Bright Precious Metal Preparations for the Production of Decals for Glass

1 General Information

Heraeus supplies bright gold and bright platinum pastes for the production of decals for glass with a precious metal content of 8% 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 µm forms after firing.

Some of the preparations mentioned in this Technical Information Sheet are also suitable for automatical decal transfer via Heat Release. Information about this special theme can be taken from our Technical Information Sheet No. 9.7 "Production and Transfer of Decals by Heat Release".

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 (e. g. 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 the production of decals 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.

W. C. Heraeus
Business Unit Precious Colours
Heraeusstraße 12-14
D-63450 Hanau
Phone: +49 (0) 6181 35 4420
Fax: +49 (0) 6181 35 9637
E-mail: preciouscolours@heraeus.com
Internet: www.heraeus-preciouscolours.com

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 cm².

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 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. 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 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“ 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.

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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 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 - 425 mesh steel screen should be used.
- For a good printing result, it is important to have a well ground squeegee (Hardness: 60-75° Shore).

5.2 Production Of Decals

- Apply an appropriate quantity of the preparation on the screen, so that the screen will be „flooded“ with one squeegee motion. We recommend to apply not too much 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 of the screen. During longer breaks, the screen has to be cleaned with our screen cleaner V 34 before the resumption of printing.
- As a general rule, the precious metal paste is printed at first. After drying, additional decoration colours can be printed.
- 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 (especially precious metal products react sensitively with cadmium containing red colours).
- As screen printing covercoat, we recommend L 406. This film stable, not 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.

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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.

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 gold film 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).

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6 Frequent Faults, Their Causes And Ways Of Avoiding Them

Fault	Possible Cause	Remedy
stripes in the printing 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 worm 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
	glue 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: • reduced atmosphere in kiln • insufficient ventilation • heat increase is too fast during critical phase between 200-400°C (390-750°F) • too many objects in the kiln	 • increase air addition • improvement of the ventilation • reduce the heating speed • reduce the number of objects in the kiln
Precious metal is cracking 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 high	do no extend the decal so much. If necessary use an elastic screen printing covercoat and take care of the following information
	steeping water is too cold and / or transfer of the decal onto a cold object	steeping water should be warmed up a little. It is of great importance to warm up the object to be decorated e.g. with a infrared radiator
low mechanical resistance of the precious metal decoration	too low firing temperature	increase the firing temperature
	the layer of the product is too thin	use a 120-34 to 140-34 polyester screen / 350 to 425 mesh steel screen

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Fault	Possible Cause	Remedy
red / very dark backside of the precious metal decoration	precious metal preparation is not suitable for the glass type	Choose a more suitable preparation from the product list. Consider for our recommendations regarding the backside of the preparation.
	chemical composition of the glass	
	application of the precious metal decoration on the glass (rule of thumb: the closer to the rim, the more is the tendency of the precious metal film to create darker / red backsides... especially regarding molten glasses)	
	Coating of glass	Eventually, the organic coating of glass is to be removed by pre-firing

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7 Bright Gold Preparations For The Production Of Decals For Glass

	Colour	Product	Precious Metal Content	Glass	Lead Crystal (firing temperature max. 540°C/1004°F)	Coated Glass	Notes	
	light yellow	GGP 2148	12%	●	●		especially suitable for lead crystal	
	light yellow	GGP 1230	10+12%	●		●	very compatible on various glass compositions	
	light yellow	GGP 1230/3	10%	●		●	suitable for Heat-Release	
	yellow	GGP 2046	10%	●	●		wide firing range up to 750°C/1380°F, suitable for Heat-Release	
	yellow	GGP 2147	9%	●			-	
	yellow	GGP 2127	9%	●			-	
	yellow	GGP 1105 D	9%	●			-	
	yellow	GGP 1230	8%	●		●	very compatible on various glass compositions	
	reddish yellow	GG 5169	10%	●		●	especially suited for hot-and-cold-end treated container glass	***new!***
	reddish yellow	GG 5165	10%	●			-	***new!***
	copper	GGP 2132	9%	●			-	

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8 Bright Platinum Preparations For The Production Of Decals For Glass

	Colour	Product	Precious Metal Content	Glass	Lead Crystal (firing temperature max. 540°C/1004°F)	Coated Glass	Notes	
	white platinum	GPP 1261	7%	●			very compatible on various glass compositions	
	platinum	GPP 1260	7%	●			very compatible on various glass compositions	
	platinum	GP 5171	6,7%	●			formerly TGP0060A, thinner DH 165	***new!***

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