ARL 300 – Working guideline for the coating of dimensionally stable and limited dimensionally stable construction elements

Windows –Front doors – Garage doors

General part

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01-20 (supersedes 10-18)

ADLER-Werk Lackfabrik, A-6130 Schwaz

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With the Working guideline in hand you get all necessary information for an optimal coating, the correct installation, as well as care and maintenance. For further questions, our technical Service is gladly at your disposal (phone: 0043/5242/6922-301, email: technical-support@adler-lacke.com).

1 Basics

All ADLER products must be processed in accordance with the technical data sheets and the General Terms and Conditions of ADLER-Werk Lackfabrik Johann Berghofer GmbH & Co KG must be observed. All relevant standards or guidelines for construction and storage must also be taken into account. Compliance with the construction monitoring obligation as well as the proper assembly according to the state of the art and measures intended for protection during the construction phase must be ensured.

This working guideline replaces the previous working guideline (including its annexes).

Information about maintenance and renovation you will find in the **ARL 304 - Working guideline for coating dimensionally stable and limited dimensionally stable construction elements - Maintenance and renovation.**

2 Conditions for a long durability

2.1 Wood quality

Windows are wooden elements with a long durability, but only when the dimensional stability is always given. This can be achieved by using wood of the quality class J10 of the standard DIN EN 042 and wood types suitable for window construction (for details see chap.**Fehler! Verweisquelle konnte nicht gefunden werden. Fehler! Verweisquelle konnte nicht gefunden werden.**). Under particular conditions, also finger joint scantlings can be used for transparent coatings (cf. VFF Merkblatt HO.02 respectively ift-Richtlinie HO 10-1).

Dimensional stability (property to reduce swelling and shrinking of wood as a result of humidity variation) depends on the wood type utilized, which must be of excellent quality for window constructions. For window construction many wood types are used and each of these wood types has its particular dimensional stability which may also depend from the cut type.

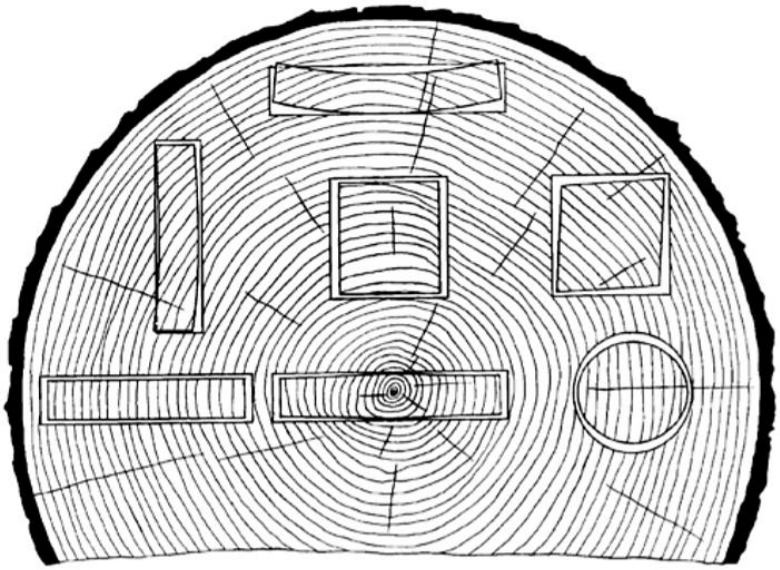

Fig. 2.1: Characteristic form changes of different wood cross sections (Source: Wood Handbook 2010)

Especially for the construction of garage doors where large wooden surfaces are used and for the construction of window shutters, only radial sawn wood should be used (see Fig. 2.1 - bottom left).

With the tangential cut (flat cut) wood bulges when exposed to weathering ("forms cups"), whereby cracks may arise and the coating film may peel off (**Fehler! Verweisquelle konnte nicht gefunden werden.**, **Fehler! Verweisquelle konnte nicht gefunden werden.**). This occurs especially when the left side of the panel is exposed to weathering. Sometimes fissures occur during weathering which have a negative influence on the durability of the coating system.

Fig. 2.2: Crack formation and flaking

Fig. 2.3: Crack formation

A gentle drying of the wood is the main condition for its resistance to the formation of cracks. Some of the wood cracks that occur during weathering and lead to flaking of the coating are often caused by incorrect wood drying.

Nearly all coniferous wood types occasionally show bleeding of resin. Especially with Siberian larch problems can occur. Repairing the bleeding of resin on windows with opaque coating films is only possible by applying a new layer of coat, while on windows with transparent coating films it is possible to remove the dry resin at low temperatures mechanically or with an appropriate solvent (c.f. also chap. 5.15.1 Prevention of resin flow and removal of resin). In principle the bleeding of resin presents no defect, but it is an optical problem (**Fehler! Verweisquelle konnte nicht gefunden werden.**).

Some wood types contain water-soluble wood extracts which may be washed out by rain and contaminate the facade as well as the coating (**Fehler! Verweisquelle konnte nicht gefunden werden.**, **Fehler! Verweisquelle konnte nicht gefunden werden.**, **Fehler! Verweisquelle konnte nicht gefunden werden.**). For these types of wood, our recommended coating systems contain insulating primers.

Fig. 2.4: Bleeding of resin in the knot area

Fig. 2.6: Comparison of the insulating effect of a coating system with and without insulating filler

Fig. 2.5: Discoloration of the coating system due to wood substances

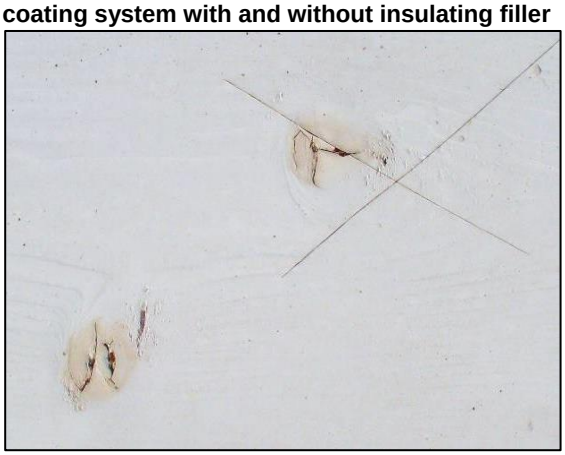

Fig. 2.7: Discoloration of the coating system due to wood substances in the knot area

2.2 Natural durability

The standard DIN EN 350 classifies the types of wood in five resistance classes according to their resistance against wood destroying fungus. As sapwood is generally scheduled in class 5 non resistant, it should not be used for dimensionally stable or limited dimensionally stable wooden construction elements. The following list exclusively concerns heartwood properties. A sapwood content of ≤ 5% does not change the classification. Wood types with a sapwood content of more than 5% generally fall into resistance class 5.

Tab. 2.1: Durability of heartwood according to DIN EN 350

Softwood	
Trade name	**Durabil-ity**
Fir (Silver Fir)	4
Spruce	4
Western Red Cedar	2-3
Hemlock (Western Hemlock)	4

Hardwood	
Trade name	**Durabil-ity**
Chestnut (noble)	2
Oak	2-4
Framiré	2-3
Red Meranti	2-4

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Douglas (Oregon Pine)	3 – 4
Pine (Scots pine)	3 – 4
Larch	3 – 4

Legend:
– high durability
– good durability
– medium durability
– low durability
– no durability

American Mahogany	2
Okoumé	4
Niangon	3
Acajù (Khaya)	3
Teak	1 – 3
Iroko (Kambala, Odum)	1 – 2
Ash	5
Eucalyptus grandis	3 – 4

2.3 Wood moisture

For coating procedures, a wood moisture in the range of 12 +/- 2 % is necessary in order to avoid swelling or shrinking, which can cause damages to the wood and the coating.

2.4 Wood storage

Wood absorbs ambient moisture very quickly, so it must be stored in well-ventilated, air-conditioned rooms and correctly stacked.

2.5 Repair of defects in the wood

Filler areas in outdoor surfaces should be avoided, as they are generally a weak point and can become clearly visible or detached under the coating after longer exposure to weathering. A technically better alternative to a wood-filler on outside surfaces is the positioning of so-called wooden shuttles. Loose knots have to be drilled out and replaced with glued in wood dowels. For repairing knots see also DIN EN 942.

2.6 Pre-treatment of the wood – sanding, planing

Water based impregnations cause the wood surface to be rougher compared to solvent based impregnations. Accurate sanding is therefore particularly important.

For **softwood** usually **grit size 120 or 150** is used**,** for **hard wood grit size 150 or 180.**
Light cross sanding (approx. grit size 280) significantly reduces roughness after impregnation, as the wood fibres are additionally broken. It is very important to use sharp sand paper, because used sand paper presses the wood fibre on the surface instead of cutting it, and the water based impregnation raises the fibre once more. In the worst case, dull sandpaper polishes the wood surface, which leads to adhesion problems of the coating when exposed to weathering. Very smooth and uniform surfaces are achieved by fine planing (hydro planing). If the cutters are too blunt, a very smooth surface is achieved, but the topmost wood cells are destroyed. The absorption of impregnation is reduced and the poorer adhesion of varnish or glaze can lead to flaking when exposed to weathering.

The careful sanding of the wood is of particular importance. The quality of the wood sanding is decisive for the final colour. After sanding, the surfaces must be well dusted.

3 Suitable types of wood and colour shades

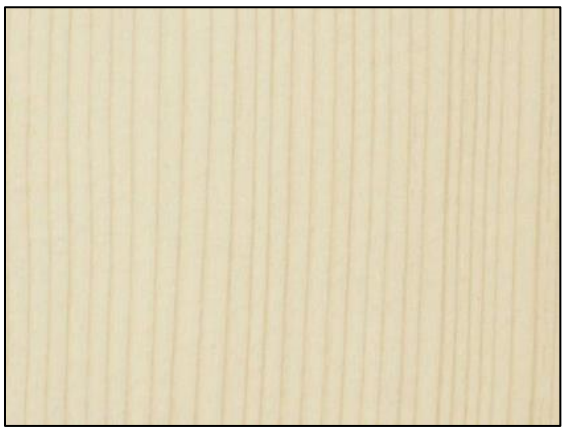
For the selection of the suitable wood species, Tab. 2.1: Durability of heartwood according to DIN EN 350 must be observed.

Colour shade changes of transparent coating systems on wood cannot be avoided when exposed to weathering, but should not become disturbing (assessment analogous to VFF data sheet HO.05). The natural wood colour tone itself has little UV resistance and bleaches strongly when exposed to weathering. This effect does not concern only the wood types Chestnut, Oak and Framiré, but appears especially and considerably on “red wood types” like Meranti, Mahogany etc. A remedy to this problem can be the choice of the colour and certainly the special formulations of the coating system (pigmented impregnation + finishing coat).

Effect and metallic colour shades are generally excluded from the guarantees. In case of covering colour shades the use of an antiheat pigmentation leads to a significantly reduced temperature on the surface in direct sunlight (depending on the colour shade approx. 10 °C – 20 °C). This leads to an increased durability (reduced thermomechanical stress) and significantly lower resin flow in woods rich in resins such as Pine or Larch. Colour shades with anti-heat finish are available from the factory.

3.1 Softwood

3.1.1 Fir (Silver Fir)



Transparent colour shades:
Colour tone combinations can be taken from the current ADLER window colour charts.

Covering colour shades:
All RAL and NCS colour shades.

Fig. 3.1: Fir (Silver Fir)

Coniferous wood type with low resin content and good dimensional stability. Wood drying is difficult. Sometimes brown occlusions may appear (blueing). Well suited for white coating.

3.1.2 Spruce

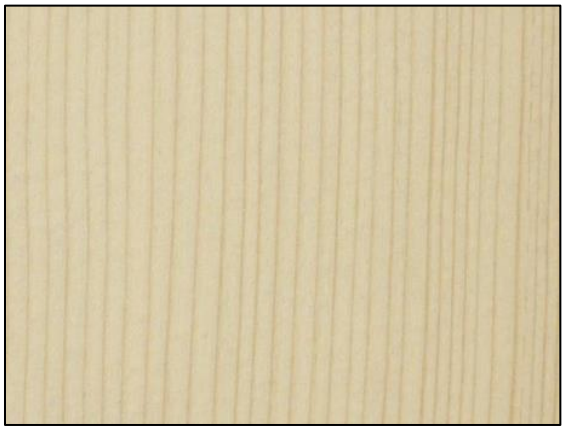


Fig. 3.2: Spruce

Transparent colour shades:
Colour tone combinations can be taken from the current ADLER window colour charts.

Covering colour shades:
All RAL and NCS colour shades.

Good dimensionally stability and low resin content, but occasional occurrence of resin pockets possible. Does not contain coloured wood extractives. Proven suitability for transparent and covering coating systems.

3.1.3 Yellow Pine (Lodgepole Pine)

Fig. 3.3: Yellow Pine (Lodgepole Pine)

Transparent colour shades:
Colour tone combinations can be taken from the current ADLER window colour charts.

Covering colour shades:
All RAL and NCS colour shades.

Moderate resin content, good dimensional stability. The humidity adjustment speed of sapwood is high compared to heartwood and therefore more sensitive to cracking. End grain sealants are particularly important for V-joints.

3.1.4 Canadian Red Cedar (Western Red Cedar)

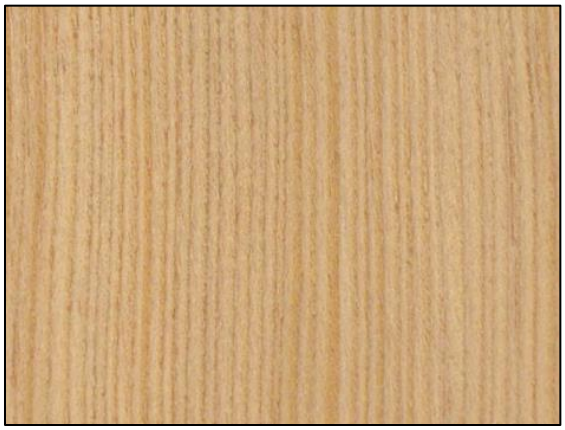
Fig. 3.4: Canadian Red Cedar (Western Red Cedar)

Transparent colour shades:
Colour tone combinations can be taken from the current ADLER window colour charts.

Covering colour shades:
All RAL and NCS colour shades (observe the note regarding light colour shades).

Good dimensional stability. Wood extractives getting in contact with metal cause dark discolorations. Increased risk for washing out of wood extractives. For covering coating systems use insulating fillers. This is absolutely necessary for white and pastel colour shades.

3.1.5 Hemlock (Western Hemlock)



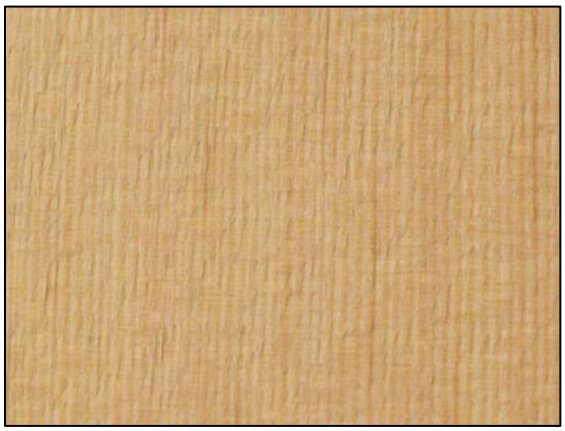
Transparent colour shades:
Colour tone combinations can be taken from the current ADLER window colour charts.

Covering colour shades:
All RAL and NCS colour shades (observe the note regarding light colour shades).

Fig. 3.5: Hemlock (Western Hemlock)

Low-resin, slightly brittle coniferous wood species with good dimensional stability. Sometimes brown cores appear, therefore the use of a insulating filler for white and pastel colour shades is required.

3.1.6 Douglas (Oregon Pine)



Transparent colour shades:
Colour tone combinations can be taken from the current ADLER window colour charts.

Covering colour shades:
All RAL and NCS colour shades (except white).

Fig. 3.6: Douglas (Oregon Pine)

Resin containing coniferous wood with good dimensional stability. Because of the content of resin not suited for covering white coating.

3.1.7 Pine (Scots fir)

Transparent colour shades:
Colour tone combinations can be taken from the current ADLER window colour charts.

Covering colour shades:
All RAL and NCS colour shades (observe the note regarding light colour shades).

Fig. 3.7: Pine (Scots fir)

Resin-containing with medium to good dimensional stability. The humidity adjustment speed of sapwood is high compared to heartwood. Often contains knots having negative influences on the durability of the coating film. Pine presenting a high amount of flat cut wood and knots usually is highly resinous (greasy appearance). Closely ringed pine of Scandinavia and Russia generally has low resin content. Laminated pine without knots is also suited for light covering colour shades, however, an insulating filler is also recommended here.

3.1.8 Larch (Origin/grown in Central and Eastern Europe)

Transparent colour shades:
Colour tone combinations can be taken from the current ADLER window colour charts.

Covering colour shades:
All RAL and NCS colour shades (observe the note regarding light colour shades).

Fig. 3.8: Larch (Central and Eastern Europe)

Resin-containing coniferous wood, a bit brittle. Medium to good dimensional stability (good only in case of laminated square timber!). The ADLER guarantees are valid only for laminated timber and not for solid wood. For covering coating systems use insulating fillers. This is absolutely necessary for white and pastel colour shades.

3.1.9 Larch (Origin/grown in Siberia and China)

Fig. 3.9: Larch (Siberia and China)

Transparent colour shades:
Colour tone combinations can be taken from the current ADLER window colour charts.

Covering colour shades:
All RAL and NCS colour shades (observe the note regarding light colour shades).

Compared to larch from Central and Eastern Europe, the Siberian Larch might contain a higher level of water-soluble wood extractives with acid reaction (“Pinosilvina”, Galakto-arabinose). This can disturb the drying of the coating film and lead to premature cracking. This problem can be avoided to a large extent by respecting our coating system recommendations. In contact with metal, black discolorations appear. For covering coating systems use insulating fillers. This is absolutely necessary for white and pastel colour shades.

3.2 Hardwood

3.2.1 Chestnut (noble)

Fig. 3.10: Chestnut

Transparent colour shades:
Colour tone combinations can be taken from the current ADLER window colour charts.

Covering colour shades:
All RAL and NCS colour shades (observe the note regarding light colour shades).

High durability, but high content of water-soluble, coloured wood substances. The extractives may have an influence on the sagging behaviour of the impregnation and reduce the stability of the impregnation during storage. In contact with metal, black discolorations appear. Such discolorations cannot be excluded also for other hardwood like Oak or Framire with deep pores. For covering coating systems use insulating fillers. This is absolutely necessary for white and pastel colour shades.

3.2.2 Oak

Fig. 3.11: Oak

Transparent colour shades:
Colour tone combinations can be taken from the current ADLER window colour charts.

Covering colour shades:
All RAL and NCS colour shades (observe the note regarding light colour shades).

High durability, but high content of water-soluble, coloured wood substances. The extractives may have an influence on the sagging behaviour of the impregnation and reduce the stability of the impregnation during storage. In contact with metal, black discolorations appear. The tannin content is strongly dependent on the growing area, but is relatively low in American white oak. Red Oak is not suited for window and front door application because of its tendency to form cracks during weathering. For covering coating systems use insulating fillers. This is absolutely necessary for white and pastel colour shades.

3.2.3 Framiré

Fig. 3.12: Framiré

Transparent colour shades:
Colour tone combinations can be taken from the current ADLER window colour charts.

Covering colour shades:
All RAL and NCS colour shades (observe the note regarding light colour shades).

For this rarely used hardwood type, similar preconditions are valid as for Chestnut and especially Oak. Framiré often is used as an alternative to these two wood types. Wood extractives are intensively yellow. For covering coating systems use insulating fillers. This is absolutely necessary for white and pastel colour shades.

3.2.4 Red Meranti

Fig. 3.13: Red Meranti

Transparent colour shades:
Colour tone combinations can be taken from the current ADLER window colour charts.

Covering colour shades:
All RAL and NCS colour shades (observe the note regarding light colour shades).

Excellent wood technology properties with good dimensional stability, very good durability (density from 500 kg/m³) and very low adaption speed to humidity. However, these qualities are only present in "Dark" and "Light" Red Meranti, not in "Yellow" and "White" Meranti, which have much worse qualities. For covering coating systems use insulating fillers. This is absolutely necessary for white and pastel colour shades.

3.2.5 Mahogany

Fig. 3.14: Mahogany

Transparent colour shades:
Colour tone combinations can be taken from the current ADLER window colour charts.

Covering colour shades:
All RAL and NCS colour shades (observe the note regarding light colour shades).

American, Sapelli and Sipo mahogany all have excellent durability, dimensional stability and low adaption speed to humidity. For covering coating systems use insulating fillers. This is absolutely necessary for white and pastel colour shades.

3.2.6 Okoumé

Fig. 3.15: Okoumé

Transparent colour shades:
Colour tone combinations can be taken from the current ADLER window colour charts.

Covering colour shades:
All RAL and NCS colour shades (observe the note regarding light colour shades).

The durability and the dimensionally stability is good, despite of its relatively low density of approx. 450 g/cm³. The content of water-soluble wood extractives is relatively low. For covering coating systems use insulating fillers. This is absolutely necessary for white and pastel colour shades.

3.2.7 Okoumé multilayer

Fig. 3.16: Okoumé multilayer

Transparent colour shades:
Colour tone combinations can be taken from the current ADLER window colour charts.

Covering colour shades:
All RAL and NCS colour shades

The Okoumé panels have to meet at least gluing class 3 according to WATT 91. The glues should be based on melamine resins. If phenolic glues (dark coloured) are used, white leaching of soda is possible. This is an optical inconvenience, but can be removed by wiping with water.

For multilayer Okoumé panels no rotary cut veneer must be used. Unfortunately, the resistance against cracking during weathering of multilayer bonded okoumé panels varies and is practically invisible before coating. This characteristic can only partially be positively influenced by a coating.

3.2.8 Niangon

Fig. 3.17: Niangon

Transparent colour shades:
Colour tone combinations can be taken from the current ADLER window colour charts.

Covering colour shades:
All RAL and NCS colour shades (observe the note regarding light colour shades).

Excellent durability, dimensionally stability and low adaption speed to humidity. Niangon can be rich of greasy (oily) wood extractives which can deteriorate the adhesion of the coating system. Starting coating immediately after sanding minimizes this effect. Furthermore the content on water-soluble wood extractives normally is very high. Therefore, coating in light opaque colours is only possible with solvent-based 2-component primer.

3.2.9 Acajù (Khaya)

Fig. 3.18: Acajù (Khaya)

Transparent colour shades:
Colour tone combinations can be taken from the current ADLER window colour charts.

Covering colour shades:
All RAL and NCS colour shades (observe the note regarding light colour shades).

Excellent durability, dimensionally stability, low adaption speed to humidity and good coatability. Contains no greasy wood extractives, but a high amount of coloured water-soluble wood extractives. Therefore, coating in light opaque colours is only possible with solvent-based 2-component primer.

3.2.10 Teak

Fig. 3.19: Teak

Transparent colour shades:
Colour tone combinations can be taken from the current ADLER window colour charts.

Covering colour shades:
All RAL and NCS colour shades (observe the note regarding light colour shades).

Excellent wood technological properties, but due to the very high price of wood only rarely used in window construction. Similar like Niangon, Teak can be rich of greasy (oily) wood extractives which can deteriorate the adhesion of the coating system. Starting coating immediately after sanding minimizes this effect. Furthermore the content on water-soluble wood extractives normally is very high. Therefore, coating in light opaque colours is only possible with solvent-based 2-component primer.

3.2.11 Iroko (Kambala, Odum)

Fig. 3.20: Iroko (Kambala, Odum)

Transparent colour shades:
Colour tone combinations can be taken from the current ADLER window colour charts.

Covering colour shades:
All RAL and NCS colour shades (observe the note regarding light colour shades).

This African wood has very good durability and dimensional stability, but contains mineral inclusions and wood substances that interfere with the filming of water-based varnishes and can lead to cracking. Solvent-based alkyd paints and varnishes are inhibited in their drying mechanism.

3.2.12 Ash

Fig. 3.21: Ash

Transparent colour shades:
Colour tone combinations can be taken from the current ADLER window colour charts.

Covering colour shades:
All RAL and NCS colour shades (observe the note regarding light colour shades).

Because of its very good mechanical properties it is used for special applications like avalanche protection windows. For covering coating systems use insulating fillers. This is absolutely necessary for white and pastel colour shades.

3.2.13 Eucalyptus grandis

Fig. 3.22: Eucalyptus grandis

Transparent colour shades:
Colour tone combinations can be taken from the current ADLER window colour charts.

Covering colour shades:
All RAL and NCS colour shades

The quality of Eucalyptus strongly depends on the growth region. Good properties are represented by Eucalyptus Grandis grown in Brasil (plantations). Qualities with a density of more than 600 g/m³ are sold under the trade name Lyptus. Unfortunately other qualities of eucalyptus are on the market with a great tendency to formation of cracks during weathering.

3.3 Modified wood types

3.3.1 Thermowood (heat treated wood)

The wood modification of thermo wood is achieved by heating to temperatures of approx. 180 °C under exclusion of oxygen. Depending on the used timber and according to the processing the best class of durability, class 1 as per EN 350, can be reached. The water absorption of Thermowood is considerably reduced. A setback of mechanical wood properties (tendency to embrittlement) must be accepted. The thermal treatment results in an optically attractive brown colouring, which unfortunately is not UV-stable. For transparent coating systems which need stable coloration, good pigmented shades of impregnation must be used, preferably adapted to the colour of the used wood. If wooden construction elements made of thermal treated wood are exposed for a long time to humidity, permanent discolorations appear. As base for thermal treated wood different species of wood are used like Poplar, Beech, Pine,

Spruce, but also Ash. Therefore it is not possible to give general declarations about the adhesion of water based coating systems and the aptitude for windows, front doors and window shutters. Application tests by ADLER-Werk are possible.

3.3.2 Accoya®

The wood modification in Accoya®, a process patented by Titan Wood BV, Arnhem, consists in the acetylation of the wood species Pinus radiata (chemical reaction with acetic anhydride at elevated pressure/temperature). In this way the best durability resistance class 1 according to EN 350 is reached. The density is significantly increased and the colour stability of the original wood species is significantly improved when exposed to weathering.
Tests of accelerating weathering on transparent coating systems exhibit very good results. Due to the low water absorption of Accoya® there is only a very slight roughening of the wood fibres during impregnation. This considerably reduces the effort required for intermediate sanding. In single cases a low odour from traces of acetic acid of Accoya® may disturb. Corrosion-resistant fitting parts must be used for safety reasons (we recommend asking your fitting manufacturer).

4 Constructional requirements and installation recommendations

4.1 General advice

4.1.1 Edges

All edges must be rounded at a minimum radius of 2 mm because all coating material shows an “alignment of the edges”. Only a rounding of 2 mm guarantees a coating layer of 90 % of the coating thickness as on the surface (**Fehler! Verweisquelle konnte nicht gefunden werden.**).

4.1.2 Inclination of profile surfaces

Horizontal profiled surfaces must have a minimum inclination of 15 ° in order to prevent water accumulation that could damage the coating film. Fig. **Fehler! Verweisquelle konnte nicht gefunden werden.**:

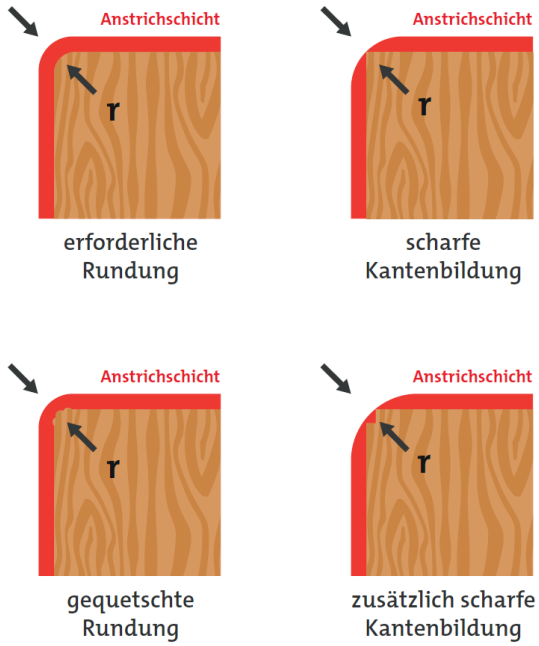


Fig. 4.1: rounding of edges

4.1.3 Description window profile

When purchasing new tools, care should be taken to ensure that all external edges are rounded by at least 2 mm. It is important that the roundings extend into the surface.

The inclination of the drainage slants must be at least 15°.

There should be a gap of approx. 1 mm between the outer sash surface and the frame stop or the weather protection rail.

The drip zone above the weather protection rails should be 7 mm wide.

The distance between outer and inner web of the weather protection rails should be at least 17 mm.

The contact area of the sealing is 12 mm.

The weather protection rail must be sealed at the ends inside the gutter.

The weather protection rail must be sealed at the ends below the weather protection rail.

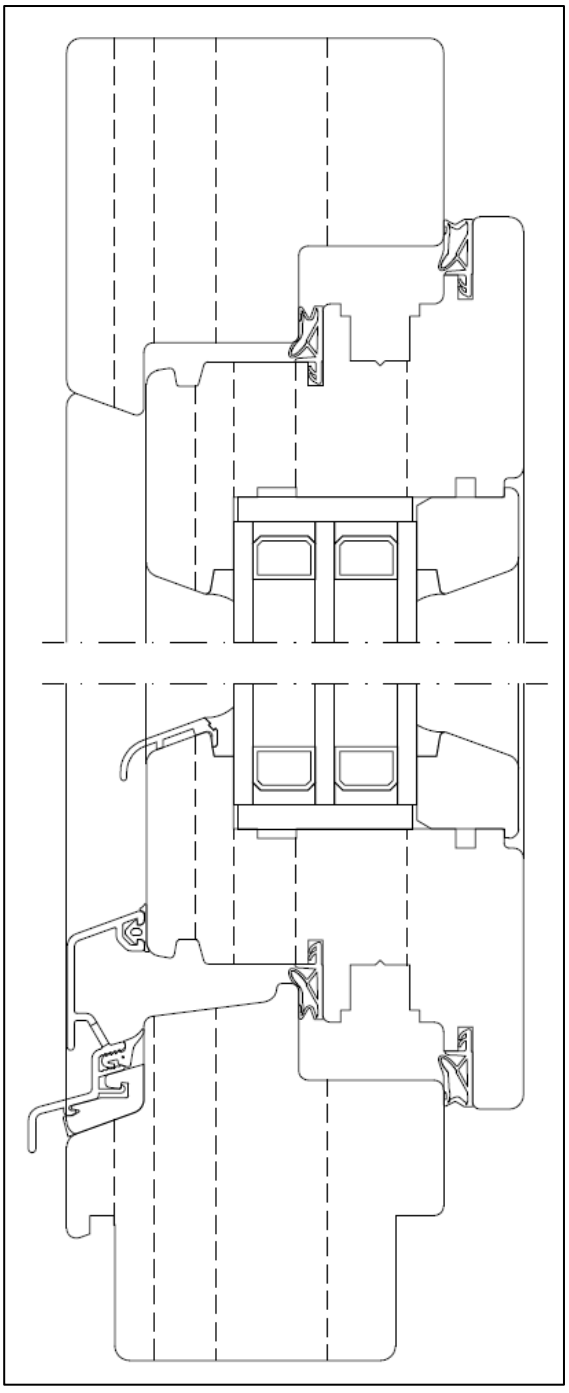


Fig. 4.2: window profile

4.1.4 Aluminium profiles as weathering protection

Especially the lower crossbars of windows are exposed particularly strong to UV radiation, rain or hailstorm. The use of aluminium profiles in these places ensures a significantly longer durability of windows and doors and their coating (**Fehler! Verweisquelle konnte nicht gefunden werden.** and **Fehler! Verweisquelle konnte nicht gefunden werden.**).
The use of aluminium profiles is necessary for the validity of ADLER guarantees.

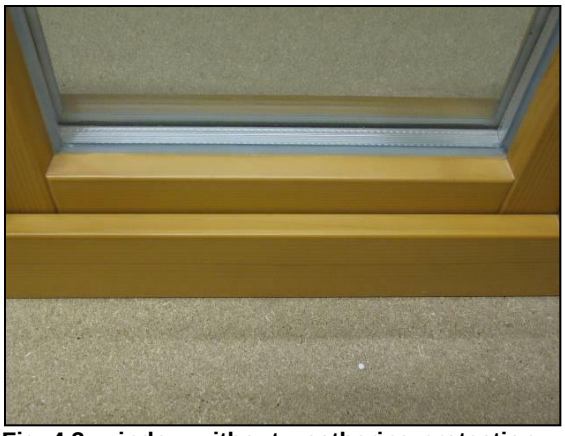


Fig. 4.3: window without weathering protection

Fig. 4.4: window with weathering protection

4.1.5 Characteristics of joints

Between the horizontal and vertical crossbar a joint exists due to the construction. During weathering, this joint can open up and water can penetrate into the wood, causing wood damage and, as a consequence, flaking of coating (**Fehler! Verweisquelle konnte nicht gefunden werden.** and **Fehler! Verweisquelle konnte nicht gefunden werden.**).

Fig. 4.5: Damage in the joint area

Fig. 4.6: damage in the joint area

Perfect gluing with sufficient application quantity (chap. 4.1.6) is the most important measure to prevent the joints from opening.
Through application technology it is possible to minimize this problem by rounding the wood in this area with radius of 2 mm. This makes it possible to impregnate and coat very well, so that water protection is considerably improved.

Treat joints and cross-grained wood sections with ADLER V-Fugensiegel 55630 ff. The joint areas of muntins (window grilles) must be impregnated on the individual part before installation and treated twice with ADLER Hirnholzversiegelung (end-grain wood sealant).

4.1.6 Gluing

For dimensionally stable and limited dimensionally stable wood construction elements only a glue of minimum class D3 may be used, better class 4D as per EN 204. The glue has to be tested according to WATT-Test 91. The processing instructions of the glue manufacturer must also be observed.

4.2 Windows

4.2.1 Sealing of the glass

Both on the inside of the window, where the glazing bead is applied, and on the outside of the window there must be a groove of 4 x 4 mm or 3 x 3 mm into which the sealant can be applied. Constructions without groove for the sealant are not professional and cannot be accepted by ADLER.

Generally, the glazing bead is subject to a high humidity stress if condensation forms and must therefore be sufficiently coated and sealed. The coating additionally creates the good adhesive bond to the sealant. Only sealants certified according to DIN EN ISO 11600 may be used.

After filling the silicone into the groove, it is sprayed with smoothing agent and levelled.

4.2.2 Glazing beads

Glazing beads must be sealed to the frame either with a gasket or with a sealant in order to optimise moisture protection. Glazing beads must be coated on all sides according to window standards (e.g. ÖNORM B 3803 and ÖNORM C 2350).

4.2.3 Installation

For the installation of windows, the Information brochure from the German RAL- Gütegemeinschaft Fenster und Haustüren e.V.: “Leitfaden zur Planung und Ausführung der Montage von Fenstern und Haustüren (Guideline for the Planning and Execution of the Installation of Windows and Front Doors)” should be noted. Installation and connection to the construction must be carried out in accordance with the state of the art.
The technical instructions of the manufacturers of exterior window sills must be observed. The water drainage to the outside must be ensured. For this purpose, a drain inclination of at least 5° must be maintained. Only systems that have been tested for driving rain tightness up to at least 600 Pa should be used.

4.2.4 Installation position of the windows

The minimum installation depth is 8 cm. If the window is installed with less depth or even to the facade, it is considerably more exposed to weathering and therefore the time interval for the maintenance is reduced. This can be remedied by using aluminium profiles on the lower crossbar or by cladding the entire outer surfaces with aluminium profiles.

4.3 Front doors and garage doors

In order to minimize the tendency to warp, wooden front doors and garage doors are increasingly made from raw multilayer boards. Often intermediate layers of aluminium are used as diffusion barrier and for burglary protection. Waterproof glued MDF and phenolic resin blanks are also frequently used in modern front door construction.

The constructional requirements with the edge rounding of at least 2 mm and the inclination of horizontal surfaces by at least 15° for faster water drainage are the same as for window profiles. A special feature of weathered front doors and garage doors is the requirement of constructive protection of the lower area against splash water up to a height of 30 cm. For this purpose, metal sheeting is used and also horizontal grids above water drains (more common for garage doors).

Attachments such as fillings and battens must be coated on all sides before installation. Millings in more absorbent substrates (intermediate layers or MDF) as well as edges are to be

protected against water penetration with an additional coat (e.g. 2K-Epoxi-Grund 68304 f or ADLER Hirnholzversiegelung 55621 f). An installation depth of at least 10 cm from the facade must be maintained.

5 Processing instructions for water-based wood coatings

5.1 Dry film thickness

In the most important national window standards such as ÖNORM B 3803 and ÖNORM C 2350 or the VFF data sheet HO.03, layer thicknesses between 80 µm (transparent) and 100 µm (opaque) dry are recommended for wooden windows coated by the manufacturer. These film thicknesses are reached by our standard coating cycles. A variation is possible for certain applications like e.g. wood-aluminium windows or products of special formulation, but only in accordance with the company ADLER.
Too high film thicknesses from approx. 120 µm dry increase the risk of flaking and cracking.

5.2 Intermediate sanding

Water-based wood varnishes generally have a very good grindability. Usually the intermediate sanding is done with grit size 220 – 280.

Because of the thermoplastic property of water-based wood varnishes a too strong grinding pressure (and a therewith mostly combined temperature rising) should be avoided.

As protection against grinding and wood dust during the sanding procedure, we recommend a dust filter minimum P2 as personal protection equipment. In case of hardwood (especially Oak) a dust filter P3 is recommended. However, priority is given to the installation of a suction apparatus.

5.3 Blocking resistance

Under certain conditions (e.g. high temperature and pressure), coating systems for outdoor applications tend to block. All ADLER coating materials have been formulated to avoid this in the best possible way. The excellent blocking resistance is regularly controlled and confirmed by independent institutes.

Precautions should be taken to prevent blocking of coated workpieces during the production process or during assembly. By use appropriate distance holders (spacers) made from PE soft foam the problem can be solved. Spacers or foils containing plasticizers must not be used because of the risk of marks and pull-outs. The compatibility must be checked in advance.

5.4 Film formation

For water-based coatings, finely in water dispersed synthetic resins based on polyacrylate and polyurethane are mainly used as binders. The film formation of such dispersion lacquers happens only without defects, if a certain minimum processing temperature is respected. This temperature must be over the minimum film formation temperature (MFT) of the dispersion lacquer in question.
The temperature of the product and object, and the room temperature must be at least +15 °C. If the coating is applied at lower temperatures, poorer mechanical and chemical resistance results; possibly even fissuring can appear.

5.5 Pot Life

When using two component water-based varnishes the hardener must be incorporated carefully into the painting component by stirring. After addition of hardener, a waiting time of approx. 10 min is recommended for improved degassing. Mixed material can be processed for a few hours; after this time application, however, is no longer possible (cr. technical data sheet!). Do not close containers with hardened material.

The paint/hardener mixture not always presents gelling or cloudness after exceeding pot life. After this time a varnish might also contain dissolved, crossed-link substances, which will conduct to cloudness, once the paint-film has dried. Therefore please respect the pot life indication in the relative technical data sheets.

Deviations to the indications in the relative technical data sheets regarding temperatures, atmospheric/substrate humidity can conduct to a reduced pot life.

5.6 Compatibility

Water-based coatings must not be mixed with traditional solvent-based coatings or thinners, because they are not compatible as liquids.

5.7 Cleaning the working equipment

In principle, only non-corrosive tools are to be used for water-based coating applications. If solvent-based paints were previously used in the application equipment to be used (spray guns, casting machines, etc.), a thorough cleaning is necessary before using a water-based wood coating. We recommend, to clean first with nitrocellulose or polyurethane thinner and to rinse afterwards with acetone. Then rinse with tap water till all solvent residues are removed. If solvent-based products are used again after the application of water-based paints, the cleaning work must be carried out in the reverse order (1st water, 2nd acetone, 3rd nitro or PUR thinner).

Application equipment should be rinsed thoroughly immediately after finishing work with tap water and then with ADLER Aqua-Cleaner 80080, diluted 1:1 with water. In case of heavy contamination it is advisable to act overnight with Aqua-Cleaner (80080), diluted 1:1 with water. Residues of swelled water-based coats can then be easily removed then using a grinding fleece. Cleaning of heavily contaminated work equipment can be done with acetone.

5.8 Drying

High levels of atmospheric humidity (more than 60 % relative air humidity) and low temperatures (below 20 °C) increase the drying time considerably! For good through-drying of water-based coated surfaces, sufficient removal of the water vapour produced during the drying process is necessary; this requires dryers with well-functioning ventilation. For stacking coated work pieces after drying, tailored spacers made from PE-foam are very well suited.
We recommend PE hoses as covers for the deposit bars of tray trolleys. Due to their plasticizer content, PVC hoses are not suitable for freshly water-based coated surfaces.

5.9 Spraying stations

For the application of water-based wood coatings dry spray walls are suited as well as water rinsed spray walls.

In case of wet separation, a suitable circuit water treatment is necessary. This cannot be arranged without a certain investment for the spraying station. Coagulating agents adapted to the processing with water-based coatings have to be used.

5.10 Explosion prevention

The flash point of most water-based coatings is over 55 °C. Thus, the observance of the directives for explosion prevention in the respective coating rooms would be invalid. Since solvent-based thinners will continue to be used for cleaning purposes in the future, or products based on alcohol (flash point below 21 °C) could be used for processing, we recommend in principle that electrically operated systems in coating rooms and the illumination should be explosion-proof.

5.11 Waste disposal

Water-based paint residues and cleaning water must never be disposed of directly into the sewerage system, but must be handed over to a special waste collector for correct disposal in the same way as paint sludge from waste water treatment plants.
Water-based paint residues and paint sludge from waste water treatment plants must be collected separately from other wastes and marked or disposed of with the following key numbers:

List of wastes, Decision 2000/532/EG on a list of waste

08 01 11x Waste paint and varnish containing organic solvents or other dangerous substances

15 01 10x Packaging containing residues of dangerous substances or contaminated by dangerous substances

List of wastes (ÖNORM S 2100)

55503 Paint and varnish sludge.

Dust of water-based and solvent-based varnishes from a dry spraying station can also be disposed as industrial waste after having consulted the waste disposal contractor.

Note:
Please observe the relevant national or regional regulations. Waste must be separated in such a way that it can be treated separately by municipal or national waste facilities.

5.12 Storage

Because of their chemical composition and the high flash point, water-based varnishes are not subject to the “Decree about inflammable liquids – VbF”, BGBl. No. 240/1991. Nevertheless, electric installations in storage rooms should be equipped according to the protection class IP 54. The floor of storage rooms must be liquid-tight, because water-based varnishes mostly are classified in the water hazard class 1 (WGK 1); the permission of the local authorities for the storage room is necessary.

Water-based coatings must be frost-protected during storage. Aqua-PUR-Härter in particularly presents a limited storage life. Permeable containers can lead to a varnish and/or hardener which is/are no longer faultless. For that reason they cannot develop their full properties anymore. Therefore, always seal opened containers well and process as soon as possible.

5.13 Sanitary protection

Processing with water-based varnishes, similar working hygiene measures like for solvent-based varnishes must be observed. Generally the inhalation of aerosol particles from water- and solvent-based varnishes must be avoided. This is ensured by correctly using a breathing mask (combination filter A2/P2).
The residual solvents used in water-based wood varnishes (prevalently below 10 % by weight) usually have a very low MAK-value, nevertheless because of their low vapour pressure during proper processing it is not possible to reach concentrations in the air, which are of toxicological concern.
This is certainly an advantage compared to solvent-based coating systems, where the observance of the MAK-value always presents a major problem.

As protection against grinding and wood dust during the sanding procedure, we recommend a dust filter minimum P2 as personal protection equipment. However, priority is given to the installation of a suction apparatus.

The further treatment / removal of paint layers such as grinding or burning off, etc. can cause dangerous dust and vapours. Always carry out with good ventilation and if necessary with appropriate protective equipment.

Please follow our **ARL 071 - Working guideline regarding respiratory protection.**

5.14 Remaining emissions of coatings

Even coating films of parts freshly treated with water-based coatings always contain a small amount of residual solvents ("film forming aids"). Usually these solvents are emitted to the room air during the first months of use.

The period until these low concentrations of solvents disappear, depends on the local conditions and especially on the practice of ventilation by the user. The solvent concentrations occurring in the room air do not present any danger or health risk to the resident, due to their low concentration. In some rare cases, mixed cycles composed by solvent-based primer and water-based top coats are recommended. In these cases the following points must be observed:

The degree of residual solvent enclosed in a coating film at the beginning is decisively influenced by the processing method. The content is low, if the applied quantity of the coating

material corresponds to the technical data sheets and the coated surfaces are dried at an intermediate drying time during one night at good ventilation (room temperature 20 °C).

The following parameters delay the emission of solvents:

- High coating thickness of the single film layers
- Short intermediate drying time
- Low room temperature during the processing and the drying
- Low air renewal rates with low fresh air percentage during drying
- Quick assembling after coating

In order to keep the content of residual solvent as low as possible and to avoid odour claims due to the emission, we recommend to store the coated elements open before installation for 5 to 7 days at room temperature (approx. 20 °C) in a very well ventilated room.

5.15 Advices and tips

5.15.1 Prevention of resin flow and removal of resin

Resin as a natural wood component is present in some coniferous species of wood like Pine, Larch or Douglasie in substantial quantity. In the case of dark transparent and opaque shades, resin release can occur, which can lead to premature cracking and flaking of the coating. To prevent the resin from penetrating through, the coating process should be carried out as soon as possible after sanding.

Under no circumstances may cleaning agents containing alcohol, other solvents or abrasives be used for removal. To remove the liquid or already hardened resin from the surface, two possibilities exist without causing damages to the surface:

- Remove mechanically liquid resin, e.g. using a little spoon. Then clean this area with ADLER Entharzer Verdünnung 80330 and apply ADLER Top-Care 7227000210 .
- Hard resin can be easily removed in winter time. At temperatures around 0 °C natural resins are very brittle and can easily be removed without residues e.g. using a plastic spatula. Alternatively, in warm ambient temperatures, the resin can be cooled down using ice spray. Then apply at warm temperatures from 15 °C ADLER Top-Care 7227000210.

The penetration of resin on windows surfaces, coated with opaque coating systems, causes yellowing. This effect remains visible even after removing the resin. For windows coated with opaque coating systems, only species of wood having a low content of resin are recommended. Dark colour shades (transparent or opaque) have more resin flow due to the higher surface temperatures. To prevent this, special anti-heat pigments have been developed for dark colours, which reduce the surface temperature and thus minimise resin flow.

For the following colour shades the use of an anti-heat finish, which leads to a significantly reduced surface temperature in direct sunlight, is recommended. Therefore thermally induced damage caused by deformation can be avoided. Colour shades with anti-heat finish are available from the factory.

Tab. 5.1: Available anti-heat shades:

RAL 3007 Schwarzrot	RAL 6022 Braunoliv	RAL 7043 Verkehrsgrau B
RAL 3009 Oxidrot	RAL 6025 Farngrün	RAL 8000 Grünbraun
RAL 5000 Violettblau	RAL 6028 Kieferngrün	RAL 8002 Signalbraun
RAL 5001 Grünblau	RAL 7002 Olivgrau	RAL 8003 Lehmbraun

RAL 5003 Saphirblau	RAL 7003 Moosgrau	RAL 8007 Rehbraun
RAL 5004 Schwarzblau	RAL 7005 Mausgrau	RAL 8008 Olivbraun
RAL 5008 Graublau	RAL 7006 Beigegrau	RAL 8011 Nussbraun
RAL 5011 Stahlblau	RAL 7008 Khakigrau	RAL 8012 Rotbraun
RAL 5013 Kobaltblau	RAL 7009 Grüngrau	RAL 8014 Sepiabraun
RAL 6003 Olivgrün	RAL 7010 Zeltgrau	RAL 8015 Kastanienbraun
RAL 6004 Blaugrün	RAL 7012 Basaltgrau	RAL 8016 Mahagonibraun
RAL 6006 Grauoliv	RAL 7013 Braungrau	RAL 8017 Schokoladenbraun
RAL 6007 Flaschengrün	RAL 7016 Anthrazitgrau	approx. RAL 8019 Graubraun
RAL 6008 Braungrün	RAL 7021 Schwarzgrau	RAL 8022 Schwarzbraun
RAL 6012 Schwarzgrün	RAL 7022 Umbragrau	RAL 8028 Terrabraun
RAL 6013 Schilfgrün	RAL 7024 Graphitgrau	RAL 9004 Signalschwarz
RAL 6014 Gelboliv	RAL 7026 Granitgrau	RAL 9011 Graphitschwarz
RAL 6015 Schwarzoliv	RAL 7031 Blaugrau	RAL 9017 Verkehrsschwarz
RAL 6020 Chromoxidgrün	RAL 7039 Quarzgrau	

5.15.2 Formation of white spots on surfaces whet from rain

Complete curing of water-based coatings with thick-layer application takes at least 4 weeks at room temperature and normal humidity. But, windows and doors usually are installed much earlier. Therefore, after heavy rainfalls white spots may appear. But these spots disappear completely after drying. This effect has no influence on the protection function of the material. When the varnish is completely cross-linked, this effect will not happen anymore.

5.15.3 Abrasion of pigments from opaque coated windows

If cleaning of opaque coated windows is done with the ADLER Top-Cleaner 51696, it is possible that the cleansing cloth takes slightly colour from the pigments of the coating film. This is not a reason for complaint, as can be seen from the following explanations.

Pigment abrasion can be caused by spray dust (e.g. processing at too low humidity, spray nozzle too small) or contamination by dust at the construction site (abrasive effect during cleaning).
Through cleaning with ADLER Top-Cleaner 51696, the loose contamination is removed and then any micropores are sealed with ADLER KH-Pflegemittel 50021. This ensures perfect weather resistance and durability.

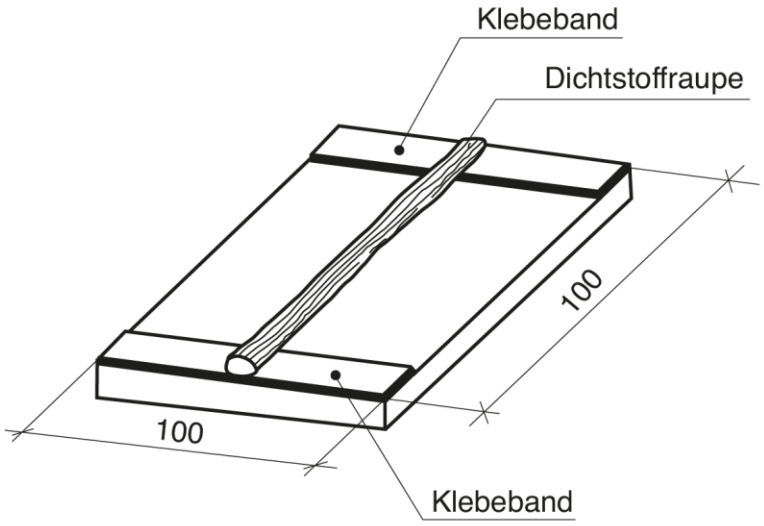
5.15.4 Service and maintenance of ADLERMix color dispenser

Please observe our **ARL 800 - Working guideline for working (including care and maintenance) with ADLER Mix, PUR Mix and Color4You dosing machines** regarding the tinting of colour shades.

Please follow the indications in the technical data sheets and in the safety data sheets.

6 Sealants

A test sample will be treated with the complete coating system. After a drying time of 5 days, an adhesive tape is applied to the surface of the coated specimens on both edges.
A sealant bead with a width of 5 mm to 10 mm is then sprayed on freely and smoothed so that the sealant is as flat as possible and has a thickness of about 5 mm (see figure below). The samples are then stored for 5 days.



For the test, the adhesive tapes are removed after drying, the sealant bead is gripped at both ends and pulled off the coating at right angles.
The sealant and the coating are considered compatible if the breakage occurs in the sealant during the peeling process. Ensure that neither the sealant is completely detached from the coating surface nor that the coating and sealant can be removed from the substrate. The sealant should not cause discoloration of the coating (see ÖNORM B 3803).

7 Surface defects

The subject of surface defects is explained in detail in our **ARL 011 - Working guideline for surface defects.**

8 Winter construction damage

In the cold season the temperature difference also causes a difference in the water vapour pressure between the inside and outside. The humid air has the tendency to get outside, so the window is more stressed from the room side. Damage occurs mainly in new buildings, because enormous quantities of water are brought in through the processed construction materials.
Even when replacing old windows, damage can occur if they are not installed properly or if ventilation is poor. "Targets" for the vapour pressure load are the joints in the area of the building structure connections, the glazing rebate and in the edge area of the insulating glass panes as well as in the rebate between sash and frame. When the room temperature is below the dew-point, condensed water is formed there.

Longer exposure times of wooden windows to condensed water leads to penetration of moisture into the profiles and to the following modes of failure:

- Swelling of the wood
- Offset in the area of the corner joints
- Deformation of window elements
- Removal of the coating in outdoor areas
- Possible infestation by wood-destroying fungi (with extreme moisture stress - wood moisture over 30%)
- Possible mold infestation
- Discoloration

Damage caused by excessive moisture is in no way attributable to our coating systems, but represents a general problem.

There are three basic points regarding the most important question of how to avoid such damage:

1. **Correct ventilation**
2. **Correct window installation in terms of construction physics**
3. **Prevention / Drainage of condensed water in the window construction**

To 1. Correct ventilation
This can be done manually or through automatic ventilation systems (see chap. 9 Correct ventilation).

To 2. Correct window installation in terms of construction physics
The best document available at present is the brochure “Guideline for the planning and execution of the installation of windows and front doors for new buildings and renovation", available from RAL-Gütegemeinschaft Fenster und Haustüren. It emphasises the importance of 3 separate functional levels (separation of room and outdoor climate, functional level for acoustic and thermal insulation and the functional level of weather protection). The construction connection joint must be protected against stress from the outside and the side of the rooms. The construction must be designed such that it is airtight all around on the room side. Any air flow from inside of rooms to the outside must be eliminated. The separation of indoor and outdoor climate must be made more vapour diffusion-tight than that of weather protection.

It must take place at a level whose temperature is above the critical temperature for mold formation. Based on a normal room climate of e.g. 20 °C, 50 % relative humidity, this temperature is 12.6 °C according to recent findings. This prevents the formation of condensation on room-side surfaces. Determination of the optimum installation position either by calculating the isothermal curve or, for example, using the planning and implementation examples in DIN 4108

Supplement 2. Window - joint - wall must be seen as a complete system and this must be realised according to the principle "tighter inside than outside". The rain tightness of the external weather protection level must be ensured and it must be possible to drain off any moisture that has penetrated inside in a *controlled* manner. In addition to the basic principles of construction physics, the guide covers the practical implementation of installation and sealing.

To 3. Prevention / Drainage of condensed water in the window construction
For this purpose, the following protective measures can be implemented according to the current state of knowledge:

- Compliance (not exceeding or reducing) of the required layer thicknesses when applying varnish or glaze, even in the often neglected rebate areas. Coating of the glazing bead on all sides.
- Use of multi-layer coating systems with increased moisture protection instead of simple two-layer coating systems.
- Sealing of the glazing bead with a special silicone, such as the Glasleistenfüller 490 from Ramsauer or OTTOSEAL® S 112 from Otto Chemie. These products allow glass replacement without destroying the battens (application in the shadow groove of the sash).
- Use of multi-pane insulating glass with high-quality spacers (e.g. foam). This allows higher temperatures to be reached at the edges and reduces the risk of condensation.
- Use of thermally insulated weather protection rails to avoid a thermal bridge and thus the danger of condensation in the rebate between sash and frame.

9 Correct ventilation

In the past, constant ventilation of living spaces was not necessary. Ventilation simply happened "by the way" through leaky windows, joints and gaps. However, these leaks also meant high energy and heat losses and thus caused higher heating costs.

On the other hand new constructions and renovated buildings are characterized by a very good thermal insulation, leak-proof windows and constructions built without thermal bridges. Therefore the heat remains in the room. The insulating effect of modern wooden windows also is much better than before. Condensation often forms on the insulating glass of the window, which is provided with the best U-value. Drops can run down it and cause mold infestation in living rooms and bedrooms.

When new buildings and conversions dry out, enormous quantities of water vapour escape from interior plaster and screed. But also the formation of humidity by the inhabitants is a natural process. This effect in form of vapour is especially visible in bath rooms or in the kitchen during cooking. Residents also “steam” continuously “, but this is not visible. A human body “evaporates” about 1 litre a night! If air is moist in inside spaces, formation of condense water can happen. So the risk of mold formation is rising.

Wrong ventilation or absence of aeration impacts the indoor climate and consequently the quality of life in the indoor space. Humidity, dust or harmful substances can accumulate in living rooms and influence the comfortable feeling in the own four walls or have a negative effect on health. Too low ventilation exchange rates cause a higher carbon dioxide content and symptoms of fatigue and reduced ability to concentrate.

A key condition for a high air quality and therefore a high quality of life is sufficient and regular air ventilation. Furthermore, the correct ventilation helps to economise energy and is environmental friendly. Because fresh and dry air more quickly warms up than air containing a high level of humidity.

9.1 Types of ventilation

- Cross ventilation: Type of ventilation in winter. 1 – 5 minutes, 3 – 4 times per day, if possible opposed windows and doors of a room at once.
- Shock ventilation: Type of ventilation in winter, if cross ventilation is not possible. 5 – 10 minutes, 3 – 4 times a day open completely one window or one door of a room.
- Tilt window: Type of ventilation in summer. In winter, this method results in too little air exchange and leads to high energy losses if the window is permanently tilted. The walls in the upper part of the lintel also cool down. Condensation water forms and subsequently mold.

More operating comfort offer automatic ventilation systems. Sensors measure the air humidity and the carbon dioxide concentration. Electro-mechanical ventilation elements open and close the windows when necessary. The window ventilators can be ordered for new windows by the window producer or also be installed as after-market equipment. By heat recovery, the loss of energy is as low as possible. According to the financial possibilities, a networking with the building systems and the heating regulation can be installed, in order to avoid heating during the ventilation phase and as a result the loss of energy.

9.2 Tips for correct heating & ventilation

- For hygienic air conditions all 2 – 3 hours ventilation is recommended.
- If it is possible cross ventilation through 2 openings should realized.
- The duration of the ventilation depends on the season. In principle, it can be said: the lower the outdoor temperature, the shorter can be the time of ventilation! Cold air from outside contains only very low humidity and absorbs high quantities of humidity by heating.
- Depending on the season, the relative humidity in the apartment should not exceed 60% in summer and 40% on cold winter days (please observe the relevant country-specific guidelines).
- Rooms should be warmed up sufficiently (approx. 20 °C). Do not allow temperatures to fall below 18 °C - even in seldom used rooms.
- Close doors between rooms with different temperatures.
- Ventilate the bath room immediately after having a shower or a bath. Close the door while having a shower.
- Close the door while cooking (use the cooker hood).
- Ventilate more frequently rooms used for drying laundry. Do not dry laundry in living rooms.
- If possible, avoid humidifiers, indoor fountains or aquariums.

Please refer to ÖNORM B8110-2 and our brochure "Correct ventilation".

10 Standards and Directives for window construction

The durability of window coating materials not only depends on the quality of the coating itself and its processing, but also on the observation of the following criteria and their valid standards and guidelines:

1. **Window construction / Test and classification standards / General**
2. **Wood quality**
3. **Coating**
4. **Glazing/sealants/sealing profiles**
5. **Installation**
6. **Maintenance and care**

to 1. Window construction / Test and classification standards / General

ÖNORM B 5300	**Windows, Requirements – Amendments to ÖNORM EN 14341-1, Edition November 2007**
ÖNORM EN 14351-1	**Windows and doors – Production standard, Features part 1: Windows and front doors, Edition September 2019**
ÖNORM EN 12046-1	**Operating forces– Test method, part 1: Windows, Edition May 2018**
ÖNORM EN 13115	**Windows – Classification of mechanical features – Vertical loads, Torsion and operating force, Edition May 2018**
ÖNORM EN 1026	**Windows and doors – air permeability – Test method, Edition August 2016**
ÖNORM EN 12207	**Windows und Doors– Air permeability - Classification, Edition February 2017**
ÖNORM EN 1027	**Windows und Doors– Tightness to pelting rain – Test method, Edition August 2016**
ÖNORM EN 12208	**Windows und Doors– Tightness to pelting rain– Classification, Edition February 2000**
ÖNORM EN 12211	**Windows und Doors– Resistance to wind load – Test method, Edition October 2016**
ÖNORM EN 12210	**Windows und Doors – Resistance to wind load– Classification, Edition August 2016**
ÖNORM EN 14608	**Windows – Determination of the resistance to racking, Edition September 2004**
ÖNORM EN 14609	**Windows – Determination of the resistance to static torsion, Edition September 2004**
ÖNORM EN 1191	**Windows und Doors – Resistance to repeated opening and closing - Test, Edition April 2013**
ÖNORM EN 12400	**Windows und Doors – Mechanical stress – Mechanical durability - Requirements and classification, Edition February 2003**
ÖNORM B 8115-2	**Sound insulation and room acoustics in building construction - Part 2: Requirements for sound insulation, Edition December 2006**

ÖNORM EN ISO 10140-3	**Acoustics - Laboratory measurement of sound insulation of building elements - Part 3: Measurement of impact sound insulation, Edition October 2015**
ÖNORM EN ISO 10140-1	**Acoustics - Laboratory measurement of sound insulation of building elements - Part 1: Application rules for specific product, Edition November 2016**
ÖNORM EN ISO 10077-1	**Thermal performance of windows, doors and shutters - Calculation of thermal transmittance - Part 1: General (ISO 10077-1:2017), Edition February 2018**
ÖNORM EN ISO 10077-2	**Thermal performance of windows, doors and shutters - Calculation of thermal transmittance - Part 2: Numerical method for frames (ISO 10077-2:2017), Edition February 2018**
SIA 331	**Windows und Window doors, Edition 2012**
ÖNORM B 2217	**Construction joineries - Contract to provide services, Edition September 2011**
ÖNORM B 5312	**Wooden windows and wooden-aluminium windows - Construction Rules, Edition May 2018**
ÖNORM EN 12519	**Windows and pedestrian doors - Terminology (multilingual version: en/fr/de), Edition November 2018**
DIN 68121-1	**Timber profiles for windows and window doors; dimensions, quality requirements, Edition September 1993**
DIN 68121-2	**Timber profiles for windows and window doors; general technical details, Edition June 1990**
DIN EN 942	**Timber in joinery - General requirements, Edition June 2007**
ift-Richtlinie HO-10/1	**Solid, finger-jointed and laminated profiles for wooden windows - Requirement and testing, Edition November 2002**
DIN EN 350	**Durability of wood and wood-based products - Testing and classification of the durability to biological agents of wood and wood-based materials, Edition Dicember 2016**
DIN EN 204	**Classification of thermoplastic wood adhesives for non-structural applications, Edition November 2016**
DIN EN ISO 11600	**Building construction - Jointing products - Classification and requirements for sealants, Edition November 2011**
DIN EN 143	**Respiratory protective devices - Particle filters - Requirements, testing, marking, Edition August 2017**
ÖNORM EN 14387	**Respiratory protective devices - Gas filter(s) and combined filter(s) - Requirements, testing, marking, Edition May 2008**
DIN 4108 Beiblatt 2	**Thermal insulation and energy economy in buildings; Supplement 2: Thermal bridges - Examples for planning and performance, Edition June 2019**
BGBl. Nr. 240/1991	**Ordinance on combustible liquids, Edition May 1991**

to 2. Wood quality

ÖNORM B 3013	**Wooden raw profiles for windows - Requirements and test specifications, Edition January 2017**
ÖNORM EN 13307-1	**Timber blanks and semi-finished profiles for non-structural uses - Part 1: Requirements, Edition February 2007**
ÖNORM EN 204	**Metallic materials - Uniaxial creep testing in tension - Method of test, Edition October 2016**
VFF-Merkblatt HO.02	**Selection of wood quality for wooden windows and wooden front doors, Edition October 2015**
VFF-Merkblatt HO.06-1	**Wood species for the window construction – Part 1: Properties, wood species table – Wood species for the manufacture of dimensionally stable construction elements, Edition August 2018**
VFF-Merkblatt HO.06-2	**Wood species for window construction – Part 2: Wood species for use in protected woodwork, Edition September 2016**
VFF-Merkblatt HO.06-3	**Wood species for window construction – Part 3: Laminated wooden scantlings from various wood species and wood products, Edition April 2019**
VFF-Merkblatt HO.06-4	**Wood species for window construction – Part 4: Modified woods, Edition March 2016**
DIN EN 14257 (WATT 91)	**Adhesives - Wood adhesives - Determination of tensile strength of lap joints at elevated temperature, Edition Dicember 2019**

to 3. Coating

ÖNORM EN 927	**Paints and varnishes - Coating materials and coating systems for exterior wood - Part 1 to 13**
VFF-Merkblatt HO.03	**Requirements for coating systems for the factory coating of wood and wood-metal windows, front doors and facades, Edition September 2012**
BFS-Merkblatt Nr. 18	**Coatings on wood and wood-based materials in outdoor applications, Edition March 2006**
ÖNORM C 2350	**Coating materials for coating systems applied on dimensionally stable exterior building constructions of wood - Minimum requirements and tests, Edition June 2016**
ÖNORM B 3803 / C 2350	**Wood protection on building construction – Coating of dimensionally stable wood – Minimum requirements and tests, Edition June 2016**
FFF-Merkblatt 05.01	**Surface treatment of windows, Edition 2011**
ift-Merkblatt	**Transparent coating systems for wooden windows and doors**

to 4. Glazing/sealants/sealing profiles

ÖNORM B 2227	**Glazing work - Contract to provide services, Edition Dicember 2017**
ÖNORM B 3722	**Glass in building – Requirements for sealings of glazing rebates and glazing systems with sealants, Edition October 2018**
DIN 52460	**Sealing and glazing - Terms and definitions, Edition Dicember 2015**
ift-Richtlinie DI-01/1	**The usability of sealants - Part 1: Testing of materials in contact with the edge-sealing of insulating glass units, Edition February 2008**
ift-Richtlinie DI-02/1	**The usability of sealants - Part 2: Testing of materials in contact with the edge of laminated glass and laminated safety glass, Edition March 2009**

to 5. Installation

ÖNORM B 5320	**Installation of windows and doors in walls – Design and execution of the building connection as well as of the joint for windows and/or doors, Edition August 2017**

Among other things, the relevant recommendations of the Institut für Fenstertechnik e.V. (Institute for Window Technology) and the "Leitfaden zur Planung und Ausführung der Montage von Fenstern und Haustüren" (Guidelines for the planning and execution of the installation of windows and front doors) of the RAL-Gütegemeinschaft Fenster und Haustüren e.V. (RAL Quality Assurance Association for Windows and Front Doors) must be observed.

to 6. Maintenance and care

ÖNORM B 5305	**Windows and external pedestrian doorsets - Inspection and maintenance, Edition May 2018**