



February 26, 2007

400 Seventh St., S.W.  
Washington, DC 20590

In Reply Refer To:  
HSSD/CC-95

Mr. Felipe Almanza  
Mr. Jan Miller  
TraFFix Devices, Inc.  
220 Calle Pintoresco  
San Clemente, California 92672

Dear Messrs. Almanza and Miller:

In your July 24, 2006, letter, you requested the Federal Highway Administration's (FHWA) acceptance of a new redirective crash cushion called Compressor at the National Cooperative Highway Research Program (NCHRP) Report 350 test level 3 (TL-3). To support your request, you also sent a copy of a KARCO Engineering report dated July 20, 2006, entitled "Crash Test Report for TraFFix Devices Compressor" and digital videos of crash tests you conducted on the Compressor. You also requested the waiver of tests 3-36, 3-37 and 3-39.

### **Requirements**

Crash cushions should meet the guidelines contained in the NCHRP Report 350, "Recommended Procedures for the Safety Performance Evaluation of Highway Features". The FHWA memorandum, "ACTION: Identifying Acceptable Highway Safety Features" of July 25, 1997, provides further guidance on crash testing requirements.

### **Product description**

The TraFFix Devices Inc. Compressor is a re-directive, non-gating crash cushion with a total length of 255.25" (6.5 m). Its effective length is 196" (4.98 m). The Compressor measures 48.66" (1.24 m) wide, and is 53.5" (1.36 m) in height.

The main components include: a steel mounting base, six plastic energy absorbing modules, and twelve steel fender panels. The base deck surface is comprised of a dovetail rail and a structural underside. The smooth deck surface allows the modules to slide as they compress during an impact. The dovetail retains the modules on the dovetail track, preventing lateral or vertical movement upon impact. The modules are made of high density polyethylene (HDPE) and are manufactured by an injection molding process. Each module is comprised of two module halves. The module halves are shaped with a combination of a concave and convex curvature. Two heights of modules are used on the Compressor, Modules # 1 and 2 are 24" (0.6 m) tall and have a wall thickness of 1-1/2" (38.1 mm). Module # 3 is 48" (1.22 m) tall and

has a wall thickness of 1-1/2" (38.1 mm). Modules # 4, 5, and 6 are 48" (1.22 m) tall and have a wall thickness of 1-7/8" (47.6 mm). Modules are attached to their adjoining modules using three 5/8" (15.9 mm) -11 grade 8 bolts between the 48" (1.22 m) tall modules and two 5/8" (15.9 mm) -10 grade 8 bolts between the 24" (0.61 m) tall modules. Each module uses lower and upper clips to fasten each module half together to make one module assembly. A dovetail shape is molded into the bottom of each module half. The dovetail is centered about the spine of the convex surface of each module half. The molded dovetail mates the module to the base dovetail, allowing for modules to compress, and slide longitudinally, but retains the modules from lateral or vertical motion. In addition to the dovetail shape molded into the module halves, the modules are further restrained to the base by retaining plates located between adjoining modules. To alleviate snagging of the test vehicle on a re-direct impact, a 29" (0.74 m) tall HDPE lateral support stiffening rib is installed between modules 1 and 2 and between modules 2 and 3. The module clips on modules 3, 4, 5 and 6 incorporate an anti snag guard.

The nose piece incorporates an expanded contact surface that mates to the dovetail rail on the base. Sliding friction of the nose shoe is reduced by incorporating fiber reinforced nylon slide inserts on the contact surfaces between the nose shoe and the dovetail rail on the base. The nose shoe is attached to the front module and the nose piece by a 1-1/4" (31.8 mm) steel pin.

The side fender panels are made from high strength steel, 0.125" (3.2 mm) thick. The shape of the fender panels allows them to resist damage on impact, slide, and telescope during longitudinal compression of the attenuator. Six sets of side fender panels are used, and are attached at their leading edge to corresponding lower edge clips of each module. The rear set of side fender panels are retained at their trailing end by two 3/8" (9.5 mm) wire rope cables. The wire rope cables allow the panels to telescope, stack, and minimize flaring of the panels during impact.

A minimum of ten and a maximum of fourteen 3/4" (19 mm) studs were used to secure the base to the concrete test pad. The 3/4" (19 mm) studs used in the testing were 5" to 6" (127 mm to 152.4 mm) ACME thread length below grade with a 1" (25.4 mm) shoulder and 3/4" (19 mm) - 10 x 1-1/2" (38.1 mm) above grade to secure the base to the studs. A high strength two part catalyzed resin anchoring material is used to secure the below grade portion of the 3/4" (19 mm) studs.

Enclosure 1 shows the general layout of the Traffix Devices Inc. Compressor and selected components.

It should be noted that the described design differs from the initial designs used in test 3-33 that was successfully passed and first unsuccessful test 3-38. The described design incorporates a change to alleviate snagging of the test vehicle on a re-direct impact observed in first unsuccessful test 3-38 by using 29" (0.74 m) tall HDPE lateral support stiffening rib between modules 1 and 2 and between modules 2 and 3 and also by addition of an anti snag guard on module clips on modules 3, 4, 5 and 6.

**Testing**

Full-scale crash testing to evaluate the impact performance of the Traffix Devices Compressor included tests 3-30, 3-31, 3-32, 3-33 and 3-38. The results of these tests are summarized in Enclosure 2. All evaluation criteria as per NCHRP 350 requirements in these tests were met. Initially, test 3-38 failed due to the observed severe damage to the right A-pillar sustained by the test vehicle. The design of the Traffix Devices Compressor was changed to alleviate snagging of the test vehicle on a re-direct impact and re-testing was successful. I agree that these design changes should not affect the results of test 3-33 conducted previously and therefore, no retesting to NCHRP 350 TL-3-33 conditions was required.

You requested the waiver of tests 3-36 and 3-37 and acceptance of the Traffix Devices Compressor based only on tests 3-30, 3-31, 3-32, 3-33 and 3-38.

In test 3-38 the C.I.P was selected to maximize the potential for pocketing or snagging, and was located 39" (1 meter) back from the leading face of the triangular nose piece, between the first and second short modules. In test 3-37 the test vehicle would be impacting with its front right corner the beginning of the first side fender panel, within the first short module. Since the crash cushion design remains essentially unchanged along its sides at these two impact points, I agree that test 3-37 would be very similar to the test 3-38 which was successfully passed. But if the truck's front right corner were impacting at the break of some sort between the actual nose and the first side panel, the test would be similar to 3-33 which was also successfully passed. Based on these considerations I agree that test 3-37 can be waived. Similarly, with tests 3-38 and 3-32 (which is generally the most demanding for a small car in terms of occupant impact velocity and ridedown acceleration) successfully passed, I agree that the test 3-36 would be less severe and can be waived.

Even though this is not a pass/fail criterion, it is preferable that the vehicle's post impact trajectory not intrude into adjacent traffic lanes. In the tests impacting the nose of the Compressor, it absorbs the impact energy by compressing and then strives to restore its initial shape by pushing back the impacting vehicle, which may result in vehicle intrusion in the adjacent traffic lanes in rearward/sideward manner. E.g. in tests 3-30 the impacting car came to rest approximately 36.7 ft (11.2 m) to the left and approximately 24 ft (7.3 m) rearward of the point of impact. The observed post-impact performance should be taken into account when determining suitability of the device to the specific highway applications

In summary, I agree that the Traffix Devices Compressor, as described above, meets the appropriate evaluation criteria for a NCHRP 350 TL-3 devices. Since no transition design has yet been developed for a reverse direction hit and the NCHRP Report 350 Test 3-39 was not conducted, the Traffix Devices Compressor should not be used in locations where opposite-direction impacts are probable without further development and testing. However, the Traffix Devices Compressor may be used at all appropriate locations on the NHS when selected by the contracting authority, subject to the provisions of Title 23, Code of Federal Regulations, Section 635.411 as they pertain to proprietary products.

**Standard provisions**

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

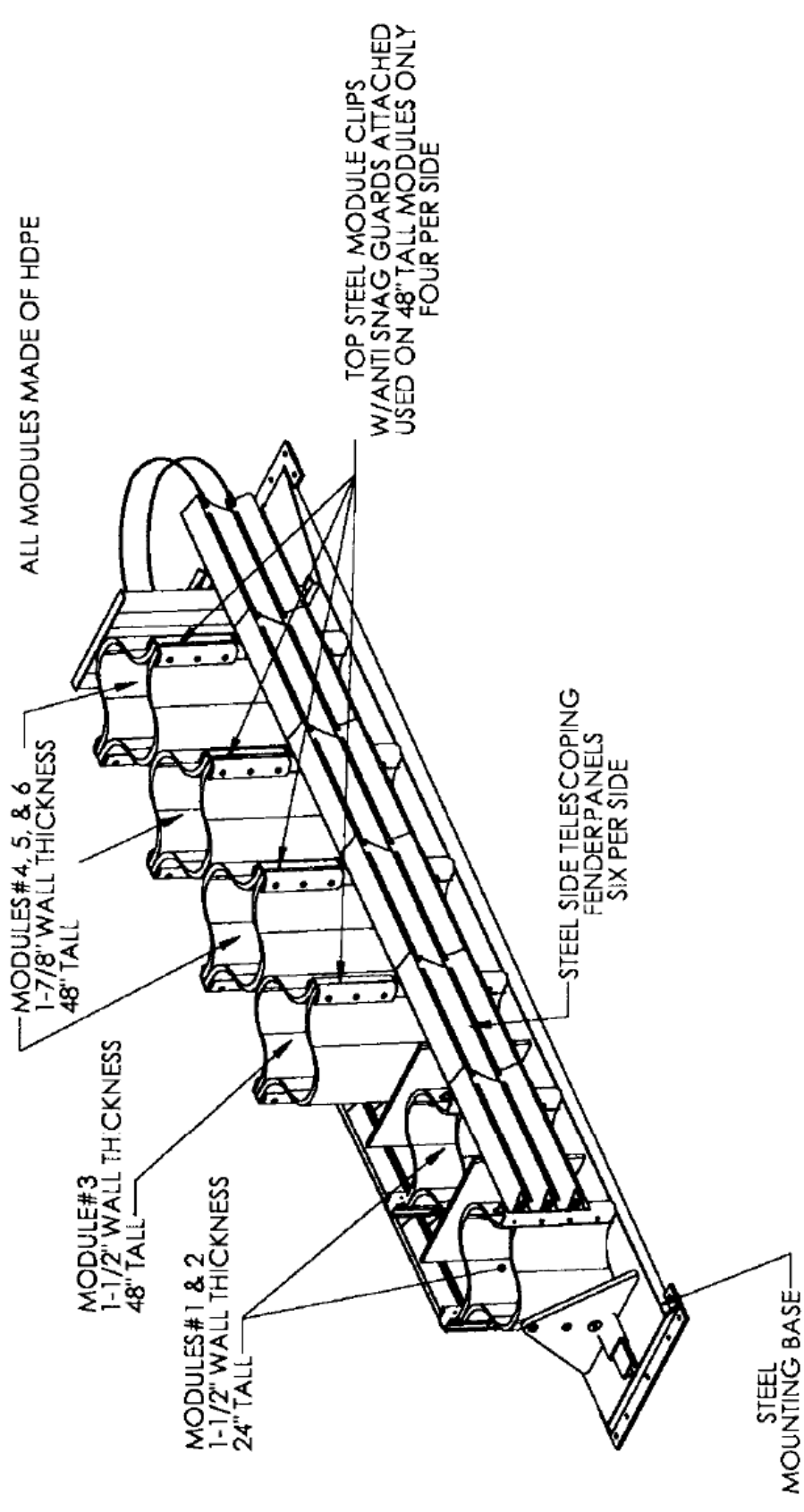
- Our acceptance is limited to the crashworthiness characteristics of the devices and does not cover their structural features, nor conformity with the MUTCD.
- Any changes that may adversely influence the crashworthiness of the device will require a new acceptance letter.
- Should the FHWA discover 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, it reserves the right to modify or revoke its 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 they will meet the crashworthiness requirements of the FHWA and the NCHRP Report 350.
- To prevent misunderstanding by others, this letter of acceptance, designated as number CC-95 shall not be reproduced except in full. As this letter and the documentation which support it become public information, it will be available for inspection at our office by interested parties.
- The Traffix Devices Compressor is a patented product and is considered "proprietary." The use of proprietary devices specified on Federal-aid projects, except exempt, non-NHS projects: (a) must be supplied through competitive bidding with equally suitable unpatented items; (b) the highway agency must certify that they are essential for synchronization with 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, a copy of which is enclosed.

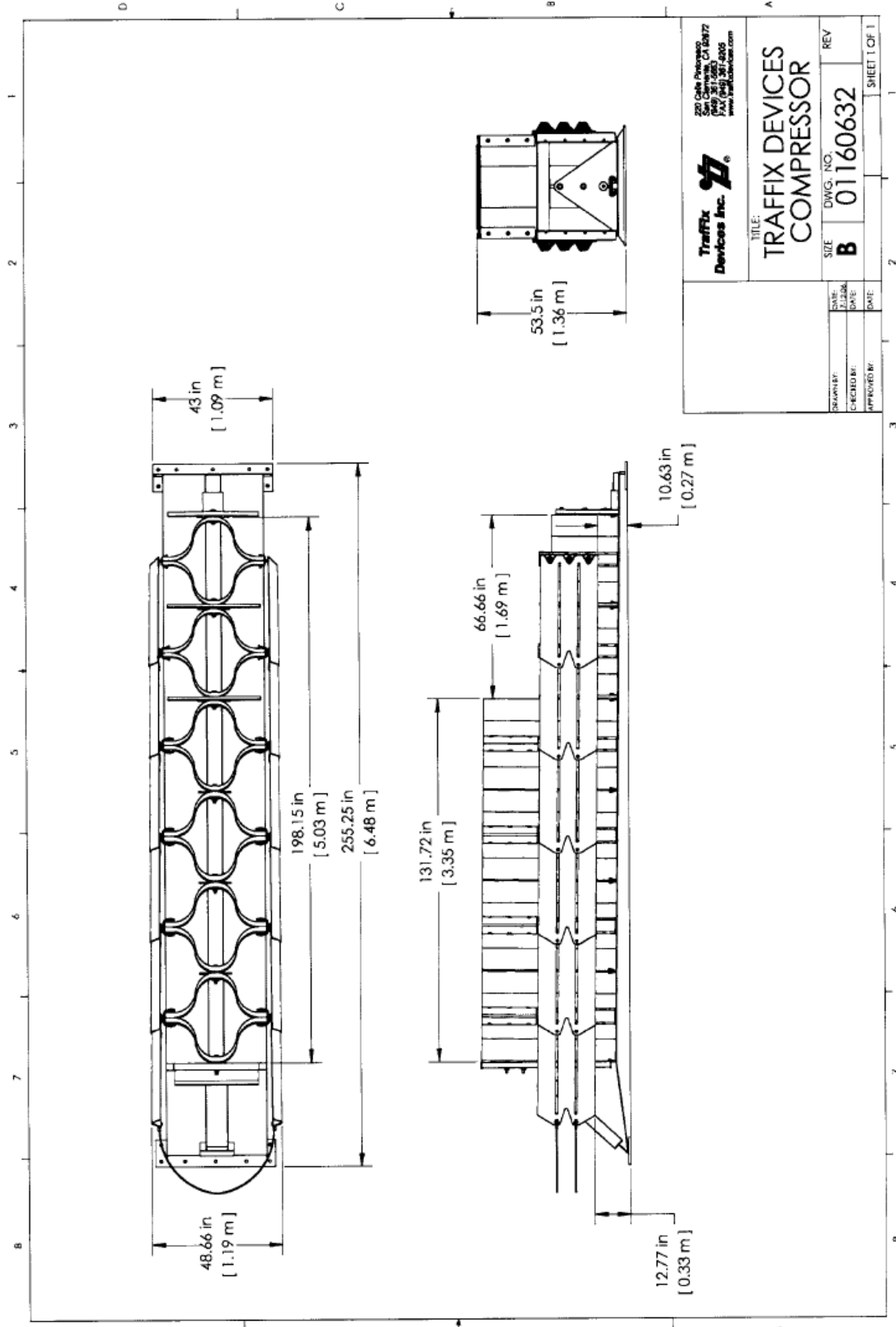
Sincerely yours,



John R. Baxter, P.E.  
Director, Office of Safety Design  
Office of Safety

Enclosures





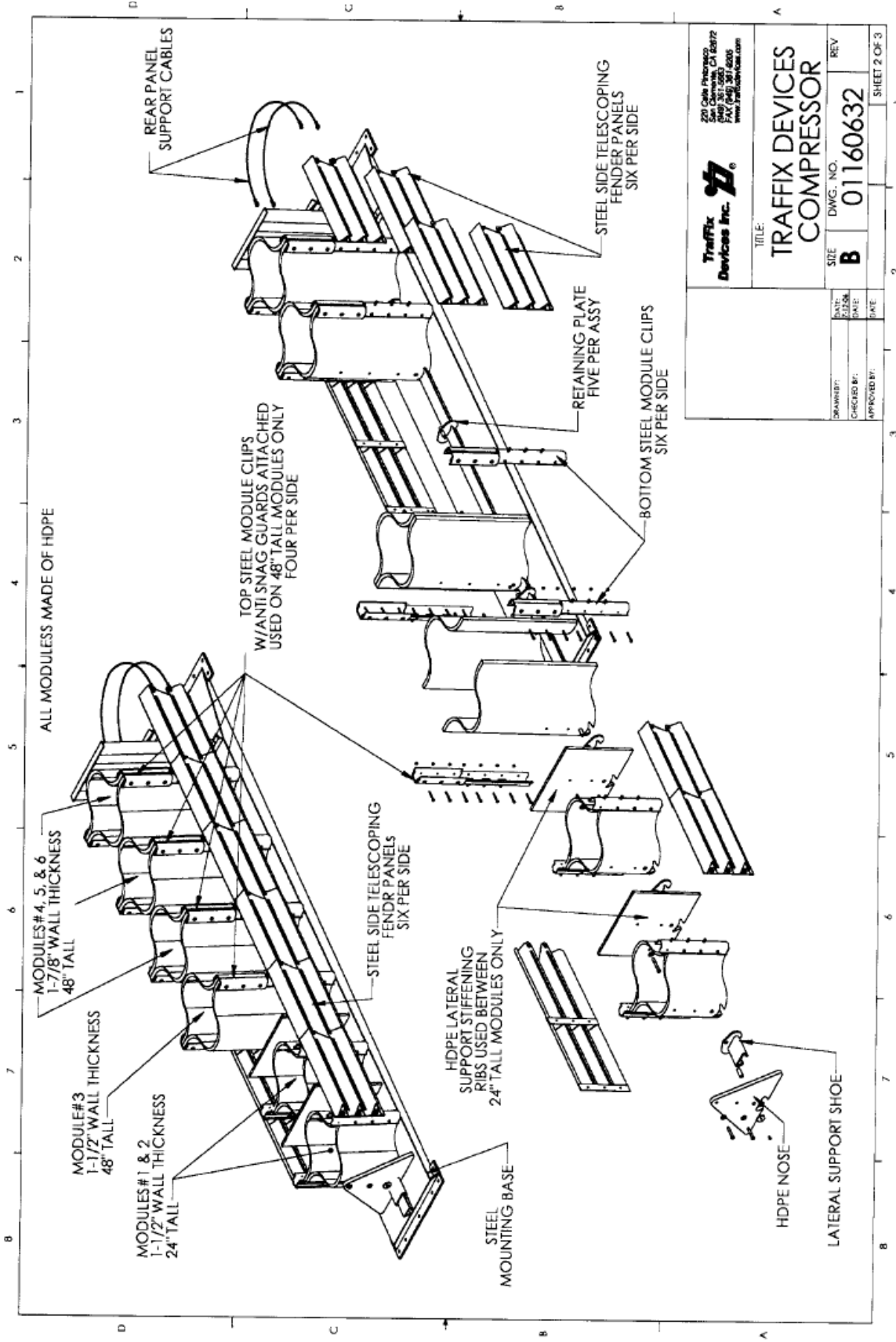
**Traffix Devices Inc.**  
 255 Oak Ridge  
 San Clemente, CA 92677  
 (949) 381-1982  
 Fax: (949) 381-1985  
 www.traffixdevices.com

**TITLE:**  
 TRAFFIX DEVICES  
 COMPRESSOR

SIZE	DWG. NO.	REV
<b>B</b>	<b>01160632</b>	

DRAWN BY:	DATE:
CHECKED BY:	DATE:
APPROVED BY:	DATE:

SHEET 1 OF 1

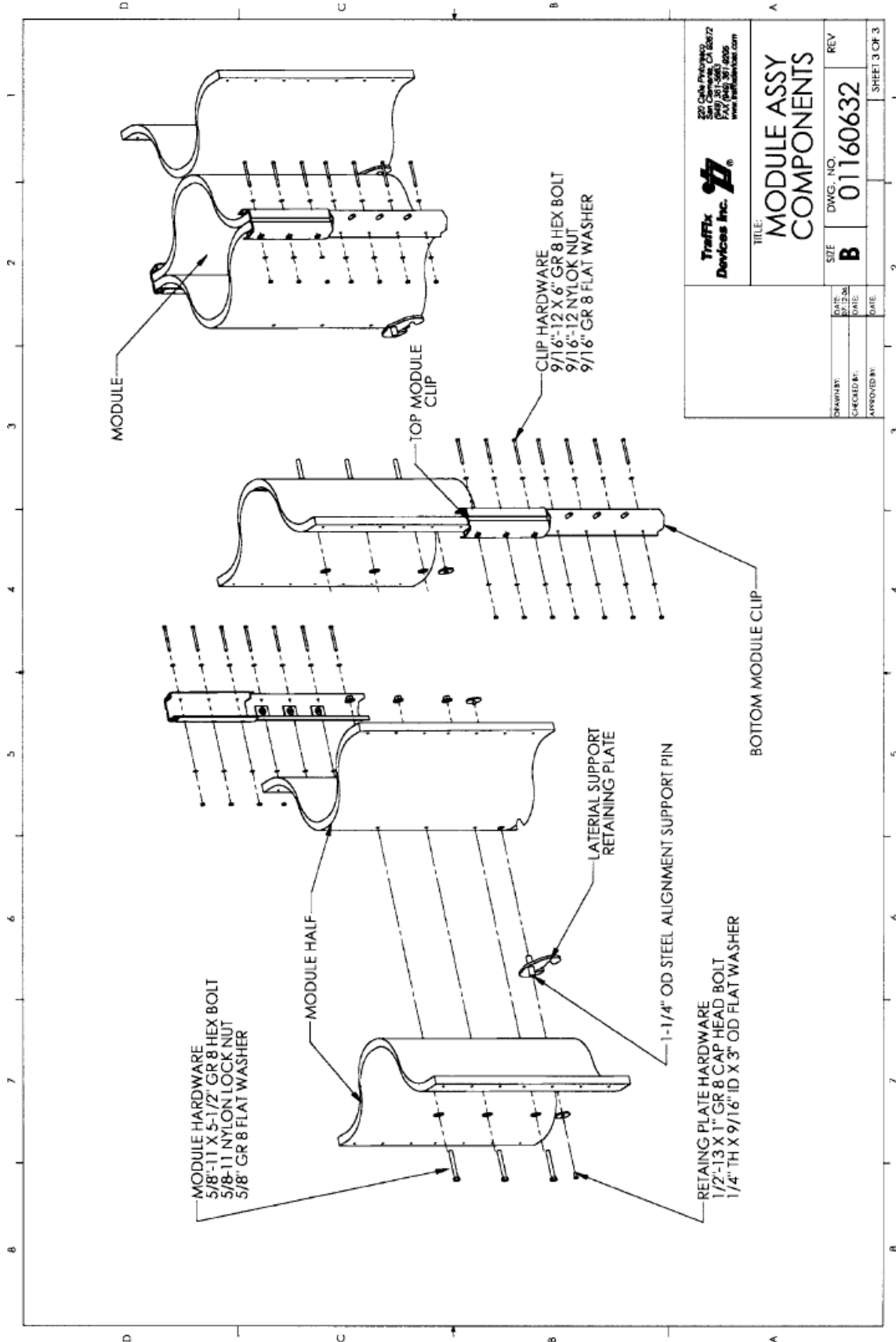


**Traffix Devices Inc.**  
 220 Calle Pinerico  
 San Clemente, CA 92672  
 (949) 351-5900  
 FAX (949) 351-6005  
 www.traffix.com

TITLE: **TRAFFIX DEVICES COMPRESSOR**

DATE: _____	REV: _____
DRAWN BY: _____	SITE DWG. NO. <b>B 01160632</b>
CHECKED BY: _____	DATE: _____
APPROVED BY: _____	DATE: _____

SHEET 2 OF 3



**Traffix Devices Inc.**  
 222 Oak Parkway  
 San Clemente, CA 92672  
 (949) 381-6200  
 www.traffixdevice.com

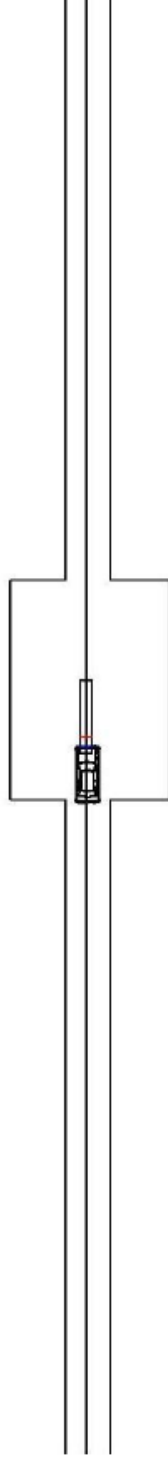
**TITLE:** MODULE ASSY COMPONENTS

DATE: _____	DATE: _____	DATE: _____
DRAWN BY: _____	CHECKED BY: _____	APPROVED BY: _____
SIZE: <b>B</b>	DMWG. NO: <b>01160632</b>	REV: _____

SHEET 3 OF 3

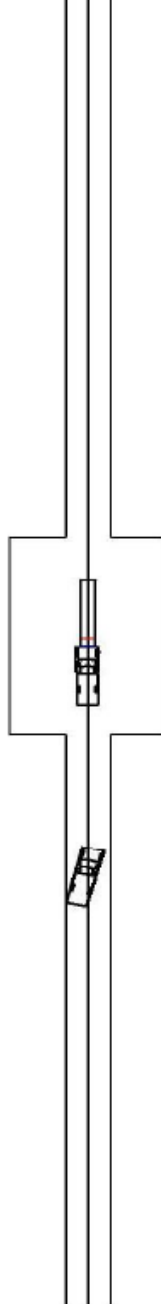


SUMMARY OF RESULTS FOR TEST NO. 3-30 (P26109-07)



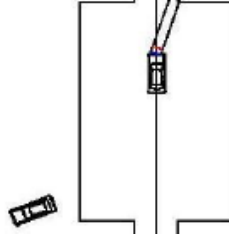
GENERAL INFORMATION		OCCUPANT RISK VALUES	
TEST AGENCY	KARCO ENGINEERING, LLC	FLAIL SPACE VELOCITY (m/sec)	10.9
TEST NO.	3-30	X-DIRECTION	0.8
DATE	05/11/06	Y-DIRECTION	
TEST ARTICLE	TRAFFIX DEVICES COMPRESSOR	THIV (optional)	
TYPE	CRASH CUSHION	RIDEDOWN ACCELERATION (g's)	12.4
INSTALLATION LENGTH	6.5 m (21.27 ft.)	X-DIRECTION	0.7
SIZE AND/OR DIMENSION OF KEY ELEMENTS		Y-DIRECTION	
SOIL TYPE AND CONDITION	CONCRETE	PHD (optional)	1.00
TEST VEHICLE	820C	ASI (optional)	
TYPE	PRODUCTION	TEST ARTICLE DEFLECTIONS	
DESIGNATION	SMALL CAR	DYNAMIC	0.8 m (2.6 ft)
MODEL	GEO METRO	PERMANENT	
MASS (CURB)	699 kg (1540 lbs)	VEHICLE DAMAGE	
MASS (TEST INERTIAL)	797 kg (1758 lbs)	EXTERIOR	
DUMMY(S) MASS	78 kg (172 lbs)	VDS	12-FR-5
GROSS STATIC WEIGHT	881 kg (1942 lbs)	CDC	12FZMW2
IMPACT CONDITIONS		INTERIOR	
SPEED (km/h)	100.18 (62.26 mph)	OCDI	FS0001000
ANGLE (Deg.)	0°		
IMPACT SEVERITY (kJ)	309	POST-IMPACT VEHICULAR BEHAVIOR	
Y = OFFSET = W/4	330 mm (13 in.)	MAXIMUM ROLL ANGLE (Deg.)	9.3
EXIT CONDITIONS		MAXIMUM PITCH ANGLE (Deg.)	-4.3
SPEED (km/h)		MAXIMUM YAW ANGLE (Deg.)	51.7
ANGLE (Deg.)			

SUMMARY OF RESULTS FOR TEST NO. 3-31 (P26109-06)



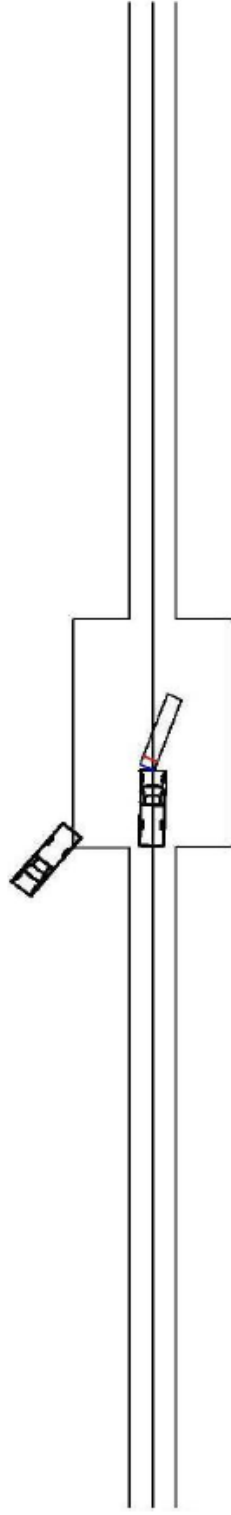
GENERAL INFORMATION		OCCUPANT RISK VALUES	
TEST AGENCY	KARCO ENGINEERING, LLC	FLAIL SPACE VELOCITY (m/sec)	
TEST NO.	3-31	X-DIRECTION	10.6
DATE	02/24/06	Y-DIRECTION	0.3
TEST ARTICLE	TRAFFIX DEVICES COMPRESSOR	THIV (optional)	
TYPE	CRASH CUSHION	RIDEDOWN ACCELERATION (g/s)	
INSTALLATION LENGTH	6.5 m (21.27 ft.)	X-DIRECTION	15.1
SIZE AND/OR DIMENSION OF KEY ELEMENTS		Y-DIRECTION	1.8
SOIL TYPE AND CONDITION	CONCRETE	PHD (optional)	
TEST VEHICLE	820C	ASI (optional)	1.1
TYPE	PRODUCTION	TEST ARTICLE DEFLECTIONS	
DESIGNATION	PICKUP TRUCK	DYNAMIC	
MODEL	CHEVROLET CHEYENNE	PERMANENT	0.7 m (2.3 ft)
MASS (CURB)	4880 lbs (2214 kg)	VEHICLE DAMAGE	
MASS (TEST INERTIAL)	4402 lbs (1997 kg)	EXTERIOR	
DUMMY(S) MASS		VDS	12-FC-4
GROSS STATIC WEIGHT	4402 lbs (1997 kg)	CDC	12FCMW1
IMPACT CONDITIONS		INTERIOR	
SPEED (km/h)	101.56 (63.12 mph)	OCDI	FS0100000
ANGLE (Deg.)	0°		
IMPACT SEVERITY (kJ)	795	POST-IMPACT VEHICULAR BEHAVIOR	
EXIT CONDITIONS		MAXIMUM ROLL ANGLE (Deg.)	2.2
SPEED (km/h)		MAXIMUM PITCH ANGLE (Deg.)	-3.6
ANGLE (Deg.)		MAXIMUM YAW ANGLE (Deg.)	-4.4

SUMMARY OF RESULTS FOR TEST NO. 3-32 (P26109-04)



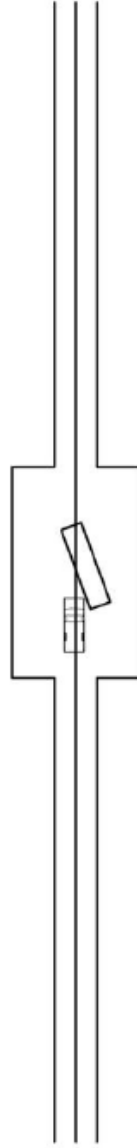
GENERAL INFORMATION		OCCUPANT RISK VALUES	
TEST AGENCY	KARCO ENGINEERING, LLC	FLAIL SPACE VELOCITY (m/sec)	
TEST NO.	3-32	X-DIRECTION	12.0
DATE	01/16/06	Y-DIRECTION	1.3
TEST ARTICLE	TRAFFIX DEVICES COMPRESSOR	THIV (optional)	
TYPE	CRASH CUSHION	RIDEDOWN ACCELERATION (g's)	
INSTALLATION LENGTH	6.5 m (21.27 ft.)	X-DIRECTION	18.0
SIZE AND/OR DIMENSION OF KEY ELEMENTS		Y-DIRECTION	3.6
SOIL TYPE AND CONDITION	CONCRETE	PHD (optional)	
TEST VEHICLE	820C	ASI (optional)	1.28
TYPE	PRODUCTION	TEST ARTICLE DEFLECTIONS	
DESIGNATION	SMALL CAR	DYNAMIC	
MODEL	GEO METRO	PERMANENT	0.5 m (1.6 ft)
MASS (CURE)	1668 lbs (843 kg)	VEHICLE DAMAGE	
MASS (TEST INERTIAL)	1804 lbs (818 kg)	EXTERIOR	
DUMMY(S) MASS	172 lbs (78 kg)	VDS	12-FD-6
GROSS STATIC WEIGHT	1952 lbs (885 kg)	CDC	12FZMW2
IMPACT CONDITIONS		INTERIOR	
SPEED (km/h)	101.05 (62.80 mph)	OCDI	FS0000000
ANGLE (Deg.)	15°		
IMPACT SEVERITY (kJ)	322.7	POST-IMPACT VEHICULAR BEHAVIOR	
EXIT CONDITION		MAXIMUM ROLL ANGLE (Deg.)	-30.8
SPEED (km/h)		MAXIMUM PITCH ANGLE (Deg.)	-13.0
ANGLE (Deg.)		MAXIMUM YAW ANGLE (Deg.)	154.9

SUMMARY OF RESULTS FOR TEST NO. 3-33 (P26109-01)



GENERAL INFORMATION		OCCUPANT RISK VALUES	
TEST AGENCY	KARCO ENGINEERING, LLC	FLAIL SPACE VELOCITY (m/sec)	
TEST NO.	3-33	X-DIRECTION	9.8
DATE	09/02/05	Y-DIRECTION	1.4
TEST ARTICLE	TRAFFIX DEVICES COMPRESSOR	THIV (optional)	
TYPE	CRASH CUSHION	RIDEDOWN ACCELERATION (g's)	
INSTALLATION LENGTH	6.5 m (21.27 ft.)	X-DIRECTION	15.2
SIZE AND/OR DIMENSION OF KEY ELEMENTS		Y-DIRECTION	2.4
SOIL TYPE AND CONDITION	CONCRETE	PHD (optional)	
TEST VEHICLE	2000P	ASI (optional)	1.08
TYPE	PRODUCTION	TEST ARTICLE DEFLECTIONS	
DESIGNATION	PICKUP TRUCK	DYNAMIC	
MODEL	CHEVROLET SILVERADO 2500	PERMANENT	3.0 ft (0.9 m)
MASS (CURB)	4458 lbs (2022 kg)	VEHICLE DAMAGE	
MASS (TEST INERTIAL)	4396 lbs (1994 kg)	EXTERIOR	
DUMMY(S) MASS		VDS	1-FD-6
GROSS STATIC WEIGHT	4396 lbs (1994 kg)	CDC	01FCHW6
IMPACT CONDITIONS		INTERIOR	
SPEED (km/h)	101.25 (62.93 mph)	OCDI	FS0000000
ANGLE (Deg.)	15°		
IMPACT SEVERITY (kJ)	789.05	POST-IMPACT VEHICULAR BEHAVIOR	
EXIT CONDITIONS		MAXIMUM ROLL ANGLE (Deg.)	-30.8
SPEED (km/h)		MAXIMUM PITCH ANGLE (Deg.)	-16.5
ANGLE (Deg.)		MAXIMUM YAW ANGLE (Deg.)	53.4

**SUMMARY OF RESULTS FOR TEST NO. 3-38 (P26109-03)**



GENERAL INFORMATION		OCCUPANT RISK VALUES	
TEST AGENCY	KARCO ENGINEERING, LLC	FLAIL SPACE VELOCITY (m/sec)	
TEST NO.	3-38	X-DIRECTION	5.3
DATE	12/02/05	Y-DIRECTION	7.0
TEST ARTICLE	TRAFFIX DEVICES COMPRESSOR	THIV (optional)	
TYPE	CRASH CUSHION	RIDEDOWN ACCELERATION (g's)	
INSTALLATION LENGTH	6.5 m (21.27 ft.)	X-DIRECTION	5.6
SIZE AND/OR DIMENSION OF KEY ELEMENTS		Y-DIRECTION	9.4
SOIL TYPE AND CONDITION	CONCRETE	PHD (optional)	
TEST VEHICLE	2000P	ASI (optional)	1.46
TYPE	PRODUCTION	TEST ARTICLE DEFLECTIONS	
DESIGNATION	PICKUP TRUCK	DYNAMIC	
MODEL	CHEVROLET CHEYENNE	PERMANENT	
MASS (CURB)	4414 lbs (2002 kg)	VEHICLE DAMAGE	
MASS (TEST INERTIAL)	4408 lbs (1999 kg)	EXTERIOR	
DUMMY(S) MASS		VDS	1-FR-6
GROSS STATIC WEIGHT	4408 lbs (1999 kg)	CDC	01RDMN3
IMPACT CONDITIONS		INTERIOR	
SPEED (km/h)	101.93 (63.35 mph)	OCDI	FSC0001000
ANGLE (Deg.)	20°		
C.I.P	1 m (39 in.)	POST-IMPACT VEHICULAR BEHAVIOR	
IMPACT SEVERITY (kJ)	93.6	MAXIMUM ROLL ANGLE (Deg.)	-14.0
EXIT CONDITIONS		MAXIMUM PITCH ANGLE (Deg.)	-3.1
SPEED (km/h)	76.58 (48.84 mph)	MAXIMUM YAW ANGLE (Deg.)	-28.5
ANGLE (Deg.)	4.9°		

**Title 23, Code of Federal Regulations,  
§ 635.411 Material or product selection.**

(a) Federal funds shall not participate, directly or indirectly, in payment for any premium or royalty on any patented or proprietary material, specification, or process specifically set forth in the plans and specifications for a project, unless:

(1) Such patented or proprietary item is purchased or obtained through competitive bidding with equally suitable unpatented items; or

(2) The State transportation department certifies either that such patented or proprietary item is essential for synchronization with existing highway facilities, or that no equally suitable alternate exists; or

(3) Such patented or proprietary item is used for research or for a distinctive type of construction on relatively short sections of road for experimental purposes.

(b) When there is available for purchase more than one nonpatented, nonproprietary material, semifinished or finished article or product that will fulfill the requirements for an item of work of a project and these available materials or products are judged to be of satisfactory quality and equally acceptable on the basis of engineering analysis and the anticipated prices for the related item(s) of work are estimated to be approximately the same, the PS&E for the project shall either contain or include by reference the specifications for each such material or product that is considered acceptable for incorporation in the work. If the State transportation department wishes to substitute some other acceptable material or product for the material or product designated by the successful bidder or bid as the lowest alternate, and such substitution results in an increase in costs, there will not be Federal-aid participation in any increase in costs.

(c) A State transportation department may require a specific material or product when there are other acceptable materials and products, when such specific choice is approved by the Division Administrator as being in the public interest. When the Division Administrator's approval is not obtained, the item will be nonparticipating unless bidding procedures are used that establish the unit price of each acceptable alternative. In this case Federal-aid participation will be based on the lowest price so established.

(d) Appendix A sets forth the FHWA requirements regarding (1) the specification of alternative types of culvert pipes, and (2) the number and types of such alternatives which must be set forth in the specifications for various types of drainage installations.

(e) Reference in specifications and on plans to single trade name materials will not be approved on Federal-aid contracts.

(f) In the case of a design-build project, the following requirements apply: Federal funds shall not participate, directly or indirectly, in payment for any premium or royalty on any patented or proprietary material, specification, or process specifically set forth in the Request for Proposals document unless the conditions of paragraph (a) of this section are applicable.

[41 FR 36204, Aug. 27, 1976, as amended at 67 FR 75926, Dec. 10, 2002]