



U.S. Department
of Transportation
**Federal Highway
Administration**

400 Seventh St., S.W.
Washington, D.C. 20590

November 28, 2000

Refer to: HSA-1/HSA-CC70

Mr. Barry D. Stephens, P.E.
Senior Vice President-Engineering
Energy Absorption Systems, Inc.
3617 Cincinnati Avenue
Rocklin, CA 95765

Dear Mr. Stephens:

In late July, Mr. Douglas Bernard presented members of my staff information on the DRAGNET Work ZoNet Vehicle Arresting System, including video tapes of two crash tests and copies of E-TECH Testing Services, Inc. June 2000 report entitled "National Cooperative Highway Research Program (NCHRP) Report 350 Crash Test Results of the DRAGNET Work ZoNet." This device is essentially the DRAGNET vehicle arresting system that was originally accepted for use on Federal-aid highway projects in 1983 and reconfirmed in Mr. L.A. Staron's December 6, 1990 letter to Mr. E. Scott Walter. Enclosure 1 shows details of the Work ZoNet and your recommended anchorage designs. Enclosure 2 describes the system and each of its main components.

As noted in your July 20 letter, a specific crash test matrix for an attenuating device like the Work ZoNet is not included in NCHRP Report 350. However, we have previously accepted head-on tests with the 820-kg car and the 2000-kg pickup truck (NCHRP Report 350 test numbers 3-30 and 3-31) as the minimum tests required for vehicle attenuators that are installed across a traffic lane. These are the two tests which you ran to confirm acceptable crash performance under the NCHRP Report 350 at the test level 3 (TL-3) impact speed of 100 km/h. Enclosure 3 shows the summary results of these tests. In both cases, the occupant impact velocities and subsequent ridedown accelerations were significantly below the *desirable* maximum values of 9 m/s and 15 g's. In the tests, the car was stopped in 12.2 m. The pickup truck deflected the net 21.5 m.

The supplemental information you provided with your October 4 letter recommended the use of lightweight, retroreflectorized signs on the net assembly so it is readily visible at all times. We assume these signs (or other retroreflective devices or markings) will conform to the applicable requirements in the Manual on Uniform Traffic Control Devices, and will not detract from the performance of the Work ZoNet nor present a hazard to any motorists or workers if the net is hit. We further assume that adequate advance warning signs or barricades will be installed to advise motorists of roadway and/or lane closures.

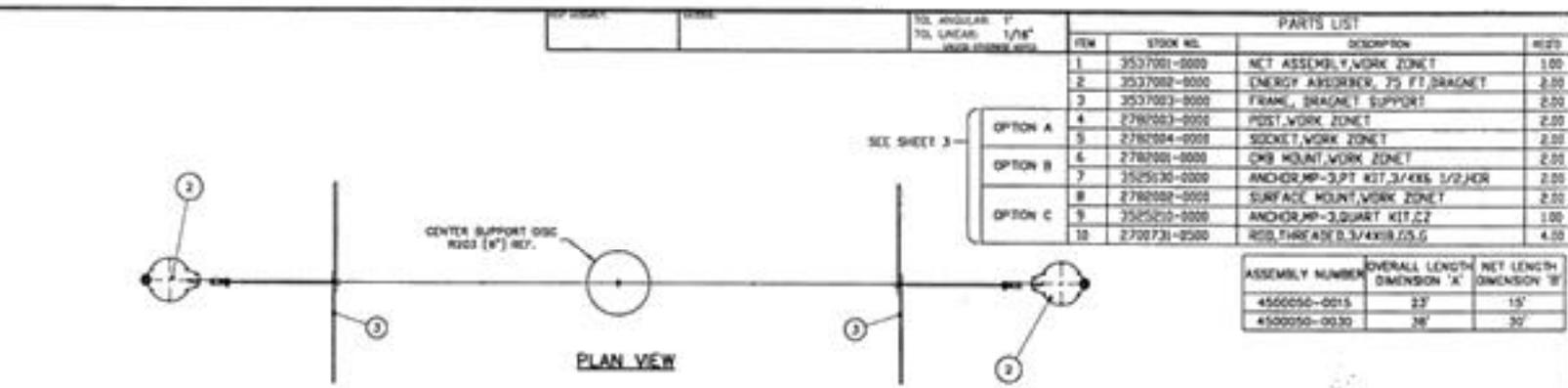
When installed as tested, or when attached to a mounting bracket on permanent (or adequately anchored) temporary concrete barrier, the Work ZoNet may be considered an NCHRP Report 350 TL-3 vehicular attenuator. Since it is a proprietary product, its use on the National Highway System (NHS) remains subject to the conditions listed in Title 23, Code of Federal Regulations, Section 635.411 when it is specified by the contracting authority.

Sincerely yours,

Frederick G. Wright, Jr.
Program Manager, Safety

3 Enclosures

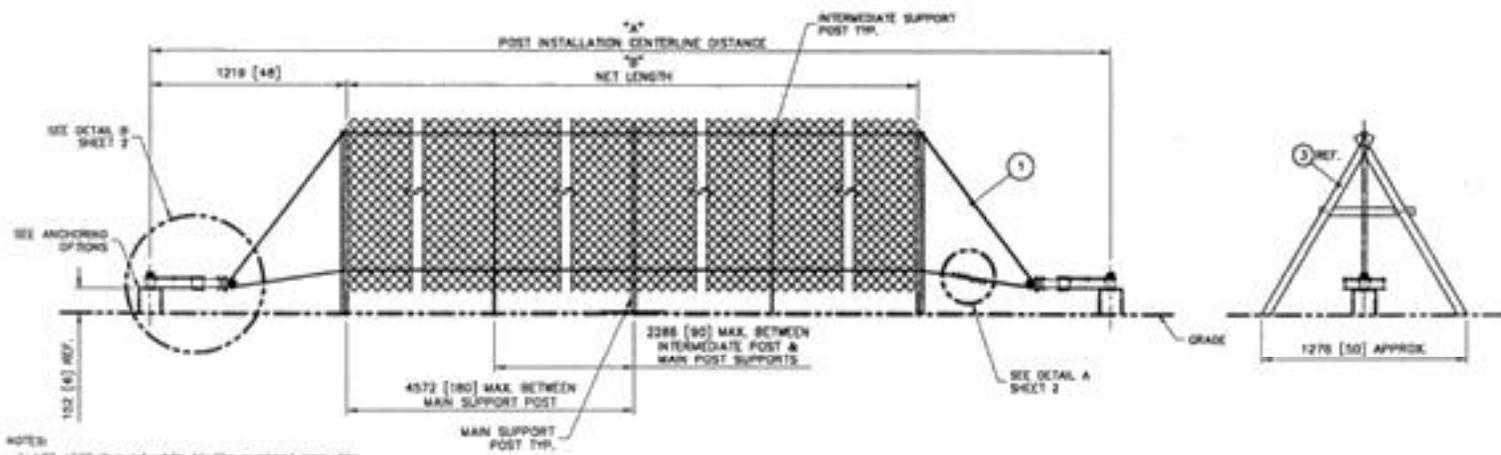
ENCLOSURE 1 (1 OF 3)



ITEM	QTY	DESCRIPTION
1	1	NET ASSEMBLY, WORK ZONE
2	1	ENERGY ABSORBER, 25 FT DRAGNET
3	1	FRAME, DRAGNET SUPPORT
4	2	POST, WORK ZONE
5	2	SOCKET, WORK ZONE
6	2	CHB MOUNT, WORK ZONE
7	2	ANCHOR, MP-3, PT KIT, 3/4X86 1/2 CLR
8	2	SURFACE MOUNT, WORK ZONE
9	2	ANCHOR, MP-3, QUART KIT, C2
10	2	ROD, THREAD, 3/4X86 1/2, G

ITEM	STOCK NO.	DESCRIPTION	QTY
1	3537001-0000	NET ASSEMBLY, WORK ZONE	1.00
2	3537002-0000	ENERGY ABSORBER, 25 FT DRAGNET	2.00
3	3537003-0000	FRAME, DRAGNET SUPPORT	2.00
4	2780003-0000	POST, WORK ZONE	2.00
5	2780004-0000	SOCKET, WORK ZONE	2.00
6	2780005-0000	CHB MOUNT, WORK ZONE	2.00
7	1525030-0000	ANCHOR, MP-3, PT KIT, 3/4X86 1/2 CLR	2.00
8	2780002-0000	SURFACE MOUNT, WORK ZONE	2.00
9	3535020-0000	ANCHOR, MP-3, QUART KIT, C2	1.00
10	2700730-0000	ROD, THREAD, 3/4X86 1/2, G	4.00

ASSEMBLY NUMBER	OVERALL LENGTH DIMENSION 'X'	NET LENGTH DIMENSION 'W'
4500050-0015	27'	15'
4500050-0030	34'	20'



- NOTES:
- NET ASSEMBLY INCLUDES CENTER SUPPORT DISC FOR NET SUPPORT FRAME'S INCLUDE ITEM NO. 3.
 - ENERGY ABSORBER INCLUDES TAPE ASSEMBLY AND NET ATTACHMENT FITTING.
 - FOR REMOVABLE ANCHOR POST USE POST, SOCKET ITEM NO. 5.
 - DIMENSIONS ARE IN MILLIMETERS (INCHES) UNLESS OTHERWISE NOTED.
 - VERIFY THE DESIGN INFORMATION INCLUDING WITH PRIOR TO ORDERING. SITE DATA FORMS ARE AVAILABLE FOR THIS PURPOSE. NETS ARE NON-REFUNDABLE.

PART NO. 45-00-05

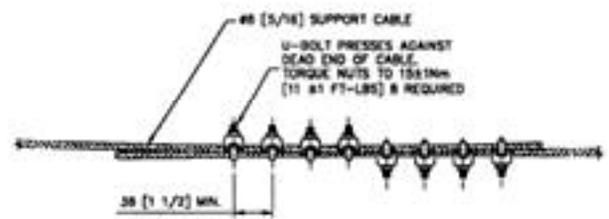
DESIGNED BY	D. Kofeld	DATE	12/10/99
DRAWN BY		DATE	
CHECKED BY		DATE	
APPROVED BY		DATE	
SCALE	1=25		

ENERGY ABSORPTION SYSTEMS, INC.
ENGINEERING AND RESEARCH DEPARTMENT

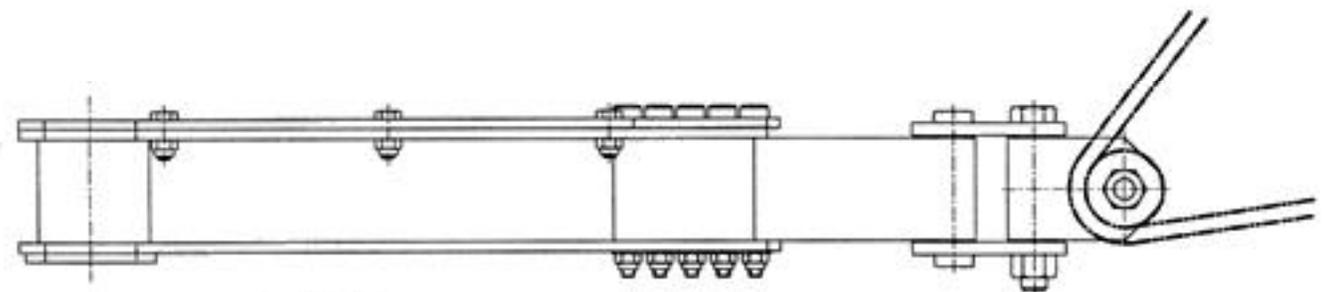
DRAGNET®
WORK ZONE™

1 of 3

ITEM	STOCK NO.	DESCRIPTION	QTY
PARTS LIST			



DETAIL A



DETAIL B

AT INSTALLATION

1. REMOVE BUSHING FROM NET ATTACHMENT FITTING AND INSTALL NET CABLE AROUND BUSHING AS SHOWN IN DETAIL B. REINSTALL BUSHING ON ENERGY ABSORBER.
2. AFTER NET CABLES HAVE BEEN INSTALLED ON BOTH NET ATTACHMENT FITTINGS LOOSEN CABLE CLAMPS AND ADJUST CABLE LENGTH. AFTER CABLE LENGTH HAS BEEN ADJUSTED FOR INSTALLATION TIGHTEN CABLE CLAMPS AS SHOWN IN DETAIL A.

ENCLOSURE 1 (2 OF 3)

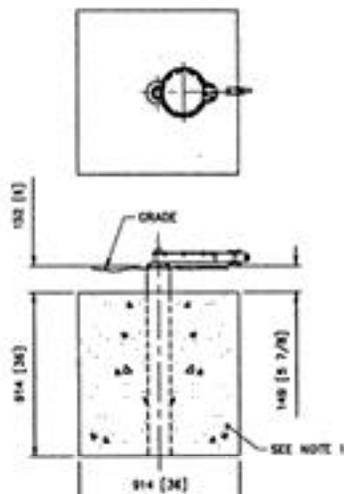
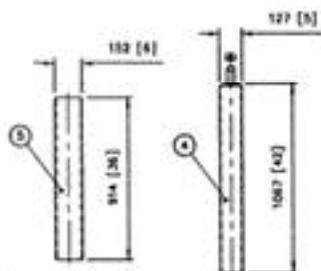
DESIGNED BY	D. Kohfeld	DATE	12/10/99
CHECKED BY		DATE	
APPROVED BY		DATE	
DATE			
FILE NO.	400005_SH02.dwg		

 ENERGY ABSORPTION SYSTEMS, INC. ENGINEERING AND RESEARCH DEPARTMENT	DRAGNET® WORK ZoNET™		

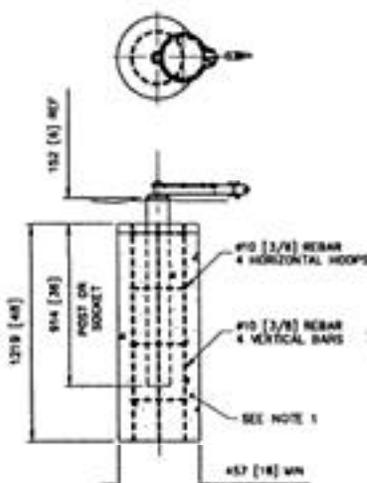
REV	STOCK NO.	DESCRIPTION	QTY
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TOL. ANGULAR: 1°
TOL. LINEAR: 1/16"

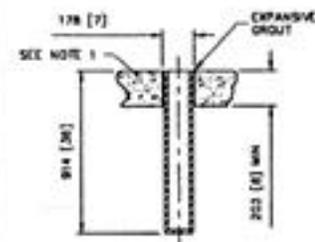
OPTION A



OPTION A DETAIL
INSTALLED IN CONCRETE BLOCK



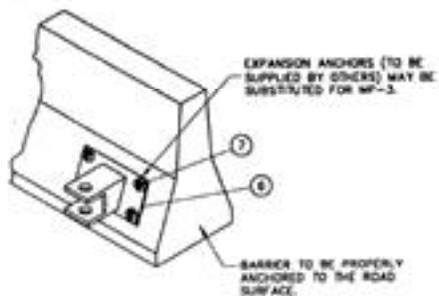
OPTION A DETAIL
INSTALLED IN CONCRETE PILE



OPTION A DETAIL
INSTALLED IN 203mm [8] MIN.
CONCRETE PAVEMENT

OPTION B

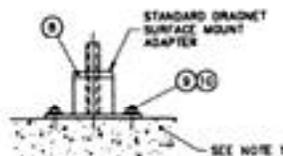
ENCLOSURE 1 (3 OF 3)



EXPANSION ANCHORS (TO BE SUPPLIED BY OTHERS) MAY BE SUBSTITUTED FOR MP-3.

BARRIER TO BE PROPERLY ANCHORED TO THE ROAD SURFACE.

OPTION C



MP-3 IS 1/2" STUOS FOR USE WITH 8" MIN. REINFORCED 28 MPa [4000 psi] CONCRETE.

- 18" THREADED RODS MAY BE USED TO INSTALL THE MOUNT ON ASPHALT. **

** REFER TO INSTALLATION INSTRUCTIONS FOR SPECIFICATIONS.

NOTE:
1. 28 MPa [4000 psi] CONCRETE.
2. ALL DIMENSIONS ARE IN MILLIMETERS [INCHES] UNLESS OTHERWISE SPECIFIED.

ANCHOR OPTIONS

DATE	12/14/99
BY	
CHK	
APP	
TITLE	
SCALE	
NO.	450005 SH-03.dwg

	ENERGY ABSORPTION SYSTEMS, INC.	
	ENGINEERING AND RESEARCH DEPARTMENT	
DRAGNET® WORK ZONET™		
1-2	45-00-05	2 of 2



DRAGNET Work ZoNET™ System General Product Specification

I. GENERAL

All DRAGNET Work ZoNET Arresting Systems shall be designed and manufactured by The Entwistle Company and distributed by Energy Absorption Systems, Inc.

DESCRIPTION OF THE SYSTEM

A. General

The DRAGNET Work ZoNET System shall consist of a chain link net assembly attached at each end to an energy absorber. Anchor posts embedded into the pavement shall support the energy absorbers. The energy absorbers shall consist of a chamber, a series of offset pins, a length of metal tape, and attaching hardware. As the metal tape is pulled through the series of offset pins, or "torture chamber," it is bent back and forth beyond its yield point absorbing energy. These devices are designed so that a force of 20 kN [4500 lbs.] is required to pull the tape through the "torture chamber". This force is relatively constant throughout an impact event.

Component Description

1. The energy absorbers consist of a chamber, a series of offset pins, a length of metal tape, and attaching hardware. The chamber shall be made from type 304 stainless steel. The tape shall be 23 m [75'] long by 51 mm [2"] wide, galvanized steel. The pins shall be made from hardened stainless steel. All hardware used on the absorber assembly shall be made from stainless steel.
2. The pull out force of each energy absorber shall be approximately 20 kN [4500 lbs.] and the maximum pay out distance shall be 23 m [75']. The pay out distance is defined as the amount of tape that will unwind from the absorber.
3. The standard chain link net assembly shall be 4.6 m or 9.1 m [15' or 30'] long. The assembly is made from 3-mm [11 gauge], 51 mm [2"] open mesh, galvanized steel, chain link mechanically attached to main support posts as well as intermediate support posts. The main support posts shall be spaced approximately 4.6 m [15'] apart. The intermediate support posts shall be centered between them. An 8 mm [5/16"] diameter, galvanized

Illustration 2. Work ZoNET General Product Specification (1 of 2)



steel cable shall pass through holes in the top and bottom of the support posts. The cable shall be joined together at the desired length by galvanized steel wire rope clips. The net is held upright by "A" shaped end frames made of either wood or fiberglass construction.

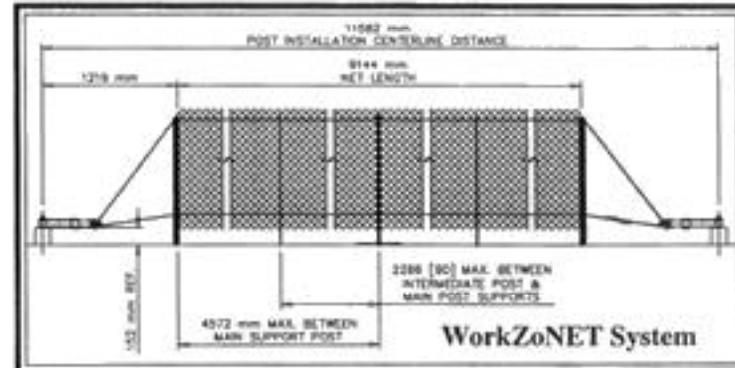
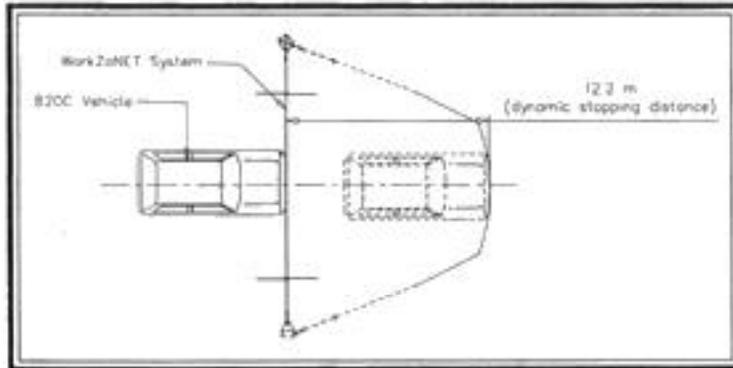
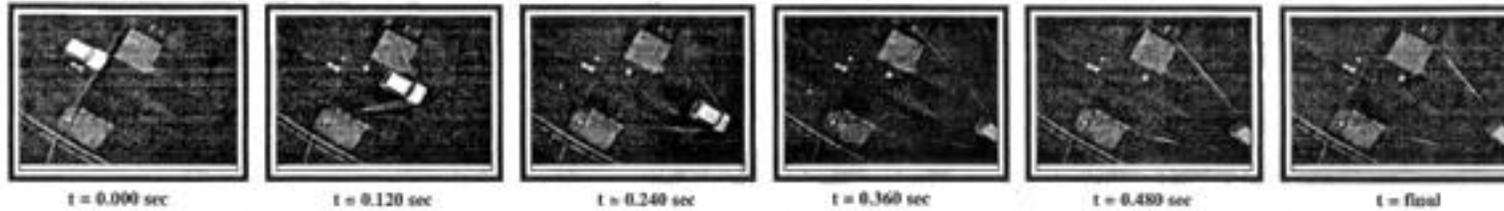
4. The standard anchor post shall be carbon steel pipe. Two anchor posts are required for each system. This post shall slide into a socket made from carbon steel pipe. The socket shall be embedded into a 455 mm [18"] diameter, 1.2 m [48"] deep, reinforced concrete block. This can be substituted with a 915 mm x 915 mm x 915 mm [3'x3'x3'], non-reinforced concrete block. Other anchoring options, such as hardware for mounting to asphalt pavement or hardware for mounting to anchored concrete barriers, shall be available from Energy Absorption Systems, Inc.

PERFORMANCE CRITERIA

- A. The DRAGNET Work ZoNET System shall be capable of attenuating the energy of vehicles ranging in weight from 820 kg [1810 lbs.] to 2000 kg [4410 lbs.] traveling at 100 km/h [62 mph] with an average deceleration force less than or equal to 5 g's. The DRAGNET Work ZoNET System shall demonstrate acceptable performance under these test conditions, and satisfy the Structural Adequacy, Occupant Risk and Vehicle Trajectory evaluation criteria per the National Cooperative Highway Research Program Report 350 (NCHRP 350), TL-3 head-on impact criteria.
- B. An 820 kg [1810 lbs.] vehicle impacting a 9.1 m [30 ft] net at 100 km/h [62 mph] will be stopped in approximately 12 m [39 feet] with an average deceleration of approximately 3.3 g's. A 2000 kg [4410 lbs.] vehicle impacting the same net at the same velocity will be stopped in 23.5 m [77 feet] with an average deceleration of approximately 1.7g's.

FIELD INSTALLATION

Installation of the DRAGNET Work ZoNET System shall be performed by experienced workers in accordance with the recommendations of Energy Absorption Systems, Inc. Site work shall be performed in accordance with the product manual and drawings supplied for the job.



E-TECH Testing Services, Inc.

General Information

Test Agency E-TECH Testing Services, Inc.
 Test Designation NCHRP 350 Test 3-30 Modified
 Test No. 01-7629-002
 Date 3/11/00

Test Article

Type Energy Absorption Systems
 WorkZoNET System
 Installation Length, (m) N/A
 Material and key elements 9.1 m net assembly width,
 post and socket anchor option
 with concrete pile footing
 Foundation Type and Condition Brown silty sand, saturated

Test Vehicle

Type Production Model
 Designation 820C
 Model 1988 Ford Festiva
 Hatchback

Mass (kg)
 Curb 779
 Test Inertial 811
 Dummy 75
 Gross Static 886

Impact Conditions

Speed (km/h) 103.2
 Angle (deg) 0
 Impact Severity (kJ) 333.1

Exit conditions

Speed (km/h) N/A
 Angle (deg) N/A

Occupant Risk Values

Impact Velocity (m/s)
 x-direction 5.7
 y-direction -0.1
 Ridedown Acceleration (g's)
 x-direction -3.9
 y-direction -1.1

European Committee for Normalization (CEN) Values

THIV (m/s) 5.7
 PHD (g's) 4.0
 ASI 0.3

Test Article Deflections (m)

Dynamic 12.2
 Permanent 12.2

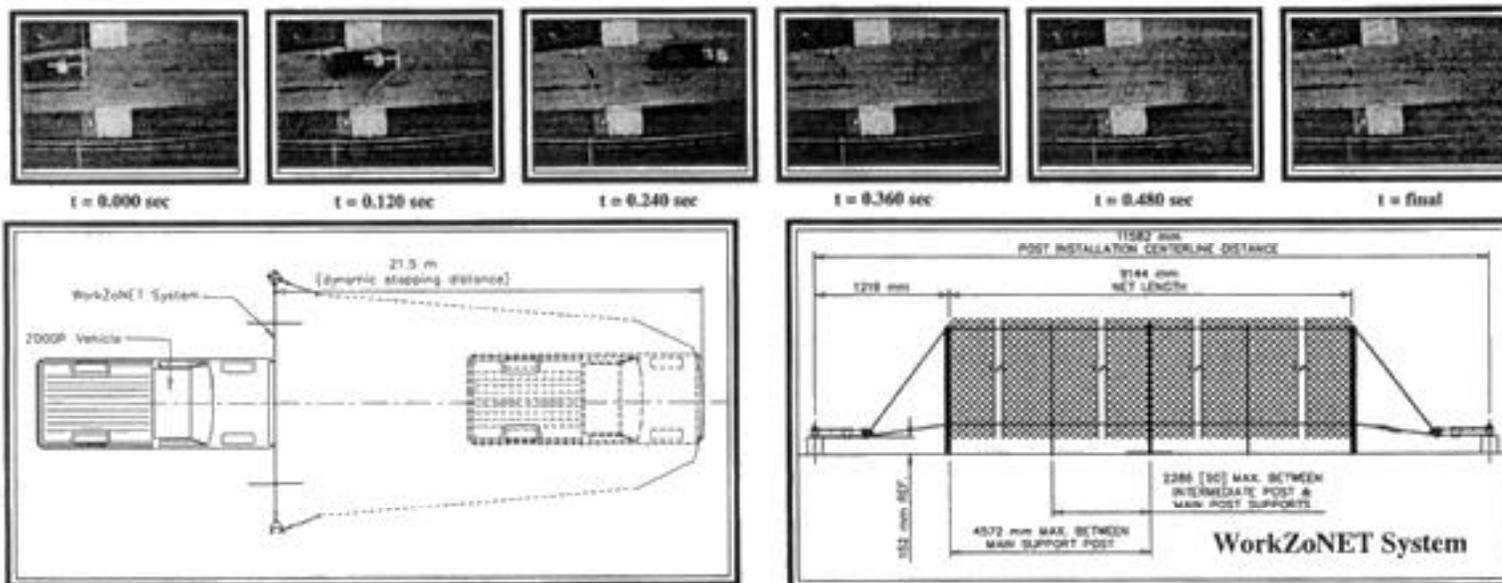
Vehicle Damage

Exterior
 VDS FD-0
 CDC 12FDEW1
 Interior
 OCDCI AS0000000

Post-Impact Vehicular Behavior (deg - rate gyro)

Maximum Roll Angle 7.7
 Maximum Pitch Angle -2.6
 Maximum Yaw Angle 12.6

Figure 1. Summary of Results - WorkZoNET Test 01-7629-002



E-TECH Testing Services, Inc.

General Information

Test Agency	E-TECH Testing Services, Inc.
Test Designation	NCHRP 350 Test 3-31
Test No.	01-7629-001
Date	2/17/00
Test Article	
Type	Energy Absorption Systems WorkZoNET System
Installation Length, (m)	N/A
Material and key elements	9.1 m net assembly width, post and socket anchor option with concrete pile footing
Foundation Type and Condition	Brown silty sand, saturated
Test Vehicle	
Type	Production Model
Designation	2000P
Model	1988 Chevrolet C2500
.....	3/4 Ton Pickup
Mass (kg)	
Curb	1903
Test Inertial	2010
Dummy	N/A
Gross Static	2005
Impact Conditions	
Speed (km/h)	93.9
Angle (deg)	0
Impact Severity (kJ)	683.3

Exit conditions

Speed (km/h)	N/A
Angle (deg)	N/A
Occupant Risk Values	
Impact Velocity (m/s)	
x-direction	4.3
y-direction	-0.2
Ridedown Acceleration (g's)	
x-direction	-2.4
y-direction	-0.5
European Committee for Normalization (CEN) Values	
THIV (m/s)	4.3
PHID (g's)	2.4
ASI	0.2
Test Article Deflections (m)	
Dynamic	21.5
Permanent	21.5
Vehicle Damage	
Exterior	
VDS	FD-0
CDC	12FDEW1
Interior	
OCDI	AS0000000
Post-Impact Vehicular Behavior (deg - rate gyro)	
Maximum Roll Angle	-2.5
Maximum Pitch Angle	-1.9
Maximum Yaw Angle	-6.0

Figure 6. Summary of Results - WorkZoNET Test 01-7629-001