

SELECTION 32 780-900°C

Resistant onglaze colors

1. General Information and Color chart

SELECTION 32 series is a range of intermixable, low metal release, resistant, onglaze colors for porcelain, bone china, earthenware and vitreous china.

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

SELECTION 32 Relief: Resistant onglaze relief flux and white.

SELECTION 35M: Lead- and cadmium-free metallic and interference metallic colors.



SELECTION 32 780-900°C Intermixable, low metal release, resistant, onglaze colors for porcelain, bone china, earthenware and vitreous china.

Table 1

Product No.	Color tone	Pantone No.	Intermixable	Precious metal containing	Lead free (<300ppm)	Cadmium free (<100ppm)	Acid resistant, DIN 1388-1-2 *1	Pb release DIN 1388-1-2 (mg/dmf) *1	Cd release DIN 1388-1-2 (mg/dmf) *1	Alkali resistant, ASTM C556-88 #2	32 100 overprinting flux	32 101 overprinting flux	Enamel ware	Bone, vitreous china, earthenware	Hard porcelain, porcelain	Remarks
32 100	flux		✓			✓	✓	0.03	<0.002	✓	✓	✓	✓	✓	✓	mixing and overprinting
32 101	flux		✓			✓	✓	0.05	<0.002	✓	✓	✓	✓	✓	✓	overprinting
32 210	mixing white		✓			✓	✓	0.021	<0.002	✓	✓	✓	✓	✓	✓	mixing white
32 201	white		✓			✓	✓	0.025	<0.002	✓	✓	✓	✓	✓	✓	opaque white
32 220	underlay white		✓			✓	✓	0.03	<0.002	✓	✓	✓	✓	✓	✓	underlay white Ti base
32 344	lemon yellow	process yellowC	✓			✓	✓	0.03	<0.002	✓	✓	✓	✓	✓	✓	four-color yellow
32 345	orange yellow	107C	✓			✓	✓	0.24	<0.002	✓	✓	✓	✓	✓	✓	four-color yellow
32 313	cadmium yellow	109C	✓			✓	✓	0.07	0.03	✓	✓	✓	✓	✓	✓	four-color Cd yellow
32 318	cadmium orange	orange021C	✓			✓	✓	0.07	0.03	✓	✓	✓	✓	✓	✓	
32 413	cadmium green	370C	✓			✓	✓	0.1	0.03	✓	✓	✓	✓	✓	✓	
32 404	chrome green	364C	✓			✓	✓	0.045	<0.002	✓	✓	✓	✓	✓	✓	
32 412	grass green	356C	✓			✓	✓	0.03	<0.002	✓	✓	✓	✓	✓	✓	
32 406	blue green	328C	✓			✓	✓	0.038	<0.002	✓	✓	✓	✓	✓	✓	
32 521	yellow brown	143C	✓			✓	✓	0.03	<0.002	✓	✓	✓	✓	✓	✓	
32 514	ochre	145C	✓			✓	✓	0.04	<0.002	✓	✓	✓	✓	✓	✓	
32 524	chestnut	478C	✓			✓	✓	0.05	<0.002	✓	✓	✓	✓	✓	✓	
32 601	iron red	484C				✓	✓	0.023	<0.002	✓		✓	✓	✓	✓	iron red, mixture limited
32 609	iron red	1665C	✓			✓	✓	0.05	<0.002	✓		✓	✓	✓	✓	iron red, intermixable
32 623	cadmium red	1788C 2X	✓			✓	✓	0.07	0.03	✓	✓	✓	✓	✓	✓	four-color Cd red
32 628	cadmium red	485C 2X	✓			✓	✓	0.07	0.03	✓	✓	✓	✓	✓	✓	
32 721	gray	650C	✓			✓	✓	0.026	<0.002	✓	✓	✓	✓	✓	✓	
32 745	black	process blackC	✓			✓	✓	0.036	<0.002	✓	✓	✓		✓	✓	four-color black
32 821	turquoise	297C	✓			✓	✓	0.02	<0.002	✓	✓	✓	✓	✓	✓	
32 841	cyan	process cyanC	✓			✓	✓	0.033	<0.002	✓	✓	✓	✓	✓	✓	four-color cyan
32 845	dark cyan	3015C	✓			✓	✓	0.033	<0.002	✓	✓	✓	✓	✓	✓	four-color cyan
32 822	sky blue	2935C	✓			✓	✓	0.03	<0.002	✓	✓	✓	✓	✓	✓	
32 808	dark azure	293C	✓			✓	✓	0.3	<0.002	✓		✓	✓	✓	✓	non acid resistant
32 900	violet	521C	✓			✓	✓	0.02	<0.002	✓	✓	✓	✓	✓	✓	
32 937	light pink	674C	✓	✓		✓	✓	0.036	<0.002	✓	✓	✓		✓	✓	
32 908	pink	205C	✓	✓		✓	✓	0.025	<0.002	✓	✓	✓		✓	✓	
32 943	blue magenta	228C	✓	✓		✓	✓	0.03	<0.002	✓	✓		✓	✓	✓	four-color bluish magenta, Cd colors mixable
32 910	magenta	227C	✓	✓		✓	✓	0.025	<0.002	✓	✓		✓	✓	✓	four-color magenta
32 916	dark blue maroon	2415C	✓	✓		✓	✓	0.03	<0.002	✓	✓		✓	✓	✓	Cd colors mixable
32 921	dark red maroon	201C	✓	✓		✓	✓	0.035	<0.002	✓		✓		✓	✓	
Relief flux & white																
32 182	relief flux		✓			✓	✓	0.05	<0.002	✓	✓	✓	✓	✓	✓	transparent relief flux, intermixable except Cd colors
32 286	relief white		✓			✓	✓	0.03	<0.002	✓	✓	✓	✓	✓	✓	opaque relief white, intermixable except Cd 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.

*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.

2. Firing Conditions

Type of ware	Firing range
Porcelain	800–900°C
Vitreous China	750–880°C
Bone China	750–880°C
Earthenware	750–800°C

SELECTION 32 colors are suitable for both normal firing 3–10 hours and fast-firing 60–120 minutes, cold-to-cold conditions.

3. Application

SELECTION 32 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 32 colors (average)	Varies between $5.6\text{--}6.3 \times 10^{-6}/^{\circ}\text{C}$
32100 mixing and overprinting flux	$5.8 \times 10^{-6}/^{\circ}\text{C}$
32101 overprinting flux	$5.0 \times 10^{-6}/^{\circ}\text{C}$
32182 relief flux	$5.0 \times 10^{-6}/^{\circ}\text{C}$
32286 relief white	$5.6 \times 10^{-6}/^{\circ}\text{C}$

SELECTION 32 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 $25 \mu\text{m}$ (approx. by 200 mesh/80T, triple printing) for porcelain glaze (C.O.E. $4.5\text{--}5.5 \times 10^{-6}/^{\circ}\text{C}$). Thicker printing of more than $25 \mu\text{m}$ could be allowed for bone china, earthen ware and vitreous china (C.O.E. $5.5\text{--}7.5 \times 10^{-6}/^{\circ}\text{C}$) 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 32 colors (average)	3–3.5 μm	30 μm
32100, 32101 flux	2.5–3 μm	30 μm
32182 relief flux	20–25 μm	100 μm
32286 relief white	2–3 μm	15–20 μm

6. Printing

【6.1 Mesh size】

We recommend mesh sizes that are 180–355 mesh (71–140T) for all screen applications.

Gold and high silver containing colors: We recommend that 32908 pink, 32910 and 32921 maroon are printed using 250–355 mesh (100–140T). If the color deposit is too thick, the high silver-containing colors become brownish especially the firing temperature is not high enough.

Relief flux and white: We recommend that 32182 relief flux is printed using 100–120 mesh (40–48T) and 32286 relief white is printed using 100–150 mesh (40–60T). Printing 1–3 times is recommended. Printing by finer mesh shows smoother surface and less pinhole than rough mesh.

【6.2 Medium ratio】

SELECTION 32 color : Medium PM2/PMT8	10 : 6–8/7–9
32100, 32101 overprinting flux : Medium PM2	10 : 8–10
32182 relief flux : Medium PM2/PMT9	10 : 6–7/6–7
32286 relief white : Medium PM2/PMT9	10 : 6–6.5/6–6.5

SELECTION 32 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.

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 32 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, 32210 mixing white or 32201 opaque white are suitable.

Mixing flux: 32 100 flux is suitable for mixing all colors. After mixing with flux, the color is lighter and glossier.

Iron oxide red: When 32601 iron red is mixed with other colors, it is necessary for 32601 to be mixed over 50% in order to maintain the stability of iron oxide but it is not recommended for mixing with cadmium-containing colors.

Cadmium containing colors: 32313 yellow, 32318 orange, 32413 green, 32623 and 32628 red can only be mixed with one another. Also, up to 5% of cyan, blue, and black and up to 20% of 32100 flux and 32210 mixing white can be mixed for these cadmium-containing colors.

Overprinting flux: 32100 flux is suitable as overprinting flux for all colors, but if blues and iron reds become very weak, and reddish gold-containing pinks and maroons become brownish, we recommend 32101 flux instead. Overprinting flux improves color gloss and chemical durability, such as heavy metal release, alkali durability and dishwasher resistance.

Relief flux and white: 32182 relief flux and 32286 relief white are suitable for mixing and overprinting with all colors except cadmium containing colors. After mixing with **SELECTION 32** colors, color relief can be developed.

Mixing with cadmium containing colors show unstable color tone and babble or orange skin surface if it is overprinted.

8. Four-color printing

【8.1 Choice of colors】

	Combination 1 (without cadmium colors)	Combination 2 (with cadmium colors)
Yellow	32344 lemon yellow, 32345 orange yellow	32313 cadmium yellow
Magenta	32943 bluish magenta, 32910 reddish magenta	32943 bluish magenta
Red		32623 cadmium red
Cyan	32841 cyan, 32 845 dark cyan	32841 cyan, 32845 dark cyan
Black	32745 black	32745 black
Flux	32100 for mixing and overprinting flux	32100 for mixing and overprinting flux

To adjust each color tone, 32344 lemon yellow can be mixed with 32345 orange yellow. 32943 bluish magenta can be mixed with 32910 reddish magenta. 32841 cyan can be mixed with 32845 dark cyan.

32943 bluish magenta can be used with cadmium-containing colors. In this case, yellow should be 32313 cadmium yellow, and additional overprinting of cadmium colors are possible.

32100 flux is 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 → 32943 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 polyester 300–420 mesh (120–165T).

【8.4 Medium ratio】

32344 lemon yellow, 32345 orange yellow, 32313 cadmium yellow : PMT8	10 : 6.5–7.5
32943 bluish magenta, 32910 magenta : PMT8	10 : 7–8
32623 cadmium red : PMT8	10 : 7–8
32841 cyan, 32845 dark cyan : PMT8	10 : 7–8
32745 black : PMT8	10 : 7–8
32100 overprinting flux : PM2	10 : 8–10

We recommend PMT8 thixotropic medium for printing **SELECTION 32** four colors.

We recommend PM2 flowing medium for overprinting 32100 flux.

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

9. Chemical durability (refer to the Table 1)

Chemical durability of **SELECTION 32** colors depends on type of ware, glaze, kiln, color deposit and firing conditions. The following are the results of tests on porcelain, fired at 820°C, with 10 minutes of soaking time and 120 minutes of cold-to-cold firing conditions of gas kiln in production

【9.1 Lead and cadmium release】

According to the DI EN 1388-1-2 test, **SELECTION 32** colors show less than lead 0.3 mg/dm² and cadmium 0.03 mg/dm² releases. However, non-cadmium-containing colors show below cadmium 0.002 mg/dm² release. For each color, please refer to table 1.

【9.2 Acid resistance】

According to the DI EN 1388-1-2 test, **SELECTION 32** colors do not show any visible attack after immersion in a 4% acetic acid solution for 24 hours at a room temperature of 22±2°C, except 32808 dark azure.

【9.3 Alkali resistance】

According to the ASTM C556-88 test, **SELECTION 32** colors do not show any visible attack for up to 6 hours.

10. Material Safety Data Sheet (MSDS)

Material safety data sheet (MSDS) of **SELECTION 32** colors are available on request.

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