

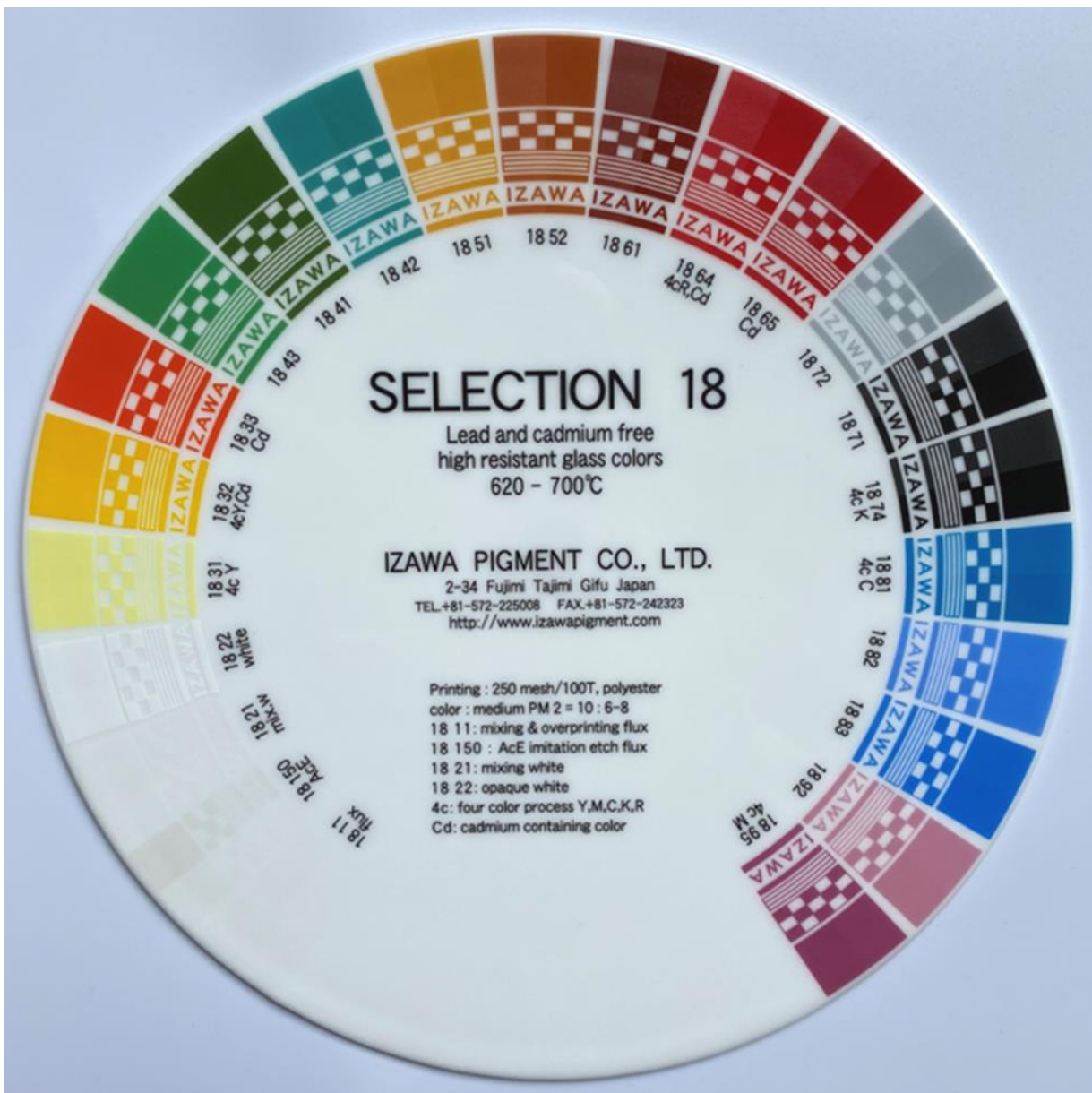
# SELECTION 18 620-700°C

Lead- and cadmium-free high resistant glass colors

## 1. General Information and Color chart

### Features!

- Intermixable and high resistant colors.
- Lead and cadmium free except cadmium colors.
- Can mix with SELECTION 18M, metallic and interference metallic glass colors.



## SELECTION 18 620–700°C Lead- and cadmium-free, intermixable, high resistant, glass colors for bottles, cosmetic containers and glass tableware.

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 *2 | Alkali resistant, ASTM C556-88 *3 | 1811 mixing and overprinting flux | Glass | Earthenware | Remarks  |
|-------------|-----------------|----------------|--------------|---------------------------|-------------------------|----------------------------|---------------------------------|-----------------------------------|-----------------------------------|-------|-------------|--|
| 1811        | flux            |                | ✓            | ✓                         | ✓                       | ✓                          | ✓*3                             | ✓                                 | ✓                                 | ✓     | ✓           | mixing and overprinting                              |
| 18150       | AcE flux        |                | ✓            | ✓                         | ✓                       | ✓                          | ✓*3                             | ✓                                 | ✓                                 | ✓     | ✓           | acid etch effect flux                                |
| 1821        | mixing white    |                | ✓            | ✓                         | ✓                       | ✓                          | ✓*3                             | ✓                                 | ✓                                 | ✓     | ✓           | mixing white, intermixable                           |
| 1822        | white           |                | ✓            | ✓                         | ✓                       | ✓                          | ✓*3                             | ✓                                 | ✓                                 | ✓     | ✓           | opaque white, intermixable                           |
| 1831        | lemon yellow    | 394C           | ✓            | ✓                         | ✓                       | ✓                          | ✓*3                             | ✓                                 | ✓                                 | ✓     | ✓           | four-color yellow                                    |
| 1832        | cadmium yellow  | 116C           | ✓            | ✓                         | *1                      | ✓                          | ✓*3                             | ✓                                 | ✓                                 | ✓     | ✓           | four-color Cd yellow                                 |
| 1833        | cadmium orange  | 021C           | ✓            | ✓                         | *1                      | ✓                          | ✓*3                             | ✓                                 | ✓                                 | ✓     | ✓           |  |
| 1843        | yellow green    | 348C           | ✓            | ✓                         | ✓                       | ✓                          | ✓*3                             | ✓                                 | ✓                                 | ✓     | ✓           |  |
| 1841        | chrome green    | 364C           | ✓            | ✓                         | ✓                       | ✓                          | ✓*3                             | ✓                                 | ✓                                 | ✓     | ✓           |  |
| 1842        | blue green      | 322C           | ✓            | ✓                         | ✓                       | ✓                          | ✓*3                             | ✓                                 | ✓                                 | ✓     | ✓           |  |
| 1851        | yellow brown    | 145C           | ✓            | ✓                         | ✓                       | ✓                          | ✓*3                             | ✓                                 | ✓                                 | ✓     | ✓           |  |
| 1852        | ocher           | 1605C          | ✓            | ✓                         | ✓                       | ✓                          | ✓*3                             | ✓                                 | ✓                                 | ✓     | ✓           |  |
| 1861        | dark iron red   | 174C           |              | ✓                         | ✓                       | ✓                          | ✓*3                             | ✓                                 | ✓                                 | ✓     | ✓           | not recommended mixing with cadmium colors           |
| 1864        | cadmium red     | 1795C          | ✓            | ✓                         | *1                      | ✓                          | ✓*3                             | ✓                                 | ✓                                 | ✓     | ✓           | four-color Cd red                                    |
| 1865        | cadmium red     | 1797C          | ✓            | ✓                         | *1                      | ✓                          | ✓*3                             | ✓                                 | ✓                                 | ✓     | ✓           |  |
| 1872        | gray            | 404C           | ✓            | ✓                         | ✓                       | ✓                          | ✓*3                             | ✓                                 | ✓                                 | ✓     | ✓           |  |
| 1871        | black           | process blackC | ✓            | ✓                         | ✓                       | ✓                          | ✓*3                             | ✓                                 | ✓                                 | ✓     | ✓           |  |
| 1874        | intensive black | process blackC | ✓            | ✓                         | ✓                       | ✓                          | ✓*3                             | ✓                                 | ✓                                 | ✓     | ✓           | four-color black, underlay black for metallic colors |
| 1881        | dark cyan       | 2935C          | ✓            | ✓                         | ✓                       | ✓                          | ✓*3                             | ✓                                 | ✓                                 | ✓     | ✓           | four-color cyan                                      |
| 1882        | blue            | 660C           | ✓            | ✓                         | ✓                       | ✓                          | ✓*3                             | ✓                                 | ✓                                 | ✓     | ✓           |  |
| 1883        | sky blue        | 293C           | ✓            | ✓                         | ✓                       | ✓                          | ✓*3                             | ✓                                 | ✓                                 | ✓     | ✓           |  |
| 1892        | dark pink       | 204C           | ✓            | ✓                         | ✓                       | ✓                          | ✓*3                             | ✓                                 | ✓                                 | ✓     | ✓           | Cd colors can be mixed                               |
| 1895        | magenta         | 227C           | ✓            | ✓                         | ✓                       | ✓                          | ✓*3                             | ✓                                 | ✓                                 | ✓     | ✓           | four-color magenta, Cd colors can be mixed           |

\*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. Refer section 9.2 and 9.3

\*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. Refer section 9.4

## 2. Firing Conditions

Normal firing is from 620–700°C in a cycle of 60–150 minutes, cold-to-cold, with 10 minutes for soaking. The best firing condition depends on firing speed and type of ware and kiln.

## 3. Application

**SELECTION 18** 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.)                               |
|---|--|
| <b>SELECTION 18</b> colors (average)                        | Varies between $9.0-9.5 \times 10^{-6}/^{\circ}\text{C}$ |
| <b>1811 flux</b> , high-firing temperature, glossy at 600°C | $9.7 \times 10^{-6}/^{\circ}\text{C}$                    |

If **SELECTION 18** colors are applied in very thick layers, the colors could crack or chip off, depending on the type of ware and thickness of the colors. We recommend testing the application of the colors under your conditions before mass production use.

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

| Product                              | D <sub>50</sub> average | D <sub>100</sub> biggest |
|--------------------------------------|-------------------------|--------------------------|
| <b>SELECTION 18</b> colors (average) | 4.0–6.0 μm (±1.0)       | 30 μm (±10)              |
| <b>1811 flux</b>                     | 4.0–6.0 μm (±1.0)       | 20 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.

### 【6.2 Medium ratio】

| Product                                     | Color : medium  | Recommended mesh                     |
|---|-----------------|--------------------------------------|
| <b>SELECTION 18</b> colors: Medium PM2/PMT8 | 10 : 6.5–9/8–10 | 195–305 mesh/inch (77–120 thread/cm) |
| <b>1811 flux</b> : Medium PM2               | 10 : 9–11       | 195–305 mesh/inch (77–120 thread/cm) |

**Screen-transfer printing:** 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).

Lead- and cadmium-free glass 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 18** 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.

**Underlay white**: **1822** white is suitable as underlay white for all colors.

**Mixing white**: To obtain pastel-color tone, it is suitable to mix **1821** mixing white or **1822** white.

**Mixing flux**: **1811** flux is suitable for mixing all colors. After mixing with flux, the color is lighter and glossier.

**Overprinting flux**: Overprinting **1811** flux can improve color gloss and chemical durability, such as heavy metal release, alkali durability and dishwasher resistance.

**AcE flux**: To obtain acid etch effect, **18150** AcE flux is suitable.

**Iron red**: **1861** iron red is not recommended for mixing with cadmium-containing colors.

**Black**: **1874** black is very intensive and it is recommended for four color printing and underlay black for metallic colors.

**Cadmium-containing colors \*1**: **1832** yellow, **1833** orange, **1864** red and **1865** red can be mixed with any other **SELECTION 18** colors except **1861** iron red.

**Gold containing colors** : **1892** pink and **1895** magenta contain gold and they can be mixed with any other **SELECTION 18** colors.

## 8. Four-color printing

### 【8.1 Choice of colors】

|         | Combination 1 (without cadmium colors) | Combination 2 (with cadmium colors) |
|---------|--|-------------------------------------|
| Yellow  | <b>1831</b> lemon yellow               | <b>1832</b> cadmium yellow          |
| Magenta | <b>1895</b> magenta                    | <b>1895</b> magenta                 |
| Red     |  | <b>1864</b> cadmium red             |
| Cyan    | <b>1881</b> cyan                       | <b>1881</b> cyan                    |

|              |  |  |
|--------------|--|--|
| <b>Black</b> | <b>1874</b> black                        | <b>1874</b> black                        |
| <b>Flux</b>  | <b>1811</b> mixing and overprinting flux | <b>1811</b> mixing and overprinting flux |

**1831** yellow and **1832** cadmium yellow can be mixed with each other and overprinted.

**1864** cadmium red and **1892** magenta can be mixed each other and overprinted.

**1811** flux are 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 → magenta/cadmium red → cyan → black → overprinting flux. (Additional overprinting of cadmium colors is possible before overprinting **1811** flux).

## 【8.3 Mesh size】

We recommend mesh sizes that are 250–305 mesh/inch (100–120 thread/cm) for all screen applications.

## 【8.4 Medium ratio】

|   |              |
|---|--------------|
| <b>1831</b> lemon yellow, <b>1832</b> cadmium yellow : PMT8 | 10 : 8.5–9.5 |
| <b>1895</b> magenta : PMT8                                  | 10 : 8.5–9.5 |
| <b>1864</b> cadmium red : PMT8                              | 10 : 8.5–9.5 |
| <b>1881</b> cyan : PMT8                                     | 10 : 8.5–9.5 |
| <b>1874</b> black : PMT8                                    | 10 : 8.5–9.5 |
| <b>1811</b> overprinting flux : PM2                         | 10 : 9–11    |

We recommend PMT8 thixotropic medium for printing **SELECTION 18** four-colors.

We recommend PM2 flowing medium for overprinting **1811** 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 18** colors depends on type of ware, kiln, color deposit and firing conditions. The following are the results of tests on soda lime glass bottle, fired at 650°C, with 10 minutes of soaking time and 90 minutes of cold-to-cold firing conditions of gas kiln in production.

## 【9.1 Residual lead and cadmium content】

**SELECTION 18** colors contain less than 90 ppm residual lead and less than 40 ppm residual cadmium, with some exceptions (cadmium-containing colors \*1) and are therefore in compliance with Californian Proposition 65, FDA, CPSIA, EU, and Japanese requirements.

**Cadmium-containing colors**, **1832** yellow, **1833** orange, **1864** red and **1865** red contain less than 90 ppm residual lead and contain more than 50,000 ppm cadmium.

## 【9.2 Lead and cadmium release】

According to the DI EN 1388-1-2 test, **SELECTION 18** colors show lead and cadmium releases are below AAS limits. Cadmium-containing colors (\*1) show considerably high cadmium release. They cannot meet FDA and EU limits. The cadmium release depends on the firing conditions and the total area of cadmium-containing colors. By overprinting, **1811** flux will reduce cadmium release but it is necessary to test under your conditions to make sure the cadmium releases are below the required limits.

## 【9.3 Acid resistance】

According to the DI EN 1388-1-2 test, **SELECTION 18** colors do not show any visible attack after immersion in a 4% acetic acid solution for 24 hours at room temperature  $22 \pm 2^{\circ}\text{C}$ .

## 【9.4 Alkali resistance】

According to the ASTM C556-88 test, **SELECTION 18** colors do not show any visible attack for up to 4 hours. If **1811** flux are overprinted, they can stand up to 6 hours.

## 10. Safety Data Sheet (SDS)

Safety data sheet (SDS) of **SELECTION 18** colors are available on request.

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