U.S. Department of Transportation
Federal Highway Administration

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

July 14, 2025

In Reply Refer To:
HSST-1/CC-183

Valtir, LLC
Bret Eckert
15601 Dallas Parkway, Suite 525
Addison, TX 75001

Dear Mr. Eckert:

We received your initial correspondence on July 5, 2024, requesting issuance of a Federal-aid reimbursement eligibility letter under the Federal-aid highway program for the roadside safety system, device, design, product, or hardware (collectively "device") described below. On January 14, 2025, we received a complete set of files needed to complete our review. We write to inform you that the device NOVUS 100 Crash Cushion is eligible for Federal-aid reimbursement. This letter is assigned Federal Highway Administration (FHWA) control number CC-183.

ELIGIBILITY LETTERS

The FHWA issues Federal-aid reimbursement eligibility letters for new roadside safety devices that are crash tested in accordance with the industry standard of the American Association of State Highway and Transportation Officials (AASHTO) Manual for Assessing Safety Hardware (MASH).

FHWA, the Department of Transportation, and the United States (government) do not regulate roadside safety devices, crash test facilities, or the manufacturing industry. Issuance of eligibility letters is discretionary and provided only as a service to the states. FHWA may, at its discretion, decline to issue, revise, or rescind an eligibility letter. Eligibility letters are only issued by the FHWA headquarters Office of Safety.

Eligibility letters are issued only as notice to the states that a device is eligible for reimbursement under the Federal-aid highway program. They do not establish approval or certification for any other purpose. Issuance of an eligibility letter is not a prerequisite or requirement for state transportation agencies seeking to use Federal-aid funds for roadside safety devices. State agencies may use a device for which an eligibility letter has not been issued and seek Federal-aid reimbursement.

FEDERAL-AID REIMBURSEMENT

The request for issuance of this letter certified the device was crash tested in accordance with the industry standard of AASHTO's MASH. This eligibility letter is based on that certification and

the material offered in support of its issuance. The device described below is eligible for reimbursement under the Federal-aid highway program.

Name of system: NOVUS 100 Crash Cushion
Type of system: Crash Cushion
Test Level: TL-3
Testing conducted by: Applus IDIADA KARCO Engineer, LLC
Date of request: July 5, 2024

Information about the device, including material such as the eligibility request, crash test reports, drawings, or images are included in one or more attachment(s) to this letter.

Eligibility letter CC-183 is inapplicable to devices, optional equipment, alternate materials, or other features that were not crash tested in accordance with AASHTO's MASH.

This letter is issued only for the subject device as crash tested under AASHTO's MASH. Later modification(s) of the device are not eligible for Federal-aid reimbursement under this letter. Notice of later modification(s) should be given to transportation agencies, facility owners, and operators (collectively "agencies").

Agencies should be provided appropriate information about the device's design, installation, maintenance, materials, and mechanical properties.

Issuance of this letter is discretionary, and it may be revised or rescinded at FHWA's discretion. This letter is not a determination of compliance with the Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD) or ownership of any intellectual property rights.

This eligibility letter is not a determination by the government that a crash involving the subject device will result in any particular outcome. It is limited to only the device's eligibility for Federal-aid reimbursement.

INTELLECTUAL PROPERTY

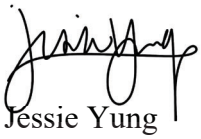
Issuance of this eligibility letter does not convey property rights of any sort nor any exclusive privilege. This letter is not authorization or consent by the government for the use, manufacture, or sale of any patented or proprietary system, device, design, product, or hardware for which the requester is not the patent owner. Eligibility letters are not an expression of any view, position, or determination by the government as to the validity, scope, or ownership of any intellectual property rights to a specific device. These letters do not grant, impute, suggest, or otherwise establish any ownership, distribution, or licensing rights to the requester. The government expresses no opinion about the intellectual property rights relating to any device for which this or any other eligibility letter is issued.

PUBLIC DISCLOSURE

To prevent any misunderstanding, and as discussed above, this Federal-aid eligibility letter is assigned FHWA control number CC-183. It should only be reproduced in full with its attachment(s). This Federal-aid eligibility letter and the material offered by the requester supporting its issuance is public information. All eligibility letters and supporting material are subject to public disclosure under the Freedom of Information Act (FOIA). Eligibility letters are available to the public at https://safety.fhwa.dot.gov/roadway_dept/countermeasures/reduce_crash_severity/.

If you have any questions please contact Paul LaFleur at Paul.LaFleur@dot.gov.

Sincerely,



Jessie Yung
Director, Office of Safety Technologies
Office of Safety

Enclosures

Request for Federal Aid Reimbursement Eligibility of Highway Safety Hardware

Submitter	Date of Request:	July 05, 2024	◉ New ○ Resubmission
	Name:	Bret Eckert, P.E.	
	Company:	VALTIR, LLC	
	Address:	15601 Dallas Parkway, Suite 525, Addison, TX 75001	
	Country:	USA	
	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	◉ Physical Crash Testing ○ Engineering Analysis	NOVUS™ 100 Crash Cushion	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:	Don Pyde	Same as Submitter ☐
Company Name:	VALTIR, LLC	Same as Submitter ☒
Address:	15601 Dallas Parkway, Suite 525, Addison, TX 75001	Same as Submitter ☒
Country:	USA	Same as Submitter ☒

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

The NOVUS™ 100 Crash Cushion ("NOVUS™ 100") system technology is the commercial embodiment of intellectual property that was assigned to VALTIR, LLC ("VALTIR"). VALTIR does not pay royalties for sales of the NOVUS™ 100. The NOVUS™ 100 system was designed and developed by engineers and employees at VALTIR.

Applus IDIADA KARCO Engineering, LLC (KARCO) conducted the certification tests of the NOVUS™ 100 system. KARCO is an internationally accredited third party crash testing laboratory. Full-scale crash testing on the NOVUS™ 100 system was performed in accordance with testing criteria, as set forth by the American Association of State Highway and Transportation Officials (AASHTO) in the Manual for Assessing Safety Hardware ("MASH") (2016), with 2020 Errata. Other than fees paid to KARCO to conduct the tests and then analyze and report the test results, KARCO and VALTIR do not share financial interests. The fees paid to KARCO were not dependent or contingent on the results of the tests.

PRODUCT DESCRIPTION

(●) New Hardware or Significant Modification ( ) Modification to Existing Hardware

The NOVUS™ 100 system is a redirective, non-gating, crash cushion for unidirectional or bidirectional applications, to include roadside, shoulder, median, and gore applications. The NOVUS™ 100 was tested to MASH-2nd Edition (2016), with 2020 Errata to Test Level 3 ("TL-3") criteria. The NOVUS™ 100 consists of eight steel diaphragms that attach to a basetrack assembly. The NOVUS™ 100 system side panels are designed to telescope rearward during head-on impacts and redirect vehicles during angled impacts into the side of the system. The system basetrack has parallel rails that control the rearward compressing action and resist lateral movement during side angled impacts. The NOVUS™ 100 system includes a self-contained back-up structure that is designed to resist movement during head-on and side impacts.

The NOVUS™ 100 system has an overall device length of 20'-11 3/4" (21' nominal) and width of 2'-11 9/16" (3' nominal). The as tested weight of the system is 3800 lbs. The NOVUS™ 100 system is configured with a back-up designed to shield fixed objects up to 26" wide. The structural portions of the NOVUS™ 100 consist of side panels, diaphragm assemblies, dual rail assembly and a self-contained backup, which are hot-dipped galvanized steel. All steel components are manufactured from ASTM A36, ASTM A500 Grade B steel or ASTM A1011 Grade 50 Class 1.

The NOVUS™ 100 may be placed on reinforced or non-reinforced concrete pads or foundations with approved anchors and adhesive. A lightweight placard with reflective sheeting is attached to the first diaphragm. During MASH 2016 Test 3-37a, the NOVUS™ 100 was tested with a transition to vertical concrete barrier which is representative of typical concrete barrier in use on the NHS. The transition is a separate component that is not part of the standard NOVUS™ 100 device.

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:	Alex Beltran	
Engineer Signature:	 Digitally signed by Alex Beltran DN: cn=Alex Beltran, o=Applus IDIADA, ou, email=Alex.Beltran@idiada.com, c=US Date: 2025.01.13 15:15:53 -08'00'	
Address:	9270 Holly Road, Adelanto, CA 92301	Same as Submitter ☐
Country:	USA	Same as Submitter ☐

A brief description of each crash test and its result:

Required Test Number	Narrative Description	Evaluation Results
3-30 (1100C)	Applus IDIADA KARCO Test No. P44008-01. Test Date January 18, 2024. Crash Test Report No. TR-P44008-01-A. MASH Test 3-30 of the VALTIR NOVUS™ 100 crash cushion. The crash cushion was impacted by a 2018 Kia Rio at a velocity of 64.24 mph (103.38 km/h) and a CIA of 0.4° relative to the centerline of the system, with the vehicle offset a 1/4 of its width so that the 1/4 width point aligns with the center of resistance of the crash cushion at the front placard. Upon impact the vehicle forced the crash cushion downstream until coming to a controlled stop 17.7 ft (5.4 m) downstream of the initial point of contact with the system. MASH deformation limits were not exceeded and there was no penetration into the vehicle's occupant compartment. The vehicle experienced a maximum occupant impact velocity (OIV) of 39.0 ft/s (11.9 m/s) and a maximum ridedown acceleration (RA) of -15.1 g. The NOVUS™ 100 crash cushion met all the requirements for MASH 2016 Test 3-30.	PASS
3-31 (2270P)	Applus IDIADA KARCO Test No. P44009-01. Test Date January 19, 2024. Crash Test Report No. TR-P44009-01-A. MASH Test 3-31 of the VALTIR NOVUS™ 100 crash cushion. The crash cushion was impacted by a 2018 RAM 1500 at a velocity of 61.16 mph (98.42 km/h) and a CIA of 0.8° relative to the centerline of the system, with the centerline of the vehicle impacting the centerline of resistance of the crash cushion at the front placard. Upon impact the vehicle forced the crash cushion until coming to a controlled stop 0.7 ft (0.2 m) from initial point of contact with the system. MASH deformation limits were not exceeded and there was no penetration into the vehicle's occupant compartment. The vehicle experienced a maximum occupant impact velocity (OIV) of 31.2 ft/s (9.5 m/s) and a maximum ridedown acceleration (RA) of -20.1 g. The NOVUS™ 100 crash cushion met all the requirements for MASH 2016 Test 3-31.	PASS

Required Test Number	Narrative Description	Evaluation Results
3-32 (1100C)	Applus IDIADA KARCO Test No. P44010-01. Test Date January 30, 2024. Crash Test Report No. TR-P44010-01-A. MASH Test 3-32 of the VALTIR NOVUS™ 100 crash cushion. The crash cushion was impacted by a 2020 Kia Rio at a velocity of 59.71 mph (96.10 km/h) and a CIA of 15.4° relative to the centerline of the system, with the centerline of the vehicle directed at the center of the nose of the system. Upon impact the vehicle forced the crash cushion downstream until coming to a controlled stop 5.7 ft (1.7 m) downstream of the initial point of contact with the system. MASH deformation limits were not exceeded and there was no penetration into the vehicle's occupant compartment. The vehicle experienced a maximum occupant impact velocity (OIV) of 38.4 ft/s (11.7 m/s) and a maximum ridedown acceleration (RA) of -17.9 g. The NOVUS™ 100 crash cushion met all the requirements for MASH 2016 Test 3-32.	PASS
3-33 (2270P)	Applus IDIADA KARCO Test No. P44011-01. Test Date January 31, 2024. Crash Test Report No. TR-P44011-01-A. MASH Test 3-33 of the VALTIR NOVUS™ 100 crash cushion. The crash cushion was impacted by a 2018 Ram 1500 at a velocity of 61.60 mph (99.13 km/h) and a CIA of 15.3° relative to the centerline of the system, with the centerline of the vehicle directed at the center of the nose of the system. Upon impact the vehicle forced the crash cushion downstream until coming to a stop 34.7 ft (10.6 m) towards the driver side from the initial point of contact with the system. MASH deformation limits were not exceeded and there was no penetration into the vehicle's occupant compartment. The vehicle experienced a maximum occupant impact velocity (OIV) of 31.5 ft/s (9.6 m/s) and a maximum ridedown acceleration (RA) of -16.1 g. The NOVUS™ 100 crash cushion met all the requirements for MASH 2016 Test 3-33.	PASS

3-34 (1100C)	Applus IDIADA KARCO Test No. P44012-01. Test Date February 27, 2024. Crash Test Report No. TR-P44012-01-A. MASH Test 3-34 of the VALTIR NOVUS™ 100 crash cushion. The crash cushion was impacted by a 2018 Kia Rio at a velocity of 61.61 mph (99.15 km/h) and a CIA of 15.7° relative to the centerline of the system, with the vehicle impacting the CIP located at 5.0 in. (127mm) upstream from the centerline of diaphragm 2. Upon impact the vehicle was redirected before coming to a controlled stop 161.7 ft (49.3 m) downstream of the initial point of contact with the system. MASH deformation limits were not exceeded and there was no penetration into the vehicle's occupant compartment. The vehicle experienced a maximum occupant impact velocity (OIV) of -23.0 ft/s (-7.0 m/s) and a maximum ridedown acceleration (RA) of 10.9 g. The NOVUS™ 100 crash cushion met all the requirements for MASH 2016 Test 3-34.	PASS
3-35 (2270P)	Applus IDIADA KARCO Test No. P44013-01. Test Date February 29, 2024. Crash Test Report No. TR-P44013-01-A. MASH Test 3-35 of the VALTIR NOVUS™ 100 crash cushion. The crash cushion was impacted by a 2018 Ram 1500 at a velocity of 61.46 mph (98.91 km/h) and a CIA of 25.6° relative to the centerline of the system, with the vehicle impacting the CIP located at 4.2 in. (107mm) downstream from the centerline of diaphragm 2. Upon impact the vehicle was redirected before coming to a controlled stop 181.9 ft (55.4 m) downstream of the initial point of contact with the system. MASH deformation limits were not exceeded and there was no penetration into the vehicle's occupant compartment. The vehicle experienced a maximum occupant impact velocity (OIV) of -29.5 ft/s (-9.0 m/s) and a maximum ridedown acceleration (RA) of 10.1 g. The NOVUS™ 100 crash cushion met all the requirements for MASH 2016 Test 3-35.	PASS

3-36 (2270P)	Applus IDIADA KARCO Test No. P44014-01. Test Date April 3, 2024. Crash Test Report No. TR-P44014-01-A. MASH Test 3-36 of the VALTIR NOVUS™ 100 crash cushion. The crash cushion was impacted by a 2018 Ram 1500 at a velocity of 63.93 mph (102.88 km/h) and a CIA of 24.6° relative to the centerline of the system, with the centerline of the vehicle aligned to the center of the backup structure. Upon impact the vehicle was redirected before coming to a controlled stop 237.2 ft (72.3 m) downstream of the initial point of contact with the system. MASH deformation limits were not exceeded and there was no penetration into the vehicle's occupant compartment. The vehicle experienced a maximum occupant impact velocity (OIV) of -29.9 ft/s (-9.1 m/s) and a maximum ridedown acceleration (RA) of 10.6 g. The NOVUS™ 100 crash cushion met all the requirements for MASH 2016 Test 3-36.	PASS
3-37a (2270P)	Applus IDIADA KARCO Test No. P44015-01. Test Date April 30, 2024. Crash Test Report No. TR-P44015-01-A. MASH Test 3-37a of the VALTIR NOVUS™ 100 crash cushion. The crash cushion was impacted by a 2019 Ram 1500 at a velocity of 60.73 mph (97.74 km/h) and a CIA of 24.7° relative to the centerline of the system, with the centerline of the vehicle impacting the CIP located at the beginning of the transition panel. Upon impact the vehicle was redirected before coming to a controlled stop 224.6 ft (68.5 m) downstream of the initial point of contact with the transition. MASH deformation limits were not exceeded and there was no penetration into the vehicle's occupant compartment. The vehicle experienced a maximum occupant impact velocity (OIV) of -10.2 ft/s (-3.1 m/s) and a maximum ridedown acceleration (RA) of -2.8 g. The NOVUS™ 100 crash cushion met all the requirements for MASH 2016 Test 3-37a.	PASS

3-38 (1500A)	Applus IDIADA KARCO Test No. P44033-01. Test Date March 12, 2024. Crash Test Report No. TR-P44033-01-A. MASH Test 3-38 of the VALTIR NOVUS™ 100 crash cushion. The crash cushion was impacted by a 2018 Chevrolet Malibu at a velocity of 64.21 mph (103.34 km/h) and a CIA of 0.5° relative to the centerline of the system, with the centerline of the vehicle impacting the centerline of the crash cushion. Upon impact the vehicle forced the crash cushion downstream until coming to a controlled stop 13.2 ft (4.0 m) downstream of the initial point of contact with the system. MASH deformation limits were not exceeded and there was no penetration into the vehicle's occupant compartment. The vehicle experienced a maximum occupant impact velocity (OIV) of 35.1 ft/s (10.7 m/s) and a maximum ridedown acceleration (RA) of -14.4 g. The NOVUS™ 100 crash cushion met all the requirements for MASH 2016 Test 3-38.	PASS
3-40 (1100C)		Non-Relevant Test, not conducted
3-41 (2270P)		Non-Relevant Test, not conducted
3-42 (1100C)		Non-Relevant Test, not conducted
3-43 (2270P)		Non-Relevant Test, not conducted
3-44 (2270P)		Non-Relevant Test, not conducted
3-45 (1500A)		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:	KARCO Engineering, INC	
Laboratory Signature:	 Digitally signed by Alex Beltran DN: cn=Alex Beltran, o=Applus IDIADA, ou, email=Alex.Beltran@idiada.com, c=US Date: 2025.01.13 15:16:24 -08'00'	
Address:	9270 Holly Road, Adelanto, CA 92301	Same as Submitter ☐
Country:	USA	Same as Submitter ☐
Accreditation Certificate Number and Dates of current Accreditation period :	International Accreditation Services (IAS) ISO 17025 Accreditation Certificate #TL-371 Expires July 1, 2024	

Submitter Signature*: Bret Eckert Digitally signed by Bret Eckert
Date: 2025.01.13 15:42:01 -08'00'

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

MASH 2016 Test 3-30 Summary

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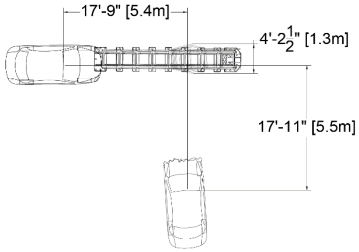


GENERAL INFORMATION

Test Agency	Applus IDIADA KARCO
Test Number	P44008-01
Test Designation	3-30
Test Date	1/18/24

TEST ARTICLE

Name / Model	NOVUS™ 100
Type	Crash Cushion
Crash Cushion Length	21.0 ft. (6.4 m)
Road Surface	Smooth, clean concrete

TEST VEHICLE

Type / Designation	1100C
Year, Make, and Model	2018 Kia Rio
Curb Mass	2,517.7 lbs (1,142.0 kg)
Test Inertial Mass	2,433.8 lbs (1,104.0 kg)
Gross Static Mass	2,599.2 lbs (1,179.0 kg)

Impact Conditions

Impact Velocity (Target)	62.14 mph (100.00 km/h)
Impact Velocity (Actual)	64.24 mph (103.38 km/h)
Impact Angle (Target)	0.0° relative to the centerline of the system
Impact Angle (Actual)	0.4° relative to the centerline of the system
Location / Orientation (Target)	1/4 vehicle width (16.9 in. [429 mm]) from the center of resistance
Location / Orientation (Actual)	16.7 in. (424 mm) from the center of resistance
Kinetic Energy	335.7 kip-ft (455.2 kJ)
Minimum KE Required	288.0 kip-ft (390.0 kJ)

Exit Conditions

Exit Velocity	N/A
Exit Angle	N/A
Final Vehicle Position	17.7 ft. (5.4 m) downstream 18.0 ft. (5.5 m) Left
Vehicle Snagging	Satisfactory
Vehicle Pocketing	Satisfactory
Vehicle Stability	Satisfactory
Maximum Roll Angle	8.4 °
Maximum Pitch Angle	-12.6 °
Maximum Yaw Angle	-112.3 °

Occupant Risk

Longitudinal OIV	39.0 ft/s (11.9 m/s)
Lateral OIV	-2.3 ft/s (-0.7 m/s)
Longitudinal RA	-15.1 g
Lateral RA	5.3 g
THIV	39.0 ft/s (11.9 m/s)
PHD	15.6 g
ASI	1.49

Test Article Deflections

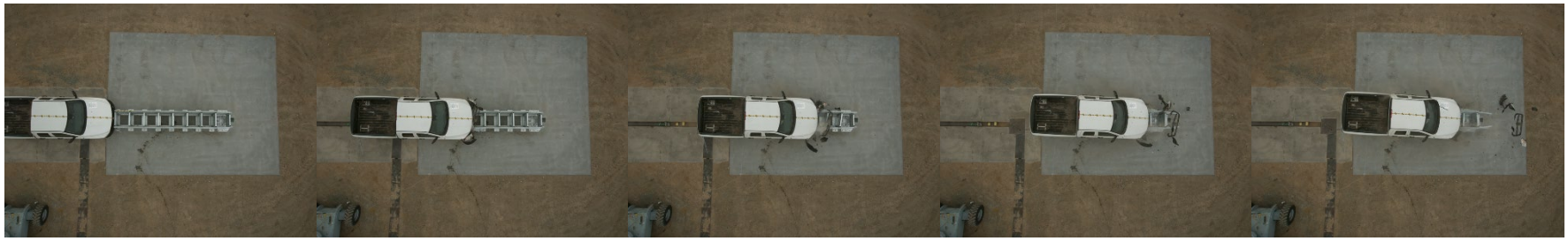
Static	0.4 ft. (0.1 m)
Dynamic	0.5 ft. (0.2 m)
Working Width	4.3 ft. (1.3 m)
Debris Field	N/A

Vehicle Damage

Vehicle Damage Scale	12-FD-7
CDC	12FDEW2
Maximum Deformation	(0.0 in.) 0.0 mm

Figure 2 Summary of Test 3-30

MASH 2016 Test 3-31 Summary



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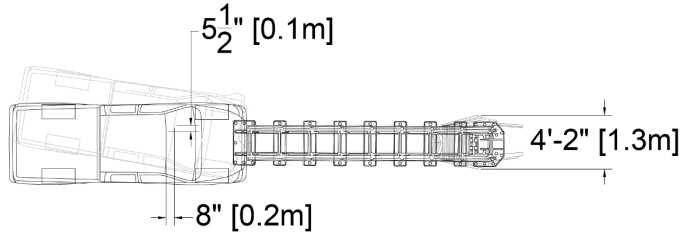


GENERAL INFORMATION

Test Agency	Applus IDIADA KARCO
Test Number	P44009-01
Test Designation	3-31
Test Date	1/19/24

TEST ARTICLE

Name / Model	NOVUS™ 100
Type	Crash Cushion
Crash Cushion Length	21.0 ft. (6.4 m)
Road Surface	Smooth, clean concrete

TEST VEHICLE

Type / Designation	2270P
Year, Make, and Model	2018 Ram 1500
Curb Mass	5,070.5 lbs (2,300.0 kg)
Test Inertial Mass	5,008.8 lbs (2,272.0 kg)
Gross Static Mass	5,008.8 lbs (2,272.0 kg)

Impact Conditions

Impact Velocity (Target)	62.14 mph (100.00 km/h)
Impact Velocity (Actual)	61.16 mph (98.42 km/h)
Impact Angle (Target)	0.0° relative to the centerline of the system
Impact Angle (Actual)	0.8° relative to the centerline of the system
Location / Orientation (Target)	Center of resistance
Location / Orientation (Actual)	2.3 in. (58 mm) from the center of resistance
Kinetic Energy	626.2 kip-ft (849.1 kJ)
Minimum KE Required	594.0 kip-ft (806.0 kJ)

Exit Conditions

Exit Velocity	N/A
Exit Angle	N/A
Final Vehicle Position	0.7 ft. (0.2 m) Upstream 0.5 ft. (0.1 m) Left
Vehicle Snagging	Satisfactory
Vehicle Pocketing	Satisfactory
Vehicle Stability	Satisfactory
Maximum Roll Angle	1.6 °
Maximum Pitch Angle	-7.0 °
Maximum Yaw Angle	5.8 °

Occupant Risk

Longitudinal OIV	31.2 ft/s (9.5 m/s)
Lateral OIV	3.3 ft/s (1.0 m/s)
Longitudinal RA	-20.1 g
Lateral RA	2.2 g
THIV	31.5 ft/s (9.6 m/s)
PHD	20.1 g
ASI	1.31

Test Article Deflections

Static	0.7 ft. (0.2 m)
Dynamic	0.7 ft. (0.2 m)
Working Width	4.3 ft. (1.3 m)
Debris Field	N/A

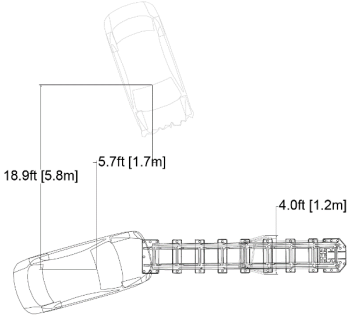
Vehicle Damage

Vehicle Damage Scale	12-FD-3
CDC	12FDEW5
Maximum Deformation	(0.0 in.) 0.0 mm

Figure 2 Summary of Test 3-31

MASH 2016 Test 3-32 Summary

0.000 seconds 0.300 seconds 0.600 seconds 0.900 seconds 1.200 seconds



GENERAL INFORMATION

Test Agency	Applus IDIADA KARCO
Test Number	P44010-01
Test Designation	3-32
Test Date	1/30/24

TEST ARTICLE

Name / Model	NOVUS™ 100
Type	Crash Cushion
Crash Cushion Length	21.0 ft. (6.4 m)
Road Surface	Smooth, clean concrete

TEST VEHICLE

Type / Designation	1100C
Year, Make, and Model	2020 Kia Rio
Curb Mass	2,507.8 lbs (1,137.5 kg)
Test Inertial Mass	2,418.5 lbs (1,097.0 kg)
Gross Static Mass	2,583.8 lbs (1,172.0 kg)

Impact Conditions

Impact Velocity (Target)	62.14 mph (100.00 km/h)
Impact Velocity (Actual)	59.71 mph (96.10 km/h)
Impact Angle (Target)	15.0° relative to the centerline of the system
Impact Angle (Actual)	15.4° relative to the centerline of the system
Location / Orientation (Target)	Center of resistance
Location / Orientation (Actual)	4.2 in. (107 mm) from the center of resistance
Kinetic Energy	288.3 kip-ft (390.9 kJ)
Minimum KE Required	288.0 kip-ft (390.0 kJ)

Exit Conditions

Exit Velocity	N/A
Exit Angle	N/A
Final Vehicle Position	5.7 ft. (1.7 m) Downstream 18.9 ft. (5.8 m) Left
Vehicle Snagging	Satisfactory
Vehicle Pocketing	Satisfactory
Vehicle Stability	Satisfactory
Maximum Roll Angle	-7.2 °
Maximum Pitch Angle	-9.6 °
Maximum Yaw Angle	86.1 °

Occupant Risk

Longitudinal OIV	38.4 ft/s (11.7 m/s)
Lateral OIV	-2.3 ft/s (-0.7 m/s)
Longitudinal RA	-17.9 g
Lateral RA	-7.5 g
THIV	39.0 ft/s (11.9 m/s)
PHD	18.0 g
ASI	1.35

Test Article Deflections

Static	0.5 ft. (0.1 m)
Dynamic	0.5 ft. (0.1 m)
Working Width	4.0 ft. (1.2 m)
Debris Field	N/A

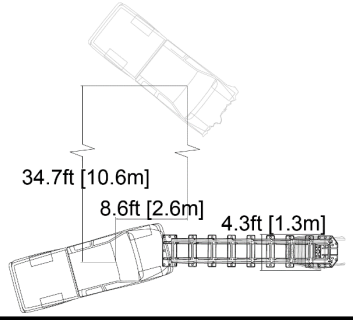
Vehicle Damage

Vehicle Damage Scale	12-FD-7
CDC	12FDEW8
Maximum Deformation	(0.0 in.) 0.0 mm

Figure 2 Summary of Test 3-32

MASH 2016 Test 3-33 Summary

0.000 seconds | 0.400 seconds | 0.800 seconds | 1.200 seconds | 1.600 seconds



GENERAL INFORMATION

Test Agency	Applus IDIADA KARCO
Test Number	P44011-01
Test Designation	3-33
Test Date	1/31/24

TEST ARTICLE

Name / Model	NOVUS™ 100
Type	Crash Cushion
Crash Cushion Length	21.0 ft. (6.4 m)
Road Surface	Smooth, clean concrete

TEST VEHICLE

Type / Designation	2270P
Year, Make, and Model	2018 RAM 1500
Curb Mass	5,050.7 lbs (2,291.0 kg)
Test Inertial Mass	5,011.0 lbs (2,273.0 kg)
Gross Static Mass	5,011.0 lbs (2,273.0 kg)

Impact Conditions

Impact Velocity (Target)	62.14 mph (100.00 km/h)
Impact Velocity (Actual)	61.60 mph (99.13 km/h)
Impact Angle (Target)	15.0° relative to the centerline of the system
Impact Angle (Actual)	15.3° relative to the centerline of the system
Location / Orientation (Target)	Center of resistance
Location / Orientation (Actual)	4.1 in. (104 mm) from the center of resistance
Kinetic Energy	635.6 kip-ft (861.7 kJ)
Minimum KE Required	594.0 kip-ft (806.0 kJ)

Exit Conditions

Exit Velocity	N/A
Exit Angle	N/A
Final Vehicle Position	8.6 ft. (2.6 m) Downstream 34.7 ft. (10.6 m) Left
Vehicle Snagging	Satisfactory
Vehicle Pocketing	Satisfactory
Vehicle Stability	Satisfactory
Maximum Roll Angle	-10.7 °
Maximum Pitch Angle	-4.7 °
Maximum Yaw Angle	90.8 °

Occupant Risk

Longitudinal OIV	31.5 ft/s (9.6 m/s)
Lateral OIV	-3.3 ft/s (-1.0 m/s)
Longitudinal RA	-16.1 g
Lateral RA	3.2 g
THIV	32.2 ft/s (9.8 m/s)
PHD	16.2 g
ASI	1.10

Test Article Deflections

Static	0.9 ft. (0.3 m)
Dynamic	1.1 ft. (0.3 m)
Working Width	4.3 ft. (1.3 m)
Debris Field	N/A

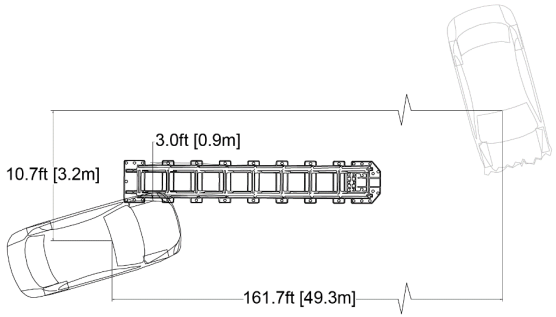
Vehicle Damage

Vehicle Damage Scale	12-FD-3
CDC	12FDEW9
Maximum Deformation	(0.0 in.) 0.0 mm

Figure 2 Summary of Test 3-33

MASH 2016 Test 3-34 Summary

0.000 seconds | 0.110 seconds | 0.220 seconds | 0.330 seconds | 0.440 seconds



GENERAL INFORMATION

Test Agency	Applus IDIADA KARCO
Test Number	P44012-01
Test Designation	3-34
Test Date	2/27/24

TEST ARTICLE

Name / Model	NOVUS™ 100
Type	Crash Cushion
Crash Cushion Length	21.0 ft. (6.4 m)
Road Surface	Smooth, clean concrete

TEST VEHICLE

Type / Designation	1100C
Year, Make, and Model	2018 Kia Rio
Curb Mass	2,544.1 lbs (1,154.0 kg)
Test Inertial Mass	2,396.4 lbs (1,087.0 kg)
Gross Static Mass	2,561.8 lbs (1,162.0 kg)

Impact Conditions

Impact Velocity (Target)	62.14 mph (100.00 km/h)
Impact Velocity (Actual)	61.61 mph (99.15 km/h)
Impact Angle (Target)	15.0° relative to the centerline of the system
Impact Angle (Actual)	15.7° relative to the centerline of the system
Location / Orientation (Target)	Centerline of diaphragm 2
Location / Orientation (Actual)	5.0 in. (127 mm) upstream from the centerline of diaphragm 2
Impact Severity	22.3 kip-ft (30.2 kJ)
Minimum IS Required	19.0 kip-ft (26.0 kJ)

Exit Conditions

Exit Velocity	54.52 mph (85.79 km/h)
Exit Angle	6.5°
Final Vehicle Position	161.7 ft. (49.3 m) downstream 10.7 ft. (3.2 m) Left
Vehicle Snagging	Satisfactory
Vehicle Pocketing	Satisfactory
Vehicle Stability	Satisfactory
Maximum Roll Angle	1.9 °
Maximum Pitch Angle	-1.6 °
Maximum Yaw Angle	22.2 °

Occupant Risk

Longitudinal OIV	9.5 ft/s (2.9 m/s)
Lateral OIV	-23.0 ft/s (-7.0 m/s)
Longitudinal RA	-2.5 g
Lateral RA	10.9 g
THIV	25.3 ft/s (7.7 m/s)
PHD	11.0 g
ASI	1.69

Test Article Deflections

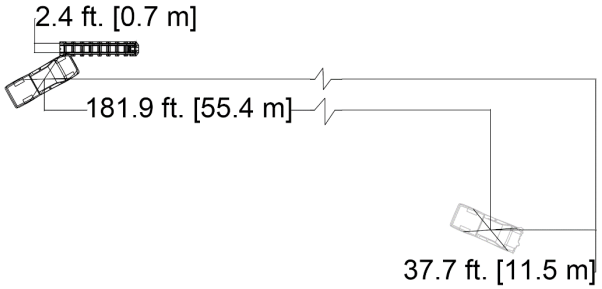
Static	0.0 ft. (0.0 m)
Dynamic	0.1 ft. (0.0 m)
Working Width	3.0 ft. (0.9 m)
Debris Field	N/A

Vehicle Damage

Vehicle Damage Scale	11-FL-2
CDC	11FLEN2
Maximum Deformation	(0.0 in.) 0.0 mm

Figure 2 Summary of Test 3-34

MASH 2016 Test 3-35 Summary



GENERAL INFORMATION

Test Agency	Applus IDIADA KARCO
Test Number	P44013-01
Test Designation	3-35
Test Date	2/29/24

TEST ARTICLE

Name / Model	NOVUS™ 100
Type	Crash Cushion
Crash Cushion Length	21.0 ft. (6.4 m)
Road Surface	Smooth, clean concrete

TEST VEHICLE

Type / Designation	2270P
Year, Make, and Model	2018 RAM 1500
Curb Mass	5,050.7 lbs (2,291.0 kg)
Test Inertial Mass	5,013.3 lbs (2,274.0 kg)
Gross Static Mass	5,013.3 lbs (2,274.0 kg)

Impact Conditions

Impact Velocity (Target)	62.14 mph (100.00 km/h)
Impact Velocity (Actual)	61.46 mph (98.91 km/h)
Impact Angle (Target)	25.0° relative to the centerline of the system
Impact Angle (Actual)	25.6° relative to the centerline of the system
Location / Orientation (Target)	Centerline of diaphragm 2
Location / Orientation (Actual)	4.2 in. (107 mm) downstream from the centerline of diaphragm 2
Impact Severity	118.2 kip-ft (160.2 kJ)
Minimum IS Required	106.0 kip-ft (144.0 kJ)

Exit Conditions

Exit Velocity	49.91 mph (80.32 km/h)
Exit Angle	7.6°
Final Vehicle Position	181.9 ft. (55.4 m) downstream 37.7 ft. (11.5 m) Passenger
Vehicle Snagging	Satisfactory
Vehicle Pocketing	Satisfactory
Vehicle Stability	Satisfactory
Maximum Roll Angle	-19.5 °
Maximum Pitch Angle	7.8 °
Maximum Yaw Angle	45.6 °

Occupant Risk

Longitudinal OIV	18.0 ft/s (5.5 m/s)
Lateral OIV	-29.5 ft/s (-9.0 m/s)
Longitudinal RA	-6.4 g
Lateral RA	10.1 g
THIV	35.4 ft/s (10.8 m/s)
PHD	10.2 g
ASI	2.02

Test Article Deflections

Static	0.1 ft. (0.0 m)
Dynamic	0.3 ft. (0.1 m)
Working Width	2.4 ft. (0.7 m)
Debris Field	N/A

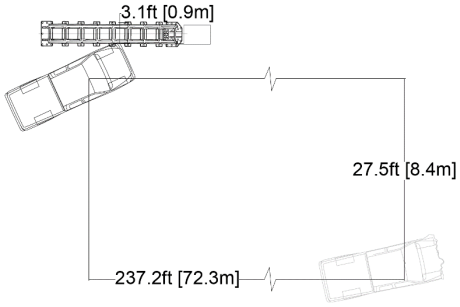
Vehicle Damage

Vehicle Damage Scale	11-FL-5
CDC	11FDEW3
Maximum Deformation	2.1 in. (53 mm) driver toepan

Figure 2 Summary of Test 3-35

MASH 2016 Test 3-36 Summary

0.000 seconds | 0.100 seconds | 0.200 seconds | 0.300 seconds | 0.400 seconds



GENERAL INFORMATION

Test Agency	Applus IDIADA KARCO
Test Number	P44014-01
Test Designation	3-36
Test Date	4/3/24

TEST ARTICLE

Name / Model	NOVUS™ 100
Type	Crash Cushion
Crash Cushion Length	21.0 ft. (6.4 m)
Road Surface	Smooth, clean concrete

TEST VEHICLE

Type / Designation	2270P
Year, Make, and Model	2018 RAM 1500
Curb Mass	5,127.9 lbs (2,326.0 kg)
Test Inertial Mass	5,001.1 lbs (2,268.5 kg)
Gross Static Mass	5,001.1 lbs (2,268.5 kg)

Impact Conditions

Impact Velocity (Target)	62.14 mph (100.00 km/h)
Impact Velocity (Actual)	63.93 mph (102.88 km/h)
Impact Angle (Target)	25.0° relative to the centerline of the system
Impact Angle (Actual)	24.6° relative to the centerline of the system
Location / Orientation (Target)	Centerline of diaphragm 5
Location / Orientation (Actual)	6.6 in. (168 mm) downstream from the centerline of diaphragm 5
Impact Severity	118.4 kip-ft (160.5 kJ)
Minimum IS Required	106.0 kip-ft (144.0 kJ)

Exit Conditions

Exit Velocity	54.86 mph (88.29 km/h)
Exit Angle	6.2°
Final Vehicle Position	237.2 ft. (72.3 m) Downstream 27.5 ft. (8.4 m) Right
Vehicle Snagging	Satisfactory
Vehicle Pocketing	Satisfactory
Vehicle Stability	Satisfactory
Maximum Roll Angle	-18.7 °
Maximum Pitch Angle	-4.8 °
Maximum Yaw Angle	44.5 °

Occupant Risk

Longitudinal OIV	16.4 ft/s (5.0 m/s)
Lateral OIV	-29.9 ft/s (-9.1 m/s)
Longitudinal RA	-4.4 g
Lateral RA	10.6 g
THIV	34.4 ft/s (10.5 m/s)
PHD	10.7 g
ASI	2.11

Test Article Deflections

Static	0.0 ft. (0.0 m)
Dynamic	0.2 ft. (0.1 m)
Working Width	3.1 ft. (0.9 m)
Debris Field	N/A

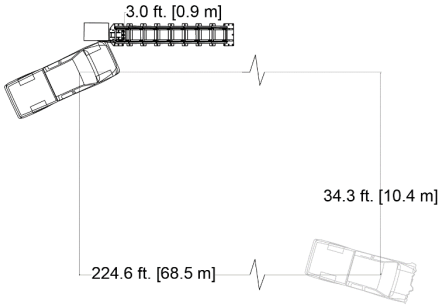
Vehicle Damage

Vehicle Damage Scale	11-FL-4
CDC	11FDEW2
Maximum Deformation	2.6 in. (65 mm) At toepan

Figure 2 Summary of Test 3-36

MASH 2016 Test 3-37a Summary

0.000 seconds | 0.150 seconds | 0.300 seconds | 0.450 seconds | 0.600 seconds



GENERAL INFORMATION

Test Agency	Applus IDIADA KARCO
Test Number	P44015-01
Test Designation	3-37a
Test Date	4/30/24

TEST ARTICLE

Name / Model	NOVUS™ 100
Type	Crash Cushion
Crash Cushion Length	21.0 ft. (6.4 m)
Road Surface	Smooth, clean concrete

TEST VEHICLE

Type / Designation	2270P
Year, Make, and Model	2019 RAM 1500
Curb Mass	5,105.8 lbs (2,316.0 kg)
Test Inertial Mass	5,081.6 lbs (2,305.0 kg)
Gross Static Mass	5,081.6 lbs (2,305.0 kg)

Impact Conditions

Impact Velocity (Target)	62.14 mph (100.00 km/h)
Impact Velocity (Actual)	60.73 mph (97.74 km/h)
Impact Angle (Target)	25.0° relative to the centerline of the system
Impact Angle (Actual)	24.7° relative to the centerline of the system
Location / Orientation (Target)	Beginning of the transition panel
Location / Orientation (Actual)	5.5 in. (140 mm) upstream from the beginning of the transition panel
Impact Severity	109.4 kip-ft (148.3 kJ)
Minimum IS Required	106.0 kip-ft (144.0 kJ)

Exit Conditions

Exit Velocity	48.00 mph (77.25 km/h)
Exit Angle	6.7°
Final Vehicle Position	224.6 ft. (68.5 m) Downstream 34.3 ft. (10.4 m) Right
Vehicle Snagging	Satisfactory
Vehicle Pocketing	Satisfactory
Vehicle Stability	Satisfactory
Maximum Roll Angle	-20.5 °
Maximum Pitch Angle	-8.6 °
Maximum Yaw Angle	35.8 °

Occupant Risk

Longitudinal OIV	8.9 ft/s (2.7 m/s)
Lateral OIV	-10.2 ft/s (-3.1 m/s)
Longitudinal RA	1.6 g
Lateral RA	-2.8 g
THIV	13.8 ft/s (4.2 m/s)
PHD	3.4 g
ASI	0.71

Test Article Deflections

Static	0.0 ft. (0.0 m)
Dynamic	0.1 ft. (0.0 m)
Working Width	3.0 ft. (0.9 m)
Debris Field	N/A

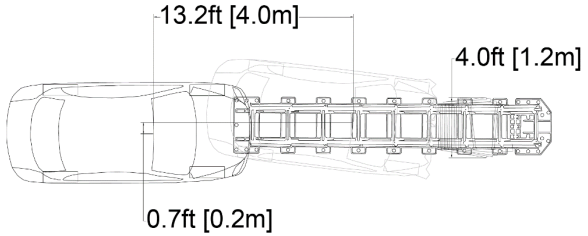
Vehicle Damage

Vehicle Damage Scale	11-FL-7
CDC	11FDEW1
Maximum Deformation	6.0 in. (153 mm) At toepan

Figure 2 Summary of Test 3-37a

MASH 2016 Test 3-38 Summary

0.000 seconds | 0.250 seconds | 0.500 seconds | 0.750 seconds | 1.000 seconds



GENERAL INFORMATION

Test Agency	Applus IDIADA KARCO
Test Number	P44033-01
Test Designation	3-38
Test Date	3/12/24

TEST ARTICLE

Name / Model	NOVUS™ 100
Type	Crash Cushion
Crash Cushion Length	21.0 ft. (6.4 m)
Road Surface	Smooth, clean concrete

TEST VEHICLE

Type / Designation	1500A
Year, Make, and Model	2018 Chevrolet Malibu
Curb Mass	3,070.9 lbs (1,393.0 kg)
Test Inertial Mass	3,282.7 lbs (1,489.0 kg)
Gross Static Mass	3,282.7 lbs (1,489.0 kg)

Impact Conditions

Impact Velocity (Target)	62.14 mph (100.00 km/h)
Impact Velocity (Actual)	64.21 mph (103.34 km/h)
Impact Angle (Target)	0.0° relative to the centerline of the system
Impact Angle (Actual)	0.5° relative to the centerline of the system
Location / Orientation (Target)	Centerline of the system
Location / Orientation (Actual)	0.7 in. (18 mm) from the centerline of the system
Kinetic Energy	452.5 kip-ft (613.5 kJ)
Minimum KE Required	392.0 kip-ft (532.0 kJ)

Exit Conditions

Exit Velocity	N/A
Exit Angle	N/A
Final Vehicle Position	13.2 ft. (4.0 m) Downstream 0.7 ft. (0.2 m) Left
Vehicle Snagging	Satisfactory
Vehicle Pocketing	Satisfactory
Vehicle Stability	Satisfactory
Maximum Roll Angle	3.3 °
Maximum Pitch Angle	-7.1 °
Maximum Yaw Angle	9.3 °

Occupant Risk

Longitudinal OIV	35.1 ft/s (10.7 m/s)
Lateral OIV	1.0 ft/s (-0.3 m/s)
Longitudinal RA	-14.4 g
Lateral RA	-2.6 g
THIV	35.1 ft/s (10.7 m/s)
PHD	14.5 g
ASI	1.01

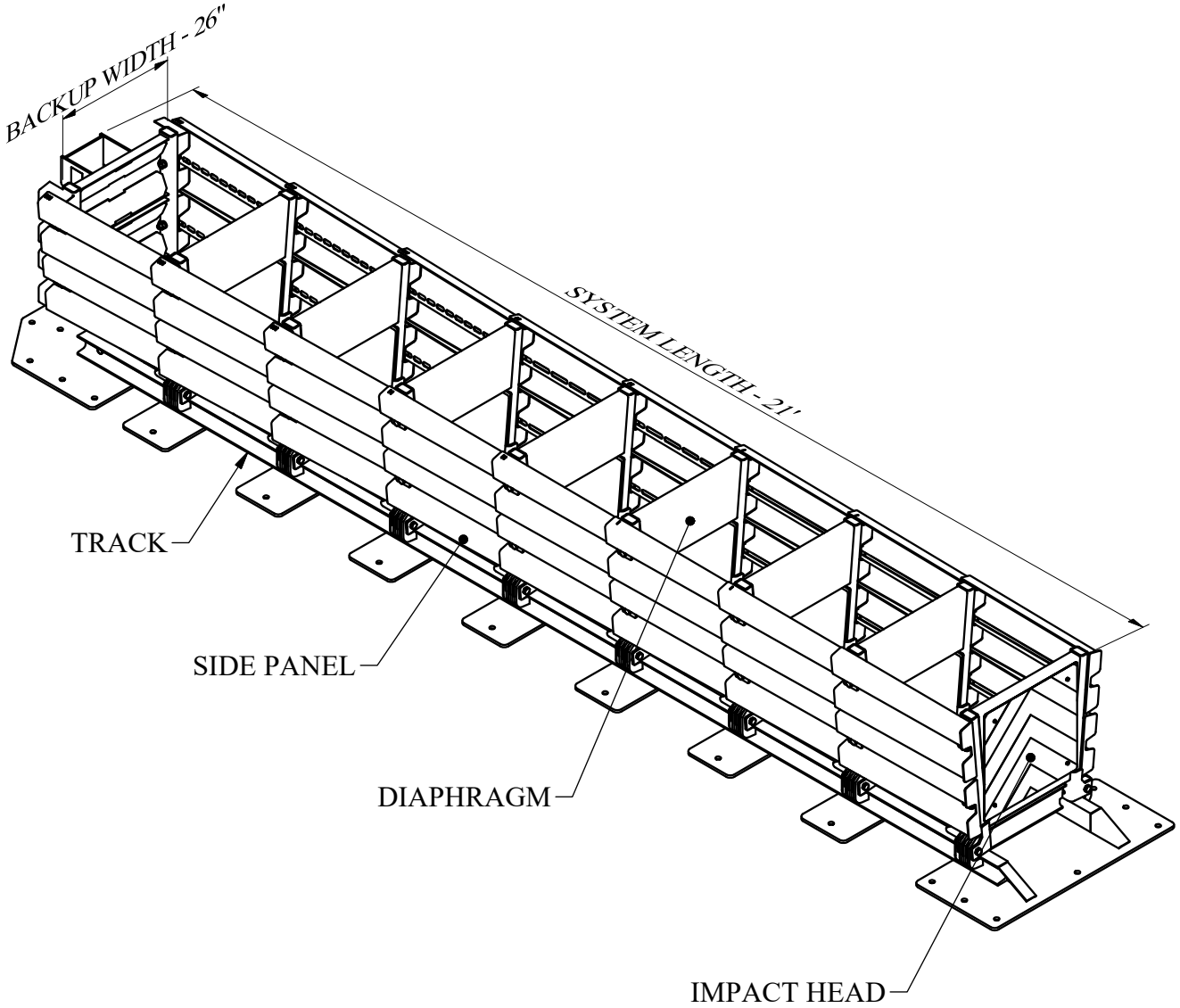
Test Article Deflections

Static	0.4 ft. (0.1 m)
Dynamic	0.4 ft. (0.1 m)
Working Width	4.0 ft. (1.2 m)
Debris Field	N/A

Vehicle Damage

Vehicle Damage Scale	12-FD-6
CDC	12FDEW5
Maximum Deformation	(0.0 in.) 0.0 mm

Figure 2 Summary of Test 3-38



2024

NOVUS™ 100 CRASH CUSHION

VALTIR

SCI XX	
SHEET NO.	DATE
1 of 2	6/21/2024

INTENDED USE

The NOVUS 100 MASH TL3 Crash Cushion consists of an engineered steel impact head and diaphragms, energy absorbing side panels. The system is MASH (Manual for Assessing Safety Hardware) Test Level 3 compliant as a re-directive, non-gating crash cushion.

The NOVUS 100 Crash Cushion consists of the Test Level 3 platform and framework and can be used to shield fixed objects of 26” [660 mm] wide.

FEATURES

Galvanized all-steel construction designed for durability.
Uses only 33 anchors.
Self contained backup.
Basetrack guide stablizers.
Anchorage in concrete and asphalt.
High strength steel panels.

SPECIFICATIONS

System Length: 21' [6.4 m]
System Width: 26" [660 mm]
System Height: 34 3/4" [883 mm]
System Weight: 3,800 lb [1723.6 kg] (approx)

ELIGIBILITY

The NOVUS has been tested in conformance to MASH 2nd Edition (2016) with 2020 Errata Test Level 3 specifications and is eligible for Federal reimbursement by FHWA.
FHWA Eligibility Letter(s): [Report #] dated [Month Day, Year] for MASH 2nd Edition (2016) Test Level 3.

REFERENCES

American Association of State Highway and Transportation Officials (AASHTO), Manual for Assessing Safety Hardware (MASH) 2nd Edition (2016) with 2020 Errata.

CONTACT INFORMATION

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NOVUS™ 100 CRASH CUSHION

SCI XX	
SHEET NO.	DATE
2 of 2	6/21/2024

VALTIR