

**Test Report No. 400001-ETP1**

**Test Report Date: April 2010**

**CRASH TEST AND EVALUATION OF THE ET-PLUS  
WITH STEEL POSTS**

by

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Contract No. P2010016

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Sponsored by

**Trinity Highway Products, LLC**

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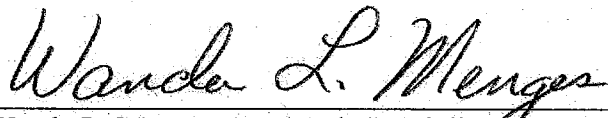
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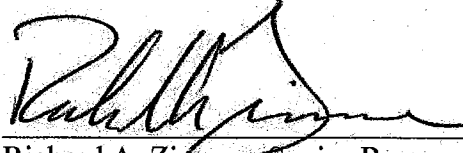
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16. Abstract					
<p>The test reported herein was performed according to modified guidelines for <i>NCHRP Report 350</i> test designation 3-30. The test involves an 820C vehicle (small passenger car) impacting the ET-PLUS with steel posts on the nose, with the vehicle centerline to the left or right of the centerline of the nose, at an impact speed and angle of 100 km/h and 0 degree. However, Trinity Highway Products, LLC, requested that the vehicle impact the nose with the centerline of the vehicle aligned with the centerline of the nose. It was also requested that the impact speed be increased to 108 km/h <math>\pm</math>4 km/h.</p> <p>The top section of post 1 detached from the lower section and was resting 6.7 m toward the field side of post 15. This did not cause undue hazard on the traffic side of the rail. The performance of the ET-PLUS with steel post was determined to perform marginally with regard <i>NCHRP Report 350</i> occupant risk Criteria D.</p>					
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# SI\* (MODERN METRIC) CONVERSION FACTORS

Symbol	When You Know	Multiply By	To Find	Symbol
<b>LENGTH</b>				
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
<b>AREA</b>				
in <sup>2</sup>	square inches	645.2	square millimeters	mm <sup>2</sup>
ft <sup>2</sup>	square feet	0.093	square meters	m <sup>2</sup>
yd <sup>2</sup>	square yard	0.836	square meters	m <sup>2</sup>
ac	acres	0.405	hectares	ha
mi <sup>2</sup>	square miles	2.59	square kilometers	km <sup>2</sup>
<b>VOLUME</b>				
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft <sup>3</sup>	cubic feet	0.028	cubic meters	m <sup>3</sup>
yd <sup>3</sup>	cubic yards	0.765	cubic meters	m <sup>3</sup>
NOTE: volumes greater than 1000 L shall be shown in m <sup>3</sup>				
<b>MASS</b>				
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
<b>TEMPERATURE (exact degrees)</b>				
°F	Fahrenheit	$\frac{5}{9}(F-32)$ or $\frac{F-32}{1.8}$	Celsius	°C
<b>ILLUMINATION</b>				
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m <sup>2</sup>	cd/m <sup>2</sup>
<b>FORCE and PRESSURE or STRESS</b>				
lbf	poundforce	4.45	newtons	N
lbf/in <sup>2</sup>	poundforce per square inch	6.89	kilopascals	kPa
<b>CONVERSION FACTORS</b>				
Symbol	When You Know	Multiply By	To Find	Symbol
<b>LENGTH</b>				
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
<b>AREA</b>				
mm <sup>2</sup>	square millimeters	0.0016	square inches	in <sup>2</sup>
m <sup>2</sup>	square meters	10.764	square feet	ft <sup>2</sup>
m <sup>2</sup>	square meters	1.196	square yards	yd <sup>2</sup>
ha	hectares	2.47	acres	ac
km <sup>2</sup>	square kilometers	0.386	square miles	mi <sup>2</sup>
<b>VOLUME</b>				
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m <sup>3</sup>	cubic meters	35.314	cubic feet	ft <sup>3</sup>
m <sup>3</sup>	cubic meters	1.357	cubic yards	yd <sup>3</sup>
<b>MASS</b>				
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
<b>TEMPERATURE (exact degrees)</b>				
°C	Celsius	$F = C \times 1.8 + 32$	Fahrenheit	°F
<b>ILLUMINATION</b>				
lx	lux	0.0929	foot-candles	fc
cd/m <sup>2</sup>	candela/m <sup>2</sup>	0.2919	foot-Lamberts	fl
<b>FORCE and PRESSURE or STRESS</b>				
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in <sup>2</sup>

\*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.  
(Revised March 2003)

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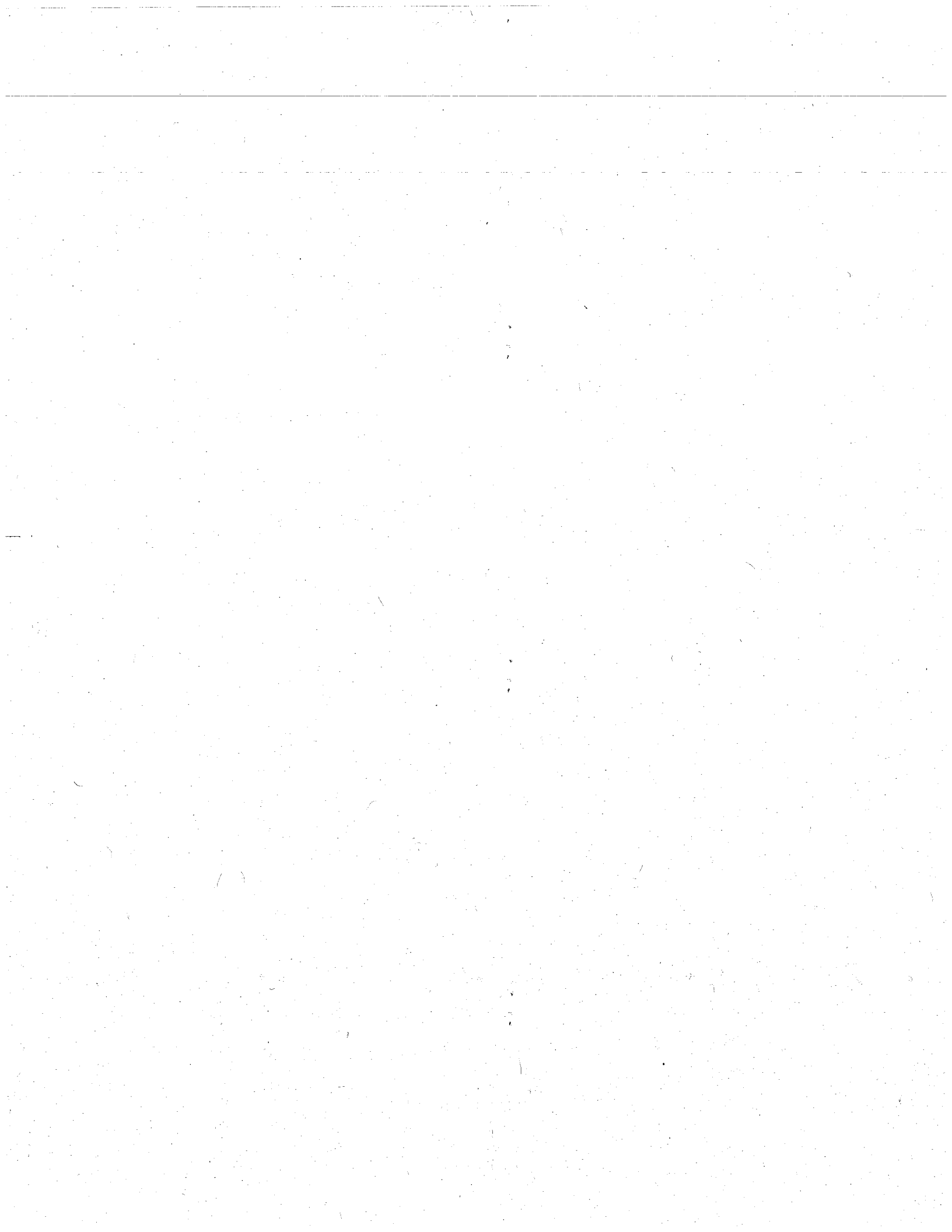
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## INTRODUCTION

The test reported herein was performed according to the guidelines for *NCHRP Report 350* test designation 3-30 with modifications. Test 3-30 involves an 820C vehicle (small passenger car) impacting the ET-PLUS with steel posts on the nose, with the vehicle centerline to the left or right of the centerline of the nose (at quarter point), at an impact speed and angle of 100 km/h and 0 degree. However, Trinity Highway Products, LLC, requested that the vehicle impact the nose with the centerline of the vehicle aligned with the centerline of the nose. It was also requested that the impact speed be increased to 108 km/h  $\pm$ 4 km/h.





# TECHNICAL DISCUSSION

## TEST PARAMETERS

### Test Facility

The full-scale crash test was performed at Texas Transportation Institute's (TTI) Proving Ground. TTI Proving Ground is an ISO 17025 accredited laboratory with American Association for Laboratory Accreditation (A2LA) testing certificate 2821.01. The full-scale crash test performed under this project was performed according to quality procedures developed for ISO 17025 accreditation and according to *NCHRP 350* guidelines. The test facilities at the Texas Transportation Institute Proving Ground consist of a 809-hectare complex of research and training facilities situated 16 km northwest of the main campus of Texas A&M University. The site, formerly an Air Force Base, has large expanses of concrete runways and parking aprons well suited for experimental research and testing in the areas of vehicle performance and handling, vehicle-roadway interaction, durability and efficacy of highway pavements, and safety evaluation of roadside safety hardware. The site selected for the placement of the ET-PLUS with steel posts was off the edge of an out-of-service apron. The apron consists of an unreinforced jointed concrete pavement in 3.8 m by 4.6 m blocks nominally 203-305 mm deep. The apron is over 50 years old and the joints have some displacement, but are otherwise flat and level.

### Test Article – Design and Construction

The test installation consisted of an ET-PLUS head and 12-gauge W-beam guardrail elements installed on steel posts. Post number 1 was an HBA post. Standard ET-PLUS anchor cable and cable anchor bracket were used. The bearing plate at HBA post number 1 was modified by the addition of two tabs to engage the top portion of the post. Post number 2 was an SYTP. All other posts in the terminal were Standard W6x8.5. Guardrail mounting height within the terminal and extending to post number 9 was 702 mm to the top of rail. The rail element was bolted to all posts in the terminal except post number 1. Total length of the installation was 45.0 m. The length-of-need portion was installed at a height of 787 mm to the top of the rail element. Height of the top of the rail was transitioned from 702 mm to 787 mm over a length of 3.8 m between posts 9 and 11. A 787 mm high Vertical Loading Terminal (VLT) was installed on the far end.

Blockouts with depth of 203 mm were used in the ET-PLUS with steel post terminal. Blockouts with 305 mm depth were used at post 11 and beyond.

Layout of the ET-PLUS with steel posts is shown in figure 1, and photographs of the completed installation are shown in figure 2. Details of the ET-PLUS with steel posts are provided in Appendix A.

