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

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

January 30, 2017

In Reply Refer To:
HSST-1/B-267

Mr. Richard A. Clausius
ArcelorMittal USA LLC
3001 East Columbus Drive
East Chicago, Indiana 46312

Dear Mr. Clausius:

This letter is in response to your August 24, 2016 request for the Federal Highway Administration (FHWA) to review a roadside safety device, hardware, or system for eligibility for reimbursement under the Federal-aid highway program. This FHWA letter of eligibility is assigned FHWA control number B-267 and is valid until a subsequent letter is issued by FHWA that expressly references this device.

Decision

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

- ArcelorMittal TL5 Steel Median Safety Barrier

Scope of this Letter

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

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

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

Eligibility for Reimbursement

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

Name of system: ArcelorMittal TL5 Steel Median Safety Barrier
Type of system: Longitudinal Barrier
Test Level: MASH Test Level 5 (TL5)
Testing conducted by: Holmes Solutions
Date of request: August 24, 2016
Date initially acknowledged: August 28, 2016
Date of completed package: November 11, 2016

FHWA concurs with the recommendation of the accredited crash testing laboratory as stated within 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

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

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

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

Any user or agency relying on this eligibility letter is expected to use the same designs, specifications, drawings, installation and maintenance instructions as those submitted for review.

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

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

Standard Provisions

- To prevent misunderstanding by others, this letter of eligibility designated as FHWA control number B-267 shall not be reproduced except in full. This letter and the test documentation upon which it is based are public information. All such letters and documentation may be reviewed upon request.

- This letter shall not be construed as authorization or consent by the FHWA to use, manufacture, or sell any patented system for which the applicant is not the patent holder.

- If the subject device is a patented product it may be considered to be proprietary. If proprietary systems are specified by a highway agency for use on Federal-aid projects: (a) they must be supplied through competitive bidding with equally suitable unpatented items; (b) the highway agency must certify that they are essential for synchronization with the existing highway facilities or that no equally suitable alternative exists; or (c) they must be used for research or for a distinctive type of construction on relatively short sections of road for experimental purposes. Our regulations concerning proprietary products are contained in Title 23, Code of Federal Regulations, Section 635.411.

Sincerely,

Scott T. Johnson
Acting Director, Office of Safety
Technologies
Office of Safety

Enclosures

Request for Federal Aid Reimbursement Eligibility of Highway Safety Hardware

Submitter	Date of Request:	August 12, 2016	◉ New ○ Resubmission
	Name:	RICHARD A. CLAUSIUS	
	Company:	ARCELORMITTAL USA LLC	
	Address:	3001 EAST COLUMBUS DRIVE, EAST CHICAGO, INDIANA 46312	
	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
'B': Rigid/Semi-Rigid Barriers (Roadside, Median, Bridge Railings)	◉ Physical Crash Testing ○ Engineering Analysis	ARCELORMITTAL TL5 STEEL MEDIAN SAFETY BARRIER	AASHTO MASH	TL5

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:	RICHARD A. CLAUSIUS	Same as Submitter ☒
Company Name:	ARCELORMITTAL USA LLC	Same as Submitter ☒
Address:	3001 EAST COLUMBUS DRIVE, EAST CHICAGO, INDIANA 46312	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.		
ArcelorMittal is the world's leading steel and mining company, with a strong presence in the USA. Guided by a philosophy to produce safe, sustainable steel, we are the leading supplier of quality steel and steel solutions in the automotive, construction, household appliances, and packaging global markets; with world-class research and development. The TL5 steel median safety barrier is a proprietary high containment steel barrier system designed by ArcelorMittal with assistance from Gregory Industries, licensed to Gregory Industries for the North American Market, and crashed tested at Holmes Solutions (New Zealand). Neither ArcelorMittal nor its affiliates, nor Gregory Industries has any financial interest, control, or influence over Holmes Solutions who was contracted for crash testing services. Under no circumstances were the fees paid to Holmes Solutions related to barrier performance and/or the outcome of crash testing.		

PRODUCT DESCRIPTION

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

The ArcelorMittal TL5 Median Barrier System is a proprietary galvanized steel high containment barrier which consists of upper W-beam guardrail and lower Thrie beam guardrail supported with spacers on both sides of steel line posts. Both guardrails are spliced mid-span between posts, and lap splices are orientated away from the direction of approaching traffic. The top height of the W-beam guardrail is 59.6". The top height of the Thrie beam guardrail is 35.2". The height of the post is 59". The Length of Need (LON) is 325 feet and consisted of 66 steel line posts. The steel barrier system consists of the following components:

Posts & Spacers: C- Section steel line posts made from ASTM A1011 Grade 50 steel, have an overall length of 118.0", installed on 60" centers in an alternating orientation, and embedded 59" into the ground. The posts have an open slot along the length to accommodate attaching spacers, cables, and nuts. All posts have upper and lower (tube) spacers to offset the W-beam and Thrie beam section from the post, and are made from ASTM A500 Grade B steel. There is also a main spacer that sits over the top of the lower tube spacer, made from ASTM A1011 Grade 50 steel, and has a front opening which must be top oriented.

Guardrails: Corrugated W-beam guardrail is made from ASTM A1011 Grade 80, 10 Gauge steel; and corrugated Thrie beam guardrail is made from ASTM A1011 Grade 80, 12 Gauge steel. These rails are 192.5" long with holes for splice joints on 180" centers. In addition, at each post location there is a 12" long Thrie beam backup plate attached to the system made from ASTM A1011 Grade 50, 12 Gauge steel.

Cable Assembly: Four load transfer diagonal cables are located in series at the beginning and end of the Length of Need (LON). Due to the orientation and shape of the posts, two different length cables are required, both manufactured from ¾" W/R Guardrail cable.

Fasteners: The guardrail is assembled using galvanized nuts, bolts, washers, and rectangular washer plates in compliance with ASTM, ANSI, or AISI standards. All spacers are connected with 5/8"x 2" bolts, 5/8" circular washers, and 5/8" nuts. All guardrails are connected with 5/8"x 2" bolts, rectangular washer plates, 5/8" circular washers, and 5/8" nuts. All lap joints are connected with 5/8" x 1 ¼" splice bolts and 5/8" 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:	Dr Chris Allington	
Engineer Signature:		
Address:	Level 2, 254 Montreal St, Christchurch	Same as Submitter ☐
Country:	New Zealand	Same as Submitter ☐

A brief description of each crash test and its result:

Required Test Number	Narrative Description	Evaluation Results
5-10 (1100C)	The ArcelorMittal center median barrier system successfully contained and redirected an 1100C test vehicle impacting the test article at 25.3 degrees and a velocity of 101 km/h (62.7 mph). No debris or detached elements penetrated or showed potential to penetrate the occupant compartment. No fragments were distributed outside of the vehicle trajectory. The trajectory of the vehicle was such that it did not present any undue hazard to other traffic, pedestrians or work zone personnel. The vehicle remained upright during and after the impact and vehicle stability was considered satisfactory. Occupant risk factors satisfied the test criteria and the vehicle exit trajectory remained within acceptable limits	PASS
5-11 (2270P)	The ArcelorMittal center median barrier system successfully contained and redirected a 2270P test vehicle impacting the test article at 25.1 degrees and a velocity of 100.0 km/h (62.1 mph). No debris or detached elements penetrated or showed potential to penetrate the occupant compartment. No fragments were distributed outside of the vehicle trajectory and therefore did not present any undue hazard to other traffic, pedestrians or work zone personnel. The vehicle remained upright during and after the impact and vehicle stability was considered satisfactory. Occupant risk factors satisfied the test criteria and the vehicle exit trajectory remained within acceptable limits.	PASS

Required Test Number	Narrative Description	Evaluation Results
5-12 (36000V)	The ArcelorMIttal center median barrier system successfully contained and redirected a 36000 kg test vehicle impacting the test article at 15.1 degrees and a velocity of 78.5 km/h. No debris or detached elements penetrated or showed potential to penetrate the occupant compartment. No fragments were distributed outside of the vehicle trajectory and therefore did not present any undue hazard to other traffic, pedestrians or work zone personnel. The vehicle remained upright during and after the impact and vehicle stability was considered satisfactory. The vehicle exit trajectory remained within acceptable limits.	PASS
5-20 (1100C)	This test is defined as optional in MASH. Based on the results obtained in Test 5-10, including the low level of embedment into the system, it was determined unnecessary to complete this test.	Non-Relevant Test, not conducted

5-21 (2270P)	The terminal end region of the ArcelorMittal centre median barrier system is near identical to the LON barrier, with the exception of the deletion of the upper w-beam rail section. This upper rail section is primarily used to provide a restoring force to the 36,000V in the LON. An assessment of the system indicates that this upper rail provides limited additional benefit to barrier performance when impacted by the 1100C or 2270P vehicle. The results obtained for Test 5-10 and Test 5-11 showed the 1100C and 2270P vehicles did not engage with the upper rail section at all. Furthermore, the vehicles showed very limited embedment into the lower Thrie beam section. The performance of the LON system was solely dominated by the lower section of the barrier, which has an identical strength and stiffness to the terminal end regions. The upper rail slopes down from the full height to the low rail height before terminating behind the low rail. Based on the results obtained from Test 5-11 it is predicted that this region would have negligible influence on the stability of the vehicle or the safety of the vehicle occupants or other road users when impacted in Test 5-21. As such, it was determined that Test 5-21 was not relevant and was not completed.	Non-Critical, not conducted

5-22 (36000V)	The terminal end region of the ArcelorMittal center median barrier system is near identical to the LON barrier, with the exception of the deletion of the upper w-beam rail section. This upper rail section is primarily used to provide a restoring force to the 36,000V in the LON due to the vehicles higher COM should it obtain a high roll angle during the impact. The transition zone in the barrier has the upper rail transitioning from the full height to the low rail height before terminating behind the low rail. The results obtained for the LON test 5-12 showed the 36,000V lightly engaged with the upper rail. The engagement observed was relatively light and the restoring force provided by the barrier to the vehicle was less than calculated in the original design parameters. An assessment was made as to the likely performance of the transition zone under test 5-22. It was noted that the primary purpose of this test is to assess the maximum strength of the transition region. Based of the results obtained for Test 5-12 it was apparent that the barrier has a high degree of residual strength after impact. Accordingly, it was assessed that the transition zone would maintain sufficient strength without the upper w-beam rail section, thereby satisfying Evaluation Criteria A. Very little debris was created by the barrier during Test 5-12 and it is predicted that the same would occur for Test 5-22, satisfying Evaluation Criteria D. The greatest potential variation in the performance of the 36,000V vehicle during Test 5-22 compared to Test 5-12 is predicted to be the roll angle. With the ramped end of the upper w-beam section, it is likely that the roll angle would be exaggerated compared to that observed in Test 5-12. However, the relatively low roll angle and overall vehicle stability observed of both the tractor and trailer units in Test 5-12 indicate that the vehicle was stable and could sustain an increased roll with a low probability of roll-over. We also note that Evaluation Criteria G states it is not essential that the vehicle remains upright during this test. Based on the expected performance of the system it was considered that this test was non-critical.	Non-Critical, not conducted

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

Laboratory Name:	Holmes Solutions	
Laboratory Signature:		
Address:	Level 2, 254 Montreal St, Christchurch	Same as Submitter ☐
Country:	New Zealand	Same as Submitter ☐
Accreditation Certificate Number and Dates of current Accreditation period :	ISO/IEC 17025: IANZ Certification Number: 1022 (23/07/2009 through to 19/06/2016)	

Submitter Signature*:

Submit Form

ATTACHMENTS

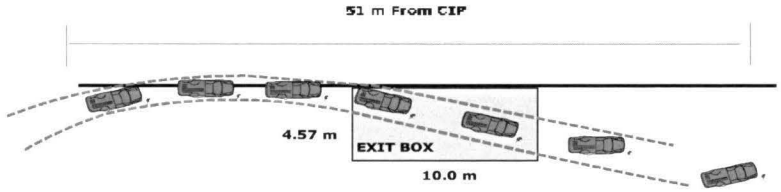
Attach to this form:

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

FHWA Official Business Only:

Eligibility Letter		
Number	Date	Key Words

				
0.000 sec	0.260 sec	0.520 sec	0.780 sec	1.04 sec



• **Test Article**	ArcelorMittal TL5 Center Median High Containment
• **Total Length**	121.5 m
• **Key Elements – Barrier**	
Description.....	Thrie and W-beam safety barrier installed at 1.52 m centres
Length	99.0 meters LON
Rail Height.....	Thrie beam 894mm (35.2") W-Beam 1513 mm (59.6")
Post Spacing	1.5 meters nominal (5 ft)
• **Test Vehicle**	
Designation.....	1100C
Make/Model.....	2009 Nissan Tiida
Dimensions (lwh).....	4260 L x 1690 W x 1540 H
Curb Wt.....	1090 kg
Test Inertial Wt.....	1104 kg
Gross Static Wt.....	1179 kg
• **Impact Conditions**	
Speed	101.0 km/h (62.7 mph)
Angle	25.3°
Impact Point	Post 22 of LoN
• **Exit Conditions**	
Exit Speed	37.8 km/h
Exit Angle	10.5°
• **Test Number**	113984.01 TL5-10
• **Test Date**	15April 2016

• **Post Impact Vehicle Behaviour**	
Vehicle Stability.....	Good
Stopping Distance.....	51 metres from CIP
• **Vehicle Snagging**	None
• **Vehicle Pocketing**	None
• **Occupant Impact Velocity**	@ 0.1162 seconds on right side of interior
Longitudinal	-8.2 m/s
Lateral (optional).....	5.8 m/s
• **Occupant Ridedown Deceleration**	
X-direction.....	6.4 g (0.1211 - 0.1311 seconds)
Y-direction.....	-8.7 g (0.1161 - 0.1261 seconds)
THIV (optional).....	37.7 km/h at 0.1162 seconds (10.5 m/s)
PHD (optional).....	10.3 g (0.1161 - 0.1261 seconds)
ASI (optional)	1.25 (0.0434 - 0.0934 seconds)
• **Test Article Damage**	Minor
• **Test Article Deflections**	
Dynamic.....	0.31 m (1.01 ft)
Permanent.....	0.095 m (0.31 ft)
Working Width.....	0.31 m (1.01 ft)
• **Vehicle Damage - Exterior**	
VDS	11FL-3
CDC	11LFEE3
Max. Deformation	150 mm

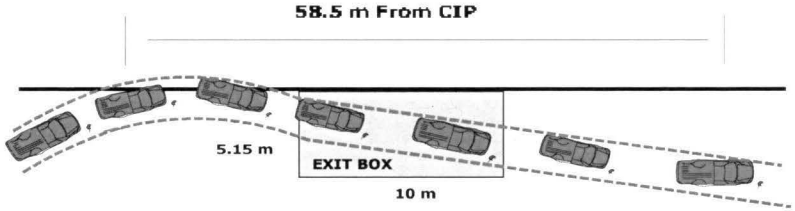
0.00 sec

0.100 sec

0.200 sec

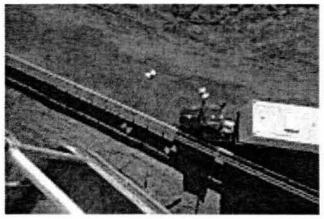
0.300 sec

0.400 sec

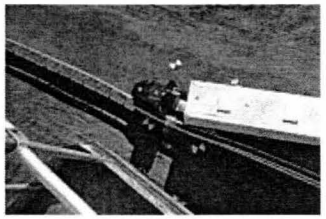


• Test Article	ArcelorMittal TL5 Center Median High Containment
• Total Length	121.5 m
• Key Elements - Barrier	
Description.....	Thrie and W-beam safety barrier installed at 1.52 m
Length	99.0 meters LON
Rail Height.....	Thrie beam 894mm (35.2") W-Beam 1513mm (59.6")
Post Spacing	1.5 meters nominal (5 ft)
• Test Vehicle	
Designation.....	2270P
Make/Model.....	2011 Dodge Ram 1500 Quad Cab
Dimensions (lwh).....	5720 L x 2030 W x 1880 H
Curb Wt.....	2210.5 kg
Test Inertial Wt.....	2240.5 kg
Gross Static Wt.....	2240.5 kg
• Impact Conditions	
Speed	100.0 km/h (62.1 mph)
Angle	25.1°
Impact Point	330 mm Upstream of line post 22 from LoN
• Exit Conditions	
Exit Speed	33.6 km/h
Exit Angle	10.2°
• Test Number	113984.03 TL5-11
• Test Date	20 April 2016

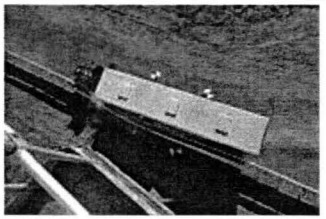
• Post Impact Vehicle Behaviour	
Vehicle Stability.....	Good
Stopping Distance.....	58.5 metres from CIP
• Vehicle Snagging	None
• Vehicle Pocketing	None
• Occupant Impact Velocity	@ 0.1225 seconds on right side of interior
Longitudinal	-5.5 m/s
Lateral (optional).....	6.7 m/s
• Occupant Ridedown Deceleration	
X-direction.....	6.9 g (0.1243 - 0.1343 seconds)
Y-direction.....	-7.9 g (0.2587 - 0.2687 seconds)
THIV (optional).....	32.8 km/h at 0.1220 seconds (9.1 m/s)
PHD (optional).....	8.1 g
ASI (optional)	1.24
• Test Article Damage	Minor
• Test Article Deflections	
Dynamic.....	0.49 m (1.60 ft.)
Permanent.....	0.157 m (0.51 ft.)
Working Width.....	0.49 m (1.60 ft.)
• Vehicle Damage - Exterior	
VDS	11FL-3
CDC	11LFEE3
Max. Deformation	220 mm



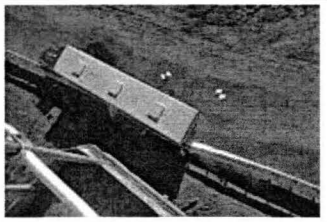
0.00 sec



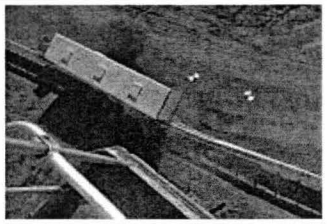
0.310 sec



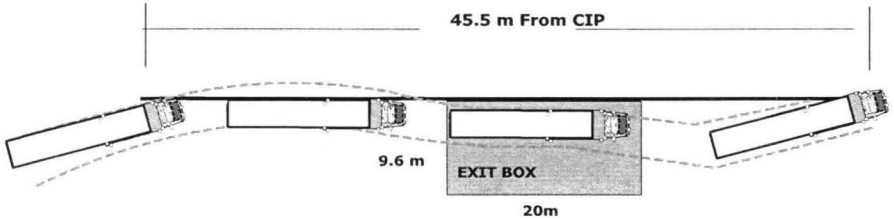
0.620 sec



0.930 sec

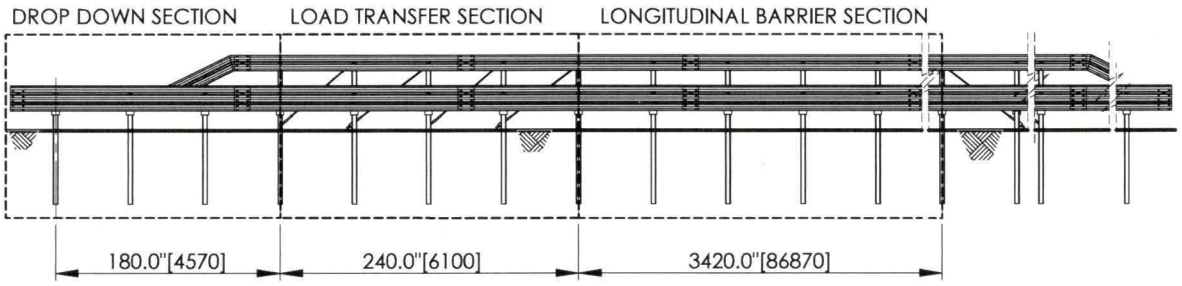


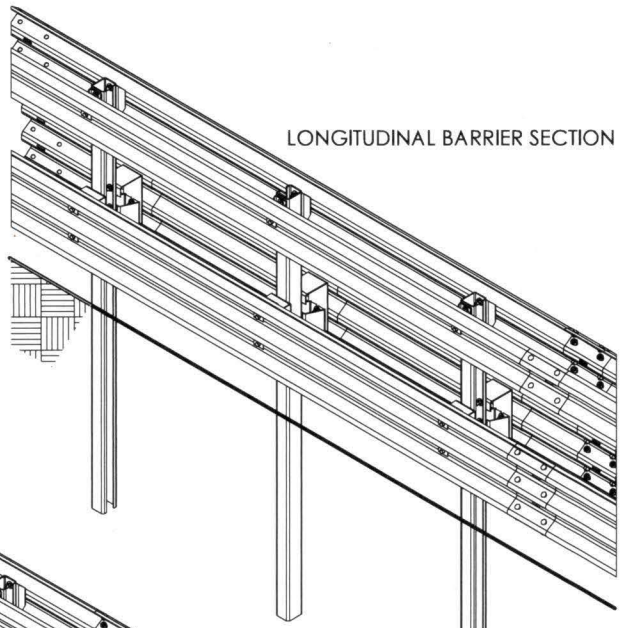
1.24 sec



• Test Article	ArcelorMittal TL5 Center Median High Containment
• Total Length	121.5 m
• Key Elements – Barrier	
Description.....	Thrie and W-beam safety barrier installed at 1.52 m centres
Length	99.0 meters LON
Rail Height.....	Thrie beam 894mm (35.2") W-Beam 1513mm (59.6")
Post Spacing	1.5 meters nominal (5 ft)
• Test Vehicle	36000V
Designation.....	36000 kg
Make/Model.....	Kenworth 404s
Dimensions (lwh).....	16850 L x 2500 W x 3550 H
Curb Wt.....	14590 kg
Test Inertial Wt.....	35770 kg
Gross Static Wt.....	35770 kg
• Impact Conditions	
Speed	78.5 km/h (48.7)
Angle	15.1°
Impact Point	350 mm downstream of LoN Post 22
• Exit Conditions	
Exit Speed	23.4 km/h (14.5 mph)
Exit Angle	1.5°
• Test Number	113984.02 TL5-12
• Test Date	19 April 2016

• Post Impact Vehicle Behaviour	
Vehicle Stability.....	Good
Stopping Distance.....	45.5 metres from CIP
• Vehicle Snagging	None
• Vehicle Pocketing	None
• Occupant Impact Velocity	at 0.4816 seconds on right side of interior
Longitudinal	-2.6 m/s
Lateral (optional).....	2.5 m/s
• Occupant Ridedown Deceleration	
X-direction.....	1.3 g (1.5198 - 1.5298 seconds)
Y-direction.....	-3.0 g (0.8947 - 0.9047 seconds)
THIV (optional).....	13.0 km/h at 0.4912 seconds (3.6 m/s)
PHD (optional).....	3.1 g (0.8947 – 0.9047)
ASI (option	0.26 (1.6425 - 1.6925 seconds)
• Test Article Damage	Moderate
• Test Article Deflections	
Dynamic.....	1.32 m (4.33 ft.)
Permanent.....	0.8 m (2.62 ft.)
Working Width.....	1.65 m (5.41 ft.)
• Vehicle Damage - Exterior	
VDS	11FL-2
CDC	11LFEE2
Max. Deformation	180 mm





TL-5 STEEL HIGH CONTAINMENT MEDIAN BARRIER

ArcelorMittal

##

SHEET NO.	DATE:
1 of 8	03/25/16