

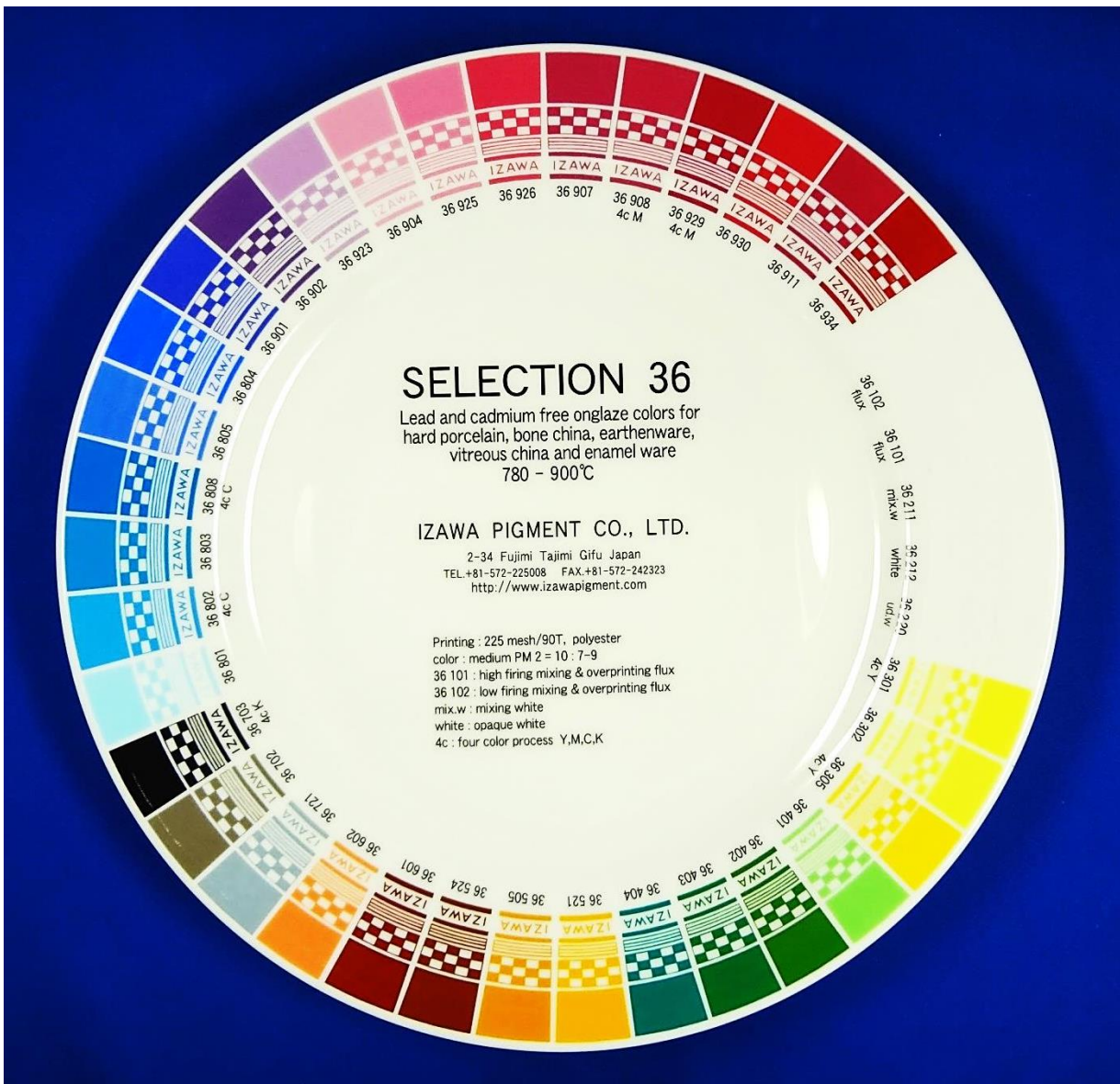
# SELECTION 36 780-900°C

Lead- and cadmium-free onglaze colors

1. General Information and Color chart

**Features!**

- Lead and cadmium free.
- Very low C.O.E and suitable for porcelain.
- Intermixable and very intensive colors.
- Relief flux and white are available.



## SELECTION 36 780-900°C Lead- and cadmium-free, intermixable, onglaze colors for hard porcelain, 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	36101 overprinting flux	36102 overprinting flux	Enamel ware	Bone, vitreous china, earthenware	Porcelain	Hard porcelain	Remarks
36101	flux		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	mixing and overprinting, high firing temperature
36102	flux		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	mixing and overprinting, low firing temperature
36211	mixing white		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	mixing white
36212	white		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	opaque white
36220	underlay white		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	underlay white Ti base
36301	lemon yellow	101C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	four-color yellow
36302	yellow	102C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
36305	orange yellow	122C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	four-color orange yellow
36401	grass green	359C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
36402	chrome green	364C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
36403	yellow green	341C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
36404	blue green	328C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
36521	yellow brown	130C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
36505	ochre	1385C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
36524	chestnut	1615C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
36601	iron dark red	181C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	iron red, mixture limited
36602	iron red	164C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	iron red, intermixable
36721	gray	650C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
36702	dark gray	warm gray 9C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
36703	black	process blackC	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	four-color black
36801	turquoise	2905C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
36802	cyan	307C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	four-color cyan
36803	dark cyan	308C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
36808	dark cyan	293C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	four-color cyan
36805	blue	2718C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
36804	azure	293C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
36901	lilac	2726C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
36902	purple	520C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
36923	violet	529C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
36904	light blue pink	203C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
36925	light red pink	1905C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
36926	red pink	205C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
36907	blue maroon	221C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
36908	magenta	220C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	four-color magenta
36929	magenta	220C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	four-color magenta intensive and reddish
36930	red maroon	201C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
36911	dark blue maroon	221C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
36934	dark red maroon	201C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
<b>Relief flux &amp; white</b>															
35180	relief flux		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	relief flux, can mix with all SELECTION 36 colors
35286	relief white		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	relief flux, can mix with all SELECTION 36 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
Hard porcelain	820–900°C
Bone china	800–900°C
Earthenware	780–840°C
Vitreous china	820–900°C
Enamel ware	800–830°C

**SELECTION 36** 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 36** 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 36</b> colors (average)	Varies between $6.0\text{--}6.5 \times 10^{-6}/^{\circ}\text{C}$
<b>36101</b> flux, high-firing temperature	$5.6 \times 10^{-6}/^{\circ}\text{C}$
<b>36102</b> flux, low-firing temperature	$6.5 \times 10^{-6}/^{\circ}\text{C}$
<b>36220</b> underlay white	$6.1 \times 10^{-6}/^{\circ}\text{C}$
<b>35180</b> relief flux for all substances	$5.5 \times 10^{-6}/^{\circ}\text{C}$
<b>35286</b> relief white for all of substances	$5.8 \times 10^{-6}/^{\circ}\text{C}$

**SELECTION 36** 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  $20 \mu\text{m}$  (approx. by 195 mesh/inch, 77 thread/cm, double printing) for porcelain glaze (C.O.E.  $4.0\text{--}5.0 \times 10^{-6}/^{\circ}\text{C}$ ). 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 <sub>50</sub> average	D <sub>100</sub> biggest
<b>SELECTION 36</b> colors (average)	5.0–6.0 μm (±1.0)	30 μm (±10)
<b>36101, 36102</b> flux	4.0–5.0 μm (±1.0)	15 μm (±10)
<b>36220</b> underlay white	3.5–4.5 μm (±1.0)	20–25 μm (±10)
<b>35180</b> relief flux	15–20 μm (±5.0)	170–200 μm (±30)
<b>35286</b> 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 **36925** pink, **36926** pink, **36929** magenta, **36930** and **36934** red maroon 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】

<b>SELECTION 36</b> color : Medium PM2/PMT8	10 : 7–9/8–10
<b>36101, 36102</b> overprinting flux : Medium PM2	10 : 9–11
<b>35180</b> relief flux : Medium PM2/PMT9	10 : 6–7/7–8
<b>35286</b> relief white : Medium PM2/PMT9	10 : 6–7/7–8

**SELECTION 36 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 36** 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 **36211** mixing white or **36212** white.

**Mixing flux**: **36102** flux is suitable for mixing all colors. After mixing with flux, the color is lightened and glossier.

**Underlay white**: **36220** white is suitable as underlay white for color glaze. For more details, please refer to the technical information of **36220** underlay white.

**Iron oxide red**: When **36601** iron red is mixed with other colors, it is necessary to mix more than 50 % of **36601** to maintain the stability of iron oxide.

**Overprinting flux**: **36102** flux is suitable as overprinting flux for all colors, but if blues and iron red become very weak, and reddish gold-containing pinks and maroons become brownish, we recommend **36101** flux instead. Overprinting flux improves color gloss and chemical durability, such as heavy metal release, alkali durability and dishwasher resistance.

**Underlay white**: **36220** underlay white can be under-printed and mixed with **SELECTION 36** colors in any proportions. In case of color changing defects, overprinting **36102** or **36102** flux as top of the color layer is effective. However we recommend testing the stability of colors under end-user's firing conditions before mass production. If you find unstable or color changing defects, please refer to the following guidelines.

**Cobalt-containing colors**: such as **36802**, **36803**, **36808** cyan, **36804**, **36805** blue, **36901** lilac can be greenish.

**Chrome-containing colors**: such as **36402** can be yellowish and **36220** becomes yellowish tone.

**Chrome-tin violet**: such as **36923** can be yellowish.

**Gold-containing colors**: they become bluish tone.



**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】

<b>Yellow</b>	<b>36301</b> lemon yellow, <b>36305</b> orange yellow
<b>Magenta</b>	<b>36908</b> magenta, <b>36929</b> reddish magenta
<b>Cyan</b>	<b>36802</b> cyan, <b>36808</b> dark cyan
<b>Black</b>	<b>36703</b> black
<b>Flux</b>	<b>361011</b> , <b>36102</b> for mixing and overprinting flux

To adjust each color tone, **36301** lemon yellow can be mixed with **36305** orange yellow. **36908** magenta can be mixed with **36929** reddish magenta. **36101** and **36102** 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】

<b>36301</b> lemon yellow, <b>36305</b> orange yellow : PMT8	10 : 8–9
<b>36908</b> magenta, <b>36929</b> reddish magenta : PMT8	10 : 8.5–9.5
<b>36802</b> cyan, <b>36808</b> dark cyan : PMT8	10 : 8–9
<b>36703</b> black : PMT8	10 : 8–9
<b>36101</b> , <b>36102</b> overprinting flux : PM2	10 : 9–11

We recommend PMT8 thixotropic medium for printing **SELECTION 36** four colors.

We recommend PM2 flowing medium for overprinting **36101** and **36102** 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 36** colors depends on type of ware, glaze, kiln, color deposit and firing conditions. The following are the results of tests on hard porcelain, fired at 850°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 36** 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 36** colors show lead and cadmium releases are below AAS limits.

### 【9.3 Acid resistance】

According to the DI EN 1388-1-2 test, **SELECTION 36** 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 **36804** azure and **36901** lilac.

### 【9.4 Alkali resistance】

According to the ASTM C556-88 test, **SELECTION 36** colors do not show visible attack for up to 4 hours. If **36101** or **36102** flux are overprinted, they can stand more than 6 hours.

## 10. Safety Data Sheet (SDS)

Safety data sheet (SDS) of **SELECTION 36** colors are available on request.

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