



STOPRAY SMART

PROCESSING GUIDE

VERSION 2.2 – MARCH 2022

Smart 51/33 – Smart 30/21 – LamiSmart 24*

** Stratobel Stopray Lamismart 24 (= Stopray LamiSmart 24 laminated against PVB)*

Your Dreams, Our Challenge

This version of the guide replaces and cancels all previous versions.
Please check www.agc-yourglass.com regularly for any updates.

WARNING

Carefully read this manual before processing Stopray Smart products.



Preliminary Important Instructions

- At each stage of the processing procedure, the personnel responsible for handling the glass must have the adequate equipment: safety shoes, safety gloves², safety glasses, ...
- Product shelf life without any protection: the glass has to be consumed within 9 months from the delivery in the processor's facility.
- Product shelf life with protection (closed packaging) : the glass has to be consumed within 12 months from the delivery in the processor's facility. Once the pack is opened, the glass has to be consumed within nine months.
- The Stopray Smart range is self-matchable: these products can be used annealed or heat treated as required by the application. Both annealed and heat treated products have similar reflection and transmission characteristics. In case of heat treatment, the procedure and set up of the furnace in chapter 6 of this manual must be strictly respected.
- Stopray Smart coatings (heat treated or not) must be assembled in insulating glazing with the coating towards the cavity, so in position 2 of the insulating glazing. The glass should be assembled in insulating glazing within one week after being heat treated. The Stopray Smart coatings cannot be used as single glazing, except Stopray LamiSmart.
- The Stopray Smart coatings can be laminated. It is mandatory to apply the coating in position 1 or 2, i.e. so that the coating does not come into contact with the PVB. The coated surface of the laminated glass will face the cavity of the IGU.
- We advise processing and handling this coated glass with care in order to avoid coating damage. The personnel responsible for handling must wear clean gloves to ensure that no fingerprints are left on the glass.. Therefore we strongly recommend that everything coming into contact with the coating of the glass during preliminary processes be pre-validated.
- No edge deletion: Tests using different sealants have shown that, under strict conditions and with a selection of sealants, prior edge-deletion is no longer required. . A specific brochure "SEALANT COMPATIBILITY - STRUCTURAL GLAZING - Technical information for Stopray® Smart products" available on www.agc-yourglass.com describes these conditions. The described instructions must be strictly respected and executed.
- For the various glazing methods (traditional framing, structural glazing, ..) tests for compatibility and adherence of the coating with the sealant must be made in each case with the sealant manufacturer. The AGC specification described in the document "SEALANT COMPATIBILITY - STRUCTURAL GLAZING - Technical information for Stopray® Smart products" must be carefully respected. This brochure is available on www.agc-yourglass.com.

CONTENTS

0.	PRODUCTS.....	5
I.	RECEPTION AND STORAGE	5
1.	Unloading	5
2.	Storage of the packs.....	5
II.	PROCESSING	7
0.	Safety & General Information.....	7
1.	Cutting	9
2.	Edge-deletion	9
3.	Edge processing	9
3.1	Handling the glass	10
3.2	Shaping the edges.....	10
3.3	Unloading.....	10
4.	Washing	11
5.	Silk screen printing	11
5.1	Stopray SMART with silkscreen.....	11
5.2	Stopray LamiSMART with silkscreen.....	13
6.	Thermal Toughening / Heat strengthening	13
6.1	Introduction	13
6.2	Generalities.....	14
6.3	Recommendations	15
6.4	Settings	16
6.5	Unloading.....	17
6.6	Heat Soak test.....	17
6.7	Quality control	17
6.8	Packaging	18
7.	Bending	18
7.1	Curved annealed glass (on a concave mould)	18
7.2	Curved toughened glass (on a concave mould)	19
8.	Use in single glazing	20
9.	Lamination.....	20
10.	Assembly in Insulating Glass Unit (except for LamiSmart 24)	21
11.	Use in Structural glazing.....	22
12.	Identifying the coated surface	22
13.	Storage of cut sizes / IGU.....	23
13.1	During processing in the same factory	23
13.2	To send cut size to another factory	23
13.3	On site	23
III.	CONFORMITY and GUARANTEE	24
1.	Conformity	24
2.	Warranty.....	24
3.	CE Marking.....	24
4.	Disclaimer.....	24
IV.	GLAZING INSTRUCTIONS.....	24
V.	CLEANING ON FACADE	24
VI.	NOTES	25

0. PRODUCTS

This Processing Guide concerns the Stopray Smart products: Stopray Smart 51/33 , Stopray Smart 30/20 and LamiSmart 24.

The Stopray Smart and Stopray LamiSmart products can be used either annealed (so without heat treatment) or with heat treatment (thermal toughening or heat strengthening).

The Stopray Smart products can be used in this configuration :

Configuration	Insulated glazing units with coating facing cavity	Laminated glazing units with coating in contact with pvb-interlayer
Smart 30/21	YES	NO
Smart 51/33	YES	NO
LamiSmart 24	NO	YES

I. RECEPTION AND STORAGE

1. Unloading

The packs of glass must be inspected on arrival. AGC shall accept no liability for coating defects arising after delivery or during handling, processing or installation of the finished product in the building if this procedure is not followed:

- The rack must be positioned on perfectly level ground.
- Use the appropriate handling equipment.
- The grab must be perfectly centered.
- Avoid damaging the protective packaging whilst handling.
- The glass must be stored on appropriate racks.
- All recommendations given in this Processing Guide shall be strictly followed.

General 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.

2. Storage of the packs

Storing packs correctly reduces the risk of chemical or mechanical damage to the glass.

As a general rule, care should be taken to avoid major fluctuations in temperature and humidity that may cause condensation on the glass. Such fluctuations generally occur near loading and unloading areas. No water must be allowed to come into contact with the sheets of glass.

Care should be taken to ensure that the 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, road salt on the ground and so forth.

Factory racks are used for packaging during transport and are not designed to be used for storage. Consequently, the PLFs must be stored on racks with spacers between packs ensuring that all packs of the same size are stored together.

Stock sheets (PLF and DLF)

Special packaging requirements apply in function of the final destination of the coated glass packs.

Shelf life without any protection: the glass has to be consumed within 9 months from the delivery in the processor's facility.

Shelf life with protection: the glass has to be consumed within 12 months from the delivery in the processor's facility.

When protection is needed, desiccant bags are fit on the upper side and on the lateral sides of the stack (two thirds of the height, from the upper corners). A protection tape is glued on the four sides.

Once the pack is opened, the glass has to be consumed within nine months.

Once the protective packaging is opened, the remaining sheets cannot be re-packed.

Upon receipt, we advise you to check if the packaging has been damaged during transport/handling. If the weather-proof packaging has been damaged, condensation marks may appear on the glass. In this case, you should open the packaging to take out a desiccant pack and weigh it. Contact AGC immediately.

However, it is important to bear in mind a number of additional points:

- The sheets must be moved using a suction-pad lifting beam or an automatic unstacking machine. The suction pads are placed on the glass side.
- If the glass is handled by placing suction pads on the coating, these suction pads must be perfectly clean and covered with a protective material¹.
- Care must be taken to ensure that the suction pads/coating do not slip.
- The personnel responsible for unloading must wear clean gloves to ensure that no fingerprints are left on the glass.

General comments:

If, despite the precautions taken, marks do appear on the coating (fingerprints etc.) they should be removed at once using a clean, soft and wet (water) cloth and then a dry cloth. Soft circular movement should be applied..



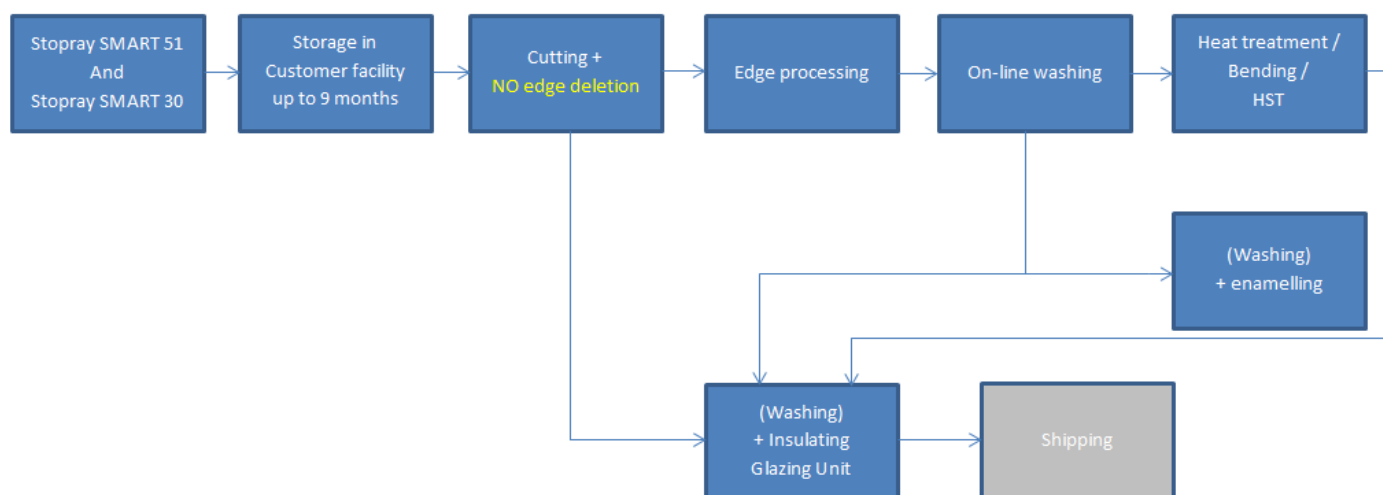
II. PROCESSING

0. Safety & General Information

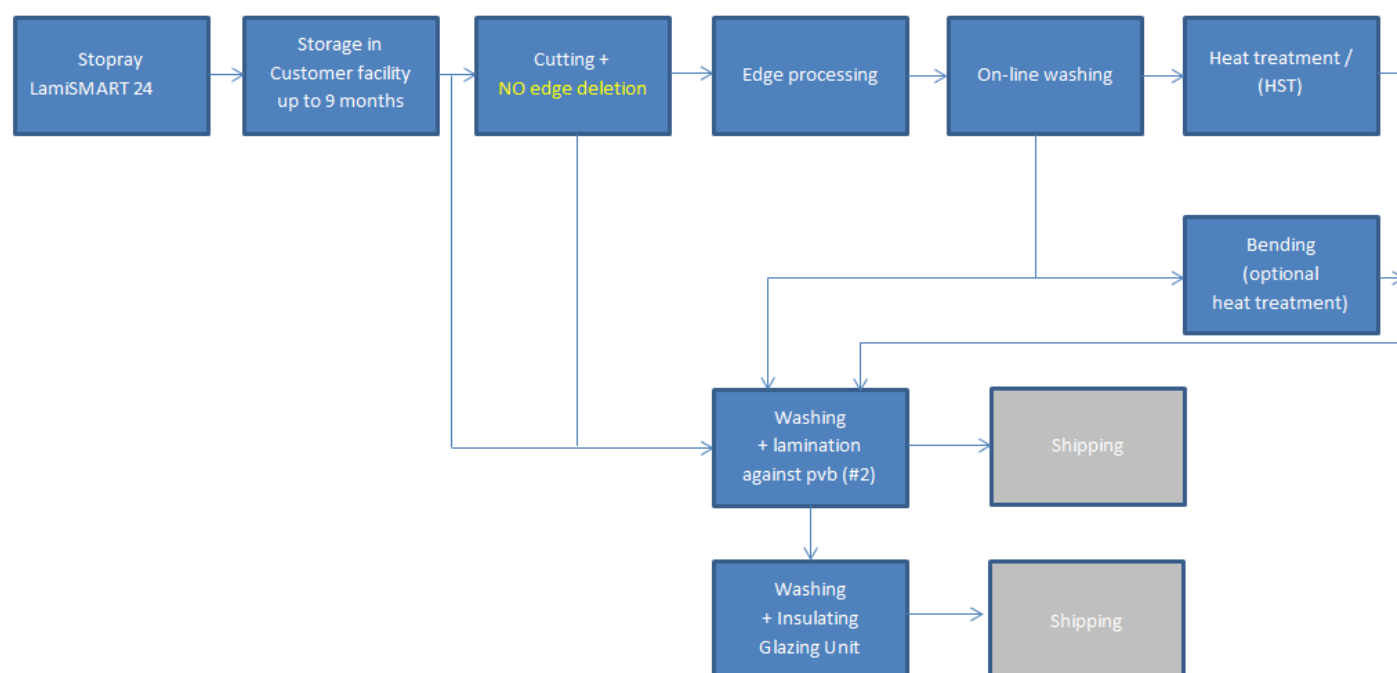
At each stage of the processing procedure, the personnel responsible for handling the glass must have the adequate equipment: safety shoes, safety gloves², safety glasses, ...

The different industrial stages for Smart and LamiSmart are described hereafter.

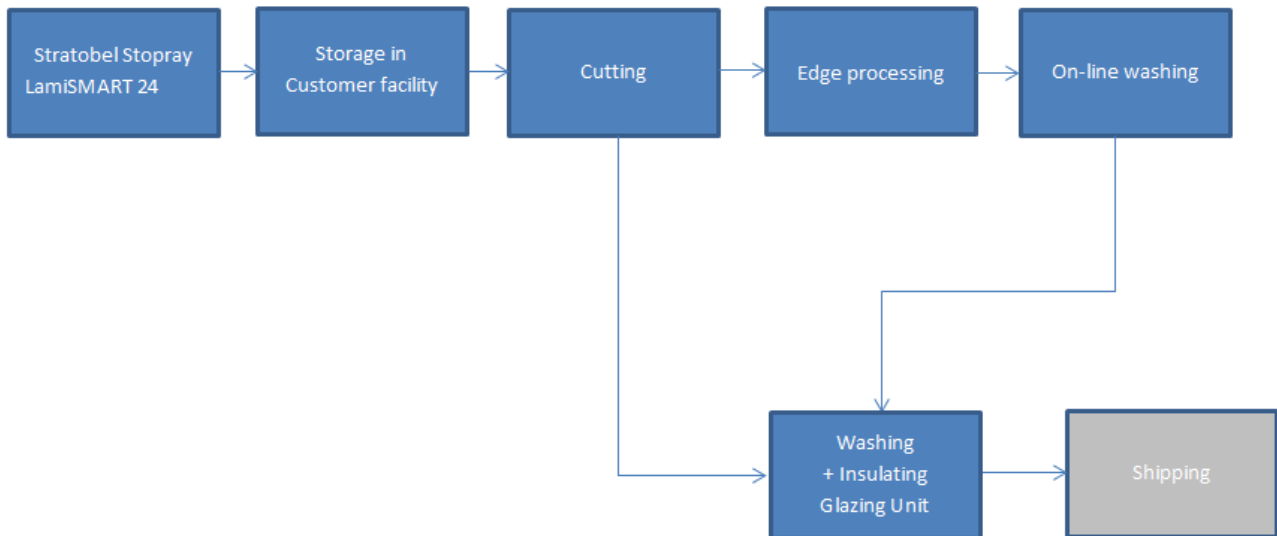
Stopray Smart 30 & Stopray Smart 51



Stopray LamiSmart 24



Stratobel Stopray LamiSmart 24 = Stopray LamiSmart 24 laminated against PVB (#2)



1. Cutting

The following specific precautions must be taken when cutting:

- When cutting, the coated side must be facing upwards to avoid any contact between the coated side and the surface of the table.
- The cutting oil used should be compatible with the coating, sufficiently volatile and water soluble³.
- The table and any break-out equipment coming in contact with the coating on the glass must be pre-validated.
- Cutting personnel must wear clean gloves to avoid leaving finger marks on the coating².
- If the glass is to be cut using a template, the template must be positioned very carefully and care must be taken not to scratch the coating. We recommend placing a protective sheet between the template and the glass.
- The cut sheets of glass must be stored on racks. Care must be taken when handling them to ensure that the coating on the first sheet does not rest against the back of the rack. All subsequent sheets should be turned the other way.
- No particular spacer is needed if the original interlayer powder is still present. However, if for any reason there is not enough interlayer powder left on the glass, we recommend that you place cork spacers between the sheets⁴.
- The coating around the edge of the glass may be removed during the cutting process provided that dust from grinding is properly removed.
- For ease of detecting if a Stopray LamiSmart is present in a laminated safety glass during the processing:

> before cutting:

Check on the presence of coating deposition on the edge (a reflection means: coated glass).

> after cutting:

Put a sticker on the uncoated glass side of cut-sizes before unloading from the cutting table.

If during the processing the sticker gets lost: compare the edge of the cut-size, the glass component with a darker edge appearance is the coated glass.

2. Edge-deletion

Tests using different sealants have shown that, under strict conditions and with a selection of sealant, prior edge-deletion is no longer required. A specific brochure "SEALANT COMPATIBILITY - Technical information for Stopray® Smart products" available on www.agc-yourglass.com describes these conditions. Contact AGC Technical Advisory Service for further information (tas@agc.com). The described instructions must be strictly respected and executed

If for any specific reasons, the customer wants to edge-delete the coating it has to be done as described in the Stopray range processing guide available on www.agc-yourglass.com.

3. Edge processing

The Stopray Smart 51 and 30, and the Stopray LamiSmart 24 products are designed to possibly undergo thermal toughening or heat strengthening. Accordingly, edge processing is required. The Stratobel Stopray LamiSmart 24 can be edge-processed, too.

3.1 Handling the glass

The personnel responsible for handling and shaping the edges of the glass must wear perfectly clean safety gloves².

3.2 Shaping the edges

Several types of edging machinery are available on the market:

3.2.1. Crossed belt system

We recommend for personnel to work with diamond belts and adhere strictly to the supplier's instructions, specifically in terms of speed and cooling. For thicknesses in excess of 6 mm, we recommend 'smooth edge' shaping.

3.2.2. Vertical single edging system

Since the glass is held with chain tracks and, depending on cleanliness and maintenance of the machine, there is a risk of scratching the coating.

3.2.3. Horizontal double edging system

It is possible to use this type of machine provided that the glass is held by smooth, non-textured belts. The speeds of the various belts must be synchronised. Mains water jets are placed in such a way that the coating is soaked and cleared of various impurities (e.g. separating powder or glass dust) just before they come into contact with the upper roller belts.

3.2.4. Numerical Control Systems (CNC)

Shaping using a numerically controlled machine is permitted provided that the glass is placed with the coated side facing upwards.

General recommendations for shaping edges:

- The glass must remain moist throughout the shaping process in order to prevent 'natural drying'.
- The glass must be washed as soon as it has been shaped.
- The glass may be drilled provided that the press is covered with a soft protective material.
- The glass may be processed using dry crossed belts provided that the extraction system is sufficiently effective to remove the dust resulting from grinding.

3.3 Unloading

Due to the fact that the interlayer powder is removed during the washing process, we recommend placing micro-suction pads ⁴ around the edge of each sheet of glass in order to prevent contact between the glass and the coatings. Paper with a neutral pH can also be used, for example, for large pieces .

The personnel responsible for handling the glass must wear clean gloves² suitable for handling coated glass.

4. Washing

This stage involves washing, rinsing and drying the glass.

A mains-water spray station should be installed just before the point where the glass enters the washer. This will remove any abrasive elements on the coating (cutting and edge-processing residues) that could cause scratches when the brushes make contact with the coating.

The glass must be washed in clean, deionized water with a pH of 7 (± 1) and a conductivity of $<30 \mu\text{S/cm}$. No hard particles (such as calcium) or acidic/detergent agents should be present in the water used for washing and rinsing as these may damage the coating.

We recommend the use of 'soft' brushes (diameter of the bristles $<0,15 \text{ mm}$), 1-2 mm of which come into contact with the glass. There must be enough water to guarantee that the water is distributed evenly and efficiently across the coating before it comes into contact with the brushes.

It is also important not to stop the cycle whilst the glass is in the washing machine.

After washing, micro-suction pads⁴ should be used on the perimeter of the glass in the area that normally would be edge-stripped in order to avoid any contact between glass and coating. For large sheets of glass, a sheet of paper should be placed on the center of the glass.

The glass must be completely dry. We recommend checking whether the air filters of the ventilation units are clean.

Two or three halogen lights should be present at the exit of the washer to light the glass correctly (vertically from top to bottom) and even detect and quickly correct any deviations from the requirements listed above.

Summary of the quality of water used for shaping and washing the glass:

	SHAPING	WASHING	
		<i>Washing</i>	<i>Rinsing</i>
Coolant	No	-----	-----
Detergent	-----	No	No
Temperature	-----	$< 40^{\circ}\text{C}$	$< 40^{\circ}\text{C}$
pH	7 ± 1	7 ± 1	7 ± 1
Conductivity	-----	$< 100 \mu\text{S/cm}$	$< 30 \mu\text{S/cm}$

Remarks:

- Any small marks after washing (during handling) can be removed by using a wet cloth (water) and then a dry cloth. Soft circular movement must be applied .
- Stratobel Stopray LamiSmart can be washed with settings as for a clear laminated glass.

5. Silk screen printing

5.1 Stopray Smart with silkscreen

In case of a silkscreen on the Stopray Smart, where the silkscreen is in contact with the sealant joint, the edge-deletion of the coating is required prior to the application of the silkscreen.

AGC recommends to assess the aesthetics by means of a mock-up sample.

The calculation and dimensioning of the sealant joint is under responsibility of the manufacturer of the insulating glazing units.

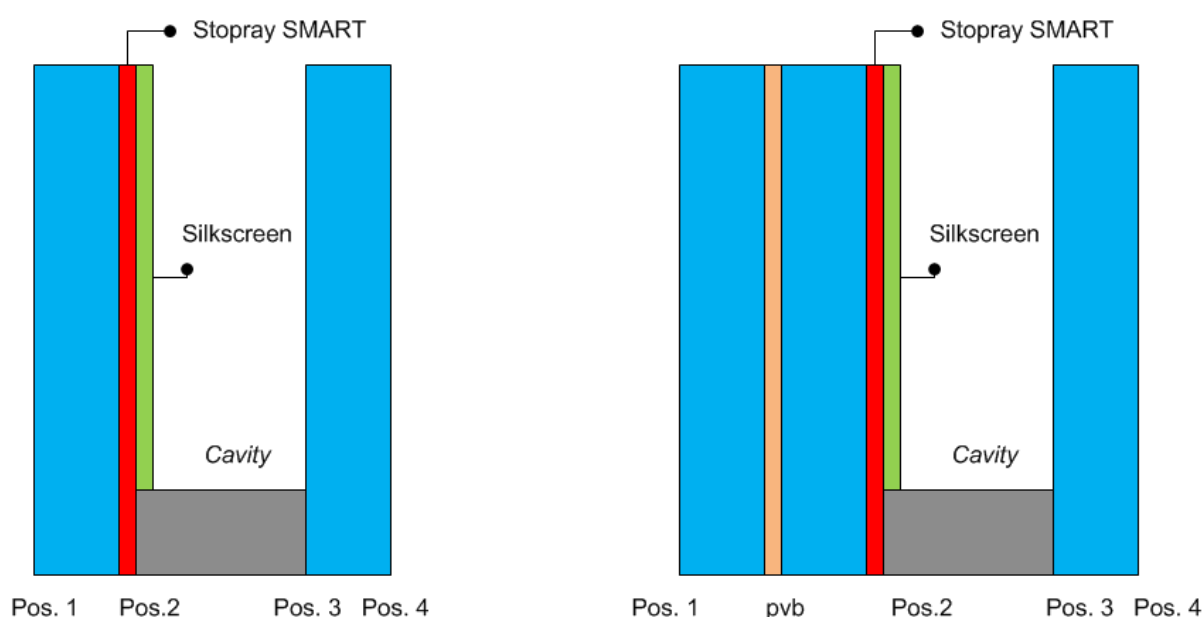
In case the silkscreen is in contact with the sealant joint, the compatibility of the sealant joint, structural joints and weatherseals with the silkscreen (enamel) paint is under responsibility of the manufacturer of the insulating glazing units, and should be assessed in cooperation with the sealant supplier.

Additional recommendations:

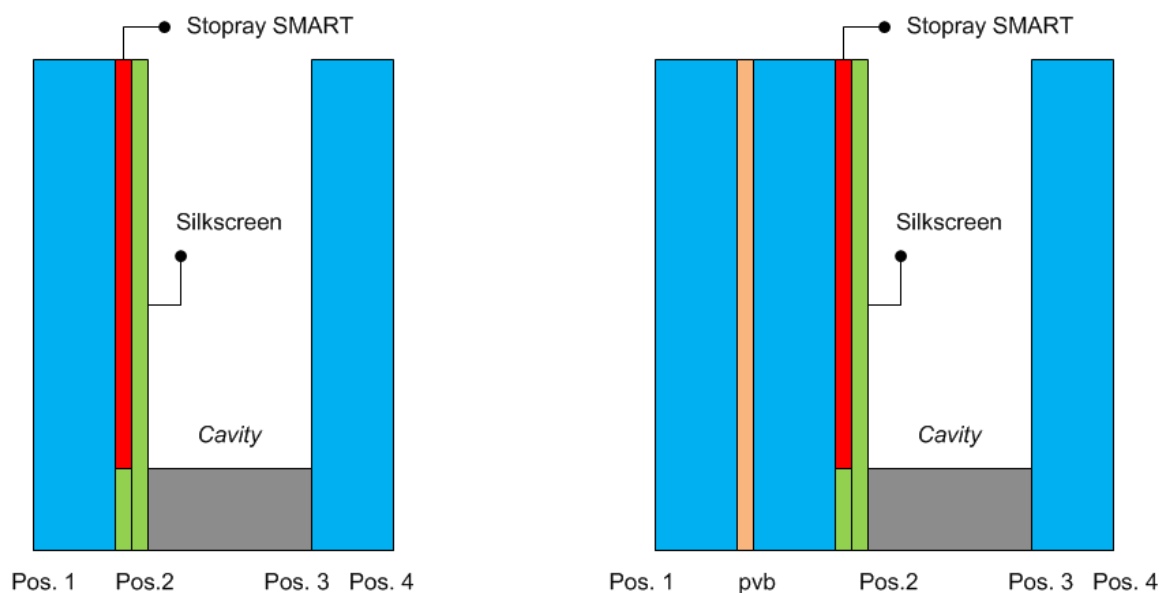
- Any impurities on the coated surface can be removed using a compressed dry-air jet.
- AGC recommends using clear-coloured enamels that have a sufficiently high energy reflection level. A dark-coloured enamel will have a relatively high energy absorption level and the coating may be damaged under the enamel during the heating process.
- Similarly, when the coverage percentage is very high and confined to a very small area, the printed section of the glass may behave differently to the uncovered section in the quench.
- In any case, the final result will depend on the type of furnace used, its parameters, the colour and type of enamel used and the desired pattern. The processor will have to carry out preliminary tests, and manufacture some mock-up samples on a case by case basis, to avoid these problems. AGC is not liable under any circumstances for the outcome of the operation.
- The presence of enamel on the coating changes the optical properties of the final glass product. These performance properties can be obtained from AGC Technical Advisory Service (tas@agc.com).

Drawing given for purpose of illustration.

5.1.1. [Silkscreen not in contact with the sealant joint](#)



5.1.2. Silkscreen in contact with the sealant joint



5.2 Stopray LamiSmart with silkscreen

The application of a silkscreen on a laminated safety glass Stopray LamiSmart is allowed, meaning:

- The coating Stopray LamiSmart is in contact with the pvb-interlayer;
- The silkscreen is applied on pos. 2, facing the cavity.

Two cases are possible :

1) the silkscreen is in contact with the sealant joint: the compatibility of the sealant joint, structural joints and weather seals with the silkscreen is the responsibility of the manufacturer of the insulating glazing units, and should be assessed in cooperation with the sealant supplier.

2) no silkscreen in contact with the sealant joint: no assessment required.

AGC recommends to assess the aesthetics by means of a mock-up sample.

The calculation and dimensioning of the sealant joint is the responsibility of the manufacturer of the insulating glazing units.

6. Thermal Toughening / Heat strengthening

6.1 Introduction

The Stopray Smart range (except for LamiSmart 24) is self-matchable: these products can be used annealed or toughened / heat strengthened as needed by the application. Both annealed and heat treated products have similar reflection and transmission. Hereafter the summary of the self-matchability:

COLOR MATCHABILITY	Stopray Smart 51 Pos 2 annealed	Stopray Smart 51 Pos 2 Heat treated or Curved	Stopray Smart 30 Pos 2 annealed	Stopray Smart 30 Pos 2 Heat treated or Curved	Stratobel Stopray LamiSmart 24 Pos 2 annealed	Stratobel Stopray LamiSmart 24 Pos 2 Heat treated or Curved
Stratobel Stopray LamiSmart 24 Pos 2 annealed	NO	NO	NO	NO	NO	NO
Stratobel Stopray LamiSmart 24 Pos 2 Heat treated or Curved	NO	NO	NO	NO	NO	NO

Stopray Smart coatings (heat treated or not) must be assembled in insulating glazing. We recommend processing and handling this coated glass with care in order to avoid coating damages.

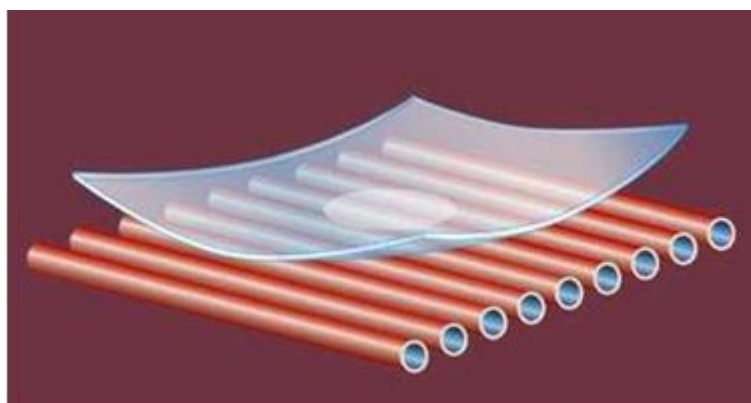
Pre-process defects will generally only be revealed by the toughening process itself and this can cause severe aesthetic defects. **Therefore we strongly recommend that all objects coming into contact with the coating of the glass during preliminary processes be pre-validated.**

6.2 Generalities

When a clear glass is placed in a toughening furnace it deforms considerably (concave shape) during the first heating cycle. The deformation is even more pronounced with low-emissivity glasses such as Stopray Smart.

This is due to the different heating speeds of the surfaces.

In a purely radiation furnace, the lower surface is heated by conduction (contact with the rollers) and radiation (lower heating resistance). Since the upper surface is covered with a low-emissivity coating, which, by definition reflects the radiation emitted by the upper heating elements in the furnace, it does not heat up as quickly. The two surfaces do not, therefore, heat up symmetrically which leads to concave deformation of the glass due to differential expansion (see photo below). This phenomenon causes a marking, or even optical deformation of the glass at the center of the pane.



The only way to neutralise these defects is to balance the heating process by using additional heat transfer onto the upper surface. Significantly increasing the temperature of the roof does not resolve the problem because the low-emissivity coating will still reflect this increase in radiated energy. Moreover, this will cause the rollers to overheat which could aggravate the problem.

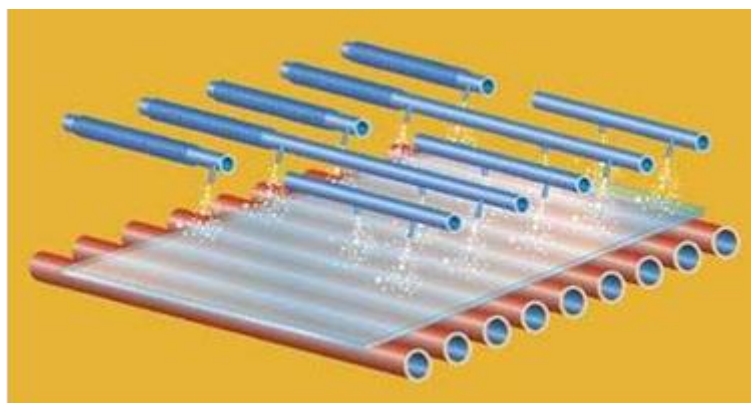
The only solution is to create additional energy via **convection over the upper surface**.

This can be done by creating an air flow over the upper surface that is hotter than the glass itself. The air is provided by an external compressor and is pre-heated in the furnace before it is pumped over the upper surface of the glass via rollers fitted with jets (see figure below). Another technique involves drawing hot air out of the furnace and pumping it back in again (re-circulation).

The latest generation of convection furnaces no longer have internal radiation elements. They only heat the glass using pre-heated air.

This additional air supply to the upper surface of the glass helps:

- Keeping the glass flat during the heating process and avoiding the aforementioned defects.
- Significantly reducing the heating time and therefore boosting the productivity of the plant.



6.3 Recommendations

- We recommend toughening or heat strengthening within 48 hours of cutting.
- The glass must be placed with the coated side facing upwards.
- The personnel handling the glass must wear clean gloves². Larger and heavier sheets should be handled with suction pads covered with a protective material¹.
- Markings may be made before toughening on the upper side of the glass coated.
- We recommend stopping the SO₂ supply in the toughening furnace at least 24 hours before toughening this kind of glass: the combination of SO₂ and a preliminary process that is not completely correct may change the appearance of the product.
- We recommend for LamiSmart24 strictly following the “Processing Guide Laminated Tempered” For further informations, please contact the AGC Technical Advisory Service (tas@agc.com).

6.4 Settings

Each furnace has its own settings for heating and quenching. As a result, the following recommendations should be taken as general guidelines.

The furnace settings depend on:

1. The product to be thermally toughened or heat strengthened

- a. dissymmetry of the absorption (emissivity of the coating/absorption of the substrate)
- b. glass thickness
- c. glass/furnace dimensions

2. Type of furnace

- a. power density
- b. convection rates
 - radiation with compressed air (type A)
 - radiation with re-circulation (type B)
 - convection (type C)
- c. heating geometry (relative position of the heating/thermocouple/glass elements)

In practice, it is advisable to start with pieces of 1,500 x 1,500 mm

1. Temperature 700°C at the top and bottom

2. Cycle time

- a. Furnace type A : 60 -75 sec/mm
- b. Furnace type B : 50 -55 sec/mm
- c. Furnace type C : 40 -45 sec/mm

3. Convection : The convection profile will be adapted to obtain a flat sheet of glass as quickly as possible and to maintain this flatness until the end of the heating process. If, despite a maximum convection rate, the glass retains a concave profile for too long, the temperature on the lower side will need to be reduced by 20-30°C.

The cycle time will be adjusted to prevent breakage in the quench and to obtain an acceptable optical quality.

The quench parameters will be set to ensure that the glass comes out flat (air balance top/bottom) and that the desired break pattern is achieved.

NB For very low-emissivity products, such as Stopray Smart products, a much higher air pressure needs to be applied to the upper surface of the glass during the actual heat treatment process. This is due to the fact that the coated surface does not cool down through radiation whilst the lower surface does. This phenomenon is all the more noticeable when the air pressure is low (very thick toughened glasses > 8 mm and heat-strengthened glass > 6 mm). A quench capable of producing highly dissymmetrical air pressure flows is therefore required.

For further information, please contact the AGC Technical Advisory Service (tas@agc.com).

6.5 Unloading

- If the glass is unloaded manually, the personnel must wear clean gloves².
- Larger and heavier sheets should be handled with a suction-pad lifting beam. The suction pads must be covered with a protective material¹. The toughened sheets are then stored on racks.
- Care must be taken when handling them to ensure that the coating on the first sheet does not rest against the back of the rack. All subsequent sheets should be turned the other way.
- Given that toughened glass sheets are never perfectly flat, micro suction pads⁴ should be placed around the edge of each sheet of glass in order to prevent contact between the glass and the coatings. For large volumes, paper with a neutral pH can be placed in the center to avoid all contact with the glass/coating during handling and transport.

6.6 Heat Soak test

The risk of spontaneous breakage due to nickel-sulphide inclusions is inherent to thermally toughened glass. The presence of such inclusions can in no way be considered as a fault in the glass. In order to eliminate the risk of spontaneous breakage, an additional heat soak test can be carried out in accordance with standard EN 14179-1 (or equivalent standards for countries outside the EU).

AGC highly recommends using electrical equipment. Gas-fired furnaces must not be used for heat soak tests due to the risk that the coating could react with the smoke.

Interlayer's should only be placed on the perimeter of the glass.

6.7 Quality control

The declared properties of toughenable coatings correspond to the performances after the heat treatment. The coating will have achieved the performances indicated once its temperature reaches 500°C

The electrical resistance of the coating is an indicator of this change in properties during the heat treatment process. Resistance (measured with a four-point probe) must be around 3.5 Ohm/square.

Annealed products present the same optical and energy performance as the heat treated glass.

Heat-strengthened products offer the same optical and energy performance as the toughened glass.

For further information, please contact the Technical Advisory Service (service.technicaladvisory@eu.agc.com).

After the toughening process, the Stopray Smart products should be inspected as follows:

- The coating is inspected in accordance with EN 1096-1*
- Toughened glass must comply with EN 12150-1*
- Heat-strengthened glass must comply with EN 1863-1*.
- The eventual Heat Soak Test (HST) must be carried out in accordance with EN 14179-1*
- The LamiSmart 24 is inspected in accordance with the Processing Guide Laminated Tempered.

* Or equivalent local standards for countries out of the EU.

N.B. For the EU, the Stopray Smart products must be CE marked in accordance with EN 1863-2, 12150-2 or EN14179-2. In accordance with EU-regulations, all the requirements set out by these standards (ITT – Initial Type Test, FPC – Factory Production Control, etc.) must be met by the processor.

6.8 Packaging

If the heat treated coating is not assembled in an insulating glazing in the same processing factory, the following recommendations for packaging must be adhered to:

- A 1 mm-polyethylene foam spacer⁵ should be placed between each sheet.
- The pack of glass should be packaged in watertight plastic. Sachets filled with desiccating agents should be placed inside the packaging⁶.
- Care must be taken to ensure that the pack is properly attached to the rack so that the sheets do not rub together.
- The glass will be assembled into insulating glass within one week after it has been toughened.

7. Bending

Bending tests have been carried out in different types of bending furnaces.

The following general recommendations refer to 6 mm Stopray Smart 51/33. Other thicknesses have not been evaluated as such and require preliminary validation tests by the glass processor. This is particularly important for glass thicker than 6 mm that will be subject to higher temperatures for a longer period of time.

The technical values stated (cycle times, temperatures and so forth) were noted during tests on certain types of bending equipment and obviously depend on the individual characteristics (shape, strength, convection rate and so on) of this equipment. The recommendations set out here are therefore intended as general guidelines and preliminary tests must be carried out for each bending furnace.

7.1 Curved annealed glass (on a concave mould)

Only bending ovens with top and bottom heating elements and with an upper convection system are suitable for bending coatings. The coating of the glass must always be in position 2 (coating in compression).

All instructions regarding the pre-process (unloading, storage, cutting, shaping, washing and handling) must **be strictly adhered to**.

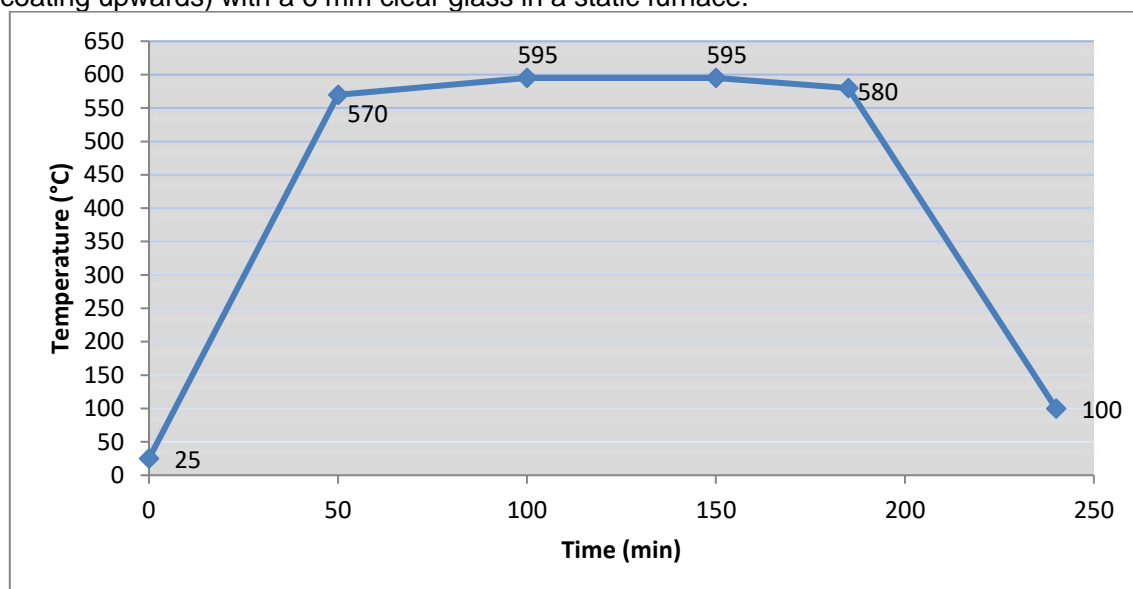
The glasses should be shaped to a smooth ground edge.

- Place the coating on the concave mould (coated surface facing upwards).
- Apply the appropriate packing powder (generally crystalline silica).
- Place a sheet of float glass on top.

Heating/cooling parameters

- The temperatures must be adjusted so that the **upper surface of the glass** matches the following curve as closely as possible.

An example of heating/cooling parameters are described in the following figure for a 6 mm Stopray Smart 51/33 (coating upwards) with a 6 mm clear glass in a static furnace.



NB: The final heating phase must be adjusted according to the position of the glass in the bending mould.

7.2 Curved toughened glass (on a concave mould)

7.2.1. Static furnace

- The glass is placed on a **concave mould** with **the coated surface facing upwards**.
- The furnace has heating elements on each of the six surfaces within the furnace and has an upper convection system composed of compressed air pipes ($P = 2$ bar).
- The temperature of the **furnace** must gradually reach its final value (640 °C) (linear progression).
- The glass must be transferred to the toughening section one to two minutes after it has completely bonded to the support.
- The cycle time lasts 15 to 20 minutes and depends largely on the size of the glass and the radius of curvature.
- The lower blow pressure is identical to that used for clear float glass of equal thickness.
- The upper blow pressure must be increased by 10 to 15%.

7.2.2. Conveyor furnace

- The glass is placed in the furnace with the coated surface facing upwards.
- The furnace is equipped with one of the latest models of upper convection system.
- The temperatures should be 700 °C and 680 °C in the upper and lower sections respectively.
- The cycle time lasts 400 seconds (this should be adjusted according to the size of the glass and the radius of curvature).
- Convection pressure: 70% of the maximum value for 220 seconds.
- Then, linear decrease to 0% at the end of the heating cycle.
- The glass is then transferred to the bending/toughening section.
- The lower blow pressure is identical to that used for clear float glass of equal thickness.
- The upper blow pressure must be increased by 10 to 15%.

For further information, please contact the Technical Advisory Service (service.technicaladvisory@agc.com).

8. Use in single glazing

The Stopray Smart coatings cannot be used as single glazing, except for the Stratobel Stopray LamiSmart 24 product.

9. Lamination

LamiSmart 24 is designed specifically for the lamination process. The coating LamiSmart 24 has to be applied against PVB interlayer in position #2. The position #3 can be used if a tinted glass is the outer pane of the laminated glass. AGC can assist its customers in calculating the light- and energy-characteristics or via the GlassConfigurator tool on www.yourglass.com.

To guarantee the aesthetics and to ensure superior performance, special care must be taken during the fabrication as described in the previous sections. Please pay attention to the processing guide instructions for the lamination process.

In general, the laminated glazing cannot be processed in an industrial atmosphere with a high levels of humidity. The edge of the laminated glazing has to be protected by a sealant to avoid permanent contact with water. AGC recommends using the validated sealants described in the sealant compatibility description. Without compatibility tests, direct contact between the PVB interlayer and a non-validated sealant is not allowed. Glazing systems should be designed to prevent delamination or corrosion of the inside coating. The processor is responsible for the correct processing of the laminated glazing.

After the lamination process, the LamiSmart products should be inspected as follows:

➔ Durability of laminated glass, please refer to EN 12543-4, EN 12600 and EN 356. The correct lamination and safety compliance is the responsibility of the processor.

The following points require special attention when using inside laminated coated glass:

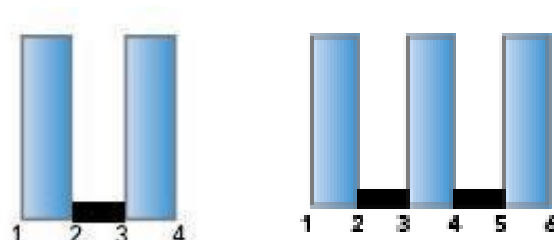
- LamiSmart 24 is a self-matchable product in position 2 of the laminated glass. The opto-energetic performances before and after tempering are similar.
- LamiSmart 24 is only dedicated to lamination (with the coating in contact with the PVB interlayer). The light- and energy-characteristics are to be calculated with the Glass Configurator tool on www.yourglass.com.
- Loss of thermal insulation performance in monolithic (u-Value)
- The adhesion test could be slightly lower for the coated side (standard values for pummel are 5.5 and 4 for uncoated and coated side, respectively)
- The interlayer is a clear architectural polyvinyl butyral (pvb)
- AGC recommends a number of tested sealing compounds in a specific document.
- For tempered LamiSmart 24, we recommend strictly following the "Processing Guide Laminated Tempered". For further information, please contact the AGC Technical Advisory Service (service.technicaladvisory@eu.agc.com).

Glazing systems should be designed to prevent delamination or corrosion of the inside coating. The processor is responsible for glazing. The correct lamination and safety compliance is the responsibility of the processor.



10. Assembly in Insulating Glass Unit (except for LamiSmart 24)

The Stopray Smart products are designed to be assembled in insulating glass units with the following restrictions for the coating position.



	Coating position in the IGU			
	1	2	3	4
Stopray Smart 51/33	KO	OK	KO	KO
Stopray Smart 30/20	KO	OK	KO	KO

As such, it is essential to check that the coating is in the correct position before assembly.

The glass should be assembled in insulating glazing within one week after being heat treated.

The individual responsible for assembly must check that the coating is compatible with the sealing products. See special brochure for sealants recommended by AGC.

AGC recommends indicating the external surface after assembly to ensure that the units are installed correctly.

N.B. For the EU, when the Stopray Smart coatings are assembled in IGUs, this IGU must be CE marked in accordance with EN 1279-5. In accordance with EU-regulations, all the requirements set out by these standards (ITT, FPC, etc.) must be met by the processor.

Quality control

It is essential to check that the coating is in the correct position before assembly. Any mistake could lead to changes in performance and/or aesthetics.

Quality control for the final product (insulating glass) involves not only strict compliance with the instructions provided in this processing guide, but also meticulous checks at each stage of the manufacturing process.

Two or three halogen projectors must be placed at the exit of each processing machine to light the glass correctly (vertically from the top to the bottom) to immediately detect any deviation from the regulatory parameters that could affect the appearance of the coating (e.g. scratches or other contamination).

11. Use in Structural glazing

When installation or assembling is by mechanical methods, structural glazing or other techniques, tests for compatibility and adherence of the coating or the adhesive must be made in each case with the adhesives manufacturer .

The AGC specification described in the document “SEALANT COMPATIBILITY - Technical information for Stopray® Smart products” must be carefully respected. This brochure is available on www.agc-yourglass.com. Contact AGC Technical Advisory Service (tas@agc.com) for further information.

12. Identifying the coated surface

Before the shaping process, the coated side can easily be identified by the cut, which is visible on the edge of the glass.

After shaping, and until the glass is assembled in double glazing, the coating may be identified using an electric tester, available on request from any AGC representative.



13. Storage of cut sizes / IGU

13.1 During processing in the same factory

After each processing step, when the glass is stored on racks, no particular spacer is needed if the original interlayer powder is still present. If for any reason there is not enough interlayer powder left on the glass, and particularly after the washing, we recommend that you place cork spacers between the sheets⁴. The same recommendations apply for packs with several glass dimensions.

The storage must be conform to the recommendations of § I.2.

13.2 To send cut size to another factory

If the Stopray Smart coatings have to be delivered from the processing factory to another factory, the following recommendations for packaging must be adhered to:

- A 1 mm-polyethylene foam spacer should be placed between each sheet⁵.
- Care must be taken to ensure that the pack is properly attached to the rack so that the sheets do not rub together.
- The pack of glass should be packaged in watertight plastic. Sachets filled with desiccating agent should be placed inside the packaging.

13.3 On site

When the glazing is delivered on site to be installed on the facade, it must be stored in a dry, sheltered and ventilated space. It must never be laid flat, nor be stored in the sun or near a heat source.

III. CONFORMITY and GUARANTEE

1. Conformity

The Stopray Smart products comply with the standard EN 1096-1, category C.
The Stopray Smart coatings (heat treated or not) must be assembled in double glazing with the coating in inside the cavity. The Stopray Smart coatings cannot be used as single glazing, except for Stratobel LamiSmart 24 products.

Information regarding inspection conditions and quality criteria are available in that standard.

2. Warranty

The warranty is available on www.agc-yourglass.com.

3. CE Marking

All information and declarations related to the CE Marking of the Stopray Smart and LamiSmart products are available on www.agc-yourglass.com/CE.

Where customers process these coatings (heat strengthening, toughening, lamination, assembly in IGUs), they are responsible for CE marking processed products and fulfilling the associated requirements (performing initial type tests (ITTs), marking the glass, factory production control, etc.).

4. Disclaimer

It is the responsibility of the processor to inspect the processed coated glass adequately before and after each step of fabrication and prior to installation. Failure to apply all professional standards, customary instructions and processing instructions written in this processing guide and related links will automatically void any warranty regarding coated glass of AGC. We advise the processor to undertake some preliminary trials with the typical glass compositions for the project prior to any further commitment with his customer. The processor is solely responsible for the quality of the final product.

Regarding preliminary trials advices can be obtained at AGC Technical Advisory Service (tas@agc.com or Jean-Marie.Sellier@agc.com).

IV. GLAZING INSTRUCTIONS

The AGC glazing instructions are available at www.agc-yourglass.com.

V. CLEANING ON FACADE

The cleaning instructions for glazing installed on facades are available at www.agc-yourglass.com.

VI. NOTES

¹ Recommended protective material for suction pads:

Product description: suction cup housing

NB: max. diameter: 300 mm.

Supplier: IMPEXACOM

Rue des tourterelles 14-16

B -5651 Thy le Château -Belgium

Tel.: + 32 71 612145

Fax: + 32 71 612164

² Recommended gloves:

Product description: HYD TUF 52-547 (glove size 8-10 for handling coated glass)

Supplier: IMPEXACOM

Rue des tourterelles 14-16

B -5651 Thy le Château -Belgium

Tel.: + 32 71 612145

Fax: + 32 71 612164

³ Recommended cutting oil:

Product description: ACPE 5503 cutting oil

Supplier: ROLAND

Rue de la petite Ile 4

B – Brussels -Belgium

Tel.: + 32 2 5250618

Fax: + 32 2 5200856

⁴ Recommended spacer for toughened/heat-strengthened:

Product description: Cork disks with micro suction pads (3x20x20 mm)

Supplier: VITO IRMEN

Mittelstrasse 74-80

D -53407 Remagen -Germany

Tel.:+ 49 26 42 40 07 10

Fax:+ 49 26 42 42 913

⁵ Recommended packing foam:

Product description: 1 mm packing foam

Supplier: SCRIPHORIA

Wellen Belgium

Tel.: + 32 11 370 111

⁶ Recommended sachets of desiccating agents:

Product description: desiccating agent in sachets of 125 g

Supplier: STOKVIS

Vilvoorde -Belgium

Tel.:+ 32 2 255 06 11