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GROGLASS ANTI-REFLECTIVE GLASS

CLEANING AND HANDLING GUIDELINES

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1. Introduction of Groglass™ Anti-Reflective products

Groglass™ anti-reflective products are soda-lime, borosilicate or organic glass coated with metal oxides by vacuum sputtering method. Combination of multiple layers reduces residual reflection close to zero.

Due to the AR coating, finger-prints or dirt are more visible than on normal float glass. They can easily be removed according the description in point 12. We recommend that Groglass™ anti-reflective glass is handled carefully, especially in the manufacturing process since finger-prints, dirt, imprints etc. are more pronounced. They must be reduced to minimum before each step of the processing.

Groglass™ anti-reflective coating is durable and resistant against environmental influences. There's no corrosion/oxidation of the double sided anti-reflective glass coating due to the insulating and durable outer layer. For individual product performance see the Technical specifications.

2. Transportation, Packing and Unloading

Delivery can be made in following packaging - End Caps (max. 2,2 t), A-frame, Crate or OSB BOX. Typically, Groglass™ anti-reflective glass stock sheets are delivered with interleaving powder. In some cases, per customer request polyethylene sheet interleaving is used – it is recommended to use the same foil for interleaving between subsequent processing steps.

In case of one-sided AR coated glass delivery, the coated side is identified with an arrow on the packaging. In addition, there is always a label on glass with text "uncoated side" indicating which side is uncoated. If possible, coated side should be facing upwards to minimize the risk of scratching.

When moving the glass between processing steps, it is necessary to separate the glasses with an interleaving layer (polyethylene foil) if glass panels are stacked. Avoid all steps that may scratch the glass such as sliding the glass sheets.

The packs of glass must be inspected on arrival. Groglass™ shall accept no liability for faults arising after delivery or during handling, processing or installation of the finished product. To minimize the risks, follow this procedure:

- Set glass on the long edge and transport and store it in vertical position;
- The rack must be positioned on perfectly level ground;
- Use the appropriate handling equipment;
- The grab must be perfectly centered;
- Avoid damaging the packaging while handling;
- Ensure CLEAN rubber surfaces for vacuum lifters. We recommend to use clean suction cup caps (from cotton) to avoid coating damage;
- When picking up a glass from end-cap with vacuum-lifter, first move the glass up only a very little bit (~5mm), then move it bit back from the other glasses in the case and only then lift it completely up to take out of case. Taking it up immediately (without separation from other sheets) may result in scratching the coating.

Comments:

Clamps, slings, lifting beams and other handling equipment must comply with prevailing regulations and be approved by the relevant authorities. Ensure the safety of personnel at all times. Keep all unnecessary personnel out of the handling area. Wear appropriate personal protective equipment. Personnel must have received the required training.

3. Storage

Groglass™ anti-reflective glass can be stored 12 months indoors and max. 2 month outdoors in a dry environment. Glass shall be installed in final application no later than the maximum allowed storage time (depending on storage conditions as describe above). After this period no claims will be considered.

Racks used for packaging during transport are not designed to be used for storage. Consequently, the packs must be stored on racks with spacers between packs. Store the packs correctly to reduce the risk of mechanical damage to the glass.

Care should be taken to avoid major fluctuations in temperature and humidity that may cause condensation on the glass. No water must be allowed to come into contact with the sheets of coated glass. Care should be taken to ensure that ambient air is not polluted by any corrosive elements such as chlorine or sulphur. Sources of such elements include machinery fitted with heat engines, battery-charging points.

Keep the glass interleaved with polyethylene foil. Do not use paper. Stock sheets shall not be stored horizontally due to risk of sticking them together. Different dimensions of glasses must be separated by polyethylene foil or corks.

4. Handling / Cutting

When handling Groglass™ anti-reflective glass always wear clean gloves, which don't leave sweat, dirt, grease residues or similar smears on the coating (rubber gloves or gummed gloves are ok, but no cotton- or leather gloves).

When working with one side coated glasses, the coated side has to be facing upwards on a working table.

The working table must be free of glass particles and clean. CLEAN OFF the working table before each new glass. Groglass™ anti-reflective glass should be cut dry or with a evaporating cutting oil (i.e. ACPE 5503 from Aachener Chemischen Werke). The dose and atomization should be the least possible. Don't use high lubrication cutting fluids to avoid leaving irremovable residue. Always keep the cutting table clean and cutters sharp to reduce incidence of scratches.

5. Edge working

Edges can be grinded, polished or beveled like any float glass. Wash the glass immediately after the wet edge working. The glass must be dry totally. Remaining water on the glass causes water spots.

6. Washing

Washing-machines with cylindric brushes, equipped with soft brushes, are suitable for Groglass™ anti-reflective glass. Diameter of the bristles <0.15mm and 20-40mm of length should be used. Be careful with 0.5 mm thick bristles and plate-bristles (normally used for a hard pre-cleaning), because they could scratch the glasses. Therefore, clean without plate-bristles.

The glass must be washed with warm (about 40°), clean, deionized water with pH of 7 (+/-1) and conductivity of <30 µS/cm. No hard particles (such as calcium) or acidic/detergent agents should be present in the water used for washing as these may damage the coating. The washing machine's all parts and transportation conveyer must be clean.

Groglass™ anti-reflective glass should not stand still within the washing-machine. After washing, please dry immediately the anti-reflective glass. Remaining water on the glass causes water spots.

7. Printing on glass

Full surface printing should not be made on 2-sided anti-reflective coated glass, as anti-reflective properties of glass in printed area will be changed.

Minor surface printing (e.g. frame printing for electronic displays) can be made on surface #1 of 2-side anti-reflective coated glass. When printing is made on surface #2 of 2-side anti-reflective coated glass, some distortion of reflected color will occur when viewing printed area. Please contact Groglass in case of any questions. In case of printing on 1-side coated glass, it can be done in either side.

8. Manufacturing of insulation glass

Insulation glass, consisting of 2 x Groglass™ anti-reflective coated glass sheets can be built together. It's not necessary to remove the coating on the border, because two-component sealings like polyurethane, polysulfide or silicone connect well with Groglass™ anti-reflective glass, according our test results. Only exception is Soft Low E AR glass, which requires edge deletion.

Please ask your sealant producer to confirm tests with Groglass™ anti-reflective glass. It's necessary to test sealants (which haven't been tested with Groglass) together with the producer against adhesion, water-resistance and climatic-shocks (DIN 1286 part 1).

As for processing recommendations:

- Unpack carefully to avoid scratching the glass;
- Wear clean gloves not to leave fingerprints;
- Do not touch glass surfaces with any objects to minimize the chance of damaging the coating
- Protect coated surfaces from aggressive materials such as silicone, grease, oil, adhesives, aluminum, paint, glues, lubricants, cement, mortar, glue, paint, varnish plaster, fragments or sparks of welding/grinding devices;
- Clean all excess sealant from the glass immediately after the unit is complete;
- Note: Do not write (e.g. with crayon or felt-tip pen) or put stickers/tape on coated side of glass.

9. Manufacturing of laminated glass

For manufacturing laminated glass, one-side coated Groglass™ anti-reflective glass is used. The Groglass anti-reflective coating needs to be on the # 1 and # 4 surfaces. As stated before, look for markings on packaging and each panel has a label on the uncoated side. *The uncoated side of one-side coated Groglass anti-reflective glass has a higher reflection, e.g. place a white paper against the glass, or look through the edge.*

Laminating Groglass anti-reflective glass:

- Refer to the washing instructions in Section 6;
- Ensure that the transport rollers are clean;
- Devise a marking system where the operator can clearly identify the coated versus uncoated sides;
- Remove any marks or stickers after having laminated together the glasses;
- Coated side should be facing upwards if possible, to reduce risk of scratching;

Pre-compound-pressing:

- In this process, the AR coated side of the glasses looks outside (to air). The surfaces of the rollers should be cleaned frequently. It's necessary to control and clean the rollers often;
- Fast rolls (passage from slow pressing to fast transportation) could damage the coating;

In the autoclave:

- Use suitable distance-holders. Cork distance-holders will leave stains on the glasses.
- Otherwise handle the Groglass anti-reflective glass like normal laminated glass in the autoclave.

10. Thermal tempering

Both - one and two side coated Groglass™ monolithic anti-reflective glass can be tempered. The glass and the furnace must be clean. It's necessary to work in a determined temperature and maintain intervals to prevent a destruction of the coating and the glass.

Processing recommendations:

- Groglass™ anti-reflective glass have different heat exchange dynamics that regular float. Processing parameters should be adjusted accordingly.
- Grind or polish the edges of anti-reflective glass before tempering;
- The coated side of one-side coated anti-reflective glass should be facing up;
- Two-side coated Groglass anti-reflective glass must be absolutely clean and dry, transported on very clean rolls. Water-stain and dirt are NOT allowed on the glass, as these could "burn into the glass" during the tempering.
- Adjust the temperature of the top and the bottom to ensure even distribution of heat, as well as the cycle time of the furnace, that the coating doesn't crack („cobweb ", crazing).

Recommended tempering conditions:

- Start with standard tempering parameters used for regular float or low-iron glass (typically low-iron glass requires higher temperature);
- If cracking appears reduce temperature in 10C° increments while increasing time in furnace or/and raising quench pressure or/and reducing quench air temperature;
- Experiment with placing glass on a different side, except for Low E glass.
- To avoid glass breakage in furnace, assure exit glass temperature of at least 640C° for regular float and 650C° for low iron glass in the center of glass sheet. If glass doesn't break lower the temperature further until cracking disappears or glass starts breaking;

It's difficult to make a precise statement for different furnaces, because the measurement of temperature and the places of these measurements are different. Be careful with thermal tempering of glasses with holes or edge-outbreaks.

11. Chemical tempering

This process will damage the anti-reflective coating; thus, such type of tempering is not recommended.

12. Cleaning of Anti-Reflective products

Finger-prints and dirt can be wiped off with ammonia-free aqueous solution, neutral and weakly alkaline window cleaner without additives of abrasive substances and a clean, dry, soft cotton or microfiber cloth. Do not use rags, tools or cleaning detergents which scratch or scour. Isopropanol mixture with water also can be used as cleaning agent.

Products NOT to use:

- Do not use strong alkalis, acids, detergents with fluoride, solvents as they will destroy the coating.
- Do not use detergents with mechanical devices (sand etc.) nor other mechanical millinery.
- Do not use blades; steel blades may hurt the surface and cause scratches.

13. Angle of View

Groglass™ anti-reflective glass has to be viewed at a 90-degree angle. Under special light conditions and angles of view, one can see small differences in the reflection and small iridescent light effects. These effects are inherent to the manufacturing process of Groglass anti-reflective glass and are not subject for a claim.