*Midwest State's Regional Pooled Fund Research Program - Fiscal Year 1995-1996*
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# A REVIEW OF BREAKAWAY SUPPORTS FOR SMALL SIGNS AND MAILBOX INSTALLATIONS

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16. Abstract (Limit: 200 words)

For many years, the Nebraska Department of Roads (NDOR) installed two types of crashworthy mailbox support systems alongside their state highways. The breakaway support systems consisted of the Eze-Erect sign support system manufactured by Franklin Steel Company and the V-LOC socket support system manufactured by Foresight Products Inc. In 1994, the Franklin Steel Company went out of business, the patent period of the Eze-Erect system expired, and the Eze-Erect system became unavailable.

The objective of this research project was to either identify new sources of low-cost, small sign and mailbox supports or, if necessary, develop a new support system as a replacement to the Eze-Erect system to meet the safety standards provided in the National Cooperative Highway Research Program (NCHRP) Report No. 350, *Recommended Procedures for the Safety Performance Evaluation of Highway Features* and the American Association of State Highway and Transportation Officials (AASHTO) *Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals.*

An extensive literature review was performed on existing small sign and mailbox supports available from several manufacturers located in the United States including those that have been crash tested. A summary was provided on each of the Pooled Fund member states' standards for addressing mailbox supports.

The research results revealed that several crashworthy, small sign and/or mailbox supports are available from manufacturers and suppliers, consisting of round pipe, square tubing, U-channel geometries as well as several wood post options. Therefore, it was not necessary to develop, test, and evaluate a new support system.

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# 1 INTRODUCTION

## 1.1 Background

For several years, the Nebraska Department of Roads (NDOR) installed two types of crashworthy mailbox support systems alongside their state highways. The two breakaway support systems consisted of the Eze-Erect sign support system manufactured by Franklin Steel Company and the V-LOC socket support system manufactured by Foresight Products Inc. The Eze-Erect system was configured with a 2 lbs/ft U-channel post that was originally developed for small signs. Subsequently, the Eze-Erect system, using a reduced post length, was successfully crash tested for use with one or two mailboxes (1-2). The V-LOC systems were configured with 2-in. diameter mechanical tubing (14-gauge) and configured in two support geometries. The first configuration consisted of a single, vertical tube that supported one or two mailboxes. The second configuration supported up to five mailboxes and consisted of a tube which was bent in a shape similar to an inverted trapezoid.

In 1994, the Franklin Steel Company went out of business, the patent period of the Eze-Erect system expired, and the Eze-Erect system became unavailable. Therefore, the NDOR had only one supplier for the mailbox supports currently listed in their State Standards and Special Plans. Although the impact performance of the supports marketed by Foresight Products Inc. were similar to those offered by Franklin Steel Company, the V-LOC support system was more costly than the Eze-Erect system. Therefore, it was necessary for the NDOR to locate an additional supplier of crashworthy supports for mailboxes and small signs that were both economical and effective. Emphasis was placed on investigating manufacturers that supply economical and safe breakaway or yielding supports, such as those available with existing U-channel posts. It is noted that allowing the use of two or more post suppliers is a primary mechanism for controlling costs.

## 1.2 Objective

The objective of this research project was to either identify new sources of low-cost, small sign and mailbox supports or, if necessary, develop a new support system as a replacement to the Eze-Erect system formerly manufactured by Franklin Steel Company. The support system alternatives for the Eze-Erect system must meet the safety standards provided in the National Cooperative Highway Research Program (NCHRP) Report No. 350, *Recommended Procedures for the Safety Performance Evaluation of Highway Features* (3) and the American Association of State Highway and Transportation Officials (AASHTO) *Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals* (4).

## 1.3 Research Plan

The research study was initialized with an extensive literature review of existing small sign and mailbox supports available from several manufacturers located in the United States. Subsequently, crashworthy systems with the potential for replacing the Eze-Erect support system were evaluated and summarized, as shown in Sections 2.3, 3, and 4. A literature review was also conducted to determine if any other mailbox support systems had been evaluated by the agencies which perform full-scale vehicle crash tests on highway safety hardware. A summary of these crash tests was also tabulated, as shown in Section 2.2. Finally, a summary was provided on each of the member states' standards for addressing mailbox supports, as shown in Section 2.4.

A review of existing small sign and mailbox supports revealed that several new sources of breakaway supports were available. Therefore, it was not necessary to develop, test, and evaluate a new support system. Rather, discussion is provided on the available systems that show the greatest promise as a replacement to the Eze-Erect system. Incidentally, during the course of the research

project, it was discovered that two companies were currently manufacturing the Eze-Erect system - Chicago Heights Steel and Franklin Industries Co.

# 2 LITERATURE REVIEW

## 2.1 Introduction

A research review was performed on several topics relating to crashworthy mailbox supports, such as previous research studies involving crash testing of mailbox supports, existing manufacturers of small sign and mailbox supports, and current procedures for addressing mailbox supports by each of the member states of the pooled fund program. The findings of these investigations are provided below.

## 2.2 Summary of Crash Testing of Mailbox Supports

Most of the crash tests involving mailbox supports were performed by three test agencies: the Texas Transportation Institute (TTI), the Southwest Research Institute (SwRI), and the Midwest Roadside Safety Facility (MwRSF). The results of these studies are summarized in Table 1.

## 2.3 Manufacturers of Small Sign and Mailbox Supports

The findings of this study revealed that, at a minimum, nine companies currently manufacture small sign and mailbox supports. Contact information for these nine companies are provided below, as well as those products available for use as small sign or mailbox supports. Detailed information on the relevant products for each company is provided in Section 3.

1. **Unistrut Corporation**
   35660 Clinton St.
   Wayne, Michigan 48184
   (800) 521-7730 (phone)
   (313) 721-4106 (fax)

**Allied Tube and Conduit Corporation**
Mechanical Tube Division
16100 South Lathrop Avenue
Harvey, Illinois 60426
(800) 882-5543 (phone)
(708) 339-1610 (phone)
c/o Tim Leahy Ext. 7865

Table 1. Summary of Crash Tests.

| Mailbox Support | Mailbox Configuration | Manufacturer | Test No. | Test Conditions | | | | Test Results | Test Agency/ Reference |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Weight (lbs) | Speed (mph) | Angle | Soil | | |
| V-LOC Anchor | 5 Mailboxes | Foresight | FP-2 | 1830 | 19.7 | 0.1 | S1 (wet) | Pass | SwRI (5) |
| V-LOC Anchor | 5 Mailboxes | Foresight | FP-3 | 1830 | 61.1 | -0.4 | S1 (wet) | Pass | SwRI (5) |
| V-LOC Anchor | 2 @ 5 Mailboxes | Foresight | FP-4 | 1830 | 63.7 | -2.3 | S1 (wet) | Pass | SwRI (5) |
| V-LOC Anchor | 5 Mailboxes | Foresight | FP-5 | 1830 | 19.7 | -0.4 | S2 (wet) | Pass | SwRI (5) |
| 4"x4" Wood | 1 Mailbox | NA | 22 | 2270 | 58.2 | 0 | Strong | Pass | TTI (6-8) |
| 4"x4" Wood | 1 Mailbox | NA | 23 | 2270 | 62.6 | 0 | Strong | Pass | TTI (6-8) |
| 4"x4" Wood | 4 Mailboxes | NA | 24 | 2440 | 58.8 | 0 | Strong | Fail | TTI (6-8) |
| 1½"Ø I.D. Pipe | 1 Mailbox | NA | 25 | 2260 | 58.8 | 0 | Strong | Pass | TTI (6-8) |
| 1½"Ø I.D. Pipe | 1 Mailbox | NA | 26 | 2260 | 60.9 | 0 | Strong | Pass | TTI (6-8) |
| 1½"Ø Pipe | 7 Mailboxes | NA | 5 | 2500 | 60 | 0 | Strong | Fail | TTI (8-9) |
| 1½"Ø Pipe | 5 Mailboxes | NA | 6 | 2500 | 60 | 0 | Strong | Fail | TTI (8-9) |
| 2"Ø Tube | 4 Mailboxes | Foresight | 1 | 2320 | 60 | 0 | Strong | Pass | TTI (10) |
| 2 lbs/ft | 1 Mailbox | NA | 2 | 2320 | 60 | 0 | Strong | Pass | TTI (10) |
| 1.9"Ø HDP Pipe | 1 Mailbox | Phillips | 3-1 | 2320 | 60 | 0 | Strong | Pass | TTI (10) |
| 2½ lbs/ft | 1 Mailbox | Franklin | 3-2 | 2320 | 60 | 0 | Strong | Pass | TTI (10) |
| 1.66"Ø Tube | 1 Mailbox | Foresight | 4-1 | 2320 | 60 | 0 | Strong | Pass | TTI (10) |
| 2 lbs/ft | 1 Mailbox | NA | 4-2 | 2320 | 60 | 0 | Strong | Pass | TTI (10) |
| 1¼"Ø Pipe | 1 Mailbox | NA | 1 | 2340 | 58.65 | 0 | Concrete | Pass | TTI (11) |
| 1¼"Ø Pipe | 1 Mailbox | NA | 2 | 2340 | 59.85 | 0 | Concrete | Pass | TTI (11) |
| 4"x4" Wood | 1 Mailbox | NA | 3 | 2300 | 58.72 | 0 | Stone | Pass | TTI (11) |
| 1¼"Ø Pipe | 1 Mailbox | NA | 4 | 2275 | 59.65 | 0 | Concrete | Pass | TTI (11) |
| 1.12 lbs/ft | 1 Mailbox | NA | 1A | 2335 | 60.88 | 0 | Strong | Pass | TTI (12) |
| 2 lbs/ft | 1 Mailbox | Foresight | 1B | 2335 | 59.45 | 0 | Strong | Pass | TTI (12) |
| 2 lbs/ft | 1 Mailbox | NA | 2A | 2335 | 60.16 | 0 | Strong | Pass | TTI (12) |
| 2½ lbs/ft | 1 Mailbox | Franklin | 2B | 2335 | 57.38 | 0 | Strong | Pass | TTI (12) |
| 2 lbs/ft | 2 Mailboxes | NA | 3A | 2335 | 59.52 | 0 | Strong | Pass | TTI (12) |
| 2 lbs/ft | 2 Mailboxes | Foresight | 3B | 2335 | 56.86 | 0 | Strong | Pass | TTI (12) |
| 2 lbs/ft | 4 @ 1 Mailbox | NA | 4 | 2335 | 60.71 | 0 | Strong | Marginal | TTI (12) |
| 2 lbs/ft | 8 @ 1 Mailbox | NA | 5 | 2335 | 59.54 | 0 | Strong | Fail | TTI (12) |
| 4 lbs/ft | 1 Mailbox | Franklin | 6A | 2365 | 59.65 | 0 | Strong | Pass | TTI (12) |
| 4"x4" Wood | 1 Mailbox | NA | 6B | 2365 | 56.87 | 0 | Concrete | Pass | TTI (12) |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| V-LOC Anchor | 2 @ 4 Mailboxes | Foresight | 1 | 2360 | 56.5 | 0 | Strong | Pass | TTI (13) |
| 2 lbs/ft | 3 @ 2 Mailboxes | NA | 2 | 2360 | 59.1 | 0 | Strong | Marginal | TTI (13) |
| 2 lbs/ft | 2 @ 2 Mailboxes | NA | 3 | 2380 | 59.0 | 0 | Strong | Pass | TTI (13) |
| V-LOC Anchor | 3 @ 4 Mailboxes | Foresight | 4 | 2380 | 60.0 | 0 | Strong | Pass | TTI (13) |
| 1.66"Ø Pipe | 2 @ 2 Mailboxes | Foresight | 5A | 2380 | 59.5 | 0 | Strong | Pass | TTI (13) |
| 2 lbs/ft | 2 Mailboxes | NA | 5B | 2380 | 57.6 | 0 | East Texas | Pass | TTI (13) |
| 2 lbs/ft | 2 Mailboxes | Foresight | 6A | 2380 | 60 | 0 | Strong | Pass | TTI (13) |
| 2⅞"Ø Pipe | 2 @ 2 Mailboxes | Southwestern Pipe | 6B | 2380 | 60 | 0 | Strong | Marginal | TTI (13) |
| NDCBU | 1 Mailbox | Auth Electric | 2343-1 | 1945 | 62.3 | 0 | Concrete | Fail | TTI (14) |
| 2 lbs/ft | 1 Mailbox | NA | 19452-1 | 1968 | 58.7 | 0 | Strong | Pass | TTI (15) |
| 2 lbs/ft | 1 Mailbox | NA | 19452-2 | 1968 | 61.3 | 0 | Strong | Marginal | TTI (15) |
| 2 lbs/ft | 1 Mailbox | NA | 19452-3 | 1968 | 61.2 | 0 | Strong | Marginal | TTI (15) |
| 2 lbs/ft | 1 Mailbox | NA | 19452-4 | 1968 | 61.2 | 0 | Strong | Pass | TTI (15) |
| 2 lbs/ft | 2 Mailboxes | NA | 19452-5 | 1968 | 62.4 | 0 | Strong | Pass | TTI (15) |
| 2⅜"Ø Pipe | 1 Mailbox | NA | 19452-6 | 1968 | 60.9 | 0 | Strong | Pass | TTI (15) |
| V-LOC Anchor | 5 Mailboxes | Foresight | 19452-7 | 1967 | 63.4 | 0 | Strong | Pass | TTI (15) |
| V-LOC Anchor | 3 Mailboxes | Foresight | 19452-8 | 1967 | 61.2 | 0 | Strong | Pass | TTI (15) |
| V-LOC Anchor | 3 Mailboxes | Foresight | 19453-9 | 1967 | 62.9 | 0 | Strong | Marginal | TTI (15) |
| 2 @ 2 lbs/ft | 1 Mailbox | NA | 19453-10 | 1969 | 62.8 | 0 | Strong | Pass | TTI (15) |
| 2 lbs/ft | 1 Mailbox | NA | 19453-11 | 1969 | 59.7 | 0 | Strong | Fail | TTI (15) |
| 3 lbs/ft | 1 Mailbox | NA | 7147-11 | 1971 | 21.8 | 0 | Strong | Pass | TTI (16) |
| 3 lbs/ft | 1 Mailbox | NA | 7147-12 | 1971 | 65.2 | 0 | Strong | Pass | TTI (16) |
| 3 lbs/ft | 1 Mailbox | NA | 7147-13 | 1971 | 64.0 | 0 | Strong | Pass | TTI (16) |
| 3 lbs/ft | 3 Mailboxes | NA | 7147-14 | 1971 | 62.8 | 0 | Strong | Fail | TTI (16) |
| 2 lbs/ft | 2 Mailboxes | Franklin | 1 | 1840 | 20.5 | 0 | S2 | Pass | MwRSF (1,2) |
| 2 lbs/ft | 2 Mailboxes | Franklin | 2 | 1840 | 21.3 | 0 | S1 | Pass | MwRSF (1,2) |
| 2 lbs/ft | 2 Mailboxes | Franklin | 3 | 1840 | 63.6 | 0 | S2 | Pass | MwRSF (1,2) |
| 2 lbs/ft | 1 Mailbox | Franklin | 4 | 1840 | 64.5 | 0 | S1 | Pass | MwRSF (1,2) |

Products: Company literature in Appendix B

(1) TELESPAR Sign Support Systems
- Single Breakaway Anchor
- Two-Piece Breakaway Anchor
- Heavy-Duty Anchor - System I
- Heavy-Duty Anchor - System II
- Stabilization Anchor Sleeve
- Slip-Base Breakaway Assembly

(2) Posts
- Square Posts with Pre-Punched Holes
- Qwik-Punch Posts with Knockouts

It is noted that Allied Tube and Conduit Corporation purchased the Unistrut Corporation in 1995.

2. **The Marion Steel Company**
912 Cheney Avenue
Marion, Ohio 43301-18011
(614) 383-4011 (phone)
(800) 333-4011 (phone)
(614) 383-6429 (fax)
c/o Steven J. Conway

Products: Company literature in Appendix C

(1) Rib-Bak U-Channel Sign Supports
(2) Lap-Splice U-Channel Breakaway System
(3) Slip-Safe Reusable Slip Base System
(4) Minute Man U-Channel Breakaway System

3. **Southwestern Pipe, Inc.**
6307 Toledo Street
P.O. Box 2002
Houston, Texas 77252
(800) 369-5009 (phone)
(713) 863-4300 (phone)
(713) 863-4313 (fax)
c/o Mike Jordan

Products: Company literature in Appendix D

(1) POZ-LOC Sign Post Anchor System
(2) POZITUBE Traffic Posts
(3) POZ-LOC Slip-Base System
(4) Mechanical Tubing Specifications

4. **Foresight Products Inc.**
6430 East 49th Drive
Commerce City, Colorado 80022
(800) 325-5360 (phone)
(303) 286-8955 (phone)
(303) 287-3866 (fax)
c/o Tom Bird

Products: Company literature in Appendix E
(1) V-LOC Socket System
- Single Mailbox Support System
- Double Mailbox Support System
- Multiple Mailbox Support System
- Signpost Anchor for Round, Square, or U-Channel

5. **Chicago Heights Steel**
211 E. Main
P.O. Box 129
Chicago Heights, Illinois 60411
(800) 424-4487 (phone)
(708) 756-5662 (phone)
(708) 756-5628 (fax)
c/o Bradley R. Corral

Products: Company literature in Appendix F
(1) Safety-Splice Signpost System
(2) Safety-Splice Signpost System with Eze-Erect Retainer Strap
(3) U-Channel Steel Posts

6. **Western Highway Products, Inc.**
Ultimate Highway Sales, Inc.
7804 College Drive
Suite 3 N.E.
Palos Heights, Illinois 60463
(800) 730-4939 (phone)
(708) 923-7320 (phone)
(708) 923-7321 (fax)

c/o Nick Calvi

Products: Company literature in Appendix G
(1) Ulti-Mate Sign Support System
(2) Penetrator Square Tube Posts

(3) Select Punch Square Tube Posts

7. **S-Square Tube Products**
3495 East 69th Avenue
Commerce City, Colorado 80022
(303) 286-7051 (phone)

Products: Company literature in Appendix H
(1) Tel-Square Sign Post

8. **Franklin Industries Co.**
P.O. Box 671
Franklin. Pennsylvania 16323
(814) 437-3726 (phone)
(814) 432-7556 (fax)

Products: Company literature in Appendix I
(1) Eze-Erect Sign Post System
(2) Base-Bolted Sign Post System
(3) U-Channel Steel Posts

9. **Xcessories Squared**
Development & Manufacturing Co.
P.O. Box 135
206 W. Washington
Auburn. Illinois 62615
(800) 621-7948 (phone)
(217) 438-3535 (phone)
(217) 438-3917 (fax)
c/o Larry Leahy

Products: Company literature in Appendix J
(1) Slip Base Assembly
(2) Soil Stabilizer
(3) Heavy Duty Winged Anchor

## 2.4 Current State Standards for Mailbox Supports

A summary on the current procedures for addressing mailbox supports by each of the member states of the pooled fund program is provided in Sections 2.4.1 through 2.4.7.

### 2.4.1 Iowa Department of Transportation (IDOT)

The IDOT standard for mailboxes is included on Detail Sheet 560-2 (revision date - 3/28/95) entitled *DETAILS OF MAILBOX TURNOUTS (GRANULAR SURFACED)*. The standard shows a single mailbox supported by a 4 in. by 4 in. wooden support post. The mailbox is positioned so that the opened door of the mailbox is at least 8 ft away from the edge of the roadway, with 10 ft being desirable. For multiple mailbox installations located at one turnout, 2 ft of space is allotted for each mailbox.

### 2.4.2 Kansas Department of Transportation (KDOT)

The KDOT standard for mailboxes is included in the Special Provisions to the Standard Specifications Edition of 1990 *SECTION 831 MAILBOX ADJUSTMENTS*. The standard states that mailbox supports shall be constructed of 4-in. nominal, square wood posts and installed no more than 24 inches into the ground. For roadway installations with curbs, the traffic-side face of the closed mailbox shall be placed 6 in. away from the curb line. For roadway installations with mailbox turnouts, the traffic-side face of the closed mailbox shall be placed 8 ft away from the edge of roadway. The bottom of the mailbox shall be placed 42 in. above the roadway surface.

### 2.4.3 Minnesota Department of Transportation (MnDOT)

The MnDOT standard for mailboxes is included in a design sheet (reference date - 1/29/96) of Minnesota's State Standards entitled *MAILBOX SUPPORT - STEEL PIPE WITH FITTINGS AND STEEL FENCE POST*. The MnDOT uses the swing-away mailbox concept consisting of a support

post manufactured from 32-mm nominal diameter steel pipe. The mailbox support post is attached to a 4.5 kg/m U-channel sign post, which is driven into the ground. The pipe orientation is changed from vertical to horizontal by going through two 45° angles, which are separated by a short length of pipe. The mailbox is attached to the top of the horizontal pipe using two bolts and tail-pipe clamps. After drilling the steel pipe, the bolts go through the pipe and tail-pipe clamp, and then into a 38 mm thick wood spacer, on which the mailbox is mounted. For rural installations, the bottom of the mailbox is positioned 965 to 1065 mm above the roadway surface. For urban installations, the bottom of the mailbox is positioned 1220 mm above the roadway surface. The horizontal distance from the traffic-side face of the mailbox to the centerline of the support post is 915 mm. In addition, the MnDOT allows contractors to use mailbox supports manufactured by MnDOT Districts and private companies within the State that have been approved by MnDOT, but not crash tested. Approved suppliers include: Marshall County; Rochester MnDOT District; Friend Innovations; and Minncor Industries.

### 2.4.4 Missouri Department of Transportation (MoDOT)

The MoDOT standard for mailboxes is briefly presented in the Missouri Standard Specifications for Highway Construction 1996 *SECTION 104.10 MAILBOXES, SIGNS, AND MARKERS*. It states that mailbox supports shall comply with the American Association of State Highway and Transportation Officials (AASHTO) guidelines. In addition to Section 104.10, the MoDOT informs the public that mailbox supports shall conform to postal regulations and Federal Highway Administration (FHWA) guidelines, stating that support posts shall not be larger than 4-in. by 4-in. wood posts, 4½-in. diameter wood posts, or 3½-in. diameter steel or aluminum pipe. If the MoDOT supplies the support post, it consists of Southern Pine or West Coast Douglas Fir, measuring 4 in. by 4 in.

### 2.4.5 Nebraska Department of Roads (NDOR)

The NDOR standard for mailboxes is included on drawing nos. 3072 E and 3072 M of Special Plan C entitled *MAILBOX SUPPORT POST*. Two different support post configurations are provided. The first option specifies that a 2 lbs/ft U-channel breakaway support system be used to support one to two mailboxes. The second option specifies the multiple mailbox support system (model no. 20-M) manufactured by Foresight Products Inc. with capabilities for supporting between one and five mailboxes. For single or double mailbox installations, the NDOR patented adjustable mailbox mounting platform is specified (patent no. DES. 309,560). In addition, the bottom of the mailbox should be positioned 39 in. above the roadway surface, and the base should be driven two and three feet into the ground for compacted, strong soil and loose soil, respectively. The centerline of the support post should be installed 1 ft from the edge of surfaced shoulder, surface mailbox turnout, or back of curb.

### 2.4.6 South Dakota Department of Transportation (SDDOT)

The SDDOT standard for mailboxes is included on drawing nos. 120.01, 120.02, and 120.03 addressing the *MAILBOX TURNOUT*, *SINGLE AND DOUBLE MAILBOX ASSEMBLIES*, and *MAILBOX SUPPORT HARDWARE*, respectively. The surfaced shoulder at the turnout shall be a minimum of 8 ft from the roadway edge with the traffic-side face of the mailbox positioned 4 in. away from the edge of surfacing. The support posts shall be fabricated with either 4-in. by 4-in. square or 4½-in. diameter round wooden posts. A 36-in. minimum embedment depth is specified for the support posts. A special mounting bracket is also specified, consisting of several bent steel plates.

### 2.4.7 Wisconsin Department of Transportation (WDOT)

The WDOT has no standard or specification for addressing mailbox installations. During the roadway design and construction phase, the District Project Development Section will hand out pamphlets to homeowners informing them of the proper ways to install safer mailbox systems. During routine maintenance activities, the District Operations Section typically will inform homeowners of hazardous installations when identified and subsequently place responsibility and liability of upgrading the installation on the homeowner.

# 3 SMALL SIGN AND MAILBOX SUPPORT HARDWARE

During the completion of this research project, it was revealed, that at least nine companies were currently manufacturing small sign supports, mailbox supports, and accessories. These nine companies are: (1) Unistrut Corporation/Allied Tube and Conduit Corporation; (2) the Marion Steel Company; (3) Southwestern Pipe, Inc.; (4) Foresight Products Inc.; (5) Chicago Heights Steel; (6) Western Highway; (7) S-Square Tube Products; (8) Franklin Industries Co.; and (9) Xcessories Squared. The relevant products for each of these companies are described below. A current listing of the Federal Highway Administration's (FHWA's) acceptance letters for sign support safety hardware is provided in Appendix A. It is noted that the manufacturer's/supplier's sign and mailbox support hardware may have been tested either according to the AASHTO specifications (4) or the NCHRP Report No. 350 guidelines. For specific details on the criteria used for crash testing as well as the test conditions (i.e., soil conditions, post sizes, post configuration, etc.), it is recommended that the State Highway Departments contact each manufacturer to obtain crash test documentation and the specific FHWA acceptance letter associated with the safety hardware of interest.

## 3.1 Unistrut Corporation/Allied Tube and Conduit Corporation

Unistrut Corporation offers the TELESPAR sign support systems consisting of square steel tubing with pre-punched holes on all surfaces or the Qwik-Punch die-cut tubing. Several breakaway ground support options are available, including yielding supports and slip-base configurations. Information supplied by the Unistrut Corporation is included in Appendix B.

Currently, there is no manufacturer-specified bracket for attaching one or two mailboxes to the TELESPAR sign support systems. However, it is believed that attachment of one or two mailboxes could be secured to the square steel tubing using NDOR's adjustable mailbox mounting

platform in combination with some new hardware. If such a modification was implemented, additional crash testing may be required.

### 3.2 The Marion Steel Company

The Marion Steel Company offers many sizes of the Rib-Bak U-channel sign supports. Several breakaway ground support options are available, including yielding supports and slip-base configurations. Information supplied by the Marion Steel Company is included in Appendix C.

Currently, there is no manufacturer-specified bracket for attaching one or two mailboxes to the Rib-Bak U-channel sign supports. However, it is believed that attachment of one or two mailboxes could be secured to the U-channel supports using NDOR's adjustable mailbox mounting platform in similar manner to that used on the Franklin Steel Company's U-channel post with Eze-Erect breakaway connection. If such a modification was implemented, additional crash testing would not likely be required.

### 3.3 Southwestern Pipe, Inc.

Southwestern Pipe, Inc. offers various sizes of POZITUBE traffic posts consisting of round steel tubing, and two breakaway ground support options - the POZ-LOC sign post anchor system and the POZ-LOC slipbase system. Information supplied by Southwestern Pipe, Inc. is included in Appendix D.

Currently, there is no manufacturer-specified bracket for attaching one or two mailboxes to the POZITUBE traffic post systems. However, it is believed that attachment of one or two mailboxes could be secured to the round steel tubing using NDOR's adjustable mailbox mounting platform in combination with some new hardware. If such a modification was implemented, additional crash testing may be required.

### 3.4 Foresight Products Inc.

Foresight Products Inc. offers the V-LOC socket system for both mailboxes and sign supports. For mailbox installations, the support posts are fabricated from round steel tubing with capabilities of supporting one, two, or five mailboxes. For sign post installations, round, square, or U-channel posts can be adapted to the V-LOC socket systems. Information supplied by Foresight Products Inc. is included in Appendix E.

Currently, there are manufacturer-specified brackets for attaching one, two, or five mailboxes to the round steel post and V-LOC socket system. Although no additional modifications to these systems are required, design modifications are being made to further refine the V-LOC anchor. Patents are currently pending on these slight changes, which include ensuring that soil does not penetrate up through the hole where the post is placed.

### 3.5 Chicago Heights Steel

Chicago Heights Steel offers many sizes of the U-channel sign supports. Two breakaway ground support options are available consisting of yielding support mechanisms. One such option includes the Eze-Erect system formerly of the Franklin Steel Company. Information supplied by Chicago Heights Steel is included in Appendix F.

Currently, there is no manufacturer-specified bracket for attaching one or two mailboxes to the U-channel sign supports. However, one or two mailboxes can be secured to the U-channel supports using NDOR's adjustable mailbox mounting platform in the same manner used prior to the Franklin Steel Company going out of business in 1994.

### 3.6 Western Highway Products

Western Highway Products offers the Ulti-Mate sign support systems consisting of square steel tubing with pre-punched holes on all surfaces or posts with selected holes punched in key regions. Several breakaway ground support options are available, consisting of yielding supports. Information supplied by the Western Highway Products is included in Appendix G.

Currently, there is no manufacturer-specified bracket for attaching one or two mailboxes to the Ulti-Mate sign support systems. However, it is believed that attachment of one or two mailboxes could be secured to the square steel tubing using NDOR's adjustable mailbox mounting platform in combination with some new hardware. If such a modification were implemented, additional crash testing may be required.

### 3.7 S-Square Tube Products

S-Square Tube Products offers the TEL-SQUARE sign support systems, consisting of square steel tubing with pre-punched holes on all surfaces. Breakaway ground support options are available, consisting of yielding supports. Information supplied by the S-Square Tube Products is included in Appendix H.

Currently, there is no manufacturer-specified bracket for attaching one or two mailboxes to the TEL-SQUARE sign support systems. However, it is believed that attachment of one or two mailboxes could be secured to the square steel tubing using NDOR's adjustable mailbox mounting platform in combination with some new hardware. If such a modification were implemented, additional crash testing may be required.

### 3.8 Franklin Industries Co.

Franklin Industries offers many sizes of the U-channel sign supports. Two breakaway ground support options, consisting of yielding support mechanisms, are available. One such option includes the Eze-Erect system formerly of the Franklin Steel Company. Information supplied by Franklin Industries Co. Appendix I.

Currently, there is no manufacturer-specified bracket for attaching one or two mailboxes to the U-channel sign supports. However, one or two mailboxes can be secured to the U-channel supports using NDOR's adjustable mailbox mounting platform in the same manner used prior to the Franklin Steel Company going out of business in 1994.

### 3.9 Xcessories Squared

Xcessories Squared offers two ground anchor assemblies and one slip-base assembly for sign supports manufactured from square steel tubing with pre-punched holes on all surfaces. Information supplied by the Xcessories Squared is included in Appendix J.

Currently, there is no manufacturer-specified bracket for attaching one or two mailboxes to square steel tube supports. If such a bracket were implemented, additional crash testing may be required.

# 4 DISCUSSION

A search of manufacturers of safety-related hardware revealed that several companies provide small sign and mailbox supports. The available supports can be classified into three general categories - U-channel supports. square steel tube supports, and round steel pipe supports. It is noted that all three support categories provide acceptable safety performance as well as an economical solution for small sign and mailbox installations.

## 4.1 U-Channel Supports

Currently three companies were found that manufacture high strength, U-channel supports with various types of breakaway mechanisms - the Marion Steel Company, Chicago Heights Steel, and Franklin Industries Co. For small sign and mailbox support applications. the high-strength steel provides a desirable brittle behavior when impacted and gives improved resistance to environmental loading.

Support posts made of steel U-channel are economical, and all criticism about them should be tempered by this acknowledgment. They may be more difficult to install, more difficult to inventory with all of their nuts, bolts, and specialty hardware, and arguably less attractive than the square tube and round pipe support systems. but they are economical.

One distinct advantage of the U-channel support systems, at least for the Nebraska Department of Roads, is that the adjustable mailbox mounting platform that NDOR currently uses, and for which it holds the patent. may be readily adapted for use on any of the U-channel systems outlined in this report.

Although safe for motorists, U-channel support systems are not particularly reusable if impacted, with the possible exception of the Marion Steel Company's Slip-Safe and Minute-Man

designs. These two Marion support systems use slip-base and shear bolt mechanisms to minimize damage to the U-channel support post and embedded base in the event of an impact.

Finally, U-channel posts are also easy to store and capable of being neatly stacked with minimal required space. This may be a concern for maintenance facilities that may be required to store several thousand units.

### 4.2 Square Steel Tube Supports

Three companies were found that manufacture square steel tube supports that offer safe, economical small sign and mailbox supports with various types of breakaway mechanisms - the Unistrut Corporation, Western Highway Products, and S-Square Tube Products. Although Xcessories Squared does not offer square steel tube supports, it does offer various ground support options.

The square steel tube is an attractive support post alternative, with telescoping features and increased torsional stability for resisting oscillating wind loads. Unfortunately, these inherent properties result in higher support costs. In addition, the advantage of increased torsional stability of the square shape over U-channel section is likely more pronounced for the longer post lengths used with small sign supports versus the shorter mailbox supports.

One disadvantage of the square steel tube support is that hardware for attaching one or two mailboxes to the tube support has not been developed and crash tested. However, the researchers believe that mailboxes could be easily adapted for use with these supports and, if crash tested, would have a high probability of meeting safety standards.

### 4.3 Round Steel Pipe Supports

Two companies were found that manufacture attractive, round steel pipe supports with various types of breakaway mechanisms - Foresight Products Inc. and Southwestern Pipe, Inc.

Foresight Products Inc. offers the only proprietary, crash tested systems developed specifically for mailbox applications with all the necessary hardware to complete the installation. Two support systems are available, one for single or double mailbox installations and another for use with up to five mailboxes. Both supports incorporate the V-LOC socket that has been crash tested extensively for use as a breakaway mailbox support and is also approved for use with square, round, and U-channel sign posts. Advantages over the U-channel systems include its ease of installation in the field, strong support anchor for all soil types, and a reduction in the number of parts required for installing the support system. One disadvantage of this design versus the U-channel and square tube systems is that the system components cannot be stored as easily in maintenance yards and stacked in a compact manner. The V-LOC system may be less economical than the U-channel support systems. However, the true material or system costs should be verified through the typical bid processes commonly used within each of the State Departments of Transportation.

Southwestern Pipe, Inc. offers a slipbase system as well as a breakaway sign post anchor system. The slipbase system will likely be more costly than the simple, U-channel systems where the ends of the U-channels are lapped together. However, the slipbase system offers some economy with reusable components following a vehicular impact. The breakaway sign post anchor system is simple, economical, and quick to install. The round steel tube is an attractive support post alternative with its increased torsional stability for resisting oscillating wind loads. In addition, the components

for the POZ-LOC sign post anchor system are likely to be stored reasonably well. One disadvantage of the round, steel tube supports by Southwestern Pipe, Inc. is that hardware for attaching one or two mailboxes to the tube support has not been developed and crash tested. However, the researchers believe that mailboxes could be easily adapted for use with these supports and, if crash tested, would have a high probability of meeting safety standards.

# 5 CONCLUSIONS AND RECOMMENDATIONS

The results of this research study revealed that several crashworthy, small sign and/or mailbox supports are available from manufacturers and suppliers, consisting of round pipe, square tubing, and U-channel geometries. Several wood post options are also acceptable and available from the local lumber suppliers. It is noted that some sign supports may not have manufacturer-specified brackets for attaching one or more mailboxes to the crashworthy sign support systems. However, it is believed that attachment of one or more mailboxes could be secured to these supports using NDOR's adjustable mailbox mounting platform, in combination with some new hardware. If such modifications were implemented, additional crash testing may be required.

In the future, prior to implementing any new small sign or mailbox support into a State Highway Department's Standards and Specifications, it is recommended that the State: (1) obtain the relevant crash test documentation from the manufacturer, supplier, or test agency (if applicable); (2) obtain the specific test conditions of the safety performance evaluation; and (3) verify the limitations associated with using the specific safety hardware (refer to the appropriate FHWA acceptance letter).

It is also recommended that consideration be given for implementing several systems into a State's Standards and Specifications. Economy is generally provided with increased competition. However, as mentioned above, additional crash testing may be required.

Finally, this research project was initiated by the Nebraska Department of Roads after the Eze-Erect support system became unavailable after the Franklin Steel Company went out of business. However, during the course of this project, it was discovered that two companies were currently manufacturing the Eze-Erect system - Chicago Heights Steel and Franklin Industries Co.

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# APPENDICES

# APPENDIX A

## Listing of FHWA's Acceptance Letters for Sign Supports

## Section 2 - Sign Supports

Introduction

Crashworthy sign supports are designed to breakaway or yield when struck by a vehicle. Testing parameters and criteria to determine acceptable breakaway performance are found in the AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals."

In 1975 AASHTO issued this combined sign and luminaire support specification and the FHWA adopted the 1975 edition for application on Federal-aid highway projects. During the period from 1976 through 1987 FHWA's Office of Engineering issued several letters to sign support manufacturers accepting their devices for use on Federal-aid projects. These devices had been tested and produced results which satisfied the criteria in the 1975 edition of the AASHTO specification. The acceptance letters are on file in the Geometric and Roadside Design Branch.

During 1985 AASHTO issued a new edition to the sign and luminaire specification. In 1988 FHWA adopted the 1985 edition of the AASHTO specification for application on Federal-aid projects. Key changes in the 1985 edition involving testing parameters and acceptance criteria for breakaway supports were:

1. The weight of the crash test vehicle was lowered from 2,250 pounds to 1,800 pounds.

2. The criterion for acceptable dynamic performance was changed from a maximum change of momentum of 1,100 pound-seconds for the test vehicle (which implied a change of velocity of 15.7 ft/sec for a 2,250 pound test vehicle) to a maximum change in velocity of 15.0 ft/sec for the new 1,800 pound test vehicle.

3. The establishment of a 4-inch maximum stub height criterion.

Following FHWA adoption of the 1985 edition of the AASHTO specification, the Office of Engineering has been issuing acceptance letters to manufacturers of sign support systems which have been tested in accordance with the parameters in the 1985 edition of the AASHTO specification and produced satisfactory performance. Also, prior to 1988 several sign support manufacturers tested their devices using the new 1985 AASHTO criteria and FHWA issued acceptance letters that stated the device was acceptable under the 1975 AASHTO criteria and would also be acceptable under the new 1985 AASHTO criteria when and if FHWA adopted it. A compilation of these acceptance letters is included in this section. Typically, the acceptance letters provide a description along with a drawing of the device tested; test results; and, information on limitations on use of the device, such as number of supports allowed within a vehicle path or possibly the type of soil the testing was done in.

Careful attention should be paid to the descriptions of the tested systems and the soil conditions used. Demonstration of satisfactory breakaway performance is limited to the system tested and soil conditions noted. The FHWA's Office of Engineering has encouraged testing of several of the sign support systems in both strong (S-1) and weak (S-2) soils as defined in NCHRP Report 230. However, in many cases the support was tested in only the strong soil. When this occurs, the crash test then only demonstrates satisfactory breakaway performance if the support is placed in a strong soil.

In 1993 the FHWA adopted NCHRP Report 350 as the guidance for crash testing of safety hardware. Report 350 permits breakaway devices to cause an occupant impact speed of 5 m/s (16.4 ft/sec.) Also, in 1994 AASHTO reissued their support criteria and the maximum permissable vehicle velocity change was revised to 16.0 feet per second. FHWA will recognize the slightly higher 5.0 m/s limit. Because the test parameters and the acceptance criteria found in NCHRP 350 are more liberal than those in the AASHTO standard, hardware previously found acceptable does not have to be re-tested to the NCHRP 350 criteria.

It is noted that breakaway sign support systems other than those covered by this compilation could be acceptable for use on Federal-aid highway projects. The FHWA's Office of Engineering has issued these acceptance letters as a service to help promote continuity and uniformity in review. However, it is not a requirement of FHWA that such a letter be issued for each crashworthy sign support system to be used on a Federal-aid project. If, for a particular sign support system, it can be demonstrated to the satisfaction of the highway agency and FHWA's Division Office that a support system has been tested in accordance with recognized procedures and the results are satisfactory, than that support system could be accepted for use on a Federal-aid project by the Division Office.

Listing of FHWA Accepted Breakaway Sign Supports *

| Code | Acceptance Letter Date | Manufacturer/ Supplier | Description of Device |
|---|---|---|---|
| SS-1 | 7/14/86 | Southwestern Pipe, Inc. | POZ-LOC anchor system - 2 3/8 in. O.D. posts, max .095 in. wall thickness. ** |
| SS-2 | 8/19/86 | Trus Joist Corp. | MICRO=LAM - 14 7/8 X 7 7/8 in. box section plywood post. Tested in S-2 soil. |
| SS-3 | 10/3/86 | Allied Tube & Conduit Corp. | QWIK-PUNCH tube system - max size 2 1/4 x 2 1/4 in. x 12 ga. post set in reinforced sleeve base. |
| SS-4 | 1/29/87 | Minute Man Anchors, Inc. | Breakaway coupling for use with 3 lb/ft steel flanged channel post (superseded by new hardware on 3/10/88. See SS-6) ** |
| SS-5 | 6/15/87 (Memo to Regions) | ----- | a.Perforated square steel tube - 2 x 2 in.x 0.105 wall thick. max size.**<br>b.Single 3 lb/ft steel U-post. **<br>c.Dual 3 lb/ft steel U-post. **<br>d.Ariz. dual legged slip base S4x7.7 post<br>e.Texas dual leg slip base, W12x45 post<br>f. to g. repeated SS-1 to SS-4 above |
| SS-6 | 3/10/88 | Minute Man Anchors, Inc. | Breakaway coupling for use with steel flanged channel supports. ** |
| SS-7 | 9/1/88 (Region 5 Memo) | ----- | Wisconsin Large Sign Support System - slip base w/no upper hinge,sign attachment clips provide for release, W12x22 posts tested |
| SS-8 | 3/31/89 | Unistrut Corp. | TELSPAR small sign supports - max size 2 1/2 x 2 1/2 in. x 12 ga. |
| SS-9 | 3/16/89<br>4/7/89 | Franklin Steel | EZE-Erect Sign Posts - max 4.0 lb/ft flanged channel posts. |
| SS-9A | 10/17/96 | | Dual EZE-Erect in strong soil. |
| SS-10 | 5/11/89 | HwyCom Corp. | 3-Inch Diameter, 1/8 in. wall, fiber-reinforced plastic post. (see SS-12) |
| SS-11 | 5/18/89 | Allied Tube & Conduit | Quick-Punch post - Max size 2.25 x 2.25" x 14 ga. in unreinforced 12 ga. sleeve base. |
| SS-12 | 8/3/89 | HwyCom Corp. | Dual post installations of 3-inch FRP. |
| SS-13 | 8/31/89<br>10/2/89<br>12/12/91<br>12/27/91 | Marion Steel | Single to triple 3 ppf and single or dual 4 ppf Rib-Bak post installations with ground splice. **<br>Project by project acceptance of Florida's splice in both soil types |
| SS-14 | 10/27/89 | Marion Steel | Rib-Bak Post with Minuteman Coupling ** |
| SS-15 | 12/12/89 (Memo to Region 1) | ---- | Single 3" and 4" diameter Aluminum, 3/16" wall, direct burial tube. ** |
| SS-16 | 12/29/89 | Minute Man Breakaway | MMB-1HD breakaway device for use with 3 #/ft. steel flanged channel "U"-posts. |
| SS-17<br>SS-17A<br>SS-17B | 1/8/90<br>3/7/95<br>4/25/95 | Transpo Industries | Type A and Type B breakaway couplings.(If installed by direct burial, then Type AUX for S-1 soil only.)<br>(Posts limited to 45 #/ft below the hinge.) |

| | | |
|---|---|---|
| SS-18 | 6/19/90 Minute Man Breakaway | MMB-1HD breakaway device for use with LWC 3 #/ft flanged channel "U" posts in strong soil. (see SS-21 for weak soil acceptance letter) |
| SS-19 | 7/31/90 Allied Tube and Conduit | Square-Fit signpost systems. |
| SS-20 | 9/20/90 Franklin Steel | 2 to 3 pound-per-foot flanged channel "U" posts. |
| SS-21 | 12/26/90 Minute Man Breakaway | MMB-1HD breakaway device with two 3 #/ft flanged channel "U" posts in both strong and weak soil. |
| SS-22 | 1/4/91 Trus Joist Corporation | Type "L" MICRO=LAM with revised saw cut |
| SS-23 | 3/14/91 (memo to Reg.1) | New Jersey Breakaway Couplings |
| SS-24 | 5/1/91 Unistrut Corp. | Triangular Slip Bases for Square Tube Sign Supports. |
| SS-25 | 6-4-91 (memo to Regions) | a.Single or dual 4"x4" wood, undrilled<br>b.Single 6"x8" wood with 3.0" holes<br>c.Single 6"x6" wood with 2.0" holes<br>d.Single 4"x6" wood with 1.5" holes<br>e.Dual W6x12 steel post on slip base (up to 18 ppf for dual supports OK) |
| SS-26 | 2/11/92 Unistrut Corp. | Telspar square perf. tube small sign supports without sleeve around base post. |
| SS-27 | 5/15/92 Montana D.O.T. | Round wood post supports |
| SS-28 | 5/26/92 --- (memo to Region 4) | 3 1/2" Diam. Thin Walled Aluminum Tube<br>Single Spliced (6" c-c) Marion Steel or Franklin Steel 4 ppf U-channel post |
| SS-29 | 7/15/92 A.B. Chance | Helical Screw Foundations for Motorist Aid Callboxes |
| SS-30 | 9/17/92 Hapco Division 10/5/92 | Cast Aluminum Shoe Base for Motorist Aid Callbox Supports |
| SS-31 | 10/22/92 Allied Tube and Conduit | Single Perforated Square Steel Tube 2 1/2" 12 ga in 7 ga anchor |
| SS-32 | 10/28/92 --- (memo to Region 7) | Western Red Cedar for Breakaway Wood Supports |
| SS-33 | 10/29/92 Transpo Industries, Inc. | 201C and 301C Pole-Safe couplings for Motorist Aid Call Box Supports |
| SS-34 | 3/20/93 Louisiana DOTD | Omni Directional Slip Base, 3.5" diameter post |
| SS-35 | 5/28/93 Imperial, Inc | Aluminum tube 2.375" diameter |
| SS-36 | 9/3/93 --- (Memo to Regions) | Large and Small Sign Supports (See memo for details on various Wood, U-Channel, Perf.Sq.Steel Tube, Slip Base, FRP posts.) |
| SS-37 | 8/13/93 Greenline | Recycled Thermoplastic Delineator Posts |
| SS-38 | 10/27/93 Unistrut Corp. | Telespar Cast Iron Three-Bolt Slip Base |
| SS-39 | 10/25/93 Recycled Plastic Prod.,Inc. | 3.5" x 3.5" Recycled Plastic Small Sign Support |
| SS-40 | 10/27/93 Unistrut Corp. | 2" Square Perforated Steel Tube, One Post, Direct Bury |
| SS-41 | 11/8/93 Richard Strizki | Load Concentrating Coupling and Adjustable Anchor and Bracket Assembly |
| SS-42 | 11/10/93 Marion Steel Co. | 1.12 PPF and 1.33 PPF A-36 Delineator Posts |

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|---|---|---|---|
| SS-43 | 1/19/94 | VSAR Systems | Speed-E-Rect breakaway device for U-channels |
| SS-44 | 3/30/94 | Unistrut Corp. | 14-gage A715 Gr 60 Perf. Square Steel posts * |
| SS-45 | 5/11/94 | --- (Memo to Region 3) | Drilled Wood posts in concrete foundations, Pennsylvania designs ** |
| SS-46 | 6/17/94 | --- | Unmodified Cedar Posts full dimension 4"x6" |
| SS-46A | 9/21/95 | (Memo to Region 8) | |
| SS-47 | 9/14/94 | South Dakota DOT | Splicing 3PPF Marion post to 4PPF Franklin Stub |
| SS-48 | 9/23/94 | SAFE, Inc. | Safe Foundation and Anchors base for breakaway couplings |
| SS-49 | 10/26/94 | Galvacor | 2 PPF U-channel A-36 steel delineator posts |
| SS-50 | 11/8/94 | --- (memo to Region 3) | Virginia's 5x5 unmodified single wood post in soil-cement foundation ** |
| SS-51 | 1/23/95 | Unistrut Corp. | A570 Perforated Square Steel Posts W/60 ksi yield |
| SS-52 | 2/8/95 | Allied Tube and Conduit | Three-Bolt Slip Base (same as SS-24) |
| SS-53 | 3/9/95 | Lancaster Composite | Concrete-filled fiberglass posts |
| SS-53A | 3-19-96 | Lancaster Composite | Direct Bury acceptance of some SS-53 posts in std soil** |
| SS-54 | 3/28/95 | Chicago Heights Steel | U-channel posts to 4 PPF in "EZE-Erect" configurations |
| SS-55 | 4/24/95 | Colorado Dept. of Transp. | 4 x 6 Wood posts installed sideways |
| SS-56 | 7/13/95 | Marion Steel Company | "Lap Splice" for triple 3ppf and 4ppf in both soils |
| SS-56A | 3-14-96 | Marionn Steel Company | Modify design to use "bar spacer" |
| SS-57 | 9/26/95 | Marion Steel Company | Minuteman coupler on Triple 3ppf and 4ppf (w/soil plate on 4ppf), in all soils. |
| SS-58 | 9/27/95 | Flexstake | Flexible delineator posts |
| SS-59 | 3-7-96 | Chicago Heights Steel | Dual 3 ppf u-channel in strong soil |
| SS-59A | 4-19-96 | Chicago Heights Steel | Modify design to use "bar spacer" |
| SS-60 | 10/27/95 | Clifford Dent | Couplings for sign supports |
| SS-60A | 10/21/96 | | Larger bolts with same necked-down diameter |
| SS-61 | 2-27-96 | (memo to Region 10) | Revised Oregon multi-directional slip base |
| [LS-45 | 4/5/96 | Transpo Industries | Prototype Double Neck Coupling for signs and luminaires] |
| [LS-45A | 4/29/96 | Transpo Industries | Double-Neck Pole-Safe coupling for signs and luminaires] |
| SS-62 | 6-3-96 | Western Highway Products | ULTI-MATE perforated square steel tube sign supports |
| SS-63 | 7/2/96 | S Square Tube Products | Perforated square steel tube sign supports |
| SS-64 | 7/18/96 | Marion Steel | Metric "Rib-Bak 2" Posts |
| SS-65 | 9/5/96 | Poz-Loc | Slip Base** |
| SS-66 | 8/8/96 | HwyCom | Universal Anchor System for FRP & Poz Loc Posts |
| SS-67 | 9/9/96 | Franklin Industries | 60 KSI U-Channel Posts recertification |

| | | | |
|---|---|---|---|
| SS-68 | 9/18/96 | X-Cessories Squared | Slip Base for Square Steel Tube posts ** |
| SS-69 | 9/18/96 | Safety Quest, Inc | U-Channel Slip Splice |
| SS-70 | 9/25/96 | Richard Buhler | Sleeve it N Go for 4x4 wood posts |
| SS-71 | 12/23/96 | Davidson Plastics | Flexi - Guide Delineator Posts |
| SS-72 | 1/13/97 | Foresight Products | V-Loc Sign Support System |
| SS-73 | 2/24/97 | PennDot | "Universal" Spacer Bar for splicing u-channels |
| SS-74 | 3/14/97 | Granger and Assoc | "ANYTWO" bracer bar for splicing u-channels |
| SS-75 | 4/9/97 | Universal Anchor Systems, Inc | Universal Anchor System with HWYCOM and POZLOC posts |

* Supports conform to FHWA breakaway requirements based on the 1985 AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals. After May 1993, velocity change permitted is 5.0 m/s (16.4 ft/s) per NCHRP Report 350.

** These small sign supports were only tested and/or found acceptable in NCHRP Report 350 "Standard" soil (Report 230 S-1 "Strong" soil.) Should a state wish to install this hardware in "weak" soil, further crash testing is recommended.

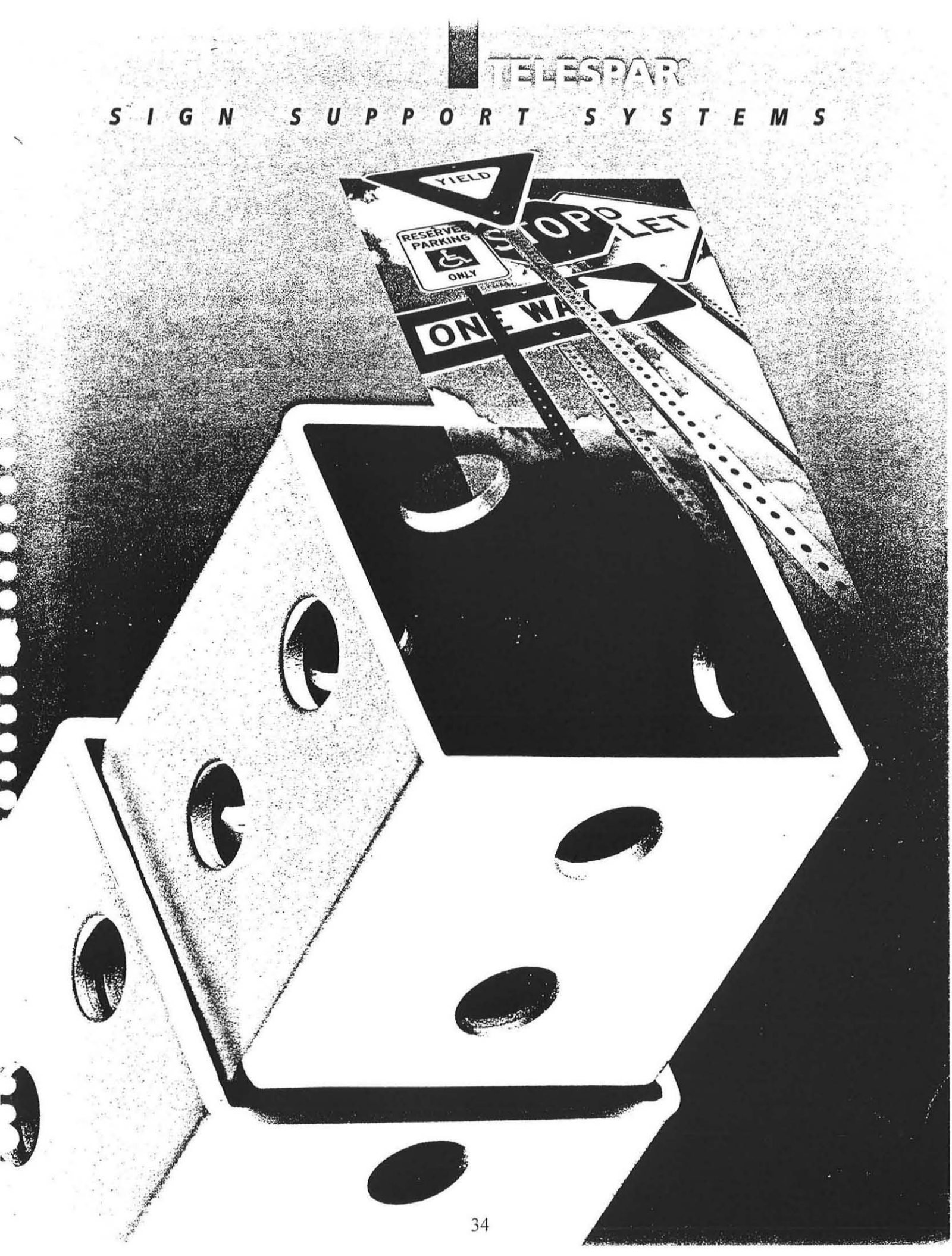
Revised June 13, 1997

# APPENDIX B

## Unistrut Corporation/Allied Tube and Conduit Corporation

TELESPAR

SIGN SUPPORT SYSTEMS



# TELESPAR®

**THE INDUSTRY'S MOST ADVANCED AND COST-EFFECTIVE SIGN-SUPPORT SYSTEM**

## *From the smallest village and back road to the largest city and interstate highway, the Telespar system offers sign support solutions that work.*


### THE TELESPAR SIGN-SUPPORT SYSTEM OFFERS ALL THESE FEATURES:

- Easy, safe installation by hand or power
- Convenient sign mounting before installation
- Superior torsional strength
- Versatile, four-sided sign mounting, at any height
- Fast, economical replacement of damaged sign posts
- Reusable materials
- FHWA-approved yielding capability

### A COMPLETE SYSTEM

The Telespar system consists of square, perforated, welded steel tubing, in eight sizes and three gauges. Perforations or knockouts on all four sides allow you to mount signs back-to-back and on adjacent sides.

The unique manufacturing method used to produce Telespar tubing permits tubular sections of different sizes to telescope into the next larger size making adjustment, reinforcement and splicing fast and easy. The square shape also provides superior windload capabilities and torsional stability.

Telespar tubing is complemented by a variety of compatible fittings, accessories, nuts and bolts, and simple installation tools, creating an engineered system of integrated parts.

### THE TELESPAR SYSTEM IS BACKED BY NATIONWIDE DISTRIBUTION

With Telespar tubing, you get the benefit of our distribution system, which extends throughout the U.S. and Canada.

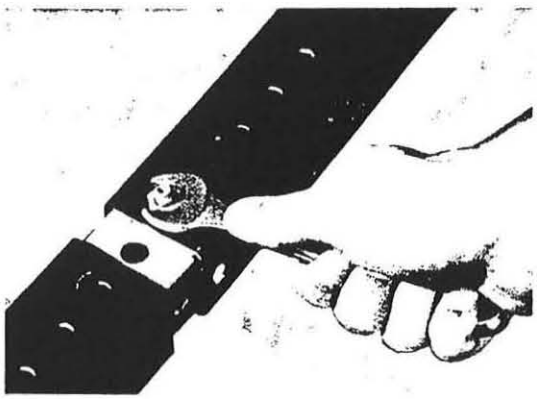
Large inventories ensure that multiple sizes of Telespar tubing are in stock. Local distribution points can provide for immediate orders and prompt delivery. Large orders are sent directly from the factory, thereby avoiding warehouse costs.

## VERSATILITY PLUS

The Telespar Sign-Support System can benefit any size town, county, or state highway department by saving time, money and lives. The versatility of the Telespar concept creates a system adaptable, not only to signpost usage, but also to identification signage, parking-meter posts, barricades and countless other applications.

## SALVAGEABILITY

An average 60% salvage rate makes Telespar one of the most economical systems available. A major portion of a damaged signpost can usually be saved and spliced with another Telespar section to produce additional posts, to form a cross member or for other general framing. This multitude of second uses adds up to savings instead of accumulating piles of useless damaged posts.



## EASY INSTALLATION

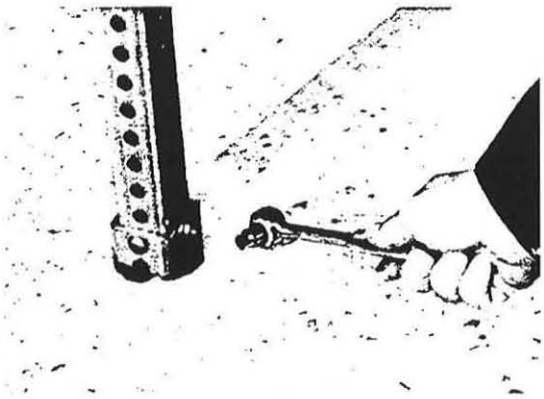
Telespar signposts require only one worker for installation. All work can be done at ground level, eliminating the need for bucket trucks and similar heavy equipment. Most important, independent tests show that Telespar signposts go up in about half the time compared to other materials.

## TORSIONAL STABILITY

Primarily because of its square shape, Telespar tubing has excellent torsional stability. The utilization of Telespar tubing means substantial reduction of sign flutter in high wind, and less loosening and damaging of sign blanks on the post. And in many applications, a single highly-stable Telespar post will do the job of *two* U-channel posts!

## SAFETY

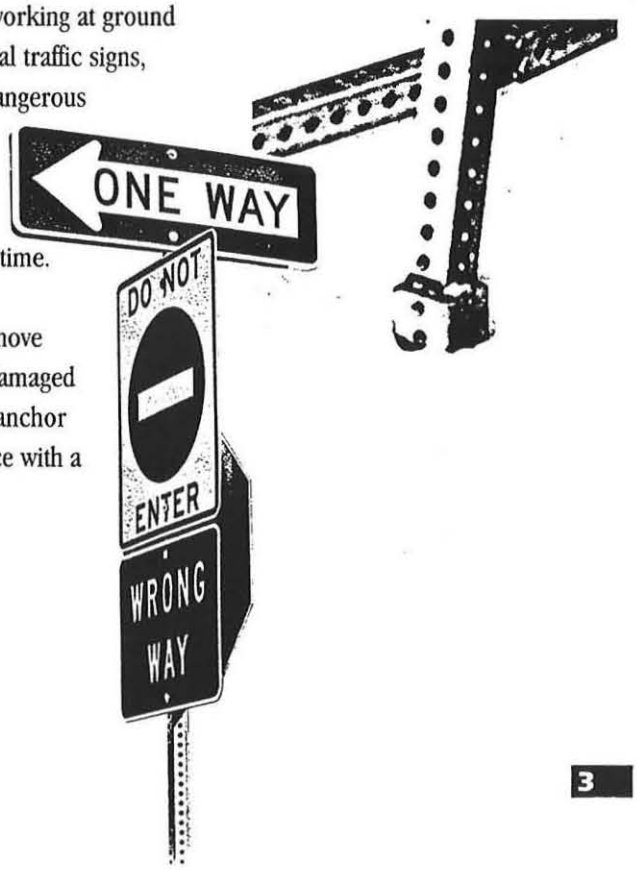
The Telespar System was the first to be used effectively in a yielding breakaway concept for small sign-support systems. It is FHWA-approved, and in compliance with AASHTO specifications.



## RAPID REPLACEMENT

Telespar sign supports can be replaced more quickly and easily by a one-man crew than any other signpost on the market. Within minutes, one man, working at ground level, can replace vital traffic signs, thus ensuring that dangerous intersections will not be left without proper signs for extended periods of time.

Simply unbolt or remove the rivets from the damaged post, lift it from the anchor assembly, and replace with a new post and sign.



## POSTS WITH PREPUNCHED HOLES

### DESCRIPTION

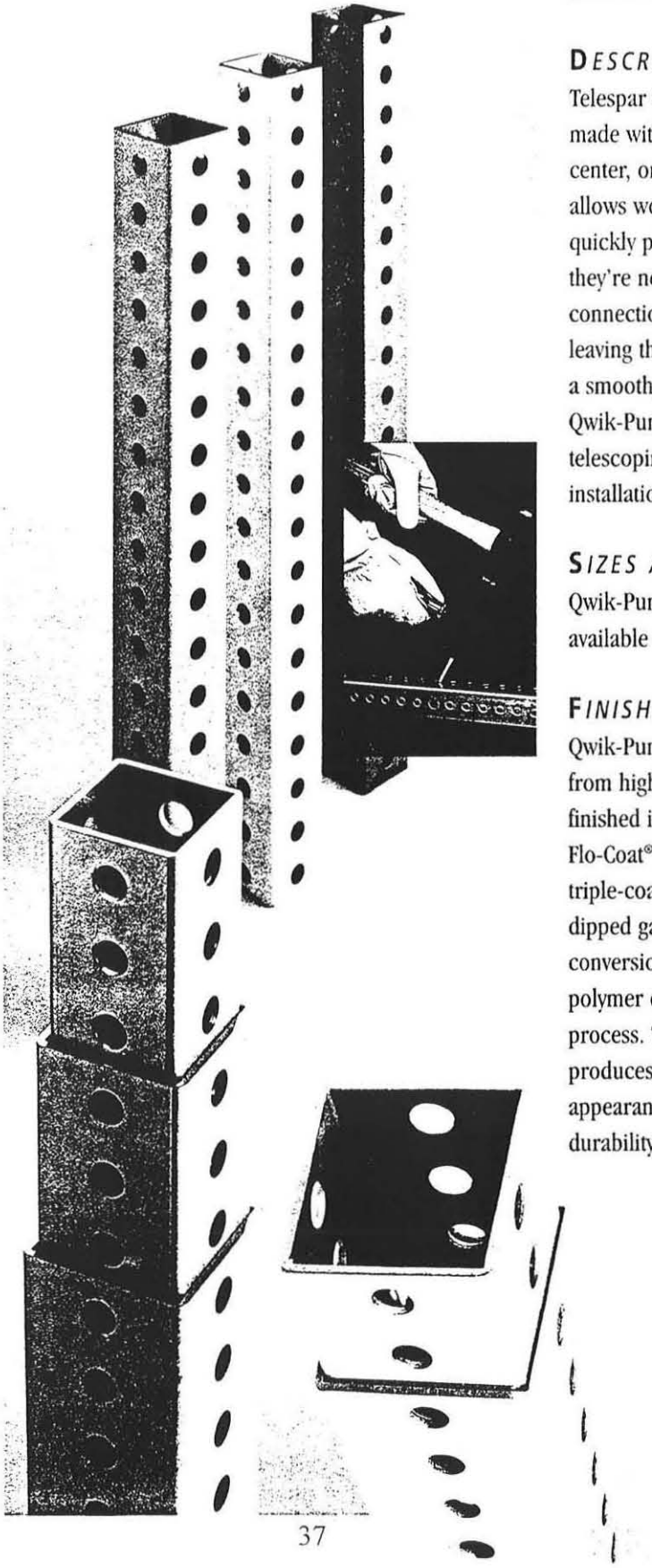
Telespar square posts with 7/16" prepunched holes on 1" centers are the standard against which all other signposts are measured. Precision manufactured from the highest-quality steel, Telespar posts are corner-welded to allow smooth telescoping action — a key to the system's versatility and ease of installation.

### SIZES AND GAUGES

Telespar 12 and 14 gauge signposts are available in sizes ranging from 1" - 2 1/2" square. Two 10 gauge posts — 2 3/16" and 2 1/2" square — meet extra heavy-duty requirements.

### FINISHES

Telespar posts are cold-formed from carbon steel on state-of-the-art high-speed rolling mills. Steel is pre-galvanized, then coated with a conversion coating and sealed with a polymer topcoat during manufacturing. The result is Pre-galv Plus™, a finish providing exceptional levels of long-term appearance and corrosion protection. For those preferring a painted post, Telespar posts are also available in Perma Green™ — a 10-step electrodeposition process that results in a super-tough acrylic finish that resists fading and checking while providing excellent corrosion protection.



## POSTS WITH KNOCKOUTS

### DESCRIPTION

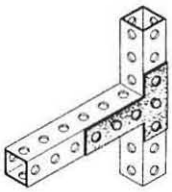
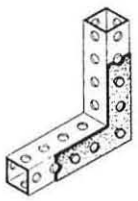
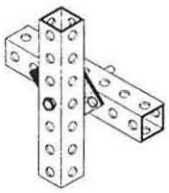
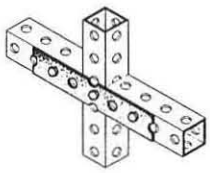
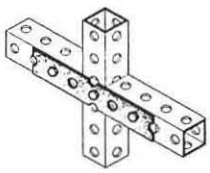
Telespar Qwik-Punch® posts are made with 7/16" knockouts, 1" on center, on all four sides. This feature allows workers in the field to quickly punch holes exactly where they're needed for anchor connections or sign mounting, leaving the balance of the post with a smooth, unbroken appearance. Qwik-Punch posts offer the same telescoping action and easy installation as regular Telespar posts.

### SIZES AND GAUGES

Qwik-Punch square posts are available in 2" square, 14 gauge.

### FINISHES

Qwik-Punch posts are cold formed from high-quality strip steel, then finished in-line with our exclusive Flo-Coat® process. This unique triple-coat finish begins with hot-dipped galvanizing followed by a conversion coating. A tough, clear polymer coating completes the process. This triple-layer protection produces a smooth, shiny appearance while providing superior durability and corrosion protection.

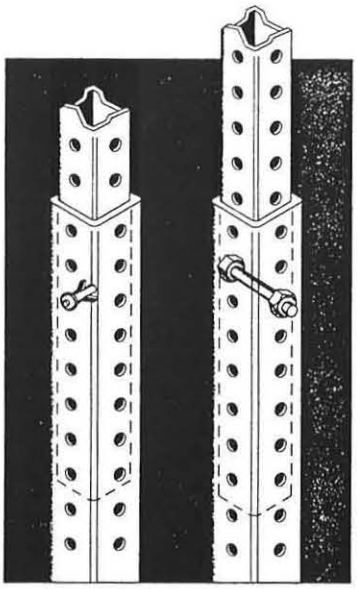
| Fittings | Tube Size | | Cutting Dimension* |
|---|---|---|---|
|  | 1 1/2" sq.<br>1 3/4" sq.<br>2" sq.<br>2 1/4" sq.<br>2 1/2" sq. | Both tubes must be same size. | 1 3/16"<br>1 1/16"<br>15/16"<br>13/16"<br>11/16" |
|  | 1 1/2" sq.<br>1 3/4" sq.<br>2" sq.<br>2 1/4" sq.<br>2 1/2" sq. | Both tubes must be same size. | 1 3/16"<br>1 1/16"<br>15/16"<br>13/16"<br>11/16" |
|  | 1 1/2" sq.<br>1 3/4" sq.<br>2" sq.<br>2 1/4" sq.<br>2 1/2" sq. | | |
|  | 1 1/2" sq.<br>1 3/4" sq.<br>2" sq.<br>2 1/4" sq.<br>2 1/2" sq. | | 1 3/16"<br>1 1/16"<br>15/16"<br>13/16"<br>11/16" |
|  | 1 1/2" sq.<br>1 3/4" sq.<br>2" sq.<br>2 1/4" sq.<br>2 1/2" sq. | | |
|  | 1 1/2" sq.<br>1 3/4" sq.<br>2" sq.<br>2 1/4" sq.<br>2 1/2" sq. | | 1"<br>1"<br>1"<br>1"<br>1" |

* Distance from end of tube to center of first hole

## FASTENERS

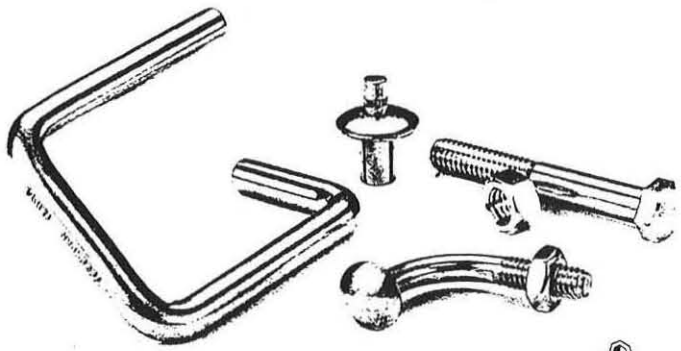
### DRIVE RIVET

Drive rivets provide the convenience of a one-piece fastener with effective tamper-resistant design and fast installation using only a hammer.



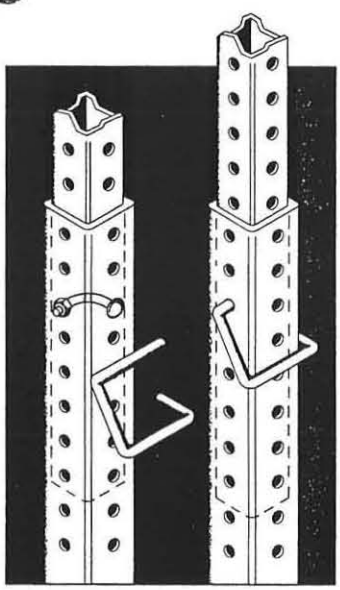
### HEX HEAD NUTS & BOLTS

Standard hex nuts and bolts can also be used to connect components. A special jam nut is available to help form permanent, tamper-resistant connections.



### CORNER BOLTS

Corner bolts can be tightened with a single wrench. By taking up fit tolerance in telescoping assemblies, they provide a tighter, more stable installation.



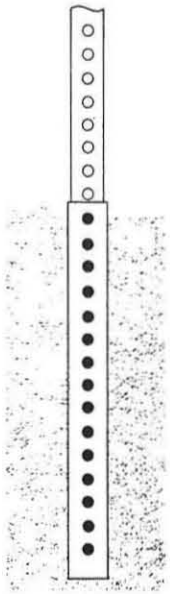
### LOCK PINS

The lock pin allows for quick, temporary connections between telescoping tube sections. Simply align holes between sections, insert lock pin and allow pin to drop into locking position.

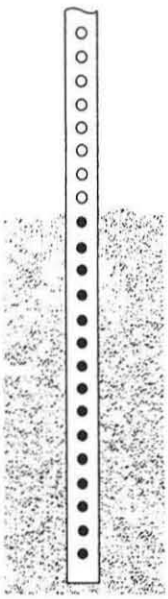
# TELESPAR® OPTIONS

*CHOICES THAT PUT YOU IN CONTROL*

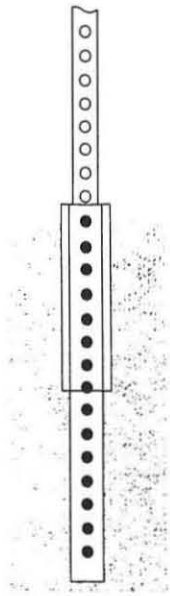
## GROUND SUPPORT OPTIONS



ANCHOR BASE



SINGLE POST



YIELDING BREAKAWAY

### *SINGLE BREAKAWAY ANCHOR*

Using either manual or power equipment, a minimum 30" section of 12 gauge Telespar tubing is driven into the soil to serve as an anchor base. 1" to 2" is left exposed above the surface. One man working at ground level can safely and easily insert a 14 gauge signpost into the anchor base and bolt it in place. Installation time is thus kept to a minimum. Signs can be bolted onto the post before installation.

### *TWO-PIECE BREAKAWAY ANCHOR*

A two-piece breakaway system is easily created by adding a 12 gauge outer sleeve of the next larger size tube to the original anchor base. This additional sleeve, approximately 18" long, provides a double wall thickness to accomplish the breakaway function. When installing in soil, it is advisable to drive the anchor base and outer sleeve together, leaving 1" to 2" of the assembly exposed above the surface. The signpost is then inserted and bolted into the anchor assembly.

## INSTALLATION OPTIONS

### *DIRECT EMBEDDED*

Signposts can be driven directly into the ground without anchoring sections, using a drive cap with sledge or power equipment.

### *MANUAL INSTALLATION*

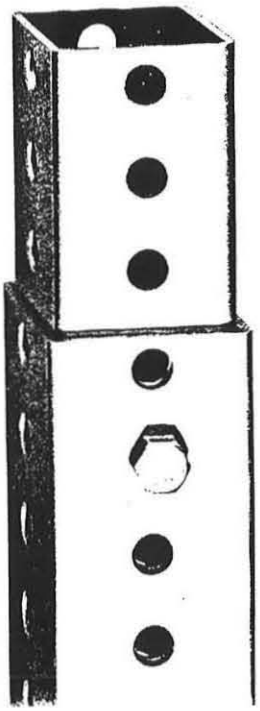
For manual installation, use a drive cap and sledge hammer to drive anchor assembly into soil, gravel or blacktop.

### *SELF-CONTAINED POWER EQUIPMENT*

The illustration above shows the technique for anchor assembly installation in any surface using self-contained power equipment.

### *PNEUMATIC HAMMER*

Installation can also be accomplished using a conventional pneumatic driving tool.



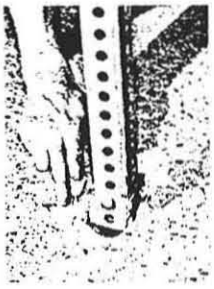
## SURFACE OPTIONS

### *BLACKTOP*

When installing Telespar tubing in blacktop, the anchor assembly is driven through the blacktop into the subsoil from ground level. All other aspects of the blacktop installation are the same as installing the Telespar system in soil.

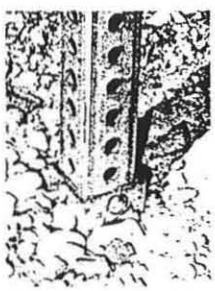
### *CONCRETE*

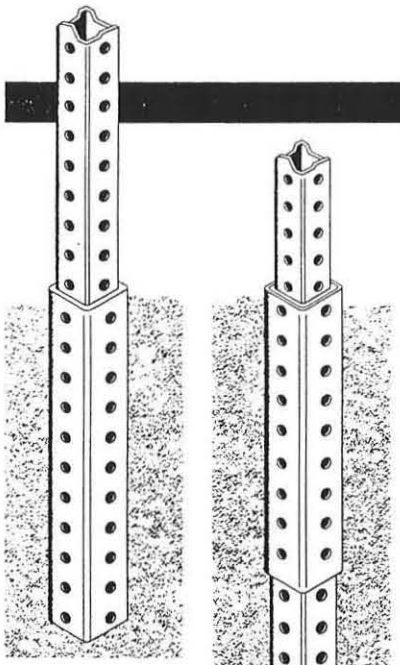
Telespar posts can be installed in concrete, using a pneumatic hammer or concrete drill to break through the surface. The anchor assembly is driven to within 1" of the surface to allow attachment of the signpost. If a flush installation is desired, clearance should be recessed on two sides to clear the bolt for the signpost connection.

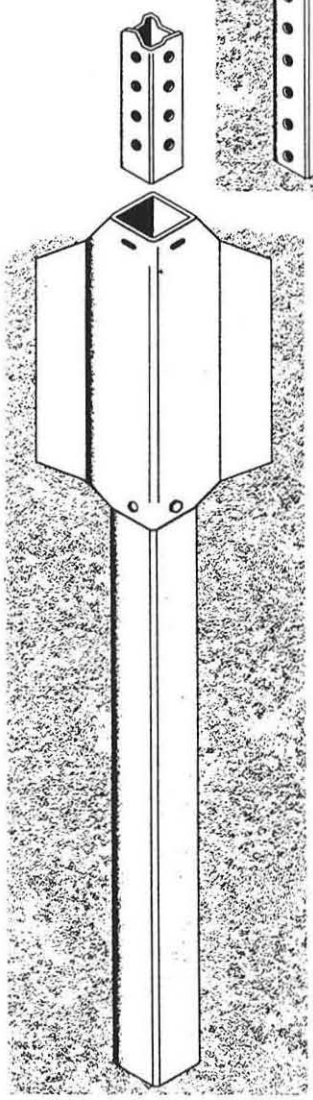


### *GRAVEL OR SOIL*

Installation of Telespar posts in gravel or soil is accomplished by driving the anchor post assembly into the ground, leaving 1" to 2" above the surface. The signpost is then inserted into the anchor assembly approximately 6" to 8" and bolted in place.







## HEAVY-DUTY ANCHOR

### SYSTEM I

**This heavy-duty breakaway anchor** easily accommodates larger size Telespar signposts (2" and 2 1/2", 10 or 12 gauge material). A square, heavy-wall (.188) one-piece anchor eliminates the need for a stiffener sleeve and allows the signpost to break away on impact without damaging the anchor wall.

*STABILIZATION ANCHOR SLEEVE*

Soft or drop-off shoulders require special anchor systems. Wind buffeting and other environmental conditions can cause the signposts to layover or twist. The **Soil Stabilizer** attaches to a single anchor with a corner bolt, securing the anchor in loose or sandy soil. It is then bolted through the post and top of the anchor. It should always be attached to the corner farthest from traffic flow (back opposite).

## HEAVY-DUTY ANCHOR

### SYSTEM II

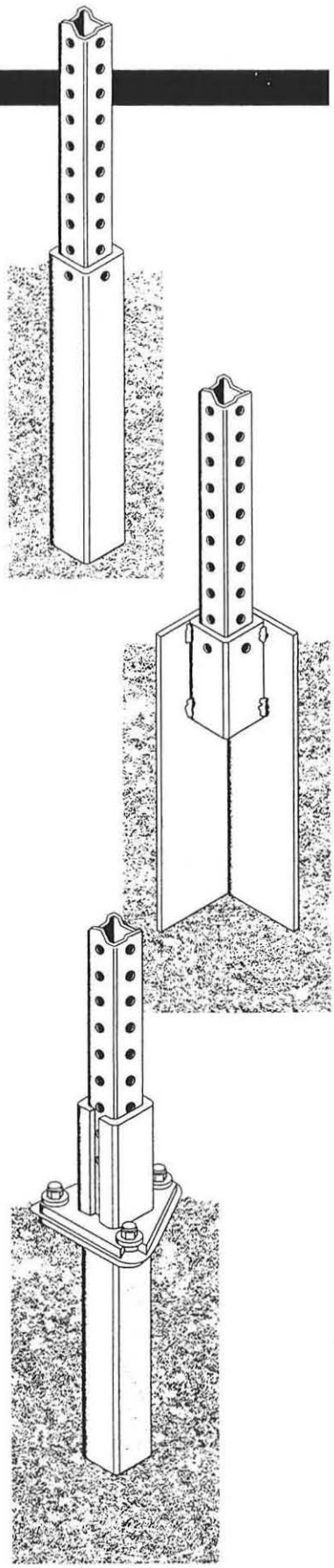
Extremely hard or rocky soil conditions can be problematic for signpost installation. A **one-piece, heavy-duty post anchor,** made from 1/4" x 4" structural angle iron, is designed specifically for ease of installation in these conditions. In addition, this anchor can be suitable in unstable soils where more lateral and torsional stability is required.

*SLIP BASE BREAKAWAY ANCHOR*

AASHTO standards for structural supports of highway signs require that you meet "change of velocity standards for 1800 pound vehicles." The **Slip Base** meets those requirements as put forth in the NCHRP-350 report. This anchor's flexibility provides:

- retrofitting of existing anchor footings.
- adapting to various post sizes.
- one of the most economical replacement costs in the industry.

The slip base, like all Telespar anchor systems, is economical to use and easy to install.

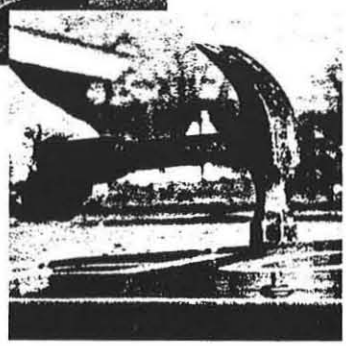


# TELESPAR® INSTALLATION

***SIMPLE, FAST, SAFE***

**1** Drive a minimum 30" piece of 12 gauge Telespar (anchor) into the soil until only 1-2 inches are left exposed. For a 2-piece anchor, use a 18" piece of tubing for a sleeve, one size larger than the anchor. Make sure the anchor and sleeve holes are aligned.

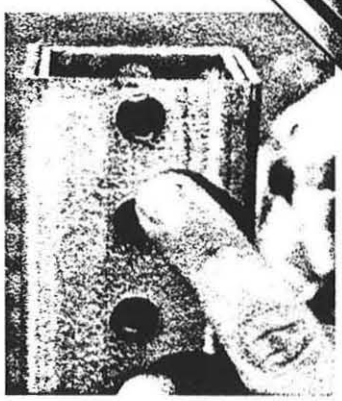
**2** Attach the sign to the post at the desired height using drive rivets or bolts.



**3** Insert the signpost, which is one size smaller than the anchor, about 6-8 inches into the anchor base.

**4** Bolt the signpost to the anchor assembly with a corner bolt.

The corner bolt takes up fit tolerance, concentrates fastening tension on only one corner of the tubing and prevents distortion of opposite tube walls which can occur when conventional through-bolts are over-tightened. If these simple steps are followed, an impacted post will break just above the anchor, or possibly at bumper height. To repair, simply remove the corner bolt, pull the post stub out of the anchor and replace it with a new post.



# SPECIFICATIONS

## MATERIAL

Steel posts conform to the standard specification for Hot-Rolled Carbon Sheet Steel, structural quality ASTM designation A570, Grade 50.

## SHAPE

The cross section of the post shall be a square tube formed of 10 gauge (.135" U.S.S. Gauge) or 12 gauge (.105" U.S.S. Gauge) or 14 gauge (.083" U.S.S. Gauge) steel, carefully rolled to size and welded in the corner.

## LENGTH

The length of the post shall be as specified on the purchase order with a length tolerance of ±1/4".

## FABRICATION

The furnished members shall be straight and shall have a smooth uniform finish. It shall be possible to telescope consecutive sizes of tubes freely with a minimum amount of play.

## PERMA-GREEN® II FINISH

*(Not available on Qwik-Punch posts)*

Tubing shall be carefully cleaned and phosphated, then coated with an acrylic enamel by electrodeposition and thoroughly baked. Color is Perma-Green per Federal Standard 595-A color number 14109 (Dark Limit V-).

## GALVANIZED POSTS (PRE-GALV PLUS AND QUIK-PUNCH®)

Signposts are galvanized conforming to ASTM specification A-653 des. G-90. Corner weld is zinc coated after scarfing operation. Qwik-Punch die-cut posts are in-line galvanized per AASHTO M-120, and all galvanized products receive a conversion coating and a clear organic polymer topcoat.

## ELEMENTS OF SECTION

| Tube Size Inches | Wall Thickness U.S. Std. Gauge & Inch | Area Sq. In. | Wt./Ft. Lbs. | I In.$^4$ | s In.$^3$ | r In. |
|---|---|---|---|---|---|---|
| 1¾ x 1¾ | 14 (.083) | .392 | 1.71 | .230 | .201 | .716 |
| 2 x 2 | 14 (.083) | .474 | 1.99 | .296 | .296 | .790 |
| 1½ x 1½ | 12 (.105) | .380 | 1.70 | .129 | .172 | .582 |
| 1¾ x 1¾ | 12 (.105) | .485 | 2.06 | .231 | .264 | .690 |
| 2 x 2 | 12 (.105) | .590 | 2.42 | .372 | .372 | .794 |
| 2¼ x 2¼ | 12 (.105) | .695 | 2.77 | .561 | .499 | .898 |
| 2½ x 2½ | 12 (.105) | .803 | 3.14 | .804 | .643 | 1.001 |
| 2 3/16 x 2 3/16 | 10 (.135) | .841 | 3.43 | .605 | .590 | .848 |
| 2½ x 2½ | 10 (.135) | 1.010 | 4.01 | .979 | .783 | .985 |
| 2 x 2 Qwik-Punch | 14 (.083) | .474 | 2.16 | .296 | .296 | .790 |

I= Moment of Inertia
s= Section Modulus
r= Radius of Gyration

# TELESPAR® ADVANTAGE

***BETTER PERFORMANCE, LOWER COST***


The Telespar sign-support system does more — and does it better — than anything else in its class. You simply won't find better performance at *any* price. Yet, no other product makes available dollars work so hard or go so far.

The reason is simple. The Telespar system was engineered specifically for sign-support use, then perfected with the help of traffic-control professionals like you. In short, we listen. That's the reason Telespar has become the most complete, cost-effective and easiest-to-use sign-support system in North America.

**UNISTRUT®**

**Unistrut Distribution Company**
**(800) 468-9510**

**Allied Mechanical Tube Division**
**(800) 882-5543**

A tyco INTERNATIONAL LTD. COMPANY





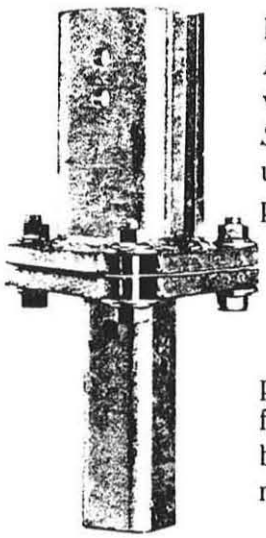
Printed in USA 3/96 ATC-L-1592

UNISTRUT

*Introducing...*

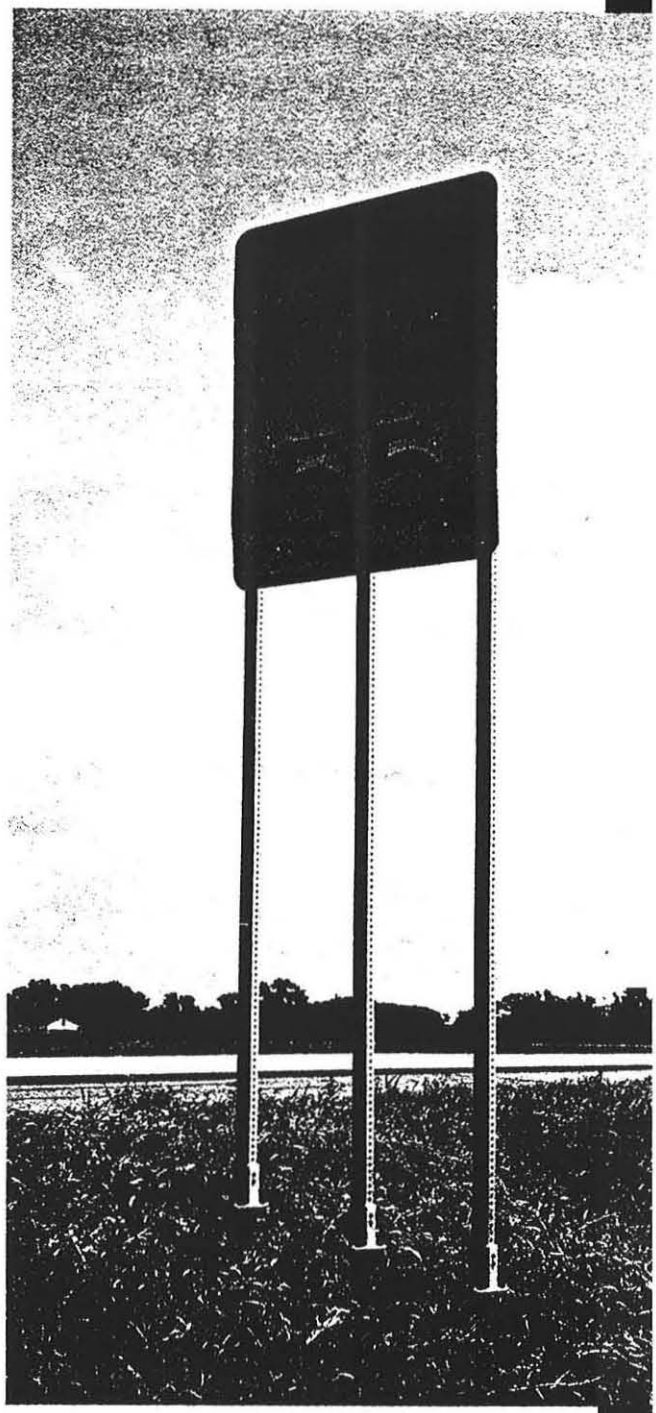
# TELESPAR® SLIP-BASE BREAKAWAY SYSTEM

## The best way to meet AASHTO 1800 lb. vehicle change of velocity standards



In order to achieve compliance with AASHTO's safety standards for lighter vehicles, specify the advanced *Telespar Slip-Base Breakaway Assembly*. This unique system from Unistrut delivers precise, multi-direction breakaway capability utilizing long-lasting, reuseable components that are easy and economical to install.

The Telespar Slip-Base System provides the support strength needed for wind resistance yet it permits easy breakaway to assure driver safety and minimize vehicle damage upon impact.

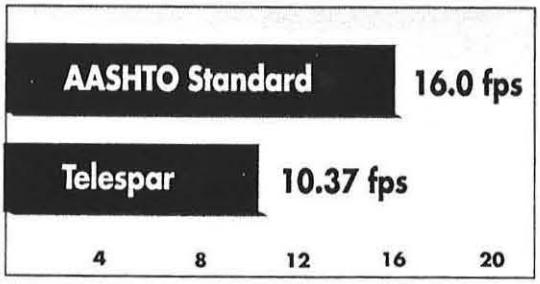


### *Meeting Your Needs*

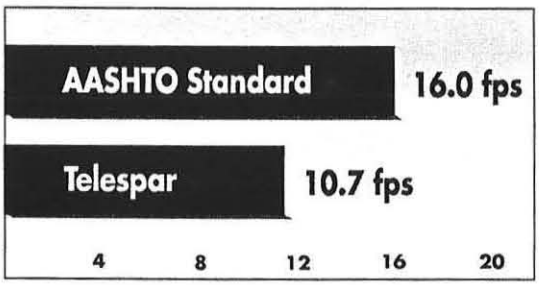
- Low cost and easy installation
- Rapid replacement after impact with low repair costs
- High recoverability and reuseability of components
- Long lasting performance
- Retrofit capabilities
- Uses all standard parts – requires no costly special hardware or installation procedures
- Achieves maximum performance upon impact without affecting the structural integrity of the installation
- Unique design allows 40 ft. lbs. of torque without altering slip performance
- For multiple or single post installations
- Works while impacted from any direction
- Crash tested for proven performance
- Acceptable for use on federal-aid highway projects
- Meets AASHTO standard structural and performance specifications and is accepted by FHWA
- Available in a full range of sizes and finishes

## Exceeding AASHTO Standards

The Telespar Slip-Base Breakaway Assembly far exceeded AASHTO small vehicle impact requirements in full-scale crash tests conducted at the Texas Transportation Institute. In both 20 mph and 60 mph tests, the Slip-Base Assembly performed magnificently and well within AASHTO guidelines. Anchor assemblies remained intact after impact suffering no deformation while sign posts and the test vehicle sustained only minor damage.



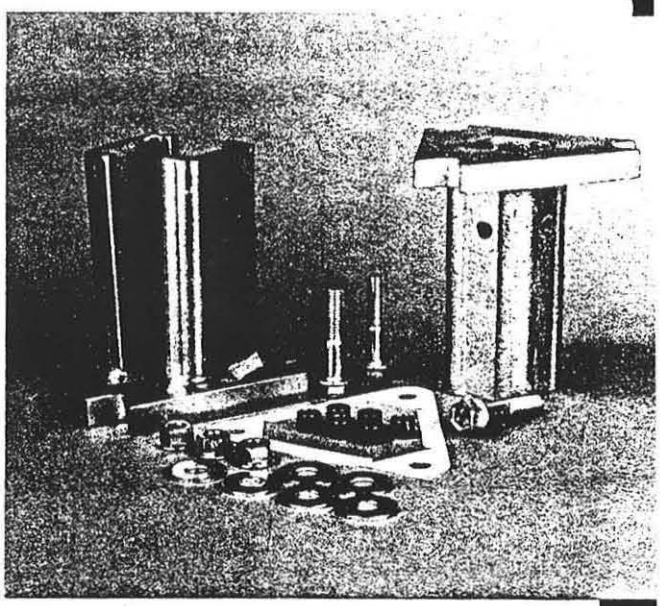

*Maximum Allowable Change in Velocity 20 MPH TEST*




*Maximum Allowable Change in Velocity 60 MPH TEST*

## Saving You Time and Money!

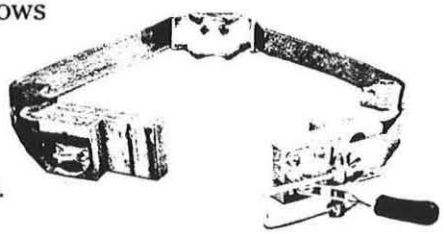
The Telespar Slip-Base Breakaway Assembly uses only standard components that are **low in cost and easy to assemble.** Unistrut offers a wide variety of sizes to address your specific needs. Assemblies are available for standard size or heavy duty applications.



*The Telespar Slip-Base Breakaway Assembly consists of the following: top subassembly, bottom subassembly, retainer gasket, flange head bolts, flange head hex nuts, flat washers, and release bushing.*

After impact, many of the Slip-Base Assembly parts are often recoverable and reuseable. Since hardware is offered in separate components, **you only replace the parts you need!**

Assembly tools are also available for accurate installation. A temporary *retainer clamp* allows for proper positioning of all components to achieve the maximum torque.



### For Further Information

Discover how the Telespar Sign Support System can meet all your sign support requirements. Your local Unistrut Service Center has information and trained representatives ready to assist you. Call today!

NOTE: For ordering information on the Telespar Slip-Base Breakaway Assembly, please refer to the *Telespar Post Anchor System brochure (TAS-1).*


Unistrut Corporation
35660 Clinton Street
Wayne, MI 48184
Phone: 800-521-7730
Fax: 313-721-4106

Unistrut Canada, Ltd.
585 Finley Avenue
Ajax, Ontario L1S 2E4
Phone: 416-683-8131
Fax: 416-683-8987

# Field Trials

***edited by Larry Flynn***

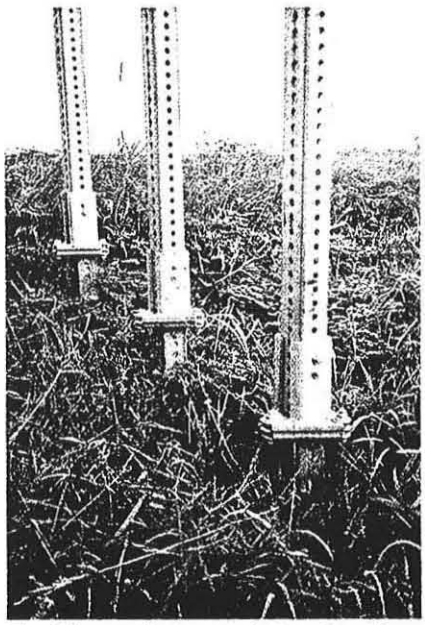
# Sign support breaks safely away when hit by lighter cars

The American Association of State Highway & Transportation Officials (AASHTO) standards for structural supports of highway signs require the sign post installation meet the new "change in velocity standard for 1800-lb vehicles." Directional sign posts along streets and highways have become a critical motorist safety issue in recent years. Many existing small sign-post installations will not meet the new AASHTO requirements when struck by new lighter weight cars.

Existing sign supports designed with multiple posts are employed to resist **heavy wind loads**, however they typically do not pass **change of velocity** requirements. Sign supports, which accommodate the change of velocity requirements, frequently do not withstand the wind load. State DOTs, frustrated with trying to meet the new standards, have searched for a system to accommodate the modifications necessary to make their sign supports legal.

The **Telespar slip base**, researched and developed at **Unistrut Corp.**, Ann Arbor, Mich., is a steel, modular, sign-support system in which the components are designed to breakaway upon impact to comply with AASHTO standards, and answer the call of state transportation departments. After review of crash tests conducted by the **Texas Transportation Institute** (TTI), the **Federal Highway Administration** has issued an acceptance letter based on satisfactory compliance to AASHTO requirements for sign supports.

The sign support system consists of a **breakaway assembly** where the lower component is anchored into the ground, utilizing a new or existing post anchor. The upper component holds the sign post. The components are separated by a teflon gasket which maintains a relatively low constant coefficient of friction. Stainless steel release bushings shield the connection bolts and ensure quick release upon impact. The following is the result of some of the testing done on the slip base.



*The Telespar slip base is designed to allow sign installation supports to safely slip from its stud-base mounts*

The sign installation used in these tests consisted of a 6 ft × 5 ft plywood sign panel mounted on three Unistrut posts. The lower slip-base components connected to Telespar post bases which were anchored in concrete footings at 21 in. on the center. Teflon gaskets were installed between components. The slip-base component assembly employed ½-in., grade-five flange bolts, flange nuts, and flat washers. The bottom of the sign was measured at 5 ft from the ground.

A **1979 Honda Civic** impacted the installation at 61.5 mph using a cable reverse tow and guidance system. Test inertia mass of the vehicle was 1800 lb and its gross static mass was 1967 lb. The height to the lower edge of the vehicle bumper was 14.5 in. and 19.5 in. to the top of the bumper.

The vehicle was free wheeling and unrestrained just prior to impact. The point of impact was the center line of the sign with the center of the vehicle. Upon impact, the sign installation supports began to slip from the stud-base mounts. At approximately 0.010 sec, the sign supports had completely detached from the slip bases. Shortly thereafter, as the sign installation yielded, the face of the sign slapped the roof of the test vehicle. The vehicle lost contact with the sign installation at approximately 0.173 sec, the brakes were applied and the vehicle came to rest approximately 306 ft from the point of impact.

In summary, **the sign installation yielded by releasing at the slip-base component connections**. The vehicle sustained very minor damage and did not present undue hazard to other traffic. The occupant impact velocity was acceptable (NCHRP report 230 limit is 15 fps) and the change in momentum was under the recommended limit of 1100 lb-s. The sign installation conformed to the evaluation criteria recommended in NCHRP Report 230 and AASHTO standards.

The test results suggest that even as standards are modified to accommodate even lighter weight cars, the support system will continue to meet the performance requirements. The slip-base assembly and sign-post installations are capable of satisfying the necessary wind loads, as well as the change of velocity requirements.

Structural capabilities of a typical sign support with a slip base provide over 700-lb wind load resistance while maintaining the required release performance at the slip-base connection. That is accomplished, in part, by the much higher allowable (40-50 ft-lb) torque used on the assembly bolts.□

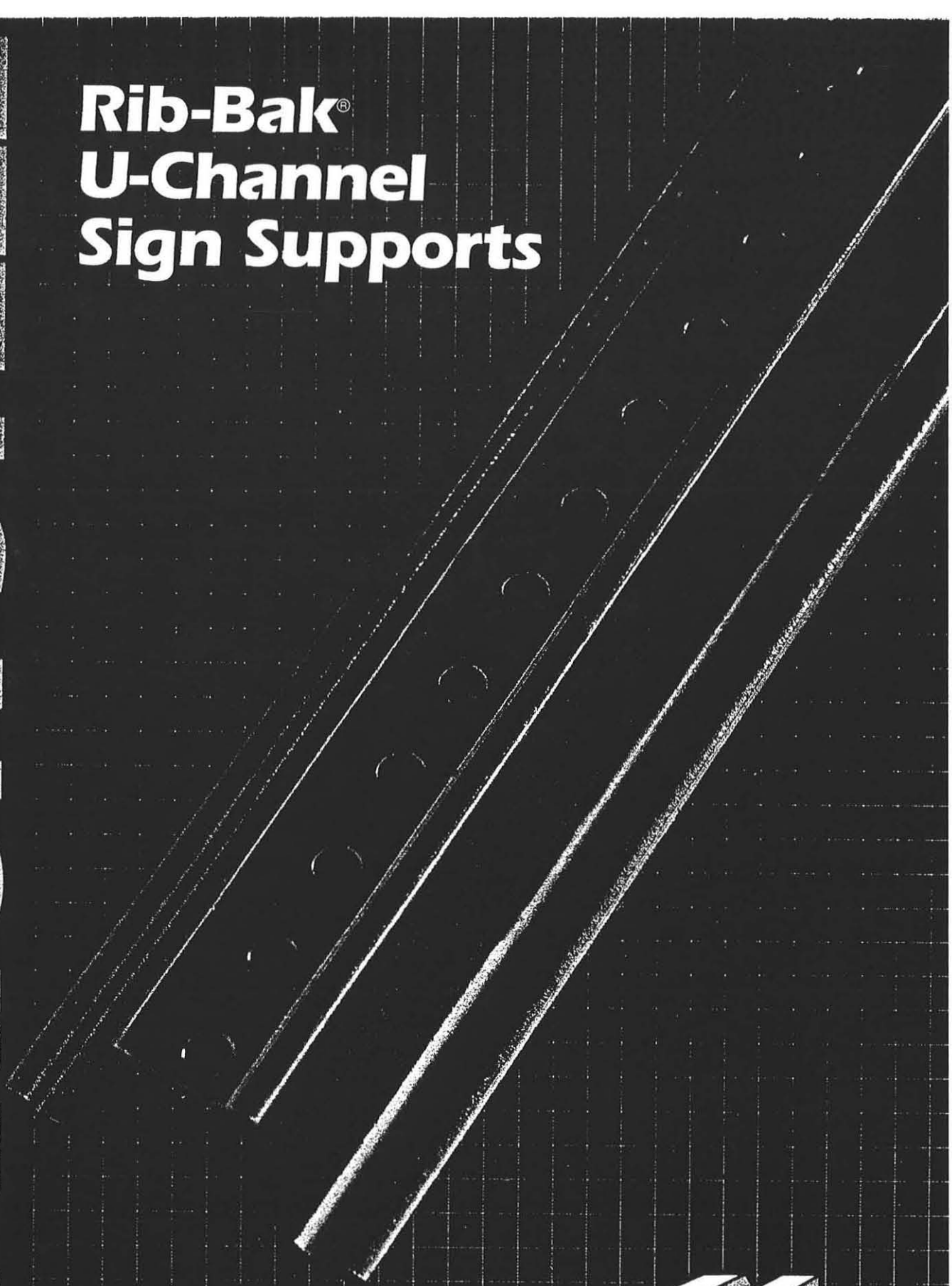
*For more information, contact Unistrut Corporation (313) 721-7224.*

# APPENDIX C

## The Marion Steel Company

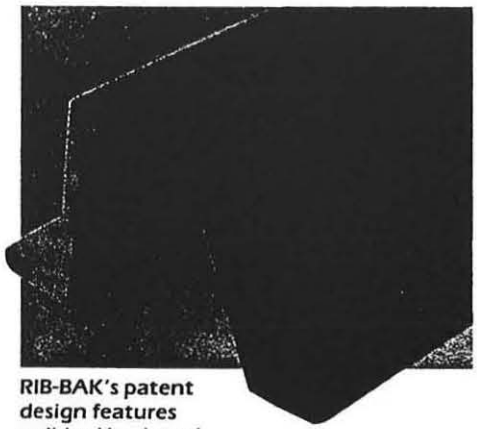
MARION STEEL

# Rib-Bak® U-Channel Sign Supports



# RIB-BAK® U-CHANNEL SIGN SUPPORTS

RIB-BAK U-Channel Sign Supports are approved by the Federal Highway Administration (FHWA) and the American Association of State Highway and Transportation Officials (AASHTO) for a wide variety of small sign support applications. These include permanent or temporary warning, regulatory, cable, guide and construction uses. A complete range of RIB-BAK sizes will support everything from the smallest signs on single posts to larger multiple post installations.



**RIB-BAK's patent design features a ribbed back and flange for extra strength.**

## FAST, EASY INSTALLATION

RIB-BAK installation is quick, easy and inexpensive... whichever method you choose to use. A trained crew, even a single person, can complete an installation in a few minutes. No post hole digging is required. The sign post or ground post is driven easily into even the hardest clay soils with conventional sledge hammers, hand or automatic drivers from ground level.

## ENGINEERED FOR ECONOMY

Marion Steel uses only the finest high-carbon new billet steel (Grade SP-80) in the manufacture of its standard U-channel supports. So RIB-BAK is more reliable than conventional U-channel sign supports made of old rail steel.

For even greater reliability, RIB-BAK's patented design features a ribbed back and flange. These ribs strengthen your posts at crucial load-bearing points, so RIB-BAK can handle even larger signs—saving you money.

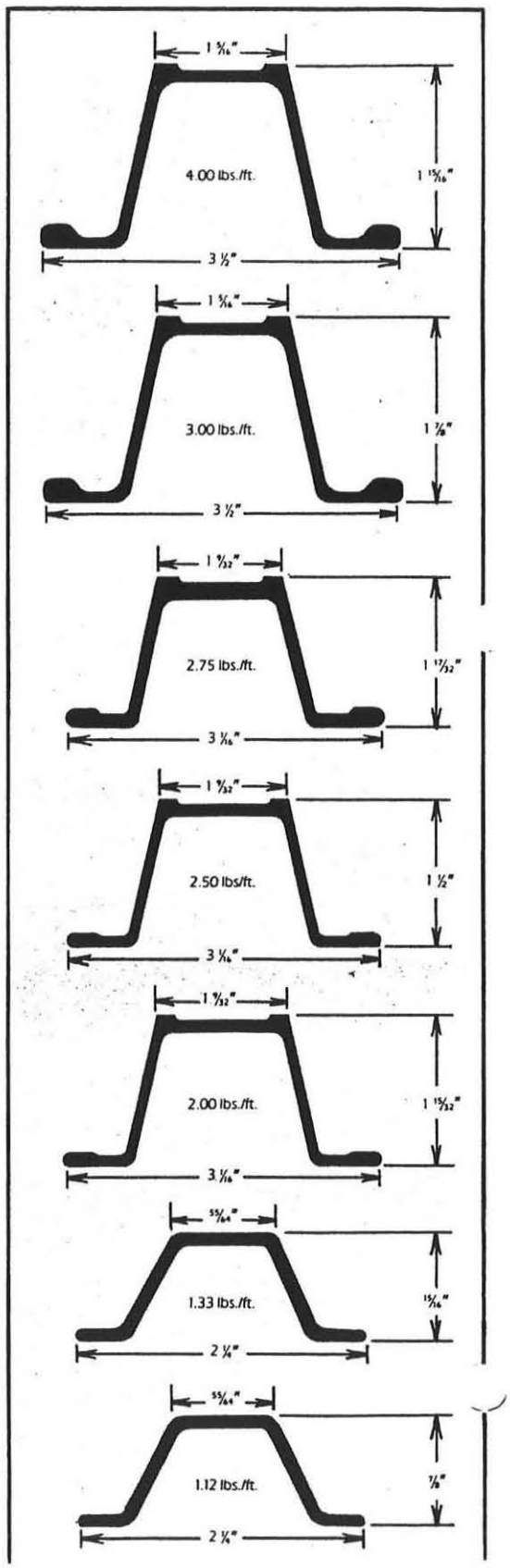
RIB-BAK's back ribs (contact points) are flush surfaces, giving you a solid, more permanent sign attachment. And there's no drilling necessary, because RIB-BAK comes with ⅜" holes the length of its post on one inch centers. RIB-BAK's side ribs also provide unmatched support for clip-type fasteners.

Marion Steel finishes its RIB-BAK sign supports for durability with your choice of electrostatic, baked on enamel, or hot dipped galvanizing, depending on application specifications.

## IN SIZES AND COLORS FOR ALL YOUR SIGNAGE NEEDS

Versatile RIB-BAK sign posts are available in seven sizes to accommodate nearly any signage requirement. These sizes are determined on a pounds-per-foot basis, and include: 1.12, 1.33, 2.00, 2.50, 2.75, 3.00 and 4.00 lbs./ft. versions. Sign-bearing dimensions are indicated in the next column.

RIB-BAK sign posts are available in six standard colors: green, orange, yellow, white, black or brown. Other colors are available upon request.



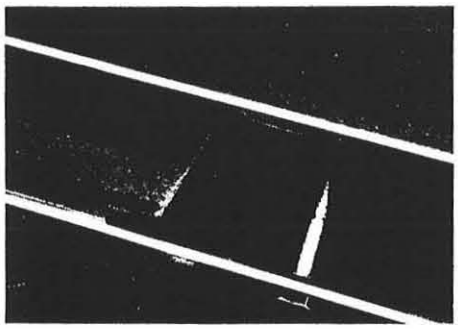
# RIB-BAK® SIGN POST SIZE RECOMMENDATIONS

The Federal Highway Administration's allowable sign areas for Marion Steel's RIB-BAK single sign support configurations are indicated in the table to the right for 70 mph wind pressures.

The AASHTO's "Standard Specifications For Structural Supports For Highway Signs, Luminaries And Traffic Signals" were used to determine wind pressures on the signs and the allowable bending stress on the posts. RIB-BAK's maximum allowable sign areas are given in the table below for post heights measured from the ground to the center of the sign for easy comparison to competitive posts.

## FHWA WIND PRESSURE TABLE FOR RIB-BAK

| Post size lbs./ft. | SIGN HEIGHT/70 MPH WIND PRESSURES | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 4' | 5' | 6' | 7' | 8' | 9' | 10' | 11' | 12' | 13' | 14' | 15' |
| 2.00 | 7.6 | 7.1 | 6.5 | 6.1 | 5.7 | 5.4 | 5.0 | 4.7 | 4.4 | 4.2 | 4.0 | 3.0 |
| 2.50 | 11.0 | 10.0 | 9.3 | 8.5 | 7.8 | 7.3 | 6.7 | 6.2 | 5.7 | 5.4 | 5.1 | 3.8 |
| 2.75 | 11.4 | 10.4 | 9.5 | 8.8 | 8.1 | 7.5 | 7.0 | 6.6 | 6.2 | 5.8 | 5.4 | 4.1 |
| 3.00 | 14.2 | 13.1 | 12.1 | 11.2 | 10.4 | 9.6 | 9.0 | 8.4 | 7.9 | 7.5 | 7.1 | 5.4 |
| 4.00 | 23.3 | 20.8 | 18.8 | 17.0 | 15.5 | 14.3 | 13.2 | 12.2 | 11.3 | 10.6 | 9.9 | 7.5 |



**Even back-to-back signs fit tight to RIB-BAK, so they resist wind loosening.**

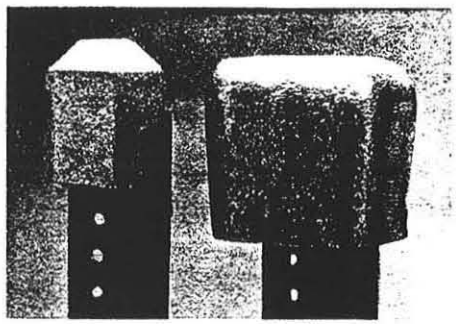

**Road sign brackets fit easily over RIB-BAK.**

# ACCESSORIES AND APPLICATIONS

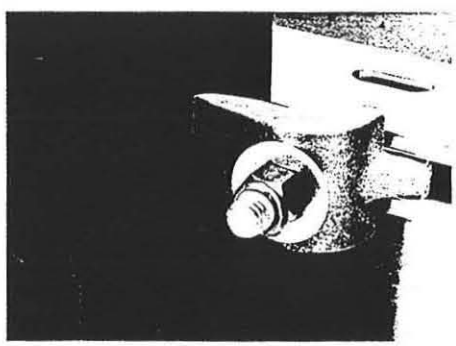
Marion Steel can make your installation even easier with an array of AISI 4140 Alloy Steel Casting drive caps for light or heavy-duty use. When only a limited number of posts are to be driven, a Junior Drive Cap (4 lbs.) is recommended. Their 3 ¾" x 2 ½" square dimensions fit all RIB-BAK sign posts.

Big Boy Drive Caps (17.3 lbs.) are for more durable use. Their 4¾" x 5¾" x 3 ½" dimensions actually protect the top end of all RIB-BAK post sizes when driven by a sledge or automatic drive.

RIB-BAK's patented U-channel design makes it easy to install road signs using cast aluminum slotted brackets. Channel locks provide another sign-bearing option. With clip fastened, the interlocking flange ribs work together with channel lock clips to provide a positive grip, structural rigidity and strength. Even back-to-back signs are easy to install on RIB-BAK posts. Bearing surfaces on each face provide stable support.



**Junior Drive CAP – Big Boy Drive Cap**



**Channel lock clips fasten tightly to RIB-BAK's flange design.**

# SPECIFICATIONS

Patents 2950787 and 3312034
All Steel Channel Sign Posts (drive type) manufactured by Marion Steel Company are:

## PRODUCED FROM

- Electric furnace "New Billet Steel."
- Chemistry to SP-80 (ASTM A 1-91#Rail Minimum.

## MOUNTING HOLES

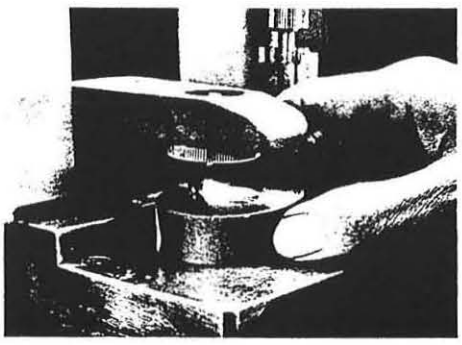
- ⅜" diameter, on 1" centers.
- Begin 1" from top of post.
- Other punching requirements upon request.

## LENGTH

- Painted 2, 2½, 2¾, 3 and 4 pound post 4' to 16'
- Galvanized lengths per request.
- Tapered ends upon request.

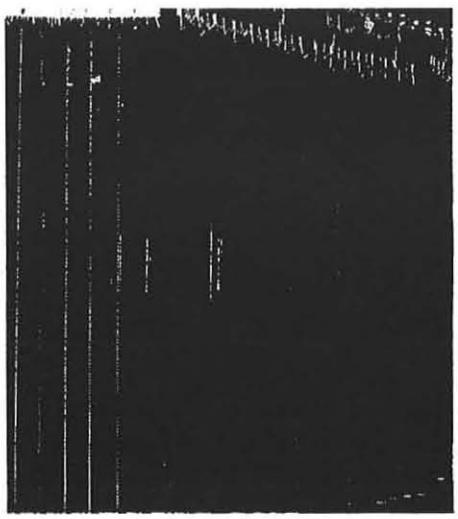
## CERTIFIED TO

- SP-80: 100,000 PSI min. tensile, 80,000 PSI min. yield.
- Other specifications produced upon request.



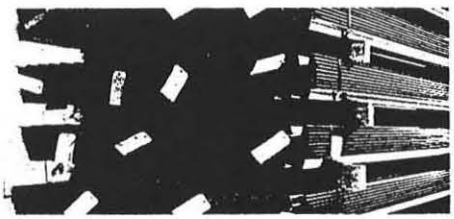
## FINISH

- Green, orange, yellow, white, black or brown baked on alkyd resin, gloss enamel paint, or hot-dipped galvanized to ASTM A 123.
- Other colors available upon request.



## PACKAGING

- All painted posts are nested & stacked in master bundles of 50.
- Galvanized post are packaged in round bundles of 100.
- Custom packaging available upon request.



## TOLERANCES

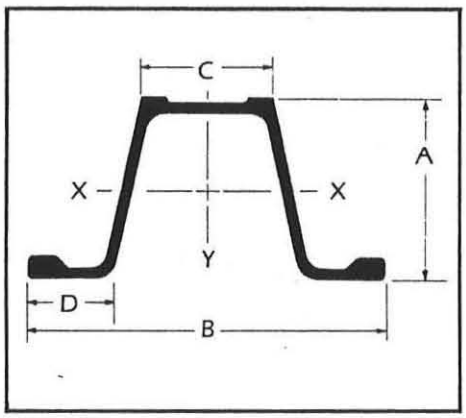
- Weight before punching, plus or minus 5%.
- Shearing, plus or minus 1"
- Other tolerances produced upon request.


**MARION STEEL CO.**
912 Cheney Avenue
Marion, Ohio 43302
Telephone: 614/383-4011
1-800-333-4011


Marion Steel Company is the sole licensee of the Minute Man Breakaway Sign Post System in the U.S.A.

## GREATER SIGN CARRYING CAPABILITY.

The Marion Steel LAP SPLICE system securely nests a RIB-BAK U-channel ground post and top post together, forming a union as strong as the posts themselves. And because Marion Steel RIB-BAK signposts are designed with superior properties built in, the LAP SPLICE system gives you the capability to carry larger signs.




## RIB-BAK U-CHANNEL PROPERTIES

| Weight *lbs/ft. | DIMENSIONS | | | | AREA $IN^2$ | X-X AXIS** | | Y-Y AXIS | |
|---|---|---|---|---|---|---|---|---|---|
| | "A" | "B" | "C" | "D" | | $I(IN^4)$ | $S(IN^3)$ | $I(IN^4)$ | $S(IN^3)$ |
| 2.00 | 1.508 | 3.028 | 1.304 | .634 | .650 | .197 | .258 | .470 | .311 |
| 2.50 | 1.523 | 3.124 | 1.305 | .722 | .795 | .248 | .313 | .600 | .384 |
| 2.75 | 1.554 | 3.101 | 1.288 | .667 | .864 | .270 | .335 | .668 | .431 |
| 3.00 | 1.903 | 3.380 | 1.326 | .725 | .968 | .453 | .447 | .900 | .533 |
| 4.00 | 1.979 | 3.377 | 1.340 | .752 | 1.252 | .625 | .596 | 1.145 | .678 |

*+ or $-3\frac{1}{2}\%$
**Governing section

## WHATEVER YOUR BREAKAWAY SMALL SIGN SUPPORT NEEDS, MARION STEEL HAS YOUR ANSWER.

The LAP SPLICE system joins the Marion Steel RIB-BAK and MINUTE MAN® breakaway system to offer you a family of U-channel breakaway systems that meet or exceed the latest FHWA guidelines, incorporating NCHRP 350. Marion Steel also offers a complete line of sign installation accessories and signpost driving equipment. So for answers to all of your small sign support needs, call Marion Steel today.

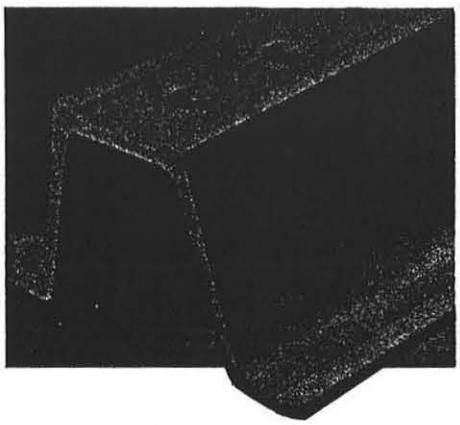
## RIB-BAK POSTS ARE ENGINEERED FOR ECONOMY AND LONG LIFE.

Marion Steel uses only the finest high-carbon new billet steel (Grade SP-80) in the manufacture of its standard U-channel supports. So RIB-BAK is more reliable than conventional U-channel sign supports made of old rail steel.

For even greater reliability, RIB-BAK's patented design features a ribbed back and flange. These ribs strengthen your posts at crucial load-bearing points, so RIB-BAK can handle even larger signs — saving you money.

RIB-BAK's back ribs (contact points) are flush surfaces, giving you a solid, more permanent sign attachment. And there's no drilling necessary, because RIB-BAK comes with 3/8" holes the length of its post on one inch centers. RIB-BAK's flange ribs also provide unmatched support for clip-type fasteners.

Marion Steel finishes its RIB-BAK sign supports for durability with your choice of electrostatic, baked-on enamel, or hot dipped galvanizing, depending on application specifications.

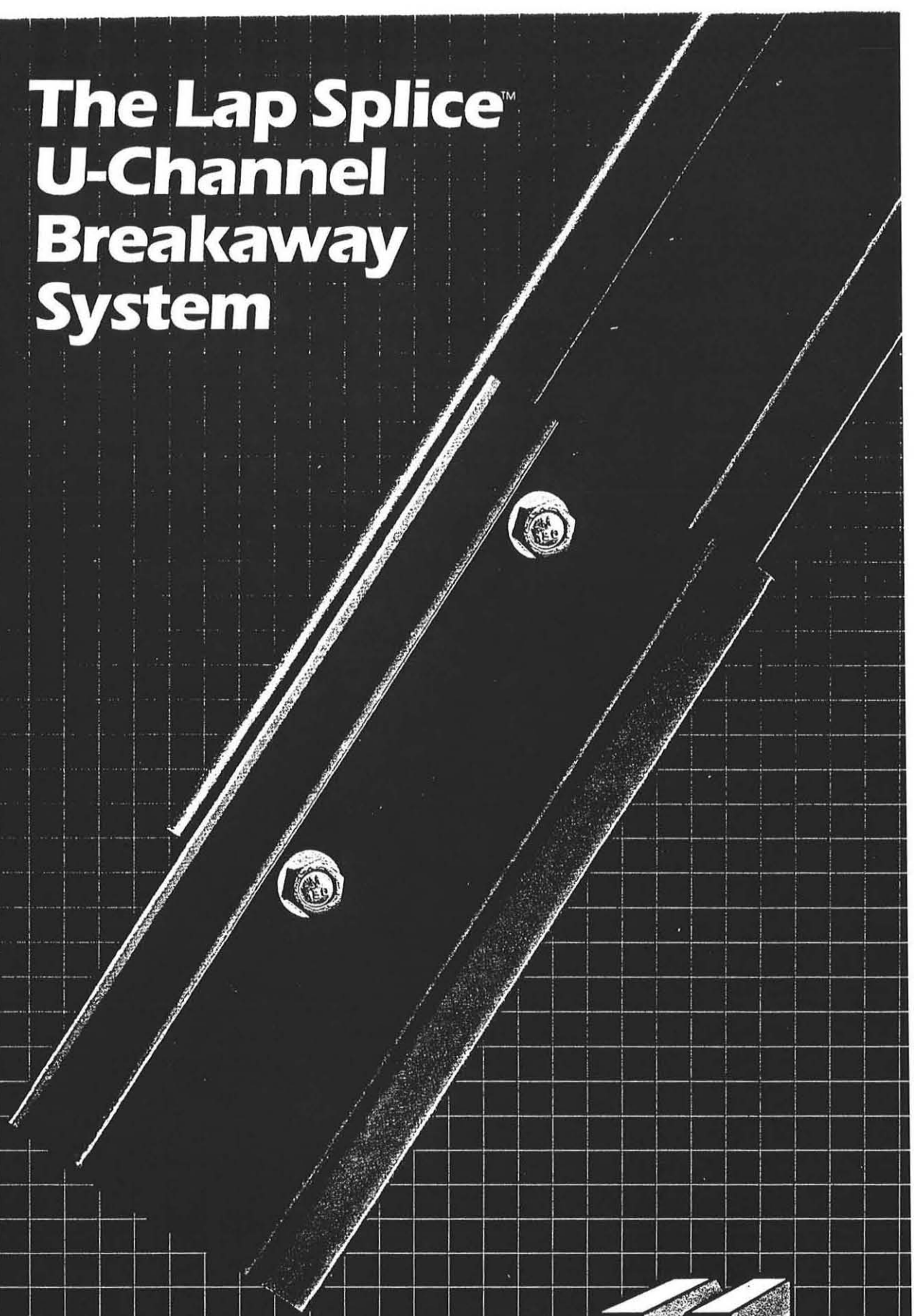


**RIB-BAK's patented design features a ribbed back and flange for extra strength.**


**MARION STEEL CO.**
**912 Cheney Avenue**
**Marion, Ohio 43302**
**Telephone: 614/383-4011**
**1-800-333-4011**

MARION STEEL

# The Lap Splice™ U-Channel Breakaway System



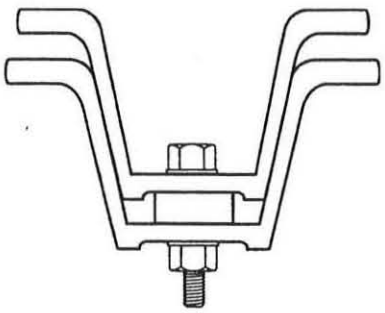
# LAP SPLICE: THE RIB-BAK® U-CHANNEL BREAKAWAY SYSTEM MADE EASY.

The FHWA-approved Marion Steel LAP SPLICE system is designed to give you an easy-to-install ground-mounted, bolted-base breakaway system for any size SP-80 RIB-BAK U-channel, up to 4 lb. posts. And, at a cost that is remarkably less than competitive breakaway systems.

## THE SYSTEM IS DESIGNED WITH SAFETY AND ECONOMY IN MIND.

Safety is a key factor in the LAP SPLICE system. Because the system utilizes a short RIB-BAK base post, it can easily be driven into even the hardest clay soils from ground level with manual or power tools, in just minutes. Nesting and bolting the LAP SPLICE system takes just minutes, too — so altogether your installation crew spends less time by the side of the road, reducing their exposure to traffic-related injury.

The economy of the LAP SPLICE system is by design. Just two special bolts and a bar spacer are needed to join the top post to the base post .



**The LAP SPLICE system securely nests RIB-BAK U-channel together, forming a union as strong as the posts themselves.**

## CRASH TESTED AND APPROVED.

FHWA and AASHTO-approved, the Marion Steel LAP SPLICE system has been tested for multiple post installations, up to three 4 lb. per foot signposts within a seven-foot span in both strong and weak soils.

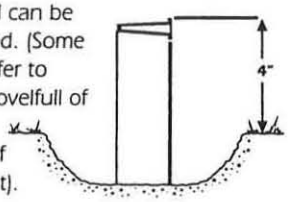
| BAR SPACER SIZE CHART | | |
|---|---|---|
| Post Size lbs./ft. | Bar Color | Bar Size |
| 2 & 2.5 | Silver | 3/8" thick 5" long |
| 3 & 4 | Gold | 1/2" thick 5" long |

## WHATEVER YOUR BREAKAWAY SMALL SIGN SUPPORT NEEDS, MARION STEEL HAS YOUR ANSWER.

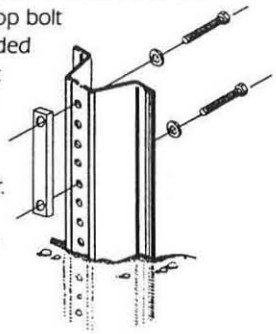
The LAP SPLICE system proudly joins the family of Marion Steel sign support systems, after successfully meeting the rigors of NCHRP 350 testing. Marion Steel also offers a complete line of sign installation accessories and signpost driving equipment. So for answers to all of your small sign support needs, call Marion Steel today.


**MARION STEEL**
912 Cheney Avenue
Marion, Ohio 43302
Telephone: 614/383-4011
1-800-333-4011

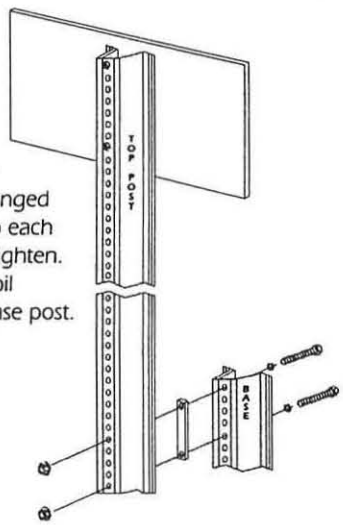

1. Drive base post so that no more than 4" is above the ground. Remove enough soil around base so that the fifth hole is exposed and can be easily reached. (Some installers prefer to remove a shovelfull of soil prior to installation of the base post).

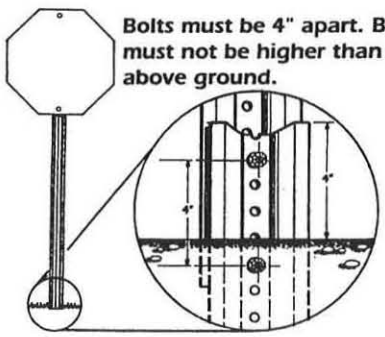



2. Put flat washer on bolt and insert into top hole of base post. (If first hole on top post is less than 1" from end, use second hole) Thread top bolt through threaded spacer bar. Put flat washer on second bolt and thread into spacer bar. Tighten both bolts in spacer securely.



3. Nest the bottom hole of the top post onto the bottom hole of protruding bolts of the base post. (If the bottom hole of the top post is less than 1" from the end of the post use the second hole.) Place self-locking flanged nuts on to each bolt and tighten. Replace soil around base post.



**Bolts must be 4" apart. Base post must not be higher than 4" above ground.**

MARION STEEL

# The Slip Safe™ Reusable Slip Base System

# SLIP SAFE™: THE REUSABLE SLIP BASE SYSTEM.

## MEETS SPECIFICATIONS FOR BOTH LARGE AND SMALL SIGN SUPPORTS.

We've designed the SLIP SAFE™ slip base system to meet all of your sign support needs. Assembled back-to-back, SLIP SAFE can handle signage up to 110 square feet using three 6 kg/m (4 lbs/ft) RIB-BAK U-channel posts within a 2.1m (7ft) span. The single-post system, configured the same way, can manage signage up to 50 square feet.

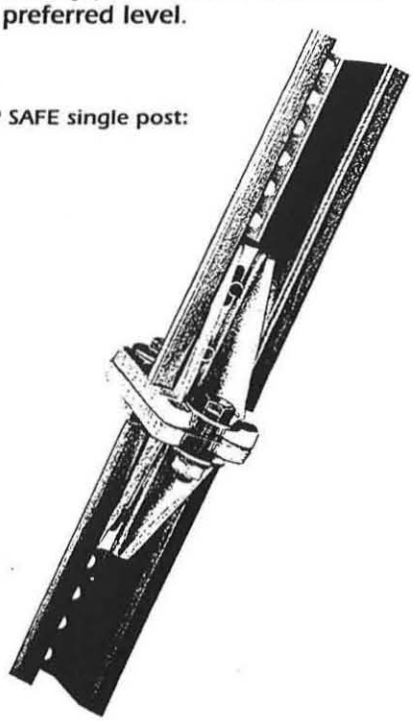
## THE SAFEST, MOST ADVANCED SIGN SUPPORT AVAILABLE.

Developed by engineers at the Texas Transportation Institute, the SLIP SAFE System is the only true 360 degree U-channel breakaway system with advanced safety and reusability components built in. In most cases, the base post, attachment hardware, casting, and top post are reusable... stub repair is unnecessary.

## CRASH TESTED AND APPROVED.

SLIP SAFE also exceeds crash impact standards by more than 200%. NCHRP 350 criteria for occupant impact velocity has established a maximum of 5 meters per second, with 3 meters per second preferred. In field tests, the SLIP SAFE consistently performed at **one-half of the preferred level**.

**SLIP SAFE single post:**



## EASY TO INSTALL.

SLIP SAFE can be installed quickly and easily because it doesn't require the concrete necessary for a large sign support system, and the base is a direct drive unit requiring only conventional power tools. In most cases, the entire system is reusable including the base post, attachment hardware, casting and top post. Stub repair is unnecessary.

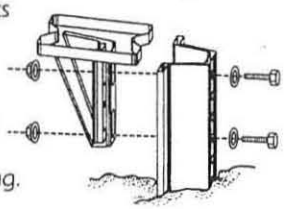
**In the past, impact at 60 mph posed serious injury to vehicle occupants. Here, tests on Marion Steel's new SLIP SAFE breakaway system at TTI result in only superficial damage to the 1989 Ford Festiva.**

**PICTURED ON FRONT:**

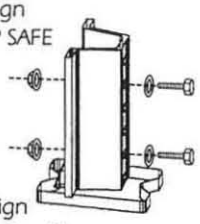
**The SLIP SAFE back-to-back post**


**MARION STEEL**
912 Cheney Avenue
Marion, Ohio 43302
Telephone: 614/383-4011
1-800-333-4011


1. Drive a 1.1 m (3.5 ft) base post in the ground so that no more than 100 mm (4") is above ground level. Nest casting into top of post. Insert two 8 mm x 40 mm SLIP SAFE socket-head attachment bolts with flat washers through the post. Place the nuts on the inside of the casting. Tighten the bolts using the turn-of-the-bolt method. The bolts should be tightened ½ to ¾ turn after snug.

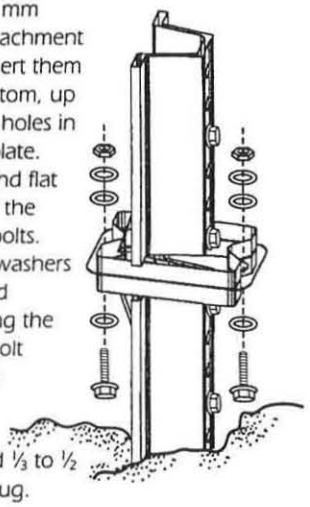


2. Attach casting to top post using two 8 mm x 40 mm SLIP SAFE socket-head attachment bolts with flat washer through casting and post. (Note: If top post will be used with a street sign bracket, attach the SLIP SAFE casting into the opposite end of the top post where the first hole is 25 mm (1") from end. This will ensure that the street sign casting will align correctly with the holes in the top post.) Attach the second casting to top post in same manner.



3. Place keeper plate on top of the base post SLIP SAFE casting with keeper plate holes aligned to v-notches in casting.

4. Position SLIP SAFE top post with attached casting over the keeper plate and base posts SLIP SAFE casting so that both SLIP SAFE castings align. Place a flat washer on the two 13 mm x 55 mm SLIP SAFE attachment bolts and insert them from the bottom, up through the holes in the keeper plate. Place a second flat washer over the protruding bolts. Put on lock washers and nuts and tighten. Using the turn-of-the-bolt method, the attachment nuts should be tightened ⅓ to ½ turn after snug.

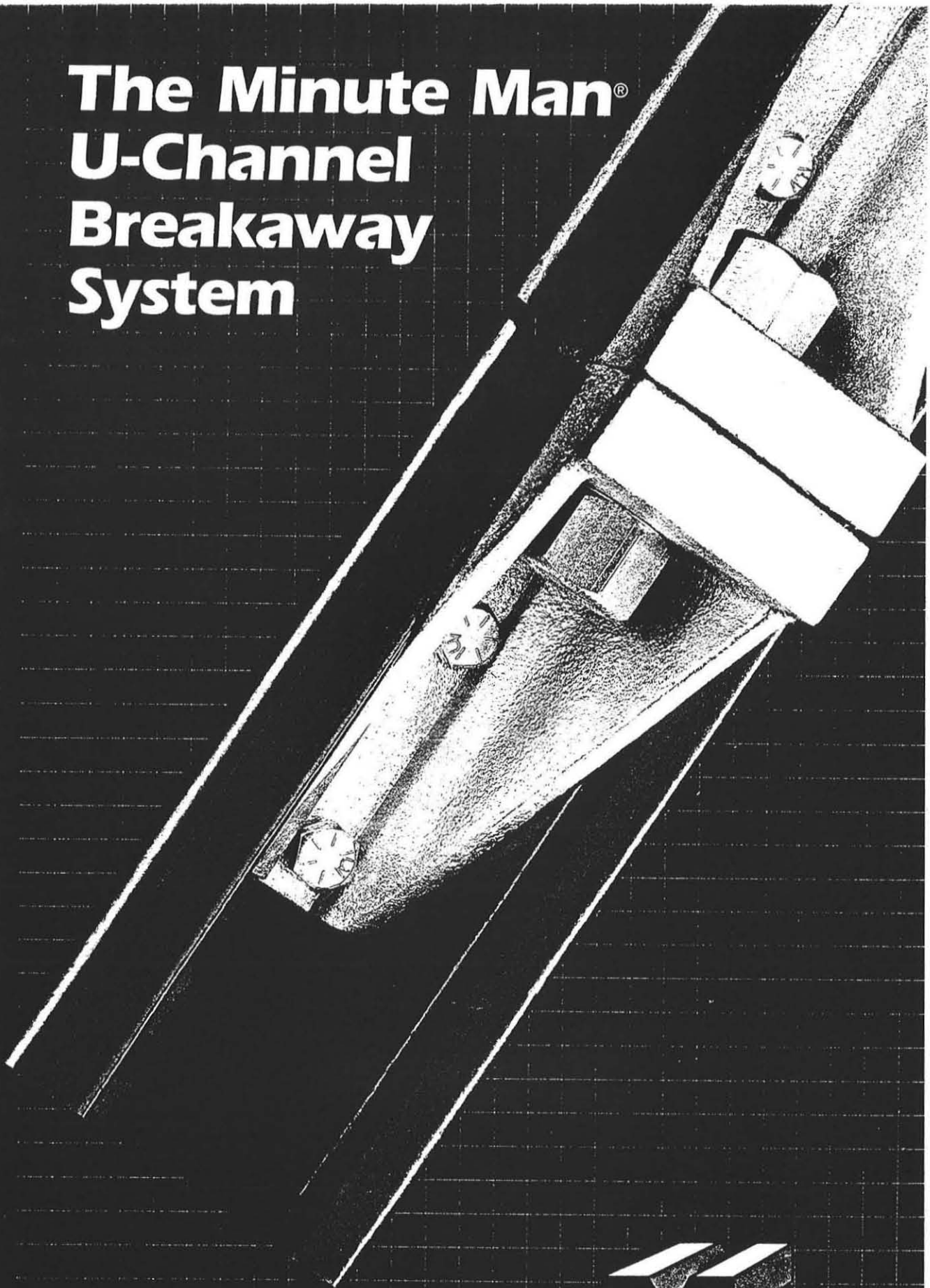


**Note: If installing the posts in soft soil (S2), use a 1.5 m (5 ft) base post with a 14" square soil plate.**

**Back-to-Back Note: Prior to Step 1, it is necessary to stitch-bolt the back-to-back base post and top post on 450 mm (18") centers.**

MARION STEEL

# The Minute Man® U-Channel Breakaway System



# HOW THE MINUTE MAN® SYSTEM BREAKS AWAY FROM THE FIELD

Replacing knocked-down signs will always be a never-ending job. Fact is, over half of the signposts purchased annually are used to reinstall a sign after a traffic mishap. Most signs will eventually be hit, costing substantial dollars in time and materials. Until now.

## MINUTE MAN...THE SYSTEM FOR LONG-TERM SAVINGS

Marion Steel offers the industry's only true 360° U-channel safety breakaway system specifically engineered to save you time and money for the long-run maintenance of your signpost program. By our calculations, reinstallation of the MINUTE MAN system is typically 50% less than the original installation. That's because you normally won't have to replace the base, so you won't have to spend as much time repairing or reinstalling the sign. One man can reinstall a downed sign in a third of the normal installation time, a safety factor that also saves you money. Now, and in the future.

## MEET THE MINUTE MAN

The MINUTE MAN consists of two pieces of alloy cast steel (ASTM A536 Gr. 80) which fit into a MINUTE MAN U-channel. These couplers are bolted to a 3½-foot, 4-pound MINUTE MAN ground post and a MINUTE MAN upright signpost; then connected by a shear pin. It is erected — and even repaired quickly and easily — by one man in less than 10 minutes using the same basic equipment used to install conventional signposts: sledges, power jackhammers, gasoline or pneumatic power drill/breakers. On-site time can be further reduced if the unit is preassembled in-shop. And in the field, there's no need for ladders, cranes or cherry pickers...so your costs are even less.

## THE INDUSTRY'S ONLY TRUE 360° U-CHANNEL BREAKAWAY SYSTEM

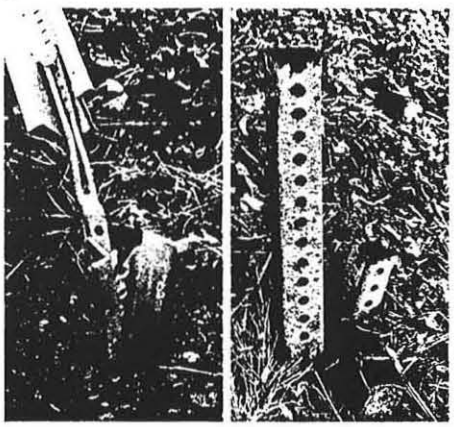
Other "breakaway" signposts are good only when hit head-on at low speeds – an unlikely combination in real life.

The MINUTE MAN, however, has been designed to leave a reusable ground post after impact from any direction, making it the industry's only true breakaway system. In fact, field tests demonstrate that the MINUTE MAN ground post can be reused up to 11 times before it may need to be replaced.

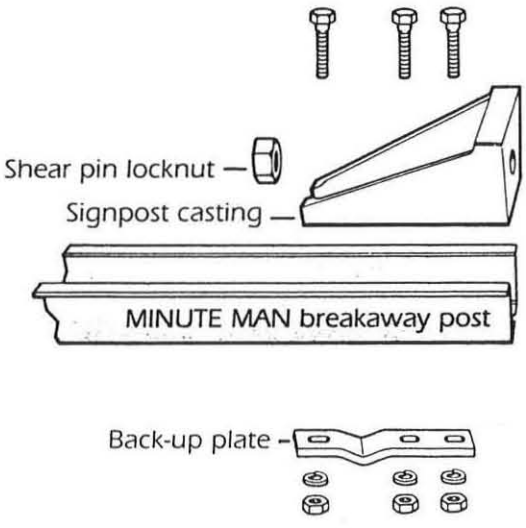
When impact occurs from the side on other "breakaway" signposts, the ground post is wrenched sideways and is often not reusable. The MINUTE MAN's ground post, however, is left intact after being hit from any side. Immediately upon impact, the pin connecting the system's two couplers shears, separating the top post from the ground post, which is left ready to use again.

**Field tests demonstrate that the MINUTE MAN ground post can be reused up to 11 times before it may need to be replaced.**

Finally, considering sign supports account for 26% of a sign's total cost, installation for 27%, and removal or repair for 4%, it's easy to see how using the MINUTE MAN will reduce your costs in all three areas.

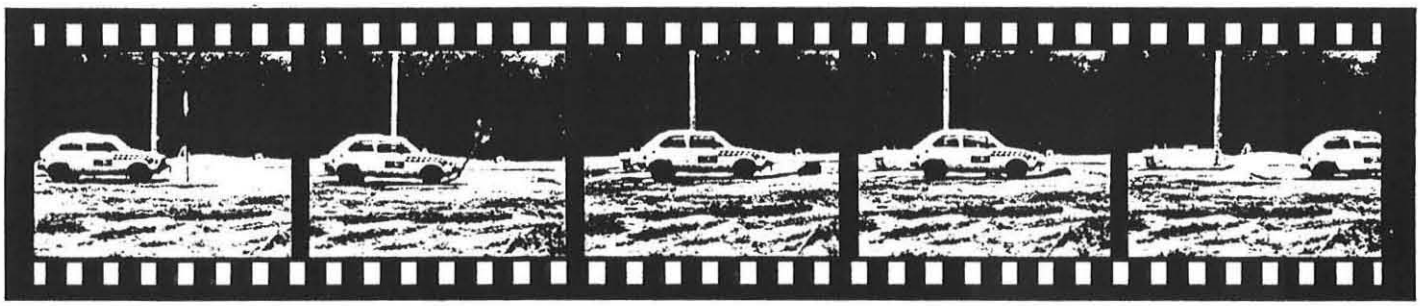


**Other "breakaway" systems are often not reusable after impact.**




### FHWA WIND PRESSURE TABLE FOR RIB-BAK WITH MINUTE MAN BREAKAWAY SYSTEM

| MAXIMUM SIGN AREAS AT 70 MPH WIND PRESSURES | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SIGN HEIGHT IN FEET | | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| SIGN AREA BY SQ. FT. | 1 POST | 11.9 | 10.8 | 9.8 | 8.9 | 8.3 | 7.6 | 7.1 | 6.6 | 6.2 | 5.8 | 4.4 |
| | 2 POSTS | 42.3 | 35.3 | 30.2 | 26.6 | 23.6 | 21.3 | 19.3 | 17.7 | 16.3 | 15.2 | 11.3 |



**The MINUTE MAN system meets all FHWA and AASHTO safety requirements. It yields the right-of-way to vehicles traveling at moderate speeds without altering trajectory.**

## HOW TO INSTALL SUPERIOR SAFETY

The MINUTE MAN is easily installed by one person, following these recommended steps:

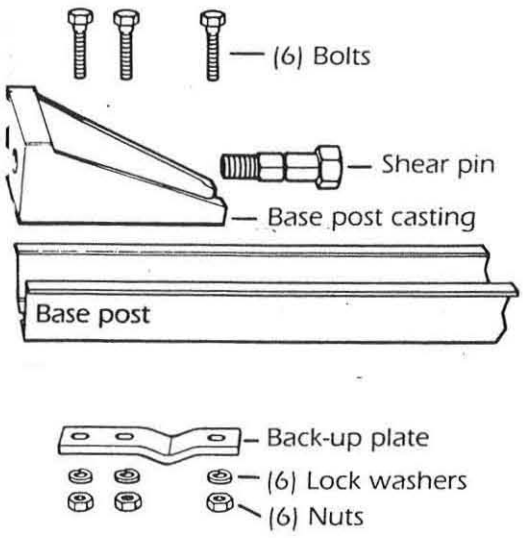
**STEP ONE:** In the convenience of your shop, simply bolt the couplers to both the MINUTE MAN ground post and accompanying sign support, using back-up plates for reinforcement.

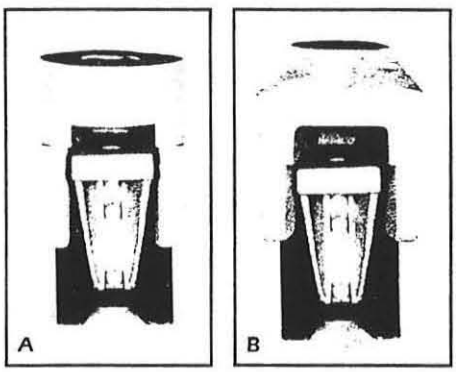
**STEP TWO:** Drive the ground post into the ground, until only three inches remain above ground (one inch of bottom coupler is buried).

**STEP THREE:** One person can then raise the sign and connect the MINUTE MAN's top and bottom sections by inserting the shear pin (often a two-person task with other systems). To finish, simply tighten shear pin bolt. Note: This pin will support the upright signpost by itself until bolt is tightened.

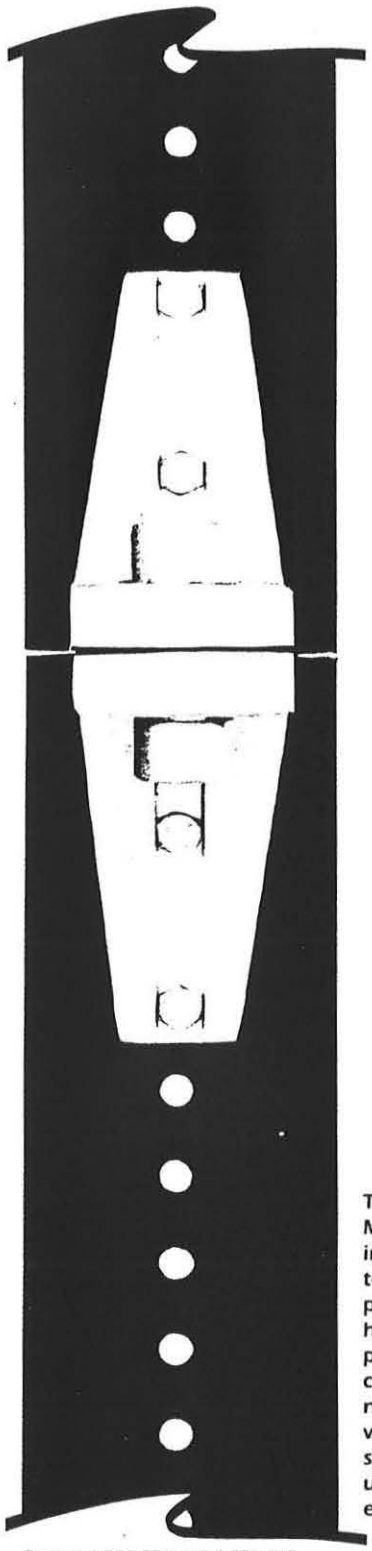
## ADOPT THE MINUTE MAN SYSTEM TO REDUCE YOUR FUTURE SIGNPOST COSTS.

When you replace a sign, chances are it's in a high-impact area, and that's the time to convert to the MINUTE MAN system. Installing the MINUTE MAN...even in concrete...is fast and easy. Reinstalling the system is where your future savings will make a big impact. But you have to start now to save money later.




**A) The MINUTE MAN Mechanical Drive Head fits virtually all hydraulic, air, electric and gas jackhammers. B) The MINUTE MAN Drive Cap is designed specifically to easily sledgehammer drive base post with MINUTE MAN coupler attached.**



**The MINUTE MAN system includes the top post, base post and all hardware. All performance claims are negated when the system is not used in its entirety.**

Patents 4,858,876 and 4,850,565

## THE MINUTE MAN SYSTEM USES RIB-BAK® POSTS FOR GREATER SIGN-CARRYING CAPABILITY.

The Marion Steel MINUTE MAN system utilizes **only** Marion Steel RIB-BAK U-channel ground posts and top posts. **The system cannot be warranted if any other post is used.** Marion Steel RIB-BAK sign-posts are designed with superior properties built in, so the MINUTE MAN system gives you the capability to carry larger signs than standard steel posts.

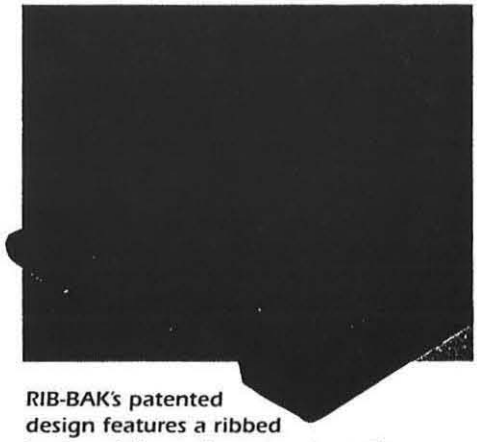
## MINUTE MAN POSTS ARE ENGINEERED FOR ECONOMY AND LONG LIFE.

Marion Steel uses only the finest high-carbon new billet steel (Grade SP-80) in the manufacture of its standard U-channel supports. They are more reliable than conventional U-channel sign supports made of old rail steel.

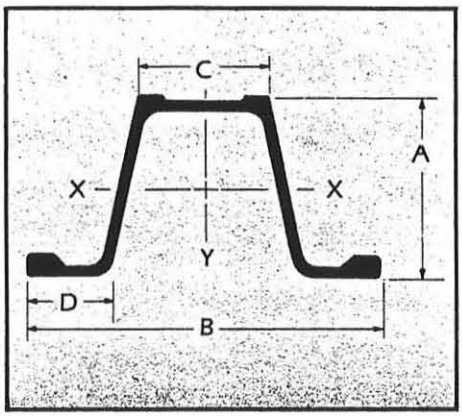
For even greater reliability, Marion Steel's patented design features a ribbed back and flange. These ribs strengthen your posts at crucial load-bearing points, so Marion Steel's RIB-BAK can handle even larger signs — saving you money.

RIB-BAK's back ribs (contact points) are flush surfaces, giving you a solid, more permanent sign attachment. There's no drilling necessary, because RIB-BAK comes with 3/8" holes the length of its post on one-inch centers. RIB-BAK's side ribs also provide unmatched support for clip-type fasteners.

Marion Steel finishes its RIB-BAK sign supports for durability with your choice of electrostatic, baked-on enamel, or hot-dipped galvanizing, depending on application specifications.



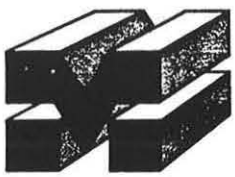
**RIB-BAK's patented design features a ribbed back and flange for extra strength.**




### RIB-BAK U-CHANNEL PROPERTIES

| Weight *lbs/ft. | DIMENSIONS | | | | AREA IN² | X-X AXIS** | | Y-Y AXIS | |
|---|---|---|---|---|---|---|---|---|---|
| | "A" | "B" | "C" | "D" | | I(IN⁴) | S(IN³) | I(IN⁴) | S(IN³) |
| 2.00 | 1.508 | 3.028 | 1.304 | .634 | .650 | .197 | .258 | .470 | .311 |
| 2.50 | 1.523 | 3.124 | 1.305 | .722 | .795 | .248 | .313 | .600 | .384 |
| 2.75 | 1.554 | 3.101 | 1.288 | .667 | .864 | .270 | .335 | .668 | .431 |
| 3.00 | 1.903 | 3.380 | 1.326 | .725 | .968 | .453 | .447 | .900 | .533 |
| 4.00 | 1.979 | 3.377 | 1.340 | .752 | 1.252 | .625 | .596 | 1.145 | .678 |

*+ or −3½%
**Governing section




**MARION STEEL CO.**
912 Cheney Avenue
Marion, Ohio 43302
Telephone: 614/383-4011
1-800-333-4011

# APPENDIX D

## Southwestern Pipe, Inc.

Type 1 and Type 2
Small Sign
Support Systems

# POZ-LOC™

## Sign Post Anchor System

FHWA APPROVED


QUICKLY INSTALLED
*WITHOUT Digging!*
*WITHOUT Concrete!*
*WITHOUT Nuts & Bolts!*
*WITHOUT Threading!*

EASILY REUSED
COST EFFECTIVE

**The POZ-LOC™ socket system offers the simplest, most cost effective sign post installation available today. It is installed flush with the ground, which prevents damage to the socket system and the vehicle upon impact.**

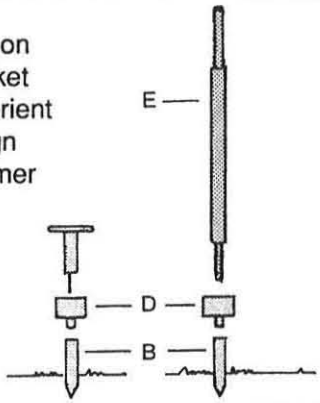
**The unique POZ-LOC™ wedge design discourages vandalism.**

**POZ-LOC™ is the sign post anchoring system that is easiest to install and the simplest to reuse.**

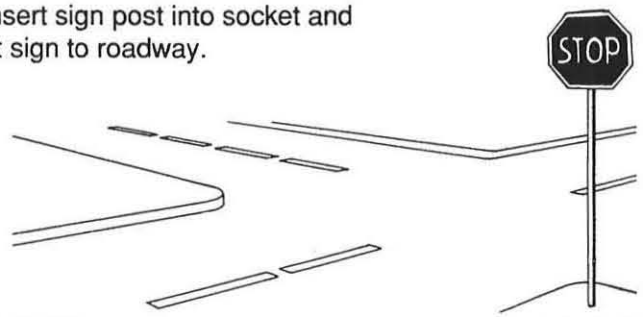
TYPE 1 (1 post) and TYPE 2 (2 post) Small Sign Support Systems

## INSTALLATION OF POZ-LOC™ ANCHOR SYSTEM

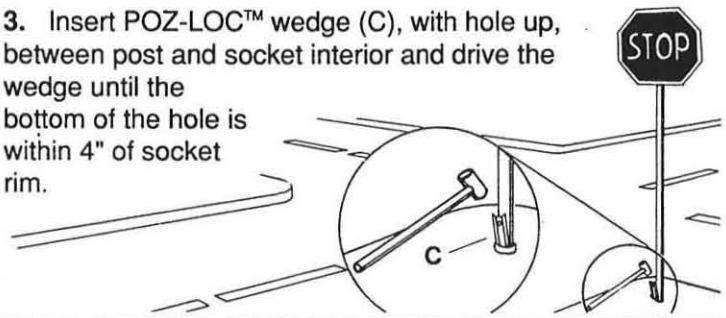
**1.** With drive cap (D) in place on end of POZ-LOC™ tubular socket (B), drive socket into ground (orient flat end of socket parallel to sign face) using a mechanical hammer or a socket driver (E).




**2.** Insert sign post into socket and orient sign to roadway.



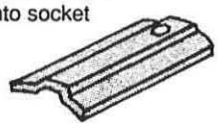

**3.** Insert POZ-LOC™ wedge (C), with hole up, between post and socket interior and drive the wedge until the bottom of the hole is within 4" of socket rim.



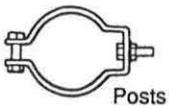

## COMPONENTS OF THE POZ-LOC™ SIGN POST ANCHOR SYSTEM

A. **TRAFFIC POST.** Galvanized 2⅜" O.D. traffic post available in several wall thicknesses

C. **WEDGE.** Locks traffic post into socket



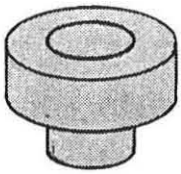
B. **TUBULAR SOCKET.** 2⅞" O.D. X 12 GA wall thickness X 27" long



Posts may be ordered with sign brackets or with pre-punched 12-hole pattern

TOOLS AVAILABLE WITH POZ-LOC™ ANCHOR SYSTEM

E. **SOCKET DRIVER**



D. **DRIVE CAP**

F. **WEDGE PULLER**

## RE-USE OF POZ-LOC™ ANCHOR SYSTEM

1. Insert wedge puller into hole in wedge (C) and remove wedge from post and socket.
2. Follow instructions 2 and 3 under INSTALLATION above.

## ORDERING INFORMATION

### POZ-LOC™ TOTAL SOCKET SYSTEM ASSEMBLY

| DESCRIPTION | PART NO. | WT. (LBS) |
|---|---|---|
| Socket 2⅞" x 2⅜" | 6601 | 7.3 |
| Wedge 2⅞" x 2⅜" | 6603 | 1.0 |
| Sign Post 2⅜" | See Below | |

### POZ-LOC™ TOOLS

| DESCRIPTION | PART NO. | WT. (LBS) |
|---|---|---|
| 2⅞" Drive Cap | 6610 | 11.9 |
| Wedge Puller | 6613 | 6.0 |
| Sign Mounting Brackets | 6606 | .39 |
| Socket Driver | 6615 | 45.0 |

### COMPLETE POST AND SOCKET ASSEMBLIES

| PRODUCT | PART NO. | OUTSIDE DIAMETER | NOMINAL PIPE SIZE | POST WALL THICKNESS | POST WEIGHT PER FOOT | | LENGTH |
|---|---|---|---|---|---|---|---|
| POZ-LOC™ UNITS | 238065 | 2.375" | 2" | .065 | 1.60 lb. | (Plus weight of one socket and wedge per post [8.3 lbs.] see above) | Available in 8' – 9' – 10' – 11' – 12' – 13' – 14' lengths |
| | 238080 | 2.375" | 2" | .080 | 1.96 lb. | | |
| | 238095 | 2.375" | 2" | .095 | 2.313 lb. | | |

POZ-LOC™ Sign Post Anchoring Systems and POZITUBE® Traffic Posts are manufactured by Southwestern Pipe, Inc. and provide the simplest, most cost effective installed sign unit available. Meets Federal Highway Administration and AASHTO provisions for change in momentum on 1,800# vehicle impact.

POZITUBE® Galvanized Traffic Posts are also available in High Visibility Yellow. Posts may be ordered with hot-dipped galvanized sign mounting brackets including nuts and bolts or with pre-punched 12-hole pattern, which meets sign blank specifications. POZITUBE® Traffic Post brochure available on request.


**With a sign post**

**you can see**

# POZITUBE®

**High Visibility Yellow**

# Traffic Posts

Day or night, drivers see **POZITUBE®** Yellow Traffic Posts up to 45% sooner than galvanized posts or channel!

Knock-down rate is significantly lower for Yellow **POZITUBE®** Traffic Posts than for galvanized posts or channel!

Initial cost of **POZITUBE®** Traffic Posts is most competitive. . . fewer replacements are needed. . . thus, total post-life cost is drastically reduced! Pre-punched hole pattern for every sign attachment saves even more money.

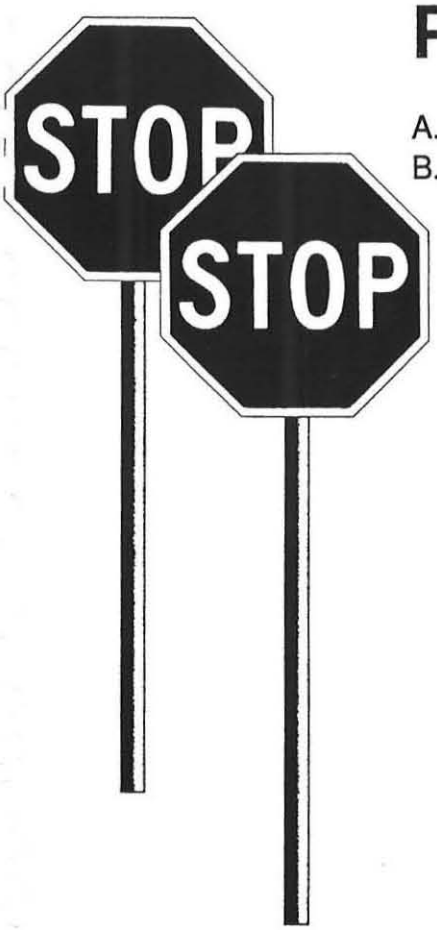
**Don't wait. Check out**

**POZITUBE®**

**HIGH VISIBILITY YELLOW**

**Traffic Posts**

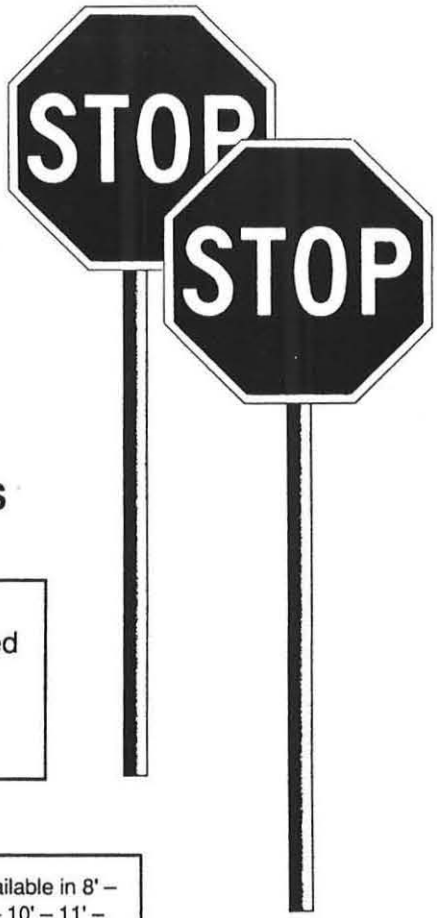
# POZITUBE® TRAFFIC POSTS




A. Galvanized Traffic Posts with High Visibility Yellow Coating
B. Galvanized and Clear Coated Traffic Posts

Both of these types of POZITUBE® Traffic Posts have the following characteristics and properties:

1. Galvanized (inside and out).
2. Electrostatically powder coated for years of additional life.
3. Electric resistance welded from hot-dipped galvanized steel sheet conforming to ASTM specifications A-525-G90 commercial weight.
4. Tubing is produced to ASTM A-513, Specification For Welded Mechanical Tubing.
5. Excellent resistance to urban environments where air pollution causes accelerated corrosion.
6. Resistant to damage by impact, abrasion, scratches, temperature variations. Provides superb protection against rust and chemicals such as salt, fertilizers, insecticides, fungicides and solvents such as motor oils, gasoline and other normally damaging substances.




## STANDARD COLORS FOR POZITUBE® TRAFFIC POSTS

1. High Visibility Yellow
2. Green, Black or Brown.

Pozitube® Traffic Posts may be ordered with pre-punched 12-hole pattern or with hot-dipped galvanized mounting brackets including nuts and bolts.

Sign Mounting Brackets #6606 100 Per Bag

## POZITUBE® TRAFFIC POST SIZES

| Product | Outside Diameter | Nominal Pipe Size | Wall Thickness | Weight Per Foot | |
|---|---|---|---|---|---|
| Traffic Post | 2.375" | 2" | .065<br>.080<br>.095 | 1.60 lb.<br>1.96 lb.<br>2.313 lb. | Available in 8' – 9' – 10' – 11' – 12' – 13' – 14' lengths. |

## POZ-LOC™ SIGN POST ANCHOR SYSTEM

Southwestern Pipe also manufactures the POZ-LOC™ Sign Post Anchor System which offers the simplest, most cost effective breakaway sign post system available today. It is installed flush with the ground, which prevents damage to the socket system and the vehicle upon impact. The POZ-LOC™ Anchor System is easiest to install and simplest to reuse after impact. Brochure available on request.



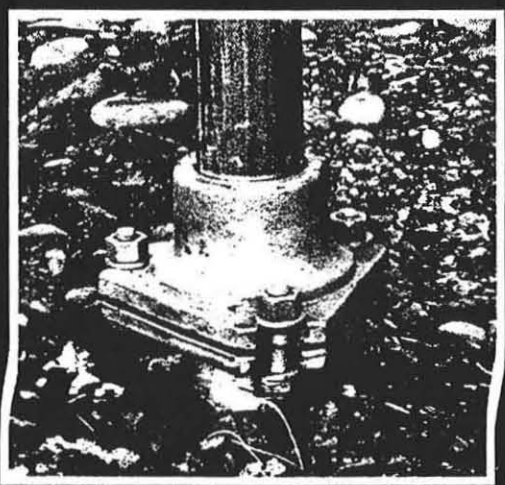
*Call Mike Jordan, Marketing Manager, or your local dealer for more information.*

**SOUTHWESTERN PIPE, INC.**

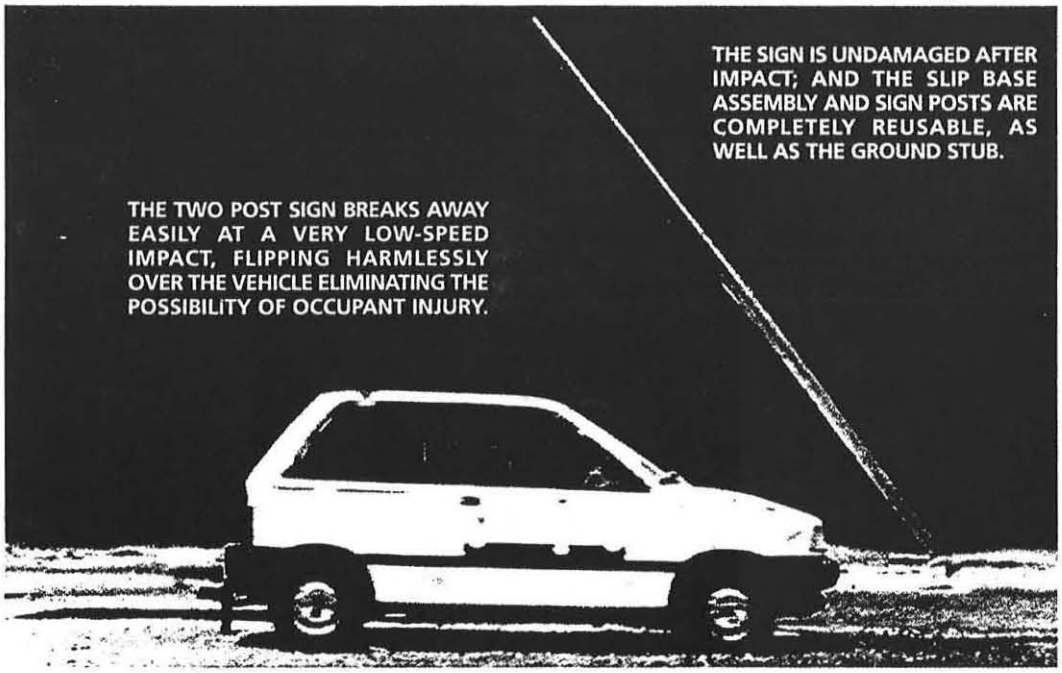
P.O. Box 2002 / Houston, Texas 77252 Phone (713) 863-4300

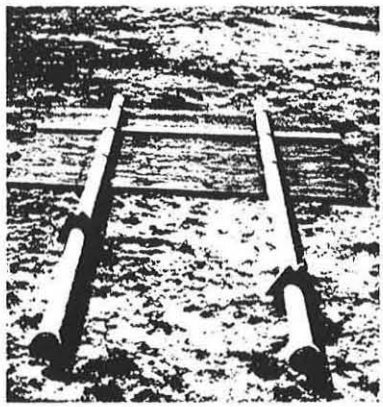
# POZ-LOC™ SLIPBASE SYSTEM

## THE MULTI-DIRECTIONAL BREAKAWAY SIGN POST SUPPORT



# THE ECONOMICAL POZ-LOC SLIPBASE MAXIMIZES SAFETY & VERSATILITY




## SAFETY

The multi-directional breakway system is designed so that at impact the post and sign flip over the vehicle safely, greatly reducing the possibility of occupant injury; and the change in vehicle velocity is minimal.

## VERSATILITY

One single slip base is used with two post sizes to reduce inventory and provide flexibility in the field. "T" and "U" sign brackets can be bolted on the post in the shop or in the field. E-Z Lifting Hinge allows easy, safe installation in the field avoiding the use of a crane.

## ECONOMY

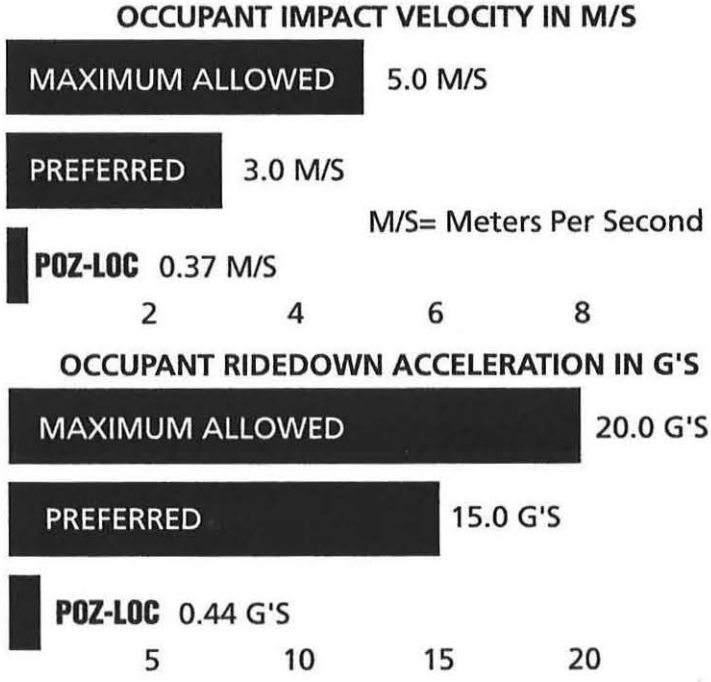
Because the POZ-LOC Slipbase breaks away so easily, the sign components usually are undamaged and reusable. All of the POZ-LOC sign system is galvanized totally, assuring long life. Ease of installation saves time and money.

## APPROVAL

The POZ-LOC Slipbase System meets or exceeds the requirements of NCHRP report 350 and AASHTO. It also has Federal Highway Administration (FHWA) approval.

## OCCUPANT RISK CRASH TEST AT 20 MPH

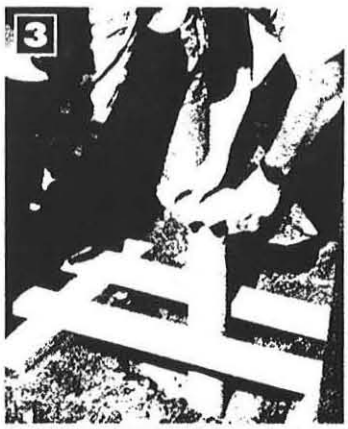
**POZ-LOC BEATS THE PREFERRED REQUIREMENTS IN THE NCHRP REPORT #350.**



# THE POZ-LOC SLIPBASE SYSTEM IS ENGINEERED FOR EASY INSTALLATION


DIG HOLE 8" TO 12" OD BY 42"DEEP.


FILL HOLE TO GROUND LEVEL WITH CONCRETE.




PRESS BASE INTO CENTER OF CONCRETE FILLED HOLE.


LEVEL BASE 3" ABOVE GROUND. LET CURE.


TIGHTEN NUTS TO PROPER TORQUE.


CLAMP E-Z LIFTING HINGE TO BASE STUB AND POST. LIFT INTO PLACE OVER BASE.

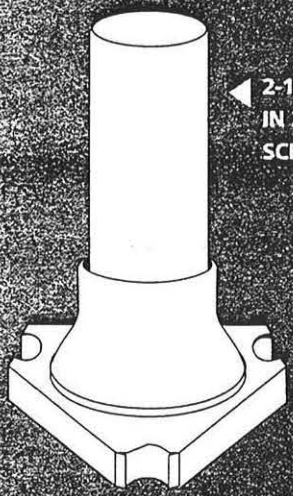

TURN POST AND POSITION SIGN IN PROPER DIRECTION.



INSTALL BOLTS AND TIGHTEN NUTS LOOSELY.

# POZ-LOC

# COMPONENTS AND SPECIFICATIONS



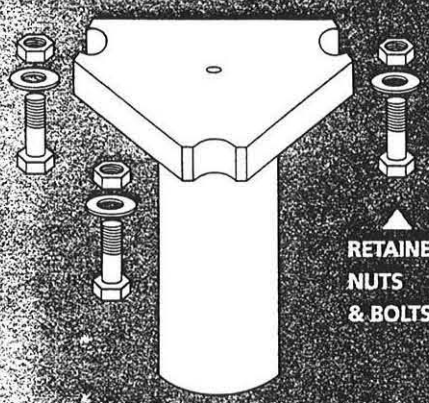
2-1/2" NPS TRAFFIC POST IN 2 WALL THICKNESSES: SCHEDULE 10 OR 80

GALVANIZED STEEL SLIP BASE CASTING

GALVANIZED STEEL SPLIT SHAFT LOCKING COLLAR

STEEL BOLT RETAINER PLATE

36" HOT DIP GALVANIZED 3" NPS GROUND STUB WITH TRIANGULAR PLATE WELDED TO IT



RETAINER NUTS & BOLTS

**The POZ-LOC Slipbase System provides maximum occupant safety while offering versatility, the economy of reusable components after impact, and ease of installation; and this system meets or exceeds the requirements of NCHRP Report 350 and AASHTO. It also has FHWA approval.**

## ENGINEERING DATA FOR POZ-LOC POST

| POZ-LOC POST SIZE | O.D. | WALL | WEIGHT | SECTION MODULUS | YIELD STRENGTH |
|---|---|---|---|---|---|
| 2 1/2" SCHEDULE 10 | 2.875" | 0.120" | 3.53 lb/ft | 0.687 $in^3$ | 55,000 PSI |
| 2 1/2" SCHEDULE 10 | 73.0 mm | 3.0 mm | 5.26 kg/m | 11.25 $cm^3$ | 375 Mpa |
| 2 1/2" SCHEDULE 80 | 2.875" | 0.276" | 7.66 lb/ft | 1.339 $in^3$ | 42,000 PSI |
| 2 1/2" SCHEDULE 80 | 73.0 mm | 7.1 mm | 11.41 kg/m | 21.94 $cm^3$ | 285 Mpa |

## POZ–LOC POST REQUIREMENTS AT VARIOUS WIND VELOCITIES

| SIGNS WIDTH X HEIGHT SIZE IN SQ. FT. | EXAMPLE | WALL | 60 MPH | 70 MPH | 80 MPH |
|---|---|---|---|---|---|
| INTERSTATE CURVE 4' X 4' 16 SQ. FT. |  | SCH. 10 .120" | SINGLE POST | SINGLE POST | |
| | | SCH. 80 .276" | | | SINGLE POST |
| INTERSTATE EXIT SPEED 4' X 5' 20 SQ. FT. |   | SCH. 10 .120" | SINGLE POST | SINGLE POST | |
| | | SCH. 80 .276" | | | SINGLE POST |
| INTERSTATE EXIT MARKER 6' X 5' 30 SQ. FT. |   | SCH. 10 .120" | DOUBLE POST | DOUBLE POST | DOUBLE POST |
| | | SCH. 80 .276" | | | |
| INTERSTATE SPEED LIMIT 4' X 9' 36 SQ. FT. |   | SCH. 10 .120" | DOUBLE POST | | |
| | | SCH. 80 .276" | | DOUBLE POST | DOUBLE POST |

Calculations based on AASHTO formula with 7' to the bottom of the sign.

SW PIPE

For more information, including complete crash test results and detailed parts and assembly specifications, write, fax or call... Southwestern Pipe, Inc., P.O. Box 2002, Houston, TX 77252, 1-800-882-1982, 318-742-0021, Fax 318-742-0027.

SPAX SWPIPE

6307 TOLEDO ST., P.O. BOX 2002, HOUSTON, TEXAS 77252, 713-863-4300, FAX 713-863-4313

# ASTM A-513 ROUND MECHANICAL TUBING WEIGHTS AND SPECIFICATIONS

## WEIGHT PER FOOT

| OUTSIDE DIAMETER | | WALL THICKNESS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| DECIMAL | FRACTION | .035 20 GA | .042 19 GA | .049 18 GA | .058 17 GA | .065 16 GA | .072 15 GA | .083 14 GA | .095 13 GA | .109 12 GA | .120 11 GA |
| .500 | ½ | .174 | .205 | .236 | .274 | .302 | | | | | |
| .625 | ⅝ | .221 | .262 | .301 | .351 | .389 | | | | | |
| .750 | ¾ | .267 | .318 | .367 | .429 | .476 | .521 | .591 | | | |
| .875 | ⅞ | .314 | .374 | .432 | .506 | .562 | .617 | .702 | .791 | | |
| .995 | | .361 | .430 | .498 | .584 | .649 | .714 | .813 | .918 | 1.037 | 1.128 |
| 1.000 | 1 | .361 | .430 | .498 | .584 | .649 | .714 | .813 | .918 | 1.037 | 1.128 |
| 1.125 | 1⅛ | .407 | .486 | .563 | .661 | .736 | .810 | .924 | 1.045 | 1.183 | 1.288 |
| 1.250 | 1¼ | .454 | .542 | .629 | .738 | .823 | .906 | 1.034 | 1.172 | 1.328 | 1.448 |
| 1.315 | 1⁵⁄₁₆ | .478 | .571 | .663 | .779 | .868 | .956 | 1.092 | 1.238 | 1.404 | 1.532 |
| 1.410 | 1¹³⁄₃₂ | .514 | .614 | .712 | .837 | .934 | 1.029 | 1.176 | 1.334 | 1.515 | 1.653 |
| 1.500 | 1½ | .548 | .654 | .759 | .893 | .996 | 1.098 | 1.256 | 1.426 | 1.619 | 1.769 |
| 1.625 | 1⅝ | .594 | .710 | .825 | .971 | 1.083 | 1.194 | 1.367 | 1.552 | 1.765 | 1.929 |
| 1.660 | 1²¹⁄₃₂ | .607 | .726 | .843 | .992 | 1.107 | 1.221 | 1.398 | 1.588 | 1.806 | 1.974 |
| 1.690 | 1¹¹⁄₁₆ | .619 | .737 | .859 | 1.011 | 1.128 | 1.244 | 1.425 | 1.618 | 1.840 | 2.012 |
| 1.750 | 1¾ | .641 | .766 | .890 | 1.048 | 1.170 | 1.290 | 1.478 | 1.679 | 1.910 | 2.089 |
| 1.875 | 1⅞ | .688 | .822 | .956 | 1.126 | 1.257 | 1.386 | 1.589 | 1.806 | 2.056 | 2.249 |
| 1.900 | 1²⁹⁄₃₂ | .697 | .833 | .969 | 1.141 | 1.274 | 1.406 | 1.611 | 1.831 | 2.085 | 2.281 |
| 2.000 | 2 | .735 | .878 | 1.021 | 1.203 | 1.343 | 1.483 | 1.699 | 1.933 | 2.201 | 2.409 |
| 2.125 | 2⅛ | .781 | .934 | 1.086 | 1.280 | 1.430 | 1.579 | 1.810 | 2.060 | 2.347 | 2.570 |
| 2.250 | 2¼ | .828 | .990 | 1.152 | 1.358 | 1.517 | 1.675 | 1.921 | 2.186 | 2.492 | 2.730 |
| 2.375 | 2⅜ | | 1.046 | 1.217 | 1.435 | 1.604 | 1.771 | 2.032 | 2.313 | 2.638 | 2.890 |
| 2.500 | 2½ | | 1.103 | 1.283 | 1.513 | 1.690 | 1.867 | 2.143 | 2.440 | 2.783 | 3.050 |
| 2.875 | 2⅞ | | 1.271 | 1.479 | 1.745 | 1.951 | 2.155 | 2.475 | 2.821 | 3.220 | 3.531 |
| 3.000 | 3 | | 1.327 | 1.544 | 1.822 | 2.037 | 2.252 | 2.586 | 2.947 | 3.365 | 3.691 |
| 3.500 | 3½ | | | | 2.132 | 2.385 | 2.636 | 3.029 | 3.455 | 3.948 | 4.332 |
| 4.000 | 4 | | | | | 2.732 | 3.020 | 3.472 | 3.962 | 4.530 | 4.973 |
| 4.500 | 4½ | | | | | 3.079 | 3.405 | 3.915 | 4.469 | 5.112 | 5.613 |

## OUTSIDE DIAMETER TOLERANCES
### HOT ROLLED AND COLD ROLLED TUBING

| OUTSIDE DIAMETER | GAUGE | TOLERANCE + OR − |
|---|---|---|
| ⅜-⅝ | 20 TO 16 | 0.003 |
| ¾-1⅛ | 20 TO 11 | 0.0035 |
| 1¼-2 | 20 TO 11 | 0.005 |
| 2⅛-2½ | 20 TO 11 | 0.006 |
| 2⅞-3 | 20 TO 11 | 0.008 |
| 3½ | 20 TO 11 | 0.009 |
| 4 | 20 TO 11 | 0.010 |
| 4½ | 20 TO 11 | 0.020 |

**STRAIGHTNESS TOLERANCE IS .030″ IN 3′.**

**TO CALCULATE WEIGHT PER FOOT:**
TAKE OUTSIDE DIAMETER MINUS WALL THICKNESS, MULTIPLY RESULT BY WALL THICKNESS, MULTIPLY RESULT BY 10.68

## WALL THICKNESS TOLERANCES–COLD ROLLED

| O.D. | .035 20 GA | .049 18 GA | .065 16 GA | .083 14 GA | .095 13 GA | .109 12 GA |
|---|---|---|---|---|---|---|
| ½-⅞ | +.002 −.005 | +.003 −.006 | +.005 −.007 | +.006 −.007 | +.006 −.007 | |
| 1-1⅞ | +.001 −.005 | +.002 −.006 | +.004 −.007 | +.005 −.007 | +.005 −.007 | +.006 −.008 |
| 1.90-3½ | +.001 −.005 | +.002 −.006 | +.004 −.007 | +.004 −.007 | +.004 −.007 | +.005 −.008 |
| 4-4½ | | | +.004 −.007 | +.004 −.007 | +.004 −.007 | +.005 −.008 |

## WALL THICKNESS TOLERANCES–HOT ROLLED

| O.D. | .065 16 GA | .072 15 GA | .083 14 GA | .095 13 GA | .109 12 GA | .120 11 GA |
|---|---|---|---|---|---|---|
| ¾-1 | +.005 −.009 | +.005 −.009 | +.006 −.010 | +.006 −.010 | +.006 −.010 | +.006 −.010 |
| 1⅛-1.90 | +.004 −.010 | +.004 −.010 | +.005 −.011 | +.005 −.011 | +.005 −.011 | +.005 −.011 |
| 2-3½ | +.003 −.011 | +.003 −.011 | +.004 −.012 | +.004 −.012 | +.004 −.012 | +.004 −.012 |
| 3¾-4½ | +.002 −.012 | +.002 −.012 | +.003 −.013 | +.003 −.013 | +.003 −.013 | +.003 −.013 |

## METRIC CONVERSIONS

**LINEAR MEASURE:**
mm × .03937 = in.
m × 39.37 = in.
m × 3.281 = ft.
m × 1.094 = yd.
Km × .6214 = mi.

**MASS (WT.)**
Kg × 2.205 = lb.
tonne × 1.102 = ton
tonne × .9842 = long ton

**AREA:**
$mm^2 \times .0155 = in^2$
$m^2 \times 10.76 = ft^2$
$m^2 \times 1.96 = yd^2$

**VOLUME:**
liter × 1.057 = qt.
liter × .2642 = gal.

**MISC:**
Kg/m × .672 = lb./ft.
KPa × .145 = $lb.f/in^2$ (psi)

SPAX SWPIPE

6307 TOLEDO ST., P.O. BOX 2002, HOUSTON, TEXAS 77252, 713-863-4300, FAX 713-863-4313

# ASTM A-513 SQUARE AND RECTANGULAR MECHANICAL TUBING WEIGHTS AND SPECIFICATIONS

| OUTSIDE DIMENSION | | BUNDLE | WEIGHT PER FOOT — WALL THICKNESS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SQUARE | RECTANGLE | SIZE | .035 20 GA. | .042 19 GA. | .049 18 GA. | .058 17 GA. | .065 16 GA. | .072 15 GA. | .083 14 GA. | .095 13 GA. | .109 12 GA. | .120 11 GA. |
| 3/4 × 3/4 | | 100 | .340 | .404 | .467 | .546 | .606 | | | | | |
| | 1/2 × 1 | 100 | | | | | | | | | | |
| 7/8 × 7/8 | | 100 | .400 | .476 | .550 | .644 | .716 | | | | | |
| 1 × 1 | | 100 | .459 | .547 | .634 | .743 | .827 | .909 | 1.035 | 1.169 | 1.321 | 1.436 |
| | 3/4 × 1 1/4 | 100 | | | | | | | | | | |
| 1 1/8 × 1 1/8 | | 100 | | | .717 | .842 | .937 | 1.031 | 1.176 | 1.331 | | |
| | 3/4 × 1 1/2 | 72 | | | | | | | | | | |
| | 3/4 × 2 | 48 | | | .884 | 1.039 | 1.158 | 1.276 | 1.458 | | | |
| 1 1/4 × 1 1/4 | | 64 | | | .800 | .940 | 1.048 | 1.153 | 1.317 | 1.492 | 1.691 | 1.844 |
| | 1 × 1 1/2 | 48 | | | | | | | | | | |
| 1 1/2 × 1 1/2 | | 49 | | | .967 | 1.137 | 1.269 | 1.398 | 1.600 | 1.815 | 2.062 | 2.252 |
| | 1 × 2 | 50 | | | | | | | | | | |
| | 1 × 2 1/4 | 48 | | | 1.050 | 1.236 | 1.379 | 1.521 | 1.741 | 1.977 | 2.247 | 2.456 |
| | 1 1/4 × 2 1/2 | 48 | | | | | 1.600 | 1.765 | 2.023 | 2.300 | 2.618 | 2.864 |
| 2 × 2 | | 36 | | | 1.300 | 1.532 | 1.711 | 1.888 | 2.164 | 2.461 | 2.803 | 3.068 |
| | 1 × 3 | 48 | | | | | | | | | | |
| | 1 1/2 × 3 | 32 | | | | | 1.932 | 2.133 | 2.446 | 2.784 | 3.174 | 3.476 |
| 2 1/2 × 2 1/2 | | 25 | | | | | 2.153 | 2.377 | 2.728 | 3.107 | 3.544 | 3.884 |
| | 2 × 3 | 20 | | | | | | | | | | |
| 3 × 3 | | 20 | | | | | 2.595 | 2.867 | 3.293 | 3.753 | 4.286 | 4.700 |
| | 2 × 4 | 16 | | | | | | | | | | |

| TWIST TOLERANCE IN 3′ | |
|---|---|
| LARGEST FLAT | TOLERANCE |
| 3/4-1 1/2 | .050 |
| 2-2 1/2 | .062 |
| 3 | .075 |
| 4 | .087 |

| O.D. TOLERANCE | |
|---|---|
| LARGEST FLAT | TOL. + OR − |
| 3/4-1 1/8 | .005 |
| 1 1/4-1 1/2 | .006 |
| 2 | .008 |
| 2 1/4-3 | .010 |
| 3-4 | .020 |

| RADIUS OF CORNERS | | |
|---|---|---|
| 3/4-3 SQ. | 16 GA. | 1/16-7/64 |
| 1-3 SQ. | 14 GA. | 5/64-1/8 |
| 1-3 SQ. | 11 GA. | 1/8-7/32 |

## DECIMAL EQUIVALENTS

| | | | |
|---|---|---|---|
| 1/64 .015625 | 17/64 .265625 | 33/64 .515625 | 49/64 .765625 |
| 1/32 .03125 | 9/32 .28125 | 17/32 .53125 | 25/32 .78125 |
| 3/64 .046875 | 19/64 .296875 | 35/64 .546875 | 51/64 .796875 |
| 1/16 .0625 | 5/16 .3125 | 9/16 .5625 | 13/16 .8125 |
| 5/64 .078125 | 21/64 .328125 | 37/64 .578125 | 53/64 .828125 |
| 3/32 .09375 | 11/32 .34375 | 19/32 .59375 | 27/32 .84375 |
| 7/64 .109375 | 23/64 .359375 | 39/64 .609375 | 55/64 .859375 |
| 1/8 .125 | 3/8 .375 | 5/8 .625 | 7/8 .875 |
| 9/64 .140625 | 25/64 .390625 | 41/64 .640625 | 57/64 .890625 |
| 5/32 .15625 | 13/32 .40625 | 21/32 .65625 | 29/32 .90625 |
| 11/64 .171875 | 27/64 .421875 | 43/64 .671875 | 59/64 .921875 |
| 3/16 .1875 | 7/16 .4375 | 11/16 .6875 | 15/16 .9375 |
| 13/64 .203125 | 29/64 .453125 | 45/64 .703125 | 61/64 .953125 |
| 7/32 .21875 | 15/32 .46875 | 23/32 .71875 | 31/32 .96875 |
| 15/64 .234375 | 31/64 .484375 | 47/64 .734375 | 63/64 .984375 |
| 1/4 .25 | 1/2 .5 | 3/4 .75 | 1 1. |

## WEIGHT PER FOOT

**SQUARES:**

O.D. MINUS WALL THICKNESS × WALL THICKNESS × 13.60.

**RECTANGLES:**

ADD LARGE FLAT TO NARROW FLAT AND DIVIDE BY 2. SUBTRACT WALL THICKNESS, MULTIPLY BY WALL THICKNESS, MULTIPLY BY 13.60.

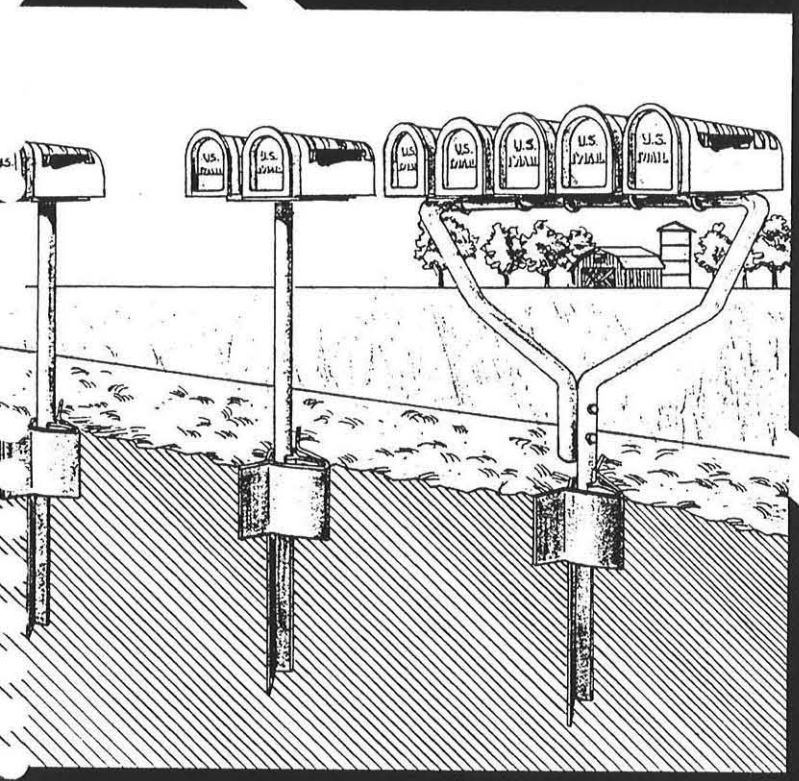
**WALL THICKNESS TOLERANCE** IS PLUS OR MINUS 10% OF THE NOMINAL WALL THICKNESS

**SQUARENESS** IS EQUAL TO LARGEST OUTSIDE DIMENSION ACROSS FLAT ×.006

**STRAIGHTNESS** IS EQUAL TO 1/16" IN 3′

# APPENDIX E

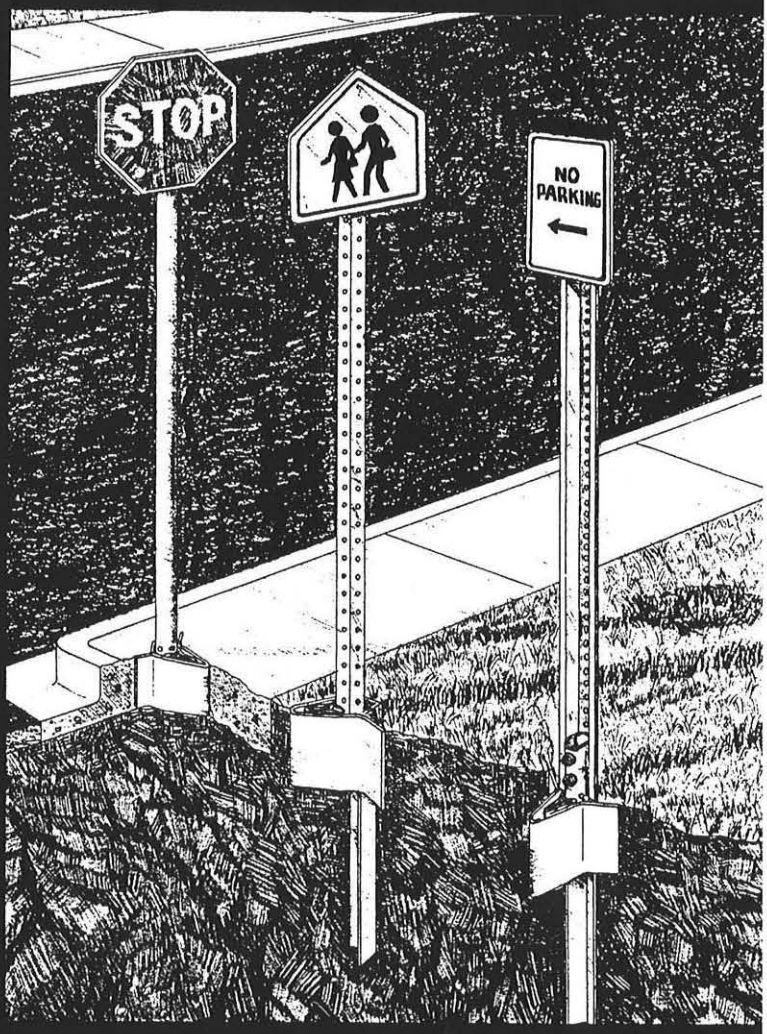
## Foresight Products Inc.



# VLOC®
## Socket System

by

Foresight
Products Inc.




# CRASH TESTED AND FHWA ACCEPTED

**The latest state of the art in re-usable yielding-base post support and mailbox support systems . . . for safety's sake**

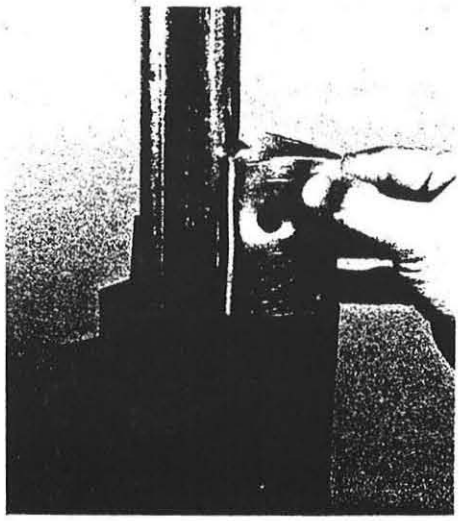
# V-Loc is a permanent post hole. It's the only flush-to- ground post support with a 360° impact zone

For safety's sake, V Loc is installed flush with the surface of the ground. When a vehicle impacts the post in a V Loc Socket, the post yields and releases to the ground, does not penetrate windshield, and leaves no stub to puncture tires or cause the driver to lose control of the vehicle. No other yielding base system on the market can match this performance.

### V Loc's radiating fins stabilize the socket

The strong steel fins of V Loc hold the socket securely in the ground, resisting torsion and lateral movement. The radiating fins offer more ground holding surface area than any other yielding base system. Once V Loc is in the ground it stays in the ground, for continuing post support and reusability, impact after impact.

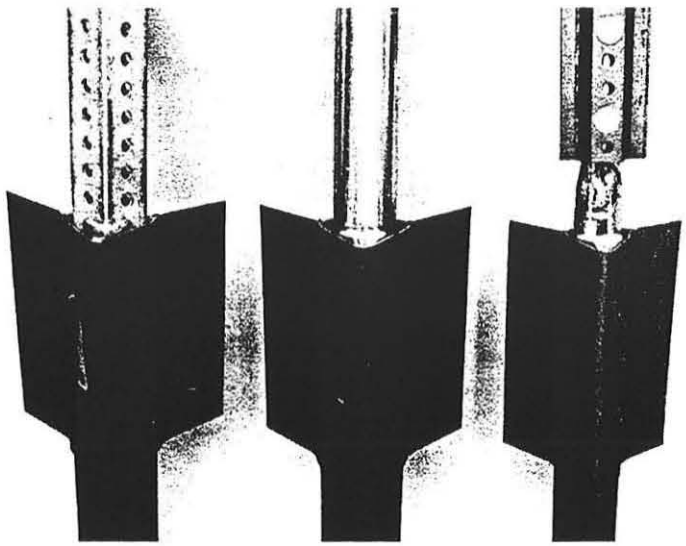
In concrete, asphalt and dirt V Loc's yielding base system provides unequalled cost savings, long life, and maximum safety. After a post is impacted, one simply removes the damaged post and replaces it with a new one — in the same V Loc Socket. If the post is only slightly damaged, it often can be repaired and put back in the V Loc Socket.



### V Loc's patented wedge locks a post in *securely*

V Loc's patented wedge allows installation and removal of a post in seconds! Just drive the wedge in flush with the socket and you have a bulldog grip on the post — with no bolts, screws or any other holding device. And, V Loc allows 360° indexing of the post for round and U channel posts.

The Foresight wedge puller removes the wedge in seconds.

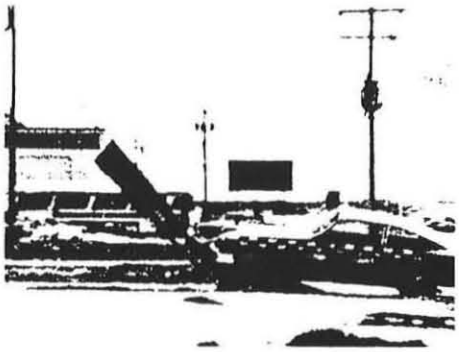


**V Loc Sockets are FHWA accepted for use with any FHWA accepted signpost — round, square or U channel.**

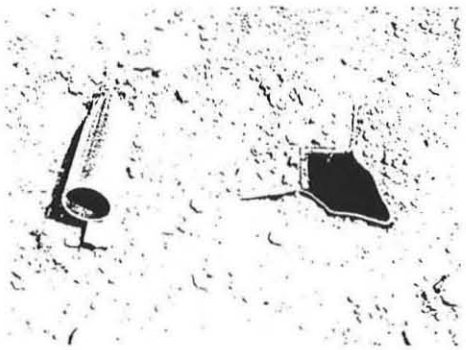
The wedge is the key to this universal adaptability. No shape is immune to the vise-like grip of the Foresight wedge.

★★★★★★★★★★★★★★★★★★★★

# Crash tests prove V Loc is the safest system



After 20 mph impact car and driver are unhurt, and sign is flat on the ground



V Loc after impact is undamaged and ready for another post to be inserted

After a 60 mph impact 2 posts of the 3 post sign are clipped off cleanly, with no loss of control, and the 3rd post still supports the sign.

## V Loc Saves You Money

V Loc is the lowest cost, as well as the safest, post support system on the market. Both at the time of installation and after-installation, V Loc is a cost cutter. At installation, one man installs V Loc in seconds. No concrete, no pre-drilling of holes, no exotic equipment needed. After installation, posts are easily and quickly changed so that new ones can be inserted. No digging, no new concrete, no high-priced tools. It's a permanent post hole for as long as it's needed.

## V Loc defies the weather

When it's 20° below in Minneapolis or 120° above in Phoenix, one man can easily replace a post in a V Loc Socket. Heat and cold have no effect on V Loc or the installation process. V Loc saves time, V Loc saves money . . . whatever the weather.

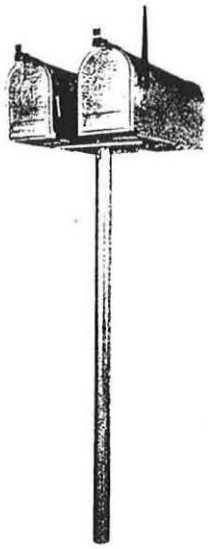
## Installation is easy

One man from ground level quickly and easily installs V Loc. Sledge hammers, jack hammers and gasoline driven impactors may be used.

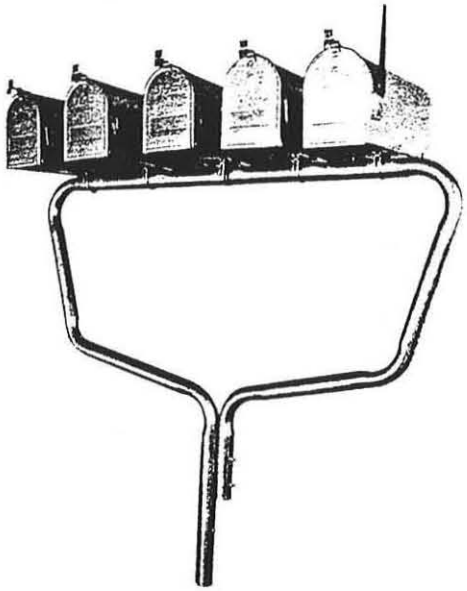
# Foresight Mailbox Support Systems

## Crash Tested, Accepted and Recommended by AASHTO's Guide for Erecting Mailboxes on Highways

**Foresight single mailbox support system**



**Foresight double support system**



**Foresight multiple support system**

### Federal and state approval

The Foresight mailbox support system, and ONLY the Foresight mailbox support system, is shown and described in published reports by a federal agency and the state of Texas.

On May 24, 1984, the American Association of State Highway and Transportation Officials (AASHTO) published a booklet entitled "A Guide For Erecting Mailboxes On Highways." It was prepared by the Task Force for Roadside Safety of the Standing Committee on Highways Sub-committee on Design.

This booklet states that there may be as many as 20 million mailboxes on rural roads and streets and another 10 to 15 million on suburban streets, and that safety is the primary reason for a highway agency's becoming involved with mailboxes. It also states that possibly 70 to 100 people die annually in the United States in vehicles striking mailboxes where the design of the mailbox or, especially, its support can be shown to have contributed to the severity of the accident.

The booklet shows pictures of the types of mailbox supports that are considered hazardous to the driving public.

### Control Regulations

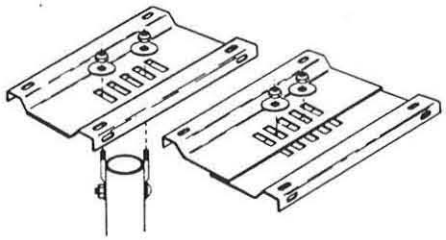
The booklet recommends that each highway agency adopt control regulations for the placement of mailboxes and newspaper boxes within rights-of-way of public highways. Such control regulations should include, among other things, the structure of such installations.

Further recommendations are that all exposed mailboxes be firmly attached to supports that yield or break away safely if struck by a vehicle; mailbox to post attachments should prevent mailboxes from separating from their supports under vehicle impacts; multiple mailbox installations must meet the same criteria as do single mailbox installations.

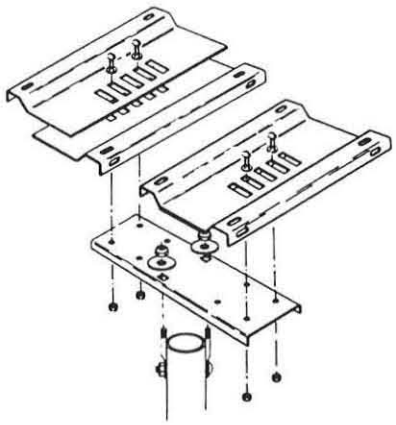
### Texas Crash Tests Prove Foresight System Safe

In a crash test at the Texas Transportation Institute where conventional U channel single post supports in a row were impacted by a vehicle traveling at high speed, the result was a vehicle rollover. A row of Foresight single post supports was then impacted at high speed with no rollover and no loss of control of the vehicle.

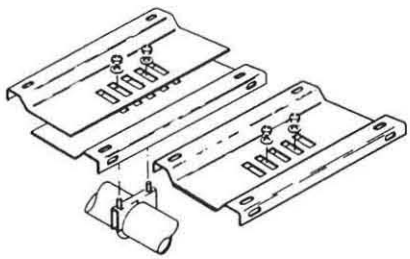
# Foresight System Meets Every AASHTO Requirement



**Foresight single mailbox bracket**



**Foresight double mailbox bracket**



**Foresight multiple mailbox bracket.**

★★★★★★★★★★

### Crash Test Videotape

A videotape presentation of crash tests of the Foresight Mailbox Support System is available for screening in your office. Call or write Foresight Products Inc. to arrange a time convenient for you.

★★★★★★★★★★

In actual, official crash tests the Foresight Mailbox Support System did yield and break away safely when impacted by an automobile. Our brackets did not separate or fly away from the support at impact. And our multiple mailbox installations do meet the same criteria as do our single mailbox installations.

The Foresight Universal bracket fits all rural mailbox support systems and is adaptable to Class 1, Class 1-A and Class 2 rural mailboxes.

**THE FORESIGHT MULTIPLE MAILBOX SYSTEM HOLDS UP TO FIVE MAILBOXES! EVERY OTHER SYSTEM IN THE BOOK HOLDS NO MORE THAN TWO MAILBOXES!**

### Foresight Meets Even More Federal Requirements

REQUIREMENT: no more than two mailboxes may be mounted in a support structure unless the support structure and mailbox arrangement have been shown to be safe by crash testing.
FULFILLMENT: Foresight has the ONLY multiple mailbox system that can support more than two mailboxes that has been proven by crash testing.
REQUIREMENT: mailbox supports shall not be set in concrete unless the support design has been shown to be safe by crash tests when so installed.
FULFILLMENT: the Foresight system has been crash tested and works equally well in dirt, concrete and asphalt.

### Crash Tested and Approved in Texas

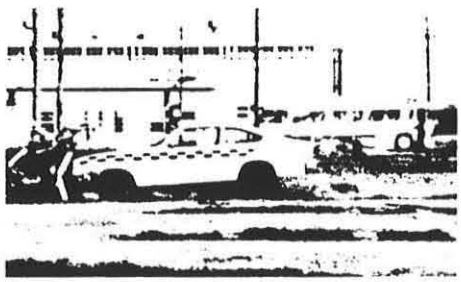
In January of 1985 the State Department of Highways and Public Transportation issued a report on highway safety devices to the Texas legislature. The report includes a photograph of a Foresight Multiple Mailbox Support System with four mailboxes. The caption says "This design prevents mailboxes from being a hazard to motorists."

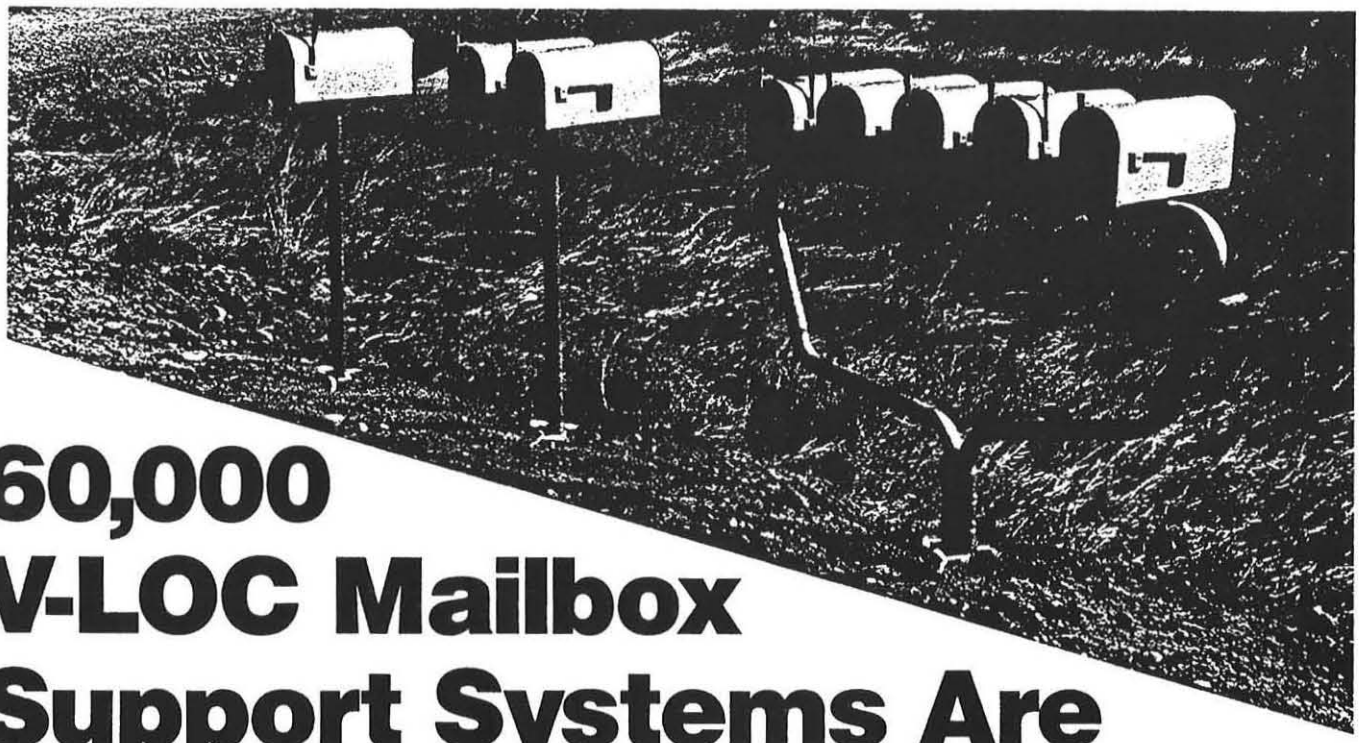
The report describes the Foresight system, saying it can hold as many as five mailboxes, and upon impact by an errant vehicle the tapered shape of the support causes the frame with the mailboxes to be freed and projected upward and forward with only slight damage to the vehicle.

The report states that this system is designed to prevent rapid deceleration of an errant vehicle and to prevent the penetration of the mailbox support into the interior of the vehicle. The change in the velocity is slight, and the danger of any part of the mailbox support penetrating the windshield of the vehicle is essentially eliminated.

The report concludes by saying that the benefit-cost ratio of the Foresight system will range upward from 60:1 on moderate volume highways . . . and generally a benefit-cost ratio of 1:1 is considered a minimum before an expenditure is justified.

Foresight Products mailbox support systems reduce liability exposure to state, county and municipality by replacing hazardous and lethal mailbox supports that exist along all highways today.





# 60,000 V-LOC Mailbox Support Systems Are In Place Nationwide

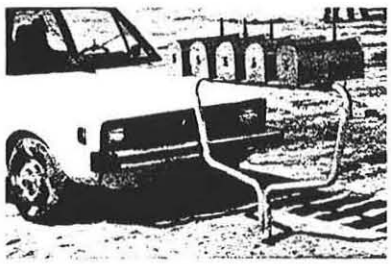
**22 states have standardized on the system so far. More will do so.**

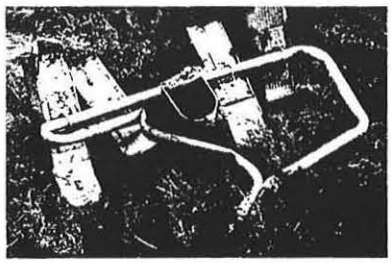
## Many of our systems have been impacted, but not one injury has occurred.

With the FHWA urging the replacement of killer mailbox supports, you owe it to the people of your state to consider the only single, double, and multiple (5 mailboxes) mailbox support system in America that has passed all impact tests using an 1800 lb. car, in both strong and weak soils . . . **for safety's sake!** The system was crash tested to meet all NCHRP 230 and AASHTO performance requirements.

In every test the V-LOC Socket activated its yield and release mechanism as designed, and in all instances the sockets were re-usable. No debris contacted the windshield or showed potential for entering the passenger compartment.

For complete details and your nearest distributor, call today. Foresight Products Inc., 6430 East 49th Drive, Commerce City, Colorado 80022. Phone 1-800-325-5360 or In Colorado (303) 286-8955. FAX (303) 287-3866.




For strength, safety, long life and low cost, nothing beats V-LOC Sockets for holding sign posts. The V-LOC system accepts round, square and U channel sign posts.

The patented Foresight V-LOC Socket is a permanent post hole . . . a yielding base, flush-to-the-ground support . . . **in concrete, asphalt and dirt.**

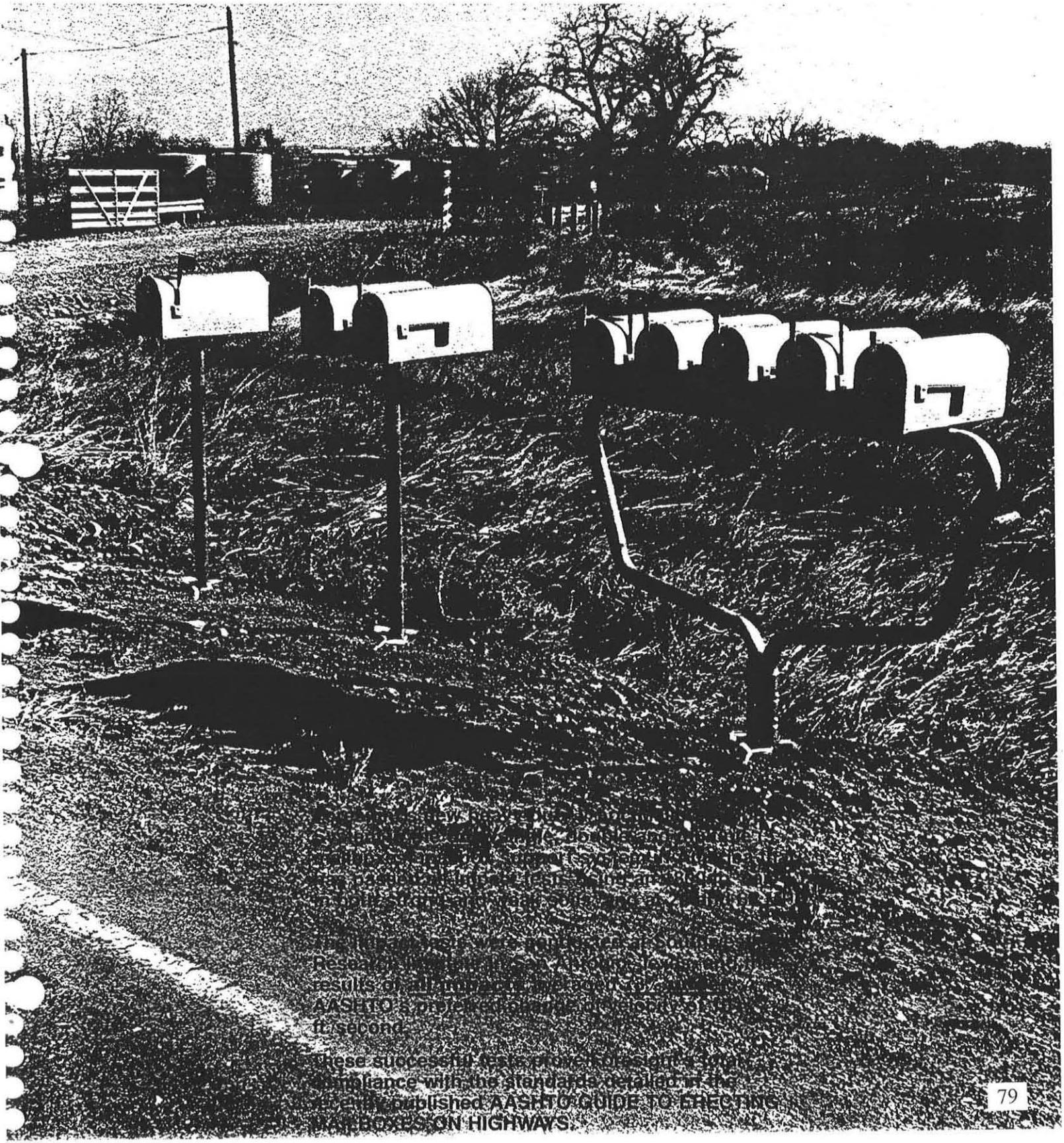
**Distributed by:**

FORESIGHT® PRODUCTS INC.

Covered by one or more of the following U.S. Patents 4,021,977, 4,320,968, 4,286,747. Other patents pending.

Patented in the United States and other countries. Additional patents pending.

# Foresight's V-LOC® Mailbox Support Systems! Crash Tested To Meet All NCHRP 230 And AASHTO Performance Requirements!



Research [illegible] results of [illegible] AASHTO [illegible] ft./second.

These successful tests prove [illegible] compliance with the standards detailed in the [illegible] published AASHTO GUIDE TO ERECTING MAILBOXES ON HIGHWAYS.

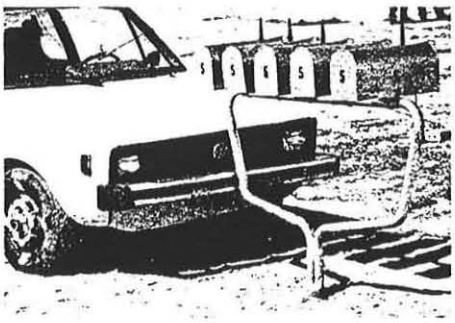
# Test Conclusions Published by the Southwest Research Institute

In all four tests the V-Loc Socket activated its yield and release mechanism as it was designed to do, and in all instances the sockets were re-usable. No debris contacted the windshield or showed potential for entering the passenger compartment, and the vehicle remained stable in decelerating to the final resting position.

The same vehicle was used in all four tests and, after the test series was complete, the vehicle was still operable and no damage to the suspension or steering system could be detected.

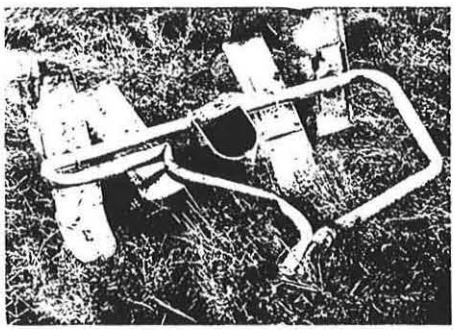
*This 1800 lb. car was used in all four tests. Notice that only minimal cosmetic damage was done to the car, and no other damage at all could be found.*

## Actual Test Photos

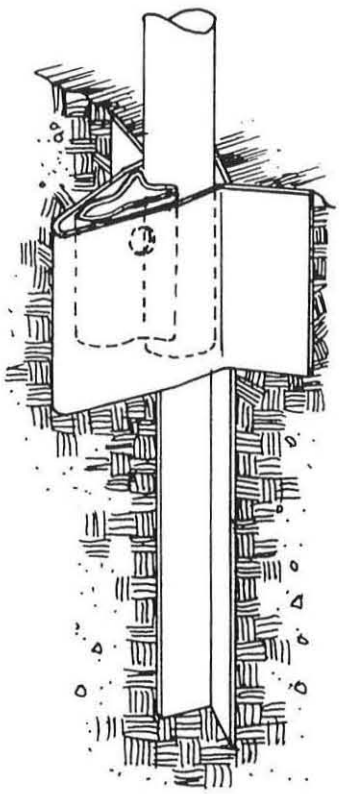


*1800 lb. car approaches Foresight multiple mailbox system*


*Car impacts mailboxes*



*Mailbox system yields and breaks away safely*



The V-Loc Socket in which the mailbox post is placed is an integral and important part of the Foresight Mailbox Support System. V-Loc is installed flush with the surface of the ground and becomes a permanent post hole which can be used over and over again with many posts.

When a vehicle impacts the post in a V-Loc Socket, the post yields and releases from the socket, does not penetrate the car's windshield, and leaves no stub to puncture tires or cause the driver to lose control of the car.

For complete information on the Foresight Mailbox Support System, a copy of the test results, and the name of your nearest distributor, **call today.** Foresight Products World Headquarters, 6430 E. 49th Drive, Commerce City, Colorado 80022 Phone 1-800-325-5360 or (303) 286-8955.

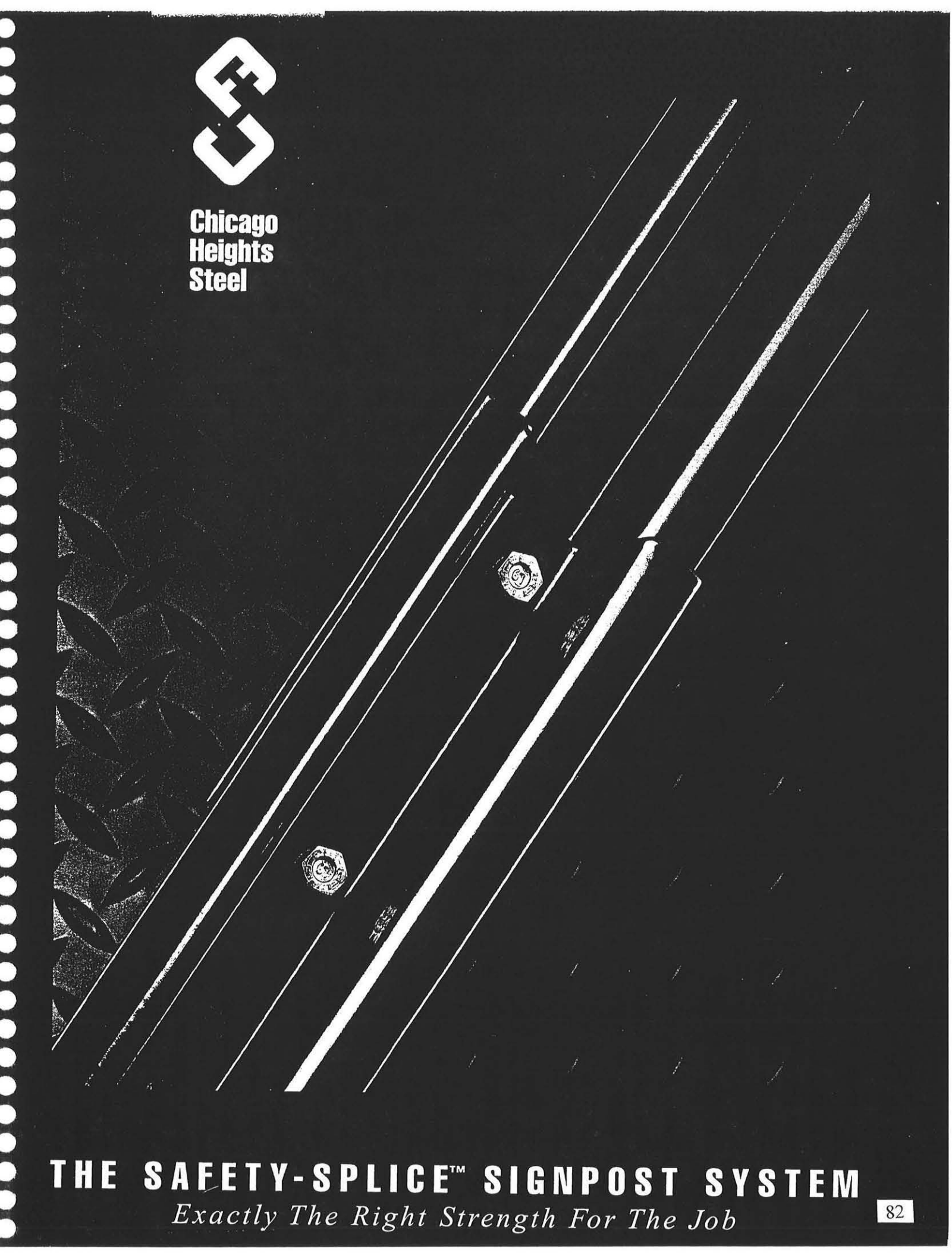
FORESIGHT® PRODUCTS INC.

Covered by one or more of the following U.S. patents: 4,021,977-4,320,068-4,286,747. Other patents pending.

**Distributed by:**

# APPENDIX F

## Chicago Heights Steel

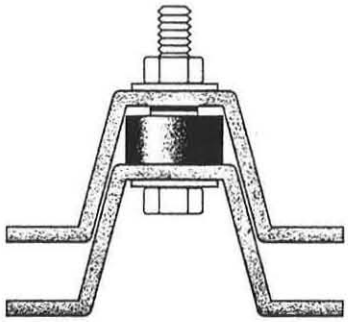

Chicago
Heights
Steel
THE SAFETY-SPLICE™ SIGNPOST SYSTEM
Exactly The Right Strength For The Job
82

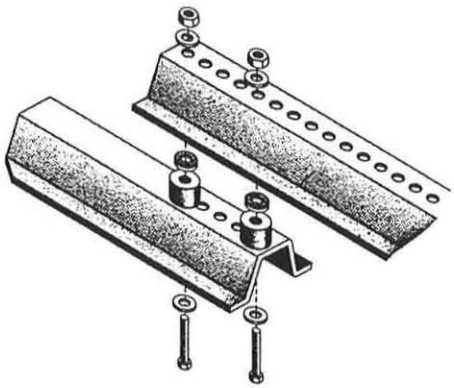
# The Safety-Splice™ Signpost System From Chicago Heights Steel

## Now Get Both Safety And Economy In An FHWA Approved Base Break-Away System!

The SAFETY-SPLICE™ Signpost System from Chicago Heights Steel is a unique, easy-to-install, ground mounted and bolted base break-away system for *any* size channel, *up to and including 4 lb. posts*!

Other systems are based on the assumption that higher yield strength posts make one system better than others, which isn't so. The SAFETY-SPLICE™ System offers a tensile strength of 70,000 psi–exactly the right strength for break-away post systems. At this strength, vehicle impact is transmitted through the post to the splice hardware. Systems using higher yield strength posts are brittle and can fracture at the point of impact (bumper height), scrapping the bottom of the vehicle or puncturing the passenger compartment, the fuel tank or both.





### Ingeniously Simple Design Offers Fast Installation In Any Terrain!

Though designed with the safety of both motorists *and* your installation crews in mind, the SAFETY-SPLICE™ System still costs considerably less than other competitive U-channel break-away systems! Because the SAFETY-SPLICE™ System uses just two special bolts and spacers to join the base to the top post, your installation crews can install more posts *faster*; they'll spend less time working by the side of the road, thus reducing their exposure to the risk of traffic-related injuries.

When you add up the low cost of SAFETY-SPLICE™ System components and the speed and efficiency with which they can be installed, you'll see why it's today's system of choice for both safety *and* economy!

### The System That's So Secure It's Both FHWA And AASHTO Approved!

The SAFETY-SPLICE™ Signpost System securely nests and bolts two U-Channel posts together–yet breaks away on impact.

The System has been tested and approved for multiple post installations, up to three 4 lb. signposts in either strong or weak soil (NCHRP 350). For single or multiple post installations, the SAFETY-SPLICE™ System stands up to a variety of wind pressure conditions and meets the new FHWA guidelines. *(See Table below.)*

## Dual Supports, Sign Design Area Values

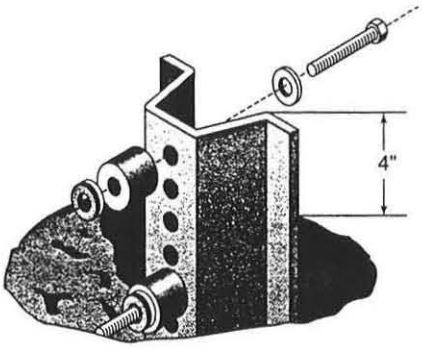
**Maximum Design Sign Area For Two Supports, S.F.***

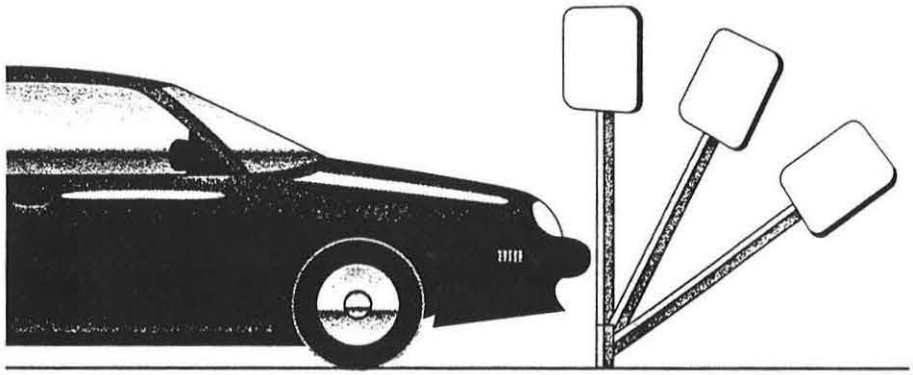
**For three supports, multiply the design area by 1.5.**

| Support Size* | Sign Centroid Height Above Ground, ft. | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 5' | 6' | 7' | 8' | 9' | 10' | 11' | 12' | 13' | 14' |
| 2.0 lb./ft. | 23.3 | 19.4 | 16.6 | 14.5 | 12.9 | 11.6 | 10.5 | 9.7 | 8.9 | 8.3 |
| 2.5 lb./ft. | 29.8 | 24.8 | 21.3 | 18.6 | 16.5 | 14.9 | 13.6 | 12.4 | 11.5 | 10.6 |
| 3.0 lb./ft. | 41.6 | 39.6 | 29.7 | 26.0 | 23.1 | 20.7 | 18.9 | 17.4 | 16.0 | 14.8 |
| 4.0 lb./ft. | 57.8 | 48.1 | 41.3 | 36.1 | 32.1 | 28.8 | 26.2 | 24.1 | 22.2 | 20.6 |

* *Chicago Heights Shapes, Fy = 70 ksi*

* *Using the values and procedures from the 1985 AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals using a 1.12 Cd. A design wind pressure of 17 psf was applied corresponding to 70 mph wind conditions per the AASHTO Specification.*



**The System That's As Easy To Install As 1-2-3!**

SAFETY-SPLICE™ Signpost System hardware consists of two high performance Grade 9 bolts and nuts, each with two Grade 9 washers and two unique spacers with easy slide-on retaining washers. These specially designed components make break-away post assembly simple and fast.

**1.** Dig a small, shallow hole approximately 6 inches in diameter and 2 inches deep; drive the ground post into the center of the hole leaving the top 4 inches above grade level exposed.

**2.** Place one bolt in the 1st and 5th holes in the ground post. Slide a spacer and push-on retaining washer onto each bolt, leaving both bolt ends exposed.

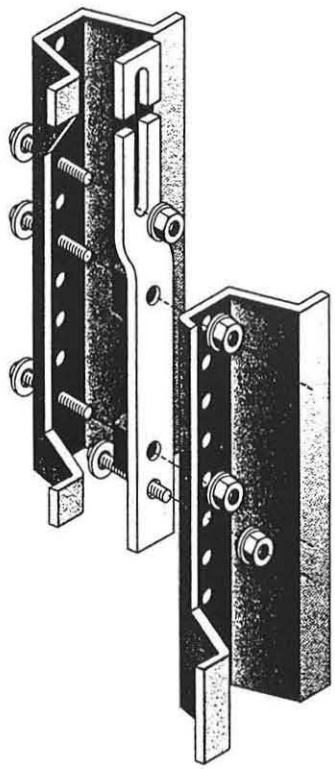
**3.** The top post is then nested over the end of the ground post and seated on the bolts. Lock nuts and washers are then installed and tightened and the earth around the post hole replaced and tamped firmly to complete the installation.

**NOTE:** Because SAFETY-SPLICE™ U-channels have holes punched along the full length, undamaged portions can be re-used even after impact – as crosspieces and horizontal supports, extensions, reinforcing posts, delineators and temporary signing.

## Safety-Splice™ Signposts With Universal Retaining Straps From Chicago Heights Steel

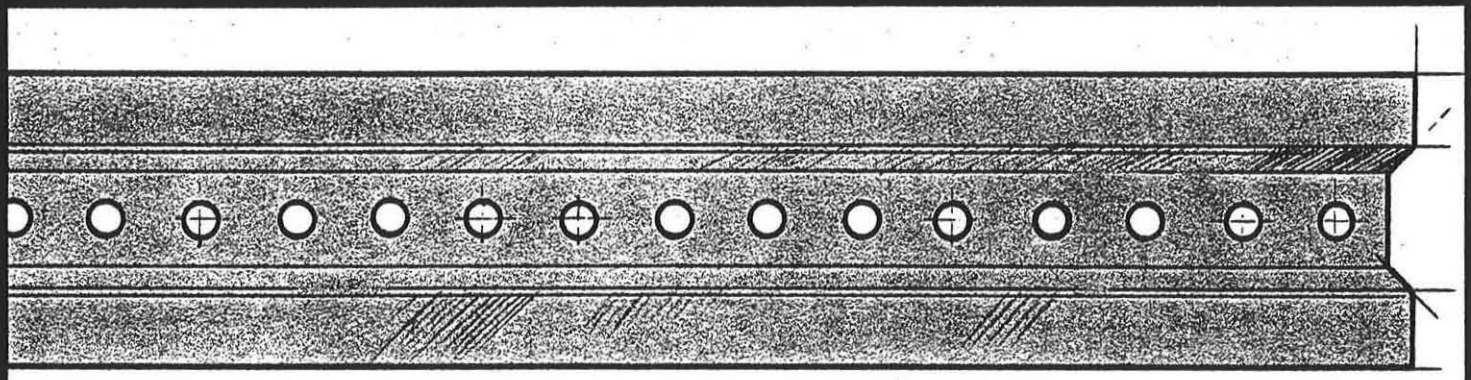
Hundreds of thousands of "Eze-Erect*" signpost systems have already been installed throughout the U.S. as single posts or in clusters. Designed for fast, easy installation, SAFETY-SPLICE™ signposts with universal retaining straps offer all of the same features, and – because of their 70,000 psi tensile strength – they can be easily driven into hardpan or even asphalt. The retaining strap securely holds the sign and post to the base upon impact. This safety feature is very important where the sign could be launched into intersections or other lanes of traffic.

Installation can be done with simple hand tools and usually takes less than 15 minutes. Dig a 2 inch deep hole and drive the base post until only the top 12 inches are exposed. Loosely attach the bottom bolt through the base post and retaining strap then drive the post to 4 inches. Secure the retaining strap as shown and bolt the signpost (with pre-mounted sign) to the base post. Back fill the hole and the job is complete.

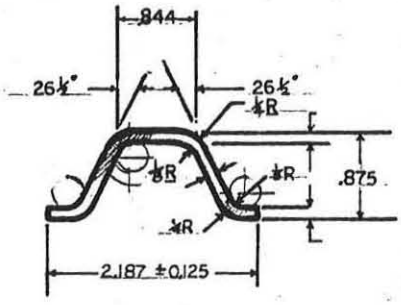


SAFETY-SPLICE™ signposts have the same section design as the Eze-Erect™ system. Our components are approved by FHWA for repair or replacement of components in any existing Eze-Erect™ system.

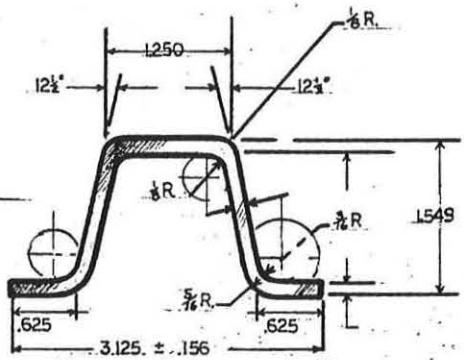
**Trademark of Franklin Steel*



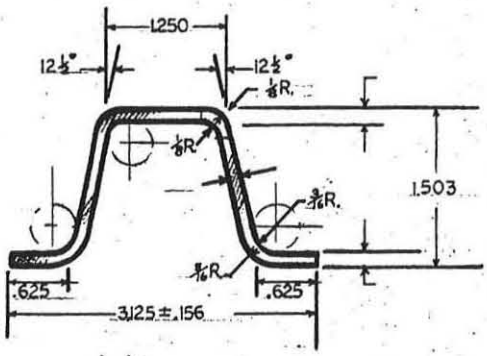
**1.12**
C-120



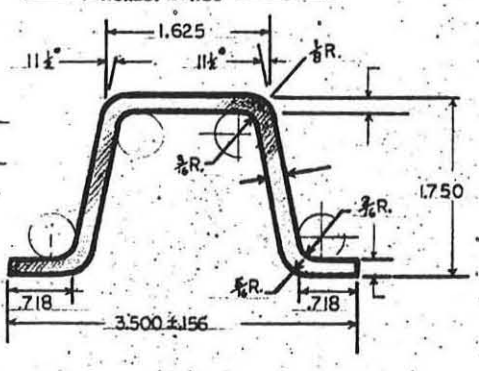

**2.50**
C-127



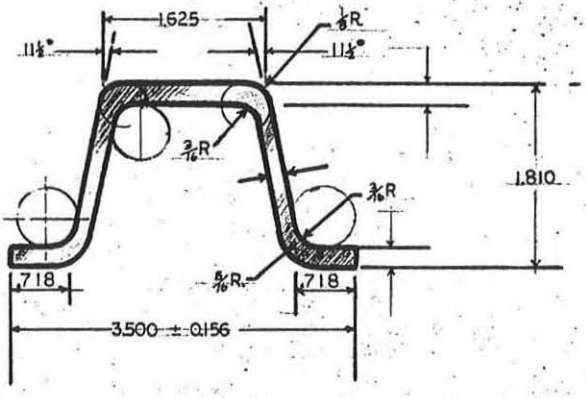

**2.00**
C-128




**3.00**
C-129




**4.00**
C-134




Chicago Heights Steel
211 E. Main • P.O. Box 129 • Chicago Heights, IL 60411
708-756-5662 • 1-800-424-4487 • FAX 708-756-5628

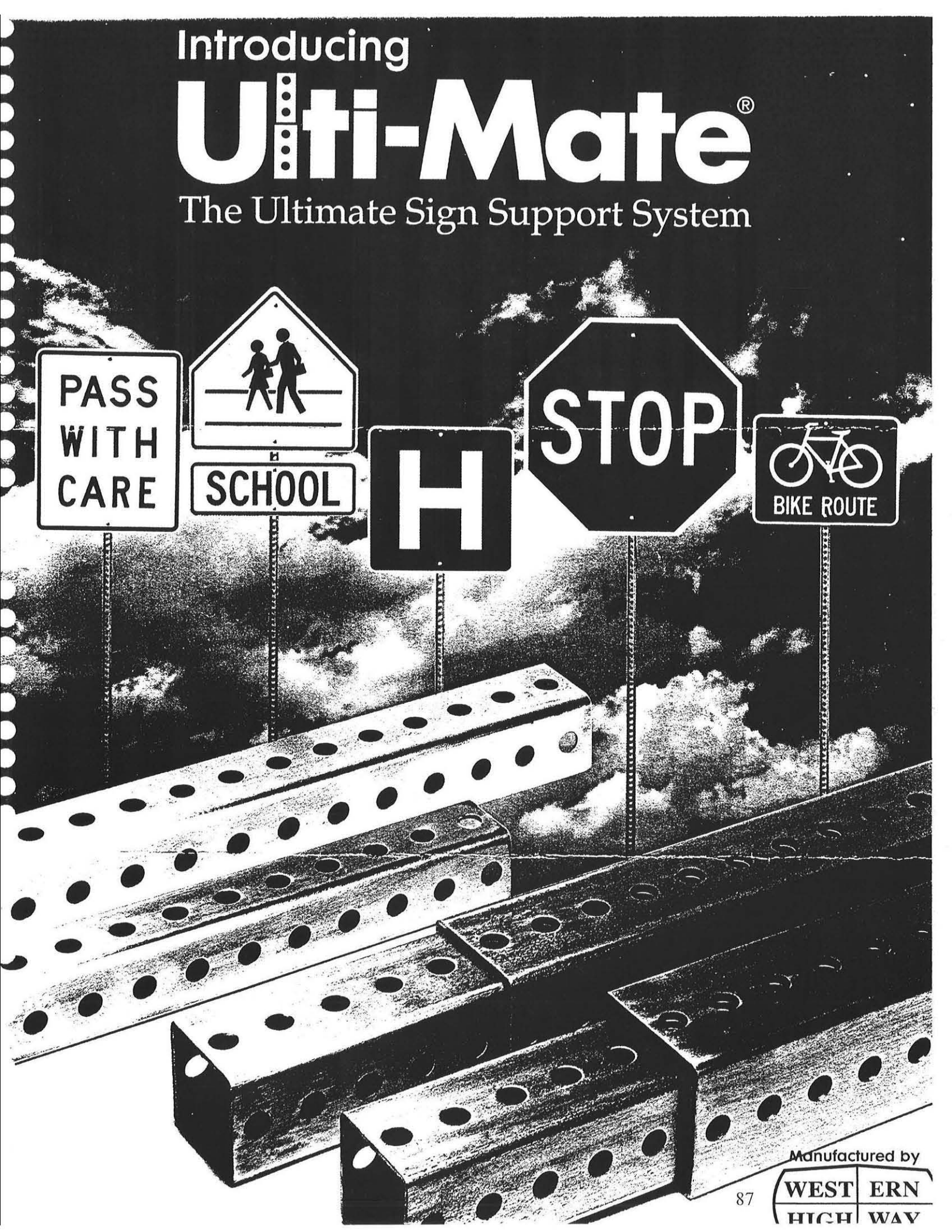
# APPENDIX G

## Western Highway Products

Introducing

# Uti-Mate®

## The Ultimate Sign Support System




Manufactured by

WESTERN HIGHWAY

# Ulti-Mate®

The Ultimate Sign Support System

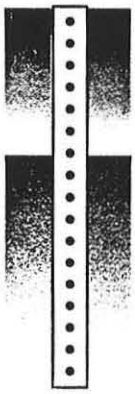
Traffic signs are the primary source of information for motorists. The biggest and brightest sign is only effective if the support it is mounted on keeps the sign in its intended position. Sign supports need to be strong, versatile and cost effective. The Ulti-Mate® sign support system, approved by the Federal Highway Administration, is the most reliable, economical and easiest to install support system available.

## MATERIALS & SPECIFICATIONS

The Ulti-Mate sign support system is available in 12 and 14 gage steel complying with ASTM specification A653, hot dip galvanized conforming to coating designation G-90 for excellent corrosion prevention.

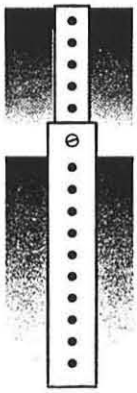
- Available with 7/16" holes on 1" centers on 2 or 4 sides (11.1mm on 25.4mm centers).
- The Ulti-Mate sign support system is completely compatible with all existing square posts.
- Mating tube sections allow for fast, safe ground level installations.
- Ground anchor posts allow for rapid replacement installations when necessary.
- Square tube sections provide superior resistance to wind and other forces over U-channel or round posts.
- The Ulti-Mate sign support system provides four flat surfaces for mounting signs in any direction and at any height without the need for additional hardware.
- FHWA approved as meeting safety requirements for sign supports.
- Custom sign support colors available on request.

## FHWA APPROVED INSTALLATIONS



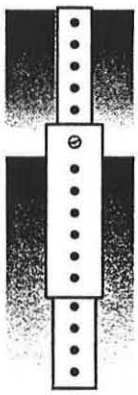
### DIRECT INSTALLATION

The Ulti-Mate sign post can be installed directly into the ground using power equipment or a sledge-hammer with driving cap.



### EZ INSTALLATION

The Ulti-Mate 12 gage anchor system allows crews to work at ground level for fast installations and replacements. The Ulti-Mate anchor is installed directly into the ground, leaving 1 or 2 holes above grade level. The Ulti-Mate sign post slides into the anchor for safe and easy installations.



### HI-IMPACT INSTALLATION

The Ulti-Mate double 12 gage system is for areas that require frequent replacements due to damaged sign posts. This unique method utilizes a two-piece breakaway anchor that makes replacement work fast and safe.

For an easy to follow post-selection ordering guide, contact your local Ulti-Mate distributor.

## AVAILABLE PRODUCTS

| | English | | | | Metric | |
|---|---|---|---|---|---|---|
| | Wall Thickness | | Pounds | | Wall Thickness | Kilograms |
| Tube Size | Gage | Inches | Per Foot | Tube Size | (mm) | Per Meter |
| 1.75 x 1.75 | 14 | 0.083 | 1.71 | 44.45 x 44.45 | 2.10 | 2.54 |
| 2.00 x 2.00 | 14 | 0.083 | 1.99 | 50.80 x 50.80 | 2.10 | 2.96 |
| 2.25 x 2.25 | 14 | 0.083 | 2.28 | 57.15 x 57.15 | 2.10 | 3.39 |
| 1.50 x 1.50 | 12 | 0.105 | 1.74 | 38.10 x 38.10 | 2.66 | 2.59 |
| 1.75 x 1.75 | 12 | 0.105 | 2.09 | 44.45 x 44.45 | 2.66 | 3.11 |
| 2.00 x 2.00 | 12 | 0.105 | 2.44 | 50.80 x 50.80 | 2.66 | 3.63 |
| 2.25 x 2.25 | 12 | 0.105 | 2.79 | 57.15 x 57.15 | 2.66 | 4.16 |
| 2.50 x 2.50 | 12 | 0.105 | 3.14 | 63.50 x 63.50 | 2.66 | 4.69 |

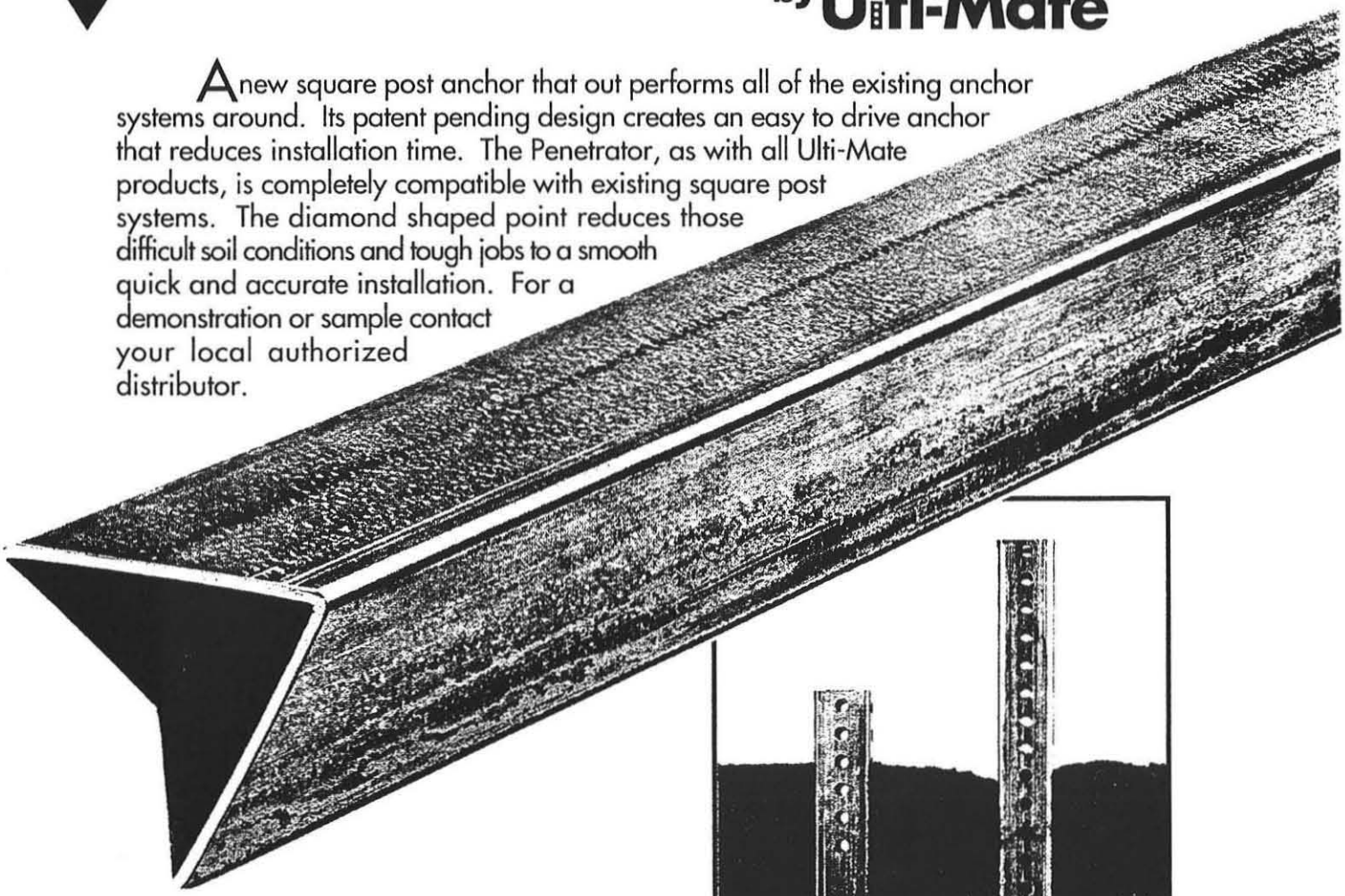
Distributed by:

For the name of your closest authorized distributor, call Ultimate Highway Sales at (800) 730-4939.
http://www.westernhighway.com
E-mail: whpsales@westernhighway.com

# The Penetrator™

by Ulti-Mate®

A new square post anchor that out performs all of the existing anchor systems around. Its patent pending design creates an easy to drive anchor that reduces installation time. The Penetrator, as with all Ulti-Mate products, is completely compatible with existing square post systems. The diamond shaped point reduces those difficult soil conditions and tough jobs to a smooth quick and accurate installation. For a demonstration or sample contact your local authorized distributor.

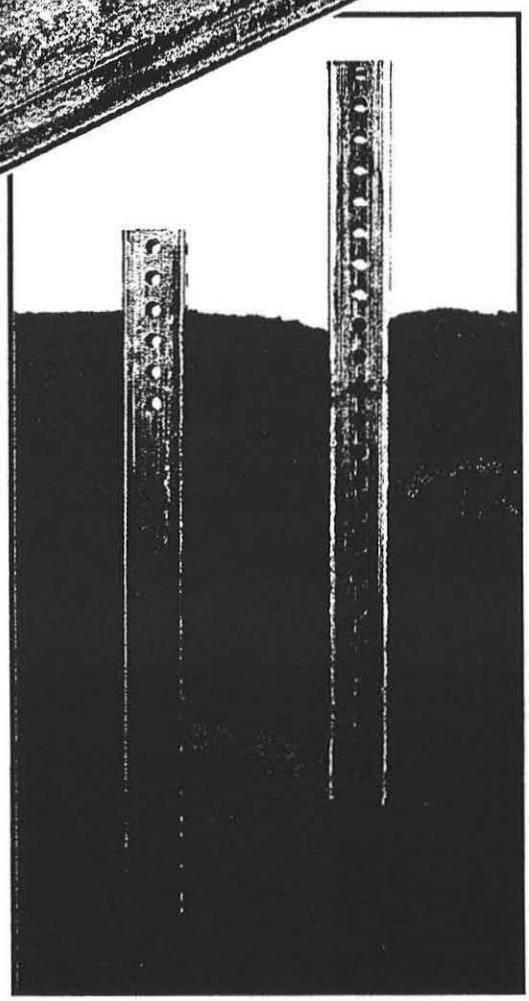


For your closest authorized distributor call:
Ultimate Highway Sales at 800/730•4939

Manufactured by

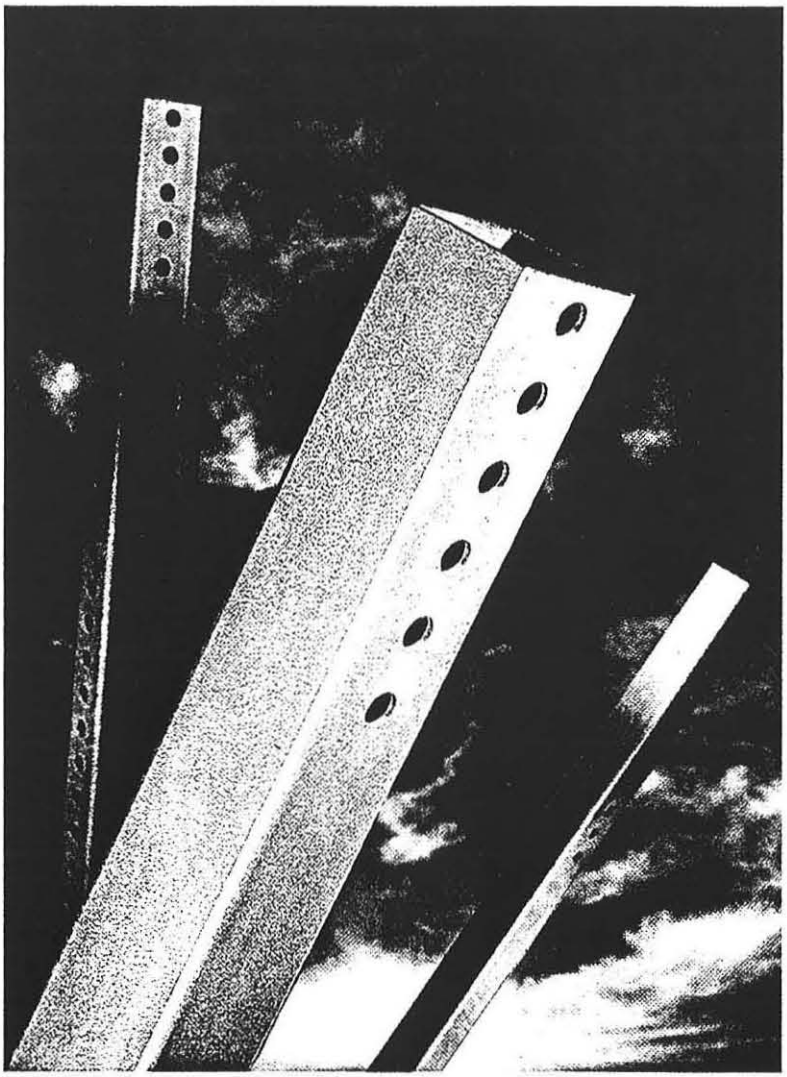
WESTERN HIGHWAY

http://www.westernhighway.com
E-mail: whpsales@westernhighway.com



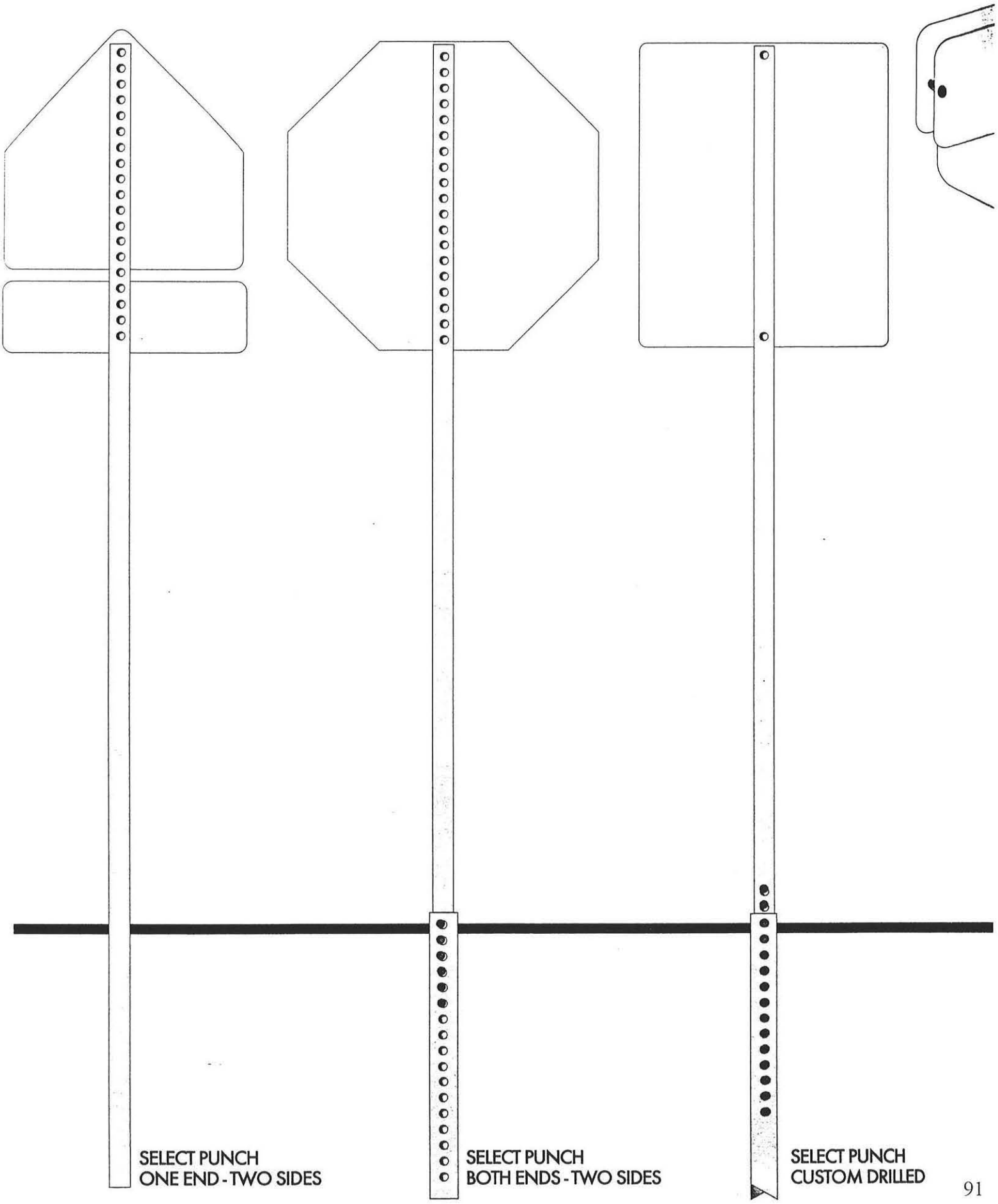
The Penetrator  Standard Square Post

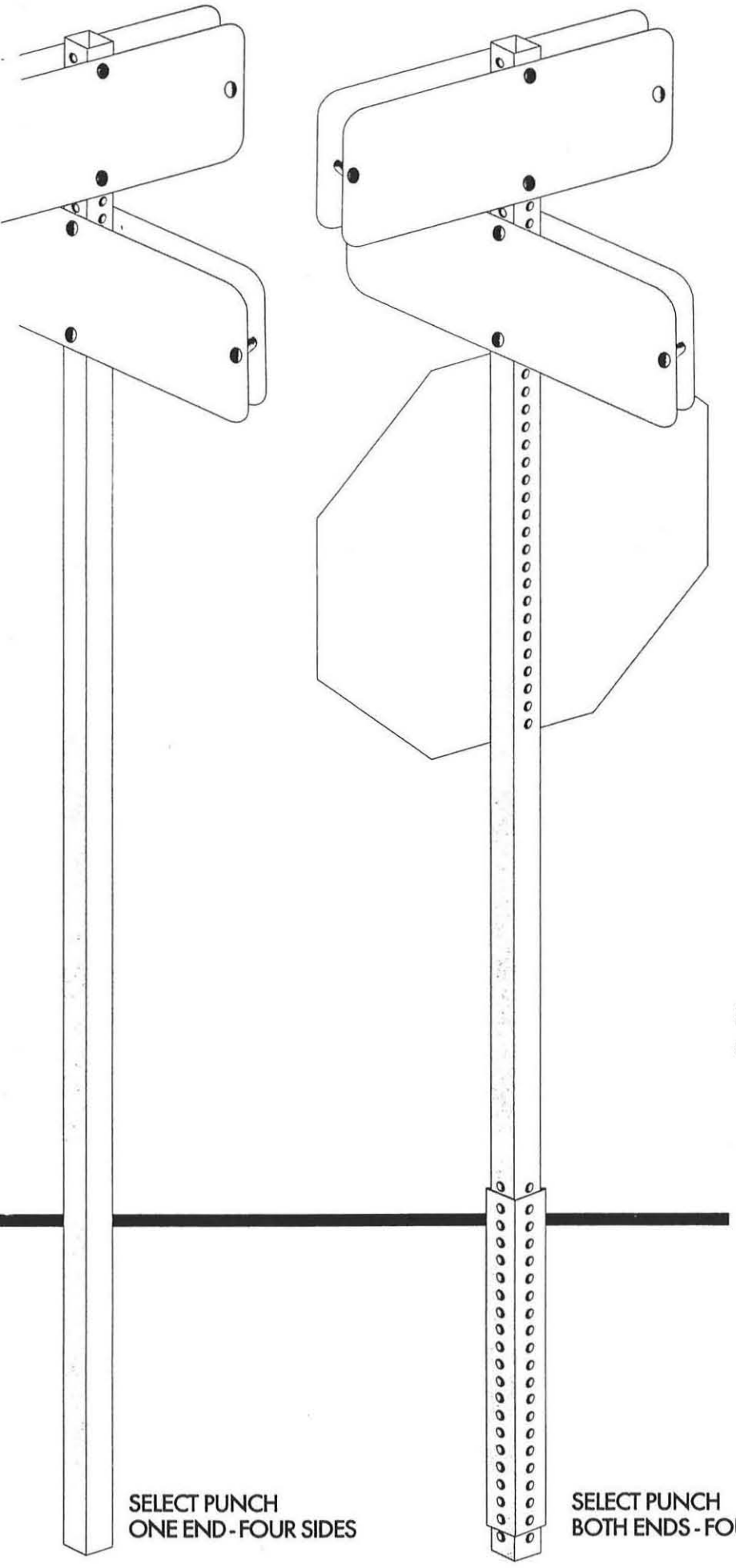
# SELECT PUNCH



by Uti-Mate®

The Ultimate Sign Support System


SELECT PUNCH
ONE END - TWO SIDES
SELECT PUNCH
BOTH ENDS - TWO SIDES
SELECT PUNCH
CUSTOM DRILLED



SELECT PUNCH
ONE END - FOUR SIDES

SELECT PUNCH
BOTH ENDS - FOUR SIDES

# Because you don't need all those holes...

Since the introduction of Ulti-Mate, the Ultimate Sign Support System, we have talked to highway engineers, designers and installers across the country on how to make the best better. The most common response was, "We don't need all those holes". The typical twelve foot post has 564 holes; in most cases only 2 holes are required. With that in mind, we are pleased to offer the Select Punch by Ulti-Mate. Choose the option that best serves your needs... No more unnecessary holes.

- Continuous punching in increments of six, on two or four sides and from either end.
- Custom drilling available to your exact location and hole size as required.
- Also available on all base posts including the Penetrator.
- Minimum of 25 posts per order.

Select Punch by Ulti-Mate. You talked and we listened. **The best just got better.**

**Ulti-Mate®**

The Ultimate Sign Support System

Manufactured by

WEST ERN
HIGH WAY

*Additional Products:*

*Custom Colored Posts*

•

*The Penetrator*

•

*The Ultimate Barricade*

•

*Select Punch*

•

*Complete Accessories*

***We not only stand behind our product,***
***We put our name on it.***

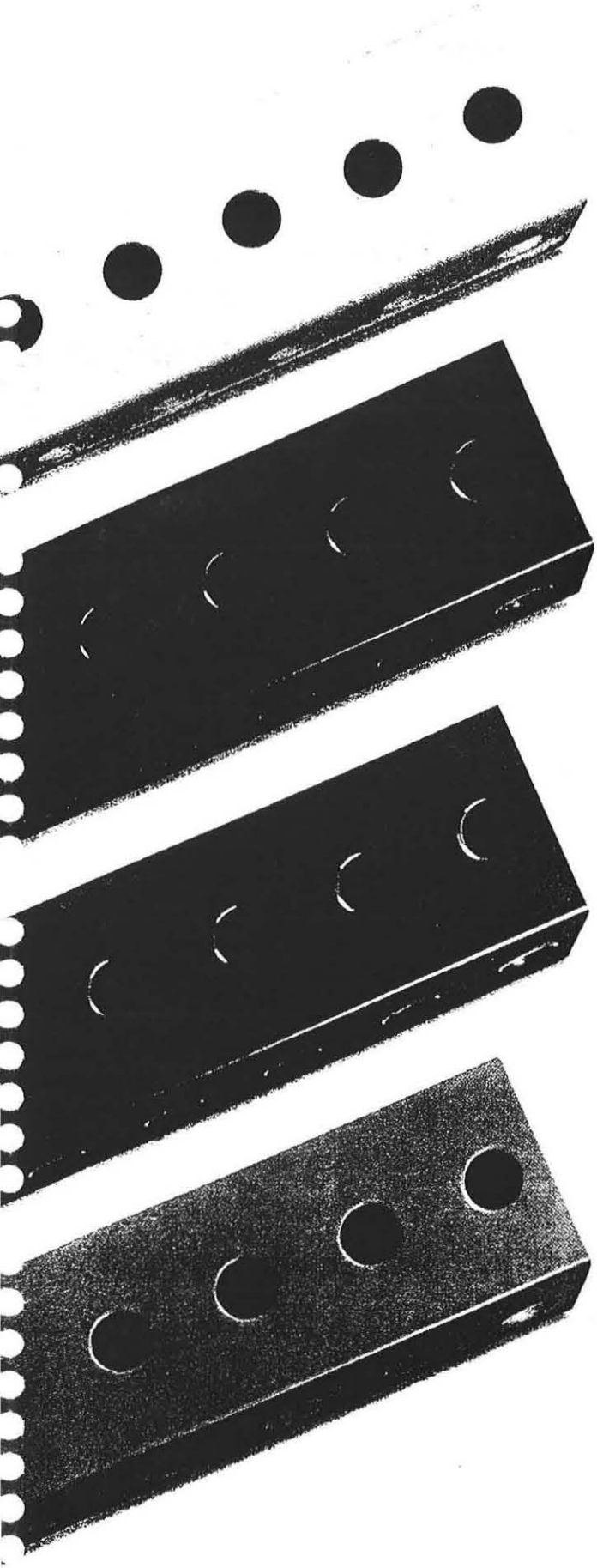
*Distributed by:*

*For the name of your closest authorized distributor, call Ultimate Highway Sales at (800) 730-4939.*
*http://www.westernhighway.com*
*E-mail: whpsales@westernhighway.com*

**Uti-Mate®**
The Ultimate Sign Support System

*Manufactured by*

WEST ERN
HIGH WAY



# Ulti-Mate® Colors... Unlimited

The Ulti-Mate® square steel tube sign support system is now available in four standard colors and an unlimited number of custom colors to fit your every need. All colors will be produced utilizing a Polyester TGIC Powder Coating in a high-gloss finish. In field tests, powder coating has shown to outlast all other known finishes for color intensity and durability. Applied to conform with the manufacturer's specification of a minimum of 2-mil thickness, the powder coating will be applied after all fabrication, cutting and punching has been completed. The finished product will be custom packaged in order to protect the post during the shipping process. Now you can have the Ulti-Mate Sign Support System in your favorite color!

For additional information or samples, call Ultimate Highway Sales at 800/730-4939 for your closest authorized distributor.

Manufactured by

WEST ERN
HIGH WAY

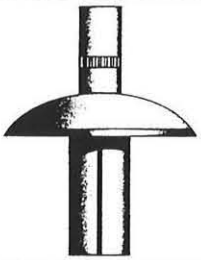
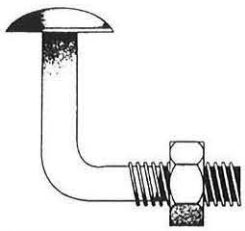
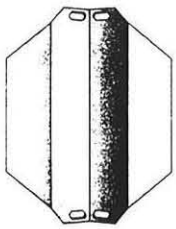
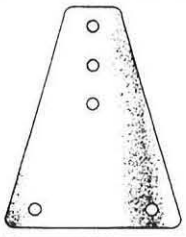
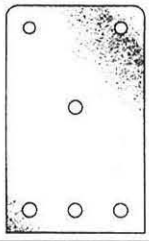
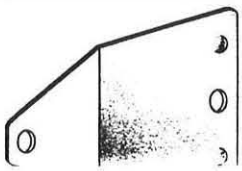
Distributed by:

http://www.westernhighway.com
E-mail: whpsales@westernhighway.com

# Uti-Mate®

The Ultimate Sign Support System

# Accessories

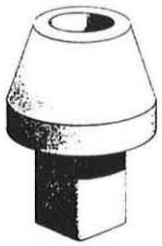
| | Part No. | Description | Quantity | Unit |
|---|---|---|---|---|
|  | UM-38S | 3/8" Drive Rivets-Steel | 100 | Bx. |
| | UM-38A | 3/8" Drive Rivets-Aluminum<br>Colors Available | 100 | Bx. |
|  | UM-SQCB | Corner Bolt (1 1/2" thru 2" tube) | 100 | Bx. |
| | UM-SQCBL | Corner Bolt (2" thru 2 1/2" tube) | 100 | Bx. |
|  | UM-TP1 | Tamper Proof Bolt Set<br>5/16" x 2 1/2" Button Head<br>Bolt & Vandalgard Nut | 100 | Bx. |
|  | UM-SS | Soil Stabilizer<br>10 1/2" x 12" 10 Gage Steel | 1 | Ea. |
|  | UM-BB | Break Away Barricade Bracket<br>4 1/2" x 6" 10 Gage Steel | 1 | Ea. |
|  | UM-SP | Splice Plate<br>3" x 5 1/8" 10 Gage Steel | 1 | Ea. |
|  | UM-AMB | Angle Mount Bracket<br>Specify Angle<br>3 1/2" x 6" 10 Gage Steel | 1 | Ea. |

# Uti-Mate®

The Ultimate Sign Support System

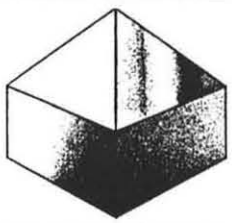
# Accessories

| Part No. | Description | Quantity | Unit |
|---|---|---|---|
| UM-MDC200 | Manual Drive Cap for 2" Anchor Post | 1 | Ea. |
| UM-MDC225 | Manual Drive Cap for 2 1/4" Anchor Post | 1 | Ea. |
| UM-MDC250 | Manual Drive Cap for 2 1/2" Anchor Post | 1 | Ea. |



| | | | |
|---|---|---|---|
| UM-PDC200 | Power Drive Cap for 2" Anchor Post | 1 | Ea. |
| UM-PDC225 | Power Drive Cap for 2 1/4" Anchor Post | 1 | Ea. |
| UM-PDC250 | Power Drive Cap for 2 1/2" Anchor Post | 1 | Ea. |

| | | | |
|---|---|---|---|
| UM-PDCS7/8-325 | Power Drive Shank 7/8" x 3 1/4" | 1 | Ea. |
| UM-PDCS7/8-425 | Power Drive Shank 7/8" x 4 1/4" | 1 | Ea. |
| UM-PDCS1-425 | Power Drive Shank 1" x 4 1/4" | 1 | Ea. |
| UM-PDCS11/8-6 | Power Drive Shank 1 1/8" x 6" | 1 | Ea. |
| UM-PDCS11/4-6 | Power Drive Shank 1 1/4" x 6" | 1 | Ea. |



| | | | |
|---|---|---|---|
| UM-RC175 | Rain Cap for 1 3/4" Post | 1 | Ea. |
| UM-RC200 | Rain Cap for 2" Post | 1 | Ea. |

For the name of your nearest authorized distributor,
call Ultimate Highway Sales at (800) 730•4939, in California (800) 479•3783
http: //www.westernhighway.com
E-mail: whpsales@westernhighway.com

**Distributed by**

# APPENDIX H

## S-Square Tube Products

# SIGN POST DAILY NEWS

January, 1997

## TEL-SQUARE SIGN POST BEING USED FROM COAST TO COAST

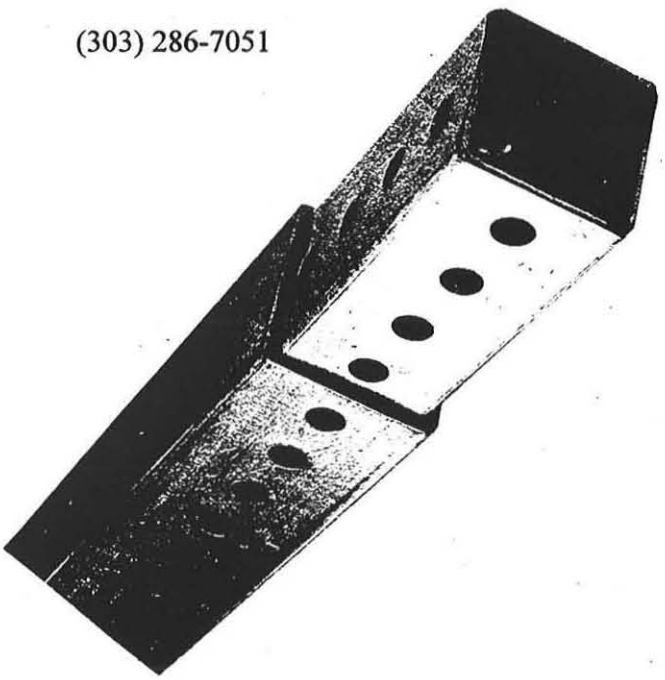
***S-Square to double capacity***

DENVER--- Since its introduction a year ago, **Tel-Square** has become known throughout the country for its high quality and competitive prices. Sign post users from Florida to California have switched to **Tel-Square.**

In order to meet demand and maintain short lead times S-Square is doubling its capacity. They will be operating out of their new facility by the first of February.

CALL TODAY FOR A NEW PRICE LIST AND BROCHURE

(303) 286-7051



Municipalities will soon be issuing bids for sign post. Let S-Square help you beat the competition with their premier sign post

**TEL-SQUARE™**

***Opportunity for Distributors***

S-Square has begun setting up distributors throughout the country but is still looking to cover certain areas. This is a great opportunity to be competitive in areas where the competition has dominated the market.

S SQUARE
TUBE PRODUCTS
5495 EAST 69th AVENUE
COMMERCE CITY, COLORADO 80022

# TEL ○ ○ ○ SQUARE™

## Square Sign Supports

**MATERIAL**

- Available in 12 and 14 gauge
- ASTM designation A653
- Available with holes on 4 sides or no holes
- FHWA approved for breakaway standards
- 7/16" holes on 1" centers

**FINISH**

- Hot dipped galvanized zinc coating conforming to coating designation G-90
- EVERBRIGHT™ finish

**TELESCOPING PROPERTIES**

- Quality controlled tube forming and punching as well as smooth welding flash allows all sizes to telescope with each other and with all existing square signposts.

**SERVICE AND PRICING**

- S-Square carries an extensive inventory and has provided quality service to customers for eleven years. Pricing is very competitive.

*Contact S-Square for price list or information on post installation

AVAILABLE PRODUCTS

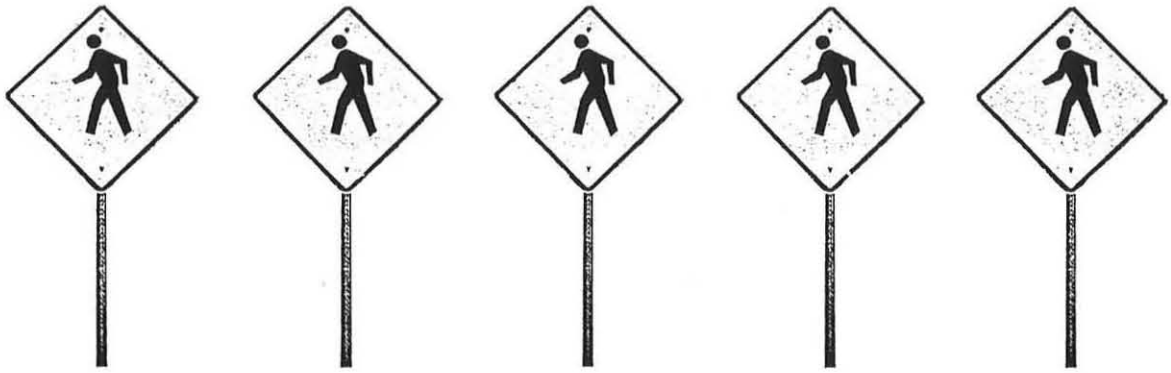
| Tube Size | Thickness Gauge/Inches | | Pounds Per Foot |
|---|---|---|---|
| 1.75 x 1.75 | 14 | .083 | 1.71 |
| 2.00 x 2.00 | 14 | .083 | 1.99 |
| 1.50 x 1.50 | 12 | .105 | 1.74 |
| 1.75 x 1.75 | 12 | .105 | 2.09 |
| 2.00 x 2.00 | 12 | .105 | 2.44 |
| 2.25 x 2.25 | 12 | .105 | 2.79 |
| 2.50 x 2.50 | 12 | .105 | 3.14 |

Distributed By:

# TEL ○ ○ ○ SQUARE™

Square Sign Supports

## ONE SQUARE SIGN POST IS JUST LIKE ANOTHER



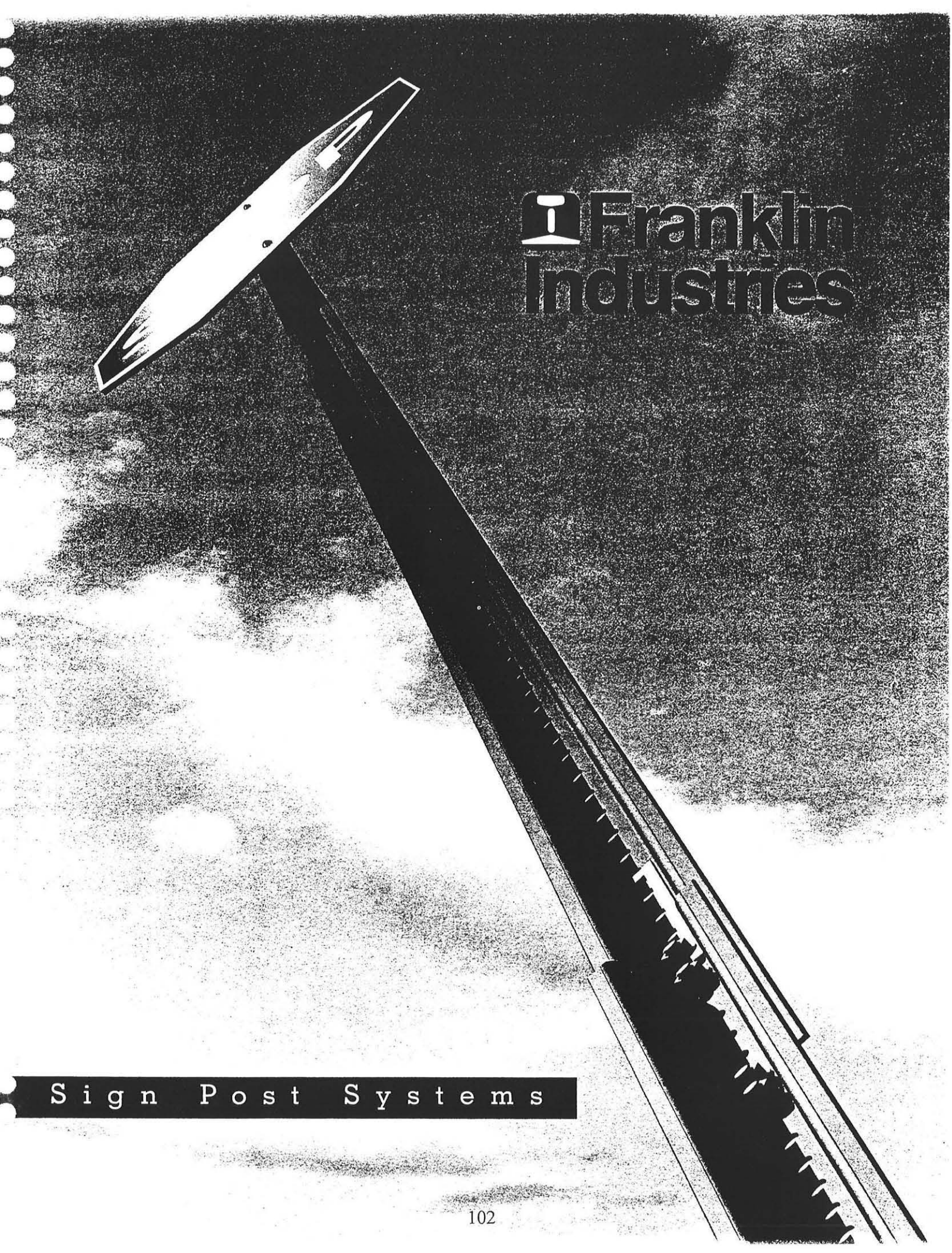
## NOT THIS ONE

Tel-Square stands alone as the only sign support system with EVERBRIGHT.™ EVERBRIGHT is a process in which the hot-dipped galvanized tube is given a grain finish followed by a baked, clear acrylic coating. This gives Tel-Square a high luster and added corrosion protection unlike any other sign support.

Manufactured by:
S-Square Tube Products
5495 E. 69th Ave.
Commerce City, CO 80022
(303) 286-7051
Fax (303) 287-0109

# APPENDIX I

## Franklin Industries Co.


Franklin
Industries
Sign Post Systems

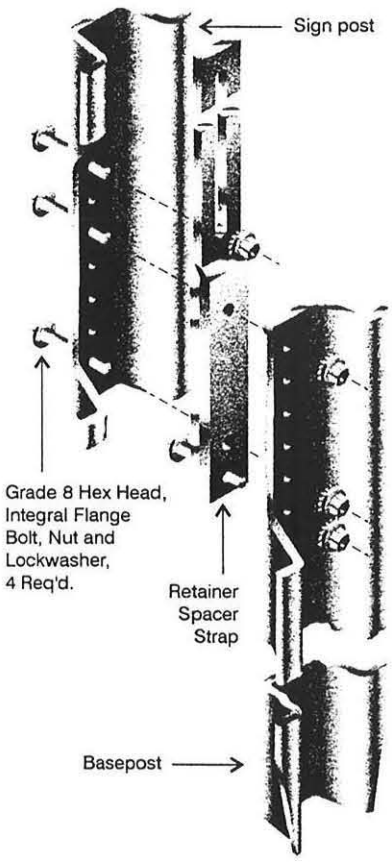
# High Strength Steel Sign Posts

Franklin Flanged Channel Sign Posts are manufactured from high quality, high tensile rail steel and finished with a protective coating of weather resistant baked enamel paint, or galvanized by hot dipping per ASTM A123. They are designed to provide an attractive appearance and years of maintenance-free service. Special colors and finishes can be supplied for special applications.

With Franklin Sign Posts' great strength and rigidity, you can support the same load with a lighter weight post. And with four different sign post weights and two delineator weights available, you can select the exact post to meet each requirement, buying only the steel needed to do the job. One person can install or replace a complete post and sign assembly in minutes. No digging, drilling or concrete to mix.

**Recommended for Warning, Regulatory and Guide Signs**


# Eze-Erect Sign Post System




Eze-Erect sign posts' design permits quick and easy installations from ground level with simple tools. The base posts are readily driven into hard soils, even asphalt. The sign post is then attached with the sign already in place. Crews are quickly trained and most installations take only minutes.

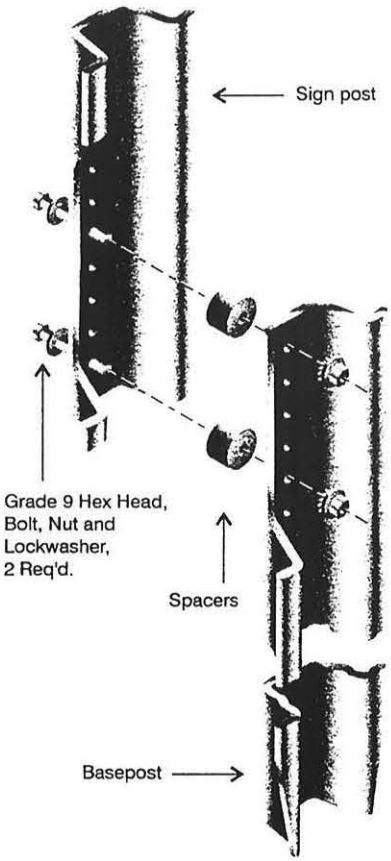
**Connection Strength**
Eze-Erect sign posts' connection develops the full design strength of the sign post; there is no compromise in sign supporting capability.

**Full Versatility**
A complete range of warning, regulatory and guide signs can be supported, from small signs on single posts to very large signs or sign clusters on multiple posts. Eze-Erect sign posts also work well for construction and temporary signing. Whatever your highway message, Eze-Erect sign posts can hold it reliably.

**Low Labor Costs/High Salvage Value**
When impacted, base posts, sign posts and sign panels are often reusable. Even if damaged, sign posts can often be cut into base posts. And more importantly, because of the breakaway action, expensive sign panels, the major cost component of a sign installation are more likely to be reusable.

**Widely Accepted**
Hundreds of thousands of Eze-Erect sign posts are in use throughout the country. Try this proven system in your area and see how Eze-Erect sign posts can save you money.

# Base-Bolted Sign Post System




Franklin Industries' base-bolted sign posts offer many of the advantages of Eze-Erect sign posts at lower cost, except there is no retaining feature. They are an economical alternative when this feature is not required.

**Connection Strength**
The base-bolted connection develops the full design strength of the sign post; so comparable signs can be supported reliably.

**Full Versatility**
Base-bolted sign posts will support any type of warning, regulatory or guide signs, from small signs on single posts to very large signs or sign clusters on multiple posts. Base-bolted sign posts also work well for construction and temporary signing. Franklin Industries' base-bolted sign posts can hold your sign dependably, whatever the message.

**Low Labor Costs/High Salvage Value**
Base posts, sign posts and sign panels are often reusable after impact with an errant vehicle. If damaged, sign posts can often be cut into base posts. But more importantly, because of the breakaway action, expensive sign panels, the major cost component of a sign installation, can most likely be reused.

**Approved By FHWA**
FHWA has approved Franklin Industries sign posts in single and multiple post installations, including up to three 4.0 lb/ft. base-bolted posts in a seven foot path, for all Federal-aid routes and projects.

# Accessories

Drive Caps

Mounting Brackets

Studded "T" Posts

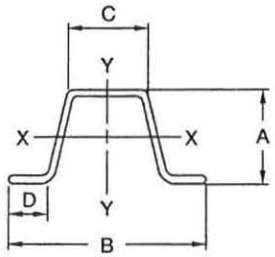
**Drive Caps For Safe Installation**
Protect post ends from driving damage. Driving caps are made of cast steel to withstand constant driving. Available in sizes to fit all Franklin Industries Posts.

Delineator - 3.0 lbs ea., for 1.12 to 1.33 lbs/ft posts
Standard - 11 lbs ea., for 2.0 to 4.0 lbs/ft posts
Heavy Duty - 17 lbs ea., for 2.0 to 4.0 lbs/ft posts

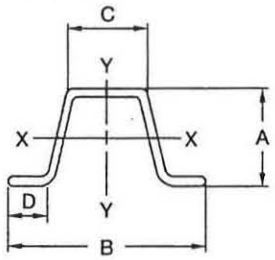
**Mounting Brackets**
Use Franklin Industries posts and brackets for multiple sign and four-way installations.

**Right-of-Way and Silt Fence Posts**
Franklin Studded 'T' Posts are designed for easy installation and trouble free service for right of way and silt fencing. Heavy anchor plates protect against natural "lifting" and vandalism. They are available in 1.25 and 1.33 lbs/ft (ASTM A702) and are either painted or galvanized.

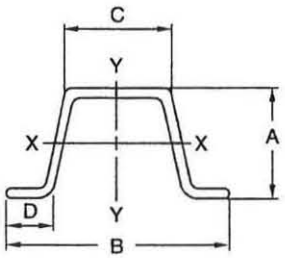
**Sign Post and Base Post**
**Weight - 2.00 lbs/ft**



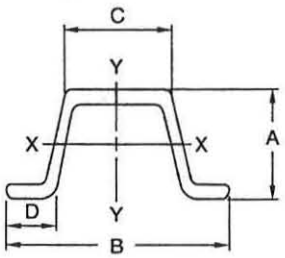

**Sign Post and Base Post**
**Weight - 2.50 lbs/ft**




**Sign Post and Base Post**
**Weight - 3.00 lbs/ft**

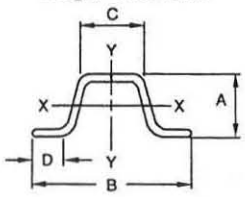



**Sign Post and Base Post**
**Weight - 4.00 lbs/ft**

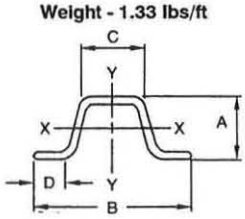



## Delineator Posts

**Weight - 1.12 lbs/ft**




**Weight - 1.33 lbs/ft**




**Material:** Posts are produced from standard "T" rails weighing 91 lbs/yd or more according to ASTM A499-81, Grade 60

**Finish:** Base posts and sign posts are finished with either a baked enamel paint or galvanized per ASTM A123.

**Base Post:** The weight of each base post before punching is 2.00 to 4.00 lbs/ft. The base post is punched with eighteen .375" diameter holes on 1.0" centers, except the first and fifth are .375" x .500" slots, with the first hole 1.0" from the top. The base post is pointed.

**Sign Post:** The weight of each sign post before punching is 2.00 to 4.00 lbs/ft. The sign post is punched with .375" diameter holes on 1.0" centers, full length. The first hole and last hole are 1.0" from the end of post.

Eze-Erect Hardware

**Retainer-Spacer Strap:** 17.125" long x 1.00" wide x .375" thick with .375" offset. The strap is galvanized to ASTM A123.

**Bolts:** Hex head, integral flange conforming to ASTM A354, Grade BD. Size is 5/16" - 18 UNC x 2.0".

**Nuts:** 5/16" - 18 UNC hex head, integral flange conforming to ASTM A563, Grade DH.

**Lockwashers:** 3/8" heavy duty external type.

**Bolts, Nuts and Lockwashers** are cadmium or zinc plated for corrosion resistance.

Base-Bolted Hardware

**Spacers:** 1.0" diameter x .625" thick with .438" hole. The spacers are zinc plated for corrosion resistance.

**Bolts:** Hex head, fully threaded Grade 9, 5/16" - 18 UNC x 1.5"

**Washers:** 5/16" Grade 9

**Nuts:** Hex head, integral flanged lock nut or standard Grade 9 hex head bolt and lockwasher.

**Bolts, Nuts and Washers** are cadmium or zinc plated for corrosion resistance.

### Flanged Channel Properties

| Weight *Lbs/Ft | Dimensions "A" | "B" | "C" | "D" | Area $IN^2$ | X - X Axis + $I(IN^4)$ | $S(IN^3)$ | Y - Y Axis $I(IN^4)$ | $S(IN^3)$ |
|---|---|---|---|---|---|---|---|---|---|
| 2.00 | 1.516 | 3.125 | 1.250 | .625 | .59 | .18 | .23 | .42 | .27 |
| 2.50 | 1.562 | 3.125 | 1.250 | .625 | .74 | .24 | .31 | .55 | .35 |
| 3.00 | 1.750 | 3.500 | 1.625 | .718 | .92 | .40 | .43 | .87 | .50 |
| 4.00 | 1.750 | 3.500 | 1.671 | .718 | 1.24 | .50 | .56 | 1.22 | .69 |

* ± 3 1/2% + Governing Section

### Delineator Properties

| Weight *Lbs/Ft | Dimensions "A" | "B" | "C" | "D" | Area $IN^2$ | X - X Axis + $I(IN^4)$ | $S(IN^3)$ | Y - Y Axis $I(IN^4)$ | $S(IN^3)$ |
|---|---|---|---|---|---|---|---|---|---|
| 1.12 | .841 | 2.037 | .802 | .182 | .329 | .029 | .073 | .100 | .098 |
| 1.33 | .871 | 2.037 | .802 | .182 | .391 | .036 | .088 | .121 | .119 |

* ± 3 1/2% + Governing Section

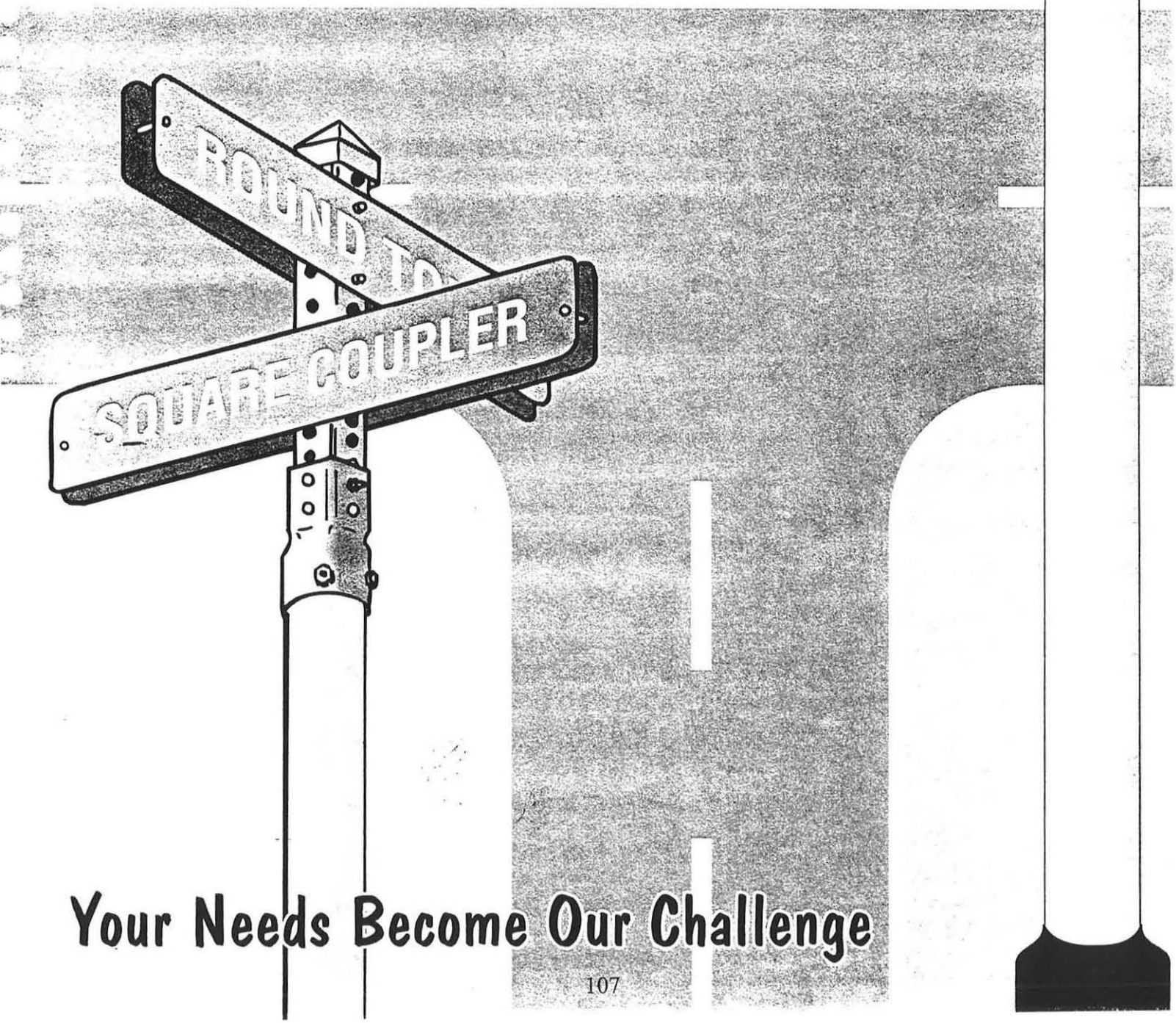
## APPENDIX J

**Xcessories Squared**

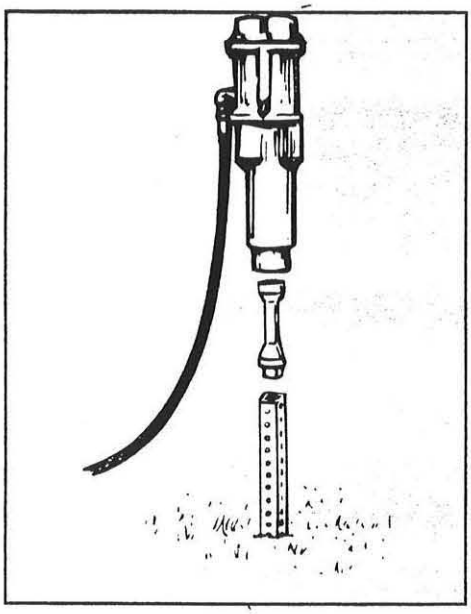
# Xcessories SQUARED

Development & Manufacturing Inc.

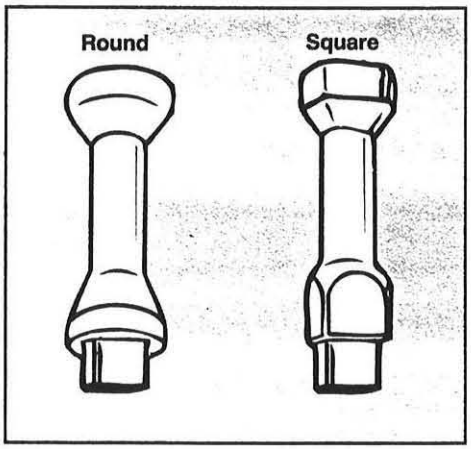
# Traffic Sign Support Systems




## Your Needs Become Our Challenge



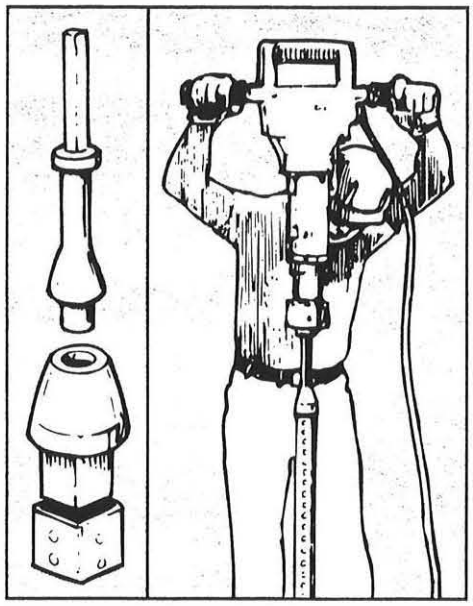
## ADAPTER DRIVE CAPS



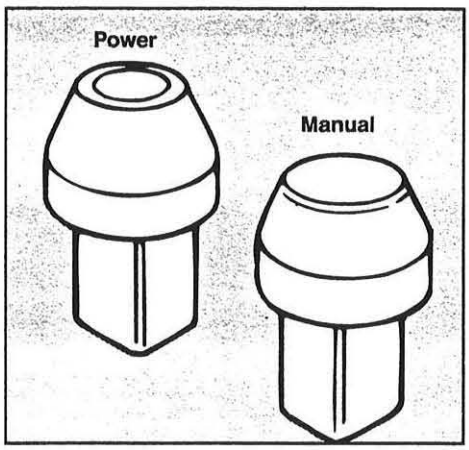

**Part No. SQ175200S**
**thru**
**RD225250**

One piece Driver Adapter to fit piston- type hammer.
STANLEY: SQ------S
FAIRMONT: RD------F
RHINO: RD------R

First three numbers of part number denote I.D. of anchor, last three numbers denote O.D. of anchor.



## DRIVE CAPS/SHANKS



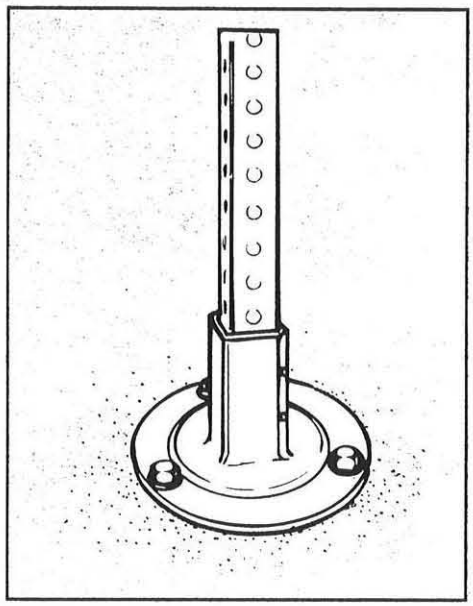

**Part No. DC150175M**
**thru**
**DC250300P**

One piece Drive Cap Manual, or Power to fit jack hammer shanks.

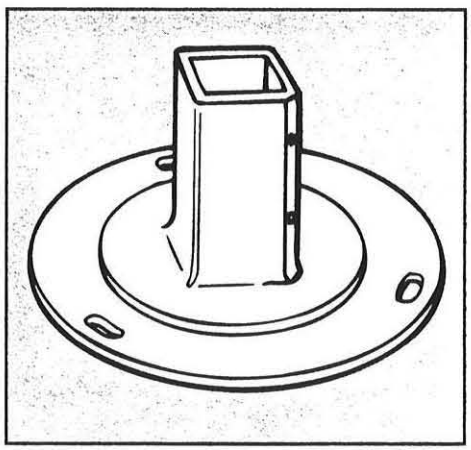
First three numbers of part number denote I.D. of anchor, last three numbers denote O.D. of anchor.

**Part No.: DS3875S**
**thru**
**DS61250S**

Drive shanks to be used with above Power Drive Caps



## PEDESTAL BASES

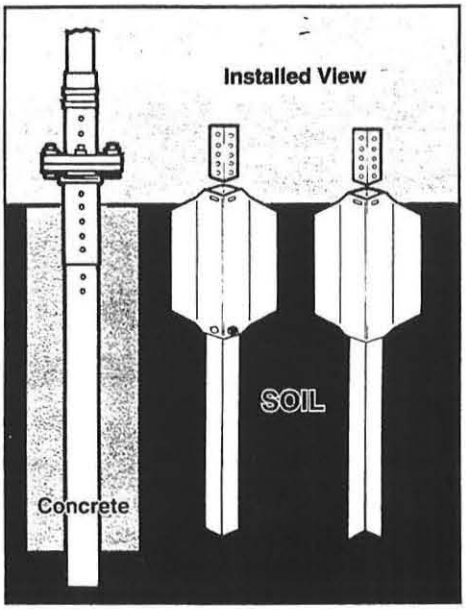


**Part No. PBS200**
**thru**
**PBS238**

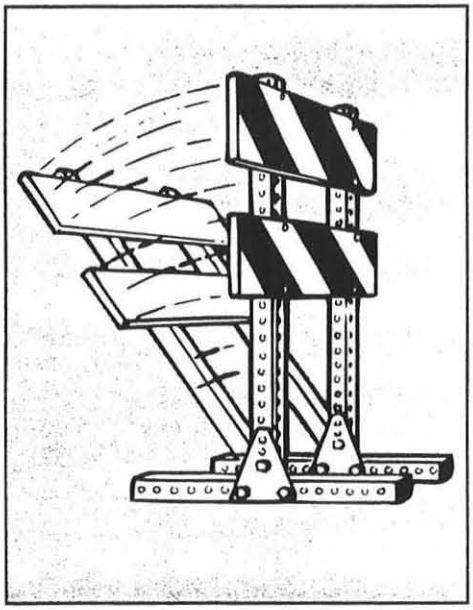
Cast iron base for lag bolting to concrete where coring is undesirable. Fits 2" Sq., 2-1/4" Sq., 2-3/8" Rd. Posts.

Lag bolts not included

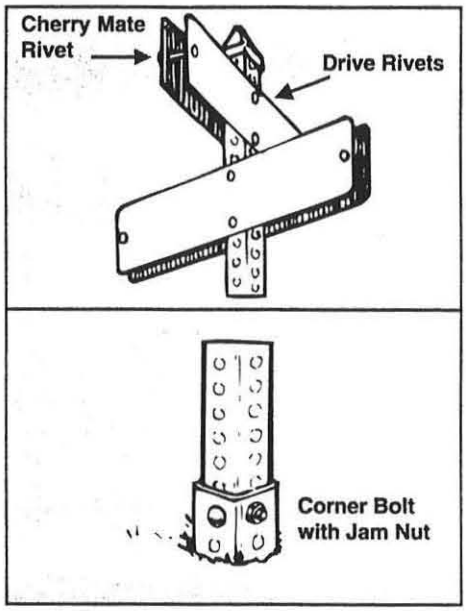
PRICE GROUP → 1 — — → 1 — — → 2



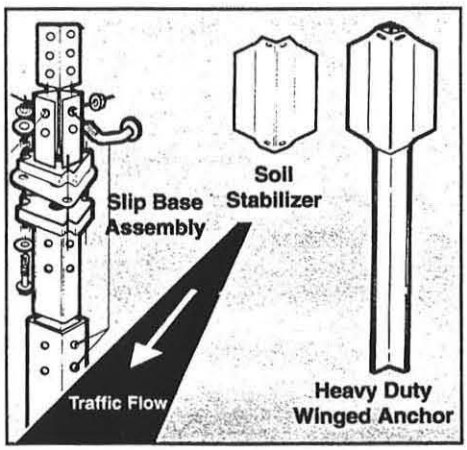

## GROUND ANCHORS



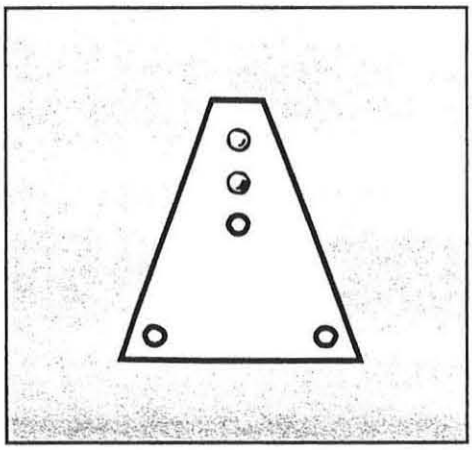
## BARRICADE BRACKETS




## HARDWARE AND MISC.



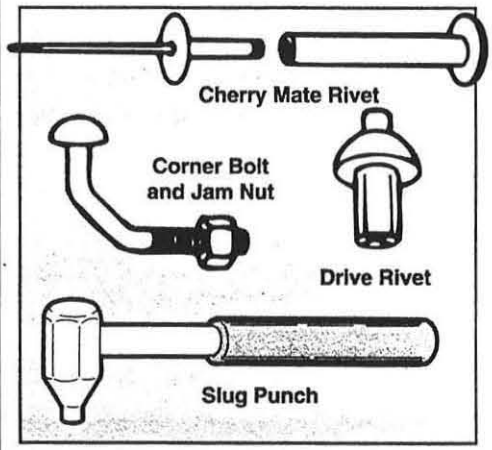

- **SB8-250G Slip Base** for 2-1/2" upright posts.
- **SS10-250 Soil Stabilizer** for bolting to standard anchor in weak soil.
- **HDWA-(200 thru 250)G Heavy Duty Winged Anchor**- one piece welded winged anchor. For 2" thru 2-1/2" Posts.



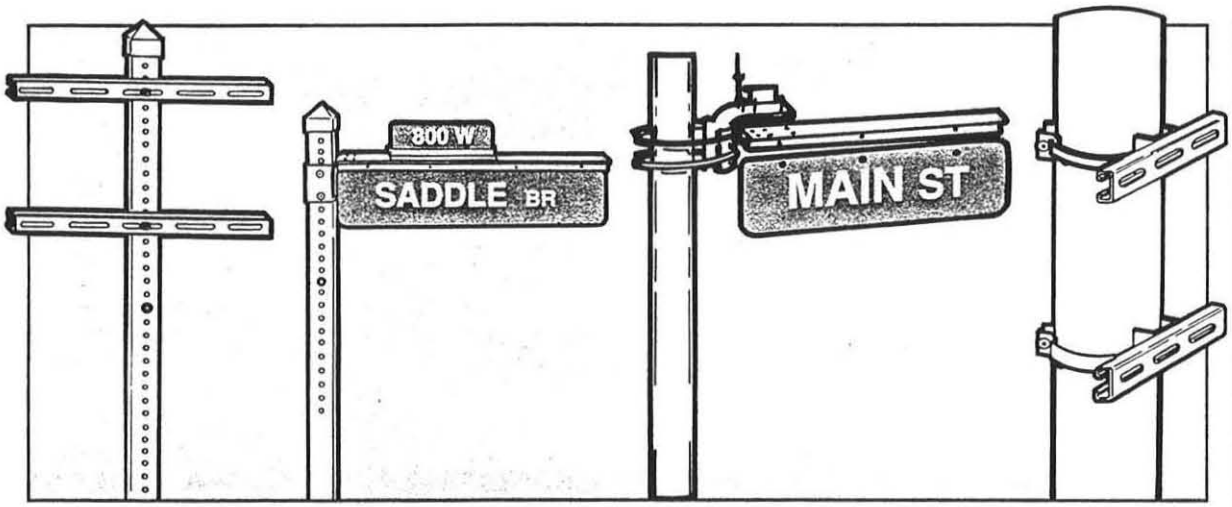
**Part No.: TBB-3**

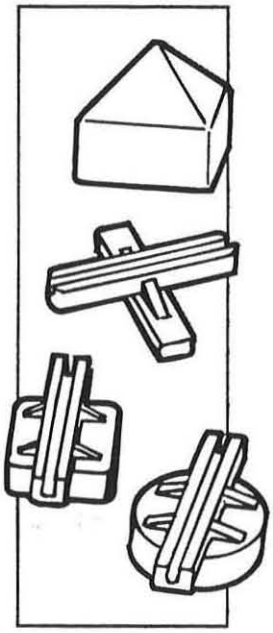
Bracket for barricades for Type III barricades & vertical panels, etc.
Requires 2 ea. brackets and 3 ea. 5/16" or 3/8" bolts per leg.

Bolts not included. Barricade Kits available on request.




- **CM250-(18-34) Cherry Mate Rivet** used to secure ends of street name signs together.
- **DR3878 Drive Rivet** used to attach signs to posts.
- **CB516 Corner Bolt and JN516H Jam Nut** used to secure top post to anchor.
- **SP8-4375 Slug Punch** removes Qwik-Punch slugs from post.

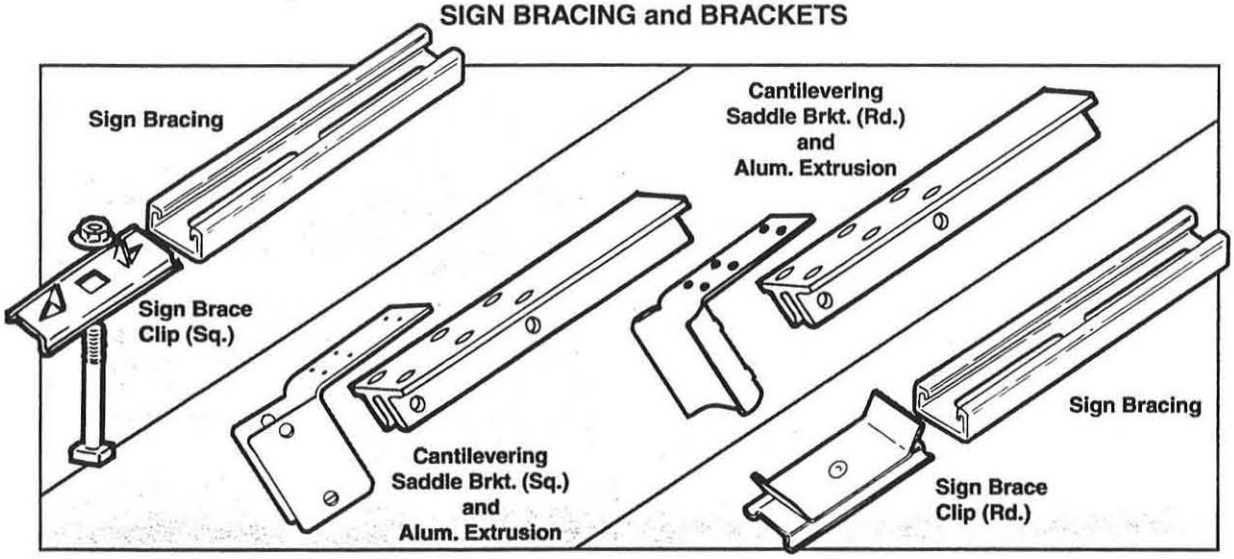


**Part No.:**
**850FL175C thru 808XL90X**

Cast aluminum street sign sign brackets and caps

**SIGN BRACING and BRACKETS**




**Part No.: CSB2005SQ thru BHB38-25**

**Cantilevering Saddle Brackets** and oversized sign bracing with **Sign Brace Clips** to fit both 2" square and 4-1/2" or larger round (luminair, mast arm, or signal) posts. Bolts, Rivets, Buckles and Banding available. **SEE PRICE PAGE**

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