Bright Precious Metal Preparations for Lining on Glass

1 General Information

Heraeus supplies bright precious metal preparations for decoration by lining machine on glass, with various precious metal contents. Depending on the precious metal content and the thickness of the precious metal application, a gold film of approx. 0,1 μm forms after firing.

Generally, it has to be differentiated between the following lining machine systems:

- Lining with a brush (Netzsch-Lining Machine)
- Lining with metal wheel
- Lining with roller system neoprene

Lining with a metal wheel or brush, fine lines of 1 - 2 mm width can be achieved. Liquid preparations are necessary.

Using a roller system neoprene, precious metal lines of up to 10 mm width can be produced. This system is often used for decorating outside edges of objects, e.g. cups or plates. Slow drying lining pastes of high viscosity are required.

Important quality features of the lining machine preparations are the following:

- the flow and the coverage (even after few rotations a sufficient precious metal layer has to be applied)
- the colour of the gold
- the brilliance of the fired precious metal decoration
- the mechanical and chemical resistance of the precious metal decoration after firing

2 Firing Range

Glass Type	Firing Range
Soda Lime Glass	520°C (970°F) - 620°C (1150°F)
Borosilicate Glass	580°C (1080°F) - 620°C (1150°F)
Lead Crystal Glass	480°C (900°C) - 540°C (1000°F)

3 Characteristics

3.1 Mechanical Resistance

The extraordinary smooth surface of glass and the low firing range of precious metal preparations on glass, limit the mechanical resistance. Therefore precious metal products on glass do not show such an abrasion resistance as similar decorations on Porcelain, Bone China or Earthenware.

3.2 Chemical Resistance

All information about dishwasher durability of precious metal decorations must be considered as approximations, because the test results depend on the type of dishwasher, rising programme, dishwashing detergent, water quality, the firing condition and so on. Heraeus tests the dishwasher durability of glass decoration in a Winterhalter Gastronom GS 29 with an automatic proportion of the detergent and the clear rinse, under defined test conditions (see our technical information sheet "behaviour of precious metal decoration in the dishwasher")

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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 term dishwasher durable.

3.3 Storage Life

Since bright precious metal products contain dissolved precious metals, there is practically no sedimentation. Nevertheless bright precious metal products are subject to an ageing process. As a rule the viscosity increases with long storage. Therefore we recommend to store bright gold pastes not longer than 9 months and bright platinum pastes not longer than 6 months.

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.

3.4 Consumption

The average product consumption for liquid lining machine preparations is approx. 0,16 to 0,20g / 100cm².

3.5 Silver containing bright golds

Lemon bright gold pastes contain silver as coloring 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 to pack the decorated ware airproofed so that the gold decoration will not get in direct contact to the cardboard box.

4 Application Information

4.1 Conditions required for good results

- Work in a well ventilated room. Good application conditions occur at a room temperature of 20 to 25°C and an relative humidity of 60 to 70%.
- Make sure that the surface of the object to be decorated is clean and dry. Dust, fingerprints and water condesation can affect the decoration, while firing, and therefore have to be removed before application.
- Take care that the object to be decorated is not taken from a cold store into a warm shop. It is possible that a fine condensation film will form. Result: Firing disturbance (pinholes) in the fired precious metal decoration. Allow enough time so that the articles can adjust to the decoration room temperature.

4.2 Application Tips

- Heraeus supplies bright gold and bright platinum preparations with a viscosity ready for use and therefore they can be used without any further thinning. After a long application time or for adjustment to individual application requirements, thinning can make sense from time to time.

  For thinning liquid lining machine preparations we recommend our thinners V 35 or V 39, for thinning lining machine pastes V 170 should be used.
- Please fill only 3/4 of the reservoir of the lining machine with the lining preparation. Refill with fresh preparation from time to time.

  During the application, the solvent parts evaporate. Regular refilling with fresh bright gold or bright platinum can keep the viscosity fairly constant.
- For finding the optimal lining conditions please run your own tests. The following parameters should be optimized:

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Fixing the roller hardness (... if a lining paste has to be applied)
With increasing width of the precious metal band and when the object has hollows in the area of the lining, rollers with low hardness should be used. In our tests, the following roller hardnesses have proved satisfactory:

- Thin lines: approx. 50 Shore
- Wide lines: approx. 40 Shore

Fixing the angle of incidence of the roller or the metal wheel
The choice of the optimal angle is of great importance for good coverage of the applied preparation on the object. Especially for wide lines and for the decoration of very arched areas or of hollows. Investigation of the optimal angle is essential.

Rotations
The number of necessary rotations is influenced by the lining machine used (two or one rollers, brush or metal wheel) and by the preparation used. Normally 2 to 4 rotations are enough for a sufficiently strong and homogenous precious metal layer.

Preparation fluidity
The optimal preparation fluidity out of the reservoir onto the roller or the metal wheel has to be investigated by tests. If too much preparation flows out of the reservoir the precious metal line tends to fray. A too thick layer can result in cracking, boiling up and matt areas of the precious metal decoration. If too little preparation is released, needless rotations are necessary to reach a homogenous precious metal film. A too thin precious metal film has influence on the chemical and mechanical resistance of the fired decoration.

- Please take care for dustfree surroundings during the application and the drying. The wet surface is extremely sensitive to dust. After drying, the decoration is not as dust sensitive as before, but the objects should be fired as soon as possible.

  Using heat radiators or infrared lamps, the drying time can be reduced to few minutes.

4.3 Firing of the decoration

- 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 by sufficient ventilation is 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. As a rough rule of thumb: The higher the firing temperature the better the adhesive strength.

4.4 Cleaning of the lining machine

After finishing the application or at the end of the working day, the reservoir should be cleared and cleaned as well as the metal wheel, the brush or the roller.

For cleaning of the stock container, the metal wheel or the roller we recommend our cleaners V 35 or V 39.

5 Frequent faults, their causes and ways of avoiding them

Fault	Possible Cause	Remedy
rough edge to the precious metal line	too much preparation was applied to the object	reduce preparation flowability and / or number of rotation
	the metal wheel is not adjusted correctly	modify the angle of the metal wheel
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
	too much organic fumes in the furnace	reduce the number of objects and / or improve the ventilation

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Fault	Possible Cause	Remedy
spots, firing disturbance	contaminations as dust, finger marks or water drops	clean the object before decorating
	problems with the furnace such as: • furnace atmosphere reduction • insufficient ventilation • too quick a heat up in the critical phase between 300-400°C (570-750°F) • too many objects in the furnace	 • optimize air addition and ventilation • improvement of the ventilation • reduce the speed of heat up • reduce the number of objects
gold is cracking after firing	the layer of the preparation is too thick	reduce the precious metal layer
	too much thinning of the product, runs give thick layers which crack during firing	less thining of the preparation
	the product was thinned with a too slow drying thinner, runs give thick layers which crack during firing	use less fat thinner
low mechanical resistance of the precious metal decoration	too low a firing temperature	increase the firing temperature
	the layer of the product is too thin	increase the layer thickness of the precious metal decoration
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.	give the goods time to take on the temperature of the decoration room and with that the possibility to evaporate the condensation film
weak, copper precious metal film	too thin precious metal layer	increase the preparation flowability or the number of rotations
bulg formation during application with neoprene roller	neoprene roller is too hard	use of a less hard neoprene roller
	paste has been thinned too much	let the solvents evaporate or add fresh preparation
precious metal film is dull but the abrasion resistance is good	too high firing temperature or too long soak time	modify the firing conditions (lower temperature and / or shorter soak time)
matt firing result	too thick product layer. Possible causes: • too high preparation fluidity • too many rotations per lined object • preparation flows into hollows in the lined area and causes a too thick layer	 • reduce preparation fluidity • reduce the number of rotation • use of a less flowing product which has normally a higher viscosity

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