



U.S. Department
of Transportation

**Federal Highway
Administration**

1200 New Jersey Ave., SE
Washington, D.C. 20590

April 20, 2016

In Reply Refer To:
HSST/B-252

Mr. Clayton Fredericks
KSI Global Australia
61 Foskew Way
Narngulu WA 6532
Australia

Dear Mr. Fredericks:

This letter is in response to your May 9, 2014 request for the Federal Highway Administration (FHWA) to review a roadside safety device, hardware, or system for eligibility for reimbursement under the Federal-aid highway program. This FHWA letter of eligibility is assigned FHWA control number B-252 and is valid until a subsequent letter is issued by FHWA that expressly references this device.

Decision

The following devices are eligible, with details provided in the form which is attached as an integral part of this letter:

- KSI Global Safety Roller roadside and median barrier.

Scope of this Letter

To be found eligible for Federal-aid funding, new roadside safety devices should meet the crash test and evaluation criteria contained in the American Association of State Highway and Transportation Officials' Manual for Assessing Safety Hardware (MASH). However, the FHWA, the Department of Transportation, and the United States Government do not regulate the manufacture of roadside safety devices. Eligibility for reimbursement under the Federal-aid highway program does not establish approval, certification or endorsement of the device for any particular purpose or use.

This letter is not a determination by the FHWA, the Department of Transportation, or the United States Government that a vehicle crash involving the device will result in any particular outcome, nor is it a guarantee of the in-service performance of this device. Proper manufacturing, installation, and maintenance are required in order for this device to function as tested.

This finding of eligibility is limited to the crashworthiness of the system and does not cover other structural features, nor conformity with the Manual on Uniform Traffic Control Devices.

Eligibility for Reimbursement

Based solely on a review of crash test results and certifications submitted by the manufacturer, and the crash test laboratory, FHWA agrees that the device described herein meets the crash test and evaluation criteria of the American Association of State Highway and Transportation Officials' Manual for Assessing Safety Hardware (MASH). Therefore, the device is eligible for reimbursement under the Federal-aid highway program if installed under the range of tested conditions.

Name of system: KSI Global Safety Roller roadside and median barrier

Type of system: Longitudinal Barrier

Test Level: MASH Test Level 4

Testing conducted by: Holmes Solutions

Date of request: May 9, 2014

Date of completed package: December 23, 2015

Full Description of the Eligible Device

The device and supporting documentation, including reports of the crash tests or other testing done, videos of any crash testing, and/or drawings of the device, are described in the attached form.

Notice

If a manufacturer makes any modification to any of their roadside safety hardware that has an existing eligibility letter from FHWA, the manufacturer must notify FHWA of such modification with a request for continued eligibility for reimbursement. The notice of all modifications to a device must be accompanied by:

- Significant modifications – For these modifications, crash test results must be submitted with accompanying documentation and videos.
- Non-signification modifications – For these modifications, a statement from the crash test laboratory on the potential effect of the modification on the ability of the device to meet the relevant crash test criteria.

FHWA's determination of continued eligibility for the modified hardware will be based on whether the modified hardware will continue to meet the relevant crash test criteria.

You are expected to supply potential users with sufficient information on design, installation and maintenance requirements to ensure proper performance.

You are expected to certify to potential users that the hardware furnished has the same chemistry, mechanical properties, and geometry as that submitted for review, and that it will meet the test

You are expected to certify to potential users that the hardware furnished has the same chemistry, mechanical properties, and geometry as that submitted for review, and that it will meet the test and evaluation criteria of the MASH.

Issuance of this letter does not convey property rights of any sort or any exclusive privilege. This letter is based on the premise that information and reports submitted by you are accurate and correct. We reserve the right to modify or revoke this letter if: (1) there are any inaccuracies in the information submitted in support of your request for this letter, (2) the qualification testing was flawed, (3) in-service performance or other information reveals safety problems, (4) the system is significantly different from the version that was crash tested, or (5) any other information indicates that the letter was issued in error or otherwise does not reflect full and complete information about the crashworthiness of the system.

Standard Provisions

- To prevent misunderstanding by others, this letter of eligibility designated as FHWA control number B-252 shall not be reproduced except in full. This letter and the test documentation upon which it is based are public information. All such letters and documentation may be reviewed upon request.
- This letter shall not be construed as authorization or consent by the FHWA to use, manufacture, or sell any patented system for which the applicant is not the patent holder.
- If the subject device is a patented product it may be considered to be proprietary. If proprietary systems are specified by a highway agency for use on Federal-aid projects: (a) they must be supplied through competitive bidding with equally suitable unpatented items; (b) the highway agency must certify that they are essential for synchronization with the existing highway facilities or that no equally suitable alternative exists; or (c) they must be used for research or for a distinctive type of construction on relatively short sections of road for experimental purposes. Our regulations concerning proprietary products are contained in Title 23, Code of Federal Regulations, Section 635.411.

Sincerely yours,



Michael S. Griffith
Director, Office of Safety Technologies
Office of Safety

Enclosures

Request for Federal Aid Reimbursement Eligibility of Highway Safety Hardware

Submitter	Date of Request:	March 29, 2016	<input checked="" type="radio"/> New <input type="radio"/> Resubmission
	Name:	Clayton Fredericks	
	Company:	Midwest Traffic Controllers Pty Ltd, Trading as KSI Global Australia	
	Address:	61 Foskew Way, Narngulu WA 6532	
	Country:	Australia	
	To:	Michael S. Griffith, Director FHWA, Office of Safety Technologies	

I request the following devices be considered eligible for reimbursement under the Federal-aid highway program.

System Type	Submission Type	Device Name / Variant	Testing Criterion	Test Level
'B': Barriers (Roadside, Median, Bridge Railings)	<input checked="" type="radio"/> Physical Crash Testing <input type="radio"/> Engineering Analysis	Safety Roller	AASHTO MASH	TL4

By submitting this request for review and evaluation by the Federal Highway Administration, I certify that the product(s) was (were) tested in conformity with the AASHTO Manual for Assessing Safety Hardware and that the evaluation results meet the appropriate evaluation criteria in the MASH.

Identification of the individual or organization responsible for the product:

Contact Name:	Clayton Fredericks	Same as Submitter <input checked="" type="checkbox"/>
Company Name:	Midwest Traffic Controllers Pty Ltd, Trading As KSI Global Australia	Same as Submitter <input checked="" type="checkbox"/>
Address:	61 Foskew Way, Narngulu WA 6532	Same as Submitter <input checked="" type="checkbox"/>
Country:	Australia	Same as Submitter <input checked="" type="checkbox"/>

Enter below all disclosures of financial interests as required by the FHWA 'Federal-Aid Reimbursement Eligibility Process for Safety Hardware Devices' document.

See attached letter titled 102350 25LT0815 100 (v1.0).

PRODUCT DESCRIPTION


<input checked="" type="radio"/> New Hardware or Significant Modification	<input type="radio"/> Modification to Existing Hardware	
Safety roller is a roadside barrier that is designed to prevent serious accidents and maximize driver safety by translating shock absorption and impact energy generated at vehicle crashes into rotational energy.		

CRASH TESTING

A brief description of each crash test and its result:

Required Test Number	Narrative Description	Evaluation Results
4-10 (1100C)	<p>25.0 deg 97.5kph No debris or detached elements penetrated or showed potential to penetrate the occupant compartment. No fragments were distributed outside of the vehicle trajectory and therefore did not present any undue hazard to other traffic, pedestrians or work zone personnel.</p> <p>The vehicle remained upright during and after the impact and vehicle stability was considered satisfactory. Occupant risk factors satisfied the test criteria and the vehicle exit trajectory remained within acceptable limits.</p>	PASS
4-11 (2270P)	<p>25.0 deg 98.4 kph No debris or detached elements penetrated or showed potential to penetrate the occupant compartment. No fragments were distributed outside of the vehicle trajectory and therefore did not present any undue hazard to other traffic, pedestrians or work zone personnel.</p> <p>The vehicle remained upright during and after the impact and vehicle stability was considered satisfactory. Occupant risk factors satisfied the test criteria and the vehicle trajectory remained within acceptable limits.</p>	PASS
4-12 (36000V)	<p>15.0 deg 89.8 kph No debris or detached elements penetrated or showed potential to penetrate the occupant compartment. No fragments were distributed outside of the vehicle trajectory and therefore did not present any undue hazard to other traffic, pedestrians or work zone personnel.</p> <p>The vehicle remained upright during and after the impact and vehicle stability was considered satisfactory. Occupant risk factors satisfied the test criteria and the vehicle exit trajectory remained within acceptable limits.</p>	PASS
4-20 (1100C)	Test 20 is an optional test for a transition section. This test is covered under a separate submission.	Non-Critical, not conducted
4-21 (2270P)	Test 21 is a test for a transition section. This test is covered under a separate submission.	Non-Critical, not conducted
4-22 (10000S)	Test 22 is a test for a transition section. This test is covered under a separate submission.	Non-Critical, not conducted

Full Scale Crash Testing was done in compliance with MASH by the following accredited crash test laboratory (cite the laboratory's accreditation status as noted in the crash test reports.):

Laboratory Name:	Holmes Solutions	
Laboratory Signature:		
Address:	Unit Five, 295 Blenheim Road, Christchurch 8042	Same as Submitter <input type="checkbox"/>
Country:	New Zealand	Same as Submitter <input type="checkbox"/>
Accreditation Certificate Number and Dates of current Accreditation period :	ISO/IEC 17025:2005; IANZ Certificate Number: 1022 (23/07/2009 thru 19/06/2016)	

Submitter Signature*: 

Submit Form

ATTACHMENTS

Attach to this form:

- 1) Additional disclosures of related financial interest as indicated above.
- 2) A copy of the full test report, video, and a Test Data Summary Sheet for each test conducted in support of this request.
- 3) A drawing or drawings of the device(s) that conform to the Task Force-13 Drawing Specifications [Hardware Guide Drawing Standards]. For proprietary products, a single isometric line drawing is usually acceptable to illustrate the product, with detailed specifications, intended use, and contact information provided on the reverse. Additional drawings (not in TF-13 format) showing details that are relevant to understanding the dimensions and performance of the device should also be submitted to facilitate our review.

FHWA Official Business Only:

Eligibility Letter		AASHTO TF13	
Number	Date	Designator	Key Words

Federal Highways Administration
Office of Safety
1200 New Jersey Avenue, SE
Washington, D.C
20590
United States of America



21 August 2015

Attention: Nick Artimovich

Testing activities completed for KSI Global Australia

I am writing to you regarding the financial interest disclosures requested by the Federal Highways Administration.

Holmes Solutions completes testing activities for the KSI Global Australia. For the completion of this service we receive payment in the form of Professional Fees. In no circumstances are the fees we received linked to the performance of the product nor the outcome of the tests. In accordance with the requirements of our ISO 17025 accreditation, I can confirm that all of our testing activities are completed free from undue commercial influence.

Holmes Solutions does not have, nor ever had, any financial interest in KSI Global Australia or any of the products that they develop and sell. Holmes Solutions does not receive any research funding (or other forms of research support) from KSI Global Australia. We have no patents, copyrights or other intellectual property rights on any of the KSI products. We have no business ownership or investment interest in KSI Global Australia. No licencing agreements exist between Holmes Solutions and KSI Global Australia.

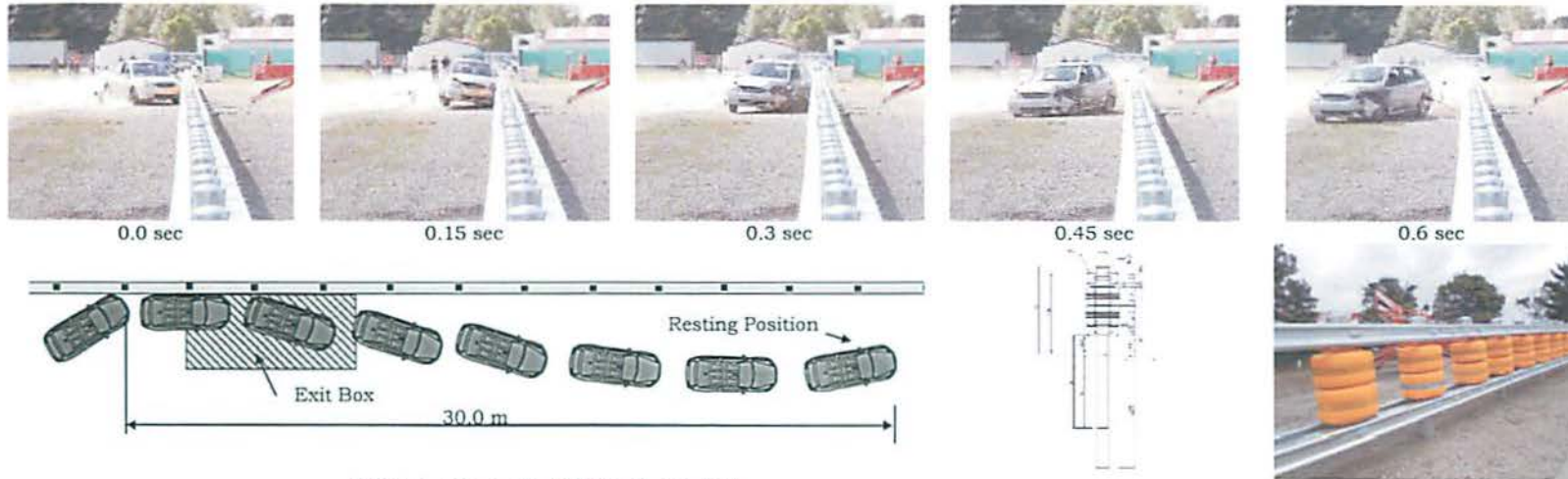
The corporate structure of Holmes Solutions is part of the wider Holmes Group of entities, the parent company being Holmes Group Limited. Holmes Group Limited currently has, and has previously held, ownership in a series of ventures, all of which are operated as separate legal entities. Holmes Solutions has no financial interest in any of the other Holmes Group entities or any of the products that they develop and sell. Holmes Solutions does not receive any research funding or other forms of research support from the other Holmes Group entities. We have no patents, copyrights, or other intellectual property rights on any of the products sold or distributed by any of the Holmes Group entities.

I trust this letter provides you with the information you require, however please feel free to contact me directly should you need any additional information or wish to seek clarification on the information contained above.

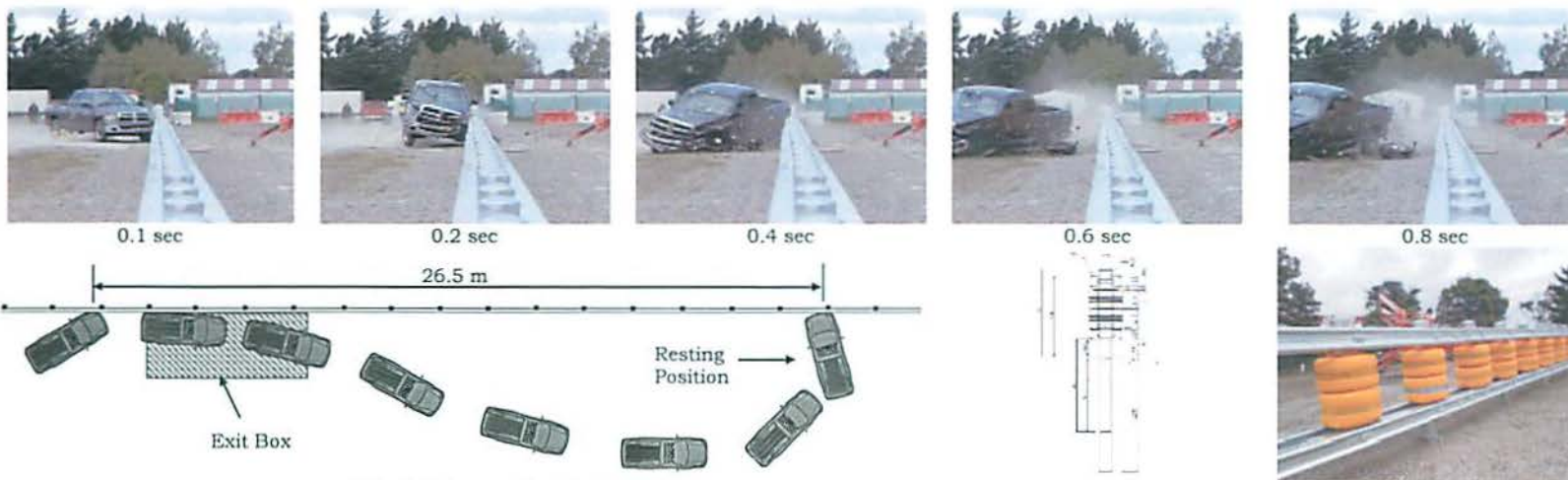
Yours Sincerely,



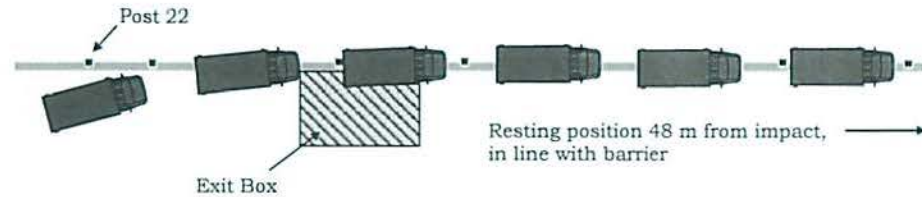
Dr Chris Allington, B.E (Hons), PhD (Civil)
CEO
Holmes Solutions LP



<ul style="list-style-type: none"> • TEST ARTICLE KSI Global Australia PTY LTD Safety Roller Barrier System • TOTAL LENGTH 60 m • KEY ELEMENTS - BARRIER <ul style="list-style-type: none"> Description..... Roller Barrier with box rail and steel line posts Length 60.0 metre LON Rail Height..... 970 mm Post Spacing 667 mm nominal • TEST VEHICLE <ul style="list-style-type: none"> Designation..... 1100C Make/Model..... 2003 Kia Rio Dimensions (lwh)..... 4225 x 1685 x 1420 mm Curb Weight 1060 kg Test Inertial weight 1082 kg Gross Static weight 1157 kg • IMPACT CONDITIONS <ul style="list-style-type: none"> Speed 97.5 kph Angle 25° Impact Point 1.0 m upstream of line post 22 • EXIT CONDITIONS <ul style="list-style-type: none"> Exit Speed est. 67.0 kph Exit Angle 14.2° 	<ul style="list-style-type: none"> • POST IMPACT VEHICLE BEHAVIOUR <ul style="list-style-type: none"> Vehicle Stability..... Good Vehicle Stopping Distance... 30 m • VEHICLE SNAGGING None • VEHICLE POCKETING None • OCCUPANT IMPACT VELOCITY <ul style="list-style-type: none"> Longitudinal 0.2 m/s at 0.0867 sec Lateral (optional)..... 8.9 m/s at 0.0867 sec • OCCUPANT RIDEDOWN DECELERATION <ul style="list-style-type: none"> x-direction..... 0.6 g (0.0976-0.1076 seconds) y-direction..... 7.0 g (0.0868-0.0968 seconds) THIV (optional)..... 7.8 m/s at 0.0836 seconds PHD (optional)..... 7.9 g (0.0836-0.0936 seconds) • TEST ARTICLE DAMAGE Low • TEST ARTICLE DEFLECTIONS <ul style="list-style-type: none"> Dynamic..... 0.135 m Permanent..... 0.060 m Working Width..... 0.135 m • VEHICLE DAMAGE - EXTERIOR <ul style="list-style-type: none"> VDS 11-LFQ-3 CDC 11FLEE2 Max. Deformation 95 mm
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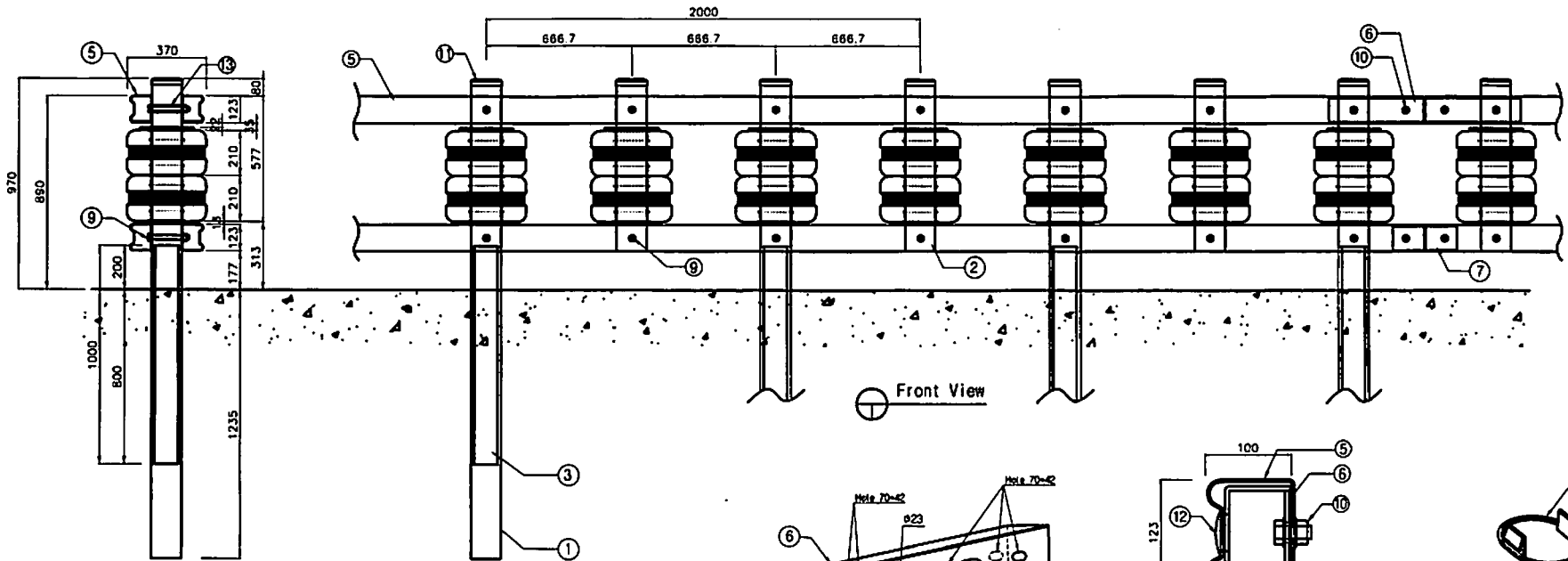


<ul style="list-style-type: none"> • TEST ARTICLE • TOTAL LENGTH • KEY ELEMENTS - BARRIER <ul style="list-style-type: none"> Description..... Roller Barrier with box rail and steel line posts Length 60.0 metre LON Rail Height..... 970 mm Post Spacing 667 mm nominal • TEST VEHICLE <ul style="list-style-type: none"> Designation..... 2270P Make/Model..... 2005 Dodge Ram 1500 Quad Cab Dimensions (lwh)..... 5720 x 2050 x 1930 mm Curb Weight 2260 kg Test Inertial weight 2282 kg Gross Static weight 2282 kg • IMPACT CONDITIONS <ul style="list-style-type: none"> Speed 98.4 kph Angle 25° Impact Point 0.7 m upstream of line post 22 • EXIT CONDITIONS <ul style="list-style-type: none"> Exit Speed est. 48.3 kph Exit Angle 21° 	<p>KSI Global Australia PTY LTD Safety Roller Barrier System 60 m</p>	<ul style="list-style-type: none"> • POST IMPACT VEHICLE BEHAVIOUR <ul style="list-style-type: none"> Vehicle Stability..... Good Vehicle Stopping Distance.... 26.5 metres • VEHICLE SNAGGING None • VEHICLE POCKETING None • OCCUPANT IMPACT VELOCITY <ul style="list-style-type: none"> Longitudinal 0.1 m/s at 0.1309 sec Lateral (optional)..... 5.9 m/s at 0.1309 sec • OCCUPANT RIDEDOWN DECELERATION <ul style="list-style-type: none"> x-direction..... 1.1 g (0.1606 - 0.1706 s) y-direction..... 9.7 g (0.1477 - 0.1577 s) THIV (optional)..... 5.6 m/s at 0.1278 sec PHD (optional)..... 9.7 g (0.1477 - 0.1577 s) • TEST ARTICLE DAMAGE Low • TEST ARTICLE DEFLECTIONS <ul style="list-style-type: none"> Dynamic..... 0.458 m Permanent..... 0.270 m Working Width..... 0.293 m • VEHICLE DAMAGE - EXTERIOR <ul style="list-style-type: none"> VDS 11-LFQ-3 CDC 11FLEE2 Max. Deformation 145 mm
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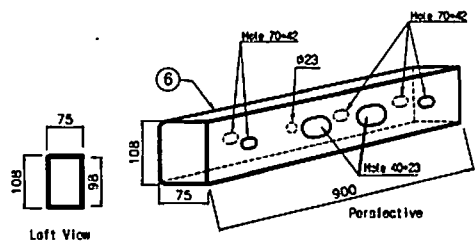
<ul style="list-style-type: none"> • TEST ARTICLE KSI Global Australia PTY LTD Safety Roller Barrier System • TOTAL LENGTH 60 m • KEY ELEMENTS - BARRIER <ul style="list-style-type: none"> Description..... Roller Barrier with box rail and steel line posts Length 60.0 metre LON Rail Height..... 970 mm Post Spacing 667 mm nominal • TEST VEHICLE <ul style="list-style-type: none"> Designation..... 10,000S Make/Model..... 2001 Mitsubishi Fuso Fighter Dimensions (lwh)..... 7665 x 2040 x 3100 mm Curb Weight 5760 kg Test Inertial weight 9960 kg Gross Static weight 9960 kg • IMPACT CONDITIONS <ul style="list-style-type: none"> Speed 89.8 kph Angle 15° Impact Point 0.7 m upstream of line post 22 • EXIT CONDITIONS <ul style="list-style-type: none"> Exit Speed est. 8.0 kph Exit Angle 0.0° 	<ul style="list-style-type: none"> • POST IMPACT VEHICLE BEHAVIOUR <ul style="list-style-type: none"> Vehicle Stability..... Low Vehicle Stopping Distance.... 48 metres • VEHICLE SNAGGING None • VEHICLE POCKETING None • OCCUPANT IMPACT VELOCITY <ul style="list-style-type: none"> Longitudinal 0.5 m/s at 0.2483 sec Lateral (optional)..... 2.8 m/s at 0.2483 sec • OCCUPANT RIDEDOWN DECELERATION <ul style="list-style-type: none"> x-direction..... 0.6 g (1.4851-1.4951 seconds) y-direction..... 4.3 g (0.3585-0.3685 seconds) THIV (optional)..... 2.5 m/s at 0.2359 seconds PHD (optional)..... 4.3 g (0.3585-0.3685 seconds) • TEST ARTICLE DAMAGE Mild • TEST ARTICLE DEFLECTIONS <ul style="list-style-type: none"> Dynamic..... 0.215 m Permanent..... 0.190 m Working Width..... 4.85 m • VEHICLE DAMAGE - EXTERIOR <ul style="list-style-type: none"> VDS 11-LFQ-5 CDC 11FLEE2 Max. Deformation 280 mm
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Safety Roller (GS-G506-TL4)



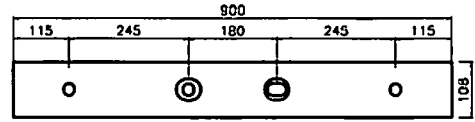
Right View

Front View



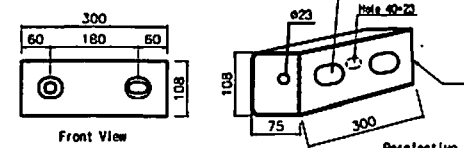
Left View

Sleeve Detail View



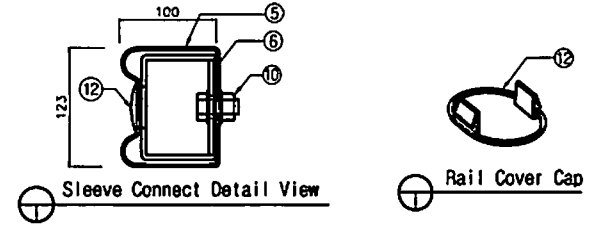
Front View

Sleeve Detail View



Front View

Sleeve Detail View



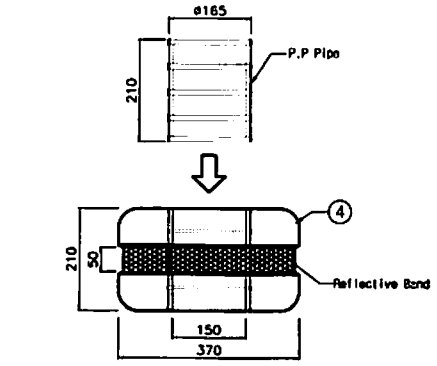
Sleeve Connect Detail View

Rail Cover Cap

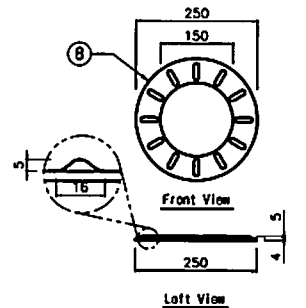
Material List

(1 SPAN : 2M)

NO	PRODUCT	STANDARD	UNIT	QUANTITY	비고
①	Post (SS400)	φ 139.8 X 2200L X 4.5T	EA	2	Hot Dip Galv.
②	Post (SS400)	φ 139.8 X 780L X 4.5T	EA	2	Hot Dip Galv.
③	Inner Post (SS400)	φ 127 X 1000L X 4.3T	EA	2	Hot Dip Galv.
④	Shock Absorbing Roller P.P. Pipe Reflective Band	φ 370 X 210 φ 165 X 210 X 8T 50 X 1250L	EA	8 6 6	E.V.A P.P Reflective Sheet
⑤	Safety Rail (SS400)	123X100X5, 995X3, 0T	M	8	Hot Dip Galv.
⑥	Sleeve Rail (SS400)	108X75X300X3, 0T	EA	0.67	Hot Dip Galv.
⑦	Sleeve Rail (SS400)	108X75X300X3, 0T	EA	0.67	Hot Dip Galv.
⑧	Stopper Board	φ 250 X 8T	EA	12	P.E
⑨	H-Bolt/Nut/H-Washer	φ 19 X 200L	EA	6	Hot Dip Galv.
⑩	H-Bolt/Nut/H-Washer	φ 19 X 40L	EA	2.67	Hot Dip Galv.
⑪	Post Cap	φ 139.8X8	EA	3	Hot Dip Galv.
⑫	Rail Cover Cap	80 X 45	EA	13	P.E
⑬	Pipe (SS400)	φ 34 X 125L X 4, 0T	EA	3	Hot Dip Galv.



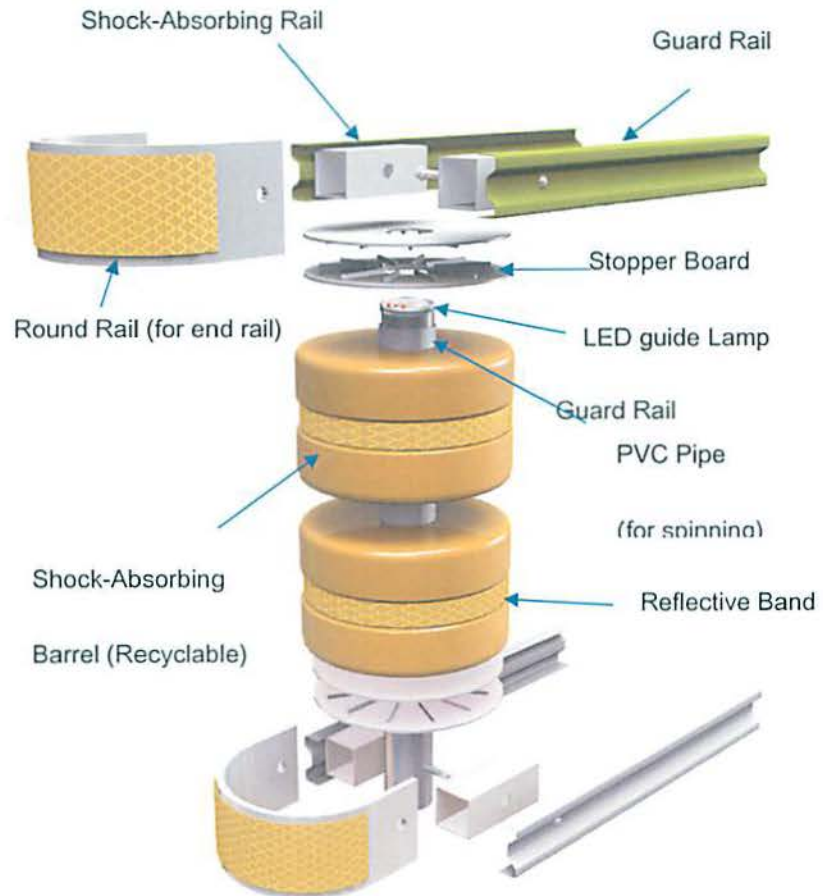
Shock Absorbing Roller Detail View



Stopper Board(9T)

PROJECT TITLE	DWG TITLE	GSI Ltd.	CONSULT	CHECK	DESIGN	DRAWN	DATE	SCALE	DRAWING NO.	SHEET NO.
	Safety Roller (GS-G506-TL4)	www.ks0486.com								

Components





KSI Global Australia PTY LTD
304 Place Rd
Geraldton, WA, 6531, Australia

23rd January 2016

Attention: John Wheatland

Testing activities completed for KSI Global Australia

Dear John

Thank you for sending us your request for additional information on the test vehicles from the recent impact tests we completed on your Safety Roller Barrier system. We understand that this request was initiated by Mr N Artimovich at the Office of Safety Technology, Federal Highways Administration. In particular, additional information is sought relating to the age of the vehicles that were utilised by completing a comparative assessment between the vehicles used and more modern variants. Additionally, we understand that Mr Artimovich has requested commentary from Holmes Solutions on the propensity of the Safety Roller system to induce roll, pitch, and yaw into the test vehicles and the sensitivity of the vehicle stability and trajectory as it relates to the vehicle age.

We can confirm that the 1100C vehicle used in this project did not comply with the recommended age limitation of 6 model years from the date of testing. However this vehicle model remained structurally unchanged from 2002 until 2005, with this later date being within the 6 year model year age recommendations. The 2270P does comply with the 6 model year age requirement on the date the project was initiated.

As a general note, wherever practical we try and source vehicles that are no more than 6 model years old, however if older vehicles are to be used we will undertake a detailed assessment of the vehicles to ensure its compliance. This is a requirement of our internal quality assurance procedures and is mandated in our ISO 17025 accreditation policy. In accordance with this policy, a review was completed on the vehicles used in the Safety Roller Barrier assessment and I can confirm that all vehicles were found suitable for use.

The internal review process adopted by Holmes Solutions LP includes a full analysis of the vehicle specifications to ensure that it remains compliant with the key criteria in MASH. Furthermore, we also complete an inspection of the structural integrity of the various vehicles models to investigate if any changes would influence the performance of the system during an impact. Key aspects of the review process includes:

- a) The key vehicle specifications remain in accordance within the parameters outlined in the Table 4.1 MASH.
- b) The vehicle model remains in accordance with MASH Appendix H and is recommended on Table H-2.

- c) The vehicles physical parameters falls within the guidelines outlined in Section MASH 4.2 Test Vehicle Description.
- d) The vehicles physical and dimensional parameters do not significantly differ from an identical model from the same manufacturer which is no more 6 model years old on the day the test. Where any difference does exists a more detailed review will be undertaken to ensure this would have a negligible influence on the outcome of any testing.
- e) Variations in the structural integrity of the vehicle that would be likely to influence the outcome of the test to be completed. Specific attention is paid to the type of test being completed particularly with regards to length of need testing verse terminal ends or crash cushions.

It is our testing laboratories preference to utilise a consistent vehicle fleet for the majority of our testing. Before settling on this fleet we completed an extensive review of the recommended vehicle models in MASH conforming to Section 4.2.1 and Appendix H. Consultation was also held with our other accredited testing facilities at the Task Force 13 meetings regarding their preferred vehicles. From this review we settled on the use of the following vehicles as our preferred vehicle stock;

1100C - Kia Rio sedan (2002-2005)

2270P - Dodge Ram 1500 Quadcab (2003-2010)

10000S - Mitsubishi Fuso fighter (1991-2008)

The vehicles used in the testing completed on the Safety Roller Barrier system complied with these requirements. A more detailed description of each vehicle used is provided below.

Test 4-10 - 1100C - Model selected KIA RIO 2003 (3 years over maximum age limit):

Our preferred 1100C vehicle is the Generation 1 Kia Rio. This model is recommended in MASH Table H-2 and has been widely adopted as the vehicle of choice by the accredited testing laboratories. The Kia Rio was maintained as a constant model from 2001-2005 after which it was updated to a Generation 2 model. The Safety Roller Barrier project was initiated in June 2011 and thereby the later years of this model vehicle do comply with the specific requirement in MASH, namely

"It is recognized that some research projects can experience extensive delays. To eliminate the potential for these delays to require replacement of test vehicles purchased in anticipation of testing, it is acceptable to utilize test vehicles that are within 6 model years of the date when the original research project was initiated."

Towards the end of 2005 the Kia Rio was updated to the Generation 2 model, however this model lies outside MASH Specifications in a critical dimension; it is 4.3" (110 mm) shorter than allowable. Given the criticality of the vehicle length the updated model was not considered a suitable substitute for the previous Generation 1 model.

When the Kia Rio model was updated, a critical assessment was completed between the older Generation 1 model (2003) and other readily available makes and models recommended in MASH Table H-2. It was determined that the pre 2005 model Kia Rio achieved the most consistent fit against key physical dimensions and the centre of mass requirements of MASH. A series of comparisons with other models is provided below in Table 1. All figures which are outside of the MASH limitations are shown in Red. We noted that the actual vehicle used in the testing for the Roller Barrier System is shown in the table as the 2003 production model (highlighted).

Table 1 Comparison of suitable 1100C vehicles.

Critical Measurements	Kia Rio (Lift back) model used	Kia Rio (Hatch)	Honda Civic (Sedan)	Nissan Tiida (Hatch)	Toyota Corolla (sedan)
Production year	2003	2005	2005-2007	2009	2009
Weight (kg)	1060	1079	1240	1120.5	1237
A (mm)	1685	1755	1755	1685	1760
B (mm)	830	-	-	850	-
C (mm)	2420	2500	2700	2600	2600
D (mm)	1420	1470	1440	1510	1465
E (mm)	975	-	-	770	-
F (mm)	4225	3990	4540	4220	4538
G (mm)	970	-	-	966	-
H (mm)	n/a	n/a	n/a	n/a	n/a
J (mm)	700	-	-	700	-
K (mm)	560	-	-	560	-
L (mm)	80	-	-	60	-
M (mm)	230	155	150	200	150
N (mm)	1470	1470	1500	1475	1529
O (mm)	1450	1460	1525	1475	1534
P (mm)	580	570	615	615	615
Q (mm)	390	390	420	420	420

An assessment was also completed on the structural integrity of the Generation 1 model (2003) and the Generation 2 model (2005). The results indicated that minimum structural changes were made

and that the two models were generally equivalent. Both models used similar suspension set up and had near identical handling characteristics. Overall, the review of the determined the models to be compatible when assessing the performance against occupant risk, vehicle trajectory, and structural integrity of both the vehicle, particularly when used in a redirective length of need test.

A final comparison of the Kia Rio model used and the MASH requirements for the 1100C are provided in Table 2. It is evident that the Kia Rio vehicle used in testing programme complied with all measurement requirements of MASH.

Table 2 Comparison of MASH Requirements and actual 1100C vehicle parameters

PROPERTY	MASH 1100C REQUIREMENT	KIA RIO USED	COMPLIANT (Y/N)
MASS			
Test Inertia (kg)	1100±25	1082	YES
Dummy (kg)	75	75	YES
Max. Ballast (kg)	80	0	YES
Gross Static (kg)	1175±25	1152	YES
DIMENSIONS			
Wheelbase (mm)	2500±125	2420	YES
Front Overhang (mm)	900±100	830	YES
Overall Length (mm)	4300±200	4225	YES
Overall Width (mm)	1650±75	1685	YES
Hood Height (mm)	600±100	700	YES
Track Width (mm)	1425±50	1460	YES
LOCATION OF ENGINE	Front	Front	YES
LOCATION OF DRIVE AXLE	Front	Front	YES
TYPE OF TRANSMISSION	Manual/Auto	Manual	YES

Based on the information obtained from our critical vehicle assessment, it was deemed that the Kia Rio Generation 1 model (2002-2005) was a suitable vehicle for use in Test 10. This model of vehicle fits within the recommended 6 age limitation given the project initiation date of June 2005, albeit that the actual age of the vehicle used in the Roller Barrier System tests does not. Across all measures employed in our review, the 2003 Kia Rio model complied with all MASH requirements.

Test 4-11 - 2270P – Model selected Dodge Ram Quad cab 2005 (1 year over maximum age limit):

Our preferred 2270P vehicle is the Dodge Ram 1500 Quad Cab. This model is recommended in MASH Table H-2 and has been widely adopted as the vehicle of choice by the majority of accredited testing laboratories. We note that the vehicle used in the Safety Roller Barrier system assessment was a 2005 model and therefore complied with the recommended age limitation when the testing project was initiated in June 2011, as allowed in MASH:

“It is recognized that some research projects can experience extensive delays. To eliminate the potential for these delays to require replacement of test vehicles purchased in anticipation of testing, it is acceptable to utilize test vehicles that are within 6 model years of the date when the original research project was initiated”

The Dodge Ram 1500 Quad cab has undergone a number of face lifts since inception. We have completed a regular assessment of the models when updates occur, spanning the previous 10 years. These assessments include a comparison of the critical vehicle dimensions, weights, and centre of weights. In addition a review of the structural integrity of the vehicles is completed for each model upgrade. The details of the dimensional and weight comparative analysis can be seen in Table 2. We noted that the actual vehicle used in the Testing for the Roller Barrier System is shown in the table as the 2005 production model (highlighted).

As shown in Table 2, there is no significant difference in physical vehicle parameters for the various models. The mass, centre of mass, and general dimensions for the models surveyed are all within the allowable tolerance of MASH. Similarly, no significant differences were found in the structural integrity of the vehicles that would affect the performance of the system in a length of need test.

When considering the minor differences in model specifications over the model various years investigated, it was determined that the change in model year would have negligible effect on performance of a length of need test. As such, it was considered acceptable to use a 2005 model Dodge Ram 1500 Quad Cab in the evaluation of the Safety Roller Barrier system. We believe the use of this vehicle would have negligible effect on the vehicles roll, pitch, or yaw in the completed tests.

Table 4 presents a direct comparison between the Recommended Properties of the 2270P vehicle in MASH (detailed in Table 4-1 of MASH) and the actual properties of the vehicle used in the testing. As noted, the Dodge Ram 1500 Quadcab model used complies with all recommendations of MASH with the exception of vehicle width which has 25 mm of excess body width on each side.

Table 3 Comparison of suitable 2270P vehicles.

Critical Measurements	Production year			
	2002	2005 (model used)	2006	2011
Weight	2301 kg	2260 kg	2215 kg	2210.5 kg
A (mm)	2040	2050	2070	2030
B (mm)	990	960	1030	950
C (mm)	3570	3565	3570	3580
D (mm)	1855	1930	1910	1180
E (mm)	1205	1190	1180	1190
F (mm)	5765	5720	5780	5720
G (mm)	1571	1560	1510	1495
H (mm)	748	730	739	735
J (mm)	1100	1075	1090	1120
K (mm)	625	670	690	660
L (mm)	110	70	70	110
M (mm)	220	350	380	280
N (mm)	1735	1730	1740	1715
O (mm)	1720	1720	1720	1715
P (mm)	790	780	820	780
Q (mm)	465	470	475	475

A detailed inspection was also completed on the handling characteristics and suspension setup of the various models. It was noted that the suspension configuration was altered from the 2002 model to the 2005 model, however all subsequent models used an identical set up as the 2005 system. Key dimensions of the critical elements used in the set up are noted in Table 3 below. Photographs of the suspension set ups for the 2002 model and 2005 model (vehicle used in testing) are also shown in Figure 1.

Table 4 Comparison of MASH Requirements and actual 2270P vehicle parameters

PROPERTY	MASH 2270P REQUIREMENT	DODGE RAM USED	COMPLIANT (Y/N)
MASS			
Test Inertia (kg)	2270±50	2282	YES
Dummy (kg)	Optional	-	YES
Max. Ballast (kg)	200	-	YES
Gross Static (kg)	2270±50	2282	YES
DIMENSIONS			
Wheelbase (mm)	3760±300	3565	YES
Front Overhang (mm)	1000±75	960	YES
Overall Length (mm)	6020±325	5720	YES
Overall Width (mm)	1950±50	2050	NO
Hood Height (mm)	1100±75	1075	YES
Track Width (mm)	1700±38	1725	YES
LOCATION OF ENGINE	Front	Front	YES
LOCATION OF DRIVE AXLE	Rear	Rear	YES
TYPE OF TRANSMISSION	Manual/ Auto	Auto	YES

Based on the investigations completed on the vehicle handling characteristics and suspension set up it was confirmed that the minor change to the components would have negligible effect on performance of the vehicle during a redirective length of need test. As such, it was considered acceptable to use a 2005 model Dodge Ram 1500 Quad Cab in the evaluation of the Safety Roller Barrier system. This model not only conformed to the 6 model year age limitation imposed by MASH but was also determined to be representative of later model year vehicles. Overall it was determined that the use of this vehicle would have negligible effect on the vehicles roll, pitch, or yaw in the completed tests.

Table 5 Suspension measurements for Dodge Ram models

Critical Measurements	Production year			
	2002	2005 (model used)	2006	2011
Springs				
Outside diameter (mm)	140	140	140	140
Coil diameter (mm)	19.5	19	19	19
Overall spring length (mm)	370	350	350	350
Set-up				
Roll Bar outside diameter (mm)	34	33	33	33
Upper A arm Pivot-Pivot (mm)	240	240	240	240
Upper A arm Pivot-Pivot (mm)	440	440	440	440



a) 2002 model suspension set up



b) 2005 model suspension set up

Figure 1 2270P suspension set up



Test 4-12 – 10000S – Model Selected Mitsubishi Fuso fighter 2001

As stated in MASH “*Although it is cost-prohibitive to apply the 6-year limit to heavy truck test vehicles, it is desirable to utilize vehicles of recent vintage. Heavy truck test vehicles should be representative of widely used designs*”

As noted in MASH, the 6 year model requirement does not apply to the heavy truck test, and the truck that was used was of a recent vintage. It is noted that the model of truck used was a cab-over engine model. However, as per previous advice obtained from the FHWA Department of Safety, the use of this model was considered an acceptable substitute. All other dimensions and vehicle physical parameters are within the MASH specifications.

I trust this letter provides you with the information you require, however please feel free to contact me directly should you need any additional information or wish to seek clarification on the information contained above.

Yours Sincerely,

Dr Chris Allington, B.E (Hons), PhD (Civil)
CEO
Holmes Solutions LP