

September 12, 2003

Refer to: HSA-10/CC-85

Mr. Randy L. Warner
Director, Product R&D
Stabler Companies, Incorporated
635 Lucknow Road
Harrisburg, Pennsylvania 17110-1635

Dear Mr. Warner:

Your August 27, 2003, letter to Mr. Michael S. Griffith, former Acting Director of the Office of Safety Design, requested formal Federal Highway Administration (FHWA) review and acceptance of a redirective, non-gating crash cushion called the Smart Cushion Innovations – 100GM (SCI-100GM). To support this request, you also sent copies of test reports prepared by KARCO Engineering detailing the results of the full-scale crash tests you conducted on your attenuator.

The SCI-100GM is a redirective, non-gating crash cushion, 6550 mm long and 850 mm high. Its main components, as shown in Enclosure 1, include base and side frame assemblies fabricated of mild steel tubing, a front sled assembly, and a series of 10-gauge galvanized Grade 50 steel side panels mounted to collapsing steel frames, and a shock arresting cylinder. A 1.125-inch diameter steel cable is attached to the front sled assembly and is then routed around a front sheave to dual sheave assemblies located at the back of the attenuator (one at either end of the shock arresting cylinder). The unit telescopes backward upon frontal impact and generates its stopping force from a combination of friction between the cable and the non-rotating sheaves, acceleration of the attenuator's masses, crush factors in the body and frame of the vehicle, and the variable resistance created by the shock arresting cylinder as it is compressed between the rear sheave assemblies by the tensioned cable. The shock arresting cylinder is metered to apply a variable resistive force to the cable in relation to the speed and mass of an impacting vehicle.

The base unit is anchored to the mounting substrate with 48 bolts. Testing was performed on a unit mounted on a concrete pad with galvanized Grade B7 all-thread rods 0.75-inches in diameter and seven inches long. These rods were inserted into .875-inch diameter holes and set with epoxy.

You conducted five certification tests (National Cooperative Highway Research Program ((NCHRP)) Report 350 tests 3-31, 3-32, 3-33, 3-37, and 3-39), the results of which are summarized in Enclosure 2. Test 3-30 was tentatively waived on the assumption that test 3-32 would be more demanding for the small car. A review of the test results for tests 3-31 and 3-33 verified that the occupant impact velocity was greater for the angle hit than for the

head-on impact for the pickup truck. Thus, one can reasonably assume the same relationship would hold for the car and I agree that test 3-30 may be omitted from this test matrix. You also requested that tests 3-36 and 3-38 be waived. Given the stiffness of the SCI-100GM seen in tests 3-37 and 3-39, I can also agree that these tests be waived. I ask, however, that you conduct a two-year in-service evaluation of the SCI-100GM and report your findings to me to verify acceptable field performance. You stated in your transmittal letter that all certification tests were conducted on the same hardware and only one side panel and one bolt were replaced during the testing, thereby minimizing repair costs and time. Your in-service evaluation should also be an excellent means of verifying and documenting the re-usability of this crash cushion.

Your SCI-100GM meets the evaluation criteria for an NCHRP Report 350 redirective, non-gating crash cushion at test level 3 and may be used on the National Highway System (NHS) when such use is acceptable to the contracting authority. The transition designs shown in Enclosure 2 are acceptable when the SCI-100GM is connected to a solid concrete barrier or backup. When attached to w-beam or Thrie-beam median barrier, that barrier must include an acceptable transition design, i.e., one accepted for use as a bridge rail transition, to redirect vehicles impacting from the backside and to prevent their snagging on the back corner of the attenuator. Acceptable transition designs require nested w-beam and a rubrail or nested Thrie-beam, as well as a post size and layout comparable to a currently acceptable bridge rail transition. Specific details can be found under Longitudinal Barriers, key word: Bridgerail Transitions on our safety hardware website at <http://safety.fhwa.dot.gov/report350hardware>.

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

- This acceptance is limited to the crashworthiness characteristics of the device and does not cover its structural features, nor conformity with the Manual on Uniform Traffic Control Devices.
- Any design changes that may adversely influence the crashworthiness of the device will require a new acceptance letter.
- Should the FHWA discover that the qualification testing was flawed, that in-service performance reveals unacceptable safety problems, or that the device being marketed is significantly different from the version that was crash tested, it reserves the right to modify or revoke its acceptance.
- You will be expected to supply potential users with sufficient information on design and installation requirements to ensure proper performance.
- You will be expected to certify to potential users that the hardware furnished has essentially the same chemistry, mechanical properties, and geometry as that submitted for acceptance, and that it will meet the crashworthiness requirements of NCHRP Report 350.
- To prevent misunderstanding by others, this letter of acceptance, designated as number CC-85 shall not be reproduced except in full. This letter, and the test documentation

upon which this letter is based, is public information. All such letters and documentation

may be reviewed at our office upon request.

- The SCI-100GM is a patented product and is considered proprietary. If proprietary devices are *specified by a highway agency* for use on Federal-aid projects, except exempt, non-NHS projects, they: (a) must be supplied through competitive bidding with equally suitable unpatented items; (b) the highway agency must certify that they are essential for synchronization with existing highway facilities or that no equally suitable alternative exists or; (c) they must be used for research or for a distinctive type of construction on relatively short sections of road for experimental purposes. Our regulations concerning proprietary products are contained in Title 23, Code of Federal Regulations, Section 635.411, a copy of which is enclosed.

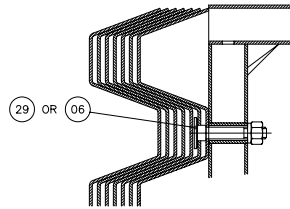
Sincerely yours,

(original signed by John R. Baxter)
John R. Baxter, P.E.
Director, Office of Safety Design
Office of Safety

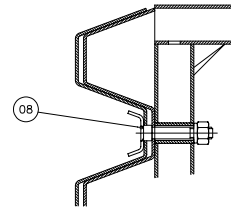
3 Enclosures

APPENDIX - FIGURE 1 - ASSEMBLY DRAWING

DETAIL A

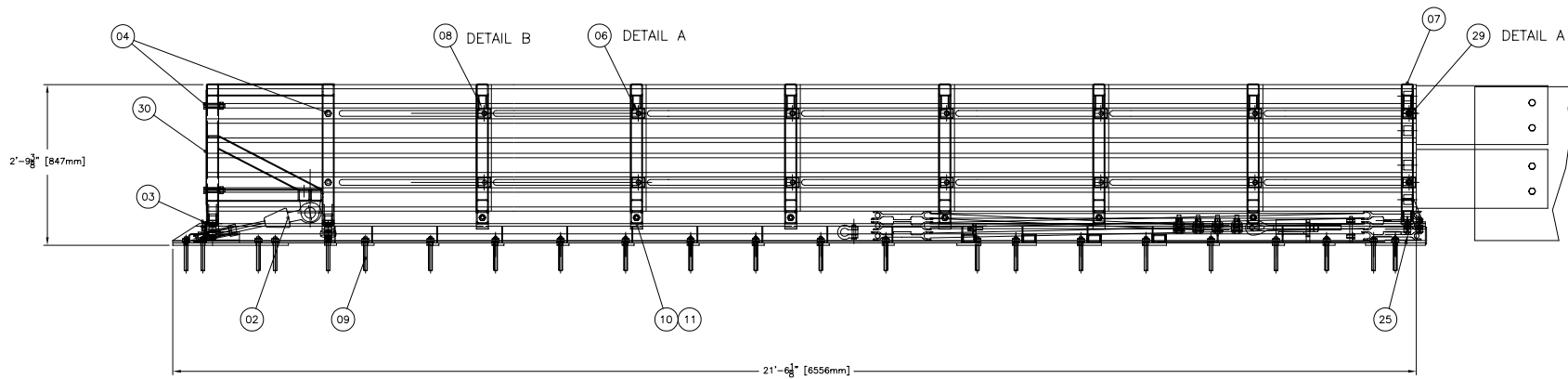
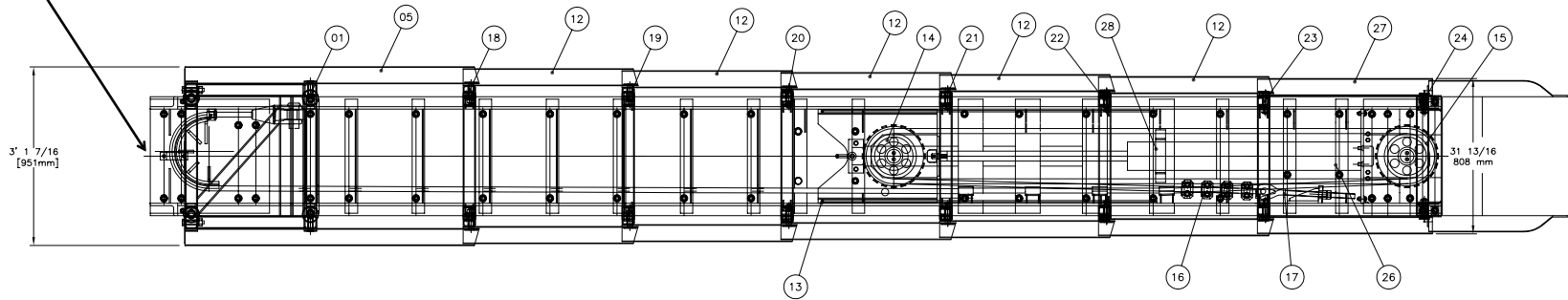


DETAIL B



- PARTS LIST**
- 01 - Front Sled
 - 02 - Cable Assembly
 - 05 - Sled Panel
 - 07 - Terminal Brace
 - 09 - Anchor Bolts
 - 12 - Side Panels
 - 14 - Mobile Sheave Asbly
 - 17 - Cable Adjuster Bolt
 - 18-23 - Mobile frames 1-6
 - 26 - Cylinder
 - 27 - Rear Panel
 - 06,08,29 - Side Keepers

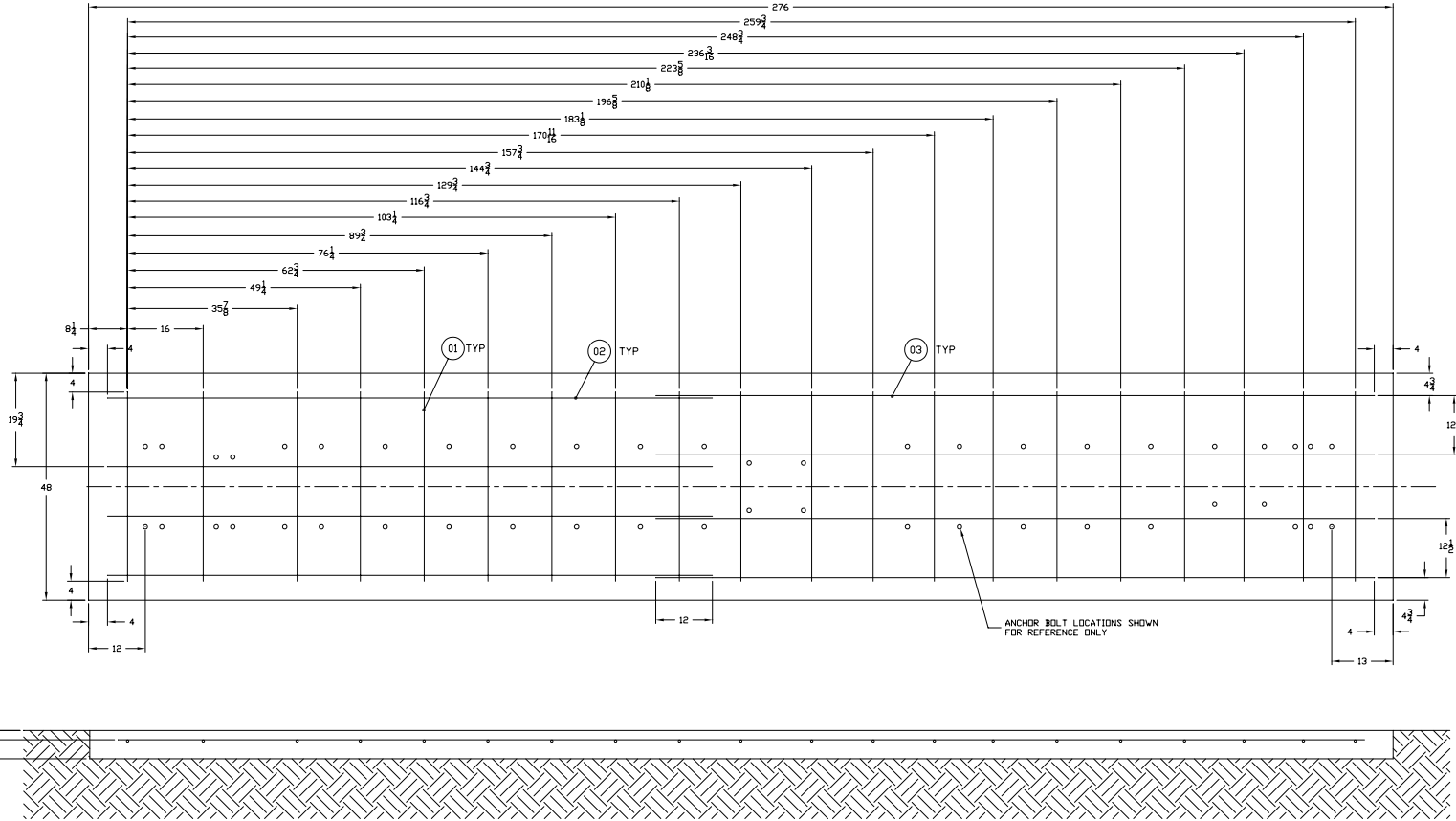
Serial number location



ITEM	QTY	DESCRIPTION	MATERIAL	NOTES
01	56	#4 REBAR (#1/2 - 13mm) x 40 LONG	ASTM-A36	126 LB
02	4	#4 REBAR (#1/2 - 13mm) x 126 LONG	ASTM-A36	53 LB
03	4	#4 REBAR (#1/2 - 13mm) x 152 LONG	ASTM-A36	60 LB

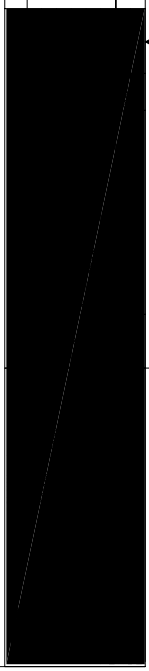
NOTES:
 CONCRETE MINIMUM 4000 PSI
 CROSS SLOPE AT TOP SURFACE NDT TO EXCEED 1 IN 12
 CROSS SLOPE NDT TO VARY MORE THAN 1 IN 48
 TOTAL CONCRETE VOLUME 46 CU FT (1.7 YD)

- 6" Reinforced Concrete Pad with anchor embedment of 5.5"
- 8" Unreinforced Concrete Pad with anchor embedment of 5.5"
- 3" Asphalt over 3" of Concrete with anchor embedment of 16.5"
- 6" Asphalt over 6" of Compacted Subbase with anchor embedment of 16.5"
- 8" Asphalt with anchor embedment of 16.5"



APPENDIX - FIGURE 2 - FOUNDATION DRAWING

PROJECT	END TREATMENT PROTOTYPE
CLIENT	STABLER COMPANIES
COMMERICAL TOLERANCES APPLY TO STOCK SIZES	TOLERANCES
	.03
	.05
	.06
	1/16
	1/2"
	UNLESS OTHERWISE NOTED



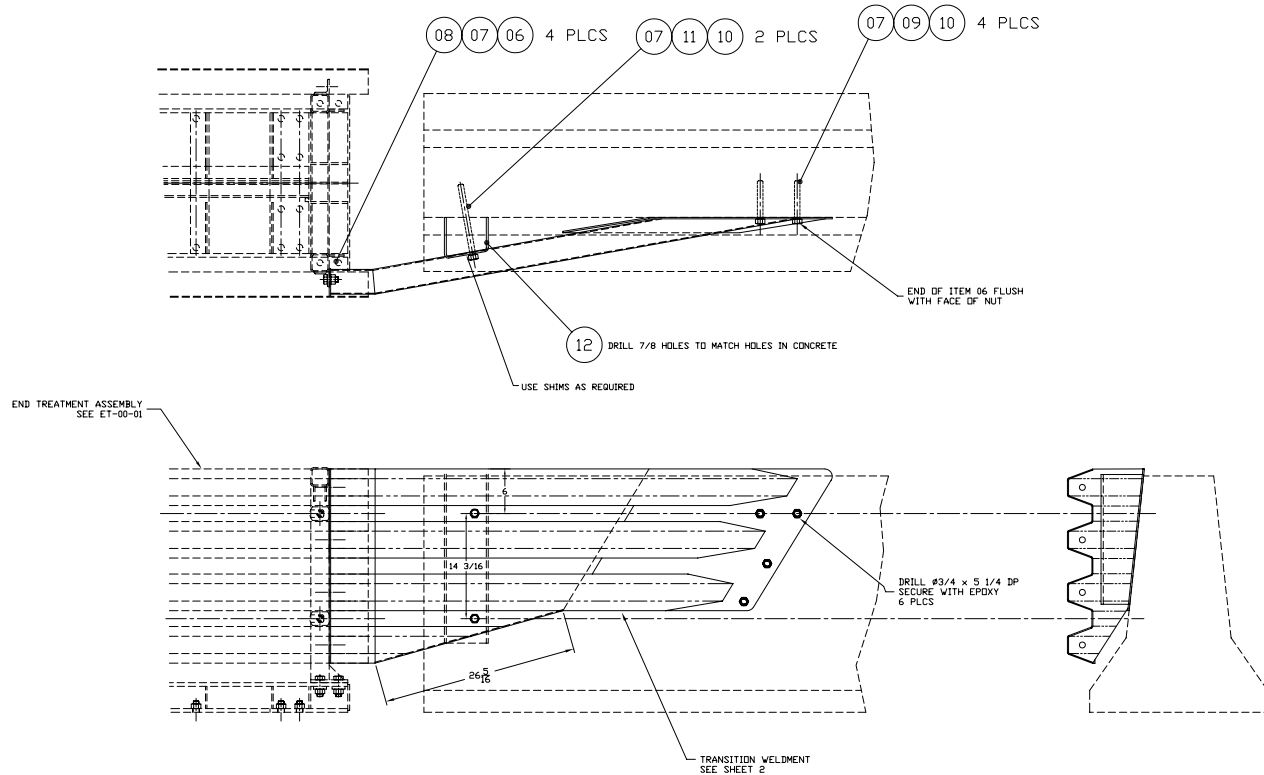
DRAWING NO.	ET-07-01
REV.	F
FILE	ET-07-01.DWG
DRAWN	PIE 06/07/01
CHECKED	LMO 07/30/03
SCALE	1:12
SHEET	1 OF 1
NEXT ASSEMBLY DRAWING NO.	N/A

ITEM	QTY	DESCRIPTION	MATERIAL	NOTES
01	1	SIDE PANEL PER ET-03-02 57 1/16 LONG - NO SLOTS/HOLES	GALV GR 50	92 LB
02	1	SIDE PANEL PER ET-03-02 6 LONG - NO SLOTS/HOLES	GALV GR 50	10 LB
03	1	PLATE 3/16 x 5 1/2 x 26 1/4 LONG	ASTM-A36	4 LB
04	1	PLATE 3/16 x 18 9/16 x 33 1/2 LONG	ASTM-A36	27 LB
05	1	PLATE 10 G6 x 4 x 28 3/8 LONG	ASTM-A36	6 LB
06	4	HEX BOLT A3/4-NC x 1 1/2 LONG	A325	PLTD
07	10	HWY HEX NUT A3/4-NC	A325	STD
08	4	LOCKWASHER FOR A3/4-NC BOLT	GR 5	PLTD
09	4	THREADER ROD A3/4-NC x 5 3/2 LONG	B7	GALV
10	6	FLAT WASHER FOR A3/4-NC	STD	PLTD
11	2	THREADER ROD A3/4-NC x 10 1/4 LONG	B7	GALV
12	1	PLATE 3/16 x 14 x 17 1/2	ASTM A36	20 LB

TOTAL WEIGHT OF WELDMENT: 159 LB

FINISH: HOT DIP GALVANIZED

APPENDIX - FIGURE 4 - JERSEY BARRIER TRANSITION Right Hand Model Shown



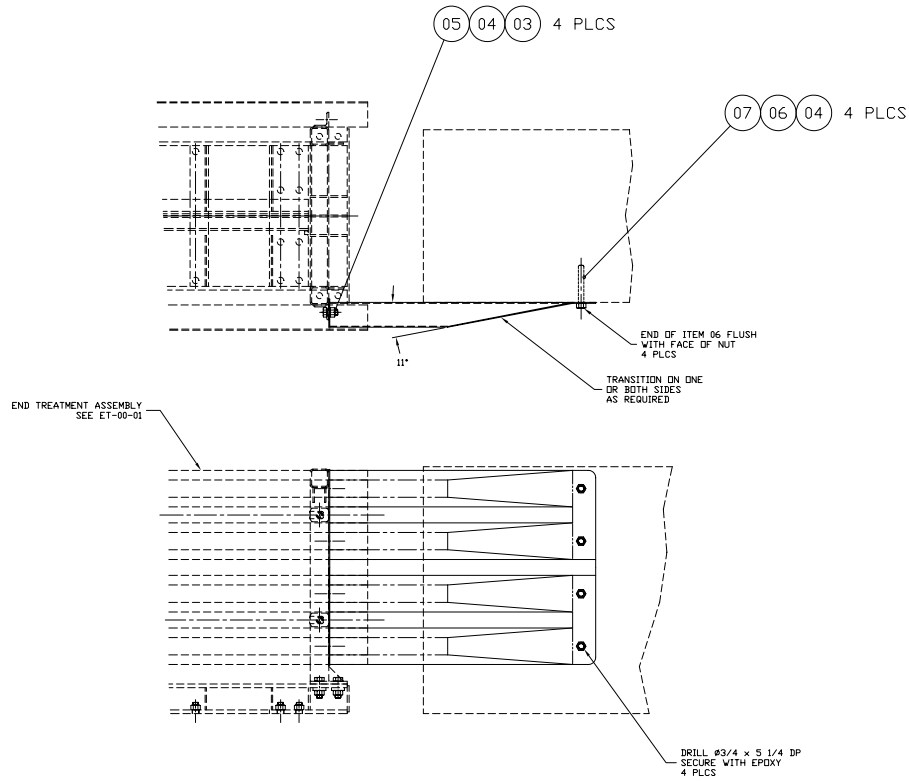
DRAWING NO. ET-06-03-1	REV. P
PROJECT END TREATMENT PROTOTYPE	CLIENT STABLER COMPANIES
FILE ET-06-03-1.DWG	DATE 06/07/01
DRAWN BY PLC	CHECKED BY LMO
SCALE 1:8	SHEET 1 OF 2
COMMERICAL TOLERANCES APPLY TO STOCK SIZES	TOLERANCES
x .03	
xx .05	
xxx .06	
FRACTIONS ± 1/16	
ANGLES ± 1/2°	
ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED	

**LEVEL 3 SYSTEM
JERSEY BARRIER TRANSITION**

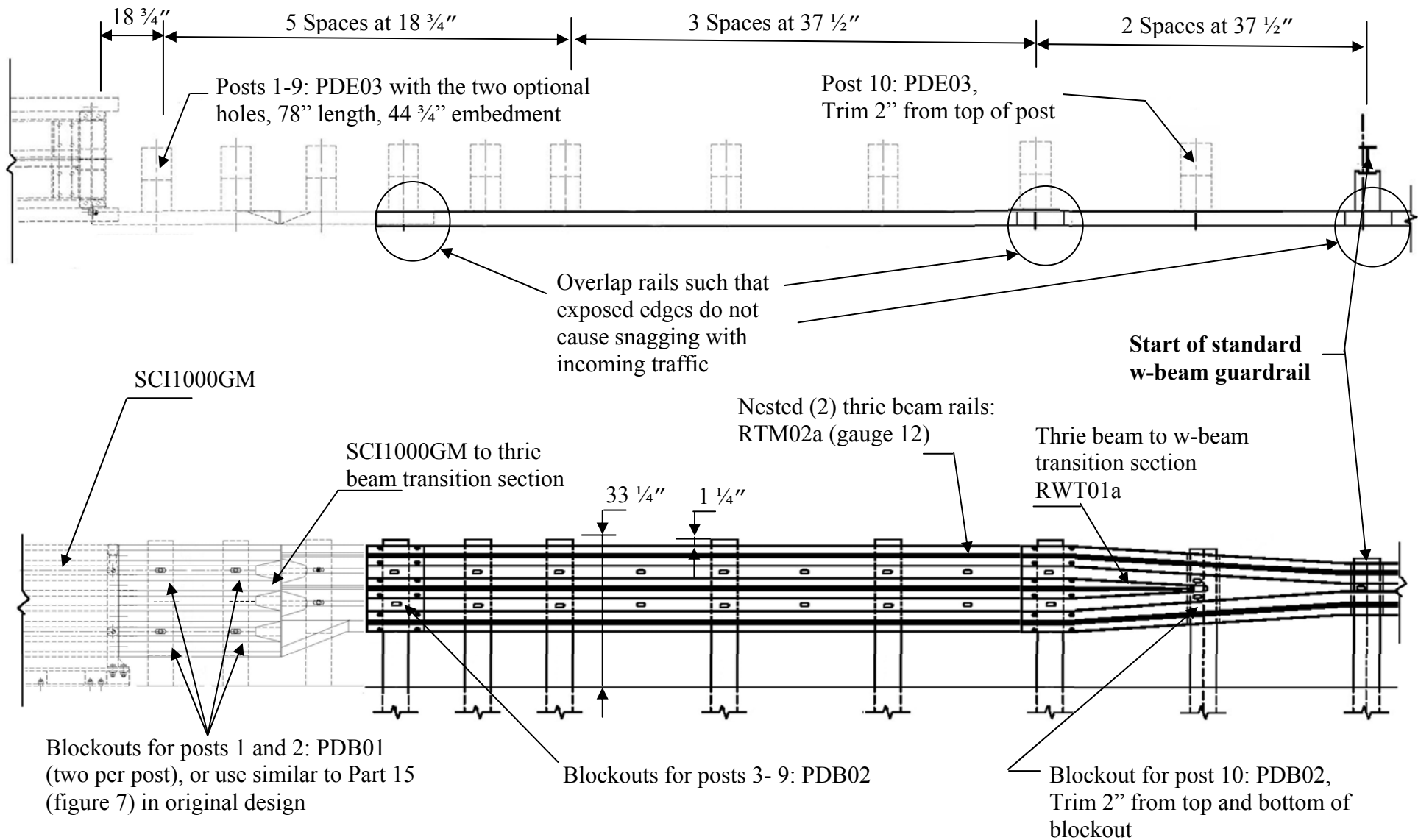
ITEM	QTY	DESCRIPTION	MATERIAL	NOTES
01	1	SHEET 10 gp x 44 x 32 3/4 LONG	GALV gr 50	50 LB
02	1	SHEET 10 gp x 3 13/16 x 26 1/2 LONG	GALV gr 50	4 LB
03	4	HEX BOLT A3/4-NC x 1 1/2 LONG	A305 GALV	
04	8	HWY HEX NUT A3/4-NC	A305 GALV	
05	4	LOCKWASHER FOR A3/4-NC BOLT	GR 5 PLTD	
06	4	THREADED ROD A3/4-NC x 5 1/2 LONG	97	GALV
07	4	FLAT WASHER FOR A3/4-NC	A305 GALV	
08	1	SHEET 10 gp x 26 3/16 x 20 1/2 LONG	GALV gr 50	16 LB

WEIGHT 70 LB PLUS HARDWARE

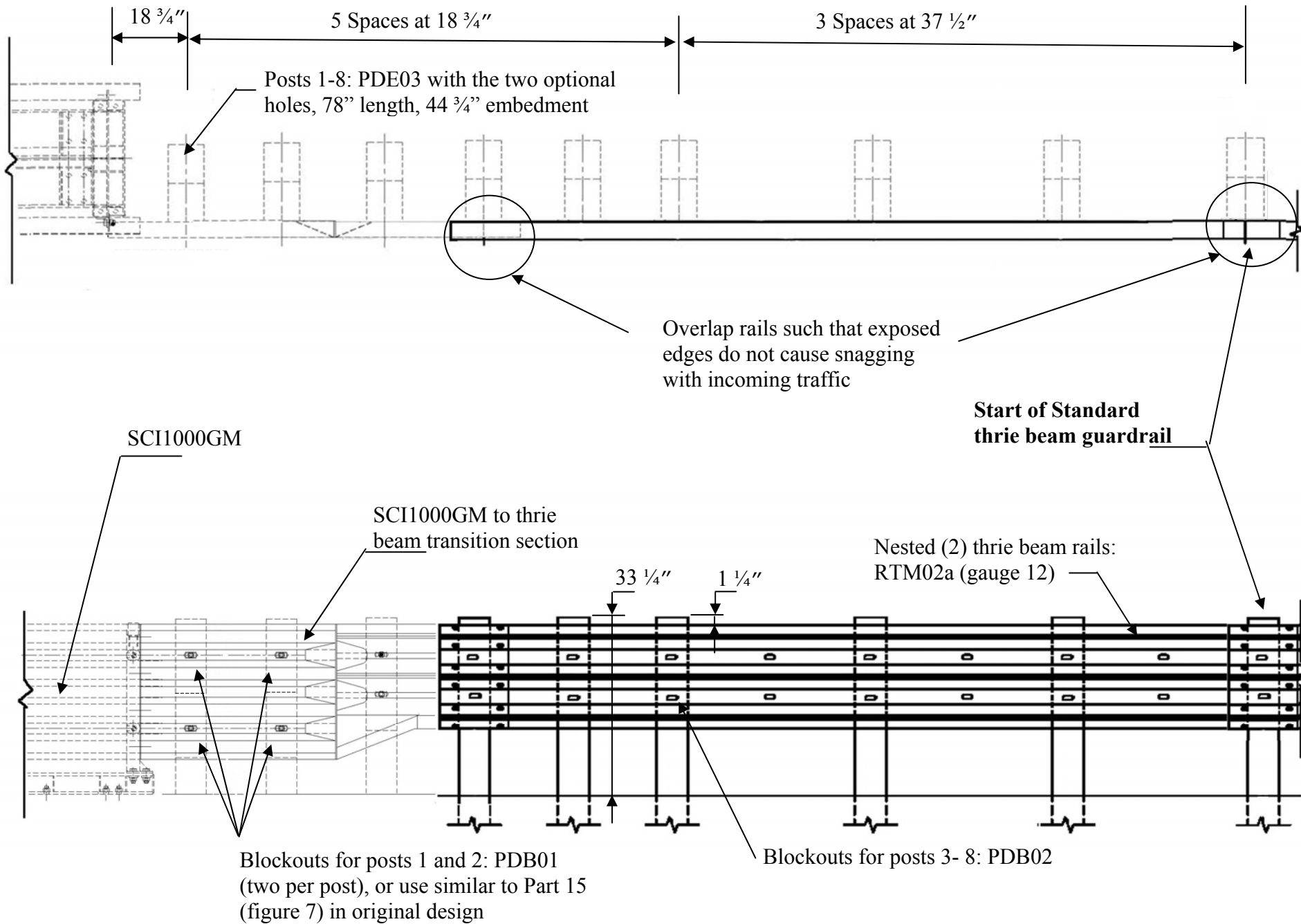
APPENDIX - FIGURE 5 - CONCRETE BARRIER TRANSITION



DRAWING NO.	ET-06-04	REV.	-
FILE			
DRAWN		CHECKED	
SCALE	1:8	SHEET	1 OF 1
PROJECT	END TREATMENT	CLIENT ASSEMBLY DRAWING NO.	N/A
COMMERCIAL TOLERANCES APPLY TO STOCK SIZES	TOLERANCES .x .03 .xx .015 .xxx .008 FRACTIONS ± 1/16 ANGLES ± 1/2° ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED		
PROJECT	END TREATMENT	CLIENT	STABLER COMPANIES, INC
LEVEL 3 SYSTEM		CONCRETE BLOCK TRANSITION	

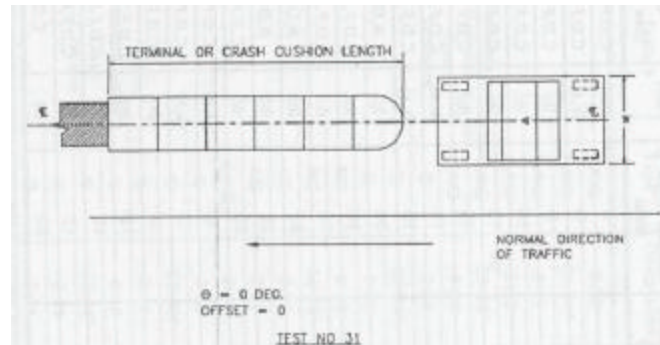


APPENDIX - FIGURE 6 - W-BEAM TRANSITION □
Right Hand Model Shown



APPENDIX - FIGURE 7 - THRIE BEAM TRANSITION □
Right Hand Model Shown

DATA SHEET NO. 4
SUMMARY OF RESULTS FOR TEST NO. 3-31



GENERAL INFORMATION

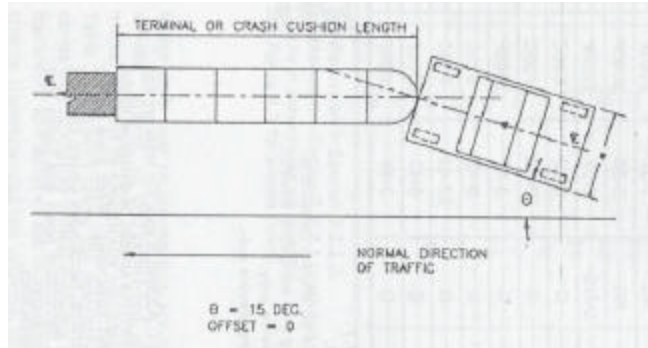
TEST AGENCY	KARCO ENGINEERING, LLC
TEST NO.	3-31
DATE	06/26/03
TEST ARTICLE	END TREATMENT
TYPE	CRASH CUSHION
INSTALLATION LENGTH (m)	6.55 m (21.5 ft)
SIZE AND/OR DIMENSION OF KEY ELEMENTS	
SOIL TYPE AND CONDITION	CONCRETE
TEST VEHICLE	2000P
TYPE	PRODUCTION
DESIGNATION	3-31
MODEL	1991 Chevrolet C2500
MASS (CURB)	2114 kg (4662 lb)
MASS (TEST INERTIAL)	1982 kg (4382 lb.)
DUMMY(s) MASS	N/A
GROSS STATIC WEIGHT	1982 kg (4382 lb.)
IMPACT CONDITIONS	
SPEED (km/h)	101.6
ANGLE (Deg.)	0.0
IMPACT SEVERITY (kJ)	801.61
EXIT CONDITIONS	
SPEED (km/h)	N/A
ANGLE (Deg.)	N/A

OCCUPANT RISK VALUES

IMPACT VELOCITY (m/sec)	
X-DIRECTION	8.6
Y-DIRECTION	1.5
THIV (optional)	N/A
RIDEDOWN ACCELERATION (g's)	
X-DIRECTION	-12.4
Y-DIRECTION	-5.3
PHD (optional)	N/A
ASI (optional)	1.11
TEST ARTICLE DEFLECTIONS (m)	
DYNAMIC LATERAL	0
LONGITUDE	5.13 m (16 ft. 1 0 in.)
PERMANENT	NONE
VEHICLE DAMAGE	
EXTERIOR	
VDS	12-FD3
CDC	12FBWDE2
INTERIOR	
OCDI	RF0001000
POST IMPACT VEHICULAR BEHAVIOR	
MAXIMUM ROLL ANGLE (Deg.)	-2.3
MAXIMUM PITCH ANGLE (Deg.)	4.3
MAXIMUM YAW ANGLE (Deg.)	-4.0

DATA SHEET NO. 4

SUMMARY OF RESULTS FOR TEST NO. 3-32



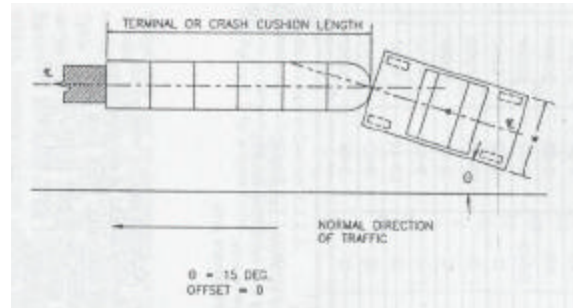
GENERAL INFORMATION

TEST AGENCY	KARCO ENGINEERING, LLC
TEST NO.	3-32
DATE	06/25/03
TEST ARTICLE TYPE	END TREATMENT CRASH CUSHION
INSTALLATION LENGTH (m)	6.55 m (21.5 ft.)
SIZE AND/OR DIMENSION OF KEY ELEMENTS	
SOIL TYPE AND CONDITION	CONCRETE
TEST VEHICLE TYPE	820C PRODUCTION
DESIGNATION	3-32
MODEL	1997 Geo Metro LSI
MASS (CURB)	848 kg (1870 lb)
MASS (TEST INERTIAL)	820 kg (1808 lb.)
DUMMY(s) MASS	75 kg (165 lb.)
GROSS STATIC WEIGHT	893 kg (1970 lb.)
IMPACT CONDITIONS	
SPEED (km/h)	101.2
ANGLE (Deg.)	15.0
IMPACT SEVERITY (kJ)	328.01
EXIT CONDITIONS	
SPEED (km/h)	N/A
ANGLE (Deg.)	N/A

OCCUPANT RISK VALUES

IMPACT VELOCITY (m/sec)	
X-DIRECTION	11.5
Y-DIRECTION	0.9
THIV (optional)	N/A
RIDEDOWN ACCELERATION (g's)	
X-DIRECTION	-13.2
Y-DIRECTION	-7.5
PHD (optional)	N/A
ASI (optional)	1.87
TEST ARTICLE DEFLECTIONS (m)	
DYNAMIC LATERAL LONGITUDE PERMANENT	0
VEHICLE DAMAGE	10 ft. 4 1/2 in.
EXTERIOR	
VDS	11-FD-6
CDC	11FDEW4
INTERIOR	
OCDI	RF0000011
POST IMPACT VEHICULAR BEHAVIOR	
MAXIMUM ROLL ANGLE (Deg.)	-6.4
MAXIMUM PITCH ANGLE (Deg.)	14.2
MAXIMUM YAW ANGLE (Deg.)	-103.7

DATA SHEET NO. 4
SUMMARY OF RESULTS FOR TEST NO. 3-33



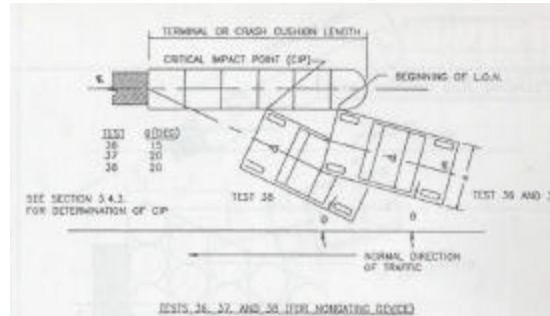
GENERAL INFORMATION

TEST AGENCY	KARCO ENGINEERING, LLC
TEST NO.	3-33
DATE	06/25/03
TEST ARTICLE	END TREATMENT
TYPE	CRASH CUSHION
INSTALLATION LENGTH (m)	6.55 m (21.5 ft.)
SIZE AND/OR DIMENSION OF KEY ELEMENTS	
SOIL TYPE AND CONDITION	CONCRETE
TEST VEHICLE	2000P
TYPE	PRODUCTION
DESIGNATION	3-33
MODEL	1998 Chevrolet C2500
MASS (CURB)	2264 kg (4992 lb)
MASS (TEST INERTIAL)	1992 kg (4370 lb.)
DUMMY(s) MASS	N/A
GROSS STATIC WEIGHT	1992 kg (4370 lb.)
IMPACT CONDITIONS	
SPEED (km/h)	100.6
ANGLE (Deg.)	15.0
IMPACT SEVERITY (kJ)	784.36
EXIT CONDITIONS	
SPEED (km/h)	N/A
ANGLE (Deg.)	N/A

OCCUPANT RISK VALUES

IMPACT VELOCITY (m/sec)	
X-DIRECTION	8.9
Y-DIRECTION	2.4
THIV (optional)	N/A
RIDEDOWN ACCELERATION (g's)	
X-DIRECTION	-10.7
Y-DIRECTION	-5.3
PHD (optional)	N/A
ASI (optional)	1.00
TEST ARTICLE DEFLECTIONS (m)	
DYNAMIC LATERAL LONGITUDE	0
PERMANENT VEHICLE DAMAGE	5.13 m (16 ft. 10 in.)
EXTERIOR	N/A
VDS	11-FD4
CDC	11FWDE3
INTERIOR	
OCDI	RF0001000
POST IMPACT VEHICULAR BEHAVIOR	
MAXIMUM ROLL ANGLE (Deg.)	7.1
MAXIMUM PITCH ANGLE (Deg.)	5.0
MAXIMUM YAW ANGLE (Deg.)	-51.8

DATA SHEET NO. 4
SUMMARY OF RESULTS FOR TEST NO. 3-37



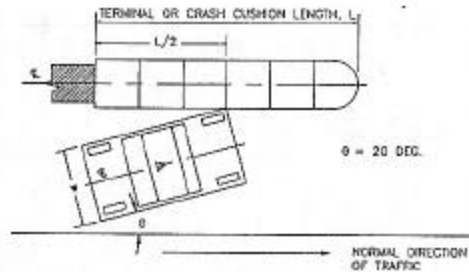
GENERAL INFORMATION

TEST AGENCY	KARCO ENGINEERING, LLC
TEST NO.	3-37
DATE	06/24/03
TEST ARTICLE	END TREATMENT
TYPE	CRASH CUSHION
INSTALLATION LENGTH (m)	6.55 m (21.5 ft.)
SIZE AND/OR DIMENSION OF KEY ELEMENTS	
SOIL TYPE AND CONDITION	CONCRETE
TEST VEHICLE	2000P
TYPE	PRODUCTION
DESIGNATION	3-37
MODEL	1991 Chevrolet C2500
MASS (CURB)	2154 kg (4748 lb)
MASS (TEST INERTIAL)	1975 kg (4354 lb.)
DUMMY(s) MASS	N/A
GROSS STATIC WEIGHT	1975 kg (4354 lb.)
IMPACT CONDITIONS	
SPEED (km/h)	98.9
ANGLE (Deg.)	20.0
IMPACT SEVERITY (kJ)	87.25
EXIT CONDITIONS	
SPEED (km/h)	97.96 kph
ANGLE (Deg.)	0

OCCUPANT RISK VALUES

IMPACT VELOCITY (m/sec)	
X-DIRECTION	1.7
Y-DIRECTION	N/A
THIV (optional)	N/A
RIDEDOWN ACCELERATION (g's)	
X-DIRECTION	6.0
Y-DIRECTION	8.1
PHD (optional)	N/A
ASI (optional)	1.26
TEST ARTICLE DEFLECTIONS (m)	
DYNAMIC LATERAL	~8 inches
PERMANENT	0
VEHICLE DAMAGE	
EXTERIOR	
VDS	2-RFQ-5
CDC	02RDAS6
INTERIOR	
OCDI	RF0000000
POST IMPACT VEHICULAR BEHAVIOR	
MAXIMUM ROLL ANGLE (Deg.)	-26.1
MAXIMUM PITCH ANGLE (Deg.)	-3.5
MAXIMUM YAW ANGLE (Deg.)	0.0

DATA SHEET NO. 4
SUMMARY OF RESULTS FOR TEST NO. 3-39



GENERAL INFORMATION

TEST AGENCY	KARCO ENGINEERING
TEST NO.	3-39
DATE	06/23/03
TEST ARTICLE	END TREATMENT
TYPE	CRASH CUSHION
INSTALLATION LENGTH (m)	6.55 m (21.5 ft.)
SIZE AND/OR DIMENSION OF KEY ELEMENTS	
SOIL TYPE AND CONDITION	CONCRETE
TEST VEHICLE	2000P
TYPE	PRODUCTION
DESIGNATION	3-39
MODEL	1989 Chevrolet C2500
MASS (CURB)	2031 kg (4474 lb)
MASS (TEST INERTIAL)	1964 kg (4330 lb.)
DUMMY(s) MASS	N/A
GROSS STATIC WEIGHT	1964 kg (4330 lb.)
IMPACT CONDITIONS	
SPEED (km/h)	98.9
ANGLE (Deg.)	20.0
IMPACT SEVERITY (kJ)	87.79
EXIT CONDITIONS	
SPEED (km/h)	84.6
ANGLE (Deg.)	0

OCCUPANT RISK VALUES

IMPACT VELOCITY (m/sec)	
X-DIRECTION	4.3
Y-DIRECTION	N/A
THIV (optional)	N/A
RIDEDOWN ACCELERATION (g's)	
X-DIRECTION	12.3
Y-DIRECTION	N/A
PHD (optional)	N/A
ASI (optional)	1.72
TEST ARTICLE DEFLECTIONS (m)	
DYNAMIC LATERAL	102 mm (4 in.)
PERMANENT	0
VEHICLE DAMAGE	
EXTERIOR	
VDS	2-RFQ-7
CDC	02RDAS9
INTERIOR	
OCDI	RF0001010
POST IMPACT VEHICULAR BEHAVIOR	
MAXIMUM ROLL ANGLE (Deg.)	-22.4
MAXIMUM PITCH ANGLE (Deg.)	-6.7
MAXIMUM YAW ANGLE (Deg.)	-25.3