

Reliable lamination of window profiles

Technical Guidelines



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Plastic window profile laminating companies have the task of processing a range of materials of sometimes changing suppliers into a long-lasting, high-quality product. In doing so they must always strive for a quality that conforms at least to the requirements of RAL-GZ 716.

These guidelines offer recommendations for how the materials used are to be handled, with particular attention being paid to the laminating process. Since the guidelines can only serve as general instructions, the product-specific recommendations for the particular products used must – as is pointed out several times in the text – also be taken into consideration. The instructions provided by the manufacturer must be followed.

The guidelines are structured as follows:

- 1 Storage of the materials:** Following delivery and prior to use, the storage conditions specified by the supplier for the respective components must be observed
- 2 Material staging:** This describes the preparation, treatment and storage of the materials prior to the start of production
- 3 Lamination:** Specifications for every component during the lamination process are provided here
- 4 Setting / curing:** This section covers the period after lamination
- 5 Avoidance of faults and effects of faults:** Tabular summary based on the cause/effect principle

Enclosures

Temperature/moisture assignment table

Lamination diagram

Definition of terms

Legal notice

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1 Storage of materials

Listed below are the conditions under which the materials for a laminating process must be stored, from the time of manufacture to their staging for processing.

1.1 Profile

Profiles must be stored in accordance with the manufacturer's processing guide. To avoid difficulties in processing, the profiles must be protected against weathering influences – in particular direct contact with water – and dirt.

1.2 (Decorative) film

The film must be stored in a clean, dry place and processed in accordance with the FIFO principle. The films must be stored for no longer than specified by the manufacturer. Rolls should not be exposed to direct sunlight, heat radiation or high temperatures and/or high humidity. It is recommended that they are stored in halls at room temperature (approx. 20 °C) and in humidity of approx. 50% (ideal conditions).

1.3 Adhesive and primer

Primer:

- Sealed original packaging
- Storage temperature: 5 °C – 25 °C

It must be ensured that the manufacturer's instructions for transport and storage conditions have been followed.

Adhesive:

- Airtight packaging
- Storage conditions: cool, dry place, not permanently above 45 °C

The airtight packaging protects the adhesive from premature setting. Care must be taken to prevent any damage to the container.

1.4 Protective film, packaging material

Follow the manufacturer's instructions.

IMPORTANT!

Storage of materials

- Protect against weathering influences (sunlight, moisture) and dirt
- Avoid frost and overheating
- Note the maximum shelf life, FIFO principle
- Meet the manufacturer's requirements

2 Material staging

All materials used in the laminating process must be suitably preconditioned if they are to be able to be processed reliably. The material staging period begins when the materials are removed from storage and ends when they are led to the laminating process. The main requirements to be met concern temperature, humidity and cleanness.

2.1 Profile

Processing parameters:

- Profile temperature 18 °C – 25 °C, fully temperature stabilised (temperature range for a reliable laminating process)
- Free of contamination (e.g. dust, adhesive residue, protective film (residue), oil/grease, moisture)

Higher profile temperatures may be unavoidable on some days, due to the time of year. At temperatures over 25 °C the parameters in the laminating process must be modified.

2.2 Film

- Do not exceed the maximum shelf life of the film
- Film temperature: 18 °C – 25 °C

Note

The film manufacturer's warranty will lapse at the end of the max. shelf life. If the film is still to be used anyway, the laminating company must carry out a processing test and guarantee adhesive strength pursuant to RAL-GZ 716.

2.2.1 Cutting film

The quality of the laminated profile is greatly influenced by how the film is cut and wound. It must be ensured that the film winding process produces rolls that have the optimum winding characteristics (particularly with regard to tightness).

To avoid lasting damage to the film in the form of tears caused by high radial stresses and telescoped rolls, it is recommended that the machine equipment and the conditions on the cutting machine meet minimum requirements:

- The braking force/tensile stress when cutting the processing roll to size should be as low as possible (but lateral variation = "telescoping" must be precluded)
- The number of rewinding processes must be kept as low as possible
- Pneumatic tensioning shafts at the unwind unit
- Constant web tension when winding and unwinding by means of diameter-dependent braking and drives
- Suitable sensor technology for automatic capture and control of the braking and winding torques
- Friction shaft for winding films cut in different widths

2.3 Primer

- Primer temperature: 18 °C – 25 °C (preconditioned)

2.4 Adhesive

There is no requirement for a defined temperature range for staged adhesive. To avoid any reaction with humidity, the original container must only be opened immediately prior to insertion into the melting unit.

2.5 Protective film

Specifications:

- Proper winding

For the protective film to be processed in the laminating machine, the rolls must have been wound properly. If the rolls are telescoped, the position of the protective film on the laminated profile cannot be ensured.

When staging the protective film, pay attention to the following:

- Compatibility of the adhesive with the laminating film
- Adhesive strength of the protective film adjusted to the types and embossed finish of the laminating film
- UV resistance

2.6 Packaging material

Specifications:

- Compatibility
- Mechanical protection

The packaging material must be specified by the system supplier. If the packaging material is in any way incompatible with the other components, this may cause undesirable effects on the laminated profile.

Care must also be taken to ensure that the packaging material offers sufficient mechanical protection for the laminated profiles.

The packaging must be suitably configured to prevent the formation of condensation.

IMPORTANT!

Material staging

- Comply with the temperature specifications for the materials
- Modify the process parameters if the profile temperature (heated through) exceeds 25°C
- Cleanness
- Follow the recommendations for the maximum shelf life
- With decorative and protective films, follow the instructions for cutting and rolling precisely

3 Lamination

The laminating process covers all stages from the processing of the materials used to the finished, laminated profile.

The entire laminating process must be protected from negative ambient influences such as dust.

3.1 Climatic influences

- Temperature: 18 °C – 25 °C
- Relative humidity: 40% – 70%
- Avoid an uncontrolled, fluctuating circulation of air

Compliance with the climatic parameters in the laminating process is an essential requirement for reliable lamination – see the “Temperature/humidity assignment table” attached to these guidelines.

3.2 Preheating temperature of the profile surface before priming

- DCM or MEK: no preheating
- Preheating temperature for VOC-reduced primers: 30 °C – 35 °C

3.3 Primer application

Processing parameters:

- Reaction time/distance:
 - MEK and DCM: approx. 0.5 m / 2-3 sec. (at 10-15 m/min)
 - VOC-reduced primers: approx. 1 m / 5 sec. (at 10-15 m/min)
- Suggestions for dosage:
 - MEK: (15-30) g/m²
 - DCM: (20-60) g/m²
 - VOC-reduced primers: 8 g/m² [± 2 g]

The dosage must be appropriate to the profile. The primer must be applied evenly and across the entire surface. The manufacturer’s instructions must always be followed.

If priming on felt, a felt density of 0.32 - 0.36 g/cm³, depending on the primer, is recommended. The felt contour must correspond to the contour of the profile. Felt thickness 10 mm – 20 mm. In the case of double priming, the felts must be positioned at a distance of approx. 20 cm from each other. Care must be taken to ensure that the set dosage of the primer is applied to all felts.

Correct application of the primer must be monitored. The laminating company must determine the replacement interval to suit the choice of components. Depending on the components, an interval of under 8 hours is recommended.

3.4 Primer drying

Specifications:

- Drying time
- Air convection
- Temperature on the profile surface: 35 °C – 55 °C

The drying capacity depends on the drying time, the air flow and the temperature. It must be ensured that the primer is sufficiently dry across the whole surface before the film is applied to the surface.

3.5 Profile surface temperature before lamination

Specifications:

- Temperature of the profile surface in the area between the primer drying section and the laminating roll: 45 °C – 55 °C

3.6 Film tension

The tension of the film between the unwind station and the laminating roll must be set so that the adhesive is applied homogeneously/evenly at the slotted nozzle. Stretching of the film must be avoided.

3.7 Film preheating

The following specifications apply for preheating the film before the adhesive is applied:

- 30 °C – 60 °C, depending on the film types used

To ensure that the adhesive and the film form a bond after application, it is important that the temperature specified for the particular film is actually achieved.

The optimum film temperature for the film quality used (e.g. PVC or acrylate based) must be agreed with the film supplier.

3.8 Adhesive application

Specifications:

- Temperature and relative humidity: see assignment table in the annex.
- Quantity of adhesive to apply: 50g/m²[± 10 g]
- Premelt temperature
- Tube temperature
- Nozzle temperature
- Maximum time in the heated state: 2h (while system is at a standstill)

The relative humidity in the area the adhesive is applied is important for the optimum setting of the adhesive. The optimum temperatures of the adhesive must be agreed with the supplier. The adhesive must be permanently protected against humidity when in the molten state in the melting unit. The recommended amount of adhesive to apply is 50 g/m².

Information on how to handle the adhesives must be obtained from the adhesive manufacturer, as the various adhesives behave differently with regard to “operating temperature range” and “behaviour at machine standstill”.

3.9 Film temperature before the laminating roll

Specifications:

- Temperature of the film-adhesive structure before the laminating roll: 45 °C – 55 °C
- Film heat-through temperature (optional): depends on the film – to be agreed with the supplier

The general rule is that, when wrapping, the film-adhesive structure must have a particular temperature on all surfaces and at all profile edges in order to ensure an optimum bond with the profile. The extent to which the film has to be heated again to obtain greater flexibility depends on the type of film, the type of adhesive, the profile geometry and the distance between the gluing nozzle and the end of the laminating section. It is recommended that the relevant manufacturer be consulted.

3.10 Film wrapping

The films must be applied and pressed on evenly across radii and surfaces, beginning from the laminating roll. The roll geometry used must be appropriate for the laminating detail (surface, radii, sink marks). No creases or bubbles must be allowed to form between the film and the profile.

Specifications:

- Homogeneous contact pressure

Additional heating can be provided at the edges if there are sharp edges or the film is very stiff. However, the extra energy applied should be kept as low as possible.

Specifications:

- Film heating temperature just before the edge: 50 – 60 °C (PVC-based film)
- Film heating temperature just before the edge: 60 – 70 °C (acrylate-based film)

If additional heating is provided at the edges, the energy applied after the film edges have been wrapped must be removed again. Cooling must take place immediately after wrapping.

Specifications:

- Distance from the edge heater
- Cooling temperature: 30 °C – 40 °C

3.11 Markings

Markings are provided for the purpose of traceability throughout the life of the laminated profile. All materials used and the entire laminating process must be verifiable.

Specifications:

- Legibility
- Covers the materials used and process parameters
- Requirements according to RAL-GZ 716, Technical Appendix Section I, Part 4

3.12 Profile discharge

Generally the profile should have a max. temperature of 35 °C on discharge from the machine.

Higher profile temperatures may be unavoidable on some days, due to the time of year. This must be compensated by adjusting the process parameters accordingly.

IMPORTANT!

Lamination

- The “temperature balance” of all materials used and the surroundings plays a critical role in the laminating process
- Reaction times and primer drying must be precisely observed
- Specifications for adhesive and primer quantities must be met
- The specified humidity must be ensured in the area between where the adhesive is applied and the lamination
- Stretching of the film must be avoided

4 Setting / curing

Specifications:

- Temperature: at least 18 °C
- Curing time: depends on the adhesive – to be agreed with the supplier

The laminated profiles require a certain temperature and length of time for curing in order to reach their full strength/long-term stability.

The peel strength can be checked not later than after 72 hours, depending on the adhesive system used.

IMPORTANT!

Setting / curing

- The profile/adhesive system/film structure does not reach its full adhesive strength until after several hours.

5 Avoidance of faults and effects of faults

Chap	Point	Problem	Effect
Chapter 1 – Storage	1.1 Profile	--	--
	1.2 (Dekorative) film	Storage too warm / long / humid	Adhesion reduces down to no adhesion
		Storage too cold	Processing only possible after lengthy conditioning
	1.3 Adhesive and primer	Storage of primer too cold	Complete loss of effectiveness (e.g. solid matter flakes / falls out) Protection against frost depends on type of primer
		Storage of primer too long / warm	Modification of primer composition; loss of solvent and loss of effectiveness
		Adhesive not airtight	Premature setting; fusion no longer possible
		Storage of adhesive too long / warm	Loss of fusibility and effectiveness due to partial setting
1.4 Protective film	Storage too long	Film no longer usable	
Chapter 2 – Material staging	2.1 Profile	Too cold	Condensation leads to loss of adhesion
		Dirty / greasy / moist	Loss of adhesion, foreign bodies under film
		Too warm	Heat is not dissipated after lamination, film detaches again (at the edges)
	2.2 Film	Too cold	Condensation leads to loss of adhesion
		Too warm	Foil elongates, damage to protective layer
		Too old	Reduction in adhesion
	2.2.1 Cutting film	Too much stretching	Foil elongates, damage to protective layer
		Too little winding tension	Telescoping; problems positioning the film
	2.3 Primer	Too cold	Impact on effectiveness when primer is applied
		Too warm	Safety risk (overpressure), particularly with DCM and MEK Modification of primer composition and reduction in effectiveness
	2.4 Adhesive	Open too long	Premature setting; fusion no longer possible
	2.5 Protective film	--	--
2.6 Packaging material	--	--	

Chap	Point	Problem	Effect
Chapter 3 – Lamination	3.1 Climatic influences	Humidity too high	Condensation, reduction in adhesion
		Humidity too low	Adhesive slowly sets, reduction in adhesion
	3.2 Profile preheating before priming	Temperature of profile surface too high	DCM/MEK primers in particular evaporate too quickly; insufficient pretreatment of the surface; adhesion problems
		Preheating temperature of profile surface too low when VOC-reduced primers are used	Pretreatment of surface at a given reaction time not sufficient; reaction time must be extended (e.g. reduce the feed rate) consequence: drying not sufficient, residual primer is trapped, adhesion problems, blistering
		Preheating temperature of profile surface too high when VOC-reduced primers are used	Reaction time of primer too short, reduction in adhesion
	3.3 Primer application	Application quantity too low	Reduction in adhesion
		Application quantity too high	Residual solvent remains on the profile surface; reduction in adhesion; blistering
		Primer temperature too high	Reaction time of primer too low, reduction in adhesion; feeders/filters clog up
		Primer temperature too low	Pretreatment of surface at a given reaction time not sufficient; reaction time must be extended (e.g. reduce the feed rate) consequence: drying not sufficient, blistering
		Primer not applied evenly	Reduction in adhesion in strips
	3.4 Primer drying	Primer drying capacity low	Residual solvent remains on profile surface, penetrates through it into the profile, where it is trapped and spreads in the profile/adhesive/film structure after lamination, causing damage to the structure
	3.5 Profile surface temperature prior to lamination	Profile surface temperature too high	At over 55 °C lubricant migrates out of the profile onto the surface, where it has a negative impact bonding (adhesive-profile adhesion)
		Profile surface temperature too low	Adhesive cools down abruptly, causing reduction in adhesion

Chap	Point	Problem	Effect
	3.6 Film tension	Film tension too high	A braking force that is not adjusted to the film width causes the film to stretch and suffer damage
		Film tension too low	A braking force that is too low causes eccentricity of the film in the area of the gluing nozzle; homogeneous wetting with the adhesive is impossible, causing localised reductions in adhesion
	3.7 Film preheating	Film temperature too high	Causes stretching and damage to the film (energy applied too high, favours recovery behaviour of the film)
		Film temperature too low	Can have a negative impact on processing and adhesion (film-adhesive ΔT too great \rightarrow reduction in adhesion)
	3.8 Adhesive application	Too little adhesive	Reduction in adhesion, flaws
		Too much adhesive	Reduction in initial adhesion Surface sensitivity increases (pressure marks) Curing of adhesive can be affected
		Temperature too high	Danger of the film stretching Adhesive viscosity problem \rightarrow application quantity
		Temperature too low	Adhesive viscosity problem \rightarrow application quantity, wetting problems, reduction in adhesion
		Adhesive heated too long in melt tank	Danger of adhesive setting prematurely through to incrustation
	3.9 Film temperature before laminating roll	Temperature too high	Reduction in initial adhesion encourages recovery behaviour of the film
		Temperature too low	Wetting problems Reduction in adhesion
	3.10 Film wrapping	Uneven contact pressure of the rolls	Blistering and creasing Localised reduction in adhesion
		Cooling too late with complex profile geometry associated with stiff films	Encourages recovery behaviour of the film
		Edge area too cold	Encourages recovery behaviour of the film
		Edge area too warm	Encourages recovery behaviour of the film
	3.11 Markings	Poor/no markings	Traceability to materials and process is not guaranteed
3.12 Profile discharge	Too warm	Encourages recovery behaviour of the film	
4	4 Setting / curing	Too cold Time too short	incomplete curing \rightarrow reduction in adhesion, film detaches on further processing

Enclosures

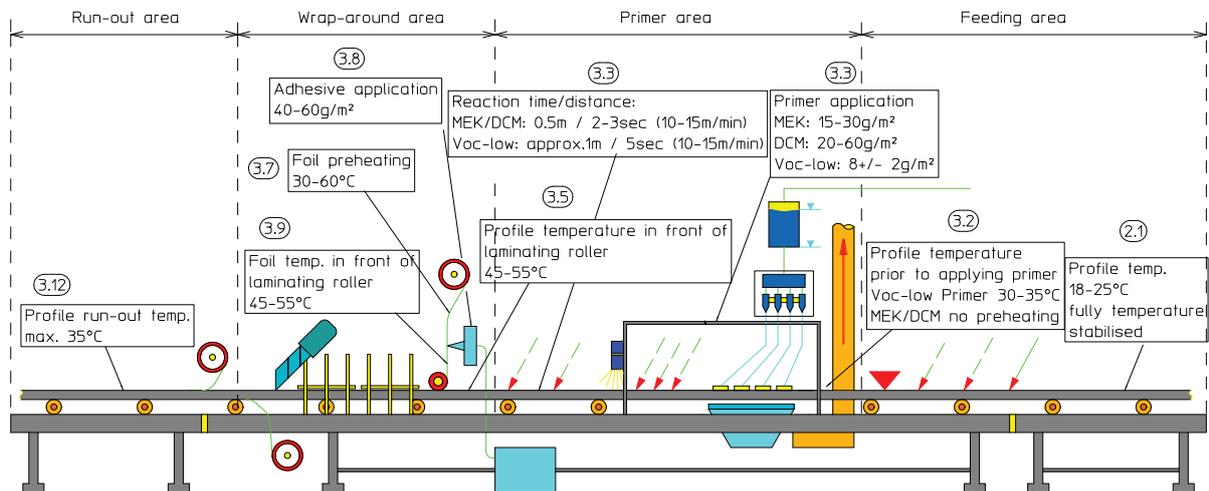
Temperature / moisture assignment table

	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%
18 °C								+	+	+	+	+	+
19 °C								+	+	+	+	+	+
20 °C						+	+	+	+	+	+	+	+
21 °C					+	+	+	+	+	+	+	+	+
22 °C					+	+	+	+	+	+	+	+	+
23 °C					+	+	+	+	+	+	+	+	+
24 °C					+	+	+	+	+	+	+	+	+
25 °C					+	+	+	+	+	+	+	+	+
26 °C				+	+	+	+	+	+	+	+	+	+
27 °C				+	+	+	+	+	+	+	+	+	+
28 °C				+	+	+	+	+	+	+	+	+	+
29 °C				+	+	+	+	+	+	+	+	+	+
30 °C				+	+	+	+	+	+	+	+	+	+
31 °C				+	+	+	+	+	+	+	+	+	+
32 °C				+	+	+	+	+	+	+	+	+	+
33 °C				+	+	+	+	+	+	+	+	+	+
34 °C				+	+	+	+	+	+	+	+	+	+
35 °C				+	+	+	+	+	+	+	+	+	+

+ ... allowing climate conditions

Lamination diagram

Lamination hall temperature: 18°C-25°C
Relative humidity: 40%-70%



Definition of terms

FIFO	„first in – first out“, i.e. the goods that are delivered first are also to be consumed first
PVC	Polyvinyl chloride
Acrylate-based	film based on acrylate polymers
UV	ultraviolet radiation
MEK	methyl ethyl-ketone
DCM	dichlormethane, methylene chloride
Solvent primer	primers based on the use of MEK or DCM
VOC	volatile organic component
Telescoping	lateral variation of the film edge

Legal notice

The information contained in these Technical Guidelines has been compiled to the best of our knowledge from practical experience and testing and conforms to the current state of the art.

It does not constitute any warranty of product characteristics and does not establish any contractual relationship.

The processor is responsible for checking that the products are suitable for use and processing.

We reserve the right to make changes in order to improve material properties and processing.

Use on other substrates and for applications other than those described above must be verified in the individual case and agreed with the relevant manufacturers/suppliers to ensure suitability.

The recommendations and instructions regarding the transport and storage of the materials and the preparation and processing instructions of the relevant manufacturers of the materials, technologies and services described must be followed at all times.

No warranty is given for the correctness and completeness of the content. All liability is excluded.

We would like to thank all our partner companies for their support in the preparation of these Technical Guidelines.



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... immer die sichere Wahl

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