burnish gold paste

PGP 357/204-28% H for decal printing

Heraeus Precious Coatings is a global manufacturer of precious metal decoration products for ceramics and glass. Heraeus profits from over 100 years experience in ceramic and glass decoration designs, which has always made the department a pioneer in the development of precious metal colours. Modern precious metal preparations have to meet high demands on different types of substrates – such as on porcelain, tiles, drinking glasses, flacons and bottles. Decorations have to achieve good mechanical and chemical resistance such as dishwasher durability.The products supplied by Heraeus Precious Coatings include: Bright gold and platinum products, silk-matt gold and platinum products, burnish gold and platinum products, lusters and metallo-organic preparations for technical use.

1 General information

PGP 357/204-28% H is a standard burnish gold paste for decals. After firing the gold layer has a thickness between 0,3 and 1,0 µm, depending on the screen size and its emulsion thickness. The decoration needs to be burnished. After burnishing PGP 357/204-28% H shows a yellow red gold colour shade. Burnish gold decorations with PGP 357/204-28% H showed in tests a good detergent durability and scratch resistance. The material is often used for institutional tableware.

2 Standard firing range

Substrate	Firing range [°C]
porcelain	780-880

The firing result depends on the firing temperature, the total cycle time, the soak time as well as the glaze chemistry of the substrate decorated. To achieve an optimal firing result, we recommend firing tests under the users own individual conditions.

Directly to the product:

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3 Properties of the product

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 decal pastes we check the viscosity and the printing properties compared to a predefined standard. After firing under standard firing conditions, we check the gold colour shade and the adhesion to the substrate. Controlling each single production lot assures the highest product quality and lot-to-lot consistency.

3.1 Processing

We supply burnish gold decal pastes ready to use. After firing the gold decoration needs to be burnished to reach its final appearance.

3.2 Storage

Printing pastes are subject to an ageing process. Therefore, we recommend using the material within 9 months. The material should be stored at room temperature (20°C). Cool storage – but no freezing – has a positive impact on the shelf life.

3.3 Consumption

The material consumption depends on the thickness of the applied precious metal layer. Under our conditions, the consumption is approx. 0,2 to 0,4g/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 Dishwasher resistance

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.

Test decorations prepared with PGP 357/204-28% H proofed to be dishwasher durable.

4.2 Abrasion resistance

Burnish gold decorations with PGP 357/204-28% H showed a good scratch resistance.

4.3 Oxidation resistance

Under unfavourable conditions silver containing precious metal decorations can tarnish in the course of time. Especially the contact to cardboard boxes, high humidity and high temperature support the reaction of silver to silver sulphide. PGP 357/204-28% H does not contain silver. Fired decoration do not face a risk of oxidation.

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5 Application of the material

5.1 Preparation for the decoration

Work in a well-ventilated room. The room temperature should be between 20-25°C with a relative humidity of 60-70%.

5.2 Preparation of the substrate to be decorated

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 object 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 substrate to adjust to the decoration room temperature.

5.3 Production of decals

- Heraeus supplies decal pastes with a viscosity ready to use. In general, thinning is not necessary. In case the paste has an increased viscosity after a long storage time, the printing properties can be improved with an addition of maximum 5 - 10% of thinner V 167. The thinner has to be stirred in very well. We recommend using a triple roll mill for an optimal homogenisation.
- Apply an appropriate quantity of the material onto the screen, so that the screen can be flooded with one squeegee motion. We recommend applying not too much paste. 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. For the printing of PGP 357/204-28% H we recommend the usage of a 77-34 to 100-34 polyester screen. For a good printing result a well sharpened squeegee is required. Shore hardness 60-75 shore.
- After the drying of the precious metal paste, additional colours might be applied. If the precious metal material borders colours, the registration of the prints is very important because an incompatibility reaction with the bordering colour is possible. Precious metals preparations typically react sensitive to bordering cadmium containing colours most of all reds.
- The complete motif needs to be covered with layer of covercoat. For the printing of the covercoat we recommend to use a 32HD polyester screen.
- After drying, the decal can be transferred to the object to be decorated.

5.4 Transfer of the decal

- The decals are soaked in slightly warmed water (20 to 30°C). If the water is too cold the decals do not release well from the decal paper. Is the water too warm, the decals might get too soft. It is important to change with water quite regularly.
- It is essential to remove the water between decal and substrate by a careful squeeging of the decal. Trapped water could fire off explosively and create defects in the metal film. Aditionally we recommend cleaning the surface of the applied decal with a sponge, in order to remove all dextrin rests on top of the decal.
- The decorated ware should be dried before firing at room temperature (20 to 22°C) for 16 to 24 hours.

5.5 Firing

- During the first heating phase the organic components of the preparation burn off. This process is completed at approx. 400°C. 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).

5.6 Burnishing of the fired gold layer

After firing the burnish gold decoration needs to be burnished. The gold layer can be burnished with a burnishing machine or by hand with a glass fiber brush. An older method it to burnish the gold with sea sand.

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6 Typical defects, root causes and countermeasures

Defect	Possible Cause	Counter measure
Stripes in the printing precious metal decoration.	The squeegee shows possibly scratches.	Change the squeegee.
Squashed printing format.	The squeegee does not have enough pressure or rounded off.	Change the squeegee.
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.	Objects were soiled by dust, finger marks or water drops before printing.	Clean the object before decorating.
Pin holes.	Dextrin residues under or on the decal.	Frequent changing of the steep water. Wipe off the decal with a damp sponge.
Matt firing result.	Problems in the kiln such as: a) Reduced atmosphere in kiln. b) Insufficient ventilation. c) Heat increase is too fast during critical phase between 200-400°C. d) Too many objects in the kiln.	a) Increase air addition. b) Improve ventilation. c) Reduce heating speed. d) Reduce the number of objects in the kiln.
Precious metal is cracking after firing.	a) Contamination of the substrat surface causes cracking. b) Water residues under the decal. c) The layer of the product is too thick.	a) Clean the substrate before application. b) Careful pressing of the decal by the squeegee and drying. c) Reduce the layer of the product.

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Defect	Possible Cause	Counter measure
Cracking of the decoration.	a) Decal extension was too great. b) Steeping water is too cold and / or transfer of the decal onto a cold object.	a) Do not extend the decal too much. If necessary use a more elastic screen printing covercoat. b) 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 chemical and mechanical resistance of the precious metal decoration.	a) The layer of the preparation is too thin. b) Too much a thinning. c) Too low a firing temperature.	a) Use a 77-34 screen or a calendered 350VA-steel screen. b) Leave the pot open for a while for evaporation. c) Increase firing temperature.

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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.