



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.

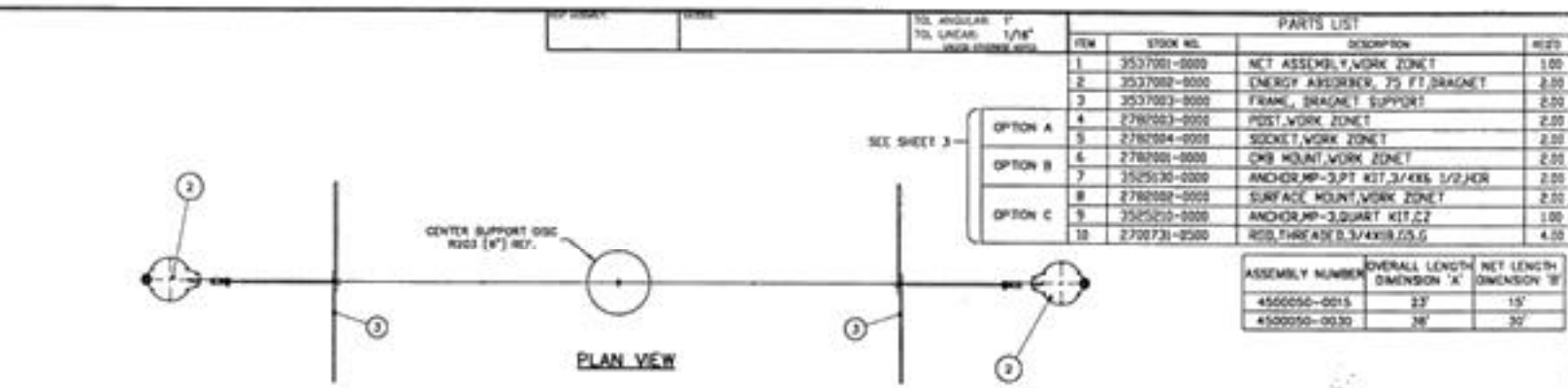
When installed as tested, or when attached to a mounting bracket on permanent (or adequately anchored) temporary concrete barrier, the Work ZoNet may be considered an NCHRP Report 350 TL-3 vehicular attenuator. Since it is a proprietary product, its use on the National Highway System (NHS) remains subject 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

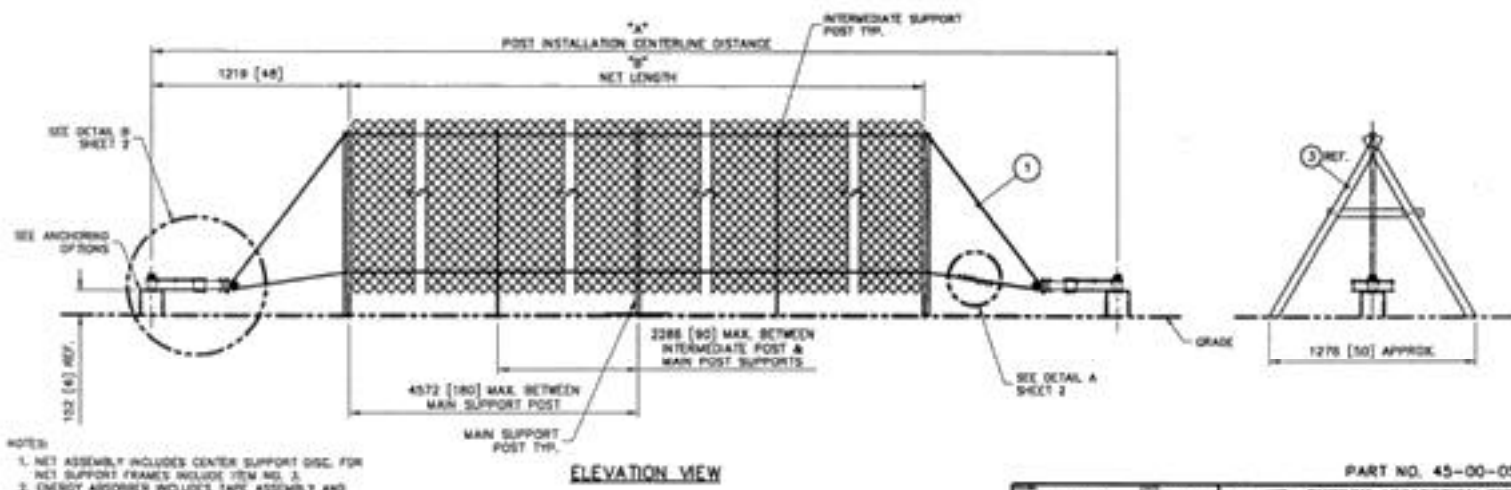
ENCLOSURE 1 (1 OF 3)



SEE SHEET 3

PARTS LIST			
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	2780001-0000	CHB MOUNT, WORK ZONE	2.00
7	2525130-0000	ANCHOR, MP-3, PT KIT, 3/4X86 1/2 CLR	2.00
8	2780002-0000	SURFACE MOUNT, WORK ZONE	2.00
9	3535210-0000	ANCHOR, MP-3, QUART KIT, C2	1.00
10	2700731-0000	RDS, THREAD, 3/4X86 1/2, G	4.00

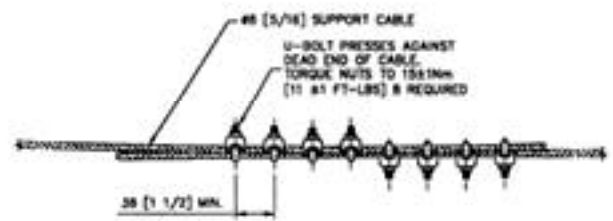
ASSEMBLY NUMBER	OVERALL LENGTH DIMENSION 'X'	NET LENGTH DIMENSION 'W'
4500050-0015	27'	15'
4500050-0030	34'	20'



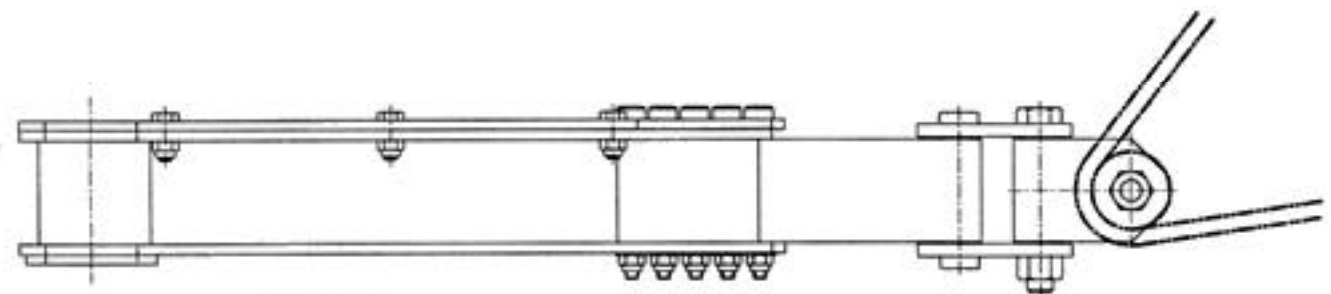
- NOTES:**
- NET ASSEMBLY INCLUDES CENTER SUPPORT DISC FOR NET SUPPORT FRAME'S INCLUDE ITEM NO. 3.
  - ENERGY ABSORBER INCLUDES TAPE ASSEMBLY AND NET ATTACHMENT FITTING.
  - FOR REMOVABLE ANCHOR POST USE POST, SOCKET ITEM NO. 5.
  - DIMENSIONS ARE IN MILLIMETERS (INCHES) UNLESS OTHERWISE NOTED.
  - VERIFY 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	
D. Kofeld DATE: 12/10/99 DRAWN: CHECKED: BY:	<b>ENERGY ABSORPTION SYSTEMS, INC.</b> ENGINEERING AND RESEARCH DEPARTMENT  <b>DRAGNET®</b> <b>WORK ZONE™</b>
FILE: 450005.dwg SCALE: 1=25 PART: 45-00-05 SHEET: 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		

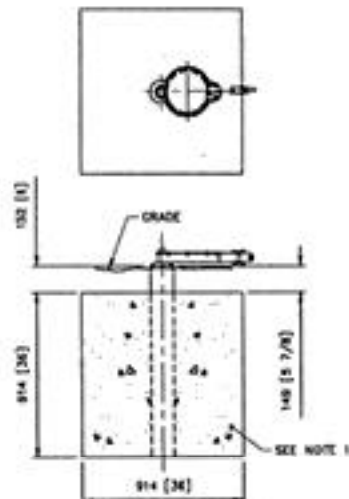
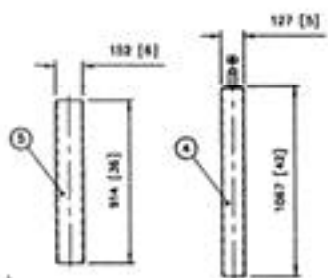
	<b>ENERGY ABSORPTION SYSTEMS, INC.</b> ENGINEERING AND RESEARCH DEPARTMENT	
	<b>DRAGNET®</b> <b>WORK ZoNET™</b>	
	1 of 2	45-00-05
		2 of 3

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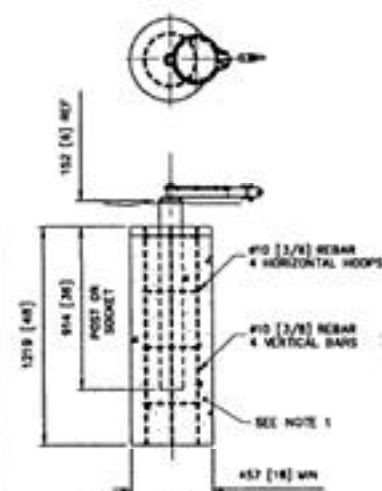
TOL. ANGULAR: 1°  
TOL. LINEAR: 1/16"  
UNLESS OTHERWISE SPECIFIED

PARTS LIST

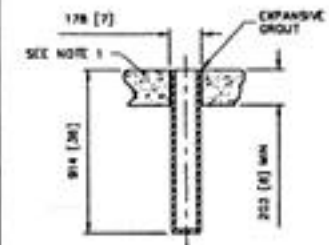
OPTION A



OPTION A DETAIL  
INSTALLED IN CONCRETE BLOCK

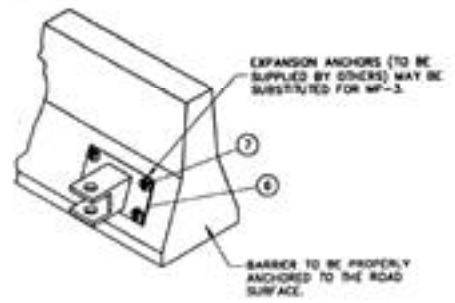


OPTION A DETAIL  
INSTALLED IN CONCRETE PILE



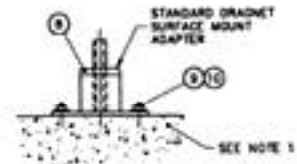
OPTION A DETAIL  
INSTALLED IN 203mm [8] MIN.  
CONCRETE PAVEMENT

OPTION B



ENCLOSURE 1 (3 OF 3)

OPTION C



MP-3 3 & 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	
CHKD	
APP'D	
TITLE	
SCALE	
NO.	450005 SH03.dwg

ENERGY ABSORPTION SYSTEMS, INC.  
ENGINEERING AND RESEARCH DEPARTMENT

**DRACNET®**  
**WORK ZONET™**

REV	1-2	DATE	45-00-05	QTY	2 of 2
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## 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.

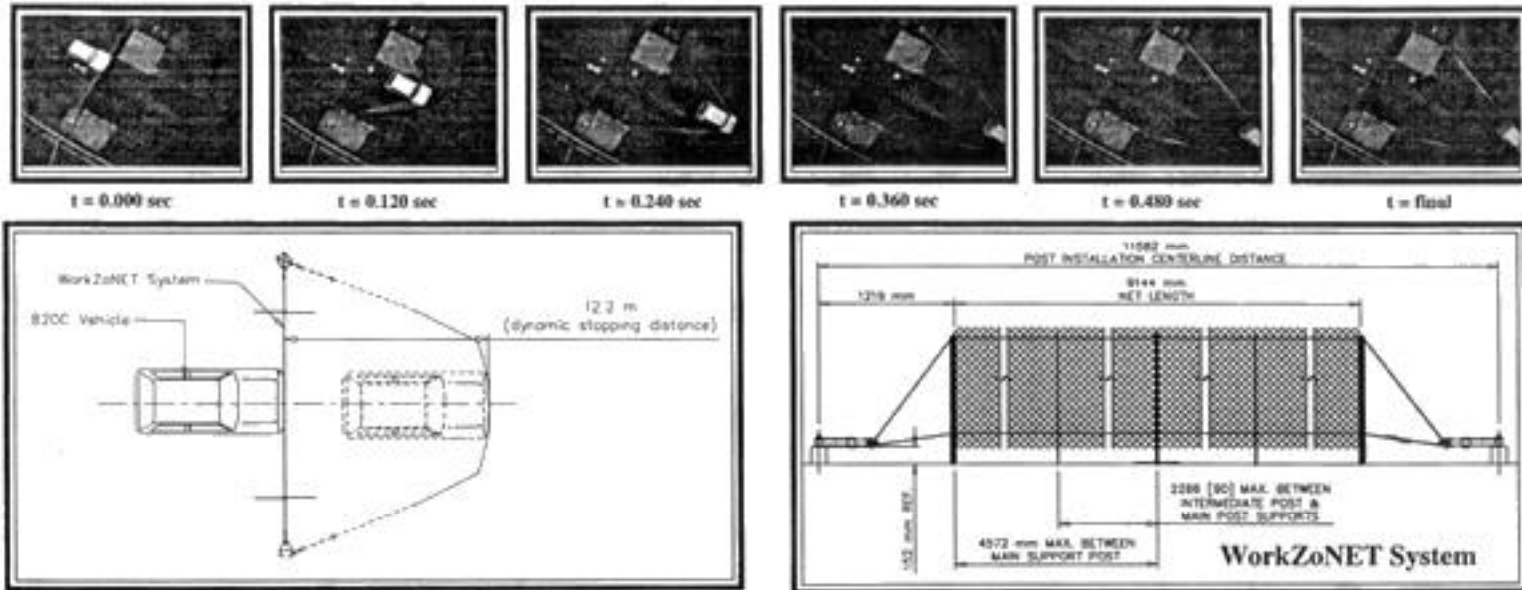
4. The standard anchor post shall be carbon steel pipe. Two anchor posts are required for each system. This post shall slide into a socket made from carbon steel pipe. The socket shall be embedded into a 455 mm [18"] diameter, 1.2 m [48"] deep, reinforced concrete block. This can be substituted with 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.



#### General Information

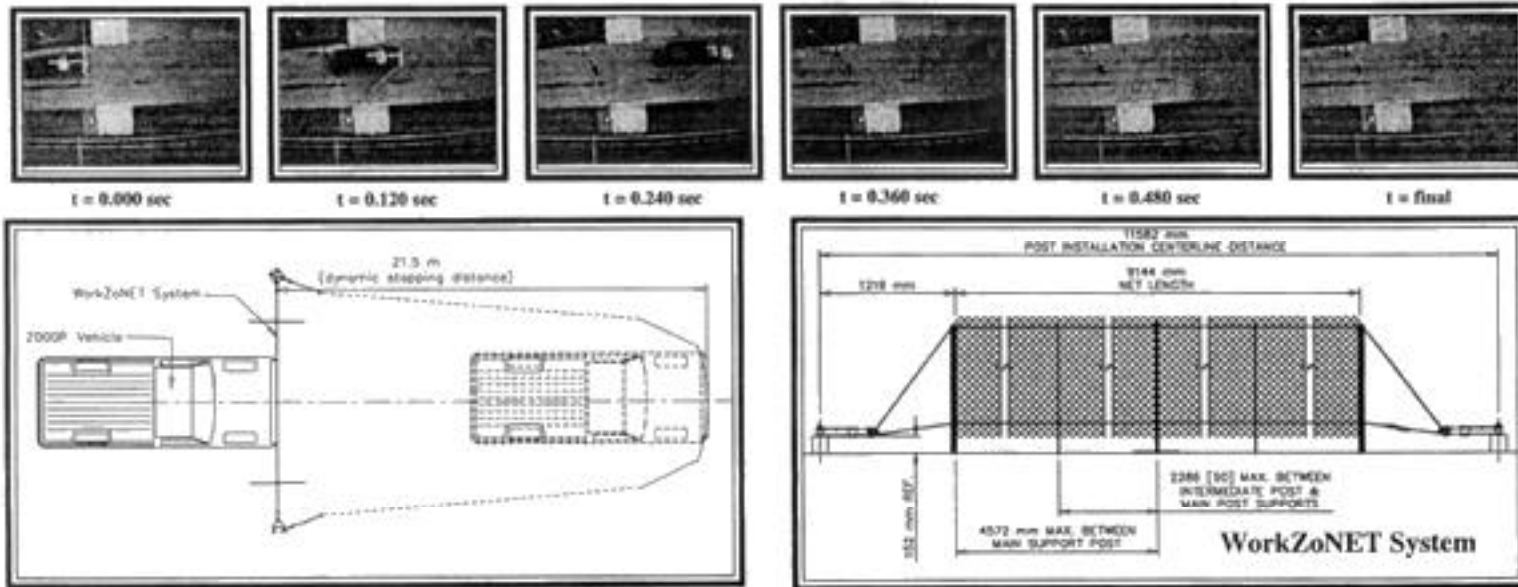
Test Agency .....	E-TECH Testing Services, Inc.
Test Designation .....	NCHRP 350 Test 3-30 Modified
Test No. ....	01-7629-002
Date .....	3/11/00
<b>Test Article</b>	
Type .....	Energy Absorption Systems WorkZoNET System
Installation Length, (m) .....	N/A
Material and key elements .....	9.1 m net assembly width, post and socket anchor option with concrete pile footing
Foundation Type and Condition .....	Brown silty sand, saturated
<b>Test Vehicle</b>	
Type .....	Production Model
Designation .....	820C
Model .....	1988 Ford Festiva Hatchback
Mass (kg) .....	
Curb .....	779
Test Inertial .....	811
Dummy .....	75
Gross Static .....	886
<b>Impact Conditions</b>	
Speed (km/h) .....	103.2
Angle (deg) .....	0
Impact Severity (kJ) .....	333.1

#### Exit conditions

Speed (km/h) .....	N/A
Angle (deg) .....	N/A
<b>Occupant Risk Values</b>	
Impact Velocity (m/s) .....	
x-direction .....	5.7
y-direction .....	-0.1
Ridedown Acceleration (g's) .....	
x-direction .....	-3.9
y-direction .....	-1.1
<b>European Committee for Normalization (CEN) Values</b>	
THIV (m/s) .....	5.7
PHD (g's) .....	4.0
ASI .....	0.3
<b>Test Article Deflections (m)</b>	
Dynamic .....	12.2
Permanent .....	12.2
<b>Vehicle Damage</b>	
Exterior .....	
VDS .....	FD-0
CDC .....	12FDEW1
Interior .....	
OCDI .....	AS0000000
<b>Post-Impact Vehicular Behavior (deg - rate gyro)</b>	
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
<b>Test Article</b>	
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
<b>Test Vehicle</b>	
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
<b>Impact Conditions</b>	
Speed (km/h) .....	93.9
Angle (deg) .....	0
Impact Severity (kJ) .....	683.3

**Exit conditions**

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