



Precious metal preparations for direct pad printing - semi-thermoplastic and wet

1 General Information

Heraeus has developed a range of precious metal preparations for pad printing on ceramics and glass. Our product range consists of bright precious metal pastes, silk matt preparations as well as burnish gold and burnish platinum pastes. An overview about the product range can be found in section 7 of this technical information.

Principally one has to differ between cold wet pad printing and pad printing with semi-thermoplastic pastes. Besides it is necessary to differ between an indirect transfer (with integrated screen printing) and a direct application of material out of a cliché.

2 Firing Range

Substrate Type	Firing Range
• Porcelain	800 - 860°C
• Bone China	780 - 850°C
• Glass	520 - 620°C

3 Properties of the preparations

Its production recipe determines the mayor characteristics of a Heraeus precious metal preparation. From each produced lot we take a sample and check defined characteristics.

In case of pad printing pastes we check the viscosity, the application characteristics, a sharp outline of the applied material as well as the colour shade and the optical appearance of the fired decoration in comparison to the "standard" of this product. The control of each lot assures a high product quality and the consistency of the characteristics from lot to lot.

3.1 Processing

Pad printing pastes are delivered in a viscosity ready to use. Therefore they can be processed without any further thinning. The check of each lot guarantees a constant quality of the pastes.

3.2 Storage life

Precious metal preparations are subject to an ageing process. As a rule the viscosity increases with long storage. A cool storage extends the shelf life of the products, though storage at room temperature (approx. 20°C / 70°F) is unproblematic. Extreme high temperatures should be avoided.

Precious metal pastes should be processed within 6 months.



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.

3.3 Consumption

The consumption of the preparations varies depending on the type of product and the application parameters. As a guideline one can calculate with the following consumption rate:

- Bright precious metal preparations: 0,2 to 0,3g / 100 cm²
- Silk matt precious metal preparations: 0,3 to 0,4g / 100 cm²
- Burnish precious metal preparations: 0,4 to 0,6g / 100 cm²

4 Achievable properties of finished decorations

Major characteristics of fired precious metal decorations are the brilliance of the fired decoration, the metal colour shade, the resistance in the dishwashing machine as well as the mechanical and chemical resistance.

The properties of finished decorations are influenced by a number of factors. The high quality of the precious metal preparation used is an absolute prerequisite for the manufacture of qualitatively high-grade decorations. The quality of a fired decoration, however, is derived from the interplay of preparation, application, substrate surface and the firing conditions. A variation in only one factor – for instance, the firing conditions – has an immediate influence in that it leads to altered properties of the fired decoration.

We have processed the precious metal preparations under defined conditions. Then we determined the properties of the finished decorations. The following gives an indication of achievable quality features for the finished decorations manufactured with burnish precious metal colours. They must, however, always be checked by the user under his own individual conditions.

4.1 Mechanical resistance

(see information for the several products in our product overview)

4.2 Dishwasher resistance/-durability

All information about dishwasher durability of precious metal decoration must be considered as approximations, because the test results depend on the type of dishwasher, rinsing programme, dishwasher detergent, water quality, the firing condition and so on. Heraeus tests the dishwasher quality of finished designs according to the dishwashing cycle programme of the "Fachnormenausschuß Materialprüfung FNM" (Board of Special Material Investigation Standards) using a Miele continuous programme dishwasher.

If a decor withstands 500 wash cycles in good condition we describe it as dishwasher durable and if it withstands 1000 wash cycles we describe it as dishwasher resistant.

Precious metal decoration on glass will not achieve the resistance as a similar decoration on porcelain. If a decor withstands 200 wash cycles we describe 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 list we mark the most reliable products with the terms dishwasher durable.

4.3 Back of precious metal decorations on glass (only for decorations on glass)

Precious metal decorations on glass often show a red discoloration at its 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. Therefore it is not possible for a supplier of decoration materials to guarantee an unchanged back colour. We test our materials on different glasses to check the influence of glass types on the back colour of our products. If we see an unchanged back colour in our test, you will find in our product listings the term "light back on most glasses". Again, this cannot be taken as a guarantee. We recommend to pre-test materials on the specific glass type and fire them under the own individual firing conditions.

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4.4 Silver containing bright precious metal preparations

Lemon gold's contain silver as colouring component in the alloy. Unfavourable conditions, mostly a combination of high temperature, high humidity, long storage time and humid cardboard boxes, can lead to oxidation effects of the lemon gold decorations. Fired again, these effects disappear.

We recommend packing the decorated ware airproofed so that the gold decoration will not get in direct contact to the cardboard box.

5 Application information

Work in a well-ventilated room. Good printing conditions occur at a room temperature of 20 to 25°C and a relative humidity of 60 to 70%.

5.1 The silicone pad

The right shape of the silicon pad depends on the body and on the form of the substrate. The hardness of the pad is measured and described in "shore". The hardness of the squeegee gum is defined according to shore A and the hardness of the pad according to shore 00.

The hardness of the pad is determined by the silicon / Indian rubber mixture. The percentage of silicon oil in the pad should be kept as small as possible, to prevent the release of oil during the pad printing. A too high release of silicon oil during the printing process can lead to a change of the surface tension of the applied precious metal preparation with the possible effect of rejections and printing defects.

To get to recommendations regarding suitable pads, Heraeus has run a number of tests with different types of pads from the company Tamponprint. In our tests we had no rejections with pads of hardness between 44 and 77 shore 00.

If the pad is not optimised in shape for the item to be decorated, deformations of the pattern are possible. A possible counteraction is the usage of a harder pad respectively a reformulation of the mixture of the pad.

5.2 Processing temperature and characteristics of the precious metal pastes

Semi thermoplastic precious metal pastes should be processed at temperatures between 65 and 75°C. At a temperature of 70°C the pastes have a typical viscosity between 800 and 2000 mPas. During application the temperature of the pad is increasing, but – according to our experience - this effect typically has not impact on the application characteristics.

For the processing of precious metal pastes for cold pad printing the screens do not need to be heated.

5.3 Cliché deepness and screens

For the processing of bright precious metal pastes the cliché used should have a depth of 40 to 60 µm respectively steel screens of 350 to 400 mesh should be used. For the processing of silk matt preparations or burnish gold and platinum pastes the cliché should have a depth of 60 to 80 µm or the usage of a 300 steel screen lead to good results.

5.4 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 are not taken from a cold store into a warm shop. It is possible that a fine condensation film will form. Possible defects: pinholes if the fired decoration. Please give the substrates to be decorated time to adjust to the temperature in the decoration room+
- Selection of a suitable precious metal preparation
- Generally we recommend testing the precious metal preparations to be used under the individual production conditions. Please also follow our hints for specific precious metal preparations.

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5.5 Firing of the decals

- During the heating up phase, first of all the organic components burn off. This process is complete at approx. 400°C (750°F). The gold film is formed. A constant slow increase in temperature, enough oxygen and sufficient ventilation are decisive for the quality of the fired precious metal decoration.
- The maximum firing temperature and the soak time have an important influence in the adhesive strength of the fired decoration. The substrate, as well as the form of the object fixes the maximum firing temperature. As a rough rule of thumb: The higher the firing temperature the better the adhesive strength.
- The rate of cooling is not as great an influence on the quality of the gold decoration as the firing temperature and the soak time. Nevertheless the firing process should not be stopped abruptly after the soak time. If the cooling rate of the decorated object is too high the glaze tends to crack.

5.6 Cleaning of screen and squeegee

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

6 Frequent faults, their causes and ways of avoiding them

Fault	Possible cause	Avoidance
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 worn out (rounded off)	squeegee exchange, or grind off the old one
blurred contours, running gold	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
gold is cracking after firing	problems with the furnace such as: <ul style="list-style-type: none"> furnace atmosphere reduction insufficient ventilation too fast a heat-up in the critical phase between 300-400°C (570-750°F) too many objects in the kiln 	<ul style="list-style-type: none"> air addition improvement of the ventilation reduce the speed of the heat up reduce the number of objects in the kiln
	contamination of the substrate surface causes cracking	clean the substrate before application
	the layer of the product is too thick	reduce the layer of the product
cracking of the decoration	decal extension was too great	do not extend the decal so much. If necessary use an elastic screenprinting 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 an infrared radiator
low mechanical resistance of the precious metal decoration	too low firing temperature	increase the 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.	allow enough time so that the objects can adjust to the decoration room temperature

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7 Bright Gold Preparations for Pad Printing on Glass

Colour	Product	Precious Metal Content	Glass	Lead Crystal (firing temperature max. 540°C/1004°F)	Coated Glass	Notes
yellow	GGP 2118/1/TT	10%	●			for hot pad printing, screen and clichée
yellow	GGP 2003/1/TT	10%	●			only suitable for cold pad printing

8 Bright Platinum Preparation for Pad Printing on Glass

Colour	Product	Precious Metal Content	Glass	Lead Crystal (firing temperature max. 540°C/1004°F)	Coated Glass	Notes
white	GPP 4022/TT	12%	●			dishwasher durable

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9 Gold Preparation for Pad Printing on Porcelain

Colour	Product	Precious Metal Content	ASTM-resistant	microwave-resistant	Sanitary Ware	Notes*
yellow	PGP Nr. 368/TT	28%				burnish gold paste

* Burnish precious metal pastes need to be stirred well before use

10 Gold Preparations for Pad Printing on Bone China

Colour	Product	Precious Metal Content	ASTM-resistant	microwave-resistant	Sanitary Ware	Notes*
yellow	GGP 2568/TT	12%				bright gold paste
yellow	PGP Nr. 369/TT	28%				burnish gold paste *
yellow	MGP 2337/TT	13%				silk matt gold paste *

* Silk matt and burnish precious metal preparations need to be stirred well before use

11 Platinum Preparation for Pad Printing on Porcelain

Colour	Product	Precious Metal Content	ASTM-resistant	microwave-resistant	Sanitary Ware	Notes*
white	PPP Nr. 363/TT	37%				burnish platinum paste

* Burnish precious metal pastes need to be stirred well before use

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12 Platinum Preparations for Pad Printing on Bone China

Colour	Product	Precious Metal Content	ASTM-resistant	microwave-resistant	Sanitary Ware	Notes*
white platinum	GPP 4312/TT	13%				bright platinum paste
white	PPP Nr. 363/TT	37%				burnish platinum paste *
white	MPP 4314/TT	12%				silk matt platinum paste *

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