

SELECTION 18 620-700°C

Lead- and cadmium-free high resistant glass colors

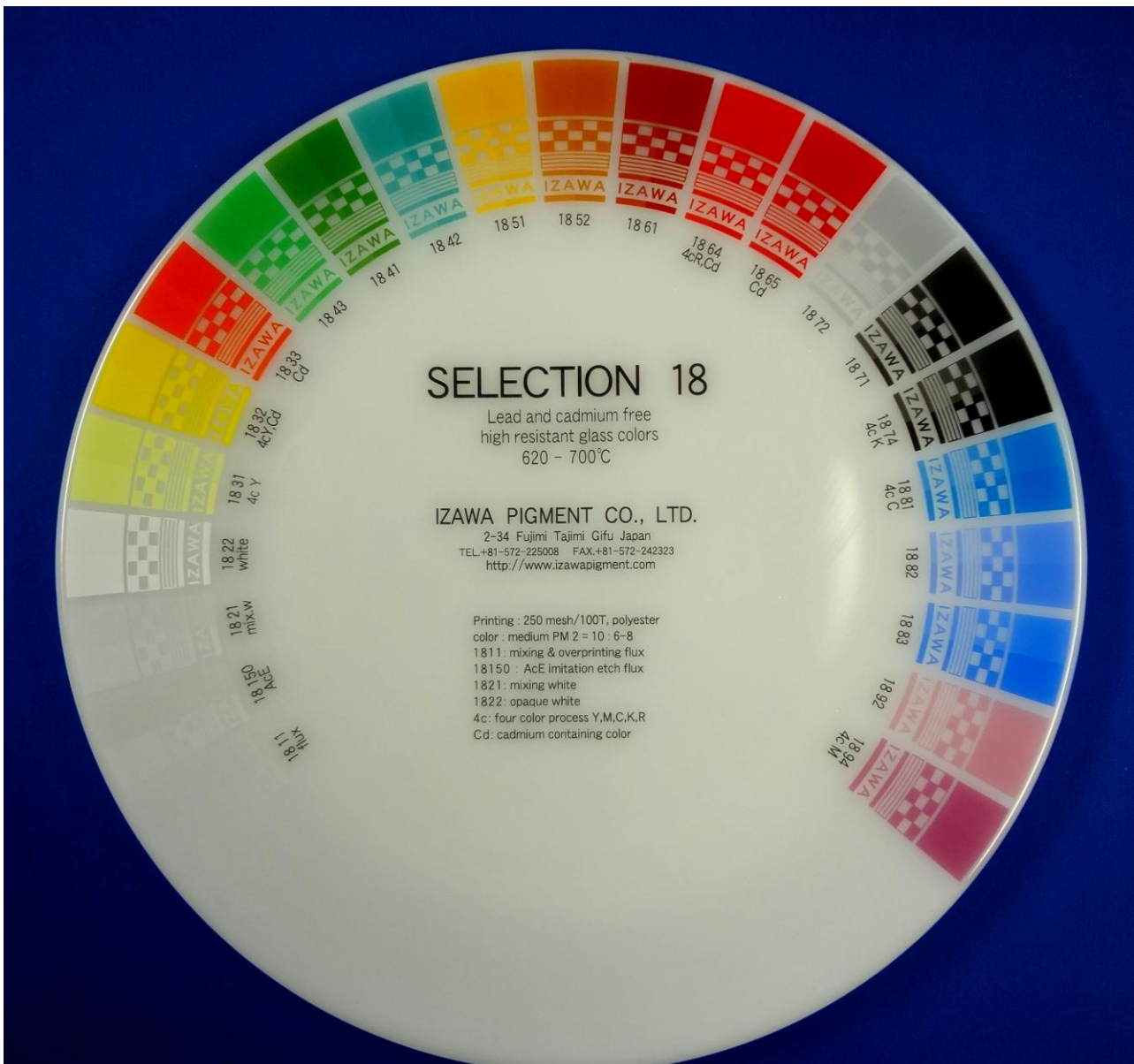
1. General Information and Color chart

SELECTION 18 series is a range of lead- and cadmium-free (*1), intermixable, high resistant, glass colors for bottles, cosmetic containers and glass tableware.

(*1) 1832 yellow, 1833 orange, 1864 red, 1865 red contain cadmium.

Options for this series: Please refer to their individual technical information.

SELECTION 18M: Metallic and interference metallic glass colors.



SELECTION 18 620–700°C Lead- and cadmium-free, intermixable, high resistant, glass colors for bottles, cosmetic containers and glass tableware.

Table 1

Product No.	Color tone	Pantone No.	Intermixable	Precious metal containing	Lead free (<300ppm)	Cadmium free (<100ppm) *1	Acid resistant, DIN 1388-1-2 *2	Alkali resistant, ASTM C556-88 *3	18 11 mixing and overprinting flux	Glass	Earthenware	Remarks
18 11	flux		✓		✓	✓	✓	✓	✓	✓	✓	mixing and overprinting
18 150	AcE flux		✓		✓	✓	✓	✓		✓	✓	acid etch effect flux
18 21	mixing white		✓		✓	✓	✓	✓	✓	✓	✓	mixing white intermixable
18 22	white		✓		✓	✓	✓	✓	✓	✓	✓	opaque white, intermixable
18 31	lemon yellow	394C	✓		✓	✓	✓	✓	✓	✓	✓	four-color yellow
18 32	cadmium yellow	116C	✓		✓	*1	✓	✓	✓	✓	✓	four-color Cd yellow
18 33	cadmium orange	021C	✓		✓	*1	✓	✓	✓	✓	✓	
18 43	yellow green	348C	✓		✓	✓	✓	✓	✓	✓	✓	
18 41	chrome green	364C	✓		✓	✓	✓	✓	✓	✓	✓	
18 42	blue green	322C	✓		✓	✓	✓	✓	✓	✓	✓	
18 51	yellow brown	145C	✓		✓	✓	✓	✓	✓	✓	✓	
18 52	ocher	1605C	✓		✓	✓	✓	✓	✓	✓	✓	
18 61	dark iron red	174C			✓	✓	✓	✓	✓	✓	✓	not good for mixing with cadmium colors
18 64	cadmium red	1795C	✓		✓	*1	✓	✓	✓	✓	✓	four-color Cd red
18 65	cadmium red	1797C	✓		✓	*1	✓	✓	✓	✓	✓	
18 72	gray	404C	✓		✓	✓	✓	✓	✓	✓	✓	
18 71	black	process blackC	✓		✓	✓	✓	✓	✓	✓	✓	
18 74	intensive black	process blackC	✓		✓	✓	✓	✓	✓	✓	✓	four-color black, underlay black for metallic colors
18 81	dark cyan	2935C	✓		✓	✓	✓	✓	✓	✓	✓	four-color cyan
18 82	blue	660C	✓		✓	✓	✓	✓	✓	✓	✓	
18 83	sky blue	293C	✓		✓	✓	✓	✓	✓	✓	✓	
18 92	dark pink	221C	✓	✓	✓	✓	✓	✓	✓	✓	✓	Cd colors can be mixed
18 94	magenta	222C	✓	✓	✓	✓	✓	✓	✓	✓	✓	four-color magenta, Cd colors can be mixed

*1: lead- free cadmium containing colors

*2: DIN EN 1388-1-2 : The test pieces are immersed in a 4% acetic acid solution for 24 hours at 22±2°C.

*3: ASTM C556-88 : The test pieces are immersed in a 0.5 % sodium carbonate solution in water at 95°C for 2, 4 and 6 hours.

2. Firing Conditions

Normal firing is from 620–700°C 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 18 colors are suitable for screen-transfer printing, direct printing, spraying, pad printing and hand painting.

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

Product	Thermal Expansion (C.O.E.)
SELECTION 18 colors (average)	Varies between $9.0\text{--}9.5 \times 10^{-6}/^{\circ}\text{C}$
1811 flux, high-firing temperature, glossy at 600°C	$9.7 \times 10^{-6}/^{\circ}\text{C}$

If **SELECTION 18** 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 18 colors (average)	2.5–3 μm	30 μm
1811 flux	2–2.5 μm	15 μm

6. Printing

【6.1 Mesh size】

We recommend mesh sizes that are 180–300 mesh (71–120T) for all screen applications.

【6.2 Medium ratio】

SELECTION 18 colors: Medium PM2/PMT8	10 : 7–9/8–10
1811 mixing and overprinting flux: Medium PM2	10 : 9–11

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 (27T).

Lead- and cadmium-free 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 18 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: 1822 white is suitable as underlay white for all colors.

Mixing white: To obtain pastel-color tone, it is suitable to mix 1821 mixing white or 1822 white.

Mixing flux: 1811 flux is suitable for mixing all colors. After mixing with flux, the color is lighter and glossier.

AcE flux: To obtain acid etch effect, 18150 AcE flux is suitable.

Iron red: 1861 iron red is not recommended for mixing with cadmium-containing colors.

Black: 1874 black is very intensive and it is recommended for four color printing and underlay black for metallic colors.

Overprinting flux: Overprinting 1811 flux can improve color gloss and chemical durability, such as heavy metal release, alkali durability and dishwasher resistance.

8. Four-color printing

【8.1 Choice of colors】

	Combination 1 (without cadmium colors)	Combination 2 (with cadmium colors)
Yellow	1831 lemon yellow	1832 cadmium yellow
Magenta	1894 magenta	1894 magenta
Red		1864 cadmium red
Cyan	1881 cyan	1881 cyan
Black	1874 black	1874 black
Flux	1811 mixing and overprinting flux	1811 mixing and overprinting flux

1831 yellow and 1832 cadmium yellow can be mixed with each other and overprinted.

1864 cadmium red and 1892 magenta can be mixed each other and overprinted.

1811 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 flux)

【8.3 Mesh size】

We recommend mesh size that is polyester 300 mesh (120T).

【8.4 Medium ratio】

1831 lemon yellow, 1832 cadmium yellow : PMT8	10 : 8.5-9.5
1894 magenta : PMT8	10 : 8.5-9.5
1864 cadmium red : PMT8	10 : 8.5-9.5
1881 cyan : PMT8	10 : 8.5-9.5
1874 black : PMT8	10 : 8.5-9.5
1811 overprinting flux : PM2	10 : 9-11

We recommend PMT8 thixotropic medium for printing **SELECTION 18** four colors.

We recommend PM2 flowing medium for overprinting 1811 flux.

We recommend C12 cover coat by printing 70 mesh (27T).

9. Chemical durability (refer to the Table 1)

Chemical durability of **SELECTION 18** 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 650°C, with 10 minutes of soaking time and 90 minutes of cold-to-cold firing conditions of gas kiln in production.

【9.1 Residual lead and cadmium content】

SELECTION 18 colors contain less than 300 ppm residual lead and less than 100 ppm residual cadmium, with some exceptions (*1 cadmium-containing colors) and are therefore in compliance with Californian Proposition 65, FDA, EU and Japanese requirements.

Cadmium containing colors contain less than 600 ppm residual lead and contain more than 50,000 ppm cadmium.

【9.2 Lead and cadmium release】

According to the DI EN 1388-1-2 test, **SELECTION 18** colors show lead and cadmium releases are below AAS limits. Cadmium-containing colors (*1) show considerably high cadmium release. They cannot meet FDA and EU limits. The cadmium release depends on the firing conditions and the total area of cadmium-containing colors. By overprinting, 1811 flux will reduce cadmium release by about half, but it is necessary to test under your conditions to make sure the cadmium releases are below the required limits.

【9.3 Acid resistance】

According to the DI EN 1388-1-2 test, **SELECTION 18** colors do not show any visible attack after immersion in a 4% acetic acid solution for 24 hours at room temperature $22 \pm 2^{\circ}\text{C}$.

【9.4 Alkali resistance】

According to the ASTM C556-88 test, **SELECTION 18** colors do not show any visible attack for up to 4 hours. If 1811 flux are overprinted, they can stand up to 6 hours.

10. Material Safety Data Sheet (MSDS)

Material safety data sheet (MSDS) of **SELECTION 18** colors are available on request.

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