Partial denture

TECHNIQUE GUIDELINES

for the processing of partial denture alloys
and investment materials

Partners in Progress

BEGO

A system for success –

What does that mean for you?

The aim of the cooperation between dentists and dental technicians is to provide patients with high quality dentures offering them a decidedly better quality of life.

The restoration of lost masticatory function and naturallooking aesthetics are the fundamental goals of each and every prosthetic restoration. From the patient's perspective, these are requirements which go without saying.

Against this backdrop, removable dentures tend to be seen less favourably in many dental practices and dental laboratories nowadays. The term "high-quality, aesthetic denture" is primarily associated with materials such as ceramics, zirconium dioxide and metal-free constructions.

Nevertheless, removable partial denture bases for the treatment of patients remain an ever-present aspect in day-to-day work in laboratories. Certain restorations cannot be produced or are only possible with considerable time and financial investment on the patient's part.

The production of dental laboratory work with fireproof, shaped materials has been possible with the casting method for about 100 years. First developed over 80 years ago, the now common partial denture technique quickly rose in popularity and has since been widely adopted as the standard. Despite the increasing share of dental CAD/CAM constructions, all the necessary materials such as the duplicating materials and dental casting investment materials still form the foundation for accurate, precisely fitting, metal-based prosthetic restorations.

The partial denture technique based on the BEGO system has been offering materials, devices and expertise to satisfy the strict requirements for more than 60 years now.
Coordinated process steps, materials tried and tested over a long period of time and practical, modern equipment of the device – combined with the dental technician's prowess – have a decisive effect on the results.

These guidelines on the partial denture technique based on the BEGO system illustrate clearly the background to the systematic approach.
It offers people who set great store by consistent, reproducible results at a high productivity level everything that laboratories require for modern partial denture techniques.

However, the guidelines are also intended as a procedural guide and can prove helpful as a reference work for further improving work results in the casting method.

Why not find out for yourself!

Contents

1

Planning and design

Model manufacturing

BegoStone plus super-hard plaster is used to make the planning and master model.

- **Step 1:** The impressions received from the dentist must be cleaned, disinfected and rinsed out with water.
- **Step 2:** The impression must be dried carefully with compressed air prior to casting. Any water left on the impression may result in different strength values for the model surface or in non-homogeneous setting behavior (expansion) of the master model.
- **Step 3:** BegoStone plus should preferably be mixed for at least 45 seconds in a vacuum mixer. Compliance with the specified powder/liquid ratio is essential for reproducible results (expansion).

  Variation of the plaster-water ratio
  20 ml +/– 1.5 ml to 100 g powder alters the material and working characteristics:
  - Less water results in harder plaster with a shorter working time
  - More water results in a softer plaster with a longer working time
- **Step 4:** The impression is poured on the vibrator. The model must then harden for at least 30 minutes before it can be removed.
- **Step 5:** The final step involves trimming of the master model – the minimum model thickness is 10 mm.

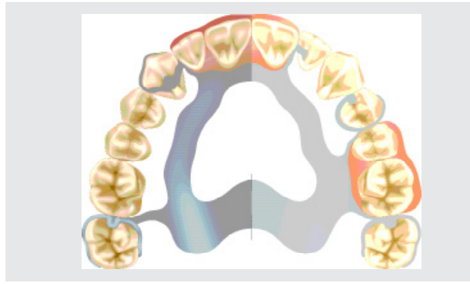
Surveying of the master model

The master model made of BegoStone plus is the most important work basis for every dental technician. It should also be treated with appropriate care and precision in the scope of the following steps.
Ultimately, the partial denture construction produced will be adapted to reflect this model and returned to the dentist.

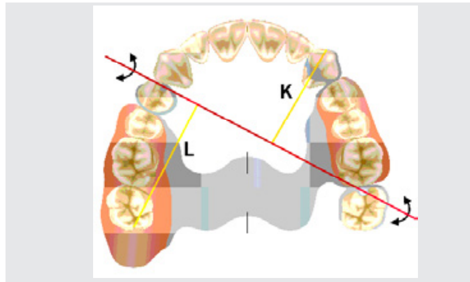
Anchoring of dentures – Determining the undercut depth

Abutment teeth capable of accepting loads are indispensable for the secure anchoring of partial dentures. They are subjected to high loads during insertion and removal of the dentures as well as during mastication. For this reason, it is important to determine the correct distance, in other words the right undercut depth, separately for each clasped tooth.
The following rule of thumb can be applied:
As much undercut as necessary and no more than truly required. As the particularities of the undercut depth/denture withdrawal force are taken into consideration individually during this assessment, it is possible to estimate the significance of an abutment well. The length and shape of the clasps as well as the type of alloy used (modulus of elasticity) all influence the strength of the clasp anchoring.

BegoStone plus 12 kg (REF 54811)



Interrupted row of teeth in upper jaw with completely periodontally supported denture (interdental insertion prosthesis)



Free-end gap in upper jaw with fulcrum line, load arm (L), force arm (K) (load-force arm ratio)

Ney measuring set; measuring instruments for model analysis, measuring of undercuts and marking of the equator (REF 22160)

Pictures and illustrations are exemplary. Colors, symbols, design, and information on the labels and/or packaging shown may differ from reality.

Parameters which influence the abutment significance and undercut value

	Good ability to accept loads	Limited ability to accept loads	Poor ability to accept loads
Type of tooth	Canine, upper molar	Lower molar	Premolar
Tooth position	Within the row of teeth	At the end or towards the saddle	Single tooth, alone
Periodontal load rating*	Good/grade 0	Limited/grade 1	Severely limited/grade 2
Inclination of tooth to the occlusal plane	Low	Medium (25–30°)	High
Clasp length	Ring clasp, approx. 24 mm	Molar clasp, approx. 16 mm	Premolar clasp, approx. 12 mm

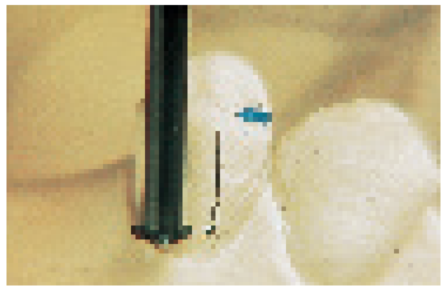
Completely tooth supported dentures "interdental insertion prostheses" (see page 5) also require a lower force of withdrawal than those with free-end saddles. An unfavourable load-force arm ratio (see page 5) generally requires a higher undercut value. Otherwise, the denture is likely to come unhinged when subjected to loads during mastication.
It is often not possible to achieve the requisite undercuts. If a modified model tilt – on the model table – fails to effect an improvement, there is no way of avoiding adaptations: for example, the path of the clasps and in certain circumstances the type of clasp or the clasp profile itself should be adjusted.

The model is placed in the zero position on the model table in a surveyor for the surveying. Starting from the zero position – with the occlusal plane parallel to the base plate – the model table is tilted and the ideal path of insertion sought with the aid of the parallel rod. For aesthetic reasons, the model should ideally be oriented in such a way that the clasps in the visible area can be positioned as low as possible. In the non-visible area, function takes priority over aesthetics, with the aim of furnishing the clasp partial denture with sufficient hold to withstand the developing masticatory forces (tensile and shearing forces).

The key steps are:
- Setting the zero position (preliminary path of insertion)
- Inserting the locating pin and determining the fields of retention (model analysis)
- Checking the retention capacity
- Determining the type of clasp (see next page)
- Marking of end of clasps with vertical line
- Inserting of undercut gauge
- Measuring of required undercut
- If necessary, slight tilting of model
- Marking of undercut point
- Do not change model position any further (fixing of final path of insertion)
- Marking of prosthodontic equator
- Drawing in of path of the clasps (approx. 1/3 in field of retention)

Marking the end of the clasp with a vertical line (locating pin)

Measuring the undercut at the vertical line (Ney undercut gauge)



Marking the undercut (Ney undercut gauge)

Marking the prosthodontic equator with the pencil lead and drawing in the path of the clasps

*Dental technicians require this information from the dentist

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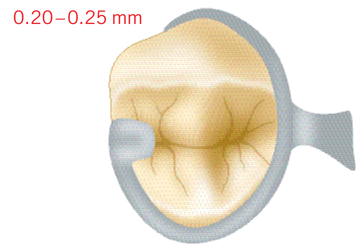
Clasp indication

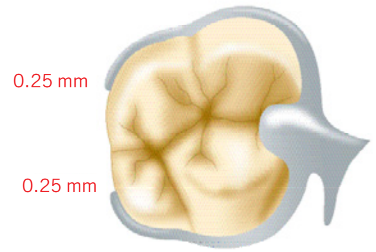
G clasp

Advantages	• Mesial support – functions as indirect saddle extension • Connector from saddle – No formation of recesses • Passive clasp arm guides and stabilizes the denture
Disadvantages	• Large degree of tooth coverage due to oral clasp arm • Occlusal point far from saddle often unstable
	Undercut values from experience: 0.20–0.35 mm



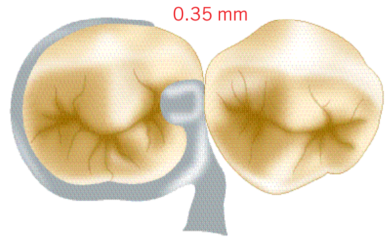
E clasp

Advantages	• Easy to determine path of insertion • Stable support close to saddle • Two clasp shoulders: secure fixation on tooth • Easy to activate
Disadvantages	• Short spring travel • Low depth of undercut
	Undercut values from experience: 0.20–0.30 mm



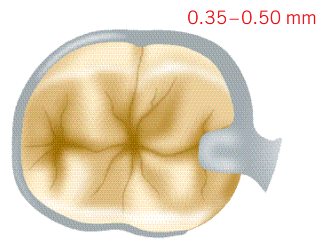
Back-action clasp

Advantages	• Long spring travel, large field of retention • Small connector stabilizes support • Aesthetically pleasing path of clasps
Disadvantages	• Formation of recess between small connector and saddle • Large degree of tooth coverage due to long clasp arm
	Undercut values from experience: 0.25–0.40 mm



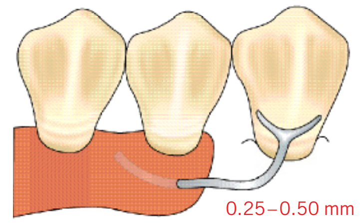
Ring clasp

Advantages	• Retention area close to saddle secures saddle against tension • Distal wandering is prevented • Long spring travel, high retentive capacity
Disadvantages	• Clinical crown is largely covered • Long clasp arm at risk of becoming deformed • Covers distal surface of terminal teeth
	Undercut values from experience: 0.30–0.50 mm



Roach or Y clasp

Advantages	• Easy insertion • Even with extreme undercut depths • Low degree of tooth coverage thanks to clasp elements
Disadvantages	• Often associated with poor fitting – unstable • Tooth can tilt towards labial • Unfavourable from a periodontal hygiene perspective
	Undercut values from experience: 0.25–0.50 mm



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Preparation of the master model

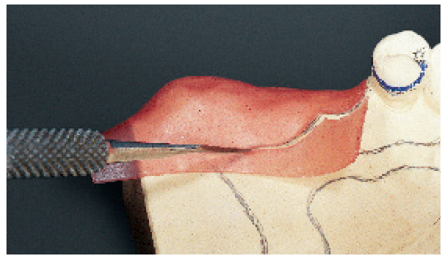
Once the surveying of the master model is complete, the markings are transferred from the study model. The construction template produced – ideally by the dentist – provides the dental technician with important information on the design and extent of the partial denture frame. In addition to the function, this refined drawing also focuses on a successful denture design. An even design is particularly important in the upper jaw. It is helpful to mark the centre of the model and design an ideally symmetrical basic shape with the help of a small pair of compasses.

The drawing begins with demarcation of the saddle zones to be underlaid. During the subsequent drawing in of the base, attention must be paid to leaving sufficient distance to the gingival margin. BEGO blocking-out wax is applied to the tooth surfaces near the saddle.

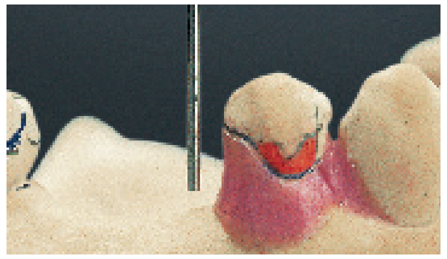
The model is replaced on the model table in the surveyor for the blocking out. A 2° tilt is now blocked out with the small blockingout instrument from the Ney measuring set. The pressure on critical areas such as the mid-palatal suture and the incisive papilla is relieved with blocking-out or preparation wax. In order to leave space for the acrylic, the saddles need to be lined with 0.5 mm of red BEGO preparation wax. A sharp instrument is used to cut it off at a right angle to the master model.
A slight wax clasp step transfers the path of the clasps to the investment model.

All these layered areas need to be carefully blocked out to ensure that the hydrocolloid or silicone mold doesn't expand when removed from the master model. The more carefully this is done, the less the risk of deformation of the duplicating material. Following removal of the model, corresponding recovery times must be observed depending on the extent of the deformation of the duplicating material.

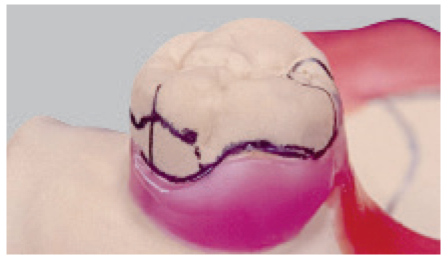
Drawing of denture design



Determination of saddle expansion, separation of preparation wax at right angle to model



Wax clasp step and area of retention on tooth



Blocked-out, undercut area with slight wax clasp step

Upper jaw model prepared for duplicating

Preparation wax, red (REF 40038) and blocking-out wax, pink (REF 40032)

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2

Duplicating

Duplicating with hydrocolloid (gel)

BEGO duplicating hydrocolloids for partial dentures have already been proving their worth for many years. Castogel® is different from Wirodouble® in that it boasts a higher strength. WiroGel® M can also be used for the acrylic casting technique and for duplicating and casting with plaster. Duplicating hydrocolloids are environmentally friendly and significantly more cost-effective than duplicating silicone.

In preparation for the hydrocolloid duplication, it is advisable to soak the master model in water for 5 to 10 minutes at a temperature of approx. 38 °C. Once no more bubbles rise, the master model can be dried off with absorbent paper. The model should not still be dripping wet. Check again that the preparation wax is still securely in position.

When the BEGO combi duplicating flask is used for hydrocolloid duplication, the base plate becomes an integrated part of the duplicate model. Firstly, the master model is placed on the base plate of the BEGO combi duplicating flask and the top then applied firmly.

The working temperatures of Castogel® and Wirodouble® are between 42 °C and 45 °C; WiroGel® M is 54 °C. Various duplicating devices are available for duplicating. Alternatively, hydrocolloid can also be heated in the microwave (e.g. WiroGel® M). Duplicating devices check the temperature and show the temperature reached on the display. A controller ensures that the hydrocolloid is heated evenly. The electronic control, which is monitored by sensors, controls the temperature with a low tolerance to prevent the duplicating material from overheating or forming lumps.

This reliably prevents overheated duplicating masses or the formation of agglomerations. Depending on the device, duplication can take place just a few hours after melting begins - an advantage that saves time and simplifies the process in the dental laboratory.

Some devices electronically record the number of melting cycles and inform the dental technician when the duplicating material needs to be changed, which is an important factor in quality assurance.

Once the duplicating material has flowed into the BEGO combi duplicating flask, it must be allowed to cool slowly to room temperature. This process takes around 60–90 minutes.

Important: Castogel®, Wirodouble® and WiroGel® M should not be placed in cold water over the model base to cool down, as otherwise the investment material filled in in the next step cannot set completely in contact with the duplicating material. The setting time of the investment material is also prolonged, resulting in raw model surfaces.

Once the duplicating material has cured, the base plate and base part are removed and the mold removed from the top. The hydrocolloid mold is cut in a ring shape parallel to the base part and the duplicating material strip pulled off the base part. The master model can now be carefully detached from the mold and removed. The hydrocolloid form is put back into the top.
The two wedges cut into the top are intended to assist secure repositioning and protect against twisting. If lower jaw dentures are cast "through" the model, the metal sleeve of the funnel former needs to be inserted into the duplicating gel in advance.
It is advantageous to fill the duplication mold with investment material only after a sufficiently long recovery time of at least 10 minutes.

Note:
- Small base plate for investing in BEGO mold former "red"
- Large base plate for investing in BEGO mold former "blue"

Example for duplicating device

Combi duplicating flask with wedge top, base and 2 base formers (REF 52090)

Wirodouble® (REF 52050), Castogel® (REF 52049), WiroGel® M (REF 54351)

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Duplicating with silicone

In contrast to hydrocolloid duplication, the blocked-out master model must not be soaked before duplication with Wirosil®. Wirosil® is an addition-curing, two-component silicone (mixing ratio 1:1) which replicates the master model with exceptional precision thanks to its high dimensional stability. With a Shore A hardness of 17 and a working time of approx. 5 minutes, it displays ideal working characteristics for taking impressions of milled surfaces in combination work.

In manual mixing, the silicone must be stirred until a completely homogeneous light blue color develops – the two components are then completely mixed. If the investment model is to be created under pressure, the silicone mold must also set under pressure. Approx. 4 bar is sufficient to put the silicone under pressure even in critical areas. This does not expel any bubbles in the silicone, but rather reduces them in size!

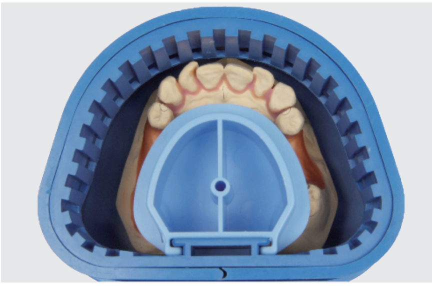
We recommend the use of the Wirosil® duplicating flask system. It is characterized by precise replication, form stability and ease of use. The stabilization insert and the three exchangeable palate formers in different sizes ensure extremely sparing silicone consumption with their flexible positioning.

After approx. 30 to 40 minutes, the base plate is removed and the silicone which has exited below the master model scraped off with a scalpel. The master model is now detached using compressed air and removed without tilting.

Wirosil® plus, the rapid alternative. The master model can be removed after just 10 to 12 minutes. When used in combination with shock-heat investment materials, remarkable time savings can be made in the work process.

For the duplicating of a master model prepared with silicone, the palate former reduces the silicone volume and increases the impression accuracy

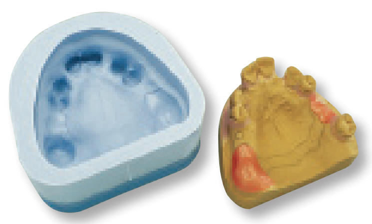
Wirosil® duplicating flask with stabilization insert and palate former



Tip for saving material:
Place broken pieces of Wirosil® from previous duplications into the base area in such a way that sufficient space is left in between for liquid Wirosil®.

Wirosil® (REF 52001)

Wirosil® plus (REF 54854)



Silicone mold following removal of the master model

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2

Producing a duplicate model

The silicone mold should be sprayed with Aurofilm before being filled with investment material. Aurofilm eliminates the water-repellent effect of the surface of the silicone. After an exposure time of 30 to 60 seconds, the Wirosil® mold is dried with compressed air.
The silicone mold must be completely dry for it to be possible to obtain optimal model surfaces. Otherwise the still damp wetting agent may react with the investment material.

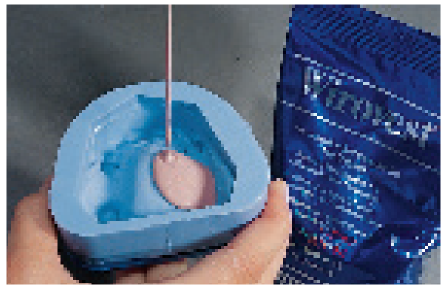
BEGO partial denture investment material is initially mixed by hand using the spatula for 15 seconds and then mixed completely in the mixing device in a vacuum for 60 seconds. A good vacuum (approx. 0.8 bar) is required to avoid air bubbles being included in the mixture and ensure smooth model and casting surfaces. Premixing by hand with the spatula is not necessary when an automatic mixer is used. The entire mixing process is performed completely automatically on the basis of preset parameters. At a temperature of 20 °C, the working time for the BEGO partial denture investment material is approximately 2:30 to 3:30 minutes. Higher temperatures shorten the working time.

The investment material is filled into the duplication mold on a vibrator at a medium level of intensity.
When using a pressure vessel, ensure that the silicone mold and the duplicate model have been produced under the same atmospheric conditions.
The model should be detached with compressed air before being removed from the silicone mold. The specified curing time of the investment model must be observed in all circumstances (see instructions for use of investment material).
Investment models produced in silicone molds can be dried in a drying cabinet or preheating furnace for 10 minutes at approx. 70 °C. The investment models are then sprayed with a thin, even layer of Durofluid model spray for improved adhesion of the wax mold parts.

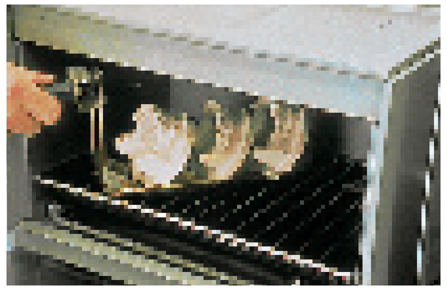
Investment models duplicated in hydrocolloid molds are dried for approximately 45 minutes at 250 °C.
These models are then immersed in the Durol dipping hardener for 5 to 8 seconds. The models should be moved gently when immersed so as to allow the Durol to penetrate evenly. They can then be replaced in the drying cabinet or preheating furnace for another 10 minutes.

Alternatively, we recommend the use of the solvent-free and – as biodegradable – environmentally friendly dipping hardener Durol E. In this case, it is sufficient merely to dry the duplicate models at 150 °C for 45 minutes. They are then briefly immersed in Durol E three times.

Note:
The specifications on mixing times, optimal working temperatures, mixing ratios, duplicating and immersion times included in the respective work instructions must be complied with if you wish to achieve a perfect casting.



Filling of partial denture investment material



Drying of investment models

Model made of Wiroplus® S

Durofluid model spray (REF 52008), Durol dipping hardener (REF 52111) and Durol E ecological dipping hardener (REF 52148)

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3

Investment

3

BEGO partial denture investment materials

The tried-and-tested BEGO partial denture investment materials lay the foundations for perfectly fitting partial denture frames. As a phosphate-bonded investment material, they are "fireproof" and their expansion can be controlled well. Their sophisticated composition produces extremely smooth model and casting surfaces displaying high edge strength and precision.

Quality control with state-of-the-art equipment: the dilatometer determines the thermal expansion of the BEGO investment materials

BegoSol®, frost protected down to –10°C (REF 51090) and BegoSol® K (REF 51120), BegoSol® HE (REF 51095) sensitive to freezing

Note:
Mixing liquids can be prepared to the required mixing ratio with distilled water. Pre-mixed liquid should be used within 4–6 weeks if possible.

WiroFine – Universal investment material for all indications in partial denture and combination technique for duplicating with hydrocolloid and silicone

- WiroFine – the phosphate-bonded shock-heat partial denture investment material which can be inserted at the final temperature
- Optimal duplication properties in silicone and hydrocolloid
- Insertion of the mold directly at 1,000 °C results in considerable time savings during the heating process
- Smooth surfaces of investment models with high edge strength
- Ideal for combination work

Wiroplus® S – Precision partial denture investment material for the silicone duplication technique

- Conventionally heatable investment material
- Developed especially for the silicone duplication technique, with outstanding material and working characteristics – high degree of detail and edge strength – ideal for combination work

Wirovest® and Wirovest® plus – Standard investment materials for partial denture technique

- Standard investment material for conventional casting
- The short setting times make it particularly suitable for hydrocolloid duplication, but also for duplication with silicone
- Wirovest® plus – The conventionally heatable standard investment material for silicone and hydrocolloid duplications and with an extended working time for more relaxed working
- Wirovest® plus for investing acrylic frames produced using the CAD/CAM procedure

VarseoVest® P plus – Shock-heat precision investment material, specially for casting 3D printed partial denture frames

- VarseoVest® P plus – the phosphate-bonded CAD/CAM shock-heat partial denture investment material is inserted directly into the furnace, which is preheated to 900–950 °C
- Creamy consistency for smooth casting surfaces with perfect reproduction of even the finest details
- Developed for investing Varseo acrylic frames produced using the CAD/CAM procedures, see page 22 ff.

Note:
Opened investment bags can absorb moisture and exhibit different expansion values during subsequent use. Always close opened investment bags airtight after removing powder, please.

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4

Wax-ups

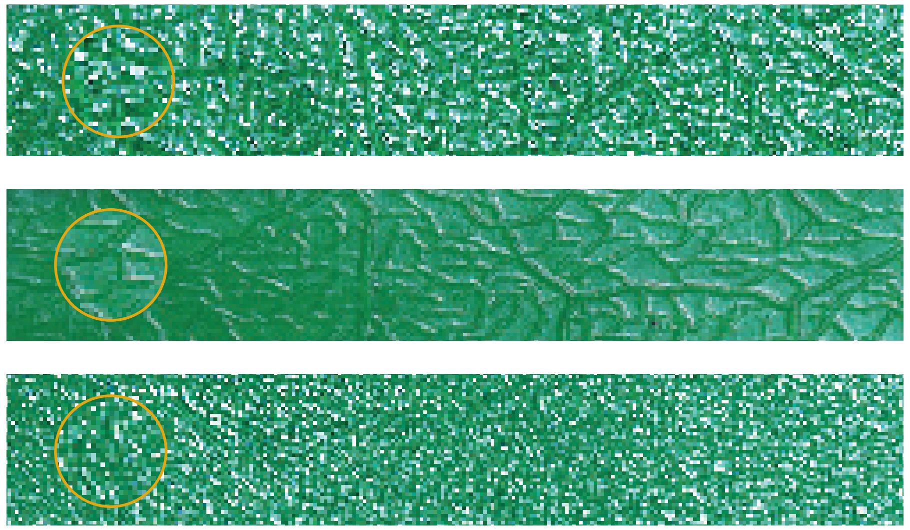
Wax-up in the upper jaw

In the first step, the design is transposed to the investment model. For the wax-up to adhere securely, the investment model should be kept at approx. 35–40°C during the wax-up. Preheated parts made of wax or acrylic facilitate the wax-up considerably.

The base is reinforced with smooth casting wax (0.30 mm). Then the retentions are positioned and waxed in place at full strength with the substructure. Semicircular wax profiles (1.15 × 1.75 mm) are helpful when waxing up the minor connectors. The stippled wax plate (0.5 mm) is best adapted from the deepest point outwards and cut off at right angles to the saddle.

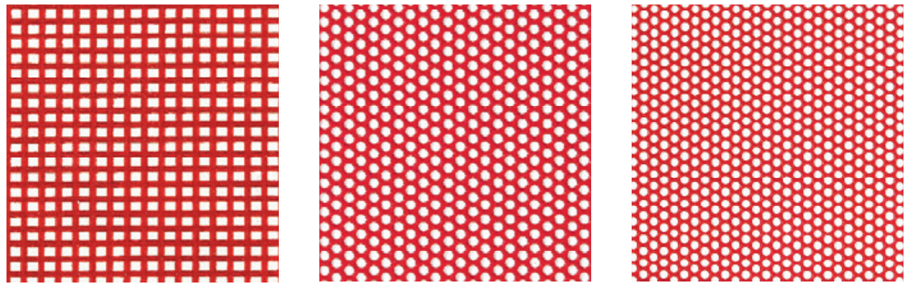
Lining with smooth casting wax

Minor connectors made from semicircular wax profile bars

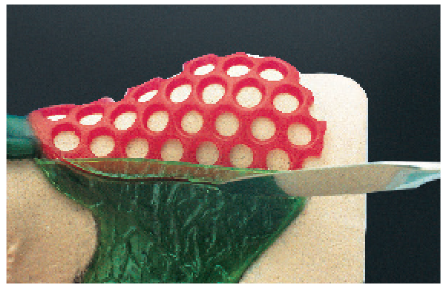


Stippled casting wax for waxing up the bases of upper partial dentures

Base is adapted from deepest point outwards



Wax grid retentions for occlusal partial denture frames – ideal for efficient and aesthetic wax-up of occlusal surfaces



The margin is cut at a right angle to the saddle

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Occlusal points and clasps should preferably be modeled last. The path of the clasps transposed from the surveyed master model shows the correct positioning of the clasps precisely on the investment model.

Starting at the tip, the clasp profile is carefully adapted to the hardened investment model. The specified shape must be preserved to ensure perfect functioning of the clasps following the casting. It should be ensured that the clasp profile tapers evenly from the rigid clasp shoulder over the upper arm of the clasp to the elastic tip. Due to the possibility of individual shortening, the wax clasp profile (REF 40022) in particular offers every technician the necessary flexibility in the scope of the
wax-up. In addition, due to its unique half-droplet cross-section, the type of clasp also effectively prevents remnants of food from becoming stuck.

As a general rule, all wax mold parts or plastic patterns need to be firmly adapted to the investment model or waxed on so that no investment material penetrates below the wax-up during investing. In combination work in particular, it has proven practical to position the first replacement teeth in advance so as to be able to transpose their position to the investment model using an overcast. The possible pontic-like design of the frame improves the wearing comfort for the patients.

Proven wax profile moulds facilitate the simple, individual modelling of a variety of dental indications. Dental indications, they are very easy to mould, do not bend open and can be easily fixed to the investment model.

Example maxillary wax-up

Taking care during wax-up saves time during finishing

0.8 mm beading wire for customisation of the saddle margin

Replacement tooth in the key for checking of design

Product details

Delivery forms	Contents	REF
Wax profiles, color: green, length 17 cm		
0.8 mm beading wire	30 g	40261
1.0 mm beading wire	40 g	40263
1.6 x 4.0 mm bars, lower jaw	75 g	40421
1.15 x 1.75 mm clasps, continuous clasps	50 g	40441
2.0 x 4.5 mm casting strips, upper jaw (small bases)	90 g	40462
2.0 x 6.5 mm casting strips, upper jaw	125 g	40461

Wax clasp profile, wax patterns/wax clasp profile for premolars, for molars, for Bonyhard clasps

Pictures and illustrations are exemplary. Colors, symbols, design, and information on the labels and/or packaging shown may differ from reality.

Wax-up in the lower jaw

The aim should be to ensure a minimum distance of 4 mm from the upper edge of the sub-lingual bar to the gingival margin. As such, it is important for the markings to be transposed from the master model carefully. Bar profiles are available in a wide variety of shapes and sizes. The anatomic wax bar profile displays very good acceptance among patients. It boasts a rounded upper edge and concave shape facing the tongue.

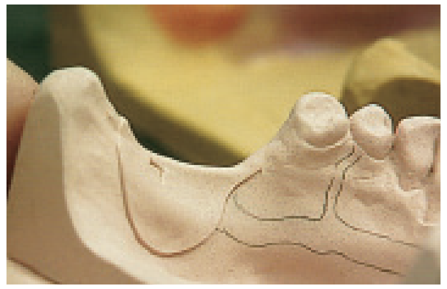
The standard bar profile has also proven popular and efficient (4 × 2 mm).

The standard bar profiles are admittedly easy to adapt and wax to the model, but need to be subsequently rounded along the contact surface with the alveolar ridge during finishing.

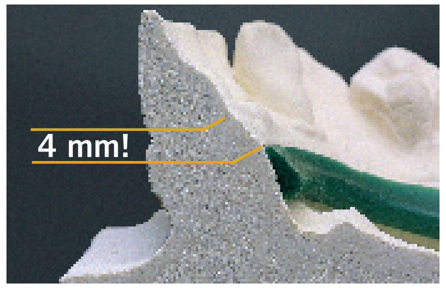
Minor connectors are produced from semicircular wax profile bars (1.15 × 1.75 mm) in advance. Position mandibular retentions in the centre of the alveolar ridge and wax to the bars at full strength. Only wax the 0.8-mm-thick wax beading wire on from the bar. The occlusal points and clasps are then modeled.

Tip:
For periodontal prophylaxis, a distance of approx. 4 mm should ideally be maintained between the gingival margin and the upper edge of the bar in the case of lower-jaw partial denture bases.

Wax retentions for lower-jaw partial denture frames
The retention profile shape for the wax retentions is determined based on the individual indications and clinical requirements. This produces an outstanding bond between the frame and surrounding acrylic resin both in the lower jaw and for full upper jaw dentures. It is possible to model partial and full partial dentures simply and efficiently.



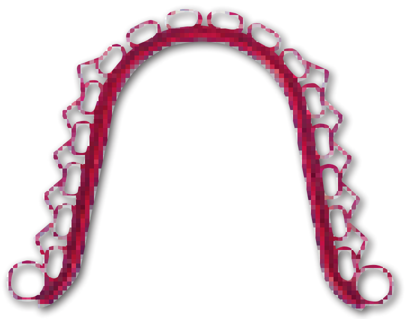
Duplicate model with markings



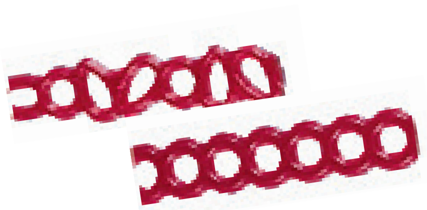
Ideal distance from base to gingival margin

Round wax profile 0.8 mm as border margin

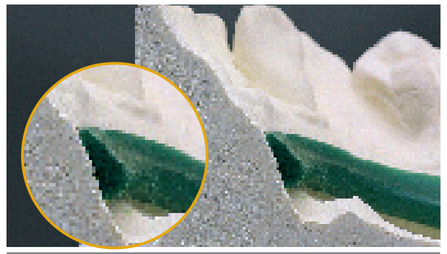
Pontic-like design of first replacement tooth



Wax border strip with retentions



Wax hole retentions and wax retentions with round holes (REF 40040–40051)



Anatomic wax bar profile

Pictures and illustrations are exemplary. Colors, symbols, design, and information on the labels and/or packaging shown may differ from reality.

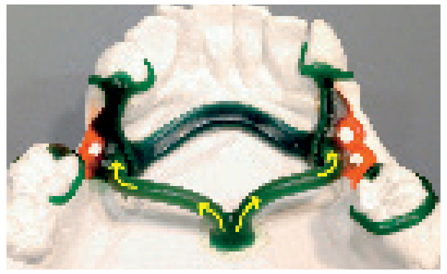
Sprue technique

During casting, the alloy should always flow “from thick to thin”. During cooling, the molten metal is sucked out of the sprues’ reservoir and thicker parts. Thinner sections of the wax-up cool down quicker than thicker elements.
For this reason, the sprues should always be positioned in the thickest areas of the wax-up, e.g., the transition from the saddle to the base.
Thick points that the molten metal can only access through thin areas are supplied by an additional round sprue measuring 3 mm in diameter.
In the upper jaw, casting strips which are as flat as possible should be used on the base due to the broad contact surface with the wax-up.

Note:
It must be possible for the molten metal to enter the mold cavity quickly and evenly. This prerequisite should always be taken into consideration when placing the sprues. It is essential to avoid bottlenecks and kinked sprues, which interrupt the flow of molten metal.

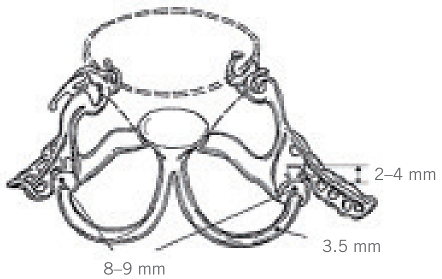
The BEGO partial denture system does not require additional auxiliary sprues or pressure compensation channels. When using vacuum pressure casting units, care must be taken to avoid additional connections between the cast object and casting funnel or wall of the mold at all costs. The coordinated process technology and a high-performance casting unit are decisive for high-quality results.

Apply sprues bent

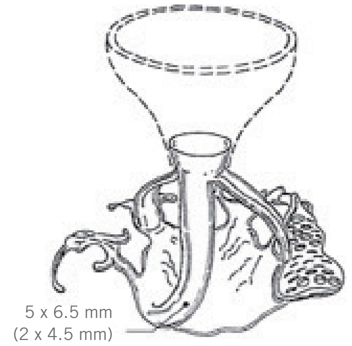


Cast through model, apply sprues bent

Sprue attachments in upper jaw, casting from above

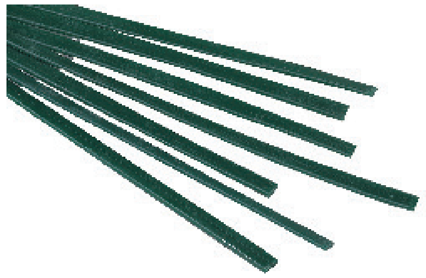


Round sprues – with reservoir – in lower jaw



Flat casting strips in upper jaw

Sprue attachments in lower jaw, casting from above



Wax profiles, upper jaw casting strips (REF 40261–40461)

Wax wire, medium-hard (REF 40085)

Pictures and illustrations are exemplary. Colors, symbols, design, and information on the labels and/or packaging shown may differ from reality.

Preparation for investing

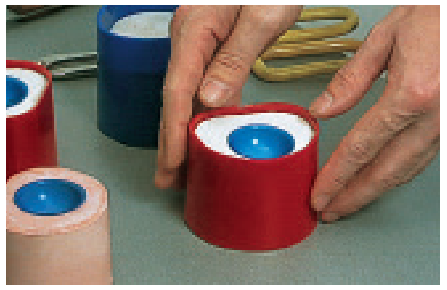
Preparation
Ideally, the wax surface of the wax-up should be degreased and the surface tension released prior to investing. This can be done by covering it with a thin film of the wetting agent Aurofilm. The Aurofilm must then be completely dried to avoid imprecisions or roughness in the casting.
If Aurofilm is not used, a thin layer of Wiropaint fine investment material can alternatively be applied to the surface.
The use of Wiropaint plus reduces oxide formation and ensures a very smooth casting surface free from casting pearls. Wiropaint plus is applied rapidly with a moistened, soft brush; the investing must then be performed without delay. Wiropaint plus must not be allowed to dry out. When fine investment materials are used, the wax-up should not be treated with a wetting agent like Aurofilm.

During duplicating with the BEGO combi duplicating flask for hydrocolloid duplication, the size of the base on the investment model corresponds to the contour of the red or blue mold former. The mold former is pressed securely onto the base.
If the investment model was produced without a base (generally during duplication with silicone), the model must be waxed onto the large (blue mold former) or small (red mold former) base plate without any gaps.

Investing the wax-up
With WiroFine, the same concentration is used for pouring the cylinder as for the model (WiroFine with BegoSol® K!). Molds made using the BEGO partial denture investment materials Wirovest® and Wiroplus® S should ideally be mixed with 30 % BegoSol®. According to the work instructions, the mixing fluid and powder should first be mixed thoroughly with a spatula by hand for 15 seconds and then mixed completely in the mixing device under vacuum for 60 seconds. When automatic mixing devices are used, the premixing with a spatula and mixing can be combined into one step. At a medium level of intensity, the investment material is filled into the mold former rapidly on the vibrator.
The molds should ideally harden in a pressure vessel for the first 10 minutes. The mold former should then be removed from the mold so as to allow the investment material unrestricted expansion. Before placing the molds in the furnace, allow them to harden completely for another 20 minutes in the scope of the conventional preheating.

Release surface tension on wax surface with Aurofilm, model on waxed-on base plate

Very smooth casting surfaces with Wiropaint plus, model with molded base



Hardening time 30 minutes for the conventional casting

Small mold former, red
Large mold former, blue

Wiropaint plus (REF 51100)

Tips for speed casting with WiroFine:
- Insertion temperature up to 1,000 °C
- Insertion time 20 minutes after mixing is started

Tips on concentration of the mixing liquid:
- Use only distilled water for adjusting the concentration of the mixing liquid.
- The quality of tap water can fluctuate.

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5

Varseo 3D printing CAD/Cast

Digital wax-up and 3D printing

Alternatively to the conventional partial denture technique, partial denture frames can be digitally designed and 3D printed using stereolithography technology in the BEGO system. 3D printer enables quick, simple and costeffective fabrication in the laboratory and with excellent flexibility and unrivalled precision.

The first step – similar to the conventional partial denture technique – is the production of a model. The master model is scanned in, digitally surveyed and virtually blocked out. The construction is then designed in 3Shape* DentalDesigner, for example. The supports required for the Varseo 3D printing are added using the included CAMcreator Print or optional CAMbridge* software. The objects are printed, post-cured, finished, invested in the VarseoVest® P plus investment material specially developed for the 3D printing of partial frames and cast at 900 – 950 °C Shock-Heat.

The workflow illustrated below is not intended to replace modeling instructions and merely represents an example for partial denture modeling from the CAD design – on the example of the partial denture modeling instructions in the 3Shape DentalDesigner – up to the partial denture frame. For detailed information on waxing up and processing, please refer to the guidelines on the production of CAD/Cast frames using the 3D printing method.

Step 1: Scanning the model

Scanner recommendations

Medit* T310, T510, T710 and 3Shape E1, E2, E3 and E4, as these scanner types are able to take over the markings on the model.
The PC configuration should comply with the 3Shape* hardware recommendations.

Software requirements

- 3Shape DentalDesigner* version from 2013 and newer
- Installation of VarseoWax DME (as of Version 2014) in 3Shape DentalDesigner

Step 2: Determining the path of insertion and virtually blocking out the model

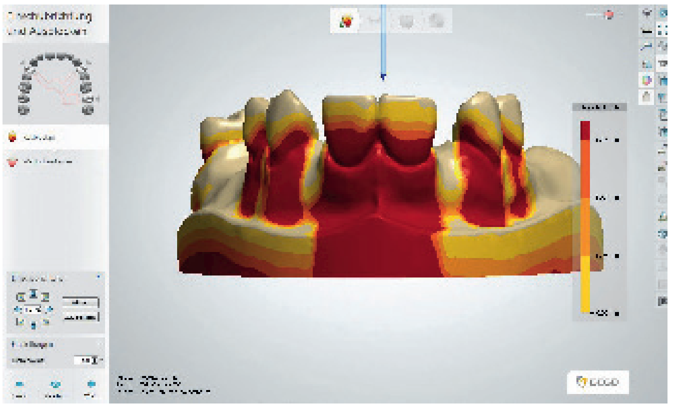
The key steps are:

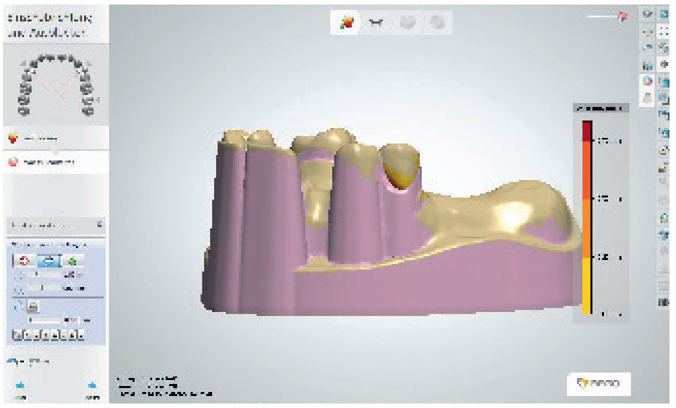
- Setting the preliminary path of insertion
- Display of undercutting areas and retention depths
- Definition and comparison of required undercuts
- If necessary, altering of path of insertion (model)
- Determining of undercut point
- Do not change model position any further; preserve final path of insertion
- Determining of positions of clasps (approx. 1/3 in field of retention)
- Blocking out: The wax knife function can be used to apply, remove and smooth "blocking-out wax"
- Check the clasp areas and remove the "blocking-out wax" in the area where the clasps will be positioned

Tip on undercut depth:
The undercut depth of the clasped teeth on the Ney model is determined as follows

- 1 ring corresponds to an undercut of 0.25 mm
- 2 rings correspond to an undercut of 0.50 mm
- 3 rings correspond to an undercut of 0.75 mm

The undercuts are shown digitally in color gradations.





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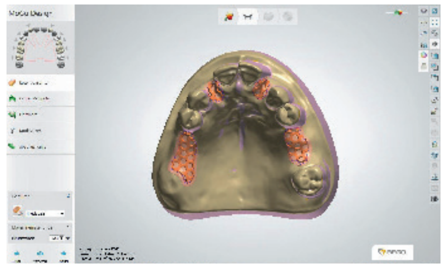
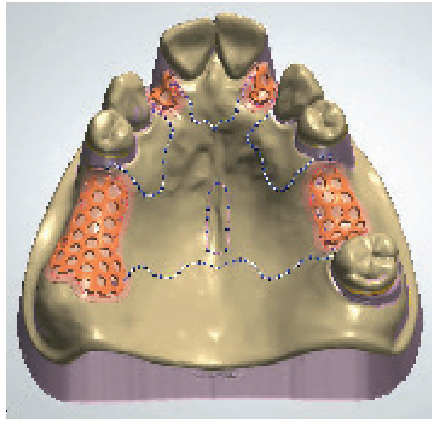
Step 3: Partial denture design, designing retention areas

There are a selection of different retention grids available in the software.
Different retention grids and lower jaw retentions can be selected in the "Contours" menu item.



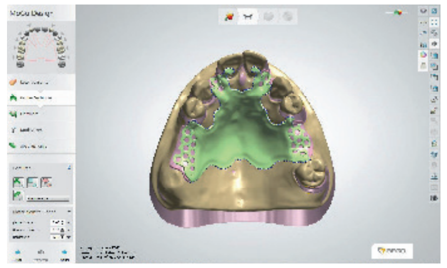


Step 4: Partial denture design, major connector

Major connector
The major connector is selected in the "Contours" menu item reflecting the model situation (upper/lower jaw).

Note:
Draw the connector contour so that it projects sufficiently into the area of the retention grid.

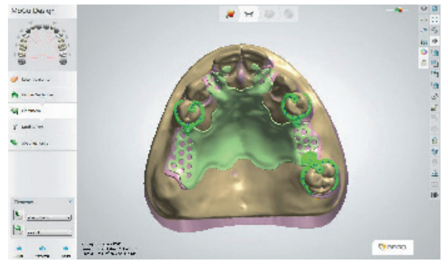
For a lower jaw, draw the sub-lingual bar using the "Sub-lingual bar" button.



Step 5: Partial denture design, clasp design

Clasps

You can choose between a number of types of clasp. The "occlusal point" can also be found under this menu item.
To connect the clasps to the base, use the "minor connector".



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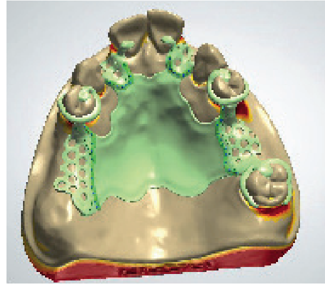
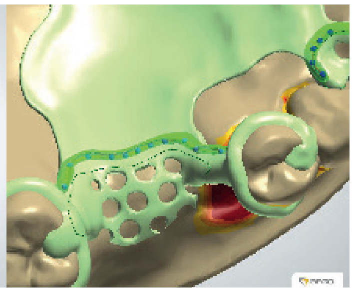
Step 6: Partial denture design, terminal edge

Terminal edge

The terminal edge should be positioned so that there is no overlap with the saddle wax, which will ensure that the partial denture is not weakened at this point. Ideally the terminal edge should be positioned further buccal.

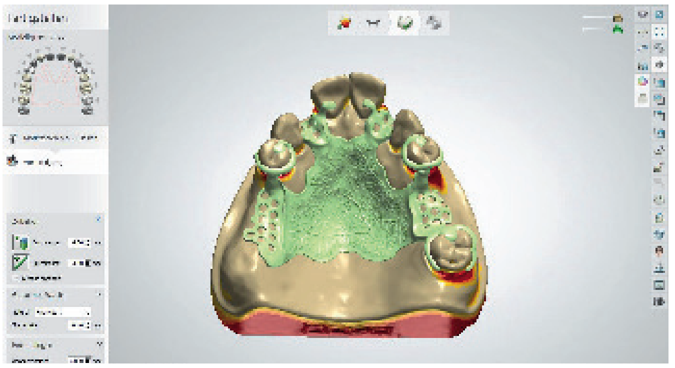




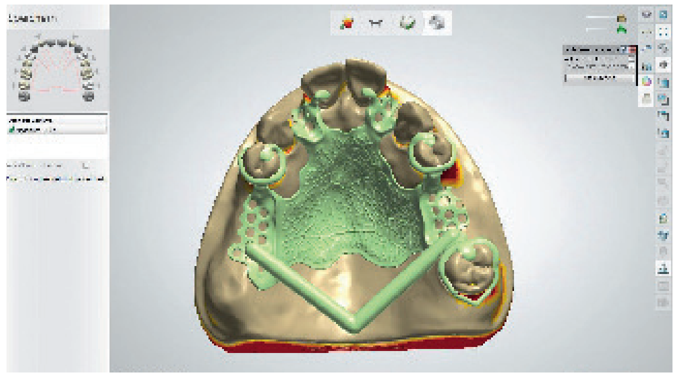
Step 7: Partial denture design, surface structure, crossbars, optional sprues

Modification of design

The “wax knife function” can be used to apply, remove and smooth the wax as usual. The transition between the base and the terminal edge should be a little thicker in order to make it smoother. Different surfaces can be selected under the “Stippled wax” menu item. If no stippling effect is desired, select “None”.

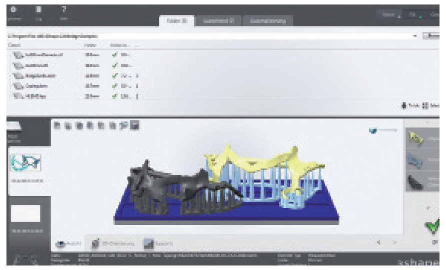


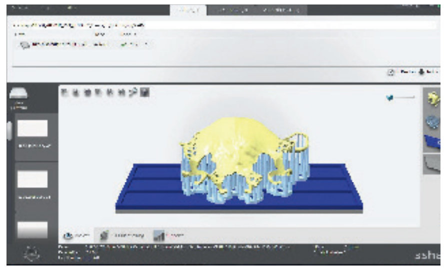
Note:
One crossbar/retaining pin is required for the production! Please attach it for the upper jaw and lower jaw. If the crossbar/retaining pin is to be used as a sprue, it must boast a minimum thickness of 3.5 mm. As a result, the partial denture can only be positioned in the mold vertically.



Step 8: Preparation for printing, nesting with 3Shape* CAMbridge software

The CAMbridge software allows you to prepare the modeled objects for the BEGO Varseo 3D printer as a build job and to provide them with supports.





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Step 9: Saving the data set and transfer to the 3D printer

System compatibility for BEGO 3D printing materials.
Select your material and printer combination.

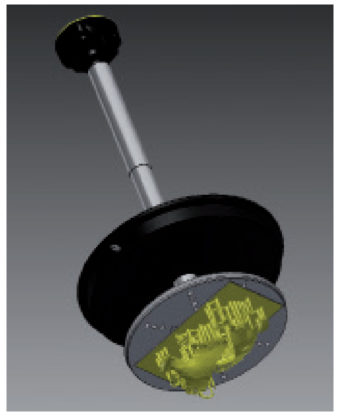
https://www.bego.com/de/3d-druck/kompatibilitaetsuebersicht/

Example 3D printer

Step 10: Removing the build platform and cleaning the printed object

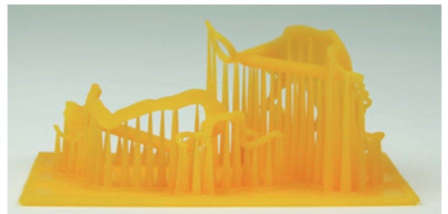
Remove the objects from the build plate as specified by the 3D printing device manufacturer.

The print object should then be completely cleaned with ethanol.



Step 11: Disconnecting supports and preparing the print object for casting

The support structures are then removed using either a cutting disc, side cutters or pliers. Make sure that the printed object does not become damaged or deformed! In order to achieve the desired material properties, avoid deformation and guarantee mechanical strength, the thoroughly cleaned print objects must be postcured.



Step 12: Investing with VarseoVest® P plus

The completely hardened objects made of VarseoWax CAD/Cast are prepared for casting in accordance with the usual specifications for “conventional” dental casting.

VarseoVest® P plus

The low-dust special investment material for casting 3D printed partial denture frames. The phosphate-bonded, shock-heat precision investment material. VarseoVest® P plus was specially developed for CAD/CAM partial denture constructions produced by means of 3D printing. The processing technique similar to that of conventional investment materials makes VarseoVest® P plus easy to use in combination with VarseoWax CAD/Cast printing resin. The unambiguous and clear expansion control with the special mixing liquid BegoSol® K ensures reproducible fit results.

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6

Preheating, melting, and casting

Preheating and casting

Preheating

Preheating

The temperature accuracy of the preheating furnace is important for perfect casting results. The molds should always be placed in the preheating furnace with the round side or funnel facing downward. This allows the heat to penetrate fully. The mold should never be allowed to come into contact with the floor of the furnace. This avoids heat build-up, which can damage the heating elements. The crucible can also be preheated to avoid premature signs of wear (with the exception of: Nautilus® crucibles and Fornax® FC crucibles).

Example of preheating furnace for crowns and bridges

Setting and preheating times for casting molds

Preheating furnace with conventional control

- After a setting time of 30 minutes, place the molds in the cold preheating furnace and heat to 250 °C
- Maintain the temperature at 250 °C for 30 to 60 minutes
- Then continue heating to the desired final temperature and maintain it for 30 to 60 minutes

Preheating furnace with computer control

- After a setting time of 30 minutes, place the molds in the cold preheating furnace
- Heat to 250 °C with a temperature increase of 5 °C/min
- Maintain the temperature at 250 °C for approx. 30 to 60 minutes
- Heat to the selected final temperature with a temperature increase of 7 °C/min
- Maintain the final temperature for 30 to 60 minutes
- The longer preheating time should be selected for large molds and full furnaces respectively

Recommended preheating temperatures for specific devices

- Vacuum pressure casting with Nautilus® for example: 950 – 1,000°C
- Centrifugal casting with the HF induction melting unit Fornax® T for example: 1,000 – 1,050°C
- Torch casting: 950 – 1,050°C

Example of preheating furnace for partial denture frameworks

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Casting concept and casting devices

Vacuum pressure casting and centrifugal casting

Nautilus® T

The compact, benchtop vacuum pressure-casting machine with integrated power cooling, induction heating and camera system.

The advantages for you:

- The casting process is manually controlled and triggered. The large touch display with intuitive menu navigation offers easy operation. An image of the melting process transmitted on the display supports the technician in detecting the casting point recognition.

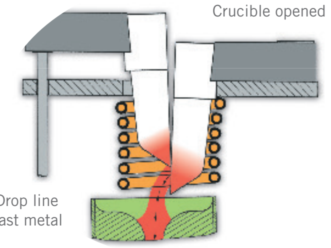
Nautilus® T (REF 26470)

Centrifugal casting with Fornax® T

As a conventional high-frequency induction casting machine, Fornax® T occupies a peak position around the world.

The infrared temperature limitation system makes it possible to maintain the casting molds at the attained temperature and heat them evenly just before they melt together. The infrared temperature limit is set to the maximum once the preheated molds have been inserted. The Fornax® T then reaches the casting temperature in just a few seconds.

This results in a controllable melting procedure and an extremely short casting delay. Casting point of BEGO partial denture alloys taking Fornax® T as an example: For WIRONIUM®, 3 to 5 seconds after complete melting together of the casting ingots. For WIRONIUM® plus/extrahart and the alloys in the Wironit® group, 9 to 12 seconds.



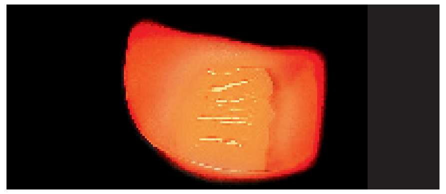
BEGO vacuum pressure casting concept: the molten mass flows from the hot zone of the crucible directly into the casting mold

To help with recognition of the correct casting point, please check out the casting videos on the BEGO website at www.bego.com.

Torch casting

Casting point of BEGO partial denture alloys: release the casting as soon as the casting metal has merged and the melt moves under the pressure of the flame.

Note:
Pressure setting for torch casting: Propane flow pressure setting "2" on the BEGO pressure regulator = approx. 0.5 bar, oxygen flow pressure 2 bar



Torch melting

Fornax® T (REF 26480)

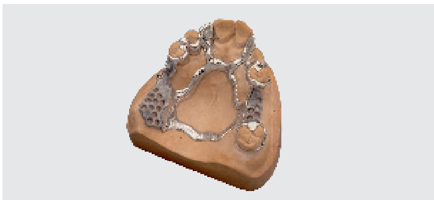
Alloys

The alloy employed has a considerable influence on the quality of the partial denture. All BEGO partial denture alloys have proven their worth over decades of use across the globe. Whichever alloy is used, they are all components of the BEGO system chain. The alloys in the Wironit® group possess mechanical characteristics which are also far superior to the requirements of the ISO 22674 standard. The alloys in the WIRONIUM® group are the premium alloys available from BEGO. Their high elongation limit and outstanding ductile yield produce frames capable of accepting high loads and with excellent ease of activation.

All WIRONIUM® and Wironit® alloys are highly corrosion-resistant. Corresponding certificates confirm the biocompatibility. All BEGO partial denture alloys can be processed with all conventional dental casting units and melting methods for the same type of alloys.

Delicate upper jaw construction

Reduced upper jaw base



Skeletonized upper jaw base

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WIRONIUM®

Alloy characteristics	WIRONIUM® plus	WIRONIUM®	WIRONIUM® extrahart	WIRONIUM® RP**
Type (according to ISO 22674)	5	5	5	5*
Density	8.3 g/cm³	8.2 g/cm³	8.2 g/cm³	8.5* g/cm³
Preheating temperature	950–1,050 °C	950–1,050 °C	950–1,050 °C	–
Solidus temperature, liquidus temperature	1,260, 1,390 °C	1,310, 1,410 °C	1,310, 1,410 °C	1,380, 1,420 °C
Casting temperature approx.	1,440 °C	1,440 °C	1,450 °C	–
Modulus of elasticity	246 GPa	233 GPa	243 GPa	235* GPa
0.2 % elongation limit ($R_{p0.2}$)	675 MPa	625 MPa	650 MPa	800 MPa*
Ductile yield (A_5)	12 %	13 %	13 %	13 %*
Vickers hardness	350 HV10	345 HV10	350 HV10	395* HV10
Qualified analysis in % by mass				
Co	62.5	63.0	61.0	66.2
Cr	29.5	29.5	30.0	28.2
Mo	5.0	5.0	5.0	5.5
Other	Mn 1.5 · Si 1.0 · C · N · Ta	Si 1.0 · C · Mn · N	Mn 2.0 · Si 1.0 · C · N	N 0.1

* after heat treatment 800 °C
** Manufactured exclusively by BEGO Medical

Wironit®

Alloy characteristics	Wironit®	Wironit® extrahart	Wironit® LA
Type (according to ISO 22674)	5	5	5
Density	8.3 g/cm³	8.2 g/cm³	8.2 g/cm³
Preheating temperature	950–1,050 °C	950–1,050 °C	950–1,050 °C
Solidus temperature, liquidus temperature	1,260, 1,400 °C	1,270, 1,400 °C	1,285, 1,390 °C
Casting temperature approx.	1,460 °C	1,420 °C	1,450 °C
Modulus of elasticity	220 GPa	238 GPa	232 GPa
0.2 % elongation limit ($R_{p0.2}$)	520 MPa	515 MPa	650 MPa
Ductile yield (A_5)	7 %	7 %	8 %
Vickers hardness	360 HV10	385 HV10	365 HV10
Qualified analysis in % by mass			
Co	64.0	63.0	63.5
Cr	28.5	30.0	29.0
Mo	5.0	5.0	5.5
Other	Si 1.0 · Mn 1.0 · C	Si 1.0 · Mn 1.0 · C	Si 1.2 · C · Mn · N · Ta

Wironit® LA (REF 50100)

Wironit® extrahart (REF 50060)

WIRONIUM® plus (REF 50190)

Pictures and illustrations are exemplary. Colors, symbols, design, and information on the labels and/or packaging shown may differ from reality.

7

Deflasking, sandblasting, and finishing

After casting

Do not quench the molds in the water after casting. In order to avoid dust, the fully cooled mold should be briefly immersed in water.
The deflasking is now performed with a small deflasking chisel or light hammer. The investment material adhering to the cast object and oxide layer can be sandblasted off manually or using a machine. This is done using Korox® special corundum with a grain size of 250 µm and a working pressure of 4–6 bar (manual) or 5–6 bar (machine). When using an automatic sandblaster, several frameworks can be blasted/cleaned simultaneously. If fewer than 3 objects are sandblasted at the same time in a machine, adding an extra casting cone or "old" partial dentures is recommended. This helps to avoid inaccuracies of fit resulting from severe roughening and excessive material removal. Critical areas (such as the insides of clasps and stress distribution arms) should always be sandblasted with Korox® 50 using a micro pencil blaster nozzle.

Note:

- Investment materials contain quartz. Do not inhale the dust!
- Danger of lung damage (silicosis, lung cancer)
- Wear an FFP 2–EN 149:2001 face mask

Sandblasted object

Korox® 250 (250 µm, REF 46014) special corundum blasting material

7

Example of a fully automatic sandblaster

Example of a combined blasting unit with two fine-jet pencils

Example of a 4-chamber sandblaster

Pictures and illustrations are exemplary. Colors, symbols, design, and information on the labels and/or packaging shown may differ from reality.

Finishing

The sprues can be disconnected particularly quickly and reliably with a high-speed grinder. The finishing is then performed either with a high-speed grinder or a handpiece motor. Carbide cutters, corundum grinding stones or diamond grinding stones are used for the processing.

The sintered diamond grinding stones boast a considerably longer service life than ceramically bonded grinding stones and help to reduce costs noticeably. They also prove more cost-effective than carbide cutters.

Eltropol 300 has proven its suitability for polishing. Two partial denture frames can be polished simultaneously in the Eltropol 300. The partial denture frame to be polished is positioned in the preheated Wirolyt polishing liquid. The liquid is moved around the objects automatically for optimal polishing results.

Note:
Used Wirolyt polishing liquid must be disposed of as hazardous waste!

The polishing current cannot reach deep areas of the palate due to shielding effects. These areas remain matt. BEGO electrolytic polishing units are equipped with a proprietary supplementary cathode.
This is positioned at the lowest point of the base without actually touching it. This ensures that the shielded points are polished as required. The partial denture frames are only adapted once they have been polished.

Disconnecting the sprues

Finishing with corundum or fine grinding stones

Eltropol 300 100–240 V (REF 26310)

Wirolyt 1 L (REF 52460)

Example of diamond grinding stones

Pictures and illustrations are exemplary. Colors, symbols, design, and information on the labels and/or packaging shown may differ from reality.

8

Shining, fitting, and polishing

Preparation

In preparation for the polishing, the object is rubber-polished with BEGO rubber polishing wheels, rubber polishing tips or rubber polishing lenses. Sharp edges must be avoided. Clasps, occlusal points and in particular the basal edge or each base should be smoothed carefully with rubber polishing tips. Clasp tips are rounded off lightly and carefully blunted.

Bubbles on the basal surface or insides of clasps are removed carefully with a carbide bur. Roughness within the stippled structure can be smoothed using a blunt bur and a rotational movement without altering the stippling.

The partial denture frame – apart from the retention section – is then polished to a high lustre evenly and without any grooves. The basal sections of the sub-lingual bar and each upper jaw base are particularly important so as to avoid mucosal irritations along the contact surfaces.

Important: The insides of clasps, the interior surfaces of stress distribution arms and the undersides of upper jaw bases must not be rubber-polished.

Polishing is performed with medium-length brushes and the blue BEGO partial denture polishing compound. A plaster base can prove very advantageous as it prevents bending of the partial denture frames during polishing.

Note:
Always switch on the extraction unit and wear a face mask when finishing.

Pre-polish and final polish for cobalt-chrome (REF 52310)

Diapol (metering syringe), diamond polishing compound for special applications (REF 52305)

Triton SLA (REF 26005)

Rubber polishing tips and polishing weels

Pictures and illustrations are exemplary. Colors, symbols, design, and information on the labels and/or packaging shown may differ from reality.

9

SLM Partial Dentures Frameworks using WIRONIUM® RP

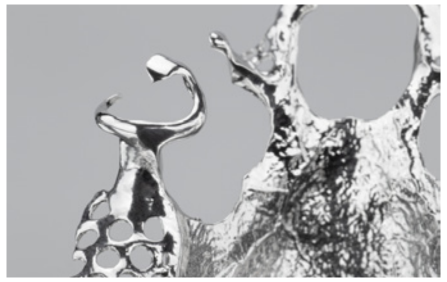
WIRONIUM® RP

The perfect combination of BEGO CAD/CAM and alloy expertise manufactured exclusively by BEGO Medical

Selective Laser Melting (SLM) – The additive procedure for the manufacturing of partial denture frameworks

The SLM procedure, co-invented and patented by BEGO offers unparalleled quality in the production of individual, complex metal frameworks. A laser is used to fuse the material together to form a virtually pore-free structure with the best material properties. The process guides a laser based on your CAD data. Based on the indication, the laser builds the framework layer by layer from the select metal powder (WIRONIUM® RP) in an additive process. BEGO has been using this technology for more than 20 years to manufacture crowns and bridge frameworks from Wirobond® C+, dispatch and process them in the dental laboratory where they are veneered with ceramic. With the BEGO powder alloys WIRONIUM® RP, BEGO offers an alloy powder for the production of high quality dental restorations in SLM systems in the dental laboratory or production centre. WIRONIUM® RP was developed based on the long-established and trusted BEGO cast alloys and optimised for the SLM production process.

Developed based on BEGO tried and true partial denture casting alloys used millions of times globally, WIRONIUM® RP offers outstanding product safety. WIRONIUM® RP also meets the requirements of the US standard ASTM F-75 for surgical implants. WIRONIUM® RP CAD/CAM frameworks produced by laser melting have a virtually pore-free microstructure, while the heat treatment adjusted to the alloy allows a precision fit. The downstream processing and final polish are comparable to conventional production, making it easy for the dental laboratory to create a smooth and high gloss partial dental framework. The laser melting process is extremely economical and allows great freedom of design.



Polished model cast

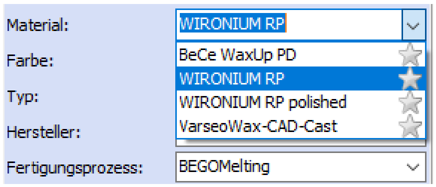
Blasted model cast

Order selection

Software requirements:

- 3Shape* DentalDesigner
- Installation of the BEGO DME material files

WIRONIUM® RP is a cobalt-based dental alloy for the SLM production process. It is suitable for the fabrication of partial denture frameworks (clasp and hybrid partial denture frameworks). When ordering, you have the option of selecting WIRONIUM® RP polished or unpolished.



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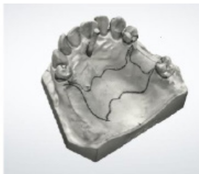
Step 1: Scanning the model

The process begins with model fabrication – similar to the conventional partial denture technique. The master model is then scanned, and it is optionally possible to measure the model conventionally.



Texture scan

Color scan

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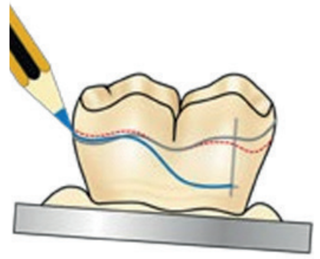
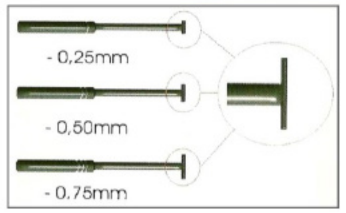


Mark the clasp line – one third is below the prosthodontic equator

Step 2: Define insertion direction and block-out the model virtually

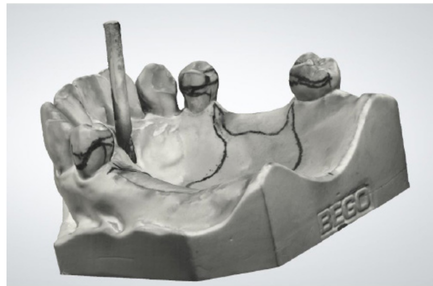
These are the important work steps

- Set the preliminary insertion direction
- The underflow areas and retention depth are displayed
- Define and adjust the desired undercuts
- If necessary, change the insertion direction (model)
- Define the undercut point
- Define the path of the clasps (approx. 1/3 into the retention field)
- Block-out, and additionally use the wax knife function for application, removal, and smoothing.
- Check the clasp areas and remove the "block-out wax" from the clasp area



Tip:
The undercut depth of the clasped teeth on the Ney model is determined as follows:

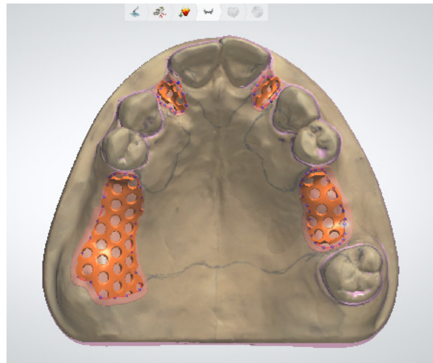
- 1 ring equals to an undercut of 0.25 mm
- 2 ring equals to an undercut of 0.50 mm
- 3 ring equals to an undercut of 0.75 mm



Insertion direction and conventional measurement (see also page 6)

Step 3: Partial denture framework design, Design retention areas

There are a selection of various retention grids available in the software.
Various retention grids and lower jaw retentions can be selected in the "Contours" menu item.



Note:
Specifications for material thickness and form can be found in the Checklist for designing Partial Dentures Frameworks using WIRONIUM® RP, from Page 42.

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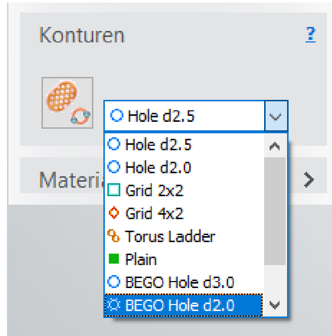


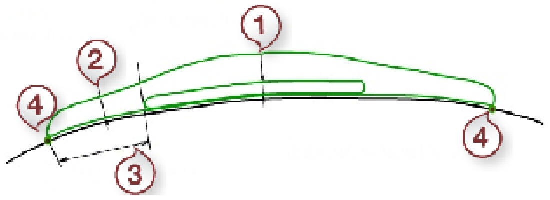
Pictures and illustrations are exemplary. Colors, symbols, design, and information on the labels and/or packaging shown may differ from reality.

Step 4: Partial denture framework design, large connector

Large connector

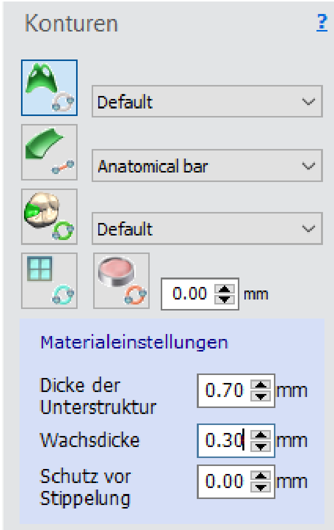
The large connectors are selected under "Contours" depending on the model (Upper jaw/lower jaw). To achieve the clinically required stability, the base should be designed to have a minimum thickness of 0.6 mm before finishing and a minimum thickness of 0.5 mm after finishing.

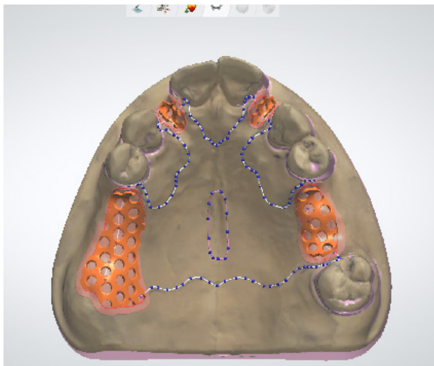
Caution!
Observe a minimum wax thickness (2) of 0.3 mm. Observe a minimum base thickness of 0.6 mm.

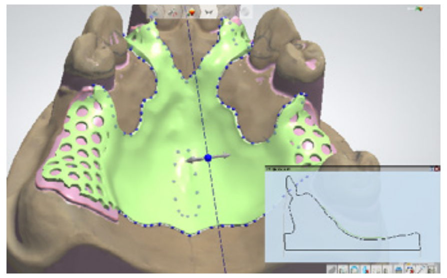


1. thickness of the substructure
2. wax thickness
3. initial distance of the supporting wax layer 2 mm
4. contour of the major connector

Note:
Draw the contour of the connector so that it extends sufficiently into the retention grid area.



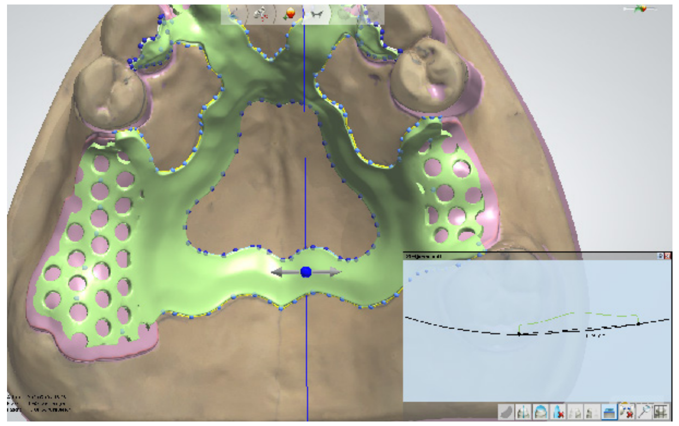




Pictures and illustrations are exemplary. Colors, symbols, design, and information on the labels and/or packaging shown may differ from reality.

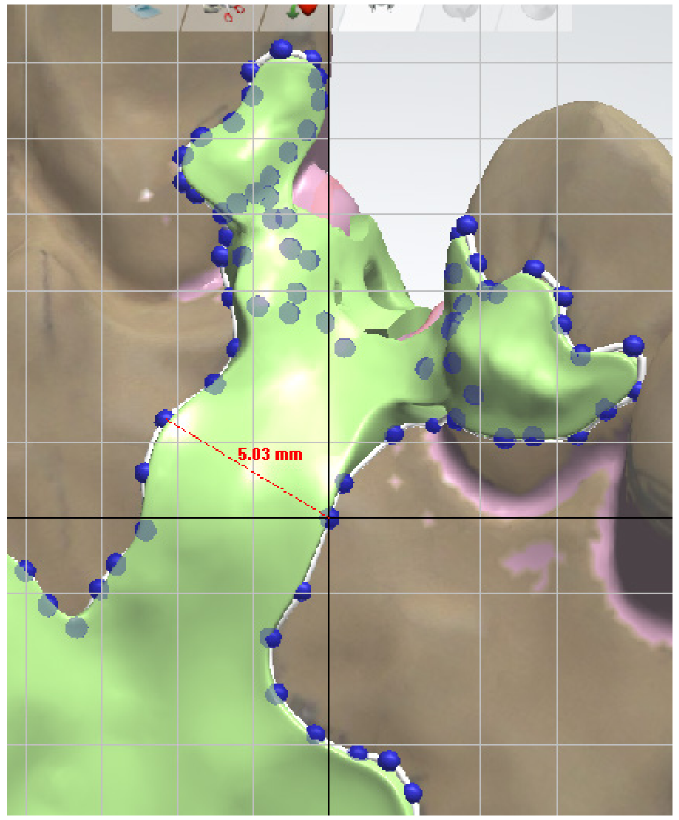
Skeletal frameworks

Since the stability of an upper jaw base is determined by a combination of shape, expansion, and material thickness, 0.6 mm (thickness) × 5.0 mm (width) should be viewed as the minimum.



Transversal bands

The minimum thickness of transversal bands is highly dependent on the respective width of the band. For a minimum total width of 5.0 mm (width), the transverse band must have a minimum thickness of 1.7 mm (thickness).

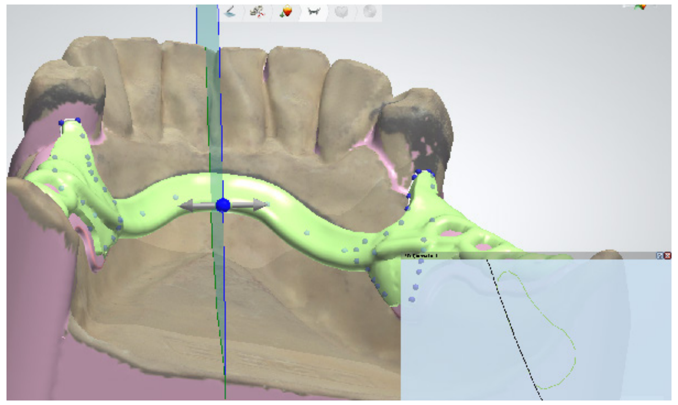


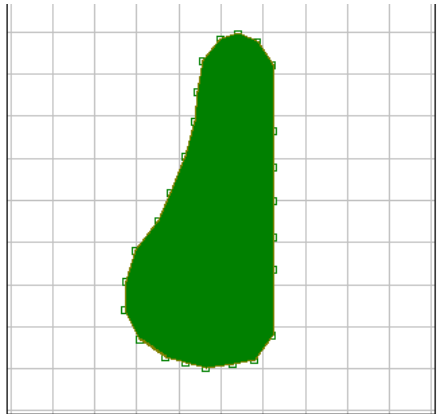
Pictures and illustrations are exemplary. Colors, symbols, design, and information on the labels and/or packaging shown may differ from reality.

Sublingual bar
For a lower jaw, draw the sublingual bar using the "Sublingual bar" button.

The sublingual bar should have cross-section dimensions of 1.8–2.0 mm (thickness) and 4.0–4.2 mm (height).

If blocking out of the sublingual bar is not desired, please deactivate this function in the control panel.

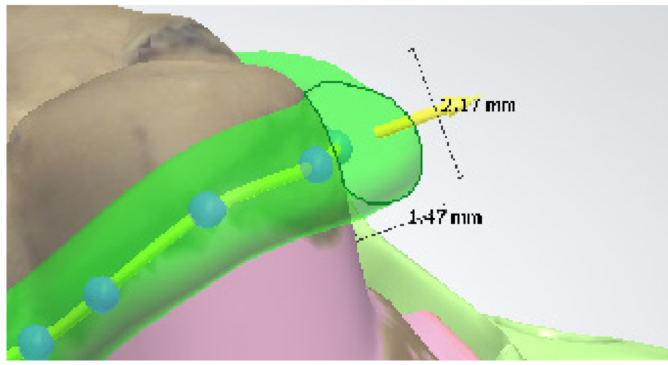




Automatic distance (hollow laying) ☑
Dimension of the distance 0.20 mm

Step 5: Partial denture framework design, clasp design

Clasps
You can choose from multiple types of clasps. BEGO clasp profiles were specifically developed for this purpose. The design of the clasp depends on its position and function, the extent of the restoration, and the requirements of the practitioner.
In the clasp shoulder area, the transition from small connector to clasp should be rounded. Ideally, clasps in the clasp shoulder area should measure 1.5 mm (thickness) x 2.00 mm (height) and taper toward the tip of the clasp 1.2 mm – 1.5 mm.



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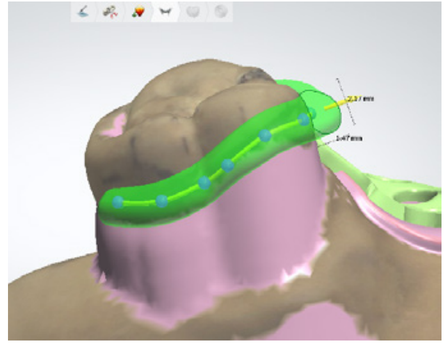
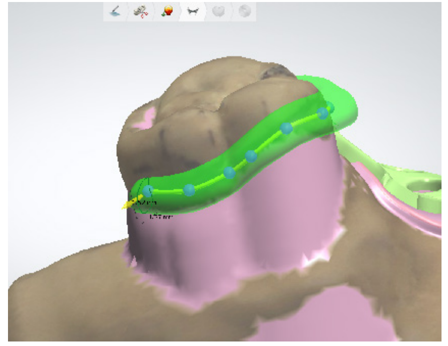
Pictures and illustrations are exemplary. Colors, symbols, design, and information on the labels and/or packaging shown may differ from reality.

Edges of area that don't meet material thickness specifications can be modified, smoothed, and reinforced using the tool.

The shapes of the clasp profiles and the parameters must be selected or defined accordingly in the design software.

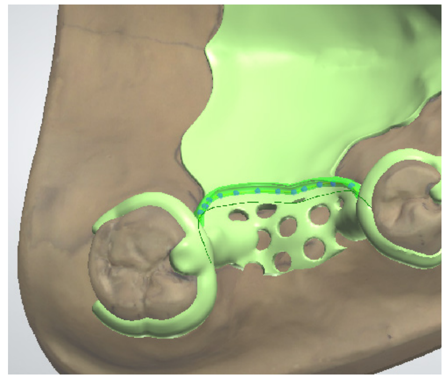
When using retentions, it is recommended that you use the profiles provided by BEGO to guarantee a smooth production process. The retention pins must be fully connected to the basal sections of the retention. The respective hole must be filled when positioning on grid or hole retentions.





Step 6: Partial denture framework design, terminal edge

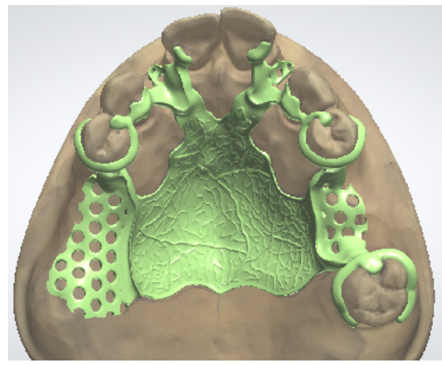
Terminal edge
The terminal edge must be positioned in a way that there is no overlap with the underlay wax, ensuring that the partial denture framework is not weakened at this point. Ideally, the terminal edge should have a more buccal position.



Step 7: Partial denture framework design, surface structurer

Design modification
As always, the "wax knife function" can be used for application, removal, and smoothing out. The transition between the base and the terminal edge should be slightly thicker to make it more even. Different surfaces can be selected under the "Stippled wax" menu item. If no stippling effect is desired, select "None".

Note:
A crossbar/retaining pin is not required for production! Attaching support structures to the construction or closing the clasps is unnecessary to stabilize the framework.



Post-processing of the objects
For finishing of the processed WIRONIUM® RP objects, use fine carbide, ceramically bonded stones or the fine-grit grinding stone commonly used in the partial denture technique (REF 43160, REF 43200). Electrolytic polishing can be performed as preparation for the final polish.

9

Pictures and illustrations are exemplary. Colors, symbols, design, and information on the labels and/or packaging shown may differ from reality.

Soldering

All parts to be soldered should be fixed using soldering investment. The maximum possible parallel-walled soldering gap is 0.2 mm. Use a suitable BEGO flux (e.g. Minoxyd, REF 52530). After soldering, the flux residues and oxides must etched of and the surfaces steam cleaned. We recommend soldering with a flame: Cobalt-chrome solder (REF 52520).

> **Note:**
> Due to the low thermal conductivity of BEGO non precious alloys, the required soldering temperature is achieved significantly later in the object than in precious metals.

Laser welding

If possible, use X seam and filler material.
Please follow the manufacturer's instructions and safety warnings for the device!!

Veneering with composite

Follow the manufacturer's instructions when processing the veneering systems on back plates. For polished partial dentures, the retention areas for acrylic saddles should be roughened before processing. Please refer to the instructions for use of the respective acrylic manufacturer.

Final processing and polishing

Metal surfaces that have not been veneered need to be ground, rubber-polished and polished. To simplify the rubber-polishing, the appropriate surfaces can be blast polished with Perlablast® micro (REF 46092, lead-free sodium glass). If required, electrolytic polishing with Eltropol (polishing liquid Wirolyt, REF 52460) can be performed. Then, they should be rubberpolished with appropriate rubber polishers and finished with suitable preliminary and final polishing compounds. The blue BEGO Co-Cr polishing compound (REF 52310) can be used for the high-lustre polishing. Any existing composite veneers or saddles must be polished according to the specifications of the respective manufacturer. Finally, the surfaces must be cleaned thoroughly by steam blasting or boiling in distilled water.

WIRONIUM® RP

Checklist for designing Partial Dentures Frameworks using WIRONIUM® RP

Please ensure when designing your partial framework that you have taken the following points into account before sending your file to BEGO

General parameters

- Smooth the model for easy insertion of the sublingual bar
- Block out the model with a blockout angle of at least 2°
- Adequately size the connections between the components based on your technical assessment
- Design the sublingual bar so that it sits flush; if necessary, set the bar distance to "zero"
- Retention pins were reinforced at the connection and firmly waxed onto the retentions
- Edges and uneven surfaces have been smoothed – please pay attention to the wall thickness
- For stippled sheets, select medium or coarse stippling
  - 3Shape*: "medium" or "coarse"
  - exocad*: "leather coarse" or "coarse"
- As part of the designing, the material removed by finishing work and polishing is taken into account – design approx. 0.1 mm thicker
- Do not attach stabilizing connections or bars
- Do not place support structures – BEGO places these individually
- Design retentions thicker, particularly when designing with exocad; close any holes in the retention mesh

- **The stated material thicknesses are guidelines that must be individually adapted depending on the design/construction**
- **The minimum thickness of the base is ≥ 0.6 mm – for a smooth base at least ≥0.7 mm**

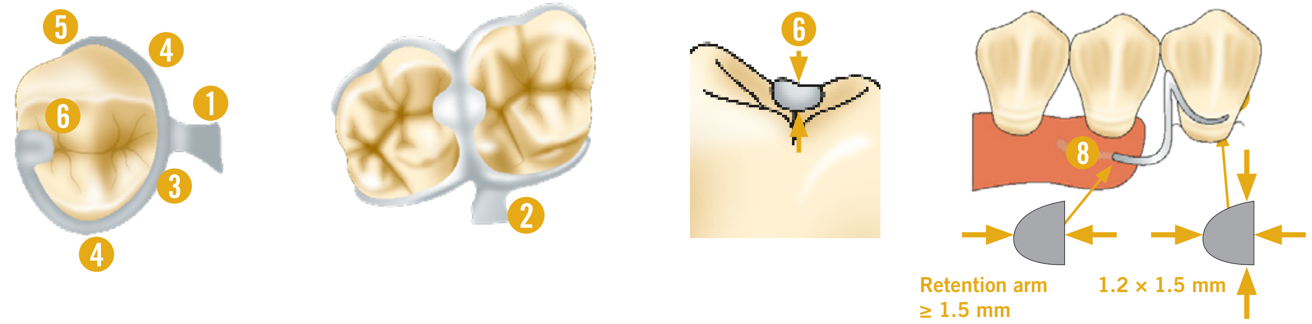
Support for the design of hybrid work from WIRONIUM® RP can be found under the following QR codes:

3Shape　　**exocad**

* This symbol is a commercial designation/registered trademark of a company which is not part of the BEGO company group.
Pictures and illustrations are exemplary. Colors, symbols, design, and information on the labels and/or packaging shown may differ from reality.

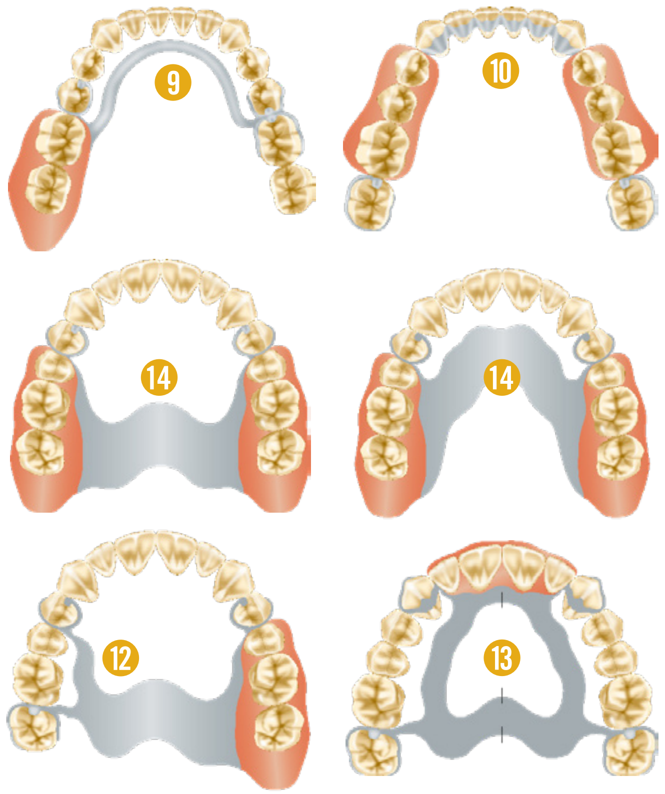
Clasp size (height × width in mm) relative to DME and exocad library for all elements

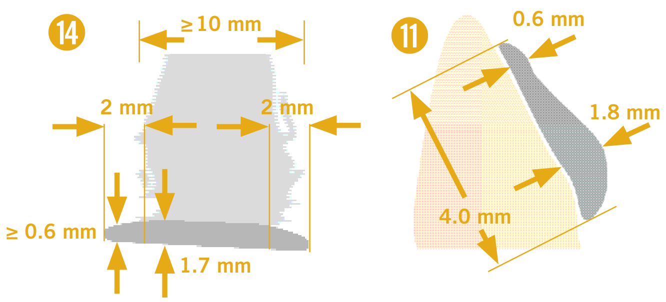
	3 Clasp shoulder*	4 Clasp arm*	5 Clasp terminal*	7 Clasp rest	8 Retention arm
E-clasp	1.5 × 2.0	1.3 × 2.0	1.2 × 1.5		
Ring clasp	1.8 × 2.0	1.5 × 2,0	1.2 × 1.5		
Bonwill clasp	1.5 × 2.0	1.3 × 2,0	1.2 × 1.5		
G-clasp	1.5 × 2.0	1.3 × 2,0	1.2 × 1.5		
Back-action clasp	1.8 × 2.0	1.5 × 2.0	1.2 × 1.5		
Bonyhard clasp		1.2 × 1.5	1.2 × 1.5	1.2 × 1.5	≥ 1.5 mm
1 Connector to the clasp shoulder	2.0 × 2.5 mm				
2 Minor connector for Bonwill clasp	2.0 × 2.5 mm				
6 Rest thickness	≥ 0.6 mm (do not design the edges tapering, avoid feather edges)				

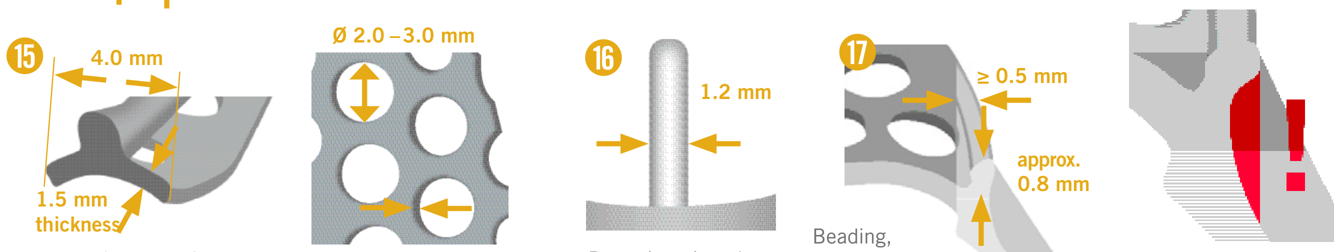


Construction elements

Nr.	Construction element	Size (height × width)
9	Sublingual bar	4.0 bis 4.2 × 2.0 mm
10	Continuous band	4.2 × 2.0 mm
11	Backplates	4.0 (tooth height) × ≥ 0.6 mm
12	Skeletal clasp connector	1.7 × 5.0 mm
13	Skeletal base	1.5 × 5.0 mm
14	Transversal connection, horseshoes-haped base minimum edge thickness	1.5 to 1.7 × ≥ 10.0 mm
15	Retentions in the saddle area	≥ 1.5 × 4.0 mm (reinforce lower jaw retentions if needed)**
16	Retention pin	Ø 1.2 mm
17	Beading	0.8 × ≥ 0.6 mm no feather edge less than 0.5 mm!







Lower jaw retention with reinforcement

Thickness approx. 1.0 – 1.2 mm
Upper jaw retention use Meshrim with exocad 3.1 Rijeka Partial CAD

Retention pin only as a simple pin, not a "mushroom"

Beading, height 0.8 × width > 0.6 mm, not tapering to less than 0.5 mm!

Do not work with an undercut! Please use the BEGO finishing line with exocad

* The stated clasp thicknesses are guidelines that must be individually adapted depending on the design.
** Depending on the retention profiles used
Pictures and illustrations are exemplary. Colors, symbols, design, and information on the labels and/or packaging shown may differ from reality.

10

Jointing technology

Laser welding

Alongside soldering and adhesive bonding, the laser welding of workpieces among other methods has established itself as one of the connection techniques commonly used in dentistry in recent years. The advantage of this technique is that workpieces can be directly joined together without any third material (solder) by means of a material bond. This allows the dental technician to create high-strength, biocompatible metal connections.

Benefits of laser welding

- Major time savings
- Simple procedure
- High strength of welded seam
- Great resistance to corrosion
- Precise working
- No difference in color to original material
- No polishing-out of solder
- Connection possible right next to composites ceramic veneers
- Option of checking accuracy of fit on master model

- No need for:
  - solder
  - soldering investment material or soldering model
  - flux or heat protection paste
  - production of keys
  - removal of saddles or veneers for laser welding

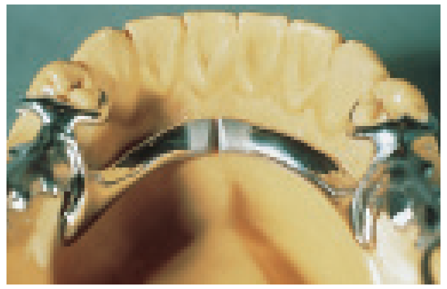
Laser stands for: light amplification by stimulated emission of radiation. All BEGO partial denture alloys have been tested in terms of laser applications. The WIRONIUM® plus and Wironit® LA alloys have been specially optimized for laser welding. Detailed dental instruction, also including the setting of parameters for key indications, will make your first use of the laser welding technique easier. This also includes the legally required training as a laser protection officer.

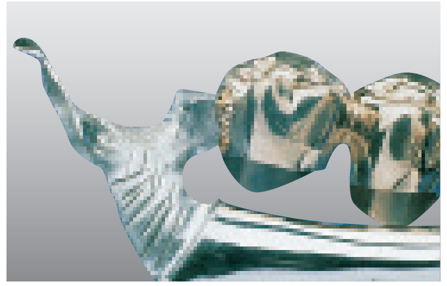
For welding of cutting split

V shape or

X shape (preferred design).

- Use filler material of the same or similar material as the basic material
- When using a combination of CoCr and precious metal, use the higher quality additional material, i.e., precious metal wire
- Build up contact points prior to fixation so as to avoid delays
- Sandblasting the fracture site from both sides with Korox® 110 minimizes reflection during welding
- Fix the workpiece on the opposite side first and then fill the seams with filler material
- Important for deep welded connections: check material strength – poor material strength results in worse performance
- Apply the welded seam resembling a caterpillar, ensuring approx. 80 % overlapping of the welding spots
- Use Wiroweld filler material


V-shaped opened and matted cutting split of a lower jaw bar


Combination of cobalt-chrome/precious metal


LaserStar T plus (REF 26405)

Note:
- Welded seam should be completely enveloped in argon – distance approx. 1 cm
- Discolored welding spots indicate an excessive combination of energy or insufficient envelopment in argon
- Cracks in welding spots point to an excessive application of energy and/or the laser beam
- When repairing partial dentures, remove the site of fracture completely and remodel the parts to be replaced as necessary
- Do not reuse compressed or overstretched frame sections; clean fracture site, produce X-shaped seam, sandblast with Korox®110; deep welding with filler material (Wiroweld); beam dia. 0.3 – 0.8

Changing the welding spot geometry when changing parameters

Increase voltage		Extend pulse duration		Enlarge beam diameter = FOKUS	
290 V-2ms-Fokus 03		290 V-2ms-Fokus 03		290 V-2ms-Fokus 03	
300 V-2ms-Fokus 03		290 V-**10ms**-Fokus 03		290 V-2ms-**Fokus 15**	
350 V-2ms-Fokus 03		290 V-**20ms**-Fokus 03		290 V-2ms-**Fokus 23**	

Welding consumables for laser welding (excerpt: a complete overview can be found in the BEGO catalogue dental technology)

Delivery forms	Composition in % by mass	Thickness in mm	Quantity	REF
Wiroweld (CoCrMo, carbon-free)	Co 65.0 · Cr 28.0 · Mo 6.0 · Mn · Sn	0.35	2 m	50003
Wiroweld (CoCrMo, carbon-free)	Co 65.0 · Cr 28.0 · Mo 6.0 · Mn · Sn	0.5	1.5 m	50005

Soldering and spot welding

Soldering is employed in the majority of laboratories as a popular method for metal connection in repairs and expansions. In contrast to welding, this technique involves an extra metal alloy – solder – which has lower working temperatures than the alloy to be joined. Flux such as Minoxyd prevents oxidation of the soldered site and allows the solder to flow into the soldering gap.

Porosity

- Porous points on the partial denture frame should be roughened slightly by grinding or sandblasted with Korox® 50 or Korox® 110
- Soldering is performed with cobalt-chrome solder (1,195 °C) and Minoxyd

Minor imperfections

- Minor imperfections can be lightly ground and sandblasted
- Apply spots of cobalt-chrome solder to the partial denture frame with the spot welding device
- Use Minoxyd flux for the soldering
- Apply the flame directly to the soldering site!

Add-on for base or clasps

The wax lift-off technique is only employed for minor expansions.

- Isolate the master model and bring in shape the part to be expanded in a detachable manner
- Apply sprue
- Remove the wax-up from the model carefully and invest
- Preferably invest in C&B investment material
- Preheating temperature: 900 °C for partial denture alloys

Tip for casting add-on parts
Bellavest® SH mixed with approx. 90 % concentration and started in the shock heat process directly at 900 °C saves time in the scope of repairs

Solders for BEGO partial denture technique

Main solder	Flux	Liquidus temperature
Cobalt-chrome solder	Minoxyd	1,195 °C
BEGO Gold solder I, 4 g roll	Minoxyd	790 °C

Transverse strip of combined attachment work with soldered secondary parts

Cobalt-chrome solder (REF 52520)

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In the case of clasp expansions and large-scale base expansion, the master model is usually blocked out, duplicated with silicone and then an investment model produced. This makes it possible to achieve an excellent accuracy of fit for the expansion.

- Remove the acrylic veneering in the area of the connection points on the partial denture for soldering
- Sandblast the soldering site to create good foundations for a durable connection
- Always cover acrylic areas with Thermostop heat protection paste
- Solder spots are added to the expansion and it is soldered with cobalt-chrome solder

Repairs

- Fix the parts to be soldered in the soldering block
- Grind recesses for the cobalt-chrome soldering rods and solder with Minoxyd flux
- If no soldering block is required, clamp the object in a soldering vice
- The areas to be soldered must be kept free of oxide and grease at all times
- For this reason, sandblasting prior to soldering is recommended
- If the soldering site oxidizes during the soldering, the soldering procedure must be stopped and the soldering site cleaned and/ or sandblasted again

Gold clasps

- Affix the gold clasps with a spot welding device or with object holders on the soldering table
- Solder with BEGO Gold solder I and Minoxyd flux
- Note: It is always better to use clasps made of a similar material!

Tip:
Anneal castings, after soldering clasps, at 400 °C for 15 min.

Fine mechanical parts

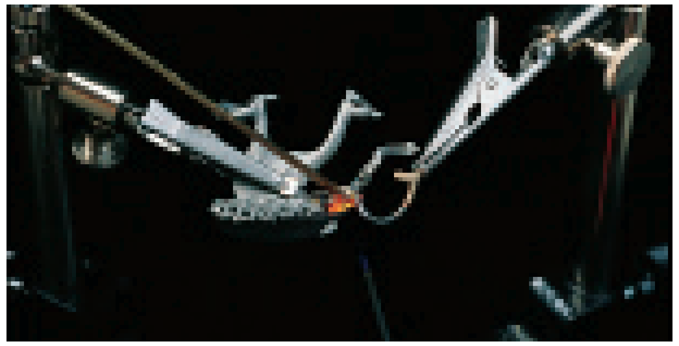
- Then fix the element
- Produce the soldering block
- Solder with BEGO Gold solder I and Minoxyd flux

Note:
Due to the low thermal conductivity of the BEGO non precious alloys the required soldering temperature in the object is significantly later reached than with precious metal.

Product details

Availability	Contents	REF
Minoxyd flux	80 g bottle	52630
Cobalt-chrome solder	4 g Pckg.	52520
BEGO Gold solder I	4 g roll	61017

Note:
Carry out repairs or extensions only using suitable solders or laser filler materials. Use cobalt-chrome solder (REF 52520) or Wiroweld wire as a laser filler material.



Soldering of a prefabricated gold clasp

Lower jaw with continuous clasp

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Preventive error management

Challenge	Cause	Solution
Minor imperfection on casting	The molten metal was not hot enough.	• Raise casting temperature or extend further heating time; set program or temperature presets to correspond to alloy; optimize flame setting when using flame melting.
	The mold was not hot enough.	• Check the temperature of the preheating furnace and raise if necessary. Maintain the mold at the final temperature for a sufficient period of time, do not position the mold too close to the furnace door.
	The casting delay was too long.	• Keep the casting delay as short as possible, preheat the alloy, do not remove the mold from the furnace until just before inserting it in the casting unit, preheat the casting crucible too if appropriate.
	The wax-up material used was not completely burnt out.	• Only use materials for wax-up which can be completely burnt out.
	An unsuitable sprue system was employed.	• Observe the fundamental principles of casting technology – cast from thick to thin; allow extra for thick sections such as metal backings, do not taper attachment points, avoid sharp edges and kinks in the sprue, use flat casting strips for upper jaw bases.
	The sprues were not waxed sufficiently.	• Wax the transitions between the funnel/base and sprue completely.
	The wrong program or tightening torque/casting pressure was set on the casting unit.	• Set casting parameters to reflect the indication and alloy.
	The wax-up was too thin.	• Produce a wax-up at least 0.4 mm thick. • Give large upper jaw palatal plates a little reinforcement.
	Too little alloy was used.	• Determine required quantity of alloy: weight of wax × density of alloy employed. Bear the alloy reserves for the sprue system in mind.
	The centrifugation time or pressure was insufficient.	• Check casting parameters and adapt.
	Auxiliary sprues were used for the vacuum pressure method.	• Do not use auxiliary sprues joining up to the casting funnel or mold wall in vacuum pressure casting – air enters the object faster than the molten metal.
	Parts of the wax-up (usually clasps) were too close to the mold surface during the vacuum pressure casting procedure (mold wall too thin, common issue in foil technique).	• Air enters the object through the pores in the investment material quicker than the molten metal. • Minimum wall thickness for mold surface in vacuum pressure casting technique is 5 mm!
Porosity in casting	Contamination within casting mold.	• Always place molds in the furnace with the opening facing downwards. Only use waxing up material that fully burns out without residue. Clean the furnace chamber and remove any contaminations!
	The casting was overheated.	• Do not overheat the alloy, shorten the further heating times, check the flame setting when flame melting.
	The sprue system was not optimally designed.	• Adjust the position of the sprue system, attach adequate re-servoirs to thicker sections, avoid sharp edges in the sprue system.

Challenge	Cause	Solution
Porosity in casting	The alloy is contaminated.	• The recast alloy was not properly cleaned or has been recast too often.
	Investment inclusions in the casting.	• The investment material was not fully set, sandy model surfaces, casting crucible scrapes the mold casting funnel; movement of the centrifugal arm carriage was not limited to 2–3 mm before the mold.
Rough castings. Refer also to "Residue in the duplication mold"	The molten metal was overheated.	• Reduce the casting temperature.
	Wax-up on rough investment model.	• Ensure correct liquid-to-powder ratio, see also "Residue in the duplication mold".
	The mold was held too long at the final temperature in the furnace/mold temperature was too high.	• Hold the molds at the final temperature for 30–60 minutes and then cast.
	The vacuum when mixing the investment material was insufficient (bubbles in the investment material).	• Ensure an adequate vacuum when mixing the investment material.
	The mixing of the investment material was insufficient.	• Observe and follow the times for premixing with a spatula and mixing as well as for any additional post-evacuation time.
Residue in the duplication mold	The duplication mold was too cold, gel was placed in cold water to solidify.	• Don't fill the duplication molds until they have reached room temperature. Aim for as short a setting time as possible.
	The surface of the gel mold was still too moist. There was still surface wetting agent residue in the silicone duplication.	• The surfaces of the duplication molds should be as dry as possible and the wetting agent should be allowed to dry completely.
	The model duplicated in gel was not hardened sufficiently.	• Allow the model to dry and harden sufficiently. Models duplicated with silicone do not required extra hardening.
	The mixing time was too short; the investment material was too cold when worked.	• Work the investment material in accordance with the instructions for use. The optimal working temperature is 20–22 °C.
	The liquid used has expired or was not suitable.	• Check the use-by date of the liquid and look out for contamination/crystal formation, only use the correct liquid.
	An incorrect mixing ratio was used for silicone duplication, the silicone was not fully set, the components were not mixed together homogeneously.	• Work the silicone in accordance with the instructions for use, ensure sufficient mixing of the components.
	The models were removed from the duplicating material too soon.	• Pay attention to the investment materials' setting times.
Cracks in the cast object	Cooled too quickly after casting.	• Allow cast mold to cool to room temperature slowly, do not quench in cold water!
	The wax-up was designed too thin.	• As far as possible, design the wax-up to be of even thickness, at least 0.4 mm.
	The fine investment material has dried out too much.	• The fine investment material should only be mixed with the main investment material "wet on wet".
	The casting cone on the object is too large.	• Due to its large surface area, the casting cone solidifies faster than the object and causes shrinkage cracks when compensating for volume loss.

Preventive error management

Challenge	Cause	Solution
Cracks in the mold	An initial crack was created at the overlap when using foils.	• Connect the overlaps properly. Avoid sharp edges by using adhesive or adding wax.
	The mold was placed in the furnace too soon or the furnace temperature was still too high when the mold was inserted.	• Adhere to the setting times, allow the furnace to cool fully before placing molds in the furnace when casting conventionally.
	The mold was heated too rapidly.	• Heat the mold using the speed or conventional technique in accordance with the indication of the investment, adhere to the recommended temperature heat rate when using the conventional technique.
	The plastic parts were invested or the wax-up was placed too close to the mold wall.	• Apply a little wax to the surface of the plastic parts, maintain a mold wall thickness of approx. 5 – 10 mm.
	Contaminated mixing bowl.	• Only use the mixing bowl to mix phosphate-bonded investment materials. • Use a separate mixing bowl for plaster, plaster-bonded investments and silicone.
	The Vaseline was absorbed into the investment material.	• Only coat the inside of the mold rings with a thin layer of Vaseline as a separator, the mold should be removed from the ring after approx. 10 – 15 minutes.
Molds crack and split in the speed casting technique	The mold was placed into the hot furnace too early, too late or at the wrong temperature.	• Pay strict attention to the insertion time window! • Follow the recommendations in the investment material instructions for use, insertion should usually take place after 20 – 30 minutes.
Defects on the casting, closed retentions. See also "Cracks in the mold"	The model and overlayer have separated.	• When using "foils", create undercuts as mechanical retention, smooth foil transitions with wax. • Avoid strong mechanical vibrations (heavy tapping).
	The wax adhesive used was too thick or overlaid.	• The wax adhesive used was too thick or overlaid.
	The dipping hardener used was not fully dried/not fully absorbed into the model.	• Dry and preheat models in accordance with the dipping hardener used, dry models for approx. 5 minutes more after dipping, if necessary. • The dipping hardener should be fully absorbed into the model. • Models duplicated using silicone do not require extra hardening; drying at approx. 80 – 100 °C is sufficient.
	The wax-up is not clean.	• Finish the wax-up cleanly on the model, avoid excess wax or remove it completely prior to overlaying.
	The models or overlayer (mold) were placed in the pressure unit too late.	• Do not put the poured duplication molds and casting molds under pressure after the initial setting reaction. Do not move the mold during the setting process.
Beads and bubbles on the casting object	The mixer fails to generate a sufficient vacuum.	• Check the mixer, pressure gauge, oil, tubes, seals.
	The wax-up was not sufficiently waxed or fixed to the model.	• Wax the wax and plastic parts together adequately; avoid cavities on the model, the wax-up must be fixed on the model securely.
	The investment material sets too quickly.	• Comply with the mixing parameters such as the mixing ratio, temperatures and times.
	The silicone surfaces were not degreased.	• Wetting agent has not been used or the wetting agent has not been allowed to dry completely before overlaying.

Challenge	Cause	Solution
Beads and bubbles on the casting object	The surfaces of the wax-up have not been degreased.	• Wetting agent has not been used or the wetting agent has not been allowed to dry completely before overlaying, alternatively use fine overlay.
Large bubbles on the wax-up	The air is "frozen" as drops in the overlayer, the investment material set too quickly.	• Block the master model out well, avoid areas with deep undercuts, adapt the wax-up correctly to the model, invest the investment under pressure, use fine investment material, fix the investment models to the mold base completely, adapt foils flush to the model, moisten the investment model slightly using distilled water before investing.
Casting too small	The concentration of mixing liquid was too low for the model or only water was used for mixing.	• Use the minimum concentration of liquid according to the instructions for use. Increase in small increments (5 – 10 %), if necessary.
	The duplicating material was too firm/hard.	• Adjust the mixing concentration to the hardness of the duplicating material (harder duplicating materials usually require a higher liquid concentration).
	The liquid has crystallized, was stored at too cold a temperature or may have frozen (check frost protection).	• Check the liquid for crystal formation – if in doubt, use a new bottle of liquid.
	Different pressure parameters were used during duplication and model fabrication with silicone.	• Use the same parameters during duplication and model fabrication with silicone. • Either both working stages with pressure or both without pressure.
Casting too large	The concentration of mixing liquid was too high for the model or only undiluted liquid was used.	• Use the mixing concentration according to the instructions for use or reduce it, if necessary.
	The duplicating material was not firm/hard enough, old duplicating gel was used.	• Check the gel mold for the correct consistency – it is better to reduce the recommended mixing concentration with very soft silicones. Change the gel, if necessary.
	Different pressure parameters were used during duplication and model fabrication with silicone.	• Use the same parameters during duplication and model fabrication with silicone. Either both working stages with pressure or both without pressure.
Casting distorted, irregular fit	The duplication mold has become deformed.	• Use duplicating flasks that are suitable for the duplicating material. Always place duplication molds on a flat surface to avoid deformation. • Move the duplication molds as little as possible during setting. • Use a stabilizing ring!
	Failure to observe the requisite recovery times for the duplicating material after removal of the master model.	• Allow an adequate recovery time when there is a high degree of deformation (deep undercuts on the model).
	The silicone has detached from the duplicating flask (stabilizing ring).	• Check for loose sections on the duplication mold after removal of the master model. • Always remove the master model carefully with the aid of compressed air.
	Error in the investment procedure (not mixed long enough, no premixing using a spatula, powder/liquid too cold).	• Adhere to the instructions for use for the investment material, follow the technique parameters.
	Deformation due to mechanical influences during deflasking.	• Do not deflask the casting while still red-hot; allow to cool fully. Deflask the casting carefully – do not hit the casting cone with a hammer, only remove investment from clasps and stress distributor by sandblasting.
	Deformation caused during polishing.	• Avoid irregular, excessive pressure when polishing, protect clasp tips (with a finger), when polishing delicate framework sections, fabricate a plaster model, if necessary, and use it to provide support.

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Challenge	Cause	Solution
Casting unsteady. Refer also to "Casting too small/ too large/ delayed".	The mold was placed in the furnace too early.	• Adhere to the technique parameters and times for placing the mold in the furnace.
	The duplication mold was moved during setting of the investment model.	• If possible, do not move the duplication mold during setting process.
Investment material sets too quickly	The storage and working temperature is usually too high. Do not clean/rinse the mixing dish with warm water.	• Store the powder and liquid in a cool, dry place; preferably in a temperature control cabinet at approx. 20 – 22°C.
	The mixing ratio was not observed or the incorrect liquid was used.	• Use the liquid and powder according to the instructions for use.
	The mixing time was too long.	• Select the mixing parameters according to the instructions for use.
Investment material sets too slowly	The working temperature is usually too low.	• Store the powder and liquid in a cool, dry place before use; preferably in a temperature control cabinet at 20 – 22°C; not in a refrigerator!
	Liquid was incorrectly transported or stored.	• Check the liquid for frost damage. Storage room should be frost free.
	The mixing ratio was not observed or the incorrect liquid was used.	• Use the liquid and powder according to the instructions for use.
	The mixing time, including premixing using a spatula, was too short/not thorough enough.	• Observe the technique parameters.
Wax parts do not adhere to the investment model	The investment model is not dry.	• Models duplicated using silicone should also be dried before waxing up; only the additional hardening stage is omitted compared with models duplicated using gel. • The wax-up adheres best to "hand-warm" models.
Bubbles in the duplicating material (gel duplication)	The master models were not properly soaked before duplication.	• Soak the master models (plaster) for at least 10 minutes at approx. 35 °C before duplicating with gel.
Silicone duplication only partially set on the surface	Silicone was not fully set – components were not mixed homogeneously or the surface of the master model was contaminated, e.g., due to residual impression disinfectant or use of unsuitable oils during milling.	• Work the silicone in accordance with the instructions for use, ensure sufficient mixing of the components. • Completely clean the surfaces of the master models before blocking out.
General investment technique	The following have an effect on the casting results: mixing concentration of the liquid, storage and working temperatures, mixing intensity (time and intensity of premixing with spatula, mixing time, speed and mixing paddle geometry of the mixer) as well as the types of duplicating material used.	• The only way to ensure consistent castings is by constantly maintaining these technique parameters and procedures.
General alloy technique	Clasps fracture easily.	• In addition to avoiding overheating of the casting or quenching during processing, the alloy should always be selected according to the specific indication; rigid alloys should be used for fixed/removable restorations and elastic alloys for clasp dentures. Use only new metal!

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Training and further services

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