



U.S. Department
of Transportation
**Federal Highway
Administration**

November 19, 2019

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

In Reply Refer To:
HSST-1/CC-156

Mr. Roberto Impero
Industry AMS SRL
Via Dante Giacosa SNC,
Marciansie (CE), 81025
Italy

Dear Mr. Impero:

This letter is in response to your July 11, 2019 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 CC-156 and is valid until a subsequent letter is issued by FHWA that expressly references this device.

Decision

The following device is eligible within the length-of-need, with details provided in the form which is attached as an integral part of this letter:

- Hercules Crash Cushion

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' (AASHTO) 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 AASHTO's 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: Hercules Crash Cushion

Type of system: Crash Cushion

Test Level: MASH Test Level 3 (TL3)

Testing conducted by: CSI SpA

Date of request: July 22, 2019

FHWA concurs with the recommendation of the accredited crash testing laboratory on the attached form

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

This eligibility letter is issued for the subject device as tested. Modifications made to the device are not covered by this letter. Any modifications to this device should be submitted to the user (i.e., state DOT) as per their requirements.

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 and evaluation criteria of AASHTO's 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 CC-156 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.
- This FHWA eligibility letter is not an expression of any Agency view, position, or determination of validity, scope, or ownership of any intellectual property rights to a specific device or design. Further, this letter does not impute any distribution or licensing rights to the requester. This FHWA eligibility letter determination is made based solely on the crash-testing information submitted by the requester. The FHWA reserves the right to review and revoke an earlier eligibility determination after receipt of subsequent information related to crash testing.

Sincerely,

A handwritten signature in blue ink that reads "Michael S. Griffith". The signature is written in a cursive, flowing style.

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:	July 11, 2019	<input type="radio"/> New <input checked="" type="radio"/> Resubmission
	Name:	ROBERTO IMPERO	
	Company:	INDUSTRY AMS SRL	
	Address:	VIA DANTE GIACOSA SNC, MARCIANSIE (CE), 81025	
	Country:	ITALY	
	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.

Device & Testing Criterion - Enter from right to left starting with Test Level

!-!-!

System Type	Submission Type	Device Name / Variant	Testing Criterion	Test Level
'CC': Crash Cushions, Attenuators, & Terminals	<input checked="" type="radio"/> Physical Crash Testing <input type="radio"/> Engineering Analysis	HERCULES	AASHTO MASH	TL3

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.

Individual or Organization responsible for the product:

Contact Name:	ROBERTO IMPERO	Same as Submitter <input checked="" type="checkbox"/>
Company Name:	INDUSTRY AMS SRL	Same as Submitter <input checked="" type="checkbox"/>
Address:	VIA DANTE GIACOSA SNC, MARCIANSIE (CE), 81025	Same as Submitter <input checked="" type="checkbox"/>
Country:	ITALY	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.

Subject: Disclosure of financial interest

CSI Spa, is an independent research and testing laboratory having no affiliation with any another entity. The principals and staff of CSI Spa have no past or present financial, contractual or organizational interest in any company or entity directly or indirectly related to the products that CSI Spa tests.

PRODUCT DESCRIPTION

☒ New Hardware or
Significant Modification

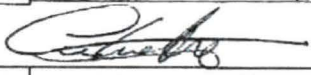
☐ Modification to
Existing Hardware

Product Description

The Hercules Crash Cushion is a fully-redirective, non-gating crash cushion tested to MASH criteria. It has a frontal trolley unit that allows a controlled deformation, a collapsible beam made up of 10 modules that crush in a frontal impact to absorb energy and stop the vehicle in a controlled manner, and 4-beam side panels for side impact redirection. The unit is 19.4 feet (5.92m) long, 23.2 inches (0.59m) wide at the rear, and 35.0 inches (0.89) high.


CRASH TESTING

By signature below, the Engineer affiliated with the testing laboratory, agrees in support of this submission that all of the critical and relevant crash tests for this device listed above were conducted to meet the MASH test criteria. The Engineer has determined that no other crash tests are necessary to determine the device meets the MASH criteria.

Engineer Name:	MASSIMO CUCCHIETTI	
Engineer Signature:		
Address:	10124 TORINO-VIA TONIS 69	Same as Submitter <input type="checkbox"/>
Country:	ITALY	Same as Submitter <input type="checkbox"/>

A brief description of each crash test and its result:

CSI S.p.A
Viale Lombardia n.20/B
20021 BOLLATE (MI)
C.F./P.I. 11380180151



Required Test Number	Narrative Description	Evaluation Results
3-30 (1100C)	<p>Test Date: 01 Jun2018 Complete test report 0059_ME_HRB_18 - CSI Spa.</p> <p>Test 3-30 involves a 1100C passenger car impactiong the crash cushion at a nominal impact speed of 100 km/h (62.2 mph) and an impact at 0 degrees with the quarter point of the vehicle aligned with the center line of the crash cushion. This test is preliminary intendet to evaluate occupanti risk and vehicle trajectory criteria. For this test a 2013 Kia Rio 2624 lbs (1190 kh) impacted the Hercules Crash Cushion at a speed 60.4 mph (97.2 km/h) and an angle of 0 degrees. Upon impact the vehicle forced the Hercules Crash Cushion's trolley rearward and began to collapse the beam modules. The crash cushion brought the vehicle to a controlled stop. The test vehicle sustained damage to its front end. The occupant compartment was not penetrated and the deformation was within allowable limits. The maximum roll and pitch angles did not exceed 75 deg. and the occupant risk values were within limits per the MASH specifications for OIV and ORA. Hercules Crash Cushion passed all evaluation criteria for test 3-30.</p>	PASS

Required Test Number	Narrative Description	Evaluation Results
3-31 (2270P)	<p>Test Date: 30May Complete test report 0051_ME_HRB_18 - CSI Spa.</p> <p>Test 3-31 involves a 2270P pick up truck impactong the crash cushion at a nominal impact speed of 100 km/h (62.2 mph) and an impact at 0 degrees with the center line of the vehicle aligned with the center line of the Crash Cushion. This test is preliminary intendet to evaluate the capacity of the attenuator to stop the vehicle in a safe and controlled manner. For this test, a 2013 Dodge Ram 1500 weighing 5033 lbs (2283 kg) impacted the Hercules Crash Cushion at a speed 60.8 mph (97.9 km/h) and an angle of 0 degrees. Upon impact the vehicle forced the Hercules Crash Cushion's trolley rearward and began to collapse the beam modules. The crash cushion brought the vehicle to a controlled stop. The test vehide sustained damage to its front end. The occupant compartment was not penetrated and the deformation was within allowable limits. The maximum roll and pitch angles did not exceed 75 deg. and the occupant risk values were within limits per the MASH specifications for OIV and ORA. Hercules Crash Cushion passed all evaluation criteria for test 3-31.</p>	PASS

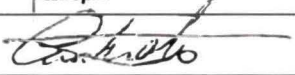
3-32 (1100C)	<p>Test Date: 05 Jun2018 Complete test report 0061_ME_HRB_18 - CSI Spa.</p> <p>Test 3-32 involves a 1100C passenger car impacting the crash cushion at a nominal impact speed of 100 km/h (62.2 mph) and an impact at 15 degrees with the centerline of the crash cushion. This test is preliminary intended to evaluate occupant risk, vehicle trajectory and the capacity of the crash cushion to stop the vehicle in a controlled manner for an oblique impact. For this test a 2014 Kia Rio 2635 lbs (1195 kg) impacted the Hercules Crash Cushion at a speed 60.5 mph (97.3 km/h) and an angle of 15 degrees. Upon impact the vehicle forced the Hercules Crash Cushion's trolley rearward and began to collapse the beam modules. The crash cushion brought the vehicle to a controlled stop. The test vehicle sustained damage to its front end. The occupant compartment was not penetrated and the deformation was within allowable limits. The maximum roll and pitch angles did not exceed 75 deg. and the occupant risk values were within limits per the MASH specifications for OIV and ORA. Hercules Crash Cushion passed all evaluation criteria for test 3-32.</p>	PASS
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3-33 (2270P)	<p>Test Date: 28 May2018 Complete test report 0050_ME_HRB_18 - CSI Spa.</p> <p>Test 3-33 involves a 2270P pick up truck impactiong the crash cushion at a nominal impact speed of 100 km/h (62.2 mph) and an impact at 15 degrees with the centerline of the vehicle aligned with the center line of the crash cushion. This test is preliminary intendet to evaluate occupanti risk, vehicle trajectory and the capacity of the crash cushion to stop the vehicle in a controlled manner for an oblique impact. For this test a 2012 Dodge Ram 1500 weighing 5064 lbs (2297 kg) impacted the Hercules Crash Cushion at a speed 60.9 mph (98 km/h) and an angle of 15 degrees. Upon impact the vehicle forced the Hercules Crash Cushion's trolley rearward and began to collapse the beam modules. The crash cushion brought the vehicle to a controlled stop. The test vehicle sustained damage to its front end. The occupant compartment was not penetrated and the deformation was within allowable limits. The maximum roll and pitch angles did not exceed 75 deg. and the occupant risk values were within limits per the MASH specifications for OIV and ORA. Hercules Crash Cushion passed all evaluation criteria for test 3-33.</p>	PASS
3-34 (1100C)	<p>Test Date: 31 May2018 Complete test report 0058_ME_HRB_18 - CSI Spa.</p> <p>Test 3-34 involves a 1100C passenger car impactiong the crash cushion at a nominal impact speed of 100 km/h (62.2 mph) and an impact at 15 degrees with the CIP at the point where the crash cushion behavior changes from capturing to redirective. This test is preliminary intendet to evaluate occupanti risk and vehicle trajectory criteria. For this test a 2012 Kia Rio 2632 lbs (1194 kg) impacted the Hercules Crash Cushion at a speed 60.7 mph (97.7 km/h) and an angle of 15 degrees. UThe impact point was downstream the trolley. Upont the impact the vehicle was smoothly redirected. The test vehicle sustained damage to its right front corner, doors and rear quarter panel. The occupant compartment was within allowable limits. The maximum roll and pitch angles did not exceed 75 deg. and the occupant risk values were within limits per the MASH specifications for OIV and ORA. Hercules Crash Cushion passed all evaluation criteria for test 3-34.</p>	PASS

3-35 (2270P)	<p>Test Date: 22 May2018 Complete test report 0046_ME_HRB_18 - CSI Spa.</p> <p>Test 3-35 involves a 2270P pick up truck impactiong the crash cushion at a nominal impact speed of 100 km/h (62.2 mph) and an impact at 25 degrees with the CIP at the point where the crash cushion behavior changes from capturing to redirective (BLON). This test is preliminary intendet to evaluate the capacity of the attenuator for redirection/containment of heavy vehicles. For this test a 2002 Dodge Ram 1500 weighing 5071 lbs (2300 kg) impacted the Hercules Crash Cushion at a speed 60.0 mph (96.6 km/h) and an angle of 25 degrees. The impact point was downstream the trolley and very near to the nose. Upont the impact the vehicle was smoothly redirected. The test vehicle sustained damage to its left front corner, doors and rear quarter panel. The occupant compartment was within allowable limits. The maximum roll and pitch angles did not exceed 75 deg. and the occupant risk values were within limits per the MASH specifications for OIV and ORA. Hercules Crash Cushion passed all evaluation criteria for test 3-35.</p>	PASS
3-36 (2270P)	<p>Test Date: 13 Sept2018 Complete test report 0099_ME_HRB_18 - CSI Spa.</p> <p>Test 3-36 involves a 2270P pick up truck impactiong the crash cushion at a nominal impact speed of 100 km/h (62.2 mph) and an impact at 25 degrees with the CIP at the rear transition whit rigid back up structure. This test is preliminary intendet to evaluate the capacity for redirection/containment of heavy vehicles at the rear of the system where shields a rigid object. For this test a 2008 Chevrolet Silverado weighing 5088 lbs (2308 kg) impacted the Hercules Crash Cushion at a speed 60.0 mph (96.6 km/h) and an angle of 25 degrees. The impact point was located 2.1 <CIP<2.7 from the backup structure. Upont the impact the vehicle was smoothly redirected. The test vehicle sustained damage to its right front corner, doors and rear quarter panel. The occupant compartment was within allowable limits. The maximum roll and pitch angles did not exceed 75 deg. and the occupant risk values were within limits per the MASH specifications for OIV and ORA. Hercules Crash Cushion passed all evaluation criteria for test 3-36.</p>	PASS

3-37 (2270P)	<p>Test Date: 14 Sept2018 Complete test report 0100_ME_HRB_18 - CSI Spa.</p> <p>Test 3-37 involves a 2270P pick up truck impactong the crash cushion at a nominal impact speed of 100 km/h (62.2 mph) and an impact at 25 degrees with the CIP at the rear transition whit rigid back up structure. This test is preliminary intendet to evaluate the potential for snagging and capacity for redirection of heavy vehicles at the rear of the attenuator. For this test a 2009 Chevrolet Silverado weighing 5057 lbs (2294 kg) impacted the Hercules Crash Cushion at a speed 60.6 mph (97.5 km/h) and an angle of 25 degrees. Provide a dimension from the front of the device. Upont the impact the vehicle was smoothly redirected. The test vehicle sustained damage to its right front corner, doors and rear quarter panel. The occupant compartment was within allowable limits. The maximum roll and pitch angles did not exceed 75 deg. and the occupant risk values were within limits per the MASH specifications for OIV and ORA. Hercules Crash Cushion passed all evaluation criteria for test 3-37.</p>	PASS
3-38 (1500A)	<p>Test 3-38 involves a 1500A sedan impacting the crash cushion at nominal speed of 100 km/h (62.2 mph) and an impact at 0 degrees with the centerline of the vehicle aligned with the center line of the crash cushion. In order to evaluate the behavior of mid-size vehicle, simulation was occured. Simulation report named TEST TL 3.38 has been attached to request.</p>	Non-Critical, not conducted
3-40 (1100C)	Test for non-redirective crash cushion is not applicable	Non-Relevant Test, not conducted
3-41 (2270P)	Test for non-redirective crash cushion is not applicable	Non-Relevant Test, not conducted
3-42 (1100C)	Test for non-redirective crash cushion is not applicable	Non-Relevant Test, not conducted
3-43 (2270P)	Test for non-redirective crash cushion is not applicable	Non-Relevant Test, not conducted
3-44 (2270P)	Test for non-redirective crash cushion is not applicable	Non-Relevant Test, not conducted
3-45 (1500A)	Test for non-redirective crash cushion is not applicable	Non-Relevant Test, 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:	CSI SpA	
Laboratory Signature:		
Address:	Viale Lombardia 20 - 20021 Bollate - MI	Same as Submitter <input type="checkbox"/>
Country:	Italy	Same as Submitter <input type="checkbox"/>
Accreditation Certificate Number and Dates of current Accreditation period :	ACCREDIA 0006 - REV.3 EXPIRING DATE : 2020-03-09	

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		
Number	Date	Key Words

CSI S.p.A
Viale Lombardia n.20/B
20021 BOLLATE (MI)
C.F.R. 11380160151

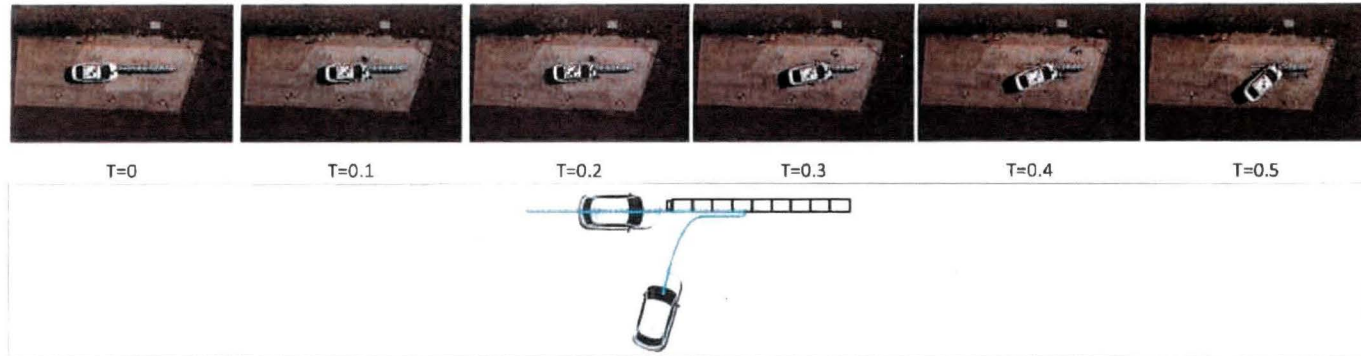
RAPPORTO DI PROVA (Test Report)



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Date: 12/07/2019

N° 0059\ME\HRB\18 Rev. 3



General Information

Test agency..... CSI S.p.A.
Test No. 0059/ME/HRB/18
Date..... 01/06/2018

Test Article

Type..... HERCULES
Installation length [m]..... 5.83
Size and/or dimension and material of key
Elements..... See attached drawings

Foundation type and condition.....

Concrete (anchored)

Test Vehicle

Type/ Designation..... 1100C
Model..... Kia Rio
Mass [kg]
Curb..... 1065.0
Test Inertial..... 1114.2
Gross static..... 1189.8

Impact Conditions

Speed [km/h]..... 97.2
Angle [deg]..... 0.0
Impact Severity [kJ]..... 433.7
Impact Location..... Frontal, offset W/4, 0°
Exit Speed [km/h]..... < 10
Exit Angle [deg]..... 60.0

Post-impact Trajectory

Vehicle Stability..... Satisfactory
Stopping Distance..... 3 m upstream
5 m lateral

Vehicle snagging..... None
Vehicle pocketing..... None

Occupant Risk Values

Impact Velocity [m/s]
X-direction..... 11.2
Y-direction..... 0.8
Ridedown Acceleration [g's]
X-direction..... -18.2
Y-direction..... -5.8

THIV 40.5
PHD 18.2
ASI 2010..... 1.11

Test Article Damage

Test Article Deflections [m]

Permanent 2.57
Dynamic 2.57
Working Width..... N/A

Vehicle Damage

See appendix A
Maximum internal deformation..... 10 mm
Maximum external deformation..... 280 mm

IMQ

annulla e sostituisce il precedente report datato 08/05/2019 / substitutes test report dated 08/05/2019



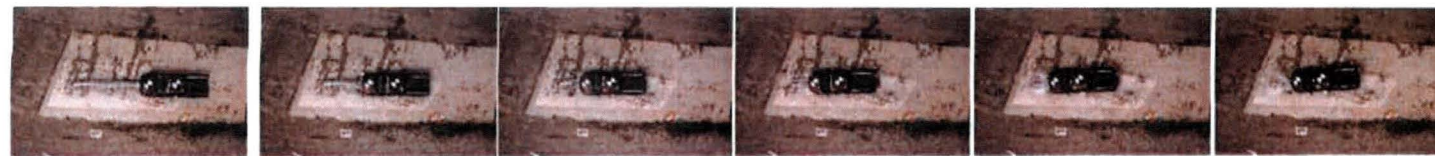
LAB 100006
Squadra di IA, IAT e IAC
National Accreditation Agency

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Date:

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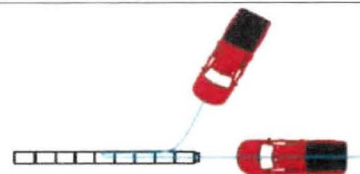
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General Information

Test agency..... CSI S.p.A.
Test No. 0051/ME/HRB/18
Date..... 30/05/2018
Test Article
Type..... HERCULES
Installation length [m]..... 5.83
Size and/or dimension and material of key
Elements..... See attached drawings
Foundation type and condition..... Concrete (anchored)

Test Vehicle

Type/ Designation..... 2270P
Model..... Dodge RAM 1500
Mass [kg]
Curb..... 2248.2
Test Inertial..... 2282.6
Gross static..... 2282.6

Impact Conditions

Speed [km/h]..... 97.9
Angle [deg]..... 0.0
Impact Severity [kJ]..... 844.0
Impact Location..... Frontal, head centered, 0°
Exit Speed [km/h]..... < 10
Exit Angle [deg]..... 10.0

Post-impact Trajectory

Vehicle Stability..... Satisfactory
Stopping Distance..... 7 m upstream
2 m Laterally
Vehicle snagging..... None
Vehicle pocketing..... None

Occupant Risk Values

Impact Velocity [m/s]
X-direction..... 9.7
Y-direction..... 0.1
Ridedown Acceleration [g's]
X-direction..... -18.6
Y-direction..... -1.5

THIV 35.0
PHD 18.6
ASI 2010..... 1.25
Test Article Damage Moderate

Test Article Deflections [m]

Permanent 4.02
Dynamic 4.05
Working Width..... N/A

Vehicle Damage

See appendix A
Maximum internal deformation..... 64 mm
Maximum external deformation..... 455 mm

IMQ

ACCREDITED

LAB IMQ006
Signatory of CA, IAF and ILAC
Mutual Recognition Agreement

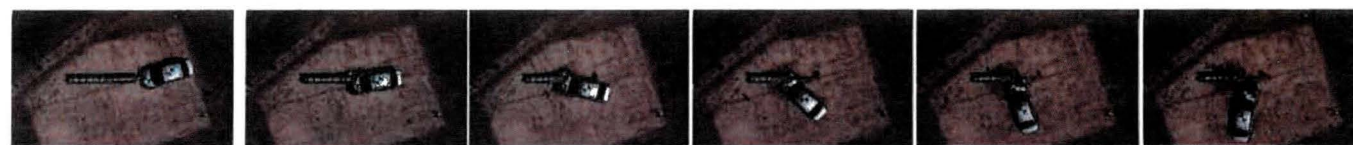
annulla e sostituisce il precedente rapporto datato 08/05/2019 / substitutes test report dated 08/05/2019

RAPPORTO DI PROVA (Test Report)

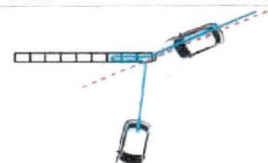
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Data: 12/07/2019
Date:

N° 0061\ME\HRB\18 Rev. 3



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General Information

Test agency..... CSI S.p.A.
Test No. 0061/ME/HRB/18
Date..... 05/06/2018

Test Article

Type..... HERCULES
Installation length [m]..... 5.83
Size and/or dimension and material of key
Elements..... See attached drawings

Foundation type and condition

Concrete (anchored)

Test Vehicle

Type/ Designation..... 1100C
Model..... Kia Rio
Mass [kg]
Curb..... 1073.8
Test Inertial..... 1119.2
Gross static..... 1194.8

Impact Conditions

Speed [km/h]..... 97.3
Angle [deg]..... 15.0
Impact Severity [kJ]..... 436.4
Impact Location..... Frontal, head centered, 15°
Exit Speed [km/h]..... < 10
Exit Angle [deg]..... N/A

Post-impact Trajectory

Vehicle Stability..... Satisfactory
Stopping Distance..... 3 m downstream
12 m Laterally

Vehicle snagging..... None
Vehicle pocketing..... None

Occupant Risk Values

Impact Velocity [m/s]
X-direction..... 11.5
Y-direction..... -0.6
Ridedown Acceleration [g's]
X-direction..... -14.0
Y-direction..... -3.9

THIV 42.4
PHD 14.0
ASI 2010..... 1.15
Test Article Damage Moderate

Test Article Deflections [m]

Permanent 2.46
Dynamic 2.50
Working Width..... N/A

Vehicle Damage

See appendix A
Maximum internal deformation..... 4 mm
Maximum external deformation..... 215 mm

CSA PAC
IMQ

annulla e sostituisce il precedente report datato 10/05/2019 / substitutes test report dated 10/05/2019



LAB IMQ006
Signatory of EA, UK and ILAC
Mutual Recognition Agreements

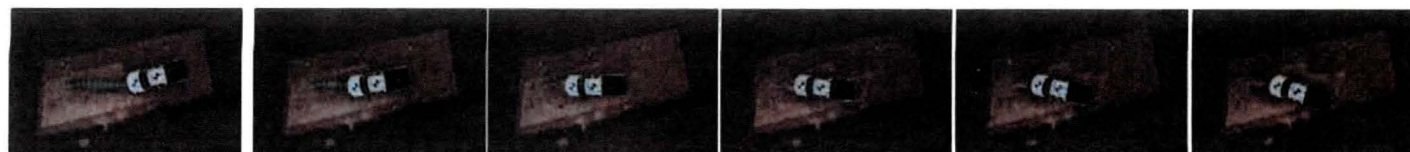
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N° 0050\ME\HRB\18 Rev. 3



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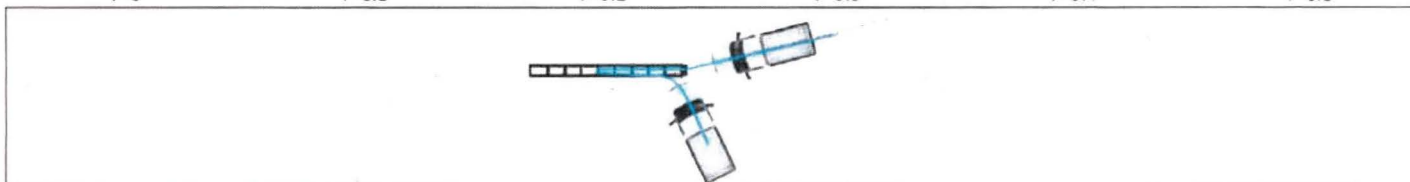
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T=0.3

T=0.4

T=0.5



General Information

Test agency..... CSI S.p.A.
Test No. 0050/ME/HRB/18
Date..... 28/05/2018
Test Article
Type..... HERCULES
Installation length (m)..... 5.83
Size and/or dimension and material of key
Elements..... See attached drawings
Foundation type and condition..... Concrete (anchored)

Test Vehicle

Type/ Designation..... 2270P
Model..... Dodge RAM 1500
Mass [kg]
Curb..... 2222.4
Test Inertial..... 2297.4
Gross static..... 2297.4

Impact Conditions

Speed [km/h]..... 98.0
Angle [deg]..... 15.0
Impact Severity [kJ]..... 851.2
Impact Location..... Front, head centered, 15°
Exit Speed [km/h]..... < 10
Exit Angle [deg]..... 25.0

Post-impact Trajectory

Vehicle Stability..... Satisfactory
Stopping Distance..... 1 m downstream
2 m Laterally
Vehicle snagging..... None
Vehicle pocketing..... None

Occupant Risk Values

Impact Velocity [m/s]
X-direction..... 10.9
Y-direction..... -2.3
Ridedown Acceleration [g's]
X-direction..... -14.9
Y-direction..... -2.3

THIV 40.0
PHD 15.0
ASI 2010..... 1.23
Test Article Damage Moderate

Test Article Deflections [m]

Permanent 3.50
Dynamic 3.55
Working Width..... N/A

Vehicle Damage

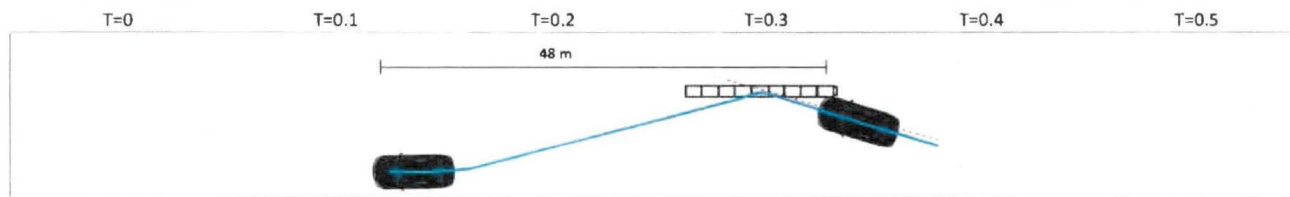
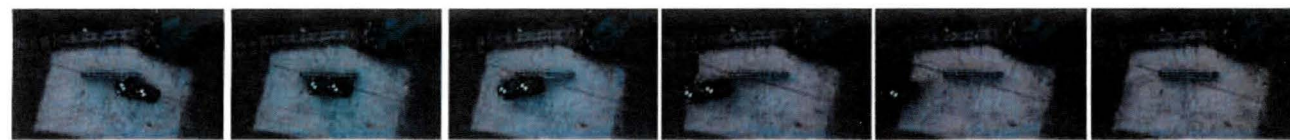
See appendix A
Maximum internal deformation..... 9 mm
Maximum external deformation..... 244 mm

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Date:

N° 0058\ME\HRB\18 Rev. 3



General Information

Test agency..... CSI S.p.A.
Test No. 0058/ME/HRB/18
Date..... 31/05/2018

Test Article

Type..... HERCULES
Installation length [m]..... 5.83
Size and/or dimension and material of key
Elements..... See attached drawings

Foundation type and condition

Concrete (anchored)

Test Vehicle

Type/ Designation..... 1100C
Model..... Kia Rio
Mass [kg]
Curb..... 1066.4
Test Inertial..... 1117.6
Gross static..... 1194.4

Impact Conditions

Speed [km/h]..... 97.7
Angle [deg]..... 15.0
Impact Severity [kJ]..... 29.5
Impact Location..... Laterally, first three wave beam
Exit Speed [km/h]..... 90.0
Exit Angle [deg]..... 11.0

Post-impact Trajectory

Vehicle Stability..... Satisfactory
Stopping Distance..... 48 m downstream
7 m Laterally

Vehicle snagging..... None
Vehicle pocketing..... None

Occupant Risk Values

Impact Velocity [m/s]
X-direction..... 3.1
Y-direction..... 6.1
Ridedown Acceleration [g's]
X-direction..... -13.1
Y-direction..... -4.5

THIV 24.6
PHD 13.2
ASI 2010..... 1.18
Test Article Damage Moderate

Test Article Deflections [m]

Permanent 0.04
Dynamic 0.10
Working Width..... N/A

Vehicle Damage

See appendix A
Maximum internal deformation..... 6 mm
Maximum external deformation..... 180 mm

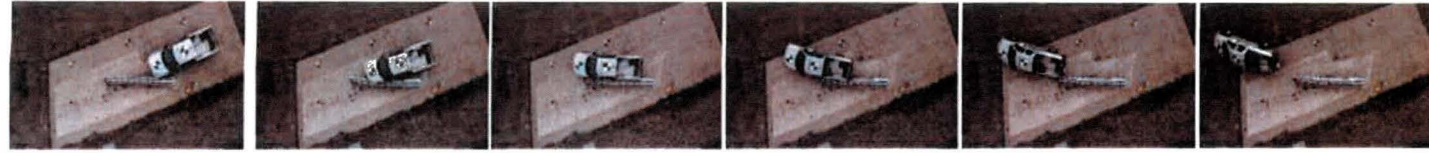
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Date:

N° 0046\ME\HRB\18 Rev. 3



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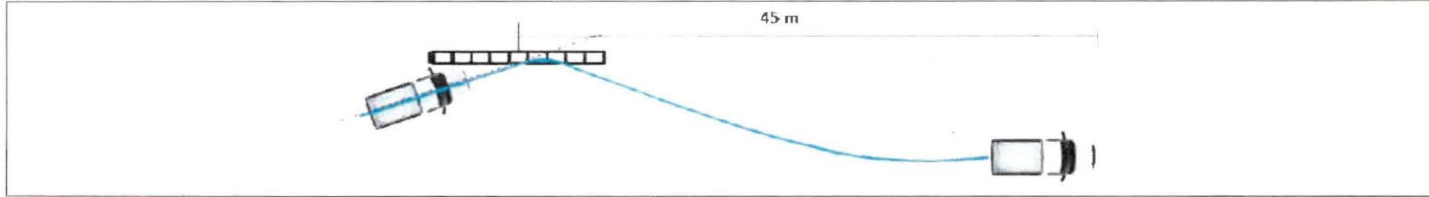
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T=0.4

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General Information

Test agency..... CSI S.p.A.
Test No. 0046/ME/HRB/18
Date..... 22/05/2018
Test Article
Type..... HERCULES
Installation length [m]..... 5.83
Size and/or dimension and material of key
Elements..... See attached drawings
Foundation type and condition..... Concrete (anchored)

Test Vehicle

Type/ Designation..... 2270P
Model..... Dodge RAM 1500
Mass [kg]
Curb..... 2239.8
Test Inertial..... 2300.0
Gross static..... 2300.0

Impact Conditions

Speed [km/h]..... 96.6
Angle [deg]..... 25.0
Impact Severity [kJ]..... 147.9
Impact Location..... 1/2 of the length of the item
Exit Speed [km/h]..... 71.5
Exit Angle [deg]..... 15.0

Post-Impact Trajectory

Vehicle Stability..... Satisfactory
Stopping Distance..... 45 m downstream
12 m Laterally
Vehicle snagging..... None
Vehicle pocketing..... None

Occupant Risk Values

Impact Velocity [m/s]
X-direction..... 5.0
Y-direction..... -7.2
Ridedown Acceleration [g's]
X-direction..... -6.0
Y-direction..... 11.6

THIV 30.9
PHD 11.8
ASI 2010..... 1.29

Test Article Damage Moderate

Test Article Deflections [m]

Permanent 0.22
Dynamic 0.35
Working Width..... N/A

Vehicle Damage

See appendix A
Maximum internal deformation..... 52 mm
Maximum external deformation..... 210 mm

CSA
IMO

Annulla e sostituisce il precedente rapporto datato 10/05/2019 / substitutes test report dated 10/05/2019

ACCREDITA
LAB IMMOBIS

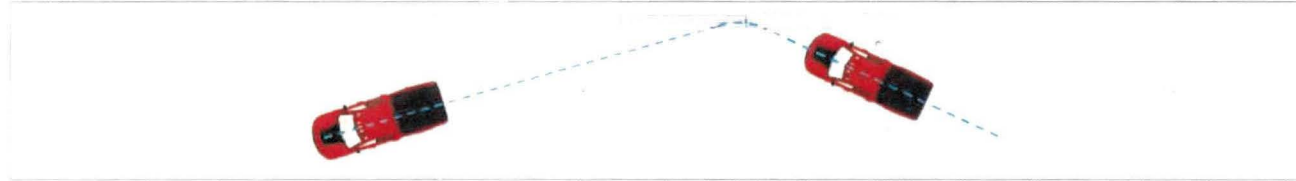
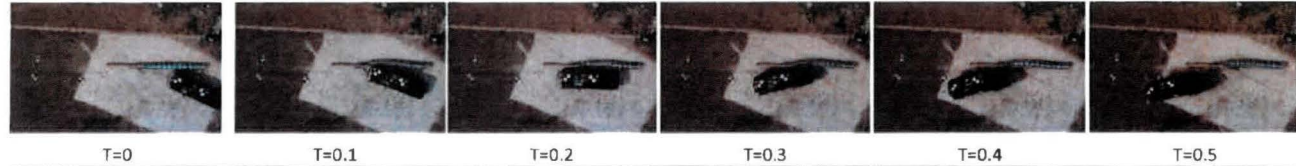
Signatory of EA, UK and ILAC
Mutual Recognition Agreements

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Data: 12/07/2019
Date:

N° 0099\ME\HRB\18 Rev. 3



General Information

Test agency..... CSI S.p.A.
Test No. 0099/ME/HRB/18
Date..... 13/09/2018

Test Article

Type..... HERCULES
Installation length [m]..... 5.83
Size and/or dimension and material of key
Elements..... See attached drawings

Foundation type and condition.....

Concrete (anchored)

Test Vehicle

Type/ Designation..... 2270P
Model..... Chevrolet Silverado
Mass [kg]
Curb..... 2262.4
Test Inertial..... 2308.0
Gross static..... 2308.0

Impact Conditions

Speed [km/h]..... 96.6
Angle [deg]..... 25.0
Impact Severity [kJ]..... 148.4
Impact Location..... 25°, middle of the back part
Exit Speed [km/h]..... 74
Exit Angle [deg]..... 14

Post-impact Trajectory

Vehicle Stability..... Satisfactory
Stopping Distance..... 45 m downstream
10 m Laterally

Vehicle snagging..... None
Vehicle pocketing..... None

Occupant Risk Values

Impact Velocity [m/s]
X-direction..... 6.9
Y-direction..... 7.5
Ridedown Acceleration [g's]
X-direction..... -11.6
Y-direction..... -9.0

THIV 37.3
PHD 14.5
ASI 2010..... 1.45
Test Article Damage Moderate

Test Article Deflections [m]

Permanent 0.26
Dynamic 0.32
Working Width..... N/A

Vehicle Damage

See appendix A
Maximum internal deformation..... 49 mm
Maximum external deformation..... 590 mm

GR P 10
IMQ



LAB IMQ
Società di LA, IMQ and ILAC
Notified Body Approval

annulla e sostituisce il precedente rapporto datato 10/05/2019 / substitutes test report dated 10/05/2019



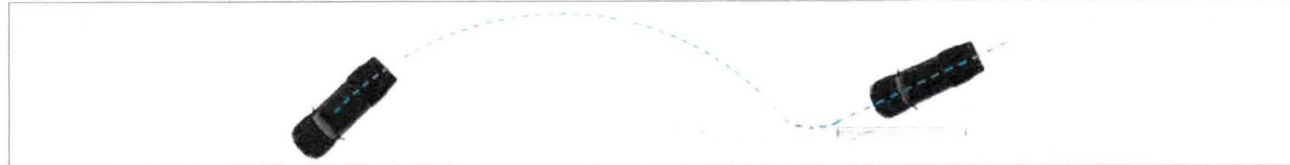
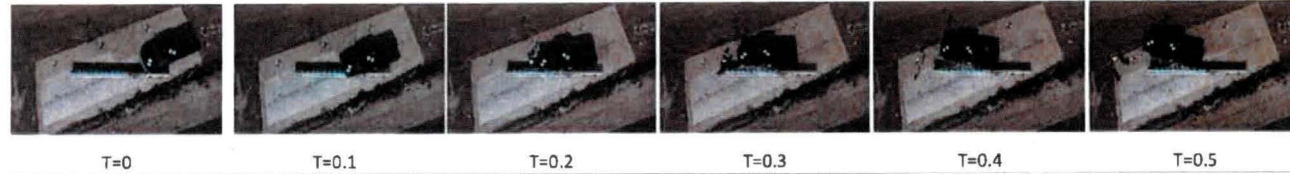
CSI
CORPORATE TESTING

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Data: 12/07/2019
Date:



General Information

Test agency..... CSI S.p.A.
Test No. 0100/ME/HRB/18
Date..... 14/09/2018

Test Article

Type..... HERCULES
Installation length [m]..... 5.83
Size and/or dimension and material of key
Elements..... See attached drawings

Foundation type and condition

Concrete (anchored)

Test Vehicle

Type/ Designation..... 2270P
Model..... Chevrolet Silverado
Mass [kg]
Curb..... 2201.6
Test Inertial..... 2293.8
Gross static..... 2293.8

Impact Conditions

Speed [km/h]..... 97.5
Angle [deg]..... 25.0
Impact Severity [kJ]..... 150.3
Impact Location..... 25°, middle of the back part
Exit Speed [km/h]..... 48
Exit Angle [deg]..... 18.0

Post-impact Trajectory

Vehicle Stability..... Satisfactory
Stopping Distance..... 25 m downstream
8 m Laterally

Vehicle snagging..... None
Vehicle pocketing..... None

Occupant Risk Values

Impact Velocity [m/s]
X-direction..... 11.4
Y-direction..... -5.8
Ridedown Acceleration [g's]
X-direction..... -10.2
Y-direction..... 6.0

THIV 44.4
PHD 11.7
ASI 2010..... 1.36
Test Article Damage Moderate

Test Article Deflections [m]

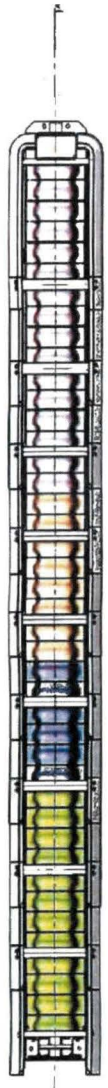
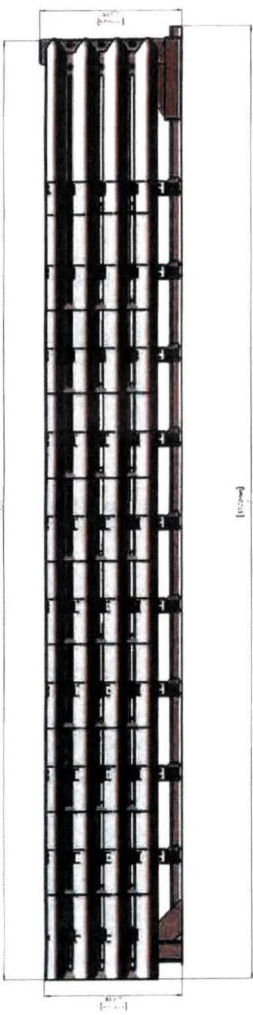
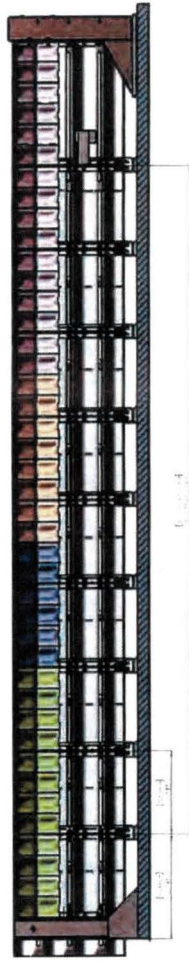
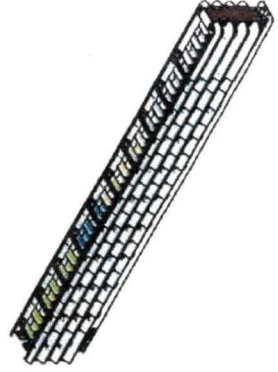
Permanent 0.60
Dynamic 0.10
Working Width..... N/A

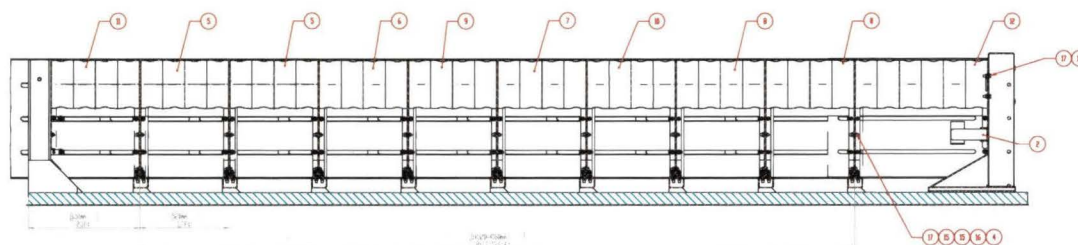
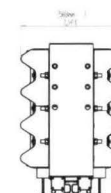
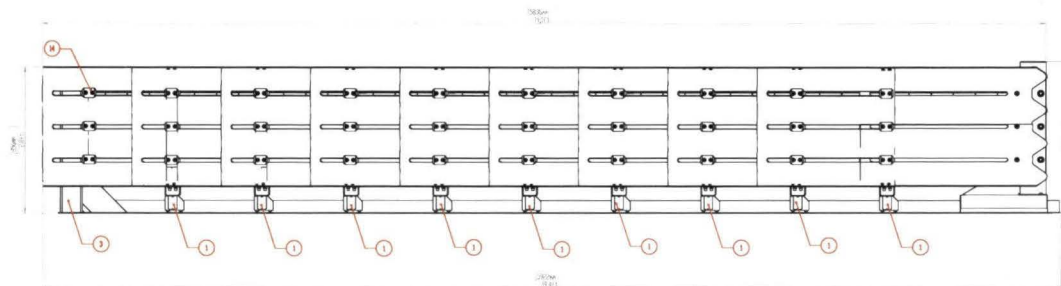
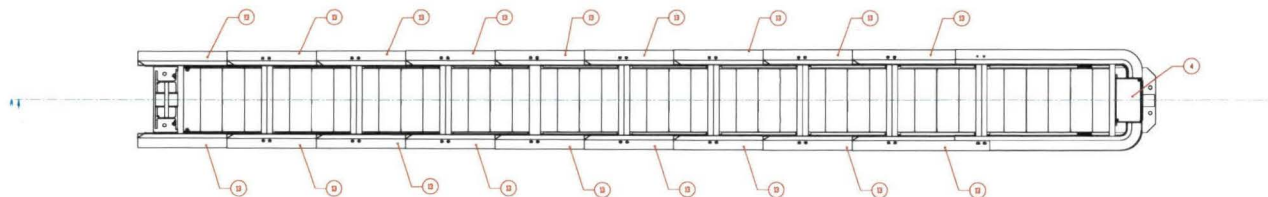
Vehicle Damage

See appendix A
Maximum internal deformation..... 199 mm
Maximum external deformation..... 895 mm

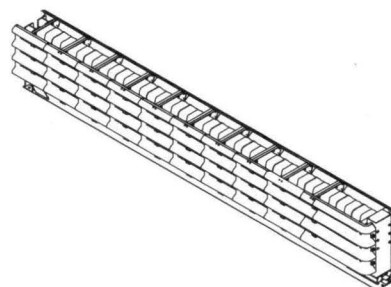


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SETTING A-A

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