



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

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

Refer to: HSA-10\WZ-74

MR. HENRY ROSS
DIRECTOR OF SALES AND MARKETING
UNITED RENTALS HIGHWAY TECHNOLOGIES
880 NORTH ADDISON ROAD
P.O. BOX 7050
VILLA PARK, IL 60181-7050

Dear Mr. Ross:

Thank you for your letters of January 24 requesting Federal Highway Administration (FHWA) acceptance of your company's "Lo-Pro 350" and "High-Pro 350" portable sign stands as crashworthy traffic control devices for use in work zones on the National Highway System (NHS). Accompanying your letter were reports from E-Tech Testing Services, Inc., and videos of the crash tests. You requested that we find your company's temporary sign stands 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."

Introduction

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.

A brief description of the devices for which you are requesting acceptance follows:

The **Lo-Pro 350 Series 20 Sign Stand** is a portable sign system featuring an "A-Frame" upright support. The sign has four 31.75 mm 2.66 mm thick formed angle iron steel upright legs interconnected with spread bars of similar construction. The material specification is ASTM A499-89 for all angle iron steel used in the sign support. The uprights are "hinged" with 12.7 mm diameter ASTM A307 zinc plated bolts with lock nuts. The uprights, spread bars, and sign connect with 7.94 mm diameter fasteners of the same type.

The Lo-Pro 350 Series 20 Sign Stand features a 762 mm x 610 mm sign made of 10 mm thick "Safetycor", an unfilled polypropylene copolymer corrugated plastic sheeting material. The sign is bolted to the uprights with (4) 7.94 mm diameter ASTM A307 hex fasteners and special 38.1 mm outside diameter rubber encased flat washers that increase the bearing area and help to prevent sign damage when the stands are stacked. When deployed the bottom of the sign is a nominal 943 mm above ground level.

The **Lo-Pro 350 Series 40 Sign Stand** is a portable sign system featuring an "A-Frame" upright support. The sign has four 31.75 mm 2.66 mm thick formed angle iron steel upright legs interconnected with spread bars of similar construction. The material specification is ASTM A499-89 for all angle iron steel used in the sign support. The uprights are "hinged" with 12.7 mm diameter ASTM A307 zinc plated bolts with lock nuts. The uprights, spread bars, and sign connect with 7.94 mm diameter fasteners of the same type.

The Lo-Pro 350 Series 40 Sign Stand features a 1219 mm square sign made of 2.03 mm thick 5052-H32 aluminum sheet. The sign is bolted to the uprights with (4) 7.94 mm diameter ASTM A307 hex fasteners and special 38.1 mm outside diameter rubber encased flat washers that increase the bearing area and help to prevent sign damage when the stands are stacked. When deployed the bottom of the sign is a nominal 479 mm above ground level.

The **Hi-Pro 350 Sign Stand** is a portable sign system featuring two "U-Channel" upright supports. The supports are 3048 mm long 2.98 kg/m formed u-channel steel. The material specification of the uprights is ASTM A499-89 Grade 60. The uprights are inserted into 50.4 mm x 101.6 mm tube steel sockets supported by a 50.8 mm x 50.8 mm by 4.76 mm thick welded angle iron steel base frame. No fasteners are used to connect the uprights to the sockets.

The Hi-Pro 350 Sign Stand features a 1219 mm square sign made of 2.03 mm thick 5052-H32 aluminum sheet. The sign is bolted to the uprights with (4) 7.94 mm diameter GD 5 hex fasteners and 31.75 mm outside diameter flat washers to increase the bearing area. When deployed the bottom of the sign is a nominal 2134 mm above ground level.

Testing

Full-scale automobile testing was conducted on your company's devices. Two stand-alone examples of the device were tested individually, one test run head-on into the device and the next impact with the device oriented 90 degrees. Because of the nature of the devices, you had discussed this testing scenario with Mr. Artimovich in advance. The complete devices as tested are shown in Enclosure 1.

The crash tests are summarized in the table below:

Test Article	Lo-Pro 350 / 20	Lo-Pro 350 / 40	Hi-Pro 350
Height to Bottom of Sign	943 mm	479 mm	2134 mm
Height to Top of Sign	1498 mm	2100 mm	3860 mm
Substrate material	SafetyCor	Aluminum	Aluminum

Flags or lights	No	No	No
Test Article Mass (each)	10.7 kg	19.8 kg	50.5 kg
Impact Speed	101.1 km/h	101.8 km/h	101.8 km/hr
Velocity Change	1.1 m/s	1.4 m/s	2.3 m/s

Vehicle crush	Superficial	Superficial	Superficial
Occupant Compart. Intrusion	None	None	None
Windshield Damage	None	Overall cracking	Overall cracking
90 Degree Test, Test #	05-3721-006	05-3721-004	05-3721-002
Vehicle Inertial Mass	812 kg	823 kg	820 kg
Impact Speed	101.8 km/h	102.5 km/h	100.4
Velocity Change	1.0 m/s	1.4 m/s	1.7 m/s
Vehicle crush	Superficial	Superficial	Extensive damage
Occupant Compart. Intrusion	None	None	None
Windshield Damage	None	Overall cracking	None

Findings

Damage was limited to bumper, hood, and grill damage for each test, with the exception of some significant cracking in the windshields of some vehicles. These vehicles were not damaged to the point where the hypothetical driver was unable to see well enough to bring the vehicle to a safe stop beyond the point of impact. The results of the testing met the FHWA requirements and, therefore, the devices described above and shown in the enclosed drawings for reference are acceptable for use as Test Level 3 devices on the NHS under the range of conditions tested, when proposed by a State.

You also requested that we find a number of other combinations of stands and signs acceptable for use. For the Lo-Pro 350 systems you noted that the series designation refers to the stand's width. The Low-Pro 350 Series 20 is nominally 20 inches (500 mm) wide, Series 30 is nominally 30 inches (760 mm) wide and the Series 40 is nominally 40 inches (1015 mm) wide. You requested acceptance for these stands with the following matrix of signs using either "0.080" aluminum or SafetyCor (identical to the PlastiCor substrates you tested earlier.) In our discussions prior to conducting the crash tests, we had agreed that the following scenarios would "bracket" or encompass the range of devices you wish to use.

1. A narrow small stand using a small lightweight plastic panel would demonstrate if there was any potential for the top of the stand to penetrate the windshield if the sign substrate were not able to deflect the uprights from the glass.
2. A wide small stand using a large aluminum sign would demonstrate if there was sufficient mass to damage the windshield in a crash.
3. A tall stand using an large aluminum sign would demonstrate the performance of the tallest of the stands considered for use.

The stand and sign combinations that fall within the "range of conditions tested" are marked with an "X" in the table below.

Sign Size	Lo-Pro 350 Series 20	Lo-Pro 350 Series 30	Lo-Pro 350 Series 40
21x15	X		
24x24	X		

24x30	X		
30x24	Tested System		
30" STOP	X		
30" Square	X		
30 " Diamond	X		
30x36	X		
36" YIELD	X		
36x12		X	
36x24		X	
36x30		X	
36" STOP		X	
36" Square		X	
36" Diamond		X	
36x48		X	
48x18			X
48x24			X
48 x 30			X
48" Stop			X
48" Yield			X
48" Square			X
48" Diamond			Tested System
48x60			X
60x24			X
60x30			X
60x36			X

For the Hi-Pro 350 series you had the following additional requests:

1. You requested that we accept individually fabricated angle-iron feet in addition to the welded frame that was essentially a rectangular box on the ground. The proposed change would remove the horizontal bars at the front and the rear of the base, and use two independent feet. This system is designated the Hi-Pro 175.
2. You requested that we accept the tested Series 43 and the narrower Series 33 for smaller signs.
3. You requested that all sign system configurations be accepted with an optional crosspiece

attached to the front and rear of the frame.

4. You requested acceptance of the device with a lightweight warning light affixed.

5. You requested acceptance for these stands with the following matrix of signs using either "0.080" aluminum or SafetyCor.

Sign Size	High Pro 350 Series 43	High Pro 350 Series 33	High Pro Series 175
48x48 Diamond	Tested System		X
48x48 Square	X		X
42x36	X		X
48x30	X		X
60x30	X		X
60x24	X		X
48x60	X		X
60x48	X		X
36x48		X	X
36" Stop		X	X
48" Stop		X	X
48" Yield		X	X

Based on the "worst-case scenario" crash testing that you had discussed with us prior to testing, and have successfully completed, we concur in your requests detailed above.

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

- 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.
- Any changes that may adversely influence the crashworthiness of the device 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 being marketed is significantly different from the version that was crash tested, it reserves the right to modify or revoke its 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 they will meet the crashworthiness requirements of FHWA and NCHRP Report 350.
- To prevent misunderstanding by others, this letter of acceptance, designated as number

WZ-74 shall not be reproduced except in full. This letter, and the test documentation upon which this letter is based, is public information. All such letters and documentation may be reviewed at our office upon request.

- United Rentals work zone devices may include patented components and if so are 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, a copy of which is enclosed.

Sincerely yours,

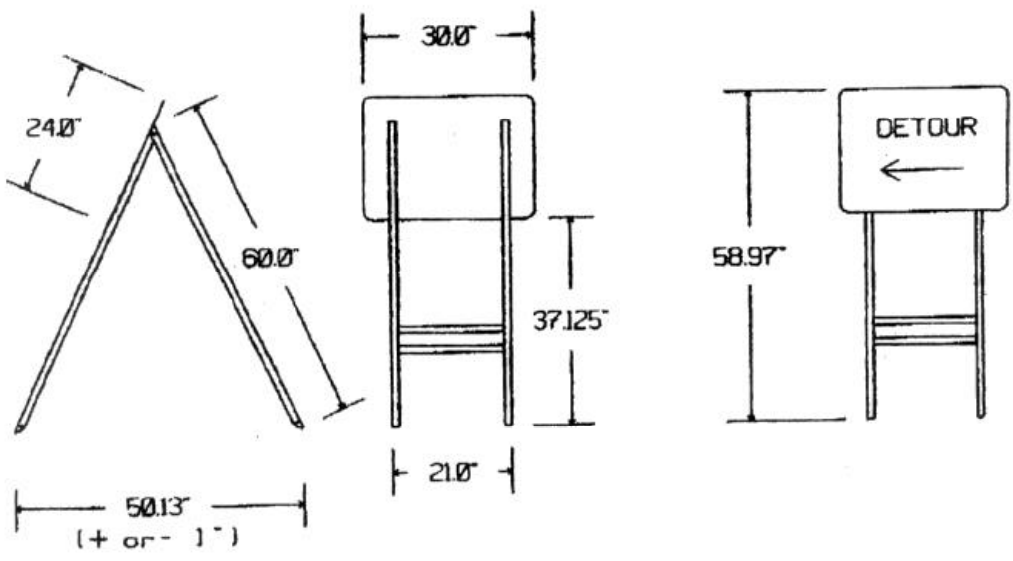
Frederick G. Wright, Jr.
Program Manager, Safety

Enclosure



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C. Illustrations

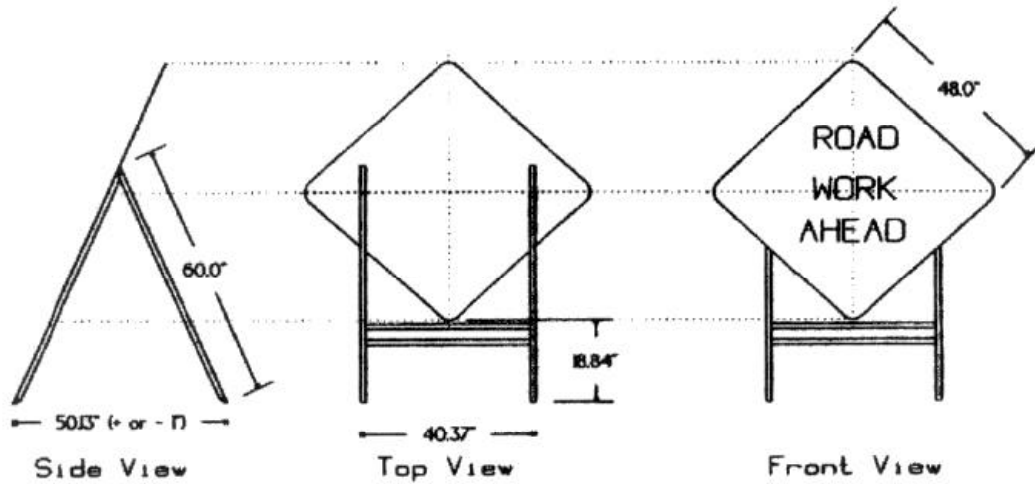


30x24 SafetyCar on Rail Steel A-Frame sign stand.

Illustration C-1. United Rentals Lo-Pro 350 Series 20 Sign Stand (1 of 1)



C. Illustrations



Materials

- 1 1/4"x1 1/4"x 12 Ga Rail Steel
- .080 Aluminum Sign

United Rentals
 Highway Technologies
 A-Frame Sign Stand

Illustration C-1. United Rentals Lo-Pro 350 Series 40 Sign Stand (1 of 1)



C. Illustrations

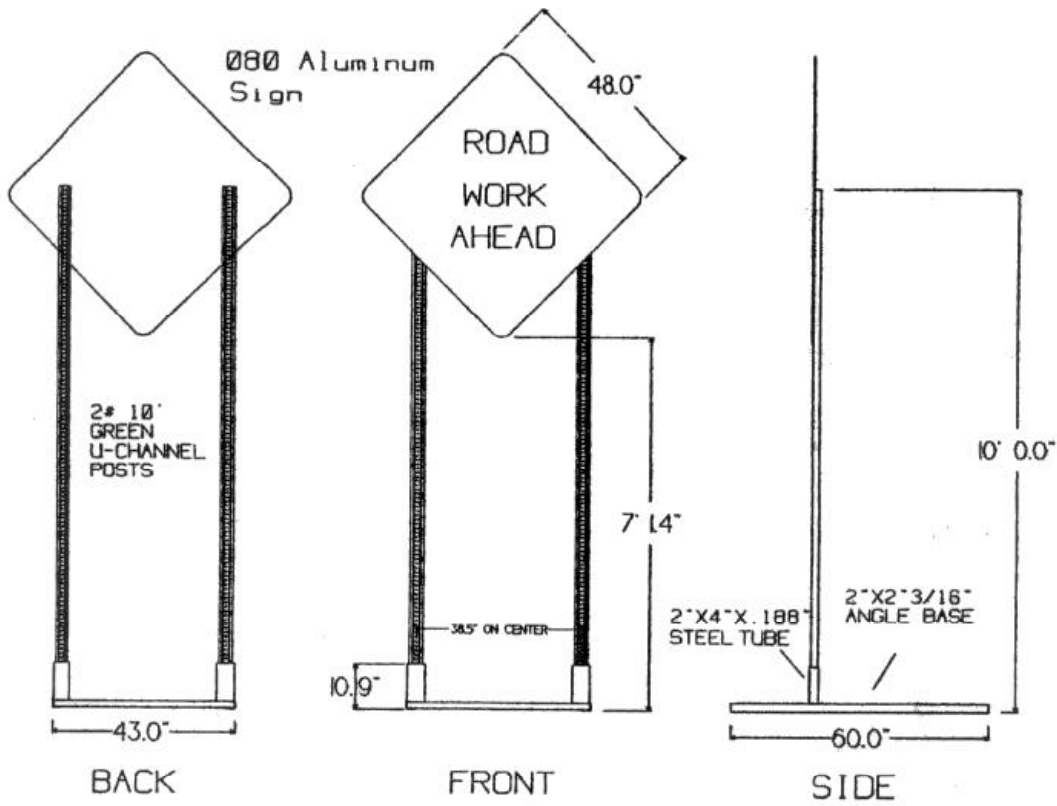


Illustration C-1. United Rentals Hi-Pro 350 Sign Stand (1 of 2)

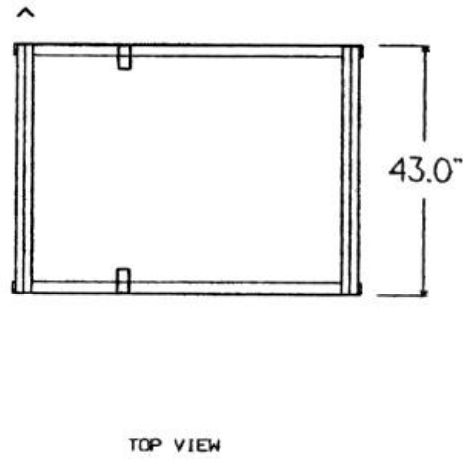
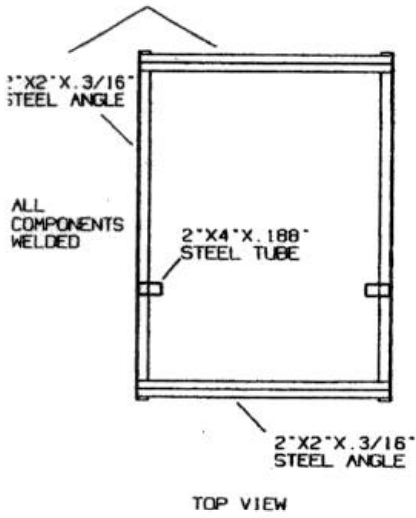
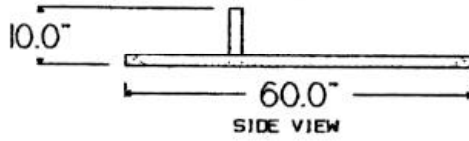
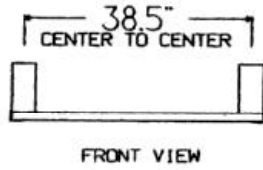


Illustration C-1. United Rentals Hi-Pro 350 Sign Stand (2 of 2)

Sec. 635.411 Material or product selection.

(a) Federal funds shall not participate, directly or indirectly, in payment for any premium or royalty on any patented or proprietary material, specification, or process specifically set forth in the plans and specifications for a project, unless:

(1) Such patented or proprietary item is purchased or obtained through competitive bidding with equally suitable unpatented items; or

(2) The State highway agency certifies either that such patented or proprietary item is essential for synchronization with existing highway facilities, or that no equally suitable alternate exists; or

(3) Such patented or proprietary item is used for research or for a distinctive type of construction on relatively short sections of road for experimental purposes.

(b) When there is available for purchase more than one nonpatented, nonproprietary material, semifinished or finished article or product that will fulfill the requirements for an item of work of a project and these available materials or products are judged to be of satisfactory quality and equally acceptable on the basis of engineering analysis and the anticipated prices for the related item(s) of work are estimated to be approximately the same, the PS&E for the project shall either contain or include by reference the specifications for each such material or product that is considered acceptable for incorporation in the work. If the State highway agency wishes to substitute some other acceptable material or product for the material or product designated by the successful bidder or bid as the lowest alternate, and such substitution results in an increase in costs, there will not be Federal-aid participation in any increase in costs.

(c) A State highway agency may require a specific material or product when there are other acceptable materials and products, when such specific choice is approved by the Division Administrator as being in the public interest. When the Division Administrator's approval is not obtained, the item will be nonparticipating unless bidding procedures are used that establish the unit price of each acceptable alternative. In this case Federal-aid participation will be based on the lowest price so established.

(d) Appendix A sets forth the FHWA requirements regarding (1) the specification of alternative types of culvert pipes, and (2) the number and types of such alternatives which must be set forth in the specifications for various types of drainage installations.

(e) Reference in specifications and on plans to single trade name materials will not be approved on Federal-aid contracts.

ENCLOSURE 2