November 4, 2002

HSA-10/B-108

Owen S. Denman, P.E.
President, Barrier Systems, Inc.
180 River Road
Rio Vista, CA 94571-1208

Dear Mr. Denman:

In your October 4 letter to Mr. Frederick Wright, former Director of the Federal Highway Administration's Office of Safety, you requested formal review and acceptance of a new longitudinal barrier named the SafeGuard Link System. To support this request, you also sent copies of a September 30, 2002 test report entitled "Barrier Systems, Inc. SafeGuard Link System" prepared by Safe Technologies, Inc. and videotapes of the crash tests that you conducted.

The SafeGuard Link System is a longitudinal barrier constructed from 8-gauge A36 galvanized steel panels assembled in 8-meter segments. These segments are hinged at both ends and contain caster wheel/jack assemblies so individual segments can be released and removed or swung open to allow temporary access through the barrier. Likewise, an entire installation can be pulled to a new location without requiring disassembly of the individual segments. The hinge assemblies are shielded from direct impact by a removable aluminum cover and the segments are connected with a 28.6-mm diameter ASTM C1018 steel pin. The effective length (including the hinge) of each segment is 8.5 m and its overall height is 847 mm. Its base width is 727 mm and the width of its "T" top section is 513 mm. Each segment weighs approximately 1525 kg. Selected design details are shown in Enclosures 1 through 3. The SafeGuard Link System can be used as a "stand alone" temporary barrier or as a removable gate within a run of portable concrete barrier. A transition design was developed and tested for the latter application and is shown in Enclosure 4.

A 68-m long test section (eight 8-m long segments) of the SafeGuard Link System was impacted at 100 km/h with an 820-kg car at 20 degrees and with a 2000-kg pickup truck at 25 degrees. Maximum deflection (with the truck) was reported to be 1920 mm. All NCHRP Report 350 evaluation criteria were met in both tests. Summary reports are shown in Enclosures 5 and 6. You also conducted a test with the pickup truck at 70 km/h into an installation that was 34-m long (four 8-m long segments). Under these test level 2 (TL-2) impact conditions, the dynamic deflection was 1040 mm. Enclosure 7 is the summary data for that test. Finally, you tested the SafeGuard Link System at its critical impact point when three 8-m long segments were inserted into a run comprised of 6-m long portable concrete barrier segments, with three on the upstream end of the test installation and four on the downstream end. The results of this test are shown in Enclosure 8.

Based on the information you submitted, I agree the SafeGuard Link System, as tested, meets NCHRP Report 350 evaluation criteria and may be used on the National Highway System (NHS) as a test level 2 (TL-2) barrier when a minimum of two 8-m segments are upstream from the length of need point and as a test level 3 (TL-3) barrier when a minimum of four segments precede the length of need point. Designers must, of course, remain aware that impacts nearer to either end of an unanchored installation will result in greater deflections and possible penetration into the area behind the barrier. The ends of a SafeGuard Link installation will need to be shielded if located within the design clear zone on projects on the NHS.

The SafeGuard Link System may also be used as a TL-3 barrier to create a temporary opening in a portable concrete barrier when it is inserted into a run of temporary concrete barrier. Based on review of the videotape of the test that was conducted, the concrete barrier segments on either end of the SafeGuard Link System should be 6-m long segments, but the remaining segments may be any length or design that have met Report 350 evaluation criteria.

Since the SafeGuard Link System is both a steel product and is proprietary, the provisions of Title 23, Code of Federal Regulations Sections 635.410 and 635.411 are applicable.

Sincerely yours,

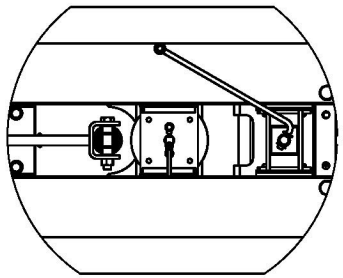
(original signed by Harry W. Taylor)
for:
Carol H. Jacoby, P.E.
Director, Office of safety Design

8 Enclosures

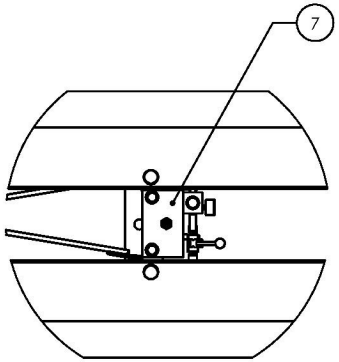
NOTES:

1.) RUBBER FEET MOUNT TO FOUR (4) PEREMETER CORNERS.

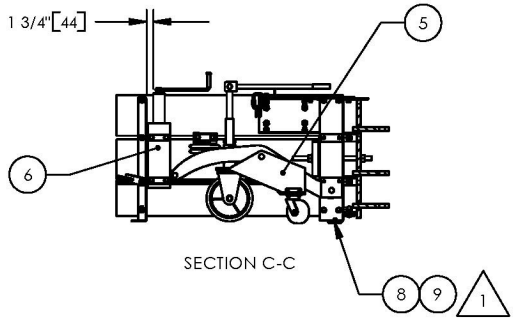
ITEM	QTY / DWG	PART DESCRIPTION	SPECIFICATION	PART #
1	2	(4) METER SECTION ASSEMBLY	NA	B020923
2	1	COUPLING SET	NA	B010343
3	1	HINGE ASSEMBLY	NA	B020784
4	1	HINGE MOUNTING SET, SAFEGUARD	NA	B020789
5	2	ASSEMBLY, LINK AND CASTER	NA	C020608-PD
6	2	MANUAL JACK ASSEMBLY	NA	B020636-PD
7	1	PNEUMATIC SYSTEM - OPTIONAL-	NA	B020801
8	4	RUBBER FOOT	NA	A010317
9	4	WHIZ NUT	1/2" UNC, CAD PLATED	2001247



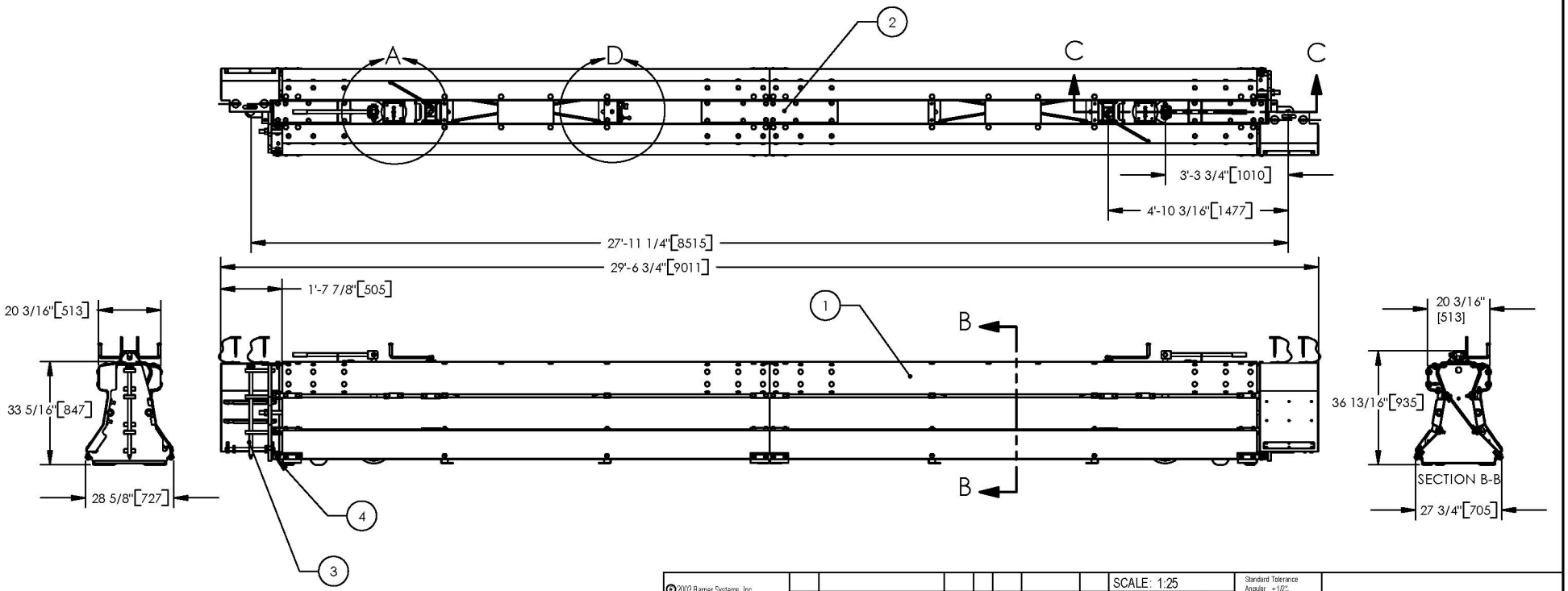
DETAIL A
SCALE 1 : 10



DETAIL D
SCALE 1 : 10



SECTION C-C



NOTE:
THICKNESS OF WELD TO BE EQUAL TO THE THINNER OF 2 PIECES BEING JOINED. WELD ALL BE ALL AROUND UNLESS OTHERWISE SPECIFIED.

REV.	CHANGES	DATE	BY	REQ'D	NEXT ASSY	ITEM

SCALE: 1:25

	DATE	INIT
DRAWN BY	09/23/02	SAD
APPRD BY	09/24/02	JSM

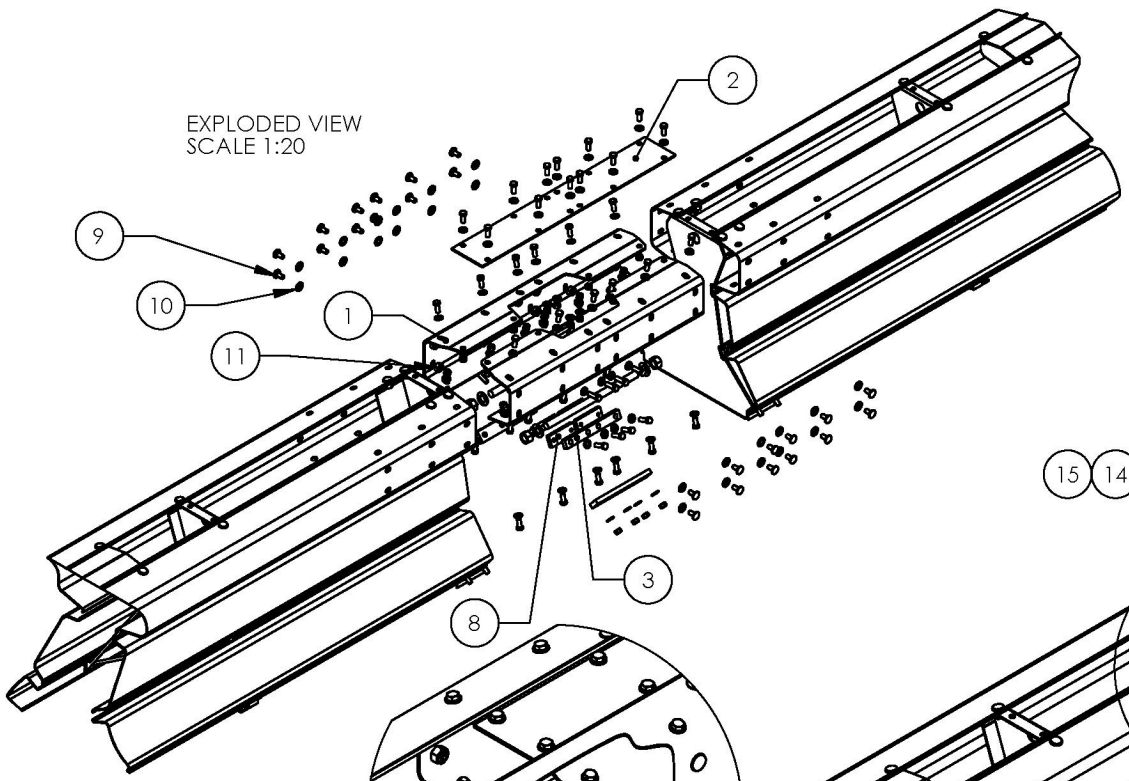
Standard Tolerance
Angular ±1/2°
Fractional ±1/16
Dec .XXX= ± .010
Dec .XX= ± .030

TITLE : 8 METER SAFEGUARD LINK, PNEUMATIC, BARRIER SYSTEMS, INC

MODEL	DRAWING NUMBER	REV.
	C020703-PD	

ITEM	QTY / DWG	PART DESCRIPTION	SPECIFICATION	DWG #
1	2	TOP PANEL CONNECTING BRACKET	NA	B020509
2	1	COUPLING SHEAR PLATE	NA	B020512
3	4	COUPLING STRAP, TOP	NA	B020701
4	2	COUPLING STRAP, BOTTOM	NA	B020702
5	2	THREADED CONNECTING ROD	NA	B020226
6	4	HEX NUT	1 1/8" UNC, OVERSIZED , GR2,	2001404
7	4	WASHER	1 1/8" FLAT ROUND, GALV.	2001405
8	8	THREADED BACKING PLATE, DOMESTIC	NA	B020703
9	24	GUARDRAIL BOLT	5/8"-11 X 1 1/4", GR2, GALV.	4001115
10	24	GUARDRAIL WASHER	NA	A020718
11	24	GUARDRAIL RECESSED NUT	5/8"-11, GR2, GALV.	4001116
12	36	HEX BOLT	5/8"-11 X 1 1/2", GR2, GALV.	2001406
13	16	HEX BOLT	5/8"-11 X 2", GR2, GALV.	2001205
14	44	HEX NUT	5/8"-11, GR2, GALV.	2000134
15	96	WASHER	FLAT, ROUND, 5/8" GALV.	2001206

EXPLODED VIEW
SCALE 1:20



DETAIL C
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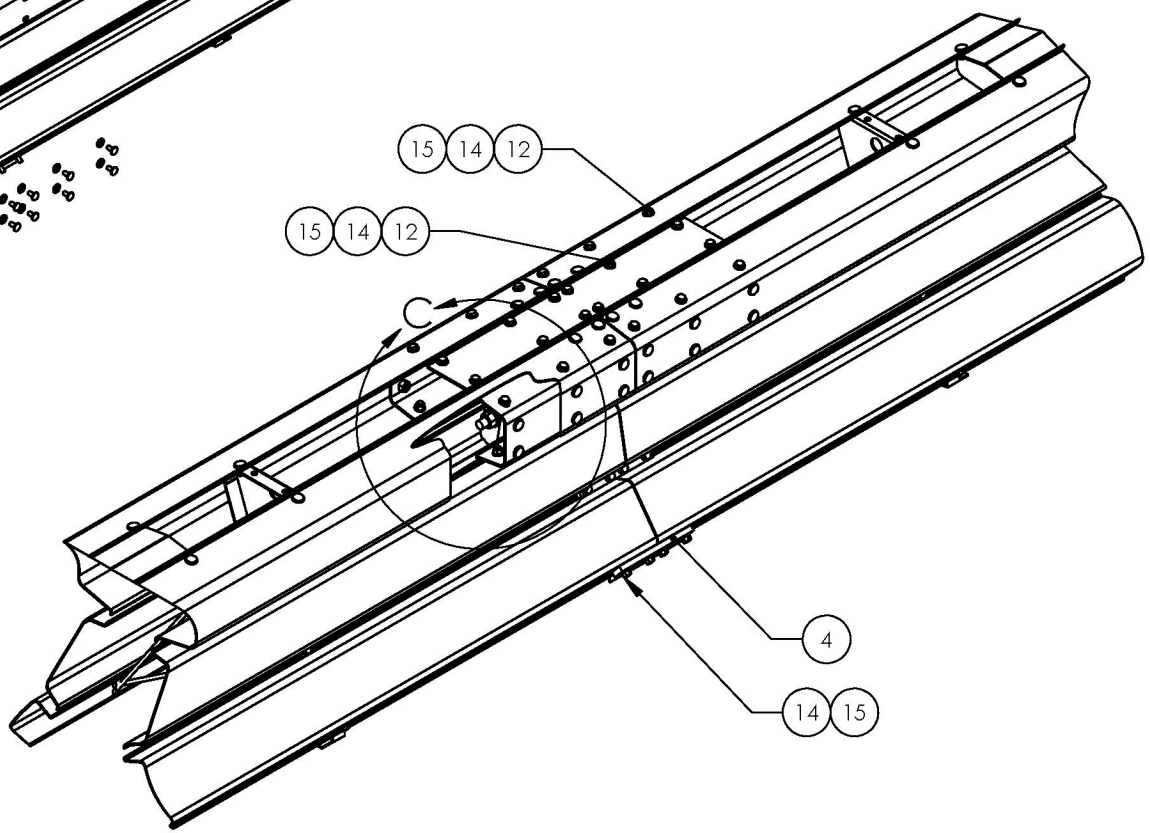


NOTE:
THICKNESS OF WELD TO BE EQUAL TO THE THINNER OF 2 PIECES BEING JOINED. WELD TO BE ALL AROUND UNLESS OTHERWISE SPECIFIED

REV.	CHANGES	DATE	BY	REQ'D	NEXT ASSY.	ITEM
A	SEE ECN 00385	07/24/02	GAD	3	D010321	2

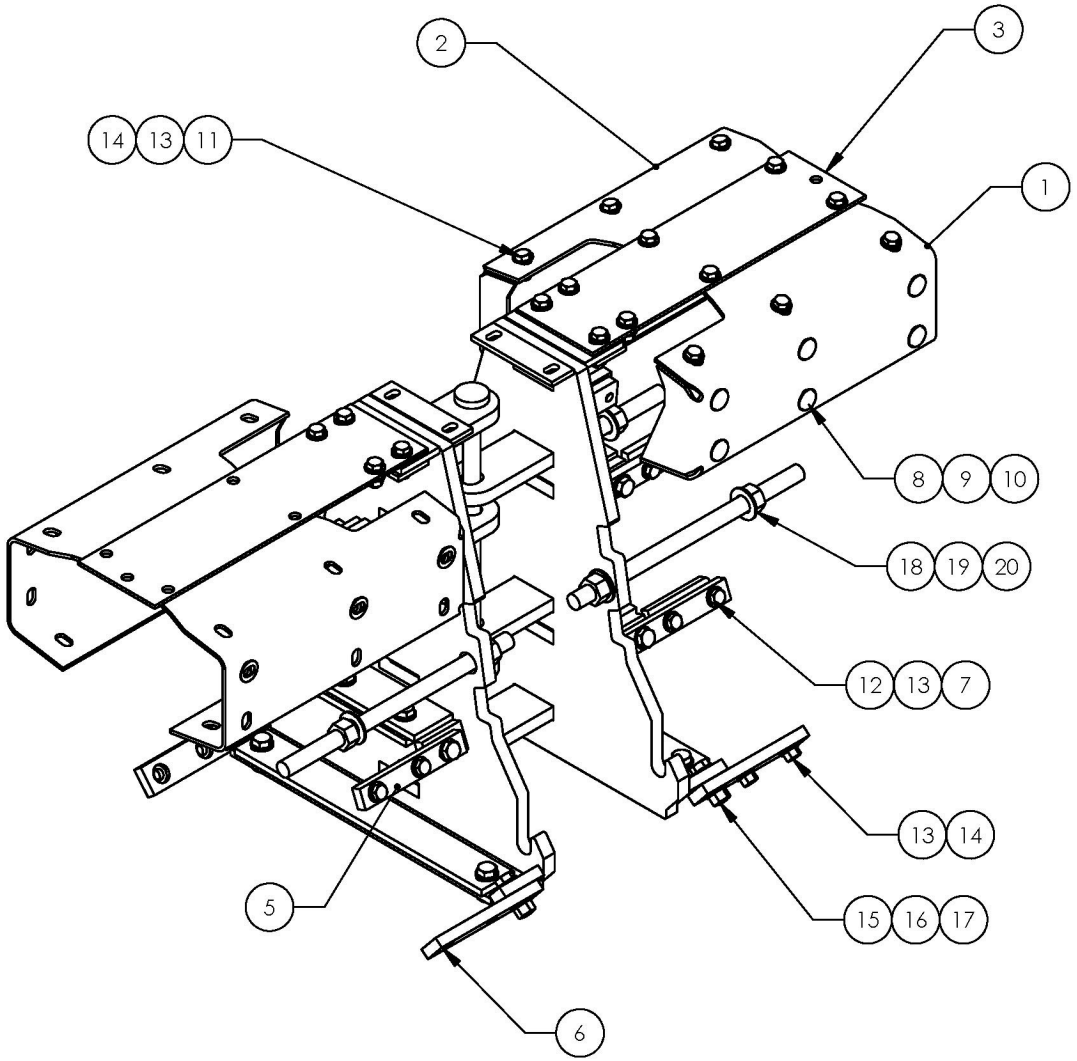
SCALE: 1:15

	DATE	INIT.
DRAWN BY	07/23/02	GAD
APPR'D BY	07/26/02	JSM

Standard Tolerance
Angular +/- 1/2 Deg.
Fractional +/- 1/16
Dec. XXX= +/- .010
Dec. XX= +/- .030

TITLE: COUPLING SET, SAFEGUARD, DOMESTIC

MODEL	DRAWING NUMBER	REV
	B010343	A



appr:	JSM	**BILL OF MATERIALS**	HINGE MOUNT SET, SAFEGUARD LINK DOMESTIC	B020789
ITEM	QTY / DWG	PART DESCRIPTION	SPECIFICATION	DWG #
1	2	TOP PANEL END CAP, RIGHT	NA	B020510
2	2	TOP PANEL END CAP, LEFT	NA	B020511
3	2	HINGE MOUNT SHEAR PLATE	NA	B020513
4			NA	
5	8	UPPER HINGE MOUNT STRAP	NA	B020514
6	4	LOWER HINGE MOUNT STRAP	NA	B020515
7	4	THREADED BACKING PLATE	NA	B020703
8	24	GUARDRAIL BOLT	5/8"-11 X 1 1/4", GR2, GALV.	4001115
9	24	GUARDRAIL WASHER	NA	A020718
10	24	GUARDRAIL RECESSED NUT	5/8"-11, GR2, GALV.	4001116
11	32	HEX BOLT	5/8"-11 X 1 1/2", GR2, GALV.	2001406
12	16	HEX BOLT	5/8"-11 X 2", GR2, GALV.	2001205
13	108	WASHER	FLAT, ROUND, 5/8" GALV.	2001206
14	60	HEX NUT	5/8"-11, GR2, GALV.	2000134
15	12	HEX BOLT	3/4"-10 X 2 1/2", GR8, GALV.	2001398
16	12	HEX NUT	3/4"-10 GR8, GALV.	2001399
17	24	WASHER	3/4" FLAT ROUND, GALV.	2001380
18	4	THREADED CONNECTING ROD	NA	B020226
19	8	HEX NUT	1 1/8" UNC, OVERSIZED , GR2,	2001404
20	8	WASHER	1 1/8" FLAT ROUND, GALV.	2001405

SEE B020789.BOM FOR MATERIAL LIST

NOTE:
THICKNESS OF WELD TO BE EQUAL TO THE THINNER OF 2 PIECES BEING JOINED. WELD TO BE ALL AROUND UNLESS OTHERWISE SPECIFIED

REV.	CHANGES	DATE	BY	REQ'D	NEXT ASSY.	ITEM
				1	C020703	4

SCALE: 1:16

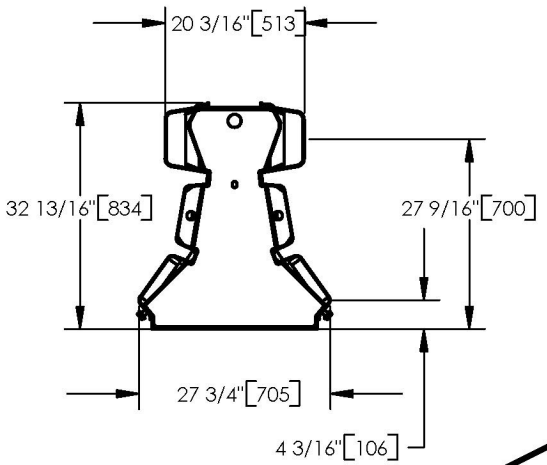
	DATE	INIT.
DRAWN BY	7/31/02	SLP
APPR'D BY	09/27/02	JSM

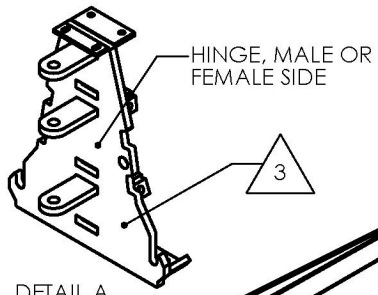
Standard Tolerance
Angular +/- 1/2 Deg.
Fractional +/- 1/16
Dec. XXX= +/- .010
Dec. XX= +/- .030

TITLE: HINGE MOUNT SET, SAFEGUARD LINK DOMESTIC

MODEL	DRAWING NUMBER	REV
	B020789	

ITEM	QTY / DWG	PART DESCRIPTION	SPECIFICATION	DWG #
1	1	ADAPTER MOUNT WELDMENT	NA	B010356
2	1	END SUPPORT	NA	B011228
3	2	TOP TRANSITION PANEL	NA	B020661
4	2	MIDDLE TRANSITION PANEL	NA	B020709
5	2	BOTTOM TRANSITION PANEL	NA	B020706
6	4	HEX BOLT	5/8"-11 HX HD X 2.0", GR2, GALV.	2001205
7	4	FLAT WASHER	5/8" FLAT RD, GALV.	2001206
8	4	GUARDRAIL BOLT (RD HEAD)	5/8"-11 RD HD X 1 1/4", GALV.	4001115
9	4	RECESSED NUT	5/8"-11, HVY RECESSED, GALV.	4001116
10	1	ANCHORING PACKAGE, SGL	NA	B021006
11	4	GUARDRAIL WASHER	NA	A020718



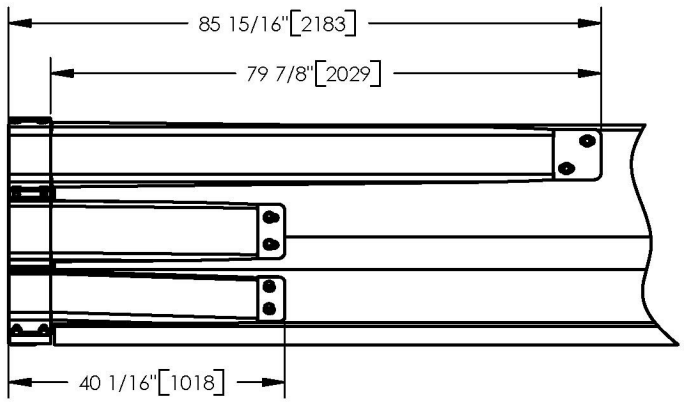


NOTES:

1.) SAFETY SHAPED CONCRETE BARRIER.

2.) TO BE USED WITH HINGE MOUNTING KIT, B010342, AND HINGE ASSEMBLY, B020748 (SEE DETAIL A).

3.) MOUNT "MALE" OR "FEMALE" HINGE AS REQUIRED TO MATE WITH SPECIFIC END OF LINK SYSTEM.



NOTE:
THICKNESS OF WELD TO BE EQUAL TO THE THINNER OF 2 PIECES BEING JOINED. WELD TO BE ALL AROUND UNLESS OTHERWISE SPECIFIED

REV.	CHANGES	DATE	BY	REQ'D	NEXT ASSY.	ITEM
				1	TBD	1

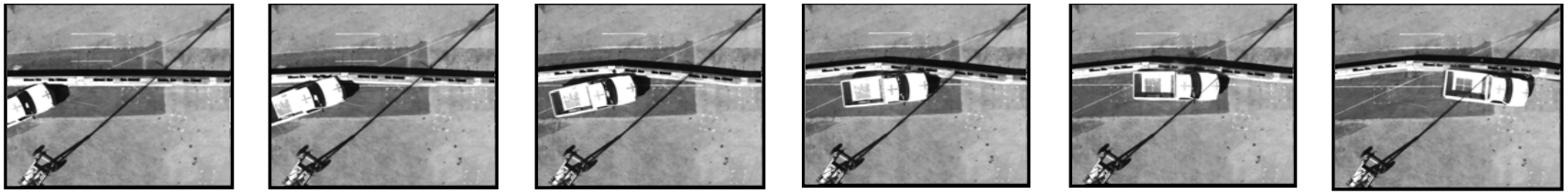
SCALE: 1:18

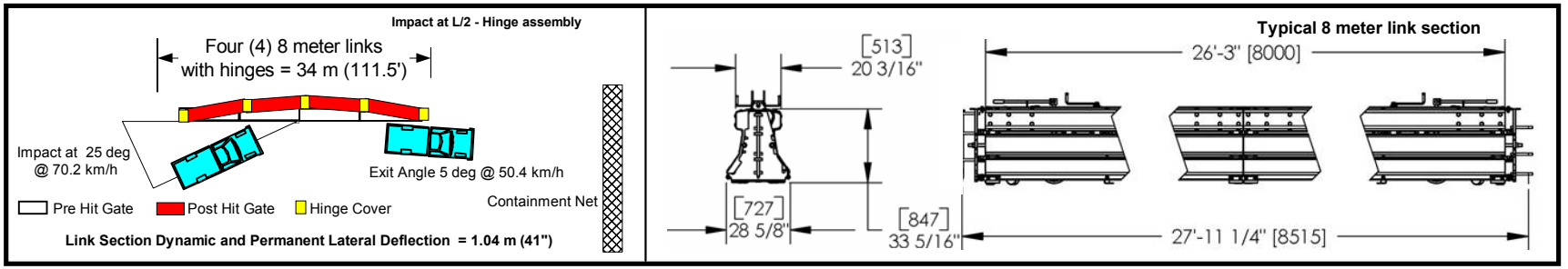
	DATE	INIT.
DRAWN BY	10/02/02	GAD
APPR'D BY	10/02/02	JSM

Standard Tolerance
Angular +/- 1/2 Deg.
Fractional +/- 1/16
Dec. XXX= +/- .010
Dec. XX= +/- .030

TITLE: SAFEGUARD LINK TRANSITION TO SAFETY SHAPED PORTABLE CONCRETE BARRIER

MODEL	DRAWING NUMBER	REV
	B021002-PD	





General Information

Test Agency	**SAFE TECHNOLOGIES, INC.**
Test Designation	**NCHRP Report 350 2-11 (LON)**
Test No.	**STI Test #SGL02**
Date	9/5/2002

Test Article

Type	Barrier Systems, Inc. SafeGuard Link System
Installation Length	8 meter link sections (34 meters overall)
Size and/or dimension and material of key elements	Height 847mm, Base width 727 mm, Top width 513mm. Mass 1525 kg / 8 meter link

Test Vehicle

Type	Production Model
Designation	2000P
Model	1989, Chevrolet Cheyenne 3/4 Ton Pickup
Mass (kg)	
Curb	1907
Test Inertial	1979
Dummy(s)	n/a
Gross Static	1979

Impact Conditions

Speed (km/h)	70.2
Angle (deg)	25
Impact Severity (kJ)	67.2

Exit Conditions

Speed (km/h)	50.4
Angle (deg)	5

Occupant risk Values

Impact Velocity (m/s)	
x-direction	3.5
y-direction	-3.7
Ridedown Acceleration (g's)	
x-direction	-3
y-direction	5.8
THIV (km/h)	16.7
PHD (g's)	5.9
ASI	0.58

Test Article Deflection (mm)

Dynamic	1040
Permanent	1040

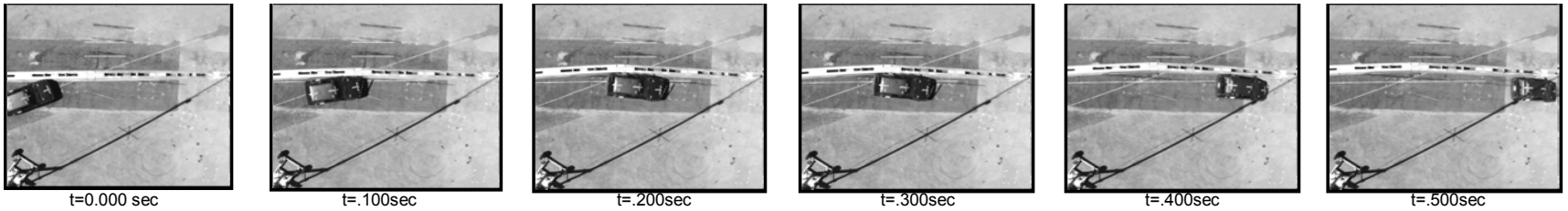
Vehicle Damage

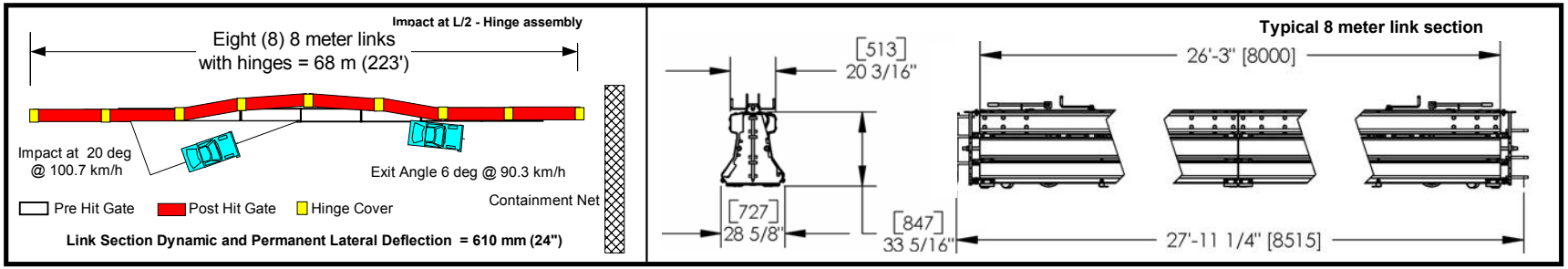
Exterior	
VDS	LFQ-2
CDC	11FLEE2
Interior	
OCDI	AS0000000

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

Maximum Roll Angle	-7.7
Maximum Pitch Angle	-4.4
Maximum Yaw Angle	46.2 (after capture)

Figure 6. Summary of Results





General Information

Test Agency	**SAFE TECHNOLOGIES, INC.**
Test Designation	**NCHRP Report 350 3-10 (LON)**
Test No.	**STI Test #SGL03**
Date	9/6/2002

Test Article

Type	Barrier Systems, Inc. SafeGuard Link System
Installation Length	8 meter link sections (68 meters overall)
Size and/or dimension and material of key elements	Height 847 mm, Base width 727 mm, Top width 513mm. Mass 1525 kg / 8 meter link

Test Vehicle

Type	Production Model
Designation	820C
Model	1993, Ford Festiva
Mass (kg)	
Curb	804
Test Inertial	825
Dummy(s)	75
Gross Static	901

Impact Conditions

Speed (km/h)	100.7
Angle (deg)	20
Impact Severity (kJ)	37.8

Exit Conditions

Speed (km/h)	90.3
Angle (deg)	6

Occupant risk Values

Impact Velocity (m/s)	
x-direction	3.7
y-direction	-7
Ridedown Acceleration (g's)	
x-direction	-5.4
y-direction	-10.8
THIV (km/h)	27.2
PHD (g's)	10.9
ASI	1.29

Test Article Deflection (mm)

Dynamic	610
Permanent	610

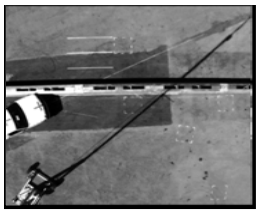
Vehicle Damage

Exterior	
VDS	LFQ-2
CDC	11FLEE2
Interior	
OCDI	AS0000000

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

Maximum Roll Angle	-10.9
Maximum Pitch Angle	-4.1
Maximum Yaw Angle	54.1 (after capture)

Figure 11. Summary of Results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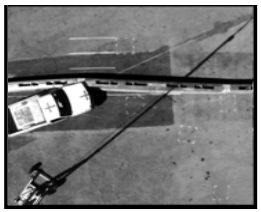
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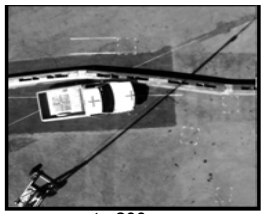
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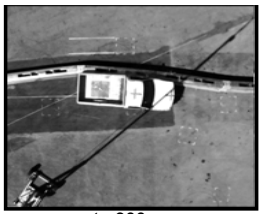
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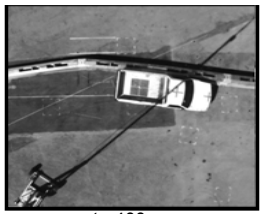
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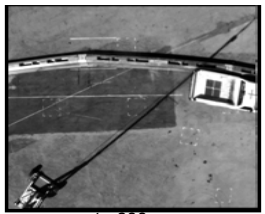
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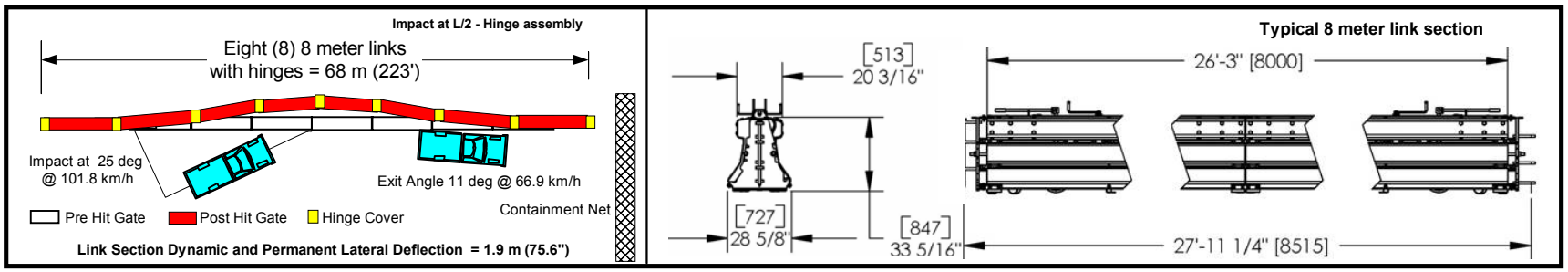


General Information

Test Agency	**SAFE TECHNOLOGIES, INC.**
Test Designation	**NCHRP Report 350 3-11 (LON)**
Test No.	**STI Test #SGL01**
Date	9/3/2002

Test Article

Type	Barrier Systems, Inc. SafeGuard Link System
Installation Length	8 meter link sections (68 meters overall)
Size and/or dimension and material of key elements	Height 847mm, Base width 727 mm, Top width 513mm. Mass 1525 kg / 8 meter link

Test Vehicle

Type	Production Model
Designation	2000P
Model	1994, GMC Sierra 3/4 Ton Pickup
Mass (kg)	
Curb	1895
Test Inertial	1976
Dummy(s)	n/a
Gross Static	1976

Impact Conditions

Speed (km/h)	101.8
Angle (deg)	25
Impact Severity (kJ)	141.1

Exit Conditions

Speed (km/h)	66.9
Angle (deg)	11

Occupant risk Values

Impact Velocity (m/s)	
x-direction	4.6
y-direction	-5.1
Ridedown Acceleration (g's)	
x-direction	-8.6
y-direction	12.4
THIV (km/h)	22.6
PHD (g's)	13.3
ASI	1.17

Test Article Deflection (mm)

Dynamic	1920
Permanent	1920

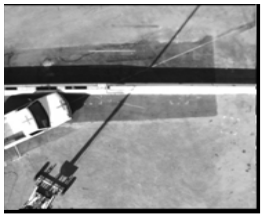
Vehicle Damage

Exterior	
VDS	LFQ-4
CDC	11FLEE4
Interior	
OCDI	AS0002000

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

Maximum Roll Angle	-8.3
Maximum Pitch Angle	25.4 (after capture)
Maximum Yaw Angle	37.2 (after capture)

Figure 1. Summary of Results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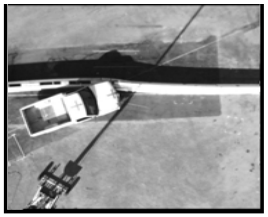
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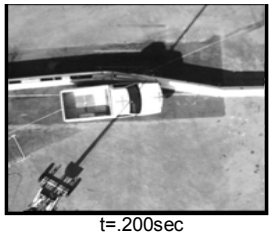
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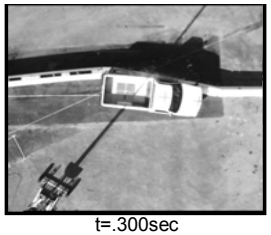
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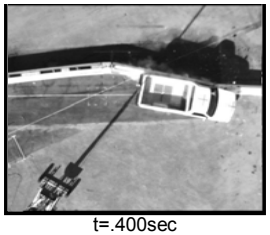
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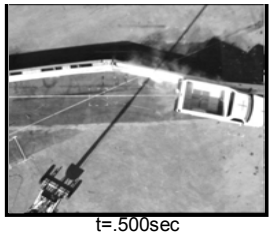
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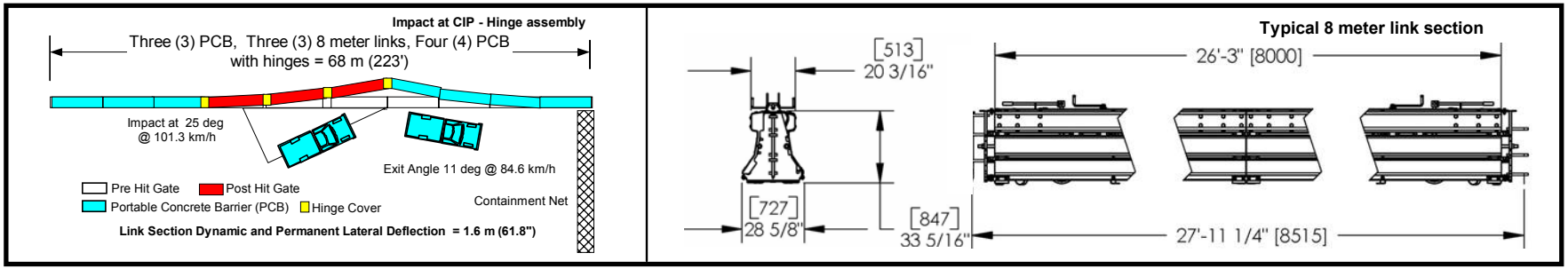

General Information

Test Agency	**SAFE TECHNOLOGIES, INC.**
Test Designation	**NCHRP Report 350 3-21 (CIP)**
Test No.	**STI Test #SGL04**
Date	9/12/2002

Test Article

Type	Barrier Systems, Inc. SafeGuard Link System
Installation Length	8 meter link sections (68 meters overall)
Size and/or dimension and material of key elements	Height 847 mm, Base width 727 mm, Top width 513mm. Mass 1525 kg / 8 meter link

Test Vehicle

Type	Production Model
Designation	2000P
Model	1988, GMC Sierra 3/4 ton pick up
Mass (kg)	
Curb	1966
Test Inertial	1967
Dummy(s)	n/a
Gross Static	1967

Impact Conditions

Speed (km/h)	101.3
Angle (deg)	25
Impact Severity (kJ)	139

Exit Conditions

Speed (km/h)	84.6
Angle (deg)	11

Occupant risk Values

Impact Velocity (m/s)	
x-direction	5.4
y-direction	-5.6
Ridedown Acceleration (g's)	
x-direction	-6
y-direction	15.9
THIV (km/h)	26.5
PHD (g's)	16.3
ASI	1.18

Test Article Deflection (mm)

Dynamic	1570
Permanent	1570

Vehicle Damage

Exterior	
VDS	LFQ-4
CDC	11FLEE4
Interior	
OCDI	AS0201010

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

Maximum Roll Angle	-8.8
Maximum Pitch Angle	-11.5
Maximum Yaw Angle	37.0 (after capture)

Figure 16. Summary of Results