



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

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

August 18, 2011

In Reply Refer To:  
HSST/ CC-75D

Mr. Gerrit A. Dyke, P.E.  
Vice President of Engineering and R & D  
Barrier Systems, Inc.  
3333 Vaca Valley Parkway, Suite 800  
Vacaville, CA 95688

Dear Mr. Dyke:

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

Name of system:	Universal TAU-IIR Crash Cushion Systems
Type of system:	Redirecting Crash Cushion/Impact Attenuator
Test Level:	NCHRP Report 350 Test Levels 2 and 3 (TL-2 and TL-3)
Testing conducted by:	Safe Technologies, Inc.
Date of request:	December 30, 2010
Date initially acknowledged:	January 4, 2011
Task Force 13 designator:	SCT 01c

You requested that we find this system, in its various configurations, acceptable for use on the NHS under the provisions of the National Cooperative Highway Research Program (NCHRP) Report 350.

#### **Requirements**

Roadside safety devices should meet the guidelines contained in NCHRP Report 350 if tested prior to December 31, 2010. Devices tested after that date must follow the guidelines contained in the American Association of State Highway and Transportation Officials' (AASHTO) Manual for Assessing Safety Hardware (MASH). The FHWA memorandum "ACTION: Identifying Acceptable Highway Safety Features" of July 24, 1997, provides further guidance on crash testing requirements of roadside features, including crash cushions.

#### **Decision**

The various configurations of the TAU-IIR crash cushion shown in Enclosure 1 are acceptable for use on the NHS at the impact speeds listed.

### **Description**

The TAU-IIR crash cushion uses the same framework as that used in the TAU-II crash cushion configurations that were accepted by the FHWA in letters CC-75 through CC-75C. Specifically, the structural diaphragms, Thrie-beam side panels, slider bolts, backstop assemblies, cables, and anchoring systems are the same as those originally accepted for use on the NHS. The TAU-IIR design uses different energy absorbing cartridges that can be partially self-restoring after some impacts, thereby reducing the need for immediate repairs. These cartridges are made from proprietary hyperelastic (HE) polyurethane and are identified as Type 1, 2, or 3 depending on the wall thickness of the cylindrical elements. Dimensions for each type are shown in Enclosure 2. A typical TL-3 installation is shown in Enclosure 3.

### **Crash Testing**

Since only the energy-absorbing elements were changed from the TAU-II design, it was mutually agreed that only the end-on tests were needed to verify acceptable crash performance. Tests were conducted on specific configurations to determine the occupant risk factors for narrow parallel designs, moderately flared designs and wide designs for TL-2 and TL-3 impact speeds. One test was run with an impact speed of 110 km/h (70 mph). Using finite element analysis (FEA) and the results of the full-scale tests that were run, a report prepared by Roadsafe LLC for Barrier Systems, Inc. concluded that the various configurations shown in Enclosure 1 were likely to produce acceptable compliance with Report 350 evaluation criteria for end-on impacts. The following summaries describe the tests that were conducted by Safe Technologies, Inc. on specific configurations of the TAU-IIR:

#### **Narrow (parallel) at TL-2**

NCHRP Report 350 tests 2-30 and 2-31 were conducted on a narrow unit at 70 km/h (42 mph) to assess the capacity and occupant risk factors associated with a lower speed impact by both test vehicles. For test 2-30, the unit was anchored to an AC base; in test 2-31, a concrete base was used. The TAU-IIR design for both tests consisted of a 4-bay unit with one Type 3 element nose piece, two Type 1 elements in bay 1, and two Type 2 elements in both bays 3 and 4. Enclosures 3 and 4 show the crash cushion design and the test summaries for the small car and the pickup truck, respectively.

#### **Narrow (parallel) at TL-3**

Tests 3-31 and 3-32 were conducted on a narrow, parallel-sided 8-bay design. The tested configuration consisted of a Type 3 element nose piece, three bays containing two Type 1 elements per bay, and five bays containing two Type 2 elements per bay. Enclosure 5 shows the tested crash cushion design and the summary sheets for both tests. This tested TL-3 configuration does not use any Type 3 elements in its interior bays.

#### **Narrow (parallel) at TL-3**

Test 3-30 was conducted on a narrow, parallel-sided crash cushion to determine its crashworthiness at an impact speed of 110 km/h (70 mph). The tested configuration was a 10-bay unit, consisting of a Type 3 nose piece, three bays containing two Type 1 elements per bay, four bays containing two Type 3 elements per bay, and three bays containing two Type 2 elements per bay. Enclosure 6 shows the tested design and the crash test summary sheet.

#### Flared at TL-3

Test 3-31 was conducted to verify the crashworthiness of a flared side-panel layout. The TAU-IIR configuration tested was a seven bay design consisting of a Type 3 nose piece, three bays containing two Type 1 elements per bay, one bay containing two Type 2 elements, and three bays containing four Type 2 elements per bay. Enclosure 7 shows the tested design and the crash test summary sheet.

#### Wide (flared) at TL-3

Tests 3-30 and 3-31 were conducted on a wide-flared unit. The tested design was a 7-bay unit with a Type 3 nose piece, three bays containing two Type 1 elements per bay and four bays containing four Type 2 elements per bay. Enclosure 8 shows the tested design and the crash test summary sheet.

#### Findings

Based on our review of the information you submitted, the TAU-IIR designs described above and detailed in the enclosed drawings are acceptable for use on the NHS under the range of conditions tested, when such use is acceptable to a highway agency. In addition, any of the configurations depicted in Enclosure 1 are also acceptable for use on the NHS. The five TAU-IIR configurations that were crash-tested were used to validate the FEA model from which the "family" of designs was created. In comparing the model results to the full-scale crash tests, it was seen that the model predictions were almost always conservative (i.e., they over-predicted the occupant risk factors). Consequently, the non-tested TAU-IIR configurations may be used with confidence that they will perform acceptably under the impact speeds listed.

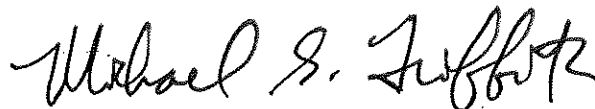
Transportation agencies specifying the 10-bay 110 km/h (70 mph) design should be advised that this unit met all NCHRP Report 350 evaluation criteria only for a head-on impact with the 2000P pickup truck at that speed. The remaining high-speed configurations were developed through analysis and should be equally acceptable for the head-on crash with the pickup truck. However, no assumption should be made that the remaining Report 350 tests for a crash cushion would meet all appropriate evaluation criteria at a 110 km/h (70 mph) impact speed. There is no federal requirement to specify crash cushions that exceed TL-3 capacity.

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

- This letter includes an AASHTO/ARTBA/AGC Task Force 13 designation that should be used when drafting new or revised Task Force 13 drawings.
- This acceptance is limited to the crashworthiness characteristics of the systems and does not cover their structural features, or conformity with the Manual on Uniform Traffic Control Devices.
- Any changes that may adversely influence the crashworthiness of the system 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 system 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 NCHRP Report 350.
- To prevent misunderstanding by others, this letter of acceptance is designated as number CC-75D 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 Universal TAU-IIR family of crash cushions 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 system for which the applicant is not the patent holder. The acceptance letter is limited to the crashworthiness characteristics of the candidate system, 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

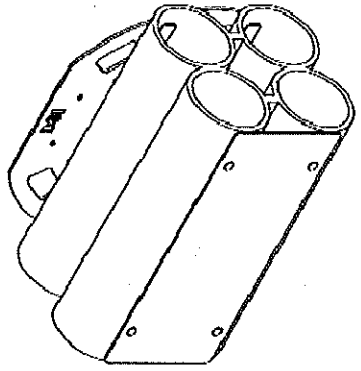
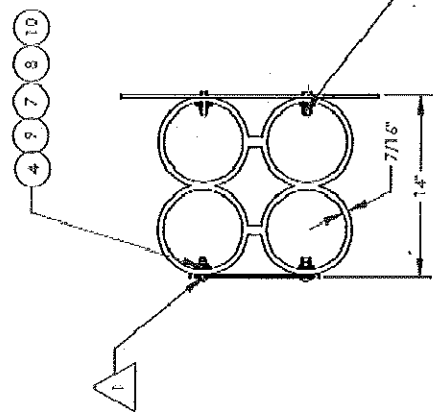
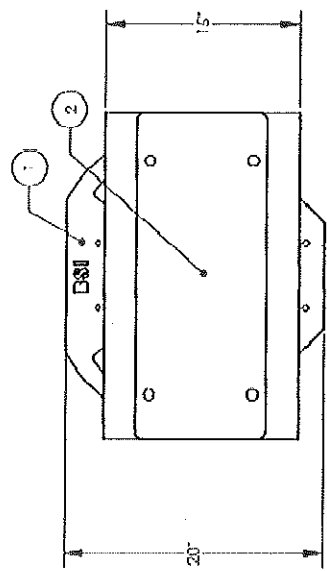
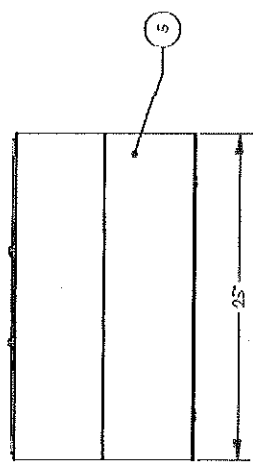
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	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
BACKSTOP WITH PARALLEL UP TO 3"	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
36" BACKSTOP	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
42" BACKSTOP	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
48" BACKSTOP	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
54" BACKSTOP	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
60" BACKSTOP	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
66" BACKSTOP			2	2	2	2	2	2	2	2	2	2	2	2	2	2
72" BACKSTOP					2	2	2	2	2	2	2	2	2	2	2	2
78" BACKSTOP					2	2	2	2	2	2	2	2	2	2	2	2
84" BACKSTOP					2	2	2	2	2	2	2	2	2	2	2	2
90" BACKSTOP					2	2	2	2	2	2	2	2	2	2	2	2
96" BACKSTOP					2	2	2	2	2	2	2	2	2	2	2	2
102" BACKSTOP					2	2	2	2	2	2	2	2	2	2	2	2

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DESIGNED BY: [Signature]	CHECKED BY: [Signature]	ISSUED FOR: [Signature]	DATE: 10/10/05
CONTRACTOR: [Signature]		PROJECT NUMBER: 1017085-10	

Enclosure 1

REV.	QTY.	DESCRIPTION	QTY.	REV.
1	1	ENERGY ABSORBING ELEMENT BACK SHEET	EACH	1500000000
2	1	ENERGY ABSORBING ELEMENT	EACH	1500000000
3	1	ENERGY ABSORBING ELEMENT FRONT SHEET	EACH	1500000000
4	3	BAY TON, INNER	EACH	1500000000
5	3	BAY TON, OUTER	EACH	1500000000
6	3	ENERGY ABSORBING ELEMENT TYP 1	EACH	1500000000
7	6	ENERGY ABSORBING ELEMENT TYP 2	EACH	1500000000
8	6	ENERGY ABSORBING ELEMENT TYP 3	EACH	1500000000
9	6	ENERGY ABSORBING ELEMENT TYP 4	EACH	1500000000
10	6	ENERGY ABSORBING ELEMENT TYP 5	EACH	1500000000
11	6	ENERGY ABSORBING ELEMENT TYP 6	EACH	1500000000
12	6	ENERGY ABSORBING ELEMENT TYP 7	EACH	1500000000
13	6	ENERGY ABSORBING ELEMENT TYP 8	EACH	1500000000
14	6	ENERGY ABSORBING ELEMENT TYP 9	EACH	1500000000
15	6	ENERGY ABSORBING ELEMENT TYP 10	EACH	1500000000

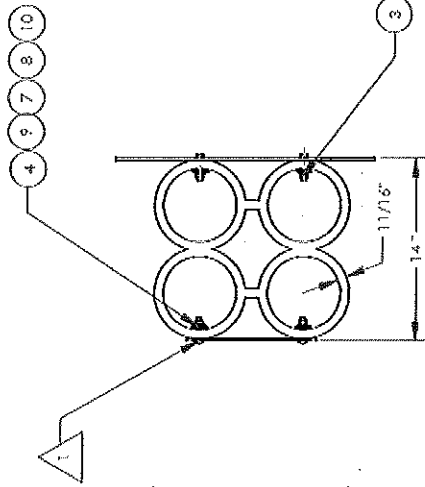
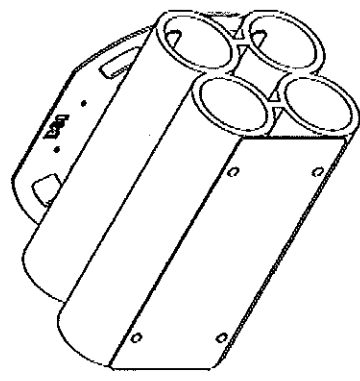
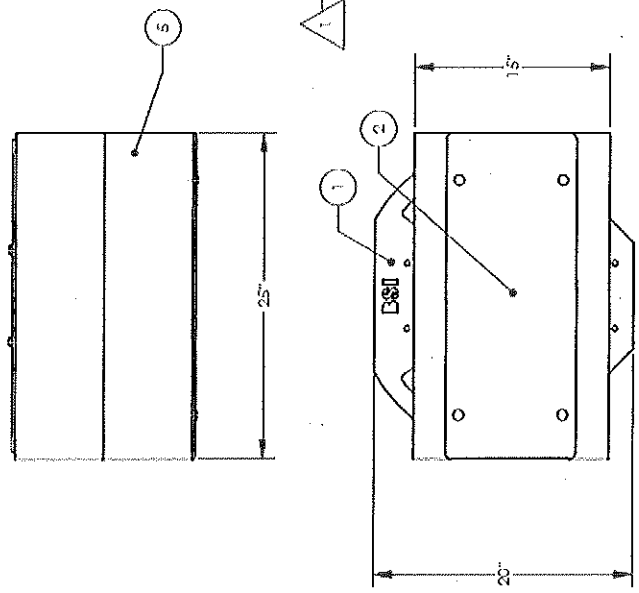
NOTES:  
 1. ALTERNATE BOLT PATTERN TOP/BOTTOM BASED ON POSITION IN BAY  
 2. ENERGY ABSORBING ELEMENT MATERIAL: CE-7623 CAST-URETHANE-FORMULATION



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<b>APPROVALS</b> DRAWN BY: J. J. DUNN DATE: 12/16/10 APPROVED: C. DYKE DATE: 12/16/10		<b>UNIVERSAL TAU-IR SYSTEM</b> <b>ENERGY ABSORBING ELEMENT ASSY. TYPE-1</b>	
DRWG NO.: B REV: 0 DATE: 12/16/10		SIZE: BSI-1012069-US REV: 0	
SHEET NO.: 13 OF 1			

NOTES:  
 1. ALTERNATE BOLT PATTERN TOP/BOTTOM BASED ON POSITION IN BAY  
 2. ENERGY ABSORBING ELEMENT MATERIAL CS-762D CAST-URETHANE-FORMULATION

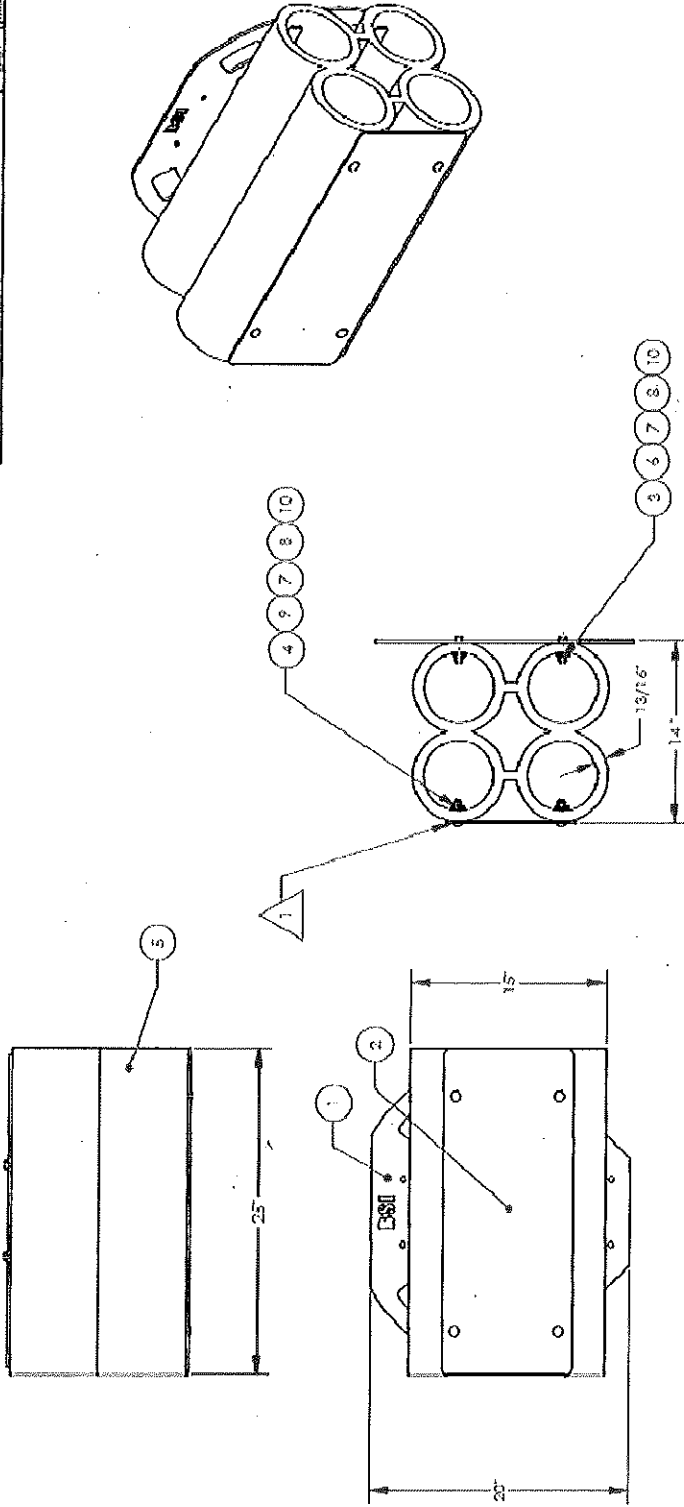
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2	1	FAULT R. EAC FACE PL.	EACH	BSI-1012070-01
3	1	BATTION INNER	EACH	BSI-1012070-02
4	1	BATTION OUTER	EACH	BSI-1012070-03
5	2	ENERGY ABSORBING ELEMENT 1/4"	EACH	BSI-1012070-04
6	4	C-56P DIA 3/8" T861 3/4" GFS PWB	EACH	25000274
7	4	C-56P DIA 3/8" T861 3/4" GFS PWB	EACH	25000274
8	2	C-56P DIA 3/8" T861 3/4" GFS PWB	EACH	25000274
9	2	C-56P DIA 3/8" T861 3/4" GFS PWB	EACH	25000274
10	6	WASH SL 2/81 PWB	EACH	25000274



3333 VEGAS BLVD, SUITE 200, LAS VEGAS, NV 89166 TEL: 702-735-1000 FAX: 702-735-1001 WWW.BSI-CORP.COM	
<b>UNIVERSAL TAU-IIR SYSTEM</b> <b>ENERGY ABSORBING ELEMENT ASSY. TYPE-2</b>	
DATE: 12/16/10 BY: S. DENNIS	DATE: 12/16/10 BY: G. DYKES PE
APPROVED: [Signature] S. DENNIS	APPROVED: [Signature] G. DYKES PE
DRAWING NO.: BSI-1012070-US	REV: 0
SCALE: 1:3	SHEET: 1 OF 1

REV	DATE	BY	CHK	DESCRIPTION
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12				
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14				
15				

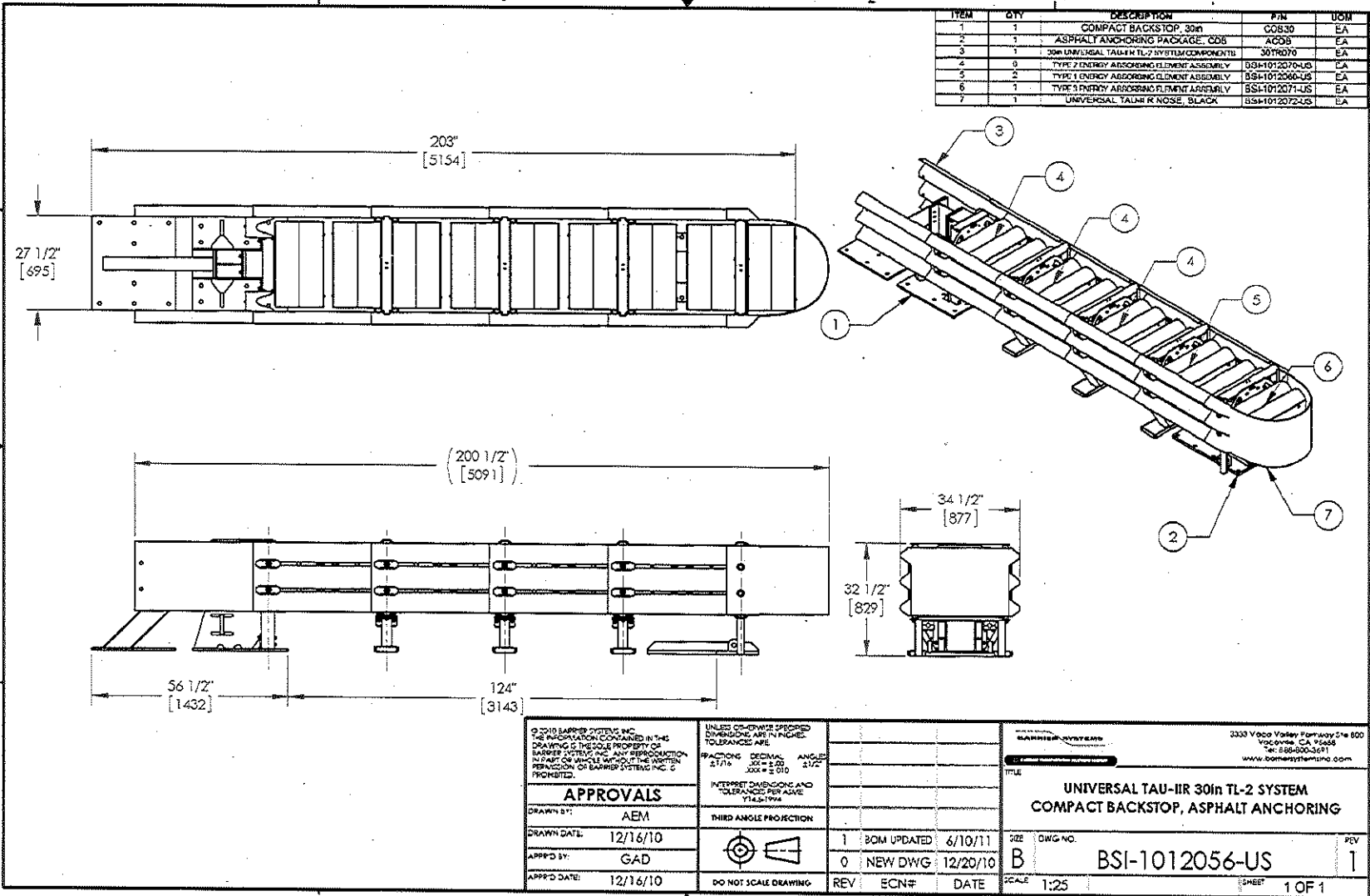
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 2. ENERGY ABSORBING ELEMENT MATERIAL: CE-7502 CAST-URETHANE-FORMULATION



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<b>UNIVERSAL TAU-HIR SYSTEM</b> <b>ENERGY ABSORBING ELEMENT ASSY. TYPE-3</b>			
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BSI-1012071-US		0	
DATE:		DATE:	
12/16/10		12/16/10	
ECN#		ECN#	
108		108	
SHEET		SHEET	
1 OF 1		1 OF 1	
UNITED STATES PATENT AND TRADEMARK OFFICE PATENT OFFICE TRADEMARK OFFICE REGISTERED DESIGN AND PATENT OFFICE REGISTERED SERVICE MARK OFFICE TRADEMARK PROTECTION			
<b>APPROVALS</b>			
DRAWN BY: S. DENNIS			
CHECKED BY: S. DENNIS			
APPROVED BY: G. DYKE PE			
APPROVED DATE: 12/16/10			

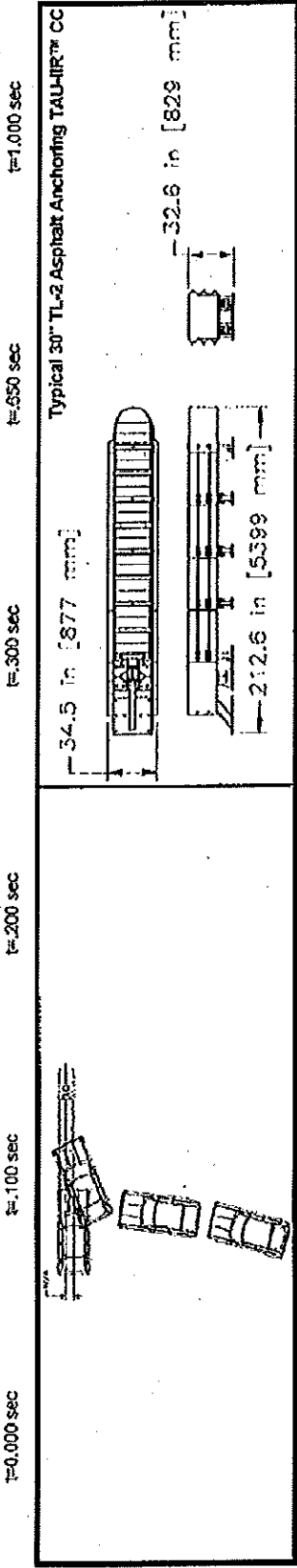
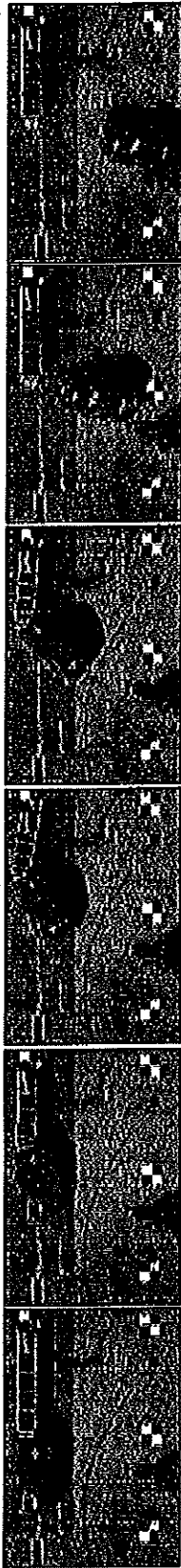


Enclosure 3 (1 of 2)



ITEM	QTY	DESCRIPTION	P/N	UOM
1	1	COMPACT BACKSTOP, 30in	CG830	EA
2	1	ASPHALT ANCHORING PACKAGE, CDB	AGD8	EA
3	1	30in UNIVERSAL TAILH TL-2 SYSTEM COMPONENT	30TRD70	EA
4	0	TYPE 2 ENERGY ABSORBING ELEMENT ASSEMBLY	BS4-1012070-US	EA
5	2	TYPE 1 ENERGY ABSORBING ELEMENT ASSEMBLY	BS4-1012060-US	EA
6	1	TYPE 3 ENERGY ABSORBING ELEMENT ASSEMBLY	BS4-1012071-US	EA
7	1	UNIVERSAL TAILH R NOSE, BLACK	BS4-1012072-US	EA

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<b>APPROVALS</b> DRAWN BY: AEM DRAWN DATE: 12/16/10 APP'D BY: GAD APP'D DATE: 12/16/10		<small>INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5-1994</small> THIRD ANGLE PROJECTION		TITLE: <b>UNIVERSAL TAU-IIR 30in TL-2 SYSTEM          COMPACT BACKSTOP, ASPHALT ANCHORING</b>	
		1 BOM UPDATED 6/10/11 0 NEW DWG 12/20/10		SIZE: B DWG NO.: BSI-1012056-US SCALE: 1:25	REV: ECN#: DATE: SHEET 1 OF 1



**General Information**

Test Agency.....SAFE TECHNOLOGIES, INC.  
 Test Designation.....NCHRP Report 350 2-30  
 Test No.....STI Test # TAR10  
 Date.....11/29/2010

Test Article  
 Type.....Crash Cushion  
 Name.....TAU-IR  
 Dimensions.....Length: 5.4 m (17.7 ft)  
 Size and/or dimension and material.....Height: 329 mm (12.9 in)  
 of key elements.....Width: 877 mm (34.5 m)

Test Vehicle  
 Type.....Production Model  
 Designation.....820C  
 Model.....1985 Honda CRX  
 Mass (kg)  
 Curb.....772  
 Test Inertial.....821  
 Dummy(s).....75  
 Gross Static.....896

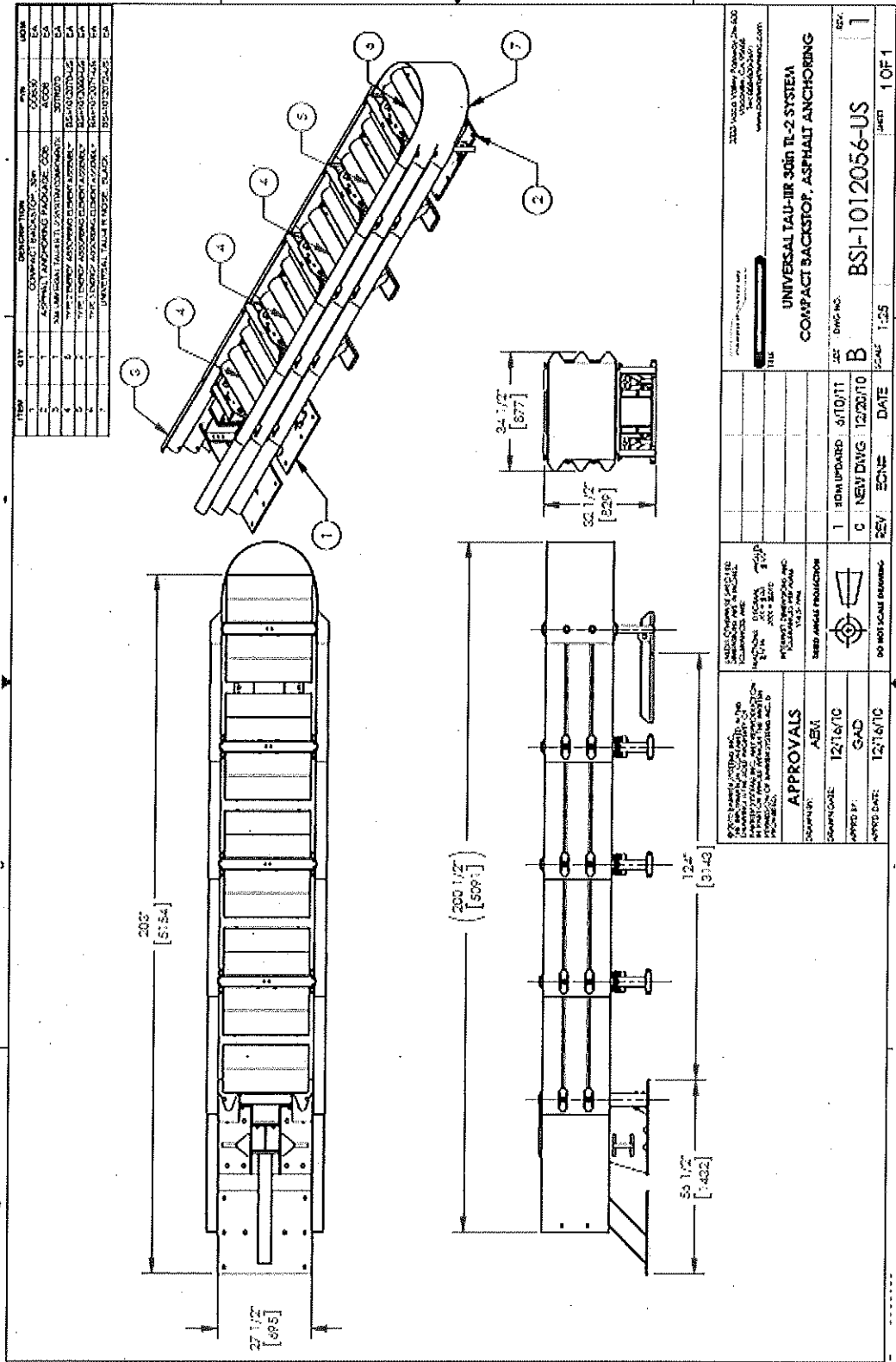
Impact Conditions  
 Speed (kph).....71  
 Angle (deg).....0  
 Impact Severity (kJ).....157.4

**Exit Conditions**

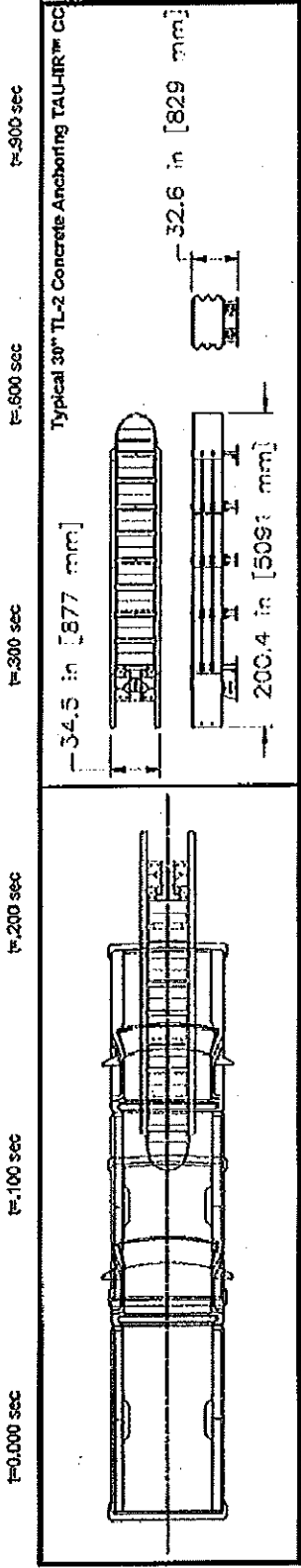
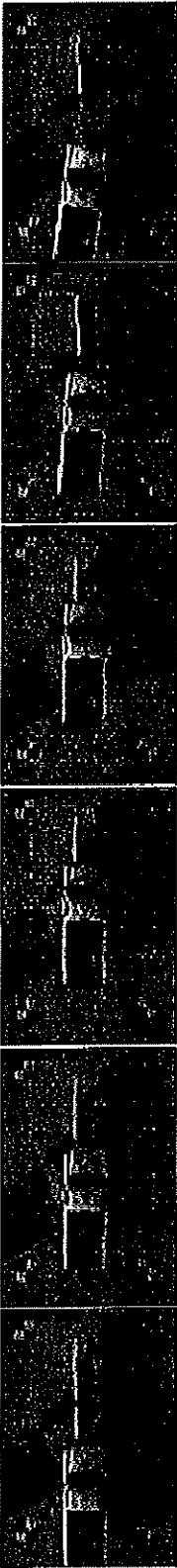
Speed (kph).....N/A  
 Angle (deg).....N/A  
 Occupant Risk Values  
 Impact Velocity (m/s)  
 x-direction.....10  
 y-direction.....1  
 Rollover Acceleration (g's)  
 x-direction.....16  
 y-direction.....7

**Test Article Deflection (mm)**

Dynamic.....N/A  
 Permanent.....N/A  
 Vehicle Damage  
 Exterior  
 VDS.....12-FL-2  
 CDC.....12FEWH  
 Interior  
 OCCD.....FS0000000  
 Post-Impact Vehicular Behavior (deg - gyro @ c.g)  
 Maximum Roll Angle.....8  
 Maximum Pitch Angle.....2  
 Maximum Yaw Angle.....80



Enclosure 4 (1 of 2)



**General Information**

Test Agency ..... SAFE TECHNOLOGIES, INC.  
 Test Designation ..... NCHRP Report 350 2-31  
 Test No. .... STI Test # TAR11  
 Date ..... 11/29/2010

Test Article  
 Type ..... Crash Cushion  
 Name ..... TAU-IR  
 Dimensions ..... Length: 5.1 m (16.7 ft)  
 Size and/or dimension and material ..... Height: 829 mm (32.6 in)  
 of key elements ..... Width: 877 mm (34.5 in)

**Test Vehicle**

Type ..... Production Model  
 Designation ..... 2000P  
 Model ..... 2004 Chevrolet 3/4 Ton Pickup  
 Mass (kg)  
 Curb ..... 2260  
 Test Inertial ..... 2013  
 Dummy(s) ..... N/A  
 Gross Static ..... 2013

**Impact Conditions**

Speed (kph) ..... 68  
 Angle (deg) ..... 0  
 Impact Severity (kcf) ..... 355.9

**Exit Conditions**

Speed (kph) ..... N/A  
 Angle (deg) ..... N/A  
 Occupant Risk Values  
 Impact Velocity (mis)  
 x-direction ..... 8  
 y-direction ..... 0  
 Ridedown Acceleration (g's)  
 x-direction ..... 20  
 y-direction ..... 3

**Test Article Deflection (mm)**

Dynamic ..... N/A  
 Permanent ..... N/A

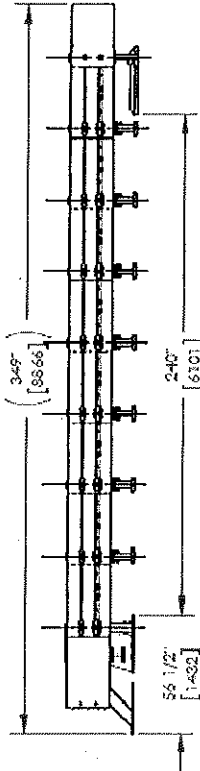
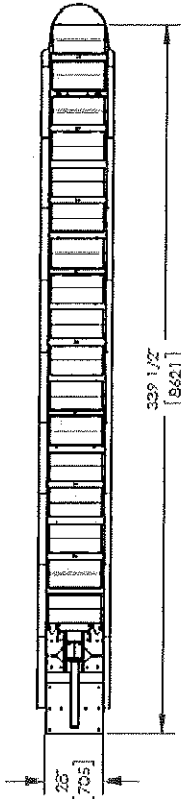
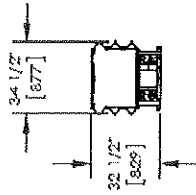
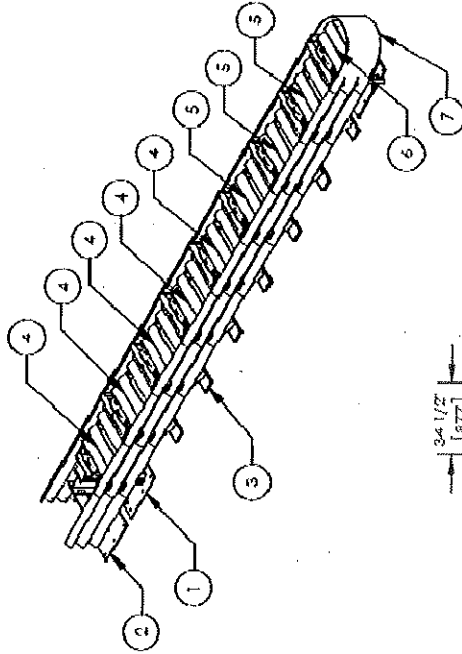
**Vehicle Damage**

Exterior  
 VDS ..... 12-FC-3  
 COC ..... 12FCEW1  
 Interior

**Post-Impact Vehicular Behavior (deg - gyro @ c-g)**

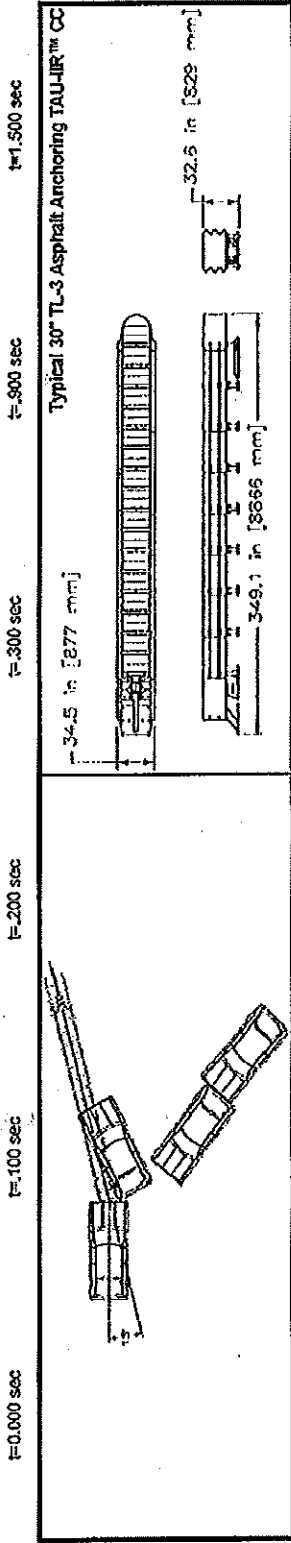
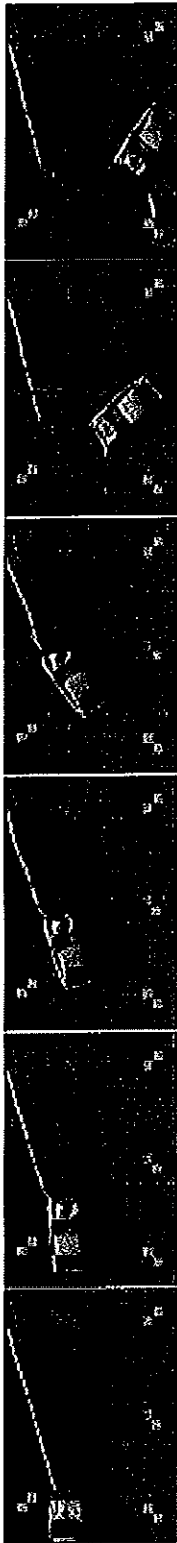
Maximum Roll Angle ..... 1  
 Maximum Pitch Angle ..... 7  
 Maximum Yaw Angle ..... 7

ITEM	QTY	DESCRIPTION	P/N	UOM
1	1	COMPACT BACKSTOP, 10R	00890	EA
2	1	ASPHALT ANCHORING PACKAGE, 10R	10100	EA
3	1	20R UNIVERSAL TAU-IR TL-3 SYSTEM COMPONENTS	10100	EA
4	10	TYPE 2 ENERGY ABSORBING ELEMENT ASSEMBLY	BSI-1012060-US	EA
5	6	TYPE 1 ENERGY ABSORBING ELEMENT ASSEMBLY	BSI-1012060-US	EA
6	1	TYPE 3 ENERGY ABSORBING ELEMENT ASSEMBLY	BSI-1012060-US	EA
7	1	UNIVERSAL TAU-IR TROUBLE SHOOTER	BSI-1012060-US	EA



UNIVERSAL TAU-IR TL-3 SYSTEM COMPACT BACKSTOP, ASPHALT ANCHORING		SHEET NO. 1 OF 1 SHEET
3200 VIGO, VIGO CENTER DRIVE, 2ND FLOOR 10000 WEST 10TH AVENUE DENVER, CO 80201 WWW.BSI-INC.COM	TITLE	REV. 0 NEW DRWG. 12/20/10 DATE
APPROVALS DRAWN BY: AEM DATE: 12/16/10 APPROVED BY: GAD DATE: 12/16/10	NOTES: ALL DIMENSIONS UNLESS OTHERWISE NOTED ARE IN INCHES. DIMENSIONS ARE TO FACE UNLESS OTHERWISE NOTED. TOLERANCES UNLESS OTHERWISE SPECIFIED: FRACTIONS ±.010 DECIMALS ±.005 ANGLES ±.010	REV. 1:50 SCALE
APPROVALS DRAWN BY: AEM DATE: 12/16/10 APPROVED BY: GAD DATE: 12/16/10	DO NOT SCALE DRAWING	

Enclosure 5 (1 of 3)



**General Information**

Test Agency.....SAFE TECHNOLOGIES, INC.  
 Test Designation.....NCHRP Report 350 3-32  
 Test No.....STI Test # TAR04  
 Date.....11/10/2010

Test Article  
 Type.....Crash Cushion  
 Name.....TAUJIR  
 Dimensions.....Length: 8.9 m (29.1 ft)  
 Size and/or dimension and material.....Height: 829 mm (32.6")  
 of key elements.....Width: 877 mm (34.5")

Test Vehicle  
 Type.....Production Model  
 Designation.....820C  
 Model.....1986 Honda CRX  
 Mass (kg)  
 Curb.....836  
 Test Inertial.....829  
 Dummy(s).....75  
 Gross Static.....904  
 Impact Conditions  
 Speed (mph).....100  
 Angle (deg).....15  
 Impact Severity (kJ).....316.6

**Exit Conditions**

Speed (mph).....N/A  
 Angle (deg).....N/A  
 Occupant Risk Values  
 Impact Velocity (m/s)  
 x-direction.....11  
 y-direction.....0  
 Ride-down Acceleration (g's)  
 x-direction.....12  
 y-direction.....3

**Test Article Deflection (mm)**

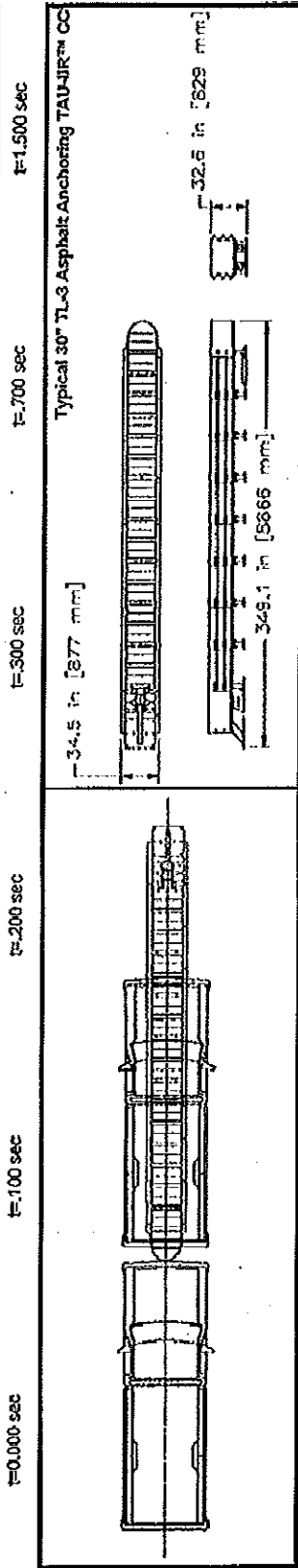
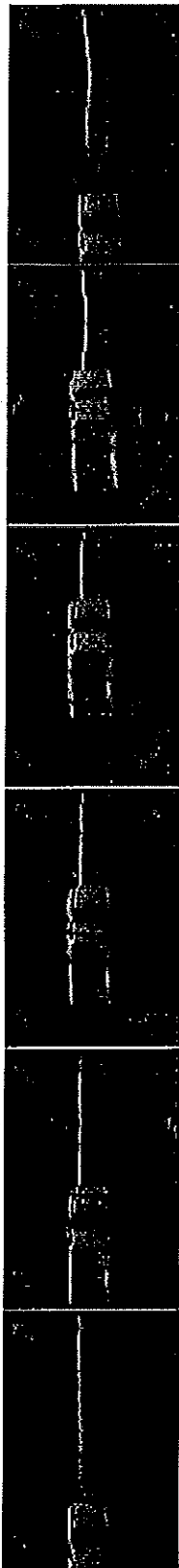
Dynamic.....N/A  
 Permanent.....N/A

**Vehicle Damage**

Exterior  
 VDS.....11-FC-3  
 CDC.....11FYEM2  
 Interior  
 OGD.....LF1010000

**Post-Impact Vehicular Behavior (deg - gyro @ c-g)**

Maximum Roll Angle.....14  
 Maximum Pitch Angle.....5  
 Maximum Yaw Angle.....137



**General Information**

Test Agency..... SAFE TECHNOLOGIES, INC.  
 Test Designation..... NCHRP Report 350 3-31  
 Test No..... STI Test # TAR03  
 Date..... 11/8/2010

Test Article..... Crash Cushion  
 Type..... TAU-JJR  
 Name..... Length: 8.9 m (29.1 ft)  
 Dimensions..... Height: 826 mm (32.5")  
 Size and/or dimension and material of key elements..... Width: 877 mm (34.5")

**Test Vehicle**

Type..... Production Model  
 Designation..... 2000P  
 Model..... 2004 Chevrolet 3/4 Ton Pickup  
 Mass (kg).....

Curb..... 2225  
 Test Inertial..... 2020  
 Dummy(s)..... N/A  
 Gross Static..... 2020

**Impact Conditions**

Speed (mph)..... 100  
 Angle (deg)..... 0  
 Impact Severity (ku)..... 776.0

**Exit Conditions**

Speed (mph)..... N/A  
 Angle (deg)..... N/A

**Occupant Risk Values**

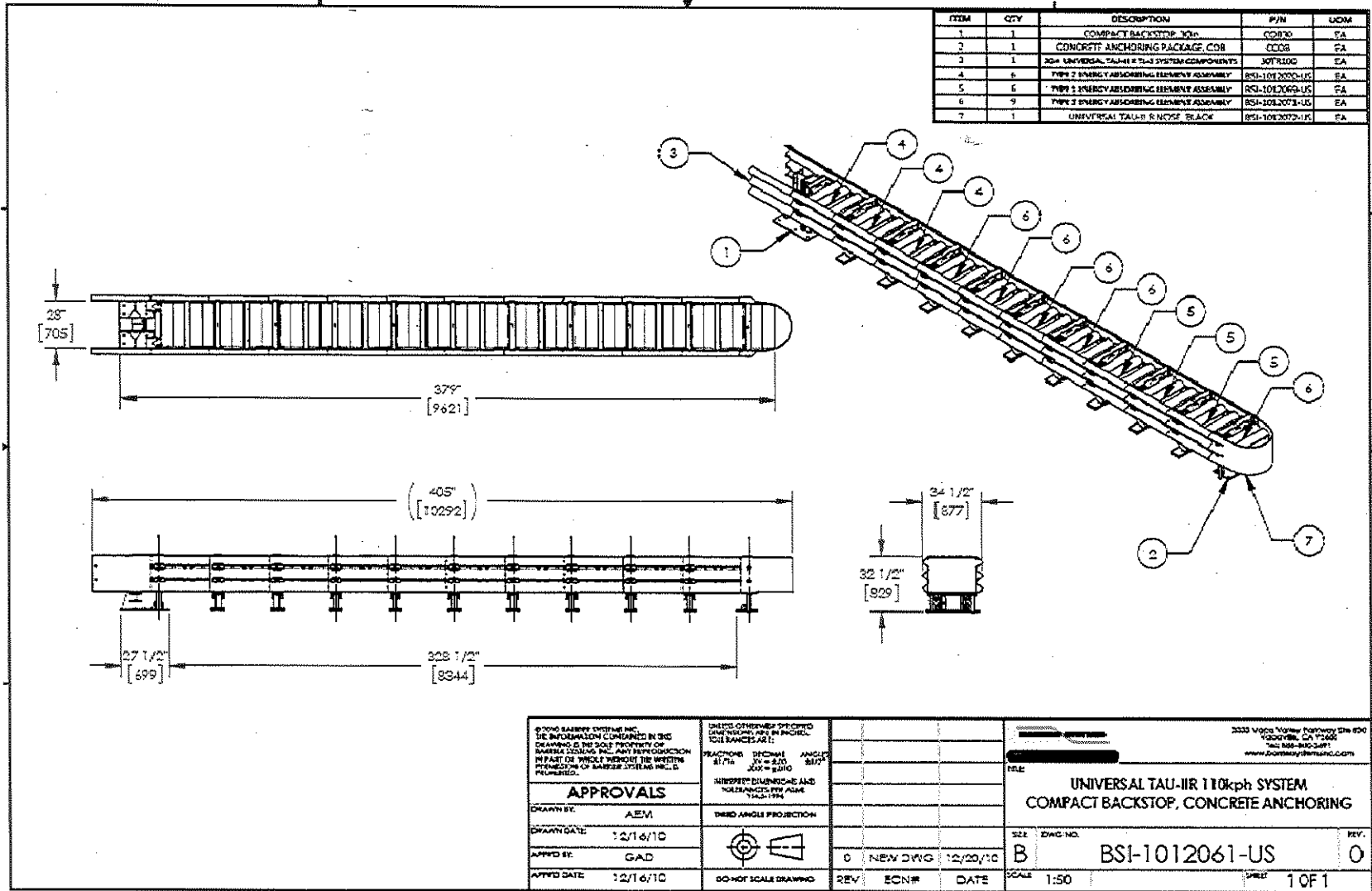
Impact Velocity (m/s)  
 x-direction..... 9  
 y-direction..... 0  
 Ridesdown Acceleration (g's)  
 x-direction..... 19  
 y-direction..... 3

**Test Article Deflection (mm)**

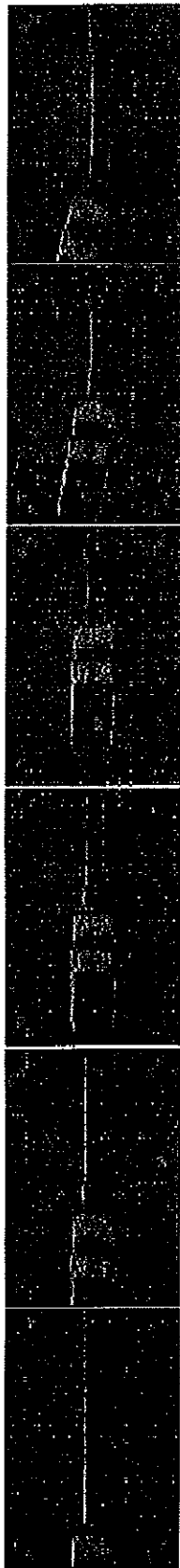
Dynamic..... N/A  
 Permanent..... N/A  
 Vehicle Damage  
 Exterior..... VDS..... 12-FC-2  
 CDC..... 12FDEW1  
 Interior.....

**Post-Impact Vehicular Behavior (deg - gyro @ c.g)**

Maximum Roll Angle..... 4  
 Maximum Pitch Angle..... 14  
 Maximum Yaw Angle..... 2







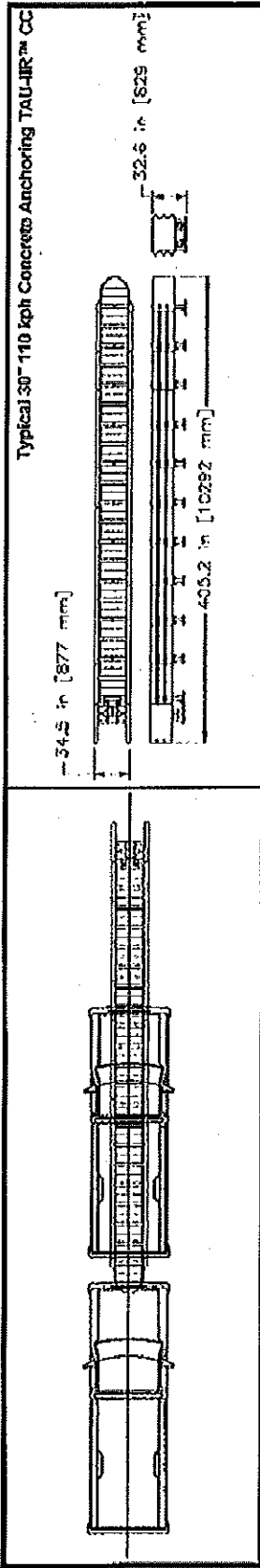
t=0.000 sec

t=1.100 sec

t=200 sec

t=300 sec

t=1.100 sec



Typical 30" 110 kph Concrete Anchoring TAU-JIR™ CC

**General Information**

Test Agency.....SAFE TECHNOLOGIES, INC.  
 Test Designation.....NCHRP Report 350 3-S1 (Modified) 10 kph  
 Test No.....STI Test # TAR12  
 Date.....12/6/2010  
 Test Article Type.....Crash Cushion  
 Name.....TAU-JIR  
 Dimensions Length: 10.3 m (33.8 ft)  
 Size and/or dimension and material Height: 829 mm (26.6 in)  
 of key elements Width: 877 mm (28.1 ft)

Test Vehicle Type.....Production Model  
 Designation.....2000P  
 Model.....2000 Chevrolet 3/4 Ton Pickup  
 Mass (kg) Curb.....2177  
 Test Inertial.....2013  
 Dummy(s).....N/A  
 Gross Static.....2013

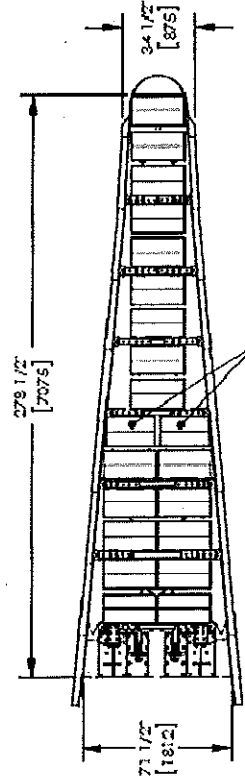
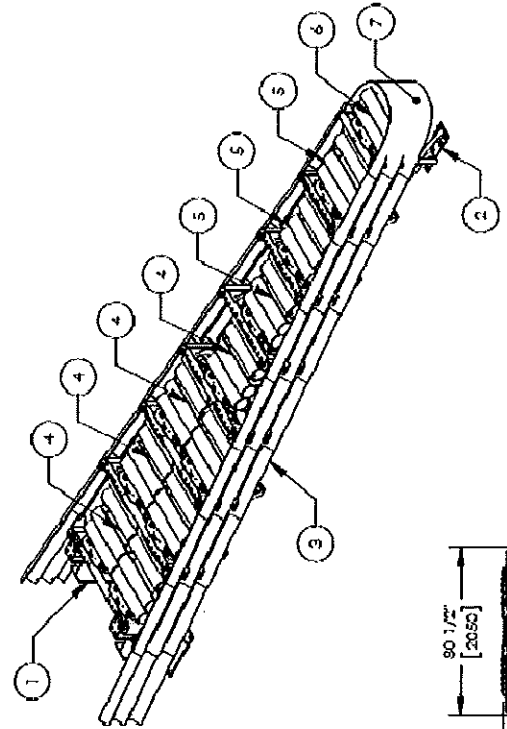
Impact Conditions Speed (kph).....109  
 Angle (deg).....0  
 Impact Severity (kJ).....914.3

**Exit Conditions**

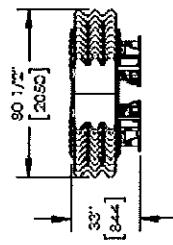
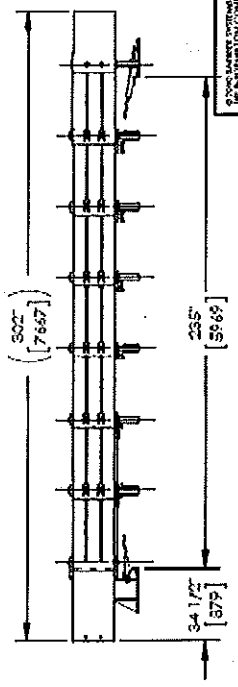
Speed (kph).....N/A  
 Angle (deg).....N/A  
 Occupant Risk Values Impact Velocity (m/s) x-direction.....10  
 y-direction.....0  
 Rollover Acceleration (g's) x-direction.....17  
 y-direction.....2

Test Article Deflection (mm) Dynamic.....N/A  
 Permanent.....N/A  
 Vehicle Damage Exterior VDS.....12-FC-2  
 CDC.....12FCEW1  
 Interior OCCDI.....FS00000000  
 Post-Impact Vehicular Behavior (deg - gyro @ c-g) Maximum Roll Angle.....11  
 Maximum Pitch Angle.....3  
 Maximum Yaw Angle.....12

ITEM	QTY	DESCRIPTION	P/N	UCOM
1	1	66in BACKSTOP ASSEMBLY, INDEPENDENT	W581L	EA
2	1	CONCRETE ANCHORING PACKAGE, WP	CANIM	EA
3	1	CONCRETE ANCHORING PACKAGE, WP	CONCRETE	EA
4	1	66in UNIVERSAL TAU-IIR 66in TL-3 SYSTEM	UNIVERSAL	EA
5	1	TYPE 1 LENSLET RESINING ELEMENT ASSEMBLY	RESINING	EA
6	1	TYPE 1 LENSLET RESINING ELEMENT ASSEMBLY	RESINING	EA
7	1	UNIVERSAL TAU-IIR 66in TL-3 SYSTEM	UNIVERSAL	EA



WIDTH REDUCED FROM 25 TO 23.5"



**APPROVALS**

DESIGNED BY: A/SW

DATE: 12/17/10

APPROVED BY: GAS

DATE: 12/17/10

**REVISIONS**

REV	DESCRIPTION	DATE
1	BOM UPDATED	6/7/11
0	NEW DWG	12/20/10

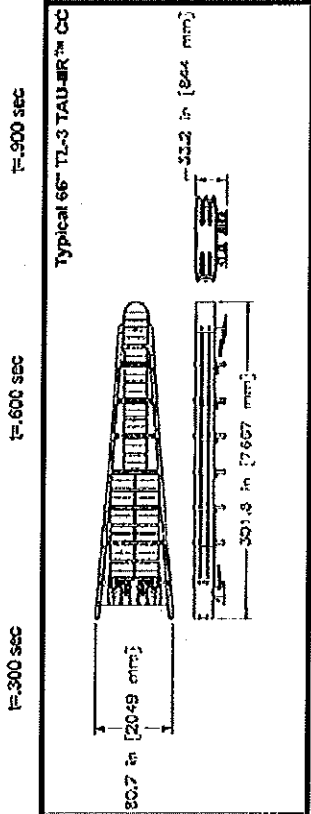
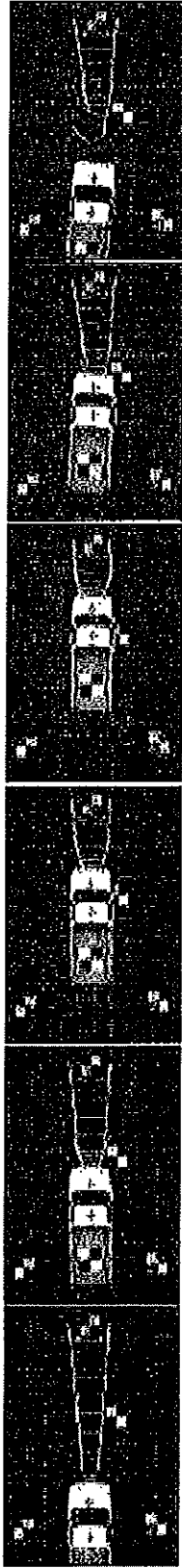
UNIVERSAL TAU-IIR 66in TL-3 SYSTEM  
WIDE FLANGE BACKSTOP, CONCRETE ANCHORING

REV: 1

DWG NO: BSI-1012058-US

SCALE: 1:50

SHEET: 1 OF 1



Typical 66" TL-3 TAU-IR™ CC

**General Information**

Test Agency.....SAFE TECHNOLOGIES, INC.  
 Test Designation.....NCHRP Report 350 3-31  
 Test No.....STI Test # TAR13  
 Date.....12/9/2010  
 Test Article  
 Type.....Crash Cushion  
 Name.....TAU-IR  
 Dimensions.....Length: 7.7 m (25.2 ft)  
 Size and/or dimension and material.....Height: 844 mm (33.2 in)  
 of key elements.....Width: 2048 mm (80.7 in)

**Test Vehicle**

Type.....Production Model  
 Designation.....2000P  
 Model.....2004 Chevrolet 3/4 Ton Pickup  
 Mass (kg)  
 Curb.....2201  
 Test Inertial.....2009  
 Dummy(s).....N/A  
 Gross Static.....2009

**Impact Conditions**

Speed (kph).....102  
 Angle (deg).....0  
 Impact Severity (kJ).....806.2

**Exit Conditions**

Speed (kph).....N/A  
 Angle (deg).....N/A  
 Occupant Risk Values  
 Impact Velocity (m/s)  
 x-direction.....9  
 y-direction.....0  
 Ridedown Acceleration (g's)  
 x-direction.....20  
 y-direction.....3

**Test Article Deflection (mm)**

Dynamic.....N/A  
 Permanent.....N/A

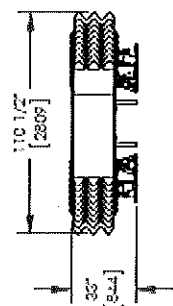
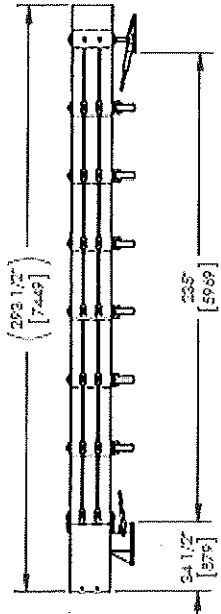
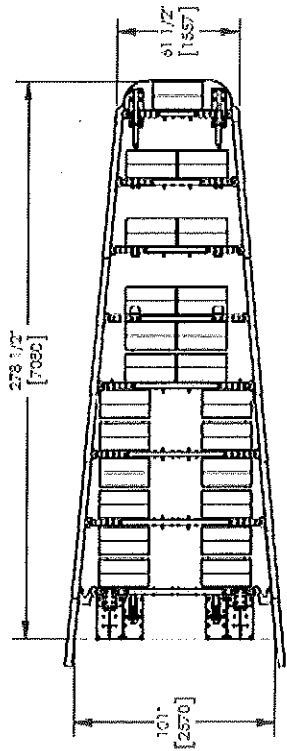
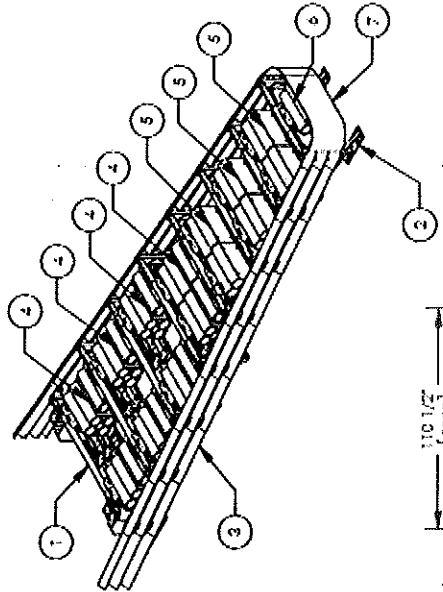
**Vehicle Damage**

Exterior  
 VDS.....12-FC-2  
 CDC.....12FCEW1  
 Interior  
 OCCI.....FS0000000

**Post-Impact Vehicular Behavior (deg - gyro @ c.g)**

Maximum Roll Angle.....2  
 Maximum Pitch Angle.....7  
 Maximum Yaw Angle.....5

ITEM	QTY	DESCRIPTION	UNIT	USDA
1	1	5/8" BACKSTOP ASSEMBLY, INDEPENDENT	ASSEMBLY	DA
2	1	WIDE FLANGE BACKSTOP, CONCRETE ANCHORING PACKAGE, 1/8"	PACKAGE	DA
3	1	INDEPENDENT ANCHOR	ANCHOR	DA
4	1	5/8" UNIVERSAL TAU-IR 7/8" IN TL-3 SYSTEM COMPONENTS	COMPONENTS	DA
5	1	TL-3 ANCHOR ASSEMBLY ELEMENT ASSEMBLY	ASSEMBLY	DA
6	1	TL-3 ANCHOR ASSEMBLY ELEMENT ASSEMBLY	ASSEMBLY	DA
7	1	UNIVERSAL TAU-IR WIDE FLANGE BACKSTOP	BACKSTOP	DA

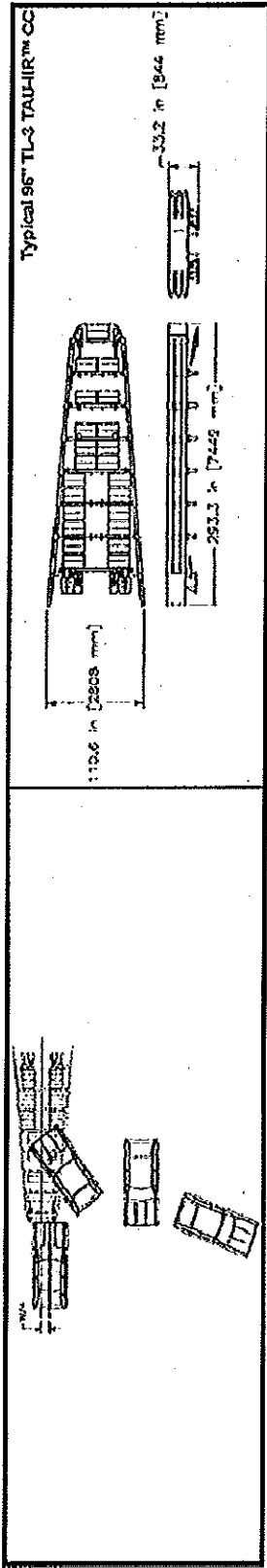
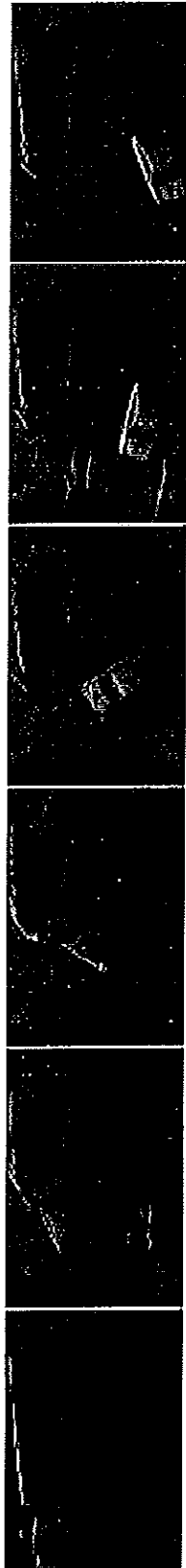


APPROVALS  
 DRAWN BY: AEM  
 CHECKED BY: GAD  
 DATE: 12/17/10  
 DATE: 12/17/10

UNIVERSAL TAU-IR 7/8" IN TL-3 SYSTEM  
 WIDE FLANGE BACKSTOP, CONCRETE ANCHORING  
 BSI-1012059-US

REV: B  
 DATE: 12/20/10  
 DATE: 12/20/10

SHEET 1 OF 1



**General Information**

Test Agency.....SAFE TECHNOLOGIES, INC.  
 Test Designation.....NCHRP Report 350 3-30  
 Test No.....SIT Test # TAR06  
 Date.....11/17/2010

**Test Article**

Type.....Crash Cushion  
 Name.....TAU-IR  
 Dimensions.....Length: 7.4 m (24.4 ft)  
 Size and/or dimension and material.....Height: 844 mm (33.2 in)  
 of key elements.....Width: 2808 mm (110.6 in)

**Test Vehicle**

Type.....Production Model  
 Designation.....820C  
 Model.....1986 Honda CRX  
 Mass (kg)  
 Curb.....768  
 Test Inertial.....817  
 Dummy(s).....75  
 Gross Static.....892

**Impact Conditions**

Speed (kph).....100  
 Angle (deg).....0  
 Impact Severity (kU).....315.0

**Exit Conditions**

Speed (kph).....N/A  
 Angle (deg).....N/A

**Occupant Risk Values**

Impact Velocity (m/s)  
 x-direction.....12  
 y-direction.....1  
 Ride-down Acceleration (g's)  
 x-direction.....17  
 y-direction.....7

**Test Article Deflection (mm)**

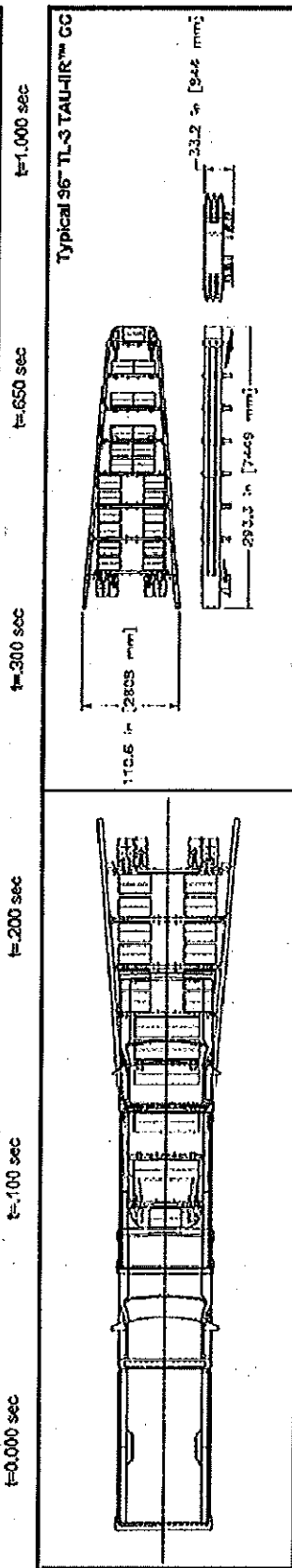
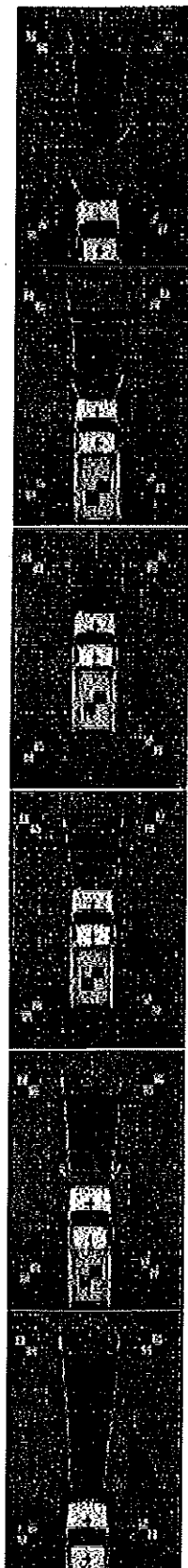
Dynamic.....N/A  
 Permanent.....N/A

**Vehicle Damage**

Exterior  
 VDS.....12-FL-5  
 CDC.....12FYEW3  
 Interior  
 OCCD.....LF000030

**Post-Impact Vehicular Behavior (deg - gyro @ c-g)**

Maximum Roll Angle.....14  
 Maximum Pitch Angle.....17  
 Maximum Yaw Angle.....162



**General Information**

Test Agency ..... SAFE TECHNOLOGIES, INC.  
 Test Designation ..... NCHRP Report 358 3-31  
 Test No ..... STI Test # TAR07  
 Date ..... 11/19/2010

Test Article ..... Crash Cushion  
 Name ..... TAU-IR  
 Dimensions ..... Length: 7.4 m (24.4 ft)  
 Size and/or dimension and material ..... Height: 244 mm (9.6 in)  
 of key elements ..... Width: 2808 mm (110.6 in)

**Test Vehicle**

Type ..... Production Model  
 Designation ..... 2000P  
 Model ..... 2004 Chevrolet 3/4 Ton Pickup  
 Mass (kg) .....

Curb ..... 2213  
 Test Inertial ..... 2004  
 Dummy(s) ..... N/A  
 Gross Static ..... 2004

**Impact Conditions**

Speed (kph) ..... 99  
 Angle (deg) ..... 0  
 Impact Severity (kJ) ..... 751.7

**Exit Conditions**

Speed (kph) ..... N/A  
 Angle (deg) ..... N/A

**Occupant Risk Values**

Impact Velocity (m/s)  
 x-direction ..... 10  
 y-direction ..... 1  
 Rollover Acceleration (g's)  
 x-direction ..... 17  
 y-direction ..... 3

**Test Article Deflection (mm)**

Dynamic ..... N/A  
 Permanent ..... N/A

**Vehicle Damage**

Exterior  
 YDS ..... 12FC3  
 CDC ..... 12FCW1  
 Interior  
 OCCDI ..... FS0000000

**Post-impact Vehicular Behavior (deg - gyro @ c.g)**

Maximum Roll Angle ..... 3  
 Maximum Pitch Angle ..... 22  
 Maximum Yaw Angle ..... 2