

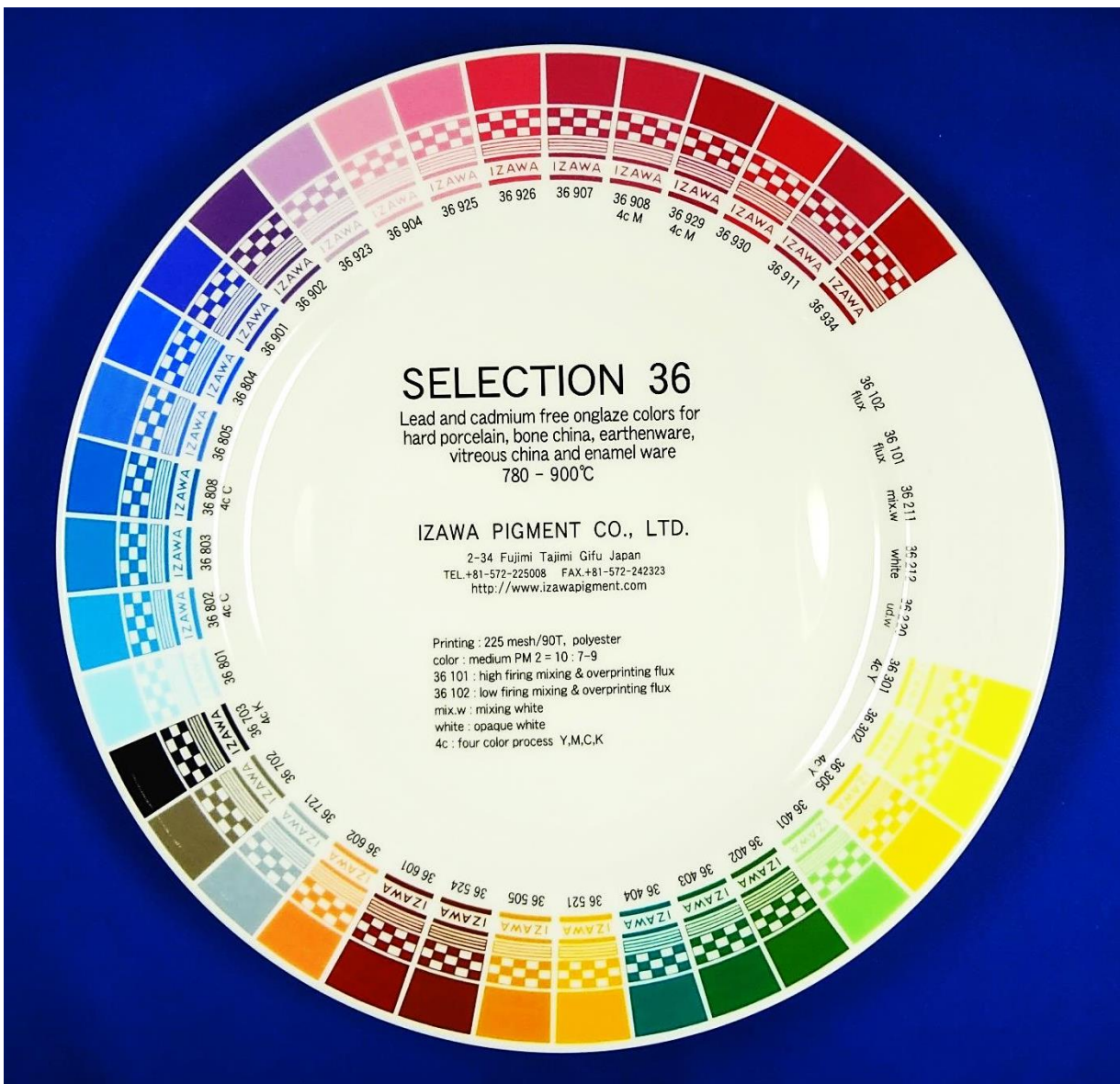
SELECTION 36 780-900°C

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	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Relief flux & white															
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.)
SELECTION 36 colors (average)	Varies between $6.0\text{--}6.5 \times 10^{-6}/^{\circ}\text{C}$
36101 flux, high-firing temperature	$5.6 \times 10^{-6}/^{\circ}\text{C}$
36102 flux, low-firing temperature	$6.5 \times 10^{-6}/^{\circ}\text{C}$
36220 underlay white	$6.1 \times 10^{-6}/^{\circ}\text{C}$
35180 relief flux for all substances	$5.5 \times 10^{-6}/^{\circ}\text{C}$
35286 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 ₅₀ average	D ₁₀₀ biggest
SELECTION 36 colors (average)	5.0–6.0 μm (±1.0)	30 μm (±10)
36101, 36102 flux	4.0–5.0 μm (±1.0)	15 μm (±10)
36220 underlay white	3.5–4.5 μm (±1.0)	20–25 μm (±10)
35180 relief flux	15–20 μm (±5.0)	170–200 μm (±30)
35286 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】

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

Yellow	36301 lemon yellow, 36305 orange yellow
Magenta	36908 magenta, 36929 reddish magenta
Cyan	36802 cyan, 36808 dark cyan
Black	36703 black
Flux	36101, 36102 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】

36301 lemon yellow, 36305 orange yellow : PMT8	10 : 8–9
36908 magenta, 36929 reddish magenta : PMT8	10 : 8.5–9.5
36802 cyan, 36808 dark cyan : PMT8	10 : 8–9
36703 black : PMT8	10 : 8–9
36101, 36102 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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