U.S. Department of Transportation
Federal Highway Administration

March 15, 2024

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

In Reply Refer To:
HSST-1/CC-178

Kevin Schrum
Sicking Safety Systems, LLC
101 Indian Trail Road, Indian Springs Village
AL 35124
USA

Dear Mr. Schrum:

We received your correspondence of February 14, 2023 requesting issuance of a reimbursement eligibility letter under the Federal-aid highway program for the roadside safety system, device, design, product, or hardware (collectively "device") described below. This letter is assigned Federal Highway Administration (FHWA) control number CC-178.

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: Next Generation Terminal (NGT)
Type of system: Terminal
Test Level: Test Level 3
Testing conducted by: Applus IDIADA KARCO Engineering, LLC
Date of request: February 14, 2023

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-178 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.

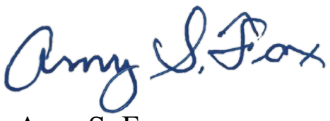
PUBLIC DISCLOSURE

To prevent any misunderstanding, and as discussed above, this eligibility letter is assigned FHWA control number CC-178. It should only be reproduced in full with its attachment(s). This 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 Aimee Zhang at Aimee.Zhang@dot.gov.

Sincerely,



Amy S. Fox
Acting Director
Office of Safety Technologies
Office of Safety

Enclosures

Request for Federal Aid Reimbursement Eligibility of Highway Safety Hardware

Submitter	Date of Request:	February 14, 2023	◉ New ○ Resubmission
	Name:	Kevin Schrum	
	Company:	Sicking Safety Systems, LLC	
	Address:	101 Indian Trail Road, Indian Springs Village, AL 35124	
	Country:	United States of America	
	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	Next Generation Terminal (NGT™)	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:	Kevin Schrum	Same as Submitter ☒
Company Name:	Sicking Safety Systems, LLC	Same as Submitter ☒
Address:	101 Indian Trail Road, Indian Springs Village, AL 35124	Same as Submitter ☒
Country:	United States of America	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.

Sicking Safety Systems, LLC is the manufacturer and marketer of device.

Applus IDIADA KARCO Engineering, LLC (IDIADA KARCO) is an independent research and testing laboratory having no affiliation with any other entity. IDIADA KARCO is actively Involved In data acquisition and compliance/certification testing for a variety of government agencies and equipment manufacturers. The principals and staff of IDIADA KARCO have no past or present financial, contractual or organizational interest in any company or entity directly or indirectly related to the products that KARCO tests. If any financial interest should arise, other than receiving fees for testing, reporting, etc., with respect to any project, the company will provide, In writing, a full and immediate disclosure to the FHWA.

PRODUCT DESCRIPTION

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

The Next Generation Terminal (NGT™) is classified as a non-gating, re-directive terminal. The NGT™ has a total length of 37'-6" (11.4 m) from the center of the anchor post to the center of NGT post 10. The system consists of an impact head, anchor post assembly, first panel, shelf bracket, standard MGS 12.5' guardrail, two (2) notched wooden blockouts, seven (7) wooden blockouts, nine (9) 6' (1.8 m) NGT posts positioned at post 1 through 9, and one (1) 6' (1.8 m) long W6 x 9 post positioned at post 10. The impact head is attached directly to NGT post 1 with one (1) 5/16" x 1" Grade 5 hex bolt, two (2) 5/16" washers and one (1) 5/16" nut. A shelf bracket, where the impact head sits, is attached to NGT post 1 with two (2) 1/2" x 1 – 1/2" grade 5 hex bolts, four (4) 1/2" washers, and two (2) 1/2" hex nuts. The anchor post has a cap that is attached by two (2) 7/16" x 1-1/2" Grade 5 hex bolts, four (4) 7/16" washers, and two (2) 7/16" hex nuts. The first panel's cable is inserted into the anchor post and held in place by the anchor cap, one (1) 1" hex nut, and one (1) 1" washer. The guardrail splice was connected by eight (8) 5/8" x 1-1/4" splice bolts and eight (8) 5/8" splice nuts.

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=IDIADA KARCO, ou=Lab, email=Alex.Beltran@idiada.com, c=US Date: 2023.11.14 12:23:33 -08'00'	
Address:	9270 Holly Road, Adelanto, CA 92301	Same as Submitter ☐
Country:	United States of America	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. P42215-01. Test Date September 16, 2022. Crash Test Report No. TR-P42215-01-NC for MASH 2016 Test 3-30 Crash Test of Sicking Safety Systems, LLC Next Generation Terminal (NGT™). The terminal was impacted by a 2016 Kia Rio small sedan at a velocity of 66.48 mph (106.99 km/h) and a CIA of 1.0°. Upon impact the impact head captured the test vehicle and they began retracting downstream along the first panel. NGT posts 1 through 5 sheared at the plug welds, as intended. The test vehicle released from the impact head and began yawing in a counterclockwise direction as it proceeded to its final resting position. 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 24.9 ft/s (7.6 m/s) and a maximum ridedown acceleration (RA) of -10.8 g.	PASS
3-31 (2270P)	Applus IDIADA KARCO Test No. P42214-01. Test Date September 23, 2022. Crash Test Report No. TR-P42214-01-NC for MASH 2016 Test 3-31 Crash Test of Sicking Safety Systems, LLC Next Generation Terminal (NGT™). The terminal was impacted by a 2017 Ram 1500 pickup truck at a velocity of 62.11 mph (99.96 km/h) and a CIA of 0.3°. Upon impact the vehicle contacted the impact head. NGT posts 1 through 8 sheared at the plug welds, as intended, and posts 9 through 11 partially yielded. The pickup truck remained in contact with 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 17.4 ft/s (5.3 m/s) and a maximum ridedown acceleration (RA) of -6.8 g.	PASS

Required Test Number	Narrative Description	Evaluation Results
3-32 (1100C)	Applus IDIADA KARCO Test No. P42191-01. Test Date September 02, 2022. Crash Test Report No. TR-P42191-01-NC for MASH 2016 Test 3-32 Crash Test of Sicking Safety Systems, LLC Next Generation Terminal (NGT™). The terminal was impacted by a 2016 Kia Rio small sedan at a velocity of 61.82 mph (99.49 km/h) and a CIA of 14.9°. Upon impact the impact head captured the test vehicle and began retracting downstream. NGT plug welded posts 1 through 4 yielded flat to grade. As the retracting continued the test vehicle began to yaw in a clockwise direction. The vehicle lost contact with the impact head and continued yawing until reaching its final resting position downstream. 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 30.8 ft/s (9.4 m/s) and a maximum ridedown acceleration (RA) of -9.7 g.	PASS
3-33 (2270P)	Applus IDIADA KARCO Test No. P42104-03. Test Date July 13, 2022. Crash Test Report No. TR-P42104-03-NC for MASH 2016 Test 3-33 Crash Test of Sicking Safety Systems, LLC Next Generation Terminal (NGT™). The terminal was impacted by a 2016 Ram 1500 pickup truck at a velocity of 61.86 mph (99.56 km/h) and a CIA of 14.5°. Upon impact the pickup truck was captured by the impact head. NGT plug-welded posts 1 through 8 yielded flat to grade as the vehicle and impact head began retracting downstream. After the retraction was complete the vehicle released from the system and began to yaw in a clockwise direction until reaching its final resting position. There was 1.0 in. (25 mm) of deformation to the floorpan/transmission tunnel but MASH 2016 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 22.3 ft/s (6.8 m/s) and a maximum ridedown acceleration (RA) of -5.8 g.	PASS

3-34 (1100C)	Applus IDIADA KARCO Test No. P42158-01. Test Date July 22, 2022. Crash Test Report No. TR-P42158-01-NC for MASH 2016 Test 3-34 Crash Test of Sicking Safety Systems, LLC Next Generation Terminal (NGT™). The terminal was impacted by a 2016 Kia Rio small sedan at a velocity of 60.84 mph (97.91 km/h) and a CIA of 15.4°. Upon impact the vehicle contacted the impact head. NGT first post remained intact, but NGT plug-welded posts 2 and 3 partially yielded. The small sedan remained in contact with the system, was redirecticted, and proceeded downstream to its final resting position. 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 -18.04 ft/s (-5.5 m/s) and a maximum ridedown acceleration (RA) of -8.3 g.	PASS
3-35 (2270P)	Applus IDIADA KARCO Test No. P42095-01. Test Date May 03, 2022. Crash Test Report No. TR-P42095-01-NC for MASH 2016 Test 3-35 Crash Test of Sicking Safety Systems, LLC Next Generation Terminal (NGT™). The terminal was impacted by a 2016 Ram 1500 pickup truck at a velocity of 61.45 mph (98.89 km/h) and a CIA of 26.4°. Upon impact NGT posts 3 through 9 yielded flat to grade and the vehicle began redirecting. The truck then continued downstream until reaching its final resting position. 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 18.0 ft/s (5.5 m/s) and a maximum ridedown acceleration (RA) of -12.2 g.	PASS
3-36 (2270P)	Test 3-36 is intended for a system that had a rigid backup structure and is not applicable for this system, therefore it was not performed.	Non-Relevant Test, not conducted

3-37 (2270P)	Applus IDIADA KARCO Test No. P42183-01. Test Date August 05, 2022. Crash Test Report No. TR-P42183-01-NC for MASH 2016 Test 3-37b Crash Test of Sicking Safety Systems, LLC Next Generation Terminal (NGT™). MASH Test 3-37b involves a 1100C or 2270P vehicle impacting the CIP of the terminal / crash cushion at a nominal velocity of 62 mph (100 km/h) and impact angle of 25° in the reverse direction of travel. The NGT™ is classified as a post-and-beam terminal to which MASH states that the 1100C vehicle will generally be the critical vehicle for this test. As such, the NGT™ was tested to Test 3-37b with an 1100C vehicle. The terminal was impacted by a 2016 Kia Rio small sedan at a velocity of 62.74 mph (100.97 km/h) and a CIA of 24.9°. Upon impact the vehicle contacted the first panel causing NGT plug welded posts 2 and 3 to yield. The vehicle then contacted the impact head and caused the NGT first post to yield. The impact head detached from the first post and the first panel then the vehicle proceeded to its final resting postion. There was 1.0 in. (30 mm) of deformation to the windshield but 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 28.2 ft/s (8.6 m/s) and a maximum ridedown acceleration (RA) of -14.8 g.	PASS
3-38 (1500A)	Test 3-38 is intended for a staged attenuation system and is not applicable for this system, therefore it was not performed.	Non-Relevant Test, not conducted
3-40 (1100C)	Test 3-40 is intended for non-redirective crash cushions and is not applicable for this system, therefore it was not performed.	Non-Relevant Test, not conducted
3-41 (2270P)	Test 3-41 is intended for non-redirective crash cushions and is not applicable for this system, therefore it was not performed.	Non-Relevant Test, not conducted
3-42 (1100C)	Test 3-42 is intended for non-redirective crash cushions and is not applicable for this system, therefore it was not performed.	Non-Relevant Test, not conducted
3-43 (2270P)	Test 3-43 is intended for non-redirective crash cushions and is not applicable for this system, therefore it was not performed.	Non-Relevant Test, not conducted
3-44 (2270P)	Test 3-44 is intended for non-redirective crash cushions and is not applicable for this system, therefore it was not performed.	Non-Relevant Test, not conducted
3-45 (1500A)	Test 3-45 is intended for non-redirective crash cushions and is not applicable for this system, therefore it was not performed.	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:	Applus IDIADA KARCO Engineering, LLC.	
Laboratory Signature:	Digitally signed by Alex Beltran DN: cn=Alex Beltran, o=IDIADA KARCO, ou=Lab, email=Alex.Beltran@idiada.com, c=US Date: 2023.11.14 15:52:15 -08'00'	
Address:	9270 Holly Road, Adelanto, CA 92301	Same as Submitter ☐
Country:	United States of America	Same as Submitter ☒
Accreditation Certificate Number and Dates of current Accreditation period :	International Accreditation Services (IAS) ISO 17025 Accreditation Certificate #TL-371 Expires April 27, 2024	

Submitter Signature*: Kevin Schrum Digitally signed by Kevin Schrum Date: 2023.11.14 18:19:10 -06'00'

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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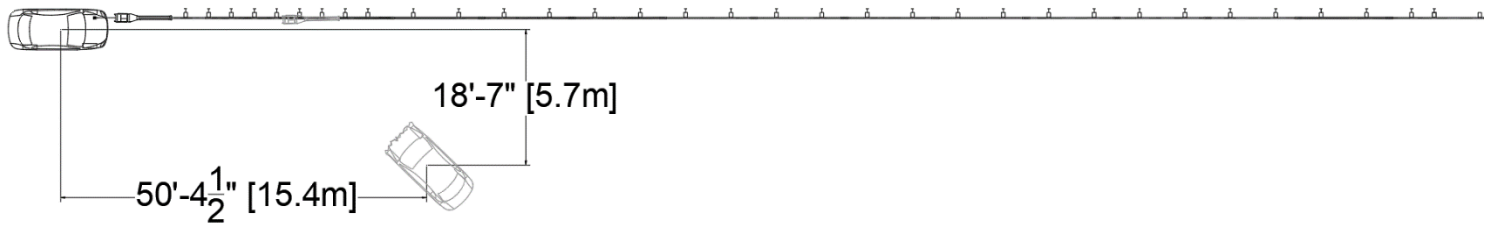

GENERAL INFORMATION	
Test Agency	Applus IDIADA KARCO
Test Number	P42215-01
Test Designation	3-30
Test Date	9/16/22
TEST ARTICLE	
Name / Model	Next Generation Terminal (NGT™)
Type	Terminal
Installation Length	187.5 ft. (57.2 m)
Terminal Length	37.5 ft. (11.4 m)
Road Surface	Smooth Concrete to Fine Silty Soil
TEST VEHICLE	
Type / Designation	1100C
Year, Make, and Model	2016 Kia Rio
Curb Mass	2,422.8 lbs (1,099.0 kg)
Test Inertial Mass	2,440.5 lbs (1,107.0 kg)
Gross Static Mass	2,615.7 lbs (1,186.5 kg)

Impact Conditions	
Impact Velocity	66.48 mph (106.99 km/h)
Impact Angle	1.0°
Location / Orientation	18.3 in. (465 mm) From Vehicle Centerline to Driver Side
Kinetic Energy	360.6 kip-feet (488.9 Kilojoules)
Minimum KE Required	288.0 kip-feet (390.0 Kilojoules)
Exit Conditions	
Exit Velocity	12.86 mph (20.70 km/h)
Exit Angle	-76.8°
Final Vehicle Position	50.4 ft. (15.4 m) Downstream 18.6 ft. (5.7 m) Toward the Impact Side
Vehicle Snagging	Satisfactory
Vehicle Pocketing	Satisfactory
Vehicle Stability	Satisfactory
Maximum Roll Angle	-14.6°
Maximum Pitch Angle	7.9°
Maximum Yaw Angle	-170.9°

Occupant Risk	
Longitudinal OIV	24.9 ft/s (7.6 m/s)
Lateral OIV	-2.3 ft/s (-0.7 m/s)
Longitudinal RA	-10.8 g
Lateral RA	-3.4 g
THIV	24.9 ft/s (7.6 m/s)
PHD	10.8 g
ASI	0.76
Test Article Deflections	
Static	Not Applicable
Dynamic	Not Applicable
Working Width	Not Applicable
Debris Field	52.5 ft. (16.0 m) Longitudinally 38.7 ft. (11.8 m) Laterally
Vehicle Damage	
Vehicle Damage Scale	12-FYEW-2
CDC	12-FL-3
Maximum Deformation	MASH Deformation Limits Not Exceeded (0.0 in.) 0.0 mm

Figure 2 Summary of Test 3-30

MASH 2016 Test 3-31 Summary

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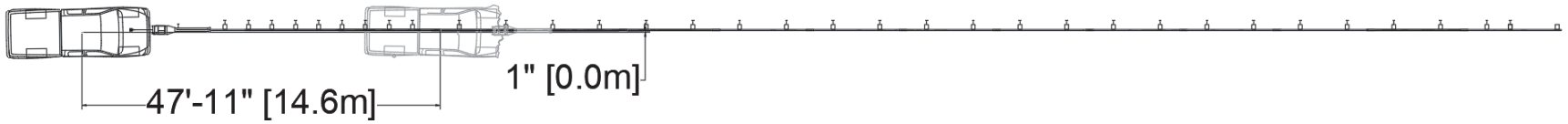

GENERAL INFORMATION	
Test Agency	Applus IDIADA KARCO
Test Number	P42214-01
Test Designation	3-31
Test Date	9/23/22
TEST ARTICLE	
Name / Model	NGT™
Type	Terminal
Installation Length	187.5 ft. (57.2 m)
Terminal Length	37.5 ft. (11.4 m)
Road Surface	Smooth Concrete to Fine Silty Soil
TEST VEHICLE	
Type / Designation	2270P
Year, Make, and Model	2017 Ram 1500
Curb Mass	4,995.6 lbs (2,266.0 kg)
Test Inertial Mass	5,006.6 lbs (2,271.0 kg)
Gross Static Mass	5,006.6 lbs (2,271.0 kg)

Impact Conditions	
Impact Velocity	62.11 mph (99.96 km/h)
Impact Angle	0.3°
Location / Orientation	0.79 in. (20 mm) From Vehicle Centerline on Passenger Side
Kinetic Energy	645.7 kip-feet (875.5 Kilojoules)
Minimum KE Required	594.0 kip-feet (806.0 Kilojoules)
Exit Conditions	
Exit Velocity	Not Applicable
Exit Angle	Not Applicable
Final Vehicle Position	47.9 ft. (14.6 m) Downstream 0.1 ft. (0.0 m) Toward the Impact Side
Vehicle Snagging	Satisfactory
Vehicle Pocketing	Satisfactory
Vehicle Stability	Satisfactory
Maximum Roll Angle	1.7°
Maximum Pitch Angle	2.9°
Maximum Yaw Angle	-1.2°

Occupant Risk	
Longitudinal OIV	17.4 ft/s (5.3 m/s)
Lateral OIV	1.3 ft/s (0.4 m/s)
Longitudinal RA	- 6.8 g
Lateral RA	1.6 g
THIV	17.4 ft/s (5.3 m/s)
PHD	6.8 g
ASI	0.53
Test Article Deflections	
Static	Not Applicable
Dynamic	Not Applicable
Working Width	Not Applicable
Debris Field	72.3 ft. (22.0 m) Longitudinally 20.3 ft. (6.2 m) Laterally
Vehicle Damage	
Vehicle Damage Scale	12-FC-3
CDC	12FCEN2
Maximum Deformation	MASH Deformation Limits Not Exceeded (0.0 in.) 0 mm

Figure 4 Summary of Test 3-31

MASH 2016 Test 3-32 Summary

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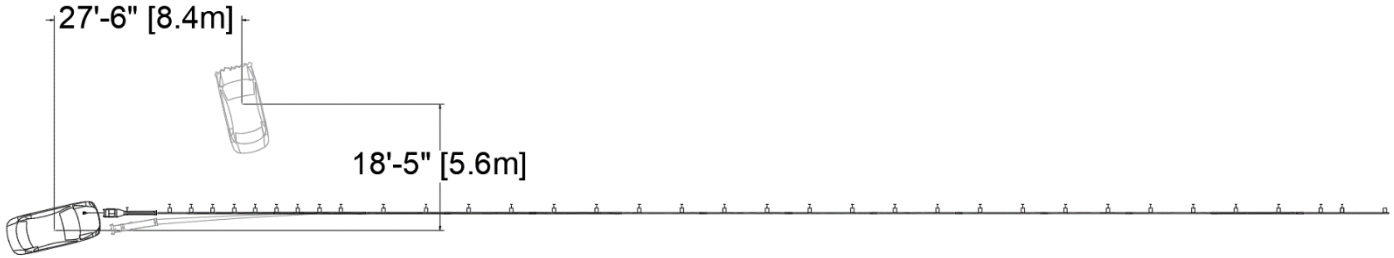


GENERAL INFORMATION	
Test Agency	Applus IDIADA KARCO
Test Number	P42191-01
Test Designation	3-32
Test Date	9/2/22
TEST ARTICLE	
Name / Model	Next Generation Terminal (NGT™)
Type	Terminal
Installation Length	187.5 ft. (57.2 m)
Terminal Length	37.5 ft. (11.4 m)
Road Surface	Smooth Concrete to Fine Silty Soil
TEST VEHICLE	
Type / Designation	1100C
Year, Make, and Model	2016 Kia Rio
Curb Mass	2,555.1 lbs (1,159.0 kg)
Test Inertial Mass	2,466.9 lbs (1,119.0 kg)
Gross Static Mass	2,635.6 lbs (1,195.5 kg)

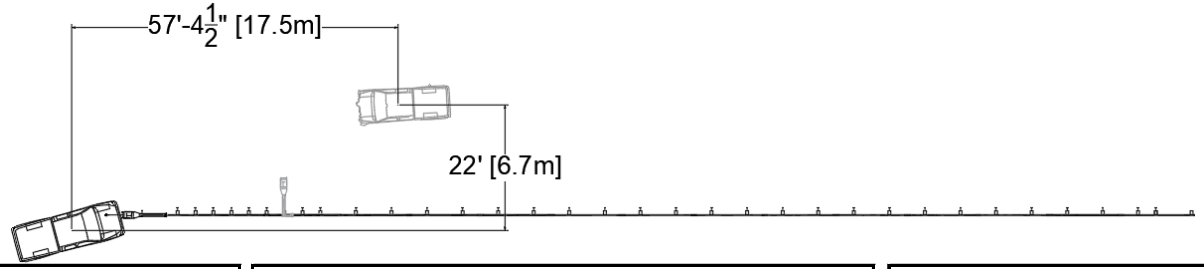
Impact Conditions	
Impact Velocity	61.82 mph (99.49 km/h)
Impact Angle	14.9°
Location / Orientation	1.0 in. (25 mm) From Vehicle Centerline on Passenger Side
Kinetic Energy	315.2 kip-feet (427.3 Kilojoules)
Minimum KE Required	288.0 kip-feet (390.0 Kilojoules)
Exit Conditions	
Exit Velocity	5.90 mph (9.50 km/h)
Exit Angle	81.3°
Final Vehicle Position	27.5 ft. (8.4 m) Downstream 18.4 ft. (5.6 m) Field Side
Vehicle Snagging	Satisfactory
Vehicle Pocketing	Satisfactory
Vehicle Stability	Satisfactory
Maximum Roll Angle	-18.1°
Maximum Pitch Angle	-17.8°
Maximum Yaw Angle	231.4°

Occupant Risk	
Longitudinal OIV	30.8 ft/s (9.4 m/s)
Lateral OIV	-3.9 ft/s (-1.2 m/s)
Longitudinal RA	-9.7 g
Lateral RA	4.1 g
THIV	31.5 ft/s (9.6 m/s)
PHD	9.8 g
ASI	0.86
Test Article Deflections	
Static	1.4 ft. (0.4 m)
Dynamic	2.1 ft. (0.6 m)
Working Width	2.4 ft. (0.7 m)
Debris Field	90.2 ft. (27.5 m) Longitudinally 6.3 ft. (1.9 m) Laterally
Vehicle Damage	
Vehicle Damage Scale	12-FD-6
CDC	12FDEW3
Maximum Deformation	MASH Deformation Limits Not Exceeded (0.0 in.) 0 mm

Figure 2 Summary of Test 3-32

MASH 2016 Test 3-33 Summary

0.000 seconds 0.200 seconds 0.400 seconds 0.600 seconds 0.800 seconds



GENERAL INFORMATION	
Test Agency	Applus IDIADA KARCO
Test Number	P42104-03
Test Designation	3-33
Test Date	7/13/22
TEST ARTICLE	
Name / Model	Next Generation Terminal (NGT™)
Type	Terminal
Installation Length	187.5 ft. (57.2 m)
Terminal Length	37.5 ft. (11.4 m)
Road Surface	Smooth Concrete to Fine Silty Soil
TEST VEHICLE	
Type / Designation	2270P
Year, Make, and Model	2016 Ram 1500
Curb Mass	5,136.7 lbs (2,330.0 kg)
Test Inertial Mass	5,009.9 lbs (2,272.5 kg)
Gross Static Mass	5,009.9 lbs (2,272.5 kg)

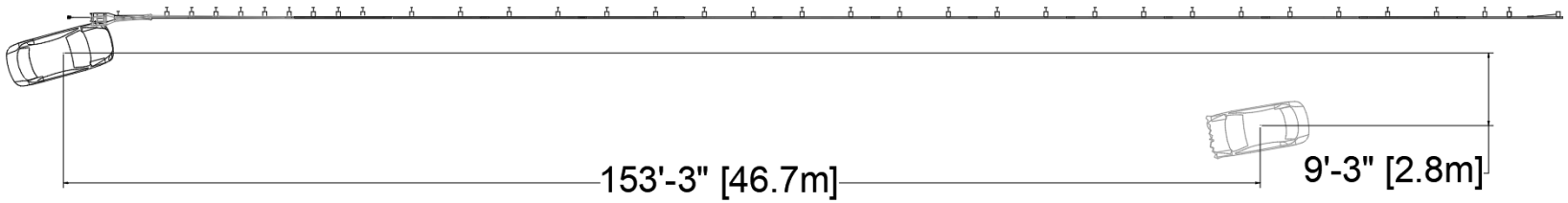
Impact Conditions	
Impact Velocity	61.86 mph (99.56 km/h)
Impact Angle	14.5°
Location / Orientation	0.7 in. (18 mm) Passenger Side of Vehicle Centerline
Kinematic Energy	641.0 kip-feet (869.0 Kilojoules)
Minimum KE Required	594.0 kip-feet (806.0 Kilojoules)
Exit Conditions	
Exit Velocity	9.6 mph (15.4 km/h)
Exit Angle	68.6°
Final Vehicle Position	57.4 ft. (17.5 m) Downstream 22.0 ft. (6.7 m) Non-Impact side
Vehicle Snagging	Satisfactory
Vehicle Pocketing	Satisfactory
Vehicle Stability	Satisfactory
Maximum Roll Angle	-17.2°
Maximum Pitch Angle	-11.5°
Maximum Yaw Angle	22.8°

Occupant Risk	
Longitudinal OIV	22.3 ft/s (6.8 m/s)
Lateral OIV	-2.0 ft/s (-0.6 m/s)
Longitudinal RA	-5.8 g
Lateral RA	2.9 g
THIV	22.6 ft/s (6.9 m/s)
PHD	6.0 g
ASI	0.42
Test Article Deflections	
Static	4.1 ft. (1.2 m)
Dynamic	3.5 ft. (1.1 m)
Working Width	4.3 ft. (1.3 m)
Debris Field	82.3 ft. (25.1 m) Longitudinally 42.2 ft. (12.9 m) Laterally
Vehicle Damage	
Vehicle Damage Scale	12-FD-5
CDC	12FDEW2
Maximum Deformation	1.0 in. (25 mm) Floorpan/Transmission Tunnel

Figure 2 Summary of Test 3-33

MASH 2016 Test 3-34 Summary

0.000 seconds 0.144 seconds 0.288 seconds 0.432 seconds 0.576 seconds



GENERAL INFORMATION

Test Agency	Applus IDIADA KARCO
Test Number	P42158-01
Test Designation	3-34
Test Date	7/22/22

TEST ARTICLE

Name / Model	Next Generation Terminal (NGT™)
Type	Terminal
Installation Length	187.5 ft. (57.2 m)
Terminal Length	37.5 ft. (11.4 m)
Road Surface	Smooth Concrete to Fine Silty Soil

TEST VEHICLE

Type / Designation	1100C
Year, Make, and Model	2016 Kia Rio
Curb Mass	1,145.0 lbs (2,524.3 kg)
Test Inertial Mass	2,429.5 lbs (1,102.0 kg)
Gross Static Mass	2,630.1 lbs (1,193.0 kg)

Impact Conditions

Impact Velocity	60.84 mph (97.91 km/h)
Impact Angle	15.4°
Location / Orientation	7.5 in. (191 mm) Upstream from CIP
Impact Severity	21.2 kip-feet (28.8 Kilojoules)
Minimum IS Required	19.0 kip-feet (26.0 Kilojoules)

Exit Conditions

Exit Velocity	59.56 mph (95.85 km/h)
Exit Angle	-5.6°
Final Vehicle Position	153.3 ft. (46.7 m) Downstream 9.3 ft. (2.8 m) Impact Side
Vehicle Snagging	Satisfactory
Vehicle Pocketing	Satisfactory
Vehicle Stability	Satisfactory
Maximum Roll Angle	-4.7°
Maximum Pitch Angle	7.5°
Maximum Yaw Angle	-61.9°

Occupant Risk

Longitudinal OIV	10.8 ft/s (3.3 m/s)
Lateral OIV	-18.0 ft/s (-5.5 m/s)
Longitudinal RA	-8.3 g
Lateral RA	6.4 g
THIV	20.0 ft/s (6.1 m/s)
PHD	9.7 g
ASI	0.72

Test Article Deflections

Static	0.5 ft. (0.2 m)
Dynamic	0.9 ft. (0.3 m)
Working Width	1.2 ft. (0.4 m)
Debris Field	37.5 ft. (11.4 m) Longitudinally 29.8 ft. (9.1 m) Laterally

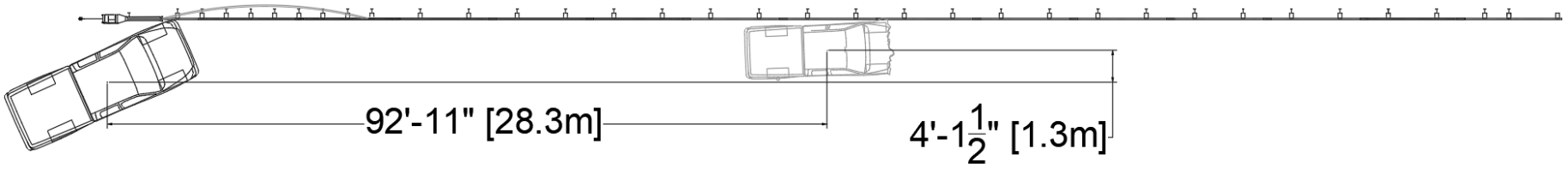
Vehicle Damage

Vehicle Damage Scale	12-FR-3
CDC	12-FLES6
Maximum Deformation	MASH Deformation Limits Not Exceeded (0.0 in.) 0 mm

Figure 2 Summary of Test 3-34

MASH 2016 Test 3-35 Summary

0.000 seconds 0.200 seconds 0.400 seconds 0.600 seconds 0.800 seconds



GENERAL INFORMATION

Test Agency	Applus IDIADA KARCO
Test Number	P42095-01
Test Designation	3-35
Test Date	5/3/22

TEST ARTICLE

Name / Model	Next Generation Terminal (NGT™)
Type	Terminal
Installation Length	187.5 ft. (57.2 m)
Terminal Length	37.5 ft. (11.4 m)
Road Surface	Smooth Concrete to Fine Silty Soil

TEST VEHICLE

Type / Designation	2270P
Year, Make, and Model	2016 Ram 1500
Curb Mass	4,985.7 lbs (2,261.5 kg)
Test Inertial Mass	5,025.4 lbs (2,279.5 kg)
Gross Static Mass	5,025.4 lbs (2,279.5 kg)

Impact Conditions

Impact Velocity	61.45 mph (98.89 km/h)
Impact Angle	26.4°
Location / Orientation	7.5 in. (190 mm) Upstream from Post 2
Impact Severity	125.4 kip-feet (170.0 Kilojoules)
Minimum IS Required	106.0 kip-feet (144.0 kilojoules)

Exit Conditions

Exit Velocity	26.2 mph (42.2 km/h)
Exit Angle	2.7°
Final Vehicle Position	92.9 ft. (28.3 m) Downstream 4.1 ft. (1.3 m) Impact side
Vehicle Snagging	Satisfactory
Vehicle Pocketing	Satisfactory
Vehicle Stability	Satisfactory
Maximum Roll Angle	-12.3°
Maximum Pitch Angle	-8.1°
Maximum Yaw Angle	30.4°

Occupant Risk

Longitudinal OIV	-10.2 ft/s (-3.1 m/s)
Lateral OIV	18.0 ft/s (5.5 m/s)
Longitudinal RA	-5.8 g
Lateral RA	-12.2 g
THIV	20.0 ft/s (6.1 m/s)
PHD	12.4 g
ASI	0.75

Test Article Deflections

Static	1.9 ft. (0.6 m)
Dynamic	2.5 ft. (0.7 m)
Working Width	2.9 ft. (0.9 m)
Debris Field	108.6 ft. (33.1 m) Longitudinally 40.6 ft. (12.4 m) Laterally

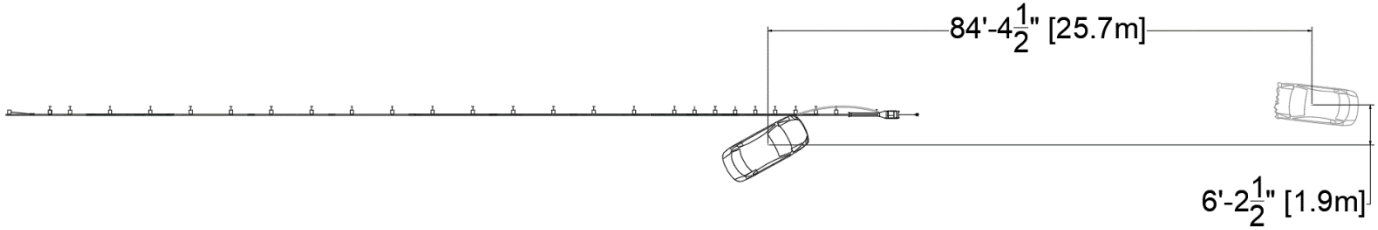
Vehicle Damage

Vehicle Damage Scale	12-LFQ-2
CDC	12FLEN5
Maximum Deformation	MASH Deformation Limits Not Exceeded (0.0 in.) 0.0 mm

Figure 2 Summary of Test 3-35

MASH 2016 Test 3-37b Summary

0.000 seconds 0.172 seconds 0.344 seconds 0.516 seconds 0.688 seconds

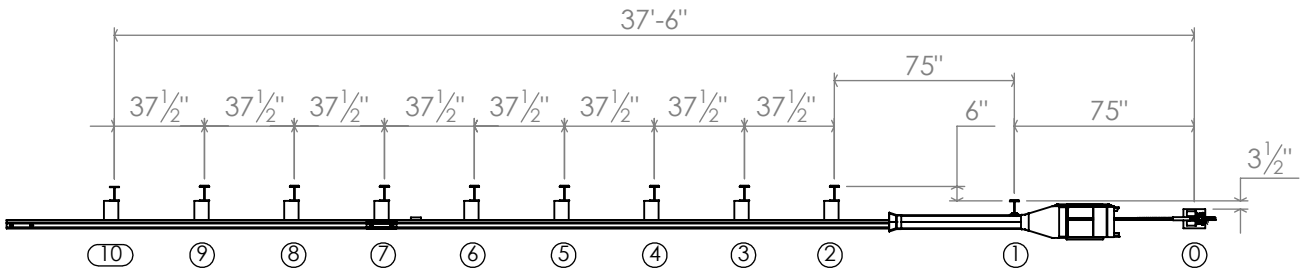


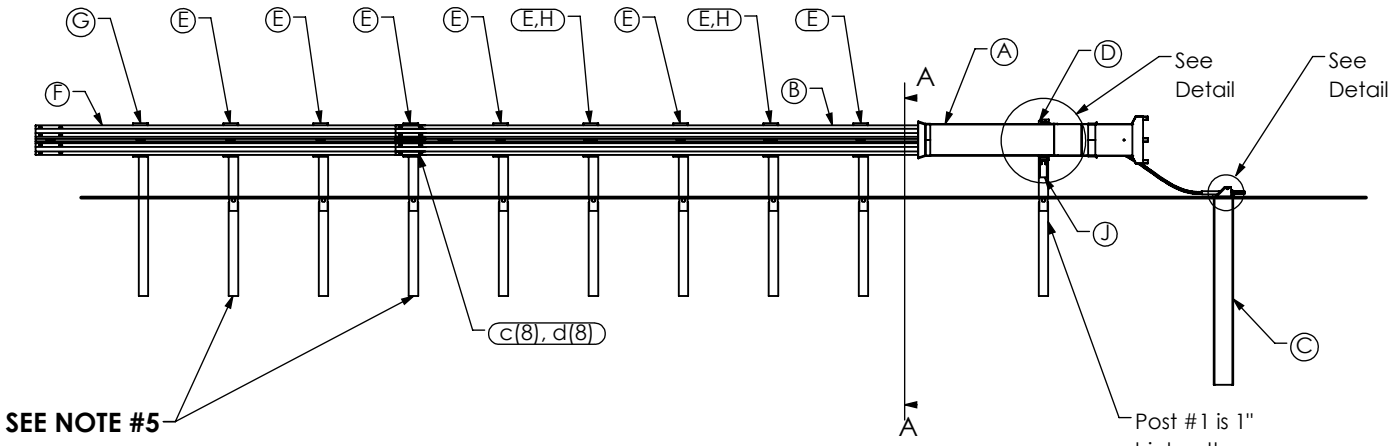
GENERAL INFORMATION	
Test Agency	Applus IDIADA KARCO
Test Number	P42183-01
Test Designation	3-37b
Test Date	8/5/22
TEST ARTICLE	
Name / Model	Next Generation Terminal (NGT™)
Type	Terminal
Installation Length	138.0 ft. (42.1 m)
Terminal Length	37.5 ft. (11.4 m)
Road Surface	Smooth Concrete to Fine Silty Soil
TEST VEHICLE	
Type / Designation	1100C
Year, Make, and Model	2016 KIA RIO
Curb Mass	2,536.4 lbs (1,150.5 kg)
Test Inertial Mass	2,447.1 lbs (1,110.0 kg)
Gross Static Mass	2,613.5 lbs (1,185.5 kg)

Impact Conditions	
Impact Velocity	62.74 mph (100.97 km/h)
Impact Angle	24.9°
Location / Orientation	1.1 in. (28 mm) Upstream from Rail Connection of NGT Post 4
Impact Severity	57.3 kip-feet (77.7 Kilojoules)
Minimum IS Required	51 kip-feet (69.7 Kilojoules)
Exit Conditions	
Exit Velocity	28.50 mph (45.87 km/h)
Exit Angle	19.8°
Final Vehicle Position	84.4 ft. (25.7 m) Downstream 6.2 ft. (1.9 m) To the Left
Vehicle Snagging	Satisfactory
Vehicle Pocketing	Satisfactory
Vehicle Stability	Satisfactory
Maximum Roll Angle	- 10.3°
Maximum Pitch Angle	32.2°
Maximum Yaw Angle	- 93.7°

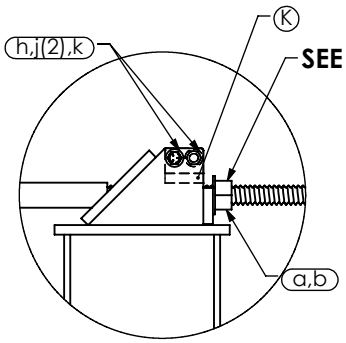
Occupant Risk	
Longitudinal OIV	28.2 ft/s (8.6 m/s)
Lateral OIV	-13.1 ft/s (-4.0 m/s)
Longitudinal RA	-14.8 g
Lateral RA	-10.7 g
THIV	29.5 ft/s (9.0 m/s)
PHD	14.8 g
ASI	0.90
Test Article Deflections	
Static	0.6 ft. (0.2 m)
Dynamic	0.3 ft. (0.1 m)
Working Width	1.1 ft. (0.3 m)
Debris Field	100.4 ft. (30.6 m) Longitudinally 39.7 ft. (12.1 m) Laterally
Vehicle Damage	
Vehicle Damage Scale	11-FL-4
CDC	11YLE3
Maximum Deformation	1.2 in. (30 mm) Windshield

Figure 2 Summary of Test 3-37b

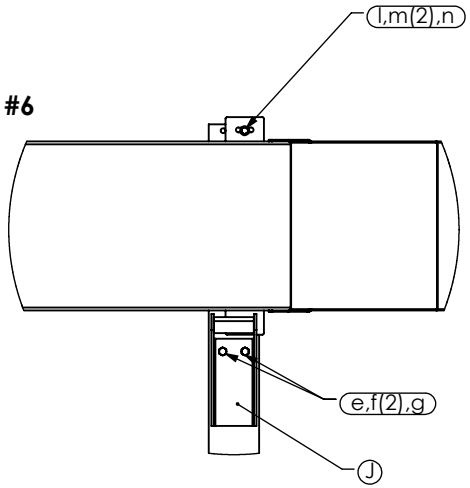


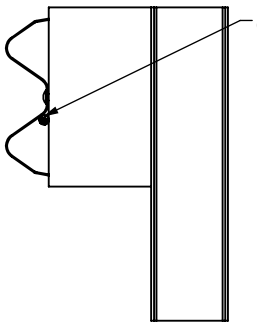


ITEM	QTY	BILL OF MATERIALS
A	1	IMPACT HEAD
B	1	FIRST PANEL
C	1	ANCHOR POST
D	1	NGT FIRST POST
E	8	NGT POST
F	1	MGS 12.5' RAIL
G	1	W6x9 POST
H	2	NOTCHED BLOCKOUT
J	1	SHELF BRACKET
K	1	ANCHOR CAP
a	1	1" Hex Nut
b	1	1" Washer
c	8	5/8" x 1 1/4" SPLICE BOLT
d	8	5/8" SPLICE NUT
e	2	1/2"x1.5" HEX BOLT GR 5
f	4	1/2" WASHERS
g	2	1/2" HEX NUT
h	2	7/16"x1.5" HEX BOLT GR 5
j	4	7/16" WASHER
k	2	7/16" HEX NUT
l	1	5/16"x1" HEX BOLT GR 5
m	2	5/16" WASHER
n	1	5/16" HEX NUT



Post #0
Anchor Post
SCALE 1 : 10





Section A-A
Post 2

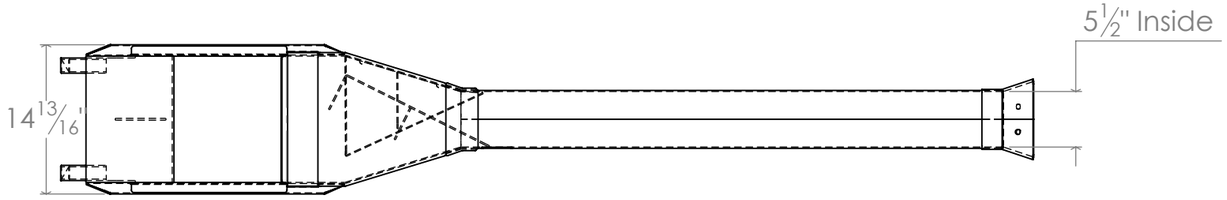
GENERAL NOTES

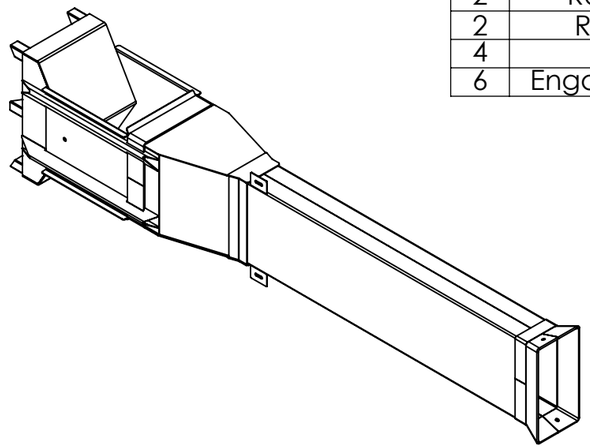
1. Cable is postioned below the post bolt at posts 2,4&6 prior to fastening the guardrail to the post.
2. Notched blockouts shoud be installed on posts 3&5 so that cutout faces traffic. No rail is attached to these posts. Cable buttons at posts 3 & 5 will nest within the cutout of the notched blockouts.
3. The base plate of the Anchor Post (post 0) should be flush with the ground.
4. Posts 2-9 should be installed so that slots face away from the terminal head.
5. Post bolts do not pass through the guardrail at Post 7 & 9.
6. Anchor nut is torqued to 120 lb-ft.

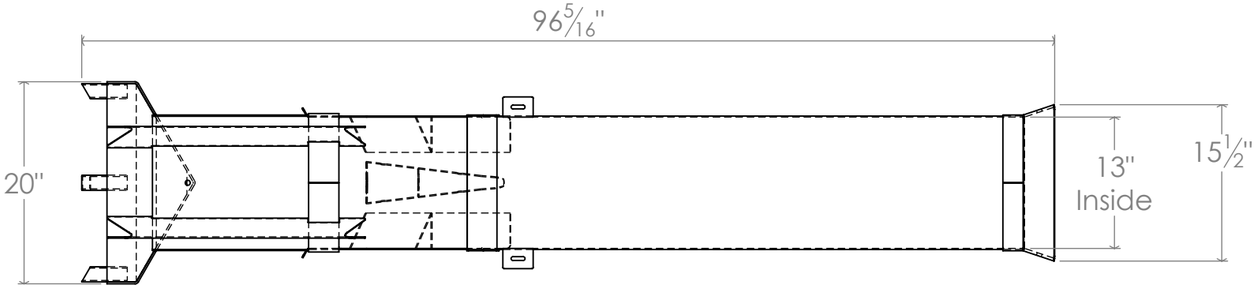
TITLE:
Next Generation Terminal (NGT)

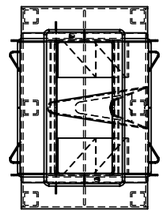
SCALE: 1:200	10/19/2022	Sheet 1 of 1

QTY	ITEM	MATERIAL	THICKNESS	WEIGHT
2	Top/Bottom Plate	50ksi	12 ga	6.1 lbs
2	Side Panel	50ksi	12 ga	45.3 lbs
1	Wedge	50ksi	12 ga	4.3 lbs
1	Wedge Filler Lg	50ksi	12 ga	0.7 lbs
1	Wedge Filler Sm	50ksi	12 ga	0.3 lbs
2	Interior Ramp	50ksi	10 ga	2.5 lbs
2	Ramp Gusset	50ksi	10 ga	0.23 lbs
1	Deflector Plate	50ksi	7 ga	19.1 lbs
1	Middle Gusset	50ksi	7 ga	2.2 lbs
2	Edge Gusset	50ksi	7 ga	3.5 lbs
2	Front Collar	50ksi	1/4"	5.6 lbs
2	Middle Side Collar	50ksi	12 ga	1.2 lbs
2	Middle Top Collar	50ksi	12 ga	0.6 lbs
2	Rear Collar	50ksi	12 ga	1.2 lbs
2	Rear Flare	50ksi	1/4"	4.6 lbs
4	Stiffner	50ksi	12 ga	2.1 lbs
6	Engagement Pin	50ksi	11 Ga	0.9 lbs





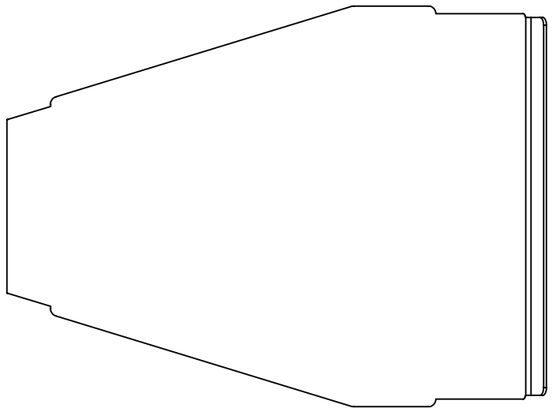


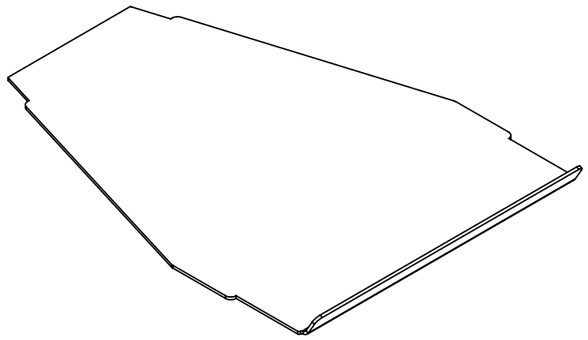


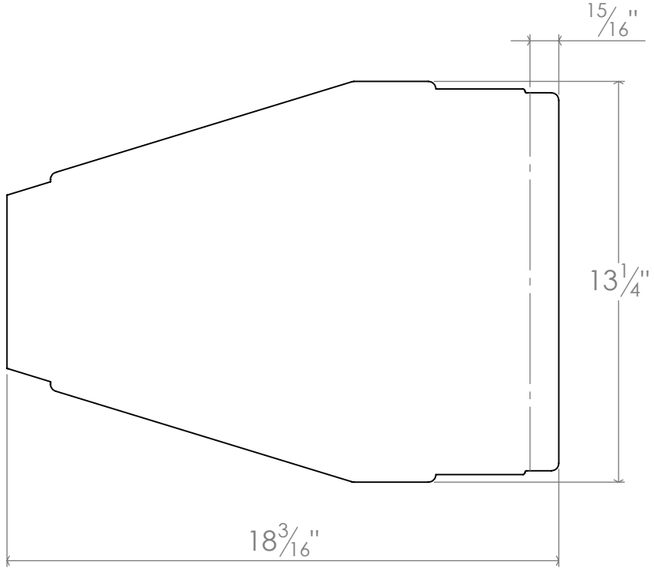
All Parts are made from 50 KSI Steel

PROJECT: NGT TERMINAL			
TITLE: Overall			
DWG. NO. NGT Terminal			
SCALE: 1:15	11/7/2023	Sheet 1 of 15	Drawn JMS

QTY	ITEM	MATERIAL	THICKNESS	WEIGHT
2	Top/Bottom Plate	50ksi	12 ga	6.1 lbs







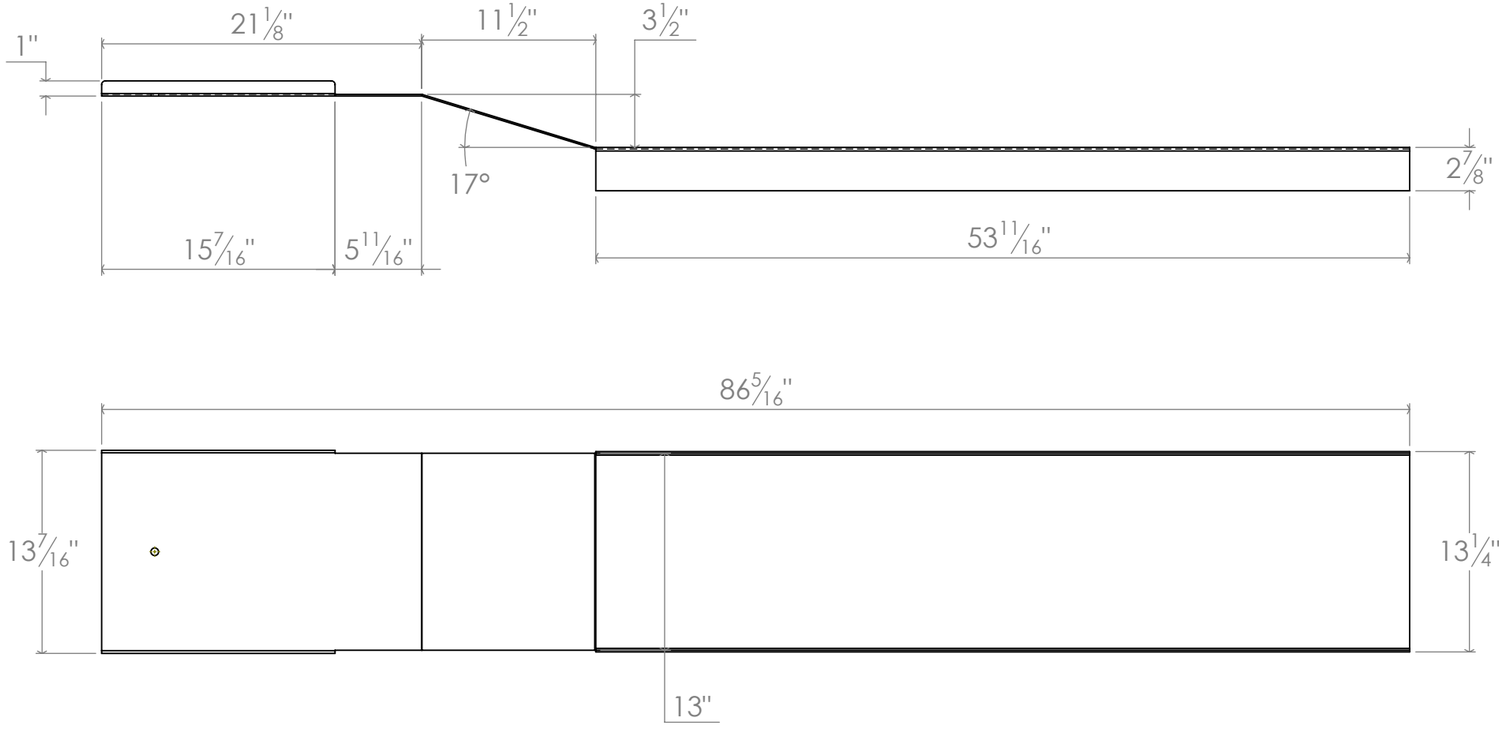
PROJECT:
NGT TERMINAL

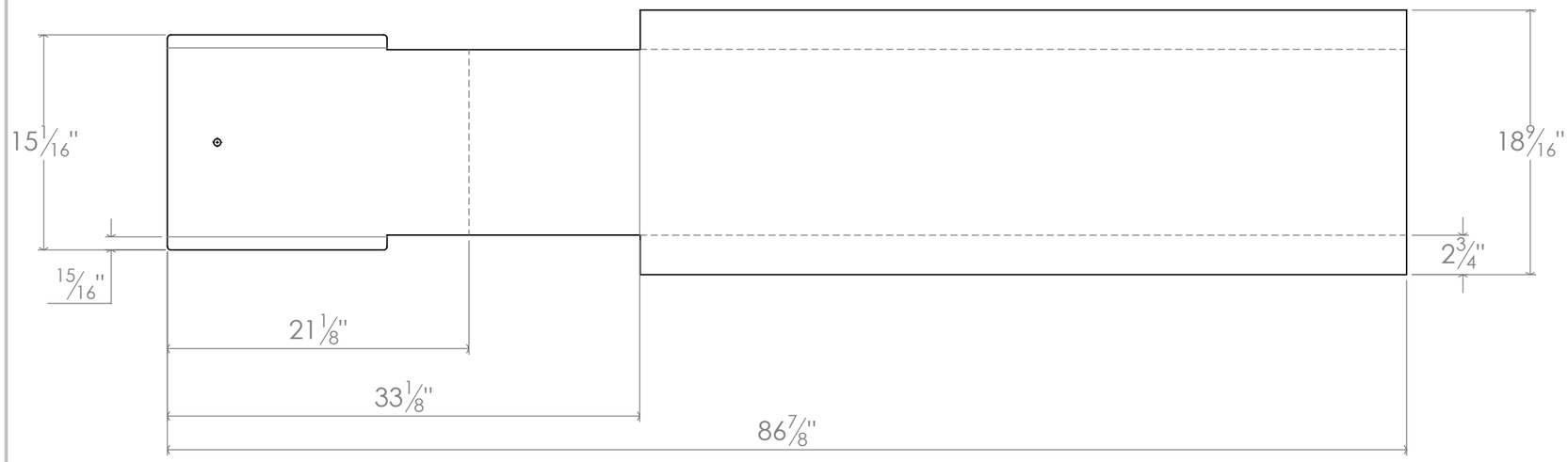
TITLE:
Top/Bottom Plate

DWG. NO.
Top Panel A NGT

SCALE: 1:5	11/7/2023	Sheet 2 of 15	Drawn JMS

QTY	ITEM	MATERIAL	THICKNESS	WEIGHT
2	Side Panel	50ksi	12 ga	45.3 lbs





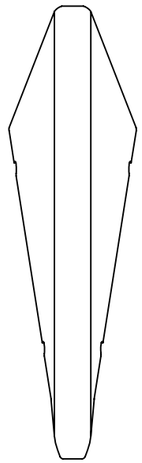
PROJECT:
NGT Terminal

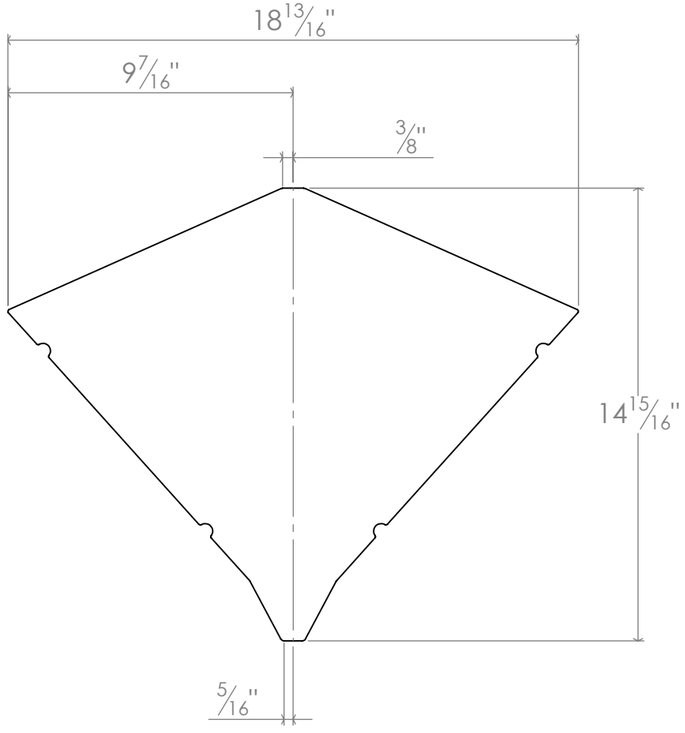
TITLE:
Side Panel

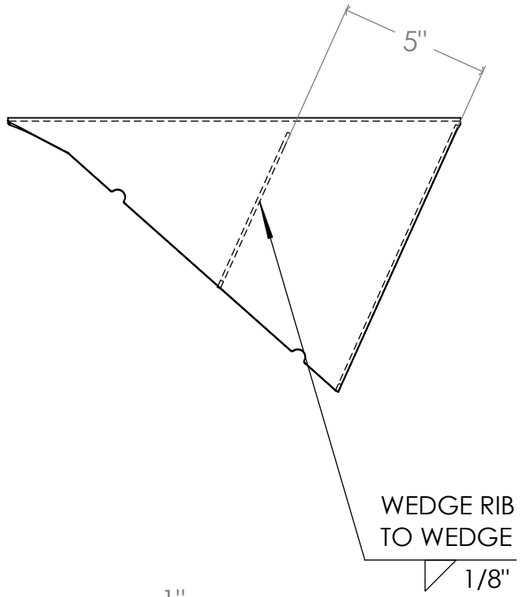
DWG. NO.
Side Panel NGT

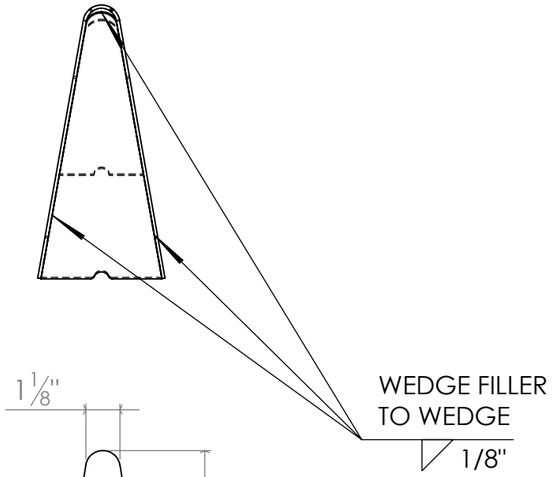
SCALE: 1:10	11/7/2023	Sheet 3 of 15	Drawn JMS

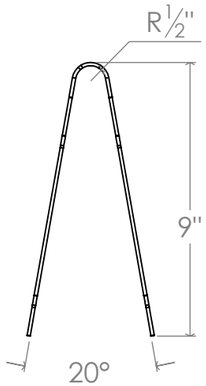
QTY	ITEM	MATERIAL	THICKNESS	WEIGHT
1	Wedge	50ksi	12 ga	4.3 lbs
1	Wedge Filler Lg	50ksi	12 ga	0.7 lbs
1	Wedge Filler Sm	50ksi	12 ga	0.3 lbs

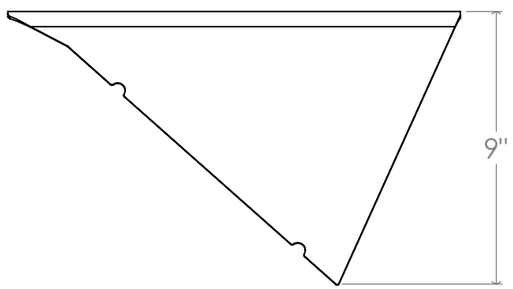


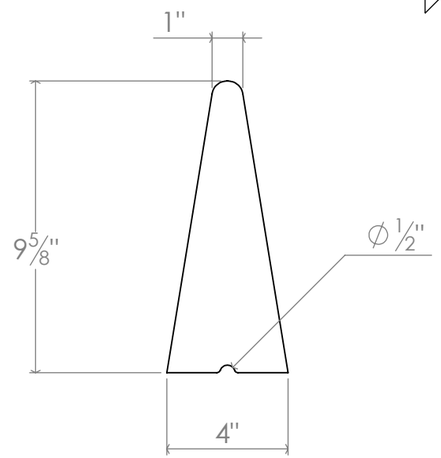




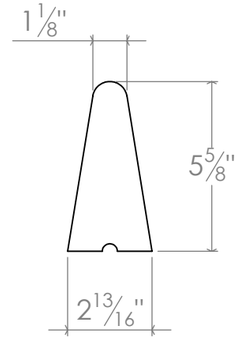








b
Wedge Filler



c
Wedge Rib

PROJECT:
NGT Terminal

TITLE:
Wedge Assembly

DWG. NO.
Wedge NGT

SCALE: 1:5	11/7/2023	Sheet 4 of 15	Drawn JMS