Burnish Precious Metal Preperations for Screen Printing and the Production of Decals on Porcelain and Bone China

1 General Information

Burnish precious metal preparations contain precious metal or precious metal compounds in solid, dispersed and dissolved form, adhesive agents, as well as resin solutions as film formers.

Decorations produced with burnish preparations result in dull, brown surfaces after firing. Only after burnishing with a glass fibre brush, sand or similar auxiliary material the typical silk matt brilliance arises.

Besides this effect, burnishing leads to compression of the precious metal particles contained in the surface and therefore to a distinctive improvement of the abrasion resistance. As a rule, decorations produced with burnish preparations are more abrasion resistant than bright gold decorations.

Heraeus supplies burnish precious metal preparations with different precious metal content for the decoration of porcelain, bone china, vitreous china and earthenware. Depending on the precious metal content and the thickness of the layer, a precious metal film of approx. 0,3 up to 1,0 µm forms after firing.

Important quality features of burnish precious metal preparations are eg. colour of the precious metal, brilliance of the fired precious metal decoration, mechanical and chemical resistance, richness and printability of the preparation as well as the firing range.

2 Firing Ranges

Substrate type	Firing range
Porcelain	780 (1440) - 880°C (1620°F)
Bone China	750 (1380) - 880°C (1620°F)
Vitreous China	750 (1380) - 850°C (1560°F)
Earthenware	650 (1200) - 740°C (1370°F)

3 Characteristics

3.1 Mechanical Resistance

(see information in our product overview)

3.2 Chemical Resistance

All details as to whether ceramic decorations are dishwasher resistant or 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. To avoid defective production the user should test the colours in connection with materials involved in further processing and determine whether the desired dishwasher proof or resistant decorations are achieved.

Heraeus tests whether finished decorations are dishwasher resistant or durable roughly following the test-washing programme of the Technical Standards Committee for Material Testing (Fachnormenausschuss Materialprüfung, FNM) in a Miele continuous dishwasher.

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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.

The user must test the required properties under his own individual conditions.

3.3 Storage

As a rule, the viscosity increases with the storage time. Therefore, we recommend to use the preparations within 3 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.

We recommend store burnish precious metal preparations not longer than 6 months.

Burnish precious metal preparations have to be shaken well before use, because the precious metal powder and undissolved precious metal settle down during storage.

3.4 Consumption

The material consumption depends on the printing parameters (screen fabric, coating, squeegee position, squeegee pressure). Under our conditions, the consumption is approx. 0.2 to 0.4 g / 100 cm².

4 Application Recommendations

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 %.

4.1 Basic Information on Products, Screens and Squeegees

- 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 167. The thinner has to be stirred in very well. We recommend using a triple roll mill for an optimum homogenisation.
- Burnish precious metal pastes have to be stirred before use, because the dispersed precious metal of the preparation settles down during storage.
- For printing the preparations, a 77T to 100T polyester screen or a 270 to 350 mesh steel screen should be used.
- For a good printing result, it is important to have a well ground squeegee (Hardness: 60-75° Shore).

4.2 Production of Decals

- Stir the burnish precious metal paste.
- 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

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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.

4.3 Transfer of Decals onto the Object to be decorated

- The decals to be transferred have to be steeped in water (water temperature: 18 to 25°C/65 to 77°F). Decals can be released faster from the decal paper if the steep water is warm.

  If the steep water is too cold, decals can hardly be released from the decal paper. During transfer of the decal, cracking of the precious metal decoration might occur. If the steep water is too warm, the decals become too weak and are difficult to apply accurately. There is also a tendency for the covercoat film to shrink.

  The steep water should be changed regularly. If the steep water is too polluted with glue residues, too much glue remains on the decal. Glue residues below or on the transferred decal might lead to a spotted precious metal film or to pin holes.

- After steeping, the decals can be removed from the water and can be slid from the decal paper onto the object to be decorated. We recommend warming up the objects before decoration (25 - 30°C/77 - 86°F). This prevents cracking of the precious metal decoration, especially when decorating hollow objects.
- 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 and glue residues as well as remaining air to escape.
- Afterwards, the surface of the decal should be cleaned with a damp sponge. Glue residues on the decal can lead to a bad firing result of the precious metal decoration (brown spots, "Pearl Strings").
- The decorated ware should be dried for 16 to 24 hours at room temperature (20 to 22°C/68 to 72°F).

4.4 Firing of the Decoration

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 precious metal 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.

4.5 Cleaning of Screen and Squeegee

Screens and squeegees have to be cleaned directly after use. We recommend screen cleaner V 34.

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5 Frequent Faults, their Causes and Ways of avoiding Them

Faults	Possible Cause	Remedy
stripes in the printing precious metal decoration	the squeegee possibly shows scratches	change the squeegee
squashed printing format	the squeegee does not have enough pressure or is ounded off	change the squeegee
blurred contours, running precious metal	too much thinning of the product	leave the pot open for a while, so that solvent can evaporate
spots, pin holes, matt firing result	Objects were soiled by dust, finger marks or water drops before printing	clean the object before decorating
	dextrin 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 • improve ventilation • reduce heating speed • reduce the number of objects in the kiln
precious metal is cracking after 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 great	do not extend the decal too much. If necessary use an elastic screen printing covercoat
	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 chemical and mechanical resistance of the precious metal decoration	the layer of the preparation is too thin	use a 77T screen or a calendered 350VA-steel screen
	too much a thinning	leave the pot open for a while for evaporation
	too low a firing temperature	increase firing temperature

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6 Burnish Precious Metal Preparations for Screen Printing and the Production of Decals on Porcelain

	Colour	Product	Precious Metal Content	ASTM-resistant	microwave-resistant	Sanitary Ware	Notes*
	light yellow	PGP 180/209	32%				lemon firing result, dishwasher durable
	light yellow	PGP 339/209	28%				abrasion-resistant, easy to burnish, dishwasher durable
	yellow	PGP 3019	24%				easy to burnish, dishwasher durable, low precious metal content
	white platinum	PPP 341/209					abrasion-resistant, easy to burnish, dishwasher durable, approved standard product
	silver	BS 113					suitable for induction

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

7 Burnish Precious Metal Preparations for Screen Printing and the Production of Decals on Bone China

	Colour	Product	Precious Metal Content	ASTM-resistant	microwave-resistant	Sanitary Ware	Notes*
	light yellow	PGP Nr. 359/209	32%				very matt surface, suitable for the decoration on relief (single fire), easy to burnish, dishwasher durable
	yellow	PGP 6311	28%				easy to burnish, dishwasher durable
	reddish yellow	PGP 6305	20%				easy to burnish, dishwasher durable
	platinum	PPP Nr. 372/204					easy to burnish, dishwasher durable

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