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16. Abstract This report describes the results of a survey of several Texas Districts to determine the comparative performance history of Thin-Wall (tube) Yellow Sign Supports compared to schedule 40 pipe and winged channel delineator supports.					
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Yellow Thin Wall Tubing Sign Support  
Field Performance and  
Recomendations

A telephone survey was made to each of the Districts indicated on the attached memo dated November 2, 1978, to determine the comparative performance history of the thin wall (tube) yellow sign support compared to schedule 40 pipe and winged channel delineator supports. A listing of the Districts and their comments concerning evaluation of these systems is included. A general interpretation of these comments is as follows:

Study Observations

1. Specific benefits accruing to the yellow tube in reduction of knock-downs is difficult to precisely establish with the limited sample size and time period. The yellow color is more visible during the daylight than is the galvanized support and if within the headlight beam, nighttime visibility is greatly enhanced.
2. "High incident" locations which were selected for trial installations generally showed little reduction in knockdown. A factor which weighs heavily in this finding is that the predominance of knockdowns at high incident location is probably due primarily to character of traffic (i.e. overwidth loads, farm equipment, trucks executing tight turning maneuvers, malicious mischief, and impacts by out of control vehicles) which frequently results in the destruction of any system at a similar rate. Where accidental knockdowns, due to failure to see the support, are a factor or where special delineation is needed, the yellow color is felt to offer benefit over the galvanized support. Field applications which have proven effective, have been in both selected urban and rural areas. The cities of Houston, San Antonio, and Austin all report a substantial reduction in the accidental knockdown in city use.

3. Field impact performance of the tubing has verified its safe impact performance for approved tube sizes tested under cooperative research study 2-18-78-264. Tubing sizes and schedule 40 pipe supports with breakaway coupling which were judged equal, are listed as follows:

<u>Tube Sizes</u>	<u>Equivalent Supports</u>
2 7/8" diameter x 0.065"	2" Schedule 40 with collar
2 3/8" diameter x 0.109"	2" Schedule 40 with collar
1.90" diameter x 0.065"	1 1/4" pipe and/or delineator posts
1.66" diameter x 0.047"	Delineator posts

The failure mode of the tubing is generally excellent with regard to safety. The vehicle usually imparts an "S" bend to the tube on impact. The ground attachment forces a forward movement of the sign and post which is felt to reduce the opportunity and/or force of sign contact with roof, windshield or hood. Damage to the tube support is extensive and reusability of the post and concrete base is unlikely. Also, there is a tendency for vehicles to ride down the sign and cause extensive damage to the sign panel as well. Conversely, failure mode of the schedule 40 pipe support with a breakaway collar is one which displays the same excellent safe performance upon impact, as well as a high rate of reusability of the foundation support and sign. After impacts, restoration of most schedule 40 pipe supports to service, involves removal of the broken thread, rethreading the pipe, and reinstallation of sign support and sign. A considerable savings in time can be realized where this operation can be performed in minutes, whereas the damaged tube support, set in concrete, usually requires removal of the sign, placing a new foundation and reinstallation of the sign the ensuing day.\*

\* See addendum for test of driven support

4. The colored post is felt to be particularly advantageous when used as a delineator in channelization of traffic onto construction detours. Whereas the general use of the thin wall tubing as a delineator post has proven adequate, major concern with its use is with its mechanical properties. Driving the tubes is generally not feasible and pre-drilling foundation holes is typically necessary in flexible base. When the drill is extracted and the tube inserted, slough of aggregate within the hole frequently prevents subsequent driving of the post to full depth. Rotation of the pipe by vandals, as well as intentional bending them over by hand, and theft, causes their use in high pedestrian areas to be discouraged.
5. Efficient salvage of damaged tubing supports does not appear practical.
6. Inventory problems associated by the required stocking of both tubing and schedule 40 pipe, present some difficulties in minimizing expense of materials on hand. Also damage of the thin wall through dents and scratching of the yellow pigment have caused some concern with its shipment, storage, and routine maintenance handling.
7. The following cost comparison for acquisition of equivalent sizes of pipe with yellow tubing indicates that for quantity purchases of the schedule 40 pipe, that pipe has been supplied at a substantially lower cost than tubing. Recent bid tabulations have indicated that prices are more competitive and should likely produce a more favorable price structure for tubing if quantity purchases are made.

Schedule 40

Galvanized, threaded both ends with  
1 collar, 21' lengths

Pozitube

Yellow coated

Size	Quantity	Date	\$/ft.	Size	Quantity	Date	Length	\$/ft.
<u>Sign Supports</u>								
2"	25,200'	3/4/80	\$1.035	2 3/8"x0.109	222	1/17/80	13'	\$1.24
2"	31,500'	7/8/80	1.15	2 7/8"x0.120"	250	8/19/80	12'	1.208
				2 3/8"x0.109"	260	8/19/80	12'	1.176
<u>Delineators</u>								
1.12 #/ft.		3/11/80	\$0.44	1.66"x0.047"		1/17/80		0.45
<u>V-loc Anchors</u>								
2 7/8"	250	8/19/80	\$11.08 each					
2 3/8"	260	8/19/80	8.90 each					

Recommendations:

Based upon these observations, it is recommended that District use of the yellow thin wall tubing be left to individual preference for contemplated applications. Where tubing is considered for areas where the yellow color is not essential, prices should be carefully compared to that of Schedule 40 pipe as prices have fluctuated over a considerable range.



## APPENDIX

### FIELD RESPONSE TO YELLOW TUBE SIGN SUPPORT TRIAL INSTALLATION

#### District 2 - Bob Hodge, Supervising Traffic Engineer

The yellow color is beneficial in reducing knockdown; however, the actual rate is difficult to ascertain, because of the lack of an accurate control.

#### Dick McCarty, Supervising Maintenance Engineer

Actual reduction in knockdown is difficult to determine due to the high percentage of malicious mischief to signs and delineators.

The schedule 40 pipe with collar has demonstrated excellent performance as well as ease of repair when impacted. Handling of the tubing requires additional care to prevent dents and scratching. Maintenance forces are not enthusiastic in its use, due to the extensive damage to the system upon impact and necessity for foundation replacement. With all factors considered, if the yellow tube can be made cost-competitive with schedule 40 pipe, District 2 will consider its continued use.

#### District 3 - Bob Myers, Supervising Traffic Engineer

The yellow delineator post has proved particularly effective where they are used to channel traffic in a detour situation. They have had no problems driving the delineators in their district; however, where used on existing pavement, a collar is utilized which is nailed to the pavement. The most effective use of the yellow sign post has been in "keep right" type signs in medians where a reduction in knockdowns was observed. Where larger signs are contemplated requiring sign "trees", the utilization of thin wall tubing may pose a problem due to anticipated difficulty in welding and/or threading.

District 5 - Mickey Powell, Senior Traffic Engineer

The yellow color of the thin wall tubing has felt to have little effect in knockdown rate. The fact that the tubing and foundation must be completely replaced when hit also serves to cause this district to not recommend their use statewide.

District 6 - James Strong, Senior Maintenance Engineer

Rate of knockdowns using the thin wall tubing does not appear to be materially reduced; however, it is suspected that knockdowns are being caused primarily by wide loads and farm implements which do not necessarily concern themselves with the presence of road-side signs and delineators. The use of the delineator posts in Midland County has estimated to have produced a saving in both time and money through their use. Delineator posts which have been knocked down can be re-bent upright two or three times prior to their replacement. The district feels that if the thin wall yellow tubing is cost-competitive with the schedule 40 pipe, this district would be interested in their continued use.

District 7 - Jim Alves

This district has excellent success with the use of the yellow tubes placed in medians, and their use elsewhere has been felt to generate a reduction in knockdowns due to the color. They have encountered no problems with damage to the pipe in handling, and for installation they predrill all foundation holes to eliminate problems with driving. The concern which the district indicates is that since the tubing cannot be used on every type sign, that tubing as well as schedule 40 pipe will require dual stocking in maintenance warehouses and add somewhat to their inventory and routine maintenance handling problems.

District 14 - Matthew Barton

No experience with the yellow tubing sign support has been generated to date. Installation of tubing delineator post at the edge of pavement has necessitated that all holes be predrilled. A problem with the use of the tubing as delineator supports is their frequent tendency toward rotation after a period of service. Vandals are felt to cause some of these problems as well as aggravated post destruction as the posts can be bent over by hand. The district has requested that the delineator tubing trial section be discontinued and the facility where they have been in use be restored to a conventional delineator post system.

District 18 - Milton Watkins, District Maintenance Engineer

Sufficient data on performance is not available at the present time; however, the yellow color of the tube sign support is felt to be marginally beneficial in reducing knockdown rate. This district would be receptive to the further utilization of the tubing supports where price is cost competitive.

District 22 - Dan Gower, District Maintenance Engineer

Although relatively few delineator posts have been knocked down in District 22, it is felt that the yellow color gives better nighttime as well as daytime visibility. Conventional delineators presently used are the 1.12 pound per foot post which has provided them with excellent performance. Also, the conventional delineator post when damaged can frequently be salvaged by running them through a straightening machine. The very excellent success in this district using the standard sign pipe support with breakaway collar causes them to recommend that the yellow post be considered for use only in certain situations which have encountered frequent knockdowns. In rural areas, they would prefer using the schedule 40 pipe with breakaway collar. One fundamental concern with the use of the tubing in rural areas is that frequent high winds may generate premature failure of the lighter material support.

D-4 - John Wright

D-4's position on purchasing sign and delineator supports for use by maintenance is one which is flexible in permitting the acquisition of both tubes and schedule 40 pipe for sign supports and delineators. One condition, however, which is of concern of this Division is that once a new commodity is stocked and made a standard contract item, they desire that its actual field use justify the added cost of maintaining warehouse supplies.

D-4 - Sequin Warehouse, Chuck Johnson

Thin wall tubings does present a material handling problem to prevent their denting and scratching, and claims have been filed with the common carrier for transit damages to past shipments. Also, the irregularity of roadside terrain frequently necessitates sign supports of varying lengths to meet minimum sign mounting height conditions. In this regard, they find the 21 foot lengths of pipe to be most desirable to enable them to provide a post of correct length at each installation. The segment cut from a schedule 40 pipe is capable of use in construction of "deerhorn" or sign tree supports, thereby keeping material waste to a minimum. The pipe which is requisitioned is supplied with threads at both ends as well as one collar thereby reducing the work required to only two saw cuts to construct the sign post with standard breakaway support. Similarly damaged schedule 40 supports which cannot be reused can frequently be salvaged for use in other sign support fabrications. A concern with the tubing support is that frequently total damage occurs to the support as well as to the sign due to ride down of the system. The possibility of its susceptibility to fatigue in high wind areas and the difficulty in welding the material if sign tree construction is contemplated are further concerns in their use.



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ENGINEER-DIRECTOR  
B. L. DEBERRY

November 2, 1978

IN REPLY REFER TO  
FILE NO. D-10R  
720.34  
750.192

Subject: Performance of Yellow Thin-Wall Tubing  
Sign and Delineator Supports

TO: DISTRICTS 2, 3, 4, 5, 6, 7, 11, 14, 18, 21 and 22

Attention: Maintenance Engineer

Dear Sirs:

Full scale crash tests have been conducted on thin-wall tubing for sign supports under Research Project 2-18-78-264, "Crash Testing Sign and Delineator Posts." The results of these tests indicate that satisfactory impact performance has been demonstrated for certain tubing sizes compared to conventional schedule "40" pipe and delineator supports. The following list indicates substitutions which are considered equal:

<u>Tube Sizes</u>	<u>Equivalent Supports</u>
2-7/8" diameter x .065"	2" diameter sign support
2-3/8" diameter x .109"	2" diameter sign support
1.90" diameter x .065"	1-1/4" diameter pipe and/or delineator posts milepost marker support
1.66" diameter x .047"	Delineator posts

In conjunction with the tests, however, several factors were encountered which might mitigate the savings expected through the reduction in material costs for the lighter weight tubing. These factors were:

1. Upon impact the support is completely collapsed and reuse of the support is not possible.
2. Laydown of the post upon impact generally scrubs the sign off the support and the resulting damage to the sign makes reuse of the sign unlikely.

3. The destruction of the sign support in an unreinforced concrete footing will require replacement of the footing on subsequent reinstallation of the sign support.

It appears therefore that significant cost reductions in signing and delineation installation can only be realized through the comparative savings in material costs as well as cost reduction realized through reduced impacts effected by the distinctive yellow color of the support.

Since your district is one of the first to requisition these supports, your cooperation is requested to assist this office in field performance evaluations to measure their expected net savings (or loss) to the Department. Based upon the response of each district using these posts, it is felt that a sufficient sample as well as diversity of installations will result in meaningful data upon which statewide recommendations for the use of these type posts can be made.

It is recognized that data on knockdown rates are generally unavailable and accurate objective comparisons will be difficult to obtain in a relatively short period of time. Similarly, an extensive program for data collection can easily exceed the capacity of field personnel and also not insure a commensurate increase in precision of results. It is recommended therefore that data generation rely heavily upon the subjective evaluations of the maintenance person performing the work of replacing signs on a day-to-day basis. An outline for the proposed data collection is listed as follows:

1. It is suggested that high knockdown locations be established and a best estimate of the rate of knockdown for each location be developed. When the next knockdown occurs at these locations, the yellow tube support be substituted and a similar written record be kept of its rate of knockdowns.
2. In order to permit repetitions, it is recommended that sufficient yellow posts be held in reserve as replacements to enable evaluation over at least a one-year period at each location.
3. As soon as data is generated, a report will be prepared summarizing the conclusions from each district and forwarded to this office.

Your thoughts on this proposed program are requested as soon as possible, in order that optimum reliance on the data generated can be achieved as well as a realistic approach to its collection be assured. Also, subsidiary information on innovative developments which are felt to influence the

Maintenance Engineer

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October 30, 1978

overall evaluation are desired. Similarly, performance which differs from test results and vehicle damage encountered which could prove helpful should be collected if at all possible. Mr. David Hustace, Senior Research Engineer, TexAn 822-7403, will coordinate the collection of this information and he is available at any time to assist in structuring your data collection procedure. Whatever assistance you can provide in this effort will be sincerely appreciated.

Sincerely yours,

B. L. DeBerry  
Engineer-Director

By:

Phillip L. Wilson

Phillip L. Wilson  
State Planning Engineer,  
Transportation

*DH*  
DH/rmf

cc: D-18

*J*

## ADDENDUM

### Alternate Foundation Design Tests

Test on the "V-loc" foundation for the tubing sign support is currently under evaluation at the Southwest Research Institute. A test was conducted using the "V-loc" foundation on June 13, 1980. A 2,250 lb. vehicle at 60 mph was impacted into the system with the driven foundation. Tubing size was 2 7/8" x 0.120". A breakaway feature of the support was tested by means of 4 drilled holes through the tubing at its base and in line with the top of the base. Test performance indicated that the support did not breakaway as desired. The foundation was partially pulled from the ground and weld failure of the plate steel wing occurred. Momentum change was within acceptable limits.

Further tests on the "V-loc" foundation were conducted by TTI in conjunction with the mailbox crash test program, Interagency Contract TTI 1980 (4).

The "V-loc" foundation posed some difficulty in installation with the pneumatic hammer, however, no apparent damage to the "V-loc" foundation occurred after crash tests with 2" and 1.66" diameter mailbox tubing supports.

In each test, the support was pulled from the foundation and whereas damage to the support was extensive, changes in vehicle momentum were within minimum acceptable limits after impacting the single and multiple mailbox installations.