U.S. Department
Of Transportation
Federal Highway
Administration

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

January 20, 1999

Refer to HNG-14/SS-81

Mr. Dick Schaefer
Square Tube Products
5495 East 69th Avenue
Commerce City, Colorado 80022

Dear Mr. Schaefer:

Thank you for your December 28, 1998 letter to Mr. Nicholas Artimovich requesting acceptance of your company's "NEX TUBE" small sign support system. Accompanying your letter was a report of crash testing done at the Southwest Research Institute. Earlier, on March 30, 1998, you submitted reports of pendulum testing along with an analysis of the "NEX TUBE" cross-section. Because we do not consider pendulum testing sufficient to qualify a new support system, we requested the automobile test which is the subject of your most recent letter.

Initial testing of the supports with an 820-kg pendulum (submitted with your March 30, 1998 letter) conducted by the Southwest Research Institute was in compliance with the guidelines contained in the National Cooperative Highway Research Program (NCHRP) Report 350 "Recommended Procedures for the Safety Performance Evaluation of Highway Features." Requirements for breakaway supports are those found in the American Association of State Highway and Transportation Officials' (AASHTO) Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals.

The tested "NEX TUBE" drawing supports were 50.8-mm (2-inch) octagonal shaped A787-94 steel, 12 gage or 14 gage tubing with 410 MPa (60,000 PSI) minimum yield strength. Each support carried a 16 gage octagonal sign blank mounted at 2100-mm above grade. The posts were installed by direct burial into weak or strong soil, or by inserting the sign post into a 63.5 mm (2 ½ inch) 12 gage perforated square steel tube anchor post into weak or strong soil. Installations using the anchor tube mount also featured a steel clip to secure the sign post in place. Soil typed and embedment depth are shown in the test summary table. Dimensions of the tube cross section are shown in the enclosed drawings. The 35-km/h pendulum tests (NCHRP Report 350 Test 3-60) are summarized in the following table.

Test #	STP-1SA	STP-1WA	STP-3WA	STP-2WD	STP-2ASD
Post Gage	12 ga	12 ga	14 ga	12 ga	12 ga
Soil	Strong	Weak	Weak	Weak	Strong
Depth* of Embedment	850 mm	850 mm	850 mm	900 mm	900 mm
Direct Bury of Anchor	Anchor	Anchor	Anchor	Direct	Direct
Test Article mass	13.6 kg	17.9 kg	10.9 kg	15.9 kg	15.9 kg
Change in Velocity	1.2 m/s	0.9 m/s	0.5 m/s	1.1 m/s	1.7 m/s
Calculated 100 km/h Delta V	0.65 m/s	0.66 m/s	0.6 m/s	0.65 m/s	0.88 m/s
Stub Height	89 mm	None	89 mm	None	51 mm
Mechanism	C	D	A	B	A

*Here, depth refers to the post itself if a direct bury installation, or the depth that the anchor is driven if an anchor tube mount.

**Mechanism of the breakaway action: A Post bent at ground line; B: Post pulled from ground; C: Post pulled form anchor; D: Post and Anchor pulled from ground.

Although the test results met the change in velocity requirements, pendulum tests at 35 km/h are not sufficient to qualify base bending/yielding small sign supports. We requested a full-scale automobile test to verify that the NCHRP Report 350 criteria for occupant compartment intrusion and vehicle post-impact trajectory were also met. To meet this need, a single crash test on a dual-post support directly buried into S-1 “Strong” soil (NCHRP Report 350 “standard” soil) was conducted to qualify the post for use in one or two post installations with or without an anchor tube. Prior testing of square steel tube sign supports has shown that the high-speed test using posts directly buried in the soil is a “worst case” condition for that type of support. The pendulum testing also indicated that the 12-gage post buried directly into the soil was the “worst case” scenario at low speed for this type of post. “NEX TUBE” supports are similar in many ways to square tube supports and were expected to perform in a similar manner. However, the breakaway performance of the “NEX TUBE” cross section needed to be verified through full-scale crash testing.

The test installation was two 3.6-m long, 50.8-mm diameters, 12 gage wall post of ASTM A78794 Type-II, 413.7 mPa (60,000 ksi) yield steel, buried 0.91 m into the soil. They were spaced 1.06-m apart. The bottom of the 0.46-m x 1.22-m sign was 2.13-m above the ground. A drawing of the 12 gage and 14 gage cross sections is enclosed. A summary of the test results is in the following table:

Test Number	SST-2L
Support	Dual 2-inch, 12 ga. "NEX TUBE"
Foundation	Direct Embedded 0.91 m into S-1 soil
Vehicle Mass	820 kg
Impact Speed	100.08 km/h (27.8 m/s)
Exit Speed	24.4 m/s
Vehicle Velocity Change (longitudinal)	3.4 m/s
Occupant Impact Velocity (longitudinal)	2.91 m/s
Maximum 50 ms average accelerations	-3.48 g's
Mechanism	Both posts pulled out of soil

The minor vehicle damage that occurred was confined to the bumper and the headlight/grille area. There was no deformation or intrusion into the passenger compartment from the impact with the sign, nor was the windshield damaged.

We note that the breakaway performance of the support depended upon both posts pulling out of the soil in the test. We do not know how the support would perform if it was fixed in the soil by means of a concrete foundation or by using a soil plate. Therefore this support should not be used with direct embedment into concrete or with soil plates.

Also, users should be informed that the maximum acceptable embedment in soil is approximately 0.91 m. When used with an anchor tube and where the post is free to pull out of the tube, the foundation tube may be embedded to any depth desired as long as the support posts are inserted only a nominal amount (typically 0.3 meter).

The tested support met the crashworthiness requirements of the AASHTO Standard Specifications and NCHRP Report 350. Therefore, they are acceptable for use on the National Highway System (NHS) within the range of conditions tested, when requested by a State. Also, single or dual supports of either 12 gage or 14 gage tubes embedded in soil or mounted in anchor tubes, as discussed above, are also acceptable. To prevent misunderstanding by others, this letter of acceptance shall not be reproduced except in full.

Out acceptance is limited to the breakaway characteristics of the supports and does not cover the structural features nor the devices' conformity with the Manual on Uniform Traffic Control Devices. Presumably, you will provide users with sufficient information on structural design and installation requirements to ensure proper performance of your supports and provide certification to transportation agencies that the hardware furnished

will have essentially the same chemistry, mechanical properties, and geometry as those used in the tests and that they will meet FHWA change in velocity requirements.

The "NEX TUBE" is a proprietary product. For proprietary devices to be specified for use on Federal-aid projects, except exempt, non-NHS projects: (a) must be supplied through completive bidding with equally suitable unpatented items; (b) the highway agency must certify that they are essential for synchronization with existing highway facilities for that no equally suitable alternative exists or; (c) they must be used for research or for a distinctive type of construction on relatively short sections of road for experimental purposes. Our regulations concerning proprietary products are contained in Title 23, Code of Federal Regulations, Section 635.411, a copy of which is enclosed.

Sincerely Yours,

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

2 Enclosures

Geometric and Roadside Safety Acceptance Letter SS-81

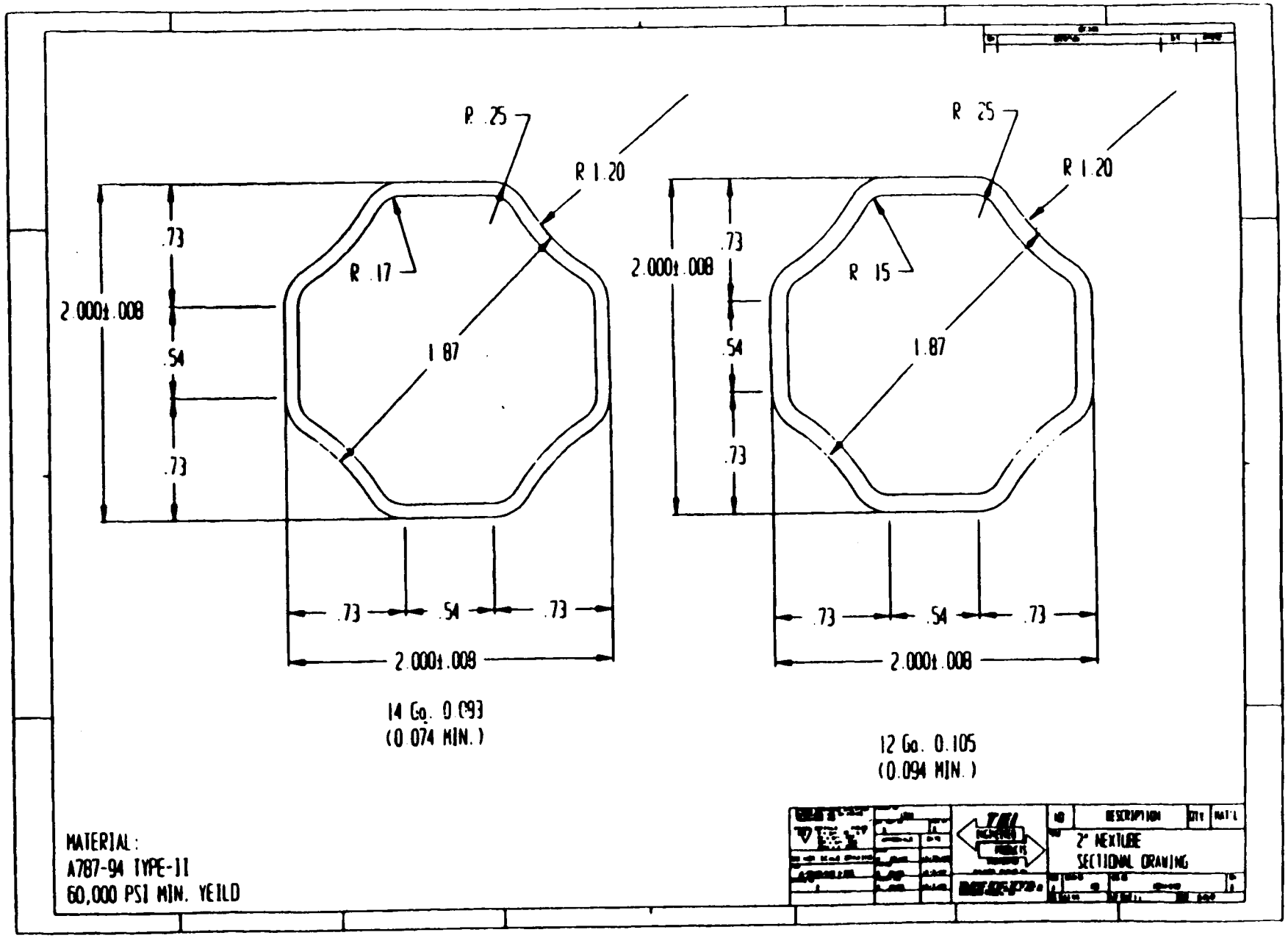

Figure 3. Manufacturer's drawing of test article, Test SST-2L.