

Transportation Safety Division

3M™ Preclear License Plate Sheeting Series 4770, 4770E, and 4770T

**With 3M™ Ensure™ Image and Optional 3M™ Ensure™ Virtual
Security Thread For Use on Multi-Year License Plates**

**Product Bulletin Series 4770, 4770E, and 4770T
June 2020**

Replaces Product Bulletins 4770 and 4770E/4770T Dated June 2018

1 Description

3M™ Preclear Reflective License Plate Sheeting Series 4770, 4770E, and 4770T (“Sheeting”) are durable, all-weather, retroreflective sheetings consisting of lens elements enclosed within a transparent resin. The Sheeting has been designed for use in the fabrication of multi-year reflective license plates. License plates can be embossed and roll coated with either transparent or opaque roll coating inks to produce attractive license plates which function 24 hours a day to enhance visibility at night and the legibility of the vehicle identification system. The Sheeting appears similar during the day and at night (when viewed by reflected light) and are highly reflective when viewed both head-on and at wide entrance angles.

The backside of the Sheetings is pre-coated with a pressure sensitive adhesive that is protected by a removable liner for easy application to license plate substrates.

The Sheeting is available with personalized graphic designs, which offers a unique opportunity to promote a country, state or national attraction, event, or image while providing motorists with the safety aspects of fully reflective license plates. Additional stretch and registry control equipment is required to process graphic printed sheetings.

3M sheetings, processing materials, and equipment provide design flexibility to license plate systems, allowing license plate issuers to satisfy specific color, reflectivity, durability, design, and plate manufacture requirements.

2 3M™ Ensure™ Directional Image

Series 4770E and 4770T Sheetings with 3M™ Ensure™ Directional Images contain, as integral parts of the Sheetings, directional positive identification images or marks that are visible only within a specific range of viewing angles. These marks are extremely difficult to counterfeit and facilitate visual evaluation of finished license plates for such purposes as:

- Inventory control
- Production traceability
- Identification of year of manufacture
- Identification of sheeting manufacturer
- Positive field verification of license plate authenticity

Ensure images may be custom designs mutually agreed upon by the purchaser and 3M. Ensure image size and spacing depend on the width of the Sheeting purchased. Each license plate incorporating Series 4770E or 4770T Sheeting with Ensure images will have a minimum of two images visible on the finished plate.

2.1 Orientation

Directional identification marks allow for easy visual verification of the license plate authenticity as follows:

- 1 The center-most mark on the plate will be visible to a viewer standing directly in front of the plate at a distance of 4 to 8 feet (1.2 to 2.5 m). This represents an angle of 30° with respect to an axis extending perpendicular to the center of the face of the plate.
- 2 The center-most mark on the plate shall not be visible to a viewer:
 - a. Standing at a distance of less than 2 feet (0.6 m) or more than 20 feet (6.1 m) directly in front of the plate.
 2. Viewing the plate at an angle greater than 45°, relative to a head-on viewing angle.

Directional identification marks are visible in both diffuse daylight and by retroreflected light at night. The marks do not alter sheeting color, reduce sheeting brightness below the minimum specified levels, or interfere with the appearances or legibilities of finished license plates. In diffuse daylight, directional identification marks are equally visible in all standard colors. The marks cannot be removed by chemical or physical means from the Sheeting or finished license plate without visibly damaging the reflective Sheeting.

3 Optional 3M Ensure Virtual Security Thread

Series 4770T Sheeting with 3M™ Ensure™ Virtual Security Thread contains a second mark, in addition to an Ensure image, that runs either vertically or horizontally through standard vehicle registration plates for security and anti-counterfeiting purposes. This virtual security thread is buried beneath the surface of the Sheeting and consists of two sinusoidal waves; one wave appears to float above the Ensure image in the retroreflective Sheeting, the other appears to float below it. Virtual security threads are durable and will function as described herein for the service life of the license plate.

When license plates are illuminated by high beam headlights and viewed head-on from distances of approximately 0 to 50 ft (0 to 15 m), virtual security threads can be seen, both from within standard police vehicles and in open air, on the unprinted areas of license plates that have been properly affixed to vehicles' designated mounting areas. The two sinusoidal wave images can be visually distinguished from one another at distances of approximately 0 to 20 feet (0 to 6 meters). Virtual security threads are not visible when viewed from angles greater than 45° from the head-on viewing position.

Virtual security threads are verifiable both under diffuse daylight and by retroreflected light at night. Virtual security threads do not alter Sheeting color, reduce Sheeting brightness below minimum specified brightness levels, or interfere with the appearances or legibilities of finished license plates. Under diffuse daylight, virtual security threads are visible on all standard Sheeting colors.

4 Specifications

The Sheetings has been designed for multi-year applications. Experience indicates that finished plates, processed and applied as recommended, will perform without appreciable fading, cracking, blistering, or peeling for up to five years.

4.1 Reflectivity

The minimum reflectivity values of the Sheetings are shown in Table 1.

Table 1. Minimum coefficient of retroreflection, R_A , at a 0.2° observation Angle,^a cd/fc/ft² (cd/lx/m²).

Sheeting Color	Product Codes	Entrance Angles ^b	
		-4°	40°
White	4770 / 4770E / 4770T	50	16
Yellow	4771 / 4771E / 4771T	25	10
Red	4772 / 4772E / 4772T	9	3
Gold	4773 / 4773E / 4773T	25	10
Orange	4774 / 4774E / 4774T	25	10
Lt. Blue	4776 / 4776E / 4776T	18	7
Lt. Green	4777 / 4777E / 4777T	18	7
Lemon Yellow	4781 / 4781E / 4781T	25	10
Pastel Colors			
Salmon	PC751 / PC751E / PC751T	35	12
Silver Gray	PC752 / PC752E / PC752T	35	12
Sand	PC753 / PC753E / PC753T	35	12
Sunflower	PC754 / PC754E / PC754T	35	12
Lime Yellow	PC755 / PC755E / PC755T	35	12
Sea Green	PC756 / PC756E / PC756T	35	12
Sky Blue	PC757 / PC757E / PC757T	35	12
Straw	PC758 / PC758E / PC758T	35	12
Chamois	PC759 / PC759E / PC759T	35	12

- a. Observation (Divergence) Angle — The angle between the illumination axis and the observation axis.
 b. Entrance (Incidence) Angle — The angle from the illumination axis to the retroreflector axis. The retroreflector axis is an axis perpendicular to the retroreflective surface.

All measurements shall be conducted in accordance with ASTM E810, “Standard Test Method for Coefficient of Retroreflection of Retroreflective Sheeting.”

Measurements on Sheeting with a preprinted graphic design shall be taken from an unprinted Sheeting area.

The reflectivity of the flat area of the same test plate, totally wet by rain, will not be less than 90% of the values specified in Table 1. Wet performance measurements shall be conducted in accordance with ASTM E810. Contact your 3M application engineer for wet performance measurement test set-up specifications.

To measure the reflectivity values of applied Sheeting, prepare test plates as follows:

- o Test plates of the same size and format as actual issue plates must be produced using the same materials, on the same equipment, and by the same metal cleaning, laminating, embossing or debossing, and roll coating processes used for production plates.
- o Test plates must each have a single section with a minimum of 36 square inches (230 sq. cm) of flat area to facilitate photometric testing.
- o All test plates should be conditioned for 24 hours at 72 ± 5 °F (22 ± 1 °C) and 50 ± 5% R.H. prior to testing.
- o Each plate must be thoroughly hand washed (see Section 6) prior to testing.

4.2 Adhesive

Sheeting adhered to test plates prepared as described above will resist peeling, scuffing, and marring during normal use handling, and resist shocking off when jabbed with a spatula at -10 °F (-23 °C).

Prior to application, the Sheeting's protective paper liner can be peeled away from the adhesive without prior soaking in water or other solvent. The liner can be removed after accelerated storage for 4 hours at 150 °F (65 °C) under a weight of 2.5 pounds per square inch (0.18 kg/cm²).

5 Fabrication of Reflective License Plates

Note: For recommended manufacturing procedures used in the fabrication of license plates, refer to [3M Information Folder 9.8](#).

5.1 Substrates

The pre-coated adhesive will form a permanent bond to the surface of clean, chemically treated or conversion coated aluminum substrates normally used in the manufacture of license plates.

5.2 Application

The Sheeting has been designed for application to clean, flat coil or sheet stock by continuous squeeze roll application.

Once the Sheeting has been applied, it is recommended that laminated blanks be stored for a minimum of 48 hours before being embossed or debossed. For best embossing results, laminated blanks must be stored on edge and used within one year of date of receipt of Sheeting.

5.3 Embossing and Debossing

The Sheeting, as applied to flat metal, is sufficiently flexible to satisfy the embossing and debossing requirements of most conventional license plate designs. 3M reflective sheeting may be embossed or debossed to a height of up to 0.080" (2 mm) using standard embossing equipment and dies used for license plate production. Minimum embossing temperature is 70 °F (21 °C).

Roll coating embossed or debossed license plates within 24 hours of embossing or debossing greatly improves license plate printability and quality.

5.4 Color Processing

Apply legends to embossed or debossed plates by roller coating with the following 3M recommended high quality transparent or opaque inks:

3M™ Series 4800 Opaque Roll Coat Inks

3M™ Series 4850 Opaque Roll Coat Inks

3M™ Series 4900 Transparent Roll Coat Inks

3M™ Series 4950 Transparent Roll Coat Inks

Note: Care should be taken when choosing color combinations to ensure attractiveness and maximum legibility. This is especially true with graphic design Sheatings. To assure suitable contrast for maximum legibility and safety, 3M recommends the use of dark color roll coated characters on a white or yellow Sheeting background.

Contact your 3M application engineer for assistance with oven drying conditions. Cool the license plates to room temperature before packaging.

5.5 Dry Roll Coat Foils

Note: For recommended dry roller coating practices, refer to [Product Bulletin HSF100/200](#). Use Series HSF100 or 200 dry roller coat foils. Contact your 3M application engineer for additional information on dry roller coating foils.

6 Storage, Packaging, and Cleaning

Sheeting and roll coat inks must be stored in their original packages in a cool, dry area and should be used within one year of date of receipt.

The Sheetings, as supplied, will be of good appearance, free from ragged edges and cracks, and packaged according to commercial standards. Sheeting must be spliced for continuous roll application. Additional Sheeting is supplied to compensate for splices.

For maximum service life, do not use harsh, abrasive, or chemically concentrated cleaners. Clean license plates using the same care taken when cleaning the paint surface of the vehicle. The license plate surface can be cleaned of normal use dirt accumulation by washing it with a mild detergent and water using a soft bristle brush or cloth.

To remove tar, oil, or road dirt, cautious use of mild solvents such as mineral spirits, turpentine, or kerosene may be employed. Use of aromatic solvents and ketones, or solvent mixtures containing either should be avoided. Following cleaning, rinse plates thoroughly with water.

7 Purchase Specifications

The information concerning Sheeting contained herein is considered to describe the typical minimum requirements for an effective reflective license plate material. As such, this information may be incorporated into a product purchase specification to be used in conjunction with a specification for finished retroreflective license plates.

8 Health and Safety Information

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. 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.

9 Warranty Information

9.1 3M Warranty

3M warrants ("3M Warranty") that Sheeting sold by 3M for use in the fabrication of reflective safety plates with areas of at least 72 inch² ("Plates") in the United States, Mexico, and Canada will remain effective for its intended use by:

- o Remaining legible by resisting excessive fading, cracking, blistering or peeling, and
- o Retaining a coefficient of retroreflection¹ of at least nine (9) candlepower per foot candle per Plate² for the number of years indicated in the following table.

Table 2. Sheeting Warranty Period by color.

Base Sheeting Color	Warranty Period (Years)
White	5
Pastel Colors	5
Yellow	5
Lemon Yellow	5
Gold	3
Orange	3
Blue	2
Green	2

Graphic preprinted transparent colored areas are warranted for the same number of years as the Sheeting.

1. All measurements are at 2° observation angle and -4° degrees entrance angle. All measurements shall be made after cleaning the Plate according to 3M recommendations and in accordance with ASTM E810 "Standard Test Method of Coefficient of Retroreflective Sheeting," except that the coefficient of luminous intensity shall be determined in accordance with ASTM E808-01 Para. 3.2.2 and ASTM E809-02 Para. 12.3.

2. Graphic printed reflective Plates may not meet this requirement as large graphic printed areas can affect the reflectivity values of the finished Plates.

9.2 3M Warranty Terms and Conditions

- o A failure to meet the 3M Warranty must be solely the result of design or manufacturing defects in the Sheeting and not of (a) outside causes including improper fabrication, handling, maintenance, or installation; (b) use of roll coat pastes or sheetings not listed herein; (c) Plate exposure to temperatures beyond 3M's recommendations; (d) use of a reflective Sheeting applicator, stretch control mechanism, brake table, or corresponding registry feed controls not provided and installed by 3M; (e) failure of Plate substrate; (f) exposure to chemicals, abrasion, or damage from fasteners used to mount the Plate; (g) collisions, vandalism, or malicious mischief; or (h) an act of God.
- o Claims made under this warranty will be honored only if the Plates have been marked with the 3M™ Ensure™ warranty mark or another clear record of the Fabrication Date, either on the plate or in an auditable records database, is maintained such that the specific 3M production run numbers from which the Sheeting originated is traceable.
- o Sheeting must be stored, applied, installed, processed, and used in accordance with all 3M application procedures found in 3M's product bulletins, information folders, manufacturing manuals, and technical memos (which will be furnished upon request), including the appropriate use of components listed in Section 11 of this product bulletin and recommended application equipment.
- o Claims made under this warranty will be honored only if 3M is notified of a failure within 30 days, reasonable information requested by 3M is provided, and 3M is permitted to verify the cause of the failure.

9.3 Exclusive Limited Remedy

If the Sheeting on a Plate is shown to not meet the 3M Warranty during the Warranty Period, 3M's sole and exclusive remedy is, at 3M's option, to replace the Plate, or reimburse the Plate's issuing agency ("Agency") at a rate of no more than \$5.00 per Plate. Reimbursement to the Agency will be in dollars and/or materials, as determined by the needs of the Agency. Replacement Sheeting will carry the unexpired warranty period of the Sheeting it replaces.

9.4 Disclaimer

THE 3M WARRANTY IS MADE IN LIEU OF ALL OTHER WARRANTIES OR CONDITIONS, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OR CONDITION OF MERCHANTABILITY, OR FITNESS FOR A PARTICULAR PURPOSE, OR ANY IMPLIED WARRANTY ARISING OUT OF A COURSE OF DEALING OR OF PERFORMANCE, CUSTOM, OR USAGE OF TRADE.

9.5 Limitation of Liability

Except for the limited remedy stated above, and except where prohibited by law, 3M will not be liable for any loss or damage arising from Plates or any 3M product, whether direct, indirect, special, incidental, or consequential damages (including but not limited to lost profits, business, or revenue in any way), regardless of the legal theory asserted including warranty, contract, negligence, or strict liability.

10 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 <http://www.3M.com/vehicleregistration>.

11 Literature References

[3M IF 9.8](#)

[3M PB HSF100/200](#)

[3M PB 4800/4900](#)

[3M PB 4850/4950](#)

Preclear Reflective License Plate Sheeting Recommended Manufacturing Procedures

Dry Roller Coat Foil Series HSF100/200 and DRF300/400

Roll Coat Inks Series 4800/4900

Roll Coat Inks Series 4850/4950

ASTM Test Methods are available from ASTM International, West Conshohocken, PA.

For Information or Assistance

Call: 1-800-553-1380

In Canada Call:

1-800-3M HELPS (1-800-364-3577)

Internet:

<http://www.3M.com/vehicleregistration>

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Web [3M.com/vehicleregistration](http://www.3M.com/vehicleregistration)

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