

SMART CUSHION
Speed Dependent Crash Attenuators



STACKING UP THE SAVINGS

**SMART
CUSHION**
delivers value
in more ways
than one
following an
impact

While in these days of tight budgetary constraints and ever-increasing demands to 'do more with less' it may be tempting to opt for a product or solution with a lower initial cost, when it comes to road safety barriers, 'whole-of-life' cost benefit analysis is a critical consideration. Put simply, low initial cost does not always equate to getting a good return on the investment.

This is particularly true for impact protection systems, which, by their very nature, are extremely likely to require repairs and/or replacement parts following a vehicular impact.

With that in mind, what may appear at the outset to be a 'better value' solution can, in fact, end up being an extremely expensive selection, with repair costs quickly adding up to multiples of the initial purchase price.

If every impact results in a majority or even total replacement of the unit, perceived savings can soon disappear - and the costs will continue to escalate... year after year!

In recent months SMART CUSHION crash cushions have been deployed in major motorway projects in both Sydney and Auckland with a total of 30 units installed since June 2015. At the time of writing this article, there have been a total of 26 impacts (5 in Auckland and 21 in Sydney). When it came to repairing and resetting the SMART CUSHION units, the savings in spare part replacements alone are estimated to be tens of thousands of dollars when compared to all other crash cushions on the market.

Then there are the labour cost savings and the reduction in risk to crews at the worksite. Indeed, despite the different angles of impact and varying degrees of severity, the average repair time for all 26 impacts was less than one hour.

What's more, the majority of repairs only required the replacement of two 1/4" shear bolts - resulting in a total replacement parts cost of less than \$5 per unit reset. Several of

the more severe impacts also required the replacement of the unit's end delineation panel which has a replacement cost of less than \$150.

The arrival of the SMART CUSHION crash cushion on North American markets in 2005 has had a profound influence on what both contractors and departments of transport (DOTs) regard as good value in crash cushion selection.

However, SMART CUSHION delivers value in more ways than incredibly low cost of spare parts... and there are more happy stakeholders than just contractors.

SMART CUSHION is manufactured by Work Area Protection (WAP) in Illinois. Fifteen years ago an innovation group within WAP were assigned to design a crash cushion that delivers greater safety and better value. They were required to present a unique solution. The result is not only unique and writ in simplicity, from an engineering perspective, it is an elegant solution that could also almost be considered a thing of mathematical beauty - enabling full and accurate expression of the laws of physics and hydraulics.

Simple components, complex responsive interactions of forces, efficient use of materials and, above all, engineered safety regardless of the operation: installation, use, repair, removal, reinstatement or maintenance. A product of extraordinary value.

WAP Sales Manager Jeff Smith said that in the US market, momentum took a few years: "...they needed the field experience. The contractors were so conditioned to buying spare parts to restore the crash cushions, any cushions, that they did not understand it was a needless expense and a waste of precious time. But they soon learnt. Well, the smart ones have learnt."

BIG SAVINGS WITH SMART CUSHION

In an earlier submission (for the California DOT nomination to the AASHTO Technology Implementation Group on 9 September 2011) Caltrans gave the following statistics based in their 5 year experience from November 2006 to August 2011 (when there were approximately 140 units installed on California roads):

- ✓ Estimated saving on frontal impacts is \$2.7M. Additional side impact savings are estimated at \$1.4M+.
- ✓ An estimated 370 crew dispatches were not required because of no damage on side impacts.
- ✓ For estimated repairs, there are savings on frontal impacts and side impacts when compared to alternate attenuators.
- ✓ Savings can be significant due to the low cost of repair parts (approximately \$40), decreased repair time (usually under 30 minutes) and reduced worker exposure.
- ✓ It is possible to repair the attenuator during incident management thereby eliminating a future site visit and lane closure.

At the time of writing this article, there are currently more than 300 SMART CUSHION SCI100 units in use in California.



One of 27 SCI100 SMART CUSHION units installed along one of Sydney's motorways.



“We have SMART CUSHIONS that have been reset 20 times without any major repairs before they show signs of needing to be replaced.”

Delivering Value in Road Safety

So in the US what is considered good value? What does “value” look like? This question has exercised the minds of many State DOTs in the USA in the last half dozen years when the statistics were making it more evident day by day, month by month, that when life-cycle costing is considered, SMART CUSHION was the smart selection for high impact low maintenance areas. In fact it was becoming a no-brainer - if SMART CUSHION was first choice then daylight was second.

So in recent years in the US the Federal Highways (FHWA) and some DOT groups have been conducting surveys and webinars to discuss and to assess the available technologies. Most of these are available in the public domain through FHWA, AASHTO and academic websites like the University of Nebraska's.

The following comments of three DOTs are the AASHTO “Highways for Life” webinar on “Severe Duty Crash Cushions” in January 2013.

A Kansas DOT Engineer stated that a severe duty crash cushion has the following characteristics:

1. Devices that exhibit acceptable crash performance.
2. Devices that have reliable/consistent repair characteristics
3. Devices that are uncomplicated to repair and provide safe operation after repair
4. Devices that provide acceptable life cycle costs

The Engineer then noted that with respect to products that are uncomplicated to inspect and make repairs, that “...all steel products such as the SMART CUSHION are easy to inspect in the field.” Further, that there is a need to select cushions that expedite maintenance and reduce exposure to motorists.

The Nevada DOT Engineer stated that:

1. The DOT's main consideration is getting crews in and out as quickly and as safely as possible when resetting or repair a system; and

2. to select the type of system to be installed the main factors are survivability and lifetime costs, with life-cycle costs the key consideration.

This speaker then noted that only SMART CUSHION attenuators are used in the Las Vegas region and explained why SMART CUSHION is the predominant crash cushion in Las Vegas:

1. We need a system made from components that can survive the harsh environmental conditions in Las Vegas;
2. Use of one system reduces confusion;
3. Use of one system simplifies training;
4. Ease of repair;
5. The tool kit is in supervisors trucks;
6. Ability to repair or reset during initial accident call;
7. Reduced system down time;
8. Minimal out of service to the travelling public equals a safer highway system;
9. 15-30 minute repair or reset time reduces the exposure of the people working on the system to hazardous high speed traffic;



REPLACEMENT PARTS

When it comes to spare/replacement part costs after an impact, the SMART CUSHION is truly in a league of its own.

Due to the strength and durability of the side panels, the SMART CUSHION crash attenuator requires only a minimal inventory of spare parts, with the most commonly replaced parts being the two 1/4” shear bolts, with a total cost of less than \$5. Side impacts and reverse angle impacts within NCHRP 350 specifications should also not damage the attenuator.



The specification directed that only SMART CUSHION attenuators be used.

✓ **Impact Attenuator:** "This work shall consist of replacing damaged impact attenuators by furnishing and installing impact attenuators as directed by the Engineer. Replacement impact attenuators shall be SMART CUSHION Products Model SCI70GM or SCI100GM."

The SMART CUSHION story in the US is bigger than just these four states. It can be seen that not all DOTs have exactly the same value propositions, however all these expressions of value involve noting the key elements of safety and life-cycle costs.

Based on the results of the initial 26 impacts in Australia and New Zealand, SMART CUSHION is once again highlighting its value, and the importance of life-cycle costs to road authorities, contractor and councils alike.

Pictured above:

- Impact # 1: SMART CUSHION sled displaced less than 1.5 metres;
- Impact # 2: SMART CUSHION sled displaced less than 0.5 metres.
- Impact # 3: SMART CUSHION system fully compressed with displacement of 5.1 metres;
- Impact # 4: SMART CUSHION displaced approximately 1.2 metres.

10. Lifetime costs - especially in locations with high hit counts.

Finally the Engineer concludes that the SMART CUSHION system has proven to be an extremely safe and easy to work on and relatively inexpensive system to reset.

"Our goal is to reset the damaged SMART CUSHION prior to the accident being cleaned up. This is accomplished 90% of the time if crews are on duty and if we are notified (of the accident)."

"We average at least three resets or repairs a week in Las Vegas. SMART CUSHION units can be reset numerous times with proper inspections and maintenance. We have SMART CUSHIONS that have been reset 20 times without any major repairs before they show signs of needing to be replaced." "In the last 5 years we have installed 80 SMART CUSHION SCI100 systems to replace older type systems."

The Californian DOT Engineer said Caltrans suggested criteria for low maintenance and or self restoring units is based on:

1. History or expectation of multiple impacts per year;
2. Systems that recover or can be easily pulled/reset to their original shape, position and capabilities after being impacted with minimal need for additional parts;
3. Sites that require short repair time limitations or are difficult to assess; and
4. Repair costs parameters and thresholds for repair time may be considered.

The Caltrans Engineer then makes the following comments about SMART CUSHION:

1. Caltrans repair time experience is 15-30 minutes
2. Caltrans has 232+ units install state wide
3. Average cost for parts is less than \$50
4. Average repair cost per impact for high impact locations is less than \$100
5. Length of system advantageous in short gore areas.

On 15 June 2015, the Virginia DOT issued the following specification for state funded roads (that is, projects with no federal funding).

