SELECTION 21M 600-680℃

High resistant, heat-resistant (borosilicate) glass colors

1. General Information and Color chart

Features!

- High resistant and intensive colors.
- Intermixable with SELECTION 21 colors.
- Glitter interference colors available.

SELECTION 21M 600–680℃ Intermixable and high resistant heat resistant (borosilicate) glass colors for bottles and glass tableware.

Table 1

Product No.	Color tone	Pantone No. / interference color on 21704 black	Intermixable	Lead free (below 90ppm)	Cadmium free (below 40ppm)	Acid resistant, DIN 2188-1-2 *1	Alkali resistant, ASTM C556-88 *2	Glass	P.S.D. D50 (average μm)	P.S.D. D100 (biggest μm)	Printing mesh size (mesh/inch, thread/cm)	Remarks
Metallic colors												
21M11	white silver		✔			✔	✔	✔	9–11	55	195, 77T	fine particle size, white silver, can mix with all of SELECTION 21colors
21M48	white silver		✔			✔	✔	✔	15–20	150	195, 77T	white silver, can mix with all of SELECTION 21colors
21M49	lemon gold	8640C	✔			✔	✔	✔	9–11	55	195, 77T	greenish gold
21M2	lemon gold	8641C	✔			✔	✔	✔	20–22	215	195, 77T	lemon gold
21M15	orange gold	871C	✔			✔	✔	✔	9–11	55	195, 77T	orange gold
21M3	copper	876C	✔			✔	✔	✔	9–11	55	195, 77T	
21M5	red copper	8903C	✔			✔	✔	✔	9–11	55	195, 77T	
Interference metallic colors												
21M24	orange gold	–/8660C	✔			✔	✔	✔	9–11	55	195, 77T	
21M28	yellow green	–/8703C	✔			✔	✔	✔	21–20	105	195, 77T	
21M29	green	–/8323C	✔			✔	✔	✔	9–11	55	195, 77T	
21M34	blue	–/8212C	✔			✔	✔	✔	9–11	55	195, 77T	
21M37	blue	–/8213C	✔			✔	✔	✔	9–11	55	195, 77T	
21M38	lilac	–/8103C	✔			✔	✔	✔	9–11	55	195, 77T	
21M41	red	–/8063C	✔			✔	✔	✔	9–11	55	195, 77T	
21M60	silver	–	✔			✔	✔	✔	70–90	420	103, 40T	glitter interference colors, firing lower than 580℃ is recommended
21M62	gold	–	✔			✔	✔	✔	45–55	420	103, 40T	glitter interference colors, firing lower than 580℃ is recommended
21M63	blue green	–	✔			✔	✔	✔	45–55	420	103, 40T	glitter interference colors, firing lower than 580℃ is recommended
21M64	red	–	✔			✔	✔	✔	45–55	420	103, 40T	glitter interference colors, firing lower than 580℃ is recommended
Special colors for SELECTION 21M colors												
21111	flux		✔			✔	✔	✔	4–5	20–30	260, 100T	mixing flux
21212	white		✔			✔	✔	✔	4–5	20–30	260, 100T	underlay white
21704	black	process blackC	✔			✔	✔	✔	4–5	20–30	260, 100T	underlay black

*1: DIN EN 2188-1-2 : The test pieces are immersed in a 4% acetic acid solution for 24 hours at 22±2℃. Refer section 7.2 and 7.3

*2: ASTM C556-88 : The test pieces are immersed in a 0.5 % sodium carbonate solution in water at 95℃ for 2, 4 and 6 hours. Refer section 7.4

Technical Information

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2. Firing Conditions

Normal firing is from 600–680℃ 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.

21M60, 21M62, 21M63 and **21M64** are very sensitive for firing temperature and conditions. We recommend to fire them bellow 620℃, otherwise they may lose metallic effect.

3. Application

SELECTION 21M metallic 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 21M metallic colors (average)	Varies between 5.0–5.2 × 10^{-6}/℃
SELECTION 21 colors (average)	Varies between 4.9–5.2 × 10^{-6}/℃
21111 flux	5.2 × 10^{-6}/℃

If **SELECTION 21M** metallic 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 you test the application of the colors under your conditions before use.

5. Particle size of Distribution (P.S.D.) and Printing

【5.1 Particle size】

21M60, 21M62, 21M63 and **21M64** are coarse particle size than other colors. As for each color particle size, please refer to Table 1. Recommended mesh size to print is below.

【5.2 Medium ratio and Mesh size】

Product	Color : medium	Recommended mesh size
SELECTION 21M normal colors : Medium PM2	10 : 7–10	195 mesh/inch, 77 thread/cm
21M60, 21M62, 21M63 and 21M64 : Medium PM2	10 : 7–10	103 mesh/inch, 40 thread/cm
SELECTION 21 colors : Medium PM2	10 : 5–7	195–305 mesh/inch (77–120 thread/cm)
21111 flux : Medium PM2	10 : 5.5–8	195–305 mesh/inch (77–120 thread/cm)

Screen-transfer printing: We recommend PM2 flowing medium. We recommend C12 cover coat by printing

70 mesh/inch (27 thread/cm).

If the ink is not a good homogeneous paste, the metallic colors will be dried easily on the screen during printing and, after firing, their surface and gloss will become not smooth and worse. In this case we recommend adding a little more medium to get a better homogenous of paste.

Glass colors absorb any moisture easily. Therefore, keep powder colors in a dry place. We recommend drying the color powder before using.

6. Color and Mixability

SELECTION 21M metallic colors can be mixed with each other in any proportions. Mixing with other **SELECTION 21** colors can be developed a wide range of metallic effect colors. However, we recommend testing the stability of mixing colors under end-user's firing conditions before mass production. Please note the following recommendations.

Mixing white silver: To obtain colored metallic, it is suitable to mix **21M11** or **21M48** white silver with approximate 15-30% of **SELECTION 21** colors. To make gray silver tone, mixing **21M11** or **21M48** white silver with **21704** black is recommended. Cadmium-containing colors, **21313** yellow, **21318** orange, 21412 **21628** and **21634** red also can be mixed with **SELECTION 21M** metallic colors.

Underlay colors: Any of **SELECTION 21** colors can be printed as underlay colors. **21704** black and **21212** white are recommended as underlay colors for both metallic and interference metallic colors to get intensive effect. If the underlay colors are over fired, especially interference metallic colors, they lose the metallic effect. In this case, we recommend firing lower.

Mixing flux: **21111** flux is recommended to mix with **SELECTION 21M** metallic colors to lighten the colors. According to our experience, maximum 30% of additional flux is allowed.

Overprinting flux: We do not recommend printing **21111** flux on **SELECTION 21M** metallic colors. If printed on **SELCTION 21M** colors, they may lose metallic effect.

Glitter interference colors: **21M60, 21M62, 21M63** and **21M64** are glitter interference metallic colors. They can be mixed with each other's and with other metallic colors. They are sensitive for firing temperature and we recommended to fire them below 650 ℃ not to lose their color intensity.

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7. Chemical durability (refer to the Table 1)

Chemical durability of **SELECTION 21M** metallic colors depends on type of ware, kiln, color deposit and firing conditions. The following are the results of tests on heat-resistant (borosilicate) glass, fired at 620℃, with 10 minutes of soaking time and 120 minutes of cold-to-cold firing conditions of gas kiln in production.

【7.1 Lead and cadmium release】

According to the DI EN 1388-1-2 test, **SELECTION 21M** metallic colors show less than lead 0.8 mg/dm^2 and cadmium 0.07 mg/dm^2 releases.

【7.2 Acid resistance】

According to the DI EN 1388-1-2 test, **SELECTION 21M** metallic 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℃.

【7.3 Alkali resistance】

According to the ASTM C556-88 test, **SELECTION 21M** metallic colors do not show any visible attack for up to 4 hours.

8. Safety Data Sheet (SDS)

Safety data sheet (SDS) of **SELECTION 21M** metallic colors are available on request.

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