

Refer to: HSA-10/WZ-129

Ron Faller, Ph.D., P.E.
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Dear Dr. Faller:

Thank you for your letter of June 5, 2002, requesting Federal Highway Administration (FHWA) acceptance of D.P. Sawyer's low-height temporary rigid panel sign stands as crashworthy traffic control devices for use in work zones on the National Highway System (NHS). Accompanying your letter was a report of crash testing you conducted and a CD-ROM of the tests. You requested that we find the 36x36 and the 48x48 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 follows:

The **36 x 36 sign stands** consisted of upright masts of 38.1 mm (1.5 inch) square ASTM A500 Grade B steel tubing with 2.5 mm (0.098 inch) wall thickness and a length of 1505 mm (59.25 inches.) The lower and upper horizontal bars were of the same material and were 838 mm (33 inches) long. The horizontal portions of the legs were 38.1 mm (1.5 inch) L-shaped

ASTM A36 steel angle with varying thicknesses as shown in the drawings, and were 1016 mm (40 inches) long. The vertical stub of the legs were 50.8 mm (2 inch) square ASTM A500 Grade B steel tubing with 4.5 mm (0.175 inch) wall thickness and a length of 127 mm (5 inches.) The horizontal bars are welded to the vertical uprights, and the vertical stubs are welded to the horizontal rail. The rigid aluminum sign panel measured 914 mm x 914 mm (36 inches square, in a diamond orientation), was 2.83 mm (0.115 inch) thick, and was mounted 333 mm (13.125 inches) above the ground.

The **48x48 sign stands** consisted of upright masts of 50.8 mm (2 inch) square ASTM A500 Grade B steel tubing with 4.5 mm (0.175 inch) wall thickness and a length of 1229 mm (48.375 inches.) The lower and upper horizontal bars were of the same material and were 838 mm (33 inches) long. The horizontal portions of the legs were 50.8 mm (2 inch) L-shaped ASTM A36 steel angle with 4.6 mm (0.183 inch) thickness, and were 1219 mm (48 inches) long. The vertical stub of the legs were 63.5 mm (2.5 inch) square ASTM A500 Grade B steel tubing with 4.5 mm (0.175 inch) wall thickness and a length of 178 mm (7 inches.) The horizontal bars are welded to the vertical uprights, and the vertical stubs are welded to the horizontal rail. The rigid aluminum sign panel measured 1219 mm x 1219 mm (48 inches square, in a diamond orientation), was 2.81 mm (0.1105 inch) thick, and was mounted 305 mm (12 inches) above the ground. The sign was fastened to the frame with 8 mm (0.3125 inch) diameter x 57 mm (2.25 inch) long grade 5 bolts and corresponding rubber washers.

Testing

Dynamic bogie vehicle testing was conducted on the Sawyer devices. One example of each device was tested head-on or turned at 90 degrees. The complete devices as tested are shown in Enclosure 1. The crash testing is summarized in the table below:

Test Number	DPS-5	DPS-6	DPS-8	DPS-9
Orientation	Head On	End On	Head On	End On
Sign Size	36x36	36x36	48x48	48x48
Height to Sign Bottom	333 mm	333 mm	305 mm	318 mm
Height to Sign Top	1578 mm	1578 mm	2029 mm	2035 mm
Flags or lights	None	None	None	None
Mass: Legs	7.275 kg	7.275 kg	11.340 kg	11.340 kg
: Frame	13.608 kg	13.608 kg	25.401 kg	25.401 kg
: Sign	5.897 kg	5.897 kg	10.886kg	10.886kg
Bogie Mass	974 kg	974 kg	974 kg	974 kg
Impact Speed	98.2 km/hr	98.2 km/hr	98.2 km/hr	98.2 km/hr
Velocity Change*	Est. 0.7 m/s	Est. 0.7 m/s	Est. 1.3 m/s	Est. 1.3 m/s

* Velocity changes were estimated through conservation of momentum.

This unique crash-testing program used a hard-nosed bogie vehicle of a mass larger than the standard 820C test vehicle. There are significant constraints involved in using such a non-standard testing device, some of which are:

1. The potential vehicle velocity change must be considered insignificant.
2. The crush characteristics of an automobile bumper must not be expected to have a significant affect on the trajectory of the test article.
3. The profile of the bogie vehicle must be configured to replicate the outline of a production vehicle. The MWRSF bogie was configured to replicate the outline of a Geo Metro, a vehicle commonly used in testing of work zone devices.
4. No part of the test article may intrude into the windshield area of the vehicle after impact.

The four tests summarized above and their results were within these constraints. The test articles did bend around the bumper of the bogie, but did not show potential to impact the windshield.

One of the tests that are not reported above shows the utility of this surrogate test vehicle. In test number DPS-7, the top of the 48 x 48 sign did, indeed, come in contact with the vicinity of the bogie's windshield. The framing material in the stand used in that test was the same as used in test numbers DPS-5 and DPS-6 supporting 36 x 36 signs. This test helped determine that the frame of the stand needed to be stiffer in order to accommodate the larger signs. The retests using 50.8 mm (2 inch) square x 4.5 mm (0.177 inch) wall steel tubes to support the 48 x 48 signs (DPS-8 and DPS-9) showed acceptable performance – the stiffer frame kept the sign from bending in and striking the windshield.

Findings

The results of the testing showed that the D. P. Sawyer Sign Stands would meet the FHWA requirements and, therefore, the devices described above and shown in the enclosed drawings for reference are acceptable for use on the NHS under the range of conditions tested, when proposed by a State.

Please note the following standard provisions that 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-129 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.
- The D. P. Sawyer 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.

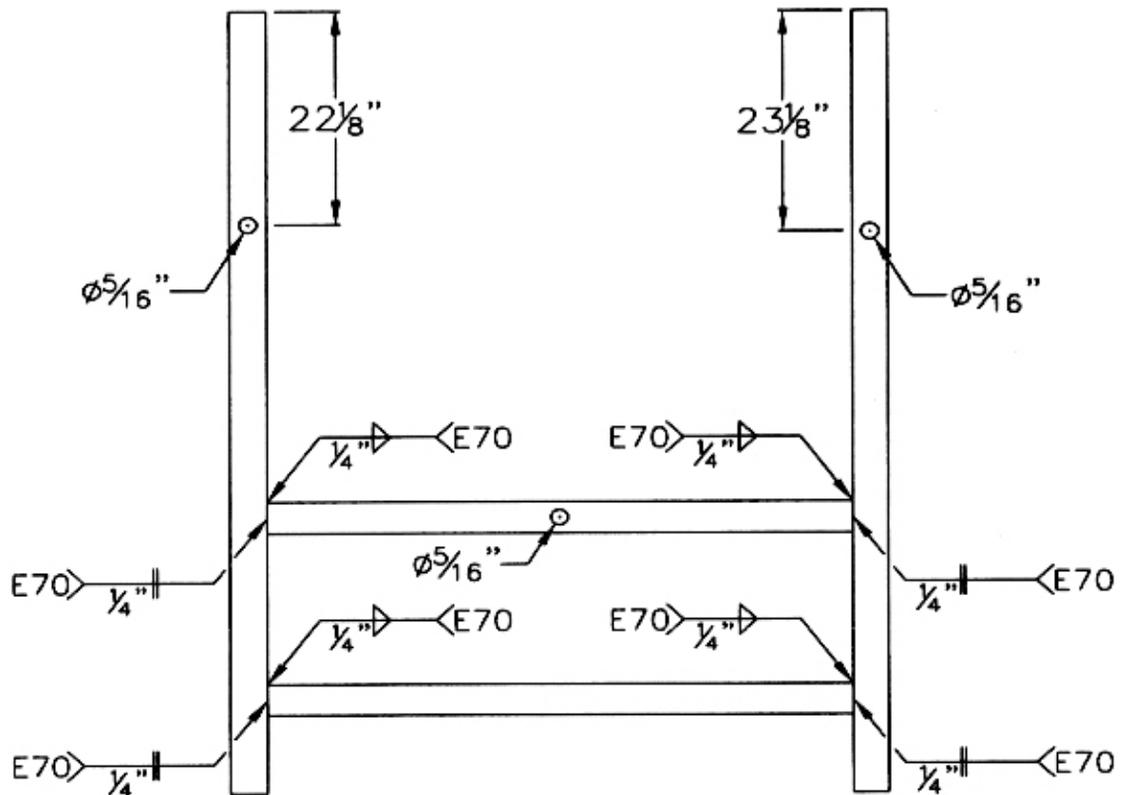
Sincerely yours,

Carol H. Jacoby, P.E.
Director, Office of Safety Design

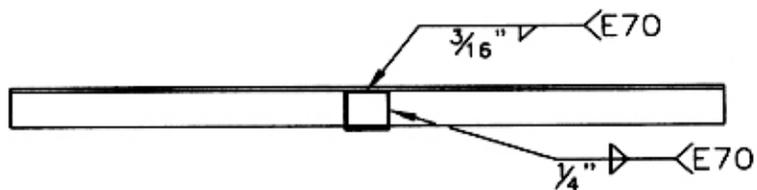
Enclosure

System: DPS-5

Front View
(Masts and Horizontal Bars)



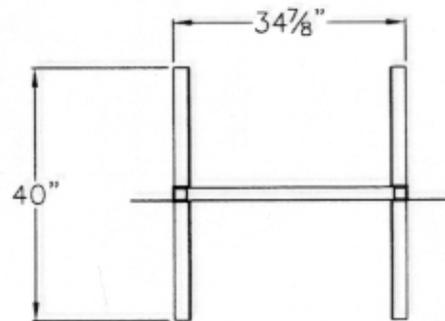
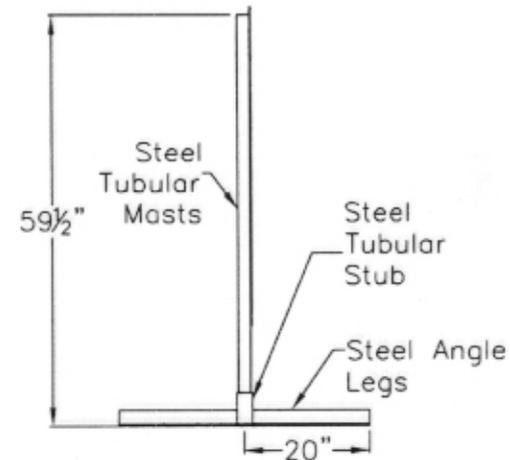
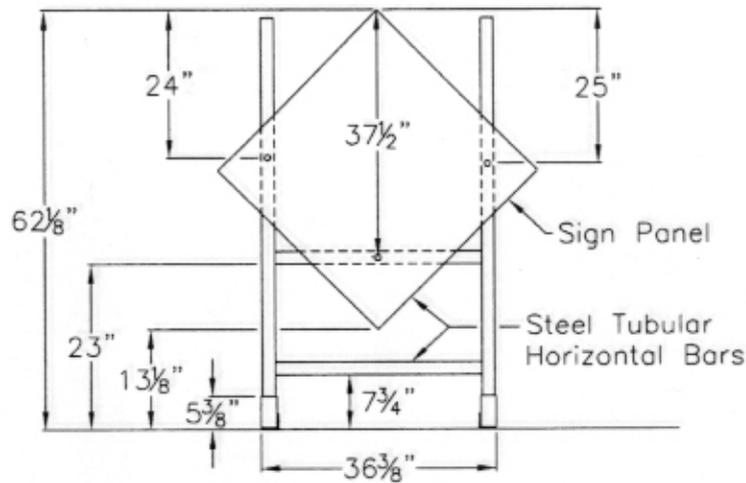
Top View (Legs)



Side View (Legs)



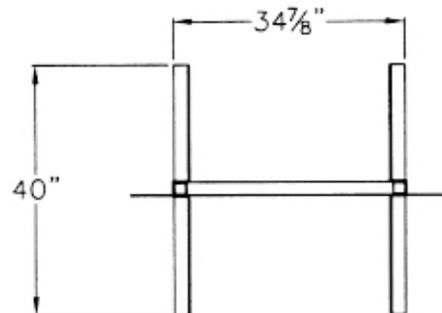
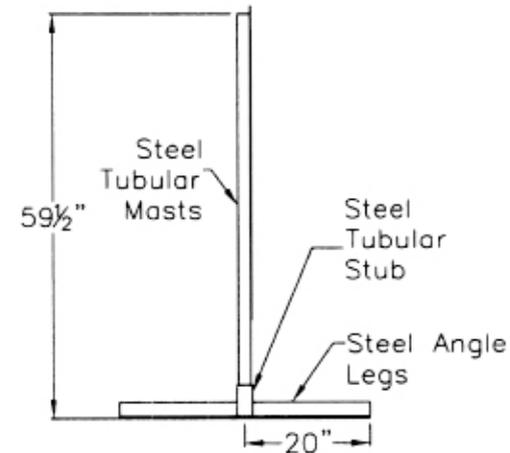
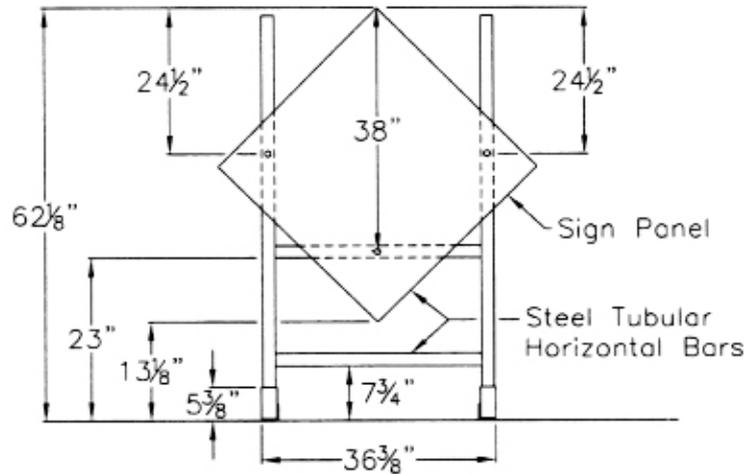
System: DPS-5



36" x 36" Rigid Panel System

- Vertical Upright Masts - 1.5" sq. x 0.098" wall x 59.25" long ASTM A500 Grade B steel tubing
- Lower and Upper Horizontal Bars - 1.5" sq. x 0.098" wall x 33" long ASTM A500 Grade B steel tubing
- Legs, Horizontal Portion - 1.5" x 1.5" x 0.184" and 0.251" thicknesses x 40" long L-shaped ASTM A36 steel angle
- Legs, Vertical Stub - 2" sq. x 0.175" wall x 5" long ASTM A500 Grade B steel tubing
- Lower and upper horizontal bars are welded to the vertical upright masts
- Vertical stub of the leg is welded to the horizontal portion of the leg on two sides
- Masts slide inside vertical stub of legs -- No bolt or fastening device used
- Sign Panel - Reflective aluminum, 36" wide x 36" long with a 0.1115" thickness
- Panel fastened to vertical mast supports and upper horizontal bar with 0.3125" diameter x 2.25" long Grade 5 bolts. A 1.625" O/D x 0.625" thick rubber washer was placed between the head of the bolt and the sign panel

System: DPS-6

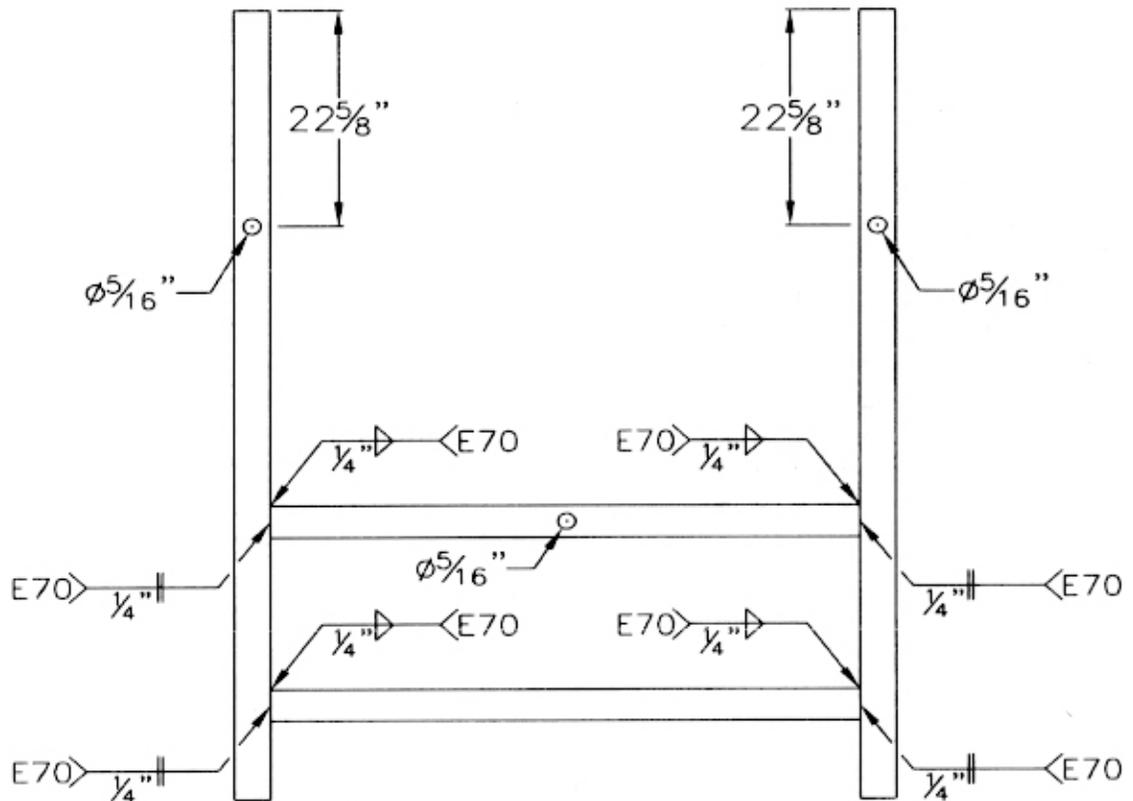


36" x 36" Rigid Panel System

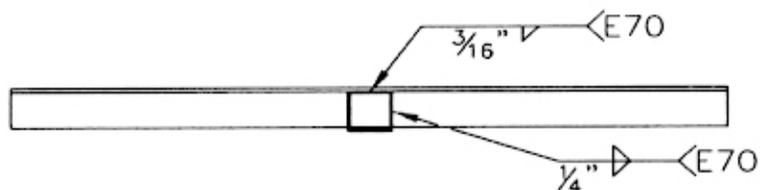
- Vertical Upright Masts – 1.5" sq. x 0.098" wall x 59.25" long ASTM A500 Grade B steel tubing
- Lower and Upper Horizontal Bars – 1.5" sq. x 0.098" wall x 33" long ASTM A500 Grade B steel tubing
- Legs, Horizontal Portion – 1.5" x 1.5" x 0.184" and 0.251" thicknesses x 40" long L-shaped ASTM A36 steel angle
- Legs, Vertical Stub – 2" sq. x 0.175" wall x 5" long ASTM A500 Grade B steel tubing
- Lower and upper horizontal bars are welded to the vertical upright masts
- Vertical stub of the leg is welded to the horizontal portion of the leg on two sides
- Masts slide inside vertical stub of legs -- No bolt or fastening device used
- Sign Panel – Reflective aluminum, 36" wide x 36" long with a 0.1115" thickness
- Panel fastened to vertical mast supports and upper horizontal bar with 0.3125" diameter x 2.25" long Grade 5 bolts. A 1.625" OI.D x 0.625" thick rubber washer was placed between the head of the bolt and the sign panel

System: DPS-6

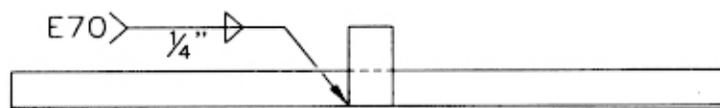
Front View
(Masts and Horizontal Bars)



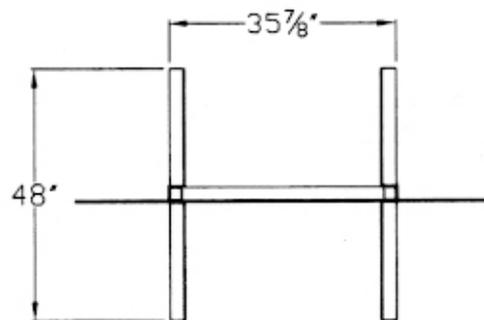
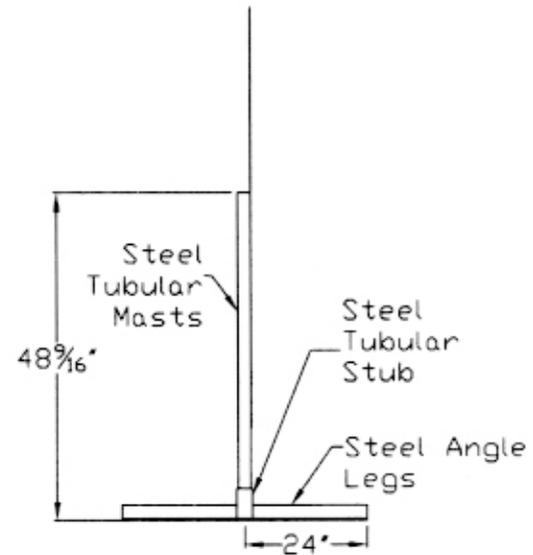
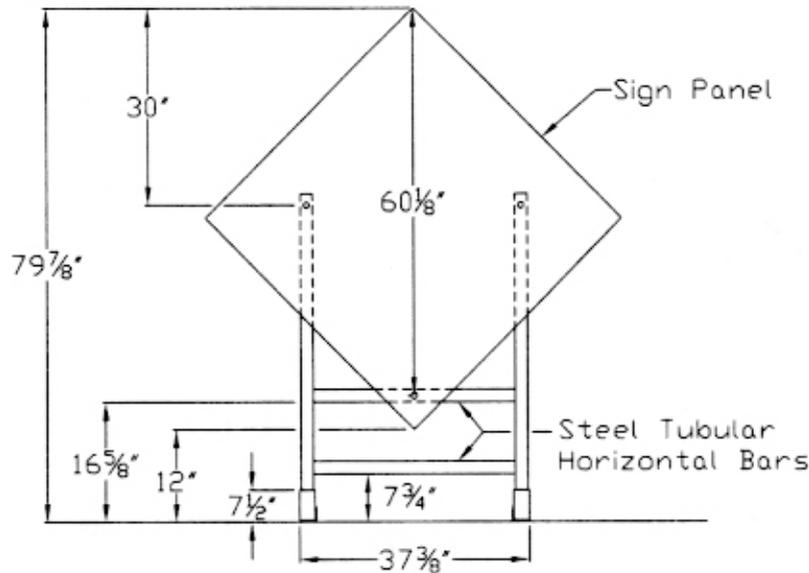
Top View (Legs)



Side View (Legs)



System: DPS-8

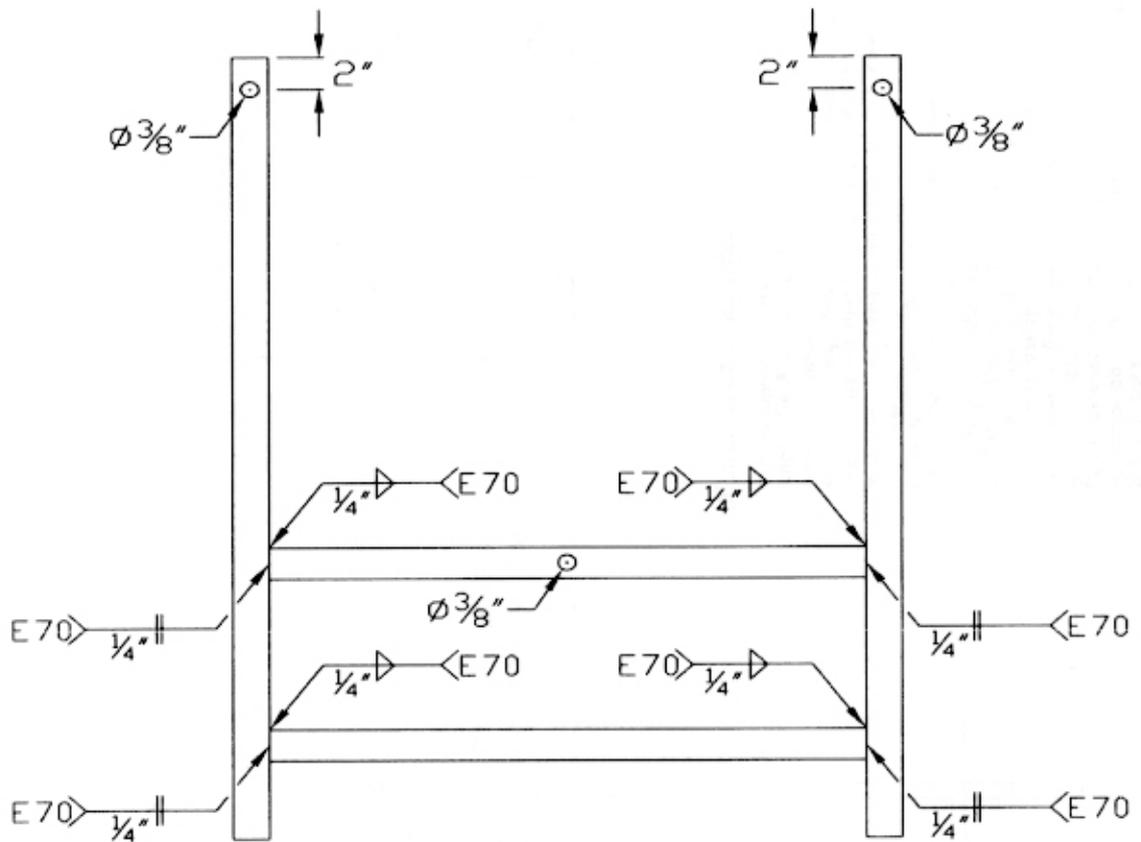


48" x 48" Rigid Panel System

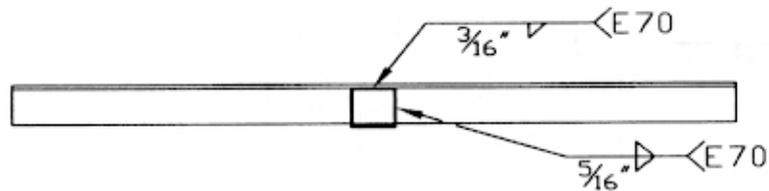
- Vertical Upright Masts - 2" sq. x 0.177" wall x 48.375" long ASTM A500 Grade B steel tubing
- Lower and Upper Horizontal Bars - 2" sq. x 0.177" wall x 33" long ASTM A500 Grade B steel tubing
- Legs, Horizontal Portion - 2" x 2" x 0.183" thickness x 48" long L-shaped ASTM A36 steel angle
- Legs, Vertical Stub - 2.5" sq. x 0.179" wall x 7" long ASTM A500 Grade B steel tubing
- Lower and upper horizontal bars are welded to the vertical upright masts
- Vertical stub of the leg is welded to the horizontal portion of the leg on two sides
- Masts slide inside vertical stub of legs -- No bolt or fastening device used
- Sign Panel - Reflective aluminum, 48" wide x 48" long with a 0.1105" thickness
- Panel fastened to vertical mast supports and upper horizontal bar with 0.3125" diameter x 3.25" long Grade 5 bolts

System: DPS-8

Front View
(Masts and Horizontal Bars)



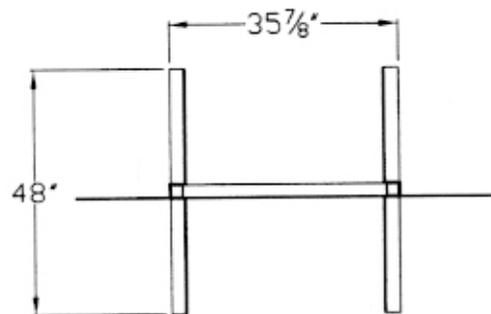
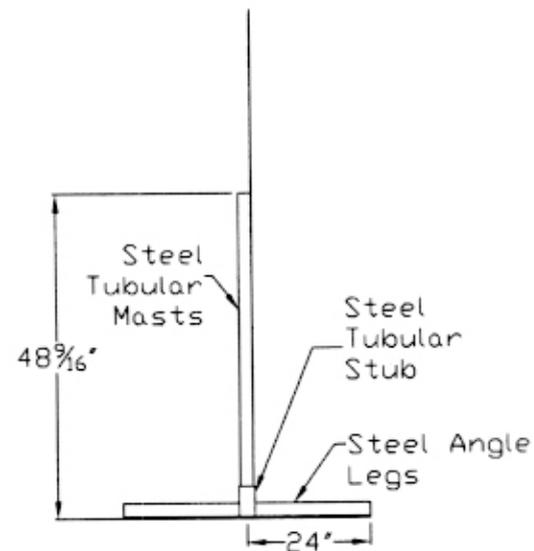
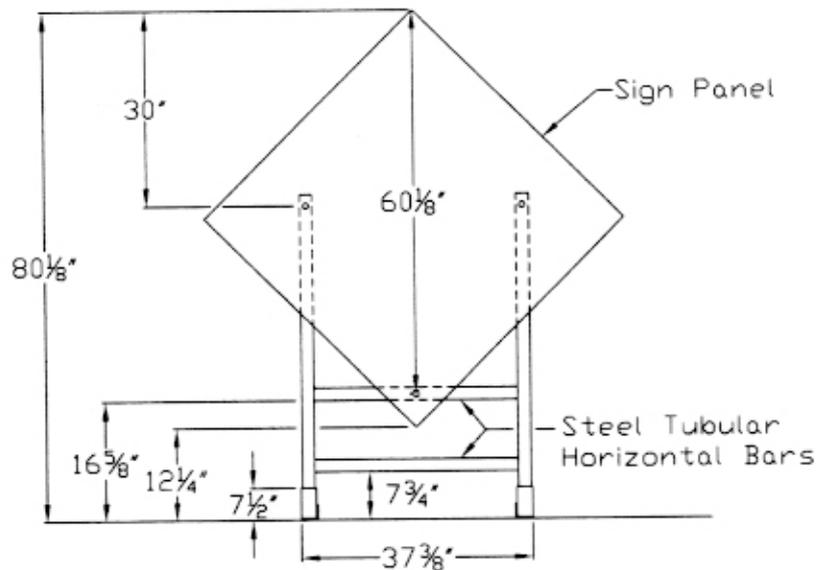
Top View (Legs)



Side View (Legs)



System: DPS-9



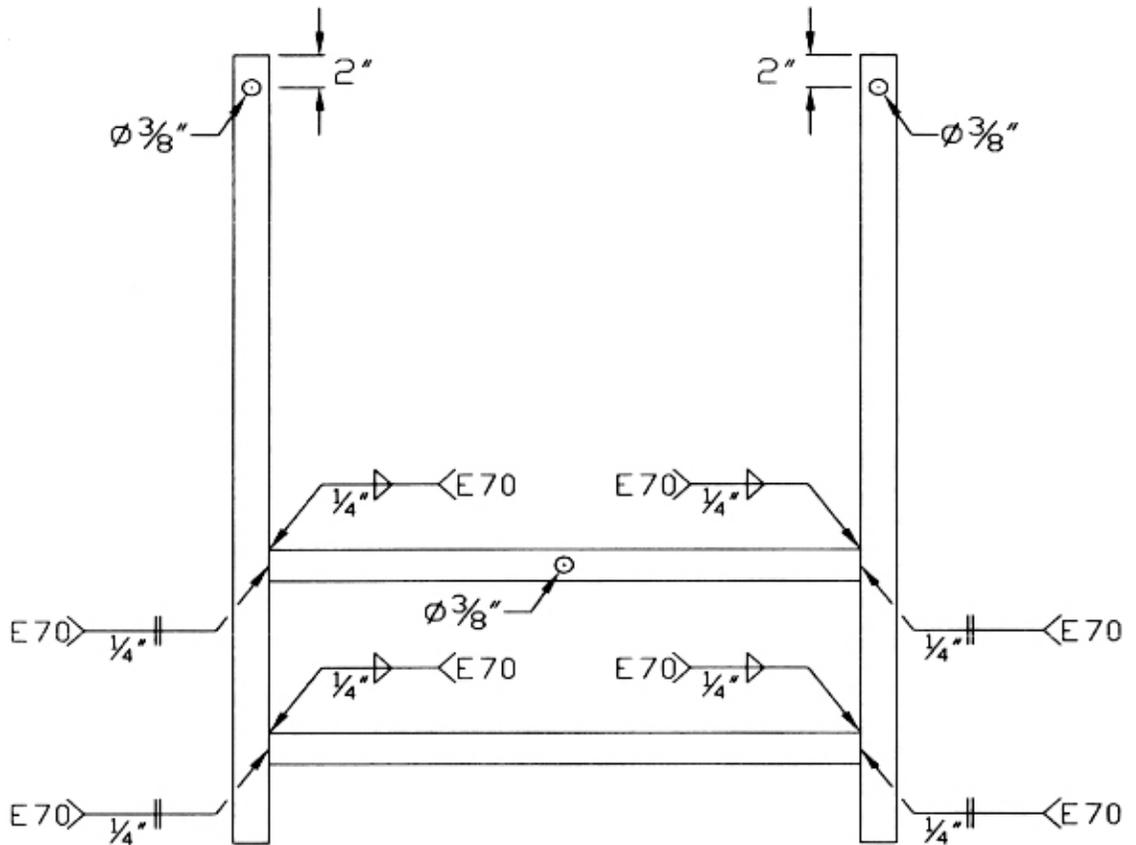
48" x 48" Rigid Panel System

- Vertical Upright Masts - 2" sq. x 0.177" wall x 48.375" long ASTM A500 Grade B steel tubing
- Lower and Upper Horizontal Bars - 2" sq. x 0.177" wall x 33" long ASTM A500 Grade B steel tubing
- Legs, Horizontal Portion - 2" x 2" x 0.183" thickness x 48" long L-shaped ASTM A36 steel angle
- Legs, Vertical Stub - 2.5" sq. x 0.179" wall x 7" long ASTM A500 Grade B steel tubing
- Lower and upper horizontal bars are welded to the vertical upright masts
- Vertical stub of the leg is welded to the horizontal portion of the leg on two sides
- Masts slide inside vertical stub of legs -- No bolt or fastening device used
- Sign Panel - Reflective aluminum, 48" wide x 48" long with a 0.1105" thickness
- Panel fastened to vertical mast supports and upper horizontal bar with 0.3125" diameter x 3.25" long Grade 5 bolts

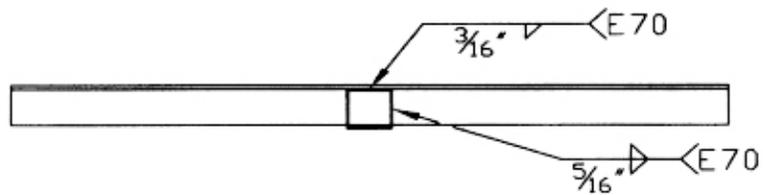
48" x 48" Rigid Panel System Design Details, Bogie Test DPS-9

System: DPS-9

Front View
(Masts and Horizontal Bars)



Top View (Legs)



Side View (Legs)

