

SELECTION 51 780-840°C

Resistant onglaze colors for enamel ware

1. General Information and Color chart

Features!

- Wide range of intermixable, low metal release, resistant, onglaze colors for enamel ware.
- No diffusion and stable color shads under fast-fire firing conditions.
- High clarity of gold containing colors.
- Very unique emboss effect by 35192 reactive flux.



SELECTION 51 780-840°C Intermixable, low metal release, resistant, onglaze colors for enamel ware.

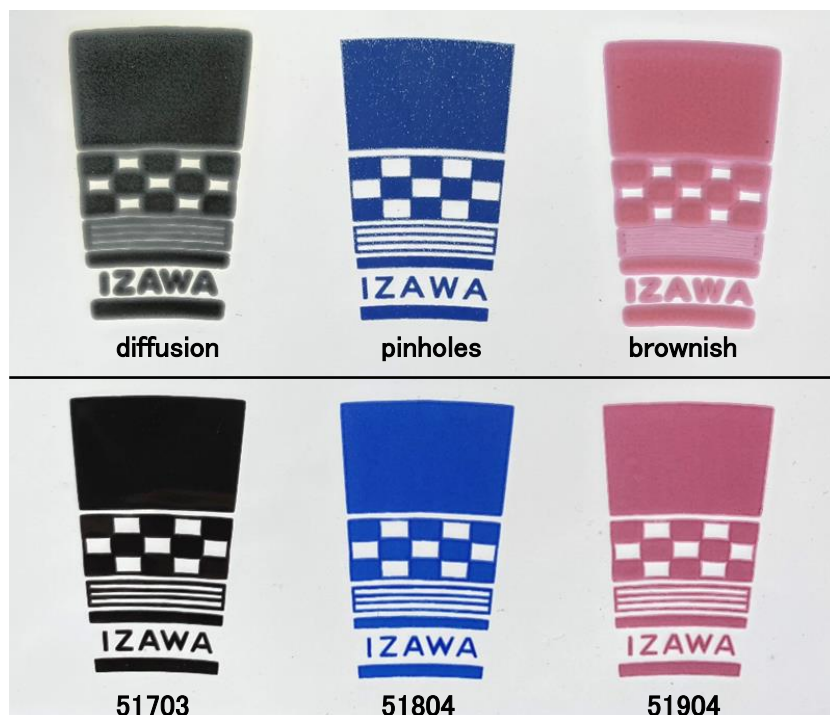
Table 1

| 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 | 51101 flux, mixing and over printing | Enamel ware | Tile, bone, vitreous china, earthenware | Oxidized porcelain (fine china) | Porcelain | Remarks |
|----------------------|----------------|-----------------|--------------|---------------------------|-------------------------|----------------------------|---------------------------------|-----------------------------------|--------------------------------------|-------------|---|---------------------------------|-----------|---|
| 51101 | flux | | ✓ | | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | mixing and overprinting |
| 51201 | mixing white | | ✓ | | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | mixing white |
| 51202 | white | | ✓ | | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | opaque white |
| 51301 | lemon yellow | process yellowC | ✓ | | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| 51302 | cadmium yellow | 109C | ✓ | | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | cadmium ccontaining color |
| 51303 | cadmium orange | orange021C | ✓ | | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | cadmium ccontaining color |
| 51401 | chrome green | 364C | ✓ | | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| 51402 | grass green | 356C | ✓ | | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| 51403 | blue green | 328C | ✓ | | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| 51501 | yellow brown | 143C | ✓ | | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| 51502 | ochre | 145C | ✓ | | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| 51503 | chestnut | 478C | ✓ | | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| 51601 | cadmium red | 1788C 2X | ✓ | | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | cadmium ccontaining color |
| 51602 | cadmium red | 485C 2X | ✓ | | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | cadmium ccontaining color |
| 51701 | blue gray | 650C | ✓ | | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| 51702 | gray | cool gray 7C | ✓ | | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| 51703 | black | process blackC | ✓ | | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| 51801 | sky blue | 2925C | ✓ | | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| 51802 | cyan | process cyanC | ✓ | | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| 51803 | dark cyan | 3015C | ✓ | | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| 51804 | dark azure | 293C | ✓ | | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| 51806 | dark azure | 286C | ✓ | | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| 51901 | purple | 261C | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | gold containing color |
| 51902 | violet | 530C | ✓ | | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| 51903 | light pink | 196C | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | gold containing color |
| 51904 | pink | 204C | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | gold containing color |
| 51905 | magenta | 228C | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | gold containing color |
| Reactive flux | | | | | | | | | | | | | | |
| 35192 | reactive flux | | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | reactive flux, emboss effect by over printing |

*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 8.1 and 8.2

*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 8.3

Normal onglaze colors



Typical problems of normal onglaze colors on enamel wares.

Diffusion, pinhole and brownish problem

SELECTION 51 colors show very stable firing results. No these problems

SELECTION 51 colors

2. Firing Conditions

| Type of ware | Firing range |
|----------------|--------------|
| Enamel ware | 780-840°C |
| Porcelain | 800-880°C |
| Vitreous China | 750-880°C |
| Bone China | 750-880°C |
| Earthenware | 750-800°C |

SELECTION 51 colors are suitable for fast-fire enamel firing, at 780-840°C, 3 minutes soaking time and 15-30 minutes cold-to-cold conditions.

This series can be fired on other substrates such as porcelain, tile, vitreous china and bone china and they can be fired at both normal firing 3-10 hours and fast-firing 60-120 minutes, cold-to-cold conditions.

3. Application

SELECTION 51 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.) |
|------------------------------------|--|
| 51101 mixing and overprinting flux | $7.3 \times 10^{-6}/^{\circ}\text{C}$ |
| 35192 reactive flux | $8.2 \times 10^{-6}/^{\circ}\text{C}$ |
| SELECTION 51 colors (average) | Varies between $6.8-7.3 \times 10^{-6}/^{\circ}\text{C}$ |

SELECTION 51 colors are suitable for enamel ware use but they can be used on other substrates if above C.O.E. amount is suitable. 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 |
|-------------------------------|-------------------------|--------------------------|
| 51101 flux | 4.5 μm (±1.0) | 30 μm (±10) |
| 35192 reactive flux | 4.5 μm (±1.0) | 18 μm (±5.0) |
| SELECTION 51 colors (average) | 4.5 μm (±1.0) | 30 μm (±10) |

6. Printing

【6.1 Mesh size】

We recommend polyester screen with 195-305 mesh/inch (77-120 thread/cm) for all screen applications.

【6.2 Medium ratio】

| Product | Color : medium | Recommended mesh |
|----------------------------------|----------------|--------------------------------------|
| 51101 flux : Medium PM2 | 10 : 7-9 | 195-305 mesh/inch (77-120 thread/cm) |
| 35192 reactive flux : Medium PM2 | 10 : 8-10 | 195-305 mesh/inch (77-120 thread/cm) |
| SELECTION 51 colors : Medium PM2 | 10 : 5-7 | 195-305 mesh/inch (77-120 thread/cm) |

We recommend C12 cover coat by printing 70 mesh/inch (27 thread/cm).

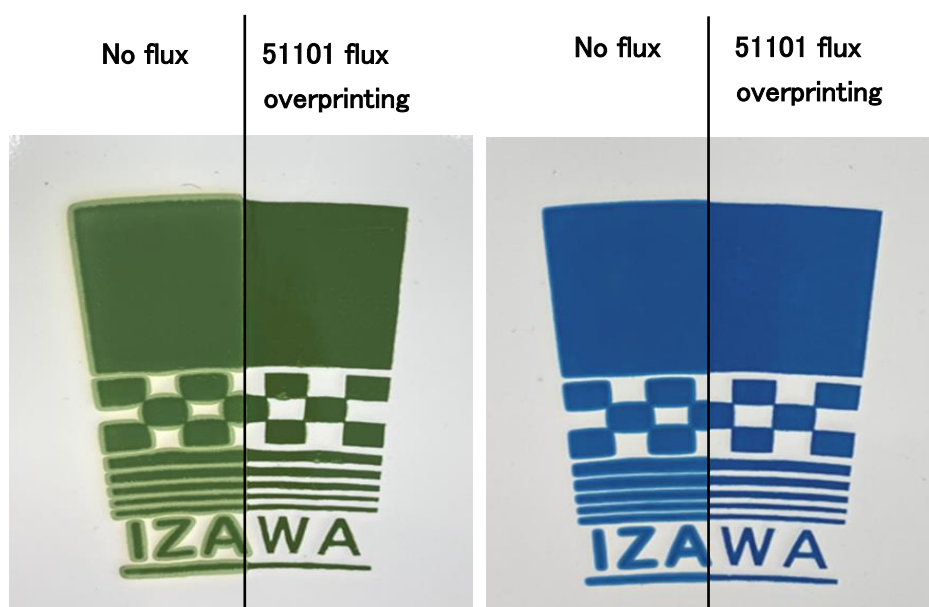
7. Color and Mixability

SELECTION 51 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, 51201 mixing white or 51202 opaque white are suitable.

Mixing flux: 51101 flux is suitable for mixing all colors. After mixing with flux, the color is lighter and glossier.

Overprinting flux: 51101 flux is suitable as overprinting flux for all colors. Overprinting flux improves color gloss and chemical durability, such as heavy metal release, alkali durability and dishwasher resistance. It also improves firing stability not to be diffused at long and over firing conditions below.



Gold containing colors: 51901 purple, 51903 light pink, 51904 pink and 51905 magenta are gold containing colors. They show very stable color shade under different firing conditions and they are intermixable with any of the other colors.

Cadmium containing colors: 51302 yellow, 51303 orange, 51601 and 51602 red can be mixed with other non-cadmium containing colors.

35192 reactive flux with SELECTION 51 colors:

35192 reactive flux is suitable for screen-transfer printing, direct printing, spraying, pad printing and hand painting. To achieve a high emboss effect, we recommend printing or applying 35192 as top of the decoration layer. Enamel ware glaze is soft enough to attain an emboss effect. Please refer to the technical data and recommendations above.



8. Chemical durability (refer to the Table 1)

Chemical durability of **SELECTION 51** colors depends on type of ware, glaze, kiln, color deposit and firing conditions. The following are the results of tests on enamel ware, fired at 820°C, with 3 minutes of soaking time and 30 minutes of cold-to-cold firing conditions of gas kiln in production

【8.1 Lead and cadmium release】

According to the DI EN 1388-1-2 test, **SELECTION 51** 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.

【8.2 Acid resistance】

According to the DI EN 1388-1-2 test, **SELECTION 51** 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.

【8.3 Alkali resistance】

According to the ASTM C556-88 test, **SELECTION 51** colors do not show any visible attack for up to 6 hours.

9. Safety Data Sheet (SDS)

Safety data sheet (SDS) of **SELECTION 51** colors are available on request.

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