

# Technical Information

## FK19

### InstantColor® Plus

#### Solutions for the Ceramic Industry

The Performance Pigments and Colors division of Ferro develops, produces, and markets pigments, special glasses, glazes, and special coating materials.

In the ceramic industry, we are world famous for our innovative, high-quality colouring products. Our most important goal is to maintain a high level of product quality and to maximize customer satisfaction. To ensure this, we emphasize dialogue and partnership with our customers, focusing on the challenges of their markets and on their suggestions and requirements, as well as on our mutual desire to protect the environment. As a result, we are always ready with the most creative and ambitious new products our customer need.

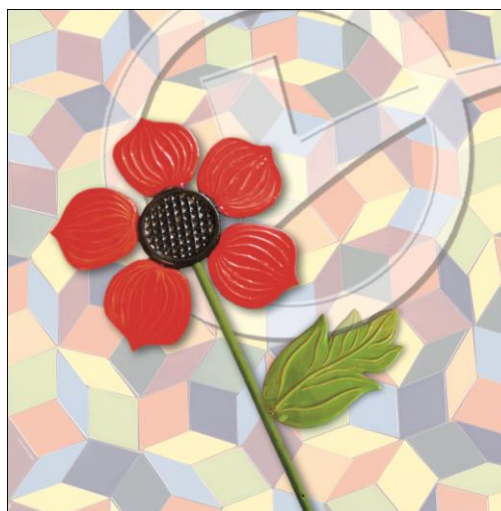
Ongoing research and development is the basis of the high quality of our stains, as we continually improve not only their composition, but also our production technology and test methods.

#### The Solution: InstantColor® Plus

Our daily life grows increasingly fast-paced with its mobile phones, e-mail, internet, and e-commerce. At every step, a new solution is required, tailored to suit an individual problem. Flexible and innovative product development makes it possible to fulfil these demands. Automation and rapid prototyping enable us to anticipate and meet your changing requirements with new products.

For the ceramic industry, our answer is: Fast-firing combined with InstantColor® Plus. With the help of InstantColor® Plus stains you save precious time, time spent traditionally in slurry preparation using a ball mill. All the stains in our InstantColor® Plus range consist of uniformly minute particles that are dissolved instantly. Practically all primary grains are smaller than 32 µm with no coarse agglomerates to grind for the slurry. Extremely fine grains mean far easier dispersibility, and for our customers this means no ball mills, much less production time, and much less waste. All this is offered in the complete colour spectrum. And of course you can prepare InstantColor® Plus-stains the traditional ball mill way if you wish.

The detailed test conditions for all our products are specified in the corresponding data sheets, which we will gladly send to you on request.



## **InstantColor® Plus: A Complete Colour Spectrum to Meet the Most Demanding Requirements**

### **Brilliant Colours:**

The 29 stains in this range exhibit the purity, intensity, and brilliance you want, in the complete colour spectrum.

### **Extremely Fine, Uniform Particles:**

99.9 % of InstantColor® particles (with exception of the inclusion pigments and the product 230 967, Melba) are guaranteed to be smaller than 32 µm, making the ideal for modern screen printing applications and for roller printing, e.g. Rotocolor®.

### **Easy Dispersibility:**

Readily dispersed in standard slurries, InstantColor® offers safe, easy handling.

### **Environmental Compatibility:**

InstantColor® Plus stains are lead free (with the exception of some sphenes) and so are particularly suitable for lead free glazes. Even our sphenes contain so little lead that – even when adding 10 weight-% – the coloured glaze needs no hazards identification. Stains using cadmium to achieve brilliant reds and oranges encapsulate the colour crystals in zirconium silicate, creating inert inclusion pigments.

### **Optimum Glaze Compatibility:**

Even in opaque glazes, InstantColor® stains create uniform, defect-free surfaces, no matter what the firing conditions are (traditional or fast-firing).

### **Flexible Production:**

Not restricted by the need to fill big ball mills, producers can easily prepare small batches, and switch from one colour to another. Just-in-time production is a reality. No mills to clean, no colour contamination, and no waste.

### **Miscibility:**

An infinite number of colours can be prepared using the InstantColor® Plus- range of 29 shades. Colours can be easily adjusted right in the barrel.

### **Cost Effectiveness:**

With minimal waste, no capital investment, no mill cleanup time, less water to dispose of, and high efficiency intense colour, the InstantColor® Plus- range is extremely cost-effective to use.

### **Proven Quality**

All stains are tested in a fast-firing process at 1100 °C for 75 minutes and compared to an established standard. The stain is released only if the colour difference of CIELABsystem  $\Delta E < 1$ .

InstantColor®- grain size distribution, sieve residue, and dispersibility are checked. Cadmium inclusion pigments are further investigated to analyze their cadmium release rate.

We are also ready to meet individual customer specifications, when requested.

## **Hints on the Glaze Compatibility and Miscibility with Other Stains**

### **Chromium Green and Cobalt-Chromium Green Blue**

210 950 Cr-Al / 210 946 Co-Al-Cr / 210 952 Co-Mg-Zn-Cr

These stains offer clear, very intense colours. Not suitable above 1000 °C for glazes rich in zinc, tin, and magnesium. Suitable for reducing and oxidizing atmosphere up to 1400 °C. Miscible with all cobalt and chromium containing greens and blues. Mixing of 210 950 with other types of stains for adjusting colours is not recommended.

### **Cobalt Blue**

220 944 Co-Al / 220 946 Co-Si / 220 943 Co-Zn-Al-Si

Cobalt stains show high firing stability and offer universal applicability. Zinc-containing glazes intensify the colour development. 220 944 could cause glaze-matting in large additions. Mixed with our sphenes, the Co stains create lilac and violet colour shades.

### **Zirconium Silicate Green, Blue, Yellow, Red**

210 960 Zr-Si-Pr-V / 220 942 and 220 955 Zr-Si-V / 230 946 and 230 955 Zr-Si-Pr / 270 946 Zr-Si-Fe

Very suitable for highly viscous glazes, especially for zircon glazes; less suitable for glazes rich in lead, boron and alkali. Good miscibility with each other, with inclusion pigments, with zircon grey and with zirconium oxide yellow. Not suitable for mixing with sphenes.



**Zirconium Oxide Yellow**

230 944 Zr-V / 230 967 Zr-V-In

Suitable for highly viscous glazes; less suitable for glazes with high lead-, zinc- and lime-content. Combining with Co-Cr containing stains should be avoided. The intensity of the stains may be drastically reduced if they are milled too long.

**Black**

240 942 Co-Ni-Fe-Cr / 240 944 Ni-Mn-Fe-Cr

The cobalt containing black is ferro-magnetic. Almost universally suitable for all glaze systems. Mixing with other stain systems, however, is not recommended. The cobalt-free black shows good colour development in lead containing glazes. In zinc-containing glazes, a brown shade develops. Mixing with stains other than brown or black is not recommended. We do not recommend using black stains to produce pale grey shades.

**Tin Antimony Grey**

250 942 Sn-Sb-V / 250 946 Sn-Sb

These stains can be universally used up to 1300 °C due to their colour stability. They are miscible with nearly all glaze and stain systems. 250 942 is a neutral grey, 250 946 a blue grey.

**Zirconium Grey**250 960<sup>1</sup> Zr-Si-Co-Ni

Like the true zircon stains, this grey stain is also very suitable for highly viscous glazes, in particular zircon glazes. Glaze composition, however, strongly influences the colour. It develops a bluish shade in glazes rich in zinc, and a greenish shade in those rich in lead.

**Brown**

260 952 Zn-Cr-Fe / 260 954 and 260 946 Zn-Al-Cr-Fe / 260 955 Zn-Mn-Fe-Cr

With the exception of stain 260 955, all these stains are very suitable for zinc-containing glazes. The colour develops extraordinarily well in transparent glazes. The stains can also be used in zircon glazes, and are miscible with brown, black and Zr-yellow stains. 260 955 has a tendency to develop surface defects in highly viscous glazes.

**Chromium Tin Burgundy (Maroon) / Violet**

270 941, 270 965, 270 966 Ca-Sn-Si-Cr / 280 942 Sn-Cr

Particularly suitable for lime-rich and lead containing glazes. Not suitable for zinc-containing and boron-rich glazes. Small additions of tin oxide as well as of wollastonite increase colour stability. Reducing impurities such as SiC, C, Fe, Cu, Al etc. lead to local discolouration in the form of white spots. Miscible with stains based on cobalt and tin.

**Inclusion Pigment Orange and Red**

230 942 Zr-Si-Cd-S-Se / 270 944 Zr-Si-Cd-S-Se

Highly suitable for glazes containing lead, lime, zinc, and boron; less suitable for alkali-rich glazes. The highest colour strength is achieved in transparent glazes with high optical refraction. Inclusion pigments create firing stable colours under oxidizing and reducing conditions up to 1350 °C. Never add inclusion pigments to the mill until 95 % of the total milling time has been completed.

**Chromium Containing Stains**

Chromium (III) oxide has significant evaporating pressure above 1050 °C, which increases considerably as the temperature rises. In a compound, Cr<sub>2</sub>O<sub>3</sub> evaporates more slowly the more closely it is incorporated into the stain, and the lower the concentration. Particular care must be taken with green and black stains. Even small amounts of Cr<sub>2</sub>O<sub>3</sub> vapour can give a dirty-green tinge to light-coloured glazes fired near a chromium source. Tin oxide containing glazes turn into a reddish colour because of this reaction.

<sup>1</sup> Hazards identification T and N; R phrases 49-61-20/22-48/23-68-42/43-51

Table 1: InstantColor® Plus stains: composition, crystal structure, firing conditions

Pigment	System	Colour	Crystal Structure	Tmax/°C	Firing Conditions
210 950	Cr-Al	Olive Green	Corund	1400	ox./red.
210 946	Co-Al-Cr	Green Blue	Spinel	1400	ox./red.
210 960	Zr-Si-Pr-V	Grass Green	Zircon	1250	ox./slightly red.
210 952	Co-Mg-Zn-Cr	Chrome Green	Spinel	1400	ox./red.
220 942	Zr-Si-V	Turquoise	Zircon	1350	ox./red.
220 943	Co-Zn-Al-Si	Indian Blue	Spinel	1450	ox./red.
220 944	Co-Al	Blue	Spinel	1450	ox./red.
220 946	Co-Si	Cobalt Blue	Olivine	1450	ox./red.
220 955	Zr-Si-V	Azure Blue	Zircon	1350	ox./red.
230 942	Zr-Si-Cd-S-Se	Brilliant Orange	Zircon	1350	ox./red.
230 944	Zr-V	Havanna	Baddeleyite	1400	ox./red.
230 946	Zr-Si-Pr	Intense Yellow	Zircon	1250	ox./slightly red.
230 955	Zr-Si-Pr	Yellow	Zircon	1250	ox./slightly red.
230 967	Zr-V-In	Melba	Baddeleyite	1400	ox./red.
240 942	Co-Ni-Fe-Cr	Black	Spinel	1300	ox./red.
240 944	Ni-Mn-Fe-Cr	Black	Spinel	1300	ox./red.
250 942	Sn-Sb-V	Neutral Grey	Cassiterite	1300	ox./red.
250 946	Sn-Sb	Blue Grey	Cassiterite	1300	ox./red.
250 960 <sup>1</sup>	Zr-Si-Co-Ni	Blue Grey	Zircon	1350	ox./slightly red.
260 946	Zn-Al-Cr-Fe	Light Brown	Spinel	1300	ox./red.
260 952	Zn-Cr-Fe	Red Brown	Spinel	1300	ox./red.
260 954	Zn-Al-Cr-Fe	Middle Brown	Spinel	1300	ox./red.
260 955	Zn-Mn-Fe-Cr	Black Brown	Spinel	1300	ox./red.
270 941	Ca-Sn-Si-Cr	Rose	Sphene	1250	ox.
270 944	Zr-Si-Cd-S-Se	Intense Red	Zircon	1350	ox./red.
270 946	Zr-Si-Fe	Coral	Zircon	1250	ox.
270 965	Ca-Sn-Si-Cr	Maroon	Sphene	1250	ox.
270 966	Ca-Sn-Si-Cr	Dark Maroon	Sphene	1250	ox.
280 942	Sn-Cr	Violet	Cassiterite	1250	ox.

<sup>1</sup> Hazards identification T and N; R phrases 49-61-20/22-48/23-68-42/43-51

Table 2: Glaze composition

Glaze	A	B
SiO <sub>2</sub>	60.8	54.7
ZrO <sub>2</sub>	-	6.1
B <sub>2</sub> O <sub>3</sub>	1.5	3.9
Al <sub>2</sub> O <sub>3</sub>	9.6	7.6
CaO	12.1	8.9
ZnO	9.5	12.4
MgO	1.7	2.4
Na <sub>2</sub> O	0.8	0.3
K <sub>2</sub> O	4.0	3.7

All stains were added to both glazes with 5 weight-%, with the following exceptions:

210 946: 2% in both glazes

210 960: 7% in both glazes

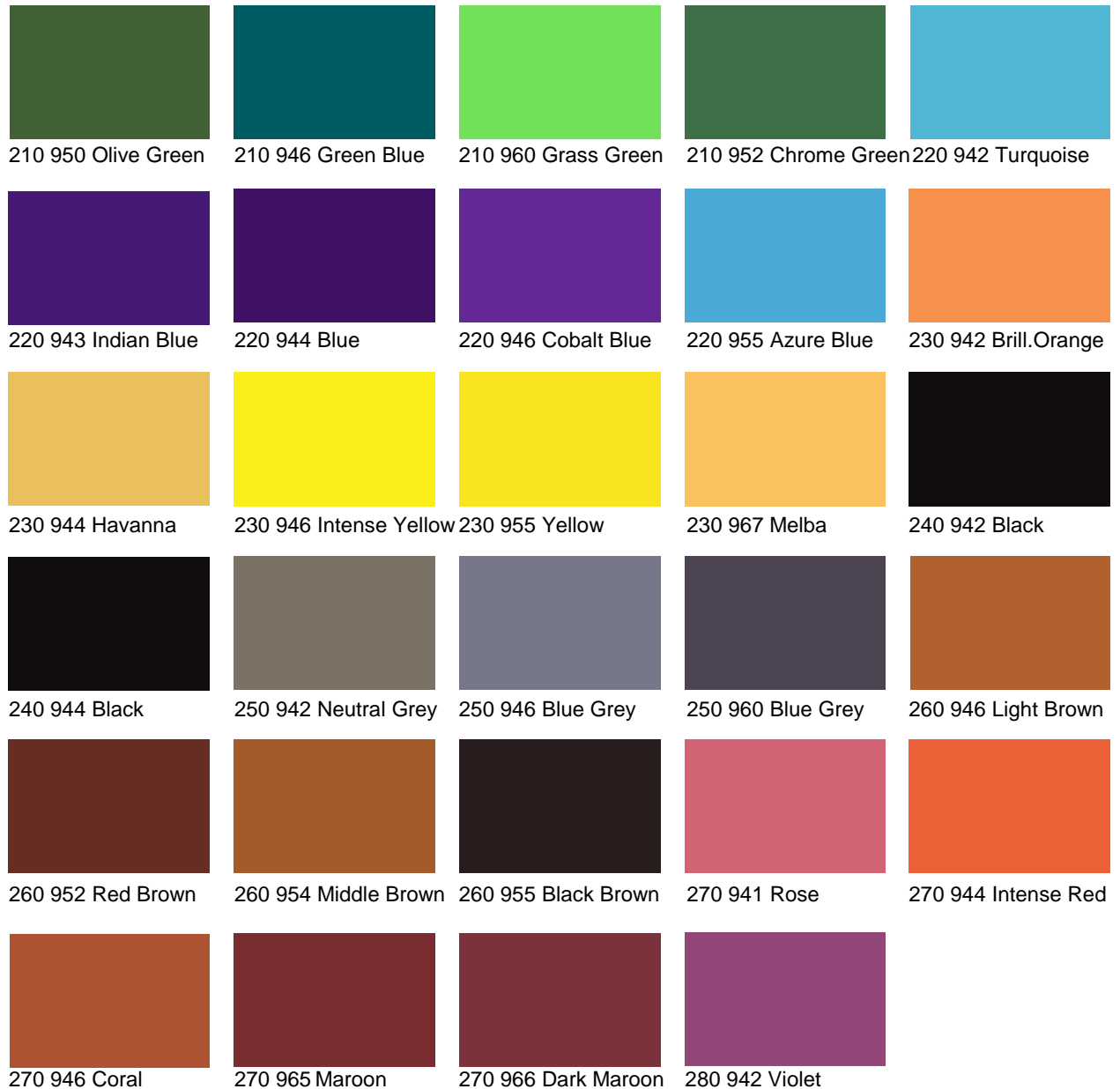
210 952: 2% in both glazes

220 943: 2% in both glazes

220 944: 2% in both glazes

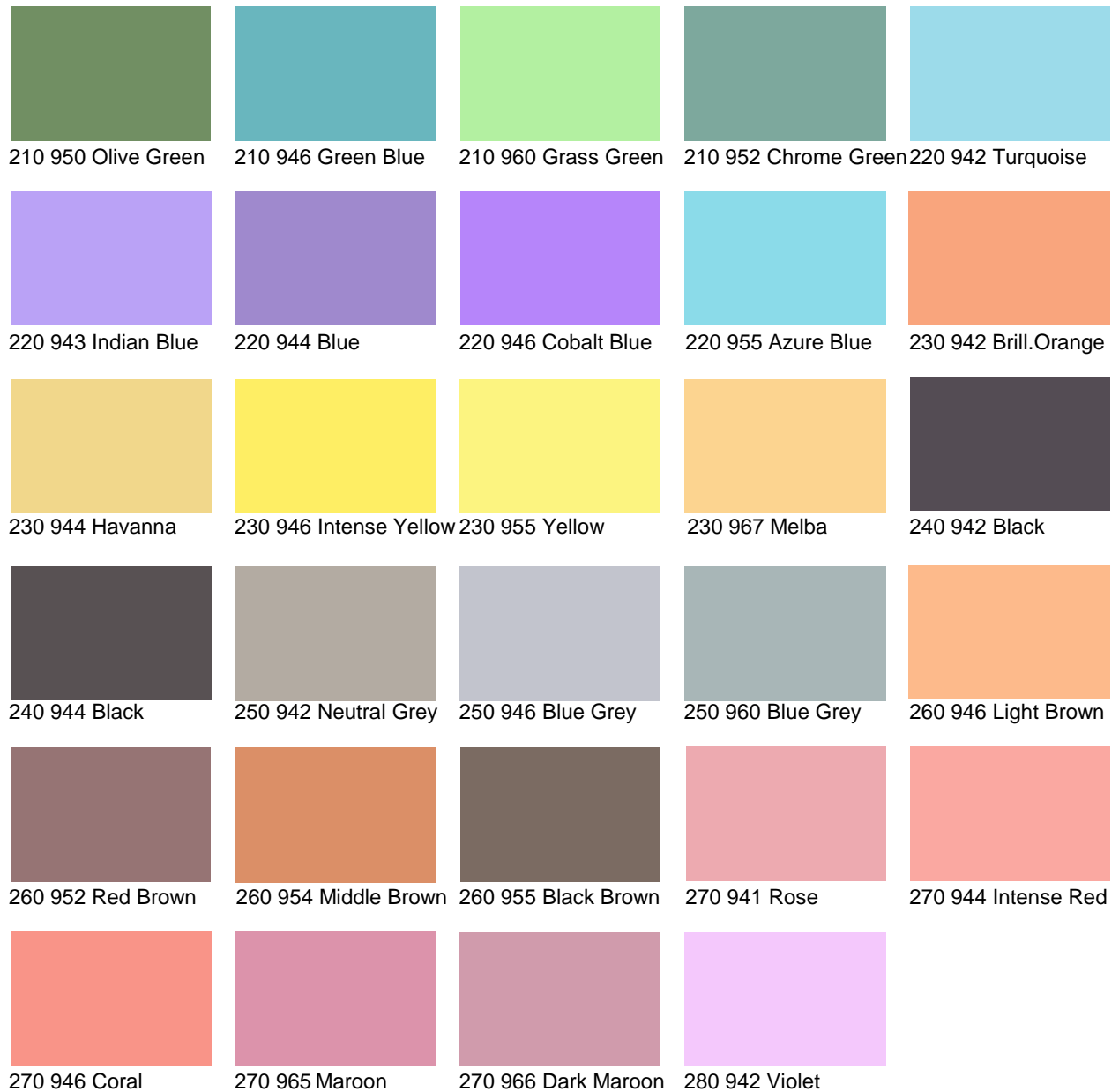
220 946: 2% in both glazes

280 942: 10% in glaze A.

**Fig. 1: InstantColor® Plus colour samples in transparent glaze A**

While every attempt has been made to reproduce colours exactly, the samples printed here may differ slightly from fired ceramic products. Each InstantColor® stain must be used according to the parameters stipulated on its accompanying technical data sheet. Please refer to these sheets for full information.

**Fig. 2: InstantColor® Plus colour samples in opaque glaze B**



While every attempt has been made to reproduce colours exactly, the samples printed here may differ slightly from fired ceramic products. Each InstantColor® stain must be used according to the parameters stipulated on its accompanying technical data sheet. Please refer to these sheets for full information.

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**Ferro GmbH Performance Pigments and Colors • Gutleutstr. 215 • 60327 Frankfurt/M.  
Tel. ++49/(0)69/27116-432 • Fax ++49/(0)69/27116-243 • e-mail: pigments@ferro.com**