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Technical Information

Media Guide

NEW ECO-FRIENDLY PRODUCTS FOR DINNERWARE

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Product Overview

Product	Chapter	Covercoat		Screen Printing			Spray-ing/ Paint-ing	Tampon-print	Heat-Release	Fixative	Sand-plasting	Auxil-iaries
		flowing	thixotrope	flowing	thixotrope	UV						
80 450	A 5	◆					◆					
80 452	B 5											◆
80 454	A 5	◆										
80 604	B 6											◆
80 650	B 4											◆
80 680	B 7											◆
80 683	B 2						◆					
80 810	A 3				◆							
80 820	A 3				◆							
80 890	B 5											◆
80 894	A 8								◆			
80 2018	A 8								◆			
80 2023	A 8								◆			
80 2024	A 8								◆			
80 2032	A 8								◆			
80 2039	B 8	◆										
83 2063	A 5	◆										
80 2200	A 7			◆								
80 3210	A 7				◆							
80 3012	A 3				◆							
80 3035	A 2			◆								
80 3068	A 4					◆						
80 3069	A 4					◆						
80 3070	A 4					◆						
80 3200	A 7			◆								
80 3210	A 7				◆							
80 3220	A 7				◆							
80 4019	B 9										◆	
80 4084	B 1							◆				
80 4085	B 1							◆				
80 4086	B 6											◆
87 4029	B 3									◆		
87 4039	B 3									◆		
L 403	B 8						◆					
L 406	A 5	◆										
L 406/THIX	A 6		◆									
L 409/3	A 6		◆									
L 412	A 5	◆										
L 412/THIX	A 6		◆									
NR. 190505UV/THIX/0,5	A 4					◆						
NR. 190505UV/THIX/1,5	A 4					◆						
NR. 209	A 2			◆								
NR. 221	A 2			◆								
NR. 221/THIX/1	A 3				◆							
NR. 221/THIX/2,2	A 3				◆							
NR. 231	B 2						◆					
NR. 255/6/UV/THIX/1,5	A 4					◆						
Sandstrahlmaske 03	B 9										◆	

◆ tack-free
◆ ECO-friendly

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Part A 1

Application Technology, General Information

In order to achieve optimum results in screen printing, it is very important to take note of the material properties and ambient conditions (temperature and atmospheric humidity).

The following advice is thus designed to briefly explain the essential technical parameters of the individual products and show the significance these parameters have on the final result.

In this respect emphasis has deliberately been placed on providing a clear outline and dispensing with more extensive definitions.

This media guide deals almost exclusively, therefore, with the properties and processing of printing media and covercoats.

After the prepress stage – pattern processing, lithography, printing mould production – the following production stages are of importance for making ceramic decals:

1.1 Composition of Ceramic Decals

1.2 Printing Paste Production – nvp - Firing Defects

1.3 Printing Paste Processing (Printing)

1.4 Printing Covercoats on Decorative Decals

A 1.1 Composition of Ceramic Decals

Ceramic decals consist of ceramic colors, printing media for pasting these colors, and covercoats which are used to overprint the decorative decals and thus turn them into a ceramic decal.

Ceramic inks:

FERRO supplies tailor-made color selections for all fields of applying ceramic decals to glass, porcelain, ceramic and enamel, which develop optimum properties in terms of shade and resistance for the application in question.
The importance of the technical parameters of ceramic color (grain size distribution, specific gravity and dispersibility) is described in more detail on the pages which follow.

Printing media:

The printing properties, as well as combustibility and depolymerization of the printing media are decisive for being able to use the decorative decals produced with such media without any difficulties. Due to the vast number of potential applications and almost perfect reproduction of decorative patterns, the range of printing media is extremely varied. From the large number of thixotropic and flowing printing media it is thus possible to select the ideal product for the intended application.
There is no one medium that is equally suitable for all applications. Owing to the different properties of thixotropic and flowing printing media, selection must be appropriate to the application in question.
The printing medium 80 820, which displays a sufficiently low degree of thixotropy, is suitable for both surface printing and – with certain restrictions – for halftone screen printing. This advantage has been known and has been field-proven over several years.
80 820 thus largely fulfils the demands made of a universal printing medium.

Covercoats:

Covercoats are made of thermoplastics, and for this reason the working temperature is of great importance when using the covercoat. Taking account of the thermoplasticity, it is evident that covercoats with a greater flexibility are required in countries with annual average temperatures of below 10 °C than in countries where the annual average temperatures are well above 20 °C. When a minimum dry film thickness of 22-25 µm is required, very careful consideration must be given beforehand to selecting the covercoat best suited to the task on hand. FERRO also offers appropriate products for all fields of application in this case, products which can be worked at temperatures of between 18 and 30 °C.
However, as even this wide range cannot satisfy all the conditions that may arise, there will be occasional situations which require the

need for auxiliary materials such as plasticizers for the film or anti-blocking agents.

From the advice given on the technical parameters it is already apparent how important the selection of material is for the flexibility, as well as combustibility and depolymerization of the ceramic decal. The individual parameters are explained below.

A 1.2 Printing Paste Production

Pasting ratio:

Ratio of color powder to printing medium. We recommend, for example, 100:60; in this case the paste is made up of 100 parts powder and 60 parts printing medium. If the mixing ratio recommended by FERRO is fallen below (i.e. lower medium content), firing defects in the form of pinholes almost always occur. If this ratio is exceeded (i.e. higher medium content), the ceramic decals may stick together in a block due to the surface being too sticky.
We have, therefore, drawn up pasting ratio tables for the individual color selections. Our technical service will be pleased to provide the tables. Here you can find the recommended optimum pasting ratio, taking account of the physical properties of the individual color. If the printing paste viscosity you obtain when observing the recommended pasting ratio is too high, you can, in most cases, achieve the printing viscosity desired by adding 1 % of the dispersing agent 80 604.

Printing paste viscosity:

The ideal printing paste viscosity is the one which achieves the fastest printing speed, the most detailed print and the best color constancy during production run-on for a specific task with a printing paste. This viscosity can vary considerably and mainly depends on the task concerned. Examples of very different degrees of viscosity and flow properties of the printing pastes are:

4-color-set decals	> 4,500 mPa*s at 200 1/s
glass colors	> 2,500 mPa*s at 200 1/s
intensive color banding	> 5,500 mPa*s at 200 1/s

Spec. gravity of color powder: Ceramic colors are made up of pigments and fluxes (frits). Although the specific gravity of the pigments differs, depending on the metal compound used, the specific gravity of the ceramic color is determined to a very large extent by the flux used. The specific gravity of fluxes containing lead is higher than that of lead-free frits. For this reason the volume of a lead-free color is considerably greater than the volume of the same quantity by weight of a color containing lead. For a lead-free type of color more printing medium is thus required to achieve the same paste viscosity as for a similar color that contains lead.

Later on in this chapter we have introduced the term color powder volume concentration (CPVC) and described the relation between color powder volume (CPV) and the ideal pasting ratio.

A 1.2 Printing Paste Production

Grain size distribution:

Finely ground ceramic colors are required for ceramic screen printing.
The more finely a color is ground, the larger its specific surface; and the opposite also applies, of course, that the coarser the color, the smaller its specific surface.
Since a printing medium should coat all particles, this means that a fine color requires more printing medium than a coarse color for all particles to be moistened. FERRO has paid particular attention in this respect when developing ceramic colors. Certain colors, however, cannot be ground too finely for physical reasons, as the color intensity and firing properties then deteriorate considerably. These include the Cd/Se colors and inclusion pigment products. FERRO colors can be used for the finest of printing screens.

The type of grinding employed when producing ceramic colors affects the dispersibility of the color powder.

Dispersibility:

Dispersibility is determined by the production technique used and the physical properties of the color. Due to the variety of colors and fluxes employed, not all colors display equally good dispersing qualities.
FERRO has taken account of this fact when developing its printing media, and for this reason many of them compensate the innately poor dispersion properties of certain colors.
In addition, dispersing agents (80 604) are offered, with which dispersion can be further improved.

A 1.2 The Effect of the NVP Content of Printing Media on the Firing Properties of Decorative Decals

General Information:

Ferro as a producer of ceramic colors and media has endeavored to establish a connection between the nvp value and the firing result of ceramic screen printing pastes.

When compiling all the empirical figures, reproducible correlations are obtained between the nvp values, the specific gravity of the color powders and the mixing ratio of color powder with printing medium and the firing results.

The term nvp stands for the non-volatile part of the printing paste, also named solid part. In media, these are typically the binder and the plasticizer.
Each printing paste needs a minimum amount of medium or rather nvp depending on the used color powder. Only with a sufficient amount of medium the color powder can be covered and completely coated after drying, without entrapped air. Firing defects should hereby be avoided.
Depending on the density of the color powder, the volume of the varies, and therefore some powders need more medium, others less.
Additionally, the nvp content of the media can be different.

In due consideration of all contents and volumes, the pasting ratio for each color powder and each medium can be calculated and should not be undercut.
We have calculated the optimum pasting ratios for all common color selections and listed them in the tables in section B3.

In the following we present the definitions of the terms and the basis of calculation.

Definition of nvp:

According to DIN 53216, the term nvp is understood to be the proportional mass content that remains after evaporation of solvents. In the product data sheets, this value is given as nvp %.

Definition of nvpv:

The nvpv is the volume of the non-volatile contents. Because the density of these contents is almost always 1, the mass and the volume are almost identical.

Definition of CPV:

The CPV is the color powder volume, i.e. mass in relation to density.

Definition of CPVC:

In order to prepare appropriate pasting ratio recommendations for the current range of colors, we introduced the term color powder volume concentration (CPVC) as a new technical parameter for ceramic screen printing.

The color powder volume concentration is the proportional quotient from the color powder volume CPV and the sum of the color powder volume CPV and the binding agent volume nvpv.

In other words, the CPVC is the ratio of the color powder volume and the total volume of non-volatile contents.
This viewpoint is referring to the volume of the used materials and not to the weight (mass) and is crucial for the firing quality.
In the pasting ration tables (B 3), this is already taken into account.

The pasting ratio tables base upon a maximum CPVC of 53% to 55%, which was defined by our experience.

Please be aware that even when following the recommendations given here, a guarantee for the firing result cannot be given. The pasting ratios should only be a basic orientation.

In the following, two calculation examples are given:

- Calculation of the CPVP of the mixture 77 1234 with medium 80 820
- Calculation of the pasting ratio of the mixture 77 1234 with medium 80 820

Arithmetic examples: The Sunshine color 77 1234 is pasted at a ratio of 100g : 60 g by weight with printing medium 80 820.
How great is the CPVC of this mixture?

CPVC formula:

$$CPVC\ \% = \frac{CPV \times 100}{CPV + nvpv}$$

1st step: Calculating the CPV of 100 g color 77 1234
Specific gravity (ρ) of 77 1234 = 4.05 g/cm³

$$CPV = \frac{Mass}{\rho}$$

$$CPV = \frac{100\ g}{4.05\ g/cm^3}$$

CPV = 24.70 cm³

2nd step: Calculating the nvpv from 60 g printing medium 80 820
npv of 80820 = 45 %
Specific gravity (ρ) of nvp 80 820 = 1.00 g/cm³

$$nvpv = \frac{60\ g \times 45}{100 \times 1.00\ g/cm^3}$$

nvpv = 27.00 cm³

3rd step: Calculating the CPVC % of the paste from 100g 77 1234 + 60 g 80 820

$$CPVC\ \% = \frac{CPV \times 100}{CPV + nvpv}$$

CPV = 24.70 cm³
nvpv = 27.00 cm³

$$CPVC\ \% = \frac{24.70\ cm^3 \times 100}{24.70\ cm^3 + 27.00\ cm^3}$$

$$CPVC\ \% = \frac{2470\ cm^3}{51.70\ cm^3}$$

CPVC = 47.80 %

Arithmetic examples:

The Summerday color 77 1634 is to be pasted in terms of weight with printing medium 80 820 so that the finished printing paste has a CPVC of 53 %.
How many grams printing medium 80 820 (M) must I add to 100 g color 77 1634, in order to obtain the desired CPVC of 53 %?

CPVC formula:

$$CPVC\ \% = \frac{CPV \times 100}{CPV + nvpv}$$

1st step:

Calculating the CPV of 100 g color 77 1634
Specific gravity (ρ) of 77 1634 = 2.64 g/cm³

$$CPV = \frac{Mass}{\rho}$$

$$CPV = \frac{100\ g}{2.64\ g/cm^3}$$

CPV = 37.88 cm³

2nd step:

Calculating the printing medium quantity **M** of 80 820 for 100 g color 77 1634, in order to obtain a CPVC of 53 %.

M = (100:nvp) x [(CPVx100:CPV) -CPV]

CPV = 24.70 cm³
CPVC = 53 %
nvp = 45 %

M = (100:45) x [(37.88 cm³ x 100:53) – 37.88 cm³]

M = 2.22 x (71.47 –37.88 cm³)

M = 2.22 x 33.59 cm³

M = 74.60 cm³

or **74.60 g** , as the specific gravity of the printing medium amounts in practice to 1.00 g/cm³.

A 1.3 Printing Paste Processing

When processing the printing paste, i.e. printing, the following parameters are important:

Printing paste rheology: This concerns the flow behaviour required of the print-ready color paste to achieve a certain printing quality and productivity. Printing media with a high to medium thixotropy, e.g. 80 810, are required to produce halftone screen décors.

Flowing printing media or those with a low thixotropy, e.g. 80 820 or NR. 221, are used for surface décors.

Type of squeegee and holder: The type of squeegee and holder used play a decisive part in obtaining an optimum print and constant production run-on.
In the field of ceramic decals it is well known that reproducible halftone decals cannot be obtained with a 65 ° Shore squeegee, which protrudes 3 cm from the holder.

This also applies to a lesser extent to surface and line decals.
When printing, the squeegee should be supported on the back in the direction of printing by a spring steel of 0.5 to 0.8 mm. This prevents the squeegee from bending toward the direction of printing, and the printing quality is thus considerably improved. This effect is increased further by using a triplex squeegee (inside 95° Shore, outside on both sides 65° Shore). The advantage of this method can also be recognized in practice by the fact that swelling of the protruding squeegee is significantly reduced thanks to the protective device, and the original initial hardness of the squeegee diminishes only very slowly when printing. This method of holding the squeegee can be used for almost any type of squeegee. If these findings are relied upon entirely, the best solution is to use the RKS-squeegee.

Screen type: The screens mostly used today for producing ceramic decals are steel and polyester screens. The advantages and disadvantages of the two types are not dealt with here. In daily practice, however, some features are very important and are mentioned for this reason.
The mesh opening of steel screens that are as fine as polyester is larger, which means that it is possible to print a greater volume of ink. Another outstanding advantage of steel screens is that there is virtually no static charging when printing with squeegees made of polyurethane or other plastics.

Electrostatic charging can become a problem when using polyester screens and certain printing media.
Please pay particular attention, therefore, to the technical advice given in the product data sheets on our printing media.

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A 1.3 Printing Paste Processing

Ceramic decal drying:

The drying of the decal depends on the following:
the type of dryer used (wicket dryer or multi-shelf dryer); the speed at which the printing medium used dries; coat thickness of the decal; number of color layers on top of one another.
Every printer would like to have a printing medium that dries as quickly as possible on the one hand, but nevertheless keeps the screen constantly open and ensures perfect color constancy during production run-on.
This demand cannot be fulfilled by printing media that contain solvents. The more slowly a printing medium dries, the better the screen remains open and the color constant during production run-on. Such a medium can only be used, however, for thin layers of color and with halftone screen printing. Even the most efficient wicket dryers would be unable to produce a satisfactory result for thick layers of color. On the basis of the task on hand, very careful attention should be paid to such matters, therefore, when selecting the printing medium.

Production run-on constancy:

The connection between drying speed and color constancy during production run-on has already been explained above.
In general the following rule applies:
The more slowly a printing medium dries, the better the color constancy during production run-on.

Overprinting:

The more printing medium contained in the printed color which is to be overprinted, the better it can be overprinted. Due to the high proportion of printing medium, the surface of the decal is not as porous and its absorbency is thus reduced. The solvents in the overprint color are therefore absorbed more slowly by the printed color and the overprinting properties are thus improved.

Printing Covercoats on Decorative Decals

When printing covercoats the following parameters are important:

Rheology of covercoat:

This concerns the flow behavior required of the print-ready covercoat to achieve a certain printing quality and productivity. A distinction is made between flowing (83 450) and thixotropic (L 406/THIX) covercoats. In the case of wicket dryers with a horizontal pre-drying zone, both flowing and thixotropic covercoats can be used. If there is no predrying zone available, we recommend using only thixotropic covercoats, to prevent the covercoat from running and forming beads. This advice applies to coatings with a dry film thickness of 22-25 µm.

Initiated dissolution of the ceramic decals:

Covercoats strongly initiate dissolution of the decals produced with **thixotropic or flowing color pastes**. If a flowing covercoat is used on a decal made of flowing color pastes and no pre-drying takes place, the coat can run due to the vertical position of the decal in wicket dryers. The decal that has been dissolved also starts to run, causing the decorative decals to become completely indistinct. Every experienced printer knows this scenario.
In order to avoid this problem, either a thixotropic covercoat or a thixotropic printing medium should thus be used for making ceramic decals.
Running can only be prevented entirely, however, with the combination **“thixotropic printing medium and thixotropic covercoat“.**

Temperature when printing:

Covercoats should always be processed at room temperatures of 18-30 °C. If covercoats are used at a temperature of below 18 °C, the following problems may occur:
1. Cobwebbing of the covercoat when printing
2. Insufficient thickness of dried coat. Failure to achieve the recommended coat thickness of approx. 23 µm.
As covercoats are frequently supplied in 180-kg drums, the process of equalizing the temperature may take several days, depending on the storage temperature of the covercoat. To be on the safe side, it is best to measure the temperature of the covercoat before starting to print. Inexpensive and accurate measuring equipment is available from specialized stores for this purpose.

Reversible solubility:

All resins contained in screen printing media and covercoats can be dissolved again, even if they have been thoroughly dried. A finished decal can thus be fully dissolved with, for example, thinners or screen cleaners. This property is called reversible solubility.

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Dissolution is not only brought about by liquid solvents. A certain amount of solvent vapour is sufficient to make the decals very tacky. In poorly ventilated printing shops this problem often occurs, and most of the time it is incorrectly attributed to poor drying of the covercoat.

A 1.4 Coating the Printed Decorative Decals

Drying:

The solvent composition of almost all covercoats today, as far as the drying speed is concerned, is comparable.
The main differences lie in the choice of the lacquer resins, plasticizers, auxiliary materials and degree of thixotropy. How the covercoat dries depends almost exclusively, therefore, on the method with which the covercoat solvents are removed from the printed coat. The so-called wicket dryers – or dryers with a continuous flow of air – take on a prominent position in this respect. The air in these dryers is conducted in such a way that a type of counter-current drying is achieved. I.e. the solvent concentration is intentionally kept at a high level in the first part of these dryers, to avoid premature film formation. Final drying does not take place until the third and last stage by feeding in fresh air. Even when drying is carried out according to the process described here, 0.8 to 1.6 % of solvents remain in the "dry film". These residual solvents have an additional plasticizing effect on the covercoat. The covercoat does not obtain its final properties until the residual solvents have evaporated completely. The time between fresh decals and the final stage is called shelf life.
Fresh decals are thus considerably more ductile than older ceramic decals

Covercoat elongation:

The ductility of all covercoats developed by FERRO has been measured on solvent-free dry films. The ductility of these films is thus determined by the quantity of plasticizer added. An additional plasticization of the films, dependent entirely on the degree of drying, comes about, however, as a result of the solvent quantities remaining in fresh decals as described under the section on drying. We have no means of influencing these parameters. We advise printers, therefore, to dry the fresh decals at 35 °C for 48 hours as a test, so that the remaining solvents evaporate and an idea of the properties of the completely dried film can be obtained.

Dry film thickness:

FERRO recommends a dry film thickness of 22-25 µm for almost all cases involving the application of ceramic decals. The dry film thickness should be increased to 32-35 µm for décors with thick layers of color and for collector plates. In order to achieve this film thickness, however, thixotropic covercoats such as L 406/THIX must always be employed if wicket dryers without a horizontal pre-drying zone are used.

Storage of Decals:

Due to its sensitivity to humidity, ceramic decals should be stored at a temperature of approx. room temperature of 15-25 ° C and preferably at 50-65% humidity.

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A 2 Flowing Media for Indirect Screen Printing

Product number	Viscosity [mPa*s] 1. D=50 1/s 2. D=200 1/s at 23°C, approx.	Con-sistency	nvp [%] approx.	Drying figures TZ	Appli-cation
NR. 221 Standard flowing medium for surfaces and lines with good reproduction of detail. Color powders are easily dispersed.	1. 605 2. 600	flowing	44	TZ10 = 92 TZ90 = 925	glass porcelain ceramics enamel
NR. 209 Flowing medium for surfaces Colour powders are easily dispersed.	1. 405 2. 400	flowing	31	TZ10 = 120 TZ90 = 1150	porcelain ceramics
80 3035 It's an Agent. Printing pastes can be made to flow. Color powders are very easily dispersed. Very good combustibility and depolymerization.	1. 200 2. 200	flowing	38	n.a.	glass porcelain ceramics enamel

The pasting ratios for the individual printing media essentially depend on the physical properties of the colors used. The specific gravity plays a special part in this respect.
We have, therefore, introduced the term **CPVC = color powder volume concentration** and use this value to determine the optimum pasting ratio for each color. Our technical service will be pleased to provide you with the necessary tables.
The technical data sheets of the individual products can be found in the Resource Center.

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A 3 Thixotropic Media for Indirect Screen Printing

Product number	Viscosity [mPa*s] 1. D=50 1/s 2. D=200 1/s at 23°C, approx.	Thixo-tropy	nvp [%] approx.	Drying figures TZ	Appli-cation
80 810					
Standard medium for CerDeChrom, dot repro-duction curve increase in production run-on, high nvp% content. Color powders easily dispersed.	1. 3000 2. 1600	high	45	TZ10 = 111 TZ90 = 1298	glass porcelain ceramics enamel
80 820					
Can be used for almost all fields of application. Due to good combustibility and depolymerization it can be used particularly for glass decors. Halftone screen printing possible with some restrictions. Well-suited to combinations of surfaces and halftone printing.	1. 1400 2. 1050	low	45	TZ10 = 100 TZ90 = 1000	glass porcelain ceramics enamel

The pasting ratios for the individual printing media essentially depend on the physical properties of the colors used. The specific gravity plays a special part in this respect.
We have, therefore, introduced the term **CPVC = color powder volume concentration** and use this value to determine the optimum pasting ratio for each color. Our technical service will be pleased to provide you with the necessary tables.
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A 3 Thixotropic Media for Indirect Screen Printing

Product number	Viscosity [mPa*s] 1. D=50 1/s 2. D=200 1/s at 23°C, approx.	Thixo-tropy	nvp [%] approx.	Drying figures TZ	Appli-cation
80 3012 Due to its low plasticizer content this medium displays special drying properties. It can be used for both 4-color set printing and intermediate printing. This medium is very well-suited to flux overprints in ratios of 100:100 to 100 : 200.	1. 1800 2. 950	medium	42	TZ10 = 73 TZ90 = 900	porzelain ceramics
NR. 221/THIX/1 Well-suited medium for printing lines and areas, very good color constancy in production run-on and minimal dot reproduction curve increase. Color powders easily dispersed.	1. 1500 2. 1200	low	44	TZ10 = 92 TZ90 = 925	glass porcelain ceramics enamel
NR. 221/THIX/2.2 Well-suited medium for 4-colour set printing, very good color constancy in production run-on and minimal dot reproduction curve increase. Color powders easily dispersed.	1. 2200 2. 1400	medium	44	TZ10 = 92 TZ90 = 925	glass porcelain ceramics enamel

The pasting ratios for the individual printing media essentially depend on the physical properties of the colors used. The specific gravity plays a special part in this respect.
We have, therefore, introduced the term **CPVC = color powder volume concentration** and use this value to determine the optimum pasting ratio for each color. Our technical service will be pleased to provide you with the necessary tables. The technical data sheets of the individual products can be found in the Resource Center.

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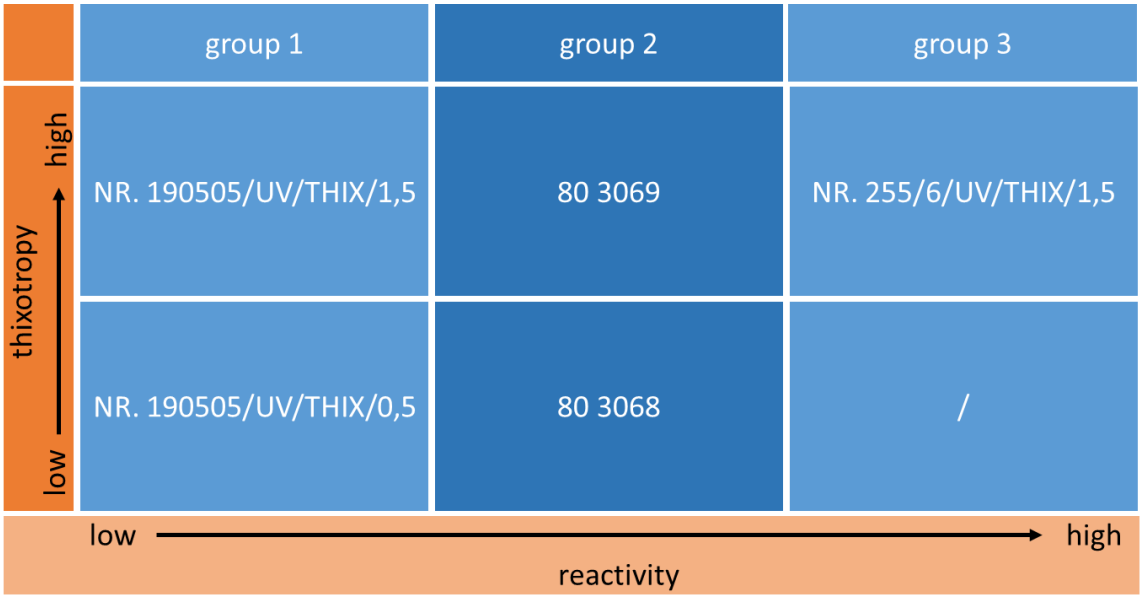
A 4 UV-Curing Media for Indirect Screen Printing

Overview



Produkt number	Viscosity [mPa*s] 1. D=50 1/s 2. D=200 1/s at 23°C, approx.	Consis-tency	nvp [%] approx.	Reacti-vity	Flexi-bility	Application
NR. 190505/UV/THIX/0,5	1. 1200 2. 1100	flowing	100	low	medium	porcelain ceramics bone china
NR. 190505/UV/THIX/1,5	1. 1500 2. 1350	high thixo-tropic	100	low	medium	porcelain ceramics bone china

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A 4 UV-Curing Media for Indirect Screen Printing

Produkt number	Viscosity [mPa*s] 1. D=50 1/s 2. D=200 1/s at 23°C, approx.	Consis-tency	nvp [%] approx.	Reacti-vity	Flexi-bility	Application
80 3068	1. 360 2. 350	flowing	100	medium	medium	glass porcelain ceramics bone china
80 3069	1. 2300 2. 1100	thix.	100	medium	medium	glass porcelain ceramics bone china
NR. 255/6/UV/THIX/1,5	1. 1450 2. 1000	thix.	100	high	low	porcelain ceramics bone china
80 3070 reactive diluent	1. 90 2. 60	flowing	100	high	low	porcelain ceramics bone china

The technical data sheets of the individual products can be found in the Resource Center.

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A 5 Flowing Covercoats for Indirect Screen Printing

Standard coloring is available for all Covercoats. We will gladly provide you with information about possible variations in color and availability.

Product-number	Viscosity [mPa*s] 1. D=50 1/s 2. D=200 1/s at 23°C, approx.	Exten-sibility index	nvp [%] approx.	Drying Figures TZ	Recommended dry film-thickness in µm	Decoration of
80 450	1. 1950 2. 1900	100	42	TZ10 = 41 TZ90 = 827	23	glass porcelain ceramics email
80 454	1. 1550 2. 1500	130	38	TZ10 = 48 TZ90 = 649	23	glass porcelain ceramics email
83 2063 Antiblock	1. 1600 2. 1550	130	38	TZ10 = 50 TZ90 = 650	23	glass porcelain ceramics email
L 406	1. 1850 2. 1800	95	42	TZ10 = 40 TZ90 = 650	23	glass porcelain ceramics email
L 412	1. 1550 2. 1500	45	42	TZ10 = 40 TZ90 = 630	23	glass porcelain ceramics email

The technical data sheets of the individual products can be found in the Resource Center.

A 6 Thixotropic Covercoats for Indirect Screen Printing

Product-number	Viscosity [mPa*s] 1. D=50 1/s 2. D=200 1/s at 23°C, approx.	Extensibility index	nvp [%] approx.	Drying Figures TZ	Recommended dry film-thickness in µm	Decoration of
L 406/ THIX	1. 1950 2. 1800	95	42	TZ10 = 40 TZ90 = 650	23	glass porcelain ceramics enamel
L 409/3 Antiblock	1. 2300 2. 2100	105	43	TZ10 = 45 TZ90 = 860	23	glass porcelain ceramics enamel
L 412/THIX	1. 1750 2. 1600	45	42	TZ10 = 40 TZ90 = 630	23	glass porcelain ceramics enamel

The technical data sheets of the individual products can be found in the Resource Center.

A 7 ECO-friendly Screen Printing Media and Covercoats for Indirect Screen Printing.

The new generation of Media and Covercoats have excellent quality and are based on raw materials with no or significantly improved hazard classification.
The Screen Printing Media are free of hazard labels.
The Covercoat have a much lower hazard classification than Ferro's standard Covercoats.
There is no labeling for environmentally hazardous substances and individual hazard statements related to health.
With these products, Ferro offers a new generation of Media and Covercoats that focus on improved occupational safety and environmental protection.

Screen Printing Medium:

Product number	Viscosity [mPa*s] 1. D=50 1/s 2. D=200 1/s at 23°C, approx.	Thixo-tropy	nvp [%] approx.	Drying figures TZ	Appli-cation
80 3200	1. 720 2. 700	flowing	45	TZ10 = 95 TZ90 = 980	glass porcelain ceramics email
80 3210	1. 1400 2. 1050	low	45	TZ10 = 95 TZ90 = 980	glass porcelain ceramics email
80 3220	1. 3200 2. 1600	high	45	TZ10 = 95 TZ90 = 980	glass porcelain ceramics email

The pasting ratios for the individual printing media essentially depend on the physical properties of the colors used. The specific gravity plays a special part in this respect.
We have, therefore, introduced the term **CPVC = color powder volume concentration** and use this value to determine the optimum pasting ratio for each color. Our technical service will be pleased to provide you with the necessary tables.
The technical data sheets of the individual products can be found in the Resource Center.

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Covercoats:

Product-number	Viscosity [mPa*s] 1. D=50 1/s 2. D=200 1/s at 23 °C, approx.	Extensibility index	nvp [%] approx.	Drying figure TZ	Recom-mended dry film-thickness in µm	Application
80 2200 (flowing)	1. 1800 2. 1800	95	42	TZ10 = 40 TZ90 = 650	23	glass porcelain ceramics email
80 2210 (thixotropic)	1. 2000 2. 1800	95	42	TZ10 = 40 TZ90 = 650	23	glass porcelain ceramics email

The technical data sheets of the individual products can be found in the Resource Center.

A 8 Heat-Release Decoration

Ferro offers a complete product range for Heat-release decoration (HR). This method of decoration allows high-quality screen printing decors to be transferred quickly and precisely.

The decors for heat-release decoration (HR) are printed on paper coated with wax compounds.

For the indirect HR method (pad application) the inks are printed true to side on wax compound paper.
Finally, an HR covercoat is applied and, in many cases, an additional thin print of antiblock paste (80 2032).
The wax compound coat causes the decals to adhere to the object being decorated when transferred.

For the direct HR method (reel to reel) the decorative decal is printed laterally inverted, i.e. the first printing cycle is a covercoat (80 894), on to which the individual inks are then screen-printed. These decors are finished with a special covercoat (80 2023) which can be activated by heat. Both sheets and reels are printed according to this method.
With the paper used for these methods the wax compound coat does not assume any adhesive function. On the contrary, the wax compound coat for the direct HR method is to release the decal completely at temperatures which are as low as possible.
The paper for the indirect HR method and that for the direct HR method differ to a great extent as regards the composition of the paper coating.

Paper manufacturers for heat-release decorative printing

Tullis Russell, Church Street,
Bollington, Macclesfield,
Cheshire, SK10 5QF, UK

Tel +44 (0)1625 573051
Fax +44 (0)1625 572085
Email: imagetransfer@tullisrussell.com

Application

In principle, a distinction is made between:

- pad application (indirect HR method) and
- reel application (direct HR method; reel to reel)

Pad-Application

- The mechanically cut decorative decals are stacked in a supply cassette in the HR machine without interlaying wax paper.
- A vacuum gripper takes the decorative decal out of the supply cassette and lays it on a heated, perforated vacuum plate.
- The wax compound coat on the printed paper melts at a temperature that has been defined for the vacuum plate, allowing the decorative decal to be removed from the paper by the pre-heated pad (silicone rubber stamp).
- The heated pad together with the decal is then pressed on the cold object to be decorated.
- When the warm decal makes contact with the cold object, the wax compound solidifies immediately, thus providing for a close adhesive bond between the decorative decal and the object being decorated.
- The empty pad now takes another decal from the heated vacuum plate.

Following the same method, the individual decals can be taken by a heated reel instead of a pad, and transferred directly, true to side, on to the object to be decorated.

Reel Application (Reel to Reel)

- According to this method, the decals are transferred to the object to be decorated by a laterally inverted, printed reel.
- The reel with the printed decals is on a reel-off device and is connected up to a reel-on device.
  The decal on the paper reel is directed to an object, e.g. a cylindrical mug, by a photocell-controlled device and pressed from the back of the paper on to the mug being decorated by a heated (140-160 °C) silicone rubber stamp. This decoration process can be compared to the exposure of a photographic film in a normal 35-mm camera. In this respect the exposure of the picture corresponds to the moment of application in the HR process.
- The high temperature of the pressing stamp causes the paper coating to melt on the one hand and, on the other, the coat on the decal that can be activated by heat to become tacky. The mug being decorated now takes the decal laterally inverted from the reel with the liquid wax coat, so that the decal is applied true to side on the mug after transfer.
- As the paper still carries the decal during application, this method has only limited application potential as regards the shape of the object to be decorated due to the stiffness of the paper.

With heat-release application the traditional steps such as soaking, laying on the object, removing excess water slime, drying etc. do not apply.

Media Guide

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Examples for making heat-release decorative decals for direct and indirect application.

1. Indirect-HR (Pad) with Downcoat

Layer	Printing note:	Medium:	Printing Screen:	Comment:
4	Antiblock paste	80 2032	PET 140-31	
3	Covercoat	83 894	PET 48-80	
2	One color/multicolor printing	80 820, NR.221, 803012	Dependent on color intensity	
1	Downcoat	80 2024 or 80 2018	PET 180-31	Steel less suitable
	Wax compound/Decal paper	HR-Paper		Sheet printing

2. Indirect-HR (Pad) without Downcoat

Layer	Printing note:	Medium:	Printing Screen:	Comment:
3	Antiblock paste	80 2032	PET 140-31	
2	Covercoat	83 894	PET 48-80	
1	One color/multicolor printing	80 820, 80 3012	Dependent on color intensity	
	downcoat not applicable	- -		
	Wax compound/Deacl paper	HR-Paper		Sheet printing

3. Indirect-HR (Pad) without downcoat

Layer	Printing note:	Medium:	Printing Screen:	Comment:
	Antiblock paste not applicable	- -		
3	Covercoat	83 894	PET 48-80	
2	One color/multicolor printing	80 820, 80 3012	Dependent on color intensity	
1	Downcoat	80 2024 or 80 2018	PET 180-31	Steel less suitable
	Wax compound/Decal paper	HR-Papier		Sheet printing

4. Direct-HR · reel application (Reel to Reel)

Layer	Printing note:	Medium:	Printing Screen:	Comment:
	Antiblock paste not applicable	- -		
3	Heat-active adhesive	80 2023	PET 48-80	
2	One color/multicolor printing	80 820, 80 3012	Dependent on color intensity	Laterally inverted printing
1	Covercoat	83 894	PET 48-80	
	Wax compound/Decal paper	HR-Paper		Roll printing or sheet

5. Direct-HR · reel Aplication (Reel to Reel)

Layer	Printing note:	Medium:	Printing Screen:	Comment:
4	Heat-active adhesive	80 2023	PET 77-48	
3	Insulating coat	80 2018	PET 110-34	
2	One color/multicolor printing	80 820, 80 3012	Dependent on color intensity	Laterally inverted printing
1	Covercoat	83 894	PET 48-80	
	Wax compound/Decal paper	HR-Paper		Roll printing or sheet

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A 8 Heat-Release Decoration

Product-number	Viscosity [mPa*s] 1. D=50 1/s 2. D=200 1/s at 23°C, approx.	Exten-sibility index	nvp [%] approx.	Drying Figures TZ	Recom-mended dry film-thickness in µm	Decoration of
83 894 Covercoat	1. 1300 2. 1270	146	35	TZ10 = 55 TZ90 = 692	10-13	glass porcelain ceramics enamel
80 2018 Downcoat	1. 3400 2. 2900	458	14	Heat adhesive	3-7	porcelain ceramics
80 2023 Heat adhesive	1. 1300 2. 700	cannot be measured	43	Heat adhesive	8-10	porcelain ceramics
80 2024 Downcoat	1. 930 2. 890	cannot be measured	27	Heat adhesive	3-7	porcelain ceramics
80 2032 Antiblocking Printing paste	1. 650 2. 350	cannot be measured	17	Heat adhesive	6-8	porcelain ceramics

The technical data sheets of the individual products can be found in the Resource Center.

B 1 Pad Printing Media for Ceramic Decoration

Description of procedure for the pad printing process
Printing equipment for the direct printing process is ideally suited for the automatic decoration of flatware or slightly curved articles such as plates. With machines of this type it is possible to print one or more colors (4-color set).
Printing is carried out using thermoplastic pastes on metal or plastic-coated engraved plates. The printing stations consist of heated printing benches, vacuum – article feeding bench with centering.

Procedure
The color application cycle is as follows: the heated engraved plate is loaded with paste and positioned at the doctor blade. While the engraved plate is fed under the printing pad, the doctor blade is lowered and scrapes off any excess paste; the printing pad descends, takes up paste from the engraving and, once the engraved plate has returned to its former position, prints it onto the ware beneath which is held in a centered position by vacuum. The printing pad must be pliable, allowing its shape to be easily formed, and thus ensuring that the print is transferred without any distortion. Due to the thermoplastic nature of the pastes, it is possible to print multicolor decals with the pad printing process, without interim drying.

Pad Printing Media

Product-number	Appli-cation	Viscosity [mPa*s] D=1250 1/s at 65°C, approx.	Consistency	nvp[%] approx.	Pasting ratios printing paste	Decoration of
80 4084	pad printing underglaze onglaze	430	thixotropic	100	100 : 50 to 100 : 70	porcelain vitro porcelain bone china
80 4085	pad printing thinning medium	140	wax-like	100	100 : 50 to 100 : 70	porcelain vitro porcelain bone china

The technical data sheets of the individual products can be found in the Resource Center.

B 2 Media for Machine Application (Brushing, Spraying

Product number	Viscosity [mPa*s] 1. D=50 1/s 2. D=200 1/s at 23°C, approx.	Consistency	nvp [%] approx.	Drying	Application
80 683	1. 930 2. 690	flowing	8	fast	Banding and lining machines. Hand-painting medium
NR. 231	1. 60 2. 60	flowing	1,7	fast	Automatic spraying maschines Spray gun

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B 3 Fixatives for Underglaze and Onglaze Ceramic Decoration

Product number	Application	Viscosity [mPa*s] 1. D=50 1/s 2. D=200 1/s at 23°C, approx.	Consis-tency	nvp [%] approx.	Application	Decoration of
87 4029	fixative for UG decors	1. 915 2. 400	thixotropic	2,1	brush sponge	earthenware vitro-porcelain bone china
87 4039	fixative for OG-Decors	1. 360 2. 170	flowing	1,1	automatic spraying machine brush sponge	frosted glass earthenware bone china vitro-porcelain

The technical data sheets of the individual products can be found in the Resource Center.

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B4 Soaking Agent for Ceramic Decals

Product number	Application	nvp [%]	Recommended amount to be added in %	Ceramic decals to decorate
80 650	added to decal water	0	3-4	onglaze porcelain glass ceramics enamel underglaze bisquits

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B 5 Cleaners for Ceramic Decoration

Produkt number	Application	nvp [%]	Recommended hygiene	Compatibility
80 452	cleaning stencils and machines	0	wear gloves	with all indirect printing media and covercoats
80 890	cleaner for pad media and Xpression	0	wear gloves	with all pad media and Xpression printing pastes

The technical data sheets of the individual products can be found in the Resource Center.

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B6 Thinners and Dispersing Agents for Printing Pastes

Product number	Application	nvp [%] approx.	Recommended amount to be added in %	Compatibility
80 4086	Thinner for printing pastes	0	2-3	with almost all printing media
80 604	added to printing pastes	16	0,5-1,00	with almost all printing media

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B 7 Anti-Blocking Agent for Ceramic Decoration

Product number	Application	nvp [%] approx.	Recommended amount to be added in %	Decoration of
80 680	solid powder for mixing in	100	1-2 %	porcelain ceramics

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B 8 Special Coatings for Ceramic Decoration

Product-number	Viscosity [mPa*s] 1. D=50 1/s 2. D=200 1/s at 23°C, approx.	Exten-sibility index	nvp [%] approx.	Drying Figures TZ	Recom-mended dry film-thickness in µm	Decoration of
L 403 Refreshing Covercoat	1. 1820 2. 1800	cannot be measured	47	cannot be measured	10-15	glass porcelain ceramics enamel
80 2018 Protective Coating	1. 3400 2. 2900	458	14	cannot be measured	3-7	porcelain ceramics
80 2039 Strippable Coating	1. 1800 2. 1760	72	34	TZ10 = 41 TZ90 = 750	28	glass porcelain ceramics enamel

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B 9 Sandblasting Mask for Ceramic Decoration

Product number	Recommended Screen	Viscosity [mPa*s] 1. D=50 1/s 2. D=200 1/s at 23°C, approx.	nvp [%] approx.	Recommended dry film thickness µm	Decoration of
Sandblasting mask 03 **2C-System**	110-30 steel 77-50 PET	1. 10500 2. 10000	90	28	glass porcelain ceramics enamel
80 4019 **Härdener 04 for Sandblasting mask 03**	--	1. 1600 2. 1600	100	--	

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Content Part C

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C 2 Rheology of Printing Media and Covercoats

C 3 Ceramic Color Indices

C 4 Practical Advice on the Use of Auxiliary Materials

C 5 Code System for Shades

C 6 Description and Function of Standard Drums

C 7 Labelling of Drums

C 8 Experience Records

C 1.1 Technical Parameters

Viscosity:

Measuring instrument:	UDS 200 Physica TM
System:	cone / plate
Measuring cone:	KP 22
Measurement:	at 200 1/s
Measured value:	mPa*s at 23 °C

When determining the flow properties of thixotropic and flowing printing media, the measurement taken is of how the viscosity of a certain quantity of substance on a plate under a rotating cone changes, depending on the speed at which the cone rotates. Thixotropic (Greek: change by touching) substances take on, by definition, a lower viscosity when stirred, and slowly return to their original gel-like state when left to rest. Regardless of the shearing, flowing printing media and covercoats do not change their viscosity.
The values given in our Product Data Sheets under "Technical Data" are the viscosity in mPa*s at a shear rate of 50 1/s and 200 1/s.

Consistency:

The general nature of a substance (e.g. flowing, solid, gel-like) relates to its Consistency.

Density:

Measuring instrument: D.S.A. 48TM from the company Paar
Measured value: g/cm³ at 25 °C
The specific gravity or the density of a body is the weight of 1 ml or 1 cm³ at a given temperature. Our measurements are taken at 25°C. This reference value is of no great significance for the covercoats and printing media, as the specific gravities of these substances do not differ very much
(0.95 to 1.10 g/ cm³).
The density is of great importance for the ceramic color powders, as the differences can be between 2.50 g/ cm³ (leadfree colors) and >5.00 g / cm³ (glass colors), depending on the color selection.

100 g of a ceramic color powder can, therefore, have a volume of 40 cm³ (spec. gravity 2.50) or 20 cm³ (spec. gravity 5.00).
When 100 g color powder is mixed with 60 g printing medium it is not possible to achieve the same printing viscosity and firing properties with these two colors. The context and the significance of this fact is explained in Application Technology Section A 1.2.

"nvp and firing defects" by means of the color powder volume concentration = CPVC.

Non-volatile parts (nvp):

Measuring instrument: MA - 30 scales from SartoriusTM
Measuring method: 120 °C 30 min
Weighed-in quantity: approx. 1 g substance
Measured value: nvp [%]

With the exception of UV curing printing pastes, covercoats and printing media consist of solvents and non-volatile parts. During printing on the decal paper, the solvents evaporate from the covercoat or printing paste and leave behind the dried film or ceramic decal, which is made up of color powder and the nvp.
There are critical nvp quantities in a printing paste, which must be maintained. If these levels are not reached, firing defects in the form of pinholes or "boiling" occur during firing (see A 1.2 "nvp and firing defects").

Flash point of media:

Measuring regulation: DIN 53213
Measuring instrument: flash point tester (Abel-PenskyTM)
Measured value: °C

The flash point is understood to be the temperature at which a mixture of solvent vapour and air can be ignited by an open flame. In terms of the printing shop it is important to realize that even the spark gap in a light switch or a burning cigarette constitutes an open flame, and if the flash point is low, i.e. < 21 °C, a mixture of solvent vapour and air can ignite. During the summer or in well-heated room's temperatures of 20-25 °C are generally reached. All the electric equipment and apparatus in such rooms must be explosion-proof if solvent-containing products with a flash point of <21 °C are to be processed.
When making ceramic screen decals, covercoats and printing media, the flash points are almost always over 40 °C. It must nevertheless be noted that these products are also combustible, and any type of open fire is to be strictly prohibited.
The printing shop must be a no-smoking zone.

Screen material DIN 16.611: In DIN 16.611 the term screen type, i.e. a description of the screen by giving the number of threads per cm or inch and the thread diameter in µm, is clearly defined. As it is more usual for the number of threads to be given per inch for steel screens in ceramic decal printing, we have deviated from the standard definition and kept to the number of threads per inch for steel (1 inch = 2.54 cm). A 300-30 steel is a steel screen with 300 steel threads per inch and a thread thickness of 30 µm A 77-55 PET is a polyester screen with 77 threads per cm and a thread thickness of 55 µm.

Dry film thickness in µm:

Gauge: MillimessTM
MAHR GmbH D 73702 Esslingen, Reutlingerstrasse 48
Phone +49 (0) 711/9312-600; Fax +49 (0) 711/9160953
Type: 838 A/1003-So Dickenmessgerät 100 µm mit Feinanzeiger oberer Messtaster ballig (sphärisch), unterer Messtaster plan

The minimum dry film thickness we recommend is the film thickness a covercoat should leave behind once the solvents on the ceramic decal have evaporated. The film thickness can be considerably influenced by the screen thickness and the type of squeegee. Most printing shops use a very rounded neoprene or polyurethane squeegee. In practice, the MillimessTM thickness gauge has proved reliable.

Extensibility index:

After drying, all covercoats form a pseudo-plastic film. There are various methods of describing the flexibility and extensibility of a dried film. Almost all methods only provide results (mostly in %) related to a standard product.
We have decided to determine the extensibility with the FischerscopeTM, but modify the absolute values found to the most widespread covercoat in our range, covercoat 80 450, whose extensibility we can assume is known.

Measuring instrument:	FischerscopeTM
Object measured:	dry film from a 60 µm wet film
Measurement:	force range 0.4-50 mN
Reading:	at 5 mN
Measured value:	29 N/mm² for the standard film 80 450

Description of measuring the extensibility with the FischerscopeTM.
A wet film of 60 µm is applied to a flat glass sheet – according to our measurements 10 x 10 cm – with a film applicator. After drying for 48 hours at 23 °C and 60 % rel. humidity, the test object with the dry film on it is laid in the FischerscopeTM for measuring.
A Vickers diamond pyramid then penetrates the dry film with a force of 0.4-50 mN at a temperature of 23 °C.
At 5 mN a reading of the value to be determined is taken in N/mm².
Our standard covercoat 80 450 provides reproducible measured values of 29 N/mm².
This value measured for 80 450 is given the extensibility index value 100.
All covercoats with a value of over 100 have a lower degree of extensibility and all covercoats with a value of below 100 are more ductile.

Drying figure TZ according to MettlerTM:

The drying properties of printing media are particularly important, especially for the color constancy during production run-on. In practical tests we have determined that, in most cases, a color paste is no longer suitable for continued printing when 10 % of the solvent quantity in the printing medium used has evaporated during printing.
In relation to the entire paste quantity this corresponds to a solvent loss of approx.
2.1 % for a pasting ratio of 100: 60 (80 820).

Our drying figures TZ10 and TZ90 indicate when 10 % of the solvent has evaporated from the printing medium at 50 °C or 90 % of the solvent at 80 °C.
In order to measure the solvent evaporation in as short a time as possible, TZ10 and TZ90 were determined according to the following test sequence.
Interval drying:

1. at 50 °C:	20 min to determine TZ10
2. continuation at 80 °C:	90 min to determine TZ90
3. subsequent drying at	150 °C: 70 min

Measuring instrument:	MettlerTM scales HR 73
Weighed-in quantity:	approx. 1 g (corresponds to a 400 µm wet application on a 5x5cm glass sheet)

The values determined are given the following drying figures (TZ):
Printing medium 80 820 10 % value = TZ10 = 100
Printing medium 80 820 90 % value = TZ90 = 1000

A TZ10 over 100 means that this printing medium dries more slowly than 80 820.
TZ10 can be used to describe the drying behavior on the screen.
A TZ90 over 1000 indicates that drying is slower than that of 80 820.
TZ90 provides information on the drying time in a wicket dryer.
However, all the information is always to be regarded as relative to the standard printing medium 80 820.

In relating the information to the printing medium 80 820 we are assuming that the drying properties of this medium are known by the printer. We know, of course, that this method can only provide some guidelines for orientation, but we have learned from practice that this drying figure provides a good basis on which to work.

Blocking Test:

Within the Technical Data on the individual Product Data Sheets we define the blocking stability merely with the terms tack-free or not tack-free.
This information is the result of a blocking test, carried out as follows.

1. The covercoat being tested is printed on normal decal paper with a 24-120 PET screen and dried openly and horizontally at 23 °C, 55-60 % rel. humidity, for 3 hours.
2. 3-4 sections from the covercoated sheets, measuring 10x10 cm and lying on top of one another, are laid with the coated side facing upward between two 10x10cm-large glass sheets and weighted down with a 5-kg weight on the top glass sheet for 48 hours at 23 °C, 55-60 % rel. humidity. (*)
3. After being weighted down for 48 hours, the covercoated sections are removed from between the glass sheets and separated.
4. We designate a covercoat tack-free if the sections can be separated without difficulty and only a slight rustling is heard. However, no torn paper fibres from the section which was lying above during weighting must be visible on the covercoat surface of the section that was underneath.
5. We designate a covercoat not tack-free if the weighted sections cannot be separated from one another, or if torn paper fibres from the section which was lying above during weighting are visible on the covercoat surface of the section that was underneath.

In the blocking test above, only the surface tackiness of the printed covercoat under weighting is tested.
In practice, however, the covercoat is usually on top of a ceramic decal, the composition of which can vary considerably. Depending on the plasticizer content of the printing media used, a "tack-free" covercoat can stick to such ceramic decals to a greater or lesser extent, even after thorough drying, and thus make the use of interlaying wax paper absolutely necessary.

Note: (*)

The weighting down in the test of 5 kg on 100 cm^2 corresponds to the weight of approx. 1400 sheets of horizontally stacked ceramic decals measuring 60x80 cm and an assumed weight for each individual printed sheet of 170 g.

We recommend always performing the described test, therefore, on finished ceramic decals. For a quick test it is sufficient to weight down two covercoated and thoroughly dried ceramic decals laying on top of one another with 6 packets of paper, each with 250 sheets of 60x60 cm, for 48 hours in the printing shop, and then to assess the blocking stability according to the method described above.

C 2 Rheology of Covercoats and Printing Media

Flowing media:

Until the introduction of thixotropic media for making ceramic decals, a printer was more or less forced to forgo defined halftone screen printing. Attempts were made to make halftone printing possible by taking printing pastes with high viscosities and printing a halftone screen solely as a result of the viscosity of the printing paste. This method, which surprisingly is still practiced by some printers today, had decisive disadvantages.

Firstly, the printing speed was drastically reduced due to poor printing properties, and competitiveness progressively declined as a result of decreased productivity.

Secondly, the poor overprinting properties with these highly viscous pastes meant that the printing screens had to be constantly cleaned and the color constancy during production run-on was thus very poor. This resulted in a great many complaints. A further drawback was the tendency to run in wicket dryers or dryers with a continuous flow of air when a flowing covercoat was used without a pre-drying zone.

When printing surfaces and lines with color pastes of medium to low viscosity, however, one positive property of the flowing printing media really stands out, namely the fact that the paste viscosity of these flowing media does not change during printing.

In technical terminology, therefore, flowing media are also called Newtonian media, and these are generally understood to be fluids which do not change their viscosity as a result of shearing forces such as stirring or printing.

Today, flowing media are thus predominantly used for surface printing or combinations of surfaces and lines. This is of great significance in the field of glass decoration. When using flowing media, a thixotropic medium should always be used as well.

Another advantage of the flowing media is that ceramic color powders are easier to paste.

In order to eliminate most of the above-mentioned disadvantages of flowing media, it was necessary to use thixotropic media.

Thixotropic Media:

In contrast to the flowing media, the viscosity of the thixotropic printing media does not remain constant, but decreases as the shearing speed increases, as is the case, for example, when printing at varying speeds. As the shearing speed decreases, however, the viscosity increases again over time. This thixotropic behavior of a color paste is very suitable for the requirements of a well-defined halftone dot. By using thixotropic media it is now possible to produce a decal quality in ceramic screen printing that could only previously be obtained by offset printing. As the degree of thixotropy required differs from job to job, FERRO now offers a wide range of thixotropic printing media, so that it is possible to accomplish almost all the jobs in question. The highly thixotropic

media 80 810 are particularly suitable for extremely fine halftone screens, whereas the media with a medium to low thixotropy, e.g. 80 820 and NR. 221/THIX/1, are used for coarser halftone screens, fine lines or surfaces.
The use of thixotropic media prevents the running of colors which is sometimes evident when using flowing covercoats.

During the manufacturing process, some Media and Covercoats are treated with Thixotropic Agents at a standard controlled temperature. The thixotropy of the treated media and covercoats is the result of a chemical/physical process, which continues to develop to a minor extent after the product has been transferred into drums for storage or dispatch.
Therefore, the viscosity specifications, within which we guarantee a consistent product, apply to the rheology up to 24 hours after manufacture.
Any thickening, which occurs afterwards, depends upon the storage temperature and time.
While apparent rheology difference can be noticeable, the post-thickening effect is almost completely neutralized by the shear applied during paste preparation on a triple roll mill.

C 3 Technical Data on ceramic colors for glass, onglaze and underglaze decorations

Introduction

In this Media Guide we have described in detail the product properties and application potential of the printing media, covercoats and auxiliary materials.
The primary purpose of the entire range of these organic media is, however, to ensure that our ceramic colors can be utilised to optimum effect having regard to parameters such as differing firing schedules and various application methods such as printing, spraying or banding.
It must be possible to fire the ceramic colors to a perfect finish, and also for them be resistant to chemical corrosion:
they should pollute the environment as little as possible, and last but not least provide a decoration that is colorful and glossy.
This matter can only be resolved successfully if the properties of the two product groups "ceramic colors on the one hand and media on the other" are known exactly and used accordingly.

The following description is an attempt to simplify the essential properties of the very complex field of ceramic colors in such a way that the importance of these products' properties when processing with the media can be recognized.

Classification

The way a decorative color behaves during pasting depends on a number of factors. The amount of medium required can vary considerably, depending on the composition, processing and condition.

Composition

A decorative color essentially consists of two components; the pigment, i.e. the part giving color, and finely ground glass, i.e. the flux.
The flux causes the color to adhere to the object being decorated during firing, and is primarily responsible for making the colors resistant and giving the surface its gloss.
The ratio of pigment to flux varies, depending on the purpose for which the color is being used.

Underglaze colors

In most cases the proportion of pigment is 80 %; the proportion of flux only serves to improve the adhesion between the body and decorative color.

High-temperature rapid-fire colors

The proportion of pigment for these is between 40-60 %

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Onglaze colors
For these the proportion of pigment is between 10-30 %

Glass colors for hollow and flat glass
Due to the low firing temperatures, the proportion of pigment for these is restricted to 5-20 %

Importance for the pasting ratio (PR)

As explained under the compositions of the individual color color selections, all ceramic colors are a mixture of finely ground flux (frits) and pigments.
The higher the proportion of pigment, the lower the amount of printing medium required, since in most cases the specific gravity of the pigment is higher than the specific gravity of the frit.
The higher the specific gravity of pigment and frit, the lower the amount of printing medium required. (A1.2 CPVC)

Specific gravities of various types of pigment in		**g / cm³**
Special pigments based on zeolite or mica		2,0-2,5
Cobalt aluminate	Co-Al	3,5-4,0
Cobalt silicon	Co-Si	3,5-4,0
Calcium-Zinn slicon chromium	Ca-Sn-Si-Cr	4,0-4,2
Inclusion pigments	Zr-Si-Cd-S-Se	4,0-4,5
Cadmium sulfoselenide	Cd-S-Se	4,7
Chromium oxide	Cr	5,2
Tin-chromium-iron	Sn-Cr-Fe	5,0-5,5
Zirconium-vanadium	Zr-V	5,5-6,0
Tin-antimony	Sn-Sb	6,0-6,5
Tin-chromium	Sn-Cr	7,0
Lead-antimony	Pb-Sb	7,0-7,5

Specific gravities of various types of frit in	**g / cm³**
Alkaline-borosilicate	2,2
Alkali-alkaline-borosilicate	2,5
Alkali-borosilicate with approx. 50 % in weight PbO	4,0
Borosilicate with approx. 75 % in weight PbO	5,5
Lead monosilicate with approx. 85 % in weight PbO	7,0

Processing

In addition to the chemical composition, the production process has a great influence on the behavior of decorative colors. The final fineness, grain spectrum and surface smoothness of the colors are determined by the type of grinding process and its length.
Aside from the traditional ball mills, annular gap bead mills, bead mills or fluidized-bed jet mills are used to an increasing extent today. These meet the demand for very fine powders with a narrow grain spectrum.

Fineness of various pigments and fluxes	**d_{50}**	**d_{90}**
Plastic pigments	1 µm	2,5 µm
Ceramic pigments	3 µm	10 µm
Inclusion pigments	15 µm	28 µm
Frits	5 µm	10 µm

Leadfree Color

This chapter describes the special features of the leadfree color selections as regards their processing and environment-friendly use.

The demands made of inorganic decorative color regarding processing, environmental protection and the properties in a fired condition are becoming more and more exacting.

This also means that the handling of these systems is increasing in complexity.

In this context we want to deal in particular with the use of leadfree color.

These color offer considerable advantages with regard to

- end-user consumer protection (no release values of heavy metals in accordance with DIN)
- industrial safety (no adverse effects from dusts)
- labelling obligations (no restrictions in trade or transit)
- disposal / environmental protection (fewer conditions regarding waste water, exhaust air, final waste storage)

Due to the chemical composition of the vitreous proportion (high alkali concentration), leadfree color are hygroscopic
(a great deal more sensitive to the effect of moisture) ; i.e. more attention must be paid to controlling residual moisture and to storage in frost-free, dry rooms.
Owing to the low specific gravity of leadfree decorative color, it is advisable to use special printing media with high powder absorption, in order to obtain an appropriate layer of ink and achieve perfect firing, while at the same time having optimum processing properties in the screen.

Leadfree decorative color do not make allowances for mistakes; i.e. mistakes that occur during printing will still be there during firing. This is due to the special composition of the vitreous components of the decorative color.
The glasses (frits) used in leadfree color have a very short sintering/melting range; furthermore, these glasses have, in the main, a relatively high surface tension and a high viscosity.
This means that, if the medium content in the pasting ratio is too low, embossed structures (screen structures / mesh marks) are not evened out during firing, but emphasized.
The use of decal paper which has a non-smooth gum coat produces poor results.
The use of moist powder or inadequately dried slide-offs causes holes in the fired glaze, as blisters do not have the chance to smooth out in the relatively short firing-in time.

Despite the fact that leadfree colour selections are more difficult to handle, the technical and professional necessity of using these color is increasing to an ever greater extent.

Printers should make sure they know about the processing and use of leadfree products comprehensively and as soon as possible.

The legislation surrounding the use of decorative color will become more stringent, and the printers who prepare themselves for this situation will have an advantage.

The application technology advisors at FERRO will be happy to assist you with any problems.

Collections – Pasting Tables

- Samba 100
- Sunshine
- Orichidee
- Azurico
- Metallic 100
- Sky 100
- Impression

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May 2022

Samba100

Pasting the Samba 100 palette with all the printing media in this Media Catalogue, taking into consideration the maximum color powder volume concentration (CPVC) of 53 %.
The table below shows the use of the color powder volume concentration (CPVC %) for the Sunshine palette.
The quantity of printing medium in column (M) depends on the specific gravity of the color powder.
The quantity of printing medium (M) given in the table is the minimum quantity required for perfect firing.
The quantities of printing medium (M) given can be exceeded in isolated cases.
They should, however, never be lower than the amounts stipulated.

Samba 100 Product number	NR. 221		NR. 221/ THIX/1.0		NR. 221/ THIX/2.2		NR. 209		80 810		80 820		80 3012	
	CP	M	CP	M	CP	M	CP	M	CP	M	CP	M	CP	M
11 1650	100	65	100	65	100	65	100	92	100	64	100	64	100	106
11 1651	100	63	100	63	100	63	100	89	100	62	100	62	100	103
11 1653	100	75	100	75	100	75	100	106	100	73	100	73	100	122
12 1650	100	61	100	61	100	61	100	87	100	60	100	60	100	100
12 1651	100	72	100	72	100	72	100	102	100	70	100	70	100	117
12 1652	100	69	100	69	100	69	100	99	100	68	100	68	100	113
12 1653	100	65	100	65	100	65	100	92	100	64	100	64	100	106
12 1654	100	54	100	54	100	54	100	77	100	53	100	53	100	89
12 1655	100	65	100	65	100	65	100	92	100	64	100	64	100	106
13 1604	100	78	100	78	100	78	100	110	100	76	100	76	100	126
13 1605	100	78	100	78	100	78	100	110	100	76	100	76	100	126
13 1650	100	65	100	65	100	65	100	92	100	64	100	64	100	106
13 1651	100	65	100	65	100	65	100	92	100	64	100	64	100	106
13 1652	100	65	100	65	100	65	100	92	100	64	100	64	100	106
13 1655	100	78	100	78	100	78	100	110	100	76	100	76	100	126
14 1650	100	63	100	63	100	63	100	89	100	62	100	62	100	103
14 1652	100	63	100	63	100	63	100	89	100	62	100	62	100	103
15 1650	100	54	100	54	100	54	100	77	100	53	100	53	100	89
15 1651	100	65	100	65	100	65	100	92	100	64	100	64	100	106
16 1650	100	61	100	61	100	61	100	87	100	60	100	60	100	100
16 1651	100	63	100	63	100	63	100	89	100	62	100	62	100	103
17 1605	100	78	100	78	100	78	100	110	100	76	100	76	100	126
17 1606	100	78	100	78	100	78	100	110	100	76	100	76	100	126
17 1656	100	78	100	78	100	78	100	110	100	76	100	76	100	126
17 1657	100	75	100	75	100	75	100	106	100	73	100	73	100	122
17 1658	100	75	100	75	100	75	100	106	100	73	100	73	100	122
17 1659	100	75	100	75	100	75	100	106	100	73	100	73	100	122
18 1650	100	58	100	58	100	58	100	82	100	56	100	56	100	94
19 1650	100	63	100	63	100	63	100	89	100	62	100	62	100	103
19 1651	100	75	100	75	100	75	100	106	100	73	100	73	100	122
19 1652	100	72	100	72	100	72	100	102	100	70	100	70	100	117
72 1650	100	67	100	67	100	67	100	95	100	66	100	66	100	110
77 1640	100	81	100	81	100	81	100	114	100	79	100	79	100	132
77 1641	100	81	100	81	100	81	100	114	100	79	100	79	100	132
77 1642	100	78	100	78	100	78	100	110	100	76	100	76	100	126
77 1643	100	81	100	81	100	81	100	114	100	79	100	79	100	132
77 1644	100	81	100	81	100	81	100	114	100	79	100	79	100	132
77 1645	100	76	100	76	100	76	100	108	100	75	100	75	100	125
10 1600	100	81	100	81	100	81	100	114	100	79	100	79	100	132
10 1650	100	81	100	81	100	81	100	114	100	79	100	79	100	132
10 1652	100	81	100	81	100	81	100	114	100	79	100	79	100	132

CP = Color Powder
M = Medium

Sunshine

Pasting the Sunshine palette with all the printing media in this Media Catalogue, taking into consideration the maximum color powder volume concentration (CPVC) of 53 %.
The table below shows the use of the color powder volume concentration (CPVC %) for the Sunshine palette.
The quantity of printing medium in column (M) depends on the specific gravity of the color powder.
The quantity of printing medium (M) given in the table is the minimum quantity required for perfect firing.
The quantities of printing medium (M) given can be exceeded in isolated cases.
They should, however, never be lower than the amounts stipulated.

Sunshine Product number	NR. 221		NR. 221/ THIX/1.0		NR. 221/ THIX/2.2		NR. 209		80 810		80 820		80 3012	
	CP	M	CP	M	CP	M	CP	M	CP	M	CP	M	CP	M
11 1232	100	55	100	55	100	55	100	78	100	53	100	53	100	89
11 1233	100	56	100	56	100	56	100	79	100	55	100	55	100	91
11 1244	100	59	100	59	100	59	100	84	100	58	100	58	100	96
12 1232	100	52	100	52	100	52	100	74	100	51	100	51	100	85
12 1234	100	59	100	59	100	59	100	83	100	57	100	57	100	96
12 1236	100	61	100	61	100	61	100	87	100	60	100	60	100	100
13 1230	100	59	100	59	100	59	100	84	100	58	100	58	100	96
13 1232	100	55	100	55	100	55	100	78	100	54	100	54	100	90
13 1233	100	54	100	54	100	54	100	77	100	53	100	53	100	89
14 1231	100	53	100	53	100	53	100	76	100	52	100	52	100	87
14 1232	100	58	100	58	100	58	100	82	100	56	100	56	100	94
15 1230	100	50	100	50	100	50	100	71	100	49	100	49	100	82
16 1232	100	48	100	48	100	48	100	67	100	46	100	46	100	78
16 1233	100	48	100	48	100	48	100	67	100	46	100	46	100	78
17 1250	100	61	100	61	100	61	100	86	100	59	100	59	100	99
17 1251	100	59	100	59	100	59	100	84	100	58	100	58	100	96
17 1252	100	59	100	59	100	59	100	84	100	58	100	58	100	97
17 578	100	45	100	45	100	45	100	65	100	44	100	44	100	74
19 1230	100	56	100	56	100	56	100	79	100	54	100	54	100	91
19 1231	100	59	100	59	100	59	100	84	100	58	100	58	100	97
19 1232	100	48	100	48	100	48	100	68	100	47	100	47	100	78
72 1233	100	53	100	53	100	53	100	75	100	52	100	52	100	87
72 1234	100	59	100	59	100	59	100	84	100	58	100	58	100	97
77 1234	100	50	100	50	100	50	100	71	100	49	100	49	100	81
77 1235	100	49	100	49	100	49	100	69	100	48	100	48	100	80
77 1241	100	61	100	61	100	61	100	87	100	60	100	60	100	100
77 1242	100	47	100	47	100	47	100	67	100	46	100	46	100	76
77 1243	100	47	100	47	100	47	100	67	100	46	100	46	100	76
10 117	100	63	100	63	100	63	100	89	100	61	100	61	100	102
10 169	100	50	100	50	100	50	100	72	100	49	100	49	100	82

CP = Color Powder

M = Medium

Orchide

Pasting the Orchidee palette with all the printing media in this Media Catalogue, taking into consideration the maximum color powder volume concentration (CPVC) of 53 %.
The table below shows the use of the color powder volume concentration (CPVC %) for the Sunshine palette.
The quantity of printing medium in column (M) depends on the specific gravity of the color powder.
The quantity of printing medium (M) given in the table is the minimum quantity required for perfect firing.
The quantities of printing medium (M) given can be exceeded in isolated cases.
They should, however, never be lower than the amounts stipulated.

Orchidee Product number	NR. 221		NR. 221/ THIX/1.0		NR. 221/ THIX/2.2		NR. 209		80 810		80 820		80 3012	
	CP	M	CP	M	CP	M	CP	M	CP	M	CP	M	CP	M
77 465	100	52	100	52	100	52	100	73	100	51	100	51	100	84
77 466	100	53	100	53	100	53	100	75	100	52	100	52	100	87
77 467	100	56	100	56	100	56	100	79	100	55	100	55	100	91
77 468	100	52	100	52	100	52	100	73	100	51	100	51	100	84
77 477	100	53	100	53	100	53	100	75	100	52	100	52	100	87
77 478	100	53	100	53	100	53	100	75	100	52	100	52	100	87
77 479	100	53	100	53	100	53	100	75	100	52	100	52	100	87
77 480	100	53	100	53	100	53	100	75	100	52	100	52	100	87
77 481	100	53	100	53	100	53	100	75	100	52	100	52	100	87

CP = Color Powder
M = Medium

Azurico

Pasting the Azurico palette with all the printing media in this Media Catalogue, taking into consideration the maximum color powder volume concentration (CPVC) of 53 %.
The table below shows the use of the color powder volume concentration (CPVC %) for the Sunshine palette.
The quantity of printing medium in column (M) depends on the specific gravity of the color powder.
The quantity of printing medium (M) given in the table is the minimum quantity required for perfect firing.
The quantities of printing medium (M) given can be exceeded in isolated cases.
They should, however, never be lower than the amounts stipulated.

Azurico Product number	NR. 221		NR. 221/ THIX/1.0		NR. 221/ THIX/2.2		NR. 209		80 810		80 820		80 3012	
	CP	M	CP	M	CP	M	CP	M	CP	M	CP	M	CP	M
12 2500	100	59	100	59	100	59	100	84	100	58	100	58	100	97
72 2500	100	59	100	59	100	59	100	84	100	58	100	58	100	97
10 2500	100	53	100	53	100	53	100	75	100	52	100	52	100	87

CP = Color Powder

M = Medium

Metallic100

Pasting the Metallic 100 palette with all the printing media in this Media Catalogue, taking into consideration the maximum color powder volume concentration (CPVC) of 53 %.
The table below shows the use of the color powder volume concentration (CPVC %) for the Sunshine palette.
The quantity of printing medium in column (M) depends on the specific gravity of the color powder.
The quantity of printing medium (M) given in the table is the minimum quantity required for perfect firing.
The quantities of printing medium (M) given can be exceeded in isolated cases.
They should, however, never be lower than the amounts stipulated.

Metallic 100 Product nubmer	NR. 221		NR. 221/ THIX/1.0		NR. 221/ THIX/2.2		NR. 209		80 810		80 820		80 3012	
	CP	M	CP	M	CP	M	CP	M	CP	M	CP	M	CP	M
13 2165	100	76	100	76	100	76	100	108	100	74	100	74	100	124
13 2166	100	75	100	75	100	75	100	107	100	74	100	74	100	123
15 2165	100	73	100	73	100	73	100	104	100	71	100	71	100	119
15 2166	100	74	100	74	100	74	100	105	100	72	100	72	100	121
16 2165	100	75	100	75	100	75	100	106	100	73	100	73	100	122
17 2165	100	73	100	73	100	73	100	104	100	72	100	72	100	120
13 55324	100	75	100	75	100	75	100	106	100	73	100	73	100	122
13 55325	100	75	100	75	100	75	100	106	100	73	100	73	100	122
13 55326	100	75	100	75	100	75	100	106	100	73	100	73	100	122
15 55009	100	75	100	75	100	75	100	106	100	73	100	73	100	122
15 55010	100	75	100	75	100	75	100	106	100	73	100	73	100	122
15 55881	100	75	100	75	100	75	100	106	100	73	100	73	100	122
15 55885	100	75	100	75	100	75	100	106	100	73	100	73	100	122
16 55222	100	75	100	75	100	75	100	106	100	73	100	73	100	122
17 55671	100	75	100	75	100	75	100	106	100	73	100	73	100	122
17 55774	100	72	100	72	100	72	100	102	100	70	100	70	100	117

CP = Color Powder

M = Medium

Sky100

Pasting the Sky 100 palette with all the printing media in this Media Catalogue, taking into consideration the maximum color powder volume concentration (CPVC) of 53 %.

The table below shows the use of the color powder volume concentration (CPVC %) for the Sunshine palette.

The quantity of printing medium in column (M) depends on the specific gravity of the color powder.

The quantity of printing medium (M) given in the table is the minimum quantity required for perfect firing.

The quantities of printing medium (M) given can be exceeded in isolated cases.

They should, however, never be lower than the amounts stipulated.

Sky 100 Product number	NR. 221		NR. 221/ THIX/1.0		NR. 221/ THIX/2.2		NR. 209		80 810		80 820		80 3012	
	CP	M	CP	M	CP	M	CP	M	CP	M	CP	M	CP	M
11 857	100	62	100	62	100	62	100	88	100	61	100	61	100	101
11 858	100	53	100	53	100	53	100	75	100	52	100	52	100	86
11 859	100	66	100	66	100	66	100	93	100	64	100	64	100	107
11 861	100	64	100	64	100	64	100	91	100	63	100	63	100	105
12 856	100	67	100	67	100	67	100	95	100	66	100	66	100	110
12 861	100	65	100	65	100	65	100	92	100	64	100	64	100	106
12 862	100	65	100	65	100	65	100	93	100	64	100	64	100	107
12 1910	100	58	100	58	100	58	100	82	100	57	100	57	100	95
12 1915	100	69	100	69	100	69	100	99	100	68	100	68	100	113
12 1916	100	69	100	69	100	69	100	99	100	68	100	68	100	113
12 1917	100	56	100	56	100	56	100	79	100	55	100	55	100	91
13 855	100	60	100	60	100	60	100	85	100	58	100	58	100	98
13 856	100	61	100	61	100	61	100	87	100	60	100	60	100	100
13 1912	100	59	100	59	100	59	100	84	100	58	100	58	100	97
13 1916	100	65	100	65	100	65	100	92	100	64	100	64	100	106
13 1917	100	59	100	59	100	59	100	84	100	58	100	58	100	97
14 1910	100	68	100	68	100	68	100	97	100	67	100	67	100	111
15 850	100	60	100	60	100	60	100	85	100	58	100	58	100	98
15 856	100	67	100	67	100	67	100	95	100	66	100	66	100	110
16 855	100	59	100	59	100	59	100	83	100	57	100	57	100	96
16 856	100	64	100	64	100	64	100	91	100	63	100	63	100	105
16 857	100	58	100	58	100	58	100	83	100	57	100	57	100	95
16 858	100	59	100	59	100	59	100	84	100	58	100	58	100	96
17 856	100	65	100	65	100	65	100	92	100	64	100	64	100	106
17 1910	100	62	100	62	100	62	100	89	100	61	100	61	100	102
17 1911	100	59	100	59	100	59	100	83	100	57	100	57	100	96
17 1912	100	63	100	63	100	63	100	90	100	62	100	62	100	103
17 1917	100	58	100	58	100	58	100	82	100	56	100	56	100	94
17 1918	100	59	100	59	100	59	100	84	100	58	100	58	100	97
18 852	100	54	100	54	100	54	100	77	100	53	100	53	100	89
19 850	100	70	100	70	100	70	100	99	100	68	100	68	100	114
77 1910	100	81	100	81	100	81	100	114	100	79	100	79	100	132
77 1911	100	81	100	81	100	81	100	114	100	79	100	79	100	132
77 1912	100	81	100	81	100	81	100	114	100	79	100	79	100	132
10 115	100	80	100	80	100	80	100	114	100	78	100	78	100	130

CP = Color Powder

M = Medium

Impession

Pasting the Impression palette with all the printing media in this Media Catalogue, taking into consideration the maximum color powder volume concentration (CPVC) of 53 %.
The table below shows the use of the color powder volume concentration (CPVC %) for the Sunshine palette.
The quantity of printing medium in column (M) depends on the specific gravity of the color powder.
The quantity of printing medium (M) given in the table is the minimum quantity required for perfect firing.
The quantities of printing medium (M) given can be exceeded in isolated cases.
They should, however, never be lower than the amounts stipulated.

Impression Product number	NR. 221		NR. 221/ THIX/1.0		NR. 221/ THIX/2.2		NR. 209		80 810		80 820		80 3012	
	CP	M	CP	M	CP	M	CP	M	CP	M	CP	M	CP	M
11 1453	100	50	100	50	100	50	100	72	100	49	100	49	100	82
11 1454	100	55	100	55	100	55	100	78	100	54	100	54	100	90
11 1455	100	75	100	75	100	75	100	107	100	74	100	74	100	123
11 1456	100	74	100	74	100	74	100	106	100	73	100	73	100	121
11 1457	100	75	100	75	100	75	100	106	100	73	100	73	100	122
11 1458	100	69	100	69	100	69	100	97	100	67	100	67	100	112
12 1451	100	57	100	57	100	57	100	81	100	56	100	56	100	93
12 1452	100	64	100	64	100	64	100	91	100	63	100	63	100	105
12 1453	100	64	100	64	100	64	100	91	100	63	100	63	100	105
12 1915	100	69	100	69	100	69	100	99	100	68	100	68	100	113
12 1916	100	69	100	69	100	69	100	99	100	68	100	68	100	113
12 2201	100	47	100	47	100	47	100	67	100	46	100	46	100	76
13 1451	100	47	100	47	100	47	100	67	100	46	100	46	100	77
13 1452	100	56	100	56	100	56	100	79	100	54	100	54	100	91
13 2203	100	46	100	46	100	46	100	65	100	45	100	45	100	75
13 1454	100	48	100	48	100	48	100	68	100	47	100	47	100	78
13 2204	100	46	100	46	100	46	100	65	100	45	100	45	100	75
14 1450	100	69	100	69	100	69	100	98	100	68	100	68	100	113
15 1450	100	57	100	57	100	57	100	81	100	56	100	56	100	93
15 1451	100	53	100	53	100	53	100	75	100	52	100	52	100	87
16 1452	100	56	100	56	100	56	100	79	100	54	100	54	100	91
16 1453	100	56	100	56	100	56	100	79	100	55	100	55	100	91
16 1454	100	54	100	54	100	54	100	77	100	53	100	53	100	89
16 1455	100	56	100	56	100	56	100	79	100	55	100	55	100	91
16 1456	100	58	100	58	100	58	100	83	100	57	100	57	100	95
17 1451	100	60	100	60	100	60	100	86	100	59	100	59	100	98
17 1452	100	48	100	48	100	48	100	68	100	47	100	47	100	78
17 1455	100	47	100	47	100	47	100	66	100	46	100	46	100	76
17 1456	100	47	100	47	100	47	100	66	100	46	100	46	100	76
17 2204	100	45	100	45	100	45	100	64	100	44	100	44	100	73
17 2205	100	45	100	45	100	45	100	64	100	44	100	44	100	73
18 1450	100	47	100	47	100	47	100	67	100	46	100	46	100	77
18 1451	100	48	100	48	100	48	100	68	100	47	100	47	100	78
19 1450	100	57	100	57	100	57	100	81	100	56	100	56	100	93
19 1451	100	56	100	56	100	56	100	80	100	55	100	55	100	92
77 1910	100	81	100	81	100	81	100	114	100	79	100	79	100	132
77 1911	100	81	100	81	100	81	100	114	100	79	100	79	100	132
77 1912	100	81	100	81	100	81	100	114	100	79	100	79	100	132
10 1600	100	80	100	80	100	80	100	114	100	78	100	78	100	130
10 115	100	82	100	82	100	82	100	116	100	80	100	80	100	134

CP = Color Powder , M = Medium

C4 Practical Advice on the Use of Auxiliary Materials

Fixatives: **EMSOL and BONDSOL**

This product group is generally suitable for helping ceramic decals to adhere to rough, porous or embossed substrates. Due to their solvent contents, the fixatives are able to initiate dissolution on the underside of the decals after application to such an extent that the organic components of the printing media and covercoats become very tacky and thus bond firmly with the substrate. Perfect firing results are achieved in this way, even on problematic surfaces.
Typical examples for application are:
frosted glass and unfired sanitary ware glazes.

Soaking agents: This product group has been well-known for years and used successfully when old decals have become unsuitable for decorative purposes.

Despite the fact that this plasticizer is so well-known, incorrect application still occurs in practice.
One of the most common errors is that of using incorrect quantities. At this point, therefore, some correlations are explained, which, if not understood and observed, will cause mistakes to be made and the effectiveness of the products to be impaired.

After adding the plasticizer (as a rule 3 %) to the soaking water, the decals are immersed.
The plasticizer's water-soluble solvent is gradually absorbed by the covercoat on the decal and the film thus becomes very flexible. This process, however, takes some time, and it is necessary, therefore, to allow the decals to soak for at least 15 minutes. The time lost only applies to the first stack of decals, because as soon as decoration begins, the next stack can be put to soak. As already mentioned, the decals absorb some of the solvent from the water, and the content of plasticizer in the water thus decreases bit by bit. At a certain point there is not enough plasticizer left in the water to achieve a good degree of flexibility for the decal. Although practiced lithographers notice that the properties of the decals are different due to the decline in flexibility, in many cases work is still continued.

The consequences of this are only recognized when the poor firing results are seen, but that, of course, is too late. For reasons of quality assurance, therefore, the soaking water should be changed completely at regular intervals during the working day.

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C4 Practical Advice on the Use of Auxiliary Materials

Thinner:

80 4086 for printing pastes; for covercoats upon request.
For the practised printer the thinners are the most interesting group of auxiliary materials; they can, however, cause many problems if used incorrectly. In most cases the main problem is overdosing, whereby the viscosity of the printing pastes becomes too low, and the details of the printed decal are not as clearly defined. For covercoats it is the thixotropy that decreases, which causes beads to form or dissolved inks to run when the decals are dried on a slant.
Some explanatory advice is designed, therefore, to assist in using the thinners sensibly and to help avoid the errors mentioned.
It is important to know that all printing media (with the exception of UV and pad media) and covercoats contain up to 60 % solvents. All solvents evaporate on the screen to a greater or lesser extent when the covercoats or printing pastes are printed. The approx. 60 % of solvents reduces during printing to a level at which the covercoat becomes too highly viscous or the color print too thick. This is entirely due to the quantity of evaporated solvents, which causes the viscosity to increase.
Many years of experience have shown that this level is reached when approx. 10% of the solvent quantity has evaporated from the printing paste.
Taking a color paste with a ratio of 100 : 60 (approx. 24 parts nvp + 36 parts solvent) this means: around 3.6 parts of the 36 parts contained in the printing medium have evaporated. In relation to the entire quantity of printing paste this corresponds to approx. 2-3 %.
These evaporated solvents can be replaced by the thinner 80 4086, whereby the thickened printing paste becomes easily printable again in almost all cases.

nvp [%] and firing:

Note!
Thinner should only be used when a thickening of the covercoat or color paste has been caused by solvent evaporation.
In this case the thinner fulfils the task for which it is intended, that of replacing the evaporated solvents. As the thinner contains no nvp parts, it must never be used as a substitute for a printing medium. Failure to observe this rule will inevitably result in firing defects such as pinholes, blistering etc.

Dispersing Agent:

80 604
This product is recommended in the data sheet for regenerating printing pastes that have thickened due to moisture, for example, and for adjusting the viscosity of pastes that are too highly viscous. The special feature of 80 604 is that a very noticeable reduction in viscosity is achieved when minimal quantities are added (0.5-1 %). There are, however, often problems caused by the sedimentation

of printing pastes, when the medium proportion of flowing printing media is around >70 % in relation to the color powder (pasting ratio 100:70). In order to prevent the hard sedimentation of the color powder in such pastes, 0.5 % can be added, with the result that only a soft sediment forms in the pastes and they can be easily homogenized by stirring. Note! The printed paste may not adhere as strongly to paper when the dispersing agent 80 604 is added. When using 80 604, therefore, test the adhesion of the dried printing paste to the paper by using adhesive tape.

C 5 Code System for Shades of Covercoats

Shades:

Coloring can help you to differentiate the Covercoat used. The coloring also increases the contrast on the water slide decal to allow easier control of the registration accuracy of the varnish. In addition, coloring also allows a visual impression of the printed film thickness of the Covercoat.
Ferro produces Covercoats colorless and in different colors.
Standard coloring is available for all film solutions. We will gladly provide you with information about possible variations in color and availability.
The technical data sheet of the Covercoats are available in a standard coloring. The technical data of the Covercoat are identical regardless of the coloration.

Covercoats:

Film solutions can be produced on request in the following colors:

Example:

8**0** 450	0 = colorless
8**1** 450	1 = green
8**2** 450	2 = blue
8**3** 450	3 = yellow
8**7** 450	7= red

Printing media:

The only standard shade in which printing media are supplied is colorless.

Beispiel:

8**0** 820	0 = colorless

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C 6 Standard Drums for Media and Covercoats

Quantity	Designation	Drum type	For flowing products	For thixotropic products
5 kg	ME	6 l drum	Drum with screw cap	Open topped drum with clamping ring lid
25 kg	MS	30 l drum	Drum with screw cap	Open topped drum with clamping ring lid
180 kg	MF	213 l drum	Drum with clamping ring lid and screw cap	Drum with clamping ring lid and screw cap

Supplied in (drums):

The standard 180 kg drums for both flowing and thixotropic products are supplied with a clamping ring lid and screw cap.
This type of lid has several advantages:

a. Flowing covercoats and printing media can be poured out via the screw cap opening.

b. The clamping ring allows the lid to be removed from the drum and ensure that it is completely emptied.

c. When 1-2 % of the antiblock powder 80 680 is to be mixed with covercoats, the clamping ring lid is an big advantage in obtaining a homogeneous covercoat. Before, it was first necessary to pour the flowing covercoats into a wide-mouthed drum, to be able to stir the product.

d. For the underglaze covercoats containing flux this type of drum with clamping ring lid is essential, because sediment tends to settle in these covercoats during storage, and they must be homogenized thoroughly before use.

e. When thinners have to be added to adjust the viscosity of a product, these drums are again advantageous, as the thinner can be worked in without any difficulty.

C 7 Labelling of Media Drums

As a rule, the media are packed in steel drums with a screw cap or screw cap lid.
Polyethylene liners are additionally used for certain media.
As end consumers you require some information on the contents and the product data pertaining to safety.

- All data pertaining to safety is described in the Safety Data Sheets; these are regularly updated by us and sent to you with every first delivery.
- The label provides precise information on the contents.

The following information is included on the label:

1. Commercial name and product number
2. Quantity
3. Batch
4. Packing date
5. Address and phone no. of supplier:
6. FERRO Geschäftsbereich PPC
   Gutleutstrasse 215
   D-60327 Frankfurt am Main
   Emergency (+49 (0)69) 27116-224
7. Details of hazardous materials according to the laws on handling
8. Danger symbols
9. Information on risks
10. Information and advice on safety
11. Symbol on recycling the packing within Germany
12. Special labelling regulations, e.g. storage at °C , stir before use, use by... etc.

The regulations and laws of the respective country are valid for returning and recycling packing materials.
If you have any questions regarding the correct disposal of packing materials, please contact the sales branch responsible for your region.

C 8 Experience Records

In order to be able to optimize our products to suit the properties you require, we would appreciate your opinion or criticism on the products you have used. For this reason, please let us know the specific use to which our products might be put, so that we are able to assess the processing conditions in your company more accurately. It might be possible for us to recommend a more suitable product for you if we know more about the processing conditions in your establishment.
The following details would be of assistance:

Company: **Place:**

Product name:	**Product number:**

Used for:	surface printing	☐	lines	☐	halftone	☐
Field of application:	onglaze	☐	inglaze	☐	underglaze	☐
Decoration on:	glass	☐	porcelain	☐	ceramic/bone china	☐

Firing temperture/duration:	**°C:**	**Zeit:**

Printing machine.:	automatic cylinder	☐	semi-automatic	☐	hand printing bench	☐
Drying:	Wicket dryer	☐	Hordentrockner	☐		
Pre-Dryer:	yes ☐	no ☐				

Paper used:	**manufacturer:**

Addhesion to paper:	good	☐	adequate	☐	poor	☐
Screen Type:	steel	☐	polyester	☐		

Number of threads/cm:	steel:	/cm	polyester:	/cm
Thread thickness:		µm		
Number of threads/inch:	steel:	/inch		

Printing quality achieved:	clear	☐	unclear	☐	blurred	☐
Surface levelling:	good	☐	adequate	☐	poor	☐

Assessment of processing properties:

In your opinion, how could the product be improved?

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Media Guide

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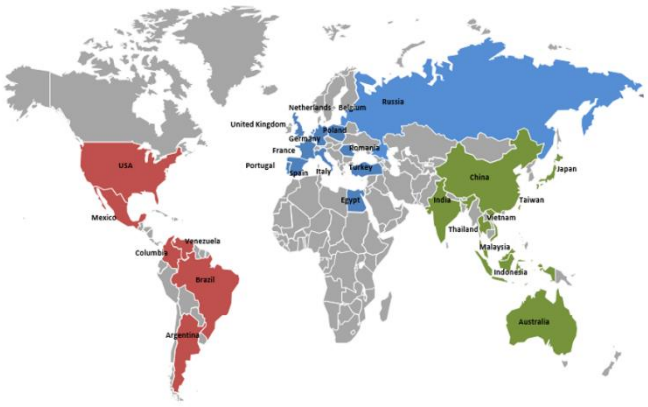

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