



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

March 18, 2019

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

In Reply Refer To:
HSST-1/B-315

Mr. Gerrit Dyke, P.E.
Lindsay Transportation Solutions
180 River Road
Rio Vista, CA 94571

Dear Mr. Dyke:

This letter is in response to your November 16, 2018 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-315 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:

- QuickChange Moveable Barrier Concrete Reactive Tension System - Fiber Series (QMB-CRTS-F)

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: QuickChange Moveable Barrier Concrete Reactive Tension System - Fiber Series (QMB- CRTS-F)

Type of system: Longitudinal Barrier

Test Level: MASH Test Level 3 (TL3)

Testing conducted by: TamTI

Date of request: December 10, 2018

FHWA concurs with the recommendation of the accredited crash testing laboratory as stated within the attached form for systems mounted on concrete only.

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

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-315 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 16, 2018	<input checked="" type="radio"/> New <input type="radio"/> Resubmission
	Name:	Gerrit A. Dyke, P.E.	
	Company:	Lindsay Transportation Solutions, Inc.	
	Address:	180 River Road, Rio Vista, CA 94571	
	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	QuickChange Moveable Barrier Concrete Reactive Tension System - Fiber Series (QMB- CRTS-F)	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:	Gerrit A. Dyke, P.E.	Same as Submitter <input checked="" type="checkbox"/>
Company Name:	Lindsay Transportation Solutions, Inc.	Same as Submitter <input checked="" type="checkbox"/>
Address:	180 River Road, Rio Vista, CA 94571	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.

Texas A&M Transportation Institute (TTI) was contracted by Lindsay Transportation Solutions, Inc. to perform full-scale crash testing of the QuickChange Moveable Barrier Concrete Reactive Tension System - Fiber Series (QMB-CFRTS-F) to MASH standards. There are no shared financial interests in the QMB-CFRTS-F by TTI, or between Lindsay Transportation Solutions, Inc. and TTI, other than costs involved in the actual crash tests and reports for this submission to FHWA.

PRODUCT DESCRIPTION

- New Hardware or Significant Modification

 Modification to Existing Hardware

Quickchange Moveable Barrier Concrete Reactive Tension System - Fiber Series (CRTS-F) is a fiber and steel reinforced concrete barrier connected end to end with tensioning hinge mechanisms and steel pins. Each barrier segment is approximately 39 in [1.0 m] and weighs approximately 1435 lb (650 kg). The barrier is 18 in [460 mm] wide. Steel variable length barriers (VLB) are used in conjunction with the concrete segments. The system is applicable to asphalt or concrete road surfaces.

The CRTS-F system can be utilized with or without VLBs. VLB positioning is configured in accordance with the requirements of the barrier application. Typical VLB spacing is 1 in 17 CRTS-F barrier segments or fewer, however, some applications may require more.

The CRTS-F pin used to link the barrier segments utilizes a recessed section which engages with the hinge mechanism to lock the pin in place and minimize maintenance of the connection during transfer operations.

The test installation consisted of a total of 178+2 repositionable MASH Concrete Reactive Tension System-Fiber (CRTS-F) Barriers, each nominally 39 $\frac{3}{8}$ inches (1000 mm) in length (pin-to-pin). The total length of the barrier installation was approximately 591 ft-8 inches (180.3 m), including a nominal 2 $\frac{3}{8}$ -inch (60 mm) gap between the encasement faces of adjacent barrier segments. Two segments (#92 and #109) were Variable Length Barriers (VLB). All barriers were delivered to the TTI Proving Ground site by the Lindsay. The barriers were installed on a 6-to-7-inch (152-178 mm) thick concrete apron. Each barrier segment was joined via the hinge pins with any slack taken up by the tightening spring mechanisms. There were no bolts, pins, or adhesives securing the barriers to the concrete apron.

Markings may be stamped into the concrete for identification, quality assurance, and tracking. The markings will be alpha numeric characters set into the top of the barrier. In some cases, a metal identification tag may be fastened to the barrier.

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:	D. Lance Bullard, Jr.	
Engineer Signature:	D. Lance Bullard, Jr.	Digitally signed by D. Lance Bullard, Jr. Date: 2019.03.13 13:58:45 -05'00'
Address:	TTI, TAMU 3135, 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)	<p>Test 3-10 involves an 1100C vehicle impacting the test article at a target speed of 62 mph and a target angle of 25 degrees. The target CIP was the centerline of the vehicle aligned with the centerline of barrier segment number 62, with the vehicle point of contact at barrier number 60. This translates to the left corner of the front bumper contacting 0.6 ft (183 mm) upstream of barrier segment 60-61 pin joint. The results of the test conducted on August 29, 2018, are found in TTI Test Report number 690900-LTS 5&6.</p> <p>The test vehicle was traveling at an impact speed of 62.0 mph as it make contact with the QMB-CRTS-F barrier 0.56 ft (171mm) upstream of the joint between segments 60 and 61 at an impact angle of 25.2°.</p> <p>Exit box criteria were met.</p> <p>After loss of contact with the barrier, the vehicle came to rest 136 ft (41 m) downstream of the impact and adjacent to the traffic face of the barrier.</p> <p>The QMB-CRTS-F barrier contained and redirected the 1100C vehicle. The vehicle did not penetrate, underride, or override the installation. Maximum dynamic deflection during the test was 27.6 inches (701 mm). Maximum permanent deformation was 26.75 inches (679mm). Working Width was 45.6 inches (1158mm) at the base of the barrier.</p> <p>No detached elements, fragments, or other debris were present to penetrate or show potential for penetrating the occupant compartment or present hazard to others in the area.</p> <p>Maximum occupant compartment deformation was 1.0 inch (25 mm) in the left side firewall area.</p> <p>The 1100C vehicle remained upright during and after the collision event. Maximum roll and pitch angles were 11° and 5°, respectively.</p> <p>Longitudinal OIV was 25.3 ft/s (7.7 m/s), and lateral OIV was 23.6 ft/s (7.2 m/s).</p> <p>Maximum longitudinal occupant ridedown acceleration was 7.5g, and maximum lateral occupant ridedown acceleration was 9.0g.</p> <p>Occupant risk factors were within the preferred limits specified in MASH.</p> <p>Maximum exterior crush to the vehicle was 8.0 inches (203mm) in both the front and side plane at the left front corner at bumper height.</p> <p>The QMB-CRTS-F barrier performed acceptably for MASH test 3-10.</p>	PASS

Required Test Number	Narrative Description	Evaluation Results
3-11 (2270P)	<p>Test 3-11 involves a 2270P vehicle impacting the test article at a target speed of 62 mph and a target angle of 25 degrees. The target CIP was the centerline of the vehicle aligned with the centerline of VLB barrier segment number 92, with the vehicle point of contact at barrier number 90. This translates to the left corner of the front bumper contacting 1.64 ft (500 mm) upstream of barrier segment 90-91 pin joint. The results of the test conducted on August 29, 2018, are found in TTI Test Report number 690900-LTS 5&6.</p> <p>The test vehicle was traveling at an impact speed of 62.5 mph as it made contact with the QMB-CRTS-F barrier 1.35 ft (411mm) upstream of the joint between segments 90 and 91 at an impact angle of 24.7°. Exit box criteria were met.</p> <p>After loss of contact with the barrier, the vehicle came to rest 270 ft (82 m) downstream of the impact and adjacent to the traffic face of the barrier.</p> <p>The QMB-CRTS-F barrier contained and redirected the 2270P vehicle. The vehicle did not penetrate, underride, or override the installation. Maximum dynamic deflection during the test was 47.0 inches (1194mm). Maximum permanent deformation was 44.5 inches (1130mm). Working Width was 65.0 inches (1651mm) at the base of the barrier.</p> <p>No detached elements, fragments, or other debris were present to penetrate or show potential for penetrating the occupant compartment or present hazard to others in the area.</p> <p>There was no observed occupant compartment deformation.</p> <p>The 2270P vehicle remained upright during and after the collision event. Maximum roll and pitch angles were 16° and 4°, respectively.</p> <p>Longitudinal OIV was 18.4 ft/s (5.6 m/s), and lateral OIV was 16.1 ft/s (4.9 m/s).</p> <p>Maximum longitudinal occupant ridedown acceleration was 5.2g, and maximum lateral occupant ridedown acceleration was 10.6g. Occupant risk factors were within the preferred limits specified in MASH.</p> <p>Maximum exterior crush to the vehicle was 12.0 inches (305mm) in the front plane at the left front corner at bumper height.</p> <p>The QMB-CRTS-F barrier performed acceptably for MASH test 3-11.</p>	PASS

3-20 (1100C)	Optional Test not performed. The QMB-CFRTS-F product is not a transition system, but is a stand alone barrier system that will not transition to any stiffer or more rigid barrier systems. Therefore, test 3-20 is not applicable.	Non-Relevant Test, not conducted
3-21 (2270P)	Test not performed. The QMB-CFRTS-F product is not a transition system, but is a stand alone barrier system that will not transition to any stiffer or more rigid barrier systems. Therefore, test 3-21 is not applicable.	Non-Relevant Test, not conducted

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

Laboratory Name:	Texas AM Transportation Institute	
Laboratory Signature:	Digitally signed by Darrell L. Kuhn 'Date: 2019.03.12 19:21:17 -05'00 	
Address:	TTI, TAMU 3135, 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 :	ISO 17025 Laboratory Certificate Number: 2821.01 Valid To: April 30, 2019	

Submitter Signature*: Gerrit Dyke, P.E. Digitally signed by Gerrit Dyke, P.E.
Date: 2019.03.13 13:46:11 -0700

Submit Form

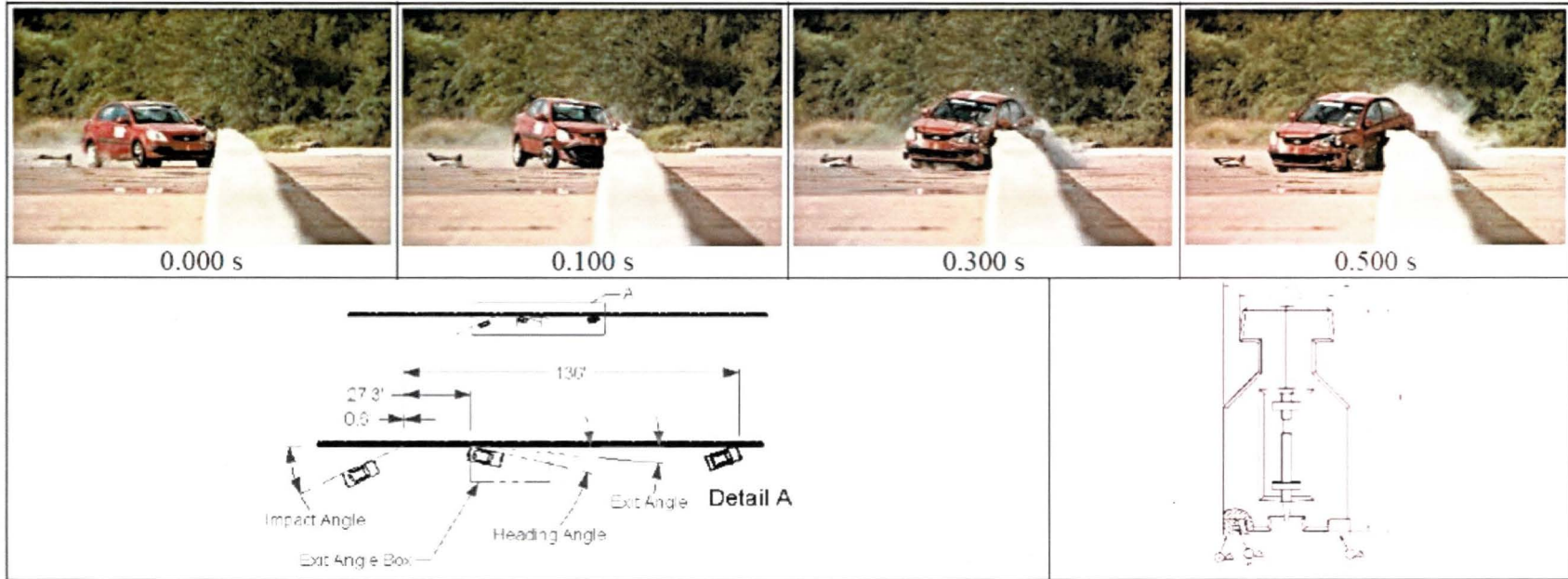
ATTACHMENTS

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



General Information

Test Agency Texas A&M Transportation Institute (TTI)
 Test Standard Test No. MASH Test 3-10
 TTI Test No. 690900-LTS5
 Test Date 2018-08-29

Test Article

Type Portable Concrete Barrier
 Name MASH CRTS-F Barrier
 Installation Length 591 ft-8 inches (180.3 m)
 Material or Key Elements 178 free-standing concrete barrier segments 37 inches (940 mm) long x 32 1/2 inches (822 mm) tall plus two variable length barriers (VLB) connected by steel pins

Soil Type and Condition

..... pins
 Concrete surface, damp

Test Vehicle

Type/Designation 1100C
 Make and Model 2009 Kia Rio
 Curb 2497 lb (1133 kg)
 Test Inertial 2437 lb (1105 kg)
 Dummy 165 lb (75 kg)
 Gross Static 2602 lb (1180 kg)

Impact Conditions

Speed 62.0 mi/h (99.8 km/h)
 Angle 25.2°
 Location/Orientation 0.56 ft upstream of joint 60-61
 Impact Severity 77 kip-ft

Exit Conditions

Speed 36.2 mi/h (58.3 km/h)
 Trajectory/Heading Angle 11.8°/23.0°

Occupant Risk Values

Longitudinal OIV 25.3 ft/s (7.7 m/s)
 Lateral OIV 23.6 ft/s (7.2 m/s)
 Longitudinal Ridedown 7.5 g
 Lateral Ridedown 9.0 g
 THIV 37.5 km/h
 PHD 10.4 g
 ASI 1.86

Max. 0.050-s Average

Longitudinal -12.2 g
 Lateral 12.1 g
 Vertical -2.3 g

Post-Impact Trajectory

Stopping Distance 136 ft downstream
 Against traffic face

Vehicle Stability

Maximum Yaw Angle 49°
 Maximum Pitch Angle 5°
 Maximum Roll Angle 11°
 Vehicle Snagging No
 Vehicle Pocketing No

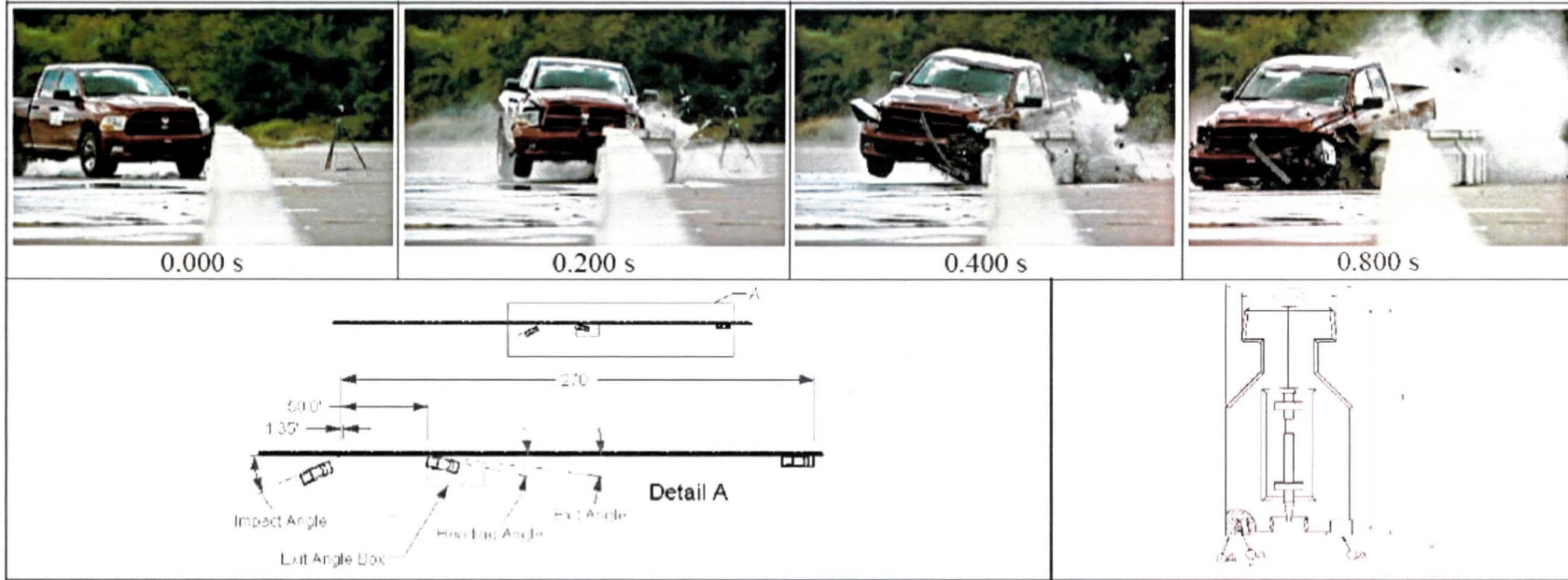
Test Article Deflections

Dynamic 27.6 inches (701 mm)
 Permanent 26.75 inches (679 mm)
 Working Width 45.6 inches (1158 mm)
 Height of Working Width At base of barrier

Vehicle Damage

VDS 11LFQ3
 CDC 11FLEW3
 Max. Exterior Deformation 8.0 inches (203 mm)
 OCDI LF0020000
 Max. Occupant Compartment Deformation 1.0 inch (25 mm)

Figure 5.7. Summary of Results for MASH Test 3-10 on MASH CRTS-F Barriers.



General Information

Test Agency..... Texas A&M Transportation Institute (TTI)
 Test Standard Test No. MASH Test 3-11
 TTI Test No. 690900-LTS6
 Test Date..... 2018-08-29

Test Article

Type Portable Concrete Barrier
 Name MASH CRTS-F Barrier
 Installation Length..... 591 ft-8 inches (180.3 m)
 Material or Key Elements... 178 free-standing concrete barrier segments 37 inches (940 mm) long x 32% inches (822 mm) tall plus two variable length barriers (VLB) connected by steel pins

Soil Type and Condition

Concrete surface, damp

Test Vehicle

Type/Designation..... 2270P
 Make and Model 2012 Dodge RAM 1500 Pickup
 Curb..... 5013 lb (2274 kg)
 Test Inertial..... 5000 (2268 kg)
 Dummy No dummy
 Gross Static..... 5000 lb (2268 lb)

Impact Conditions

Speed 62.5 mi/h (100.6 km/h)
 Angle 24.7°
 Location/Orientation 1.35 ft upstream of joint between 90-91

Impact Severity

Speed Out of view
 Angle Out of view

Exit Conditions

Speed Out of view
 Angle Out of view

Occupant Risk Values

Longitudinal OIV 18.4 ft/s (5.6 m/s)
 Lateral OIV 16.1 ft/s (4.9 m/s)
 Longitudinal Ridedown 5.2 g
 Lateral Ridedown 10.6 g
 THIV 26.4 km/h
 PHD 10.9 g
 ASI 0.98

Max. 0.050-s Average

Longitudinal -7.4 g
 Lateral 6.8 g
 Vertical..... -2.0 g

Post-Impact Trajectory

Stopping Distance 270 ft downstream Against traffic face

Vehicle Stability

Maximum Yaw Angle..... 41°
 Maximum Pitch Angle..... 4°
 Maximum Roll Angle..... 16°
 Vehicle Snagging..... No
 Vehicle Pocketing..... No

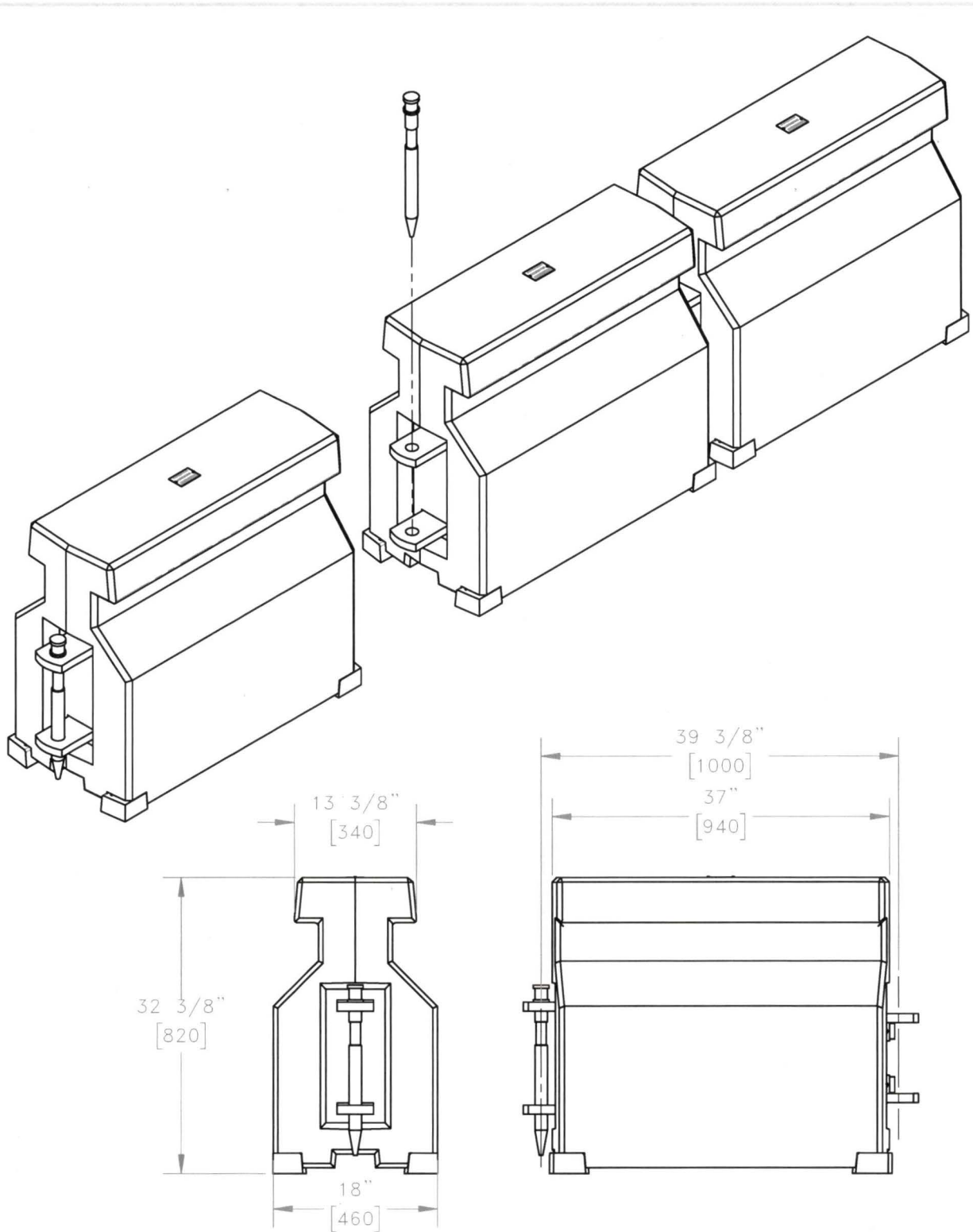
Test Article Deflections

Dynamic 47.0 inches (1194 mm)
 Permanent..... 44.5 inches (1130 mm)
 Working Width 65.0 inches (1651 mm)
 Height of Working Width At base of barrier

Vehicle Damage

VDS 11LFQ4
 CDC 11FLEW4
 Max. Exterior Deformation 12.0 inches (305 mm)
 OCDI LF0000000
 Max. Occupant Compartment Deformation..... None

Figure 6.8. Summary of Results for MASH Test 3-11 on MASH CRTS-F Barriers.



CONCRETE REACTIVE TENSION[®] – FIBER BARRIER, MASH TL-3



XXX

Lindsay Transportation Solutions, 180 River Rd., Rio Vista CA. 94571, 888-800-3691
www.theroadzipper.com

SHEET NO.
1 OF 2

DATE:
11/20/18

INTENDED USE

The Concrete Reactive Tension® QuickChange® Moveable Barrier System Fiber Series (CRTS-F) is a MASH TL-3 longitudinal barrier capable of rapid lateral transfer by a transfer vehicle. The CRTS-F is designed to meet the rigid requirements of deployment in moveable barrier applications where positive separation is required, and where lane widths and lateral space are limited. The CRTS-F system is unanchored and has low deflection during vehicle impacts.

The CRTS-F is a steel and fiber-reinforced concrete barrier connected end to end with tensioning hinge mechanisms and grooved steel pins. Each barrier segment is approximately 39 in [1.0 m] in length and weighs approximately 1435 lb [650 kg]. The barrier is 18 in [460 mm] wide.

Specifically constructed transfer machines are used to lift, move, and reposition the barrier laterally on the roadway. Transfer vehicles are capable of moving the barrier wall up to 30 ft [9.1 m] at up to 10 mph [16 kph] on a permanent system and up to 5 mph [8 kph] for a temporary or construction system.

The CRTS-F is used as a median barrier on congested roadways to open and close lanes of traffic to adapt to changing traffic volumes during commuting hours or special events. It is also used to open and close construction zones on a periodic basis to increase safety, workspace, reduce congestion, and improve construction worker productivity.

The CRTS-F barrier is compatible with the ABSORB 350® Crash Cushion (SC111).

APPROVALS

The Concrete Reactive Tension® QuickChange® Moveable Barrier System Fiber Series (CRTS-F) has been fully tested in conformance with MASH 2016 Test Level 3 and determined eligible for federal reimbursement by the FHWA.

FHWA Eligibility Letter: TBD

CONTACT INFORMATION

Lindsay Transportation Solutions
180 River Rd.
Rio Vista, CA 94571
www.barriersystemsinc.com
Phone: 888-800-3691 or 707-374-6800
Fax: 707-374-6801
Email: info@barriersystemsinc.com

CONCRETE REACTIVE TENSION® – FIBER BARRIER, MASH TL-3

XXX

SHEET NO.

DATE:

2 OF 2

11/20/18



Lindsay Transportation Solutions, 180 River Rd., Rio Vista CA, 94571, 888-800-3691
www.theroadzipper.com