

35M51 Gray and 35M52 Black 800–880°C

Lead- and cadmium-free onglaze metallic colors

1. General Information and Color chart

New development of 35M51 gray and 35M52 black (SELECTION 35M series) are lead- and cadmium-free, intermixable, intensive onglaze metallic colors for hard porcelain, porcelain, bone china, earthenware, vitreous china and enamel ware.

These color shade cannot be achieved by mixing onglaze gray or black and silver metallic.

They show very unique color tone especially on colored glaze and look iron and platinum shade.

Options for this series: Please refer to their individual technical information.

SELECTION 35M: Metallic and interference metallic colors.

SELECTION 35 and 36: Lead- and cadmium-free colors.

SELECTION 34: Lead- free cadmium containing colors.

SELECTION 35 Relief: Relief flux and white.

Features!

- Very intensive gray and black tone
- Low C.O.E.
- Lead and cadmium free
- Can overprint and mix with other normal colors and metallic colors



2. Firing Conditions

Type of ware	35M51, 35M52
Hard porcelain	820–880°C
Porcelain	820–880°C
Bone china	800–880°C
Earthenware	760–840°C
Vitreous china	800–880°C
Enamel ware	800–830°C

35M51 gray and **35M52 black** 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-and cadmium-free colors and glazes. They must be fired only under lead-and cadmium-free conditions to avoid heavy lead and cadmium release.

Interference metallic colors are recommended to fire fast-fire condition and lower temperature than the other metallic colors to avoid losing the interference effect.

3. Application

35M51 gray and **35M52 black** are suitable for screen-transfer printing, direct printing, spraying, pad printing and hand painting.

Both of the **35M51 gray** and **35M52 black** show interesting effect not only color itself but also show excellent effect by mixing with other colors, overprinting on relief and underlay colors.

4. Coefficient of Thermal Expansion (C.O.E.)

Product	Thermal Expansion (C.O.E.)
35M51, 35M52 (average)	between $6.8-7.3 \times 10^{-6}/^{\circ}\text{C}$
35103 overprinting flux	$4.3 \times 10^{-6}/^{\circ}\text{C}$

35M51 gray and **35M52 black** 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 200 mesh/80T, double printing) for porcelain glaze (C.O.E. $4.0-5.0 \times 10^{-6}/^{\circ}\text{C}$).

Thicker printing of more than $25 \mu\text{m}$ could be allowed for bone china, earthen ware and vitreous china (C.O.E. $5.5-7.5 \times 10^{-6}/^{\circ}\text{C}$) 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.) and Printing

【5.1 Mesh size】

	35M51, 35M52
Appearance	Intensive and high metallic effect
Particle size	Average 12-18 μ m, biggest 60 μ m
Mesh size (polyester)	100-200 mesh/40-80T

【5.2 Medium ratio】

35M51, 35M52 : Medium PM2	10 : 11-13
35103 overprinting flux : Medium PM2	10 : 9-11

Screen-transfer printing: We recommend PM2 flowing medium for printing **35M51 gray** and **35M52 black**. We recommend PM2 flowing medium for printing 35103 flux. We recommend C12 cover coat by printing 70 mesh (27T).

We recommend adding a little more medium for fine particle-color range to get a better homogenous of paste because the gravity of fine-particle colors is lighter than rough-particle colors. If the ink is not a good homogeneous paste, the color will dry on the screen during printing and, after firing, the gloss will become worse.

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

6. Color and Mixability

35M51 gray, 35M52 black and the other **SELECTION 35M** can be mixed with each other in any proportions. Mixing with other **SELECTION 35** colors can be developed a wide range of metallic effect colors. Please note the following recommendations.

Mixing white silver: To obtain lighter gray tone, mixing **35M51 gray, 35M52 black** with 35M11 or 35M12 white silver are recommended. 35M13 is not recommended because after mixing the tone become redder.

Underlay colors: Any of **SELECTION 35** colors and **35M** metallic colors can be printed as underlay colors. 35703 black is recommended as underlay black. If the underlay colors are over fired they lose the metallic effect. In this case, we recommend firing lower.

Relief effect: Mixing **35M51 gray** and **35M52 black** with 35180 relief flux or 35286 relief white can be developed relief metallic colors. Overprinting **35M51 gray** and **35M52 black** on 35180 relief flux or 35286 relief white show unique effect of relief metallic. In this case two time firing, firing relief first then apply additional metallic colors, shows better results.

Mixing flux: 35101 low firing temperature flux or 35104 high firing temperature flux is recommended to mix with **35M51 gray** and **35M52 black** to lighten the colors. To choose 35101 flux or 35104 flux depend on firing conditions and type of ware. According to our experience, maximum 30% of additional flux is allowed. 35103 flux is not suitable for mixing.

Overprinting flux: Only 35103 flux is suitable as overprinting flux for **35M51 gray** and **35M52 black**. Overprinting flux improves color gloss, increase metallic effect but this flux does not improve chemical durability, such as acid, alkali and dishwasher resistance. This flux can be overprinted on all of the **SELECTION 35M** metallic colors and **SELECTION 35** colors. 35101 flux and 35104 flux are not suitable for overprinting on **35M** metallic colors

We recommend testing the stability of mixing colors, overprinted flux and colors under the end-user's firing conditions before mass production.

7. Chemical durability

Chemical durability of **35M51 gray** and **35M52 black** depends on type of ware, glaze, kiln, color deposit and firing conditions. The following are the results of tests on porcelain, fired at 830°C, with 10 minutes of soaking time and 120 minutes of cold-to-cold firing conditions of gas kiln in production.

【7.1 Residual lead and cadmium content】

35M51 gray and **35M52 black** contain less than 300 ppm residual lead and less than 100 ppm residual cadmium and are therefore in compliance with Californian Proposition 65, FDA, EU and Japanese requirements.

【7.2 Lead and cadmium release】

According to the DI EN 1388-1-2 test, **35M51 gray** and **35M52 black** show lead and cadmium releases are below AAS limits.

【7.3 Acid resistance】

According to the DI EN 1388-1-2 test, **35M51 gray** and **35M52 black** do not show any visible attack after immersion in a 4% acetic acid solution for 24 hours at room temperature of $22 \pm 2^\circ\text{C}$.

【7.4 Alkali resistance】

According to ASTM C556-88 test, **35M51 gray** does not show any visible attack up to 4 hours but **35M52 black** shows slightly visible attack.

8. Material Safety Data Sheet (MSDS)

Material safety data sheet (MSDS) of **35M51 gray** and **35M52 black** are available on request.

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