SELECTION 21 600-680℃

High resistant, heat-resistant (borosilicate) glass colors

1. General Information and Color chart

Features!

- Intermixable and high resistant colors.
- Wide color range for heat-resistant (borosilicate) glass.



SELECTION 21 600-680 ℃ Intermixable and high resistant heat resistant (borosilicate) glass colors for bottles and glass tableware.

Table 1

Product No.	Color tone	Pantone No.	Intermixable	Transparent	Precious metal containing	Lead free (below 90ppm)	Cadmium free (below 40ppm)	Acid resistant, DIN 1388-1-2 *1	Alkali resistant, ASTM C556-88 *2	21111 mixing & overprinting flux	Remarks
21111	flux		✔	✔				✔	✔	✔	mixing and overprinting
21150	AcE flux		✔					✔	✔	✔	acid etch effect flux
21212	white		✔					✔	✔	✔	opaque, underlay & mixing white for all colors
21301	lemon yellow	101C	✔					✔	✔	✔	
21313	cadmium yellow	108C	✔					✔	✔	✔	
21318	cadmium orange	1655C	✔					✔	✔	✔	
21412	yellow green	363C	✔					✔	✔	✔	
21404	Cr green	364C	✔					✔	✔	✔	
21406	blue green	328C	✔					✔	✔	✔	
21521	yellow brown	130C	✔					✔	✔	✔	
21514	ochre	160C	✔					✔	✔	✔	
21601	dark iron red	1815C						✔	✔	✔	iron red, mixture limited
21628	cadmium red	186C	✔					✔	✔	✔	
21634	cadmium red	187C	✔					✔	✔	✔	
21701	gray	Cool gray 8C	✔	✔				✔	✔	✔	
21704	black	process blackC	✔					✔	✔	✔	
21811	dark cyan	3015C						✔	✔	✔	
21812	blue	285C	✔	✔				✔	✔	✔	
21813	sky blue	2935C	✔	✔				✔	✔	✔	
21979	purple	2607C	✔				✔	✔	✔	✔	
21977	pink	507C	✔	✔	✔		✔	✔	✔	✔	
21973	blue maroon	511C	✔		✔		✔	✔	✔	✔	
21974	reddish maroon	507C	✔		✔		✔	✔	✔	✔	

*1: DIN EN 1388-1-2 : The test pieces are immersed in a 4% acetic acid solution for 24 hours at 22±2℃. Refer section 8.1 and 8.2
*2: ASTM C556-88 : The test pieces are immersed in a 0.5 % sodium carbonate solution in water at 95℃ for 2, 4 and 6 hours. Refer section 9.3

Technical Information

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2. Firing Conditions

Normal firing is from 580–650℃ in a cycle of 60–150 minutes, cold-to-cold, with 10 minutes for soaking. The best firing condition depends on firing speed and type of ware and kiln.

3. Application

SELECTION 21 colors are suitable for screen-transfer printing, direct printing, spraying, pad printing and hand painting. **SELECTION 21** colors contain lithium oxide. Therefore, it cannot be denied that the internal pressure resistance of the substrate decreases due to the diffusion of lithium.

4. Coefficient of Thermal Expansion (C.O.E.)

Product	Thermal Expansion (C.O.E.)
SELECTION 21 colors (average)	Varies between $4.9–5.2 \times 10^{-6}$/℃
21111 flux	5.2×10^{-6}/℃

If **SELECTION 21** colors are applied in very thick layers, the colors could crack or chip off, depending on the type of ware and thickness of the colors. We recommend testing the application of the colors under your conditions before mass production use.

5. Particle size of Distribution (P.S.D.)

Product	D_{50} average	D_{100} biggest
SELECTION 21 colors (average)	3.5 –5.5 μm (±1.0)	30 μm (±10)
21111 flux	3.5 –5.5 μm (±1.0)	30 μm (±10)

6. Printing

【6.1 Mesh size】

We recommend mesh sizes that are 195–305 mesh/inch (77–120 thread/cm) for all screen applications.

【6.2 Medium ratio】

Product	Color : medium	Recommended mesh
SELECTION 21 colors: Medium PM2/PMT8	10 : 5–7/6–8	225–305 mesh/inch (90–120 thread/cm)
21111 flux: Medium PM2	10 : 5.5–8	225–305 mesh/inch (90–120 thread/cm)

Screen-transfer printing: We recommend PM2 flowing medium, PMT8 thixotropic medium for dot printing. We recommend C12 cover coat by printing 70 mesh/inch (27 thread/cm).
To avoid glass colors absorb any moisture easily. Therefore, keep powder colors in a dry place. We recommend drying the color powder before using.

7. Color and Mixability

SELECTION 21 colors can be mixed with each other in any proportions. However, we recommend testing the stability of mixing colors and overprinted flux colors under end-user's firing conditions before mass production. Please note following points and refer to Table 1.

Underlay white: **21212** white is suitable as underlay white for all colors.

Mixing white: To obtain pastel-color tone, it is suitable to mix **21212** white.

Mixing flux: **21111** flux is suitable for mixing all colors. After mixing with flux, the color is lighter and glossier.

Overprinting flux: Overprinting **21111** flux can improve color gloss and chemical durability, such as heavy metal release, alkali durability and dishwasher resistance.

AcE flux: To obtain acid etch effect, **21150** AcE flux is suitable.

Iron red: **21601** iron red is not recommended for mixing with cadmium-containing colors.

Cadmium-containing colors *1: **21313** yellow, **21318** orange, **21628** red and **21634** red can be mixed with any other **SELECTION 21** colors except **21601** iron red.

Precious metal containing colors: **21979** purple, **21977** pink, **21973** blue marron and **21974** red marron contain precious metals and they can be mixed with any other **SELECTION 21** colors.

8. Chemical durability (refer to the Table 1)

Chemical durability of **SELECTION 21** colors depends on type of ware, kiln, color deposit and firing conditions. The following are the results of tests on heat-resistant (borosilicate) glass bottle, fired at 620℃, with 10 minutes of soaking time and 90 minutes of cold-to-cold firing conditions of gas kiln in production.

【8.1 Lead and cadmium release】

According to the DI EN 2188-1-2 test, **SELECTION 21** colors show less than lead 0.8 mg/dm^2 and cadmium 0.07 mg/dm^2 releases.

【8.2 Acid resistance】

According to the DI EN 2188-1-2 test, **SELECTION 21** colors do not show any visible attack after immersion in a 4% acetic acid solution for 24 hours at a room temperature of 22±2℃.

【8.3 Alkali resistance】

According to the ASTM C556-88 test, **SELECTION 21** colors do not show any visible attack for up to 4 hours.

Overprinting **21111** flux can improve color gloss and chemical durability, such as lead and cadmium release, acid and alkali durability and dishwasher resistance.

9. Safety Data Sheet (SDS)

Safety data sheet (SDS) of **SELECTION 21** colors are available on request.

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