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Transportation Safety Division

3M™ Reflective License Plate Sheeting Recommended Manufacturing Procedures

Information Folder 9.8
February 2021

Replaces Information Folder 9.8 Dated March 2020

1 Description

3M Reflective License Plate Sheeting Series 3750, 4770, 4780, 4790, 6700, 6750, and 9250 are durable, all-weather sheetings designed for use in the fabrication of multi-year retroreflective license plates. They are used to produce attractive license plates which function 24 hours a day to enhance nighttime safety and the legibility of the vehicle identification system. The backsides of these sheetings are pre-coated with a pressure sensitive adhesive, protected by a removable liner, for application to license plate substrates. Plates can be embossed and roll coated with either transparent or opaque roll coating inks, or dry roll coating foils. Plates made with digitally printed variable plate message sheeting need no roll coating.

2 Substrates

Metal cleanliness, pretreatment, and surface temperature are the most important factors for ensuring good adhesion of the sheeting to the metal substrate. For instructions on checking metal cleanliness, see Section 4.1, Quality Checklist: Metal Cleaning.

After metal straightening, aluminum entering the sheeting laminator should be in the temperature range of 105 ± 10 °F for optimal adhesion.

A minimum temperature of 70 °F is recommended.

Table 1 presents the desired characteristics of recommended aluminum stock materials.

Table 1. Typical aluminum stock characteristics

Material		Property	DLP (non-embossed)	DLP & Embossed	Embossed
Al coil base	Base metal	Alloy	3105		
		Temper	H-18 or H-28	H-12 or H-22	
		Gauge (in.)	0.022	0.027	0.032
Front surface	Pretreatment	Formulation	Chemically treated or conversion coated[a]		
		Powdery residue	None		
		Appearance	No change in coating pattern		
Back surface	Pretreatment or polyester washcoat	Powdery residue	None		
		Appearance	No change in coating pattern		

a. 3M has experimented extensively with license plate pretreatments and concluded:

Aluminum pretreated with Bonderite 1455SF is no longer recommended for use.

Aluminum pretreated with Bonderite M-CR 1430C is recommended as a suitable replacement.

License plate manufacturers should consult with their aluminum stock supplier to discuss best options.

3 Procedure

3.1 Retroreflective Sheeting Application

Applicator operators must maintain proper side to side alignment of the sheeting on the metal by adjusting the steering on the 3M Squeeze Roll Applicator (16 inches) as needed.

For graphic printed sheeting, the 16 inch squeeze roll applicator adjustment must be set and monitored to maintain the correct repeat pattern measurement on the sheeting after it is applied to the metal substrate. On 3M applicators, this adjustment is set by the thumb-wheel switches on the applicator electronic control panel (refer to Information Folder 9.4).

3.2 Cut Blanks

Cut blanks must be stored on edge after being removed from the blanking press. Avoid packing blanks too tightly to minimize sticking of blanks and scuffing or scraping of sheeting.

The cut blanks must be stored for a minimum of 48 hours prior to embossing to allow the sheeting to reach maximum adhesion to the metal substrate. Check the adhesion of the sheeting to the metal after the 48 hour rest period (see Section 4.2 Quality Checklist: metal cleaning).

The surface of the license plate sheeting scratches easily. Care must be taken when handling cut blanks to prevent the sheeting surfaces from getting scratched.

Blanking dies must be kept sharpened as any burrs on the bolt holes or along the edges of the plate can scratch the surface of the sheeting.

3.3 Embossing

Embossing height must be uniform and maintained at a height sufficient to avoid smudging the background during roll coating.

1. Satisfactory embossing heights are usually in the range of 0.070–0.080 inches (1.8–2.0 mm).
2. If registration characters and fixed copy cannot be maintained at a uniform height, registration characters may be slightly higher, however, the difference between the registration character and fixed copy heights should not exceed 0.003 inches (0.076 mm).

Dies causing scuffing and cutting should be removed from production, polished, adjusted, and/or repaired before being put back into use.

Check all new die setups for roll coating quality before beginning any volume production.

Cover the tops of racks of embossed plates to prevent accumulation of dust and other foreign matter.

License plate blanks must be handled with care during the embossing operation to prevent scratching their sheeting surfaces.

3.4 Roll Coat and Oven Drying Operations

The roll coat color should be applied to match the shade established by the appropriate state agency.

1. Mount sample plates on or near roll coaters for operator reference. See Section 4.3, Quality Checklist: Color Shade.
2. Match the color shade by adjusting the doctor roll on the roll coater (refer to roll coater operator's manual).

Roll coat ink can be thinned as necessary according to the manufacturer's recommendations.

1. Colors may be pre-thinned using up to 10% by weight of the recommended thinner.
2. Additional thinning on the rolls using a pistol oiler or spray may be necessary to keep the ink from drying on the rolls during equipment shutdowns or other production delays.

Roll coat ink smudges on background areas of plates must be removed prior to drying.

- Smudges, or all of the wet coating, may be wiped off with a cloth saturated in a solvent recommended in the appropriate roll coat product bulletin. Wiped off plates must be completely dry before being re-coated.

Dry roll coat foils.

- Dry roll coat foils are applied to clean, embossed plates using high quality roll-on dry roll coat machines capable of providing adequate heat and pressure. It is recommended that adhesion between dry roll coat foil and license plate sheeting be tested each time a new roll of foil is loaded onto the machine.

Consistent oven temperature and dwell time must be maintained to provide thorough curing of roll coat inks.

- The hardness of the dried roll coat, when applied to the bare metal backside of the plate, must be sufficient to resist rupture of the coating by a “B” hardness pencil. See Section 4.4, Quality Checklist: Hardness Test.

License plates must be allowed to cool down to room temperature prior to being stacked and packaged.

4 Quality Checklist

4.1 Metal Cleaning

Test and record the cleanliness of the metal substrate using the Water Break Test.

1. Pour water onto the surface of the substrate.
2. The water should not bead up, but rather flow out to form a uniform film on the surface (see Figure 1).
3. Following the water break test, be sure to wipe the water off of the substrate before laminating the retroreflective sheeting.

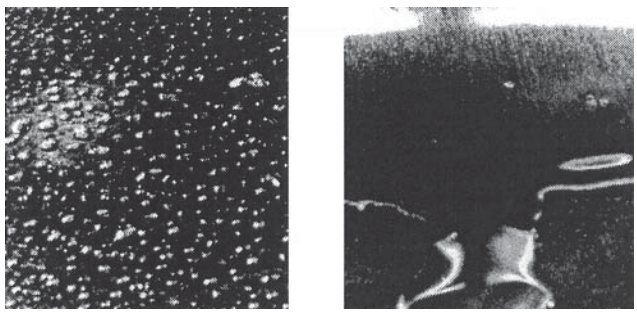

Figure 1. Water break test: the image on the left illustrates a failure, the image on the right, a pass.

4.2 Sheeting Adhesion

Test the sheeting adhesion on a scrap blank 48 hours after application of sheeting.

1 Starting at the rounded corner of a scrap blank, peel the sheeting away from the metal substrate with your fingernail.
2 Peel sheeting away until you have enough to hold with your fingers.
3 Hold the sheeting and pull it away from the substrate using uniform tension.
4 It should be difficult to impossible to peel the sheeting, including its adhesive, in one piece from the aluminum.
5 In case of a failure, recheck cleanliness of aluminum stock.

4.3 Color Shade

Compare the color shade on the roller coated plates with a target color shade sample and record lighter, equal to, or darker on a sample plate or sheeting.

If necessary, adjust roll clearances on the roll coater to achieve the correct color shade match.

4.4 Hardness Test

Test and record the hardness of the dried roll coat ink applied to the back of the license plate.

Emboss a blank upside down so the embossed alpha/numeric characters are on the backside of the blank.

With a set of graded drawing pencils consecutively rated for hardness B, HB, F, and H:

1 Press the lead into the surface at a 45° angle. Apply sufficient pressure in a forward direction to crumble the lead or penetrate the ink film, but not enough to break the main piece of lead.
2 Results shall be reported as the range of hardness of consecutive pencils, the softer of which crumbles, and the harder of which penetrates the ink film. Example: Pencil B-HB.
3 Ink coatings showing pencil hardnesses of B-HB or harder are needed for best reflectorized license plate durability and performance.

5 Environmental, Health, and Safety

Read all health hazard, precautionary, and first aid statements found in the Safety Data Sheets (SDS) and Article Information Sheets for important health, safety, and environmental information. Consult local regulations and authorities for possible restrictions. To obtain SDSs and Article Information Sheets for 3M products, go to 3M.com/SDS, contact 3M by mail, or for urgent requests call 1-800-364-3577.

6 Other Product Information

Always confirm that you have the most current version of the applicable product bulletin, information folder, or other product information from 3M's Website at 3M.com/VehicleRegistration.

7 Literature Reference

Before starting any job, be sure you have the most current Product and Instruction Bulletins.

3M IF 9.4	3M™ Squeeze Roll Applicator (16 inch)
3M PB 3750/3750P	3M™ Reflective License Plate Sheeting Series 3750
3M PB 4770E/T	3M™ Preclear Reflective License Plate Sheeting Series 4770E/4770T
3M PB 4780E/T	3M™ Preclear Reflective License Plate Sheeting Series 4780E/4780T
3M PB 4790	3M™ Preclear Reflective License Plate Sheeting Series 4790
3M PB 4800/4900	3M™ Roll Coat Inks Series 4800/4900
3M PB 4850/4950	3M™ Roll Coat Inks Series 4850/4950
3M PB 6700	3M™ High Definition Reflective License Plate Sheeting Series 6700
3M PB 6750	3M™ High Definition Reflective License Plate Sheeting Series 6750 With Removable Top Liner
3M PB 9250E/T	3M™ Digital License Plate Reflective License Plate Sheeting Series 9250E/9250T
3M PB HSF 100/200 and DRF 300/400	3M™ Dry Roller Coat Foil Series HSF 100/200 and DRF 300/400

For Information or Assistance
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1-800-3M HELPS (1-800-364-3577)

Internet:
http://www.3M.com/roadsafety

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