U.S. Department
Of Transportation
Federal Highway
Administration

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

June 20, 1997

Refer to: HNG-14/SS-65A

Philip C. Lewis, P.E.
Southwestern Pipe, Inc.
P.O. Box 2002
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Dear Mr. Lewis:

This is in response to your March 7 letter to Mr. James H. Hatton, Jr., requesting the Federal Highway Administration's (FHWA's) acceptance of your company's POZ-LOC Slip-base System and POZ-LOC Yielding Anchor System for use on the National Highway System (NHS) when breakaway devices are required. Both systems had previously been found acceptable for use in strong soils, the Slip-base System was accepted in our September 5, 1996, letter (SS-65) and the Yielding Anchor System in our July 14, 1986, letter (SS-1). In both cases, dual post supports were found acceptable. The current request was to find both systems acceptable for use in weak soils as well. You also asked that a single letter be issues which addressed all FHWA action on your company's breakaway supports, which we are pleased to do.

Testing was in compliance with the guidelines contained in National Cooperative Highway Research Program (NCHRP) Report 350, <u>Recommended Procedures for the Safety Performance Evaluation of Highway Features</u>. Requirements for breakaway supports are those in the American Association of State Highway and Transportation Officials' (AASHTO) <u>Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals.</u>

The testing of the two systems in the various soil types are discussed below in sections titled as follows:

1. Weak soil testing of both the slip-base and the socket Systems.
2. Strong soil testing of the prototype slip-base (and the similar Texas DOT system for comparison).
3. Strong soil testing of the production model slip-base.
4. Extrapolation of the results considering:
    a. Additional numbers of poles using the socket and slip-base systems;

b. Additional pole gage with the slip-base system.
5. Summary of accepted supports and qualifications on acceptability.

1. Weak soil testing of both the slip-base and the socket systems. (For drawings, see Enclosure A.)

Accompanying your letter of March 7 was a report and film of the weak-soil crash testing. The report, by the Texas Transportation Institute, is dates February 1997 and describes four crash tests that are summarized in the table below. A letter from you dated May 12, 1997, provided additional information in response to our request. The results of these single-post, weak-soil tests meet the change-in-velocity and stub-height requirements adopted by the FHWA.

Test Number 405851	-1	-2	-3	-4
Test Article – Breakaway System	Socket	Socket	Slipbase	Slipbase
Foundation Condition	Direct Bury in Weak Soil*	Direct Bury in Weak Soil*	Concrete in Weak Soil**	Concrete in Weak Soil**
Number of Posts Struck	1	1	1	1
Sign Support Diameter, mm	60	60	73	73
Support Wall Thickness, mm	2.4	2.4	7.0	7.0
Bolt Torque, Newton-meters	N/a	N/a	51.5	51.5
Vehicle Mass, kg	820	820	820	820
Impact Speed, km/h	34.76	99.22	34.13	97.63
Vehicle Velocity Change, m/s	2.05	3.07	0.63	0.97
Occupant Impact Speed, m/a	2.09	1.56	None	0.83
Stub Height, mm	None***	None***	76	76

* The Poz-Loc socket is 73 mm diameter x 2.7 mm-thick walled steel, 838-mm in length.
** The precast concrete foundation for the slip-base tests were 305-mm diameter, 1067-mm deep, placed in weak soil and backfilled.
*** The foundation anchor (socket) pulled completely out of the soil.

2. Strong soil testing of the prototype slip-base (and the similar Texas DOT system for comparison).

The prototype used in the first series of tests was fabricated and machined from ASTM A36 steel. It was similar to the triangular, three-bolt slip-case support test by TTI for the State of Texas. The principal difference between the two designs is the means of attaching the pipe support to the upper slip plate. In the Texas design a pipe support is welded to the slip plate. In your design the pipe passes through a hole in the upper slip plate and a stabilizing riser that is integral with the upper slip plate. The pipe is prevented from pulling out of the slip plate by a split-ring collar that is clamped on the end of the pipe by tightening a bolt through the split in the collar. The collar fits into a recess in the upper slip plate and the projects slightly into the space between the upper and lower slip plates. This projections keeps the facing surfaces of the slip plates apart, much as interface washers, which have been eliminates in your design, do in the Texas design. The two tests on the prototype that you sponsored, plus two additional tests conducted on the Texas design, are summarized in the table below. The cars used in all four tests were 820 kg.

Test Number	405481-1 (POZ-LOC)	405481-2 (POZ-LOC)	419714-3 (Texas)	419714-4 (Texas)
Sign Post Dimensions	NPS 2 ½ ‘, Schedule 10 73 mm OD, 3.0 mm wall	NPS 2 ½ ‘, Schedule 10 73 mm OD, 3.0 mm wall	NPS 3’, Schedule 40 89 mm OD, 7.0 mm wall	NPS 3’, Schedule 40 89 mm OD, 7.0 mm wall
Breakaway Device	POZ-LOC 3 bolt slip-base assembly**	POZ-LOC 3 bolt slip-base assembly**	Texas 3-bolt slip-base**	Texas 3-bolt slip-base**
Keeper Plate	30 gage (0.40 mm)	30 gage (0.40 mm)	30 gage (0.40 mm)	30 gage (0.40 mm)
Foundation	Concrete Foundation*** in strong soil	Concrete Foundation*** in strong soil	(Mounted to rigid test frame)	(Mounted to rigid test frame)
Impact Speed	35.43 km/h	103.24 km/h	34.8 km/h	103.0 km/h
Vehicle Delta V	0.80 m/s	1.62 m/s	1.28 m/s	2.17 m/s
Occupant Impact	0.69 m/s	0.59 m/s	(no contact)	1.1 m/s
Stub Height	76 mm	76 mm	****	****

*Nominal Pipe Size
** Three 15.9-mm x 63.5-mm long high strength bolts were tightened to a torque of 51.5 N.m.
*** The concrete foundations for the POZ-LOC tests were 305 mm in diameter and 1067 mm in depth.
**** The anchor place was mounted less than 100 mm above the test frame.

The results of the POZ-LOC prototype tests met the change in velocity and stub height requirements adopted by the FHWA. However, we concluded that testing on the machines prototype was not representative of the production castings that you intended to market. We requested additional testing which was conducted by TTI and is described in the next section.

3. Strong Soil testing of the production model slip-base (For drawings and description, see Enclosure B)

   The 820-kg auto tests on productions model slip-bases are summarized in the following table:

Test Number	405481-3	105481-4	405481-5
Sign Post Dimensions	73 mm OD, Schedule 10 3.0 mm wall	73 mm OD, Schedule 80 7.0 mm wall	73 mm OD, Schedule 80 7.0 mm wall
Number of Posts	One	Two	Two
Breakaway Device	POZ-LOC 3 bolt slip-base assembly*	POZ-LOC 3 bolt slip-base assembly*	POZ-LOC 3 bolt slip-base assembly*
Keeper Plate	30 gage (0.40 mm)	30 gage (0.40 mm)	30 gage (0.40 mm)
Foundation	Concrete Foundation ** in strong soil	Concrete Foundation ** in strong soil	Concrete Foundation ** in strong soil
Impact Speed	34.8 km/h	34.3 km/h	102.3 km/h
Occupant Impact	0.4 m/s	0.83 m/s	1.93 m/s
Stub Height	75 mm	75 mm	75 mm

* Three 15.9-mm x 63.5-mm long high strength bolts were tightened to a torque of 51.5 N.m.
** The concrete foundation for the POZ-LOC tests were 305-mm diameter, 1067-mm deep

The test results of the production model slip-base meet the change in velocity and stub height requirements adopted by the FHWA.

4. Extrapolation of the results. You also requested FHWA acceptance of the following variations.
   a. Additional numbers of poles using the socket and slip-base systems.

You enclosed a letter from Mr. Roger P. Bligh of the Texas Transportation Institute dated May 8, 1997. This letter discusses the use of the dual-post Poz-Loc socket and slip-base systems. The Poz-Loc socket system in weak soil usually functions by the post and socket pulling entirely out of the soil. Pullout occurs before sufficient forces have been generated to pull the post out of the socket, as generally happens in standard soil. Mr. Bligh notes that the weak soil tests of single posts results in lower occupant impact velocities than the standard soil tests. Because the dual post socket system has been shown to be acceptable in standard soil, we concur with Mr. Bligh's assessment that dual post/socket installations in weak soil will pull out with less energy being absorbed than in the dual post test in strong soil. This use in weak soil is acceptable for a Poz-Loc socket up to 838-mm in length.

For the Poz-Loc Slip-Base, Mr. Bligh notes that there was no significant movement in the weak soil-mounted concrete base of the single post test, and that the occupant impact velocity was so low as to indicate that dual post installations would also meet the evaluation criteria. We concur in this finding.

   b. Additional pole gage with the slip-base system.

We reviewed the testing of the breakaway slip-base using the same diameter posts with thicker walls. The tested Schedule 10 pipe single support has the thinnest wall and is the one most likely to deform and cause the slip base to seize. The tested Schedule 80pipe dual support has the thickest wall and was the most massive installation. Since the results of tests at both extremes met the breakaway criteria, we will consider Schedule 10, 40, or 80 posts acceptable when used with the Poz-Loc slip-base.

5. Summary of accepted supports and qualifications on acceptability.

   The tested production model POZ-LOC three-bolt slip-base cast from ASTM A536 Grade 65-45-12 ductile iron, is acceptable for use on the National Highway System (NHS), when requested by a State, with one or two Schedule 10 (3.0 mm wall), Schedule 40 (3.9 mm wall), or Schedule 80 (7.0 mm wall) NPS 2 ½ (73 mm) steel pipes, with 305-mm diameter and 1067-mm deep concrete foundations in either strong or weak soil. The tested POZ-LOC Socket System supporting 2.4-mm wall, 60-mm diameter steel tubes is acceptable for use on the NHs with one or two posts supported in strong or weak soil. Our acceptance is limited to the breakaway characteristics of the supports with your slip-base or the socket systems and dies not cover their structural features. Presumably, you will supply potential users with sufficient information on structural design and installation requirements to ensure proper performance. We anticipate that the States will require certification from Southwestern Pipe that the hardware furnished will have essentially the same chemistry, mechanical properties and geometry as that used in the tests, and that they will meet the FHWA change in velocity requirements.

Because the POZ-LOC breakaway systems are proprietary products, to be used in Federal-aid projects, except exempt, non-NHS projects, they: (a) must be supplied through competitive bidding with equally suitable unpatented items; (b) the highway agency must certify that they are essential for synchronization with existing highway facilities or that no equally suitable alternative exists; or (c) they must be used for research or for a distinctive type of construction on relatively short sections of road for experimental purposes. Our regulations concerning proprietary products are contained in Title 23, Code of Federal Regulations, Section 635.411, a copy of which is Enclosure C.

Sincerely yours,

Dwight A. Horne, Chief
Federal-Aid and Design Division

3 Enclosures