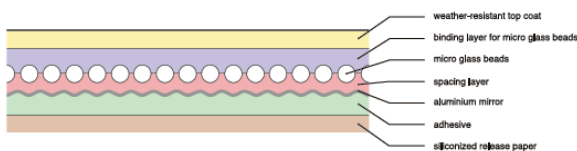


1. Processing instructions for ORALITE® reflective films of reflection class RA1, class A

These processing instructions apply to the following ORALITE® reflective films of reflection class RA1:

ORALITE® 5700 Engineer Grade *Premium*
ORALITE® 5710 Engineer Grade *Premium*
ORALITE® 5500 Engineer Grade
ORALITE® 5510 Engineer Grade
ORALITE® 5300 Commercial Grade
ORALITE® 5310 Commercial Grade
ORALITE® 5400 Commercial Grade
ORALITE® 5430 Construction Grade

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



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 RA1, A.

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 of the reflection class RA1, A should be stored in a cool and dry place that is protected from direct sunlight. We recommend temperatures ranging 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 series 5700, 5710, 5500, 5510, 5300 and 5310 featuring an alkyd resin surface are suitable for screen printing process with screen inks ORALITE® 5010 and ORALITE® 5018, whereas series ORALITE® 5400 and 5430 featuring a modified PVC topcoat can be printed only with one-component silk-screen ink ORALITE® 5018.

All ORALITE series covered in this instruction are suitable to be printed with ORALITE® 5019 UV Digital Ink with the ORALITE® UV Traffic Sign Printer.

3.1 Printing process

ORALITE® 5018 silk-screen inks are a solvent based, quick drying color 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 colors and opaque black;

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

ORALITE® 5018 (one-component ink) is supplied ready for printing in a container with a capacity of 800 ml and 5kg. 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.

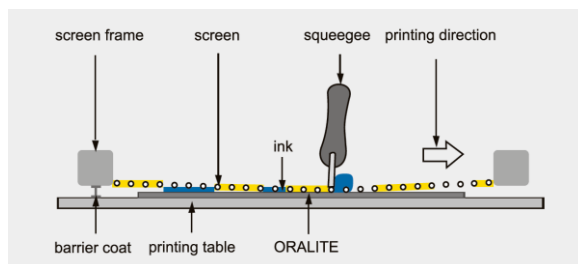
3.2 Preparation of the screen

It is recommended to use polyester fabric with a mesh count of 61 to 64 [155 to 163 mesh], as screen-printing stencils. When such screen-printing stencils and ORALITE® screen printing inks are used, ORAFOL guarantees that prints onto ORALITE® Reflective films of colour 010 (white) comply with the required chromaticity and specific retroreflective values called for in international specifications for reflective materials of these classes provided that the printing process is correctly carried out.

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 recommended maintaining a medium squeegee speed of approximately 0.75m/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 20% to 50%. Unfavorable ambient conditions may require the use of thinning or retarding agents to adjust the ink for processing. To meet the required specification values for color and retroreflection, it is crucial to ensure that no more than 3% thinner and not more than 1.5% retarding agent are used in the ORALITE® 5018 Screen Printing Ink.

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.**

The following procedure has proved successful in air-drying by means of fans:

It is recommended that the prints are individually placed on a platform rack truck or a similar shelf system. 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 tray 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 vapors.

The following drying times are general guidelines:

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	

ORALITE® 5010 Screen Printing Ink

Drying Condition	Over printable		Stackable (max. 40 sheets)		Notes
	Temp.	Time	Temp.	Time	
Air Drying	20°C	30 minutes	20°C	5 hours	RH 40-60%
Oven Drying	60°C	6 minutes	60°C	45 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 tables 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.

3.6 UV digital printing

ORAFOL's UV digital printing system, especially designed for but not limited to the manufacturing of traffic signs, consists of ORALITE® UV Traffic Sign Printer using the supplied RIP software, ORALITE® 5019 UV Digital Ink and our recommended ORALITE® overlay films. Clear lamination after printing yields films with long term outdoor stability that meets the requirements of reflection class RA1.

The printing process requires an air and material temperature between 20 °C and 26 °C as well as air humidity between 40 - 60 %. The room should be free from dust to prevent entrapment of dust during printing. The surface of the ORALITE® reflective film requires cotton gloves for the digital printing preparation to prevent contamination of the surface and to allow a flawless print image.

For further details on printing preparation, cleaning and care intervals please refer to the handbooks and documentations of the ORALITE® UV Digital Traffic Sign Printer and the RIP software.

4. Cutting, die cutting, plotting

ORALITE® reflective films of the reflection class RA1,A 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 also non-reflective ORALITE® films can be processed in this manner.

For the manufacturing of traffic signs with ORALITE® reflective films of reflection class RA1 in a small series and/or with variable lettering, ORAFOL offers the ORALITE® 5061 Transparent Film series in all common traffic sign colors. 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 good adhesion of the films, the substratum must be dry and free of dust, oil, fats, silicon or other contamination. If the substratum needs to be treated with a solvent, the next processing step cannot be carried out until the

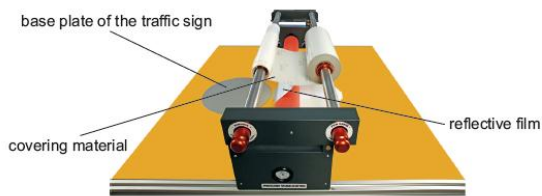
solvent is completely evaporated. When bonding films to metallic substrata, slight grinding of the surfaces is advantageous.

ORALITE® reflective films series 5700, 5710, 5500, 5510, 5400 and 5300 have been optimized for bonding to flat substrata of aluminum alloys or galvanized steel plate, whereas ORALITE® reflective films 5430 are also suitable for bonding to polyolefin substrates such as polyethylene and polypropylene. However, the foreman should test the reliability of bonding in each concrete case.

Bonding 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 a period of at least 48 hours in the premises designated for their processing.

Adequate hardening of the ink is an indispensable 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, we recommend using a machine with controllable unwinding and winding motors. The upper roller should be coated with Shore hardness 65-75 rubbers. The optimum roll gap should be adjusted over the entire width. We recommend using a ROLLROLLER flatbed applicator for the bonding.



When several film webs need to be bonded side by side, they should always overlap. Depending on the format, the overlap should be 3-5mm. Please make sure that a right side of the film web is always bonded to a right side and a left side is bonded to a left side.

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 5mm from the surface on all sides. We recommend proceeding as follows to ensure the accurate positioning of the sheet: In a first step, peel off 60 to 80cm of the protective paper or film from the ORALITE® reflective film. Align the sheet on the substratum 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 bonding ORALITE® reflective films, please make sure that they are dry.

6. Color adjustment

If several film sheets or film webs of ORALITE® reflective films of the reflection class RA1,A are to be bonded to a substrate, they should be color-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 or abrasive cleaning agents like sand for the cleaning of reflective films!

These instructions apply to the following materials:

Retroreflective films with a reflector system based on embedded micro glass beads

ORALITE® 5700 Engineer Grade *Premium*
ORALITE® 5710 Engineer Grade *Premium*
ORALITE® 5500 Engineer Grade
ORALITE® 5510 Engineer Grade
ORALITE® 5300 Commercial Grade
ORALITE® 5310 Commercial Grade
ORALITE® 5400 Commercial Grade
ORALITE® 5430 Construction Grade

Colour laminates

ORALITE® 5051 Transparent Film

Lettering materials

ORALITE® 5071 Lettering Film

Clear Laminates

ORALITE® 5061 Transparent Film
ORALITE® 5051 Transparent Film

Transfer materials

ORATAPE® MT 95
ORATAPE® MT 72
ORATAPE® LT 72
ORATAPE® MT 52

For further information on the above-described materials, please go to www.orafol.com.