

HNG-14 3298



Memorandum

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

Washington, D.C. 20590

Subject Breakaway Sign and Luminaire Supports

Date JUL , 6 1990

From Director, Office of Engineering

Reply to
Attn of HNG-14

To Regional Federal Highway Administrators
Federal Lands Highway Program Administrator

As indicated in our June 25 ONTYME message to you, the Federal Highway Administration (FHWA), by Federal Register notice dated January 5, 1989, adopted, with a minor modification, Section 7 - Breakaway Supports of the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals - 1985. An approximately 18-month transition period was provided for developing new or revising existing hardware to meet the new specification, and to allow State highway agencies to incorporate the new hardware requirements in construction contracts. That transition period expired on July 1 of this year. The Federal-aid highway projects which have their bid opening after this date shall include breakaway supports which meet the 1985 AASHTO specification, as modified by FHWA. Retrofit of existing highway signs, luminaires and traffic signals is not required but may be done at the State's option. Since existing FHWA policy recommends that obsolete safety hardware be upgraded when being repaired, replaced, or relocated, we suggest hardware meeting the new specification be used in these cases.

There are already several types of breakaway supports or bases available for both signs and luminaires which meet the new standard. The Geometric and Roadside Design Branch, as a service to industry and users, reviews crash test results of new hardware submitted by developers, manufacturers, and highway agencies to assess compliance with applicable requirements. If appropriate, an acceptance letter is sent to the requestor. That letter describes the hardware and the testing program and spells out restrictions, if any, for use of the hardware on Federal-aid projects. Copies of these acceptance letters are provided to the regional offices. Attachments A and B contain the lists of acceptance letters covering breakaway luminaire and breakaway sign supports, respectively. These acceptance letters deal only with the breakaway performance of the hardware and do not imply structural adequacy. One item is listed with a "pending" date. It has been submitted to us for determining acceptability, but our review is continuing. You will receive copies of any new acceptance letters when they are issued.

In addition to hardware manufacturers and State agencies conducting their own tests, an HP&R Pooled fund study, "Small and Large Sign Supports," will crash test hardware selected by the 27 contributing States. Representatives of these States met on April 17 and 18 to vote on which supports were to be tested. Attachment C is the priority ranking of the sign supports to be crash

tested under this study. Because no results were available prior to the July 1, 1990, deadline for implementing the 1985 AASHTO standards, all of the sign support systems included in the list in Attachment C will be considered provisionally acceptable for continued use in Federal-aid highway projects. However, some of the designs to be tested appear marginal, particularly the multiple support 4 pound-per-foot base bending flange channel structures. Therefore, we suggest that States not adopt new design standards from this list before testing has been completed. However, should a State find a compelling need to use a design from the list that it is not currently using, such use should be on a project-by-project basis until the design has been qualified through testing. Under the pooled-fund study, if a system passes all recommended tests, its acceptability will be confirmed. If a system fails a test the failure will be documented and the system will no longer be acceptable. Those systems well down the priority list may not be tested owing to lack of funds. If this happens, those systems will no longer be eligible for Federal-aid funds unless crash tested by others.

The pooled fund study does not include rectangular slip bases for large signs. However, since we know that the basic slip-base design will work with a 1,800-pound car (see acceptance letter SS-5), large slip-base roadside sign supports with legs further than 7 feet apart may continue to be installed after July 1 under the following conditions:

- (a) Weight of the support is 45 pounds-per-foot or less, and total weight of the support post plus slip plate is less than 600 pounds below the hinge.
- (b) Base bolt torques conform to values listed in Table 4.1 of the AASHTO Roadside Design Guide.
- (c) Keeper plate, if used, is 28 gauge (0.0149 inches) in thickness or less.
- (d) Height of slip-base conforms to the 4-inch stub height requirement in the AASHTO breakaway standard.

To date, FHWA has accepted, for restricted use, breakaway supports that have only been qualified through testing in one of the NCHRP soils. The pooled-fund study cited above will test supports in both "strong" and "weak" soils. In this study testing will be discontinued on any support system that fails in one of the soils and the system will be judged unacceptable unless it is modified and found acceptable in both soils. Furthermore, this office, from now on, will only evaluate the breakaway acceptability of sign support systems where there is assurance that they will meet our breakaway requirements in both soil types. Thus, it seems likely that near the end of the study (last testing is scheduled for late 1992) the FHWA will begin to require that all new breakaway systems installed on Federal-aid highway projects be qualified as breakaway in both "strong" and "weak" soils. For those supports that have been found acceptable by FHWA for use in only one type soil, FHWA will, for

the present, continue to accept installation of those supports in the soil within which they have been qualified. Such conditionally qualified supports are identified in Attachment B with a plus sign (+).

Slip-base luminaire supports will be acceptable for use on Federal-aid highways if proposed by a State highway agency provided they fall within the limitations set forth in Attachment D.

In meeting the new breakaway requirements, in some instances, the manufacturers have developed new breakaway concepts, in others, they have only reconfigured older designs. Presumably all the resulting hardware meets the structural requirements of the AASHTO specifications. However, it would be prudent for the States to require evidence of this from the suppliers.

T. O. Willett
Thomas O. Willett

Attachments

Federal Highway Administration
HNG-14:Artimovich/Hatton:gm:6-25-90:61320:File: f
Revisions: Sillan/Hatton:7-6-90
copies to:
HED-1 HNG-1 HNG-10 HNG-14 Reader, 3206
Reader, 3212 Reader, 3128 File, 3128

Attachment A, Page 1 of 2

Code	Date of Letter	Manufacturer or supplier	Breakaway Device or Mechanism	Type of Support	Description of tested pole or base	Luminaire Mounting Height (ft.)	Bolt Circle Diameter (inches)	Soil Type	Embed. Depth (inches)	Impact Speed (mph)	Bolt V (fps)	Stub Height (inches)	Weight of Pole (lbs)
LS-1	6/15/88	Sherman International, Inc	Separation of pole from base	Fiberglass, Direct Burial	MII J6-U-50-56		n/a	strong	60	20.0 60.0	14.4 10.3	none none	
LS-2	6/29/88	Akron Foundry Company	Cast Aluminum Transformer Base	Aluminum	TB1-AF-1315-17	42	15	n/a	n/a	20.0 calc60.0	6.2 8.2	none n/a	437.0
				Aluminum	TB-1AF-1315-17 1W	51.2	15	n/a	n/a	20.0 calc60.0	7.2 10.2	none n/a	511.0
				Steel	TB-1-AF-1315-17	42	15	n/a	n/a	20.0 calc60.0	6.4 14.4	none n/a	832.0
				Steel	TB1-AF-1315-17 1W	50	15	n/a	n/a	20.0 calc60.0	10.1 15.8	none n/a	778.0
				Steel	TB1-AF-1315-17 1W	50	15	n/a	n/a	20.0 calc60.0	11.2 16.1	3.06 n/a	778.0
				Steel	TB1-AF Modified-17	42	10.5	n/a	n/a	20.0 calc60.0	9.3 15.4	5.75 n/a	832.0
				Steel	TB1-AF Modified-17	42	10.5	n/a	n/a	20.0 calc60.0	9.9 15.6	none n/a	832.0
LS-3	6/24/88	Union Metal Corporation	Cast Aluminum Shoe Base	Aluminum, 0.189" wall	A2940	50	14.5	n/a	n/a	20.0 calc60.0	14.8 9.7	4.0 n/a	331.0
				Aluminum, 0.250" wall					20.0 calc60.0	13.8 10.5	4.0 n/a	405.0	
LS-4	1/12/89	Akron Foundry Company	(reaffirmation of TB-1 base)										
LS-5	3/14/89	Ilapco Division	Impact Safety Coupling	Aluminum, 10" dia. 0.250" wall	6723R	54	15	n/a	n/a	20.0 calc60.0	5.0 9.6	2.0 n/a	556.0
LS-6	4/4/89 3/5/89	Shakespeare Products Group	Separation of pole from base (acceptance covers these poles: BH20, BH24, BH30, BH35, BS30, BS35, BX30, BX35, BA41, BA47, BB30, BB35, BB41, BB47, BC30, BC35, BC41, BC47)	Fiberglass, Direct Burial	BC47-18N5BK44BW	40	n/a	Strong	84"	20.0 calc60.0	12.6 8.9	none n/a	349.5
					BC47-18N5BK44BW	40	n/a	Strong	84"	20.0 calc60.0	11.0 8.3	none n/a	349.5
					BH35-18N5RG20	30	n/a	Strong	60"	20.0 calc60.0	3.7 3.3	none n/a	175.0
					BH35-18N5RG20	30	n/a	Strong	60"	20.0 calc60.0	4.0 3.4	none n/a	175.0
					BC47-18N5BK10B	40	n/a	Weak	84"	20.0 calc60.0	11.8 8.8	none none	unk. unk.
					BH35-18N2RG20	30	n/a	Weak	60"	20.0 calc60.0	8.8 9.4	none n/a	unk. unk.
LS-7	11/8/89	Shakespeare Products Group	TranspoSafety 201 or 301 Couplings (acceptance covers series AA, AH, AC, and AI poles for heights from 39' to 47')	Fiberglass	AI45 pole with shoe base no. 37-60 0713-10	45	15.5	n/a	n/a	20.0 calc60.0	7.8 9.4	4.0 n/a	444.0
LS-8	1/11/90	Transpo Industries, Inc.	Pole-Safe Breakaway Couplings Series 201 or 301	Poles weighing no more than 900 pounds	201 II	55	13	n/a	n/a	20.0 calc60.0	17.7 19.4	4.6 4.6	897.0
					301 II	55	13	n/a	n/a	20.0 calc60.0	13.8 18.2	4.6 4.6	897.0
					201 II	55	13	n/a	n/a	20.0 calc60.0	13.5 16.0	4.6 4.6	897.0
					301 II	55	13	n/a	n/a	20.0 calc60.0	11.5 16.6	4.6 4.6	897.0

Attachment A, Page 2 of 2

Code	Date of Letter	Manufacturer or supplier	Breakaway Device or Mechanism	Type of Support	Designation of tested pole or base	Luminaire Mounting Height (ft.)	Bolt Circle Diameter (inches)	Soil Type	Embed. Depth (inches)	Impact Speed (mph)	Delta V (fps)	Stub Height (inches)	Weight of Pole (lbs)
LS-9	1/24/90	Akron Foundry Company	Cast Aluminum Transformer Bases TB-2 and TB-3	Steel	TB2-AF 1012 I.W.-17	40.8	10.5	n/a	n/a	20.0	6.4	(bolt only)	494.0
					TB3-AF 1517-17	50	17.25	n/a	n/a	calc60.0	12.0	2.0	778.0
					TB3-AF 1517 I.W.-17	50	17.25	n/a	n/a	calc60.0	15.6	n/a	778.0
					TB3-AF 1517 I.W.-17	50	10.5	n/a	n/a	calc60.0	16.3	(bolt only)	778.0
LS-10	2/26/90	PrecisionForm, Inc.	Frangible Coupler	Aluminum (Poles weighing up to 800 pounds may be used)	PF1 200-1	53	15	n/a	n/a	20.7	12.4	2.5	523.0
						53	15	n/a	n/a	61.2	10.3	2.5	523.0
LS-11	5/15/90	Union Metal	Cast Aluminum Transformer Base	Steel	A2850-C1R10	50	12.5	n/a	n/a	20.0	6.9	2.4/6.4	810.0
LS-12	5/14/90	P&K Pole Products	Aluminum Shoe bases	Aluminum	7" SB-2G	30	11	n/a	n/a	20.0	8.8	2.3	193.5
					7" SB-2G	30	11	n/a	n/a	calc60.0	5.1	2.3	218.0
					8" SB-2G	30	11	n/a	n/a	calc60.0	12.2	2.3	212.0
									20.0	9.1			
									calc60.0	5.8			
LS-13	5/29/90	P&K Pole Products	Aluminum Slip Base	Aluminum	Aluminum Slip Base	50	21	n/a	n/a	20.0	12.9	3.5	548.0
										calc60.0	14.3		
LS-14	5/30/90	Valmont Industries	Cast Aluminum Transformer Base Valmont Number 02HJ09J	Steel	02B309J (base) 0560-TU0L486-150	55	15	n/a	n/a	20.0	9.5	3.3/6.7	950.0
LS-15	5/30/90	Akron Foundry Company	Cast Aluminum Transformer Base	Steel	TB2-AF-1012-17-I.W.	40	12	n/a	n/a	20.0	14.6	3.3/6.0	548.0
					TB-1-AF-1315-17-I.W.	55	15	n/a	n/a	calc60.0	12.8	20.0	9.5
LS-16	6/29/90	Valmont Industries	Steel Slip Bases (Generic criteria for acceptance)	Steel	Many poles were tested up to a maximum weight of 964 pounds.	55.5 max.	14 (base BC was 15")	(clamp force:) (8,000 lbs) (7,614 lbs) (12,500 lbs) (12,500 lbs)		20.0	17.7	4.0 max.	486.0
										calc60.0	16.7	20.5	14.8
										19.8	14.5	964.0	
										58.7	15.5	964.0	
LS-17	PENDING	Shakespeare Products Group	Cast Aluminum Shoe Base on poles ASW37 thru AAW35 and ANW27 through ANW35	Fiberglass									

n/a = not applicable

Code	Date of Letter	Manufacturer or supplier	Breakaway Device Or Mechanism	Type of Support	Size of Support	Steel Grade	Soil Type	Embed. Depth (inches)	Number of Posts	Impact Spred (mph)	Delta V (fps)						
SS-1	7/14/86	Southwestern Pipe, Inc.	POZ-LOC anchor system.	Steel pipe, max. 0.95" thick wall	2 3/8" O.D.		Strong +	27	Two	20.60	14.80						
									One	20.70	9.90						
									One	60.30	5.90						
SS-2	8/19/86	Trus Joist Corp.	Fracture	Plywood Box, 1 1/4" thick wall with slotted sides at 3" and 18"	14 7/8" x 7 7/8"		Weak	96	One	70.60	7.80						
SS-3	10/3/86	Allied Tube and Conduit	Fracture/Basebending	Perforated square tube, with sleeve	2 1/4" square	A-570-90	Weak	27	One	19.80	10.40						
									One	20.00	9.70						
									One	60.90	5.50						
									One	60.70	6.10						
									Two	19.00	11.50						
									Two	58.60	6.40						
									One	19.90	8.20						
									One	20.30	8.90						
									One	62.20	8.50						
									One	60.60	6.30						
									Two	20.90	12.40						
									Two	62.30	7.00						
									SS-4	1/29/87	Minute Man Anchors, Inc. (see SS-6, SS-14, and SS-16)	Breakaway coupling	Flanged channel U-post	3 PPF		Strong +	46
SS-5	6/15/87	FHMA memo to regions	Fracture/Basebending	Perforated Square Steel Tube, 12ga with base sleeve	2" x 2" max.		Strong	30	One	70.00	3.50						
									Basebending	Flanged Channel u-post	3 PPF	HiCarb Billett or Re-rolled Rail	Strong	30	One	19.90	6.00
															Two	60.50	3.10
															Two	20.00	9.40
															Two	62.80	11.70
Inclined slip base	Steel structural shape	54 x 7.7		Strong	n/a	One	19.60 59.30	5.00 3.10									
Rectangular slip base	Steel structural shape	W12 x 45		Strong	n/a	One	20.60 61.00	9.90 8.80									
SS-6	3/10/88	Minute Man Anchors, Inc. (revised design)	Breakaway coupling	Flanged Channel u-post			Strong +		Two *	20.00 calc 60.0	5.80 2.70						
SS-7	9/1/88	FHMA Memo from Region 5	Rectangular Slip Base Wisconsin Stif Leg	Steel structural shape	W12 x 22		Strong	n/a	One	70.00 60.00	7 7						
SS-8	3/31/89	Unistrut Corp	Fracture	Unistrut square tube	2 1/2" sq, 10 ga	A466 Gr.A	Strong	34	One	20.10	12.80						
									One	62.20	11.70						
									One	20.20	12.50						
									One	60.60	5.10						
									Two	20.10	14.80						
									Two	20.10	14.00						
									One	20.00	12.50						

Attachment B, Page 2 of 2

Code	Date of Letter	Manufacturer or supplier	Breakaway Device Or Mechanism	Type of Support	Size of Support	Steel Grade	Soil Type	Embed. Depth (inches)	Number of Posts	Impact Speed (mph)	Delta V (fps)
SS-9	3/16/89 4/7/89	Franklin Steel	EZE-Erect Sign Posts	Flanged Channel u-post	4 PPF	A 499-81 Grade 60	Strong Strong Weak Weak		One	20.00 60.00 18.90 59.30	5.50 4.70 6.50 2.60
SS-10	5/11/89	HwyCom Corp.	Basebending post in sleeve	Fiber-reinforced plastic post	3 inch diameter		Strong	12	One	19.70 63.00	14.10 2.90
SS-11	5/18/89	Allied Tube and Conduit	Fracture/Basebending	Perf. Square steel tube w/o sleeve	2.25 x 2.25" 14 ga		(see SS-3)				
SS-12	8/3/89	HwyCom Corp.	Basebending post in sleeve	Fiber-reinforced plastic post	3 inch diameter		Strong	12	Two	20.20 59.70	16.00 4.10
SS-13	8/31/89	Marion Steel Co.	Basebending or separation of 4" ground splice	"Rib-Bak" flanged channel u-post	4 ppf 3 ppf	HiCarb Billet or Re-rolled Rail	Strong ++ Strong ++	36 36	Two Three	** 21.70 61.60	** 12.60 9.10
SS-14	10/27/89	Marion Steel Co.	Minuteman Breakaway Coupling (see SS-4)	"Rib-Bak" flanged channel u-post							
SS-15	12/12/89	FHWA Memo to Region 1	Basebending, direct burial	Aluminum tube, 3/16" wall thickness	3" or 4" diameter		Strong +				
SS-16	12/12/89	Minute Man Breakaway Inc.	MMB-IHD breakaway coupling	Flanged channel u-posts	3 ppf	"mild"	Strong +	39	One	20.00 calc 60.0	7.30 3.10
SS-17	1/8/89	Transpo Industries, Inc.	Type B coupling	Steel Structural shapes	W 8 x 18		n/a	n/a	One	20.00 60.00	4.10 4.90
			Type B coupling	Steel Structural Shapes	W 12 x 35		n/a	n/a	One	20.00 60.00	5.70 10.70
			Type A coupling	Steel Structural Shapes	W 6 x 9		n/a	n/a	One	20.00 60.00	1.60 4.10
			Type B coupling (45 deg hit)	Steel Structural Shapes	W 8 x 18		n/a	n/a	One	20.00 60.00	2.80 4.40
			Type AU coupling	Flanged Channel U-posts	4ppf, back to back		Strong +		One	20.00 60.00	2.30 2.40
SS-18	6/19/90	Minute Man Breakaway Inc.	MMB-IHD coupling	Dual Flanged Channel U-posts	3 ppf high carbon base post 3 ppf mild steel sign post		Strong +	39	Two	20.00 calc 60	13.40 5.80

* Tests were run with single posts. Calculations show dual support is acceptable.

** Tests were run with triple posts and failed. Calculations show dual support is acceptable.

+ Performance not confirmed in "weak" soil.

** Performance of flanged-channel U-posts is not confirmed in "weak" soil. Testing under pooled fund study is proposed. Basebending (direct burial) flanged-channel U-posts of various weights have been prioritized for testing in the matrix as numbers 11,12,20,21,22,28,29,30,34,38, and 39.

Matrix for Testing Small and Large Sign Supports

Order	Support	Number of Supports	Description	Note
1	Rect Slip Base	2 post/ 2 posts hit	W 6 x 12, concrete	◆
2	Incl Slip Base	2 post/ 1 post hit	S7 x 15.3, concrete	
3	Rect Slip Base	2 post/ 1 post hit	W10 x 45, concrete	♣
4	Wood	1 post/ 1 post hit	4 x 6, no holes, soil	
		2 post/ 2 posts hit		
5	Incl Slip Base	2 post/ 2 posts hit	S4 x 7.7, concrete	♠
6	Wood	2 post/ 2 posts hit	4 x 4, no holes, soil	●
7	Wood	2 post/ 1 post hit	6 x 8, 3" holes, soil	
8	Wood	2 post/ 1 post hit	6 x 6, 1½" holes, soil	●
9	Omni Slip Base	1 post/ 1 post hit	8 x 8 tube, conc	
10	Small tube, anchor	3 post/ 3 post hit	1 3/4 x 12g, soil	
11	Channel-basebend	2 post/ 2 posts hit	4 lb/ft, soil	
12	Channel-basebend	2 post/ 2 posts hit	2 lb/ft, b-to-b, soil	
13	Incl Slip Base	1 post/ 1 post hit	8" pipe, conc	
14	Omni Slip Base	2 post/ 1 post hit	W 6 x 12, conc	
15	Channel-splice	2 post/ 2 posts hit	4 lb/ft, soil	
16	Wood	1 post/ 1 post hit	4 x 6, no holes, conc	
		2 post/ 2 posts hit		
17	Rect Slip Base	2 post/ 1 post hit	tube, conc	
18	Wood	2 post/ 2 posts hit	4 x 4, no holes, conc	●
19	Timber	1 post/ 1 post hit	5", 1" hole, soil-crete	
20	Channel-basebend	3 post/ 3 post hit	2½ lb/ft, soil	
21	Channel-basebend	3 post/ 3 post hit	2 lb/ft, soil	●
22	Channel-basebend	3 post/ 2 post hit	4 lb/ft, soil	
23	Pipe-basebend	1 post/ 1 post hit	2", soil	
24	Wood	2 post/ 1 post hit	6 x 8, 3" holes, conc	
25	Wood	2 post/ 1 post hit	6 x 6, 1½" holes, conc	●
26	Channel-splice	3 post/ 3 posts hit	2½ lb/ft, soil	
27	Channel-splice	3 post/ 3 posts hit	2 lb/ft, soil	
28	Channel-basebend	2 post/ 2 posts hit	2 lb/ft, braced, soil	
29	Channel-basebend	2 post/ 2 posts hit	4 lb/ft, conc	▶
30	Channel-basebend	3 post/ 2 posts hit	4 lb/ft, conc	▶

- ◆ This is a larger section than originally proposed as requested by three states.
- ♣ ~~This is being tested under separate contract. The post is slightly smaller than originally proposed.~~ (Further review indicates this testing is unnecessary.)
- ♠ TTI ran two tests on two W 8 x 12 posts on inclined slip bases in March 1990 for Louisiana. This system may be satisfied under these tests.
- If test of larger size passes, tests of this system will not be required.
- ▶ Test of strong soil may be evaluated as acceptable for this case. If so, tests on this system will not be required.

Matrix for Testing Small and Large Sign Supports

<u>Order</u>	<u>Support</u>	<u>Number of Supports</u>	<u>Description</u>	<u>Note</u>
31	Large fiberglass	2 post/ 1 post hit		
32	FRP fiberglass	2 post/ 2 posts hit	,soil	
33	Round Slip Base	1 post/ 1 post hit	8 x 6 x ¼, conc	
34	Channel-basebend	3 post/ 3 posts hit	2½ lb/ft, conc	▶
35	Channel-splice	2 post/ 2 posts hit	4 lb/ft, conc	▶
36	EZE-Erect	3 post/ 3 posts hit	4 lb/ft, soil	
37	Channel-splice	3 post/ 3 posts hit	2½ lb/ft, conc	▶
38	Channel-basebend	3 post/ 3 posts hit	2 lb/ft, conc	●,▶
39	Channel-basebend	2 post/ 2 posts hit	2 lb/ft, b-to-b, conc	▶
40	V-Loc	2 post/ 2 posts hit	3 lb/ft, 18", conc	
41	POZ-LOC	2 post/ 2 posts hit	2 3/8" x 13g, soil	♪
42	Channel-splice	3 post/ 3 posts hit	2 lb/ft, conc	●,▶
43	V-Loc	2 post/ 2 posts hit	3 lb/ft, 30", soil	

-
- If test of larger size passes, tests of this system will not be required.
 - ▶ Test of strong soil may be evaluated as acceptable for this case. If so, tests on this system will not be required.
 - ♪ Only weak soil tests required for this system.

Requirements and Commentary on Use of
Steel Slip-base Luminaire Supports

Basic Type: Triangular, three-bolt base similar to Caltrans' Type 30 and 31 bases (see page 3 of this Attachment).

Minimum Shaft Wall Thickness: 0.1196 inches for diameters up to 10 inches.

Bolt Circle Diameter: 14 inches (minimum).

Base Plate Thickness: 1 inch (minimum), 1 1/4 inches (maximum).

Lower Slip Plate Thickness: 1 1/4 inches (minimum), 1 1/2 inches (maximum).

Anchor Plate Thickness: 1 1/4 inches (maximum).

Steel Keeper Plate Thickness: 0.0149 inches before coating (28 gage) (maximum).

Height Top of Lower Slip Plate from Ground Line: 4 inches (maximum).

Clamp Bolt Type: Galvanized ASTM A325 with dry lubricant (Heads and nuts shall have heavy hex dimensions).

Clamp Bolt Size: 7/8-inch to 1 1/4-inch diameter.

Rectangular Clamp Bolt Washer Size: Length, width, and thickness shall be sufficient to prevent significant deflection (bending) when clamp bolt is loaded to its tensile capacity.

Hole in Clamp Bolt Rectangular Washer: Clamp bolt diameter plus 1/16 inch, with edges chamfered to prevent binding with radius under bolt head.

Clamp Bolt Tension: 8,000 pounds per bolt (maximum). In the absence of a more exact method of determining bolt tension the following maximum tightening torques shall be used:

<u>Bolt diameter (inches)</u>	<u>7/8</u>	<u>1</u>	<u>1 1/8</u>	<u>1 1/4</u>
Torque (foot-pounds)	87	95	104	111

Finish: All faying surfaces to be galvanized, free of paint, and smooth and free of ridges, scallops, nicks, and burrs.

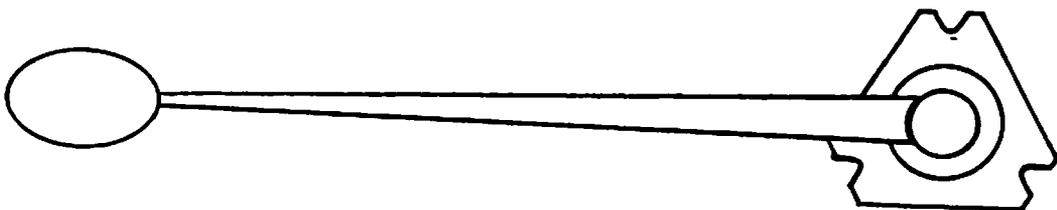
Mounting Height: 56 feet, 6 inches measured from bottom of pole base plate to centerline of luminaire mounting tenon (maximum).

Weight: 1,000 pounds (include luminaire, mast arm(s), pole, and base plate) (maximum).

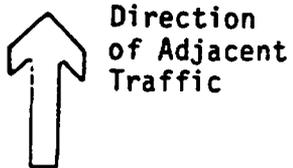
Mast Arm Orientation: Mast arm may be parallel to a flat side of the base provided that side faces approach traffic or may pass over a clamp bolt (see page 4 of this Attachment).

Placement: The terrain about the pole base shall not inhibit translation of the pole and approach topography shall be such that a vehicle leaving the roadway at design speed and an angle of up to 25 degrees will not strike the pole at a height greater than were the pole located at the edge of the pavement. (The approach terrain will not cause an errant vehicle to become airborne.)

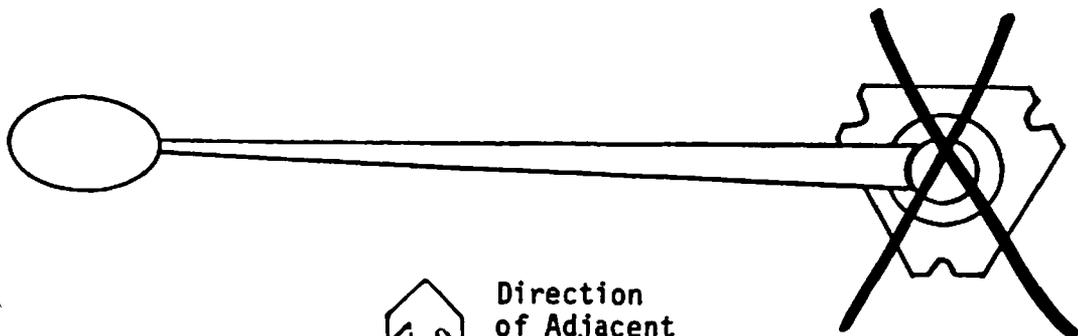
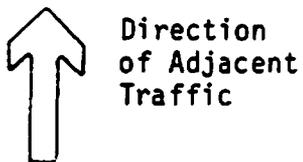
While the restrictions listed here are rather extensive and in some instances differ from some current practices, for example the clamp bolt tension, keeper plate thickness, and mast arm orientation prescribed differ from those in the Caltrans standard, one should not infer FHWA is apprehensive about the use of slip-base luminaire supports. It is just that our extensive study of these structures has given us an insight that leads us to believe they will work best and the public will be best served by adhering to the guidance we have outlined.



Best Breakaway
Performance
Acceptable



Best Compromise
to avoid undesirable
orientation
Acceptable



Worst Breakaway
Performance
Not Recommended

