SAINT-GOBAIN

CERAMIC PRINT ON COOL-LITE® COATINGS FOR FACADE APPLICATIONS

GUIDELINES

DECEMBER 2025

SAINT-GOBAIN GLASS

ENAMELLING OF COOL-LITE®

Enamels are primarily developed for printing on standard raw soda-lime float glass. During the glass tempering process, the enamels melt and permanently fuse to the glass surface, forming a colored ceramic layer.

Enameled glass serves multiple purposes: to conceal, advertise, protect, or differentiate. In some cases, enameling may be required on coated glass, including applications such as:

- **Glass spandrels** (with full-face enamel covering the entire coated surface)
- **Design printing** (patterns applied by screen printing or images produced via digital printing)
- **Edge enameling (**to cover construction elements or protect sealants and components against UV radiation)
- **Mandatory safety stamp** printing for regulatory compliance

Saint-Gobain Glass (SGG) has conducted tests to evaluate the feasibility of enameling products from the COOL-LITE® range using selected ceramic ink and coated glass combinations under production conditions. After enameling and firing, measurements were taken to verify product performance in terms of optical, mechanical, and aging properties.

This guideline focuses on enameling. For detailed processing instructions for COOL-LITE® ST, K(N) (II), SKN (II), or XTREME (II) regarding other processing steps, please contact us or visit our website: www.saint-gobain-glass.com/processing-guidelines

Content

DOCUMENT VERSION	DATE OF PUBLICATION
Version E	December 2025

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 Glass representative.

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1. ENAMELING ON COOL-LITE® ST COATINGS

COOL-LITE® ST is our range of flexible, temperable solar control coatings; they are durable (class B as per EN 1096 standard) and based on Ag-free functional layers.

A - RECOMMENDED ENAMELS

Our recommendations for COOL-LITE® ST coatings are the following:

COOL-LITE® FAMILY	ENAMELLING AND SILK PRINTING
COOL-LITE® ST & STB	YES – Recommended with Vibrantz system 140 for face #2
COOL-LITE® ST BRIGHT SILVER	YES, Recommended with Vibrantz system 140 for face #2 with enamel with less than 75% weight of black basic color in the enamel recipe

It is recommended that any offer for the possible supply of enameled COOL-LITE® ST be subject to previous acceptance by the client of full-size project mock-ups produced in the operation concerned.

- It is recommended to enamel the COOL-LITE® ST range (ST120, ST136, ST150, ST167, STB120 & STB136) with enamel from Vibrantz System 140 for face 2.
- COOL-LITE® ST BRIGHT SILVER (STBS) can be enameled as well with enamel from Vibrantz System 140. However, having a special aesthetic and this a different composition from other COOL-LITE® ST products, it is not recommended to enamel COOL-LITE® ST BRIGHT SILVER with ceramic paint containing more than 75% weight of basic black color in the enamel recipe (e.g., RAL 7021 or RAL 9005).

B - PROCESSING RECOMMENDATIONS

COOL-LITE® ST / STB / STBS may be fully or partially enameled using different techniques (roller-coater, spray or screen-printing for instance). Given the variety of enameling products, different operations and practical experiences, each processor should carry out tests with its own equipment. Unfavorable tempering conditions may also be the reason to get poor results. **The processor is responsible for the quality control and quality of the final product.** For further information and assistance contact Saint-Gobain Glass technical support team.

The enameling of COOL-LITE® ST must be performed according to the state of art and good industry practices regarding enameling of glass and coated glass. We recommend to especially take the following into consideration:

- The viscosity of the paste must be adjusted according to the printing process (roller, spray, or screen-printing). For roller-coater, the paste should flow in between 60 - 120 seconds at working temperature, measured with 6mm cup[1].
- COOL-LITE® ST coating must be properly cleaned before enamel printing.
- Wet thickness of the enamel deposited by roller, spray or screen-printing must be ≥ 40µm[2]

[1]Viscometer measurement - ISO 3219 / DIN 53018 or Ford cup measurement - ISO 2431:2011 / ASTM D1200
[2] Roller gauge measurement - ISO 2808:2007 / ASTM D1212

- After firing / tempering, the enamel should not be porous, liquid dropped on the enamel side must not soak through and be visible on glass side[3] and gloss at 60° should be higher than >15 GU in enamel side[4].

2. ENAMELING ON COOL-LITE® K(N) II, SKN II and XTREME II COATINGS

COOL-LITE® K(N) II, SKN II and XTREME II are to-be-tempered silver-based solar control coatings. Our recommendations for COOL-LITE® K(N) II, SKN II and XTREME II coatings are the following:

COOL-LITE® FAMILY	ENAMELLING AND SILK PRINTING
COOL-LITE® K(N) II	NOT RECOMMENDED
COOL-LITE® SKN II	NOT FULLY RECOMMENDED (exception for some specific designs for SKN183 II - see hereafter)
COOL-LITE® XTREME II	NOT RECOMMENDED

Enameling may lead to some aesthetic issues (haze, defects due to bubbles apparition…), create colour deviations after firing and induce loss of adhesion to the glass, therefore, **we do not recommend the enameling of these high-performance coatings.**

Saint-Gobain Glass have noticed some few exceptions, where enamel and coating may be deposited on the same side of a glass.

- EDGE ENAMELING: it is mandatory to proceed to edge deletion of these silver-based high-performance coatings before assembling into an insulated glazing unit (IGU). The edge-deleted surface can be enameled.
    - Due to processing tolerance, an overlap may occur. It is recommended to avoid or at least keep this overlap as thin as possible.
    - Use of masking tape to delimit enameled edge-deleted glazing periphery will be on glass processor full responsibility. Removal of the tape may lead to the coating tearing even if protected by EASYPRO® layer.
- COATING REMOVAL ENAMEL: it is proposed by some enamel supplier a type of enamel able to remove the coating and to print on the glass in a one-step process. In that case, recommendations of the supplier should be followed.
    - Saint-Gobain Glass recommend for instance the possible use of VIBRANTZ TDF9627 or TECGLASS 1C009_MMH.
    - One global recommendation is to do all same project with the same coating batch, same enamel batch and same furnace tempering. To heat treat the glass at temperature about 640°C-660°C maximum is a good way to minimize risk of color dispersion.
    - Compatible coating ranges are COOL-LITE® K(N) II, SKN II and XTREME II **without EASYPRO®.**

[3] Vibrantz Industrial Specialty Materials System 140 Lead-free flat glas enamel - Methods of use & recommendations 9. p26 – accessed May 2022
[4] Gloss measurement - ISO 2813 :2014

- MANDATORY SAFETY STAMP: due to the very small size, there is a very limited risk to print the mandatory marking on COOL-LITE® II coatings with or without EASYPRO®.
    - This permanent enameled marking (stamp) of the tempered safety glass can be done either on the edge or on the EASYPRO® layer.
    - On EASYPRO® layer, the recommended enamels are the following: 194020 from Vibrantz supplier and DV77-357-0 from PEMCO supplier.
    - More details are given in the EASYPRO® processing guidelines. Ask us for this specific processing guidelines.
- COOL-LITE® SKN 183 II: Specific development for the enameling of COOL-LITE® SKN 183 II have been performed under several conditions and first recommendations with restricted designs specific for bird protection application and enamels are given. More details are available in the following section.

3. ENAMELING ON COOL-LITE® SKN 183 II

Special development and sufficient tests (optical, mechanical, and ageing) have been performed for the given recommendations on enameling of COOL-LITE® SKN 183 II for bird protection application.

COOL-LITE® SKN 183 II can be enameled by screen-printing (only), following all the below recommendations to ensure good results. As of the release date of these Guidelines[5], the enameling of COOL-LITE® SKN 183 II is limited to specific enamel references, printing designs and processing:

- **Technology**: Screen-printing only (no digital printing)
- **Design**: several designs with pattern or lines, with low surface coverage. All details are given below.
- **Enamel**:
    - Black: VIBRANTZ 14 4001 and VIBRANTZ 14 4011 references
    - White: VIBRANTZ 19 4002 and VIBRANTZ 19 4011 references
    - Grey: VIBRANTZ 15 4001 reference (dark grey); for light and middle grey colors, please ask for VJN 5895 (RAL 7035) and VJN 5005 (RAL 7024) references.
- **Coating Range:** up to 10mm glass thickness, without EASYPRO®

This guideline may be updated at a later stage with further validated possibilities.
The processor is responsible for the quality control and quality of the final product in compliance with the given recommendations on technology, design and enamels.

[5] Ceramic Print on Cool-Lite® Coatings for Facade Applications Guidelines, Version E- December 2025

A - RECOMMENDED DESIGNS

As of the release date of these Guidelines[5], the following enameled designs have been tested and are thus recommended for enameling on COOL-LITE® SKN183 II:

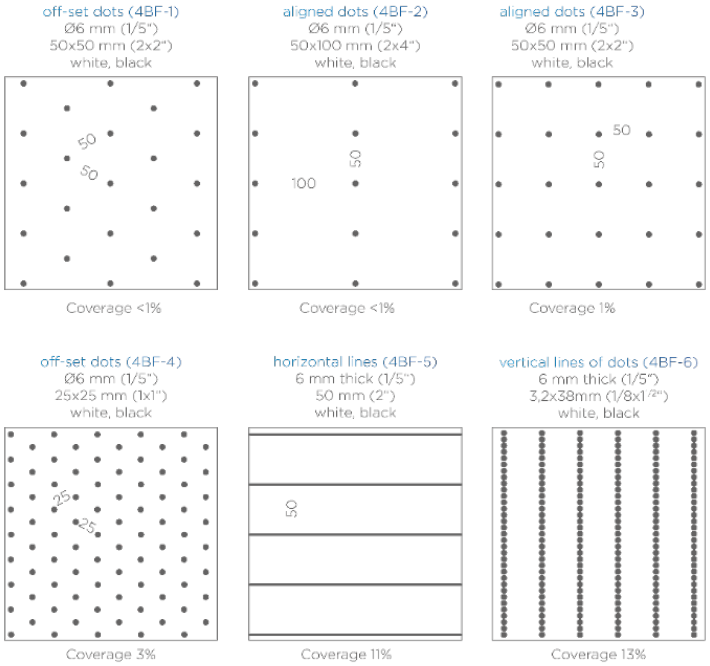

Figure 1: List of recommended designs for enameling on COOL-LITE® SKN183 II coating

- These designs, with off-set or aligned dots as well as lines comply with currently known guidelines for bird protection and meet the recognized 2x2“and 2x4“design rules.
- The details of the configurations which have been evaluated by ABC are given in the 4BIRD®Frit documentation.
- **Such designs are the only ones we recommend as of the release date of these Guidelines[5]. Additional designs or slight modifications may be added to this list (different shape of the pattern, change of the pattern size…) at a later stage depending on our testing capacities.**

B - RECOMMENDED ENAMELS

The enamels 194011, 144011, 194001 and 144001 from Vibrantz are the ones recommended for the enameling on COOL-LITE® SKN 183 II. Tests were done with formulations available at the date of the first version of guideline (Version A – January 2022). Other enamels may be tested in the future and this guideline will be updated accordingly.

C - COATING RANGE

COOL-LITE® SKN 183 II is the only silver-based coating today we give recommendations for this application. The results **cannot be extended to other COOL-LITE® II coatings, neither other COOL-LITE® SKN II coatings comparable to COOL-LITE® SKN 183 II**.

To ensure good final quality after tempering:

- it is not recommended to enamel COOL-LITE® SKN 183 II in thickness higher than 10mm.
- it is **not possible to enamel on EASYPRO®**

For this application, COOL-LITE® SKN 183 II has to be ordered without EASYPRO® temporary protection layer.

- COOL-LITE® SKN 183 II is delivered on standard with EASYPRO®, it has thus to be specifically mentioned during ordering. **Note that COOL-LITE® SKN 183 II without EASYPRO® is only produced on order. Make sure your ordering delays are in accordance with the service charter (MTO product).**
- The product will thus not benefit from all advantages of EASYPRO® regarding among other shelf-life or mechanical protection. This must be considered during the planning of the production and all processing steps before tempering.

D - PROCESSING RECOMMENDATIONS

Saint-Gobain Glass performed tests at industrial level to verify the good quality of the enameled coating after tempering and after washing and assembling into an IGU.

The enameling of COOL-LITE® SKN 183 II must be performed according to the state of art and good practices regarding enameling of glass and coated glass.

A good adjustment of all process's parameters and appropriate maintenance of the equipment is key to avoid any quality issues. **Contact Saint-Gobain Glass' technical support team** for further information and assistance when needed.

Given the variety of operations and practical experiences, each processor should carry out tests with its own equipment. Unfavorable processing conditions or tempering conditions may also be the reason to get poor results. The **processor is responsible for the quality control and quality of the final product.**

For the enameling of COOL-LITE® SKN 183 II we recommend to especially take following into consideration:

- The viscosity of the paste has to be adjusted according to the screen-printing process with well cleaned equipment.
- COOL-LITE® SKN183 II coating has to be properly cleaned before enamel printing and coating has to be handle with care during screen-printing process.
- Recommended screens are 90 - 68 mesh per cm for 25-30 microns wet thickness.
- If trouble during screen-printing process – no reuse of the coating after washing to enameled, it again (enamel stains could be visible on coating after tempering)
- Enamel has to be well-dried after dryer (line speed and adapted temperature of dryer to avoid stains after tempering)

- Time between screen-printing and tempering should be lower than <24h
- After tempering, the enamel should not be porous, liquid dropped on the enamel side must not soak through and be visible on glass side.
- Use appropriate furnace settings for SKN183 II without EasyPro. Furnace with convection is mandatory. No use of SO_2. The sheets should be handled as "cold" as possible to achieve a flawless coating after toughening 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.

E - IMPORTANT NOTICES ON QUALITY

- AESTHETIC: The enamel being placed behind the coating, the colors of the **printed pattern from outside of the building may be impacted, especially for white.**
    - It must be noted that COOL-LITE® SKN183 II interacts with the enamels, it may lead to a different optical rendering (color, reflection level) than enameling on uncoated clear glass.
    - Enameled COOL-LITE® SKN183 II may be mixed on the same façade with COOL-LITE® SKN183 II without printing. Depending on the coverage rates, the printed patterns can change the overall perception of the aesthetics of the glazing at a distance. In this case and if a Matchability/complementarity of the aesthetic is desired, an observation is recommended.
    - It is mandatory to observe and validate the aesthetic by mock-ups by the decision-making customer(s) according to the glazing orientation and configuration.
- COLOR DISCREPANCY: Slight coating variations, which may occur for different production campaigns and are fully acceptable for usual insulated unit applications, may lead to some color discrepancies of the printed pattern on the coating as well as slight enamel variation.
    - In this case, we recommend making the full project with:
        - **A single production batch from SGG (the processor must ensure that the full quantities from the single batch are reserved for this project).**
        - **A single enamel batch**
        - **A single tempering recipe**
    - This is to ensure the color consistency of the façade and that a replacement from the same production batch can be obtained in case of breakage, thus limiting color inconsistencies.
- DURABILITY: enameled COOL-LITE® SKN183 II must be edge deleted and placed on face #2 of an IGU ensuring thus the durability of the coating and the enamel.
    - Durability test have been performed on IGU according to CEKAL Pvi131vi01 protocol with a positive result.
    - Glass processor can manage their own test to validate this use with their process.

Given the variety of operations and practical experiences, each processor is responsible for carrying out its own tests.

The final quality and the satisfaction of all stakeholders of the project is our common objective.

As sufficient knowledge and skills are mandatory for this processing of enameled COOL-LITE® SKN 183 II, a preliminary training is required.

Please ask your local Saint-Gobain Glass technical support manager (TSM) to schedule it. Glass processor shall always ensure that its personnel is sufficiently trained and maintain the appropriate level of technical skills.

F - REMARKS ON PERFORMANCES

Even for low percentage of coverage of the enameling pattern, enameling a coating will induce changes of its thermal and energetic performances.

This can be intentionally used to create new functions and performances for projects; depending on the pattern, the light transmission and solar factor (g-value) may be adjusted.

In case of question on the performances, you can contact Saint-Gobain Glass for support. Indicative values may be calculated/simulated using several software.

As coated glass supplier, Saint-Gobain Glass do not process the glass and therefore is not controlling the screen-printing process, enamel used (color, thickness, opacity…) as well as the curing and tempering process. Saint-Gobain Glass do not guarantee the performances after processing.

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