Practical Information
ORALITE® Reflective Films of Reflection Class ASTM type IX and type XI for Road Safety
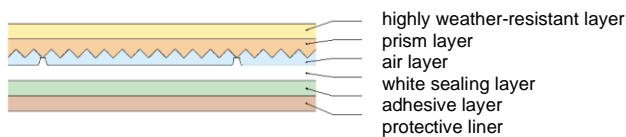
1. Processing instructions for ORALITE® reflective films of reflection class type IX and type XI

These processing instructions apply to the following ORALITE® reflective films of reflection class ASTM type IX and type XI:

ORALITE® 7900 Brilliant Grade
ORALITE® 7910 Brilliant Grade (with watermark)

ORALITE® 9900 Brilliant Grade Premium
ORALITE® 9910 Brilliant Grade Premium (with watermark)

The basic composition of these ORALITE® films is shown in graphic below:

highly weather-resistant layer
prism layer
air layer
white sealing layer
adhesive layer
protective liner

The information within this document is based on our knowledge, experience and application tests. Its purpose is to provide suggestions and support to practitioners. Even though it is not possible to explain all aspects that need to be taken into account, this guideline comprises a large number of useful tips for handling ORALITE® reflective films of reflection class ASTM type IX and type XI.

Specific knowledge and skills of sign producers are prerequisites for the processing of ORALITE® reflective films. On account of the large number of conditions that may influence the processing, adhesive bonding and use of the films, the sign producer should carefully consider the suitability and performance of the product for each intended use and perform their own tests.

2. Storage and Transportation

ORALITE® reflective films should be stored in a cool, dry indoor area that is protected from direct sunlight. Recommend temperatures for storage are from 20° C to 24° C and relative air humidity of 40% to 60%.

Rolled material should be stored in the original carton. The rolls have standard spacers (core plugs) that prevent contact between the roll surface and the carton and thus the formation of pressure marks and surface damage. Please make sure that partly processed rolls are never stored without spacers.

When making the rolls available for processing, it is advisable to use a horizontal suspension system. If the rolls are stored in a vertical, freestanding position, a negative influence on the film's characteristics is not expected. It is crucial to place the roll on the spacer so as to avoid breakage at the edges and contamination.

Blank or printed film sheets are supplied in cartons that have been specifically designed to the sheet dimensions. There are 50 sheets per carton. If the sheets are stored outside the carton, please make sure to put individual sheets on a flat and stable support so that they do not adjoin or overlap at the edges. Sheets may be stacked. However, in order to limit the weight load not more than 40 to 50 sheets should be stacked.

3. Printing

ORALITE® Reflective Films of reflection class ASTM type IX and type XI can be screen-printed with the silk-screen inks ORALITE® 5018 (one-component) or ORALITE® 5010 (two component). Digital printing is possible with the ORALITE® UV Traffic Sign Printer and the ORALITE® 5019 UV Digital Printing Ink.

Practical Information
ORALITE® Reflective Films of Reflection Class
ASTM type IX and type XI for Road Safety

Document 4.6
2019/19
Page 2 of 6

3.1 Screen printing process

ORALITE® 5018 silk-screen inks are a solvent based, quick drying colour system. The resulting surface is glossy and exceptionally weather resistant. After proper curing, the ink is extremely resistant to mechanical stresses such as those caused by cleaning brushes, etc. The application of an additional clear topcoat is not necessary for these ink systems.

ORALITE® 5018 (one-component ink) is available in the following transparent colours and opaque black;

| Yellow | (020) |
Red	(030)
Orange	(035)
Blue	(050)
Green	(060)
Brown	(080)
Grey	(073)
Black (opaque)	(070)

ORALITE® 5018 (one-component ink) is supplied ready for printing in a container with a capacity of 800 ml, 2400 ml, one gallon and 5 litres. Before application, the ink must be stirred and allowed to stand for at least 10 minutes so that the trapped air can escape. Opened containers must be closed tightly immediately after use. This helps prevent solvent evaporation, so that the ink remains suitable for future printing.

3.2 Preparation of the screen

It is recommended using polyester fabric with a mesh count of 61 to 64 [155 to 163 mesh] as printing screens. When such screen and ORALITE® screen printing inks are used, ORAFOL guarantees that prints onto ORALITE® films permanent and temporary traffic control products comply with the specifications for chromaticity and specific retroreflectivity provided that the printing process is carried out correctly.

Manual printing tables or automatic printing systems may be used. The screen-printing table must be flat and mechanically stable. Vacuum conveying is required for printing film sheets. The hardness or elasticity of squeegees has a decisive influence on the printing result. Squeegee rubbers with Shore hardness of 65 to 75 are recommended. Checking and surface grinding, if required, of the squeegees is crucial. The squeegees should be 7 to 10 cm bigger than the printing format.

3.3 Screen printing
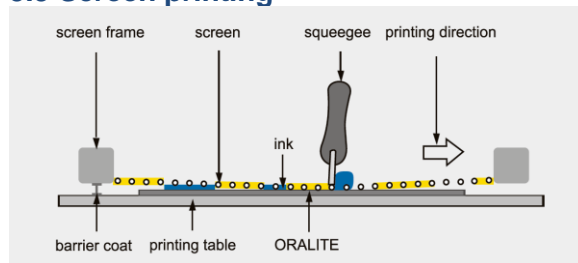
Before starting the screen printing process, the screen, squeegee and flood bar must be cleaned with a suitable solvent. In addition, each film should be wiped with an anti-dust or anti-static cloth prior to printing.

For printing, it is recommend maintaining a medium squeegee speed of approximately 0.75 m/s and the squeegee should be applied at an angle of 30° to the print surface.

The distance between the screen and the film surface should be set to about 10mm. If the distance is too short, the screen does not come off the substrate neatly, which results in poor print quality. Excessive squeegee pressure can result in smearing or blurred contours and edges. The ink containers must be closed immediately after use.

Optimum conditions for the printing process require an air temperature ranging from 20° C to 24° C and humidity of 35% to 50%. Unfavourable ambient conditions may require the use of thinning or retarding agents to adjust the ink for processing. To meet the required specification values for colour and retroreflection, it is crucial to ensure that no more than 3% thinner or not more than 1.5% retarder and not more than 0.5% print modifier are added to ORALITE® 5018 Screen Printing Ink. Humidity at or below 30% can lead to unsatisfactory printing results and long term stability of prints and is not recommended or warranted.

Practical Information
ORALITE® Reflective Films of Reflection Class
ASTM type IX and type XI for Road Safety

Document 4.6
2019/19
Page 3 of 6

3.4 Drying after screen printing
The drying time of the prints depends on the type of sheet or ink used, and specific local conditions such as the positioning of the prints, ambient temperature, air humidity, etc.

To facilitate quick and economical processing of the sheets after printing, it is recommended that forced drying by means of fans or drying in a convection oven at 40° C to 50° C be utilized. Furthermore, forced drying can prevent crack formation in the films after printing.

When using fans and drying at room temperature, we recommend that prints are individually placed on a rack or a similar shelf system as pictured below. To ensure adequate air circulation, a distance of at least 5 cm should be kept between the storage levels. Furthermore, it is recommended to use at least three or four fans for drying. The fans are best arranged one above the other in a movable manner on a trolley that can be driven up to the sheets from a distance of 1 to 2 m. immediately after printing; the fans should run at a higher speed for about 30 minutes, after that normal speed for another 30 minutes should be sufficient.

The use of a heatable drying rack results in a temperature increase and thus a substantially reduced drying time.

Drying conditions can be further optimized by using convection ovens. These closed systems permit a low-dust drying phase at constant temperature, low air humidity and do not subject the operator to solvent vapours.

The following drying times are general guidelines for ORALITE® 5018 Screen Printing Ink:

ORALITE® 5018 Screen Printing Ink

Drying Condition	Over printable		Stackable (max. 40 sheets)		Notes
	Temp.	Time	Temp.	Time	
Air Drying	20° C	60 minutes	20° C	3 to 4 hours	RH 40-60%
Oven Drying	60° C	5 minutes	60° C	30 minutes	

In case the sheets are printed in an overlapping manner, please make sure that the lower ink layer is not fully cured yet and that overprinting must take place within 12 hours after the first printing.

At an ambient temperature of 20° C and an average relative air humidity of 40 to 60%, printed traffic signs can be shipped after a drying time of 48 hours. Prints made with the two ink series are fully cured after approximately 8 days.

3.5 Storage and transportation of printed sheets and traffic signs
When the inks are cured (see table above), printed sheets can be stored horizontally. Please note that the maximum number of sheets stacked should not exceed 40 to 50 sheets. Prints on pre-laminated traffic sign substrates should be stored vertically and separated by an intermediate layer of suitable paper or support film. A low pressure load is crucial.

Practical Information
ORALITE® Reflective Films of Reflection Class
ASTM type IX and type XI for Road Safety

Document 4.6
2019/19
Page 4 of 6

3.6 UV digital printing

ORAFOL's UV printing system is especially developed for the manufacture of traffic signs but also capable to print any full colour graphic. The system consists of the ORALITE® UV Traffic Sign Printer, the ORALITE® 5019 UV Digital Printing Ink and the recommended ORALITE® protective laminates. Lamination of UV digital prints ensures durability as well as conformity of colour and reflectivity to specifications. Please refer to the printer's manual and the datasheet of the UV ink for further details.

Lamination with clear protective laminates shall be done at a maximum temperature of 37°C [100F] and 0.6 m/min [2 ft./min] to yield a good lay flatness and stress free laminated product.

4. Cutting, die cutting, plotting

ORALITE® reflective films of the reflection class ASTM type IX can be cut by means of a commercial stack cutter. The holding-down clamp should be set to very low pressure and, as an additional measure, the film should be protected from compression. It is recommended to limit the stacking height to 40 to 50 sheets (see Storage and Transportation). Sealing cut edges of these ORALITE® reflective films is not required.

If ORALITE® reflective films are die-cut by means of steel strip tools, it is not recommended to place several sheets on the platen at the same time.

Commercial cutting plotters with tangential blades, preferably of the flatbed type, should be used as plotter systems. Tangential control ensures high-quality cut edges. The cutting depth can be adjusted, from starting a cut, to cutting through. Systems with a pneumatically controlled die head, where the cutting pressure can be adjusted precisely in accordance with the specific material used, are highly recommended. The use of drag-knife systems is not recommended. The respective cutting or processing speed depends on the complexity of the cutting pattern and the applied cutting system.

Besides ORALITE® reflective films of the reflection class ASTM type IX and type XI, also non-reflective ORALITE® films can be processed in this manner.

For the manufacturing of traffic signs with ORALITE® reflective films of these reflection classes in a small series and/or with variable lettering, ORAFOL offers the ORALITE® 5061 Transparent Film series in all common traffic sign colours. For black letterings, markings and symbols the ORALITE® 5081 Lettering Film is recommended. Additional laminates are the ORALITE® 5090 Anti-Dew Film and ORALITE® 5095 Anti-Graffiti Film, as well as the transparent film of the series ORALITE® 5061 Transparent Film.

For the application of cut films ORAFOL offers the ORATAPE® MT95 transfer film or ORATAPE® MT72, LT72 and MT52 application tapes. The application can be done by film laminating machine or hand roller.

5. Adhesive bonding and laminating

In order to achieve proper adhesion of the films, the substrate must be dry and free of dust, oil, fats, silicon or other contamination. If the substrate needs to be treated with a solvent, the next processing step cannot be carried out until the solvent is completely evaporated. When bonding films to metallic substrates, slight grinding of the surfaces is advantageous.

ORALITE® reflective films series 7900, 7910, 9900 and 9910 have been optimized for bonding to flat substrates of aluminium alloys or galvanized steel. However, the installer should test the reliability of bonding in each case.

Bonding/laminating should not be carried out at air and material temperatures of less than 15° C. The optimum bonding temperature is about 21° C. The films should be stored for at least 48 hours in the rooms in which they will be processed. Adequate curing of the ink is a prerequisite for any further processing of printed reflective films as otherwise the escaping solvent may cause blistering and even tearing of the films. If you intend to use a film-laminating machine, it is recommended using a machine with controllable unwinding and winding motors. The upper roller should be rubber coated with Shore hardness 65 to 75. The optimum roll gap should be adjusted over the entire width. It is recommended that a flatbed roll applicator for the bonding of several film webs.

ORALITE®

aluminium corpus
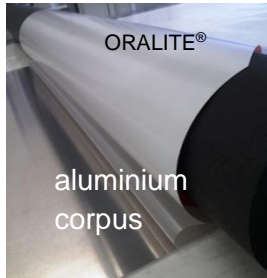
If it is necessary to apply two pieces of prismatic sheeting side by side (splicing), they must not overlap. Depending on the format, the gap should be approximately 1 mm [0.04 inches]. Please make sure that a right side of the film web is always bonded to a left side, thus ensuring the uniform orientation of the film's honeycomb structure.

When a hand roller is used for lamination, the film must be placed on the sheet in such a way that it protrudes at least 5 mm from the surface on all sides. It is recommended to proceed as follows to ensure the accurate positioning of the sheet: In a first step, peel off 60 to 80 cm of the protective paper or film from the ORALITE® reflective film. Align the sheet on the substrate and press down the area where the adhesive is exposed. Then get hold of the folded-over protective paper underneath the sheet and slowly peel it off further, while pressing down the sheet with the rubber hand roller. Finally, the edges of the traffic sign sheet should be trimmed with a **sharp knife** applied at a 30° angle.

Caution! Before laminating any ORALITE® film to a substrate, please make sure it is dry!

6. Colour adjustment

If several film sheets or film webs of ORALITE® reflective films of the reflection class ASTM type IX and type XI are to be bonded to a substrate, they should be colour-matched in daylight and when illuminated in retroreflection. It is preferable to use only films from the same roll. If more than one roll is required, only material from the same production lot should be used.

7. Cleaning of the applied products

Surfaces should only be cleaned with clear water, water/isopropanol (80/20%) or diluted soap solution. Please do not use any solvents, thinner or abrasive cleaning agents for the cleaning of reflective films! We also do not recommend the use of power washers for cleaning of read signs.

8. Intermediate storage of traffic signs

ORAFOL recommends indoor storage of signfaces or finished signs in an upright vertical position, with 2 cm [1 inch] spacers between the signs in an area protected from excessive moisture or overheating. Outdoor storage should be done in a vertical position with 10 cm [4 inches] spacers between the signs. The spacers should not touch the reflective surface. If a wrapping is done, the material used shall allow air circulation and be removed when wet.

These instructions apply to the following materials:

Microprismatic retroreflecting films
ORALITE® 7900 Brilliant Grade
ORALITE® 7910 Brilliant Grade (with watermark)
ORALITE® 9900 Brilliant Grade Premium
ORALITE® 9910 Brilliant Grade Premium (with watermark)

Colour laminates
ORALITE® 5061 Transparent Film

Lettering materials
ORALITE® 5081 Lettering Film

Laminates
ORALITE® 5061 Transparent Film, transparent
ORALITE® 5090 Anti-Dew Film
ORALITE® 5095 Anti-Graffiti Film

Transfer materials
ORATAPE® MT 95
ORATAPE® MT 72
ORATAPE® LT 72
ORATAPE® MT 52

For further information on the above described materials, please visit www.orafol.com.