

July 10, 2003

Refer to: HSA-10/CC-78A

Barry D. Stephens, P.E.
Senior Vice President of Engineering
ENERGY ABSORPTION Systems, Inc.
3617 Cincinnati Avenue
Rocklin, California 95765

Dear Mr. Stephens:

Your April 8 and April 23 letters were recently delivered to Mr. Richard Powers of my staff by Mr. Douglas Bernard. In those letters, you requested the Federal Highway Administration's (FHWA) acknowledgement that your modified Safe Stop 180 truck mounted attenuator (TMA) successfully met the evaluation criteria for the supplemental TMA tests recommended in the National Cooperative Highway Research Program (NCHRP) Report 350. To support your request, you provided copies of an April 2003 report by E-TECH Testing Services, Inc., entitled "NCHRP Report 350 Crash Test Results for the Improved Safe-Stop 180 TMA" which contained data on both of the required TMA tests (i.e., test 3-50 and a "modified" test 3-51 as described below), and on the optional tests (tests 3-52 and 3-53). With the April 23 letter, you submitted a supplemental report that contained the results of the standard TMA test 3-51. However, you requested that the FHWA withhold issuance of its formal acceptance letter until July when the new Safe-Stop 180 was expected to be ready for distribution.

Like the original Safe-Stop 180, the improved version is 4190-mm long and 2360-mm wide at the impact face, but weighs approximately 5 kilograms less (940 kg). Although there were some minor external changes made, the most significant change was in the internal arrangement of the individual energy-absorbing cells to accommodate off-center and/or angle impacts into the end of the unit. Enclosure 1 is a drawing of the improved Safe Stop 180.

Enclosure 2 consists of the summary sheets for Report 350 tests 3-50, 3-51, 3-52, and 3-53. All evaluation criteria were met, but in each test the actual impact speeds were below the nominal speed of 100 km/h. In fact, for modified test 3-51 (see Enclosure 3) where the support vehicle was physically blocked to minimize forward movement and in test 3-52, the reported impact speeds were slightly below the speed tolerance recommended for these tests. Since the impact speed was within tolerance for the standard test 3-51 and ridedown acceleration reported in test 3-52 was 17.8 g's (2.2 g's below the allowable limit), I will accept the results of these two tests

in spite of the reported low Impact Severity (IS). Please note section 3.3.5 in Report 350 recommends that "...the actual IS be equal to or greater than the target value" for a TMA. In none of the tests you conducted was the target value obtained. However, in the two tests noted above none of the evaluation criteria were at the upper limit. I am reasonably confident that the improved Safe Stop 180 would meet all evaluation criteria if the target IS had been met, but at some point in the future the FHWA may not accept the results of new tests for TMAs (or crash cushions) in which the target impact severities are not substantially met and one or more of the evaluation criteria are at or near the upper limits.

In light of the above discussion, your improved Safe Stop 180 is acceptable for use on the National Highway System as a TL-3 TMA when such use is acceptable to the contracting authority. Since the improved version is similar in outward appearance to the original design, the new unit should be clearly marked in some manner so the two designs can be readily differentiated in the field.

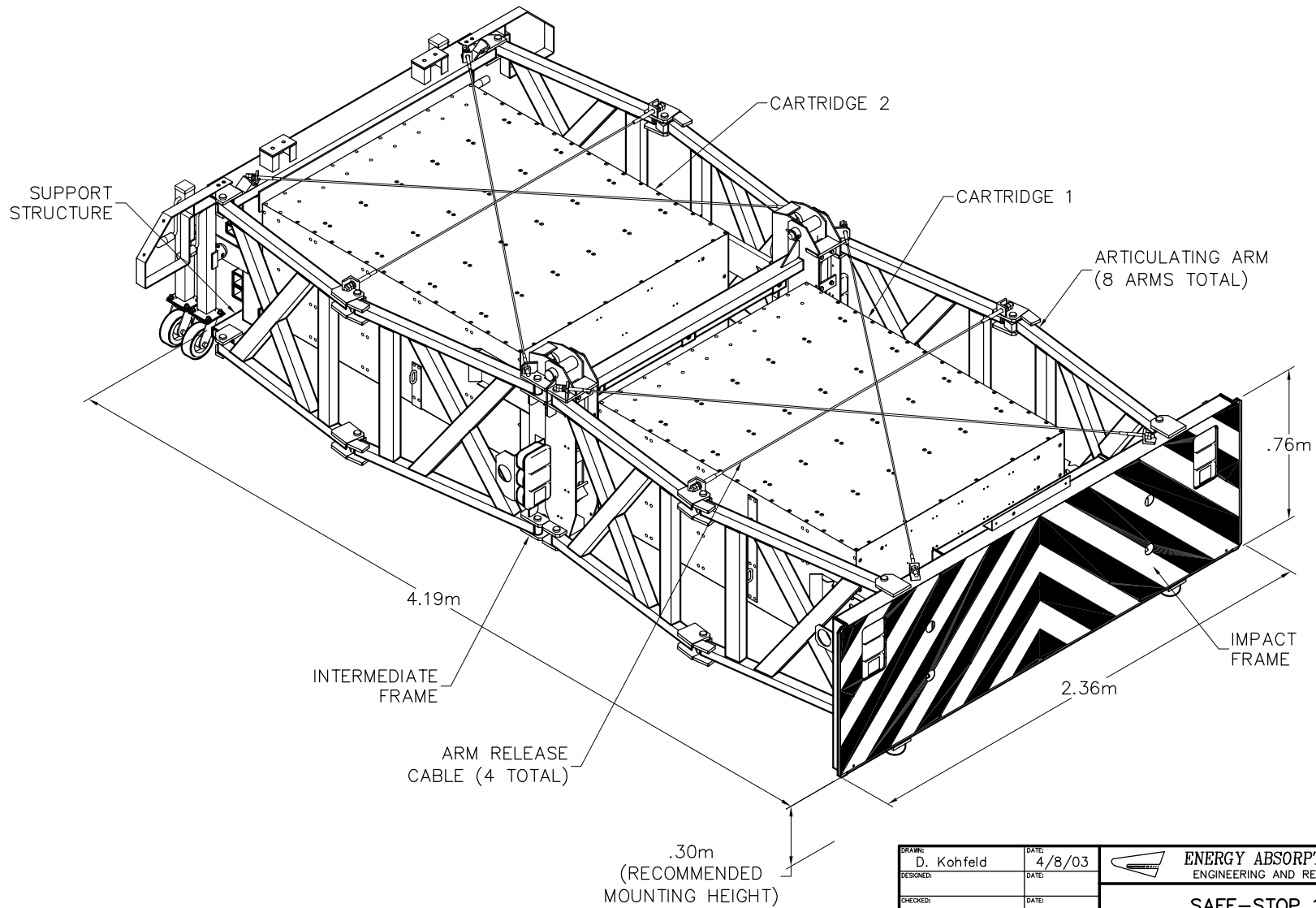
As noted above, your modified test 3-51 consisted of a blocked support vehicle and all evaluation criteria were met except the ridedown acceleration, which was reported to be 20.7 g's. Since the support vehicle could not roll forward when blocked, a truck of any weight over 9,000 kg could be used as a support vehicle and similar accelerations would be likely. I agree that a heavier support vehicle can be used with the improved Safe Stop 180 at the discretion of the contracting authority and with its understanding that ridedown accelerations will approach and may surpass the 20 g limit under some impact conditions when the support vehicle is significantly heavier than 9,000 kg.

Sincerely yours,

(original signed by Michael S. Griffith)

Michael S. Griffith
Acting Director, Office of Safety Design
Office of Safety


3 Enclosures



.30m
(RECOMMENDED
MOUNTING HEIGHT)

FIGURE 1

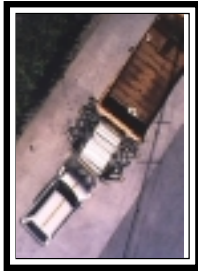
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DESIGNED:	DATE:
CHECKED:	DATE:
APPROVED:	DATE:
D.C.:	DATE:
CAD FILE: SAFE-STOP 180 TMA.dwg	

 ENERGY ABSORPTION SYSTEMS, INC. ENGINEERING AND RESEARCH DEPARTMENT			
	SAFE-STOP 180 TMA		
SCALE: 1=1	DWG.:	SHEET: 1 of 1	REV:



E-TECH Testing Services, Inc.

3617 B Cincinnati Avenue
 Rocklin, CA 95765
 PHONE (916) 645-8188
 FAX (916) 645-3653



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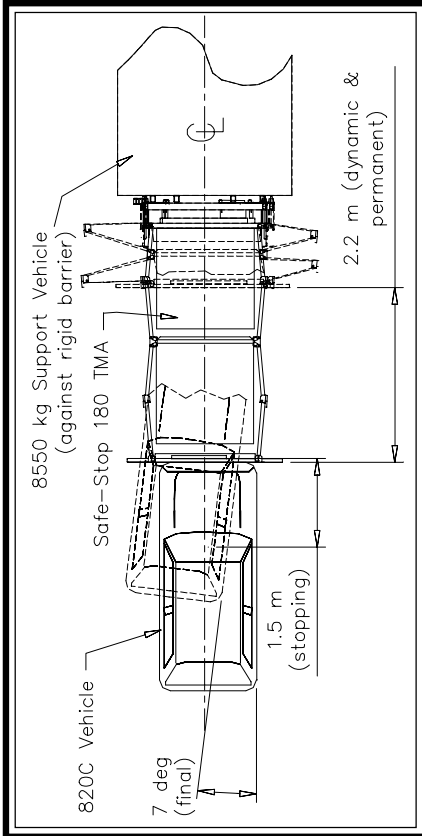
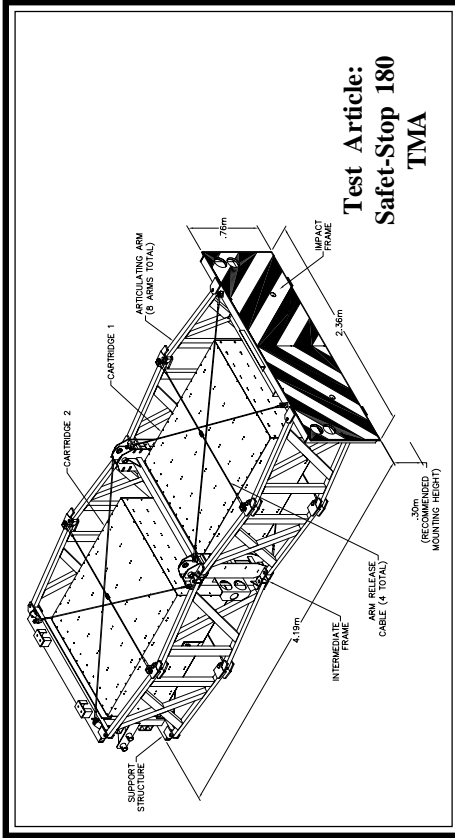
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General Information

Test Agency	E-TECH Testing Services, Inc.
Test Designation	NCHRP 350 Test 3-50
Test No.	01-4307-006
Date	3/18/03
Test Article	
Type	Energy Absorption Systems, Inc. Safet-Stop 180 TMA™
Installation Length, (mm)	4191 (overall system)
Material and key elements	(2) Aluminum Cartridges; LxHxW 1524 mm x 572 mm x 1219 mm
Foundation Type and Condition	Concrete, clean and dry
Test Vehicle	
Type	Production Model
Designation	820C
Model	1988 Ford Festiva
Mass (kg)	809
Curb	828
Test inertial	75
Dummy	903
Gross Static	1970 GMC 7500 T/A Dump
Support Vehicle Model	8550
Test Inertial Mass (kg)	Against rigid barrier
Restraint	
Impact Conditions	
Speed (km/h)	97.7
Angle (deg)	0
Impact Severity (kJ)	304.7

**Test Article:
Safet-Stop 180
TMA**

NCHRP 350 Occupant Risk Values

Impact Velocity (m/s)	11.1
x-direction	-0.2
y-direction	-16.2
z-direction	8.1
Ridedown Acceleration (g's)	
x-direction	N/A
y-direction	39.9
z-direction	16.7
Support Vehicle Acceleration (g's)	2.1
European Committee for Normalization (CEN) Values	
THIV (km/h)	2.2
PHD (g's)	2.2
ASI	2.2
Test Article Deflections (m)	
Dynamic	FD-6
Permanent	12FDEW5
Vehicle Damage	
Exterior	
VDS	
CDC	
Interior	
OCDI	AS0000000
Deflection (mm - max)	100
Post-Impact Vehicular Behavior (deg - rate gyro)	
Maximum Roll Angle	5.6
Maximum Pitch Angle	-25.7
Maximum Yaw Angle	-8.2

Figure 1. Summary of Results - Safe-Stop 180 TMA Test 01-4307-006



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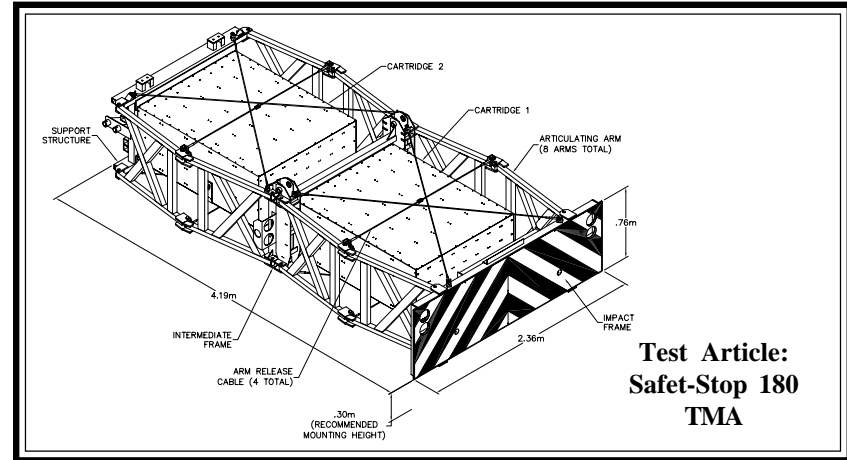
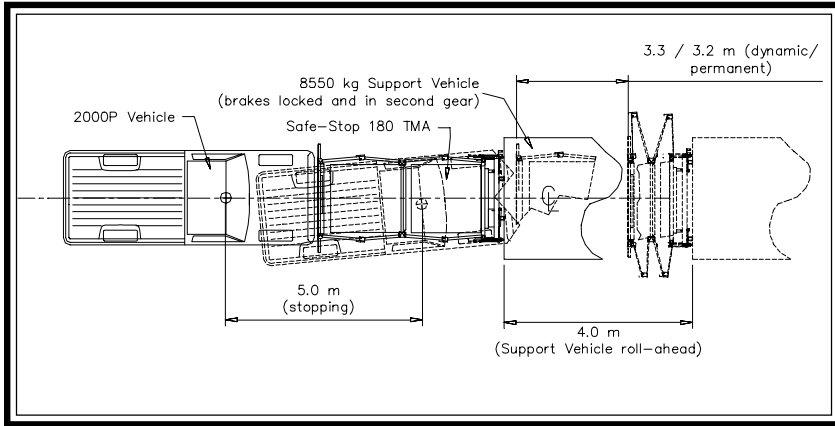
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Test Article:
Safet-Stop 180
TMA

General Information

Test Agency E-TECH Testing Services, Inc.
 Test Designation NCHRP 350 Test 3-51
 Test No. 01-4307-007
 Date 4/16/03

Test Article

Type Energy Absorption Systems, Inc.
 Safe-Stop 180 TMA™
 Installation Length, (mm) 4191 (overall system)
 Material and key elements (2) Aluminum Cartridges; LxHxW
 1524 mm x 572 mm x 1219 mm

Foundation Type and Condition

Concrete, clean and dry

Test Vehicle

Type Production Model
 Designation 2000P Pickup
 Model 1990 Chevrolet C2500
 Mass (kg)
 Curb 1980
 Test inertial 1998
 Dummy N/A
 Gross Static 1998

Support Vehicle

Model 1970 GMC 7500 T/A Dump
 Test Inertial Mass (kg) 8550
 Restraint Park brakes on / second gear

Impact Conditions

Speed (km/h) 96.4
 Angle (deg) 0
 Impact Severity (kJ) 715.8

NCHRP 350 Occupant Risk Values

Impact Velocity (m/s)
 x-direction 9.0
 y-direction -0.3
 Ridedown Acceleration (g's)
 x-direction -17.2
 y-direction -2.7
 Support Vehicle Acceleration (g's)
 x-direction 5.9

European Committee for Normalization (CEN) Values

THIV (km/h) 32.4
 PHD (g's) 17.2
 ASI 1.3

Test Article Deflections (m)

Dynamic 3.3
 Permanent 3.2

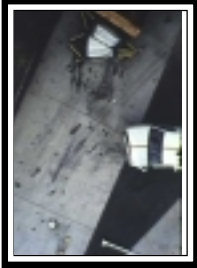
Vehicle Damage

Exterior
 VDS FD-6
 CDC 12FDEW5
 Interior
 OCIDI AS0000000
 Deformation (mm - max) Negligible

Post-Impact Vehicular Behavior (deg - rate gyro)

Maximum Roll Angle -3.8
 Maximum Pitch Angle -3.9
 Maximum Yaw Angle -5.3

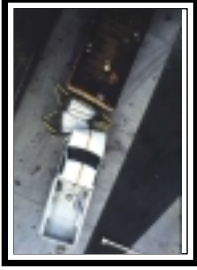
Figure 1. Summary of Results - Safe-Stop 180 TMA Test 01-4307-007



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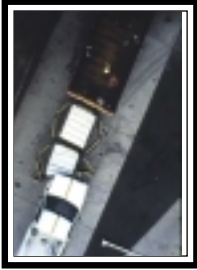
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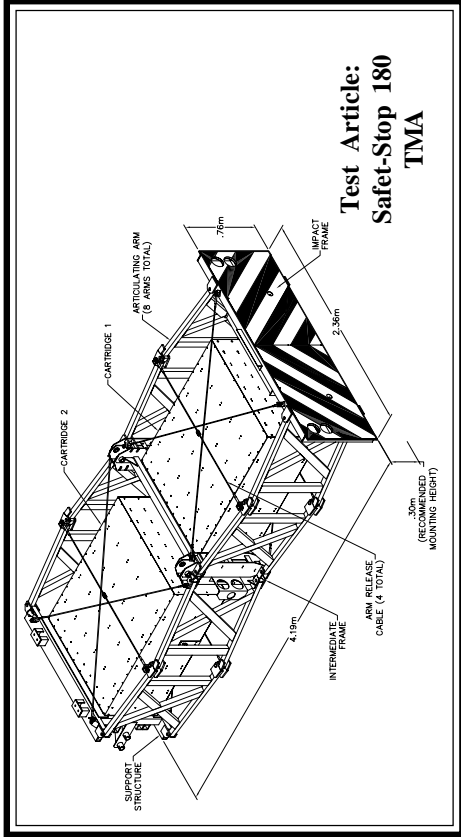
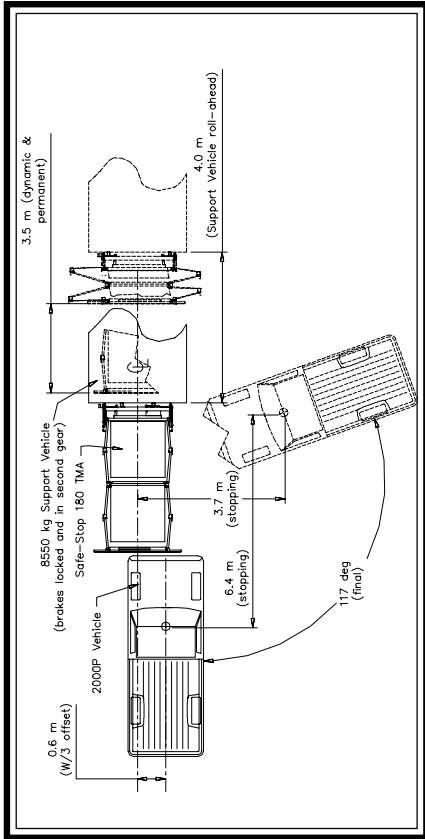
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**Test Article:
 Safe-Stop 180
 TMA**

General Information

Test Agency	E-TECH Testing Services, Inc.
Test Designation	NCHRP 350 Test 3-52
Test No.	01-4307-003
Date	2/25/03
Test Article	Energy Absorption Systems, Inc. Safe-Stop 180 TMA™ 4191 (overall system) (2) Aluminum Cartridges; LxHxW 1524 mm x 572 mm x 1219 mm Concrete, clean and dry
Type	
Installation Length, (mm)	
Material and key elements	
Foundation Type and Condition	
Test Vehicle	
Type	2000P Pickup
Designation	1990 Chevrolet C2500
Model	
Mass (kg)	
Curb	2006
Test inertial	1988
Dummy	N/A
Gross Static	1988
Support Vehicle	
Model	1970 GMC 7500 T/A Dump
Test Inertial Mass (kg)	8550
Restraint	Park brakes on / second gear
Impact Conditions	
Speed (km/h)	95.7
Angle (deg)	0
Impact Severity (kJ)	702.4

NCHRP 350 Occupant Risk Values

Impact Velocity (m/s)	
x-direction	8.8
y-direction	0.5
Ridedown Acceleration (g's)	
x-direction	-17.9
y-direction	6.0
Support Vehicle Acceleration (g's)	
x-direction	5.2
European Committee for Normalization (CEN) Values	
THIV (km/h)	32.0
PHD (g's)	18.2
ASI	1.3
Test Article Deflections (m)	
Dynamic	3.5
Permanent	3.5
Vehicle Damage	
Permanent	FD-6
Exterior	12FDEW5
VDS	
CDC	
Interior	
OCDI	AS0000000
Deformation (mm - max)	Negligible
Post-Impact Vehicular Behavior (deg - rate gyro)	
Maximum Roll Angle	-12.9
Maximum Pitch Angle	-8.1
Maximum Yaw Angle	--117.0

Figure 11. Summary of Results - Safe-Stop 180 TMA Test 01-4307-003



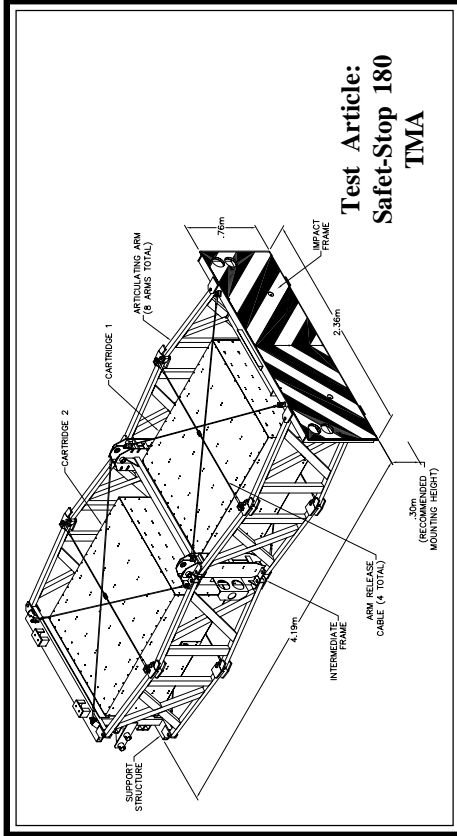
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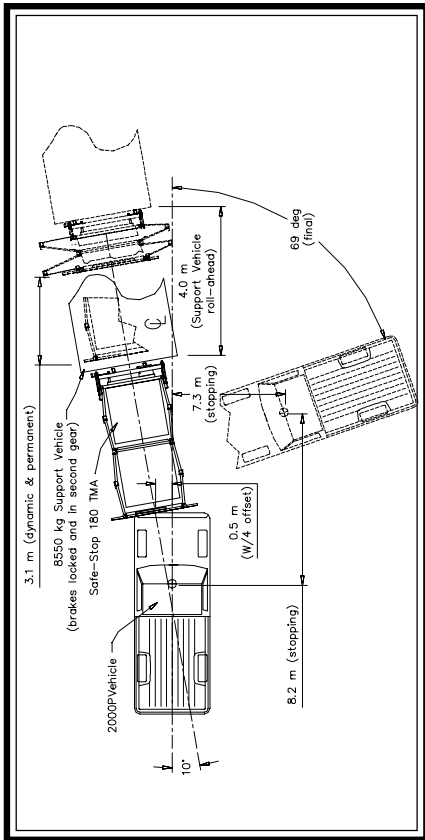
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**Test Article:
 Safe-Stop 180
 TMA**



General Information

Test Agency	E-TECH Testing Services, Inc.
Test Designation	NCHRP 350 Test 3-53
Test No.	01-4307-004
Date	2/27/03
Test Article	Energy Absorption Systems, Inc. Safe-Stop 180 TMA™
Type	4191 (overall system)
Installation Length, (mm)	(2) Aluminum Cartridges; LxHxW
Material and key elements	1524 mm x 572 mm x 1219 mm
Foundation Type and Condition	Concrete, clean and dry
Test Vehicle	Production Model
Type	2000P Pickup
Designation	1989 Chevrolet C2500
Model	2038
Mass (kg)	2021
Curb	N/A
Test inertial	2021
Dummy	1970 GMC 7500 T/A Dump
Gross Static	8550
Support Vehicle	Park brakes on / second gear
Model	
Test Inertial Mass (kg)	
Restraint	
Impact Conditions	
Speed (km/h)	97.0
Angle (deg)	10
Impact Severity (kJ)	733.7

NCHRP 350 Occupant Risk Values	
Impact Velocity (m/s)	8.3
x-direction	0.9
y-direction	-17.3
Ridedown Acceleration (g's)	7.6
x-direction	
y-direction	5.5
Support Vehicle Acceleration (g's)	
x-direction	30.1
European Committee for Normalization (CEN) Values	18.1
THIV (km/h)	1.1
PHD (g's)	
ASI	3.1
Test Article Deflections (m)	3.1
Dynamic	
Permanent	
Vehicle Damage	
Exterior	
VDS	FD-6
CDC	12FDEW5
Interior	
OCDI	AS0000000
Deformation (mm - max)	Negligible
Post-Impact Vehicular Behavior (deg - rate gyro)	
Maximum Roll Angle	-16.2
Maximum Pitch Angle	-5.8
Maximum Yaw Angle	-110.7

Figure 16. Summary of Results - Safe-Stop 180 TMA Test 01-4307-004