



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

Enclosure 1

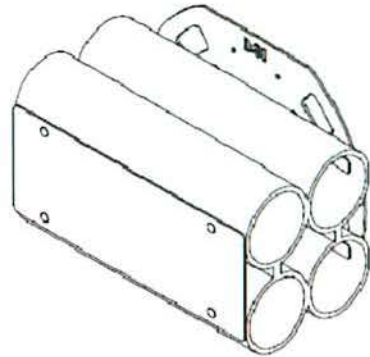
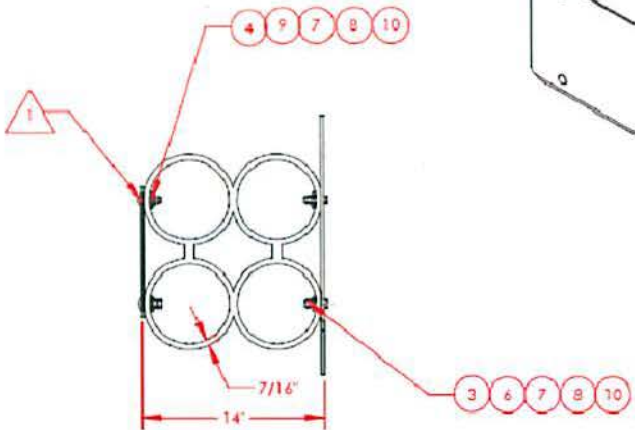
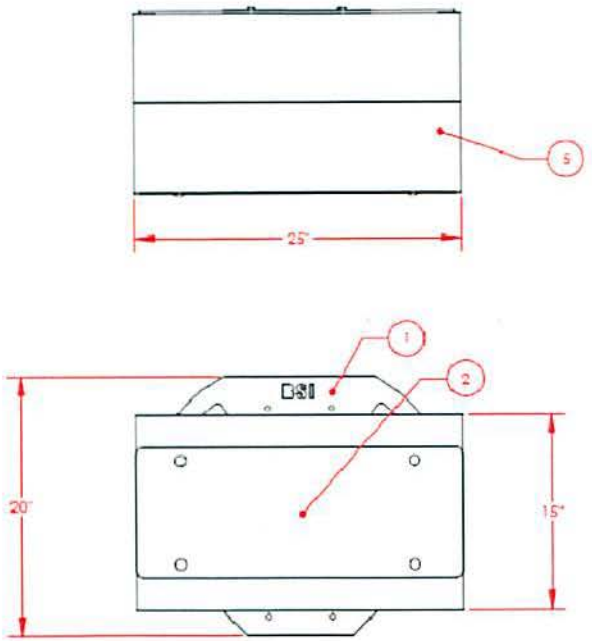
BACKSTOP WITH	SYSTEM CAPACITY							
	50 KPH	60 KPH	70 KPH	80 KPH	90 KPH	100 KPH	105 KPH	110 KPH
PARALLEL UP TO 30'								
30' BACKSTOP								
40' BACKSTOP								
45' BACKSTOP								
50' BACKSTOP								
60' BACKSTOP								
70' BACKSTOP								
75' BACKSTOP								
80' BACKSTOP								
85' BACKSTOP								
90' BACKSTOP								
100' BACKSTOP								

SCALE: 1" = 100' (SEE NOTE 1)  
 1" = 100' (SEE NOTE 1)  
 1" = 100' (SEE NOTE 1)  
 1" = 100' (SEE NOTE 1)

DATE: 10/10/2005  
 DRAWN BY: J. J. JONES  
 CHECKED BY: J. J. JONES  
 PROJECT NO.: 83-1012065-45

Enclosure 2 (1 of 3)

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



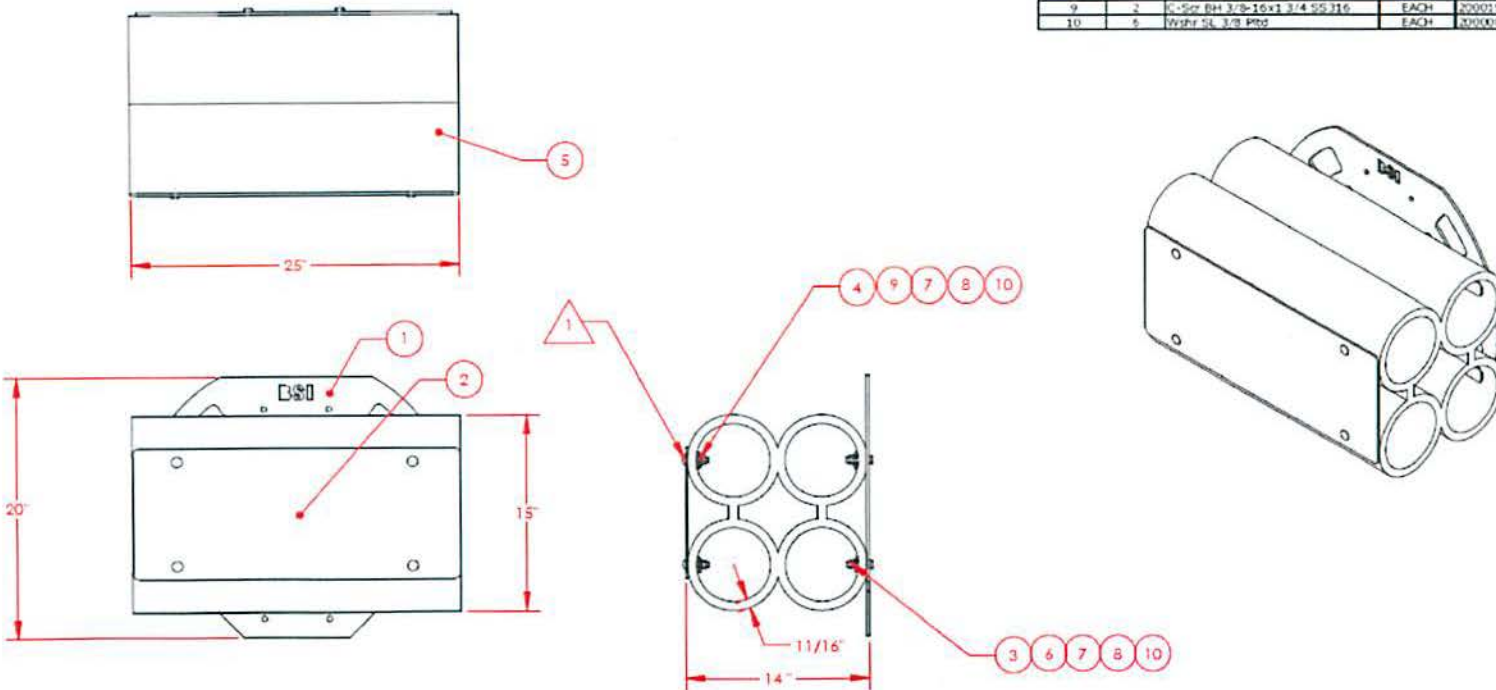
Qty	Description	Part No.	Rev.
1	ENERGY ASORB ELEMENT BAY 1	BSI-1012069-00	
1	TAU-IR FAC PLATE PL1	BSI-1012068-02	
1	BATTON, INNER	BSI-1011035-00	
1	BATTON, OUTER	BSI-1011037-00	
1	ENERGY ASORB ELEMENT TYP 1	BSI-1012069-05	
4	C-Scr RH 3/8-16x1 3/4 Gr5 PHD	3000371	
6	Nut HN 3/8-16 Gr5 Gal	3000405	
6	WSPR FI 1/8-10x1 PHD	3001090	
2	C-Scr RH 3/8-16x1 1/4 SS 316	3000194	
6	WSPR SL 3/8 PHD	3000087	

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	INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5-2014 THIRD ANGLE PROJECTION	TITLE <b>UNIVERSAL TAU-IR SYSTEM                  ENERGY ABSORBING ELEMENT ASSY. TYPE-1</b>	
<b>APPROVALS</b> DRAWN BY: S. DEBUS DATE: 12/16/10 APP'D BY: G. DYKE DATE: 12/16/10	DO NOT SCALE DRAWING	REV: 0 DATE: 12/16/10	SIZE: B DWG NO.: BSI-1012069-US SCALE: 1:8 SHEET: 1 OF 1

**NOTES:**

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

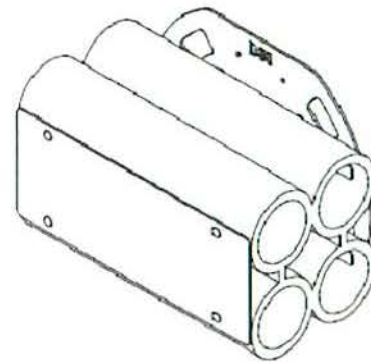
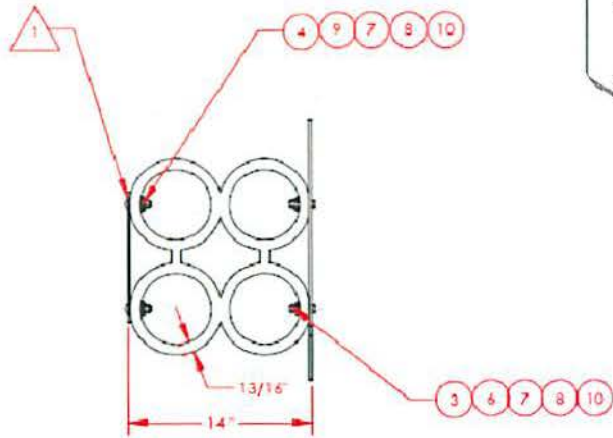
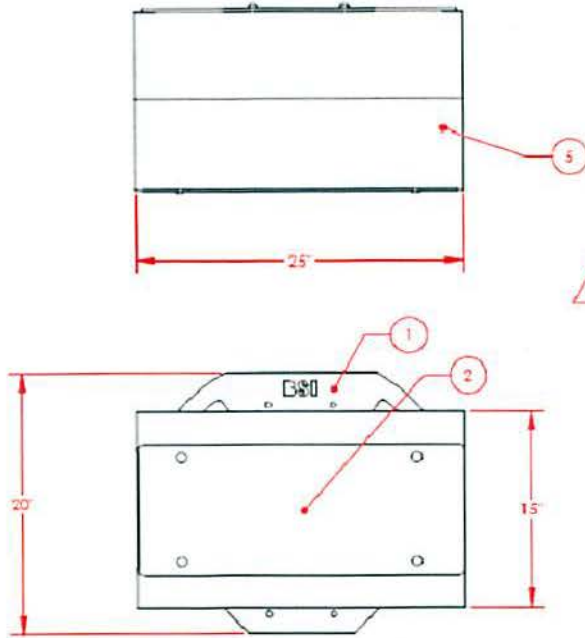
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1	1	ENERGY ASORB ELEMENT (BACK PL)	EACH	BSI-1012049-00
2	1	TAU IIR FAC FACE PLT	EACH	BSI-1012066-US
3	1	BATTEN, INNER	EACH	BSI-1011036-00
4	1	BATTEN, OUTER	EACH	BSI-1011037-00
5	1	ENERGY ASORBING ELEMENT 1TH	EACH	BSI-1012063-US
6	4	C-507 RH 3/8-16x1 3/4 GFS PHD	EACH	2000071
7	6	NUT 3/8-16-1.5 GFS PHD	EACH	2000065
8	6	Washer 3/8-16x1 PHD	EACH	2000090
9	2	C-507 RH 3/8-16x1 3/4 SS 316	EACH	2000194
10	6	Washer 3/8 PHD	EACH	2000057



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	READING: DECIMAL ANGLES 1/16" .001" .015"	INTERPRET DIMENSIONS AND TOLERANCES FOR ASME Y14.5M	FILE: <b>UNIVERSAL TAU-IIR SYSTEM                  ENERGY ASORBING ELEMENT ASSY. TYPE-2</b>	
<b>APPROVALS</b> DRAWN BY: S. DENNIS DRAWN DATE: 12/16/10 APP'D BY: G. DYKBE APP'D DATE: 12/16/10		THIRD ANGLE PROJECTION DO NOT SCALE DRAWING	C 12/16/10 DATE	SIZE: B DWG NO.: BSI-1012070-US SCALE: 1:8 REV: 0 SHEET: 1 OF 1

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

REV.	DATE	DESCRIPTION	APP'D.	CHK'D.
1		ISSUE FOR ASSEMBLY DRAWING	S.A.C.	BSI-1012071-01
2		CHANGE TO BOLT PATTERN	S.A.C.	BSI-1012071-02
3		CHANGE TO BOLT PATTERN	S.A.C.	BSI-1012071-03
4		CHANGE TO BOLT PATTERN	S.A.C.	BSI-1012071-04
5		CHANGE TO BOLT PATTERN	S.A.C.	BSI-1012071-05
6		CHANGE TO BOLT PATTERN	S.A.C.	BSI-1012071-06
7		CHANGE TO BOLT PATTERN	S.A.C.	BSI-1012071-07
8		CHANGE TO BOLT PATTERN	S.A.C.	BSI-1012071-08
9		CHANGE TO BOLT PATTERN	S.A.C.	BSI-1012071-09
10		CHANGE TO BOLT PATTERN	S.A.C.	BSI-1012071-10



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 DRAWN DATE: 12/16/10  
 APP'D BY: G. DYKES PE  
 APP'D DATE: 12/16/10

UNLESS OTHERWISE SPECIFIED  
 DIMENSIONS ARE IN INCHES.  
 TOLERANCES ARE:

DECIMAL ANGLES  
 .015" .010" .010"  
 .015" .010" .010"

INTERPRET DIMENSIONS AND  
 TOLERANCES FOR ASME  
 Y14.5M1994

THIRD ANGLE PROJECTION

DO NOT SCALE DRAWING

REV	EQN#	DATE
0		12/16/10

3333 Virginia Valley Parkway, Suite 200  
 Watsonville, CA 95076  
 Tel: 831.840.5401  
 www.barriersystems.com

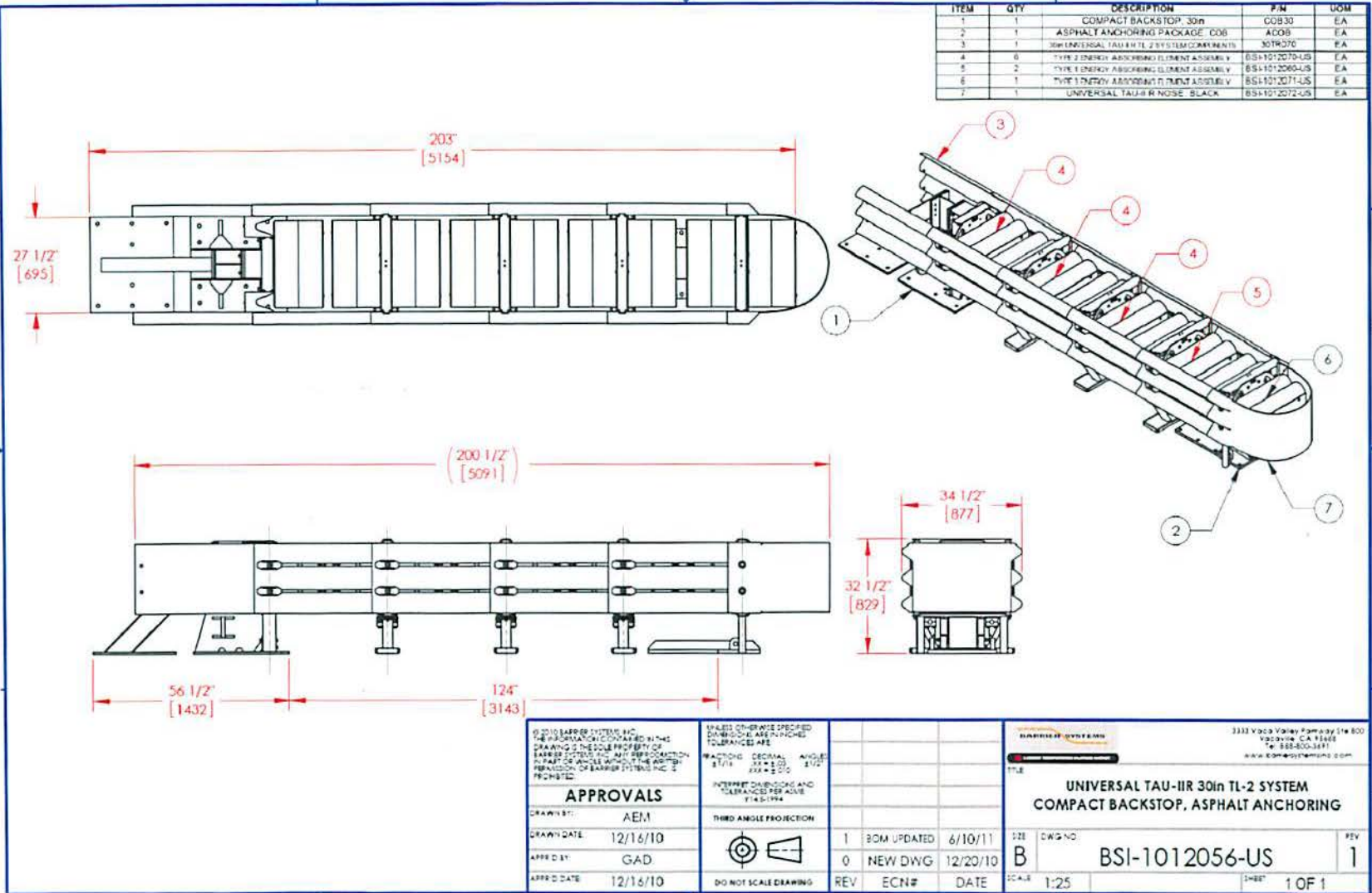
**UNIVERSAL TAU-IR SYSTEM  
 ENERGY ASORBING ELEMENT ASSY. TYPE-3**

SIZE: B  
 DWG NO: BSI-1012071-US  
 SCALE: 1:8  
 SHEET: 1 OF 1

REV: 0



Enclosure 3 (1 of 2)



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 DRAWN DATE: 12/16/10  
 APP'D BY: GAD  
 APP'D DATE: 12/16/10

UNLESS OTHERWISE SPECIFIED  
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 TOLERANCES ARE:

FRACTIONS DECIMAL ANGLE  
 1/16 .0039 1/16  
 1/32 .0012 1/16  
 .0012 .0012 1/16

INTERPRET DIMENSIONS AND  
 TOLERANCES PER ASME  
 Y14.5-1994

THIRD ANGLE PROJECTION

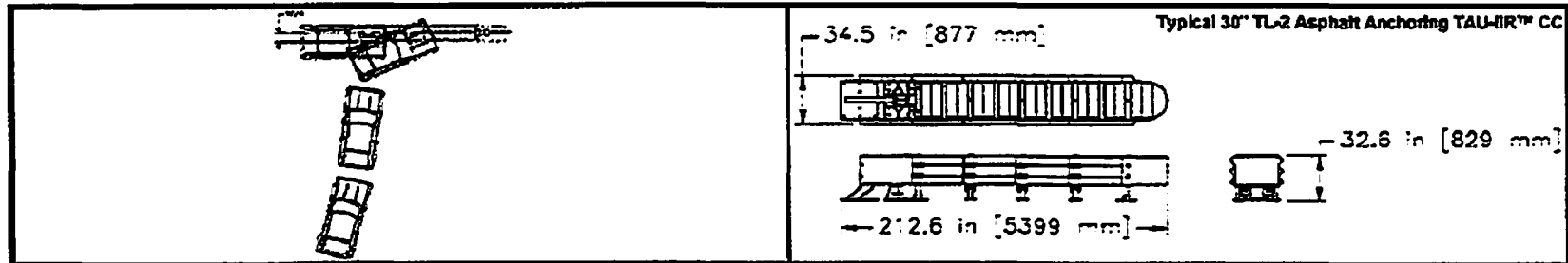
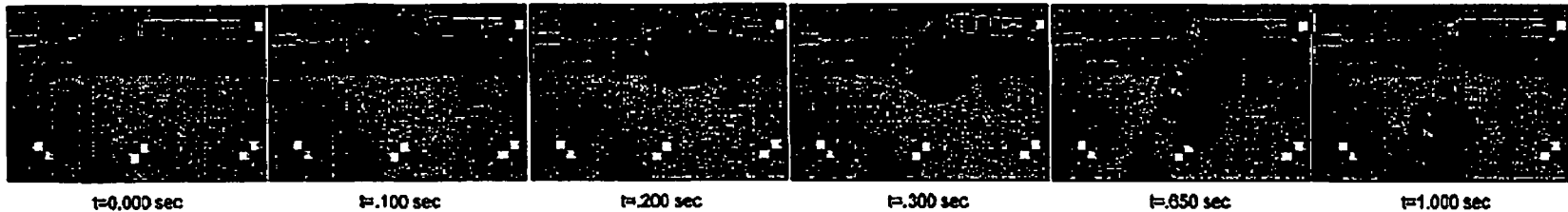
DO NOT SCALE DRAWING

REV	ECN#	DATE
1	BOM UPDATED	6/10/11
0	NEW DWG	12/20/10

**BARRIER SYSTEMS**  
 3333 Vaca Valley Parkway Ste 800  
 Vacaville, CA 94998  
 Tel: 888-800-3671  
 www.bsisystemsmfg.com

**UNIVERSAL TAU-IIR 30in TL-2 SYSTEM  
 COMPACT BACKSTOP, ASPHALT ANCHORING**

SIZE: B  
 DWG NO: BSI-1012056-US  
 SCALE: 1:25  
 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-IIR  
 Dimensions .....Length: 5.4 m (17.7 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 .....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  
 Ridedown Acceleration (g's)  
 x-direction .....16  
 y-direction .....7

**Test Article Deflection (mm)**

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

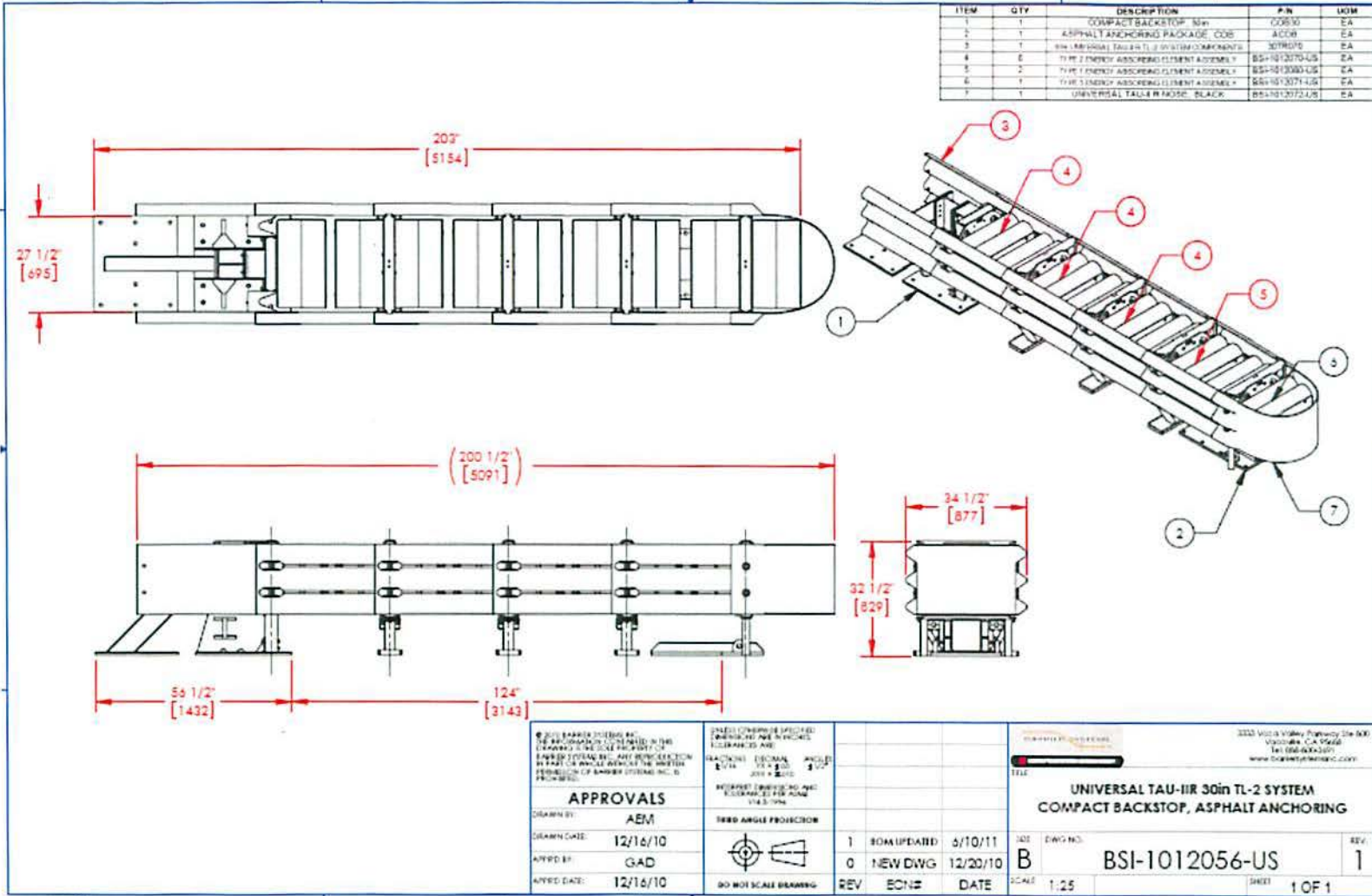
**Vehicle Damage**

Exterior  
 VDS .....12-FL-2  
 CDC .....12FYBAM  
 Interior  
 OCDI .....FS000000

**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)



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**APPROVALS**  
 DRAWN BY: AEM  
 DRAWN DATE: 12/16/10  
 APPROVED BY: GAD  
 APPROVED DATE: 12/16/10

UNIVERSAL TAU-IIR SYSTEM  
 UNITS: METRIC AND IMPERIAL  
 DIMENSIONS AND  
 TOLERANCES ARE  
 IN MILLIMETERS  
 UNLESS OTHERWISE  
 SPECIFIED  
 1/8" = 3.175mm  
 1/4" = 6.35mm  
 1/2" = 12.7mm  
 3/4" = 19.05mm  
 1" = 25.4mm

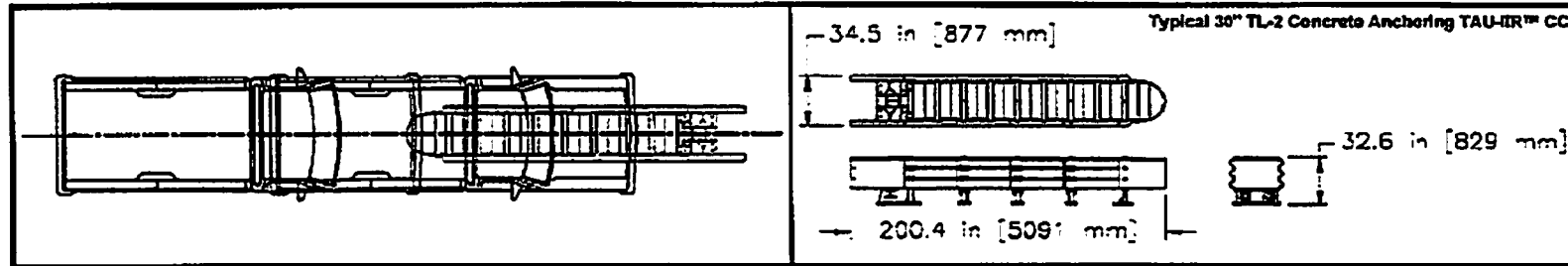
INTERVIEW ENGINEERING AND  
 ARCHITECTURE FOR PLANS  
 114.3 1194  
  
 THIRD ANGLE PROJECTION  
 DO NOT SCALE DRAWING

REV	ECN#	DATE
1	BOM UPDATED	5/10/11
0	NEW DWG	12/20/10

UNIVERSAL TAU-IIR SYSTEM  
**UNIVERSAL TAU-IIR 30in TL-2 SYSTEM  
 COMPACT BACKSTOP, ASPHALT ANCHORING**

3030 Villa Valley Parkway Ste 300  
 Visalia, CA 93291  
 Tel: 558-644-2277  
 www.barriersystemsinc.com

DATE: 12/20/10  
 DWG NO: BSI-1012056-US  
 SCALE: 1:25  
 SHEET: 1 OF 1



**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 (kJ).....355.8

**Exit Conditions**

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

**Occupant Risk Values**

Impact Velocity (m/s)  
 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

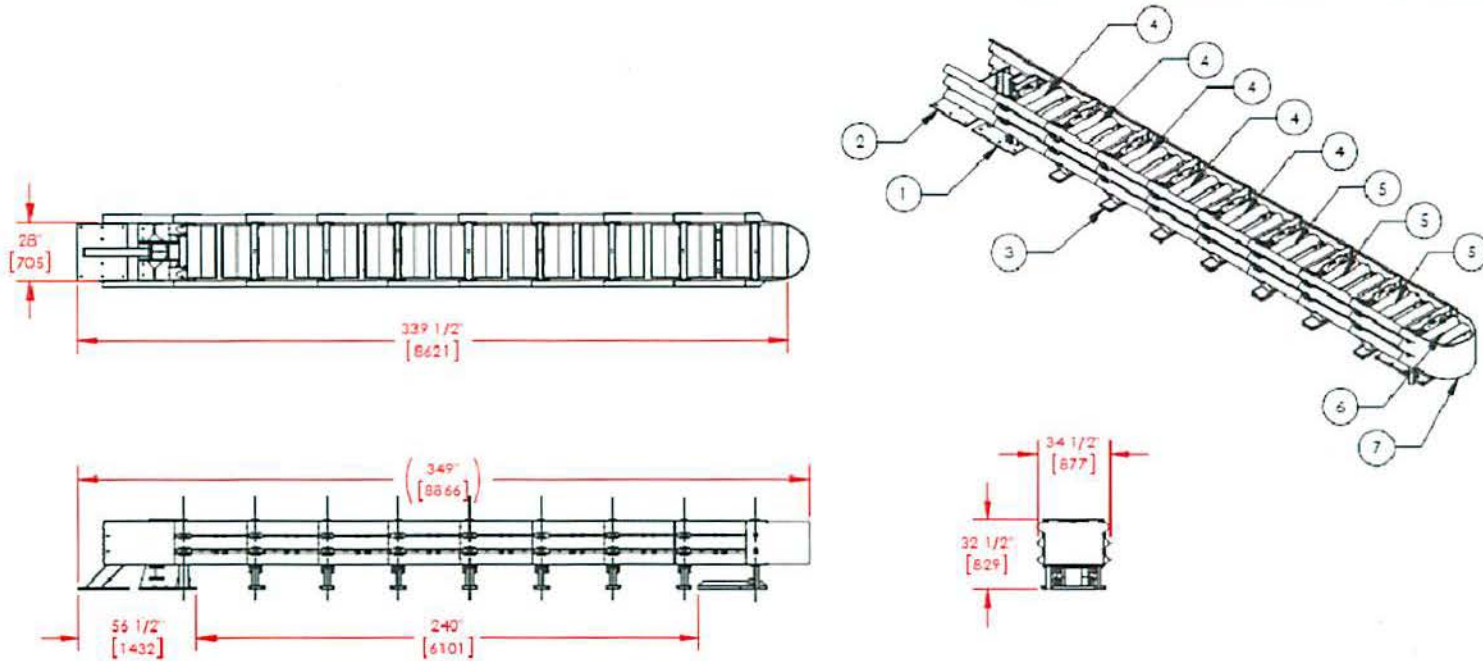
**Vehicle Damage**

Exterior  
 VDS.....12-FC-3  
 CDC.....12FCEW1  
 Interior  
 OCCl.....FS0000000

**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, 30in	COR30	EA
2	1	ASPHALT ANCHORING PACKAGE, COB	ACOB	EA
3	1	30in UNIVERSAL TAU-IIR TL-3 SYSTEM COMPONENTS	BT30KO	EA
4	10	TYPE 2 ENERGY ABSORBING ELEMENT ASSEMBLY	BSI-1012070-US	EA
5	6	TYPE 1 ENERGY ABSORBING ELEMENT ASSEMBLY	BSI-1012069-US	EA
6	1	TYPE 3 ENERGY ABSORBING ELEMENT ASSEMBLY	BSI-1012073-US	EA
7	1	UNIVERSAL TAU-IIR NOISE BACK	BSI-1012072-US	EA



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**APPROVALS**

DRAWN BY: AEM  
 DRAWN DATE: 12/16/10  
 APP'D BY: GAD  
 APP'D DATE: 12/16/10

UNITS: DIMENSIONS SPECIFIED  
 (UNLESS NOTED) ARE IN INCHES.  
 DIMENSIONS IN PARENT  
 SQUARES ARE IN MILLIMETERS.

READING (ICM) ANGLE  
 1/4" = 1" 30° 1/8" = 2" 30°  
 1/16" = 1/8" 30°

INTERPRET DIMENSIONS AND  
 TOLERANCES PER ASME  
 Y14.5M

THIRD ANGLE PROJECTION

DO NOT SCALE DRAWING

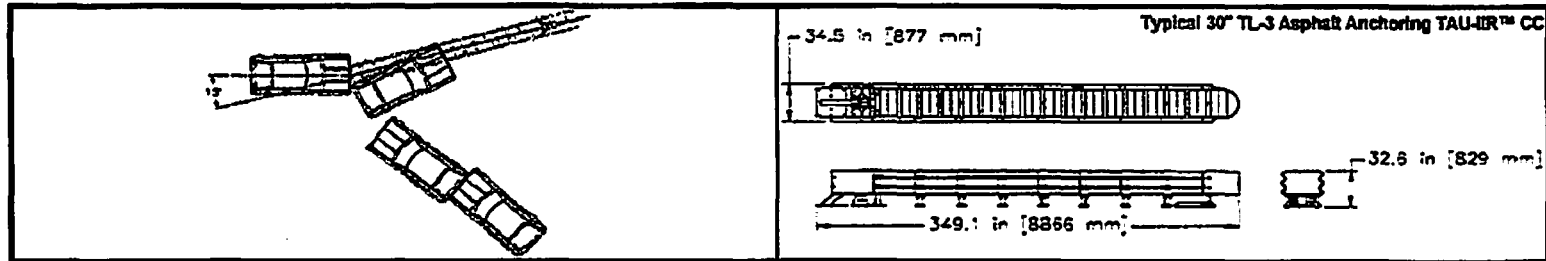
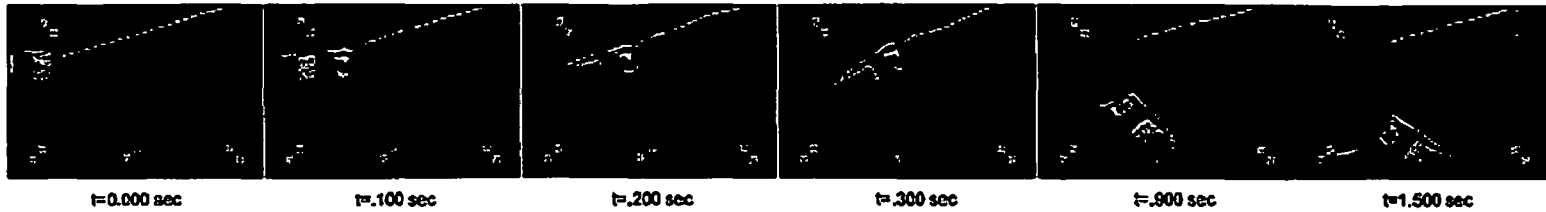
3030 Vista View Parkway Ste 200  
 Vacaville, CA 94988  
 Tel: 800-860-3471  
 www.baewte.com

**UNIVERSAL TAU-IIR TL-3 SYSTEM  
 COMPACT BACKSTOP, ASPHALT ANCHORING**

REV	0	NEW DWG	12/20/10
REV	0	DATE	

SIZE: DWG NO. B BSI-1012060-US REV. 0

SCALE: 1:50 SHEET 1 OF 1



**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 .....TAU-IIR  
 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 (kph) .....100  
 Angle (deg) .....15  
 Impact Severity (kw) .....316.6

**Exit Conditions**

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

**Occupant Risk Values**

Impact Velocity (m/s)  
 x-direction .....11  
 y-direction .....0  
 Ridedown Acceleration (g's)  
 x-direction .....12  
 y-direction .....3

**Test Article Deflection (mm)**

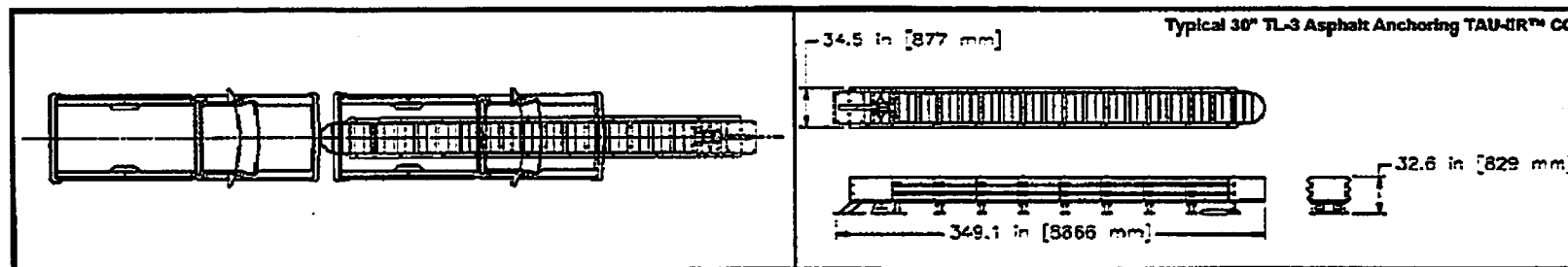
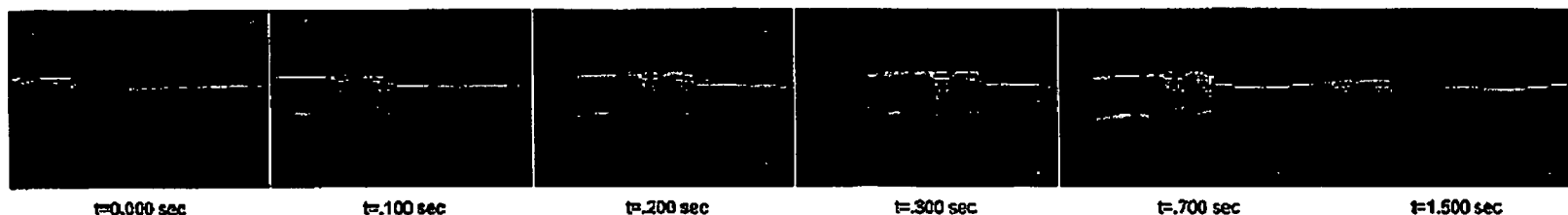
Dynamic .....N/A  
 Permanent .....N/A

**Vehicle Damage**

Exterior  
 VDS .....11-FC-3  
 CDC .....11FYEW2  
 Interior  
 OCDI .....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.....ST1 Test # TAR03  
 Date.....11/8/2010

**Test Article**

Type .....Crash Cushion  
 Name .....TAU-IR  
 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 .....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 (kph) .....100  
 Angle (deg) .....0  
 Impact Severity (kJ) .....776.0

**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 .....19  
 y-direction .....3

**Test Article Deflection (mm)**

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

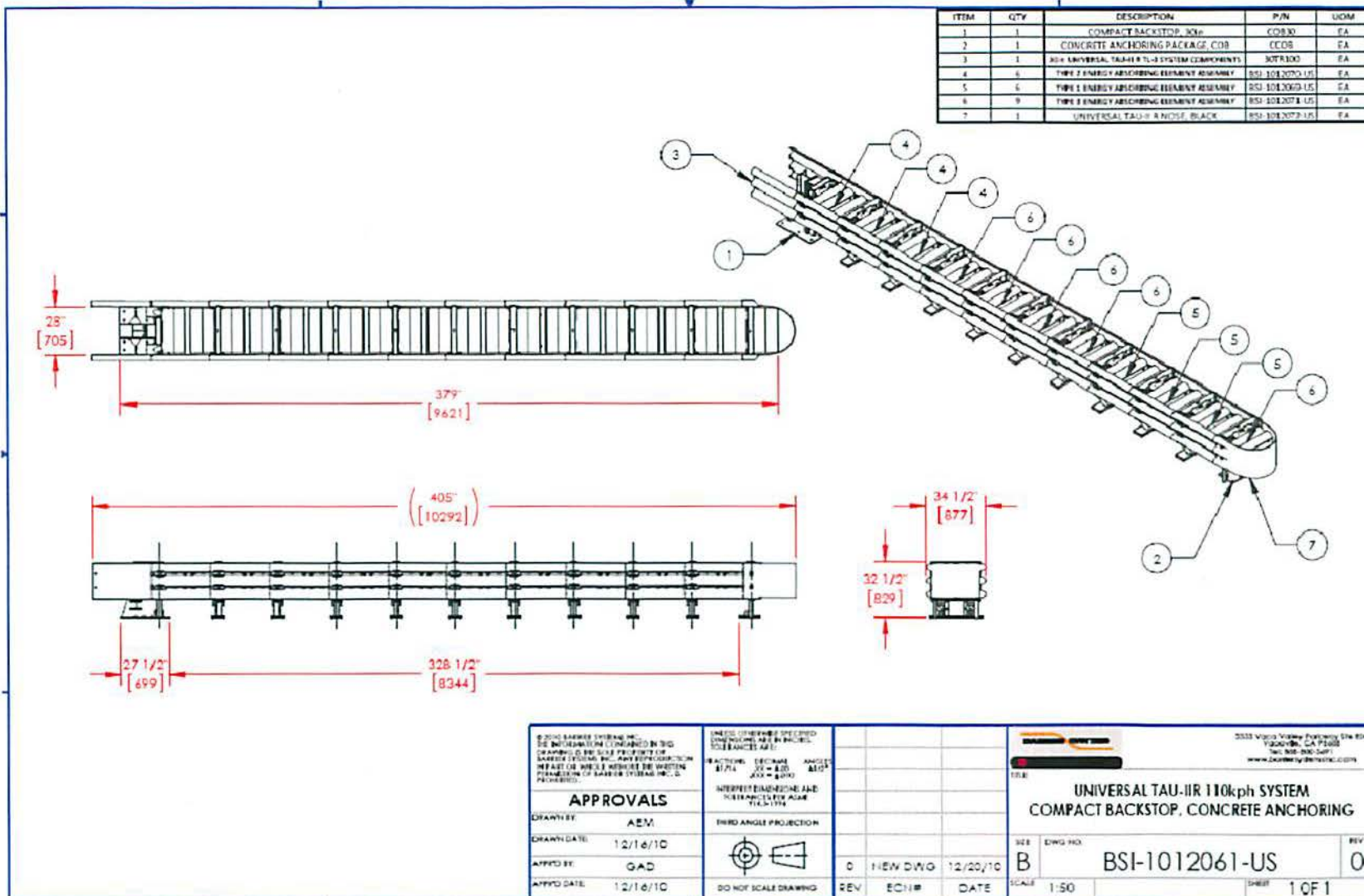
**Vehicle Damage**

Exterior  
 VDS .....12-FC-2  
 CDC .....12FDEW1  
 Interior  
 OCCDI .....FS0000000

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

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

Enclosure 6 (1 of 2)



ITEM	QTY	DESCRIPTION	P/N	UOM
1	1	COMPACT BACKSTOP, 30k	CC030	EA
2	1	CONCRETE ANCHORING PACKAGE, C08	CC08	EA
3	1	30k UNIVERSAL TAU-IIR SYSTEM COMPONENTS	30T300	EA
4	4	TYPE 1 ENERGY ABSORBING ELEMENT ASSEMBLY	BSI-1012070-US	EA
5	4	TYPE 1 ENERGY ABSORBING ELEMENT ASSEMBLY	BSI-1012060-US	EA
6	9	TYPE 2 ENERGY ABSORBING ELEMENT ASSEMBLY	BSI-1012074-US	EA
7	1	UNIVERSAL TAU-IIR ANCHOR, BLACK	BSI-1012073-US	EA

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	INTERIOR DIMENSIONS AND CLEARANCES FOR ASSEMBLY UNLESS NOTED	THIRD ANGLE PROJECTION	TITLE: UNIVERSAL TAU-IIR 110kph SYSTEM COMPACT BACKSTOP, CONCRETE ANCHORING
<b>APPROVALS</b> DRAWN BY: AEM DRAWN DATE: 12/16/10 APP'D BY: GAD APP'D DATE: 12/16/10	DO NOT SCALE DRAWING	0 NEW DWG 12/20/10 REV ECH# DATE	SHEET 1 OF 1 B BSI-1012061-US 0





t=0.000 sec

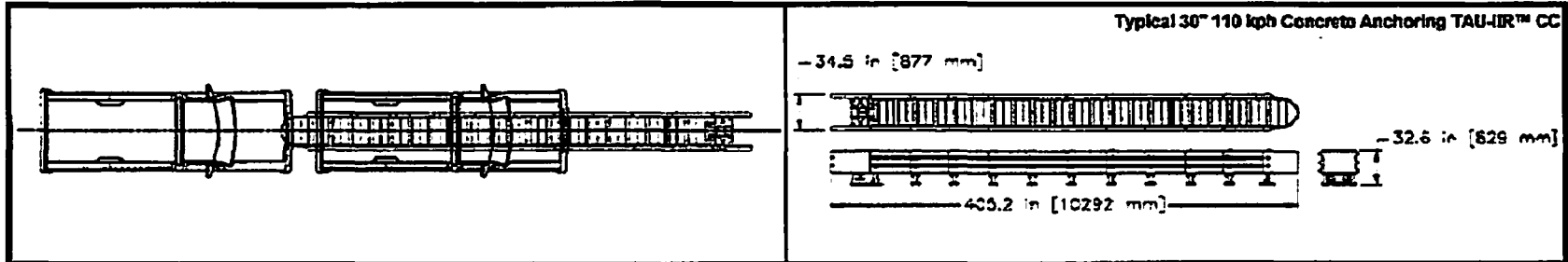
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t=.200 sec

t=.300 sec

t=.700 sec

t=1.100 sec



**General Information**

Test Agency.....SAFE TECHNOLOGIES, INC.  
 Test Designation.....NCHRP Report 350 3-31 (Modified) 110 kph)  
 Test No.....STI Test # TAR12  
 Date.....12/6/2010

**Test Article**

Type .....Crash Cushion  
 Name .....TAU-IIR  
 Dimensions .....Length: 10.3 m (33.8 ft)  
 Size and/or dimension and material .....Height: 629 mm (32.6 in)  
 of key elements .....Width: 877 mm (34.5 in)

**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) .....100  
 Angle (deg) .....0  
 Impact Severity (L) .....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  
 Ridedown Acceleration (g's)  
 x-direction .....17  
 y-direction .....2

**Test Article Deflection (mm)**

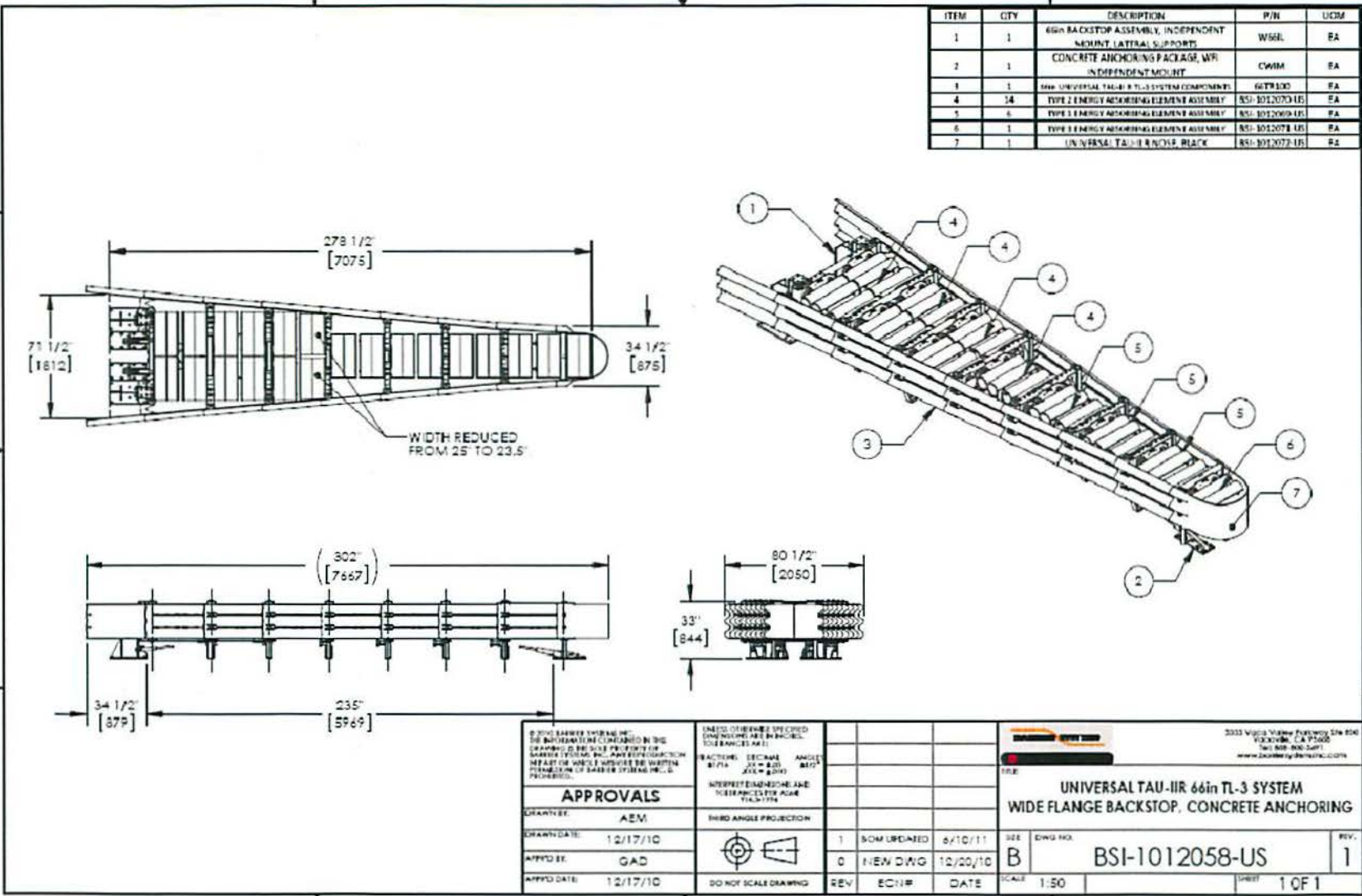
Dynamic .....N/A  
 Permanent .....N/A

**Vehicle Damage**

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

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

Maximum Roll Angle .....11  
 Maximum Pitch Angle .....3  
 Maximum Yaw Angle .....12



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**APPROVALS**

DESIGNED BY: AEM  
 DRAWN BY: GAD  
 APPROVED BY: GAD  
 DATE: 12/17/10

UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES. TOLERANCES ARE:

FRAC.	DECIMAL	ANGLE
±1/16"	±0.005"	±10°
±1/32"	±0.0025"	±5°

INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5-2009

FIRST ANGLE PROJECTION

DO NOT SCALE DRAWING

REV	DESCRIPTION	DATE
1	SOM UPGRADED	6/10/11
0	NEW DWG	12/20/10

3033 Vista Verde Parkway, Ste 504  
 Yorba Linda, CA 95603  
 Tel: 800-800-5001  
 www.barbersystems.com

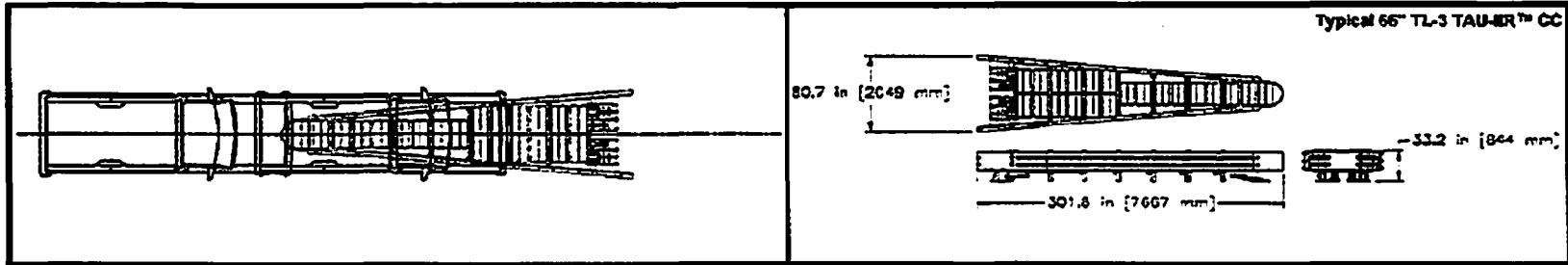
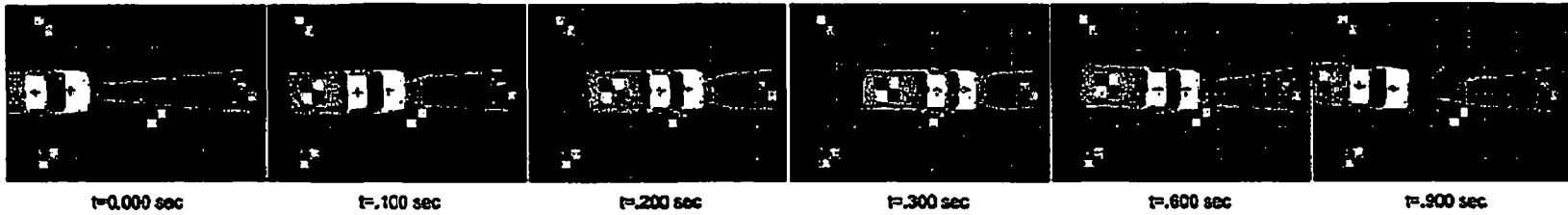
**UNIVERSAL TAU-IIR 66in TL-3 SYSTEM**  
**WIDE FLANGE BACKSTOP, CONCRETE ANCHORING**

SCALE: 1:50

DWG NO: **BSI-1012058-US**

REV: **1**

SHEET 1 OF 1



**General Information**

Test Agency.....SAFE TECHNOLOGIES, INC.  
 Test Designation.....NCHRP Report 350 3-31  
 Test No.....STI Test # TAR13  
 Date.....12/8/2010

**Test Article**

Type .....Crash Cushion  
 Name .....TAU-HIR  
 Dimensions .....Length: 7.7 m (25.2 ft)  
 Size and/or dimension and material .....Height: 844 mm (33.2 in)  
 of key elements .....Width: 2049 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 (mph) .....102  
 Angle (deg) .....0  
 Impact Severity (kJ) .....806.2

**Exit Conditions**

Speed (mph) .....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)**

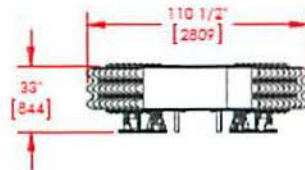
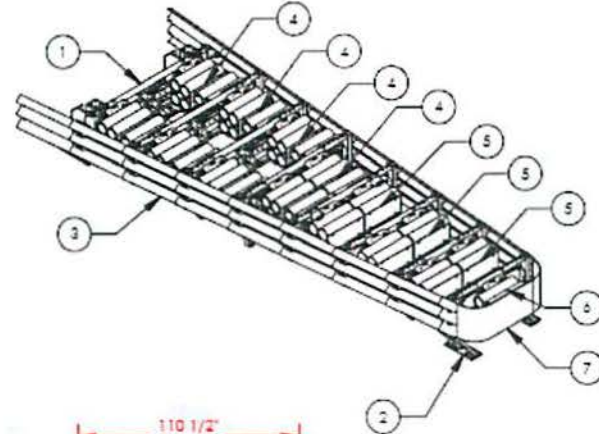
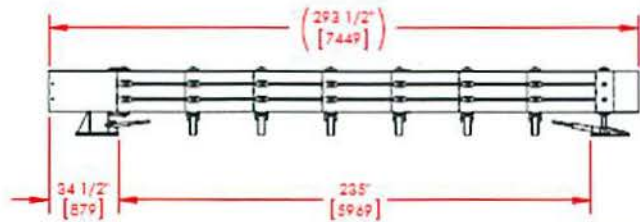
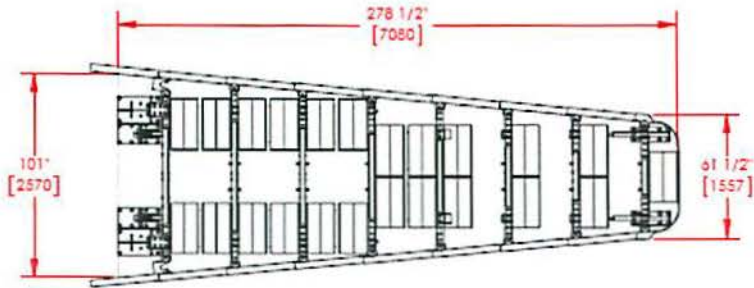
Dynamic .....N/A  
 Permanent .....N/A

**Vehicle Damage**

Exterior  
 VDS .....12-FC-2  
 CDC .....12FCEW1  
 Interior  
 OCDI .....FS000000

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

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



ITEM	QTY	DESCRIPTION	P/N	UOM
1	1	96in BACKSTOP ASSEMBLY, INDEPENDENT MOUNT, LATERAL SUPPORTS	WTKL	EA
2	1	CONCRETE ANCHORING PACKAGE, W/INDEPENDENT MOUNT	CWIM	EA
3	1	96in UNIVERSAL TAU II R TL-3 SYSTEM COMPONENTS	96TR100	EA
4	16	TYPE 2 ENERGY ABSORBING ELEMENT ASSEMBLY	BSI-1012070-US	EA
5	6	TYPE 1 ENERGY ABSORBING ELEMENT ASSEMBLY	BSI-1012065-US	EA
6	1	TYPE 3 ENERGY ABSORBING ELEMENT ASSEMBLY	BSI-1012073-US	EA
7	2	UNIVERSAL TAU II R WIDE NOSE, BLACK	BSI-1012075-US	EA

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**APPROVALS**

DRAWN BY: AEM  
 DRAWN DATE: 12/17/10  
 APP'D BY: GAD  
 APP'D DATE: 12/17/10

SALES ENGINEER SPECIFIED DIMENSIONS AND TOLERANCES ARE:  
 FINISHES: (SEE MAN. 1) FIN. (2) = 303 (3) = 304 (4) = 304

REWORK DIMENSIONS AND TOLERANCES FOR FINISH (1) IS 1/16"

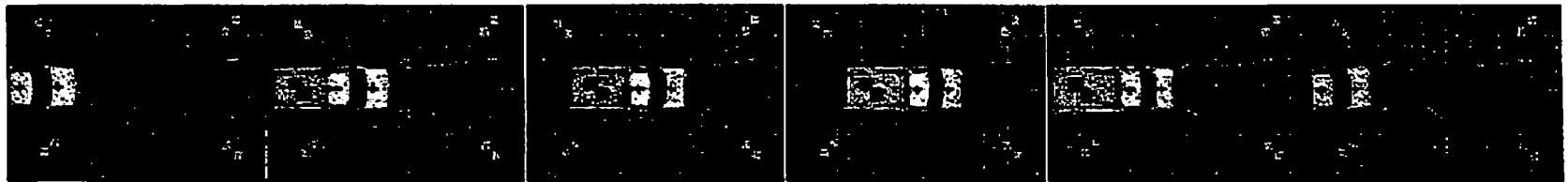
180° ANGLE PROJECTION

DO NOT SCALE DRAWING

REV	CON#	DATE
1	BOM UPDARD	6/10/11
0	NEW DWG	12/20/10

UNIVERSAL TAU II-R 96in TL-3 SYSTEM  
 WIDE FLANGE BACKSTOP, CONCRETE ANCHORING

REV: B  
 Dwg No: BSI-1012059-US  
 SCALE: 1:50  
 SHEET: 1 OF 1



t=0.000 sec

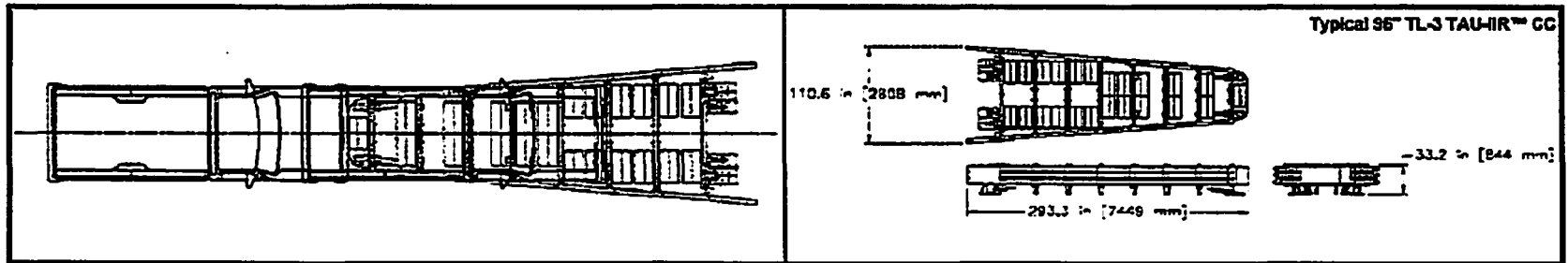
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t=.200 sec

t=.300 sec

t=.650 sec

t=1.000 sec



**General Information**

Test Agency.....SAFE TECHNOLOGIES, INC.  
 Test Designation.....NCHRP Report 350 3-31  
 Test No.....STII Test # TAR07  
 Date.....11/18/2010

**Test Article**

Type .....Crash Cushion  
 Name .....TAU-IIR  
 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 .....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 (mph) .....99  
 Angle (deg) .....0  
 Impact Severity (kJ) .....751.7

**Exit Conditions**

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

**Occupant Risk Values**

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

**Test Article Deflection (mm)**

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

**Vehicle Damage**

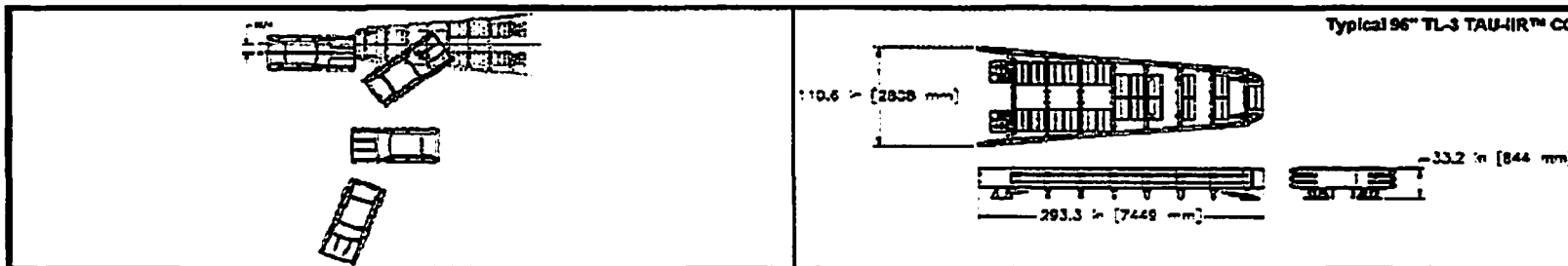
Exterior  
 VDS .....12-FC-3  
 CDC .....12FCBW1  
 Interior  
 OCCDI .....FS0000000

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

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



t=0.000 sec      t=.200 sec      t=.400 sec      t=.700 sec      t=1.000 sec      t=1.300 sec



**General Information**

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

**Test Article**

Type .....Crash Cushion  
 Name .....TALL-IIR  
 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 .....1988 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 (kJ) .....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  
 Ridedown 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-6  
     CDC .....12FYEW3  
 Interior  
     OCDI .....LF0000000

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

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