



Tech. Information Version: 05.Feb. 2009	Glass Colours Breakline Firing temperature ~ 550°C	Page: 1/4
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General information

In the past the set nick points on the necks of the ampoules were marked by mechanical scratching. During the last years industry has gone to carry out the preselected breaking lines by the application of ceramic substances.

Doing this, they utilize the knowledge, that glasses fused among one another and having different coefficients of extension provoke micro cracking resulting from arising tensile stresses.

Owing good processing characteristics and a coefficient of thermal expansion (CTE) between 77 and $88 \times 10^{-7} / 20 - 300 \text{ }^\circ\text{C}$, the break line colours are optimally suitable for this section of application.

We supply the colours as pastes ready for processing.
The numbers are composed as follows:

Example: F 9114/ 35/ 0480

F 9114 = number of the type of colours
/ 35 = procentual proportion of medium in
100 weight units of the finished paste
/ 0480 = type number of the medium

Processing

General

The penetration depth of the cracks - brought forth by the applied enamel - depends on the accumulated elastic energy of the break colour, which increases by growing thickness.

Laboratory tests have shown, that through this tensile stresses take place in the enamel in an order of magnitude of about $1000 \text{ kp} / \text{cm}^2$, which practically always will lead to a tight net of cracks in the basic glass.

These investigations showed, that only the way of hair line cracking as well as the geometry in the region of the set nick point (the pre-selected breaking line) are important for the breaking process. The system of crackle depends on the difference of the coefficients of extension between enamel and glass and on the thickness of the colour covering.

Please Note:

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Tech. Information Version: 05.Feb. 2009	Glass Colours Breakline Firing temperature ~ 550°C	Page: 2/4
---	--	---------------------

Application Thickness

The most advantageous application thickness of a ceramic layer is between 14 and 16 µm.

If this application thickness will be too low – presuming a limit of about 10 µm - then too little of ceramic substance will be left being unable to produce sufficient tensile stresses.

In this case the cracks produced by the tensile fusions are indicated so slightly, so that a force too strong has to be used in breaking the necks of the ampoules.

The normal force for breaking should be between 2 and 6 kp.

With enamel layers being thicker – limiting value about 18 – 20 µm - the danger is existing that basic glass particles will blast off from the fusion level already before the breaking process. This will appear as an exfoliation of the breaking line.

For the degree of tensions penetrating into the basic glass, the melting process of the ceramic colour proportional to the particular temperature is important.

The coefficient of extension with its difference between glass and enamel should be optimally chosen. The most advantageous difference values are between 28 and 38 x 10⁻⁷ /° C.

Melting Behaviour (F 9114 / F 9165 / F 9166)

Concerning the three a. m. white break line colours, we made heat microscope investigations related to their melting behaviour.

Heat Microscope Analysis			
Colour type	F 9114	F 9165	F 9166
Coefficient of extension 20 – 300 ° C	77 x 10 ⁻⁷	87,3 x 10 ⁻⁷	88,4 x 10 ⁻⁷
Beginning of sintering	450 ° C	420 ° C	380 ° C
Sintering point	520 ° C	460 ° C	440 ° C
Beginning of melting	540 ° C	480 ° C	460 ° C
Melting point	620 ° C	540 ° C	520 ° C
Flow Point	730 ° C	630 ° C	610 ° C

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Tech. Information Version: 05.Feb. 2009	Glass Colours Breakline Firing temperature ~ 550°C	Page: 3/4
--	--	---------------------

The table shows, that for example white colour F 9114 (AK 77 x 10⁻⁷), being decorated on fiolax glass, shows best difference values. Condition for achieving such like ideal values always is a sufficient layer thickness of the enamel between 12 and 18 µm and a sufficient fusion with the basic glass.

White F 9165 with a coefficient of 83,3 x 10⁻⁷ is in the upper limit of the tensile differences recommended. Especially in short firing cycles this enamel brings forth better results in the aspect of creating tensile stresses, and this is because of its low melting behaviour. In the temperature up to about 450 ° C – in which organic media and covercoats decompose – the kiln should exhaust very effective.

Medium

The special Colour break printing medium 0480 is equipped with excellent combustion characteristics, and it dries out comparatively slowly.

When processing, you have strictly to take care, in order to avoid a thickening of the pastes.

Thickened pastes will lead to extraordinary thick colour coverings from which above mentioned faulty productions will result.

The colour pastes are delivered ready for processing, packaged in 1,7 kg tin cans.

We recommend you to keep the colour quantity which is provided for production permanently in motion (for instance on a ball mill drive).

By this way you will always have at your disposal homogenously dispersed colour pastes, ready to be refilled into the colour receptacles.

Security Advices

Ceramic colours are chemical products. For processing them you have to consider specific security advices according to the danger substance decree. The colours contain lead. While processing, it is most important to obey the hygienic precautions such as:

- Do not eat, drink or smoke while being at work.
- Do not inhale dust or solvents
- Keep it away from food-stuff, beverage and fodder.
- In case of contact with skin: Wash off and rerinse with water and soap.
- If having inhaled: Rinse mouth with cold water.

For more information please contact us or ask for a Material Safety Data Sheet.

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Tech. Information Version: 05.Feb. 2009	Glass Colours Breakline Firing temperature ~ 550°C	Page: 4/4
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Forms of Delivery

Colour pastes: Minimum purchase quantity per colour shade: 5 kg

Storage

Colour powder grants the advantage of unlimited durability, if stored in dry condition.

The powders are a little bit of water-attracting (hygroscopic).

Before being processed with oily media. they should by all means be dried at a temperature of about 120°C, because a content of even less than 0,1 % water leads to „cheesy“ pastes. In this case they can no longer be perfectly printed, because they become thick.

Please take care to disperse the colour powder with the medium homogenously. In mixing the powder with the medium, small colour lumps will still remain. Therefore please use a three roll mill or dissolver.

Even in closed vessels the pastes for screen process printing have only a limited shelf-life. We advice you to store the pastes under cool conditions.

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