



## Bright Precious Metal Preparations for Brush Application and for Spraying on Glass

### 1 General Information

Heraeus supplies bright gold and bright platinum preparations for the decoration of glass with a precious metal content of up to 12%. Depending on the precious metal content and the thickness of the applied precious metal preparation, a gold film of approx. 0.05 – 0.2 µm forms after firing. With a thin layer and a low fine gold content, the decoration will look transparent. Therefore, the decorators use precious metal preparations with a 10 or 12% precious metal content.

### 2 Standard Firing Range

Glass Type	Firing Range
Soda Lime Glass	approx. 520 - 620°C (940-1150°F)
Borosilicate-Glass	approx. 580 - 620°C (1080 - 1150°F)
Lead Crystal	approx. 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.

We check the physical properties (e.g. viscosity) and also the application properties (e.g. brushability) of our precious metal preparations for brush application against a predefined standard before firing. 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 deliver bright precious metal preparations for brush application ready to use. They can be applied without further thinning and distinguish themselves by their excellent application properties and outline. In the product programme, you also find some high viscosity preparations that are marked accordingly, and that need to be thinned prior to application. Thinning may also be necessary after a longer processing time and the resulting

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solvent evaporation of the used preparation, or when decorating large areas.

## 3.2 Storage

Since bright precious metal products contain precious metal organically bound, there is no sedimentation. Nevertheless, a minor sedimentation may occur in case of thin fluid preparations. Should there be any sedimentation, it must not be shaken and remains in the bottle.

Also bright precious metal preparations are subject to an ageing process. As a rule, the viscosity increases with the storage time. Therefore, we recommend to use the preparations within 9 months. They should be stored at room temperature (approx. 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 thickness of the applied precious metal layer. 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, 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 on 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 don't 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“

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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 Colour on the Back of Precious Metal Decorations

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

- Work in a well-ventilated room. Good printing conditions occur at a room temperature of 20 to 25°C.
- 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 is not taken from a cold store into a warm shop. A fine condensation film may occur, which is not visible for the naked eye. Result: Firing disturbance (pinholes) in the fired precious metal decoration! Allow enough time for the material to 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 often 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 Application Information

- Do not shake the bright precious metal preparations prior to use.
- Draw from the bottle only as much as you can consume within 15 or 30 minutes and close the bottle. Consider that the solvent continuously evaporates in air and therefore the viscosity slowly increases.

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- Apply the preparation in a moderate layer thickness onto the object to be decorated. A too thin layer influences the mechanical, chemical and optical properties of the fired decoration. In extreme cases, it can lead to a reddish colour of the surface without any gold character. A too thick layer may lead to cracking, blistering, or to a matt surface.
- In case the preparation is used for spraying, thinning with about 30% thinner V 35, V 16 or V 18 is required.

## 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 formed. A constant slow increase in temperature, 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).

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

Fault	Possible Cause	Remedy
blurred contours, running precious metal	too much thinning of the product	leave the bottle open for a while, so that some of the solvent can escape
	the substrate was dirty with a grease film	clean the substrate before decorating
	the thinner was too fat or drying to slow	use a less fat thinner
	too much organic steam in the furnace	reduce the number of objects in the furnace
preparation shows bad application condition (poor flow properties)	viscosity is too high after long application or long storage	thinning of the product with V 35, V 16 or V 18 for brush application
spots, firing disturbance	contaminations as 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 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 film is very transparent	too much thinning of the product.	leave the bottle open for a little while, so that the solvent can escape
	the layer of the precious metal product is too thin	increase the layer thickness of the precious metal product
Precious metal is cracking during firing	contamination of the glass surface causes cracking	clean the glass before decorating
	the layer of the product is too thick	reduce layer of the product
Precious metal is matt after firing	the layer of the product is too thick	reduce layer of the product
low mechanical resistance of the precious metal decoration	too low a firing temperature	increase firing temperature
fine pinholes	pinholes can be released by moisture on the surface of the decorated object. Taking objects from a cool store into a warm shop gives invisible condensation on the surface. Note this cannot be welding off. It reforms immediately.	allow enough time for the object to reach the shop temperature
	too long storage of the decorated glasses before firing	don't leave the decorated unfired glass stay up too long

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## 7 Bright Precious Metal Preparations For Brush Application And For Spraying On Glass

Colour	Produkt	Precious Metal Content	Lead Crystal (firing temperature max. 540°C / 1004°F)				Notes
			Glass	Borosilicate Glass	Quartz Glass		
light yellow	GZ 117	12%	●	●	□	□	Bright Gold, lemon yellow firing result, dishwasher proof
light yellow	GG 1212 D	10%	●	□	□	□	Bright Gold,
yellow	GG 1046	12%	●	●	□	□	Bright Gold, suitable for relief, silk matt and etch imitation
yellow	GG 1013	10%	●	□	□	□	Bright Gold, robust, suitable for etch imitation
yellow	GG 1209 D		●	□	□	□	Bright Gold
reddish yellow	GG Q3/ST/2	15%	□	□	□	●	Bright Gold, only suitable for quartz glass
reddish yellow	GG B 15/M	12%	●	□	□	□	Bright Gold, robust
reddish yellow	GG 100	8+10%	●	●	□	□	Bright Gold, good adherence
reddish yellow	GG 234-55		●	●	□	□	Bright Gold, microwave resistant, also suited for applications on ceramics, glass ceramics and earthenware
white platinum	GP 205 B		●	□	□	□	Bright Platinum, suitable firing range 580-720°C (1076-1330°F), high viscosity, thinner required
platinum	GP 110		●	□	□	□	Bright Platinum, dishwasher proof
platinum	GP 105		●	●	□	□	Bright Platinum
platinum	GP 3000		●	●	□	□	Bright Platinum

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