

SELECTION 66 950-1,150°C

Lead- and cadmium-free inglaze colors

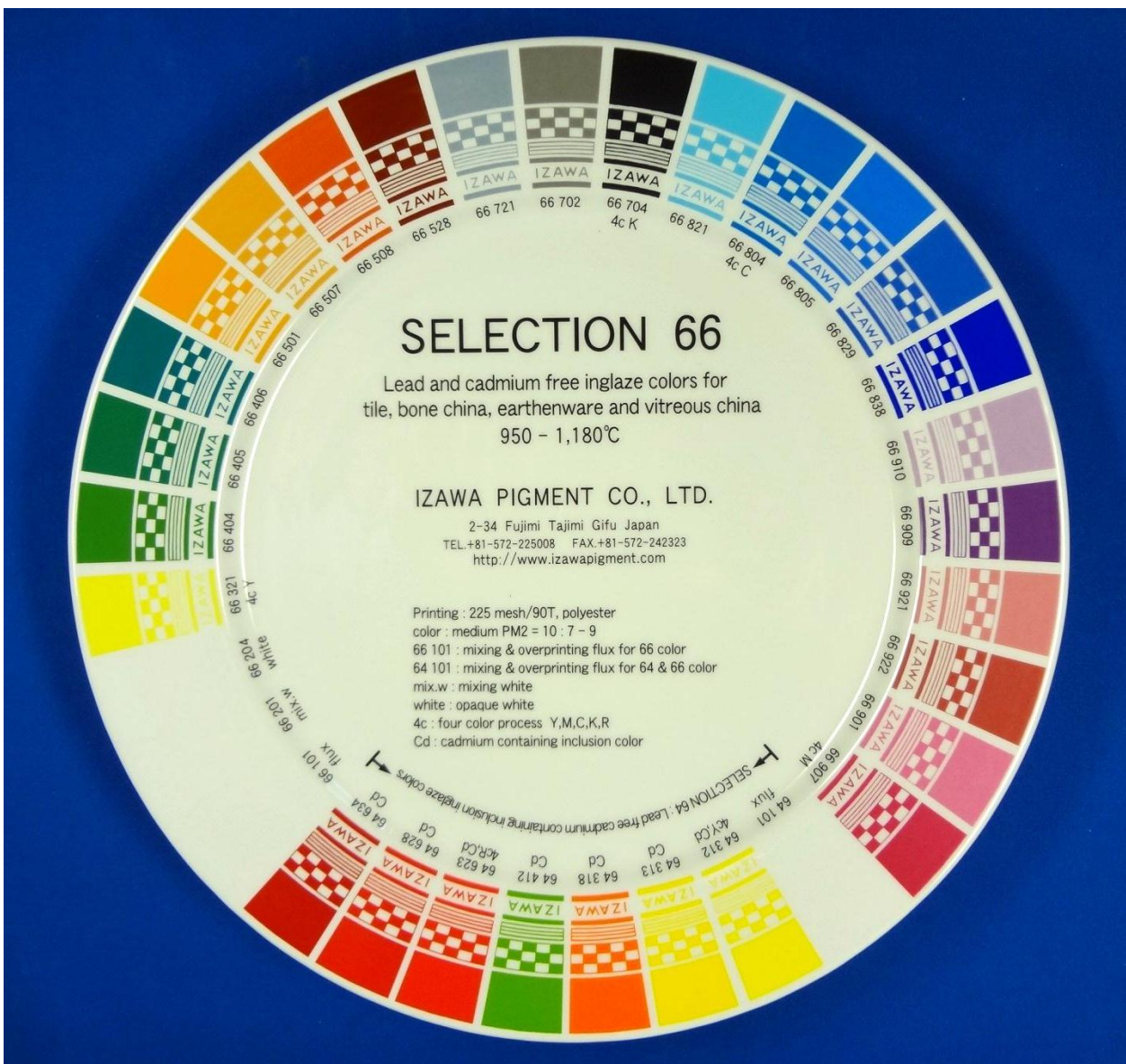
1. General Information and Color chart

SELECTION 66 series is a range of lead- and cadmium-free, intermixable, fast-fire, low firing temperature inglaze colors for tile, bone china, earthenware and vitreous china.

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

SELECTION 64: Lead- free cadmium containing, inclusion inglaze colors.

SELECTION 66 Relief: Lead- and cadmium-free inglaze relief flux and white.



SELECTION 66 950-1,150°C Lead and cadmium free inglaze colors for tile, bone china, earthenware and vitreous china.

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	66 101 mixing and overprinting flux	64 101 mixing and overprinting flux	Vetrosa	Tile	Bone, vitreous china, earthenware	Remarks
66 101	flux		✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	mixing and overprinting
66 201	mixing white		✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	mixing white
66 204	opaque white		✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	opaque white
66 321	yellow	101C	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	four-color yellow
66 404	chrome green	364C	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	
66 405	yellow green	342C	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	
66 406	blue green	322C	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	
66 501	yellow brown	137C	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	
66 507	ochre	1385C	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	
66 508	rose wood	1595C	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	
66 528	chestnut	478C	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	
66 721	gray	652C	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	
66 702	dark gray	404C	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	
66 704	black	Process blackC	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	four-color black
66 821	turquoise	2915C	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	
66 804	dark cyan	3015C	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	four-color cyan
66 805	sky blue	2935C	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	
66 829	cobalt blue	286C	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	
66 838	reddish cobalt blue	Blue 072C	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	high stain contents, mix flux if necessary
66 910	violet	529C	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	
66 909	purple	260C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
66 921	pink	701C	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	
66 922	maroon	703C	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	
66 901	light pink	190C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
66 907	red magenta	207C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	four-color magenta
Relief flux & white														
66 180	relief flux		✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	relief flux, can mix with all 66, 64 colors
66 280	relief white		✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	relief white can mix with all 66, 64 colors
SELECTION 64: Lead-free cadmium containing inclusion inglaze colors, additional colors for SELECTION 66														
64 101	flux		✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	special overprinting flux for 64 inclusion colors
64 312	lemon yellow	Yellow C	✓		✓	*1	✓	✓	✓	✓	✓	✓	✓	four-color orange yellow
64 313	cadmium yellow	Yellow 012C	✓		✓	*1	✓	✓	✓	✓	✓	✓	✓	
64 318	cadmium orange	Orange 021C	✓		✓	*1	✓	✓	✓	✓	✓	✓	✓	
64 412	cadmium green	377C	✓		✓	*1	✓	✓	✓	✓	✓	✓	✓	
64 623	cadmium red	Red 032C	✓		✓	*1	✓	✓	✓	✓	✓	✓	✓	
64 628	cadmium red	186C	✓		✓	*1	✓	✓	✓	✓	✓	✓	✓	four-color red
64 634	cadmium red	187C	✓		✓	*1	✓	✓	✓	✓	✓	✓	✓	

*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. SELECTION 64 Series

SELECTION 64 colors are lead-free cadmium containing inclusion colors. They show very intensive color tone and are stable at low- and high-firing temperatures. Even though, they do not show cadmium release after proper firing, we separated them from the **SELECTION 66** series because they contain cadmium. **SELECTION 64** colors are intermixable and can be used with **SELECTION 66** colors under the same firing conditions. As overprinting flux for **SELECTION 64** colors, we recommend 64101flux instead, if 66101 flux shows rough surface (orange skin problem).

3. Firing Conditions

Type of ware	Firing range
Vitreous china	1,000–1,180°C
Tile	950–1,050°C
Bone china	950–1,050°C
Earthenware	950–1,050°C

SELECTION 66 and **64** colors are suitable for fast-firing conditions, 30–150 minutes, cold-to-cold. They can be used as under colors of Vetrosa for tile decorations.

4. Application

SELECTION 66 and **64** colors are suitable for screen-transfer printing, direct printing, spraying, pad printing and hand painting

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

Product	Thermal Expansion (C.O.E.)
SELECTION 66 and 64 colors (average)	n/a
66101 flux, low-firing temperature,	$9.6 \times 10^{-6}/^{\circ}\text{C}$
64101 flux, high-firing temperature,	$8.5 \times 10^{-6}/^{\circ}\text{C}$
66180 relief flux	$6.2 \times 10^{-6}/^{\circ}\text{C}$
66280 relief white	$6.3 \times 10^{-6}/^{\circ}\text{C}$

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

Product	D ₅₀ average	D ₁₀₀ biggest
SELECTION 66 colors (average)	3-3.5 μ m	30 μ m
SELECTION 64 colors (average)	5 μ m	40-50 μ m
66101, 64101 flux	3-3.5 μ m	30 μ m
66180 relief flux	15-20 μ m	80-100 μ m
66280 relief white	15-20 μ m	80-100 μ m

7. Printing

【7.1 Mesh size】

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

Relief flux and white: We recommend that 66180 relief flux and 66280 relief white are printed using 100-120 mesh (40-48T). Printing 1-3 times is recommended. Printing by finer mesh shows smoother surface and less pinhole than rough mesh.

【7.2 Medium ratio】

SELECTION 66 : Medium PM2/PMT8	10 : 7-9/7.5-9.5
SELECTION 64 color : Medium PM2/PMT8	10 : 6-7/6.5-7.5
66101, 64101 overprinting flux : Medium PM2	10 : 9-11
66180 relief flux, 66280 relief white : Medium PM2/PMT9	10 : 5.5-6.5/6.5-7.5

SELECTION 66 and 64 colors: We recommend PM2 flowing medium, PMT8 thixotropic medium for dot and four-color printing. We recommend C12 cover coat by printing 70 mesh (27T).

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 (27T). 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.

8. Color and Mixability

SELECTION 66 and **64** 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 66201 mixing white.

Mixing flux: 66101 flux are suitable for mixing all colors. After mixing with flux, the color is lighter and glossier.

66838 cobalt blue: 66838 cobalt blue is specially developed for soft-glaze, tile, bone china, vitreous china and earthenware. This color is very intensive and has a reddish, inglaze, cobalt-blue tone. This blue will not be glossy if the firing temperature is not high enough. In this case, we recommend that the firing temperature is adjusted by mixing or overprinting 66101 flux, if necessary.

Gold containing colors: 66901 pink, 66907 magenta and 66909 purple contain gold and silver. They are intermixable with any of **SELECTION 66** and **64**, cadmium-containing, colors.

Overprinting flux: 66101 flux is suitable as overprinting flux for all colors except **SELECTION 64** inclusion colors. 64101 flux is suitable especially for **SELECTION 64** inclusion colors. Overprinting flux improves color gloss and chemical durability, such as heavy metal release, alkali durability and dishwasher resistance.

Relief flux and white: 66180 relief flux and 66280 relief white are suitable for mixing and overprinting with all colors. After mixing with **SELECTION 66** and **64** colors, color relief can be developed. It is also possible to adjust firing temperature by mixing with 66101 flux or 66201 white if necessary.

9. Four-color printing

【9.1 Choice of colors】

	Combination 1 (without cadmium colors)	Combination 2 (with cadmium colors)
Yellow	66321 lemon yellow	66312 cadmium yellow
Magenta	66907 magenta	66907 magenta
Red		64628 cadmium red
Cyan	66804 cyan	66804 cyan
Black	66704 black	66704 black
Flux	66101 mixing and overprinting flux	64101 mixing and overprinting flux

To adjust each color tone, 66321 lemon yellow can be mixed with 64312 orange yellow.

SELECTION 64 colors can be mixed and overprinted with above colors. For overprinting on **SELECTION 64** colors, 64101 flux is recommended.

【9.2 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)

【9.3 Mesh size】

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

【9.4 Medium ratio】

66321 lemon yellow, 64312 orange yellow : PMT8	10 : 7-8
66907 reddish magenta : PMT8	10 : 9-10
64628 cadmium red : PMT8	10 : 7-8
66804 : PMT8	10 : 7.5-8.5
66704 black : PMT8	10 : 7.5-8.5
66101, 64101 overprinting flux : PM2	10 : 9-11

We recommend PMT8 thixotropic medium for printing **SELECTION 66** and **64** four colors.

We recommend PM2 flowing medium for overprinting 66101 and 64101 flux.

We recommend C12 or C33 cover coat by printing 70 mesh (27T).

10. Chemical durability (refer to the Table 1)

Chemical durability of **SELECTION 66** 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 1,180°C, with 10 minutes of soaking time and 120 minutes of cold-to-cold firing conditions of gas kiln in production

【10.1 Residual lead and cadmium content】

SELECTION 66 colors contain less than 600 ppm residual lead and less than 100 ppm residual cadmium and are therefore in compliance with Californian Proposition 65, FDA, EU and Japanese requirements.

SELECTION 64 colors contain less than 600 ppm residual lead and contain more than 50,000 ppm cadmium. After proper firing **SELECTION 64** colors do not show cadmium release therefore they can pass FDA, EU and Japanese requirements.

【10.2 Lead and cadmium release】

According to the DI EN 1388-1-2 test, **SELECTION 66** and **64** colors show lead and cadmium releases are below AAS limits.

【10.3 Acid resistance】

According to the DI EN 1388-1-2 test, **SELECTION 66** and **64** colors do not show any visible attack after immersion in a 4% acetic acid solution for 24 hours at a room temperature of $22 \pm 2^{\circ}\text{C}$.

【10.4 Alkali resistance】

According to ASTM C556-88 test, **SELECTION 66** and **64** colors do not show any visible attack for up to 6 hours. If 66101 or 64101 flux are overprinted, they can stand more than 6 hours.

11. Material Safety Data Sheet (MSDS)

Material safety data sheet (MSDS) of **SELECTION 66** and **64** colors are available on request.

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