U.S. Department of Transportation
Federal Highway Administration

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

August 16, 2011

In Reply Refer To:
HSSD/CC-26J

Barry D. Stephens, P.E.
Sr. Vice President Engineering
Energy Absorption Systems, Inc.
3617 Cincinnati Avenue
Rocklin, CA 95678

Dear Mr. Stephens:

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

Name of device/system:	REACT 350® II
Type of device/system:	Redirective non-gating impact attenuator
Test Level:	NCHRP Report 350 Test Level 3 (TL-3)
Testing conducted by:	E-TECH Testing Services
Date of request:	December 10, 2010
Date initially acknowledged:	December 22, 2010
Date final package received:	July 22, 2011
Task Force 13 Designator:	SCI 16c

You requested that we find this device acceptable for use on the NHS under the provisions of National Cooperative Highway Research Program (NCHRP) Report 350 “Recommended Procedures for the Safety Performance Evaluation of Highway Features.”

Requirements
Roadside safety devices should meet the guidelines contained in the NCHRP Report 350, "Recommended Procedures for the Safety Performance Evaluation of Highway Features" or the AASHTO Manual for Assessing Safety Hardware. FHWA Memorandum “ACTION: Identifying Acceptable Highway Safety Features” of July 25, 1997, provides further guidance on crash testing requirements of longitudinal barriers.

Decision
The following device was found acceptable, with details provided below:

• REACT 350® II Redirective Non-gating Impact Attenuator

FHWA: HSSI WLongstreet: mb: x60087:8/5/11
File: h: //directory folder/HSST/ CC-26J_REACT 350 II.docx
cc: HSST Will Longstreet

Description

The REACT 350® II Redirective Non-gating Impact Attenuator (REACT 350® II) uses an array of different energy absorbing cylinders with varying wall thicknesses to dissipate impact energy as per FHWA acceptance letters CC-26 (dated March 3, 1995) and CC-26I (dated April 18, 2008). The current design presented in this submission requests FHWA review and acceptance of a shorter six cylinder system which is a self-restoring, redirective, non-gating crash cushion that can be used in temporary or permanent installations for both single-direction and bi-directional traffic applications when appropriately transitioned and anchored. The six-cylinder design includes slightly thicker cylinders in the front and additional internal energy absorbing segments in the first and last two cylinders creating a more robust design as per NCHRP 350 compliance report prepared by E-TECH Testing Services, Inc. The crash test report describes the REACT 350® II as well as the two full-scale crash tests conducted on this new attenuator. Design details are provided as enclosure to this correspondence.

Crash Testing

To validate a shorter design, full-scale NCHRP 350 crash testing was conducted on the following two tests. The crash test summaries are enclosed for reference.

A. NCHRP 350 Test 3-30: This test utilizes a 820C vehicle (100KPH/0 deg/ w/4 offset). The purpose of this test was to evaluate occupant risk and vehicle trajectory criteria for a small 820C passenger vehicle under a head-on centered, one quarter vehicle width offset, impact on the test article. The curb mass of the vehicle was 827 kg, and the final test inertial mass was 827 kg. The actual impact conditions were 97.7 km/h (60.7 mph) and 0 deg. the impact severity was 304.3 kJ which was within the NCHRP 350 recommended tolerance of 316.4 (-24.8/ +25.8) kJ. The maximum dynamic deflection of the test article was 2.4 meters (7.9 feet) and the post-test deflection was 0.8-meter (2.6 feet).

B. NCHRP 350 Test 3-31: This test is a capacity test utilizing a 2000P vehicle (100KPH/0 deg). The purpose of this test was to evaluate the occupant risk and vehicle trajectory criteria for a large 2000P passenger vehicle under a head-on centered impact aligned with the nose of the system. The curb mass of the vehicle was 2063 kg (4548 lbs.) and the final test inertial mass was 2021 kg (4674 lbs.). The actual impact conditions were 97.0 km/h (60.7 mph) and 0 deg. the impact severity was 733.7 kJ which was within the NCHRP 350 recommended tolerance of 771.7 (-60.4 / +62.9) kJ. The maximum dynamic deflection of the test article was 4.0 meters (13.1 feet) and the post-test deflection was 1.0-meter (3.3 feet) immediately after the test.

In addition, other required testing is hereby requested to be waived, as follows:

Test Number	Test Level	Requested Comparison
3-32	TL3	Not necessary since Test 3-30 considered worst case because in 3-32 car yaws quickly, resulting in lower ORV values
3-33	TL3	Not necessary since Test 3-31 considered worst case because in 3-33 pickup yaws quickly, resulting in lower ORV values
3-36	TL3	Not necessary since shorter configuration does not

		affect system performance. Vehicle sees same wire ropes and the cylinder wall thickness (stiffness) has increased, improving performance
3-37	TL3	Not necessary since shorter configuration does not affect system performance. Vehicle sees same wire ropes and the cylinder wall thickness (stiffness) has increased, improving performance (see reference test 270687-VAN9)
3-38	TL3	Not necessary since shorter configuration does not affect system performance. Vehicle sees same wire ropes and the cylinder wall thickness (stiffness) has increased, improving redirective performance. (see reference test 472380-8)
3-39	TL3	Not necessary since shorter configuration does not affect system performance. Vehicle sees same wire ropes and the cylinder wall thickness (stiffness) has increased, improving redirective performance.

Findings

Based upon the successful completion of the provided NCHRP 350 tests and consideration of requested waiver of testing, we concur the six cylinder TL-3 REACT 350® II self restoring, redirective, non-gating crash cushion can be used in temporary or permanent installations for both unidirectional and bidirectional traffic applications when appropriately transitioned and anchored. Therefore, the system as described above may be used on the NHS when such use is acceptable to the contracting authority.

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

- This acceptance provides a AASHTO/ARTBA/AGC Task Force 13 designator that should be used for the purpose of the creation of a new and/or the update of existing Task Force 13 drawing for posting on the on-line 'Guide to Standardized Highway Barrier Hardware' currently referenced in AASHTO 'Roadside Design Guide'.
- This acceptance is limited to the crashworthiness characteristics of the devices/systems and does not cover their structural features, nor conformity with the Manual on Uniform Traffic Control Devices.
- Any changes that may adversely influence the crashworthiness of the device/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 device/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 the NCHRP Report 350.

- To prevent misunderstanding by others, this letter of acceptance is designated as number CC-26J 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 REACT 350® II is a patented product and considered proprietary. If proprietary devices/systems 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 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 device/system for which the applicant is not the patent holder. The acceptance letter is limited to the crashworthiness characteristics of the candidate device/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 Design
Office of Safety

Enclosures

U.S. Department of Transportation
Federal Highway Administration

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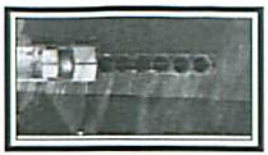
Sincerely yours,

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

Enclosures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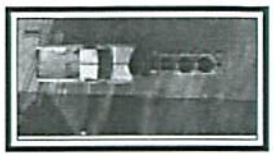
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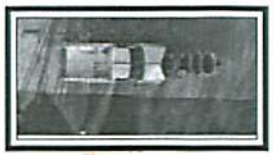
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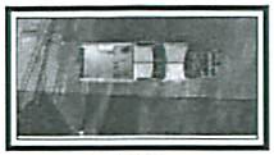
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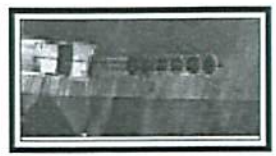
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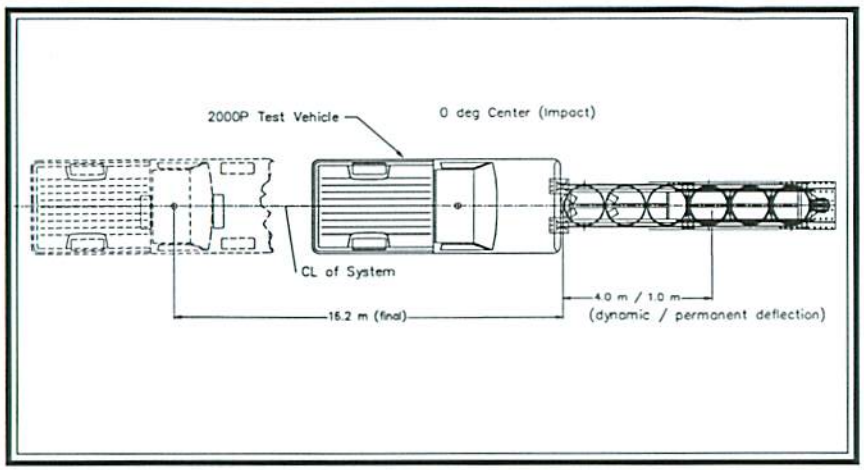
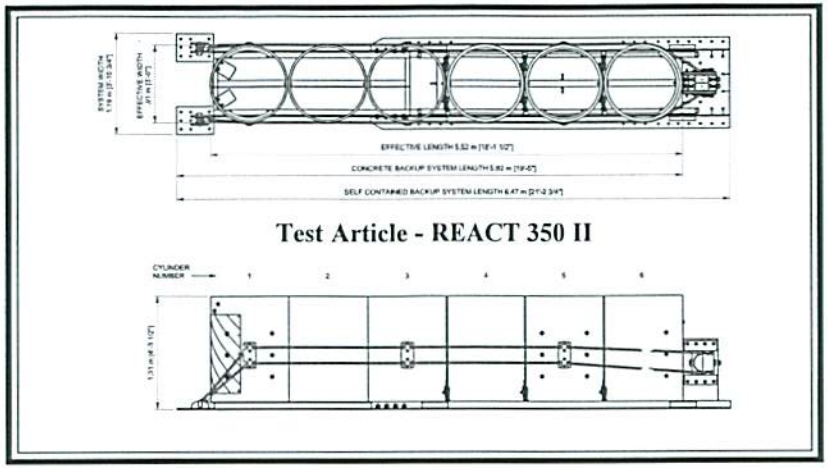
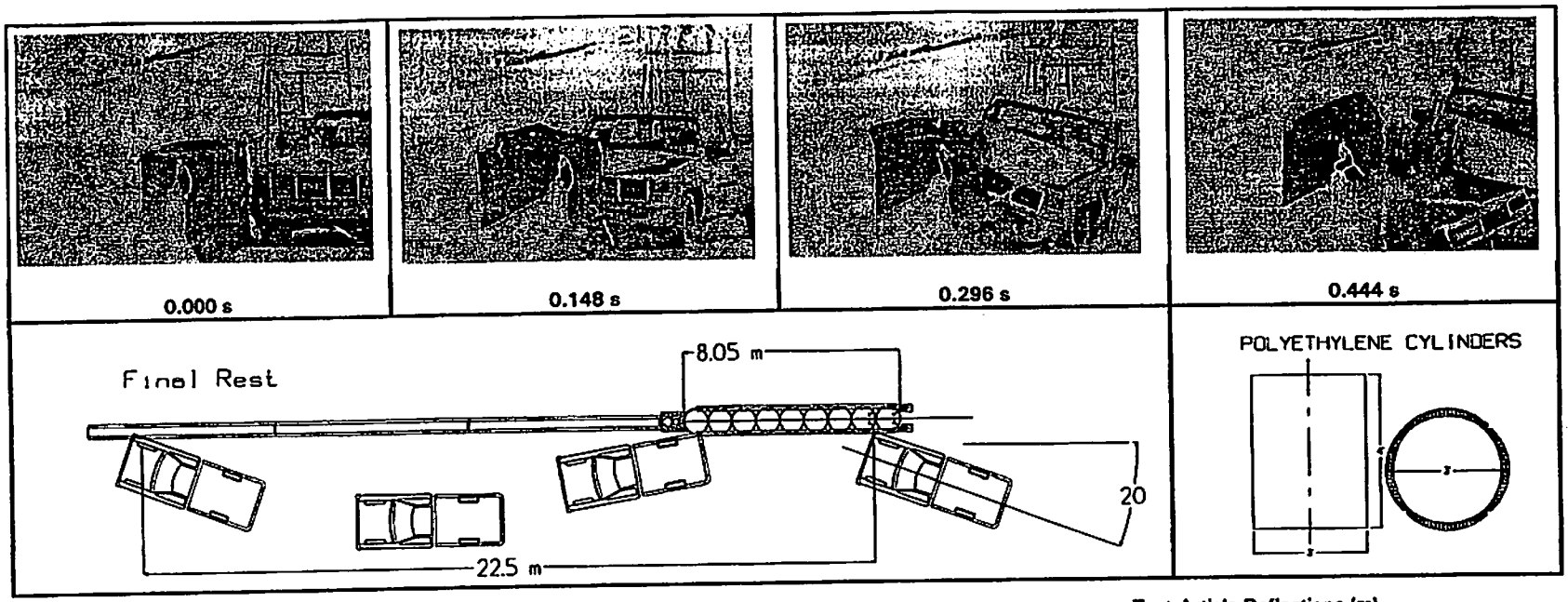




General Information	
Test Agency	E-TECH Testing Services, Inc.
Test Designation	NCHRP 350 Test 3-31
Test No.	01-1670-001
Date	9/30/10
Test Article	
Type	Energy Absorption System
	REACT 350 II
Installation Length,	5.5 m (6 cylinder arraty, effective
	length)
Material and key elements	(6) 915 mm OD HDPE eneergy
	absorbing cylinders
Foundation Type and Condition	Portland Cement Concrete,
	clean and dry, unanchored
Test Vehicle	
Type	Production Model
Designation	2000P
Model	1989 Chevrolet C2500 Pickup
Mass (kg)	
Curb	2063
Test inertial	2021
Dummy	N/A
Gross Static	2021
Impact Conditions	
Speed (km/h)	97.0
Angle (deg)	0
Impact Severity (kJ)	733.7
Exit conditions	
Speed (km/h)	N/A
Angle (deg - veh. c.g.)	N/A
Occupant Risk Values	
Impact Velocity (m/s absolute value)	
x-direction	8.6
y-direction	0.2
Ridedown Acceleration (g's - absolute value)	
x-direction	19.5
y-direction	2.9
European Committee for Normalization (CEN) Values	
THIV (km/h)	30.9
PHD (g's)	19.5
ASI	1.5
Post-Impact Vehicular Behavior (deg - rate gyro)	
Maximum Roll Angle	14.8
Maximum Pitch Angle	-6.1
Maximum Yaw Angle	-9.4
Test Article Deflections (m)	
Dynamic	4.0
Permanent	1.0
Vehicle Damage (Primary Impact)	
Exterior	
VDS	FD-3
CDC	12FDEW3
Interior	
VCDI	AS0000000
Maximum Deformation (mm)	Negligible

Figure 6. Summary of Results - REACT 350 II Test 01-1670-001

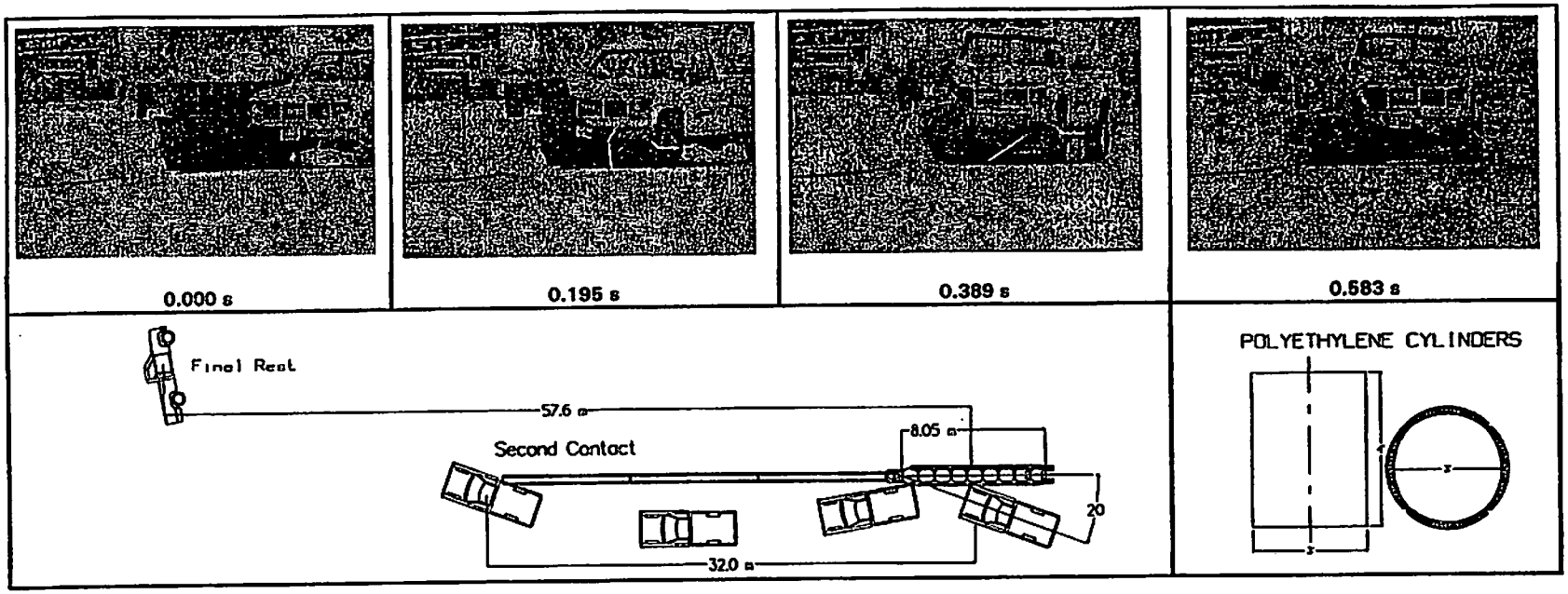


General Information	
Test Agency	Texas Transportation Institute
Test No.	270687-VAN9
Date	3/14/95
Test Article	
Type	Vanderbilt Crash Cushion
Name or Manufacturer	
Installation Length (m)	8.08 (26.52 ft)
Size and/or dimension and material of key elements	Polyethylene Cylinder 1.22 m tall 0.91 m dia.
Soil Type and Condition	N/A
Test Vehicle	
Type	Production
Designation	2000P
Model	1989 GMC 2500 Pickup Series
Mass (kg) Curb	1989 (4384 lb)
Test Inertial	2000 (4409 lb)
Dummy	0
Gross Static	2000 (4409 lb)

Impact Conditions	
Speed (km/h)	102.50(63.7mi/h)
Angle (deg)	20.33
Exit Conditions	
Speed (km/h)	38.29(23.80mi/h)
Angle (deg)	4.30 (Heading)
Occupant Risk Values	25.03 (Transl)
Impact Velocity (m/s)	
x-direction	8.62 (28.27ft/s)
y-direction	4.01 (13.16ft/s)
THIV (optional)	
Ridedown Accelerations (g's)	
x-direction	-15.18
y-direction	-18.10
PHD (optional)	
ASI (optional)	
Max. 0.050-sec Average (g's)	
x-direction	-10.85
y-direction	-4.06
z-direction	-5.12

Test Article Deflections (m)	
Dynamic	0.84 (2.76 ft)
Permanent	0.30 (1.00 ft)
Vehicle Damage	
Exterior	
VDS	12FR-6
CDC	12FREW5
Interior	
OCDI	FS0105000
Maximum Exterior	
Vehicle Crush (mm)	940 (37.01 in)
Max. Occ. Compart. Deformation (mm)	65 (2.56 in)
Post-Impact Behavior	
Max. Roll Angle (deg)	-19.72
Max. Pitch Angle (deg)	-5.08
Max. Yaw Angle (deg)	-24.07

Summary of results for test 270687-VAN9.



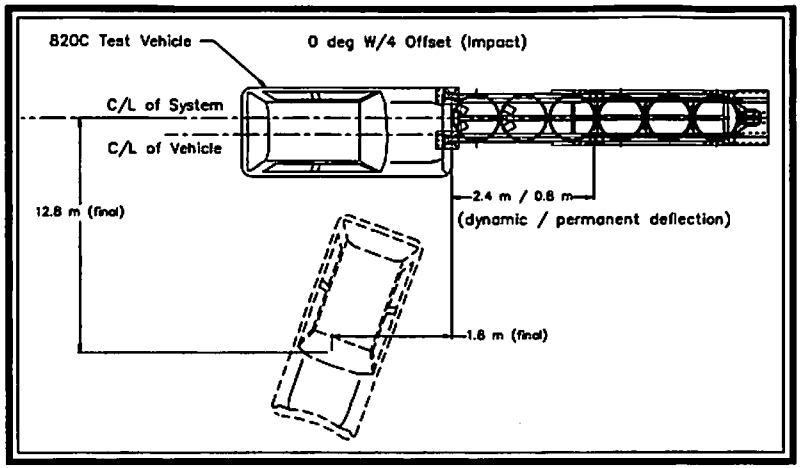
General Information	
Test Agency	Texas Transportation Institute
Test No.	472380-8
Date	1/4/95
Test Article	
Type	Vanderbilt Crash Cushion
Name or Manufacturer	
Installation Length (m)	8.08 (26.52 ft)
Size and/or dimension and material of key elements	Polyethylene Cylinder 1.22 m tall 0.91 m dia.
Soil Type and Condition	N/A
Test Vehicle	
Type	Production
Designation	2000P
Model	1989 GMC 2500 Pickup Series
Mass (kg) Curb	1979 (4363 lb)
Test Inertial	2000 (4409 lb)
Dummy	0
Gross Static	2000 (4409 lb)

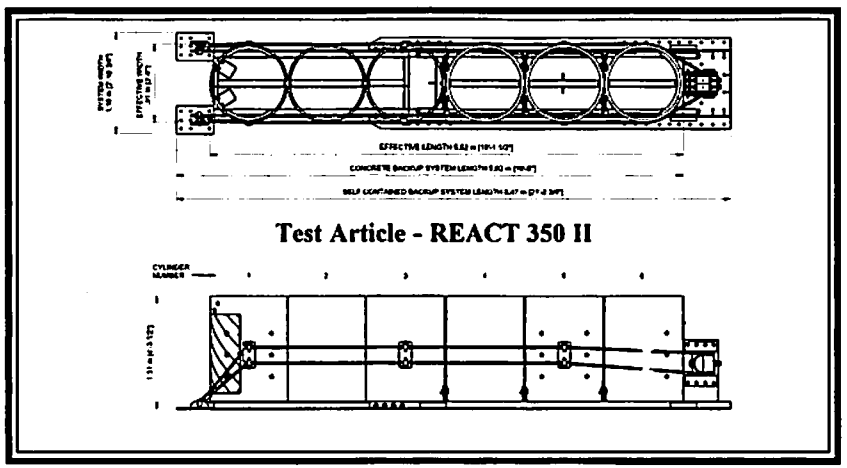
Impact Conditions	
Speed (km/h)	101.92(63.3mi/h)
Angle (deg)	20.7
Exit Conditions	
Speed (km/h)	69.67(43.30mi/h)
Angle (deg)	10.6
Occupant Risk Values	
Impact Velocity (m/s)	
x-direction	8.95 (29.37ft/s)
y-direction	6.90 (22.64ft/s)
THIV (optional)	
Ridedown Accelerations (g's)	
x-direction	-9.59
y-direction	-19.88
PHD (optional)	
ASI (optional)	
Max. 0.050-sec Average (g's)	
x-direction	-10.63
y-direction	-9.61
z-direction	5.40

Test Article Deflections (m)	
Dynamic	0.40 (1.32 ft)
Permanent	0.10 (0.33 ft)
Vehicle Damage	
Exterior	
VDS	12FR-6
CDC	12FREW5
Interior	
OCDI	RF1312100
Maximum Exterior Vehicle Crush (mm)	610 (24.02 in)
Max. Occ. Compart. Deformation (mm)	236 (9.59 in)
Post-Impact Behavior*	
Max. Roll Angle (deg)	5.23
Max. Pitch Angle (deg)	-3.55
Max. Yaw Angle (deg)	-32.77

*Prior to second contact

Summary of results for test 472380-8.





General Information

Test Agency	E-TECH Testing Services, Inc.
Test Designation	NCHRP 350 Test 3-30
Test No.	01-1670-002
Date	10/25/10

Test Article

Type	Energy Absorption System
	REACT 350 II
Installation Length,	5.5 m (6 cylinder arraty, effective length)
Material and key elements	(6) 915 mm OD HDPE eneergy absorbing cylinders
Foundation Type and Condition	Portland Cement Concrete, clean and dry, unanchored

Test Vehicle

Type	Production Model
Designation	820C
Model	1990 Ford Festiva
Mass (kg)	
Curb	827
Test inertial	827
Dummy	75
Gross Static	902

Impact Conditions

Speed (km/h)	97.7
Angle (deg)	0
Impact Severity (kJ)	304.3

Exit conditions

Speed (km/h)	N/A
Angle (deg - veh. c.g.)	N/A

Occupant Risk Values

Impact Velocity (m/s - absolute value)	
x-direction	11.0
y-direction	0.9
Ridedown Acceleration (g's - absolute value)	
x-direction	15.4
y-direction	4.2

European Committee for Normalization (CEN) Values

THIV (km/h)	40.0
PHD (g's)	15.6
ASI	1.3

Post-Impact Vehicular Behavior (deg - rate gyro)

Maximum Roll Angle	-24.9
Maximum Pitch Angle	-47.2
Maximum Yaw Angle	-249.9

Test Article Deflections (m)

Dynamic	2.4
Permanent	0.8

Vehicle Damage (Primary Impact)

Exterior	
VDS	FD-3
CDC	12FDEW3
Interior	
VCDI	AS0000000
Maximum Deformation (mm)	Negligible

Figure 1. Summary of Results - REACT 350 II Test 01-1670-002