SELECTION 13 580-650℃

High resistant glass colors

1. General Information and Color chart

Features!

- Intermixable and high resistant colors.
- Can mix with SELECTION 13M, metallic and interference metallic glass colors.



SELECTION 13 580-650℃ Intermixable and high resistant glass colors for bottles, cosmetic containers 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	13111 mixing & overprinting flux	Remarks
13111	flux		✔	✔				✔	✔	✔	mixing and overprinting
13150	AcE flux		✔					✔	✔	✔	acid etch effect flux
13212	white		✔					✔	✔	✔	opaque, underlay & mixing white for all colors
13301	lemon yellow	101C	✔					✔	✔	✔	four-color printing yellow
13313	cadmium yellow	108C	✔					✔	✔	✔	cadmium yellow, four-color printing
13318	cadmium orange	172C	✔					✔	✔	✔	cadmium orange
13412	yellow green	362C	✔					✔	✔	✔	
13404	chrome green	364C	✔					✔	✔	✔	
13406	blue green	328C	✔					✔	✔	✔	
13521	yellow brown	130C	✔					✔	✔	✔	
13514	ochre	154C	✔					✔	✔	✔	
13601	dark iron red	181C						✔	✔	✔	iron red, mixture limited
13628	cadmium red	1797C	✔					✔	✔	✔	cadmium red, four-color printing red
13634	cadmium red	1807C	✔					✔	✔	✔	cadmium red, four-color printing red
13701	gray	651C	✔	✔				✔	✔	✔	
13706	intensive black	process blackC	✔					✔	✔	✔	four-color printing black
13811	dark cyan	307C	✔	✔				✔	✔		four-color printing cyan
13812	blue	2935C	✔	✔				✔	✔	✔	
13813	sky blue	2945C	✔	✔				✔	✔	✔	
13804	cobalt blue	2748C	✔				✔		✔	✔	
13909	purple	260C	✔		✔		✔	✔	✔	✔	
13902	pink	204C	✔	✔	✔		✔	✔	✔	✔	
13905	magenta	234C	✔	✔	✔		✔	✔	✔	✔	
13907	reddish magenta	207C	✔	✔	✔		✔	✔	✔	✔	

*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 9.1 and 9.2

*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

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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 13 colors are suitable for screen-transfer printing, direct printing, spraying, pad printing and hand painting. **SELECTION 13** 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 13 colors (average)	Varies between $8.5–9.0 \times 10^{-6}/℃$
13111 flux	$8.5 \times 10^{-6}/℃$

If **SELECTION 13** colors are applied in very thick layers, the colors could have pinholes or cracking, 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 13 colors (average)	3.0–6.0 μm (±1.0)	30 μm (±10)
13111 flux	3.5–5.5 μm (±1.0)	20 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 13 colors: Medium PM2/PMT8	10 : 5–7/6–8	195–305 mesh/inch (77–120 thread/cm)
13111 flux: Medium PM2	10 : 5.5–8	195–305 mesh/inch (77–120 thread/cm)

Screen-transfer printing: We recommend PM2 flowing medium, PMT8 thixotropic medium for dot and four-color 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 13 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: **13212** white is suitable as underlay white for all colors.

Mixing white: To obtain pastel-color tone, it is suitable to mix **13212** white.

Mixing flux: **13111** flux is suitable for mixing all colors. After mixing with flux, the color is lighter and glossier.

Overprinting flux: Overprinting **13111** 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, **13150** AcE flux is suitable.

Iron red: **13601** iron red is not recommended for mixing with cadmium-containing colors.

Black: **13706** black is very intensive and it is recommended for four color printing and underlay black for metallic colors.

Cadmium-containing colors *1: **13313** yellow, **13318** orange, **13628** red and **13634** red can be mixed with any other **SELECTION 13** colors except **13601** iron red.

Precious metal containing colors: **13909** purple, **13902** pink, **13905** magenta and **13907** red magenta contain gold and they can be mixed with any other **SELECTION 13** colors. **13902** pink and **13907** red magenta cannot mix with above cadmium-containing colors *1

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8. Four-color printing

【8.1 Choice of colors】

	Combination 1 (without cadmium colors)	**Combination 2** (with cadmium colors)
Yellow	**13301** yellow	**13313** cadmium yellow
Magenta	**13905** magenta, **13907** red magenta	**13905** magenta
Red		**13628** cadmium red
Cyan	**13811** cyan	**13811** cyan
Black	**13706** black	**13706** black
Flux	**13111** mixing and overprinting flux	**13111** mixing and overprinting flux

13301 yellow and **13313** cadmium yellow cannot be mixed with each other and overprinted.
13628 cadmium red and **13905** magenta can be mixed each other and overprinted.
13111 flux are suitable as overprinting flux for all colors.

【8.2 Printing order】

Combination 1, Y-M-C-K-F: yellow → magenta → cyan → black → overprinting flux.

Combination 2, CdY-M/CdR-C-K-F: cadmium yellow → magenta/cadmium red → cyan → black → overprinting flux. (Additional overprinting of cadmium colors is possible before overprinting **13111** flux).

【8.3 Mesh size】

We recommend mesh sizes that are 250-305 mesh/inch (100-120 thread/cm) for all screen applications.

【8.4 Medium ratio】

13301 yellow, **13313** cadmium yellow : PMT8	10 : 5-7
13905 magenta, **13907** red magenta : PMT8	10 : 5-7
13628 cadmium red : PMT8	10 : 5-7
13811 cyan : PMT8	10 : 5-7
13706 black : PMT8	10 : 5-7
13111 overprinting flux : PM2	10 : 5.5-8

We recommend PMT8 thixotropic medium for printing **SELECTION 13** four-colors.
We recommend PM2 flowing medium for overprinting **13111** flux.
We recommend C12 cover coat by printing 70 mesh/inch (27 thread/cm)

9. Chemical durability (refer to the Table 1)

Chemical durability of **SELECTION 13** colors depends on type of ware, kiln, color deposit and firing conditions. The following are the results of tests on soda lime glass bottle, fired at 600℃, with 10 minutes of soaking time and 90 minutes of cold-to-cold firing conditions of gas kiln in production.

【9.1 Lead and cadmium release】

According to the DI EN 1388-1-2 test, **SELECTION 13** colors show less than lead 0.8 mg/dm2 and cadmium 0.07 mg/dm2 releases.

【9.2 Acid resistance】

According to the DI EN 1388-1-2 test, **SELECTION 13** 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℃, except 13804 cobalt blue.

【9.3 Alkali resistance】

According to the ASTM C556-88 test, **SELECTION 13** colors do not show any visible attack for up to 4 hours.

Overprinting **13111** flux can improve color gloss and chemical durability, such as lead and cadmium release, acid and alkali durability and dishwasher resistance.

10. Safety Data Sheet (SDS)

Safety data sheet (SDS) of **SELECTION 13** colors are available on request.

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