium FLEAT - 5 medium	-0-	-0-	-0-
Hinged Steel & Wood Post System	SKT - 2 long FLEAT - 2 long	-0-	-0-	-0-	SKT - 6 FLEAT - 5	-0-
All Breakaway Wood Post System	-0-	-0-	-0-	SKT - 2, 4 or 8 FLEAT - 2 only	SKT - 6, 4 or 0 FLEAT - 5 only	SKT - 2, 4 or 8 FLEAT - 2 only

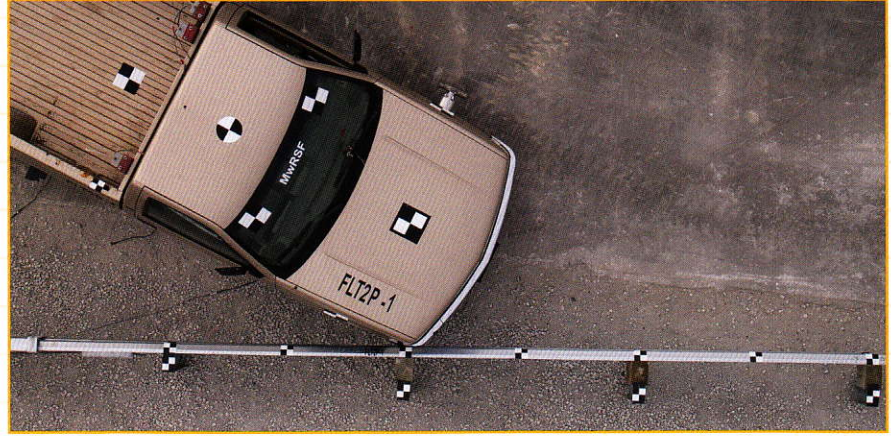
**REDUCE INVENTORY WITH INTERCHANGEABLE PARTS**

# NCHRP 350 and MASH

The NCHRP Report 350 crash testing and evaluation criteria has been updated. The publication is called **MASH** (Manual for Assessing Safety Hardware).

As part of the rewrite of NCHRP 350, there were three main focus areas:

- 1) Test Vehicles were updated to what's being produced and sold today.
- 2) Impact Condition Criteria were modified to correct inconsistencies and identify needed conditions.
- 3) Evaluation Criteria were modified to correct subjective criteria and better define other criteria.



Previous crash testing guidelines were published as NCHRP documents, but MASH is an AASHTO document. This will allow the state DOTs more control of the implementation and approval processes.

Here are some of the more significant changes from the NCHRP 350 conditions to the AASHTO MASH conditions:

- Pickup truck increases from 4,400 lbs. to 5,000 lbs.
- Small car increases from 1,800 lbs. to 2,420 lbs.
- Small car impact angle for barrier tests changed from 20 to 25 degrees
- Terminal & Crash Cushion impact angle changed from 20 to 25 degrees
- TL-4 truck increases from 17,650 lbs. to 22,000 lbs.
- TL-4 truck speed changed from 80 km/hr to 90 km/hr.

## Historical Review

Document Source	Year Issued	Test Vehicle & Weight
HRB #482	1962	4,400 lb. car
NCHRP #115	1971	4,000 to 5,000 lb. cars
NCHRP #118	1972	2,000 & 4,500 lb. cars
NCHRP #153	1974	2,250 & 4,500 lb. cars
TRC #191	1978	2,250 & 4,500 lb. cars
NCHRP #230	1981	1,800 & 4,500 lb. cars
NCHRP #350	1993	1,800 lb. car & 4,400 lb. pickup
MASH	2009	2,420 lb. car & 5,000 lb. pickup

## NCHRP 350 and MASH Test Levels for Barriers

Test Level	NCHRP 350 Vehicle Mass	MASH Vehicle Mass	NCHRP 350 Impact Speed	MASH Impact Speed	Impact Angle For Barriers
TL-1	1800 lb. (820 kg) 4400 lb. (2000 kg)	2420 lb. (1100 kg) 5000 lb. (2270 kg)	31 mph (50 km/hr)	31 mph (50 km/hr)	25 deg.
TL-2	1800 lb. (820 kg) 4400 lb. (2000 kg)	2420 lb. (1100 kg) 5000 lb. (2270 kg)	44 mph (70 km/hr)	44 mph (70 km/hr)	25 deg.
TL-3	1800 lb. (820 kg) 4400 lb. (2000 kg)	2420 lb. (1100 kg) 5000 lb. (2270 kg)	62 mph (100 km/hr)	62 mph (100 km/hr)	25 deg.
TL-4	17,650 lb. (8000 kg)	22,000 lb. (10,000 kg)	50 mph (80 km/hr)	56 mph (90 km/hr)	15 deg.
TL-5	79,400 lb. (36,000 kg) Tractor-Van Trailer	79,400 lb. (36,000 kg) Tractor-Van Trailer	50 mph (80 km/hr)	50 mph (80 km/hr)	15 deg.
TL-6	79,400 lb. (36,000 kg) Tractor-Tank Trailer	79,400 lb. (36,000 kg) Tractor-Tank Trailer	50 mph (80 km/hr)	50 mph (80 km/hr)	15 deg.

# ROADSIDE PRODUCTS

**R**oad Systems, Inc. (RSI) is the source for the highest-quality roadside products available today. The researchers and engineers who develop these products have been responsible for the most dramatic innovations in end terminals in the last three decades, setting a standard in the industry that remains unequaled.

Our technical support, marketing and service staffs work closely with Designers, Consultants, State Departments of Transportation, Counties and Municipalities, and Contractors to achieve innovative and cost-effective safety solutions.

All of our products have been successfully tested to meet NCHRP 350 criteria. In addition to on-site training, we can provide a variety of support materials to aid in the installation of our products to precise specifications.



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