FLEXIBLE DELINEATOR POSTS

TESTING AND RESEARCH DIVISION
RESEARCH LABORATORY SECTION

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Flexible delineator posts

FLEXIBLE DELINEATOR POSTS

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Research Laboratory Section
Testing and Research Division
Research Project 81 TI-766
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Michigan Transportation Commission
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INTRODUCTION

Delineator posts currently used in the State of Michigan consist of one or two reflective buttons mounted on a steel channel. Flexible delineator posts, usually made of fiberglass or plastic, have recently appeared on the market. Manufacturers claim that the principal advantage of such posts is that they will rebound to their original upright position after vehicle impact resulting in lower replacement frequency than conventional delineator posts, thus reducing maintenance costs. Further, it is claimed that these posts are less likely to inflict vehicle damage, are virtually vandal-proof, easy to install, and due to their light weight, should cost less to transport.

The Testing and Research Division was requested to develop procedures for evaluating flexible delineator posts. Most of the emphasis of this project was on the laboratory testing evaluations, but a cursory field survey was also conducted and cost data obtained. A review of flexible delineator post use in other states was also conducted.

Description of Posts Evaluated

Several companies submitted posts for evaluation. The roadside delineator posts included the Carsonite Roadmarker, the Carsonite Curveflex, the TLB Guardian Post, the PVC Flexopost, and the Unistrut Post. The lane delineator posts evaluated were the Technibilt Repo post, the Services and Materials' Maxi-Post, and the Services and Materials' Lane Delineator. Each delineator post is shown and described in Appendix A.

LABORATORY EVALUATION PROCEDURE

Laboratory tests were devised to compare the various posts, and the complete test results are given in Appendix B.

Rigidity Test

A 5-1/2-lb weight was suspended a distance of 4 ft from the fixed end of each post as shown in Figure 1. This was used to determine the flexibility of one post in relation to another. A test failure was defined as a deflection angle greater than 60° from horizontal as shown in Figure 2. The test was conducted at room temperature.

Impact and Deflection Resistance at Low Temperatures

Each post was cooled to a temperature of -8 F for at least two hours prior to being subjected to the following two tests:

1) Impact Resistance Test. With the post supported at both ends, a 2-lb steel weight was dropped onto the face of the post from a height of 5 ft as shown in Figure 3.

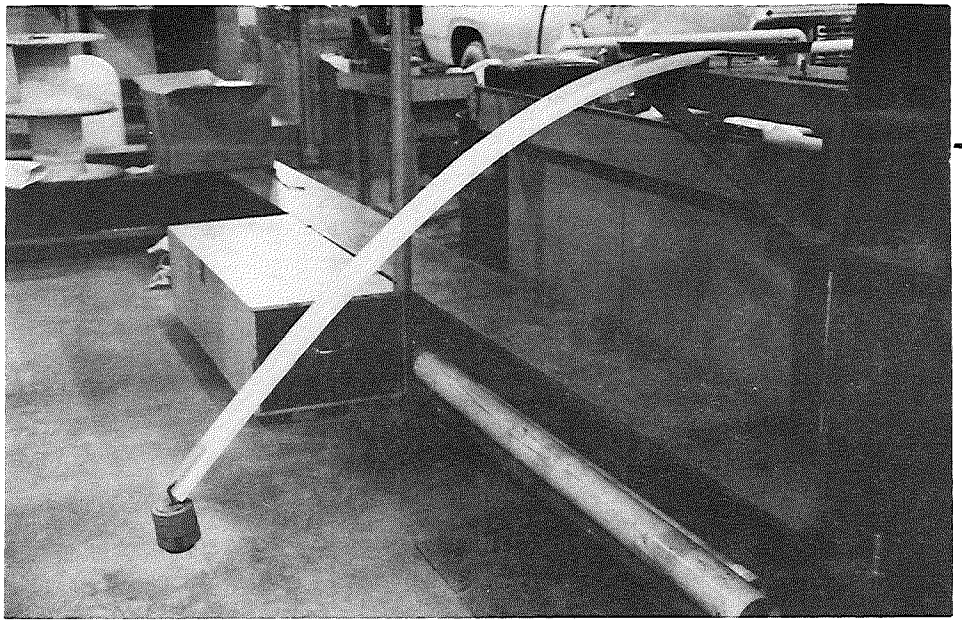


Figure 1. Deflected delineator post.

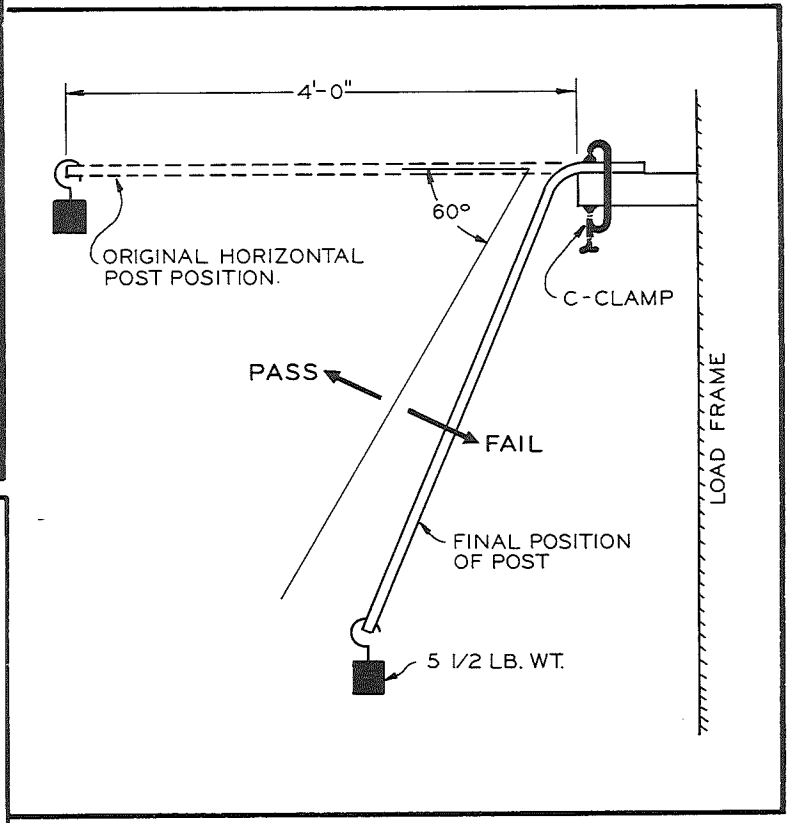


Figure 2. Rigidity test set-up.

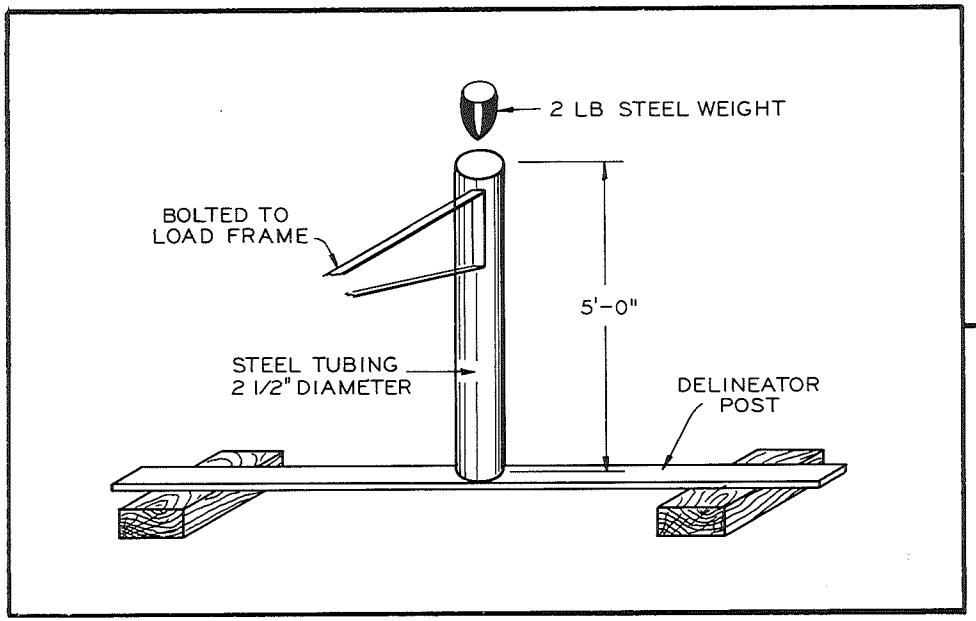


Figure 3. Impact resistance test at cold temperatures.

This test was repeated five times for each post and any fractures, cracks, or splits were noted.

2) Deflection Resistance and Brittleness Test. Each of the roadside delineator posts was cast in a concrete cylinder to simulate a post mounted in hard ground. Lane delineator posts were bolted or epoxied to the cylinder rather than cast in place. A load was applied using the MTS electro-hydraulic testing apparatus with a ram nose designed to represent a vehicle bumper. A diagram of the test set-up is shown in Figure 4.

The load was applied to deflect the post 9 in. at the point of load application (Fig. 5). It took 140 seconds to complete one full up-and-down cycle. This cycle was applied three times, and the resulting permanent deflection, at the load application point was measured after each cycle, as shown in Figure 6.

Deflection Resistance at High Temperatures

The same basic set-up which was used for the deflection resistance test at low temperatures was used for the high temperature deflection resistance tests. Each post was heated to 140 F for at least two hours prior to being subjected to the following tests:

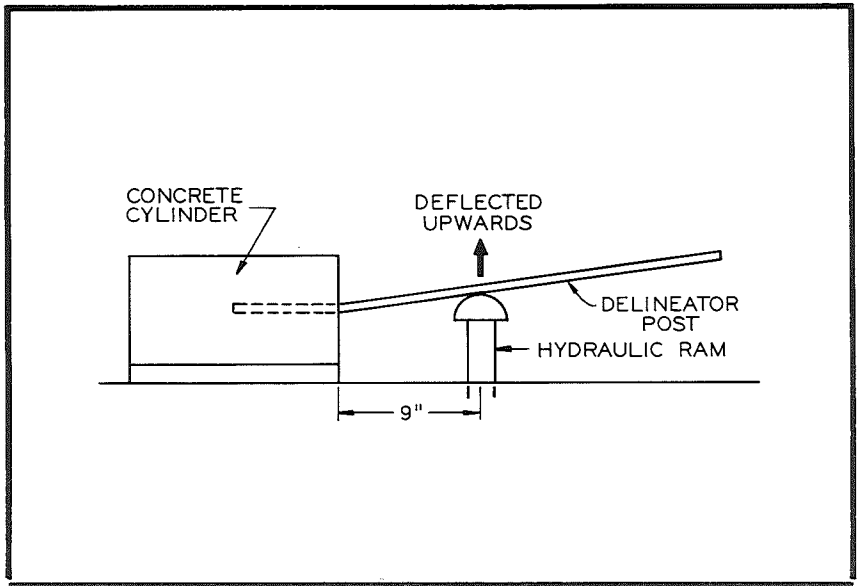
1) The load was applied 9 in. from the fixed end to obtain a deflection of 8 in. at the point of load applications as shown in Figure 7.

This load cycle was applied five times at the rate of one complete up-and-down cycle per 140 seconds and the resulting permanent deflection was measured after each cycle, as was done with the low temperature tests.

2) The above test was repeated, except the load was applied 5 in. from the fixed end, as shown in Figure 8. Each load cycle was applied three times, and the resulting permanent deflection was measured at the end of the last cycle.

Based on the results of these tests, only the PVC Flexopost and the Unistrut post should be considered for use. Both the Carsonite Roadmarker and the Carsonite Curveflex fractured when subjected to the deflection resistance tests, although the Carsonite Curveflex post only fractured completely during the 5-in. deflection resistance test. The TLB Guardian post failed the rigidity test by a wide margin and is considered too flexible for field use.

The PVC Flexopost appeared to be the best roadside delineator post. Its permanent deflection of less than 1 in. after the deflection resistance tests appears to be adequate to withstand field conditions. The Unistrut post did not fail any of the tests; however, its 5-1/8 in. permanent deflection after the cold temperature deflection resistance testing makes it questionable for use in the field during the winter season.



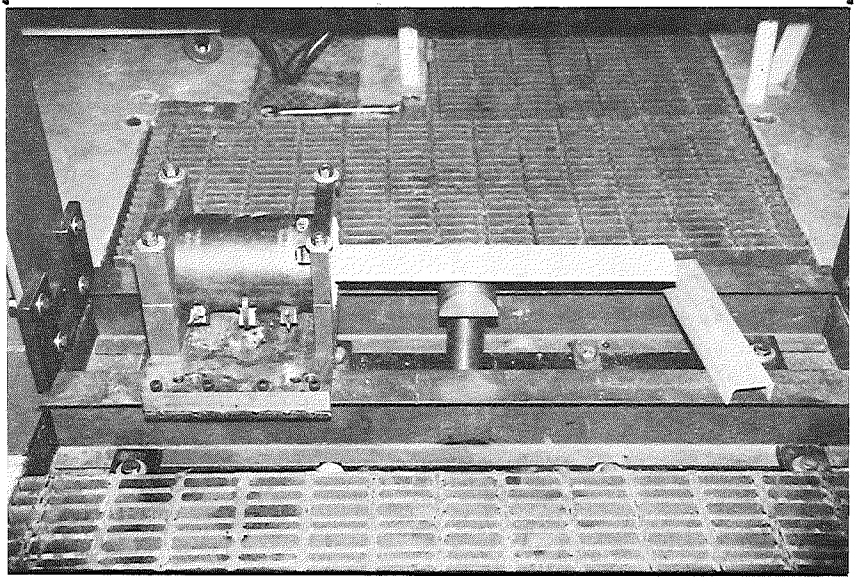
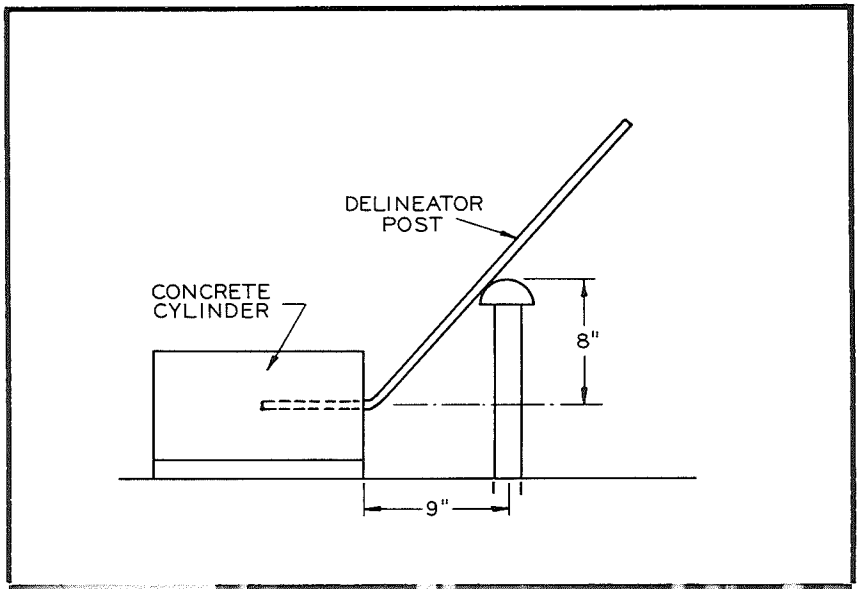


Figure 4. Loading of delineator post with MTS hydraulic ram.



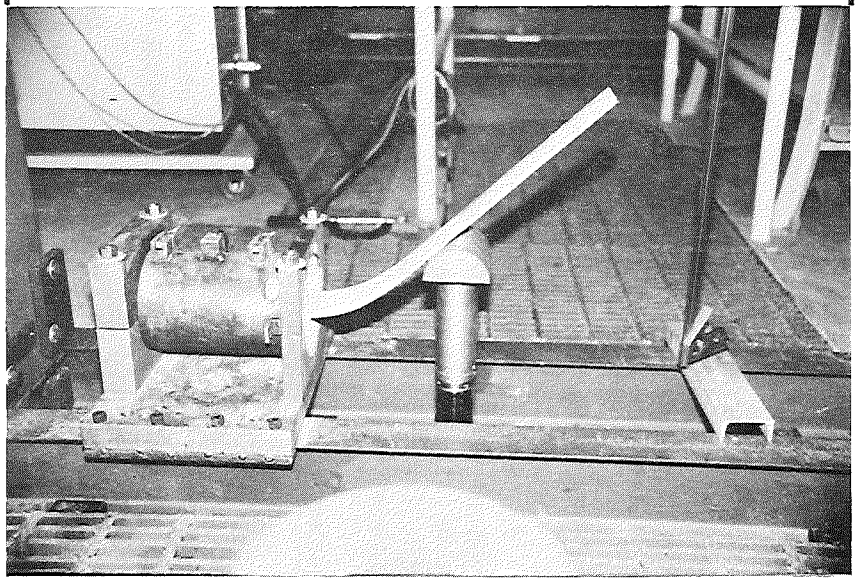


Figure 5. Post deflection at the peak of the loading cycle.

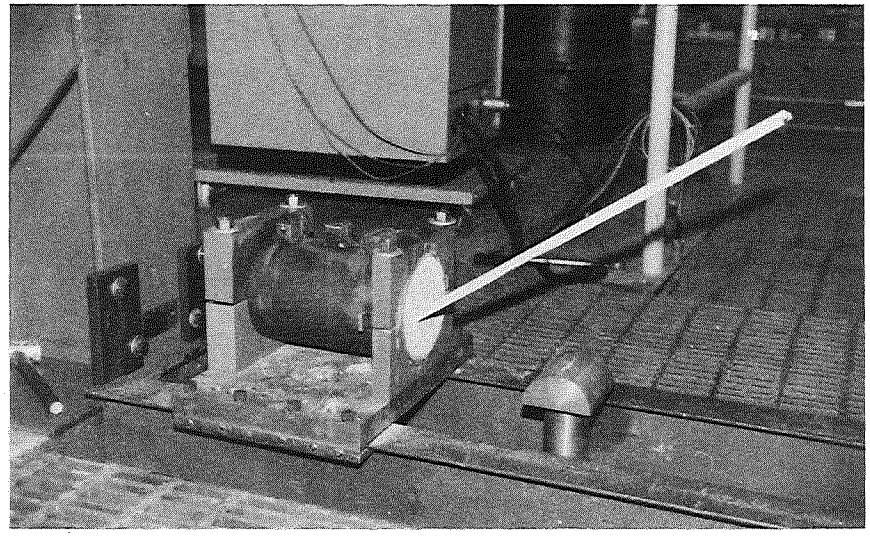


Figure 6. Permanent deflection of post after test.

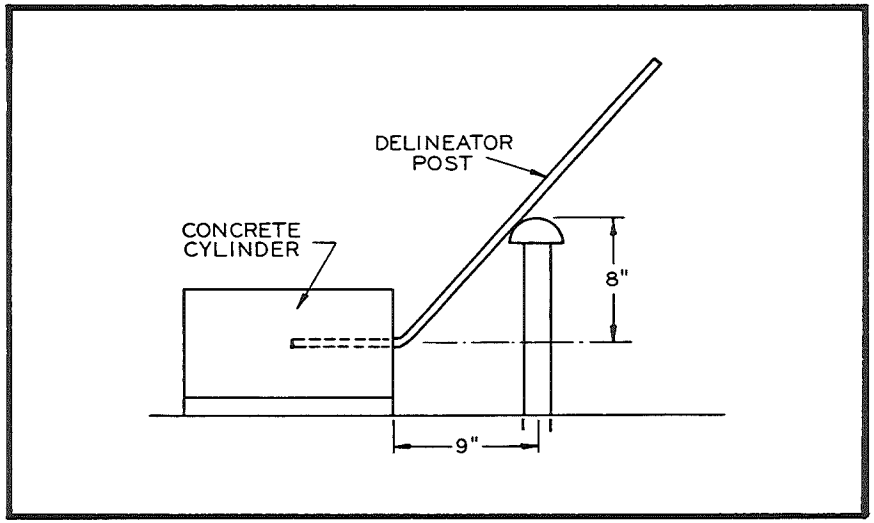
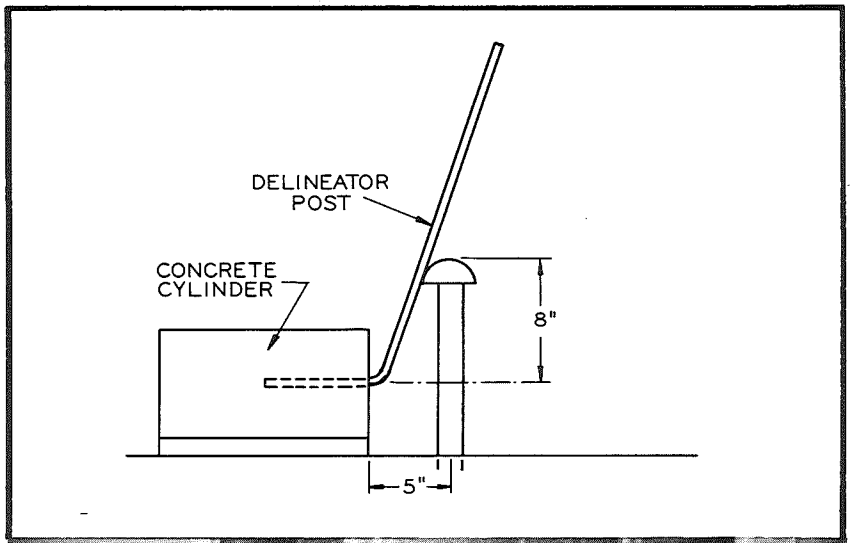
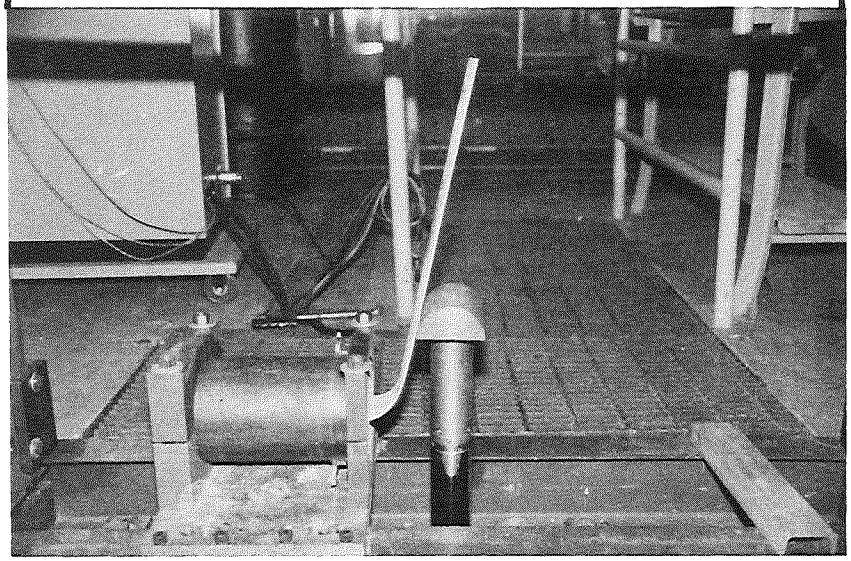


Figure 7. Loading 9 in. from fixed end at the peak of the cycle.

Figure 8. Loading 5 in. from fixed end at the peak of the cycle.





The two Services and Materials' lane delineator posts failed both the high and low temperature deflection resistance tests. Although the Technibilt Repo post did not fail any of the evaluation tests, problems were found with the epoxy holding the delineator base to the concrete when subjected to cold temperatures. It is, therefore, recommended the post should not be used when temperatures fall below freezing.

FIELD SURVEY

A cursory field survey was conducted in the winter of 1982 and continued during the spring of 1983. Eight locations of flexible delineator posts around the Lansing area were surveyed, which included a total of

TABLE 1
RESULTS OF MICHIGAN DEPARTMENT OF TRANSPORTATION RESEARCH LABORATORY FIELD SURVEY
(Includes only Carsonite Roadmarker and Carsonite Curveflex Post which were Intermixed at each Location)

Location	Original No. Of Posts	No. Of Posts Replaced	No. Of Original Posts Remaining	No. Of Broken Posts At Time Of Survey	% Of Remaining Posts Broken	Total Failures*		Post Pull-out Effort
						No.	% of Total No. of Posts	
Loop Ramp EB I 496 to NB US 27	37	27	10	10	100	37	100	Minimal
Off Ramp WB I 496 to Creyts Rd.	40	0	40	1	2.5	1	2.5	Minimal
Loop Ramp EB I 96 to Pennsylvania-Cedar Sts.	36	1	35	6	17.1	7	19.4	Medium
Loop Ramp WB I 96 to SB US 27	30	1	29	6	20.7	7	23.3	Minimal
Loop Ramp SB Penn. Ave. to EB I 96	27	1	26	15	57.7	16	59.3	Minimal
On Ramp Curve SB BL 96 to EB I 96	31	4	27	6	22.2	10	32.3	Minimal
Off Ramp WB I 496 to Jolly Rd.	3	1	2	1	50	2	66.7	Minimal
Grand River Ave & Airport Rd.	15	2	13	9	69.2	11	73.3	Hard
Total	219	37	182	54	29.7	91	41.6	

*Assuming replaced posts had failed

219 Carsonite Roadmarker and Carsonite Curveflex posts, originally installed by the Maintenance Division in June of 1979. These posts were straightened, or replaced in March of 1982. When this survey was conducted, the Roadmarkers and Curveflex posts were intermixed. It is not known when each of these two types of posts was installed. The survey showed 37 (16.9 percent) of the original 219 posts had been replaced. Of the remaining 182 posts, 54 (29.7 percent) were broken. Assuming that the replaced posts had also been broken, 91 (41.6 percent) of the original posts failed after 4-1/2 years of service. At most of the locations, minimal effort was required to pull the posts out of the ground. A summary of the field survey is shown in Table 1.

WASHINGTON DOT POST EVALUATION

The Washington Department of Transportation conducted controlled field evaluations in August 1980 which included several flexible delineator posts of the same types evaluated by the State of Michigan (1, 2). These posts were the Unistrut, Carsonite Roadmarker, Carsonite Curveflex, TLB Guardian, PVC Flexopost, and Technibilt Repo post. The Washington DOT also evaluated the Carson Flextron F1B and Van Der Ree Harpoon posts.

One of the tests conducted was a pull-out test using a hydraulic ram connected to the delineator post with a C-clamp. A vertical tension was applied and the maximum force read on a spring scale. The maximum capacity of the spring scale was 275 lb, and over one-half of the posts evaluated reached this limit.

The vehicular impact testing consisted of 10 passes at 35 mph followed by 10 passes at 50 mph using a vehicle with an extended bumper. From the impact testing, a survival rate was calculated defined as the ratio of the total number of impacts prior to post failure to the total number of possible impacts for that test set, expressed as a percent. For example, in a set of three posts scheduled for 10 vehicle test runs each with the three posts failing after 4, 5, and 6 impacts, the survival rate would be (3+4+5)/30 = 12/30 = 40 percent. Sets of posts tested at two speeds have a rate expressed for each speed. Where failure occurred in one or more posts at the lower initial test speed, the survival rate for the higher speed is based on the number of posts still erect at the start of the higher speed test set. For example, an initial set of three posts experiencing failure of one post at 35 mph after the eighth impact would have a 35 mph rate of (10+10+7)/30 = 27/30 = 90 percent. For the 50 mph test set, the total possible number of impacts would be 20, and if the two remaining posts remained effective for the total set, there would be a 100 percent survival rate for 50 mph.

The Washington DOT study showed the Unistrut, TLB Guardian, and PVC Flexopost delineator posts performed much better at 50 mph than

the other posts, with survival rates of 100, 93, and 95, respectively. Results of the Washington DOT experiment are summarized in Table 2. The Washington DOT field study is given for informational purposes.

TABLE 2
RESULTS OF THE WASHINGTON DOT FIELD EVALUATIONS OF FLEXIBLE DELINEATOR POSTS

Post Name	Pull-out Force (275 lbs Max.)	Impact Testing				
		No. of Posts	Failures		Survival Rate (%)	
			Number	Percent	35 MPH	50 MPH
*Unistrut	275	6	0	0	100	100
*Carsonite Roadmarker (Control)	275	4	4	100	100	10
*Carsonite Roadmarker	155	4	4	100	100	20
Carson Flextron F1B	135	6	6	100	82	16
*Carsonite Curveflex	240	6	5	83	100	33
Harpoon 80	70	6	6	100	14	0
*TLB Guardian	275	6	2	33	100	93
*PVC Flexopost	275	6	1	17	100	95
*Technibilt Repo	275	6	6	100	100	27
Total for all posts		50	34	68	89	55

*Posts which were also evaluated in the laboratory by the Michigan Department of Transportation.

Reference: Washington State Department of Transportation, "Flexible Guidepost Durability Study," Report No. 168, May 1981

MDOT's Testing and Research field survey was kept to a minimum because it is understood that the Maintenance Division is in the process of conducting a comprehensive field survey of the eight Lansing and one Grand Rapids locations. These results will be presented in a separate report distributed by their Division.

ECONOMIC CONSIDERATIONS

The flexible delineator posts have a much higher initial cost ranging from $9.50 per post to $30.02 per post as compared to the $2.60 for the standard steel channel post currently used by the State of Michigan. During the previous two fiscal years, the number of posts used by the Maintenance forces amounted to 8.4 percent of the total number of posts in service. This figure is probably lower than the actual replacement rate because the number of posts used included not only the amount for replacement, but also included all new installations. The total statewide maintenance costs included travel time and equipment costs for routine delineator post maintenance performed in the winter when there is no other work scheduled such as fill-in work between snowstorms. In addition to delineator post repair, a large portion of the routine maintenance costs include driving to and visually inspecting different locations, and this would continue to be done whether flexible or steel delineator posts were used. A summary of costs provided by the Maintenance Division can be found in Tables 3 and 4.

It should be noted that data for the steel post delineator replacement are based on all delineator posts statewide. The flexible delineator posts would probably only be used in high impact areas. Since MDOT has no data on steel post delineator replacement in high impact areas, it is not known what fraction of the 8.4 percent total post replacement would be attributed to these areas. Still, the 8.4 percent of total posts used is a relatively small amount and the $2.60 per post is significantly less expensive.

CONCLUSIONS

As discussed previously in the laboratory evaluation section of this report, the PVC Flexopost and the Unistrut post appeared to be the only two suitable alternates for use as roadside markers. The Technibilt Repo post appeared to be usable from a physical point of view under certain specilized conditions, but even this is questionable because of the very high cost. Since the Technibilt Repo post and Unistrut post are open at the top, some way of allowing water to drain out of these posts should be provided.

The Washington DOT study showed most flexible delineator posts to have an overall survival rate that is relatively low at 50 mph. Only three types showed reasonable survival rates. Michigan's cursory field survey showed a 41.6 percent failure rate over 4-1/2 years for the two brands of Carsonite posts used in the field. This information was not broken down by each specific type of Carsonite post, but laboratory evaluations proved the Curveflex to be a somewhat better post than the Roadmarker.

It is doubtful that any of these flexible posts could survive a direct tire impact, particularly in cold weather. Based on the tire-width to bumper-width ratio, there is approximately a one in six chance that an impact will be of this type.

TABLE 3
COST OF DELINEATOR POSTS EVALUATED OR USED BY MDOT

Post Name	Cost Per Post	Comments
Carsonite Roadmarker	$11.48	-Price includes 3" x 6" reflective sheeting -Must be bought in quantities greater than 750 to obtain this price
Carsonite Curveflex	11.48	-Same as Carsonite Roadmarker
Technibilt Repo Post	30.02	-Price includes $12.70 for epoxy kit which must be used
TLB Guardian Post	9.50	-Based on a reported 1982 bid for the State of Ohio in which 10,000 were purchased
PVC Flexopost	N/A	
Unistrut	13.33	-Must be bought in quantities greater than 500 to obtain this price
S&M Maxi-Post S&M Lane Delineator	19.18 15.00	-$12.70 for optional epoxy kit
Avg. for flexible delineator posts	$15.71	
MDOT Standard Steel Channel	$ 2.60	-Plus $0.29 per reflective button

TABLE 4
MICHIGAN DEPARTMENT OF TRANSPORTATION DELINEATOR MAINTENANCE

Fiscal Year	Total Statewide Maintenance Cost[1]	Number of Posts Used[2]	% of Total Posts Replaced[3]	Maintenance Cost Per Post Used	Number of Buttons Replaced
1981-82	$225,692	14,160	7.6	$15.94	45,280
1982-83	317,453	17,213	9.3	18.44	52,513
2 Year Average	$271,573	15,686	8.4	$17.31	48,896

NOTE:

1 Considered routine maintenance and done during the winter between snowstorms when there is nothing else scheduled. These figures include driving time and equipment costs.

2 This is the total number of posts used during the fiscal year. New installations were not separated from the number of replacement posts.

3 Based on approximately 186,000 delineator posts statewide.

One of the major manufacturer claims is that the flexible posts provide a greater reflective surface area than the reflective buttons and thus enhances safety. If this is so, a piece of reflective sheeting on aluminum of the desired size could be attached to the steel channel post in lieu of the button to enhance the safety of the steel delineator posts. The Michigan Department of Transportation has found that the greater area of reflective sheeting would not be more effective than the buttons (3). Because of the intensity of the buttons, it would take a sheet of reflective sheeting 3 by 12 in. to equal the brightness of one button. These conclusions are based on tests conducted at right angle to each reflective surface.

RECOMMENDATIONS

Due to their high initial cost, flexible delineator posts do not appear to be a suitable replacement for the current Michigan Standard of reflective buttons mounted on a steel channel post. If it is determined by the Traffic and Safety or Maintenance Divisions that in high impact areas such posts are necessary, the PVC Flexopost appears to be the best, with the Unistrut post a less desirable alternative because of its poorer performance in low temperature deflection.

If lane delineators are needed during the construction season, the Technibilt Repo post would be the best of the three lane delineator posts evaluated, although other brands of lane delineator posts which were not evaluated may be better alternatives for such purposes, at lower cost. The Technibilt Repo post can only be used as long as temperatures are above freezing.

Since such posts are likely to be used for special applications only, there is no need to write a general specification and acceptance procedure. The Traffic and Safety Division should determine the safety aspects of flexible delineator posts, and whether or not this makes them cost effective for continued use in the State of Michigan.

REFERENCES

1. Washington State Department of Transportation, "Flexible Guidepost Durability Study," Report No. 160, January 1980.

2. Washington State Department of Transportation, "Flexible Guidepost Durability Study," Report No. 168, May 1981.

3. Michigan Department of Transportation, "Specific Luminance and Cost of Red Delineators," Memo from L. T. Oehler to K. A. Allemeier, November 2, 1973.

APPENDIX A

Flexible Delineator Posts Evaluated by the Research Laboratory

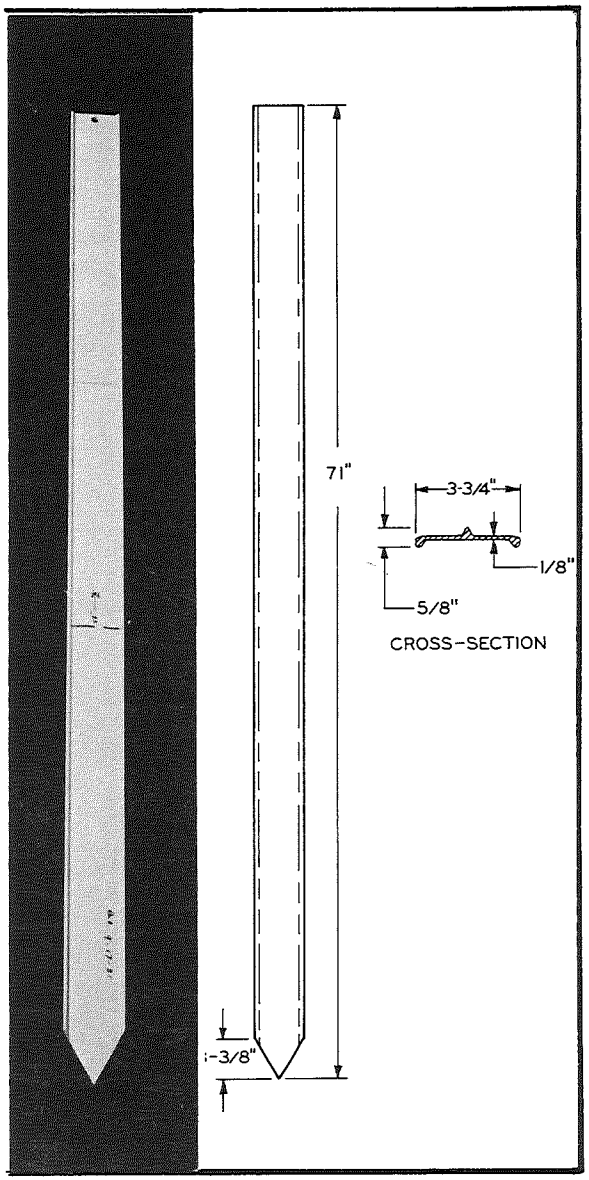


Figure A1. Carsonite Roadmarker. Carsonite International, Carson City, NV.

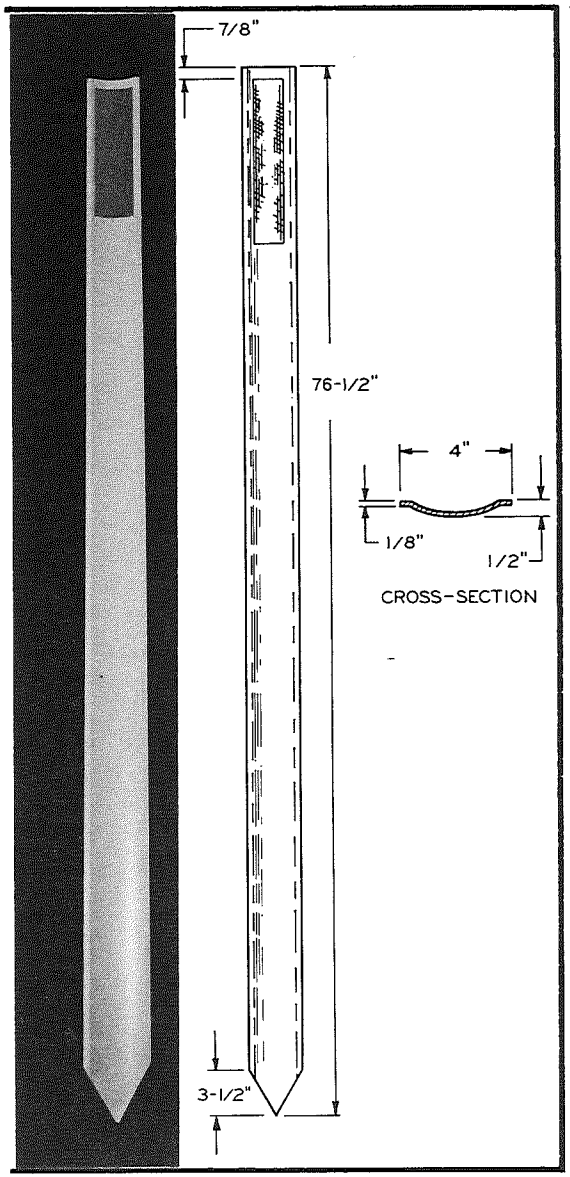


Figure A2. Carsonite Curveflex. Carsonite International, Carson City, NV.

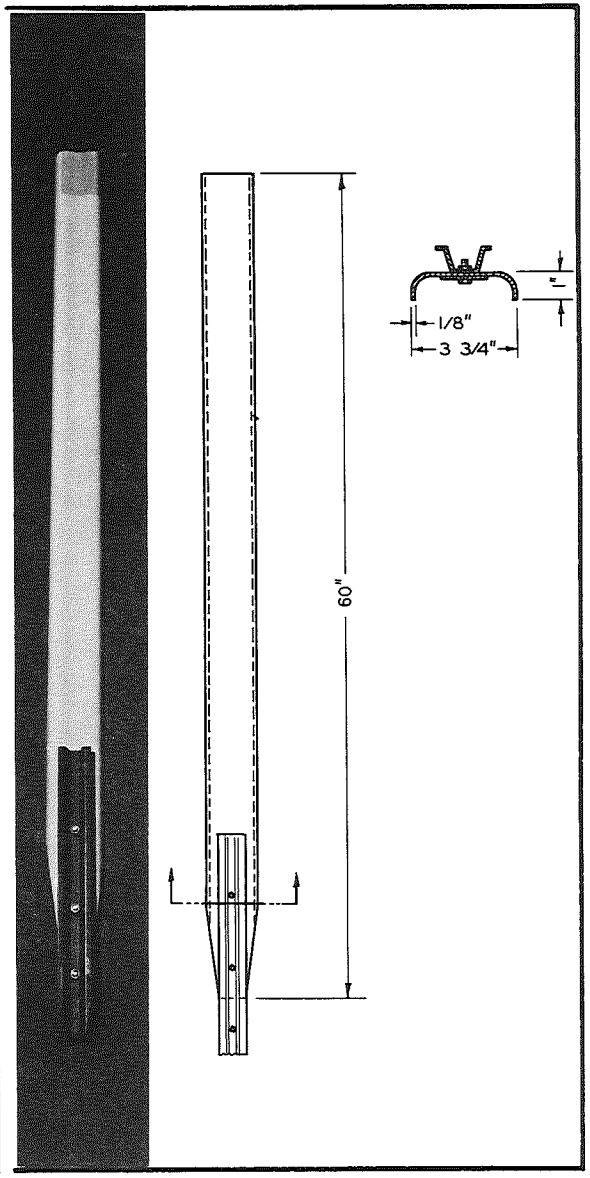


Figure A3. TLB Guardian. Potter Industries, Cleveland, OH.

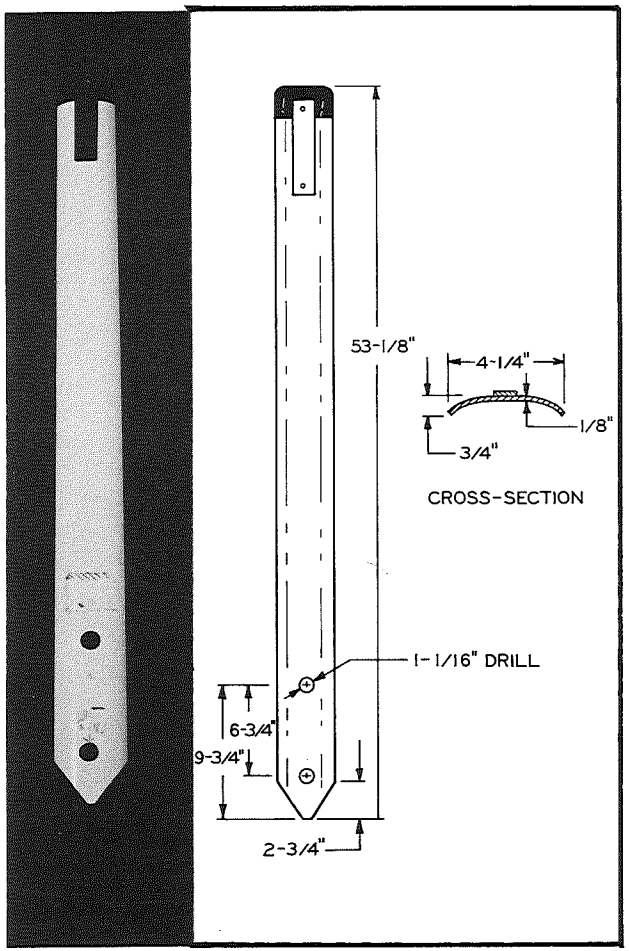


Figure A4. PVC Flexpost. Proven Products, Portland, OR.

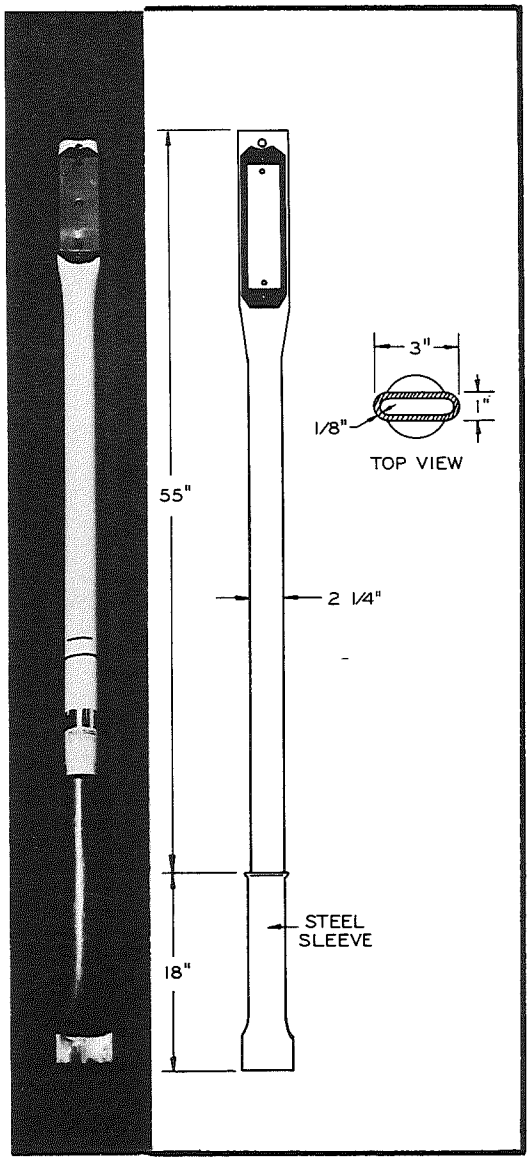


Figure A5. Unistrut. Safe-Hit Corp., Hayward, CA.

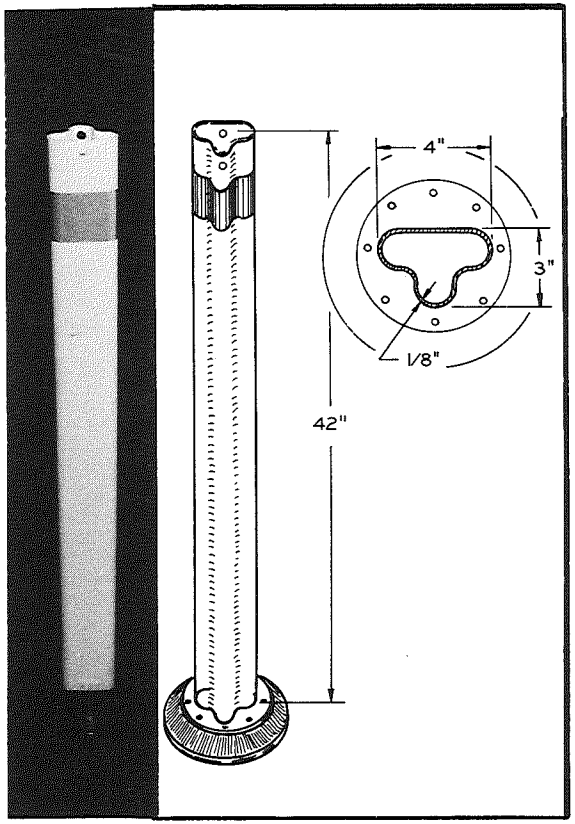


Figure A6. Technibilt Repo. Technibilt Corp., Burbank, CA.

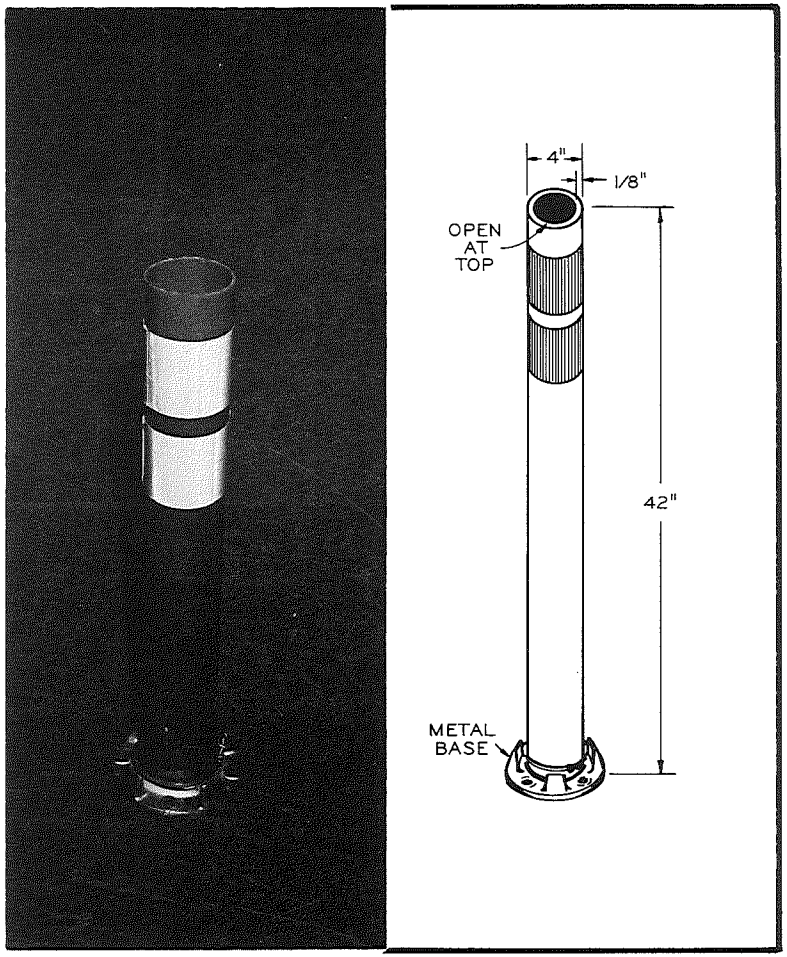


Figure A7. Maxi-Post. Services and Materials Co., Elwood, IN.

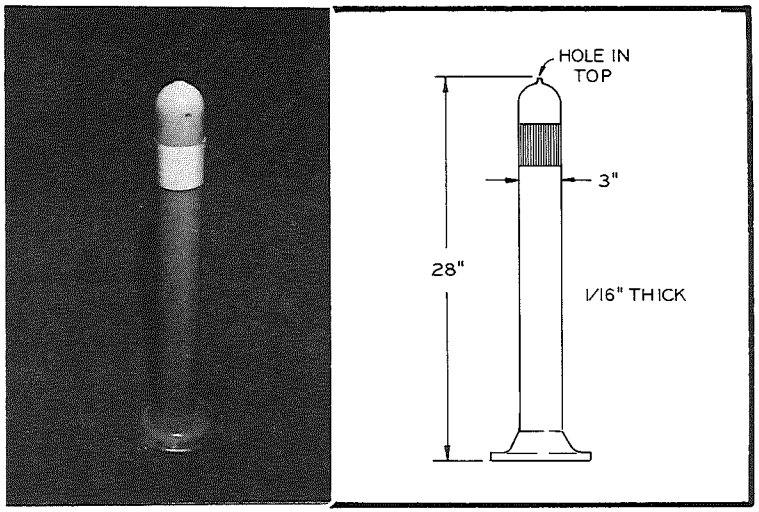


Figure A8. Lane Delineator. Services and Materials Co., Elwood, IN.

APPENDIX B

Results of Laboratory Evaluations

RESULTS OF LABORATORY EVALUATIONS

Carsonite Roadmarker

Rigidity Test: Passed

Impact and Deflection Resistance at low temperatures

a. Impact: No cracks or splits
b. Deflection: Fractured on first cycle

Deflection Resistance at high temperatures

a. Deflection cycle at 9 in.: Failed on first cycle
b. Deflection cycle at 5 in.: No test

Carsonite Curveflex

Rigidity Test: Passed

Impact and Deflection Resistance at low temperatures

a. Impact: No cracks or splits
b. Deflection: Partial fracture on first cycle; 1/8" deflection after 3 cycles

Deflection Resistance at high temperatures

a. Deflection cycle at 9 in.: 1/8" deflection after 5 cycles
b. Deflection cycle at 5 in.: Failure on first cycle

TLB Guardian Post

Rigidity Test: Failed

Impact and Deflection Resistance at low temperatures

a. Impact: No cracks or splits
b. Deflection: 5/8" deflection after 3 cycles

Deflection Resistance at high temperatures

a. Deflection cycle at 9 in.: 7/8" deflection after 5 cycles
b. Deflection cycle at 5 in.: 7/8" deflection after 3 cycles

PVC Flexopost

Rigidity Test: Passed

Impact and Deflection Resistance at low temperatures

a. Impact: No cracks or splits
b. Deflection: 1/2" deflection after 3 cycles

Deflection Resistance at high temperatures

a. Deflection cycle at 9 in.: 5/8" deflection after 5 cycles
b. Deflection cycle at 5 in.: 7/8" deflection after 3 cycles

Unistrut

Rigidity Test: Passed

Impact and Deflection Resistance at low temperatures

a. Impact: No cracks or splits
b. Deflection: 5-1/8" deflection after 3 cycles

Deflection Resistance at high temperatures

a. Deflection cycle at 9 in.: 1-13/16" deflection after 5 cycles
b. Deflection cycle at 5 in.: 7/8" deflection after 3 cycles.

Technibilt Repo Post

Rigidity Test: Passed

Impact and Deflection Resistance at low temperatures

a. Impact: No cracks or splits
b. Deflection: 2-7/16" deflection after 3 cycles

Deflection Resistance at high temperatures

a. Deflection cycle at 9 in.: 1-1/2" deflection after 5 cycles
b. Deflection cycle at 5 in.: 11/16" deflection after 3 cycles

Service & Materials Maxi-Post

Rigidity Test: Passed

Impact and Deflection Resistance at low temperatures

a. Impact: No cracks or splits
b. Deflection: Failed on first cycle

Deflection Resistance at high temperatures

a. Deflection cycle at 9 in.: 4-3/4" after 5 cycles
b. Deflection cycle at 5 in.: Failed on first cycle

Service & Materials Lane Delineator

Rigidity Test: Passed

Impact and Deflection Resistance at low temperatures

a. Impact: No cracks or splits
b. Deflection: Failed on first cycle

Deflection Resistance at high temperatures:

a. Deflection cycle at 9 in.: Failed; too flexible
b. Deflection cycle at 5 in.: Failed; too flexible