



## Bright Precious Metal Preparations for the Production of Decals for Porcelain and Bone China

### 1 General Information

Heraeus supplies bright precious metal preparations for the production of decals for porcelain and bone china with different precious metal content. Depending on the precious metal content and the thickness of the precious metal application, a precious metal film of approximately 0.2 µm forms after firing.

Some of the preparations mentioned in this Technical Information sheet are also suitable for automatical decal transfer via Heat Release. For further information please refer to technical information Nr. 9.7 "Production and Transfer of Decals by Heat Release".

### 2 Standard Firing Range

Substrate type	Firing range
Porcelain	780 - 880°C (1440 - 1620°F)
Bone China	750 - 880°C (1380 - 1620°F)
Vitreous China	750 - 850°C (1380 - 1560°F)

The firing result depends on the firing temperature, on the total firing time, the soak time and not least on the properties of the glaze. To achieve an optimized firing result, we therefore recommend the user to check under his own individual conditions.

### 3 Properties Of The Preparations

The major characteristics of a Heraeus precious metal preparation are determined by its production recipe. From each lot produced, we take a sample and check defined characteristics.

Before firing, screen printing preparations, are checked for their physical properties (e. g. viscosity, thixotropy) and the application properties (e. g. printing and drying properties), compared to a predefined standard. After firing under defined conditions, we check the optical properties (gloss level and colour). Controlling each single production lot assures the highest product quality and lot-to-lot stability.

#### 3.1 Processing

We supply bright precious metal preparations for screen printing ready to use. They can be applied without further thinning.

Screen printing pastes have a thixotropic nature in order to achieve their printing properties. In some cases, the preparations reach their typical processing viscosity only under mechanical stress, that means by a certain print speed. Thixotropic pastes allow for printing fine lined decorations with a sharp outline.



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.

## 3.2 Storage

Since bright precious metal products contain precious metal organically bound, there is no sedimentation. Also bright precious metal products are subject to an ageing process. As a rule, the viscosity increases with the storage time. Therefore, we recommend to use the preparations within 12 months. They should be stored at room temperature (c. 20°C / 70°F).

Storage at 7-14°C / 45-57°F reduces the increase of viscosity during the storage.

## 3.3 Consumption

The material consumption depends on the printing parameters (screen fabric, coating, squeegee position, squeegee pressure). Under our conditions, the consumption is approx. 0.15 to 0.30 g / 100 cm<sup>2</sup>.

## 4 Properties Of Finished Decorations

The main properties of fired bright precious metal decorations comprise brilliance and precious metal tone, as well as resistance to mechanical and chemical attack.

These properties are influenced by a number of factors. The high quality of the preparation used is an absolute prerequisite for manufacturing high-quality decorations. The quality of a fired decoration, however, derives from the interplay of preparation, application, substrate surface and firing conditions. A variation in one factor – for instance, the firing conditions - has an influence that leads to altered properties of the fired decoration.

We processed bright precious metal preparations under defined conditions. Then we determined the properties of the finished decorations. The following data indicate achievable quality features for the finished decorations manufactured with bright precious metal preparations. However, the user must always test the products under his own individual conditions.

### 4.1 Mechanical Resistance

The mechanical resistance of a precious metal decoration is influenced by the chemical composition of the used precious metal preparation and also by the substrate surface, the firing conditions and the layer thickness of the fired precious metal layer.

### 4.2 Dishwasher Durability

All details as to whether decorations are dishwasher 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.

Heraeus tests whether finished decorations are dishwasher durable, roughly following the test-washing programme of the Technical Standards Committee for Material Testing (Fachnormenausschuss Materialprüfung) 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.

### 4.3 Silver Containing Precious Metal Preparations

To achieve lemonish, light yellow and yellow gold decorations, silver is added to the formulation of precious metal preparations. Silver containing precious metal decorations can change their appearance in the course of time, under certain unfavourable external circumstances. Especially the contact to cardboard boxes, high humidity and high temperature support the reaction of silver to silver sulphide. Therefore, the user must individually check the suitability of a silver containing preparation.

Products with a higher silver content we labeled as "silver containing". We recommend the hermetical packaging of items decorated with precious metal preparations we describe as "silver containing", and to prevent direct contact with cardboard boxes.

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## 5 Application Recommendations

### 5.1 Basic Information On Products, Screens and Squeegees

- Work in a well-ventilated room. Good printing conditions occur at a room temperature of 20 to 25°C / 68 to 77°F and a relative humidity of 60 to 70%.
- Heraeus supplies precious metal preparations with a viscosity ready for use. In general, thinning is not necessary. In case the pastes have an increased viscosity after a long storage time, the printing properties can be improved with an addition of maximum 5 - 10% of thinner V 170. The thinner has to be stirred in very well. We recommend using a triple roll mill for an optimum homogenisation.
- For printing the bright precious metal preparations, a 120-34 to 140-34 polyester screen or a 350 - 400 mesh steel screen should be used.
- For a good printing result, it is important to have a well sharpened squeegee (hardness: 60-75° shore).

### 5.2 Production Of Decals

- Apply an appropriate quantity of the preparation onto the screen, so that the screen will be „flooded“ with one squeegee motion. We recommend applying a small amount of paste because it is better to add fresh paste during the printing procedure. This way, the viscosity increase caused by the evaporation of the solvent from the precious metal paste during printing can be minimized.
- During shorter printing breaks (a few minutes), the screen should be continuously flooded, to prevent the paste from drying and blocking the screen. During longer breaks, the screen has to be cleaned with our screen cleaner V 34 before printing is restarted.
- Generally, the precious metal paste is printed at first. After drying, additional decoration colours can be applied.
- If precious metal products and colours are adjacent, the registration of the prints is very important because an incompatibility reaction with the colours is possible (precious metal products particularly react with red colours that contain cadmium).
- As screen printing covercoat, we recommend L 406. This film stable, non block resistant standard covercoat with a solids content of approx. 42 % is also available as a thixotropic version. Please refer to our product programme and technical information sheets regarding further special screen printing covercoats.
- After drying, the decal can be transferred to the object to be decorated.

### 5.3 Transfer Of The Decals To The Object To Be Decorated

- The decals to be transferred have to be steeped in water (water temperature 20 to 30°C / 68 to 86°F). Decals can be released faster from the decal paper when the steep water is slightly heated.

In case the steep water is too cold, decals can be released from the decal paper only with difficulty and during transfer of the decal, cracking of the precious metal decoration can occur. If the steep water is too warm, the decals become too soft and are difficult to apply accurately. There is also a tendency for the covercoat film to shrink during drying.

The steep water should be changed regularly. If the steep water is too much polluted with dextrine residues from the decal paper, spots or pin holes may appear after firing.

- The transferred and adjusted decal has to be pressed carefully onto the object with a squeegee. The squeegee should be used from the centre to the edge of the decal, to allow water residues, dextrine residues and air bubbles to escape.
- Afterwards, the surface of the decal should be cleaned with a damp sponge. Dextrine residues on the decal may lead to a bad firing result of the precious metal decoration (spots).
- The decorated ware should be dried before firing at room temperature (20 to 22°C / 68 to 72°F) for 16 to 24 hours.

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## 5.4 Firing Of The Decals

- During the heating up phase, first of all the organic components of the decals burn off. This process is completed at approx. 400°C (750°F). The precious 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 precious metal decoration, unlike the firing temperature and soak time. However, the firing process should not be stopped too abruptly after the soak time. In case the decorated article cools down too quickly, the glaze might crack.

## 6 Frequent Faults, Their Causes And Ways Of Avoiding Them

Fault	Possible Cause	Remedy
stripes in the printed precious metal decoration	the squeegee shows possibly scratches	squeegee exchange, or grind off the old one
squashed printing format	the squeegee has not enough pressure or is worn out (rounded off)	squeegee exchange, or grind off the old one
blurred contours, running precious metal	too much thinning of the product	leave the pot open for a while, so that some of the solvent can evaporate
spots, pin holes, matt firing result	contamination as dust, finger marks or water drops	clean the object before decorating
	Dextrine residues under or on the decal	frequent changing of the steep water. Wipe off the decal with a damp sponge
	problems in the kiln such as: <ul style="list-style-type: none"> <li>• Reduced atmosphere in kiln</li> <li>• insufficient ventilation</li> <li>• heat increase is too fast during critical phase between 200-400°C (390-750°F)</li> <li>• too many objects in the kiln</li> </ul>	<ul style="list-style-type: none"> <li>• increase air addition</li> <li>• improve ventilation</li> <li>• reduce the heating speed</li> <li>• reduce the number of objects in the kiln</li> </ul>
Precious metal cracks during firing	contamination of the substrate surface causes cracking	clean the substrate before application
	water residues under the decal	careful pressing of the decal by the squeegee and drying
	the layer of the product is too thick	reduce the layer of the product
cracking of the decoration	decal extension was too huge	do not extend the decal so much. If necessary, use an elastic screen printing covercoat
	steeping water is too cold and / or transfer of the decal onto a cold object	steeping water should be warmed up a little
low mechanical resistance of the precious metal decoration	firing temperature is too low	increase firing temperature
	layer of the product is too thin	use a 120-34 to 140-34 polyester screen / 350 to 400 mesh steel screen

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## 7 Bright Gold Preparations For The Production Of Decals For Porcelain

Colour	Product	Precious Metal Content	ASTM-resistant	microwave-resistant	Sanitary Ware	Notes
light yellow	GGP 2538	12%				bright gold paste, lemon yellow firing result, wide firing range, very scratch-resistant, suitable for the Heraeus "silk matt gold system"
light yellow	GGP 1215	10+12%				lemon yellow firing result, suitable for the Heraeus "silk matt gold system"
light yellow	GGP 1213	10+12%				suitable for the Heraeus "silk matt gold system"
light yellow	GGP 2538	10%				wide firing range, very scratch-resistant, suitable for the Heraeus "silk matt gold system"
yellow	GGP 2536	10%				wide firing range, very scratch-resistant, suitable for the Heraeus "silk matt gold system"
yellow	GGP 2552	10%				suitable for the Heraeus "gold-under-flux-system"
yellow	GGP 2567	7%				-
yellow	GGP 2569					firing stable up to max. 820°C / 1508°F
yellow	GGP 2570					-
yellow	GGP 2571	12%	●			excellent chemical resistance (ASTM, Calgonite, dishwasher)
yellow	GGP 2572	10%	●			excellent chemical resistance (ASTM, Calgonite, dishwasher), suitable for the Heraeus "silk matt gold system"
reddish yellow	GGP 1220	10+12%				suitable for the Heraeus "silk matt gold system"
reddish yellow	GGP 2555	12%	●			excellent chemical resistance (ASTM, Calgonite, dishwasher)
reddish yellow	GGP 2386/HT	10%				high temperature bright gold paste, firing range 900-1180°C/1650-2155°F
reddish yellow	GGP 2516/MW	9%		●		very scratch-resistant
reddish yellow	GGP 1220	8%				-
reddish yellow	GGP 2565	7%				-
reddish yellow	GGP 2531/MW	7%		●		very scratch-resistant

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## 8 Bright Gold Preparations For The Production Of Decals For Bone China

	Colour	Product	Precious Metal Content	ASTM-resistant	microwave-resistant	Sanitary Ware	Notes
	light yellow	GGP 2341	12%				suitable for the decoration on cobalt blue
	yellow	GGP 2536	10+12%				suitable for the Heraeus "silk matt gold system", on soft glazes only suitable for firing range 780-800°C / 1436-1472°F
	yellow	GGP 1211	10+12%				suitable for the Heraeus "silk matt gold system"
	reddish yellow	GGP 2335	12%				suitable for the Heraeus "silk matt gold system"
	reddish yellow	GGP 1220	10+12%				suitable for the Heraeus "silk matt gold system"

## 9 Bright Platinum Preparations For The Production Of Decals For Porcelain

	Colour	Product	Precious Metal Content	ASTM-resistant	microwave-resistant	Sanitary Ware	Notes
	white	GPP 1241	11%				suitable for the Heraeus "silk matt gold system"
	white platinum	GPP 4520	10%	●			dishwasher-resistant, suitable for the Heraeus "silk matt gold system"
	white platinum	GPP 1240	8%				suitable for the Heraeus "silk matt gold system"
	white platinum	GPP 1240/2	8%				wide firing range, suitable for the Heraeus "silk matt gold system"
	white platinum	GPP 4528	8%				suitable for the Heraeus "flux-on-platinum-system"
	white platinum	GPP 4530	8%				suitable for the Heraeus "silk matt gold system"
	platinum	GPP 4529	8%				suitable for the Heraeus "flux-on-platinum-system"
	platinum	GPP 4330	5%				-
	platinum	GPP 4527/HT	8%		●		high temperature bright platinum paste, wide firing range (850-1180°C / 1560-2155°F)
	platinum	GPP 4391/HT	8%				high temperature bright platinum paste, wide firing range (900-1180°C / 1650-2155°F)

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## 10 Bright Platinum Preparations For The Production Of Decals For Bone China

	Colour	Product	Precious Metal Content	ASTM-resistant	microwave-resistant	Sanitary Ware	Notes
	white platinum	GPP 1240/3	8%				suitable for the Heraeus "silk matt gold system"
	platinum	GPP 4308	8%				-

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