

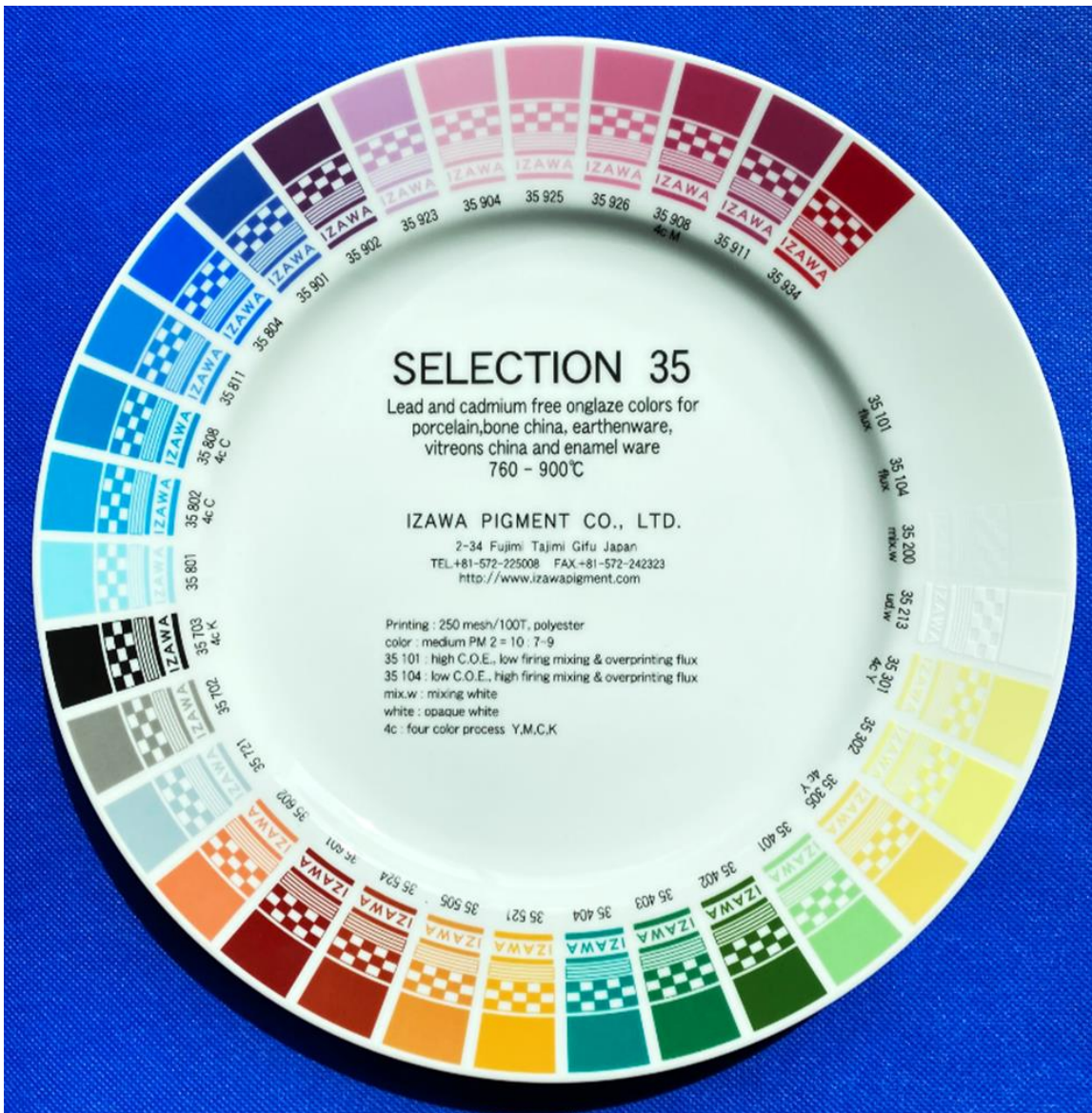
SELECTION 35 760-900°C

Lead- and cadmium-free onglaze colors

1. General Information and Color chart

Features!

- Lead and cadmium free.
- Intermixable and high resistant colors.
- Relief flux and white are available.
- Can mix with SELECTION 35M, metallic and interference metallic onglaze colors.



SELECTION 35 760–900°C Lead- and cadmium-free, intermixable, onglaze colors for porcelain, bone china, earthenware, vitreous china and enamel ware.

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 *1	Alkali resistant, ASTM C556-88 #2	35101 mixing and overprinting flux	35104 mixing and overprinting flux	Enamel ware	Bone, vitreous china, earthenware	Porcelain	Hard porcelain	Remarks
35101	flux		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	mixing and overprinting except porcelain and hard porcelain
35104	flux		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	mixing and overprinting except hard porcelain
35200	mixing white		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	mixing white
35213	opaque white		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	very opaque white, underlay white on color glaze
35301	lemon yellow	101C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	four-color yellow
35302	yellow	102C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
35305	orange yellow	123C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	four-color orange yellow
35401	grass green	359C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
35402	chrome green	364C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
35403	yellow green	3425C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
35404	blue green	328C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
35521	yellow brown	130C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
35505	ochre	1385C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
35524	chestnut	1615C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
35601	iron dark red	181C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	iron red, mixture limited
35602	iron red	164C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	iron red, intermixable
35721	gray	650C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
35702	dark gray	warm gray 8C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
35703	black	process blackC	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	four-color black
35801	turquoise	2905C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
35802	cyan	307C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	four-color cyan
35808	dark cyan	641C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	four-color cyan
35811	sky blue	2727C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	need overprinting flux for gloss, for soft glaze recommended
35804	azure	293C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
35901	lilac	2748C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
35902	purple	525C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
35923	violet	529C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
35904	light blue pink	203C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
35925	light red pink	1905C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
35926	red pink	205C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
35908	magenta	220C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	four-color magenta
35911	dark blue maroon	221C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
35934	dark red maroon	215C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	four-color reddish magenta
Relief flux & white															
35180	relief flux		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	relief flux, can mix with all 35 colors
35286	relief white		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	relief white, can mix with all 35 colors

*1: 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

*2: 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

Type of ware	Firing range
Porcelain	820–900°C
Vitreous china	800–900°C
Bone china	780–900°C
Earthenware	760–840°C
Enamel ware	800–830°C

SELECTION 35 colors are suitable for both normal firing of 3–10 hours and fast-firing of 60–120 minutes, cold-to-cold conditions. They should also be only used with lead-free colors and glazes. They must be fired only under lead-free conditions to avoid heavy lead release.

3. Application

SELECTION 35 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 35 colors (average)	Varies between $6.8-7.3 \times 10^{-6}/^{\circ}\text{C}$
35101 flux, low-firing temperature, mixing and overprinting for all substances except porcelain	$8.4 \times 10^{-6}/^{\circ}\text{C}$
35104 flux, high-firing temperature, mixing and overprinting for all substances	$6.3 \times 10^{-6}/^{\circ}\text{C}$
35180 relief flux for all substances	$5.5 \times 10^{-6}/^{\circ}\text{C}$
35286 relief white for all of substances	$5.8 \times 10^{-6}/^{\circ}\text{C}$

SELECTION 35 colors are carefully developed and tested under optimum conditions to minimize cracking or chipping problems. The maximum thickness of the color layer should be below $20 \mu\text{m}$ (approx. by 195 mesh/inch, 77 thread/cm, double printing) for porcelain glaze (C.O.E. $4.0-5.0 \times 10^{-6}/^{\circ}\text{C}$). Thicker printing of more than $25 \mu\text{m}$ could be allowed for bone china, earthen ware and vitreous china (C.O.E. $5.5-7.5 \times 10^{-6}/^{\circ}\text{C}$). However, it is necessary to test the cracking or chipping before mass production. The results will depend on the end-user's conditions.

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

Product	D ₅₀ average	D ₁₀₀ biggest
SELECTION 35 colors (average)	5.0–6.0 μ m (±1.0)	30 μ m (±10)
35101, 35104 flux	4.0–5.0 μ m (±1.0)	15 μ m (±10)
35180 relief flux	15–20 μ m (±5.0)	170–200 μ m (±30)
35286 relief white	3.5–4.5 μ m (±1.0)	20–25 μ m (±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.

Gold and high silver containing colors: We recommend that **35925** pink, **35926** pink, **35934** magenta are printed using 260–355 mesh/inch (100–140 thread/cm). If the color deposit is too thick, these high silver-containing colors become brownish.

Relief flux and white: We recommend that **35180** relief flux is printed using 70–123 mesh/inch (27–48 thread/cm) and **35286** relief white is printed using 103–148 mesh/inch (40–58 thread/cm). Printing 1–3 times is recommended. Printing by finer mesh shows smoother surface and less pinhole than rough mesh.

【6.2 Medium ratio】

SELECTION 35 color : Medium PM2/PMT8	10 : 7–9/8–10
35101, 35104 overprinting flux : Medium PM2	10 : 9–11
35180 relief flux : Medium PM2/PMT9	10 : 6–7/7–8
35286 relief white : Medium PM2/PMT9	10 : 6–7/7–8

SELECTION 35 colors: 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).

Relief flux and white: We recommend PM2 flowing medium for smooth relief and PMT9 weak thixotropic medium for high and sharp relief. We recommend C33 cover coat by printing 70 mesh/inch (27 thread/cm). Adding just sufficient medium will improve the surface of relief, if it has pinhole problems.

Lead-and-cadmium free onglaze 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 35 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.

Mixing white: To obtain pastel-color tone, it is suitable to mix **35200** mixing white or **35213** opaque white.

Mixing flux: **35101** flux (except for porcelain) and **35104** flux are suitable for mixing all colors. After mixing with flux, the color is lighter and glossier.

Underlay white: **35213** is opaque white and suitable for using as underlay white on color glaze.

Overprinting flux: **35101** flux is suitable as overprinting flux for all colors. If blues and iron red become very weak or high silver containing reddish pinks and maroons become brownish, we recommend **35104** flux instead. For porcelain we recommend using **35104**. Overprinting flux improves color gloss and chemical durability, such as heavy metal release, alkali durability and dishwasher resistance.

35101 flux on porcelain: Basically, mixing and overprinting **35101** flux with **SELECTION 35** colors on porcelain are not recommended. Because of high thermal expansions, it will be a cause of cracking or chipping problems but it depend on type of porcelain glaze and firing conditions.

Relief flux and white: **35180** relief flux and **35286** relief white are suitable for mixing all colors. After mixing with **SELECTION 35** colors, color relief can be developed.



Iron oxide red: When **35601** iron red is mixed with other colors, it is necessary to mix more than 50 % of **35601** to maintain the stability of iron oxide.

35811 sky blue: **35811** sky blue is specially developed for soft-glaze, bone china, vitreous china and earthenware. On porcelain, it becomes very mat appearance. This blue is high firing temperature and we recommended overprinting **35104** flux to make it glossy.

SELECTION 35M: Metallic and interference metallic colors are available. Please refer technical information of **SELECTION 35M**. They are intermixable with **SELECTION 35** colors.

8. Four-color printing

【8.1 Choice of colors】

Yellow	35301 lemon yellow, 35305 orange yellow
Magenta	35908 magenta, 35934 reddish magenta
Cyan	35802 cyan, 35808 dark cyan
Black	35703 black
Flux	35101, 35104 , mixing and overprinting flux

To adjust each color tone, **35301** lemon yellow can be mixed with **35305** orange yellow. **35908** magenta can be mixed with **35934** reddish magenta. **35802** cyan can be mixed with **35808** dark cyan. **35101** and **35104** flux are suitable as overprinting flux for all colors.

【8.2 Printing order】

yellow → magenta → cyan → black → overprinting flux.

【8.3 Mesh size】

We recommend mesh sizes that are 305–355 mesh/inch (120–140 thread/cm) for all screen applications.

【8.4 Medium ratio】

35301 lemon yellow, 35305 orange yellow : PMT8	10 : 8–9
35908 magenta, 35934 reddish magenta : PMT8	10 : 8.5–9.5
35802 cyan, 35808 dark cyan : PMT8	10 : 8–9
35703 black : PMT8	10 : 8–9
35101, 35104 , overprinting flux : PM2	10 : 9–11

We recommend PMT8 thixotropic medium for printing **SELECTION 35** four-colors.

We recommend PM2 flowing medium for overprinting **35101** and **35104** 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 35** colors depends on type of ware, glaze, kiln, color deposit and firing conditions. The following are the results of tests on vitreous china, fired at 850°C, with 10 minutes of soaking time and 120 minutes of cold-to-cold firing conditions of gas kiln in production.

【9.1 Residual lead and cadmium content】

SELECTION 35 colors contain less than 90 ppm residual lead and less than 40 ppm residual cadmium and are therefore in compliance with Californian Proposition 65, FDA, CPSIA, EU, and Japanese requirements.

【9.2 Lead and cadmium release】

According to the DI EN 1388-1-2 test, **SELECTION 35** colors show lead and cadmium releases are below AAS limits.

【9.3 Acid resistance】

According to the DI EN 1388-1-2 test, **SELECTION 35** colors do not show any visible attack after immersion in a 4% acetic acid solution for 24 hours at a room temperature $22 \pm 2^\circ\text{C}$, except **35804** azure and **35901** lilac.

【9.4 Alkali resistance】

According to the ASTM C556-88 test, **SELECTION 35** colors do not show visible attack for up to 6 hours. If **35101** or **35104** flux are overprinted, they can stand more than 6 hours.

10. Safety Data Sheet (SDS)

Safety data sheet (SDS) of **SELECTION 35** colors are available on request.

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