EKO® PRO

Processing Guidelines

SAINT-GOBAIN

ACKNOWLEDGMENT

The below signature confirms that the processor has read and understood the present Guidelines and commit to respect its content.

Date:

Name: Title:

Signature:

Company:

Thank you to send back this page signed to your SAINT-GOBAIN representative.

Document code	Date
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1. GENERAL

1.1. Product description

EKO® PRO is a high performance low emissivity (low-E) glazing product, intended to be used as cover lids for horizontal freezers or ice cream cabinets. This coating is specifically not to be used in residential or façade applications. It is manufactured by vacuum cathodic sputtering of several metallic and ceramic layers on clear PLANICLEAR® float glass. The low-E coating offers enhanced thermal insulation by reflecting long-wave infrared heat radiation.

EKO® PRO can be used in single glazing, with the coating facing the interior of the cabinet. It can also be used in double glazing unit. In any configuration, EKO® PRO coating should not be located on the extreme glass face out of the cabinet.

The product covered by this guideline is “to be tempered”. This product cannot be used in annealed form since it acquires its characteristics during the tempering process.

Contact your sales representatives for more information. For complete performance data, please refer to our commercial documentations and our website www.saint-gobain-glass.com.

To improve customer satisfaction, we constantly improve the quality of our coatings. This could lead to improvement in the processability of our coating, so please make sure you have an up-to-date version of the processing guidelines.

1.2. Thickness and dimensions

EKO® PRO is available in 3.9,4.9 and 5.9mm thicknesses and in standard sizes. For more details, please refer to the relevant product documentation from Saint-Gobain Glass or contact your local sales service.

1.3. Quality criteria

Without prior agreement between both parties, the standard EN 1096-1 will apply.

1.4. Position of the coating and identification of the coated face

1.4.1. Position of the coating

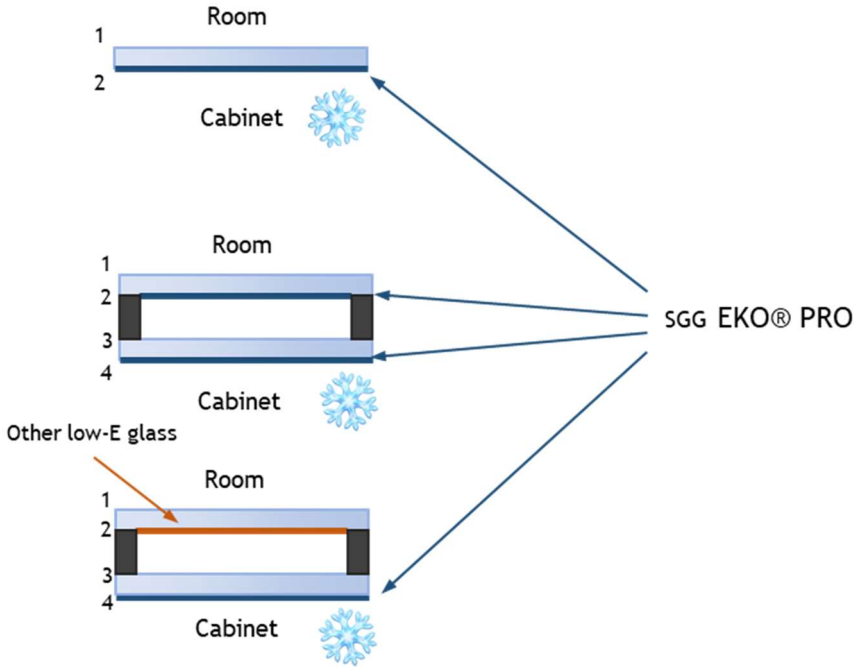
Possible configurations of use of EKO® PRO:

a) Monolithic, with EKO® PRO facing the inside of the cabinet;

b) in DGU, associated with various other glass. EKO® PRO can be assembled in IGU. In that case, the exposed EKO® PRO coating should be placed on the inner face of the cabinet (face 4 of a DGU, counting from the outside of the cabinet).

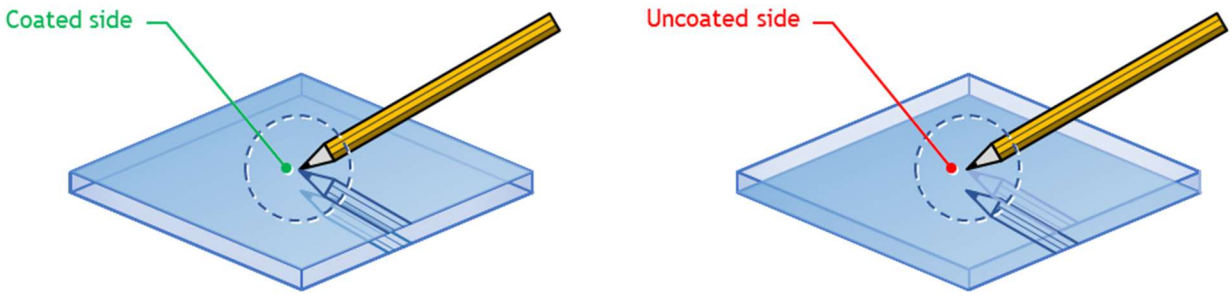
All low-E coating including EKO® PRO coating inside the IGU have to be edge deleted.

Direct contact of corrosive materials on the coating, or materials likely to emit corrosive vapours with the action of heat (acids, ammonia, mortar water, acetic-curing silicones, among others) is prohibited.



1.4.2. Identification of the coated face

The coated side of a EKO® PRO is generally easy to identify as it exhibits a recognizable colour shade. Otherwise, coating detectors can be used. Information is available from your local Technical Support Manager (TSM).



2. TRANSPORT, ACCEPTANCE, STORAGE AND HANDLING

2.1. Transport

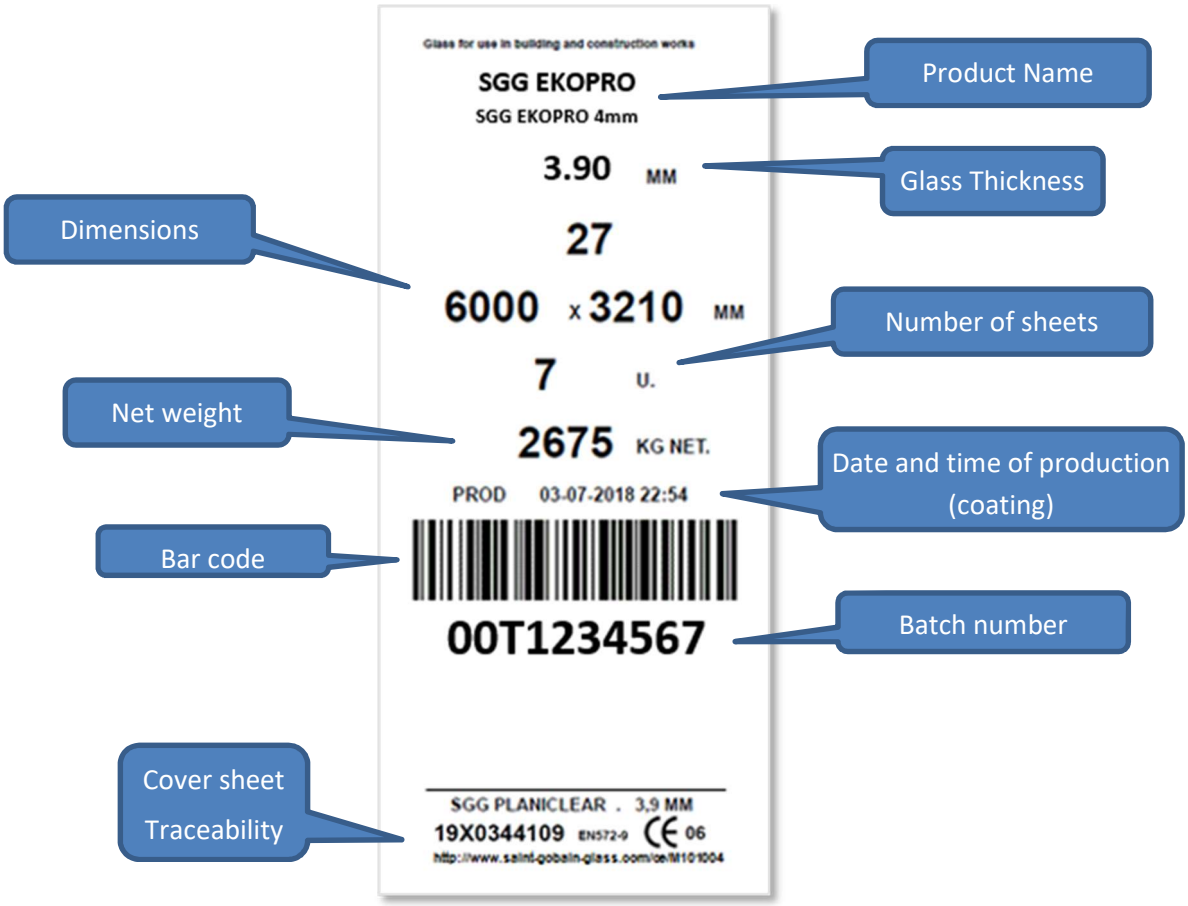
- Coated glass sheets are usually transported in 2.8 tons packs (jumbo or split sizes).
- Glass sheets must be transported vertically;
- The individual sheets are packed with the coated side towards the inside of the frame unless otherwise requested by the customer;
- The glass panes never come into direct contact with each other: the glass sheets are always separated by neutral polymeric powder;
- In each pack, a clear 4 mm float glass pane is placed as the first sheet during loading to protect the coating of the first coated glass sheet;
- The pack and its contents must be protected from water.
- If the glass is wrapped and sealed, the seal should remain closed until the product is used in the factory;
- During transport, violent and repeated shocks should be avoided;
- When handling with a hoisting apparatus, measures must be taken not to damage the pack.

2.2. Receipt of the delivery

Care must be taken concerning the orientation of the coating that has been ordered. Please check it before starting processing.

- Every pack must be opened with care in order not to damage the glass sheets or the coating(s) (contacts, scratches, etc.). Handling instructions on the packing must be respected, particularly the instructions for opening.
- Before processing, glass sheets should be checked in accordance with the specifications defined above. Any possible defect in the coating must immediately be reported to the supplier, accompanied by:
  - The date of delivery;
  - The data mentioned on the identification label;

- All deliveries are identified with a label providing the following data:



No claim can be accepted for damages caused during and after processing due to a lack of adherence to these guidelines. Therefore, glass processor should ensure that the process is adapted for coated glass and that the quality control is relevant to detect any quality problem as soon as possible. In case of claim, samples will be required and a visit from a SGG representative may be requested.

2.3. Storage

2.3.1. General

All glass products may degrade (become stained or corroded) when stored in humid conditions. The iridescence may take the appearance of a "rainbow" or milky white haze on the surface of the glass, or corrosion pitting on the coated side.

EKO® PRO glass sheets must be stored, as float glass, vertically (at 3 to 7 degrees) under the following conditions:

- In a dry, well ventilated warehouse, to prevent any condensation on the surface;
- Away from glass dust;
- Protected from rain and running water (e.g. any roof leakage must be rectified);
- Never outside or in the open air (even when packed);

- Protected from wide changes in temperature and humidity levels (coated glass products should be stored far from opening doors).
- In case the coated glass is delivered packed (aluminium, PE):

  Before breaking the seal, to avoid condensation, one should ensure that the temperature of the pack has reached the temperature of the environment of the warehouse.

2.3.2. Shelf life

If the above (§ 2.3.1) storage conditions are respected, EKO® PRO is guaranteed for 2 months from the date of reception at the customer's premises. Only sealed packs can be store until 6 months and when open, glass have to be processed in coming 2 months.

In case the date of reception is lost by the customer, the date of the delivery note will serve as evidence. A first-in-first-out (FIFO) system must be adopted.

2.4. Handling

- EKO® PRO coated glass sheets must be handled with dry, clean and appropriate safety gloves.
- In case handling operations with vacuum cups on the coated side cannot be avoided, make sure that the vacuum cups are perfectly clean. Not all solutions are suitable for cleaning vacuum cups, see manufacturer documentation for details. A sheet of interlayer paper (acid-free, thin, soft and air-permeable) or suitable suction-cups caps can also be placed on the coated side, between the vacuum cups and the surface, but care must be exercised as this may reduce the vacuum level (especially in the case of thick and heavy panes).
- Each coated glass pane must be released from the next pane before being lifted from the pack. Any relative movement of the coating with the next glass pane must be avoided.
- Automatic unstacking of glass sheets or removal using a glass clamp is possible, but the gripping area should be kept to a minimum and condemned from the cutting pattern;
- In case of doubt, the position of the coating must be checked (see § 1.5.2). Do not place the coating in contact with a rough surface or hard objects.
- Try to avoid wiping the coating. If necessary, the coating may be gently wiped with a soft dry cloth and a suitable solution (e.g. isopropyl alcohol (IPA)).

3. PROCESSING OF EKO® PRO

3.1. Handling on the production lines

All the recommendations outlined in § 2.4 remain valid.

- Ensure, as much as possible, that the coating does not come in contact with guide rollers on the line; the coating must be turned towards the operator when facing the line. If it has to go through, make sure the conveying belts are perfectly clean and free from any abrasive material / particle;
- Hoisting and handling instruments, tools and vacuum cups must be kept perfectly clean (or covered with adapted caps) so as not to leave traces on the coating;
- Wear dry and clean safety gloves when lifting the glass sheet manually. Limit area of contact as much as possible;
- The coating must be protected from any contact with greasy substances;

3.2. Glass cutting

EKO® PRO is cut in the same way as any other ordinary coated glass. However, the following recommendations have to be respected:

- Any irregularity or damage of the edges must be avoided since it is likely to increase the risk of breakage during the toughening process;
- Use only light **vaporising cutting oil** (for instance Acecut 5503 or 5250) adapted to coated glass;
- Do not dilute or mix the cutting oil;
- Avoid all excess of cutting oil: Max width: 1 cm;
- For cutting operation, avoid using natural latex coated gloves as latex tends to dissolve in cutting oil. This leaves a greasy residue on the coating which may be difficult to wash in the industrial washing machines. Grade 5 leather or PU palmed gloves as well as NBR nitrile dipped gloves should be preferred;
- Cutting templates can be used but great care must be taken not to scratch the coating. Soft protection (soft tissue, felt or cork pad) should be placed underneath the template;
- Fine glass splinters on the coated surface should not be wiped off by hand, but blown off by **dry and oil-free air**;
- When stacking cut sizes prior to further processing, separate the panes by either:
  - New cork pads (recommended);
  - Paper interlayer (chlorine free);
  - Foam pads;
  - Corrugated cardboard strips.

This is especially important with glass of different dimensions. Do not put additional separating powder.

- The use of so-called “harp carts” to store the cut sizes must not be used as the contact of the wires on the coating may damage the latter when the cut sizes are pulled from or pushed in between the wires

3.3. Edge deletion

In case of **single glass**, EKO® PRO does not need to be edge deleted. The four sides of the glass pane are then integrated into a plastic frame.

In case **of IGU**, EKO® PRO have to be edge deleted as for other soft low-E glass products. It could be done at cutting stage or after tempering. A special care to residual glass grinding dust is well sucked away to avoid scratching the coating. Good quality of edge deletion should be controlled and if necessary edge deletion parameters should be adapted to achieve good results. The coating deletion width should be at least 10 mm.

3.4. Edge working

It is good practice to edge work the glass directly after cutting. Provided it is stored under conditions as stated in section 2.3.1, the glass must be edge worked within 24 hours from cutting.

- Wet edge-working: it is essential to keep the glass fully wet during the whole grinding process and to wash the glass directly afterwards so that the grinding water is not able to dry on the coated surface.
- Dry edge-working: such processing is generally not recommended as small glass dust particles may be sprayed on the dry coated surface. In case of use, make sure the suction is powerful enough to avoid a too important dispersion of dust.

3.4.1. Manual Edge Working

Generally carried out using manual cross belts to achieve arrised edges (100 - 120 grit belts are recommended);

- The top belt should run downwards to minimise grit deposited on the coated surface;
- Horizontal roller backstops can be fitted to ensure consistent pressure and arris width;
- The glass should be handled (with glass dust free gloves) at the edges to avoid damaging the coating.

3.4.2. Automatic Edge Working

It is possible to grind the coated glass on vertical, CNC and double edger machines provided that the handling instructions are observed and adaptations of the machines are made (if necessary, contact your local Technical Support Manager). For double-edger and vertical machines, cleanliness and perfect synchronization of the pressure belts must be checked.

3.5. Drilling

The drilling of coated glass can be performed provided that the handling instructions are observed and adaptations of the machines are made (if necessary, contact your local Technical Support Manager - TSM).

The glass must be washed immediately after drilling in a washing machine adapted to coated glass. (see § 3.6. Washing). Before being moved to the washing machine, the glass must be rinsed with plenty of water (ramp at the top of the washing machine). This prevents the water in the washing machine from becoming polluted by drilling residue hence risk of scratches.

3.6. Washing

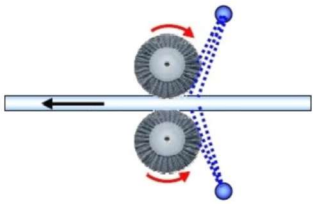
It is recommended to wash the glass immediately after edge working. In case EKO® PRO is submitted to several processing steps (edge working + drilling +…) each of them followed by washing, it is recommended to pass the cut sizes in the same direction for each washing phase (to avoid possible generation of multiple crossed scratches).

We recommend the use of the following installation. If the washing installation differs from the one described here, we recommend that tests be carried out to check the washing quality (traces, rings, dust, etc.) and to ensure that the installation does not damage the coating. Please contact your local TSM:

- Pre-washing area:
  - Prewash ramp followed by one pair of cylindrical brushes
  - Tap water between 30 and 40°C, preferably close to 40°C, without any detergent
  - The prewash ramp is particularly important for the removal of the glass dust and splinters created during the edge-working process
- Washing area:
  - 2 pairs of cylindrical brushes
  - demineralised water
  - pH value comprised between 6 and 8;
- Rinsing area:
  - Demineralised water at room temperature
  - Maximum conductivity 20 µS/cm
  - pH value comprised between 6 and 8;
- Brushes:
  - Flexible (soft) clean polyamide bristles
  - Maximum diameter of 0.2 mm, 20 - 40 mm long.
  - Take care that all the brushes are perfectly clean and regularly maintained. Any hard brush must be lifted;
  - Compatible rotation speed with soft coatings.
- Drying:
  - Use an air-blowing installation equipped with filters

- Clean and regularly maintained filters;

- Water should be sprayed directly onto the glass, not onto the brushes (as per below drawing;
- The glass sheet does not stop inside the washing machine. The washed panes should not remain in the washing unit for any length of time, especially not while the brushes are rotating;



- No water must remain on the coated surface after the drying process;
- It is strongly recommended that the washing machine is regularly cleaned, especially for the brushes and in areas where demineralised water is used. Clean the filters every day, and the tanks every week. For the brushes, steam cleaning gives good results, but do not spray the bristles with high temperature and high pressure water.
- In case dirt / stains are still present on the coating after the washer, cleaning may be performed using a soft cloth and isopropanol (IPA) or ethanol followed by rapid drying, provided this is done carefully and immediately after contamination has occurred.
- For interim stacking of washed panes, use cork pads near the edge of the sheets.

As EKO® PRO will be tempered, **it is of the highest importance that no residues or marks are left on the coating surface after the exit of the pre-processing washing machine**. Pollutions left on the coating may induce hot corrosion (giving the aspect of pinholes) of the coating in the tempering furnace. Such marks may not be washable.

3.7. Tempering

3.7.1. General

EKO® PRO must be heat-treated to get a tempered flat glass or curved glass. coated glass. These products have to be tempered before use as cover lids for freezers. These coatings are designed to withstand the heat-treatment process. During the process, the color and the spectrophotometric / thermal characteristics change.

3.7.2. Prerequisites for tempering /bending

The cleanliness of EKO® PRO coating before entering the tempering furnace is essential. From the exit of the washer to the entrance of the tempering furnace, only the use of perfectly clean gloves should be permitted. The coating may be gently cleaned with isopropanol (IPA) on the furnace entry bed to remove dirt or marks (from gloves, separators, fingerprints…).

Special care and attention must be taken at every stage of processing, in particular before and during the toughening process. Please consult your local TSM if necessary. Washed panes should be tempered maximum 2 days after washing.

3.7.3. Tempering instructions

From a general point of view, tempering of EKO® PRO can be carried out using appropriately adjusted furnace settings. This will obviously vary depending upon the type of furnace being used. The sheets should be handled as "cold" as possible to achieve a flawless coating after tempering and obtain the desired level of stress (breaking pattern). This means that the temperatures and heating times are set so as just to avoid breakage in the blower box and to meet the requirements for single-sheet safety glass.

- The sheets are **always tempered with the coated side upwards**, never place the coating against the furnace rollers
- The functional layers giving their properties to EKO® PRO bring some low emissive characteristics to the product. This low-emissivity characteristic is to be taken into consideration when tempering EKO® PRO.
- Convection furnaces are recommended for the heat treatment of EKO® PRO. Use of thermal scanner is recommended to help adjustment and follow up of production. Contact your local TSM for the adjustment of the appropriate settings.
- Note: the high convection furnaces give much faster cycle times as well as improved optical quality of the end-product.
- **Do not use SO_2** in the furnace when tempering EKO® PRO. Do stop SO_2 right in time. SO_2 may remain in the furnace for up to 48h.

3.8. Heat-Soak testing

Heat-soaking tempered EKO® PRO cut sizes must be carried out in accordance with EN 14179 European standard. Every piece must be individually separated; the separating blocks may be made out of PTFE (e.g. Teflon) and contact with the coating should be limited to a minimum and located at the extreme edge of the glass. Gas fired Heat-Soak-Test furnaces with direct combustion in the oven must not be used as hot fumes may damage the coating.

3.9. Bending

EKO® PRO can be curved tempered (in tempering furnaces fitted with a bending cell). Not all curvature radii may be attainable with convex or concave shape according to the type of process used. The processor is then asked to check and validate that its bending process is capable to obtain a good quality on a particular shape before giving a final offer for a project requesting this shape. **It is recommended that a representative sample of such a validation trial should be presented to the final customer for acceptation** (produced in the same furnace under the same conditions).

- Coating position: concave
- Avoid as much as possible the contact of the coating with bending tools to avoid degradation of the coating

3.10. Enamelling

3.10.1 Logotype

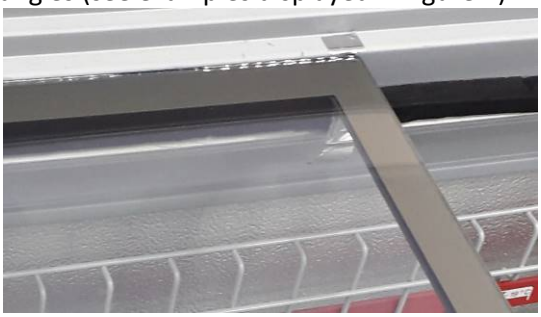
Printing of the brand logotype and/or the normative stamp is possible directly onto EKO® PRO coating without any limitation.

3.10.2 Guidelines for larger printed areas (frames)

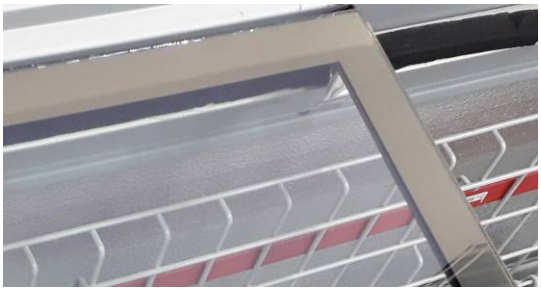
EKO® PRO may be partially enamelled on the coating side using screen-printing. Given the variety of enamel products and different operating processes, each processor should carry out their own tests on their equipment prior to any production. It has to be noted that EKO® PRO interacts with enamels upon heating, leading to a different optical rendering than on uncoated clear glass.

- Recommended enamels:

  Enamels from Ferro Series 140[1] are recommended. In case of screen-printed grey frames, RAL 7012, 7015 or RAL 7024 color enamels[2] are recommended. Aesthetic renderings depend on observation angles (see examples displayed in figure 1)[3].



(a)



(b)

Figure 1: Screen-printed grey frame (3cm width) on EKO® PRO with RAL 7012 enamel from Ferro series 140 (a) seen in front of the freezer (normal incidence) (b) seen from above the freezer(with incidence angle)

[1] Ferro Technical Information Flat Glass System 140 - Accessed November 2020

[2] https://www.ferro.com/-/media/files/resources/industrial-specialty-materials/technical/ferro-industrial-specialty-materials-system-140-lead-free-flat-glass-enamels.pdf -p10 - Accessed November 2020

[3] When enamel is deposited on EKO® PRO, a particular color in specular reflection is obtained. In the case of grey shades, the signature of EKO® PRO coating is a bronze specular reflection.

The color in transmission (obtained through the glass) is also different from the one obtained on uncoated clear glass. As an example, a RAL 7015 enamel will appear lighter on EKO® PRO coating (closer to a RAL 7012) than on an uncoated substrate.

- General features:
  - The viscosity of the paste has to be adjusted according to the screen-printing process;
  - EKO® PRO glass has to be properly cleaned before enamel printing;
  - Wet thickness of the enamel deposited by screen-printing has to be ≥ 40µm[4];
  - After tempering the enamel should not be porous, liquid dropped on the enamel side must not soak through the layer and be visible on glass side[5];
  - After tempering the enamel has to reach a gloss value ≥ 20 GU[6];
  - After tempering of different batch of the enamel on the same EKO® PRO, the enamelled glass colour has to reach a DeltaE ≤ 1.5[7].

3.11. Handling of heat-treated glass

Following tempering, each pane should be separated with pads.

- Glass panes must be stored vertically (at 3 to 7 degrees) under the following conditions:
  - In a dry, well ventilated store, to prevent any condensation on the surface;
  - Protected from rain and running water (any roof leaks must be rectified);
  - Never outside or in the open air;
  - Protected from wide changes in temperature and humidity levels (store coated glass products far from opening doors).
- Clean, dry and soft gloves must be worn for all handling.
- In case EKO® PRO is assembled into double-glazed units, this should be performed within 2 days.

3.12. Manufacture of Insulating Glass Units

It is recommended to assemble the panes in insulating glass units within 2 days. When manufacturing double-glazed units using EKO® PRO, please follow the handling, cutting, and washing instructions detailed above.

The coated glass must be edge deleted and washed before making it into insulating glass units. Recommended washing conditions are described in § 3.6.

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[4] Roller gauge measurement - ISO 2808:2007 / ASTM D1212

[5] Ferro Technical Information Flat Glass System 140 - Recommended Test Methods to Check Correct Firing of Enamels p26 – accessed November 2020

[6] Gloss measurement - ISO 2813 :2014

[7] Color measurement based on CIE-L*ab (SCE) colour space - CIE 15.3:2004

- The coating should always face outwards on the production line to avoid contact with the guide rollers respecting the coating position as described in paragraph 1.5;
- All types of secondary seal can be used (polyurethane, polysulfide, silicone and hot melt). Check with the sealant supplier that a particular reference has been validated with EKO® PRO.
- Traditional presses or gas presses are compatible. Suction cups must be clean.
- Any traces of sealant remaining on the coating after application must be removed immediately before they harden. They can be cleaning off using isopropanol and soft paper.
- After assembly, each sheet of glass must be separated using cork pads or sheets of interlayer paper (acid-free, thin, soft and air-permeable).

3.13. Processing quality checks

It is the responsibility of the processing plant to define and adjust the quality process control to match the quality standards acceptable for its own market and in respect of relevant national requirements.

- **Reception**: Control of delivery document of the coated glass supplier. Visual inspection of the packs (breakages, condensation…);
- **After cutting**:
  - Visual aspect control (scratches, oxidation/corrosion, splinters etc.);
  - Normal control of the cutting quality;
- **After grinding / drilling / washing:**
  - Visual aspect control (scratches, oxidation/corrosion, splinters etc.);
  - Visual control (as to whether the pane is completely dry);
  - Check for suction cups or cork pad marks etc…;
  - Normal control of the grinding / drilling quality;
- **Prior to tempering:**
  - Check for glass splinters (if present, remove them by rewashing);
  - Check for marks, dirt… If any remove them by gently wiping the coating with a soft cloth and IPA;
- **After tempering:**
  - Visual aspect control (burns, cracks, scratches, oxidation/corrosion, haze…);
  - Optical quality (distortion, bow etc.);
  - Visual detection of roller wave;
  - Normal control of the tempering quality (break pattern etc.);
- **After heat-soak testing:**
  - Visual aspect control (scratches, oxidation/corrosion, splinters etc.);
  - Check that no damage has been caused by separating blocks;
- **On the insulating glazing unit line:**
  - Visual aspect control in conformity with the relevant national quality standard for double-glazed units.

For plants just starting to use coated glass products, a system of “first off” inspection after each process can be useful until experience is gained. Operator training and experience in identifying faults (which are often difficult to see, especially before tempering) is important. In any case, **a visit from your local TSM should be organised**.

4. ENVIRONMENT / WASTE GLASS / HEALTH ISSUES

EKO® PRO coated glass product can be disposed of as per clear float glass.

Edge working residues have to be continuously and completely collected during the grinding process. These residues must be further treated in compliance with national legislation about industrial wastes. In some legislation, residues from grinding process have to be treated as toxic wastes.

As for any dust coming from the grinding process, any inhalation or skin contact of these residues must be avoided.

On request, a **S**afety **U**se **I**nstruction **S**heet (SUIS) relating to the EC Directive 91/155/EEC can be supplied.

5. GLAZING INSTRUCTIONS

Framing with plastic profile

When using EKO® PRO as single glass tempered for cover lids, the framing of the glass pane with plastic profile will prevent damage of the coating from the edge due to moisture interaction. It is the responsibility of the processor to ensure the compatibility of its plastic framing materials and used glue with EKO® PRO.

The use of clean gloves is recommended to handle EKO® PRO single glass during mounting operation of profiles around the glass, and integration into the cabinet.

The selection of a suitable and practical glazing method depends on a variety of factors such as the size of the glass, the exposure and the type of framing material and system.

Glazing and fixing techniques must comply with the recommendations of the relevant national standards. Glazing blocks, frame size and maximum frame deflection for double-glazed units are not specific to EKO® PRO glass product.

6. PROTECTION, CLEANING AND MAINTENANCE OF THE END PRODUCTS

6.1. Removal of labels and markings

- On cut-sizes, the label is to be found on the face opposite to the coating.
- The identification labels on the glass sheets must be removed before or immediately after installation. Do not use sharp tools for this purpose. Acetone and alcohol are the approved solvents.
- To indicate the presence of the glass sheet, do not use materials such as lime, chalk or soap on the coating. If warning signs must be placed, we suggest fixing a notice or streamer to the frame, making sure they do not touch the glass.

6.2. Protection during integration and transport

During all steps of transport, framing and final integration into the refrigerated cabinet, the coated side of EKO® PRO tempered panes has to be protected against mechanical shock, friction with other materials etc. and against contact with water, fingerprints or any chemical compound,

6.3. Cleaning and maintenance

The interior surface of the glass cover, facing the cold side of the cabinet **must not be cleaned when the cabinet is running at low temperature**, in order to prevent formation of ice at the surface.

Only a soft and completely clean cotton cloth should be used to clean the interior surface of the cover lid which is the coated side of EKO® PRO.

Cleaning instructions is to **use the clean cotton cloth lightly moistened with pH neutral water**, to gently wipe the interior surface.

The use of glass cleaners or other cleaning agents available in stores **ARE NOT ALLOWED**, as they can damage the EKO® PRO coated side.

DO NOT USE cleaning tools like **abrasive microfiber cloth, glass wiping squeegee and absorbent sponge.**

Saint-Gobain declines any responsibility in case of damage of EKO® PRO further to non-respect of the above cleaning instructions.

7. DISCLAIMER

SAINT-GOBAIN GLASS has taken every reasonable measure to ensure that the information contained in the present leaflet was exact at the time of its publication.

However, SAINT-GOBAIN GLASS keeps the right to modify or add any information without previous notice. SAINT-GOBAIN GLASS is not liable for the possible lack of information on EKO® PRO product that would not be contained in the present document.

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