



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

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

August 22, 2011

In Reply Refer To:  
HSST /CC-118

Mr. Mark R. Morgan  
Director of Engineering  
Smith & Wesson Security Solutions  
277 Mallory Station Road, Suite 112  
Franklin, TN 37067

Dear Mr. Morgan:

This letter is in response to your request for the Federal Highway Administration (FHWA) acceptance of a roadside safety device for use on the National Highway System (NHS).

Name of device:	Expeditionary Mobile Barrier
Type of device:	Crash Cushion / Arrester net
Test Level:	NCHRP Report Test Level 3
Testing conducted by:	Texas Transportation Institute
Date of request:	December 10, 2010
Date of completed package:	December 10, 2010
Initially acknowledged:	December 14, 2010

You requested that we find this system acceptable for use on the NHS under the American Association of State Highway and Transportation Officials Manual for Assessing Safety Hardware (MASH).

### **Requirements**

Roadside safety devices should meet the guidelines contained in the NCHRP Report 350 or the American Association of State Highway and Transportation Officials' Manual for Assessing Safety Hardware (MASH). The FHWA Memorandum "Identifying Acceptable Highway Safety Features" of July 25, 1997 provides further guidance on crash testing requirements of longitudinal barriers.

### **Decision**

The following device was found acceptable:

- Expeditionary Mobile Barrier with 14 foot to 40 foot wide net

FHWA:HSSI:NArtimovich:ms:x61331:06/29/11  
File: s://directory folder/HSST/CC-118\_USR Expeditionary Mobile  
Barrier.docx  
cc: HSST (NArtimovich)

## Description

The Smith & Wesson Security Solutions Expeditionary Mobile Barrier (EMB) is a deployable net system which may be used as a method of lane closure or temporary access control. The EMB consists of four main components: (1) net; (2) lift arms; (3) textile brakes; and (4) anchors.

The net is constructed of 2 inch polyester webbing woven together. At each joint, the webbing is stitched together. The net is 48 ft long, 42 inches tall and weighs approximately 29 pounds. It is configurable to provide a barrier width range from 14 ft to 40 ft. Enclosure 1 shows the details of the net.

The net is supported by two lift arms, one on each side of the roadway where the net is to be deployed. Each lift arm is constructed of aluminum tubing and contains an electric powered actuator that lowers and raises the net (Enclosure 2). Power to each attenuator is provided by a 12 volt battery that is attached at the base of the lift arm. Each assembled lift arms weighs approximately 132 pounds.

Upon impact by a vehicle, the net releases from the lift arms. Two textile breaks connect the two ends of the net to the anchors. Once the net is released from the lift arms, it begins to engage the textile brakes. The textile brake is an energy absorption technology that is based on absorbing kinetic energy through the tearing action of two textile straps woven together.

In this submission, two separate methods for anchoring the textile brakes were used: (1) earth anchors or (2) vehicle anchors. In the earth anchor method, each end of the net is anchored to two M.K. Rittenhouse & Sons, Ltd. 88DB1 duckbill earth anchors. Each anchor cable is 42 inches long and ¼ inch in diameter and is rated for 3000 pounds static holding force. The duckbill earth anchors are driven into the ground leaving steel loop above the ground. In the vehicle anchor method, each brake is anchored to a standard class III trailer hitch of a vehicle that weighs at least 6000 pounds.

Enclosures 3 and 4 show the earth anchorage system and the vehicle anchorage system respectively. Connections between the anchor and the textile brake are accomplished using two 10,000 pound rated polyester straps with hooks on each end and three shackles. A ½ inch shackle attaches the 10,000 pound straps to each earth anchor while a ¾ inch shackle attaches the straps to the textile brake. When the textile brake is anchored to a trailer hitch receiver, a ¾ inch shackle is used to connect the two 10,000 pound straps to the receiver.

## Crash Testing

Three full crash tests were conducted on the test article described above according to MASH guidelines as shown in the following table:

ID	MASH Test	Width of the Net (ft)	Anchorage Method
USR16	3-40	40	Earth Anchor
USR17	3-41	40	Vehicle Anchor
USR18	3-41	14	Earth Anchor

In test 3-40, the centerline of the vehicle (MASH 1100C small car) was aligned with the right quarter point of the barrier. In both tests conducted according to test 3-41, the centerline of the vehicle (MASH 2270P pickup truck) was aligned with the centerline of the net.

In all three tests, the test article slowed, captured, and stopped the test vehicle. The post impact trajectories of the test vehicles were predictable. In all three tests the Occupant Impact Velocity values are smaller than the maximum limits set by MASH and Occupant Ridedown Acceleration values are below the preferred limits. Therefore, it is judged that the test article successfully passed the three tests. Enclosures 5 through 7 summarize the test results for tests USR16 through USR18 respectively.

The stopping distances of vehicles in tests USR16, USR17, and USR 18 were 78 ft, 152.3 ft, and 138.2 ft respectively.

### **Findings**

According to MASH, test designations 3-40 through 3-45 are to be conducted for non-redirective gating crash cushions for Test Level 3 approval. The test article described above was not crash tested according to MASH tests 3-42 through test 3-45. You have requested that these tests be waived for the EMB system.

The test article is a symmetric net. Therefore, the oblique impacts are not perceived to be more critical than straight impacts (the impacts where the longitudinal axis of the impacting vehicle is perpendicular to the net). Therefore, it is judged that test 3-42 will not be more critical than test 3-40. Also, test 3-43 and 3-44 will not likely to be more critical than test 3-41.

Test 3-45 is intended to examine the performance of crash cushions during impact by mid-sized vehicles. The main concern for the test is that attenuator staging can be tuned to meet the testing requirements for small cars and heavy pickup trucks without adequately accommodating mid-sized vehicles. Due to the design of the EMB, it is not expected that the system will perform differently for mid-sized cars than small cars or heavy pickup trucks.

Therefore, we concur with your request that the tests 3-42 through 3-45 be waived.

Because the lift arms are substantial structures, they would generally require shielding in an actual field installation to prevent errant motorists from striking one and further losing control of their vehicles. The same consideration would apply when other vehicles are used to anchor the ends of the EMB.

In your letter you requested the approval of the EMB for the following conditions:

- Earth anchor or vehicle anchor, and
- The net width within the range of 14 ft to 40 ft.

The FHWA concurs with your first request on the grounds that the EMB performed as expected with both anchorage systems. We also agree with your second request because the test results associated with test USR 17 and USR 18 are consistent with each other. The videos of both tests also show a consistent behavior of the system.

According to the results obtained from crash testing, no hazard shall be present within 160 ft behind the nets for the net width of 14 ft and 40 ft respectively. No information is available for the stopping distance of vehicles for nets with the net width between 40 ft and 14 ft and a conservative approach has to be adopted.

Therefore, the device described in the various requests above and detailed in the enclosed drawings is acceptable for use on the NHS under the range of conditions tested, when acceptable to a highway agency.

Please note the following standard provisions that apply to FHWA letters of acceptance:

- This acceptance is limited to the crashworthiness characteristics of the devices and does not cover their structural features, nor conformity with the Manual on Uniform Traffic Control Devices.
- Any changes that may adversely influence the crashworthiness of the device will require a new acceptance letter.
- Should the FHWA discover that the qualification testing was flawed, that in-service performance reveals unacceptable safety problems, or that the device being marketed is significantly different from the version that was crash tested, we reserve the right to modify or revoke our acceptance.
- You will be expected to supply potential users with sufficient information on design and installation requirements to ensure proper performance.
- You will be expected to certify to potential users that the hardware furnished has essentially the same chemistry, mechanical properties, and geometry as that submitted for acceptance, and that it will meet the crashworthiness requirements of the FHWA and MASH.
- To prevent misunderstanding by others, this letter of acceptance is designated as number CC-118 and 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 at our office upon request.
- The Expeditionary Mobile Barrier systems are patented products and considered proprietary. If proprietary devices are specified by a highway agency for use on Federal-aid projects, except exempt, non-NHS 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.

- This acceptance letter shall not be construed as authorization or consent by the FHWA to use, manufacture, or sell any patented device for which the applicant is not the patent holder. The acceptance letter is limited to the crashworthiness characteristics of the candidate device, and the FHWA is neither prepared nor required to become involved in issues concerning patent law. Patent issues, if any, are to be resolved by the applicant.

Sincerely yours,

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

Enclosures



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

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

August 22, 2011

In Reply Refer To:  
HSST /CC-118

Mr. Mark R. Morgan  
Director of Engineering  
Smith & Wesson Security Solutions  
277 Mallory Station Road, Suite 112  
Franklin, TN 37067

Dear Mr. Morgan:

This letter is in response to your request for the Federal Highway Administration (FHWA) acceptance of a roadside safety device for use on the National Highway System (NHS).

Name of device:	Expeditionary Mobile Barrier
Type of device:	Crash Cushion / Arrester net
Test Level:	NCHRP Report Test Level 3
Testing conducted by:	Texas Transportation Institute
Date of request:	December 10, 2010
Date of completed package:	December 10, 2010
Initially acknowledged:	December 14, 2010

You requested that we find this system acceptable for use on the NHS under the American Association of State Highway and Transportation Officials Manual for Assessing Safety Hardware (MASH).

### **Requirements**

Roadside safety devices should meet the guidelines contained in the NCHRP Report 350 or the American Association of State Highway and Transportation Officials' Manual for Assessing Safety Hardware (MASH). The FHWA Memorandum "Identifying Acceptable Highway Safety Features" of July 25, 1997 provides further guidance on crash testing requirements of longitudinal barriers.

### **Decision**

The following device was found acceptable:

- Expeditionary Mobile Barrier with 14 foot to 40 foot wide net

## Description

The Smith & Wesson Security Solutions Expeditionary Mobile Barrier (EMB) is a deployable net system which may be used as a method of lane closure or temporary access control. The EMB consists of four main components: (1) net; (2) lift arms; (3) textile brakes; and (4) anchors.

The net is constructed of 2 inch polyester webbing woven together. At each joint, the webbing is stitched together. The net is 48 ft long, 42 inches tall and weighs approximately 29 pounds. It is configurable to provide a barrier width range from 14 ft to 40 ft. Enclosure 1 shows the details of the net.

The net is supported by two lift arms, one on each side of the roadway where the net is to be deployed. Each lift arm is constructed of aluminum tubing and contains an electric powered actuator that lowers and raises the net (Enclosure 2). Power to each attenuator is provided by a 12 volt battery that is attached at the base of the lift arm. Each assembled lift arms weighs approximately 132 pounds.

Upon impact by a vehicle, the net releases from the lift arms. Two textile breaks connect the two ends of the net to the anchors. Once the net is released from the lift arms, it begins to engage the textile brakes. The textile brake is an energy absorption technology that is based on absorbing kinetic energy through the tearing action of two textile straps woven together.

In this submission, two separate methods for anchoring the textile brakes were used: (1) earth anchors or (2) vehicle anchors. In the earth anchor method, each end of the net is anchored to two M.K. Rittenhouse & Sons, Ltd. 88DB1 duckbill earth anchors. Each anchor cable is 42 inches long and ¼ inch in diameter and is rated for 3000 pounds static holding force. The duckbill earth anchors are driven into the ground leaving steel loop above the ground. In the vehicle anchor method, each brake is anchored to a standard class III trailer hitch of a vehicle that weighs at least 6000 pounds.

Enclosures 3 and 4 show the earth anchorage system and the vehicle anchorage system respectively. Connections between the anchor and the textile brake are accomplished using two 10,000 pound rated polyester straps with hooks on each end and three shackles. A ½ inch shackle attaches the 10,000 pound straps to each earth anchor while a ¾ inch shackle attaches the straps to the textile brake. When the textile brake is anchored to a trailer hitch receiver, a ¾ inch shackle is used to connect the two 10,000 pound straps to the receiver.

## Crash Testing

Three full crash tests were conducted on the test article described above according to MASH guidelines as shown in the following table:

ID	MASH Test	Width of the Net (ft)	Anchorage Method
USR16	3-40	40	Earth Anchor
USR17	3-41	40	Vehicle Anchor
USR18	3-41	14	Earth Anchor

In test 3-40, the centerline of the vehicle (MASH 1100C small car) was aligned with the right quarter point of the barrier. In both tests conducted according to test 3-41, the centerline of the vehicle (MASH 2270P pickup truck) was aligned with the centerline of the net.

In all three tests, the test article slowed, captured, and stopped the test vehicle. The post impact trajectories of the test vehicles were predictable. In all three tests the Occupant Impact Velocity values are smaller than the maximum limits set by MASH and Occupant Ridedown Acceleration values are below the preferred limits. Therefore, it is judged that the test article successfully passed the three tests. Enclosures 5 through 7 summarize the test results for tests USR16 through USR18 respectively.

The stopping distances of vehicles in tests USR16, USR17, and USR 18 were 78 ft, 152.3 ft, and 138.2 ft respectively.

### **Findings**

According to MASH, test designations 3-40 through 3-45 are to be conducted for non-redirective gating crash cushions for Test Level 3 approval. The test article described above was not crash tested according to MASH tests 3-42 through test 3-45. You have requested that these tests be waived for the EMB system.

The test article is a symmetric net. Therefore, the oblique impacts are not perceived to be more critical than straight impacts (the impacts where the longitudinal axis of the impacting vehicle is perpendicular to the net). Therefore, it is judged that test 3-42 will not be more critical than test 3-40. Also, test 3-43 and 3-44 will not likely to be more critical than test 3-41.

Test 3-45 is intended to examine the performance of crash cushions during impact by mid-sized vehicles. The main concern for the test is that attenuator staging can be tuned to meet the testing requirements for small cars and heavy pickup trucks without adequately accommodating mid-sized vehicles. Due to the design of the EMB, it is not expected that the system will perform differently for mid-sized cars than small cars or heavy pickup trucks.

Therefore, we concur with your request that the tests 3-42 through 3-45 be waived.

Because the lift arms are substantial structures, they would generally require shielding in an actual field installation to prevent errant motorists from striking one and further losing control of their vehicles. The same consideration would apply when other vehicles are used to anchor the ends of the EMB.

In your letter you requested the approval of the EMB for the following conditions:

- Earth anchor or vehicle anchor, and
- The net width within the range of 14 ft to 40 ft.



The FHWA concurs with your first request on the grounds that the EMB performed as expected with both anchorage systems. We also agree with your second request because the test results associated with test USR 17 and USR 18 are consistent with each other. The videos of both tests also show a consistent behavior of the system.

According to the results obtained from crash testing, no hazard shall be present within 160 ft behind the nets for the net width of 14 ft and 40 ft respectively. No information is available for the stopping distance of vehicles for nets with the net width between 40 ft and 14 ft and a conservative approach has to be adopted.

Therefore, the device described in the various requests above and detailed in the enclosed drawings is acceptable for use on the NHS under the range of conditions tested, when acceptable to a highway agency.

Please note the following standard provisions that apply to FHWA letters of acceptance:

- This acceptance is limited to the crashworthiness characteristics of the devices and does not cover their structural features, nor conformity with the Manual on Uniform Traffic Control Devices.
- Any changes that may adversely influence the crashworthiness of the device will require a new acceptance letter.
- Should the FHWA discover that the qualification testing was flawed, that in-service performance reveals unacceptable safety problems, or that the device being marketed is significantly different from the version that was crash tested, we reserve the right to modify or revoke our acceptance.
- You will be expected to supply potential users with sufficient information on design and installation requirements to ensure proper performance.
- You will be expected to certify to potential users that the hardware furnished has essentially the same chemistry, mechanical properties, and geometry as that submitted for acceptance, and that it will meet the crashworthiness requirements of the FHWA and MASH.
- To prevent misunderstanding by others, this letter of acceptance is designated as number CC-118 and 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 at our office upon request.
- The Expeditionary Mobile Barrier systems are patented products and considered proprietary. If proprietary devices are specified by a highway agency for use on Federal-aid projects, except exempt, non-NHS 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.

- This acceptance letter shall not be construed as authorization or consent by the FHWA to use, manufacture, or sell any patented device for which the applicant is not the patent holder. The acceptance letter is limited to the crashworthiness characteristics of the candidate device, and the FHWA is neither prepared nor required to become involved in issues concerning patent law. Patent issues, if any, are to be resolved by the applicant.

Sincerely yours,

A handwritten signature in blue ink that reads "Michael S. Griffith". The signature is written in a cursive, flowing style.

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

Enclosures

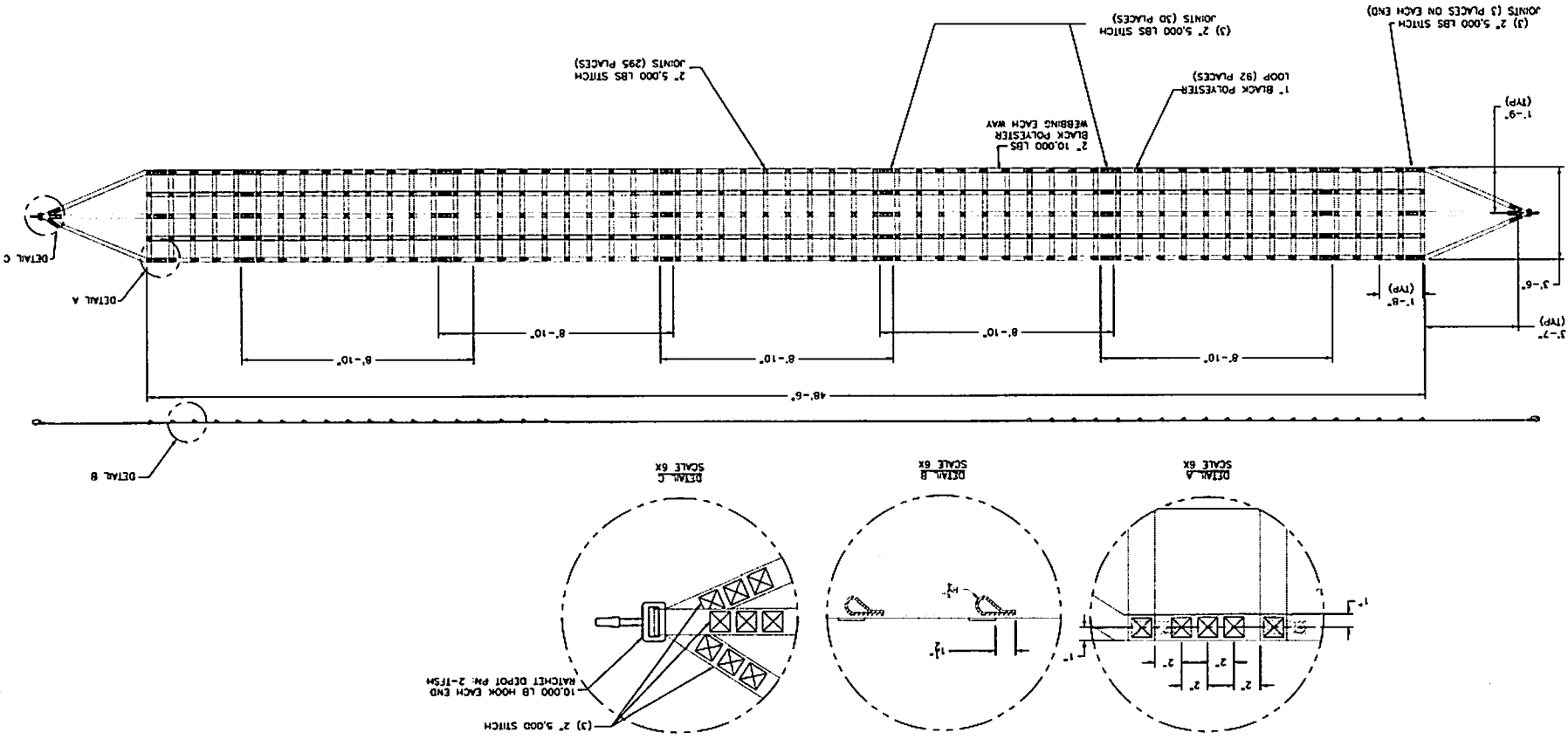
31  
SHEET 0

EXCEPTIONARY MOBILE BARRIER  
NET ASSEMBLY

**Smith & Wescott**  
Engineering & Construction

Project No. 001601  
Design No. 001601  
Scale: AS BUILT  
Drawing No. 001601

REV	DATE	DESCRIPTION



1'-9" (TYP)

(3) 2" 5,000 LBS STITCH JOINTS (30 PLACES) ON EACH END

(3) 2" 5,000 LBS STITCH JOINTS (30 PLACES)

2" 5,000 LBS STITCH JOINTS (295 PLACES)

2" 10,000 LBS BLACK POLYESTER WEBBING EACH WAY

1" BLACK POLYESTER LOOP (92 PLACES)

DETAIL A

DETAIL A

3'-7" (TYP)

1'-8" (TYP)

3'-6" (TYP)

DETAIL B

DETAIL C

DETAIL B

DETAIL A

48'-6"

8'-10"

8'-10"

8'-10"

8'-10"

8'-10"

8'-10"

8'-10"

8'-10"

8'-10"

8'-10"

8'-10"

3'-7" (TYP)

3'-6" (TYP)

(3) 2" 5,000 STITCH JOINTS (30 PLACES) ON EACH END


10,000 LB HOOK EACH END

RATCHET DEPOT PN. 2-175M

DETAIL C

DETAIL B

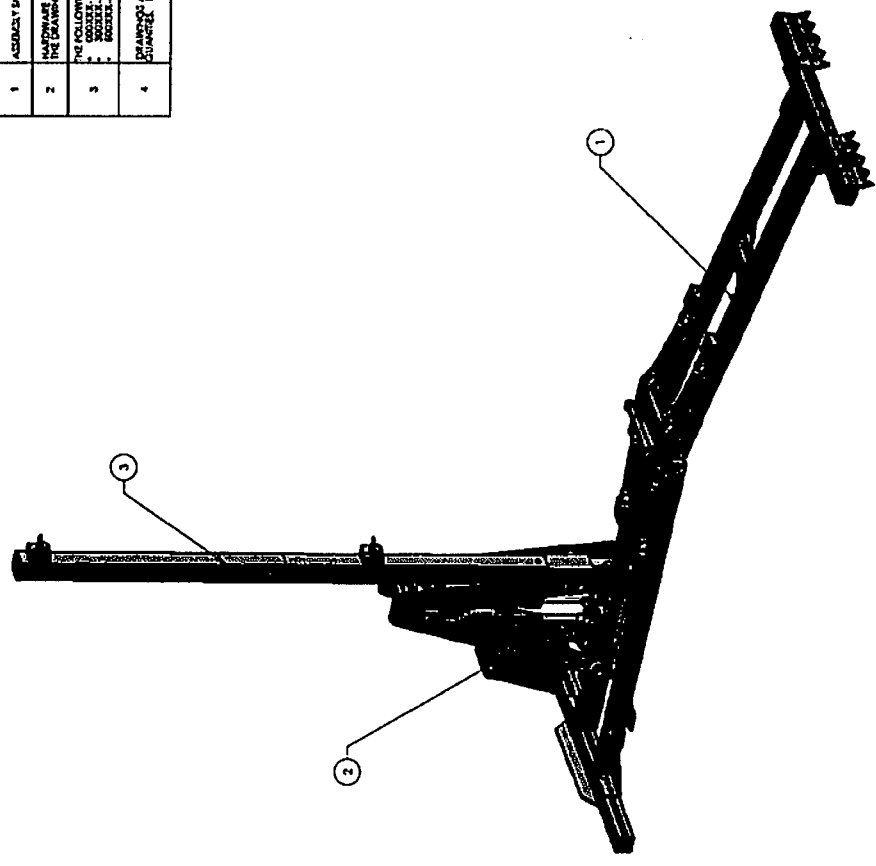
DETAIL A

 <b>Smith &amp; Wesson</b> SECURITY SOLUTIONS		EXPLOSION-PROOF MODEL MARKER MAIN ASSEMBLY
DRAWING NO. <b>D</b> REV. <b>001</b> DATE <b>01/11/01</b>	PROJECT NO. <b>000000</b> DRAWING NO. <b>000000</b> REV. <b>001</b> DATE <b>01/11/01</b>	SHEET IDENTIFICATION SHEET 1 OF 1


PART NUMBER	QTY	DESCRIPTION
000000	1	EXPLOSION-PROOF MODEL MARKER MAIN ASSEMBLY
000000	1	EXPLOSION-PROOF MODEL MARKER MAIN ASSEMBLY
000000	1	EXPLOSION-PROOF MODEL MARKER MAIN ASSEMBLY

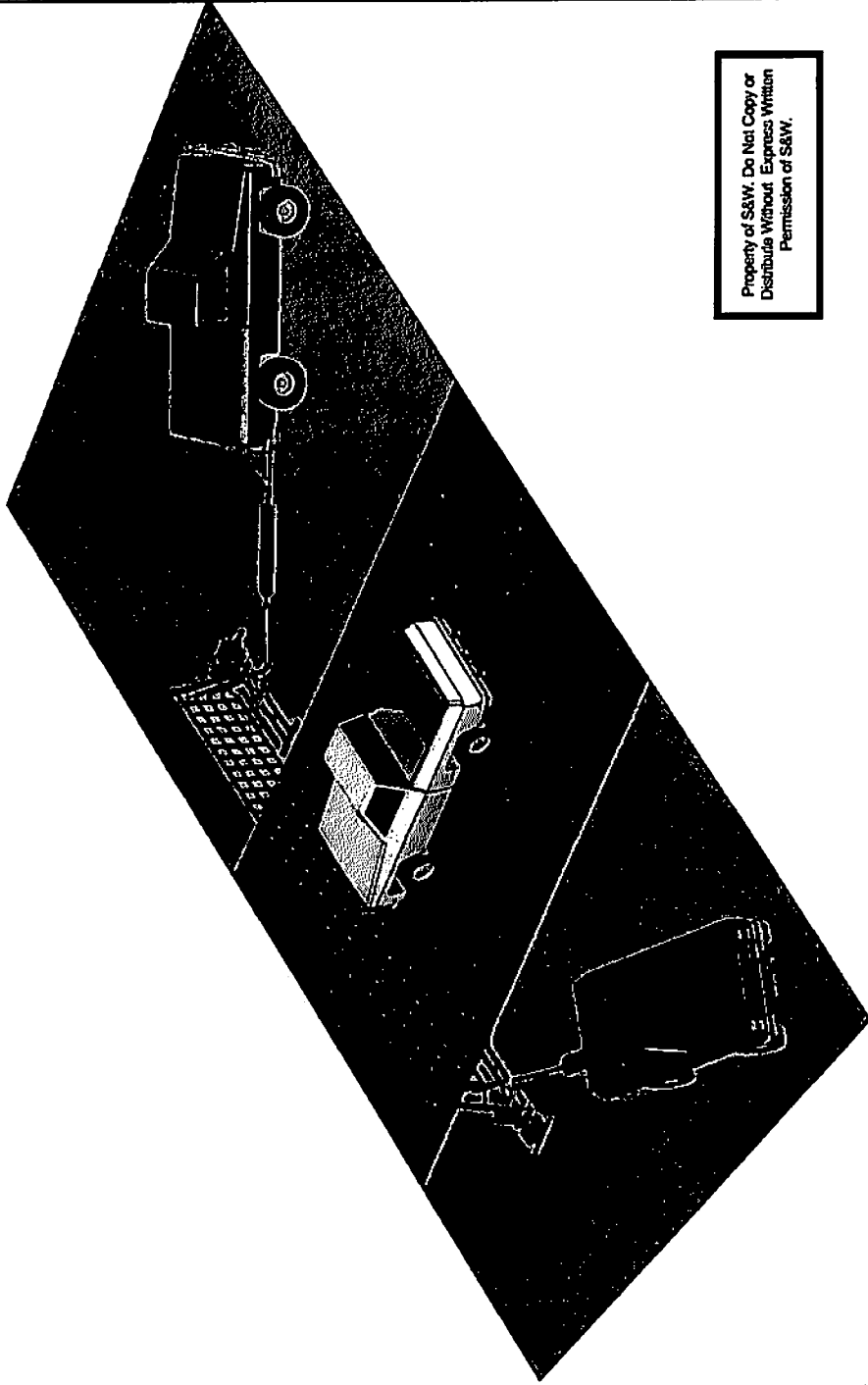
**NOTES**

- ASSEMBLY SHOWN REPRESENTS (1) EXPLOSION-PROOF MODEL MARKER MAIN ASSEMBLY.
- ALL DIMENSIONS AND ELECTRICAL COMPONENTS WILL BE PROVIDED BY OUR GREAT UNCLE'S NOTES OTHERWISE ON THE DRAWING.
- THE FOLLOWING REPRESENT THE GREAT UNCLE'S ENGINEERING DRAWING SYSTEM:
  - DIMENSIONS TO CENTER UNLESS OTHERWISE NOTED
  - DIMENSIONS TO FACE UNLESS OTHERWISE NOTED
  - DIMENSIONS TO CENTER UNLESS OTHERWISE NOTED
- ALL DIMENSIONS ARE TO CENTER UNLESS OTHERWISE NOTED. DIMENSIONS TO FACE UNLESS OTHERWISE NOTED.




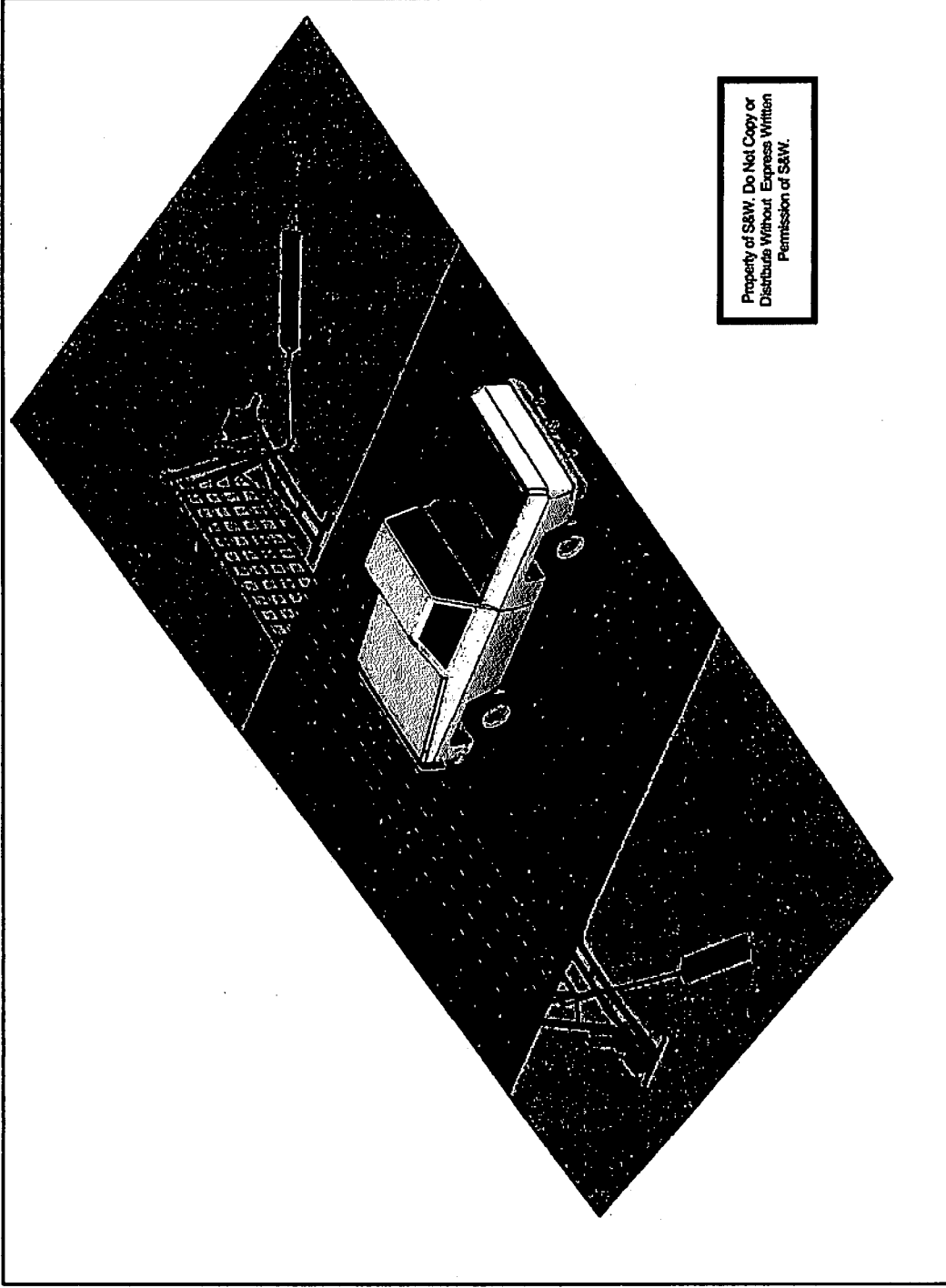
Property of S&W. Do Not Copy or Distribute Without Express Written Permission of S&W.

 <b>Smith &amp; Wesson</b> Security Solutions		ORDER NO. 8 DATE 12/1/2011 ORDER BY	ORDER NO. 1234 DATE 12/1/2011 ORDER BY
ORDER NO. 1234 DATE 12/1/2011 ORDER BY		ORDER NO. 1234 DATE 12/1/2011 ORDER BY	

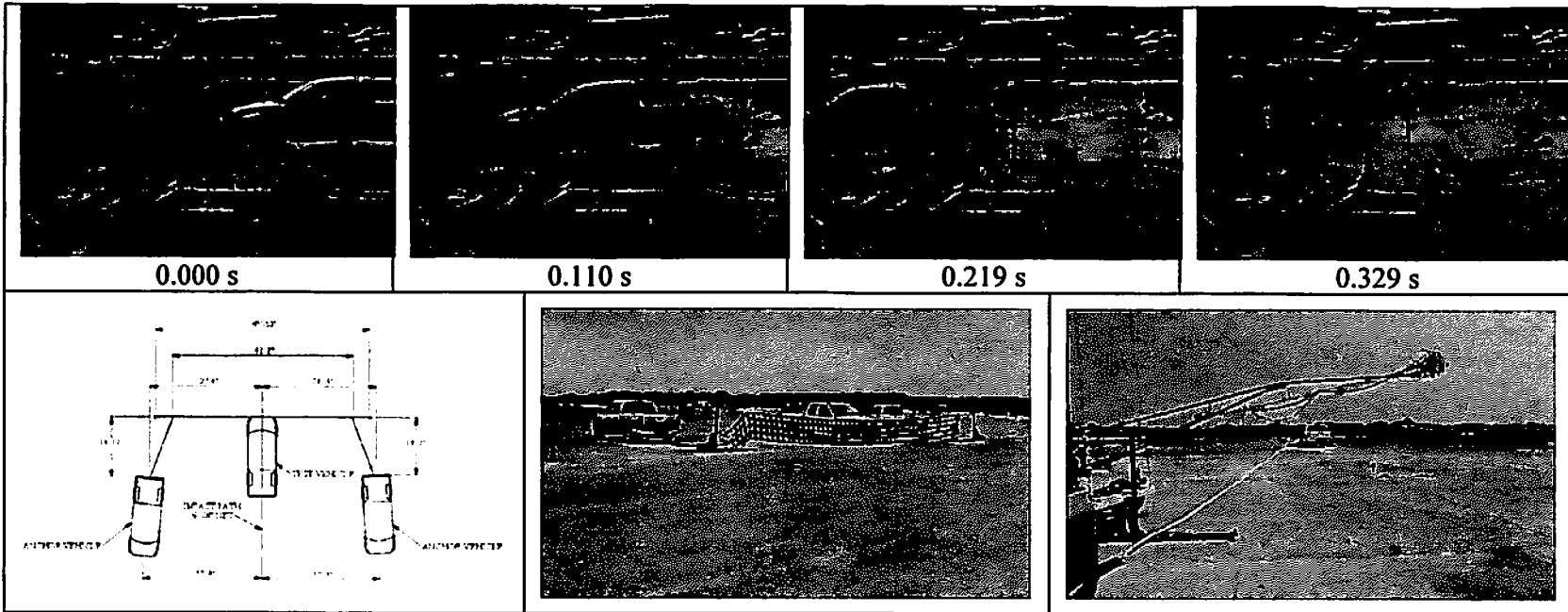


Property of S&W. Do Not Copy or  
 Distribute Without Express Written  
 Permission of S&W.

THE SERVICES 8 1981 12/21/81 6210		 <b>Smith &amp; Wesson</b> Security Products	EXTRAORDINARY MODEL SAFES 147111 147112	MODEL SAFES 147111 147112 SHEETS: 1 OF 1
---	--	--	--	--



Property of S&W. Do Not Copy or Distribute Without Express Written Permission of S&W.



19

**General Information**

Test Agency..... Texas Transportation Institute (TTI)  
 Test Standard Test No. .... MASH Test 3-41  
 TTI Test No. .... 400001-USR17  
 Date ..... 2010-08-12

**Test Article**

Type..... Crash Cushion  
 Name ..... Expeditionary Mobile Barrier  
 Installation Width ..... 52 ft  
 Material or Key Elements ..... 40 ft net, end lifting assembly, and vehicle end anchor system with textile brakes

**Soil Type and Condition**..... Vehicle anchored

**Test Vehicle**

Type/Designation..... 2270P  
 Make and Model ..... 2005 Dodge Ram 1500 Quad-Cab  
 Curb ..... 4755 lb  
 Test Inertial..... 5002 lb  
 Dummy ..... No dummy  
 Gross Static..... 5002 lb

**Impact Conditions**

Speed .....64.1 mi/h  
 Angle .....0.7 degrees  
 Location/Orientation .....Centerline

**Exit Conditions**

Speed .....Out of view  
 Angle .....Out of view

**Occupant Risk Values**

**Impact Velocity**  
 Longitudinal .....10.5 ft/s  
 Lateral ..... 0.3 ft/s  
**Ridedown Accelerations**  
 Longitudinal .....-1.2 G  
 Lateral .....-0.5 G  
 THIV .....11.7 km/h  
 PHD ..... 1.2 G  
 ASI ..... 0.10  
**Max. 0.050-s Average**  
 Longitudinal .....-1.2 G  
 Lateral .....-0.2 G  
 Vertical .....-0.5 G

**Post-Impact Trajectory**

Stopping Distance ..... 127 ft dnstrm  
 2 ft left of cntrln

**Vehicle Stability**

Maximum Yaw Angle.....3 degrees  
 Maximum Pitch Angle.....5 degrees  
 Maximum Roll Angle.....4 degrees  
 Vehicle Snagging.....N/A  
 Vehicle Pocketing.....N/A

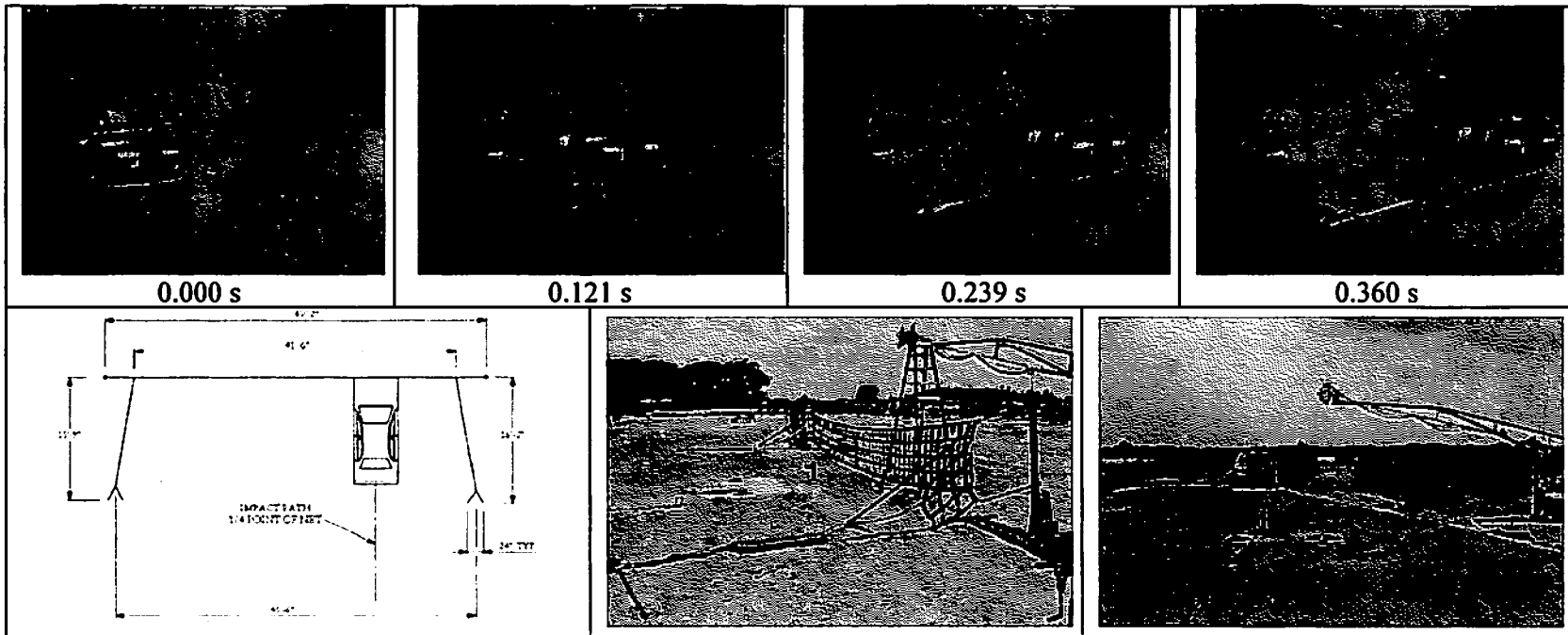
**Test Article Deflections**

Dynamic..... 152.3  
 Permanent..... 127 ft  
 Working Width ..... 152.3 ft

**Vehicle Damage**

VDS ..... 12FD1  
 CDC ..... 12FDEW1  
 Max. Exterior Deformation..... 0  
 OCDI..... FS0000000  
 Max. Occupant Compartment Deformation..... 0

Figure 5.7. Summary of results for MASH test 3-41 on Expeditionary Mobile Barrier (40 ft net).



18

**General Information**

Test Agency..... Texas Transportation Institute (TTI)  
 Test Standard Test No. .... MASH Test 3-40  
 TTI Test No. .... 400001-USR16  
 Date ..... 2010-08-11

**Test Article**

Type..... Crash Cushion  
 Name ..... Expeditionary Mobile Barrier  
 Installation Width ..... 52 ft  
 Material or Key Elements ..... 40 ft net, end lifting assembly, and end earth anchor system with textile brakes

**Soil Type and Condition**..... Crushed Limestone, Dry

**Test Vehicle**

Type/Designation..... 1100C  
 Make and Model ..... 2004 Kia Rio  
 Curb ..... 2379 lb  
 Test Inertial..... 2431 lb  
 Dummy ..... 172 lb  
 Gross Static ..... 2603 lb

**Impact Conditions**

Speed .....60.4 mi/h  
 Angle .....0.8 degrees  
 Location/Orientation .....Qtrpt of net

**Exit Conditions**

Speed .....Out of view  
 Angle .....Out of view

**Occupant Risk Values**

**Impact Velocity**  
 Longitudinal .....14.1ft/s  
 Lateral ..... 1.0 ft/s  
**Ridedown Accelerations**  
 Longitudinal.....-1.9 G  
 Lateral .....-1.7 G  
 THIV ..... 15.6 km/h  
 PHD ..... 2.1 G  
 ASI..... 0.20  
**Max. 0.050-s Average**  
 Longitudinal.....-1.8 G  
 Lateral .....-1.5 G  
 Vertical ..... 0.8 G

**Post-Impact Trajectory**

Stopping Distance ..... 78 ft downstrm  
 10 ft left of cntrln

**Vehicle Stability**

Maximum Yaw Angle.....-45 degrees  
 Maximum Pitch Angle.....-20 degrees  
 Maximum Roll Angle.....-13 degrees  
 Vehicle Snagging.....N/A  
 Vehicle Pocketing ..... N/A

**Test Article Deflections**

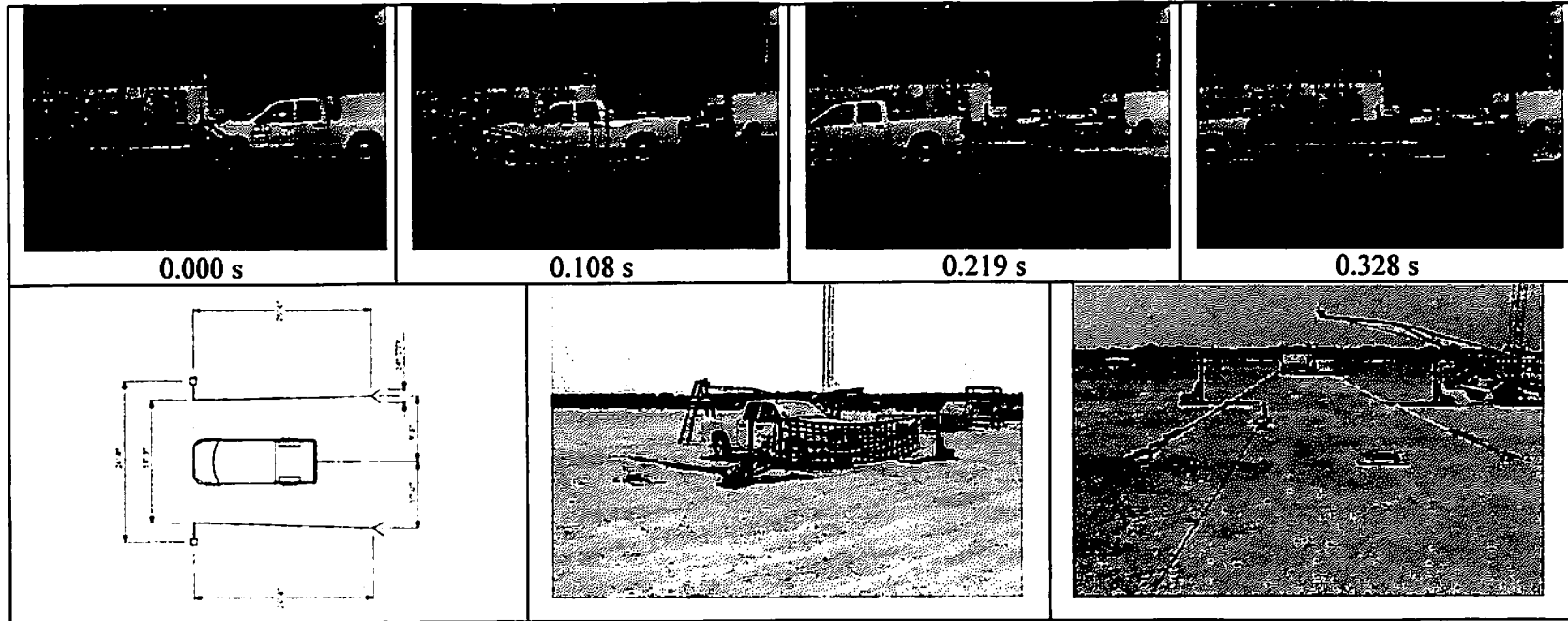
Dynamic..... 78 ft  
 Permanent..... 54 ft  
 Working Width ..... 78 ft

**Vehicle Damage**

VDS ..... 12FD1  
 CDC..... 12FDEW1  
 Max. Exterior Deformation..... 0.25 inch  
 OCDI..... FS0000000  
 Max. Occupant Compartment  
 Deformation..... 0  
 Kinetic Energy..... 9541 kip-ft (-4.6%)

Figure 5.6. Summary of results for MASH test 3-40 on Expeditionary Mobile Barrier (40 ft net).





**General Information**

Test Agency..... Texas Transportation Institute (TTI)  
 Test Standard Test No. .... MASH Test 3-41  
 TTI Test No. .... 400001-USR18  
 Date ..... 2010-08-12  
**Test Article**  
 Type..... Crash Cushion  
 Name ..... Expeditionary Mobile Barrier  
 Installation Width ..... 24 ft  
 Material or Key Elements ..... 14 ft net, end lifting assembly, and end earth anchor system with textile brakes  
**Soil Type and Condition**..... Crushed Limestone, Dry  
**Test Vehicle**  
 Type/Designation..... 2270P  
 Make and Model ..... 2005 Dodge Ram 1500 Quad-Cab  
 Curb ..... 4755 lb  
 Test Inertial..... 5002 lb  
 Dummy ..... No dummy  
 Gross Static..... 5002 lb

**Impact Conditions**

Speed .....64.3 mi/h  
 Angle .....0.5 degrees  
 Location/Orientation .....Centerline

**Exit Conditions**

Speed .....Out of view  
 Angle .....Out of view

**Occupant Risk Values**

**Impact Velocity**  
 Longitudinal.....11.2 ft/s  
 Lateral ..... 0.3 ft/s  
**Ridedown Accelerations**  
 Longitudinal.....-1.2 G  
 Lateral .....-0.3 G  
 THIV .....12.2 km/h  
 PHD ..... 1.2 G  
 ASI..... 0.12  
**Max. 0.050-s Average**  
 Longitudinal.....-1.1 G  
 Lateral .....-0.2 G  
 Vertical ..... 0.8 G

**Post-Impact Trajectory**

Stopping Distance ..... 138.2 ft downstrm  
 ..... 2 ft right of cntrln

**Vehicle Stability**

Maximum Yaw Angle..... 9 degrees  
 Maximum Pitch Angle.....-30 degrees  
 Maximum Roll Angle.....-23 degrees  
 Vehicle Snagging..... N/A  
 Vehicle Pocketing..... N/A

**Test Article Deflections**

Dynamic.....138.2 ft  
 Permanent..... 74 ft  
 Working Width .....138.2 ft

**Vehicle Damage**

VDS ..... 12FD1  
 CDC ..... 12FDEW1  
 Max. Exterior Deformation.....0.5 inch  
 OCDI..... FS0000000  
 Max. Occupant Compartment  
 Deformation..... 0  
 Kinetic Energy..... 2224 kip-ft (+7.7%)