



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

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

December 22, 2016

In Reply Refer To:
HSST-B-261

Mr. John P. Donahue, PE
Washington State Department of Transportation
310 Maple Park Avenue, SE
Olympia, Washington 98504-7329

Dear Mr. Donahue:

This letter is in response to your April 5, 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-261 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:

- WSDOT Guardrail On Slope (MGS with 8 in blockout, face of post 1 ft onto 1V:2H slope)

Scope of this Letter

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

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

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

Eligibility for Reimbursement

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

Name of system: WSDOT Guardrail On Slope (MGS with 8" blackout)
 Type of system: W-beam guardrail with face of post at one foot onto 1V:2H slope
 Test Level: MASH Test Level 3 (TL3)
 Testing conducted by: Texas A&M Transportation Institute

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.

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

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

and evaluation criteria of 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-261 shall not be reproduced except in full. This letter and the test documentation upon which it is based are public information. All such letters and documentation may be reviewed upon request.
- This letter shall not be construed as authorization or consent by the FHWA to use, manufacture, or sell any patented system for which the applicant is not the patent holder.
- If the subject device is a patented product it may be considered to be proprietary. If proprietary systems are specified by a highway agency for use on Federal-aid projects: (a) they must be supplied through competitive bidding with equally suitable unpatented items; (b) the highway agency must certify that they are essential for synchronization with the existing highway facilities or that no equally suitable alternative exists; or (c) they must be used for research or for a distinctive type of construction on relatively short sections of road for experimental purposes. Our regulations concerning proprietary products are contained in Title 23, Code of Federal Regulations, Section 635.411.

Sincerely yours,



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

Enclosures

Request for Federal Aid Reimbursement Eligibility of Highway Safety Hardware

Submitter	Date of Request:	November 3, 2016	<input checked="" type="radio"/> New <input type="radio"/> Resubmission
	Name:	John P. Donahue, P.E.	
	Company:	Washington State Department of Transportation	
	Address:	310 Maple Park Ave SE, Olympia, WA	
	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)	<input checked="" type="radio"/> Physical Crash Testing <input type="radio"/> Engineering Analysis	Guardrail on slope	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:	John P. Donahue, P.E.	Same as Submitter <input checked="" type="checkbox"/>
Company Name:	Washington State Department of Transportation	Same as Submitter <input checked="" type="checkbox"/>
Address:	310 Maple Park Ave SE, Olympia, WA	Same as Submitter <input checked="" type="checkbox"/>
Country:	USA	Same as Submitter <input checked="" type="checkbox"/>

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

TTI Proving Ground test lab has no financial interests in the tested barrier. The Roadside Safety Research Program Pooled Fund TPF-5(114) contracted for the service of crash testing this barrier according to specifications for American Association of State Highway and Transportation Officials (AASHTO) Manual for Assessing Safety Hardware (MASH) Tests 3-10 and 3-11, for which TTI Proving Ground was compensated for the cost to perform the tests. No consulting relationships, research funding or other forms of research support, patents, copyrights, other intellectual property interests, licenses, contractual relationships, business ownership, or investment interests are retained for the TTI Proving Ground.

PRODUCT DESCRIPTION

- New Hardware or Significant Modification
 Modification to Existing Hardware

The guardrail on slope system test installation had a total length of 181.25 ft. The system was comprised of a 106.25 ft length of need section and a 37.5 ft long ET Plus terminal on each end. The 12-gauge W-beam was mounted on W6x8.5 steel posts. The guardrail height was 31 inches above the flat terrain. A 2H:1V sloped ditch was excavated behind the rail to represent the sloped terrain. The ditch was centered along the installation length and was 75 ft long and 12 ft wide. Six 6-ft long W6x8.5 posts were placed at 6 ft-3 inch spacing on the flat terrain portion of the test installation. These were posts 7-9 and 22-24. Along the sloped section, the 8-ft long posts were placed at 6 ft-3 inch spacing. These were post 10 through post 21. Standard size 8 inch x 6 inch x 14 inch wood blocks were used in the length of need section. The rail splices of the W-beam rail sections in the length of need portion are located between posts. The traffic face of the W-beam rail is aligned with the hinge point of the 2H:1V slope.

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:	Roger P. Bligh	
Engineer Signature:	Bligh, Roger P	Digitally signed by Bligh, Roger P DN: postalCode=77843, o=TAMU-SIGN, street=Texas A&M University, st=TX, l=College Station, c=US, cn=Bligh, Roger P, email=rbligh@tamu.edu Date: 2016.11.09 10:05:28 -06'00'
Address:	3135 TAMU, College Station, TX 77843-3135	Same as Submitter <input type="checkbox"/>
Country:	USA	Same as Submitter <input type="checkbox"/>

A brief description of each crash test and its result:

Required Test Number	Narrative Description	Evaluation Results
3-10 (1100C)	TEST 405160-2: The guardrail on slope contained and redirected the 1100C vehicle. The vehicle did not penetrate, underride, or override the installation. Maximum dynamic deflection during the test was 2.7 ft. The rail element separated from some of the posts. However, the rail element did not penetrate, nor show potential to penetrate the occupant compartment, nor to present undue hazard to others in the area. No occupant compartment deformation occurred. The 1100C vehicle remained upright during and after the collision event. Maximum roll and pitch angles were 7 degrees and 5 degrees, respectively. Occupant risk factors were below the preferred limits specified in MASH. The 1100C vehicle crossed the exit box at the end of the guardrail.	PASS

Required Test Number	Narrative Description	Evaluation Results
3-11 (2270P)	TEST 405160-1: The guardrail on slope contained and redirected the 2270P vehicle. The vehicle did not penetrate, underide, or override the installation. Maximum dynamic deflection during the test was 4.3 ft. The rail element separated from some of the posts and one blockout separated from a post. However, these elements did not penetrate, nor show potential to penetrate the occupant compartment, nor to present undue hazard to others in the area. No occupant compartment deformation occurred. The 2270P vehicle remained upright during and after the collision event. Maximum roll and pitch angles were 13 degrees and 3 degrees, respectively. Occupant risk factors were below the preferred limits specified in MASH. The 2270P vehicle exited within the exit box.	PASS
3-20 (1100C)		Non-Relevant Test, not conducted
3-21 (2270P)		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:	Texas AM Transportation Institute	
Laboratory Signature:	<i>Darrell L. Kuhn</i>	Digitally signed by Darrell L. Kuhn DN: cn=Darrell L. Kuhn, o=Texas A&M Transportation Institute, ou=Proving Ground, email=d-kuhn@tti.tamu.edu, c=US Date: 2016.11.08 16:55:57 -06'00'
Address:	3135 TAMU, College Station, TX 77843-3135	Same as Submitter <input type="checkbox"/>
Country:	USA	Same as Submitter <input type="checkbox"/>
Accreditation Certificate Number and Dates of current Accreditation period :	A2LA Mechanical Testing 2821.01: February 19, 2015 to April 30, 2017	

Submitter Signature*: *John Donahue* Donahue, John

cosign

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

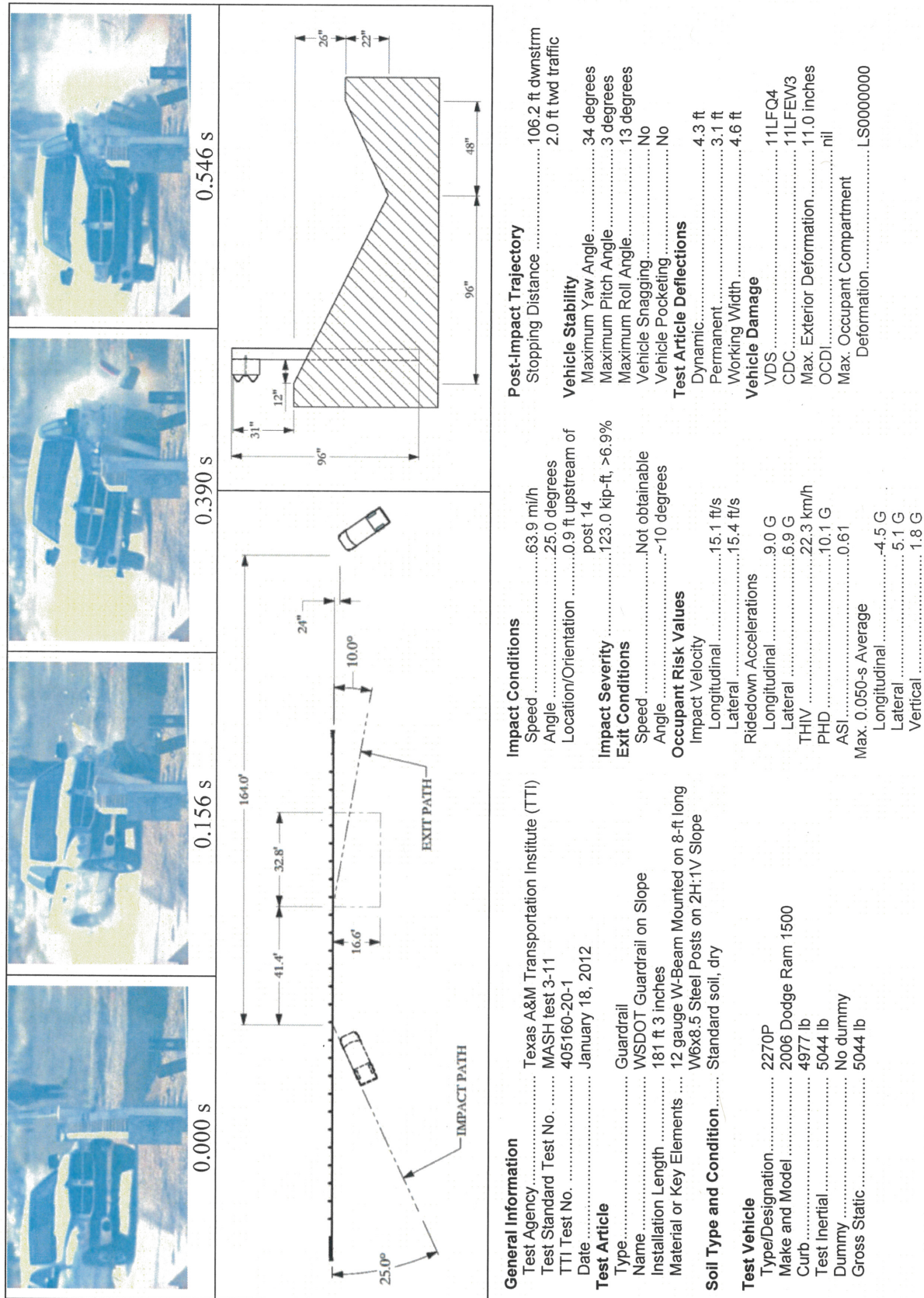
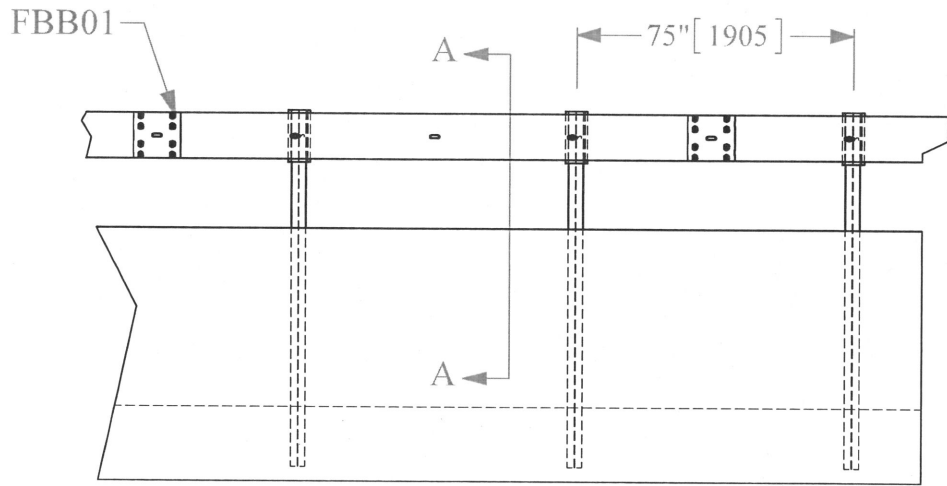
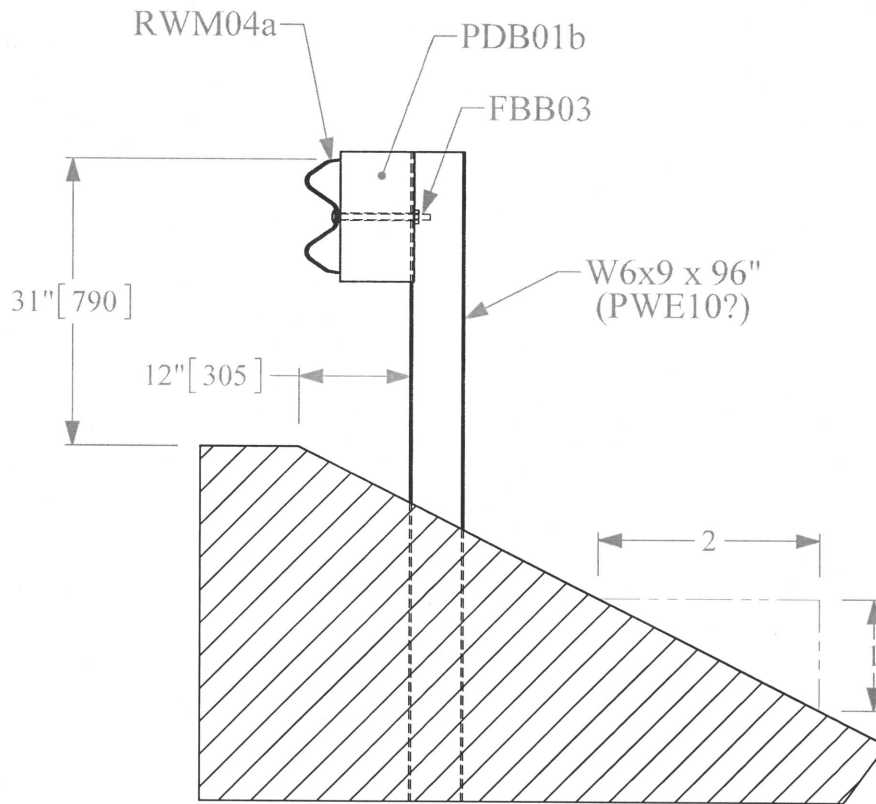


Figure 5.7. Summary of results for MASH test 3-11 on the guardrail on slope.



ELEVATION VIEW



SECTION A-A

2013

Guardrail on Slope



SXX00

SHEET NO.

DATE

1 of 2

01/08/2016

INTENDED USE

This guardrail system is intended for use on roadsides where the shoulder side is sloped downward at 2H:1V rate or flatter. The guardrail post is to be installed on the slope at 12" [305] from the slope break. It consists of traditional strong post W-beam guardrail components. The posts are longer (8' [2438] instead of 6' [1829]) and splices are placed between posts.

This guardrail system was tested successfully per both MASH TL- 3-11 and 3-10 tests.

2013

Guardrail on Slope



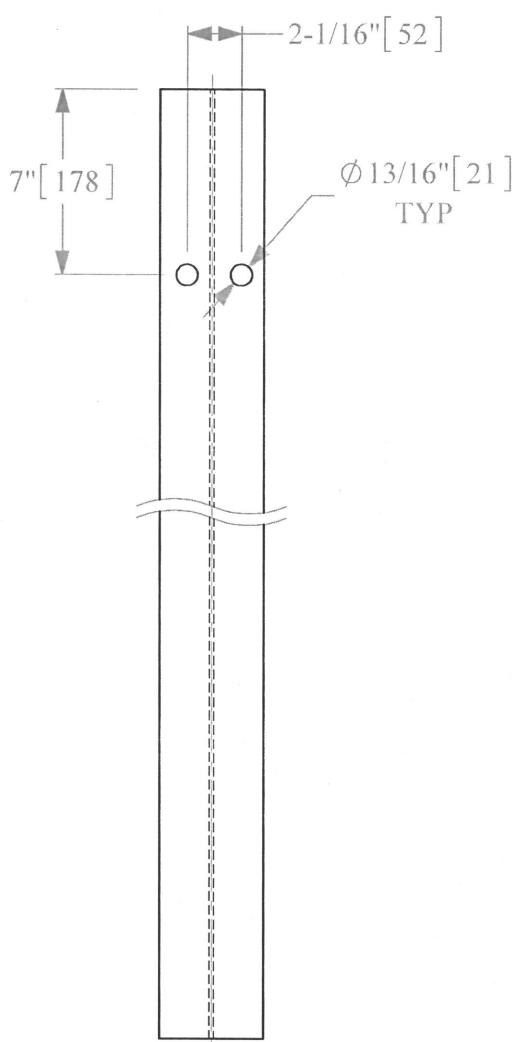
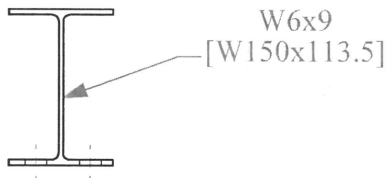
SXX00

SHEET NO.

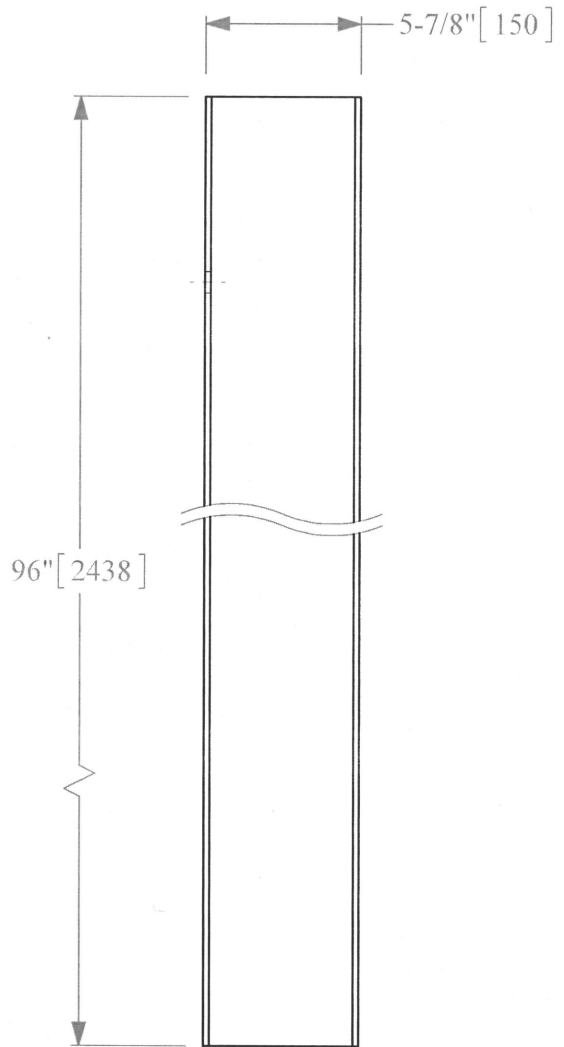
DATE

2 of 2

01/08/2016



FRONT



SIDE

2013

Wide-Flange Post for Guardrail on Slope



PWE10

SHEET NO.

DATE

1 of 2

07/15/2013

SPECIFICATIONS

See PWE01-04 for Specifications.

INTENDED USE

The PWE10 Post is used in the SXX00 Guardrail on Slope System.

2013

Wide-Flange Post for Guardrail on Slope



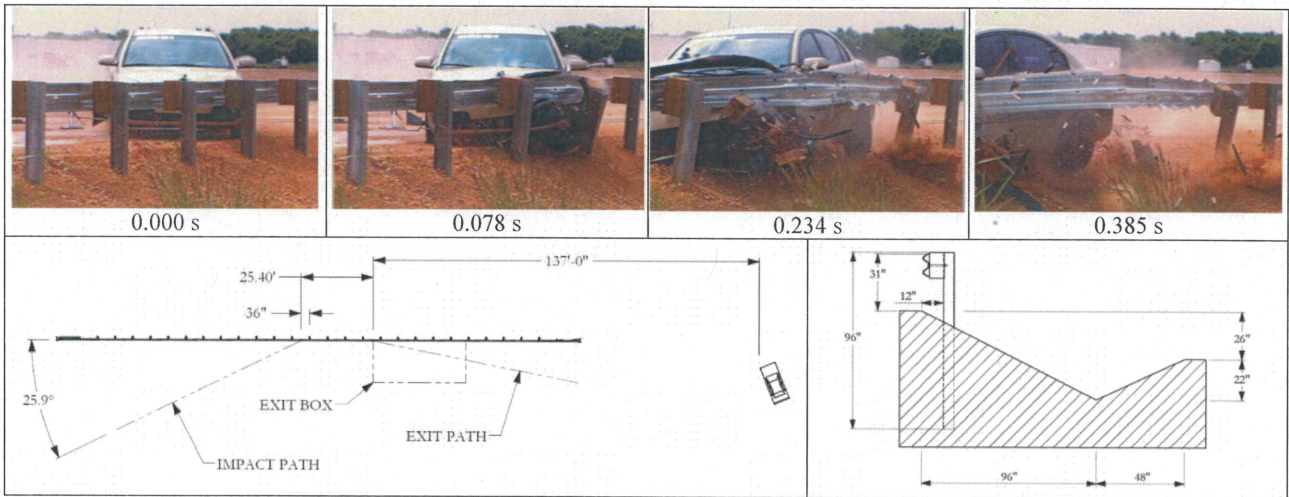
PWE10

SHEET NO.

DATE

2 of 2

07/15/2013



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General Information

Test Agency Texas A&M Transportation Institute (TTI)
 Test Standard Test No. MASH test 3-10
 TTI Test No. 405160-20-2
 Date April 20, 2012

Test Article

Type Guardrail
 Name WSDOT Guardrail on Slope
 Installation Length 181 ft 3 inches
 Material or Key Elements 12 gauge W-Beam Mounted on 8-ft long
 W6x8.5 Steel Posts on 2H:1V Slope

Soil Type and Condition..... Standard soil, dry

Test Vehicle

Type/Designation 1100C
 Make and Model 2006 Kia Rio
 Curb 2457 lb
 Test Inertial 2429 lb
 Dummy 164 lb
 Gross Static 2593 lb

Impact Conditions

Speed 60.3 mi/h
 Angle 25.9 degrees
 Location/Orientation 3.0 ft upstrm post 15

Impact Severity 60.1 kip-ft, >7.9%

Exit Conditions

Speed 31.3 mi/h
 Angle 32.3 degrees

Occupant Risk Values

Impact Velocity
 Longitudinal 17.4 ft/s
 Lateral 16.1 ft/s
 Ridedown Accelerations
 Longitudinal 7.3 G
 Lateral 6.8 G
 THIV 24.6 km/h
 PHD 9.3 G
 ASI 0.75
 Max. 0.050-s Average
 Longitudinal -5.7 G
 Lateral 5.5 G
 Vertical -2.3 G

Post-Impact Trajectory

Stopping Distance 162.4 ft downstrm
 twd traffic

Vehicle Stability

Maximum Yaw Angle 38 degrees
 Maximum Pitch Angle 5 degrees
 Maximum Roll Angle 7 degrees
 Vehicle Snagging No
 Vehicle Pocketing No

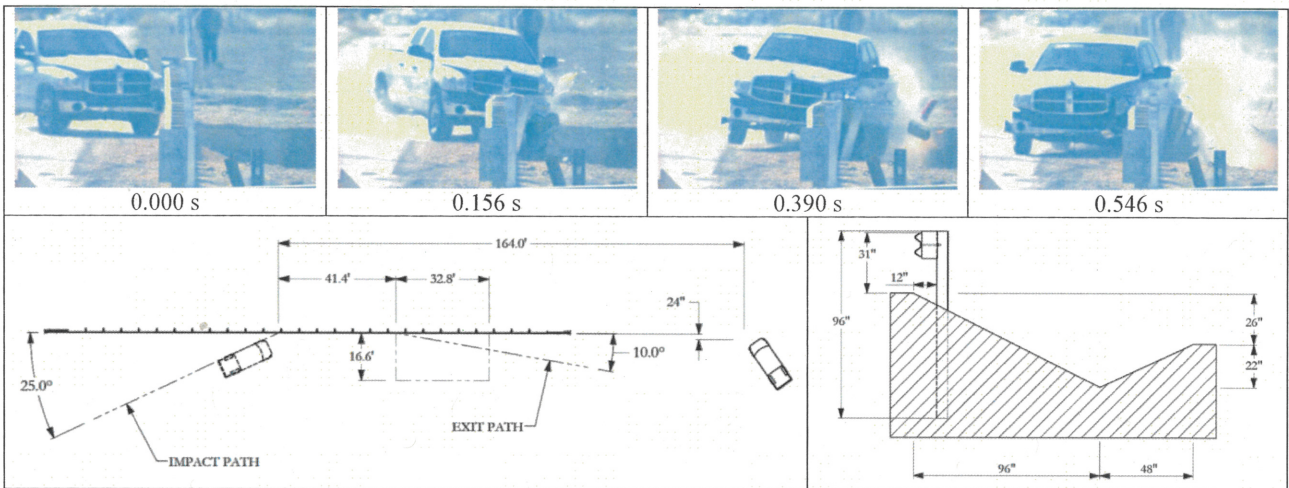
Test Article Deflections

Dynamic 2.7 ft
 Permanent 1.9 ft
 Working Width 3.1 ft

Vehicle Damage

VDS 11LFQ3
 CDC 11FLEW3
 Max. Exterior Deformation 10.5 inches
 OCDI FS0000000
 Max. Occupant Compartment
 Deformation None

Figure 6.7. Summary of results for MASH test 3-10 on the guardrail on slope.



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General Information

Test Agency Texas A&M Transportation Institute (TTI)
 Test Standard Test No. MASH test 3-11
 TTI Test No. 405160-20-1
 Date January 18, 2012

Test Article

Type Guardrail
 Name WSDOT Guardrail on Slope
 Installation Length 181 ft 3 inches
 Material or Key Elements 12 gauge W-Beam Mounted on 8-ft long
 W6x8.5 Steel Posts on 2H:1V Slope

Soil Type and Condition..... Standard soil, dry

Test Vehicle

Type/Designation 2270P
 Make and Model 2006 Dodge Ram 1500
 Curb 4977 lb
 Test Inertial 5044 lb
 Dummy No dummy
 Gross Static 5044 lb

Impact Conditions

Speed63.9 mi/h
 Angle25.0 degrees
 Location/Orientation0.9 ft upstream of
 post 14

Impact Severity

SpeedNot obtainable
 Angle~10 degrees

Exit Conditions

SpeedNot obtainable
 Angle~10 degrees

Occupant Risk Values

Impact Velocity
 Longitudinal15.1 ft/s
 Lateral15.4 ft/s
 Ridedown Accelerations
 Longitudinal9.0 G
 Lateral6.9 G
 THIV22.3 km/h
 PHD10.1 G
 ASI0.61
 Max. 0.050-s Average
 Longitudinal-4.5 G
 Lateral5.1 G
 Vertical1.8 G

Post-Impact Trajectory

Stopping Distance106.2 ft downstrm
 2.0 ft twd traffic

Vehicle Stability

Maximum Yaw Angle34 degrees
 Maximum Pitch Angle3 degrees
 Maximum Roll Angle13 degrees
 Vehicle SnaggingNo
 Vehicle PocketingNo

Test Article Deflections

Dynamic4.3 ft
 Permanent3.1 ft
 Working Width4.6 ft

Vehicle Damage

VDS11LFQ4
 CDC11LFEW3
 Max. Exterior Deformation11.0 inches
 OCDInil
 Max. Occupant Compartment
 DeformationLS0000000

Figure 5.7. Summary of results for MASH test 3-11 on the guardrail on slope.