



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

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

March 4, 2005

In Reply Refer To:  
HSA-10/WZ-100 Amendment #6

Mr. William M. Korman, Jr.  
Korman Signs, Inc.  
3029 Lincoln Avenue  
Richmond, Virginia 23228

Dear Mr. Korman:

Thank you for your letter of November 18, 2004, requesting Federal Highway Administration (FHWA) acceptance of a number of your company's portable sign stands and Type III barricades as crashworthy traffic control devices for use in work zones on the National Highway System (NHS). Accompanying your letter were reports of crash testing you conducted and which were witnessed by AnteRapture Engineering. Video of the tests was submitted with your request dated October 5, 2004, which resulted in acceptance letter WZ-100 Amendment #5. Your current request is that we find these devices 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 are those lightweight devices which are to be self-certified by the vendor, Category II devices are other lightweight devices which need individual crash testing but with reduced instrumentation, Category III devices are barriers and other fixed or heavy devices also needing crash testing with normal instrumentation, and Category IV devices are trailer mounted lighted signs, arrow panels, etc. for which crash testing requirements have not yet been established. 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.

Your present request is for several new Model WBT3, Type III barricades with optional attached lights and signs. Based on the results of the recent tests, you asked to amend WZ-100 to add additional features to the NCHRP 350 accepted models by the original WZ-100 and the



previous amendments. Also, you requested acceptance of a new method of mounting ALPOLIC® 350 signs on existing Model SS548E, SS548AE, SS548CE, SS548CAE, SS548ETL, SS548AETL, SS560, SS560A, SS560E and SS560AE sign stands.

### **Description of Devices**

All steel used for the Type III barricade crash test articles was ASTM A500, 45,000 psi yield/48,000 psi tensile typical, Grade 1008 with maximum of 0.10% carbon, 0.50% Manganese, 0.030% Phosphorus and .035% Sulfur.

Based upon previous tests and approvals you expect similar results and requested approval for steel up to a nominal 60,000 psi yield in the as-formed cold worked, welded and galvanized condition.

The first series of requests concerns the acceptance of Model WBT3 Type III barricades that are as follows:

1. 4' to 12' wide and 5' or 7' tall with 8" to 12" tall panels of hollow fluted plastic (polyethylene or polypropylene) of 10mm or 13mm thickness, and hollow extruded plastic (polyethylene, polypropylene or polyolefin) of 1" or 2" nominal thickness or, 2mm thick ALPOLIC® 350 aluminum composite laminate (see drawings). They may be used with or without ballast or staking. They may be used with or without up to two lights of up to 4.4 pounds attached to the top of the upright posts. These barricades may be used with or without up to 33' square of ALPOLIC® 350 signs fastened directly to the panels with a minimum height of 12" to the bottom of the sign.
2. As above with horizontal legs and vertical upright posts of 1 3/4" to 2" perforated square steel tubing (PSST) with 12 or 14 gauge wall thickness and one or two horizontal cross braces of 1 1/4" to 1 1/2" non-perforated 12 to 16 gauge square steel tubing or 1 3/4" to 2" PSST with 12 to 16 gauge wall thickness. The steel cross braces shall be fastened to the upright posts at a level no higher than 27" from the bottom of the legs to the bottom of the top cross brace. The legs, uprights and cross braces may be joined by splice plate brackets, hinge plate brackets, hinge or stub tees, or welded stubs as previously approved.
3. As above with a range of hinge plate joining brackets for the horizontal legs or the horizontal cross braces from 2" to 4" wide and of steel from 10 gauge to 6 gauge.
4. As above with optional telescopic legs such that the inner legs as small 1 1/4" square 16 gauge up to 1 3/4" 12 gauge steel tubing (see drawing).
5. As above with 4" long and at least 1 1/4" square 12 to 16 gauge steel tubes to adapt the lights to the top of the barricade post.
6. As above with internal stub leg of 60" x 1 1/2" square 12 to 16 gauge steel tubing and 4" minimum length stub of the same to fit inside of the 1 3/4" square steel upright. The stub may be attached by welding or by approved brackets.
7. As above except without the use of warning lights in which case 1-1/2" to 2" square 16 gauge steel tubing may be used for vertical upright posts.

The last request has to do with a modification to ALPOLIC® 350 signs (refer to enclosure 9):

8. Attaching a lightweight bracket to the signs so that they may be mounted in the same way as a roll-up signs as accepted in WZ-100 and Amendments 2 and 3 for the Models

SS548E, SS548AE, SS548CE, SS548CAE, SS548ETL and SS548AETL stands at the mounting height of 60" and the Models SS560, SS560A, SS560E and SS560AE stands at the mounting height of 84".

The results of the informal crash testing witnessed by AnteRapture Engineering on September 21, 2004, with 5' x 12' barricades constructed of 1 1/2" square 16 gauge steel tubing showed that the cross brace at 51" was not crashworthy as it broke out the right rear passenger window of the Ford Escort test vehicle during the head-on impact number (111A). Also, in the 90 degrees impact (111B) the forward upright post bent and allowed the light to slightly penetrate the windshield even though that barricade had the high cross brace. The impacts of the 7' x 12' barricades (impact numbers 110A and 110B) with two cross braces in the lower position performed better and even though the light impacting the upper part of the windshield in the head-on impact did not penetrate the windshield, it did cause a 2" depression in it. Due to these problems you only requested approval of the 1 1/2" to 2" square 16 gauge uprights without warning lights at this time. The damage to the vehicle windshields (except for the case of the high level second cross brace breaking the side window) was caused by the bending of the vertical upright posts allowing the windshield to be struck at high velocity by the posts, panels and lights. Stronger posts, as in your previous testing, control this bending to a greater degree.

The last request, number 8, is by extrapolation from previous acceptances of ALPOLIC® 350 and roll-up signs in the FHWA accepted sign stands. In acceptance letters WZ-100, WZ-100 Amendment 2 and Amendment 3 the mounting of roll-up signs at a maximum of 60" or 84" depending on sign stand model was accepted for models SS548E, SS548AE, SS548CE, SS548CAE, SS548ETL, SS548AETL, SS560, SS560A, SS560E and SS560AE. At the mounting heights of 60" and 84" it is established that the signs and masts detach from the stand and go over the vehicle, so the same is expected in this case. To facilitate achieving these greater than normal mounting heights we would use a lightweight bolt-on interface for the sign that would allow the sign to be attached to the existing roll-up sign mounting adapters. The interface is mounted in the center of the sign so that its configuration approximates that of the ribs of a roll-up sign.

The following are enclosed for reference:

**Enclosure 1** is a drawing of the WBT3 Type III barricades showing the requested features.

**Enclosure 2** is a drawing of the hinge plate variations.

**Enclosure 3** is a drawing of the 1 1/2" square 16 gauge steel tube stub barricade leg and the telescopic leg assemblies.

**Enclosure 4** is an updated product description and glossary summarizing the additional items.

**Enclosure 5** is a Summary of Requests Chart.

**Enclosure 6** is an updated Summary of Accepted Devices Chart.

**Enclosure 7** is an updated Summary of the NCHRP 350 crash tests.

**Enclosure 8** is the crash test report for the tests conducted on September 21, 2004.

**Enclosure 9** is a drawing of the ALPOLIC® 350 roll-up bracket interface for request number 8.

These enclosures support the positions outlined in the requests. Enclosure 6 is a reference revised summary of all the accepted devices in WZ-100 and its revisions as well as this letter.

### Testing

Full-scale automobile testing with Ford Festivas was conducted on your company's devices except test 111A and 111B, which used a Ford Escort. Two stand-alone examples of the 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. Impact speeds were approximately 58 to 60 mph, as measured by calibrated speed radar on site.

The Type III Barricade tests are summarized in the tables below:

Test Number	110A	110B
Barricade Tested	12' long, 7' tall, 1.5" 16 gauge non-PSST	12' long, 7' tall, 1.5" 16 gauge non-PSST
Barricade Feet	Telescoping, 1.25 into 1.5" PSST	Non-telescoping 1.5" PSST
Barricade Rails	8" x 2" x 144" hollow extruded	½" thick fluted
Crossbars	Two 1.25" 16 gauge 10" and 51" height*	Two 1.25" 16 gauge 10" and 51" height*
Orientation	Head on	End on
Lights?	One 4.4# light atop each post	One 4.4# light atop each post
Signs?	None	None
Extent of contact	Windshield and side window hit	No additional impact
Windshield Damage	2" Deformation	No additional damage
Other notes	None	None

Test Number	111A	111B
Barricade Tested	12' long, 5' tall, 1.5" 16 gauge non-PSST	12' long, 5' tall, 1.5" 16 gauge non-PSST
Barricade Rails	0.79" Alpolic 350	0.79" Alpolic 350
Crossbars	Two 1.25" 16 gauge 10" and 51" height*	Two 1.25" 16 gauge 10" and 51" height*
Lights?	One 4.4# light atop each post**	One 4.4# light atop each post**
Signs?	33' square Alpolic 350 signs	33' square Alpolic 350 signs
Extent of contact	Light struck base of windshield	Light, crossbar hit windshield
Windshield Damage	1.5 inch deformation, cracking	Windshield penetration
Other notes	Side window destroyed	None

\* Because the height of the upper cross brace appeared to exacerbate the cracking, the final design will have the upper cross brace located at no higher than 27" above the ground.

\*\* Because the lights were the direct cause of windshield cracking and/or penetration, they will not be acceptable for use with these 16 gauge PSST barricades.

## Findings

Damage consisted of moderate cracking for the 16 gauge non-PSST framed barricades. However, there was occupant compartment intrusion in tests 111A and 111B. In order to avoid similar damage, no lights will be permitted on the 16 gauge barricades, and the upper cross brace will be lowered from 51 inches to 27 inches. This will relocate the horizontal structure that caused a hole in the windshield to a lower position, and reduce and relocate the mass impacting the side of the vehicle.

Except as noted above, the results of the testing met the FHWA requirements and, therefore, the devices described in the various requests numbered 1 through 7 above and detailed in the enclosed drawings are acceptable for use on the NHS under the range of conditions tested, when proposed by a State. We also concur in the mounting bracket revision detailed in Request # 8. We also concur in your request to use steel up to a 60 ksi yield in the as-formed cold worked state as the performance of crashworthy Type III barricades tends to improve with greater stiffness.

Please note the following standard provisions that apply to the 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 the FHWA and the NCHRP Report 350.
- To prevent misunderstanding by others, this letter of acceptance, designated as number WZ-100, Amendment #6 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.
- Many Korman Signs and barricades contain patented devices and 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 by a highway agency* for use on Federal-aid 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. These provisions do not apply to exempt Non-NHS projects. Our regulations concerning proprietary products are contained in Title 23, Code of Federal Regulations, Section 635.411, a copy of which is enclosed.

- This acceptance letter shall not be construed as authorization or consent by the FHWA to use, manufacture, or sell any patented device for which the applicant is not the patent holder. The acceptance letter is limited to the crashworthiness characteristics of the candidate device, and the FHWA is neither prepared nor required to become involved in issues concerning patent law. Patent issues, if any, are to be resolved by the applicant.

Sincerely yours,

*/Original Signed by/*

*~for~*

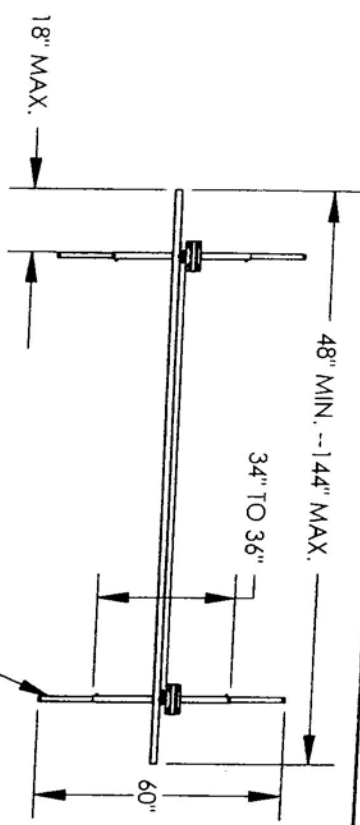
John R. Baxter, P.E.  
Director, Office of Safety Design  
Office of Safety

Enclosure

FHWA:HSA-10:NArtimovich:tb:x61331:2/24/05

File: h://directory folder/artimovich/WZ100-Korman#6FIN

cc: HSA-10 (Reader, HSA-1; Chron File, HSA-10;  
N.Artimovich, HSA-10)



3 RAILS FOR 5' HIGH  
4 RAILS FOR 7' HIGH  
OR 1" OR 2" THICK  
HOLLOW EXTRUDED  
POLYPROPYLENE  
POLYETHYLENE OR  
POLYOLEFIN, 10MM  
OR 13 MM THICK  
FLUTED POLYETHYLENE  
OR POLYPROPYLENE,  
2MM THICK ALPOLIC 350

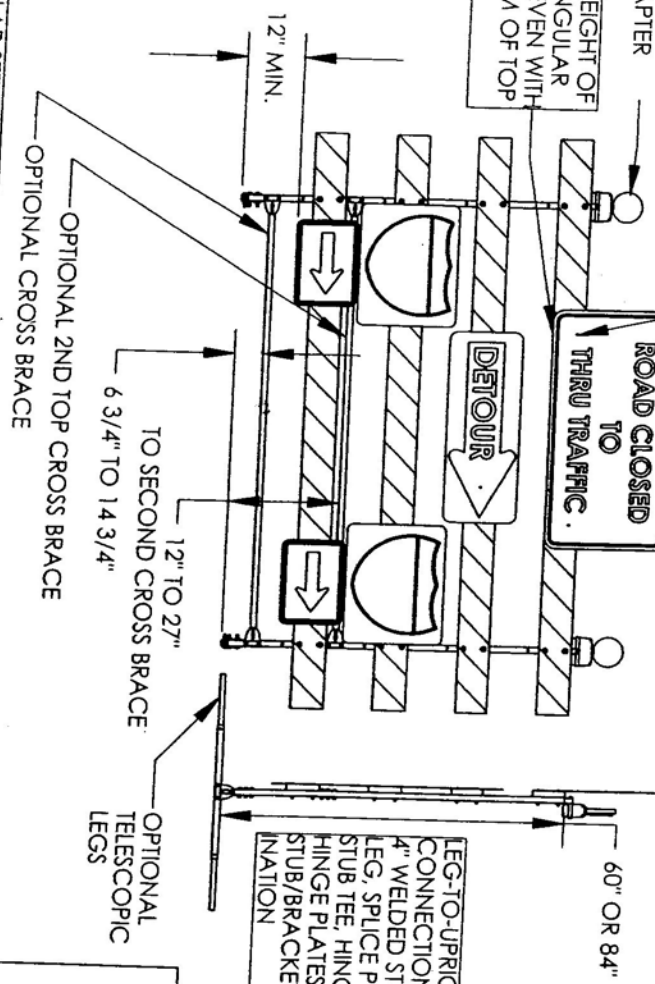
LEGS MAY BE STAKED  
OR WEIGHTED WITH  
SAND OR WATER BAGS

TYPICAL MOUNTING POINT,  
SIGNS MAY BE ATTACHED TO  
MORE THAN ONE RAIL.

OPTIONAL  
LIGHT WITH  
FLAT BAR OR  
SQ TUBE  
ADAPTER

MAX. HEIGHT OF  
RECTANGULAR  
SIGNS EVEN WITH  
BOTTOM OF TOP  
RAIL

UP TO 33 SQUARE FEET OF ALPOLIC 350  
SIGN OR SIGNS MOUNTED DIRECTLY TO  
RAILS AND/OR CROSS BRACE. 12" MIN.  
TO BOTTOM OF SIGNS FROM GROUND



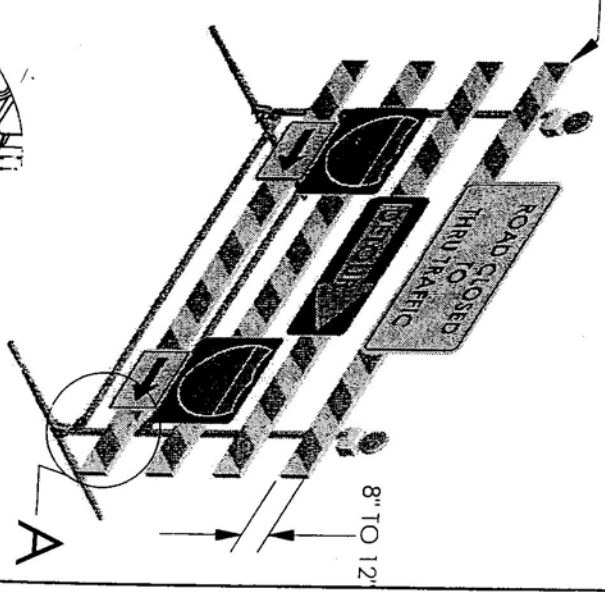
LEG-TO-UPRIGHT  
CONNECTION BY  
4" WELDED STUB ON  
LEG, SPLICE PLATES,  
STUB TEES, HINGE TEES,  
HINGE PLATES OR  
STUB/BRACKET COMB.

OPTIONAL 2ND TOP CROSS BRACE  
OPTIONAL CROSS BRACE  
TO SECOND CROSS BRACE:  
6 3/4" TO 14 3/4"  
12" TO 27"

SQUARE TUBULAR STEEL:  
UPRIGHTS, 1-3/4" OR 2" 12 OR 14 GAUGE WITH LIGHTS OR 1-1/2" TO 2" 16 GAUGE WITHOUT.  
LEGS, 1-1/2", 1-3/4" OR 2", 12, 14 OR 16 GAUGE.  
CROSS-BRACES, 1-1/4" TO 2" 12, 14 OR 16 GAUGE

REVISIONS

REV. A	ORIGINAL ISSUE: 11/3/04
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DETAIL A  
SCALE 1:18

JOIN CROSS BRACE  
TO UPRIGHT WITH  
SPLICE PLATES,  
STUB TEES, HINGE  
TEES DOUBLE HINGE  
PLATES OR SINGLE  
HINGE PLATES AS  
SHOWN



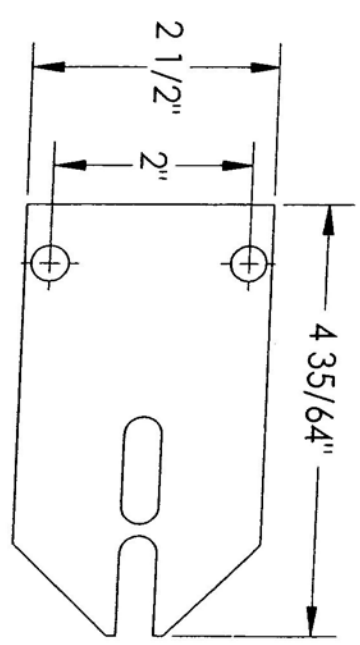
**Korman Signs**  
INC.

MODEL WB13 TYPE III BARRICADE OPTIONS

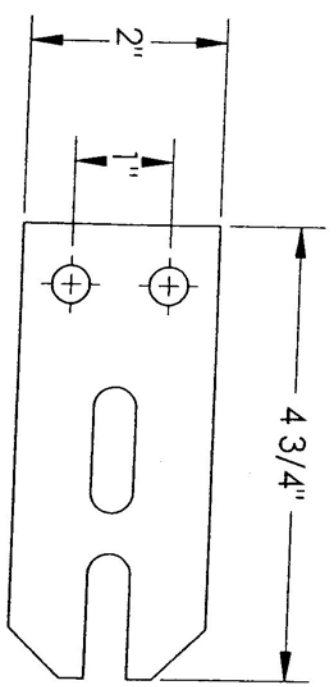
SCALE: NOT TO SCALE  
DATE: 11/11/04  
REV. A  
APPROVED:

WZ-100 AMENDMENT 6 ENCLOSURE 2

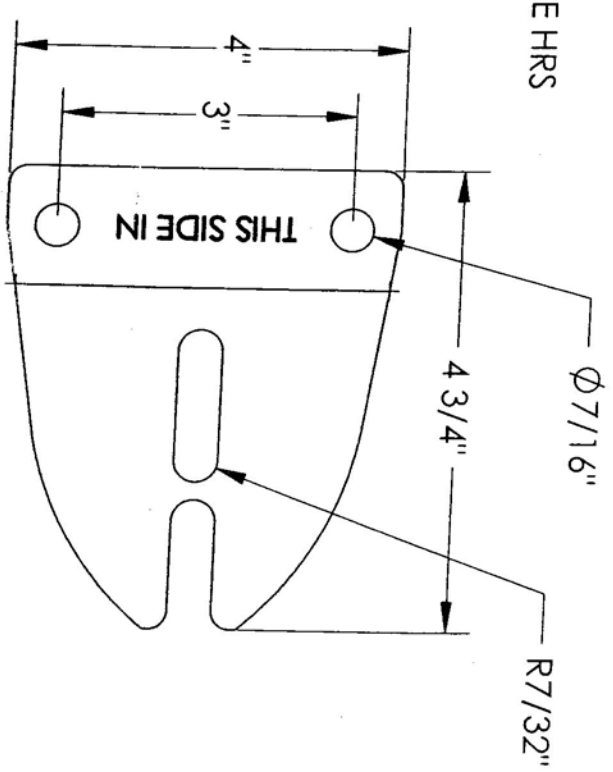
NOTE: ALL STEEL IS  
ASTM A-569



MEDIUM  
MATERIAL: 6 GAUGE HRS



SMALL  
MATERIAL: 10 GAUGE HRS



LARGE  
MATERIAL: 6 GAUGE HRS



**Korman Signs**  
INC.

HINGE PLATES STYLES FOR TYPE III BARRICADES

SCALE: NOT TO SCALE REV. A APPROVED:

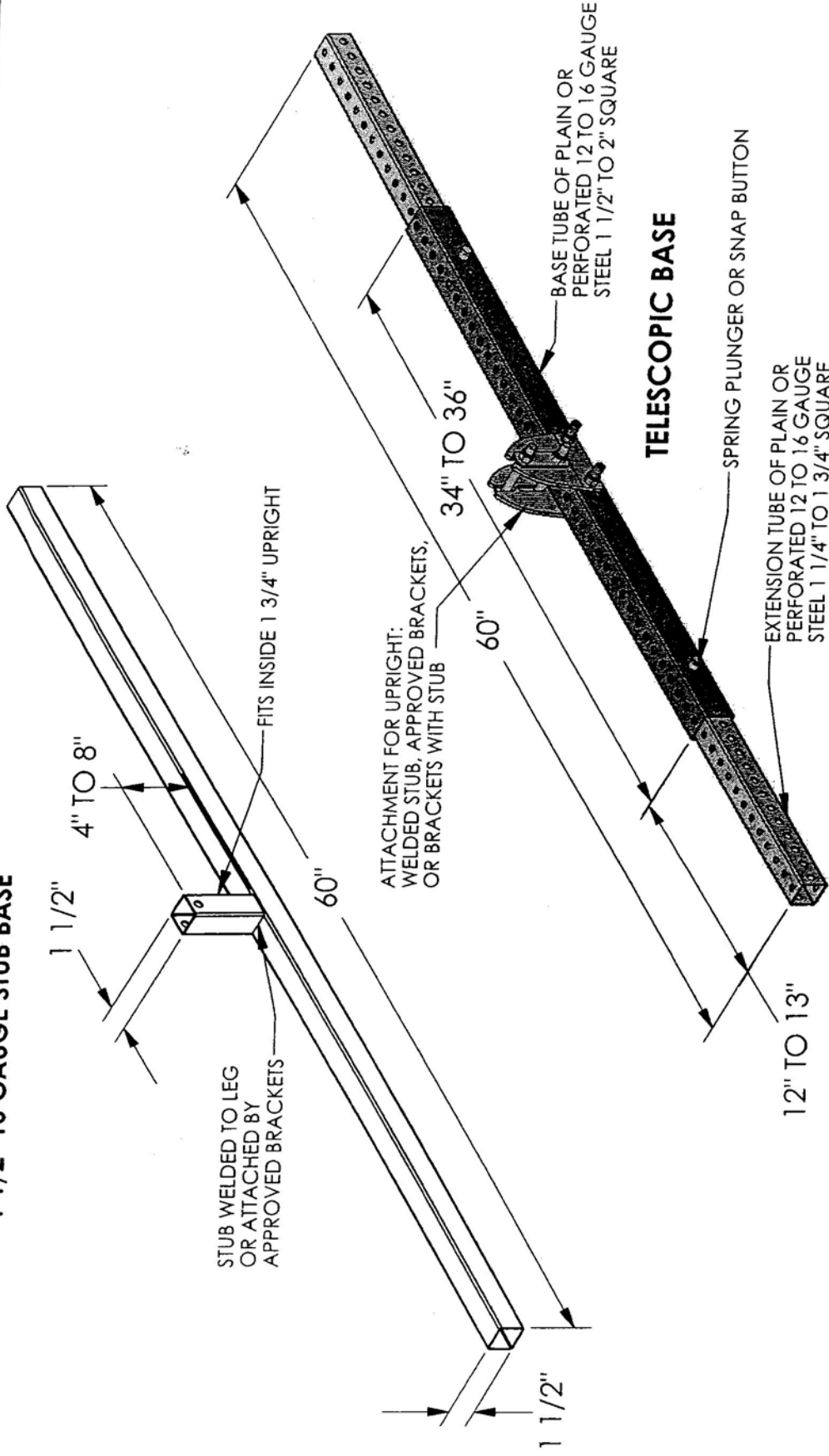


WZ-100 AMENDMENT 6 ENCLOSURE 3

REVISIONS

REV. A - ORIGINAL ISSUE, 10/29/04

1 1/2" 16 GAUGE STUB BASE



**Korman Signs**  
INC.

TYPE III BARRICADE BASE  
ADDITIONAL OPTIONS

SCALE: NOT TO SCALE | REV. A | APPROVED:

Product Description and Glossary of Terms

**WB73 Type III Barricade:** Frame of 1 1/2" up to 2" perforated or plain tubing uprights and legs of 12 to 16 gauge steel with cross bars of 1 1/4" up to 2" perforated or plain 12 to 16 gauge steel tubing. Tubing sections can be joined with welded or bracketed stubs, splice plate brackets, hinge plate brackets, stub tees or hinge tees. The barricades may be from 48" to 144" wide and 60" or 84" tall with 8" to 12" tall panels of Alpollic 350, 10mm or 13mm fluted plastic, or 1" to 2" thick by 8" tall extruded hollow core plastic, with up to 33 square feet of ALPOLIC® 350 signs attached directly to the rails, with or without lights or ballast.

**Alpollic:** Signs with this designation are manufactured from ALPOLIC® 350, a 2mm aluminum composite material manufactured by Mitsubishi Chemical America and normally covered with 3M reflective sheeting.

**Ballast:** Sand Bags, water bags weighing 45 to 50 lbs, or staked.







Item #	Material	125 AI	100 AI	80 AI	5/8 Plywood	1/2 Plywood	Endurance	6.35 mm SP	10mm CP	HDPE	3-4mm ACS	Alpolic 350	Roll up	w/Supl. Panel	w/wo Flags	w/Light	w/wo Ballast
1	SS560	60	60	60	60	60	60	60	60	60	60	60	60-84	21	yes	yes	yes
2	SS560E	60	60	60	60	60	60	60	60	60	60	60	60-84	21	yes	yes	yes
3	SS560EE	60-84	60-84	60-84	60-84	60-84	60-84	60-84	60-84	60-84	60-84	60-84	60-84	21	yes	yes	yes
4	SS560A	60	60	60	60	60	60	60	60	60	60	60	60-84	21	yes	yes	yes
5	SS560AE	60	60	60	60	60	60	60	60	60	60	60	60-84	21	yes	yes	yes
6	SS560AEE	60-84	60-84	60-84	60-84	60-84	60-84	60-84	60-84	60-84	60-84	60-84	60-84	21	yes	yes	yes
7	SS560UC												60-84	21	yes	yes	yes
8	SS560UCX												60-84	21	yes	yes	yes
9	SS560UCA												60	21	yes	yes	yes
10	SS560UCAX												60	21	yes	yes	yes
11	SS560UCR												60	21	yes	yes	yes
12	SS560UCRX												60	21	yes	yes	yes
13	SS560UCRA												60	21	yes	yes	yes
14	SS560UCRAX												60	21	yes	yes	yes
15	SS548												13	13	yes	yes	yes
16	SS548E												13	13	yes	yes	yes
17	SS548ETL												19-21	19-21	yes	yes	yes
18	SS548EE	60	60	19, 60	60	60	19, 60	19, 60	19, 60	19, 60	19, 60	19, 60	19-21, 48-60	21	yes	yes	yes
19	SS548A												19-21, 48-60	21	yes	yes	yes
20	SS548AE												19-21, 60	21	yes	yes	yes
21	SS548AETL												19-21	21	yes	yes	yes
22	SS548AEE	60	60	19, 60	60	60	19, 60	19, 60	19, 60	19, 60	19, 60	19, 60	19-21, 48-60	21	yes	yes	yes
23	SS548C												19-21	21	yes	yes	yes
24	SS548CE												19-21, 60	21	yes	yes	yes
25	SS548CA												19-21	21	yes	yes	yes
26	SS548CAE												19-21, 48-60	21	yes	yes	yes
27	SS548UC												19-21	21	yes	yes	yes
28	SS548SSUC												19-21, 48-60	21	yes	yes	yes
29	SS548UCX												21	21	yes	yes	yes
30	SS548UCA												21	21	yes	yes	yes
31	SS548SSUCA												19-21	21	yes	yes	yes
32	SS548UCAX												21	21	yes	yes	yes
33	SS548UCR												21	21	yes	yes	yes
34	SS548UCRX												19-21	21	yes	yes	yes
35	SS548UCRA												13	13	yes	yes	yes
36	SS548UCRAX												13	13	yes	yes	yes
37	SS1												13	13	yes	yes	yes
38	WB2 Type II Barricades +	14	14	14	14	14	14	14	14	14	14	12 min.	13	13	yes	yes	yes
39	Type III Bar.														yes	yes	yes

Notes: Maximum Sign size = 60x60 diamond/square, or 48x60 rectangle  
 Check Product Literature for actual capacity  
 Rigid rectangular signs mounting height is usually 2-3 inches higher than diamond shape  
 \* Maximum sign size 16 square feet mounted top rail

Revised 11/8/04



Request Number	2	3	3	3	4	4	4	4	4	4	5	5	5
Test Reference	61A	1A	1B	73B	2A	3B	58A	59B	60A	66A	66B	73B	
Stand	SS548	SS548E	SS548E	SS548E	Type III	Type III	Type III	Type III	Type III	SS1	SS1	SS1	
Sign Size	48x60	60x60	60x60	48x48	60x60	60x60	48x48	48x48	48x30	48x48	48x48	48x60	
Sign Type	Alpolic	Roll Up	Roll up	Roll Up	Alpolic	Alpolic	Alpolic	Alpolic	Alpolic	.08 AI	.08 AI	48x60	
Orientation	Head On	Head On	90 Degree	90 Degree	Head On	90 Degree	Head On	90 Degree	Head On	Head On	90 Degree	90 Degree	
Height to Bottom	21	48	48	60	19	19	9	9	41	14	14	24	
Height to Top	81	132	132	144	102	102	76	76	71	73	73	88	
Height to Top of Mast	84	132	132	90	63	63	63	63	60	73	73	88	
Stand Weight	38	40	40	40	84	84	84	84	55	20	20	20	
Sign Weight	12	7	7	6	18	18	10	10	6	18	18	20	
Rib Thickness		1/4, 3/8	1/4, 3/8	3/16, 3/16								18	
Vehicle Damage	Bumper	Dents	Dents	Dents	Slight	Severe	Minor	Severe	Hole Roof	Dents	Dents	Dents	
Windshield Damage	None	Cracking	Cracking	Cracking	None	None	None	None	None	None	None	None	
Intrusion	None	None	None	None	None	None	None	None	None	None	None	None	
Flags													
Flag Weight													
Light Weight													
Ballast	No	No	No	No	Yes*	Yes*	Yes*	Yes*	Yes*	No	No	No	
Test Facility	KSI	GTKL	GTL	KSI	GTL	GTL	KSI	KSI	KSI	KSI	KSI	KSI	
Date of Test	02/10/01	10/18/01	10/18/01	08/30/01	10/18/01	10/18/01	02/10/01	02/10/01	02/10/01	08/02/01	08/02/01	08/09/01	
Related WZ Letters	WZ-29	WZ-29	WZ-29	WZ-29						WZ-29/103	WZ-29/103	WZ-29/103	

\* 4 Sand Bags @ 45 lb each



Korman Signs Inc.  
Summary of Crash Tests

WZ-100  
Sheet 3

Request Number	5	5	7	7,8	7,8	7,8	7,8	8	9	9	11	11
Test Reference	87A	87B	68B	81B	7,8	7,8	7,8	76B	5A	5B	7A	7B
Stand	SS1	SS1	SS548E	SS548A	6A	6B	SS548E	SS548	SS548UC	SS548UC	SS548UCR	SS548UCR
Sign Size	48x48	48x48	60x60	60x60	60x60	60x60	60x60	60x60	60x60	60x60	48x60	48x60
Sign Type	.08 AI	.08 AI	Alpolic	Roll Up	Alpolic	Alpolic	Alpolic	Roll Up	Roll Up	Roll Up	Roll Up	Roll Up
Orientation	Head On	90 Degree	90 Degree	90 Degree	Head On	90 Degree	90 Degree	Roll Up	Roll Up	Roll Up	Roll Up	Roll Up
Height to Bottom	13	13	21	19	21	21	21	21	21	21	13	13
Height to Top	72	72	105	103	105	105	105	105	105	105	73	73
Height to Top of Mast	72	72	105	103	105	105	105	105	105	105	25	25
Stand Weight	20	20	40	31	40	40	40	38	32	32	24	24
Sign Weight	18	18	18	8	18	18	18	7	8	8	8	8
Rib Thickness				1/4, 1/4				3/16, 3/16	1/4, 3/8	1/4, 3/8	3/16, 3/8	3/16, 3/8
Vehicle Damage	Dents	Hole/Roof	Dents	Minor	Minor	Minor	Minor	Uncertain	Slight	Slight	Minor	Minor
Windshield Damage	None	Cracking	None	None	None	Cracking	Cracking	Cracking*	Cracking	Cracking	Cracking	Cracking
Intrusion	None	None	None	None	None	None	None	None*	None	None	None	None
Flags	VFO2436	VFO2436										
Flag Weight	0.6	0.6										
Light												
Light Weight					0.6	0.6						
Ballast	Yes**	Yes**			yes	yes						
Test Facility	KSI	KSI	No	No	No	No	No	No	No	No	No	No
Date of Test	03/06/02	03/06/02	08/09/01	10/02/01	10/18/01	10/18/01	10/18/01	08/30/01	10/18/01	10/18/01	10/18/01	10/18/01
Related WZ Letters	WZ-29, 103	WZ-29, 103	WZ-29	WZ-29	WZ-29	WZ-29	WZ-29	WZ-29	WZ-21, 29	WZ-21, 29	WZ-21, 29	WZ-21, 29

\* Interpretation: Vehicle damaged prior to this test.  
\*\* 50 lb Sand Bag

Korman Signs Inc.  
Summary of Crash Tests

Request Number	12	12	9, 10, 11	9, 10, 11	1,2,3	1,2,3
Test Reference	10A	10B	99A	99B	100A	100B
Stand	SS548	SS548	SS548UCRAX	SS548UCRAX	SS548UCA	SS548UCA
Sign Size	48x48	48x48	48x48	48x48	48x48	48x48
Sign Type	.08 Al	.08 Al	Roll Up	Roll Up	Alpolic 350	Alpolic 350
Orientation	Head On	90 Degree	Head On	90 Degree	Head On	90 Degree
Height to Bottom	19	19	13	13	21	21
Height to Top	86	86	80	80	86	86
Height to Top of Mast	86	86	18	18	33	33
Stand Weight	40	40	14	15**	24	24
Sign Weight	18	18	6	7	11	11
Rib Thickness			1/4, 1/4	3/16, 3/8	3/16, 3/8	3/16, 3/8
Vehicle Damage	Minor	Minor	Slight	Slight	Minor	Minor
Windshield						
Damage	Cracking*	Cracking*	Cracking	Cracking	Cracking	Cracking
Intrusion	None	None	None	None	None	None
Flags						
Flag Weight						
Light						
Light Weight						
Ballast	No	No	No	No	No	No
Test Facility	GTL	GTL	KSI	KSI	KSI/AE	KSI/AE
Date of Test	10/18/01	10/18/01	05/06/02	05/06/02	11/13/02	11/13/02
Related WZ Letters	WZ-29, 78	WZ-29, 78	WZ-21, 29	WZ-21, 29	WZ-21, 29, 100	WZ-21, 29, 100

\* Interpretation: Windshield had minor cracking prior to this test.  
\*\* Longer legs on this stand

Request Number	5	5	5	5	6	6	5	6	AMEND. 6 1-7	AMEND. 6 1-7	AMEND. 6 1-7	AMEND. 6 1-7
Test Reference	101A	101B	102A	102B	103A	103B	104B	105A	110A	110B	111A	111B
Stand	WB13BR***	WB13BR***	WB13BR***	WB13BR***	SS1	SS1	WB13BRH***	WB13BR***	WB13HPPH	WB13HPPH	WB13HPPH	WB13HPPH
Sign Size	60x30, 48x18, 360x30, 48x18, 30x24, 21x15	60x30, 48x18, 360x30, 48x18, 30x24, 21x15	48x18, 30x24, 48x18, 30x24, 21x15	48x18, 30x24, 21x15	48x48	48x48					48x18, 30x24, 21x15	48x18, 30x24, 21x15
Sign Type	Alpolic 350	Alpolic 350	Alpolic 350	Alpolic 350	Alpolic 350	Alpolic 350	Alpolic 350	Alpolic 350	Head On	Head On	Head On	Alpolic 350
Orientation	Head On	90 Degree	Head On	90 Degree	Head On	90 Degree	90 Degree	Head On	Head On	Head On	Head On	Alpolic 350
Height to Bottom	12	13	12	12	14-1/2	15	15	15				90 Degree
Height to Top	101	101	70	70	72	72						
Height to Top of Mast	86-3/8	86-3/8	62-3/8	62-3/8	72	72	61-1/2	63-3/4"				
Stand Weight	71	71	49	49	20	20	52	59	85.5"	85.5"	61.5"	61.5"
Sign Weight	19	19	15	15	9	9			94.2	85.5	81.2	78.3
Rib Thickness												
Vehicle Damage	Slight	Slight	Slight	Slight	Minor	Minor	Slight	Slight	Slight	Heavy dent in bumper	Right rear pass. Window broken	Bumper and hood badly dented
Windshield Damage	Cracking	Cracking	None	None	None	Cracking	Cracking*	Cracking	Cracking, 2" depression	None	Cracking 1-1/2" depression	
Intrusion	None	None	None	None	None	None	None	None	None	None	None	
Flags												
Flag Weight	2	2										1/2" hole
Light												
Light Weight	8.8 lb.	8.8 lb.			2	2	1	2	2	2	2	2
Ballast	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Test Facility	KSI/AE	KSI/AE	KSI/AE	KSI/AE	KSI/AE	KSI/AE	KSI/AE	KSI/AE	KSI/AE	KSI/AE	KSI/AE	KSI/AE
Date of Test	06/06/03	06/06/03	06/06/03	06/06/03	06/06/03	06/06/03	06/06/03	06/16/03	09/21/04	09/21/04	09/21/04	09/21/04
Related WZ Letters	WZ-100	WZ-100	WZ-100	WZ-100	WZ-29, 100, 103	WZ-29, 100, 103	WZ-100	WZ-100	WZ-100 AMEND. 3	WZ-100 AMEND. 3	WZ-100 AMEND. 3	WZ-100 AMEND. 3

\* Interpretation: Windshield had minor cracking prior to this test.  
 \*\* Longer legs on this stand  
 \*\*\* Type III Barricade



WZ-100 AMENDMENT 6, ENCLOSURE 9

REVISIONS

REV. A - ORIGINAL ISSUE: 11/17/04

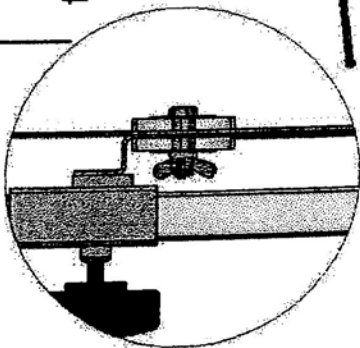
MODEL SS548E,  
 SS548AE, SS548CE,  
 SS548CAE, SS548ETL,  
 SS548AETL, SS560,  
 SS560A, SS560E  
 OR SS560AE SIGN  
 STAND

DETAIL A  
 SCALE 1 : 4



NON-OBSCURING  
 ADAPTER  
 INTERFACE  
 ON FACE  
 OF SIGN

DETAIL C  
 SCALE 1 : 4

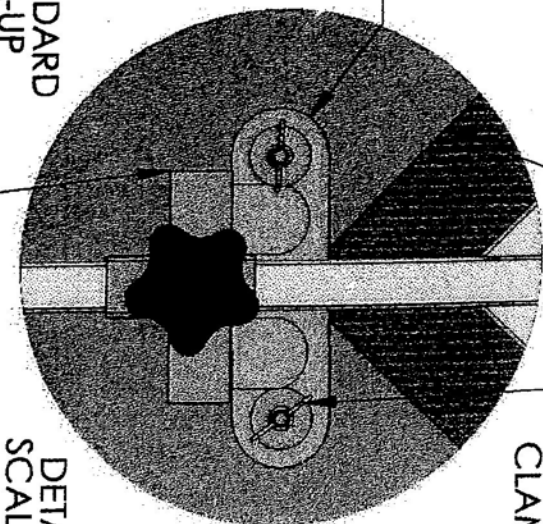


ADAPTER  
 INTERFACE

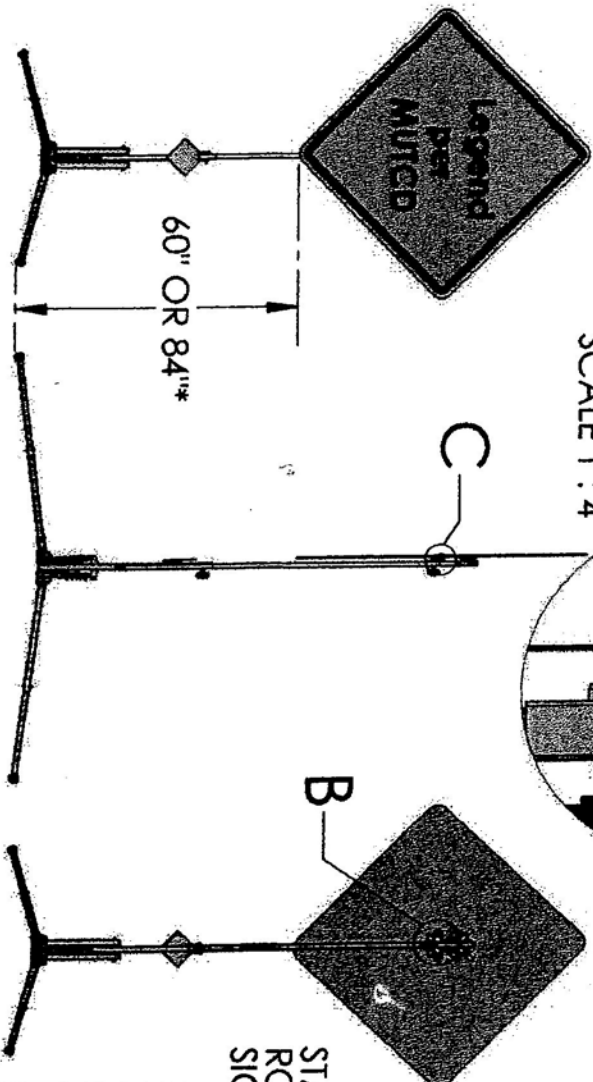
STANDARD UPPER V-CLIP ON  
 MAST OF SIGN STAND

ADAPTER  
 INTERFACE  
 CLAMP

STANDARD  
 ROLL-UP  
 SIGN HOLDER



DETAIL B  
 SCALE 1 : 4



\*NOTE: 60" FOR MODELS SS548E, SS55AE, SS548CE, SS548CAE, SS548ETL AND SS548AETL  
 84" FOR MODELS SS560, SS560A, SS560E AND SS560AE



**Korman Signs**  
 INC.

MODELS SS548E, SS548AE, SS548CE, SS548CAE, SS548ETL, SS548AETL,  
 SS560, SS560A, SS560E AND SS560AE SIGN STANDS WITH  
 ALPOIC 350 SIGN AT 60" USING ROLL-UP ADAPTER INTERFACE

SCALE: NOT TO SCALE

REV. A

APPROVED:

DATE: 11/17/04