

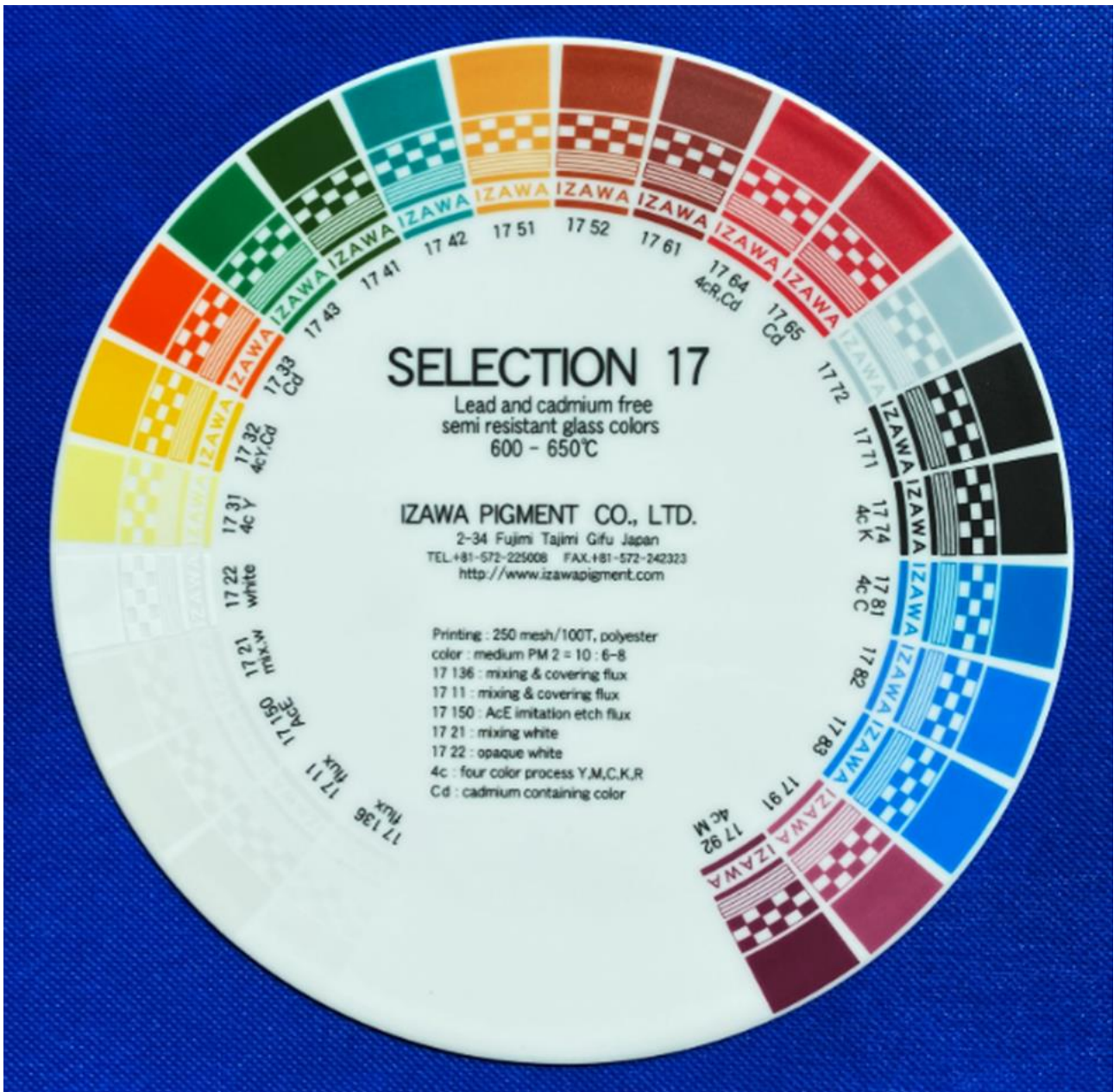
SELECTION 17 600-650°C

Lead- and cadmium- free semi-resistant glass colors

1. General Information and Color chart

Features!

- Intermixable, semi-resistant colors.
- Lead and cadmium free except cadmium colors.



SELECTION 17 600–650°C Lead- and cadmium-free, intermixable, semi-resistant, glass colors for bottles, cosmetic containers and glass tableware.

Table 1

Product No.	Color tone	Pantone No.	Intermixable	Precious metal containing	Lead free (below 90ppm)	Cadmium free (below 40ppm)	Acid resistant, DIN 1388-1-2 *2	Alkali resistant, ASTM C556-88 *3	17136 mixing and overprinting flux	1711 mixing and overprinting flux	Glass	Earthenware	Remarks
17136	flux		✓		✓	✓			✓	✓	✓	✓	mixing and overprinting, low firing temperature
1711	flux		✓		✓	✓	✓*2	✓*3	✓	✓	✓	✓	mixing and overprinting, high firing temperature
17150	AcE flux		✓		✓	✓	✓*2	✓*3			✓	✓	acid etch effect flux
1721	mixing white		✓		✓	✓	✓*2	✓*3	✓	✓	✓	✓	mixing white, intermixable
1722	white		✓		✓	✓	✓*2	✓*3	✓	✓	✓	✓	opaque white, intermixable
1731	lemon yellow	394C	✓		✓	✓	✓*2	✓*3	✓	✓	✓	✓	four-color yellow
1732	cadmium yellow	116C	✓		✓	✓*1	✓*2	✓*3	✓	✓	✓	✓	four-color Cd yellow
1733	cadmium orange	021C	✓		✓	✓*1	✓*2	✓*3	✓	✓	✓	✓	
1743	yellow green	348C	✓		✓	✓	✓*2	✓*3	✓	✓	✓	✓	
1741	chrome green	364C	✓		✓	✓	✓*2	✓*3	✓	✓	✓	✓	
1742	blue green	322C	✓		✓	✓	✓*2	✓*3	✓	✓	✓	✓	
1751	yellow brown	145C	✓		✓	✓	✓*2	✓*3	✓	✓	✓	✓	
1752	ochre	1605C	✓		✓	✓	✓*2	✓*3	✓	✓	✓	✓	
1761	dark iron red	174C			✓	✓	✓*2	✓*3	✓	✓	✓	✓	not recommended mixing with cadmium colors
1764	cadmium red	1795C	✓		✓	✓*1	✓*2	✓*3	✓	✓	✓	✓	four-color Cd red
1765	cadmium red	1797C	✓		✓	✓*1	✓*2	✓*3	✓	✓	✓	✓	
1772	gray	404C	✓		✓	✓	✓*2	✓*3	✓	✓	✓	✓	
1771	black	process blackC	✓		✓	✓	✓*2	✓*3	✓	✓	✓	✓	
1774	intensive black	process blackC	✓		✓	✓	✓*2	✓*3	✓	✓	✓	✓	intensive four-color black
1781	dark cyan	2935C	✓		✓	✓	✓*2	✓*3	✓	✓	✓	✓	four-color cyan
1782	blue	660C	✓		✓	✓	✓*2	✓*3	✓	✓	✓	✓	
1783	sky blue	293C	✓		✓	✓	✓*2	✓*3	✓	✓	✓	✓	
1791	dark pink	221C	✓	✓	✓	✓	✓*2	✓*3	✓	✓	✓	✓	Cd colors can be mixed
1792	magenta	222C	✓	✓	✓	✓	✓*2	✓*3	✓	✓	✓	✓	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. Refer section 9.2 and 9.3

*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. Refer section 9.4

2. Firing Conditions

Normal firing is from 600–650°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 17 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 17 colors (average)	Varies between $8.5\text{--}9.0 \times 10^{-6}/^{\circ}\text{C}$
17136 flux, low-firing temperature, glossy at 580°C	$9.7 \times 10^{-6}/^{\circ}\text{C}$
1711 flux, high-firing temperature, glossy at 600°C	$8.9 \times 10^{-6}/^{\circ}\text{C}$

If **SELECTION 17** 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 17 colors (average)	4.0–6.0 μm (±1.0)	30 μm (±10)
17136, 1711 flux	4.0–6.0 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 17 colors: Medium PM2/PMT8	10 : 6.5–9/8–10	195–305 mesh/inch (77–120 thread/cm)
17136, 1711 flux: Medium PM2	10 : 9–11	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).

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 17 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: **1722** white is suitable as underlay white for all colors.

Mixing white: To obtain pastel-color tone, it is suitable to mix **1721** mixing white or **1722** white.

Mixing flux: **17136** lower-firing temperature flux and **1711** higher-firing temperature flux are suitable for mixing all colors. After mixing with flux, the color is lighter and glossier.

Overprinting flux: Overprinting **17136** or **1711** flux can improve color gloss and chemical durability, such as heavy metal release, alkali durability and dishwasher resistance. **1711** flux shows better chemical durability than **17136**.

AcE flux: To obtain acid etch effect, **17150** AcE flux is suitable.

Iron red: **1761** iron red is not recommended for mixing with cadmium-containing colors.

Cadmium-containing colors *1: **1732** yellow, **1733** orange, **1764** red and **1765** red can be mixed with any other **SELECTION 17** colors except **1761** iron red.

Gold containing colors : **1791** pink and **1792** magenta contain gold and they can be mixed with any other **SELECTION 17** colors.

8. Four-color printing

【8.1 Choice of colors】

	Combination 1 (without cadmium colors)	Combination 2 (with cadmium colors)
Yellow	1731 lemon yellow	1732 cadmium yellow
Magenta	1792 magenta	1792 magenta
Red		1764 cadmium red
Cyan	1781 cyan	1781 cyan

Black	1771 black	1771 black
Flux	17136, 1711 mixing and overprinting flux	17136, 1711 mixing and overprinting flux

1731 yellow and 1732 cadmium yellow can be mixed with each other and overprinted.

1764 cadmium red and 1792 magenta can be mixed each other and overprinted.

17136 and 1711 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 sizes that are 250–305 mesh/inch (100–120 thread/cm) for all screen applications.

【8.4 Medium ratio】

1731 lemon yellow, 1732 cadmium yellow : PMT8	10 : 8.5–9.5
1792 magenta : PMT8	10 : 8.5–9.5
1764 cadmium red : PMT8	10 : 8.5–9.5
1781 cyan : PMT8	10 : 8.5–9.5
1771 black : PMT8	10 : 8.5–9.5
17136, 1711 overprinting flux : PM2	10 : 9–11

We recommend PMT8 thixotropic medium for printing **SELECTION 17** four-colors.

We recommend PM2 flowing medium for overprinting **17136** and **1711** 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 17** 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°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 17 colors contain less than 90 ppm residual lead and less than 40 ppm residual cadmium, with some exceptions (cadmium-containing colors *1) and are therefore in compliance with Californian Proposition 65, FDA, CPSIA, EU, and Japanese requirements.

Cadmium-containing colors, **1732** yellow, **1733** orange, **1764** red and **1765** red contain less than 90 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 17** 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, **17136** or **1711** 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 17** colors show slight visible attack but the colors do not come off 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 17** colors do not show any visible attack for up to 2 hours. If **17136** or **1711** flux are overprinted, they can stand up to 4 hours.

10. Safety Data Sheet (SDS)

Safety data sheet (SDS) of **SELECTION 17** colors are available on request.

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