

SELECTION 39 760-900°C

Lead- and cadmium-free high resistant onglaze colors

1. General Information and Color chart

Features!

- Lead and cadmium free.
- Intermixable and very intensive colors.
- Very high chemical resistant colors.
- Combination with SELECTION 35 colors.
- Relief flux and white are available.



SELECTION 39 760-900°C Lead- and cadmium-free, intermixable and high resistant onglaze colors for 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	39102 mixing and overprinting flux	Enamel ware	Bone, vitreous china, earthenware	Porcelain	Hard porcelain	Remarks
35101	flux		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	mixing and overprinting, low firing temperature
39102	flux		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	mixing and overprinting, high firing temperature
39250	mixing white		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	mixing white
35213	opaque white		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	very opaque white, underlay white on color glaze
39356	lemon yellow	100C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	four-color yellow
39352	yellow	101C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
39355	orange yellow	123C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	four-color orange yellow
39455	grass green	359C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
39452	chrome green	364C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
39453	yellow green	3415C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
39454	blue green	3292C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
35521	yellow brown	130C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
39555	ochre	1385C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
39554	chestnut	1615C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
39652	iron red	164C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	iron red, intermixable
39751	gray	650C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
39753	black	process blackC	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	four-color black
39851	turquoise	2905C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
35802	cyan	307C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	four-color cyan
35808	dark cyan	641C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	four-color cyan
35811	sky blue	2727C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
35804	azure	293C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
39972	purple	262C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
35923	violet	529C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
39954	light blue pink	672C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
39955	light red pink	673C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
39956	red pink	493C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
39973	dark blue maroon	215C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
39974	dark red maroon	216C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	four-color magenta
Relief flux & white															
35180	relief flux		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	relief flux, can mix with all SELECTION 35, 39 colors
35286	relief white		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	relief flux, can mix with all SELECTION 35, 39 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
Bone china	820–900°C
Vitreous china	820–900°C
Earthenware	760–840°C
Enamel ware	800–830°C

SELECTION 39 and **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 39 and **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 39 colors (average)	Varies between $6.9\text{--}7.8 \times 10^{-6}/^{\circ}\text{C}$
SELECTION 35 colors (average)	Varies between $6.8\text{--}7.3 \times 10^{-6}/^{\circ}\text{C}$
35101 flux, low-firing temperature, mixing, overprinting for all except porcelain	$8.0 \times 10^{-6}/^{\circ}\text{C}$
39102 flux, high-firing temperature, mixing, overprinting for all wares	$7.3 \times 10^{-6}/^{\circ}\text{C}$
35180 relief flux	$5.5 \times 10^{-6}/^{\circ}\text{C}$
35286 relief white	$6.2 \times 10^{-6}/^{\circ}\text{C}$

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

Product	D ₅₀ average	D ₁₀₀ biggest
SELECTION 39, 35 colors (average)	5.0–6.0 μm (±1.0)	30 μm (±10)
35101, 39102 flux	4.0–5.0 μm (±1.0)	15 μm (±10)
35180 relief flux	15–20 μm (±5.0)	170–200 μm (±30)
35286 relief white	3.5–4.5 μm (±1.0)	20–25 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.

Gold and high silver containing colors: We recommend that **39925** pink, **39926** pink, **39974** 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 39, 35 color : Medium PM2/PMT8	10 : 7–9/8–10
35101, 39102 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 39, 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 39 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 **39250** mixing white or **35213** opaque white.

Mixing flux: **35101** flux and **39102** 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, but if blues and browns become very weak, and reddish gold-containing pinks and maroons become brownish, we recommend **39102** flux instead. Overprinting flux improves color gloss and chemical durability, such as heavy metal release, alkali durability and dishwasher resistance.

35811 sky blue: **35811** sky blue is specially developed for soft-glaze, bone china, vitreous china and earthenware. If it becomes mat appearance, we recommended overprinting **39102** flux to make it glossy.

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.



8. Four-color printing

【8.1 Choice of colors】

Yellow	39356 lemon yellow, 39355 orange yellow
Magenta	39973 bluish magenta, 39974 reddish magenta
Cyan	35802 cyan, 35808 dark cyan
Black	35753 black
Flux	35101, 359102 , mixing and overprinting flux

To adjust each color tone, **39356** lemon yellow can be mixed with **39355** orange yellow. **39973** magenta can be mixed with **39974** reddish magenta. **35802** cyan can be mixed with **35808** dark cyan. **35101** and **39102** 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】

39356 lemon yellow, 39355 orange yellow : PMT8	10 : 8–9
39973 bluish magenta, 39974 reddish magenta : PMT8	10 : 8.5–9.5
35802 cyan, 35808 dark cyan : PMT8	10 : 8–9
39753 black : PMT8	10 : 8–9
35101 , 39102 , overprinting flux : PM2	10 : 9–11

We recommend PMT8 thixotropic medium for printing **SELECTION 39, 35** four-colors.

We recommend PM2 flowing medium for overprinting **35101** and **39102** 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 39** and **35** colors depends on type of ware, glaze, kiln, color deposit and firing conditions. The following are the results of tests on bone china, fired at 860°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 39 and **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 39** and **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 39** and **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.

【9.4 Alkali resistance】

According to the ASTM C556-88 test, **SELECTION 39** and **35** colors do not show visible attack for up to 6 hours. If **35101** or **39102** flux are overprinted, they can stand more than 6 hours.

10. Safety Data Sheet (SDS)

Safety data sheet (SDS) of **SELECTION 39** and **35** colors are available on request.

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