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REVIEW OF SIGN OVERLAY PROCEDURES IN VIRGINIA

by

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Research Scientist

(The opinions, findings, and conclusions expressed in this report are those of the author and not necessarily those of the sponsoring agencies.)

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## ABSTRACT

Maintaining the large number of signs on the state's roads demands a substantial effort, especially now that many of the signs erected during construction of the interstate and urban arterial systems are deteriorating to the point of requiring replacement. It is imperative that an expeditious sign refurbishing program be established to ensure the efficiency of procedures in view of the Department's efforts to economize while continuing to maintain the highest level of safety for both the motorist and Department employees.

This report discusses the procedures used by the Department with special attention to cost, manpower, time, and quality of the product. In addition, it presents the results of a questionnaire survey made to obtain information on procedures used in other states. Recommendations concerning the most cost-effective and expeditious method of refurbishing signs in Virginia are presented.



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## INTRODUCTION

Traffic signs are a primary means of warning and guiding motorists, and they must be properly maintained at all times to aid the safe and efficient flow of traffic. Newly fabricated signs have good visibility and legibility; however, the reflective sheeting on the face of the signs deteriorates from exposure to weathering and the accumulation of grime. Once this deterioration reaches the point that the sign is no longer effective, the sheeting should be refurbished or replaced.

Maintaining the large number of signs on the state's roads demands a substantial effort, especially now that many of the signs erected during construction of the interstate and urban arterial systems are deteriorating to the point of requiring replacement. Also, refurbishment will have to be done under increased traffic flow conditions as a result of increases in travel demands which causes concern for the safety of both the highway user and the maintenance employee. This concern, coupled with motorist delays resulting from the sign messages being unavailable for guidance while being refurbished, necessitates the use of efficient refurbishment procedures.

It is imperative that an expeditious sign refurbishing program be established to support the Department's efforts to economize without sacrificing safety. Also, it is important that the refurbished sign be of a quality to assure that it will effectively inform and guide the motorist. In this regard, it should be noted that there has been some concern about possible problems associated with the waviness ("hot spots") of refurbished signs using overlay panels.

Various methods of refurbishing are used by the Department, including replacement and the application of overlay panels, and each method requires certain manpower, material, equipment, etc.

In view of the above, it was believed that a review of the Department's sign refurbishing program was timely and would provide information for optimizing the economics and effectiveness of the program.

## PURPOSE AND SCOPE

It was, therefore, the purpose of this study to examine the procedures used by the Department for refurbishing signs with the intent of recommending improvements. Specifically, information concerning the cost of refurbishment, the time and manpower required, problems encountered, safety, and the quality of the finished product was desired. Also, a survey of other states was made to obtain information concerning their refurbishing procedures.

The investigation was limited to large, ground-mounted and overhead guide signs.

## PROCEDURE

Information was obtained through the use of a questionnaire and from observations of sign refurbishing projects around the state. Also, a questionnaire was sent to the other states to solicit information on their refurbishing procedures, problems, etc.

In addition to studying the methods presently used by the Department, a new overlaying procedure developed by the 3M Company and designated "Grade 9800 System 5" was observed on several of the field projects monitored. It is noted that System 5 is a high intensity grade, retroreflective sheeting with a thin, semirigid backing coated with a pressure-sensitive adhesive. This material can be applied over the existing sign in the field.

The questionnaire sent to each district gathered information on methods of refurbishing and the materials and fabricating process used. Information relating to the refurbishing procedures, manpower, cost, problems, etc., was obtained through observation of 13 sign refurbishing projects around the state. Each project was closely monitored from the time the refurbishing process was initiated in the shop until it was completed in the field. Of the projects observed, 6 involved refurbishing in the field with overlay panels attached with rivets, while 1 involved attaching overlay panels in the field using rivets and an adhesive. Five of the projects involved the use of the System 5 procedure for refurbishment. On 1 project, the entire sign was replaced.

## OBSERVATIONS AND INFORMATION FROM DISTRICT QUESTIONNAIRE

The results are based on data received from the questionnaire sent to each district and from the observation of the shop and field

procedures used for the refurbishing projects observed. Also, a summary of the nationwide questionnaire is presented.

### Method of Refurbishing

A summary of the sign refurbishing procedures used in the districts is shown in Table 1. All districts use 4' aluminum panels for overlaying. These are sized in the shop to fit the sign to be refurbished and are faced with encapsulated lens background sheeting. Five districts use these panels to overlay their signs in-place on the highway, using rivets to attach the overlay panel to the old sign, two use rivets plus an adhesive and one either replaces the entire sign or uses riveted overlays. One of the districts that uses an adhesive in addition to the rivets overlays the sign in-place in the field, while the other brings the sign into the shop for overlaying. It is noted that two districts are trying the new System 5 method.

### Shop Preparation

#### Riveted Panels

For this refurbishing process, the overlay panels are prepared in the shop by sizing the 4' wide aluminum panels to correspond to the sign to be refurbished and applying the encapsulated lens sheeting. These panels are then either carried to the field for application, which is the procedure used by most districts, or applied in the shop to the old sign which is brought in from the field. It is noted that the copy is also applied in the shop by most of the districts and this subject will be discussed later.

#### System 5

The only shop time required for the System 5 process is that for cutting and preparing the copy, which is normally applied in the field. Although one district experimented with applying the copy to the System 5 material in the shop, this procedure is not recommended because the sheeting can be damaged by excessive handling (bending, crimping, etc.) and it is difficult to align and match the sheets in the field.

#### Sign Replacement

For the project on which the sign was replaced, the new sign was fabricated in the shop with directly applied copy, taken to the field, and erected in place of the old sign.

Table 1

## District Refurbishment Procedures

## DISTRICTS

[illegible]

## REFURBISHING PROCEDURE

## Overlay on Highway

- Rivets in-place

- Rivets/glue in-place

## Overlay in Shop

- Rivet/glue

## Replace on Highway

- Erect in-place

## System 5

## FABRICATION PROCEDURE

Application of Copy

- Direct applied in Shop

- Demountable in Field

- Demountable in Shop

### Aluminum Overlay Thickness

- 0.040"

- 0.063"

- 0.080"

- 0.125"

PANEL WIDTH

RIVET SPACING (hor./vert.), in.

## CREW SIZE

- Shop

- Field



### Sign Surface Preparation

Preparation of the sign to be refurbished differs according to the method of overlaying. Initially, the sign is stripped of all demountable copy, rivets, etc., which would prevent an overlay panel from laying flat on the surface. For signs to be refurbished using riveted overlay panels, the panels are simply aligned and riveted. For signs to be riveted and glued, an adhesive is applied to the overlay panel and sign prior to attachment.

Figure 1 shows a sign being prepared for the application of System 5 material. It is noted that applications to reflective sign surfaces are limited to surfaces that are smooth, clean, and dry. For weathered surfaces which exhibit spalling, ply separation, delamination, or poor adhesion of the paste, all loose materials should be removed by scraping and brushing before the System 5 material is applied. (See Appendix A for additional information on applying System 5 material.)



Figure 1. Sign preparation for System 5 material.

There was some question involving the suitability of a sign for overlaying with System 5. Although instructions for application are provided, there is some uncertainty concerning the degree of deterioration (weathering, spalling, ply separation, delamination, etc.) beyond which System 5 should not be applied. Also, since System 5 adheres to the original sign surface, any dents, bends, etc., will be visible; therefore, judgment should be used in selecting signs to be refurbished. Many imperfections, dents, bullet holes, etc., however, can be overlaid without any significant problems.

#### Overlay Panel Thickness

In Virginia, 0.063" and 0.080" thick aluminum overlay panels are used for most large guide signs. Panels 0.040" thick have been used, especially for smaller signs; however, this thinner material is more difficult to handle and is more susceptible to the formation of "hot spots." There are no data for comparison of the 0.063" and 0.080" panels; however, based on the assumed cost of each material, the 0.080" material costs approximately \$0.50/ft.<sup>2</sup> more than the 0.063" for new material (\$0.32/ft.<sup>2</sup> for recycled material). The prices may vary with individual bids and quantities. Acceptable results are reported in Virginia for both the 0.063" and 0.080" thicknesses.

The System 5 material is a thin, semirigid aluminum with an encapsulated lens retroreflective sheeting.

For the project on which the sign was completely replaced, 0.125" aluminum was used.

#### Attaching Overlay Panels

##### Riveted Panels

For riveted overlay panels, a rivet spacing of between 8" and 20" in horizontal and vertical lines is used; however, rivets are spaced closer along the edges. It is noted that sufficient rivets should be placed to secure the sign and minimize waviness; but too many rivets will detract from the appearance. Figure 2 shows an overlay panel being aligned and Figure 3 shows it being riveted. For the projects on which riveted overlay panels were used, no problems were encountered and the panels were aligned and riveted expeditiously.

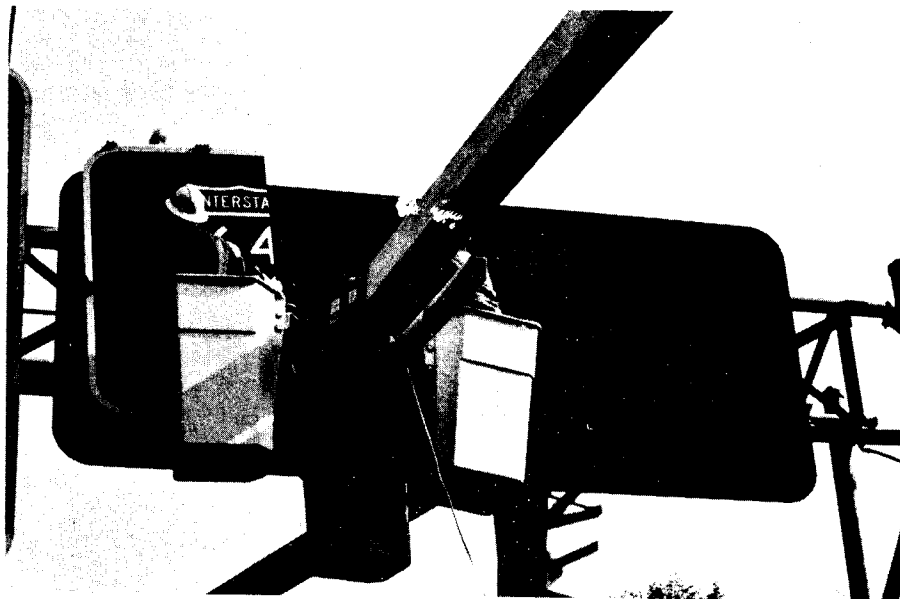


Figure 2. Aligning overlay panel on in-place sign.



Figure 3. Riveting overlay panel to in-place sign.

### Riveted and Glued Panels

It is noted that in the past some districts attached the overlay panels using only an adhesive, since this method gave a smooth surface. However, problems were encountered when the old sheeting bearing the adhesive delaminated and thus caused the overlay panel to become detached. In an attempt to prevent this situation, rivets were used in addition to the adhesive to secure the panel.

For the refurbishing method employing rivets and an adhesive, the adhesive is uniformly brushed onto the in-place sign and the overlay panel, and the panel is aligned and secured to the sign. Care must be taken when aligning the overlay panel, as once the adhesive covered surfaces contact it is very difficult to realign or remove the panel. Also, care must be taken to ensure that the adhesive does not get on the face of the panel and that the cemented surfaces be kept free of dirt, trash, etc. Using an adhesive in addition to rivets extends the process by requiring extra care in handling and aligning the panels.

### System 5 Material

The System 5 material is backed with a pressure-sensitive adhesive and is attached by aligning the 2' sheets and pressing them onto the surface with a rubber roller or a soft cloth (see Appendix A). It is noted that no rivets are used in this procedure. Figure 4 shows the System 5 sheeting being applied. This procedure requires more field application time than that used for riveted overlays since additional time and care is required in preparing the old sign surfaces and aligning and applying the material. Data on shop and field manpower and time requirements are given later. It should be noted that, although it is important to refurbish a sign as quickly as possible, workmanship is also important and special care should be taken in handling and applying the panels. For example, some problems were encountered when the System 5 sheeting wrinkled or captured air bubbles, primarily because the sheeting was improperly crimped or applied. There were situations, also, where wind caused problems in application, especially for very high signs or high winds.

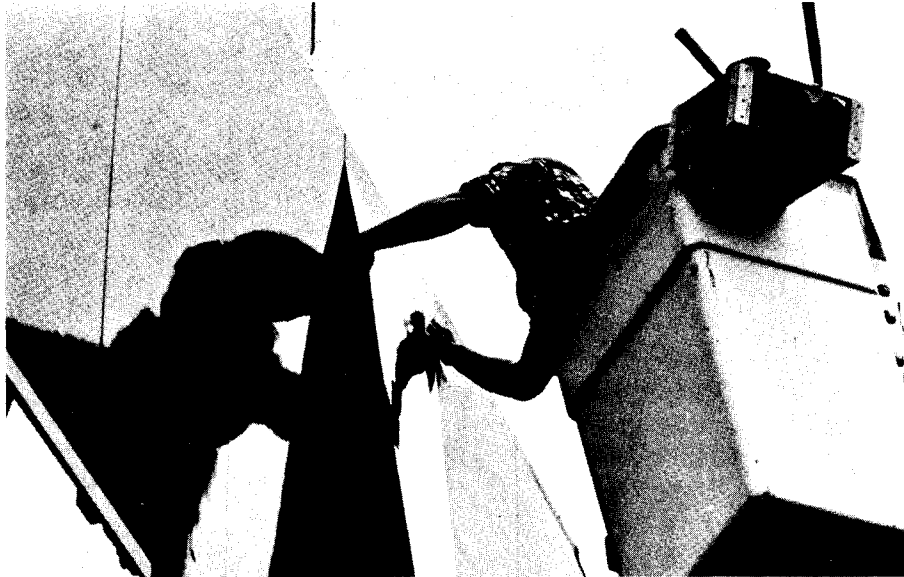


Figure 4. Applying System 5 sheeting.

#### Application of Copy

Five of the eight districts use directly applied copy for riveted overlay panels, finding this method more convenient and cheaper than the alternatives. The directly applied copy is attached in the shop and under favorable conditions, since it can be easily positioned and there is no concern for traffic and work site protection. Figure 5 shows copy being aligned in the shop for overlay panels to be riveted. Fabricators using demountable copy cite the advantage of being able to change the message without changing the background; others using directly applied copy indicate that changing messages is not a problem. The districts using demountable copy report that the copy is removed from the sign, taken back to the shop, covered with reflective sheeting, brought back to the sign, and reattached. Unless spare letters are available and taken to the field, this process takes more time than using directly applied copy and renders the sign useless for guidance for longer periods of time. In some cases, the message is off for a day.

For System 5 overlays, the position of the old copy is measured from the old sign and the new copy positioned and applied directly over the System 5 overlay in conformance with these measurements. Figure 6 shows the application of the copy. In cutting the copy out of the System 5 material in the shop, it was difficult to get smooth edges. Using tin snips, two cuttings were sometimes required to get the edges straight and flat. Also, machine pressing or shearing the copy and border created a concave area around the edges that made it difficult to get the copy and border to lay uniformly flat on the sign. After approximately 6 months, some evidence of deterioration, probably caused by irregular edges, around the edges of the copy and border was noted. Consideration should be given to ways of improving the quality of the copy and border; e.g., perhaps an improved procedure for cutting in the shop could be found or precut copy and borders could be purchased.

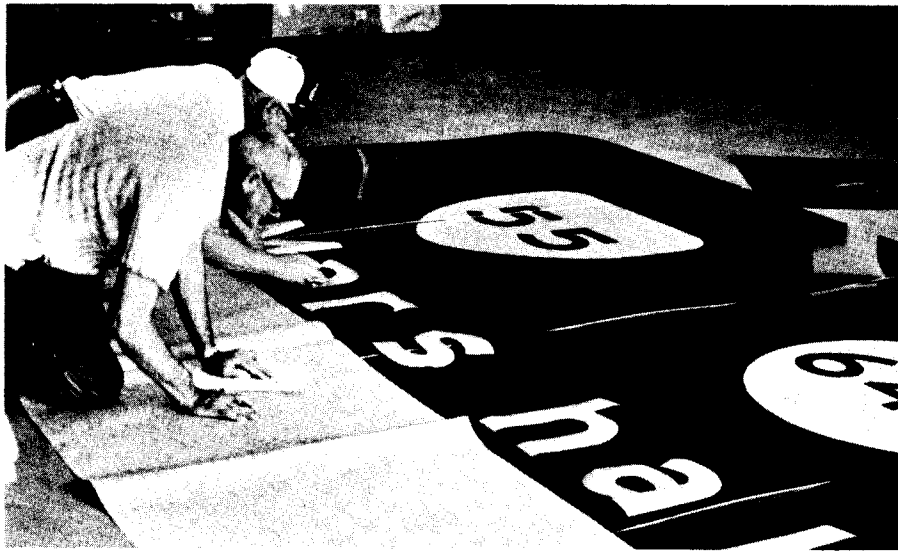


Figure 5. Shop application of directly applied copy.

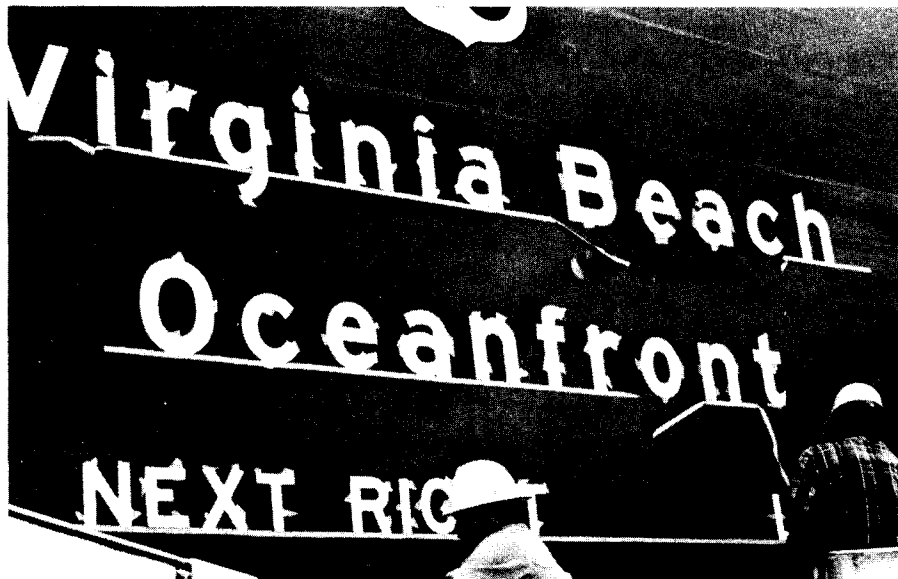


Figure 6. Applying copy to System 5 overlay.

## Shop and Field Manpower Requirements

A summary of the shop and field manpower requirements for the refurbishing projects monitored during this study is shown in Table 2. All projects employed directly applied copy, with the System 5 copy being prepared in the shop but applied in the field.

Shop times are the man-hours required to prepare the overlay panels for field application, including preparation of the aluminum blanks for the background reflective sheeting, application of the sheeting to the metal blanks (roller and heat application), and application of the copy and border. The shop times did not include any time for letter/border/shield cutting and preparation.

Field manpower requirements include man-hours for loading and unloading at the shop and sign, removing copy and border from the in-place sign, preparing the sign surface, and installing the overlay panels. Travel and lane closure times were not included since they vary according to the sign location and number of signs refurbished per trip.

Table 2 also gives the total time that the sign was out of service, i.e., the message was either not visible or was incomplete, and the time that maintenance personnel were on the highway.

It is noted that for the System 5 method of overlaying, shop time is required for preparing the copy and border, but all copy and border usually are applied to the sign in-place.

Figure 7 shows plots of the total man-hours (shop and field) required for the methods of sign refurbishment versus the total area of the signs on the projects monitored. Sufficient points were available for plots of the procedures in which the overlay panels were fabricated in the shop with directly applied copy and attached with rivets to the sign in-place and for System 5 material applied in the field. For riveting/glueing in-place and sign replacement, data were available for only one project each. In order to obtain estimates of the man-hours for these refurbishing procedures with limited data and different sign sizes, lines were drawn through the single points with assumed slopes identical to those for the riveted overlay projects.

It is noted that only two of the available projects were used to establish the curve for the refurbishing procedure using System 5 material. The two were completed by the Culpeper District and represent the last two of six System 5 overlay projects in that district. The last two projects were used because the System 5 overlaying procedure is new and required time for the workmen to become familiar with the material and procedures.

Table 2  
Shop and Field Manpower Requirements

	Overlay							System 5					Replace- ment
	Rivet	Rivet	Rivet	Rivet	Rivet	Rivet	Rivet/ Glue	7/81	4/82	6/82	8/82	9/82	
Sign Area (ft. <sup>2</sup> )	80	119	138	163	173	224	213	116	158	109	126	214	182
Shop No. Men	1.5	*	2	2	2	2	3.5	0	0	0	0	0	7
Man-hours	4.1	*	6.9	7.0	7.8	10.1	20.1	0	0	0	0	0	30.8
Field No. Men	3	5	4	4	2.5	*	3	5	4	3	3	4	8
Man-hours	3.1	6.2	6.0	5.5	5.6	*	13.2	20.3	16.9	17.0	9.9	13.2	23.7
Total Man-hours	7.2	*	12.9	12.5	13.4	*	33.3	20.3	16.9	17.0	9.9	13.2	54.5
Message Unavailable (Hr.)	0.63	0.97	1.20	*	1.48	*	2.83	3.58	3.75	3.73	2.72	3.88	2.83
Personnel on Road (Hr.)	0.87	1.13	1.38	*	2.03	*	3.15	3.97	4.08	4.13	3.03	4.22	3.17

\*Data not available.



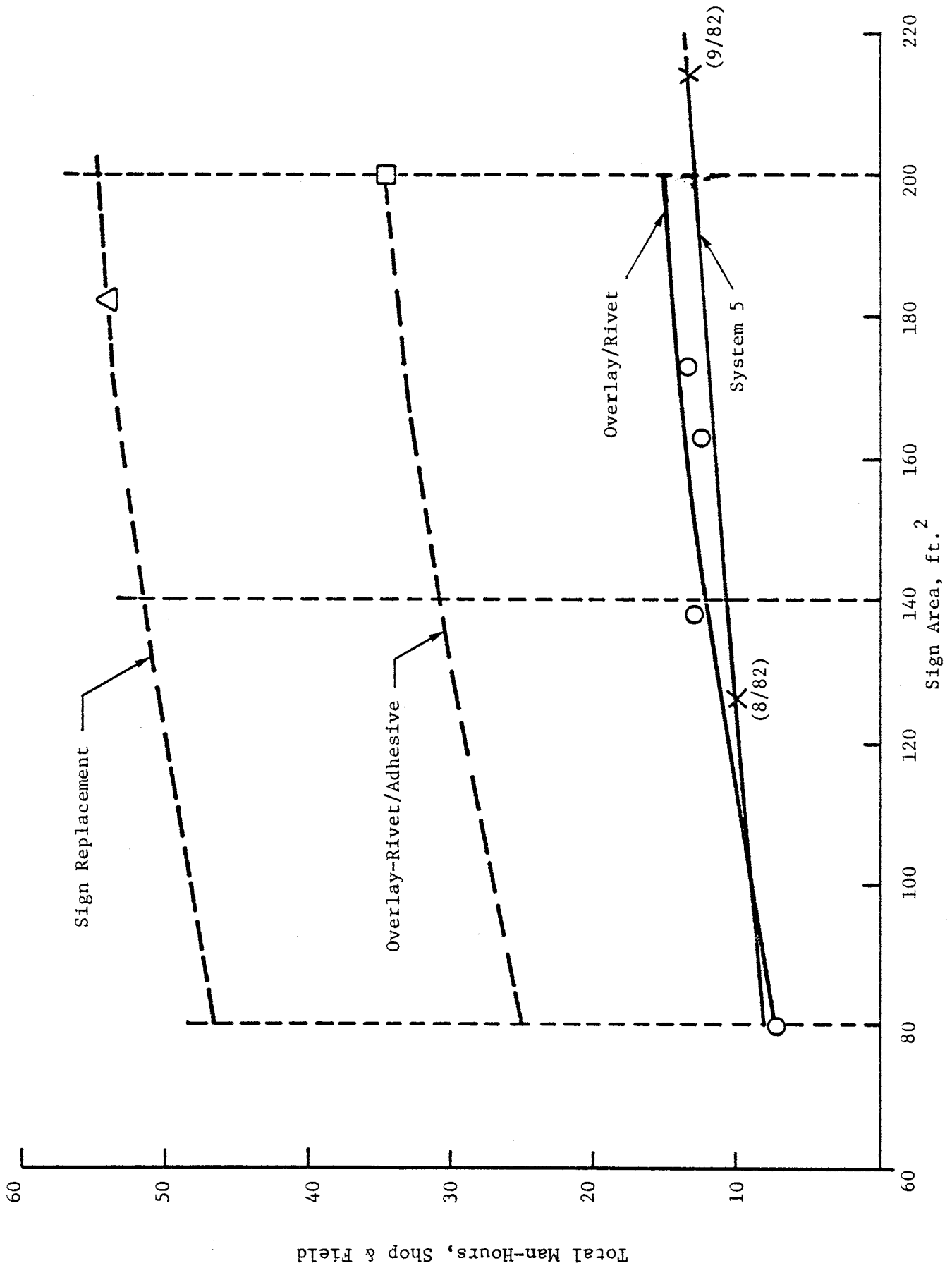


Figure 7. Total man-hours for refurbishing procedures.

Considering the refurbishing procedures normally used by the Department, it is obvious from the curves that the method of using riveted overlay panels attached in-place requires the least number of man-hours for completion. Overlaying in-place using rivets and glue takes significantly more man-hours, whereas sign replacement requires substantially more man-hours than either overlaying method. Based on data gathered from the last two System 5 refurbishing projects, this new method requires slightly fewer total man-hours than the method of riveting.

#### Crew Size and Equipment

The crew size varies among districts, ranging from two to four persons for shop preparation depending upon the method of refurbishing.

The crews used in the field for applying both the overlay panels and System 5 material ranged from 3 to 4 men, with the exception of sign replacement, which required more. Unless there are reasons for having a larger work crew, it appears that a 3-man is appropriate.

Most districts use a bucket truck and a flatbed for refurbishing. These vehicles seem appropriate for the refurbishing procedure used, with the exception of sign replacement, which may require more vehicles.

#### Cost of Refurbishing

A cost comparison of the refurbishing procedures is shown in Table 3. In establishing relative costs, sign sizes of 80 ft.<sup>2</sup> (small sign), 140 ft.<sup>2</sup> (medium sign), and 200 ft.<sup>2</sup> (large sign) were used. It is noted that the total costs do not include those for handcutting copy, space rental, or miscellaneous items such as rivets, glue, and tools.

#### Material Costs

Costs for materials are those currently being paid by the Department for aluminum sign blank material and silver and green encapsulated lens sheeting. The costs of aluminum for the overlay panels were calculated using costs for recycled aluminum, which is presently being used by the Department. Also, a salvage value for the overlay panels was included as these can be recycled.

Table 3

Cost of Refurbishing, Dollars

Method of Refurbishment	Rivet in-place			Rivet in-place			Rivet/Glue in-place			System 5			Replace Sign		
	0.063			0.080			0.063						0.125		
	80	140	200	80	140	200	80	140	200	80	140	200	80	140	200
Sign Blank Thickness, in.															
Sign Area, ft. <sup>2</sup>															
Material															
Aluminum Blanks	45	79	113	71	124	177	45	79	113				105	183	262
Reflectorized Sheeting															
H.I. Green - \$2.94/ft. <sup>2</sup>	235	412	588	235	412	588	235	412	588				235	412	588
H.I. Silver - \$2.94/ft. <sup>2</sup>	64	111	159	64	111	159	64	111	159				64	111	159
S-5, H.I. Green - \$3.65/ft. <sup>2</sup>										\$292	511	730			
S-5, H.I. Silver - \$3.05/ft. <sup>2</sup>										66	115	165			
Total Material Cost	344	602	860	370	647	924	344	602	860	358	626	895	404	706	1009
Labor Cost (\$9.94/hr.)															
Total (Shop & Field)	72	119	150	72	119	150	249	293	328	\$81	104	129	463	517	552
Travel & Work site Protection (cost per sign)	45	52	75	45	52	75	75	52	75	75	52	75	75	75	75
Total Labor Cost	117	171	225	117	171	225	290	363	397	133	179	204	538	592	627
Vehicle Rental (cost per sign)	37	55	110	37	55	110	55	110	110	55	110	110	152	152	152
Total Cost of Refurbishing	498	828	1195	524	873	1259	700	1080	1373	546	915	1209	1094	1450	1788
Total cost per ft. <sup>2</sup>	6.23	5.91	5.98	6.55	6.24	6.30	8.75	7.71	6.87	6.83	6.54	6.05	13.68	10.36	8.94

### Labor Costs

The labor costs for shop fabrication and field application were estimated by superimposing lines representing the three sizes of signs on Figure 7 and multiplying the resulting total man-hours by the hourly wage. Labor costs for travel and work site protection were calculated assuming 1.5 hours per day for travel to and from the sites and an assumed 1.0 hour per sign for work site protection. The cost of labor was taken from the Culpeper District and represents an average hourly rate with additives included.

### Vehicle Rental

Vehicle costs were estimated using the daily rental costs for a bucket truck and a flatbed truck in the Culpeper District. This total daily cost was adjusted depending on the number of signs refurbished per day, which resulted in a vehicle cost per sign.

### Total Cost

The total cost of refurbishing is given for each sign size and per ft.<sup>2</sup> Figure 8 is a plot of the total cost/ft.<sup>2</sup> for the refurbishing procedures.

Of the procedures normally used for sign refurbishing in Virginia, the use of overlay panels fabricated in the shop with directly applied copy and attached in-place in the field using rivets was the most economical method. The use of 0.063" aluminum was approximately \$0.32/ft.<sup>2</sup> cheaper than the 0.080" material.

The application of overlay panels (0.063") using rivets and glue was more expensive, costing between \$0.89 and \$2.52/ft.<sup>2</sup> more (depending on sign size) than when using rivets only. As could be expected, replacing a sign is significantly more expensive than overlaying.

The cost of using the System 5 material was higher than the riveted-in-place method of refurbishing for small and medium sign sizes, costing approximately \$0.61/ft.<sup>2</sup> more than 0.063" aluminum panels and \$0.29/ft.<sup>2</sup> more than 0.080" panels. For large signs, the cost/ft.<sup>2</sup> for System 5 material was approximately equal to that for the 0.063" panels and less expensive (\$0.25/ft.<sup>2</sup>) than that for the 0.080" panels.

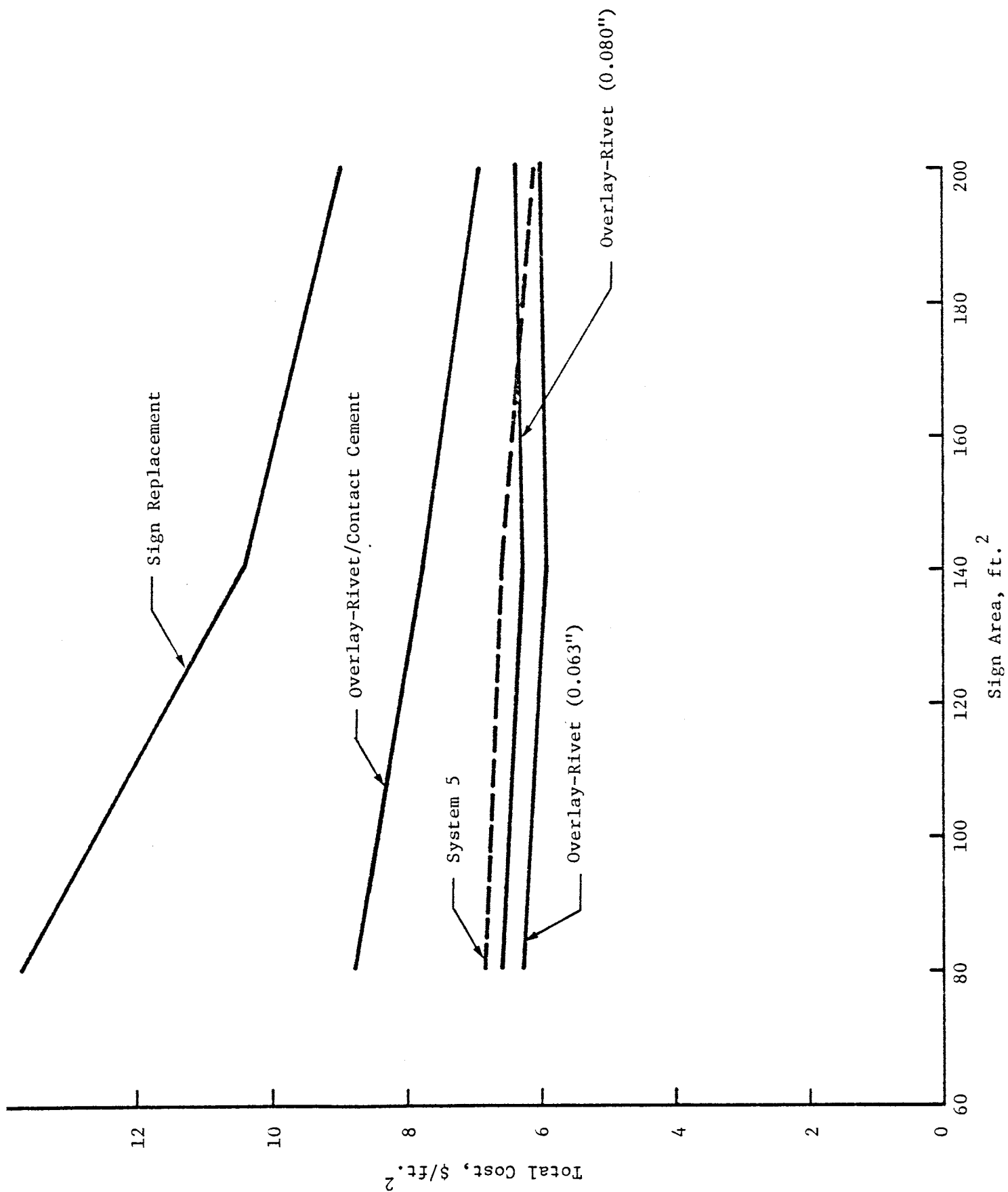


Figure 8. Total cost of sign refurbishing.

The total cost of sign refurbishing will vary according to the number of signs refurbished per trip, the number of man-hours for fabrication and erection, the cost of sheeting, the aluminum sign panel salvage value, etc. Good planning and the effective use of manpower are, therefore, important in ensuring an efficient refurbishing program, since many of the costs are fixed.

#### Exposure to Traffic

The length of time that the sign crew is on the highway refurbishing the sign and exposed to traffic and the length of time that the message is unavailable for guidance are shown in Figure 9. Both of these figures are lowest for the riveted overlay with directly applied letters. The other methods require substantially more time, with the System 5 procedure requiring at least double the time (1½-2 hours) since the message is applied in the field. Although data are not available, it is noted that for the use of demountable copy on riveted overlay panels (copy taken to shop for sheeting application), the time on the highway and the time that the message is absent would be higher than those for riveted panels with directly applied copy.

In the interest of safety, it is important to minimize the time spent on the road refurbishing signs, especially where there is congestion or high traffic volumes. Also, where the availability for motorist guidance is important, the time required for refurbishing should be kept to a minimum. There are, however, areas where these factors are not so critical.

#### Quality of Refurbished Signs

The relationship between the costs of the refurbishing procedures and the quality of the refurbished sign in terms of durability and legibility has been the subject of a great deal of discussion. For example, it has been noted that use of the most economical procedure, overlaying with aluminum panels, tends to produce signs with wavy surfaces, especially at rivet locations, that cause "hot spots" at night.

Problems with hot spots caused by wavy overlay panels were acknowledged by personnel in some districts; however, these were not believed to be of great concern. Various opinions are given concerning the cause of sign waviness, especially that at the rivet locations. Some theorize that the overlay panel, being thinner than the background sign, tends to react more quickly to temperature variations, and thereby cause a differential in expansion and contraction between the two. Also, some district personnel stated that the thinner aluminum overlay panels presented more problems with hot spots.

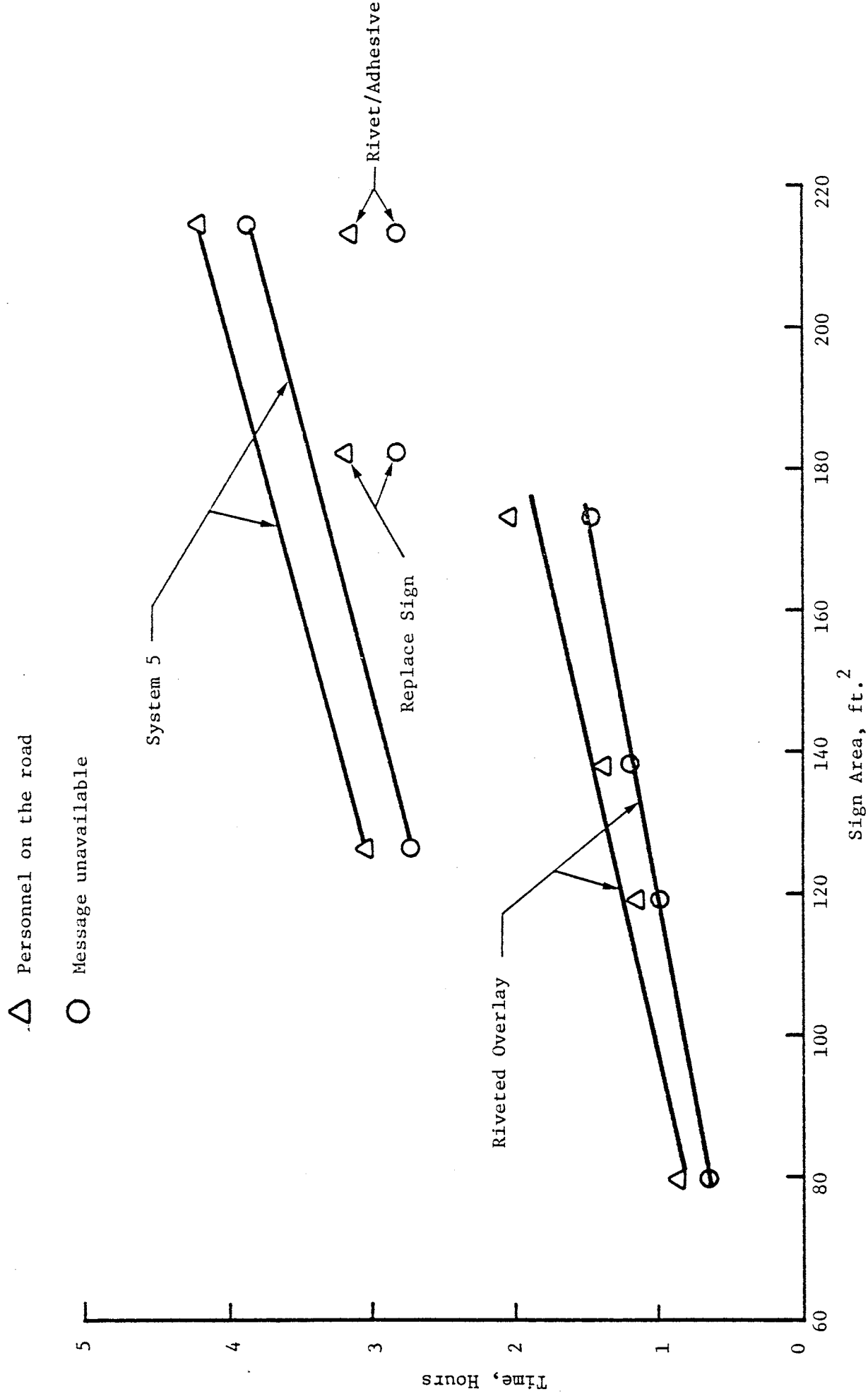


Figure 9. Time for personnel on the road and message unavailability.

At all the district shops visited, it was observed that the new aluminum material used for overlaying was uneven. The material was not uniformly flat; i.e., one edge would be flat on the floor, whereas the opposite edge would be wavy. This unevenness would keep an overlay panel from lying flat against the face of the sign being refurbished.

The unevenness of the aluminum sheeting could decrease the effectiveness of adhesives used for attaching overlay panels. Personnel in one district commented that the adhesive used would not hold after a period of time, and persons in another reported overlay panels being separated from the background sign when the adhesive failed. In light of these problems, and considering the extra cost and time and inconvenience of using adhesives, the use of the procedure should be questioned.

Overall, the System 5 method produced a refurbished sign of good quality for those installations where care was taken in applying the material and the sign to be overlaid was in good condition. Periodic observations were made of all the signs refurbished with System 5, and after one year most of them were in good condition. One sign showed numerous air bubbles or circular areas in the sheeting. It is noted that, prior to refurbishing, numerous rivets were removed from this sign and the old sheeting exhibited spalling. The sign was prepared according to instructions and primed prior to application of the System 5 material. Close examination of the bubbles reveals that the problem has resulted from a lack of adhesion between the System 5 material and the background panel. In some cases this was caused by small protrusions, especially at the old rivet holes, which prevented the sheeting from adhering uniformly to the back panel. Possible contributors to the problem include entrapment of air during application and entrapment of solvent, caused by incomplete drying of the primer, which cannot diffuse through the aluminum. Therefore, care should be taken to ensure a smooth surface for the application of System 5. It is very difficult to see any entrapped bubbles unless they are viewed at a small angle from beneath or beside the sign. They cannot be detected at night and do not influence the legibility of the sign. Also, the bubbles do not appear to be getting larger.

Data are not available on the long-term durability and visibility of the System 5 material since it is a new product. Therefore, observations will continue to be made.

#### QUESTIONNAIRE SURVEY OF STATES

Forty-nine questionnaires were sent to other states soliciting information on their practices and procedures. The general items



covered in the questionnaire and the responses are discussed below. Appendix B gives a tabulation of responses on the forty-five questionnaires returned.

#### Method of Refurbishing

Fifty-one percent of the states reported that they refurbish their guide signs by attaching overlay panels in the field, 13% replace the sign, and 34% either replace the sign or attach overlay panels. Forty-seven percent are experimenting with the System 5 method of refurbishing; however, only 2% are using System 5 or other commercial overlays exclusively.

Of the signs refurbished, 58% are overlaid in-place, 16% are lowered to the ground, and 7% are taken to the shop.

#### Fabrication of Overlay Panel

Ninety-four percent of the states use aluminum overlay panels with the thickness varying from 0.032" to 0.080". Most overlay panels are either 0.040" or 0.060" thick, with thicker panels generally being used for larger signs. Eighty-eight percent of the states reported using the same thickness for all sizes of signs.

Seventy-four percent of the states use 4' wide overlay panels with 77% using a butt joint and 14% using an overlap joint.

Rivets are commonly used (87% of the states) for attaching the overlay panel to the sign backing. Most rivets are either 1/8" diameter (48%) or 3/16" diameter (39%) with spacing varying from 6" to 24" (see Appendix for specifics).

#### Placement of Copy

Forty-three percent of the states reporting refurbish their signs with directly applied copy, with 30% using demountable copy and 23% using either directly applied or demountable copy. Four percent use button copy.

Most states (59%) apply copy in the shop; however, 21% do this in the field. Eighteen percent apply copy using both the shop and field, depending upon the circumstances.

For those states applying copy in the field, 33% measure from drawings, 22% measure from the original sign, 19% drill through the

existing holes, and 15% measure from either the drawing or the original sign.

#### Problems Related to Field Overlay Installations

Fifty-nine percent reported no problems related to work methods and handling of overlay panels, while 13% noted problems with handling and damage in transport. Thirteen percent indicated problems related to traffic control and equipment use. Seven percent reported problems with wind.

#### Appearance of Overlay

Generally, the states were happy with the final appearance of their overlaid signs, with 53% reporting no problems. Ten out of 34 states noted problems with "hot spots"; however, 4 states said the problems were minor, while 1 blamed the "hot spots" on excessive rivet drawdown and 1 attributed them to prior sign damage.

The sign overlay materials and procedures used by all states were examined to determine if the problem with hot spots was associated with overlay panel thickness, rivet size, or rivet spacing. For 0.040" material, 5 states reported hot spots, whereas 6 had none. Four states had a problem with 0.060" to 0.063" panels, while 8 reported no problem. All 6 states using 0.080" material reported no problems with hot spots or legibility.

There were no apparent influences of either rivet size or rivet spacing.

#### Criteria for Refurbishing Guide Signs

Seventy-three percent of the states responding have a criterion for determining when guide signs should be refurbished. Of this number, 87% inspect the signs, while 13% use age as the criterion. Inspection involves either day, night, or day and night observation of appearance, visibility, etc.

### Questionnaire Comments

Most comments concerned the procedure for refurbishing included in the above discussions. Some of the more relevant comments are listed below.

- Tried 0.040 in. thick aluminum panels (overlapping away from traffic) but found that the surface warped or waved, perhaps due to the thin overlay contracting/expanding at a different rate than the original sign background. Now use 0.080-in. overlay with 1/8-in. rivets (24 in. vertical and 12 in. horizontal) with no problems.
- New decade will see a lot of refurbishment of existing signs. It will be a question of what takes most labor to erect, new sign or overlay, plus cost of materials.
- Savings of approximately 200% using overlay as opposed to fabricating new sign.
- Costs have been up to \$12/ft.<sup>2</sup>, including furnishing and applying new button copy. (Overlay panels were usually attached in field -- encapsulated lens with rivets.)
- All refurbishing is done by contract -- recent costs are \$12 to \$13/ft.<sup>2</sup>, depending on quality (price includes necessary traffic control) compared to \$15 to \$17 ft.<sup>2</sup> for new extruded aluminum sign panels. (Encapsulated lens overlay panel [0.040" & 0.063"] riveted in place.)

### CONCLUSIONS AND RECOMMENDATIONS

Of the procedures used for sign refurbishing in Virginia, the use of overlay panels fabricated in the shop with directly applied copy and attached in-place in the field with rivets is the fastest and most economical. It is believed that this method is an effective and economical means of refurbishing signs, and that the Department can save a significant amount of money if it adopts the method for use throughout the state and utilizes personnel and equipment as recommended. Little or no surface preparation is necessary and signs can be overlaid in the summer and winter. Also, this procedure requires the least exposure to traffic for maintenance personnel and equipment and also results in the least amount of time out of service for the sign.

Although problems with hot spots were acknowledged in some districts, they were not believed to be of great concern. This belief was

confirmed by responses to the nationwide questionnaire, which indicated no problems with hot spots.

It is believed that under certain conditions, as noted in this report, the System 5 method of refurbishing large guide signs is an acceptable alternative. This method, although more expensive, is in the cost range of the riveted overlay method of refurbishing, and, based on a limited observation period, results in a refurbished sign of good quality.

The nationwide questionnaire survey, to which approximately 92% of the states responded, showed that slightly more than half of the states refurbish signs by attaching overlay panels in the field and that 13% replace the signs. Fifty-eight percent of the signs overlaid in the field were refurbished in-place; however, 16% were lowered to the ground. Directly applied copy is used more than demountable copy and both are applied in the shop by 59% of the states. Most states (94%) use aluminum overlay panels of thicknesses ranging from 0.032" to 0.080". Most panels are either 0.040" or 0.060", with the thicker 0.080" panels generally being used for larger signs. Rivets are typically used to attach the overlay panels and are usually spaced from 6" to 24".

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APPENDIX A

March, 1982

Supersedes and Obsoletes Product Bulletin 170 dated September, 1980

INSTRUCTIONS FOR

APPLICATION OF

"SCOTCHLITE" BRAND

REFLECTIVE SHEETING

HIGH INTENSITY

GRADE 9800

SYSTEM 5

## I. General

"Scotchlite" Brand Reflective Sheeting High Intensity Grade 9800 System 5 is a bright, durable, retroreflective sheeting with a thin, semi-rigid aluminum backing coated with a pressure sensitive adhesive, which is protected with an easy release liner.

Because of the use of the thin metal substrate in the product, care should be taken in handling to avoid injury from sharp edges.

9800 System 5 Sheeting is intended for the fabrication of sign faces, backgrounds and copy. The sheeting can be cut, screened and directly applied using techniques common to the signing industry. Faces fabricated from 9800 System 5 sheeting can be applied in the sign shop or in the field to a variety of clean, smooth, weather resistant surfaces, including old sign surfaces meeting these criteria, when air and application surface temperatures are above 50°F (10°C).

## II. Application

### A. Surface Selection and Preparation

9800 System 5 Sheetings can be applied to a variety of relatively smooth, tightly adhered, clean, water resistant surfaces, including weathered reflective sign surfaces. Prior to the application of the System 5 Sheeting, the sign surface must be cleaned by solvent wiping with a clean rag dampened with xylol or VM&P naphtha. Do not use oily solvents which may leave a film such as kerosene or mineral spirits. Use proper ventilation and protection, such as the use of rubber gloves when using solvents. **Application to weathered reflective sign surfaces is limited to those surfaces that are smooth, clean and dry. Weathered sign surfaces which exhibit spalling, ply separation, delamination or poor process paste adhesion should not have 9800 System 5 Sheetings applied to them until all loose materials are removed from the surface by**

**scraping and brushing. Solvent wipe the surface with xylol or VM&P naphtha. Prime the outer two inches of the sign surface and the area around bolt heads with "Scotchlite" Brand Primer 4448. Some surfaces may not be acceptable for use with 9800 System 5 sheetings. The user should determine the suitability of the product for the intended use prior to the fabrication of signs.**

## B. Shop Application

9800 System 5 Sheeting can be hand or machine applied in the shop using the normal application procedures for pressure sensitive adhesives. The following application methods have been successfully used and are recommended.

### 1. Hand Application

- a. After the sign face, or copy has been cut to the desired size, lay the sheeting face down on a clean dry surface.
- b. Beginning at one edge or corner, start liner removal and pull back approximately 3" of the liner parallel to edge of the sheeting, to expose the adhesive. Crease the liner to hold it out of the way during positioning of the sheeting onto the substrate (see Figure 1).

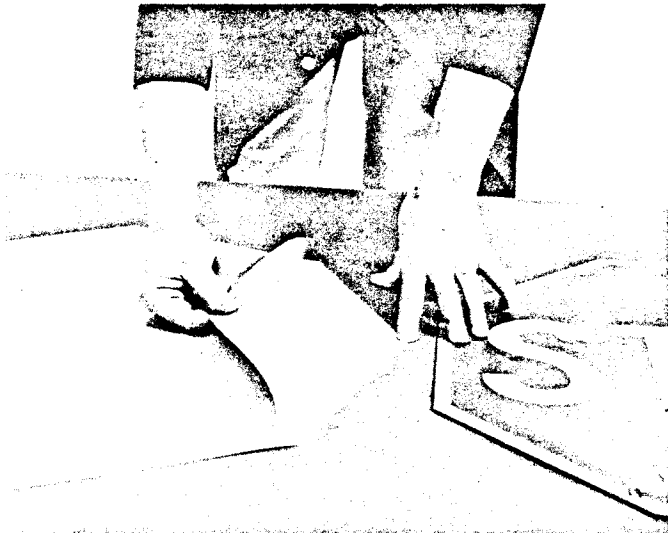


Figure 1

- c. Position the sheeting on the substrate and adhere the exposed adhesive to the surface (see Figure 2).



Figure 2

- d. Once positioned, firmly adhere the adhesive to the surface using a 2" rubber roller, plastic squeegee with a low function sleeve or clean nonabrasive cloth.
- e. Remove remaining liner by pulling liner out parallel to the sign edge and simultaneously rolling, or rubbing the sheeting to the surface (see Figure 3).

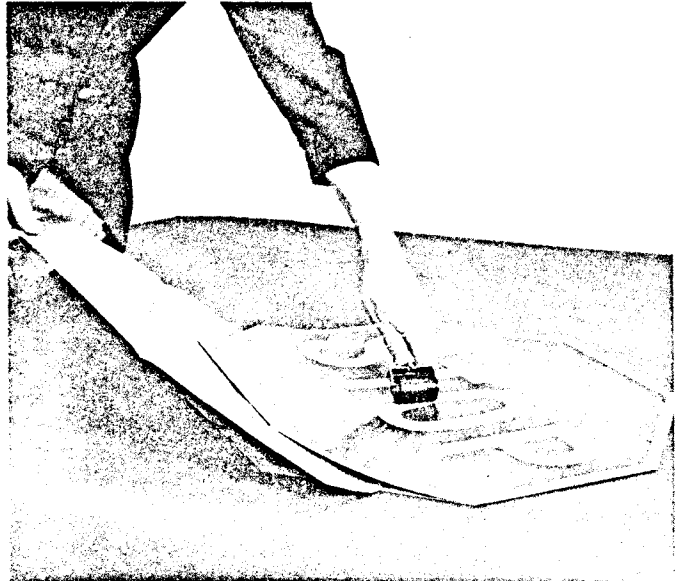


Figure 3

- f. Once the 9800 System 5 Sheeting has been applied to the surface, trim any excess material cutting from the top side, using a sharp rigid cutting knife. (Don't trim 9800 System 5 Sheeting using razor blades) (see Figure 4).

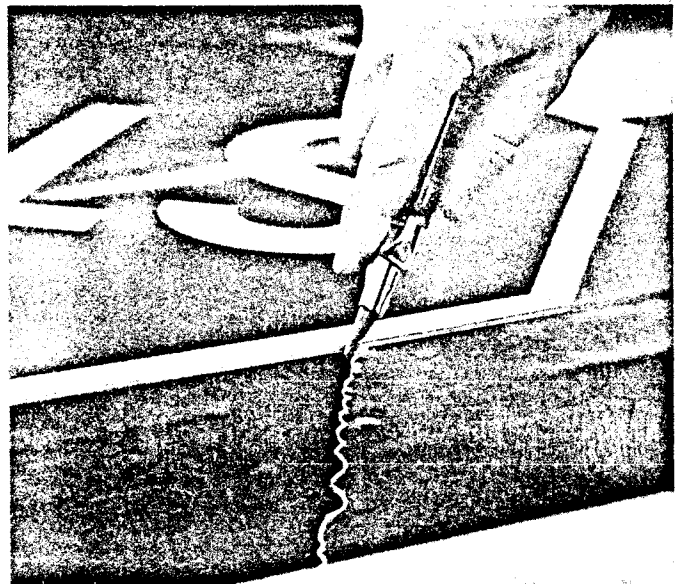


Figure 4

- g. Re-roll all edges and areas around bolt holes with firm pressure.

### 2. Mechanical Application

9800 System 5 Sheetings can be applied using a hand squeeze roll applicator or a powered squeeze roll applicator. Two methods can be used, both of which are acceptable.

#### Method 1

- a. After the sign face, or copy has been cut to the desired size, lay the sheeting face down on a clean dry surface.

- b. Beginning at corner, pull liner back approximately 3" parallel to the edge of the sheeting to expose the adhesive. Crease the liner to hold it out of the way during positioning of the sheeting onto the substrate (see Figure 5).

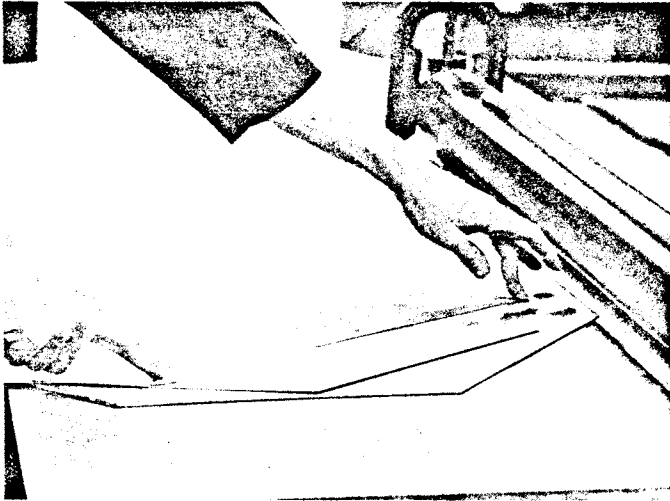


Figure 5

- c. Position the 9800 System 5 Sheeting on to the substrate and adhere the exposed adhesive to the surface (see Figure 6).

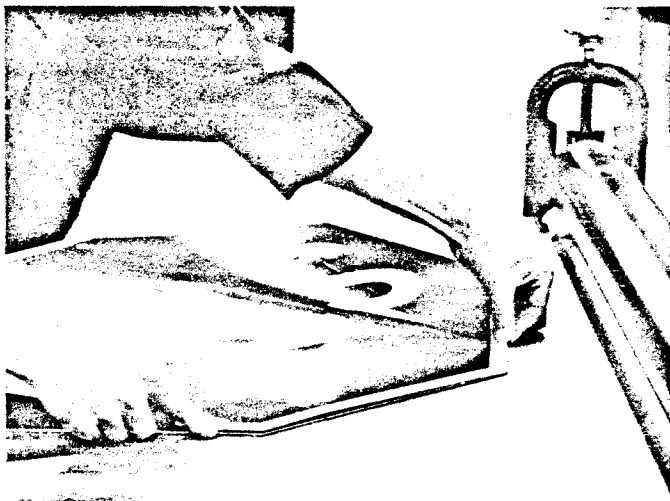


Figure 6

- d. Start the substrate and sheeting into the nip rolls of either a hand or power squeeze roll applicator (see Figure 7).

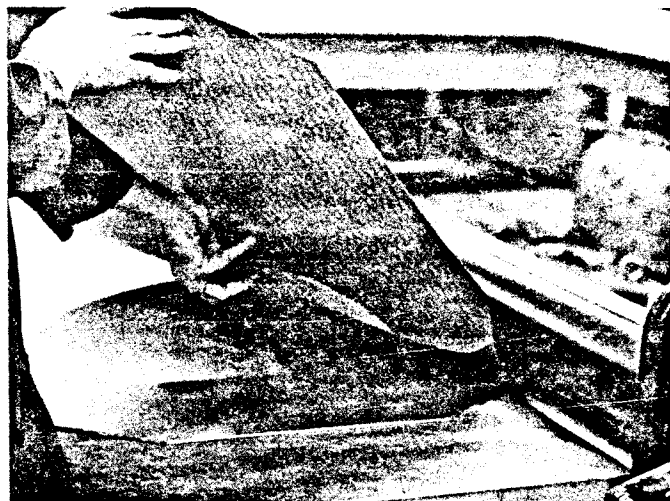


Figure 7

- e. Lift sheeting and pull liner to remove it while the sheeting and substrate pass through the rolls, being careful not to allow the exposed adhesive to prematurely contact the substrate (see Figure 8).

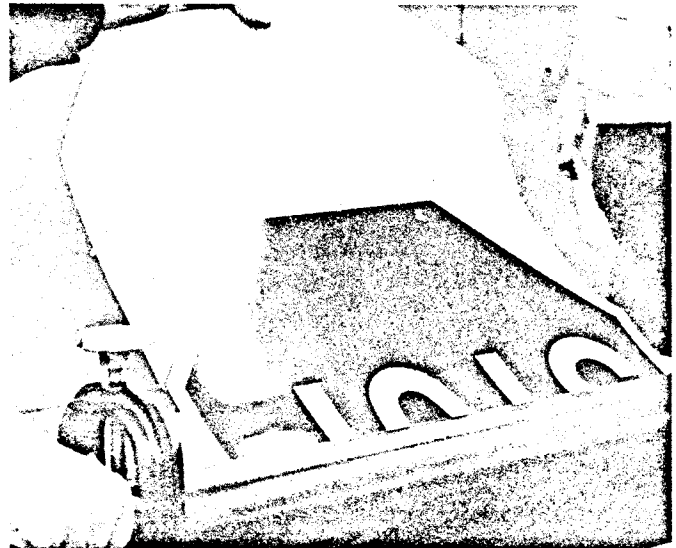


Figure 8

- f. Trim any excessive material using a sharp, rigid cutting knife cutting from the top side. Do not use razor blades.

## Method 2

This method requires the use of a hand squeeze roll applicator and works best with faces up to 48" x 48".

- Center the sign substrate to be covered between the rolls of the hand squeeze roll applicator, with the rolls open slightly.
- Place the 9800 System 5 face on the top of the substrate with the liner in place.
- Properly register the face to the blank and tighten the adjusting knobs until the top rubber roll firmly contacts face and sign blank.
- Lift the face and remove approximately  $\frac{1}{3}$  of the liner.
- While holding the face with the exposed adhesive away from the substrate, run the face and blank through the applicator to adhere that portion of the face to the blank.
- Run the blank with the portion of the face adhered back into the rolls.
- Lift the portion of the face with the liner remaining and remove the liner.
- While holding the exposed adhesive away from the surface, run the remaining portion of the sign through the roller.

## C. Field Application

9800 System 5 Sheeting can be applied in the field to a variety of surfaces with the sign in place or temporarily removed. For applications with the sign in place, the following procedure is recommended.

### Sign in Place

- Once the surface has been determined to be acceptable for use with 9800 System 5 materials, clean the surface by washing and solvent wiping with a rag dampened with xylol or VM&P naphtha. For surfaces that have more than moderate weather checking, spalling or show ply separation, removal of the loose materials by abrading or scraping the surface followed by a solvent wipe is recommended. After the surface has dried, prime with "Scotchlite" Brand Primer 4448.

2. Before removing liner, align the 9800 System 5 face over the old sign. Secure firmly in place with masking tape (see Figure 9).



Figure 9

3. Press the face against the fasteners to mark their location. Make appropriate sized holes using a hole punch<sup>1</sup> (see Figure 10).

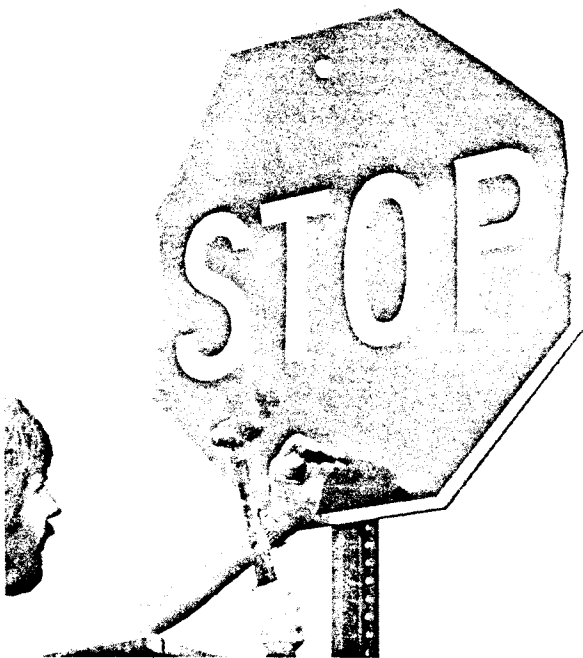


Figure 10

4. Peel back approximately 3 inches of liner at the top edge of the face and crease it to expose the adhesive. Adhere to surface by rubbing toward the top edge of the face. Begin in the center and work towards each edge (see Figure 11).

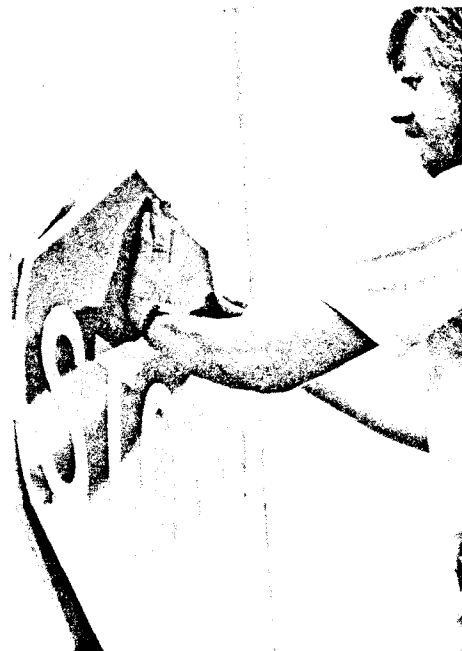


Figure 11

5. Adhere the remainder of the face by pulling the liner down while adhering the face with a soft cloth or rubber roller. Use a side to side motion proceeding slowly down the face. Make contact only where the face is flat against the surface. Do not remove liner more than 6 inches ahead of application (see Figure 12).



Figure 12

<sup>1</sup>Hole punches can be purchased locally from stores which sell material for gaskets. Punches with the bevel inside do not bend the metal as much as an outside bevel punch. Obtain punches from the following companies:

J. F. Heimold & Bro. Inc.  
Elk Grove Village, IL 60007

Brookstone Company  
127 Vose Farm Road  
Petersborough, NH 03450  
Arch Punch w/handle



6. Re-roll all edges and areas around bolt holes with firm pressure. Trim any excess material flush with the sign edge (see Figure 13).



Figure 13

### Sign Removed from Post

Once the sign has been removed from the post, the 9800 System 5 face can be applied either by hand or through the use of a hand squeeze roll applicator as described in the section on shop application.

### Multi-Panel Signs

The following procedure has been used successfully to refurbish guide signs in the field.

Sheeting no wider than 24 inches should be used for ease of application. For beginning applications, sheeting length should be limited to 8-10 feet. Longer lengths may be applied after application skills have been developed.

#### 1. Surface Preparation

- a. Remove old raised copy and retain copy spacing if necessary.
- b. Flatten any protusions on substrate with a hammer.
- c. Remove any loose materials by scraping or wire brushing.
- d. Clean by solvent wiping with a clean rag dampened with xyiol or VM&P naphtha.
- e. If priming is required, prime using 4448 "Scotch-lite" Brand Primer. Refer to Section II A.

#### 2. Cutting Panels to Length

- a. Determine panel length by measuring sign height (see Figure 14).



Figure 14

- b. Unroll 9800 System 5 sheeting on flat, dry working surface. Measure and mark desired length. Cut using a sharp, rigid cutting knife and a straight edge.

- c. Insure proper color matching by locating like edges adjacent to each other (see Figure 15).

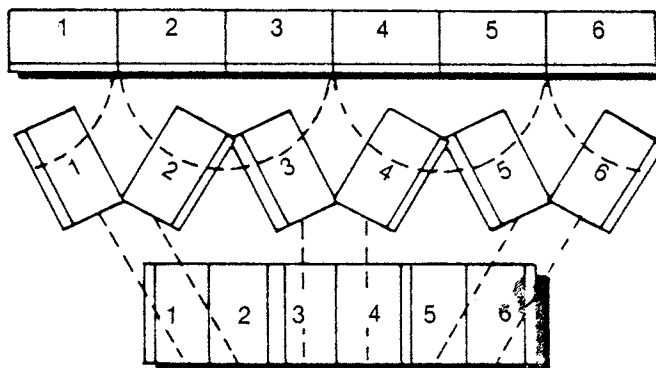


Figure 15

- d. Panels longer than 4 feet should be loosely rolled to carry to the sign. Do not dent edges or damage panels (see Figure 16).



Figure 16

#### 3. Application

- a. Align the first panel to the sign edge or a vertical chalk line if the side edge is not straight. Secure firmly in place with 2 inch wide masking tape. Place tape on each edge approximately 12 inches from **top** and **bottom** of sign. An assistant may hold the bottom in position for short pieces (see Figure 17).

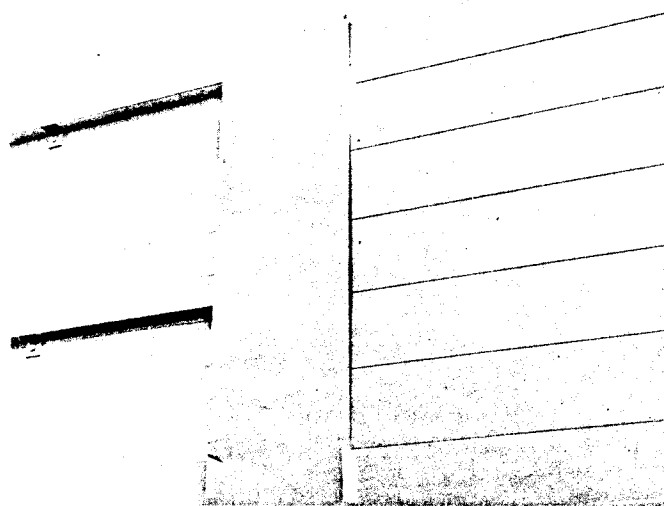


Figure 17

- b. Peel back approximately 3 inches of the liner at the top edge of the panel and crease it to expose the adhesive (see Figure 18).

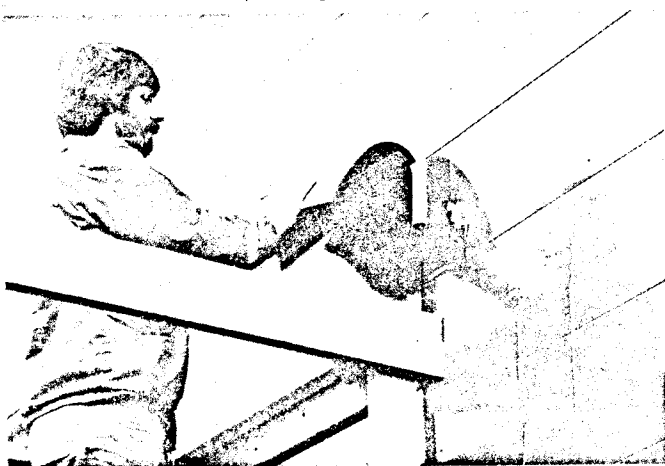


Figure 18

- c. Adhere to surface by rubbing towards the top edge of the panel. Begin in the center of the panel and then work towards each edge (see Figure 19).
- d. Remove the tape and re-check alignment. Re-position if necessary.

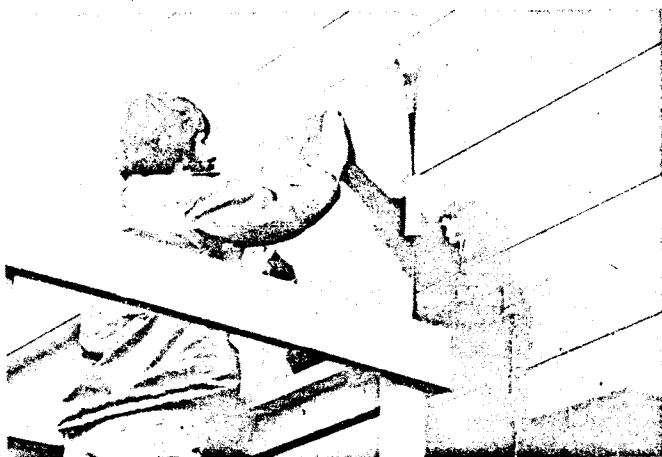


Figure 19

- e. Adhere the sheeting to the surface with a rubber roller or soft cloth. Use a side to side motion proceeding slowly down the panel. Make contact only where the sheeting is flat against the surface. With the other hand, pull the liner straight down. Keep the liner parallel to the edge of the panel. Do not remove the liner more than 6 inches ahead of the application (see Figure 20).

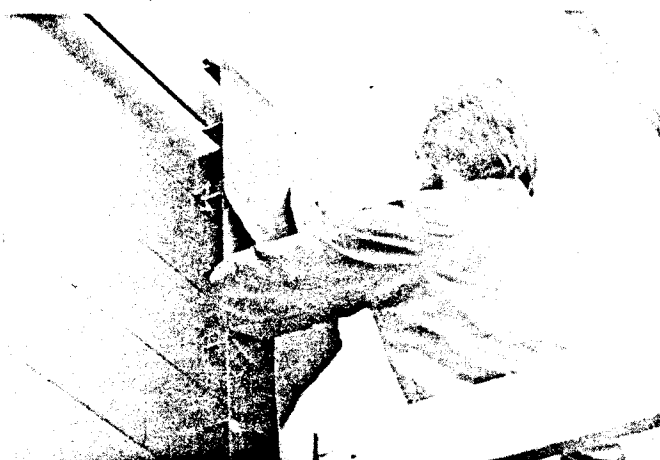


Figure 20

- f. Upon complete application of the panel, trim the bottom of the sign (see Figure 21).

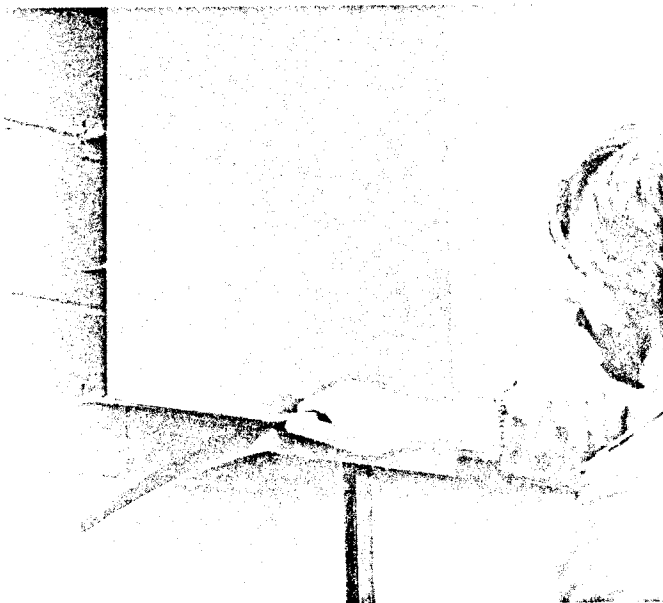


Figure 21

- g. Roll all edges firmly with a rubber roller (see Figure 22).

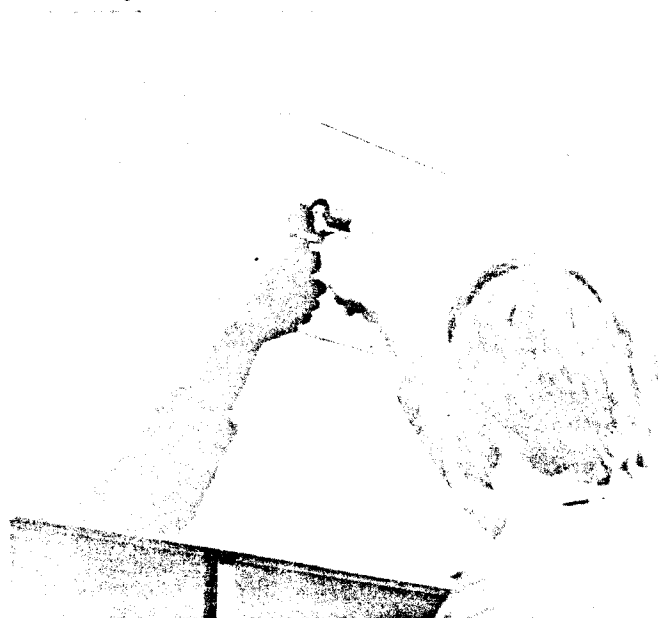


Figure 22

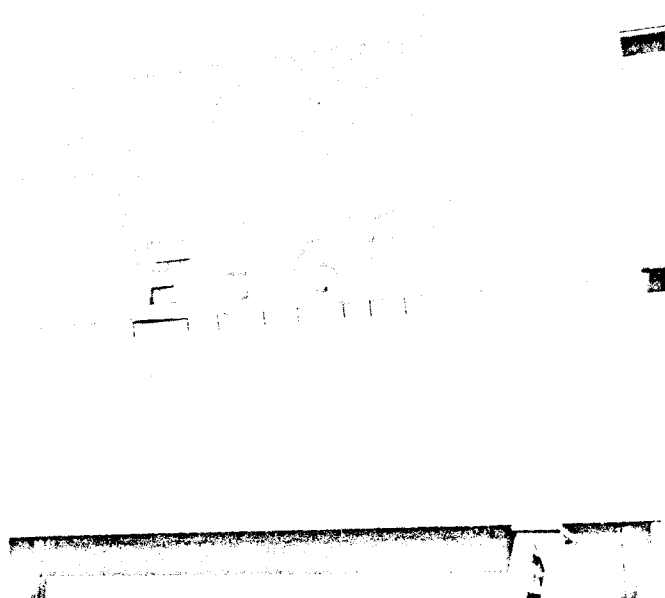
- h. Apply remaining overlay panels using Steps a-f. Carefully align each panel to the edge of the previously applied panel with like edges adjacent for color matching as shown in Step 2c under Multi-Panel Signs of Field Application.

#### 4. Application of Border and Copy

Direct applied copy and borders of "Scotchlite" Brand Reflective Sheeting, High Intensity Grade 3800 series or 9800 System 5 may be applied to the 9800 System 5 background in the field using the following procedures. Shields, arrows and copy with a stroke width greater than 6" must be fabricated from 9800 System 5 sheeting.

The easiest black sheeting to apply is "Scotchcal" Brand Film 180-12 with Controltac Brand adhesive. Use of SPCM-3 application tape for large letters of "Scotchcal" Film or High Intensity Grade 3800 series is desirable.

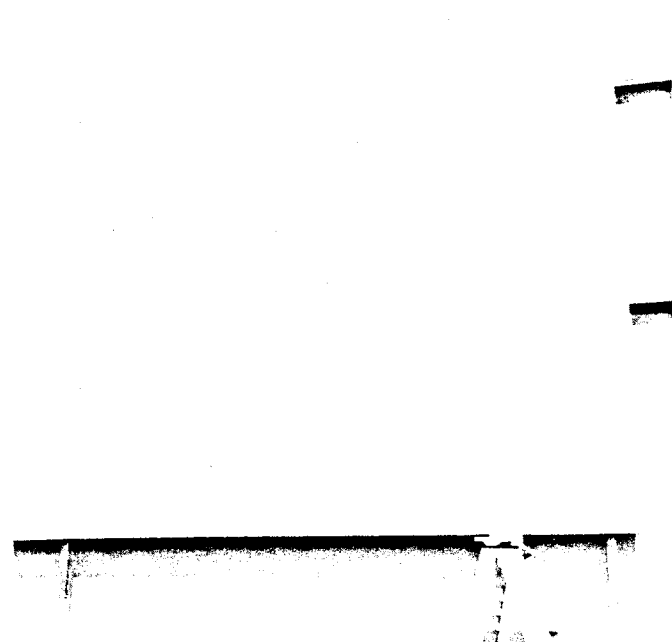
a. If engineering drawings are available for copy layout, make a paper tape for each line of copy indicating proper letter spacing. Then secure the tape on the background to facilitate copy location (see Figure 23).



**Figure 23**

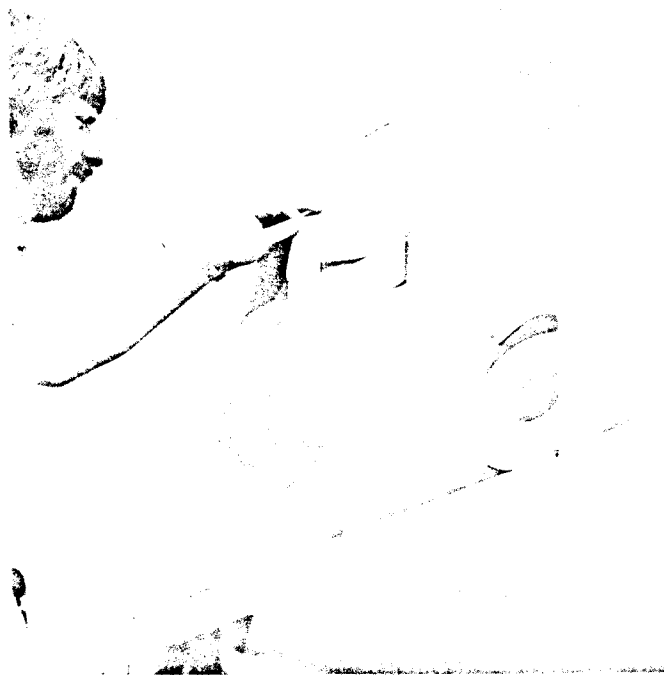
b. If drawings are unavailable, take appropriate measurements from the old sign to locate line and letter spacing BEFORE removing old copy. Use a chalk line on the new surface to mark height of each line of copy and measure letter spacing for proper location. Spacing can be recorded by applying 1" Post-it® note tape below copy. Mark left edge location and letter. Remove tape. Following application, tape can be re-applied and new copy applied at correct position.

c. Align copy and secure top edge with masking tape to serve as a hinge (see Figure 24).



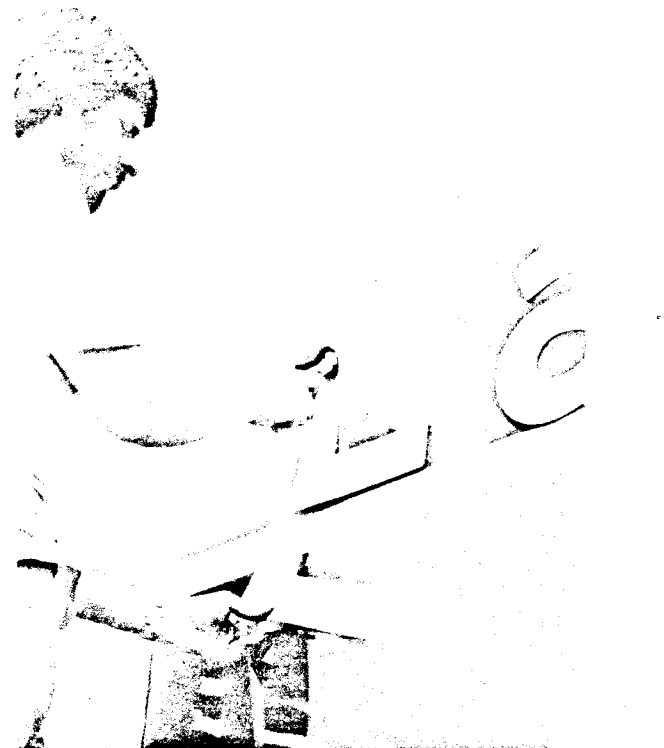
**Figure 24**

d. Lift copy back over hinge and remove several inches of liner (see Figure 25).



**Figure 25**

e. Hinge copy back and squeegee or roll to surface, removing the remaining liner as the application progresses. Firmly re-roll copy edges (see Figure 26).



**Figure 26**

## 5. Miscellaneous

### a. Making a Horizontal Splice

A horizontal overlap splice may be desirable to correct misalignment in a vertical butt seam or when two short panels are used instead of one long one.

When a widening gap occurs between panels, or during application of the top panel, STOP and leave approximately 1 foot of liner at the bottom edge of the top panel. Cut and remove excess liner. Align the bottom panel and position  $\frac{1}{4}$  inch under the top panel to provide an overlap splice. After applying several inches of the bottom panel, STOP and finish the top panel. Roll the overlap splice firmly. Apply the remainder of the bottom panel (see Figure 27).

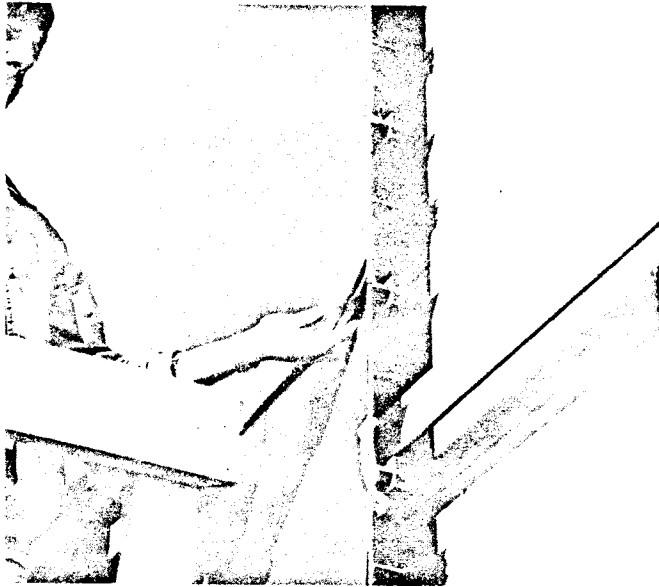


Figure 27

### b. Applications on Substrates with Raised Fasteners

Depending on spacing of the fasteners, application can be accomplished by the following method. Align sheet and tape securely in position. Begin application as in Step 3 a-h under Multi-Panel Signs of Field Application; however, approximately 12 inches prior to reaching a fastener, STOP. Press the sheeting (with liner intact) against the fastener to mark its location. Punch a hole of appropriate size in the sheeting and resume application.

### c. Shop Fabrication for Field Installation

Sheets of 9800 System 5 may be prepared in the shop with applied copy to fit the sign being overlaid.

This procedure is satisfactory if application skills have been developed, or should be limited to small signs 6 feet or less in height. Misalignment of preapplied sheets may lead to misaligned copy, therefore care must be used during field application.

- 1) Lay cut sheets on a flat working surface with edges butted, like edges adjacent for proper color matching.
- 2) Position and apply direct applied copy of "Scotchlite" Brand Reflective Sheeting, High Intensity Grade 3800 Series or 9800 System 5. Mark location of large copy, such as shields and arrows, onto the surface for field application. **Always** apply the border in the field.

- 3) Cut copy at panel edges, number the sheets and make alignment marks on the sheeting surface near the top and bottom of each panel. Do not dent edges or damage the panels during shop fabrication, packaging or in subsequent handling.
- 4) Package the sheets either in wooden boxes or rolled onto 6" or larger cores.
- 5) Surface preparation is as described in Step 1 a-e under Multi-Panel Signs of Field Application.
- 6) Installation of the panels is as described in Step 3 a-h under Multi-Panel Signs of Field Application.

## III. Fabrication

For detailed instructions on the use of "Scotchlite" Brand Transparent colors on 9800 System 5 Sheeting, refer to Information Folder 60.

### A. Screen Processing

#### 1. Transparent Colors

9800 System 5 sheeting must be screen processed using "Scotchlite" Brand Transparent Colors, and Clears Series 840 as described in Information Folder 60. For best results use a high grade synthetic screen fabric such as, polyester PE-157. Use only stencil materials that will resist lacquer type solvents. Normal off-contact screening techniques should be used.

#### 2. Clear Coating

Only those areas screen processed with transparent 840 series process colors need to be clear coated with 840 clear. Application of clear coating by spraying or roll coating is not recommended.

#### 3. Drying

Screened and/or cleared faces must be racked individually with at least 2 inches (5.1 cm) open space between layers. Air dry a minimum of 24 hours with high volume fans directing air through all shelves of the racks. Drying time may increase dependent upon humidity conditions, temperature, thickness of color, air circulation, etc.

### B. Cutting and Stacking

9800 System 5 Sheeting may be hand cut or die cut one sheet at a time, band sawed or guillotined in stacks to a maximum of 25 sheets. Whenever two or more pieces are used together they must be matched to assure uniform day color and night reflective appearance. The edges of cutting tools used to cut 9800 System 5 sheeting should be kept sharp and clean. Blades may be cleaned by wiping with mineral spirits or, if die cutting, by occasionally cutting through a piece of cardboard soaked in mineral spirits. If sheeting applied to a substrate must be stacked flat temporarily, cover the sheet face with SCW 82 slip sheeting with the glossy side of the slip sheet against the sheet face. The maximum stack heights will vary depending on the type and thickness of the substrate. Applied sections of different size or shapes, or which have sheeting splices, should not be stacked flat since excessive pressure at edges, corners or splices may result in sheeting damage.

### C. Edge Sealing

Edge sealing of 9800 System 5 Sheeting is not generally required. Avoid contact with oil or solvents. If sheeting may be subjected to oil or solvent splash or spray, or if edges may contact oil or solvents, edge seal applied sheeting with 840 Clear.

#### IV. Storage

9800 System 5 Sheeting should be stored in a cool, dry area, preferably at 70 to 75°F (20° to 24°C) and 30 to 50% relative humidity, and should be applied within one year after purchase.

Rolls should be stored horizontally in the shipping carton; partially used rolls should be reinserted into and stored in the shipping carton. Cut sheets should be stored flat. Do not apply pressure to stacks of cut sheets.

Applied sheeting must be protected with SCW 82 slipsheeting, with the glossy side against the sheeting face and padded with closed cell packaging foam padding<sup>1</sup>. DO NOT use the sheeting liner or other slipsheeting materials.

All applied sheeting must be stored and shipped on edge. Avoid banding, crating, or stacking which puts panels, copy and finished signs under pressure. Package to prevent movement and chafing, which may cause damage to the reflective sheeting during shipment.

**Warning:** If signs or sign faces are not properly packed or stored, warranty is void. See Information Folder 150 for details of storage and packing.

#### V. Maintenance

##### A. Mounting

Nylon washers (available from 3M) must be used between the heads of all twist fasteners (such as screw heads, bolts, or nuts) and the sheeting to protect the sheeting from the twisting action of the bolt head; use of two washers will further minimize the possibility of twisting damage. Rivets or carriage bolts with square shanks do not require nylon washers. Do not overtighten fastener so as to cause the sign faces to warp or distort.

##### B. Cleaning

Following exposure, the smooth surface of 9800 System 5 Sheeting may be cleaned by rinsing, then washing the surface with a mild detergent, followed by a final rinse. Steam cleaning is NOT RECOMMENDED. Use cleaning materials and equipment which will not abrade the surface. To remove oil, tar, or road film, it is recommended that the sheeting be wiped with a rag dampened with heptane or VM&P naphtha, then rewashed and rinsed with clean water.

**CAUTION:** The cleaners used for Engineer Grade Sheeting may damage 9800 System 5 Sheeting; test on a small area and determine that the cleaner selected does not damage the sheeting before large scale use.

Large surface scratches resulting during storage, shipment, or from abrasion, may be buffed out using a compound designed for buffing out "PLEXIGLAS" Brand or "LUCITE" Brand Plastics and similar materials and a soft cloth.

Following extended exposure, airborne dust particles may become trapped within the row of cut hexagonal cells along the sheeting edge. This should have no adverse affect upon sign performance.

*3M assumes no responsibility for any injury, loss or damage arising out of the use of a product that is not of our manufacture. Where reference is made in our literature to a commercially available product made by another manufacturer, it shall be the user's responsibility to ascertain and follow the precautionary measures for its use outlined by the manufacturer.*

#### VI. Literature Reference

Scotchlite Brand Reflective Sheeting	LM-PB 102,
Encapsulated Lens for use on Traffic	Att. #2 9880
Control Signs	

##### Screen Processing

Color and Matching Instructions	LM-IF 50
Sign Base Materials	LM-IF 40
Hand Squeeze Roll Applicators	LM-IF-30

##### Maintenance

Storage, Maintenance and Removal	LM-IF 150
Color Measurement	ASTM E97-77
Gloss Measurement	ASTM D523-78
Snow Burial Information Memo	LM-GIJ 143R-1 (1975)
Shop Practices Manual	LM-SSPM

#### Terms and Conditions of Sale

All statements, technical information and recommendations contained herein are based on tests we believe to be reliable, but the accuracy or completeness thereof is not guaranteed, and the following is made in lieu of all warranties express or implied:

Seller's and manufacturer's only obligation shall be to replace such quantity of the product proved to be defective. Neither seller nor manufacturer shall be liable for any injury, loss or damage, direct or consequential, arising out of the use of or the inability to use the product. Before using, user shall determine the suitability of the product for his intended use, and user assumes all risk and liability whatsoever in connection therewith.

Statements or recommendations not contained herein shall have no force or effect unless in an agreement signed by officers of seller and manufacturer.

<sup>1</sup>"Microfoam" manufactured by Dupont, available from Tekra Corp., St. Paul, MN or "Jiffyfoam" manufactured by Jiffy Mfg. Co., 360 Florence Ave., Hillside, NJ 07205.



APPENDIX B  
QUESTIONNAIRE

SIGN REFURBISHMENT

1. How are your guide signs refurbished? (45 states reporting)

A. They are replaced 13%

B. Overlay panels are attached in the field 51%

C. Other method of overlaying; 3M System-5 or other commercial overlay 2%

D. Combination A & B 34%

F. Comments: 47% are experimenting with System-5

2. How is sign overlaid? (45 states)

A. In place on posts 58%

B. Lowered to ground 16%

C. Taken to shop 7%

D. Other (specify)

- contractor option 4%

- combination A & B 7%

- combination A & C 2%

- combination B & C 2%

- combination A, B, and C 4%

3. How is overlay panel attached to original sign? (37 states)

A. Rivets 87%

Size: 1/8" 48%

3/16" 39%

1/4" 9%

5/16" 4%

Spacing: 6"-8" 18%

6"-12" 9%

8"-10" 4%

12" 9%

18" 17%

24" 4%

Variable 9%

B. Rivet plus adhesive 5%

C. Other Methods 8%

4. What type of material is used for overlay panels? (42 states)

A. Aluminum 94% (includes System-5)

B. Wood 2%

C. Other 2%

D. Aluminum or wood 2%

5. What type of reflective sheeting is used on overlay panels? (45 states)

A. Encapsulated lens 51%

B. Engineering grade 24%

C. Encapsulated lens or engineering grade 17%

D. Other: 8%

- Prismatic Button copy 2%

- Encapsulated copy & Engineering grade background 4%

- Opaque Porcelain enamel 2%

6. What is the thickness of the overlay panel on:

A. Small signs (2'-4' wide) (28 states)

.032 4%

.040 36%

.050 5%



.060-.063 42%

.080 14%

B. Medium (4'-8' wide) (34 states)

.040 29%

.050 6%

.060-.063 47%

.080 18%

C. Large (8' + wide) (33 states)

.040 30%

.050 3%

.063 46%

.080 21%

D. States using same thickness for all sign sizes 22 states.

E. States using different thickness for different size signs 3 states.

7. What is the width of the overlay panel? (40 states)

- A. 2 ft. 8%
- B. 3 ft. 8%
- C. 4 ft. 74%
- D. Different Widths 10%

8. What method do you use to join panels? (43 states)

- A. Both joint 77%
- B. Overlap 14%
- C. Butt and overlap 9%

9. What type of letters do you use? (44 states)

- A. Demountable 30%
- B. Direct Applied 43%
- C. Demountable or Direct Applied 23%
- D. Button 4%

10. Where are letters laid out? (39 states)

- A. In shop 59%
- B. In field 21%
- C. Shop and/or field 18%
- D. Other prison - 2%

11. If laid out in the field do you: (27 states)

- A. Drill through existing holes from rear of sign? 19%
- B. Measure from drawing? 33%
- C. Measure from original sign? 22%
- D. Measure from drawing or original sign? 15%
- E. Other 11%

12. What problems do you find are related to work methods and handling of overlay installation? (45 states)

- A. Care in handling, damage in transport, etc. 13%
- B. Traffic control and safety, equipment in field, height of sign, etc. 13%
- C. Wind blowing panels while erecting 7%
- D. Waviness and wrinkling of signs 4%
- E. Assuring squareness, sizing, etc. 4%
- F. No problem and no problem with proper precaution 59%

13. What problems do you find with the final appearance of the overlay?  
(34 states)

A. Legibility	9%	
B. Durability	3%	
C. Hot Spots	29%	
1. Minor Problem		4
2. Excess rivet drawdown		1
3. Prior sign damage		1
D. None	53%	
E. Other	6%	
	100%	

#### Overlay Fabrication

		<u>Hot Spots</u>	<u>No Problem</u>
Overlay thickness	0.032	*1	*0
	0.040	5	6
	0.050	0	1
	0.060-.063	4	8
	0.080	0	6
Rivet Size	1/8"	4	6
	3/16"	2	4
	1/4"	0	2
	5/16"	0	1
Rivet Spacing	6"-8"	1	3
	6"-12"	1	1
	8"-10"	0	1
	12"	1	7
	18"	3	2

\*Numbers state using

200