



# Ceramic Print – Spandrel Glass

Product Application Information

Enamels have been carefully developed for printing and firing on normal soda-lime based float glass. During the tempering process of the glass, these enamels melt and fuse permanently to the glass surface to form a colored ceramic layer.

Various Guardian SunGuard® coatings, equipped with the special Silacoat layer system, can be printed with ceramic paints\*.

Glass enamels may react during firing with coatings causing some hazy appearance or even complete destruction of the coating. Therefore it is necessary to test the compatibility of enamels with coated glass, under production firing conditions in order to get optimum results. It is recommended to run preliminary tests with the selected ceramic paint/glass combination, using the intended production furnace, glass geometries and ceramic covered areas. Unfavorable temper conditions could be the reason to get poor results (low gloss, color, homogeneity, durability, density, adhesion).

Compatibility and suitability tests are essential for each project. Any printing on a coated glass surface can create color deviations after firing. Full size project mock-ups are advisable. The processor is responsible for the quality control and quality of the final product.

SunGuard® products can be printed with ceramic paint for various purposes:

#### **Decorative print**

- Patterns (dots or lines) which are applied to the coating by silk-screen or digital printing.
- Must be used facing inside the cavity of insulating glass only - except Guardian SunGuard® High Durable (HD).
- The part to be covered by IG sealant should remain free of printed pattern, otherwise compatibility tests must be carried out to ensure sufficient adhesion.

#### **Parapet wall glazings / Spandrels (ceramic paint covering the whole coated surface)**

- With most SunGuard® HD and SunGuard® Solar coatings only (see compatible products at page 3).
- Can be used as a single glazing.
- Ceramic paint needs to cover the SunGuard® coating in order to ensure an effective protection against any environmental influences.

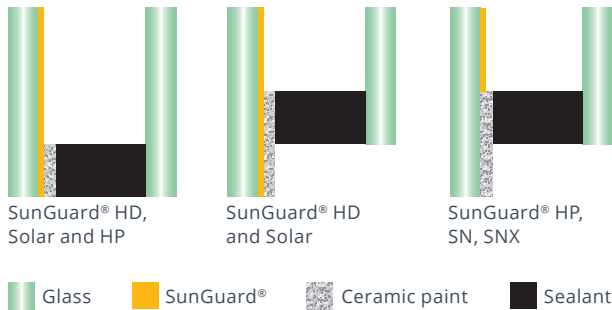
#### **Edge enameling**

- Covers up construction elements in the edge area.
- Protects IG sealants against UV radiation.
- No common approval in combination with Guardian SunGuard® High Performance (HP).  
Please contact Guardian regarding necessity of coating removal.
- Edge enameling of SunGuard® HP with a width over 5 cm can create distortions during heat treatment caused by differential heating up of the glass

\* Contact Guardian for the list of SunGuard® coated glass that can be printed with ceramic paints

- Stepped insulating glass units with enameled SunGuard® HP on the outer pane are not allowed unless the enameled surface is additionally protected by suitable sealing material.
- If the edge enameled surface will be part of the IG seal, the sufficient adhesion must be tested.

Fig. 1:



Since there are various ceramic paints that may contain different chemicals, tests must be made in advance. Please check product compatibility before applying glue to the ceramic paint.

## Requirements on enameling of Guardian SunGuard®

### Ceramic print with FERRO System 140

Ferro and Guardian have tested “System 140” colors using recommended solvent “Medium 80 1022” or “Medium 80 1026” on Guardian SunGuard® products:

- **Guardian SunGuard® HP**
  - All SunGuard® HP types for edge enameling (no structural glazing) or design print in standard IGU applications.
- **Guardian SunGuard® HD**
  - HD Silver 70, HD Neutral 67, HD Diamond 66, HD Light Blue 52, HD Silver Grey 32, HD Silver 20, HD Silver 10 for edge enameling, design print and full coverage for spandrels (for structural glazing applications please contact Guardian).
  - Important: SunGuard® HD Royal Blue 20 is not suitable for any enameled application.
- **Guardian SunGuard® Solar**
  - Solar Royal Blue 20, Solar Bright Green 20, Solar Bronze 20 for edge enameling and design print in standard IGU applications and full coverage for spandrels (Bright Green 20 and Bronze 20 are not suitable for structural glazing).

The Ferro System 140 includes various types of ceramic paints, composed of partially different chemical components. In relation to the glass products indicated above, Guardian recommends the following types:

- For spandrel glass: 140 15 4001 (color similar to RAL 7031 Blue grey)
- For edge enameling: 14014 4001 (color similar to RAL 9005 Deep black)  
140 14 4011 (color similar to RAL 9005 Intensive black - more pigments)

After performing extensive internal tests, Guardian recommends the following procedures:

- All enamels must not contain following ingredients: lead, cadmium, graphite, lithium, carbonate.
- Minimum thickness of the wet coating after printing with correct adjusted processing viscosity:
  - 70 µm by silk-screen printing (e.g. silk-screen type PET 1500/32-100)
  - 90 µm by enameling with roller coating
- Complete drying through the entire thickness of the enamel has to be ensured before firing.
- The final thickness of the enamel coating after firing should not be less than 30 µm.
- The ceramic frit must melt without bubbling, under normal temper conditions for flat glass, in order to ensure a dense and uniform cover with a minimized porosity.
- Minimum quality control of the final product:
  - All test methods recommended by the enamel manufacturer
  - Scratch resistance and adhesion (test with Erichsen-pen)
  - Porosity and adhesion (iso-propanol test)
  - Melting behavior and surface roughness (gloss test with gloss meter)
  - Uniform and dense coverage (detection of pinholes in transmission – halogen lamp test \*\*)
- The processor must follow specific processing instructions supplied by the enamel producer.

## Spandrel glass

Spandrel glass is the glass that conceals structural building components such as columns, floors, air conditioning systems, electrical wiring, plumbing, etc. Spandrel glass is typically located between vision glasses on each floor of a building.

Curtain wall and structurally glazed designs often require the use of spandrel glass to achieve a designer's vision of the finished project. Spandrel glass applications can be complementary or contrasting in color when compared to the vision glass appearance. Spandrel glass must be heat treated to avoid thermal stress breakage. Guardian has experience with spandrel glass applications and can help architects and building owners achieve the desired appearance while minimising the risk of thermal stress breakage.

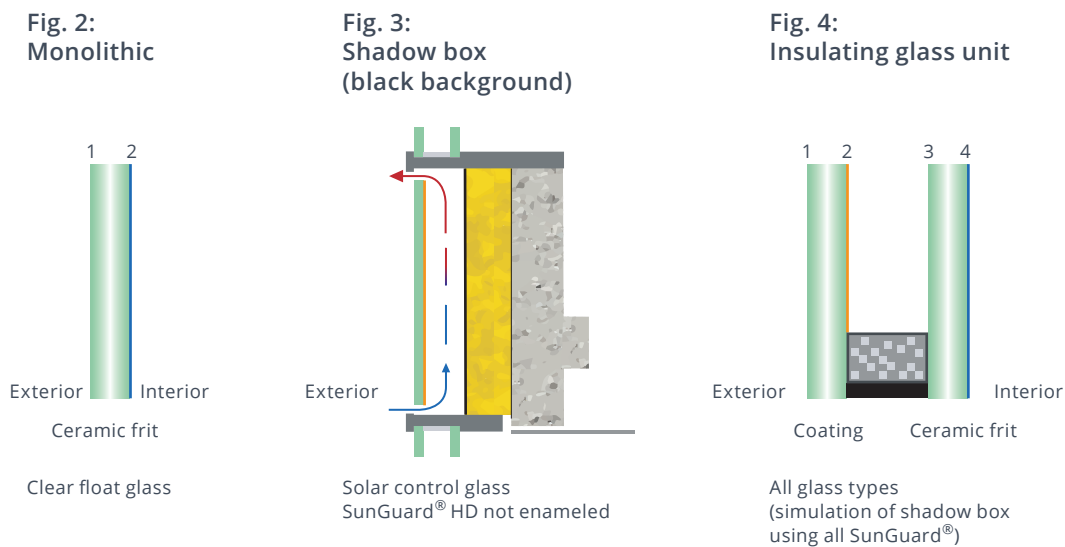
\*\* Installation of a halogen lamp (min. 100 W) in a distance of max. 50 cm from the glass. Evaluation of the glass pane in transmission, viewing on the enameled side regarding number, dimension and distribution of the pinholes (selection of the worst area, not more than 30 pinholes / dm<sup>2</sup>, single holes not larger than 0.2 mm in diameter). The distance of the observer to the glass should be not more than 50 cm.

When vision glass is specified with a high light transmission or low external reflection, an exact color match between spandrel and vision glass is challenging. Daylight conditions can have a dramatic effect on the perception of vision to spandrel appearance. For example, a clear, bright sunny day provides a higher reflective appearance, which will improve the vision to spandrel match. A grey, overcast day may allow more visual transmission from the exterior and produce a greater contrast between the vision and spandrel glass. Guardian recommends that a full size outdoor mock-up be prepared and approved in order to confirm the most desirable spandrel option for a specific project.

Spandrel glass can consist of an opacified uncoated glass, an opacified reflectively coated glass, a reflective coated glass in a shadow box construction or can be an insulating glass unit composed of a solar control glass as the exterior pane and an opacified uncoated interior pane.

Beside enameling of uncoated float glass (Fig. 2), a selection of Guardian SunGuard® HD or Guardian SunGuard® Solar reflective coated glass allows for the application of ceramic frit directly to the coated surface for a monolithic spandrel.

This provides an economical solution that is suitable for many applications. If the desired match cannot be realized with the monolithic spandrel solution a shadow box construction using a monolithic SunGuard® HD coated glass (Fig. 3) or an insulation glazing spandrel can be considered (Fig. 4).



The following table provides guidelines for the use of SunGuard® products in both monolithic and insulated glass spandrel applications. All glass configurations are with the coating on surface #2, on single glass the frit is directly applied to surface #2 and the frit or other opacifier on surface #4 of an insulated glass unit.

# Recommended enamel combinations for SunGuard® spandrels

Guardian SunGuard® glazing	Monolithic spandrel		Insulating glass spandrel <sup>2</sup> (coating on #2 + enamel on #4) [Fig. 4]
	Enameled <sup>1</sup> [Fig. 2]	Shadow box (ventilated with black background) [Fig. 3]	
<b>Guardian SunGuard® eXtra Selective</b>			
SNX 60	Clear float glass + WO-B-14-7067 <sup>3</sup> SG Solar Royal Blue 20 + Ferro 140 15 4001 on #2	SG HD Royal Blue 20	SG SNX 60
SNX 50	Clear float glass + WO-B-14-7067 <sup>3</sup> SG Solar Royal Blue 20 + Ferro 140 15 4001 on #2	SG HD Royal Blue 20	SG SNX 50
<b>Guardian SunGuard® SuperNeutral™</b>			
SN 75	Clear float glass + WO-E-14-7065 (Greyish) <sup>3</sup> Clear float glass + WO-B-14-7066 (Blueish) <sup>3</sup>	-	SG SN 75
SN 70S	Clear float glass + WO-E-14-7063 <sup>3</sup>	-	SG SN 70S
SN 70/37	Clear float glass + WO-E-14-7063 <sup>3</sup>	-	SG SN 70/37
SN 70/35	Clear float glass + WO-B-14-7067 <sup>3</sup>	-	SG SN 70/35
SN 63	Clear float glass + WO-B-14-7064 <sup>3</sup>	SG HD Light Blue 52	SG SN 63
SN 51	Clear float glass + WO-E-14-7063 (Greyish) <sup>3</sup> Clear float glass + WO-B-14-7064 (Blueish) <sup>3</sup>	SG HD Light Blue 52	SG SN 51
SN 40/23	Clear float glass + WO-B-14-7067 <sup>3</sup> SG Solar Royal Blue 20 + Ferro 140 15 4001 on #2	SG HD Royal Blue 20	SG SN 40/23
SN 29/18	Clear float glass + WO-B-14-7067 <sup>3</sup> SG Solar Royal Blue 20 + Ferro 140 15 4001 on #2	SG HD Royal Blue 20	SG SN 29/18
<b>Guardian SunGuard® High Performance</b>			
HP Light Blue 62/52	Clear float glass + WO-B-14-7067 <sup>3</sup>		SG HP Light Blue 62/52
HP Neutral 60/40	Clear float glass + WO-B-14-7064 <sup>3</sup> SG HD Silver Grey 32 + Ferro 140 15 4001 on #2	SG HD Silver Grey 32	SG HP Neutral 60/40
HP Neutral 50/32	Clear float glass + WO-B-14-7064 <sup>3</sup> SG HD Silver Grey 32 + Ferro 140 15 4001 on #2	SG HD Silver Grey 32	SG HP Neutral 50/32
HP Silver 43/31	-	SG HD Silver 70	SG HP Silver 43/31
HP Neutral 41/33	Clear float glass + WO-B-14-7064 <sup>3</sup> SG HD Silver Grey 32 + Ferro 140 15 4001 on #2	SG HD Silver Grey 32	SG HP Neutral 41/33
HP Amber 41/29	-	-	SG HP Amber 41/29
HP Royal Blue 41/29	SG Solar Royal Blue 20 + Ferro 140 15 4001 on #2	SG HD Royal Blue 20	SG HP Royal Blue 41/29
HP Bronze 40/27	SG Solar Bronze 20 + Ferro 140 15 4001 on #2	-	SG HP Bronze 40/27
HP Bright Green 40/29	SG Solar Bright Green 20 + Ferro 140 15 4001 on #2	-	SG HP Bright Green 40/29
HP Silver 35/26	SG HD Silver 10 + Ferro 140 15 4001 on #2	SG HD Silver 10	SG HP Silver 35/26
<b>Guardian SunGuard® High Durable</b>			
HD Silver 70	-	SG HD Silver 70	SG HD Silver 70
HD Neutral 67	Clear float glass + WO-E-14-7063 (Greyish) <sup>3</sup> Clear float glass + WO-B-14-7064 (Blueish) <sup>3</sup>	SG HD Neutral 67	SG HD Neutral 67
HD Diamond 66	-	SG HD Diamond 66	SG HD Diamond 66
HD Light Blue 52	Clear float glass + WO-E-14-7063 (Greyish) <sup>3</sup> Clear float glass + WO-B-14-7064 (Blueish) <sup>3</sup>	SG HD Light Blue 52	SG HD Light Blue 52
HD Silver Grey 32	Clear float glass + WO-B-14-7064 <sup>3</sup> SG HD Silver Grey 32 + Ferro 140 15 4001 on #2	SG HD Silver Grey 32	SG HD Silver Grey 32
HD Royal Blue 20	SG Solar Royal Blue 20 + Ferro 140 15 4001 on #2	SG HD Royal Blue 20	SG HD Royal Blue 20
HD Silver 20	SG HD Silver 20 + Ferro 140 15 4001 on #2	SG HD Silver 20	SG HD Silver 20
HD Silver 10	SG HD Silver 10 + Ferro 140 15 4001 on #2	SG HD Silver 10	SG HD Silver 10

Guardian SunGuard® glazing	Monolithic spandrel		Insulating glass spandrel <sup>2</sup> (coating on #2 + enamel on #4) [Fig. 4]
	Enameled <sup>1</sup> [Fig. 2]	Shadow box (ventilated with black background) [Fig. 3]	
<b>Guardian SunGuard® Solar</b>			
Solar Bronze 20	SG Solar Bronze 20 + Ferro 140 15 4001 on #2	-	SG Solar Bronze 20
Solar Gold 20	-	-	SG Solar Gold 20
Solar Grey 20	-	-	SG Solar Grey 20
Solar Bright Green 20	SG Solar Bright Green 20 + Ferro 140 15 4001 on #2	-	SG Solar Bright Green 20

The information provided above is a general recommendation only based on visual mock-ups and compatibility tests performed with the indicated Ferro ceramic frit system. Other ceramic frit systems/paints can consist of different components; this can lead to compatibility issues with the Guardian SunGuard coatings and/ or can modify the final esthetic appearance of the relevant paint-coating combination. It is the responsibility of the users of this information to assure that appropriate compatibility tests in a real size mock-up are performed to verify the color matching between vision and spandrel.

<sup>1</sup> The indicated enamels (numbers) from Ferro and Wolbring (WO) are based on the enamel type FERRO System 140 and special color mixtures to adapt best to the related vision. Please contact the Guardian Technical Services Department for more information.

<sup>2</sup> In insulating glass spandrels, based on our experience, black or dark grey are the enamel colors that better match with the vision areas. For more information you can contact your local Technical Services Department.

<sup>3</sup> When working on matching visual appearance for neutral and low reflecting glass types, which might be challenging, Guardian recommends a full size outdoor mock-up. When selecting and applying enamels of other providers, the following RAL approximations can be used:

WO-E-14-7065	RAL 7011 / 7043
WO-B-14-7066	RAL 5007 / 5024
WO-E-14-7063	RAL 7011 / 7031
WO-B-14-7067	RAL 5023
WO-B-14-7064	RAL 5007 / 5009

## SunGuard® HD in combination to ceramic frit on surface #1

Special applications, such as ceramic frit on surface #1, may require the tempering of the glass with the coating facing down.

Such a particular application requires sufficient processing equipment. Especially the ceramic rollers of the furnace must be clean of dirt and the glass should not be slid over stationary machine parts (rollers, castors, etc.).

Production set-up as well as a mock-up are mandatory. However, Guardian will have no responsibility whatsoever and will not be held liable for any damages whatsoever such as but not limited to surface damages resulting from this type of processing.

Provided that the tempering got performed properly, the overall glass performance, such as light transmission or shading coefficient should not deteriorate.

### Important note

It must be ensured that Guardian SunGuard® spandrels are not exposed to any aggressive media before, during and after installation.

# Verification

The signature below verifies that the processor has read and understands the full content of these product application information: Ceramic Print - Spandrel Glass / Product Application Information / "Guardian\_Spandrel\_PAI\_EN\_1021".

Name / Signature: \_\_\_\_\_ Title: \_\_\_\_\_

Company / Stamp: \_\_\_\_\_ Date: \_\_\_\_\_

Please return this page signed via e-mail to your local Guardian Technical Services representative.

Guardian Glass - United Kingdom Phone: 0044 (0) 800 032 6322 e-mail: uktechnical@ guardian.com	Guardian Glass - Luxembourg Phone: 00 352 50301 e-mail: taluxembourg@ guardian.com	Guardian Glass - Spain Phone: 00 34 948 817255 e-mail: tactudela@ guardian.com	Guardian Glass - Hungary Phone: 0036 (0) 68 887 200 e-mail: Technical_Hungary@ guardian.com
Guardian Glass - Germany Phone: 0049 (0) 3494 361 800 e-mail: anwendungstechnik@ guardian.com	Guardian Glass - Poland Phone: 0048 (0) 34 323 9300 e-mail: tac_poland@ guardian.com	Guardian Glass - Russia (Ryazan) Phone: 007 (8) 4912 956600 e-mail: gsr_tac@guardian.com	Guardian Glass - Russia (Rostov) Phone: 007 (8) 86367 50900 e-mail: gsr_tac@guardian.com

#### Disclaimer:

The present version of this document replaces and cancels all previous versions, please be sure to use the latest one. This document is only valid for the processing of the products mentioned in there. For more technical information, latest version of this document and other Guardian guidelines please refer to [www.guardianglass.com](http://www.guardianglass.com) or contact Guardian Technical Services. The guidelines contained herein are for information purposes only and are not intended to be a comprehensive set of instructions but assume the processor has professional knowledge of glass processing. Guardian does not provide any warranty with respect to the content of this document, as well Guardian does not assume any liability for the accuracy or completeness hereof, unless otherwise stipulated by applicable law. It is the responsibility of the purchaser to confirm that the products are suitable for their intended application in compliance with the applicable laws and regulations. Guardian does not provide any warranty regarding the intended further processing or end product, which remains the full responsibility of the processor. The products in this publication are sold subject to Guardian's standard terms and conditions of sale and any applicable written warranties. Nothing in this document provides any express or implied warranty, or serves to change or supplement Guardian's written warranties, which warranties are provided in Guardian's Conditions of Sale, or any additional written limited warranties for certain fabricated, coated or safety glazing products located on our website at [www.guardianglass.com](http://www.guardianglass.com).