

Technical Information

DF30

Performance Pigments and Colors



Lead Free Onglaze Colours for Porcelain, Bone China, Vitreous China, Earthenware, and Enamel

In this leaflet, Ferro presents **SAMBA100**, the next generation of our high pigmented onglaze colours. With a lead content of no more than 100 ppm, the colours of this series set new standards in the area of lead free onglaze decoration.

By now, a limit of 600 ppm PbO (0.06%) is accepted as a minimum standard for lead free colours. In launching the **SambaPlus** series some years ago, Ferro was first in the market to guarantee this limit.

Now we take a step forward and lower the upper limit for lead content to 100 ppm (0.01%).

Hence these colours already comply today with the legal requirements that become effective step by step until the year 2011 in the US, for example. Thus you are on the safe side.

Even the smallest contamination during the production process may cause the excess of the 100 ppm limit, therefore Ferro cares for an accurate processing and precise quality control. Our high quality products easily fulfil the increased demands on heavy metal content.

Advantages of the SAMBA100 Series

The **SAMBA100** colours offer numerous advantages:

- all colours fulfil the heavy metal release limits of EN 1388 1-2 as well as the Californian prop. 65 and the FDA
- maximum possible colour intensity even with thin colour deposits
- low colour consumption by using fine screens (e.g. for fine lines)
- improved flexibility in decoration designs by a wider colour space
- new colour shades
- excellent processing characteristics
- multi-purpose system: mixing or overprinting with different fluxes enables a wider application range than any other colour series so far on the market
- economic and logistic advantages due to the use of only one colour range for varying substrates and firing conditions.



SAMBA 100 Colours

Due to their strong pigmentation, the colours of this series are very intense and need to be overprinted with a flux to obtain a sufficient gloss. The cadmium free colours of this palette could also be mixed with a flux during processing. Although mixing with a flux reduces the intensity, it could possibly save the overprinting with flux and therefore a production step. Mixing with a flux instead of overprinting is especially useful when a design with decorating colours is combined with precious metal preparations. The proportion of flux addition should be determined under individual production conditions.

All available colours are shown in table 1 and fig. 1.

Cadmium Containing Supplementary Colours

The cadmium containing supplementary colours have to be processed without flux overprinting. They could be used on porcelain as well as on bone china. All available colours are listed in table 2 and fig. 1.

Fluxes

The fluxes mentioned in table 3 are intermixable and ensure in combination with the SAMBA 100 colours a broad variety of applications, depending on the design, substrate, and firing conditions. By adding the flux 10 1650 to SAMBA 100 colours, the colours of the Summerday series can be reproduced (see Technical Information DF07). The flux 10 1600 allows a reproduction of the Terra Nova colours.

The highest intensity is obtained by printing the colours without flux addition, just with an overprint of flux. Gloss and intensity can be fine-tuned by adding a higher or lower amount of fluxes.

Application

The colours of the SAMBA 100 range have excellent processing properties in all conventional decorating methods like screen printing (direct and indirect), spraying, machine lining and banding, and brush application. For cleaning all equipment and screens we recommend cleaning oil 80 452.

Colour Deposit

The maximum colour deposit depends on the firing cycle, the body, the glaze, and the form of the decorated surface as well as on the sintering grade of the colour in combination with the glaze. Too thin layers may result in an uneven, matt

surface; too thick layers of colour may lead to chipping or cracking.

Screen Printing (Direct and Indirect)

For direct and indirect screen printing, we recommend polyester screens with 100-140 threads/cm (255-355 mesh/inch) for colours and with 100-120 threads/cm (255-305 mesh/inch) for the flux.

On porcelain (C.T.E. approx. $40-45 \times 10^{-7}/K$), the colour deposit should not exceed $24 \mu m$, measured prior to firing, in order to avoid cracking or chipping. This thickness will be reached e.g. by a double printing with polyester screen 73 S and medium 80 820 (mixing ratio 100 parts colour and 70 to 80 parts medium).

When printing colours on top of each other or overprinting colours with a flux, the total colour deposit should not be thicker than the recommended value.

Applied on earthenware, bone china, and vitreous china, the maximum value of $24 \mu m$ may be exceeded.

In the information leaflets DF34 and DF14 further details to 4 or 7 process-colour printing is given.

Spraying

Colour suspensions for spraying application can be produced with oil-based media as well as with water-soluble media. Water containing colour suspensions with **purple colours** should be consumed immediately and not be stored for a longer time.

Spray application requires flux addition to all colours except to the purple colours and the cadmium containing supplementary colours.

Machine Banding and Lining

Colour suspensions applied with brushes, steel- or neoprene rollers are generally based on water-soluble media.

Machine banding and lining requires flux addition to all colours except to the purple colours and the cadmium containing supplementary colours.

Media

For all standard methods, Ferro offers suitable media and covercoats. Further detailed technical information can be found in our **CerDePrint Media Guide**.

Storage

The colours should be stored in a dry place. Opened containers should be closed carefully. To ensure that the colours have not absorbed any humidity, we recommend drying the colour powder at approx. 130 °C prior to mixing.

Miscibility and Compatibility

All SAMBA 100 colours with the exception of the cadmium containing colours are generally intermixable. The cadmium containing colours can only be mixed with one another, but not with cadmium free colours or with a flux. In any case, we recommend to test mixtures under the specific processing conditions prior to use.

Firing Conditions

The firing range in fast firing conditions (60 to 90 minutes) lies between 860 and 900 °C, in normal firing conditions between 820 and 850 °C.

The colour 12 1654 is best suitable for the use on bone china; on porcelain the colour might become matt.

The colour 18 1650 may show variations in intensity under unfavourable firing conditions.

It is absolutely necessary to apply lead free colours on lead free glazes. Due to the reactions between colour and glaze the surface of lead containing glazes may be altered chemically during firing and considerable amounts of lead

can be released. Lead free products should not be fired together with those containing lead as the resulting emissions could have adverse effects on the heavy metal release. Lead free colours could then be contaminated with lead.

Acid and Alkali Resistance

The alkali and acid resistance of fired colour layers is influenced by the thickness of the layer, the firing conditions, and the glaze. The colours of the **SAMBA 100** range show in laboratory tests and under industrial conditions with one exception, see below, no visible acid attack and only a slightly visible alkali attack (tested with 3% hydrochloric acid, 20 °C, 5 h, as well as with 0.5% Calgonite solution, 77 °C, 16 h).

Cobalt Blue 12 1654: According to our tests a slight acid attack was visible.

Heavy Metal Release and Heavy Metal Content

The cadmium free **SAMBA 100** colours are controlled lead and cadmium free with following upper limits: 100 ppm Pb and 600 ppm Cd. The cadmium containing colours are controlled lead free.

All colours of the series SAMBA 100 fulfil the heavy metal release limits of EN 1388 1-2 as well as the Californian prop. 65 and the FDA.

However, it is still necessary that the end user tests the cadmium release according to the relevant standard procedures for all products which contain cadmium colours and are manufactured under his technical production conditions.

Our safety data sheets, which are available for every product, provide you with useful advice for working with our products.

Fig. 1: The available SAMBA100 colours



While every attempt has been made to reproduce colours exactly, the samples printed here may differ slightly from the finished ceramic products.

Table 1: The SAMBA100 colours

Product No.	Colour Shade	Pantone® Code ¹
11 1650	Chrome Green	364 c
11 1651	Blue Green	3292 c
11 1653 ²	Green	362 c
12 1650	Light Blue	632 c
12 1651	Cyan	314 c
12 1652	Dark Blue	308 c
12 1653	Sky Blue	2727 c
12 1654	Cobalt Blue	285 c
12 1655	Cyan (4 colour process)	307 c
13 1650	Lemon Yellow	101 c
13 1651	Yellow (4 colour process)	122 c
13 1652	Golden Yellow	137 c
13 1655 ²	Yellow	116 c
14 1650	Intense Black	Black 2c 2x
14 1652	Black	Black c
15 1650	Neutral Grey	424 c
15 1651	Blue Grey	429 c
16 1650	Light Brown	153 c
16 1651	Dark Brown	1685 c
17 1656 ²	Orange	151 c
17 1657 ²	Intensive Red	172 c
17 1658 ²	Dark Red	1795 c
17 1659	Iron Red	484 c
18 1650	Violet	251 c
19 1650	White	
19 1651	Opaque White	
19 1652	Mixing White	
72 1650	Cobalt Blue	2756 c
77 1640 ³	Rose	203 c
77 1641 ³	Magenta (4 colour process)	207 c
77 1642 ³	Dark Purple	208 c
77 1643 ³	Pink	197 c
77 1644 ³	Maroon	702 c
77 1645 ³	Dark Maroon	201 c

¹ The above mentioned **Pantone®** code is only a guideline for the colour shade. **Pantone®** is a registered trade mark of Pantone Inc.

² Cadmium containing colours

³ These colours fire to a glossy surface with and without a flux coat.

Table 2: Cadmium containing supplementary colours for the use without flux overprinting

In contrast to the colours in table 1, the cadmium containing supplementary colours of table 2 do not need a flux overcoat (e.g. in spray application). They may be used on porcelain or on bone china.

Product No.	Colour Shade	Pantone® Code ¹
13 1604 ²	Yellow	116 c
13 1605 ²	Orange	151 c
17 1605 ²	Orange-Red	172 c
17 1606 ²	Intensive Red	1795 c

¹ The above mentioned **Pantone®** code is only a guideline for the colour shade. **Pantone®** is a registered trade mark of Pantone Inc.

² Cadmium containing colours

Table 3: Fluxes

Product No.	C.T.E. ($\times 10^{-7}/^{\circ}\text{K}$)	Softening Point	Product	Field of Application
10 1600	80	640 °C	Transparent flux	Mixing and coating flux for earthenware, bone china, vitreous china, enamel
10 1650	70	660 °C	Transparent flux	Mixing and coating flux for porcelain, earthenware, bone china, vitreous china, enamel
10 1652*	65	620 °C	Transparent flux	Coating flux for porcelain, earthenware, bone china, vitreous china, enamel

* For cadmium containing decorations, we recommend to use 10 1652 as coating flux.

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