

## Decoration System Heraeus Gold under Flux System for decals on porcelain



### 1 General Information

Bright precious metal preparations have a layer thickness of approximately 0,1 µm. This extremely thin precious metal layer has to meet the everyday requirements with regard to its abrasion and dishwasher durability. Despite considerable improvements in dishwasher resistance, unprotected bright precious metal surfaces will eventually be damaged by mechanical wear. A coating of protective flux is able to make a lasting improvement to the abrasion durability of the bright precious metal layer. The flux coating has to form a protective layer over the precious metal film without having an adverse effect on the appearance and colour shade of the fired layer.

A further advantage is an end to the sensibility of precious metal decorations to finger prints. The system consists of a bright precious metal paste, a flux and a medium. It is easy and reliable to use and can be used for direct screen printing as well as for the production of decal transfer prints.

### 2 Standard Firing Range

Substrate	Firing range
Porcelain	820 – 860°C

The firing result depends on the firing temperature, the total cycle time, the soak time as well as the glaze chemistry of the substrate decorated. To achieve an optimal firing result, we recommend firing tests under the users own individual conditions.

### 3 Properties of the preparations

The product composition and the production process determine the major product characteristics of the components of the decoration system. Testing each production lot guarantees a constant product quality.

With regard to the bright precious metal pastes of the system we regularly check the viscosity, the printing characteristics, the outline of printed test decorations as well as the precious metal colour shade and the brightness of the decoration after firing on a defined test substrate.

In case of the lead free protective flux F080802, we test the grain sizes and the grain size distribution of each produced lot, the behaviour of the materials when pasted and the fired result in a test firing.



#### 3.1 Processing

Heraeus bright precious metal pastes are supplied ready to use. They can be processed without any thinning. The testing of each produced lot assures the consistent quality of our pastes.

The protective flux needs to be pasted with the recommended pasting ratio and homogenized with a triple roll mill.

The statements concerning our products correspond to our current knowledge and experience. It is the obligation of the purchaser to examine the usefulness of the products in its intended use in each individual case. In order to prevent production losses the user has to test the preparations in connection with every other material being involved in the production process and has to be satisfied that the intended result can be consistently produced.

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### 3.2 Storage

#### Precious metal decal pastes

Printing pastes are subject to an ageing process. Therefore, we recommend using the material within 9 months. The material should be stored at room temperature (20°C). Cool storage – but no freezing – has a positive impact on the shelf life.

#### Special flux F080802

The special flux powder basically has no storage limitation. One needs to take care that they are stored in dry environment. Exposure to humidity can lead to problems during the pasting with the special medium.

#### Finished decals

We recommend using decals within 3 months time. With time the softners in the decal covercoat will reduce, decals tend to get brittle and the decal transfer will get more difficult if not completely impossible. The decals should be stored at room temperature (20°C), vertically and without stress onto the covercoat layer.

### 3.3 Consumption of precious metal paste

The material consumption depends on the thickness of the applied precious metal layer. Under our conditions, the consumption is approx. 0,15 to 0,30g/100 cm<sup>2</sup>.

## 4 Properties of finished decorations

Major characteristics of a Heraeus Gold under Flux decoration is its scratch resistance and dishwashing resistance.

These properties are influenced by a number of factors. To achieve a high quality decoration it is essential to use high-grade preparations. The quality of the fired decoration, however, depends upon the interaction between the preparations, the application, the porcelain glaze and the firing conditions. Varying one factor – for example the firing conditions – will affect the characteristics of the fired decoration.

We process bright precious metal preparations under defined conditions. Then we determined the properties of the finished decorations. The following data gives an indication to the achievable quality features of the finished decorations manufactured with bright precious metal preparations. However, the user must always test the products under their own individual conditions.

### 4.1 Dishwasher resistance

All details as to whether decorations are dishwasher resistant or durable are to be regarded as approximate values, as test results vary widely according to the type of dishwasher, washing programme, washing-up detergent, water quality and firing conditions. To avoid defective production, the user should test the colours in connection with materials involved in further processing and determine whether the desired dishwasher proof or resistant decorations are achieved.

Heraeus tests whether finished decorations are dishwasher resistant or durable, roughly following the test-washing programme of the Technical Standards Committee for Material Testing (Fachnormenausschuss Materialprüfung, FNM) in a Miele continuous dishwasher. If a decoration withstands 500 washing cycles essentially without damage, we designate it as dishwasher durable. If it withstands 1000 washing cycles, we designate it as dishwasher resistant.

In our tests decorations created with the Heraeus Gold under Flux System proofed to be dishwasher durable.

### 4.2 Abrasion resistance

In our tests the mechanical resistance of decorations created with the Heraeus Gold under Flux System surpassed the resistance of unprotected precious metal decoration considerably.

In a cutting test with a knife weighed down by 1 kg, over 5000 revolutions could be achieved without damaging the surface. Only with high pressure and sharp pointed objects could the flux surface been scratched.

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### 4.3 ASTM-Resistance

In compliance with ASTM C556-88, the plate is immersed into a 0.5% sodium carbonate solution at 95°C ( $\pm 1^\circ\text{C}$ ). Every two hours the plate is removed from the solution and rubbed with a cloth. The decoration is examined for any damage and then the plate is returned to the solution for a further two hours. The ASTM test has been successfully passed if the decoration shows no damage after 3 x 2 hours in the test solution and after respective rubbing with a cloth.

All test decorations protected with protective flux F080802 proved to be ASTM durable.

## 5 Application recommendations

### 5.1 Preparation of the substrate to be decorated

Make sure that the surface of the object to be decorated is clean and dry. Dust, fingerprints and water condensation can affect the decoration while firing.

Take care that the objects to be decorated are not taken from a cold store into a warm shop. A fine condensation film may occur, which is not visible to the naked eye. This results in firing disturbance (pinholes) in the fired precious metal decoration. Allow enough time so that they can adjust to the decoration room temperature.

### 5.2 Production of decals

Work in a well-ventilated room. The room temperature is recommended to be between 20 and 25°C with a relative humidity of 60 to 70%.

Printing of the precious metal paste with a 120-34 to 130-34 polyester screen.

Drying of the printed precious metal paste.

Pasting of the lead free flux F080802 with special silk screen oil No. 258. We recommend a mixing ratio of 100:100 parts by weight. The paste needs to be homogenized with a triple roll mill.

Printing of the flux paste with a 100-40 to 77-50 polyester screen.

Drying of the flux paste.

Printing of the covercoat layer. We recommend using a 32-120 polyester screen.

Screens and squeegees have to be cleaned directly after use. We recommend our screen cleaner V 34. This special screen cleaner prevents blocking of the fine screen structure and prolongs its lifespan.

### 5.3 Transfer of the decal

The decals are soaked in slightly warmed water (20 to 30°C). If the water is too cold the decals do not release well from the decal paper. Is the water too warm, the decals might get too soft. It is important to change with water quite regularly.

It is essential to remove the water between decal and substrate by a careful squeeging of the decal. Trapped water could fire off explosively and create defects in the metal film. Additionally we recommend cleaning the surface of the applied decal with a sponge, in order to remove all dextrin rests on top of the decal.

The decorated ware should be dried before firing at room temperature (20 to 22°C) for 16 to 24 hours.

### 5.4 Firing

During the first heating phase the organic components of the preparation burn off. This process is completed at approx. 400°C. The bright metal film is formed. A constant, slow temperature increase, enough oxygen and sufficient ventilation are decisive for the quality of the fired precious metal decoration.

The firing profile considerably influences the mechanical and chemical properties of the fired decoration.

The rate of cooling has no major influence on the quality of the gold decoration, unlike the firing temperature and soak time. However, the firing process should not be stopped too abruptly after the soak time. If the rate of cooling is too fast, there may be a danger of damaging the article.

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## 6 Typical defects, root causes and countermeasures

Defect	Possible Cause	Countermeasure
The precious metal layer is cracked.	The peak temperature might have been too high and / or the soak time too long.	Check firing conditions. It might be necessary to reduce the peak temperature and / or the soak time.
The flux is difficult to print. Screen pattern appears on precious metal layer.	Viscosity of the flux paste is too high.	Add more silk screening oil No. 258 and homogenise the flux paste anew with a triple roll mill.
The flux coating does not "stand" exactly. The contours spread out.	Viscosity of the flux paste is too low.	Add more flux to reduce the concentration of the silk screening oil No. 258.
The fired flux/precious metal layer looks matt.	Firing temperature has been too low.	Check firing conditions.
	Flux layer is too thin.	We recommend 100-40 to 77-50 polyester screens.

## 7 Products

Product	Appearance	Major characteristics
Bright gold and bright platinum pastes		
GGP 2555-12% H	yellow	Good detergent durability, good ASTM and Calgonite resistance, suitable for the Heraeus Matt Gold System, the One Fire Etching Imitation System and the Gold under Flux System
GGP 2556-10% H	yellow	Good detergent durability, good ASTM resistance, suitable for the Heraeus Matt Gold System, the One Fire Etching Imitation System and the Gold under Flux System
GGP 1211-10% H	yellow	Good detergent durability, oxidation insensitive, suitable for the Heraeus Matt Gold System, the One Fire Etching Imitation System and the Gold under Flux System
GPP 4520 H	platinum white	Bright palladium paste, good detergent resistance, suitable for Heraeus Matt Gold System and the One Fire Etching Imitation System
GPP 4522 H	platinum white	Bright palladium paste, slightly lower percentage version compared with GPP 4520 H, good detergent resistance, suitable for Heraeus Matt Gold System and the One Fire Etching Imitation System
Flux		
F080802	transparent	Special lead free flux for the Heraeus Gold under Flux System.

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