



## Bright Precious Metal Preparations for Direct Screen Printing on Glass (without Thermoplastic Products)

### 1 General Information

Heraeus supplies bright gold and bright platinum pastes for direct screen printing on glass with a precious metal content of 7% up to 12%. Depending on the precious metal content and the thickness of the precious metal application, a gold film of approx. 0.1 – 0.2  $\mu\text{m}$  forms after firing.

You will find information about our thermoplastic bright gold pastes for glass in our separate technical information Nr. 1.22.

### 2 Standard Firing Range

Glass Type	Firing Range	
Soda Lime Glass	520 - 620°C	(940 - 1150°F)
Borosilicate Glass	580 - 610°C	(1080 - 1130°F)
Lead Crystal	480 - 540°C	(890 - 1004°F)

The firing result depends on the firing temperature, on the total firing time, the soak time and not least on the glass type. 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.

In case of screen printing preparations, before firing, we check the physical properties (e. g. viscosity, thixotropy) and also the application properties (e. g. printing and drying properties), compared to a predefined standard. After the 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 direct screen printing ready to use. They can be applied without further thinning.

Screen printing pastes have a thixotropic nature in order to reach their printing properties. In some cases, the preparations reach their typical processing viscosity only under mechanical stress, that means under 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 bright gold preparations within 9 months and the bright platinum preparations within 6 months. They should be stored at room temperature (c. 20°C / 70°F).

Storage at approx. 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 0.30g / 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, dishwasher resistance and 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 only one factor – for instance, the firing conditions, has an immediate influence that leads to altered properties of the fired decoration.

We have processed the bright 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. They must, however, always be checked by the user 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.

We have fired preparations on different substrates and under different firing conditions, and have performed an abrasion test. Preparations that showed a „good abrasion resistance“ or a „very good abrasion resistance“ are marked accordingly in the product list.

The chemical composition of glass and the low firing range of glass limit the obtainable mechanical resistance. Therefore, precious metal products on glass do not show such an abrasion resistance as similar decorations on porcelain, bone china or earthenware.

### 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 the dishwasher durability of glass decorations under defined test conditions in a Winterhalter Gastronom GS 29 with an automatic proportion of the detergent and the clear rinse (see technical information Nr. 9.11 „Behaviour of precious metal decorations in the dishwasher“).

Precious metal decorations on glass usually do not achieve the resistance of a similar decoration on ceramics. If a decor withstands 200 wash cycles under our conditions essentially without damage, we designate it as dishwasher durable.

Although, as mentioned above, many factors have an influence on the dishwasher durability, choosing the „right“ product is essential for a dishwasher durable decoration. In the product overview, the most reliable products are designated as “dishwasher durable”. The user must test the required properties under his own conditions.

## 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 to hermetically package items decorated with precious metal preparation we describe as "silver containing", and to prevent direct contact with cardboard boxes. To exclude any risk, we recommend using yellow red gold preparations.

## 4.4 Precious Metal Colour On The Reverse Side Of Glass

Precious metal decorations on glass often show a red discoloration at their back. The tendency to this kind of red discoloration is strongly related to the chemical formulation of the glass itself, but is also influenced by bright precious metal product used and the oven atmosphere during firing. Products that are designated in our product overview as having „light-coloured back on most glasses“ proved under our conditions to be extremely resistant against discolorations. Nevertheless, it is vital for the user to test his own glasses under his own firing conditions.

## 5 Application Recommendations

### 5.1 Conditions Required For Good Results

- 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, and therefore have to be removed before application
- Take care that the objects to be decorated is not taken from a cold store into a warm shop. A fine condensation film may occur. Result: Firing disturbance (pinholes) in the fired precious metal decoration. Allow enough time so that they can adjust to the decoration room temperature.

### 5.2 Influencing Factors

A number of parameters can influence the decoration quality and need to be considered when choosing the precious metal product.

- Chemical composition of the glass
- Application of the precious metal decoration onto the glass  
Especially critical for the decoration is, for example, the rim of a drinking glass. Before applying a precious metal product to the rim of a drinking glass, we recommend making your own tests.
- Glass coating can impair the precious metal decoration  
Glasses are produced with inorganic and organic coatings, in order to minimize friction or damage of the glass surface during transport. Moreover, coatings are applied very unevenly. This can lead to quality loss with regard to brightness, colour shade and adhesion.
- Firing range (see recommendation under point 2)

### 5.3 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.
- 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 gold- and bright platinum paste, 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 ground squeegee (hardness: 60-75° shore).

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## 5.4 Firing

- During the heating up phase, first of all the organic components of the preparation burn off. This process is completed at approx. 400°C (750°F). The gold 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 (cracks and broken glass).

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

Fault	Possible Cause	Remedy
stripes in the printed precious metal decoration	possibly the squeegee shows scratches	exchange squeegee, or grind the old one
squeezed printing format	the squeegee is not enough grounded or is worn out (rounded edges)	exchange squeegee, or grind 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, firing disturbance	contaminations like dust, finger marks or water drops	clean the object before decorating
	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 furnace</li> </ul>	<ul style="list-style-type: none"> <li>increase air addition</li> <li>improve ventilation</li> <li>reducing the heating speed</li> <li>reduce the number of objects in the kiln</li> </ul>
Precious metal flakes off during firing	contamination of the substrate surface causes chip offs	clean the substrate before application
	the layer of the product is too thick	reduce the layer of the product
low mechanical resistance of the precious metal decoration	too low firing temperature	increase the firing thickness
	the layer of the preparation is too thin	the use a 120-34 to 140-34 polyester screen or a 350 to 400 mesh steel screen has proofed
fine pinholes	pin holes can be released by moisture on the surface of the to be decorated object, which forms when the object is taken from a cool store into a warm decoration room	give the ware enough time to acclimate to the temperature of the decoration room and so a possible condensation film to evaporate
red / very dark backside of the precious metal decoration	unsuitable precious metal product	choose a suitable preparation out of the product list (point 7). Pay attention to our reference about the back side of each preparation.
	chemical composition of the glass	
	coating of the glass	Eventually, the organic coating of glass is to be removed by pre-firing

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