

# Technical Information

DF58

Performance Pigments and Colors

## Springtime - Intensive Lead Free Underglaze Colours for Earthenware, Vitreous China, Bone China, Stoneware, Porcelain and Tiles

In this Technical Information Ferro presents the springtime underglaze colours. This series comprises 18 intensive colours which are to a wide extent miscible with each other, so that many colour shades can be obtained. The colours are particularly finely ground so that they are suitable for almost all application processes, e.g. direct and indirect screen printing (decals), spraying and hand painting. Springtime colours can be applied to both biscuit and greenware.

### Direct Screen Printing

The pasting ratio should be ten parts by weight of the colour powder to four to six parts of the medium SC-PL 940. This medium is water soluble and has therefore the advantage that all equipment and screens can be cleaned with water.

We recommend polyester screens with 73-140 threads/cm (185-355 mesh/inch).

When using medium SC-PL 940, porous substrates can be overprinted with additional colours after a very short period of time. An intermediate drying step at elevated temperature is not required.

The finished prints can be glazed directly after printing. A heat treatment to remove organic binders is in many cases not necessary. The medium volatilises already at low temperatures without leaving any residues.

### Indirect Screen Printing (Decals)

We recommend a pasting ratio of ten parts per weight colour powder to five to eight parts of the medium 80 820 or 80 595.

The printing should be done with polyester screens with 73-150 threads/cm (185-380 mesh/inch).

For **underglaze decoration *without intermediate firing*** the glaze lacquer 83 2014 should be used. In case of unfavourable atmospheric conditions, glaze lacquer 87 2015 is recommendable.

Please note that both glaze lacquers contain lead. They should be printed with polyester screens with 19 threads/cm (48 mesh/inch). The dried film deposit prior to firing should be around 55-65 µm.

For **underglaze decoration *with hardening-on firing*** we recommend the covercoat 83 2028. It should be printed with polyester screens with 21-24 threads/cm (53-60 mesh/inch). The dry film deposit should be around 30-35 µm. The covercoat 83 2028 is quite hard and inflexible after drying; it becomes very elastic only after contact with Bondsol or Emsol.

For cleaning equipment and screens we recommend cleaning oil 80 452.

On porous biscuit surfaces (e.g. earthenware or hard earthenware) as well as on non-porous surfaces (e.g. vitreous china or bone china) the adhesive effect of the dextrin is not sufficient for a satisfactory bond between the reverse side of the decal and the biscuit surface. For underglaze decoration of vitreous china and bone china this problem can be solved by using **Bondsol**; for earthenware, hard earthenware and stoneware we recommend the thixotropic agent **Emsol**. The more porous the object to be decorated, the higher the viscosity of the Bondsol or Emsol product should be. Ferro supplies Bondsol and Emsol products with different viscosities.

The underglaze decoration of **flatware without intermediate firing** should be done as follows:

1. The decals are soaked in water as usual and thoroughly wetted.
2. The biscuit surface is thinly covered with Bondsol or Emsol by means of a sponge or brush.
3. The decals are applied wet onto the freshly covered areas and thoroughly squeezed directly afterwards.
4. The squeezed water slime is removed with a wet cloth or sponge.
5. The decorated objects have to be dried for 24 hours at minimum 20 °C prior to glazing, after that, the **spray glaze application** and gloss firing can take place. Prior to spray glazing, the flatware has to be pre-heated to approx. 130 to 160 °C.

The underglaze decoration of **flatware with intermediate firing** differs only in the last step:

- 5.a The decorated objects have to be dried for 24 hours at minimum 20 °C prior to glazing, after that the intermediate firing is done at 740-850 °C.

Under particular circumstances the underglaze decoration of **hollow ware** is possible **without hardening-on firing**:

- The hollow ware has to be glazed inside.
- The surface decoration is done according to the description "underglaze decoration of flatware without intermediate firing".
- Spray glaze application is required afterwards.

When applying underglaze decoration on **hollow ware with hardening-on firing**, following guidelines should be noticed:

- The application of the decals has to be done with 87 4039 Bondsol.
- After drying the decals (24 hours at 20 °C) the intermediate firing is done at 740 to 850 °C, after that follow dip glazing and gloss firing.

For cleaning equipment and screens we recommend cleaning oil 80 890.

## Spray Application

For spray application we offer the water soluble spray medium 80 520. In this case, all equipment can be cleaned with water as well.

Further detailed technical information on all mentioned media can be found in our **CerDePrint Media Guide**.

## Glazing

When glazing **flatware** (bone china, vitreous china, or earthenware) **without intermediate firing**, the glaze should be applied by spraying. We recommend pre-heating the objects up to 130-160 °C.

**Hollow ware with intermediate firing** is in most cases dip-glazed, so that above mentioned process description is not applicable.

The hardening-on fire at 740-850 °C is followed by dip glazing and gloss firing.

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

All colours are widely intermixable. In any case, we recommend to test mixtures under the specific processing conditions prior to use.

The intense basic colours might be lightened by using White 19 1710.

## Transparent Fluxes and Additives

The colours of the Springtime series do not contain any flux addition. The quantity of added flux is variable according to the individual needs. The optimum compositions for the application on bone china, vitreous china, and earthenware are listed in table 2.

These mixtures contain a sufficient amount of adhesive flux that allows easy handling and glazing after the biscuit fire (750 °C, 2 h ↑, 10 min, 2 h ↓).

The following fluxes may be used:

- Lead free adhesive flux 10 4001, melting point 580 °C, surface tension 297 mN/m (calculated according to Dietzel).

- Lead containing adhesive flux 10 117, melting point 650 °C, surface tension 262 mN/m.

For the application on porcelain we recommend the colours marked in table 1 in combination with following fluxes:

- Lead free adhesive flux 10 1650, melting point 800 °C, surface tension 380 mN/m.
- Lead free adhesive flux 10 083, melting point 1200 °C, surface tension 208 mN/m.

### Firing Conditions

Depending on the glaze, the colours are fired at 900-1250 °C (porcelain 1200–1400 °C). Colour variations and firing stability of the colours are also influenced by the glaze. Please refer to the colour system given in table 1 to determine the compatibility of the colour and the glaze.

Unsuitable colour/glaze combinations lead to colour deviations or, in case of extreme incompatibility, even to blistering of the glaze.

### Resistance

The resistance of the underglaze decoration is determined by the glaze used. When decorating tableware that comes into contact with food, therefore lead free glazes should be used.

Ferro supplies lead free glazes and frits for vitreous china, bone china and earthenware. Kilns, in which lead containing glazes have been fired in the past, have dissolved lead in the kiln lining and might contaminate lead free glazes.

Attention: The fine ground stains of the Springtime and InstantColor series are glaze stains which are not especially tested for underglaze applications.

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

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

**Fig. 1: Colour samples of the Springtime series**



210 946 Green Blue



220 942 Turquoise



220 944 Blue



220 946 Cobalt Blue



230 946 Intensive Yellow



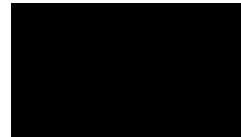
230 955 Yellow



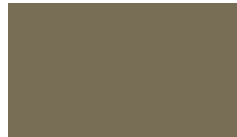
230 942 Brilliant Orange



240 942 Deep Black



240 944 Black



250 942 Neutral Grey



260 952 Red Brown



260 954 Middle Brown



270 965 Pink Red



270 941 Rose



270 946 Coral



270 944 Int. Red Light



270 950 Int. Red Dark



280 942 Violet

Table 1: The colours of the Springtime series

Reference	Colour Shade	Pantone® Code <sup>1</sup>	System	Old Reference	Hints and Recommendations
210 946 <sup>3</sup>	Green Blue	547 c	Co-Al-Cr	11 1715	for glazes low in zinc and magnesium
220 942 <sup>3</sup>	Turquoise	298 c	Zr-V-Si	12 1710	for all glazes
220 944 <sup>3,4</sup>	Blue	2758 c	Co-Al	12 1711	for all glazes
220 946 <sup>3</sup>	Cobalt Blue	2745 c	Co-Si	12 1712	for all glazes
230 946	Intensive Yellow	3965 c	Zr-Pr-Si	13 1713	for all glazes
230 955	Yellow	108 c	Zr-Pr-Si	13 1715	for all glazes
230 942 <sup>2</sup>	Brilliant Orange	165 c	Zr-Si-Cd-Se-S	13 1716	for all glazes
240 942 <sup>3</sup>	Deep Black	Black c	Co-Ni-Fe-Cr	14 1710	for all glazes
240 944	Black	Black 7 c	Ni-Mn-Fe-Cr	14 1711	for lead containing glazes low in zinc
250 942 <sup>3</sup>	Neutral Grey	7536 c	Sn-Sb-V	15 1710	for all glazes
260 952 <sup>3</sup>	Red Brown	483 c	Zn-Cr-Fe	16 1710	for glazes rich in zinc
260 954	Middle Brown	153 c	Zn-Al-Cr-Fe	16 1711	for glazes rich in zinc
270 965 <sup>5</sup>	Pink Red	492 c	Ca-Sn-Si-Cr	17 1710	for glazes low in zinc and rich in lime
270 941	Rose	493 c	Ca-Sn-Si-Cr	17 1711	for glazes low in zinc and rich in lime
270 946	Coral	1675 c	Zr-Fe-Si	17 1714	for all glazes
270 944 <sup>2</sup>	Intensive Red Light	179 c	Zr-Si-Cd-Se-S	17 1715	for all glazes
270 950 <sup>2</sup>	Intensive Red Dark	1805 c	Zr-Si-Cd-Se-S	17 1716	for all glazes
280 942	Violet	688c	Sn-Cr	18 1710	for glazes low in zinc and rich in lime
19 1710 <sup>3</sup>	White		Zr-Si		for all glazes

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

<sup>2</sup> Cadmium containing colours.

<sup>3</sup> These colours are suitable for high temperature firing on porcelain.

<sup>4</sup> Hazards identification Xn, R phrases 20/22.

<sup>5</sup> Hazards identification T, R phrases 61, 20/22, 33.

**Table 2: Recommendations for mixtures of Springtime with an adhesive flux**

Reference	Colour Shade	Quantity of Colour	Quantity of Flux	Additives
210 946	Green Blue	70%	30%	
220 942	Turquoise	80%	20%	
220 944	Blue	68%	20%	12 % china clay, calcined
220 946	Cobalt Blue	68%	20%	12 % china clay, calcined
230 946	Intensive Yellow	80%	20%	
230 955	Yellow	80%	20%	
230 942	Brilliant Orange	80%	20%	
240 942	Deep Black	75%	25%	
240 944	Black	75%	25%	
250 942	Neutral Grey	80%	20%	
260 952	Red Brown	70%	30%	
260 954	Middle Brown	80%	20%	
270 965	Pink Red	80%	20%	
270 941	Rose	80%	20%	
270 946	Coral	80%	20%	
270 944	Intensive Red Light	80%	20%	
270 950	Intensive Red Dark	80%	20%	
280 942	Violet	80%	20%	
19 1710	White	80%	20%	

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