



Memorandum

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

Subject: **INFORMATION:** Crashworthy Work Zone Traffic
Control Devices Pooled-Fund Study

Date: June 6, 2000

From: Frederick G. Wright, Jr.
Program Manager, Safety

Reply: to: HSA-1

To: Resource Center Directors
Division Administrators
Federal Lands Highway Division Engineers

This memorandum finds three work zone traffic control devices acceptable for use in work zones on the National Highway System (NHS). They were tested at the Texas Transportation Institute (TTI) as part of an FHWA pooled-fund study (Contract No. DTFH61-97-C-00064) under the provisions of National Cooperative Highway Research Program (NCHRP) Report 350 "Recommended Procedures for the Safety Performance Evaluation of Highway Features." The three acceptable devices are:

Type III Perforated Steel Tubing Barricade (with sign as tested, or without)
Illinois L-Channel Type III Barricade
Crosswind Portable Sign Support

A fourth device, the New Jersey DOT PVC Barricade with Sign Panel, was tested and failed. It is described at the end of this memorandum

The FHWA guidance on crash testing of work zone traffic control devices is contained in two memoranda. The first, dated July 25, 1997, titled "Information: Identifying Acceptable Highway Safety Features," established four categories of work zone devices: Category I devices were those lightweight devices which could be self-certified by the vendor, Category II devices were other lightweight devices which needed individual crash testing, Category III devices were barriers and other fixed or massive devices also needing crash testing, and Category IV devices were trailer mounted lighted signs, arrow panels, etc. The second guidance memorandum was issued on August 28, 1998, and is titled "**INFORMATION:** Crash Tested Work Zone Traffic Control Devices." This later memorandum lists devices that are acceptable under Categories I, II, and III. For an up-to-date list of crash tested hardware see our web site at <http://safety.fhwa.dot.gov/roadside>.

Drawings of the tested devices are attached. A brief description of the three devices follows:

Type III Perforated Steel Tubing Barricade

The barricades were fabricated from perforated square steel tubing (PSST) with wooden horizontal rails and had a 1219 mm x 1219 mm plywood sign panel (13 mm exterior BC) mounted at a height of 2134 mm. AU PSST sections were 13 gage (2.4 mm wall) of A-36 steel. The skids were fabricated from 44 mm PSST, 1524 mm in length. A 102 mm long stub of 44 mm PSST was welded to the top of each skid in the center with E6011 weld all around. The vertical supports, of 38 mm PSST, were inserted into the stubs and secured with 10 mm (3/8-inch) diameter, 57 mm long A307 bolts or pins. The overall height of the barricade was 1524 mm.

The 1219 mm long horizontal rails were made of 25 mm x 203 mm No.2 white pine spaced 508 mm apart. The No. 2 yellow pine vertical supports were placed 889 mm center to center. The wood rails were bolted to the vertical supports with four 10 mm diameter A307 bolts per rail. The horizontal rails were also bolted to two 51 mm x 102 mm wood vertical braces, one on each side of the barricade outside of the vertical supports.

Inside the vertical braces were another set of 51 mm x 102 mm wood vertical supports for the sign panel. These, too, were attached to the barricade with four 10 mm A307 bolts per rail. Standard 10 mm washers were used when fastening the barricade rails and the sign panel in place. Sandbags were added to the front and rear of each skid. The crash test is summarized in the table following these descriptions.

Illinois L-Channel Type III Barricade

The skids and vertical supports of this barricade were fabricated from 50 mm x 50 mm x 5 mm A-36 steel L-channels or angles. The skids were 1524 mm long and the vertical supports were welded to the skids 450 mm from the front. The vertical supports were spaced 814 mm center to center. The 1220 mm long horizontal rails were 25 mm x 254 mm white pine spaced 500 mm apart. These rails were bolted to the vertical supports using four 10 mm diameter A307 bolts per rail. Sandbags were added to the front and rear of each skid. The crash test is summarized in the table following these descriptions.

Crosswind Portable Sign Support

The "Crosswind" model 606-EHD portable sign stand is manufactured by Lang Products International and is available commercially. The legs are 32 mm square steel tubing, 3 mm thick and each is 1830 mm long. When fully deployed the four legs create an X-footprint that is 1356 mm wide and 2154 mm long. The four legs are secured by spring-loaded lock pins and 13 mm hardware. The brackets that join the legs at the base are made of 6 mm thick steel plates. A 1200 mm x 1200 mm vinyl roll-up sign panel was mounted to the support at an extended mounting height of 1520 mm from the ground to the bottom of the sign panel. The crash test is summarized in the table following these descriptions.

Crash Testing

Full-scale automobile testing was conducted on each of these three devices, Two stand-alone examples of each device were tested in tandem one head-on and the next placed six meters downstream turned at 90 degrees, as called for in our guidance memoranda. The complete devices as tested are shown in the Attachment. The crash tests are summarized in the table below:

Test Article	PSST Type III Barricade	Illinois Type III Barricade	CrossWind Sign Stand
Height to Top of Rails	1524 mm	1524 mm	n/a
Height to Bottom of Sign	2134 mm	no sign	1520 mm
Width of Barrier	1219 mm	1220 mm	n/a
Flags or lights	None	None	none
Test Article Mass (each)	52.3 kg	32.2 kg	25.9 kg
Ballast Mass	72.8 kg	72.6 kg	None
Vehicle Inertial Mass	820 kg	820 kg	820 kg
Impact Speed, Head-on	98.7 km/h	99.2 km/h	100.0 km/hr
Impact Speed, 90 Deg.	87.2 km/h	81.3 km/h	95.2 km/hr
Occupant Impact Speed	4.5 m/s	3.4 m/s	1.0 m/s
Vehicle crush	Major dents	Minor dents	Minor dents
Occupant Compart. Intrusion	41mm roof dent	None	40 mm roof dent
Windshield Damage Head-on	Cracking	No contact	Minor cracking
Windshield Damage 90 Dee.	Cracking	No contact	Minor cracking

All three tests resulted in minor to moderate denting to the bumpers, hoods, and roofs of the test vehicles. Windshield damage was limited to cracking, but not to the extent that the glass was deformed or that any holes were made through the glass. Also, the barricades did not show potential for penetrating the occupant compartment. On the test of the sign stand the researchers noted that the dent in the roof indicated a remote potential for occupant compartment intrusion, but FHWA considers this performance to be within allowable limits.

The results of this testing met the FHWA requirements and, therefore, the devices listed in the table above and shown in Attachment 1 are acceptable for use as Test Level 3 devices on the NHS under the range of conditions tested, when proposed by a State.

Our acceptance is limited to the crashworthiness characteristics of the devices and does not cover their structural features, nor conformity with the Manual on Uniform Traffic Control Devices. Potential users should ensure that the hardware furnished has essentially the same chemistry, mechanical properties, and geometry as those tested with successful results, and that they will meet the crashworthiness requirements of FHWA and NCHRP Report 350. Any changes that may adversely influence the crashworthiness of the devices will require a new acceptance letter. To prevent misunderstanding by others, this letter of acceptance, designated as number WZ-40 shall not be reproduced except in full.

Additional discussion of PSST Type III barricades:

Numerous tests have been run on Type III barricades using PSST as horizontal skids and uprights. Wood or plastic rail elements have been used in the mostly head-on tests, These tests, some of which are covered in our FHWA Acceptance Letter WZ-3 dated August 28, 1998, show acceptable performance. Some individuals have expressed concern that an end-on test was not conducted on this class of barricade. (New York State DOT ran an informal end on test in the 1980's and reported acceptable results.) The test above shows that the PSST Type III barricade is crashworthy per Report 350 when struck head-on and at 90 degrees, at least when the horizontal barricade rails are 1219 mm (4 feet) long. We now consider the barricade to be acceptable with or without the sign, however the vertical wood elements to the outside of the PSST uprights may be necessary to ensure that the barricade structure remains intact during a crash

Longer rail elements are used on Type III barricades by many agencies. In the PSST test reported above, the occupant impact velocity was close to the maximum allowable limit of 5 m/s. Therefore, we cannot allow PSST Type III Barricade / Sign supports wider than the one tested.. However, if the sign and its supports are not present, the PSST Type III barricade with rails up to 2440 mm (8 feet) long will also be acceptable. We consider that the performance of the barricade would be similarly acceptable if rigid polyolefin or other similar rigid plastic panels were used for the horizontal rail elements, Frangible plastic rails may not be used as they may separate or fracture and penetrate the windshield.

Proprietary Devices:

The CrossWind sign stands are patented products and considered "proprietary." The use of proprietary work zone traffic control devices in Federal-aid projects is generally of a temporary nature. They are selected by the contractor for use as needed and removed upon completion of the project. Under such conditions they can be presumed to meet requirement "a" given below for the use of proprietary products on Federal-aid projects. On the other hand, if proprietary devices are specified 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 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.

Failed Device

The fourth device that was tested was a PVC "Type III" barricade constructed of 76 mm diameter pipes with aluminum horizontal rails and an aluminum sign blank. The tested barricade is shown in the attached drawing. The barricade failed the 90 degree test when one of the horizontal PVC elements penetrated the windshield, leaving part of the plastic tube on the dashboard. Although, at 32.8 kg this is a relatively lightweight barricade, the frangibility of the PVC elements lead to poor crash performance. Agencies using this barricade should consider redesigning it to improve its performance or adopt barricades meeting Report 350 criteria.

4 Attachments

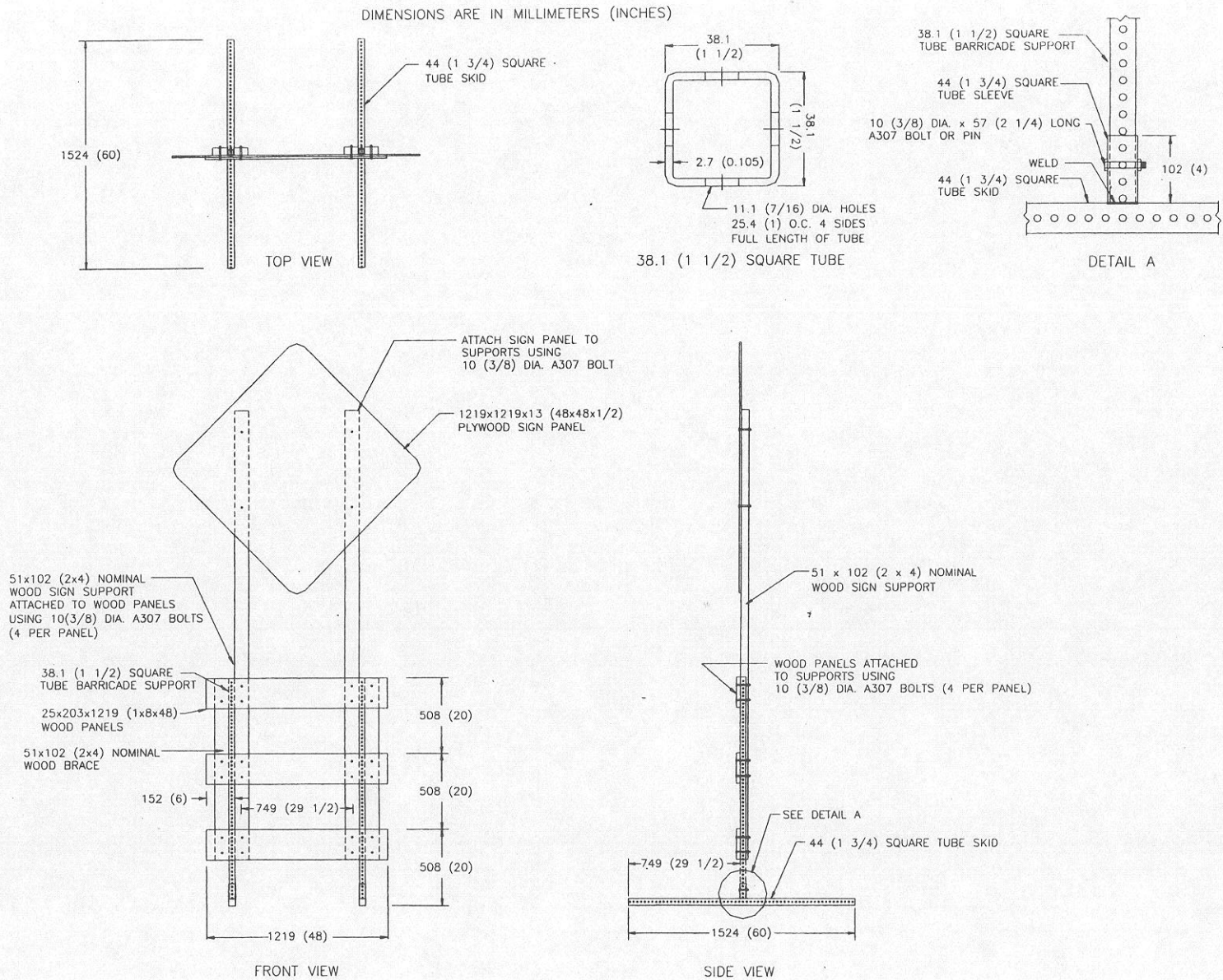
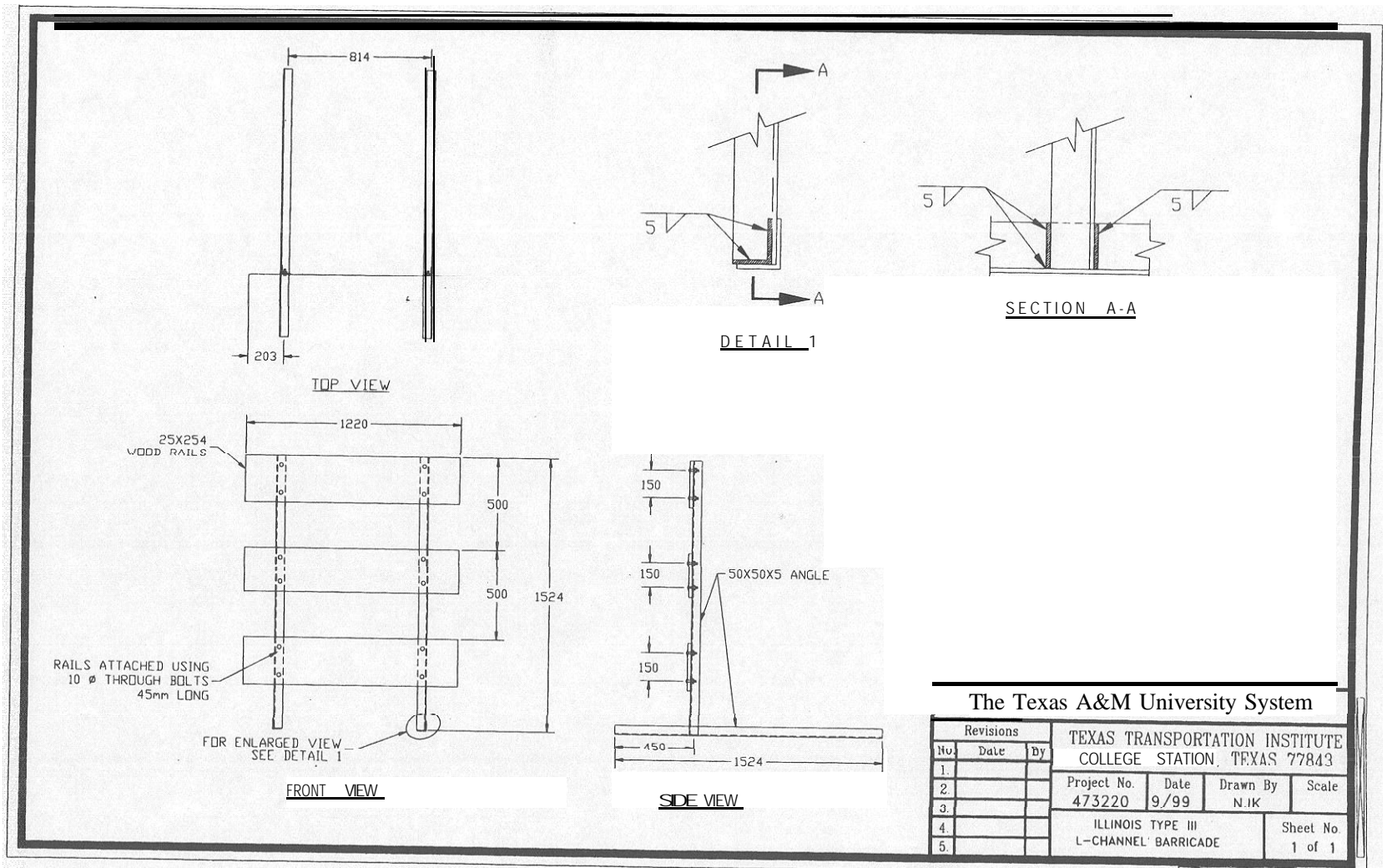


Figure 1. Details of the Type III perforated steel tubing barricade.



The Texas A&M University System

Revisions			TEXAS TRANSPORTATION INSTITUTE COLLEGE STATION, TEXAS 77843			
No.	Date	By	Project No.	Date	Drawn By	Scale
1.			473220	9/99	NJK	
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ILLINOIS TYPE III
L-CHANNEL BARRICADE

Sheet No.
1 of 1

Figure 1. Details of the Illinois L-Channel Type III barricade.