Tight-fitting, safe, and easy

Gramm's Gold-Electroforming-System

GAMMAT® easy

Manual of GAMMAT® easy

Instructions for use of ECOLYT SG100

gramm

GAMMAT® easy Equipment

The heart of the GES technique is the GAMMAT® easy processor which controls the different processes of gold refining like the electric circuit as well as the temperature and the agitation of the solution inside the heating chamber.

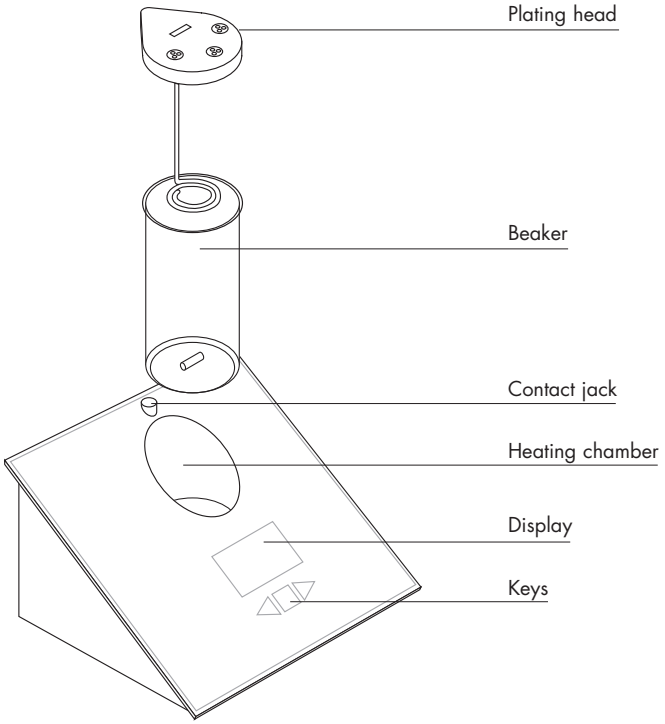


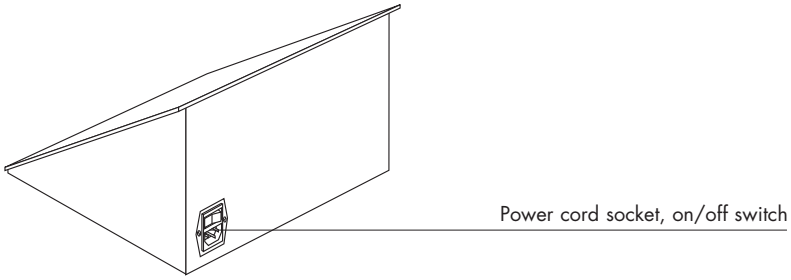
Fig. 1

Specifications

Length	24.0cm
Width	24.0cm
Height	15.0cm
Weight	2.0kg

⚠
Ensure power supply during the complete electroforming process!

Eventually the electroforming unit has to be connected to a separate socket which is not coupled to the main switch of the lab.



WEEE registration No.
DE 85878009

Accessories GAMMAT® easy

The basic equipment comprises all parts necessary for the electroforming technique.

1.1

Recycling Stick
Art. No. 004.03.121

1.2

Magnetic Stirrer Bar
Art. No. 004.03.135

1.3

2 Displacement Glass Cylinders
Art. No. 003.03.254

⚠
Do not use a different stirrer!
Size of the stirrer: 6x35mm
Art. No. 004.03.135

Electrolytes

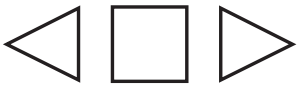
It is necessary to read the safety data sheets of the liquids used before filling. The gold solution is to be stored in closed containers. After the electroforming or recycling process respectively the liquids have to be collected in closed containers and returned to the manufacturer or an appropriate authority for disposal.

ECOLYT SG 100
The gold solution ECOLYT SG 100 contains 15g gold per liter as a non-toxic sulphite complex as well as different supplementary ammonium salts and additives of smallest concentrations. The gold solution ECOLYT SG 100 successfully passed a cytotoxity test and was certified according to the Medical Device Safety Act (CE 0483).

ACTIVATOR SG 100
The ACTIVATOR SG 100 necessary for successful electroforming contains an antimony salt in high concentration. The required quantity of ACTIVATOR SG 100 is added just before the electroforming process is started (see page 5).

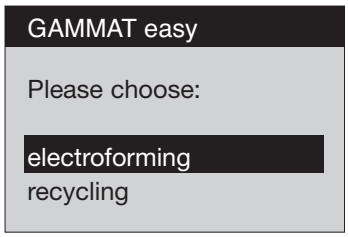
Basic settings GAMMAT® easy

Operation is menu-lead. The display keeps you informed about the current steps and tells you when to enter certain data. Settings are made using the three soft action keys and are confirmed by an acoustic signal. Characters on a black bar show the action chosen which is to be confirmed by touching the square enter key in the middle of the display.

2 

RESET
If data entered are incorrect, the unit may be reset. Therefore the left and right arrow keys have to be pressed simultaneously for about 5 seconds. This is possible at any time during the entering of data and also during the process run.
⚠ *Do not RESET the unit by means of the ON/OFF switch!*

3



Choosing the operating mode
The unit is switched on by means of the on/off switch located on the back of the unit. Choose the electroforming mode and confirm.

4

GAMMAT easy

Please choose:

layer thickness 1
layer thickness 2

◁ □ ▷

Determining the layer thickness

With the GAMMAT® easy unit, electroforming items can be manufactured in two different layer thicknesses:
layer thickness 1 approx. 200µm
layer thickness 2 approx. 260µm
The optimum layer thickness for most cases is approx. 200µm (enter layer thickness 1).

5

Electroforming 1

Please choose:
quantity of gold req.

0,50g

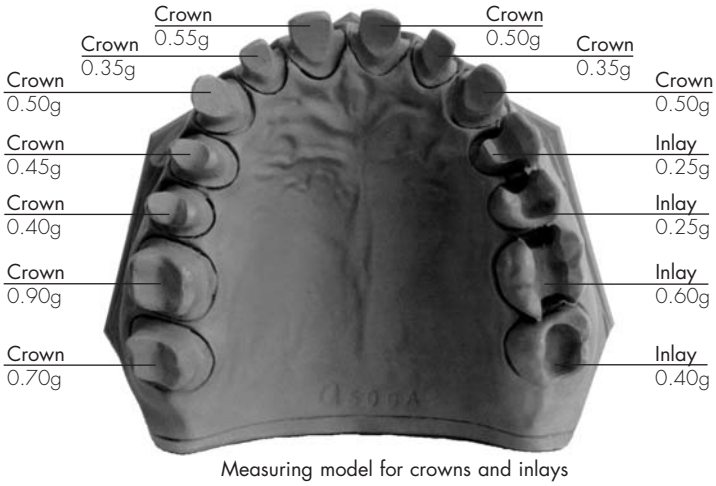
◁ □ ▷

Determination of the solution volume

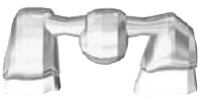
Enter the total amount of gold required in grams by means of the left or right key. Confirm by pressing the square key.

The determination of the bath volume, i.e. of the quantity of gold solution required, depends on the size of surfaces to be electroformed. For 1cm² surface to be electroformed about 0.4g of gold are necessary. The measuring model shows the most common preparations; the quantity of gold solution required is engraved on the according plinth. These values can be used for layer thickness 1 and layer thickness 2 as well. The gold solution mentioned results in a layer thickness of 200 or 260µm respectively.

Measuring model for telescopic cases



Measuring model for crowns and inlays



3-unit bridge
2.20g
150ml

3-unit bridge
2.50g
170ml

6

Calculating example for an electroforming process

Indication	Estimated surface as per measuring model
Premolar crown	0.40 g
Molar crown	0.80 g
Anterior crown	0.50 g
Inlay	0.60 g
Total amount	2.30 g

An improperly estimated amount of gold solution leads to deviations of a few percents only and, in general, results in a slightly thicker or thinner electroforming layer.
The total amount of gold solution required for one electroforming process is determined by adding up the quantity of gold needed for all items that are to be electroformed in the same cycle. The total sum has to be entered in the display. The GAMMAT® easy unit then indicates the according quantities of ECOLYT SG 100 and ACTIVATOR SG 100.
A more accurate calculation of the gold solution required is achieved if the attachment GAMMAT® control is used.

7

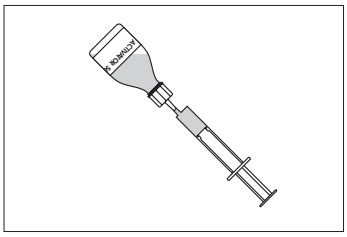
Electroforming 1	
perc. of gold	0,50g
gold solution	040ml
activator	2,0ml
<START>	

☐

Dosing the liquid volume

According to the total weight determined before, the necessary amounts of ECOLYT SG 100 and of ACTIVATOR SG 100 are automatically calculated by the unit and then indicated in the display.

8



The gold solution ECOLYT SG 100 is measured by means of the measuring cylinder and then filled into the beaker.
For the dosing of ACTIVATOR SG 100 the 5ml syringe supplied (Art. No. 910.01.018) is used. The ACTIVATOR SG 100 is then added to the gold solution in the beaker.

⚠ *For each new bottle of ACTIVATOR SG 100 a new syringe has to be used. Keep ACTIVATOR SG 100 closed and store it at a dark place. The syringe serves as cover.*

⚠ *Please note that in case of layer thickness 2 the unit automatically indicates the higher amount of gold solution. Do not forget to consider this higher amount of gold when calculating your price.*

⚠ *Put the magnetic stirrer bar into the gold solution.*

9

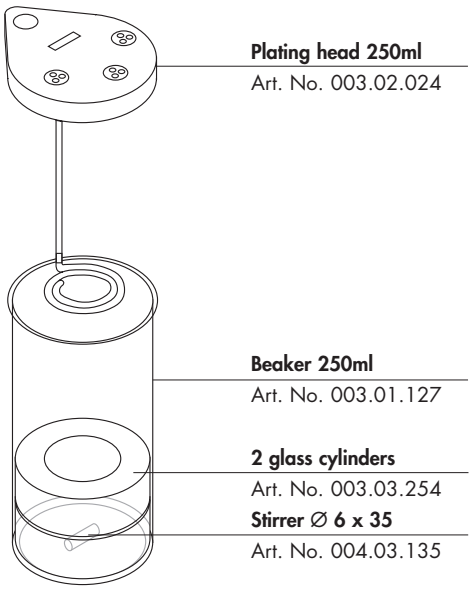
Use of the displacement glass cylinders

The number of electroforming items can freely be chosen since the beaker used may be adapted to the according liquid volume.
The displacement parts are necessary in case of small amounts of up to 0.9g (= 60ml) in order to adequately cover all items with liquid (see display).

⚠ *If necessary in terms of quantity, both displacement glass cylinders should be used.*

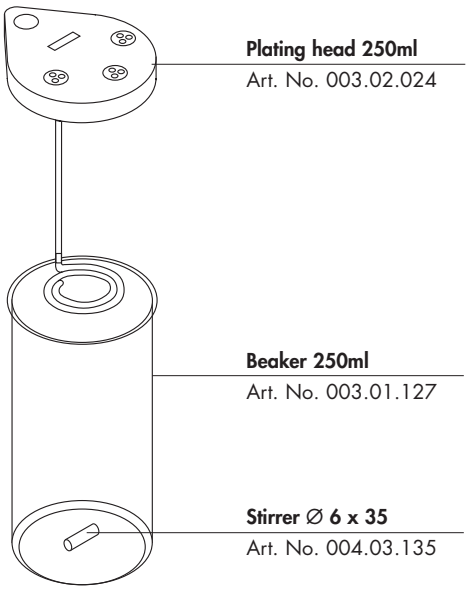
9.1

Gold quantity up to 0.90g

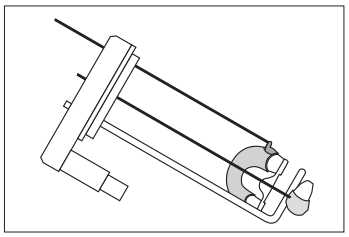


9.2

Gold quantity over 1.00g



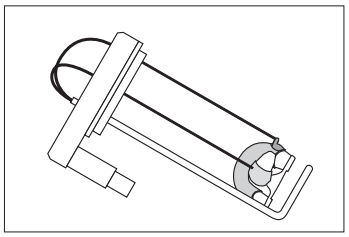
10



Loading the plating head

Prior to inserting the copper wires through the silicone cover of the plating head, please check if each item has proper contact. Therefore the use of a contact meter with resistance measurement is recommended. The through resistance of each item should be between 0.5 and 2 Ω.

11



Providing contact

After inserting the copper wires, they are stuck into the contact jack on top of the plating head and the dies are checked for correct position.

Important notes regarding the placement:

1 Ensure that all items can be washed around adequately. Avoid vibrations. Consider the rotation direction of the stirrer (clockwise).

2 In order to achieve a better wash-around, the occlusal surfaces have to be placed in the stream in anti-clockwise direction. Incline larger occlusal surfaces in the stream.

3 See to it that no item touches the beaker or the displacement parts.

4 Load the plating head evenly and at the same height above the anode (spiral).

5 The distance between the items and the anode has to be 15 to 20mm. Use the red mark at the mantle of the anode holder as optical aid.

⚠ *All items loaded have to be at the same level.*

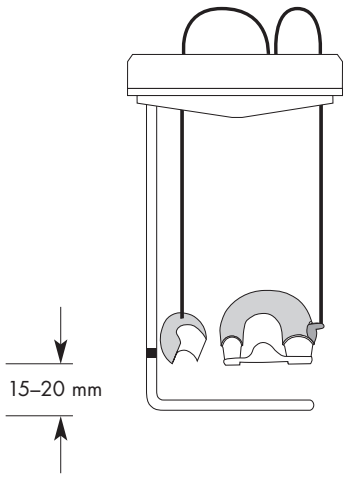
6 In case of amounts of gold solution of less than 60ml (corresponding to 0.9g gold) both displacement glass cylinders have to be used.

7 Place inlays in an angle of approx. 45° towards the stream.

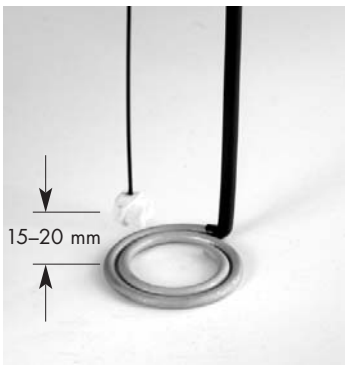
8 Insert bars, bridges and splints in a horizontal way and crosswise to the stream while the surfaces to be plated look downwards.

9 If all recommendations are considered, each item should completely be covered with liquid even when being stirred.

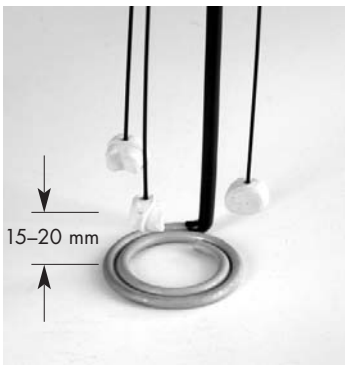
12



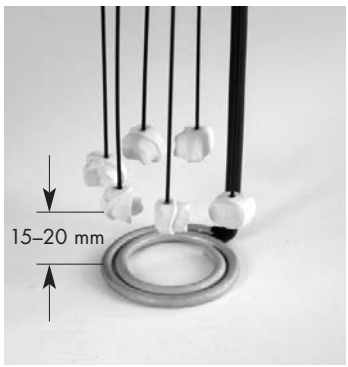
12.1



12.2

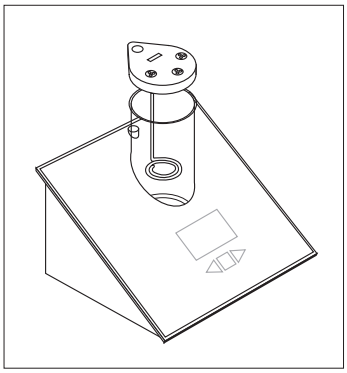


12.3



Possible placements of different dies in the plating head.

13



Contacting the plating head

Carefully guide the plating head into the beaker. Provide contact to the plating head by inserting the plug into the jack.

⚠ *Prevent the plating head from getting wedged during insertion. Therefore, please orient at the hollow on the plating head.*

□ The process is started by pressing the square enter key.

14

Electroforming 1
preheating runs
00:28:12

Preheating period

Now, the unit heats up. The remaining time before the actual electroforming process starts is indicated in the display.

⚠ *After the electroforming process has started, neither the beaker nor the plating head may be removed from the unit.*

15

Electroforming 1
electroforming runs
05:52:38

Electroforming process

As soon as the preheating period is over, the electroforming process starts automatically. The remaining time to the end of the electroforming process is then indicated in the display.

RESET

◁ ▷ If the process is to be stopped or if you notice that the amount of gold entered is wrong, the electroforming process can be stopped by simultaneously pressing both arrow keys for 5 seconds.

16

Electroforming 1
electroforming finished

End of the electroforming process

When the electroforming process is over, the unit turns off automatically. Then take the beaker with the plating head out of the heating chamber. However, the electroformed items will not be harmed if they remain in the electrolyte for several more hours.

17

Error !
Aborted Galvano 1
<RESET>

Power failure

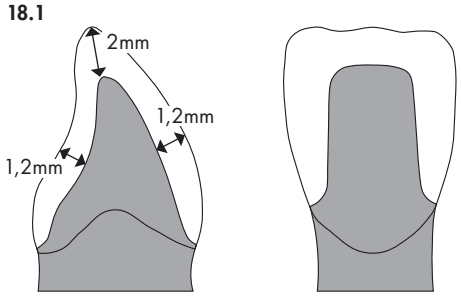
If a power failure occurs during the heating phase or during the electroforming process, the process will be continued if the temperature of the gold solution has not dropped too much. At the end of the electroforming process a power failure is indicated in the display by ??.??. The layer thickness of the items has to be checked with a suitable device, e.g. gauge.

⚠ *If either the work temperature has not been reached, or the power failure lasted too long to maintain the electroforming parameters, the unit stops the process.*

⚠ *Please use magnifying glasses!*

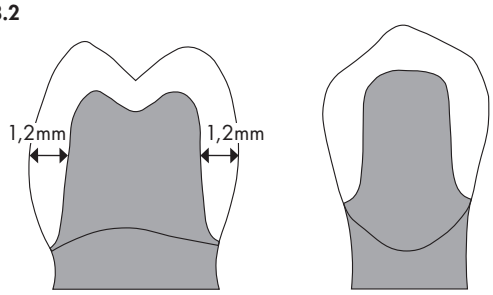
For more preparation advice please consider also our informative brochure for dentists.

18.1



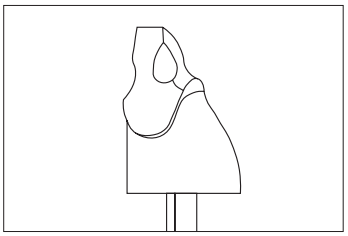
Chamfer preparation with edges rounded off (round shoulder preparation)
(The wall thickness of the electroformed framework is approx. 0.2mm, the porcelain facing will require at least 1mm.)

18.2



Anatomical preparation of the posteriors
Chamfer preparation with parallel sides, no sharp edges or undercuts. For crown preparation of the anterior tooth follow its anatomical shape.

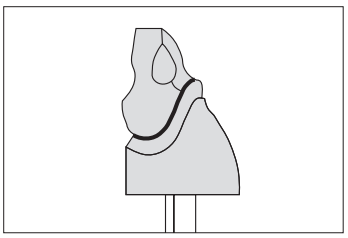
19



Finish line

The master model can be prepared according to the common model system used at your lab. Ditch the margin at the master die. Grind the die plinth slightly conical. Prepare a slight chamfer below the finish line. Mark the margin using a margin liner.

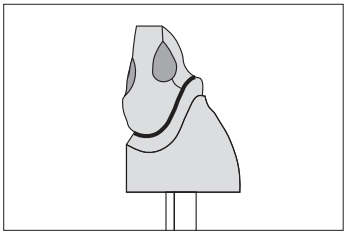
20



Sealing varnish

Sealing varnish is used to isolate plaster and silicone. Seal the complete die using Gramm's Sealer (Art. No. 910.00.044). Let dry for approx. 15min.

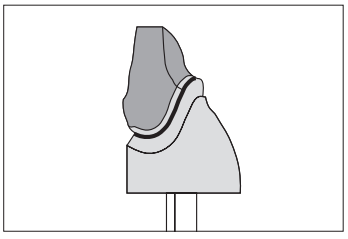
21



Blocking-out

Block out all undercuts as well as defects using Gramm's Galvanowax (Art. No. 910.00.046).

22

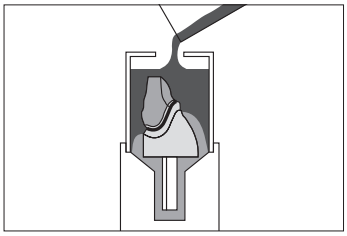


Spacing varnish

In order to gain enough space for the cement, apply Gramm's Spacer (Art. No. 910.00.043) twice up to approx. 1mm before the margin. With a thickness of 20µm this corresponds to the cement gap and may also be used as spacer for the glueing gap of telescopic cases. In such cases it is removed by means of acetone after finishing the tertiary construction.

⚠ *Please use magnifying glasses!*

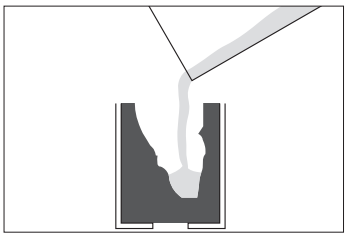
23



Duplication

Remove the upper part of the duplication mold (Art. No. 910.00.007). Place putty into its lower part. Stick the prepared master die into the putty. Put on the upper part of the duplication mold. Fill it with 1:1 or 9:1 duplicating silicone.
Please follow the manufacturer's instructions.

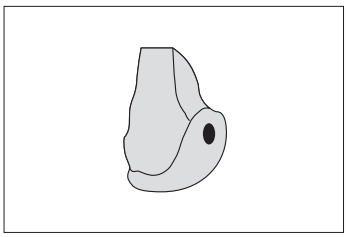
24



Casting with H4 plaster

When the silicone has set, very carefully lift off the lower part of the duplication mold. After removing the master die, pour super hard plaster of class IV into the silicone mold. Let set according to the manufacturer's instructions. Store the silicone mold for fabricating a die out of GES refractory die material (see page 11).

25

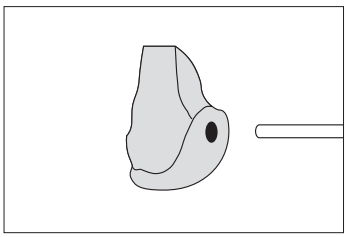


GES working die

Separate the duplicate die from the silicone. Trim the die as much as possible leaving a small plinth. Round off the edges. Below the finish line a small hole of 1.0mm is drilled at right angle to the tooth shape (drill: Art. No. 910.00.012)

⚠ *Drill only once since drill and copper wire are coordinated!*

26

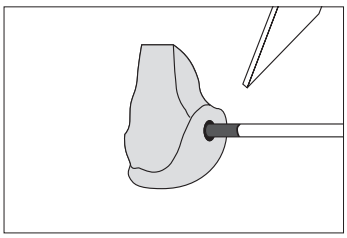


Copper wire

Stick in the isolated side of the coated copper wire (art. No. 910.00.022) and let dry. Please note: The non-coated part of the copper wire has a shiny surface. If oxide development occurs, remove it using grinding paper.

⚠ *Use each copper wire only once!*

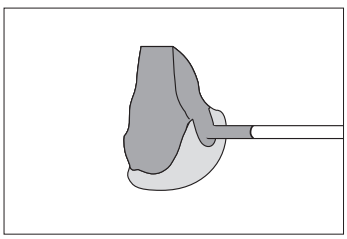
27



Contacting

About 1 to 2mm – beginning at the plaster die – of the isolation of the copper wire is removed by means of a scalpel to provide electric contact between copper wire and crown.

28



Conductive Silver Lacquer

Since the silver pigments separate from the solvent after standing for a while, the Conductive Silver Lacquer (Art. No.910.00.049) has to be shaken well before use. Then apply Silver Lacquer with the brush (Art. No. 910.00.015) onto the complete surface to be electroformed and on the connection to the copper wire; the area where the isolation was removed before, has to be covered completely with Silver Lacquer. Then continue with the actual electroforming process (see page 6).

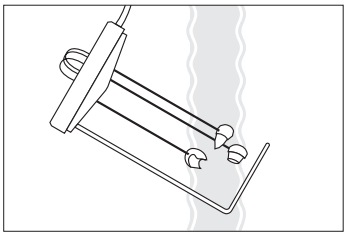
⚠ *We strongly recommend wearing magnifying glasses!*

⚠ *Let the Silver Lacquer dry completely (60 minutes at least).*

⚠ *Measure the Ohm resistance with a contactmeter to check for proper contact.*

Finish

29

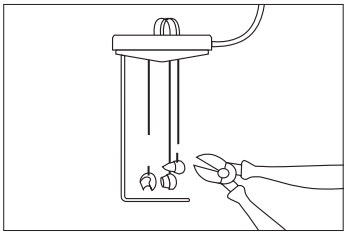


Rinsing the plating head

Remove the plating head together with the beaker from of the electroforming unit. Take the plating head out of the gold solution and rinse the electroformed items and the anode under running water. Collect the used gold solution for later recycling.

⚠ *Keep the plug dry.*

30

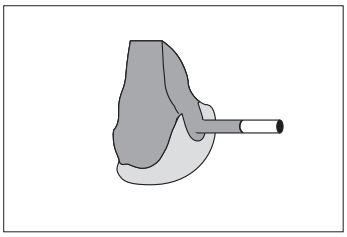


Removing the GES parts

Nip off the electroforming parts using a wire cutter and pull the copper wires out of the plating head upwards. Then steamclean the plating head.

⚠ *Keep the plug dry.*

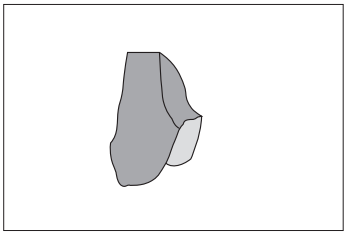
31



Dissolving the plaster die

Treat the plaster die with plaster dissolution (Art. No. 910.01.019) and dissolve the die in an ultrasonic cleaner. Heating the ultrasonic bath to approx. 70°C speeds up the dissolution process.

32



Removing the Conductive Silver Lacquer

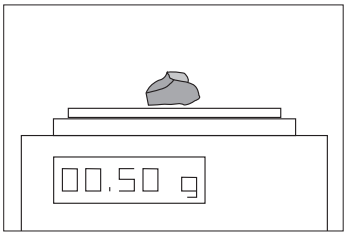
In case Silver Lacquer is left, it must be removed carefully. Therefore the electroformed items are put into an acid-resistant receptacle with screw top containing 40% nitric acid (HNO_3); the receptacle is then put into an ultrasonic unit to remove the Silver Lacquer.

⚠ *Please comply the safety regulations regarding acids. When using nitric acid, these works have to be effected under a powerful extraction system. Wear protective clothing! If after that there are still remainders of Silver Lacquer, these should be removed using acetone and a cotton bud.*

Then steamclean all items.

⚠ *Check if the Conductive Silver Lacquer has been removed completely. If not, the remaining silver will diffund into the pure gold during baking. Silver that has not been removed may, in the oral environment, cause discolourations in case of outer telescopic crowns or flaking-off of the porcelain facing in case of crowns.*

33

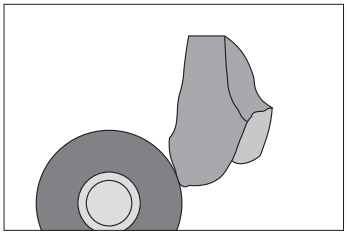


Checking the weight

Lay each single GES item on a weigh and take its weight down into your laboratory record book.

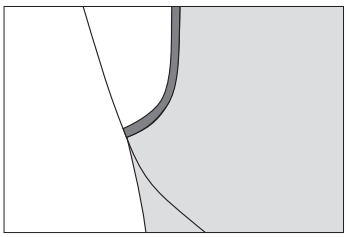
Fitting to the Master Die

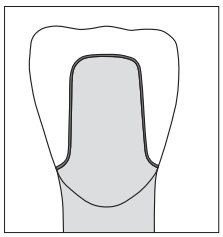
34



After acidifying the Conductive Silver Lacquer with nitric acid, the excess margin is removed by means of a medium-hard silicone polishing wheel (e.g. EVE 601).
Usually the margin is thick enough to leave a small visible gold margin in case of porcelain facings (if desired).
⚠ *Please use magnifying glasses!*

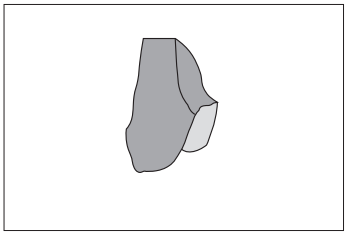
35





Bonder and Porcelain Bake

36



Sandblasting of electroformed items
The electroformed items are fit on to the master die. Sandblast the GES electroforming item at 2bar using 50µm aluminum oxide (do not use a circulating sandblasting unit!). Steamclean the galvanized item, then put it in alcohol (ethanol) for approx. 2 min. Let air-dry (do not use compressed air!).

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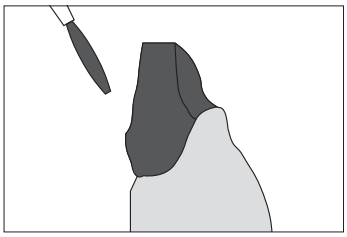

GES die material
For easier handling of the GES items, a die is produced using refractory die material (Art. No. 910.00.061). This die serves as working die; thus distortion due to uneven support during firing is avoided.

Galvanobonder
Mix Gramm's Galvanobonder (Art. No. 910.00.021) according to the instructions; apply a thin layer.

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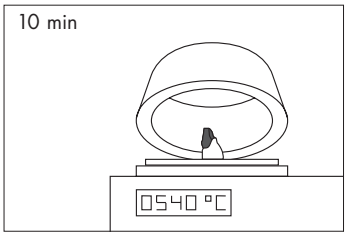
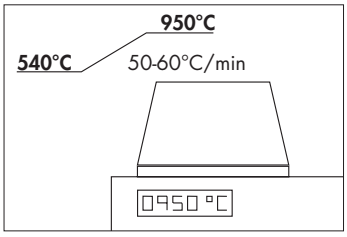


Drying
Let the Galvanobonder air-dry for 10 minutes. Then place it in front of the opened firing chamber for another 10 minutes. For the complete drying of the Galvanobonder, the items are put inside the firing chamber which has been heated up to 540°C for another 10 minutes.
⚠ *Do not change the temperature setting and/or the drying period! Otherwise the porcelain surface might flake off or crack later on.*

39



Bonder bake
Heat rate: 50–60°C/min (122–140°F).
Firing (fixing) temperature at 950°C (1742°F).
No vacuum, no delay necessary.
After the bonder bake the electroformed item is steamcleaned and cleaned with ethanol.

Telescopic Cases (Direct Method)

⚠ *Please use magnifying glasses!*

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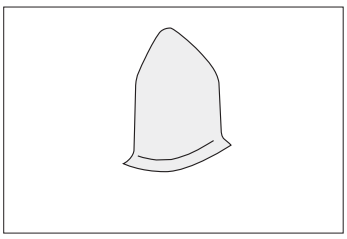


Inner telescopic crown

The inner telescopic crown is modelled and milled in the conventional way. In case of short parts an angle of inclination of 0° is recommeded, in case of long parts 2°. However, the angle of inclination may not exceed 2° and a chamfer-like step is recommendable. A smooth milling surface is required.

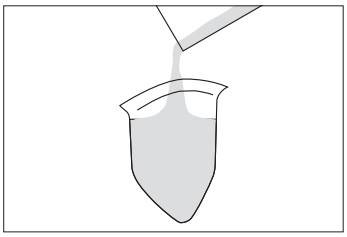
⚠ *The metal parts to be electroformed have to be completely free of milling oil and remainders of polishing agent.*

Measuring model for outer telescopic crowns

Primary part	Treatment
Gold	provide a high polish, mill the angle of inclination according to the adhesive area
Non-precious alloy	mill fine, polish. Use sandpaper, grit 1000, to roughen the milling surface in order to allow the gold particles to deposit more homogeneously.
Titanium	see non-precious alloy
Zirconium oxide	We recommend the indirect method via duplicate model.

Preparing the electroforming process

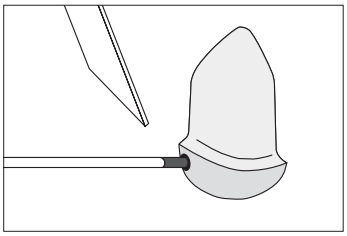
41



Variant 1

The inner telescopic crown is cast with super stone class IV. Let the super stone dry according to the manufacturer's instructions. Then trim the plaster die leaving a small plinth for the contact. Make the drilling for the contact (drill: Art. No. 910.00.012).
Stick in the isolated side of the coated copper wire (remove excess glue). Please note: the non-coated part of the copper wire has a shiny surface.

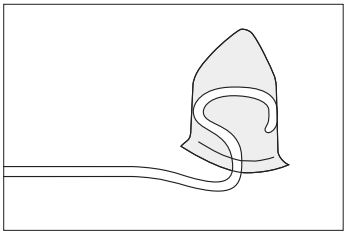
42



Variant 2

It is, however, faster and easier if the telescopic crown is poured out with a pattern resin; then continue as in case of a plaster die.

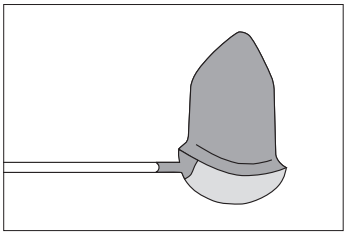
43



Variant 3

It is easier and avoids drilling and sticking in of the copper wire to bend a retention loop at the isolated side of the copper wire which is fixed inside the telescopic crown and then filled with pattern resin.

44



In order to provide electric contact between the copper wire and the crown, a scalpel is used to remove approx. 1 to 2mm of the isolation of the copper wire - beginning at the plaster die. Conductive Silver Lacquer (Art. No. 910.00.049) is shaken very well before use. By means of the brush (Art. No. 910.00.015) a covering layer of Silver Lacquer is applied onto the surface to be electroformed and on the connection to the copper wire. The area that has been stripped before must completely be covered with Conductive Silver Lacquer.

⚠ *Let the Silver Lacquer dry completely (60 minutes at least).*

⚠ *Measure the Ohm resistance with a contactmeter to check for proper contact.*

⚠ *In case of telescopic crowns out of gold the complete outer surface of the telescopic crown has to be covered with Silver Lacquer as separating layer.*

Then continue with the actual electroforming process (see page 6).

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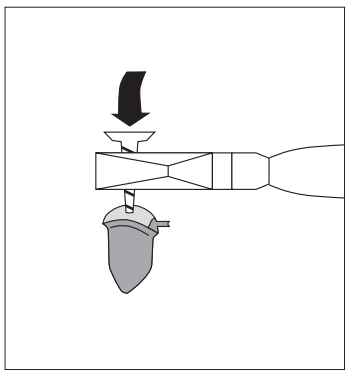
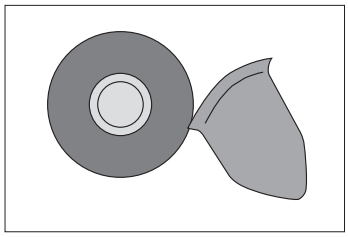


After the electroforming process

Remove the copper wire after electroforming and use a separating disk to cut the connection between crown and contact area of the copper wire. Trim the excess margin of the electroformed item by means of a medium-hard silicone polishing wheel (e.g. EVE 601). Use a drill with a diameter of approx. 2.35mm to drill a hole into the die and screw in a screw. Due to the vibrations of a riveting hammer onto the screw head, the secondary crown comes off the primary part.

In case of plaster dies, these have to be treated with plaster dissolution (Art. No. 910.01.019) and removed in an ultrasonic bath.

46

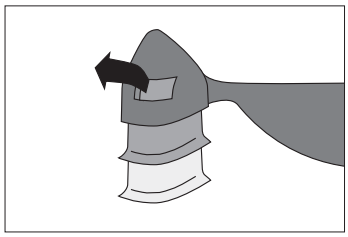


Working the gold margin

After removing the Conductive Silver Lacquer with nitric acid, the margin is finished with a medium-hard silicone polishing wheel (e.g. EVE 601).

⚠ *Please use magnifying glasses!*

47



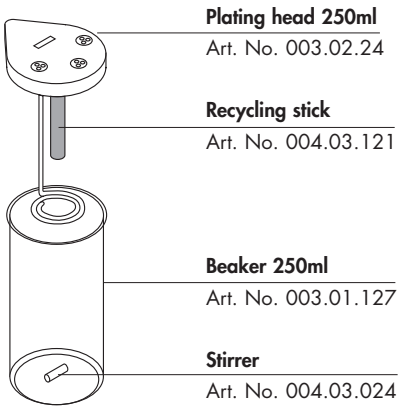
Tertiary construction:

After acidifying the Conductive Silver Lacquer out of the secondary telescopic crowns by means of nitric acid, the crowns are fit on to the master model.

– Prior to the duplication (modellation with light wax), a spacer out of varnish or wax is applied in order to create enough space for the glue and to avoid unnecessary fit-on work.
– "Drainage grooves" at the tertiary framework prevent a congestion of the glue when the secondary parts are stuck in.
– An optimal connection between the tertiary construction and the electroformed telescopic crown is achieved if in the oral area the crowns are designed in the same length as the electroforming crowns. Due to esthetic reasons, the tertiary construction should not comprise the cervical area (step) in the vestibule.

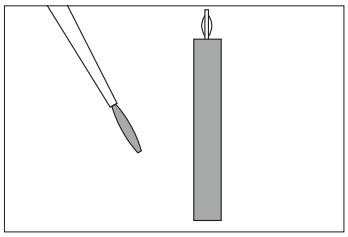
Recycling of Used Gold Solution

48



The Gramm Electroforming Technique allows almost complete output of the electrolyte SG100. However, an output of 100% is impossible since then the parts refined would no longer be shiny gold but only dull or even brown or black.
Do not use gold solution where ACTIVATOR SG100 is added for another electroforming process! In order to draw the remaining gold out of the electrolyte, the unit series GAMMAT® easy comprises a recycling cathode.

49



Preparations
Steamclean the recycling stick before first use. We recommend further cleaning in an ultrasonic bath containing a degreasing solution, e.g. Gramm's Cleaner (art. No. 910.00.031).
Furthermore, it is possible to apply a thin layer of Conductive Silver Lacquer onto the recycling stick which serves as separating agent and makes it easier to remove the gold layer later on.

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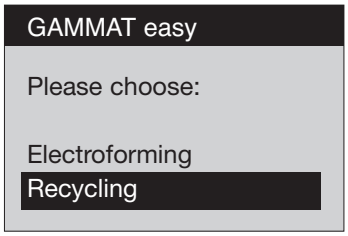
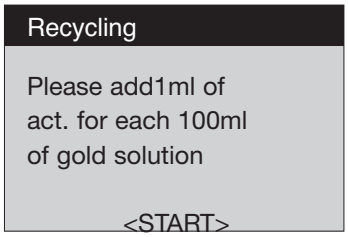


☐ **Preparing the unit**
Choose Recycling.

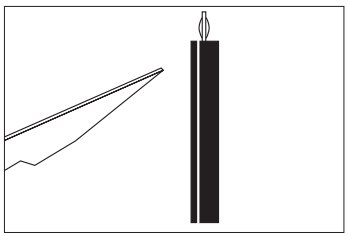
51



☐ **Recycling process**
Use as much ACTIVATOR SG100 for every 100ml of used gold solution ECOLYT SG100 as indicated in the display. Optimal results are achieved when 250ml gold solution and 2.5ml of ACTIVATOR are used. Confirm by pressing the square key. The recycling process runs fully automatically.

⚠ *Please consider the maximum capacity of the beakers. The plug of the recycling rod may not get in contact with the gold solution.*

52



Removing the gold layer
After the recycling process the recycling cathode is pulled out of the plating head, then rinsed.
Since the output rate during the actual electroforming process is relatively high already, only a thin gold layer deposits on the recycling cathode during the recycling process. Thus, it is sensible to effect several recycling processes with one cathode in order to get a thicker gold layer. Then the gold layer on the recycling cathode is cut longwise and pulled off the cathode.
Collect the recycled solution and ensure proper disposal.

Trouble Shooting

	problem/error message	elimination
No deposits at all after 15min	– No ACTIVATOR SG 100 was added	Add the according amount of ACTIVATOR SG 100, enter the settings again, restart the process.
	– The items are not adequately washed around by the gold solution	No displacement parts! Put both displacement glass cylinders into the beaker (see page 5).
No deposits on certain items after 5min	– The item does not have proper contact	Check the contact of the copper wire at the plating head. If the contacts at the plating head are okay, remove the plating head from the gold solution, rinse, let dry, scratch again into the surface of the copper wire of the item without deposits, provide contact by applying Silver Lacquer, allow the varnish to dry completely, enter the settings again and restart the process.
Electroformed items are too thin	– Too little amount of gold solution	The surfaces were determined too small prepare new electroforming dies and start the process again.
Pearly, brittle electroforming surfaces	– Too much gold solution	The surfaces were determined too big prepare new electroforming dies and start the process again.
The porcelain facing flakes off	– Bonding agent sticks to the porcelain	Use Gramm's Goldbonder (Art. No. 910.00.021) as described in the according instructions. Ensure that the drying time required is provided.
	– Silver Lacquer has not been removed completely	Redo the electroforming items.
	– Uneven layer thickness of the porcelain facing	Enlarge the surface of the electroforming crown, and apply porcelain again.

Electroforming step by step

1	Choose the layer thickness desired.
2	Determine the surfaces to be electroformed by means of the measuring model. Or have the requisite gold calculated by the attachment GAMMAT® control.
3	Enter the gold quantity at the display > the unit automatically calculates the according amount of gold solution.
4	Place the beaker – containing the displacement glass cyclinders, if required – into the unit.
5	Fill the determined amount of ECOLYT SG 100 and of ACTIVATOR SG 100 in a suitable beaker.
6	Put the magnetic stirrer bar into the beaker containing the gold solution ECOLYT SG 100.
7	Load the plating head according to the placement recommendations.
8	Contact the plating head.
9	Press start; the process runs fully automatically.

When electroforming, please follow this sequence of operations step by step.

Do not make any experiments!!

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