



GUIDELINES

THE CROWN AND BRIDGE TECHNIQUE

Achieving success with the BEGO System –

What does this mean for you?

For over 45 years BEGO has offered a coordinated system of materials, alloys and equipment, as well as training courses on the fabrication of fixed restorations suitable for veneering with ceramics. Although the traditional skill of the dental technician has undergone major changes following the introduction of CAD/CAM technology in recent years, the key steps of the work process have retained their importance. Our top priority here is safe usage and further processing by dental technicians. As an innovative dental company we not only make stringent demands on the optimum quality of our own products, but also their systematic and safe application.

All non-precious alloys are specially developed by BEGO in-house with their intended application in mind. One example here is the alloys belonging to the Wirobond® product family, which have proved their worth for more than 30 years. Depending on the production process selected, objects made from Wirobond® can be processed using laser sintering (SLM), high-speed cutting (HSC) or casting.



Jörg Fasel,
Product Manager Consumables
BEGO

Clinical performance

The entire Wirobond® and Wiron® product family is not only clinically tested but also clinically proven. It is this fine difference that guarantees safety for the dentist, dental technician and, above all, for the patient. The prosthetic reliability, clinical suitability have been verified for many years now.

A wide range of consumables from wax through to investment materials and blasting materials ensuring optimum processing have been available for classical processing with the casting method for many years. The BEGO system is rounded off by innovative equipment, such as for example the automatic Nautilus® CC plus casting unit.

In addition, every BEGO casting unit is not only suitable for casting Wironit® or Wironium® partial denture alloys, but also for Wirobond®, Wiron® and Wirocer plus. Moreover, if appropriate crucible inserts are used, it is of course also possible to cast precious-metal alloys, which are very similar to non-precious alloys in terms of their processing.

Impressive processing

In the case of Wiron® 99, Wiron® light, Wirocer plus, Wirobond® 280 and Wirobond® LFC there is no need for the prolonged cooling of the ceramic normally required for non-precious alloys. In addition, we have managed to significantly reduce the hardness for Wiron® 99 and Wirobond® 280: This results in easier finishing by the dental technician and optimum usage for all milling work, as well as simple polishing. As regards veneering, dental ceramics of all known manufacturers can be used, depending on the alloy-specific CTE range. Wirobond® and Wiron® alloys can naturally also be veneered with composites.

Where extensions are required, with Wirobond® or Wiron® solder two materials are available for high-strength soldered connections. They are not visible after polishing and can also be ceramically veneered with ease. The laser welding technique should be given preference over conventional soldering. The use of similar filler materials guarantees a safe, biocompatible connection. Wiroweld welding wire is available for Wirobond® and Wiroweld NC for nickel-chromium alloys.

A company like BEGO that handles, researches and develops all variants of metal-ceramic systems for 45 years acquires extensive theoretical and practical experience. This expertise is available to you at any time via the BEGO Service hotline and is also communicated in full at our metal-ceramics training courses and programmes.

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1

Dental processing

Model making and coping fabrication

Model making

The model forms the basis for all work at the dental laboratory! The more carefully it is made, the more precisely crowns and bridges will fit.

The BegoStone plus super-hard plaster is used to make the master model/saw-cut model.

Process steps

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

Variation of the plaster-water ratio

20 ml +/- 1.5 ml to 100 g powder changes the material properties and working characteristics

- A reduction in the quantity of water will make the plaster harder while shortening the working time
- An increase in the quantity of water will make the plaster softer while lengthening the working time
- **Step 4:** The impression is poured on the vibrator. The model must then harden for at least 30 min before it can be removed.
- **Step 5:** Trimming of the teeth, setting of the pins, base positioning and sawing are the subsequent steps, which may vary depending on the modelling system used

Coping fabrication: the key steps:

- Shorten the spacer foil to approx. 1/3 of the tooth stump and reposition (Note: Before investing, the spacer foil must be removed from the coping. It creates the cement line necessary for fixation)
- Shorten the Adapta coping to approx. 1 mm above the preparation limit
- Separate the plaster die with Isocera and reposition on the tooth stump
- Close the space between the Adapta coping and the preparation limit with cervical wax
- Complete the crown



Heating the foils



Fit heated, soft foils on the forming unit



Press the tooth stump into the foils or Adapta mastic



Shaped coping with spacer foil



Deep drawing copings adapted on the stumps



Adapta deep drawing system (REF 20500)



BegoStone plus 5 kg (REF 54812) and BegoStone plus 12 kg (REF 54811)

Modelling: Copings made from wax

As an alternative to the Adapta deep drawing system, copings made from wax can be produced using the wax dipping technique. For the cement line, it is necessary to apply spacer varnish instead of spacer foil. The working temperature of BEGO dipping wax is approx. 75 °C. The crown margin of the dipped coping is completed with cervical wax. During wax-up sufficient space must be provided for subsequent ceramic veneering.

The metal frame should support the ceramic veneering from the inside and ideally have a reduced tooth form for the veneering. Within the framework of the wax-up it is important to observe the recommended minimum wall thicknesses of 0.4 mm for non-precious alloys and 0.5 mm for precious-metal alloys.

If a ceramic shoulder is to be created for the construction, the metal margin of the coping must end on the step or chamfer. This support is extremely important for the stability and durability of the ceramic shoulder.

If you are using a metal margin, it should end with a chamfer to support the ceramic veneering.

Note

From the outset the wax frame must always be prepared without sharp edges (especially in incisal areas), undercuts or abrupt transitions.

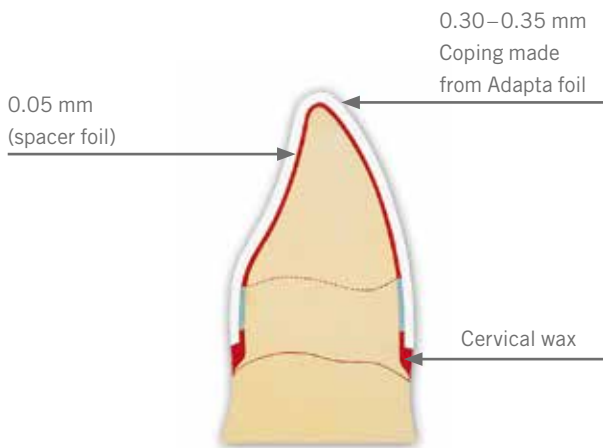
Transitional areas from the ceramic to the frame should be modelled with precision to prepare a sufficient layer thickness for subsequent ceramic veneering.



Occlusal wax, grey
Bridge frame with metal occlusal surface and vestibular veneering



Bridge frame for ceramic veneering, coping made from modelling acrylic



Cervical wax, aubergine (REF 40112) and dipping wax, green (REF 40009)

Compensating for missing tooth substance

If the tooth stump is too small, the missing substance is built up in metal as this is the only way to guarantee that the frame/ceramic layer thickness is as even as possible.

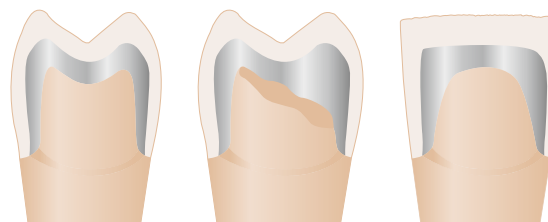
Alternatively, there is the option of already carefully blocking out or building up the tooth stump.

Where missing substance requires the tooth stump to be built up, this is the task of the dentist. If it is built up on the master model, this will produce a cement line of indeterminate size, which will preclude clear-cut positioning of the crown in the mouth.

When planning bridge constructions, the design of the interdental connections is of special importance. Pontics and interdental connections must offer maximum stability while simultaneously delivering optimum results in terms of aesthetics. Stability is influenced by the shape of the connection area – ranging from droplet-shaped to oval – as well as by the surface itself.

In general, we can say the higher the connectors, the greater their resistance to deflection of the construction when under masticatory load. Ideally, there should be a cross-section of min. 7 mm² in the anterior region and min. 9 mm² in the posterior region.

With limited space or with long-span bridges, the stability of interdental connections can be improved with elements resembling collars or inlays.



If the tooth stump is too small, the missing substance is built up in metal



Interdental connection not sufficiently dimensioned, risk of fracture

Interdental connection too flat, risk of fracture due to masticatory pressure



Interdental connection sufficiently dimensioned

Interdental connection in the anterior region



Occlusal wax, grey (REF 40114)



Occlusal wax, dentine (REF 40118)



Palatal collar with interdental reinforcement



Interdental connections at a sufficient height provide additional stability



Dipping wax copings

Sprue system

1

With single crowns and bridges sprues are waxed at an angle of 45° between the cast object and distribution channel.

After fitting on the mould former, the crowns are located outside the centre of heat, close to the wall of the mould, and can cool down first after casting. The distribution channel should be approx. 2 mm longer than the bridge on each side.

Overall, it must be ensured that the restoration is located outside the heat centre. Slender parts should be positioned at the edge of the mould as far as possible. This ensures they are the first to solidify and can no longer be drawn back in.

As solid pontics show greater volume shrinkage than the other thin-walled bridge sections on solidification, the distribution channel must be reinforced in this area so that it has at least the same volume as the pontic. Reinforced distribution channel with solid pontics.

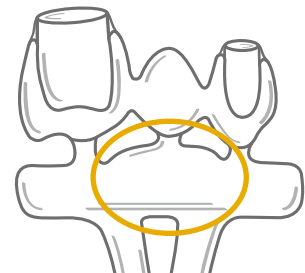
If the sprues are created according to these recommendations, the distribution channel will function as a casting reservoir. It supplies the cast object and in particular, the solid pontics with sufficient melt so that contraction cavities are prevented during cooling. The cast object can cool down from the crown margins over the occlusal surfaces towards the distribution channel if it is placed on the base socket mould former outside the heat centre during base positioning. See page 9 for more information (positioning of objects in the mould).



Attaching the sprues



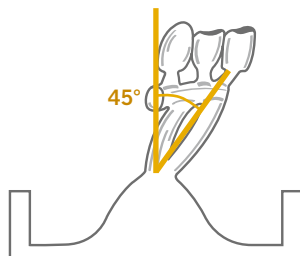
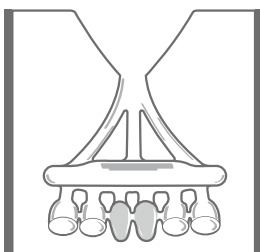
Sprues with distribution channel



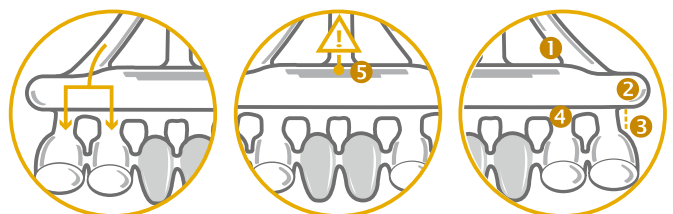
Reinforce distribution channel with solid pontics



4 mm wax wire for feeding from the base socket mould former to the distribution channel



- ① Ø 4–5 mm
- ② Ø 5 mm
- ③ approx. 2–3 mm in length
- ④ Ø 2.5–3 mm
- ⑤ Reinforce the diameter of the casting reservoir with solid pontics. The volume of the reservoir should correspond to that of the pontic.



Attaching the sprues

To avoid cavities, it is recommended to also supply single crowns indirectly. The sprues should be 4 mm wide and must not taper. A wax wire approx. 2–3 mm in length and 2.5 mm in width is required here for connection to the crown. With bridges, a distribution channel 5 mm in diameter should be provided. Besides wax wires, it is also possible to use hollow sticks with side openings which can be closed with wax. If solid plastic sticks are used, they should be covered with wax as the mould may otherwise tear during filling with wax.

Wax wires approx. 2–3 mm in length and 2.5 mm in width are used for connection to the individual pontics.

A wax wire 4 mm in width is sufficient for the channels from the base socket mould former to the distribution channel.

With large bridges, the distribution channel is created in the shape of a horseshoe and preferably divided in the canine area. This prevents distortion of the bridge during cooling.

Mixing and investing

- Apply Aurofilm wetting agent to the wax-up affixed to the base socket mould former
- Then dry carefully with compressed air
- Insert the moist BEGO fleecy inlay strip in the mould ring so it is flush with the upper edge of the ring

Precious-metal alloys:

Use one fleecy inlay strip for the mould sizes 1 and 3, and two fleecy inlay strips for the mould sizes 6 and 9.

Non-precious alloys:

Use two fleecy inlay strips for all mould sizes. If the 40 mm fleecy inlay strip (REF 52409) is used, the investment material is in contact with the mould ring at the lower edge.

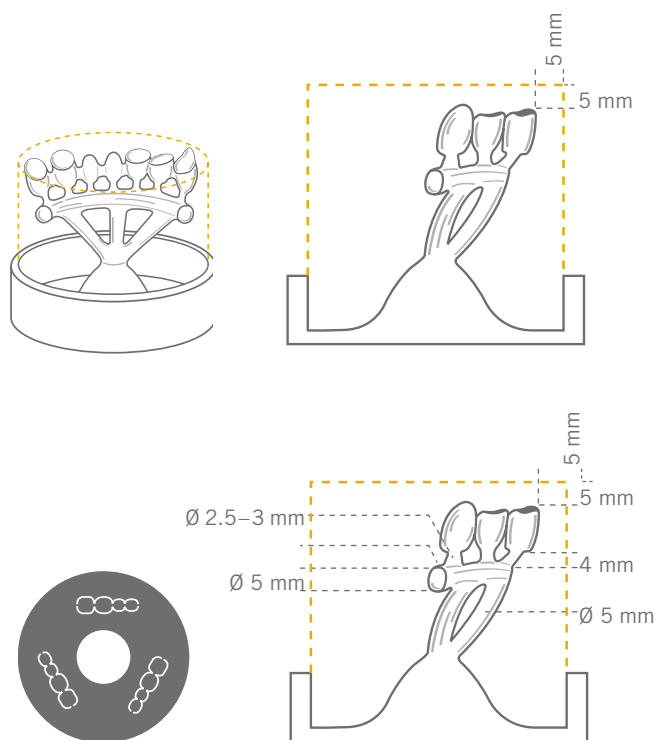
“Ringless” investing

If a system without a ring is used, e.g. BEGO Rapid Ringless System, no fleecy inlay strip is required!

Note
The silicone ring used should be removed as quickly as possible after the investment material has set (after approx. 10–15 min with a room temperature of 20 °C).



Divided distribution channel



Positioning of the objects in the mould



Investing with a metal ring and fleece



Ringless investing

Investing

1

Selection of investment material

When it comes to investing the wax-up, BEGO offers a range of investment materials such as Bellavest® SH or BellaStar XL which are innovative and have also proved their worth over many years. Mixing liquids which are exactly matched to the type of investment material reliably control the required degree of expansion, so ensuring outstanding casting results with all precious-metal or non-precious alloys.

Our product recommendation

Bellavest® SH

Rapidly or conventionally heatable, phosphate-bonded precision casting investment material, suitable for all crown and bridge alloys and pressable/press-to-metal ceramics. Precise expansion control and a fine, creamy consistency ensure reproducible accuracy of fit in the range of indications, from pressable ceramics to telescopic crowns made from non-precious alloys. BegoSol® HE is used as the liquid here. (REF 51095)

Bellavest® DR

Rapidly or conventionally heatable, phosphate-bonded precision investment material, suitable for all crown and bridge alloys as well as for telescopic crowns made from non-precious alloys. The at least 80 % reduced dust development during the processing provides a substantial improvement in the health protection in the dental laboratory. Precise expansion control and a fine creamy consistency lead to a reproducible accuracy of fit in the range of indications. BegoSol® HE is used as the liquid here. (REF 51095)

BellaStar XL

The rapidly or conventionally heatable, phosphate-bonded premium investment material is especially suitable for all crowns and bridges made from precious-metal alloys. It is also excellent for many indications involving non-precious alloys. Extremely fine-grained, light-bodied investment material with outstanding accuracy of fit and superb deflasking properties. BegoSol® K is used as the liquid here. (REF 51120)

Bellavest® T

Conventionally heatable, phosphate-bonded precision casting investment material, suitable for all crown and bridge alloys. BegoSol® is used as the liquid here. If greater expansion is required, BegoSol® HE can be used here as an alternative. (REF 51095)

Bellasun

Phosphate-bonded precision casting investment material, suitable for all crown and bridge alloys with an extremely long working time at high ambient temperatures. Conventionally heatable. BegoSol® is used as the liquid here. (REF 51090)



Suitable liquids for investment materials

	Bellavest® SH/DR		Bellavest® T		BellaStar XL		Bellasun
Liquid	BegoSol® HE 1 bottle (1 l) 51095 1 canister (5 l) 51096		BegoSol® 1 bottle (1 l) 51090 1 canister (5 l) 51091		BegoSol® K 1 bottle (1 l) 51120 1 canister (5 l) 51121		BegoSol® 1 bottle (1 l) 51090 1 canister (5 l) 51091
	BegoSol® HE 1 bottle (1 l) 51095W* 1 canister (5 l) 51096W*		alternatively BegoSol® HE		BegoSol® K 1 bottle (1 l) 51120W* 1 canister (5 l) 51121W*		
Delivery form	Bellavest® SH 144×90 g bag 54257 50×100 g bag 70060 30×160 g bag 54247 80×160 g bag 54252		30×160 g bag 54201 80×160 g bag 54202		30×160 g bag 54361 80×160 g bag 54362		80×160 g bag 54270
	Bellavest® DR 30×160 g bag 54862 80×160 g bag 54861						

Note: The mixing ratios are guide values and should be selected according to the specific alloy. Please see the work instructions (supplied with the investment material) for our recommendations regarding the concentration of the mixing liquid!

* (sensitive to frost) Shipping from 01.10. – 31.03. in thermal protection packaging

Tips for processing investment materials

Influencing factors	Recommendation	Comments
Mixing ratio Powder/liquid	Follow the specifications in the work instructions	<ul style="list-style-type: none"> • Change in setting behaviour and expansion values • With deviations an adverse influence on surface quality is possible
Concentration of mixing liquid	Select as specified in the work instructions, according to the alloy to be used for casting	<ul style="list-style-type: none"> • High concentration = high expansion • Low concentration = lower expansion • Properties such as hardness increase with the strength of the concentration
Material temperature	Approx. 18–20 °C is ideal for powder and liquid, store in a temperature control cabinet	<ul style="list-style-type: none"> • Higher temperatures result in shorter working and setting times. • Processing at excessively low temperatures may make casting surfaces rougher • Changes in the working temperature will affect e.g. the expansion behaviour of the investment material
Room temperature	Approx. 20 °C is ideal	
Premixing by hand	Premix by hand for 15 s	<ul style="list-style-type: none"> • Complying with the mixing times using an automatic, suitably programmed mixer ensures reproducible results. • Changes in the mixture intensity will affect e.g. the expansion and setting behaviour of the investment material.
Mixture intensity (speed)	Approx. 250–450 rpm	See above
Storage	Dry, dark and cool, liquid not below 5 °C!	<ul style="list-style-type: none"> • BegoSol® HE and BegoSol® K are not protected from frost – if the liquid freezes, it may become unusable!

Note: Reproducible results (cast objects) are only guaranteed by systematic processing using constant parameters of use!

Detailed information about processing investment materials for crowns and bridges can be found from page 36 forwards.



Fleecy inlay strips for moulds 40 mm, (REF 52409),
Fleecy inlay strips for moulds 45 mm, (REF 52408)



Investing with a metal ring and fleece



Wax wire for sprues Ø 2,5–5
(REF 40085–40089)

Preheating

1

Preheating

The preheating temperatures for Wirobond® and Wiron® alloys are 850–950 °C, depending on the casting unit used.
Exception: The preheating temperature for Wiron® light is 780–830 °C!

Shock-heat with Bellavest® SH/DR or BellaStar XL

Moulds in the sizes 1–6 made from Bellavest® SH/DR or BellaStar XL can be heated rapidly. Roughen mould surfaces, place moulds upright in the furnace (funnel former facing down) without direct contact with the floor or walls (use spacer or ceramic plate, see image to the right).

Observe setting time:

- 20–30 min after the start of mixing place the moulds in the furnace heated to 900 °C
- When using a system without a ring, e.g. BEGO Rapid Ringless System, remove the silicone ring used as quickly as possible after the investment material has set (after approx. 10–15 min with a room temperature of 20 °C).
- Final temperature 900–950 °C
- Hold times after attainment of final temperature (depending on number of moulds): 30–60 min



Miditherm with fluted floor plate

Conventional heating with Bellavest® SH or BellaStar XL

Furnaces with conventional control:

- After a setting time of 30 min place the moulds in the cold furnace or a furnace preheated to max. 250 °C
- Hold at 250 °C for 30–60 min
- Then heat to the final temperature and hold for 30–60 min

Furnaces with computerised control:

- After a setting time of 30 min place the moulds in the cold furnace
- Heat to 250 °C at 5 °C/min and hold for 30–60 min
- Then heat to the final temperature at 7 °C/min and hold for 30–60 min

Conventional heating with Bellavest® T and Bellasun

Furnaces with conventional furnace control:

- After a setting time of 30 min place the moulds in the cold furnace or a furnace preheated to max. 250 °C
- Hold at 250 °C for 30–60 min
- Then heat to the final temperature and hold for 30–60 min

Furnaces with computerised control:

- After a setting time of 30 min place the moulds in the cold furnace
- Heat to 250 °C at 5 °C/min and hold for 30–60 min
- Then heat to the final temperature at 7 °C/min and hold for 30–60 min



Miditherm 100 MP (REF 26150)



Miditherm 200 MP (REF 26155)

Melting and casting

Always use ceramic crucibles for non-precious alloys. Never melt different alloys in the same ceramic crucible. Always mark crucibles so that they cannot be mixed up. When casting with an open flame, the crucibles are placed with the moulds in the furnace and preheated.

Note

Graphite crucibles or inserts should never be used for non-precious alloys: Do not overheat alloy when melting, keep to specified casting times without fail!

Alloy quantity

The quantity required is calculated by multiplying the weight of the wax-up including the sprue with the density of the alloy. An additional 1–2 casting ingots are required for the casting cone. No casting cone is necessary when casting with the Nautilus®! Weight = approx. 6 g per casting ingot.

Casting point for BEGO non-precious alloys

When determining the optimum casting point for BEGO's individual non-precious alloys, the recommendations in the instructions for use supplied with the alloy are binding. The relevant information in the instruction manual for the casting unit should also be noted. Individual alloy-specific recommendations for casting BEGO non-precious alloys can additionally be found from page 16.

For recognition of the correct casting point, please take note of the casting videos available from the Media Library or the BEGO homepage at www.bego.com or ask us for a CD (REF 82987).

Casting concept and casting devices

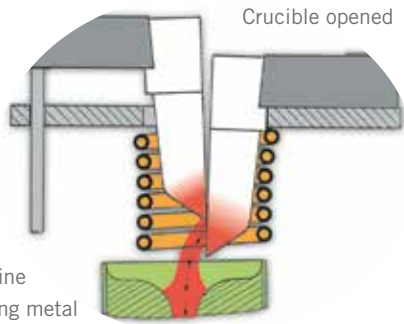
Vacuum pressure casting, casting with Nautilus® CC plus and Nautilus® T

Inductively heated premium vacuum pressure casting unit

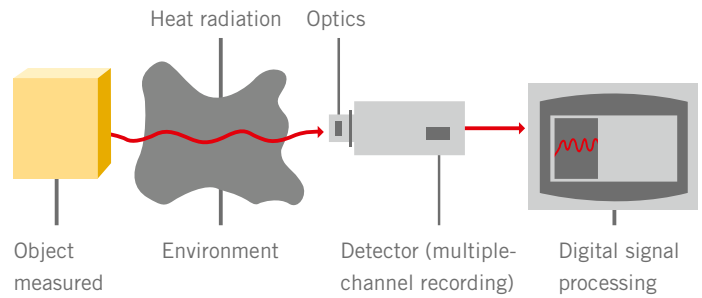
Nautilus® CC plus combines the advantages of high-frequency melting with those of vacuum pressure casting: the alloy is melted in the area around the crucible opening. Using a highly efficient vacuum pump, the oxygen level in the entire casting chamber is greatly reduced within a very short space of time and the alloy melted by means of a high-frequency magnetic field. The melt then flows directly under vacuum from the hot area into the mould without temperature loss (see figure on page 14). Within fractions of a second, the still molten alloy is then pressed into the finest crevices of the object. Integrated power cooling provides for over 50 casts in a row, even with high ambient temperatures, while saving water and so helping to protect the environment. Eco mode switches off all unnecessary components when idle and reduces operating costs.



Nautilus® CC plus (REF 26475)



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



Measuring system – functional principle (Nautilus® CC plus)
The optics of the measuring system route the measured data to the digital signal processing unit

Fully automatic temperature measuring system

All precious-metal and non-precious alloys with casting temperatures of between 700 °C and 1,550 °C can always be cast at the optimum casting temperature. Casting point recognition is fully automatic with a multi-channel temperature control. Material-specific fluctuations of the hot melt due to reflection and emission are recorded in short time sequences in the ms range and automatically compensated for by the system.

The advantages for you:

- The melt cannot overheat
- Measuring accuracy in excess of 99 %

User-friendly operation via the 7 inch colour touch display

The Nautilus® CC plus and Nautilus® T is operated and controlled via a 7 inch colour touch display which offers quick response times and simple menu navigation accompanied by recommendations on what to do.

The advantages for you:

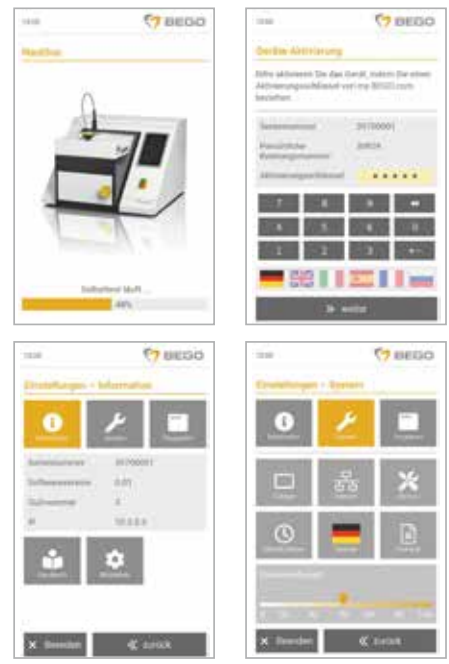
- Convenient, intuitive operation; direct and quick access to all necessary parameters
- Permanent orientation and control

Nautilus® T

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

The advantages for you:

- Compared to the Nautilus® CC plus 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® CC plus, color touch display



Nautilus® T (REF 26470)



Nautilus® crucible (REF 52488)

Images and illustrations are examples. Colors, symbols, designs and information on the depicted labels and/or packaging may differ from reality.

Compact induction casting machine

Fornax® T, the compact benchtop casting machine with very high-performance induction heating, guarantees short melting cycles, minimises oxidation and thus facilitates finishing. Integrated power cooling allows for over 50 casts in a row, even with high ambient temperatures. Casting temperatures up to 1,550 °C are possible: ideal for all commercially available dental alloys (apart from titanium). After assessing the melt, the dental technician initiates the casting manually. The specifications relating to the preheating and further heating times of the alloys are a reliable basis for determining the casting point.



Fornax® T (REF 26480)

Ceramic crucibles for optimum casting results

The ceramic crucibles for Fornax® casting units in genuine BEGO quality offer you many benefits:

- Excellent thermal shock resistance up to 1,550 °C, so minimising the risk of cracking
- The special geometry ensures optimum outflow properties for alloys
- The smooth, high-end surfaces additionally emphasise the high quality of the crucibles and enhance them perfectly

Only genuine BEGO crucibles are characterised by high-precision geometry and outstanding thermal shock resistance to ensure a long service life. Do not additionally preheat crucibles prior to usage!



Fornax® ceramic crucible FC (REF 52483)

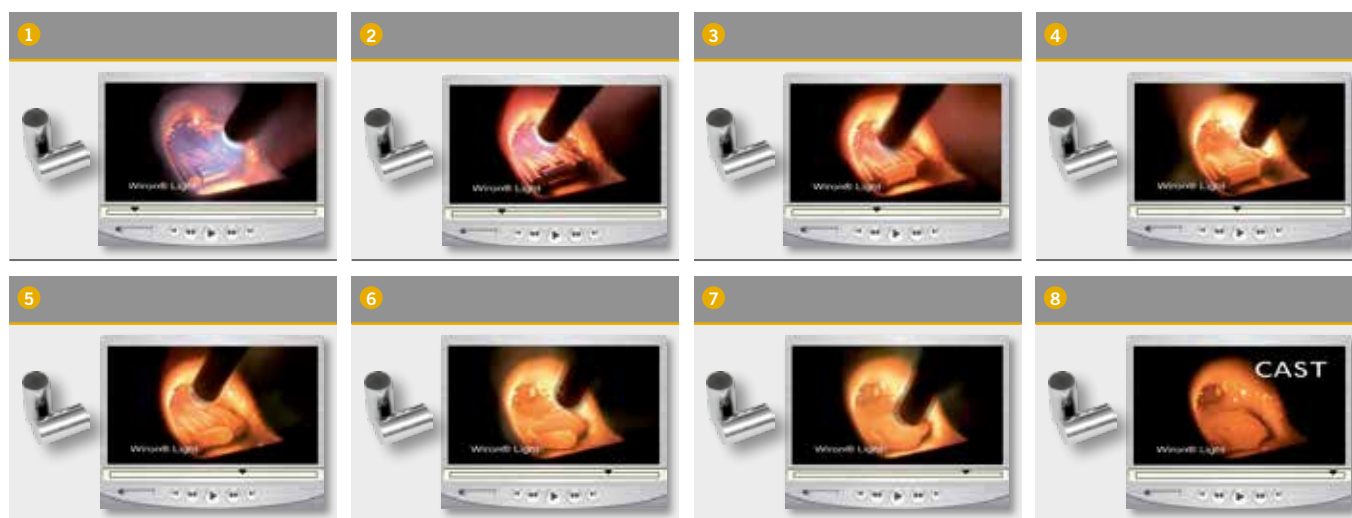
Flame casting

The prerequisites for trouble-free flame casting are a high-performance melting unit and the correct pressure setting for gas and oxygen. Unless specified otherwise, the following settings can be seen as guide values for the flow pressure:

Propane 0.5 bar, when using natural gas the relevant line pressure, oxygen 2.0 bar. Before melting, place the casting ingots close together in the **preheated crucible**. To melt, apply the flame using a circular motion. Continue melting until the casting metal merges under a joint oxide film and can be visibly moved with the pressure of the flame. Initiate the casting process without the oxide film tearing.



Torche melting



Melting video Wiron® light · www.bego.com/schmelzvideo-wiron

Casting point for Wirobond® 280

Vacuum pressure casting with induction heating (Nautilus®) and **centrifugal casting** with induction heating (Fornax®):
Once the last solid constituent in the melt bath is completely immersed continue heating for 1–5 s (depending on the induction output of the casting unit), then initiate casting. Observe the instruction manual for Fornax® and Nautilus®.

Centrifugal flame casting: Cast once the last solid constituent in the melt bath is completely immersed and the melt clearly moves under the pressure of the flame.

Casting point for Wirobond® C and Wirobond® SG

Vacuum pressure casting with induction heating (Nautilus®) and **centrifugal casting** with induction heating (Fornax®):
Once the last solid constituent in the melt bath is completely immersed continue heating for 0–12 s (depending on the induction output of the casting unit), then initiate casting. Observe the instruction manual for Fornax® and Nautilus®.

Centrifugal flame casting:
Cast once the last solid constituent in the melt bath is completely immersed and the melt clearly moves under the pressure of the flame.

Casting point for Wirobond® LFC

Vacuum pressure casting (Nautilus®): Once the ‘glow shadow’ has disappeared, continue heating for approx. 2 to max. 4 s, then initiate casting.

Centrifugal casting (Fornax®):
Immediately after disappearance of the shadow.

Centrifugal flame casting:
Cast once the casting metal has merged and the melt moves under the pressure of the flame.

Casting point for Wiron® 99

Vacuum pressure casting with induction heating (Nautilus®) and **centrifugal casting** with induction heating (Fornax®):
Once the last solid constituent in the melt bath is completely immersed continue heating for 0–12 s (depending on the induction output of the casting unit), then initiate casting. Observe the instruction manual for Fornax® and Nautilus®.

Centrifugal flame casting:
Cast once the last solid constituent in the melt bath is completely immersed and the melt clearly moves under the pressure of the flame.

Casting point for Wiron® light

Vacuum pressure casting with induction heating (Nautilus®) and **centrifugal casting** with induction heating (Fornax®):
Once the last solid constituent in the melt bath is completely immersed, continue heating for 0–10 s (depending on the induction output of the casting unit) and then initiate casting when the oxide film is completely torn. Observe the instruction manual for Fornax® and Nautilus®.

Centrifugal flame casting:
Flame setting for propane / oxygen: flow pressure setting 0.5 bar propane, 2.0 bar oxygen. The blue tips in the middle of the flame at the burner head should be 6–8 mm in length. Distance between burner head and metal: 15–25 mm. Always preheat the ceramic crucible. Heat the metal in the crucible, moving the flame with a slightly circular action until the metal glows bright red. Then insert the mould and continue heating the metal. An oxide film forms once the individual casting pieces have merged together. Continue melting, moving the flame with a slightly circular action until the casting metal merges under a joint oxide film and can be visibly moved with the pressure of the flame. The melt must be uniformly bright in colour. Initiate the casting process without the oxide film tearing.

Casting time for Wirocer plus

Vacuum pressure casting with induction heating (Nautilus®) and **centrifugal casting** with induction heating (Fornax®):
Once the last solid constituent in the melt bath is completely immersed continue heating for 0–12 s (depending on the induction output of the casting unit), then initiate casting. Observe the instruction manual for Fornax® and Nautilus®.

Centrifugal flame casting:
Flame setting for propane / oxygen: flow pressure setting 0.5 bar propane, 2.0 bar oxygen. Continue melting, moving the flame with a slightly circular action until the casting metal merges under a joint oxide film and can be visibly moved with the pressure of the flame. The melt must be uniformly bright in colour. Initiate the casting process without the oxide film tearing.



Preheating the alloy in Nautilus®

Cooling of moulds

After casting allow the moulds to cool down slowly until warm to the touch, in a protected and designated location, **do not quench in water!**

To avoid dust during deflasking, place the moulds in water, once they have cooled down completely after casting, until they are thoroughly moistened.

Deflasking and surface finishing

Carefully deflask the object, blast the investment material with Korox® 110/250 (aluminium oxide, 110/250 µm) and detach the sprues. When blasting crowns with Korox® 250, make sure that excessive force is not applied to the crown margins!

To finish, use sintered BEGO diamond grinding stones, ceramically bonded grinding stones or, **preferably, carbide cutters**. Veneering surfaces should only be processed with cross-cut or fine-toothed carbide cutters!

Pretreatment of frame

Finishing must be followed by blasting of the surfaces to be veneered with Korox® 250 using a pencil blaster at 3–4 bar. When blasting crowns with Korox® 250, make sure that the crown margins are not damaged.

When using a blasting unit with a blasting material circulatory system, ensure it is not used to blast investment material. The microscopically fine dust from investment material may form a separating layer that will result in an insufficient bond to ceramic materials.

With these recycling sandblasters it is necessary to change the blasting material frequently, as over time the size and edge definition (abrasive behaviour) of the blasting material particles will decrease. Sufficient roughening of the metal surface is therefore no longer guaranteed. Where possible, a recycling sandblaster should not be used for blasting before ceramic veneering. The frame must be cleaned thoroughly before applying the first layer of matrix. The Triton SLA steam cleaner has proved its worth here.

Allow the frame to air-dry. Do not use compressed air under any circumstances, as oil particles or residues from corrosion could be picked up from the compressed air line. Do not touch the frame with your fingers in the areas to be veneered: use an aid to hold, e.g. an arterial clamp. No oxide firing is necessary. It can however be carried out to check the metal surface (960–980 °C; 10 min).



Diamond grinding stones, the specified Ø indicates the greatest diameter of the sintered diamond grinding stone.

Diamond grinding stones

1	Medium grain: Ø 8 mm, REF 43491
2	Medium grain: Ø 5 mm, REF 43492
3	Medium grain: Ø 5 mm, REF 43494
4	Medium grain: Ø 2.3 mm, REF 43495
5	Medium grain: Ø 3.7 mm, REF 43496
6	Medium grain: Ø 5 mm, REF 43497
7	Coarse grain: Ø 5 mm, REF 43498

Important

The oxide on the areas to be veneered must be sandblasted again with Korox® 250 at 3–4 bar before ceramic veneering (see page 18 for more information)!



Example four-chamber fine blasting unit



Example of a circulating jet with fine jet nozzles



Triton SLA (REF 26005)

Processing dental ceramics

1

For processing dental ceramics all commercially available metal-to-ceramics and press-to-metal ceramics as per ISO 9693-1 with firing temperatures of up to approx. 980 °C are suitable. Ceramics with a reduced firing temperature can also be used here. No additional adhesives or bonders are required for BEGO's non-precious alloys. Here it is only important to note that the matrix must be applied and fired twice.

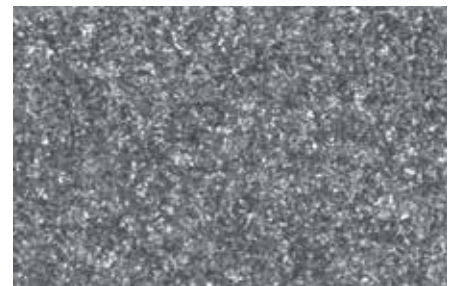
High-expanding ceramics should be used for Wirobond® LFC: take note of the coefficient of thermal expansion!

With any uncertainty regarding the compatibility of veneering ceramics with BEGO alloys, experts from the BEGO Service hotline (+49 421 20 28-282) will be delighted to assist.

In addition to precise frame preparation, special importance is also attached to the first firing of the matrix (wash firing process) This is a prerequisite for a reliable bond between the alloy and ceramic.

Blasting with pure aluminium oxide with a particle size of 110 µm will not roughen the surface sufficiently, regardless of the blasting pressure applied. This will not produce a perfect metal-ceramic bond.

If surfaces are sandblasted using pure aluminium oxide with a particle size of 250 µm (e.g. Korox® 250 REF 46014) and a blasting pressure of between 3–4 bar, this will provide the basis for optimum retention and a metal-ceramic bond of maximum strength.



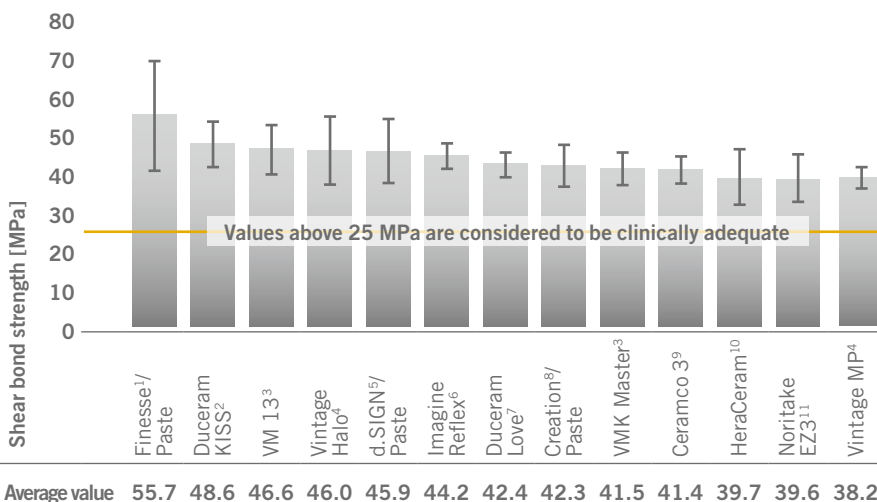
Wirobond® 280 blasted with Korox® 110 µm



Wirobond® 280 blasted with Korox® 250 µm

Important

Do not process the surface to be veneered with rubber polishers!



Shear/bond strength test as per ISO 9693-1 (Schwickerath test) for Wirobond® 280

The veneering materials are products supplied by 1Dentsply, 2DeguDent, 3VITA, 4Shofu, 5Ivoclar, 6Wieland, 7DeguDent, 8Geller, 9Ceramco, 10Heraeus Kulzer, 11Noritake. Unless specified otherwise, powder opaquer was used here.

Images and illustrations are examples. Colors, symbols, designs and information on the depicted labels and/or packaging may differ from reality.

To ensure a clean transition from the metal to the ceramic, the first opaque layer should be applied slightly beyond the crown margin. This excess material will be ground back before glaze firing.

To create the first layer, apply a light-bodied opaque layer (wash firing) so all areas to be veneered are covered (Fig. 1), then fire according to the manufacturer's instructions. Take note here of the specific recommendations of the manufacturer (use of bonder or pre-opaque, different drying or firing temperatures) regarding the ceramic veneering of non-precious alloys.

The second opaque layer must ensure uniform coverage. The metal should no longer shimmer through (Fig. 2). When using paste opaquer, make sure that the predrying period is sufficiently long. This will avoid detachment of the paste opaquer, resulting in an insufficient metal-ceramic bond. This is followed by firing of the dentine and incisal materials (Fig. 3). To prevent green discoloration and soiling, clean objects under running water or with the Triton SLA steam cleaner (page 17) before every firing.

Please check regularly for updates to the instructions for use of the ceramic manufacturers (e.g. on the Internet).

Important

It is imperative to follow the instructions for use supplied by the ceramic manufacturer. The ceramic manufacturer's specific firing recommendations must be followed when fusing non-precious alloys.

If prolonged cooling is recommended for a specific alloy, the relevant programme should be selected on the ceramic furnace.

Following firing of the glaze paste or glaze the oxide is removed by blasting the inside of the crowns with Korox® 50 using a pencil blaster.

Metal surfaces which are not veneered must be ground and rubber-polished with uniform pressure (Fig. 4).

The blue BEGO Co-Cr polishing compounds (REF 52310) or the Diapol diamond polishing compound (REF 52305) are suitable for the high-lustre polishing.

Once complete, clean under running water with a brush. Cracks may appear if a steam blaster or ultrasonic bath is used.

Cooling after dentine firing

Cooling depends on the CTE values of the alloy and ceramic.

Wiron® 99

- 25–500 °C · 13.9 × (10⁻⁶ K⁻¹)
- Normal cooling

Wiron® light

- 25–500 °C · 13.7 × (10⁻⁶ K⁻¹)
- Normal cooling

Wirocer plus

- 25–500 °C · 13.8 × (10⁻⁶ K⁻¹)
- Normal cooling

Wirobond® 280

- 25–500 °C · 14.3 × (10⁻⁶ K⁻¹)
- Only normal cooling due to optimum composition

Wirobond® C

- 25–500 °C · 14.3 × (10⁻⁶ K⁻¹)
- Prolonged cooling recommended

Wirobond® SG

- 25–500 °C · 14.3 × (10⁻⁶ K⁻¹)
- Normal cooling



Fig. 1 · 1. Opaque-firing



Fig. 2 · 2. Opaque-firing



Fig. 3 · Applying the dental ceramic



Fig. 4 · Rubbering as prepolishing

Steps involved in the double crown technique

1

In terms of cost-effective treatment of patients, the anchoring of prostheses using non-precious double crowns offers an interesting alternative to conventional clasp partial dentures. In contrast to classical fabrication with precious-metal alloys, the production of friction-fit double crowns made from non-precious alloys calls for a comparatively high level of manual skill. The reasons for this are the greater hardness and more marked contraction of the alloys on cooling after casting, in addition to the oxide layer which needs to be removed mechanically (sandblasted). Friction adjustment is made significantly easier thanks to additional friction elements such as WiroFix which were already taken into account at the planning stage.

WiroFix – friction element for the combination technique

Friction adjustment is made easier by WiroFix, particularly in the case of non-precious constructions.

- Wide range of indications: Double crowns, full and ring telescopes, bars, RS
- Ideal in combination with one-piece casting constructions
- Strong retentive force combined with small size
- Friction can be adjusted to two different degrees
- Requires minimal space; can be shortened individually
- Extremely easy processing thanks to ceramic spacers
- Highly durable, but easy replacement if necessary



Primary parts in wax with semi-canal friction groove Ø 1 mm



Semi-canal-friction groove Ø 1 mm on primary part



Primary part with ceramic spacer attached



Secondary part in modelling acrylic with integrated ceramic spacer



WiroFix friction elements: standard yellow (REF 52835) strong violet (REF 52833); medium pink (REF 52832)



Finished restoration with integrated WiroFix friction elements



Inserting yellow friction element with neutral friction

Images and illustrations are examples. Colors, symbols, designs and information on the depicted labels and/or packaging may differ from reality.

2

Jointing technology

Laser welding

Besides soldering and adhesive bonding, in recent years the laser welding of workpieces has established itself as a connection technique commonly used in dentistry. The advantage of this technology is that objects 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 saving
- Simple procedure
- High strength of welded seam
- Great resistance to corrosion
- Precise working
- No difference in colour to original material
- No polishing-out of solder
- Connection possible right next to acrylics or 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 indices
 - removal of saddles or veneers for laser welding

All BEGO non-precious alloys have been tested in terms of laser applications. Detailed dental instruction, also including the setting of parameters for key indications, will make your first use of the laser welding technique easier.

During welding please note

- Welded seam should be completely enveloped in argon – distance between object and argon nozzle approx. 1 cm
- Discoloured 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, remove the site of fracture completely and remodel the parts to be replaced as necessary
- Do not reuse compressed or overstretched frame sections

2



Laser weld seam



LaserStar T plus (REF 26405)

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	

Images and illustrations are examples. Colors, symbols, designs and information on the depicted labels and/or packaging may differ from reality.

Soldering with Bellatherm® soldering investment material

Being phosphate-bonded, Bellatherm® is resistant to high temperatures. To produce a block of solder, combine 100 g Bellatherm® with 23 ml tap water and mix thoroughly with a spatula for a short period. This guide value can be adjusted depending on the consistency required. After it has hardened, leave the block of solder to dry in the furnace. Bellatherm® can be easily separated from the soldered object under cold running water.

Soldering before firing – solders and flux

The solder has similar properties to the alloy to ensure that the ceramic adheres to the soldered areas equally well. BEGO Minoxid flux (REF 52530) should be used for soldering before firing.

Any soldering iron is suitable for BEGO non-precious alloys as long as it produces a finely adjustable flame. When soldering in the block, make sure that the gap does not exceed max. 0.2 mm in width. The soldering joints must be exposed so that they are easily accessible with the flame. Apply the Minoxid flux before preheating. Keep the block of solder as small as possible and predry in the preheating furnace at approx. 300 °C. When making repairs, the soldering joint is extended in a bell shape.

First of all, prepare a suitable piece of solder and coat with Minoxid flux. Then position the solder on the object and heat, moving the flame with a circular action. Once the soldering temperature is attained, direct the flame towards the solder and concentrate there until it completely fills the soldering gap.



Bellatherm® soldering investment material (REF 51105)



Block of solder prepared for furnace soldering

Note

Due to the low thermal conductivity of BEGO non-precious alloys, the required soldering temperature in the object is achieved considerably later than with precious metals.

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
Wiwoweld (CoCrMo, carbon-free)	Co 65.0 · Cr 28.0 · Mo 6.0 · Mn · Sn	0.35	2 m	50003
Wiwoweld (CoCrMo, carbon-free)	Co 65.0 · Cr 28.0 · Mo 6.0 · Mn · Sn	0.5	1.5 m	50005
Wiwoweld NC (NiCrMo, carbon-free)	Ni 60.0 · Cr 22.0 · Mo 9.0 · Fe 4.0 · Nb 3.6 · Al · Co · Cu · Mn · Si · Ta · Ti	0.35	approx. 5.5 m	50006
Titanium wire, grade 2	Ti 100.0	0.35	approx. 5 m	50008

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Furnace soldering after firing – with pretreatment

This method can be used to bond Wirobond® to Wirobond® and Wiron® to Wiron® or to precious metals. Before firing the soldering joint is ground down to create a depression and pre-treated with a fusing solder: for example, BegoStar® solder (Liquidus 1,100 °C, REF 61081), flux: Minoxyd (REF 52530)

The solder can be fired over with ceramic.

After firing clean the soldering joint by grinding. Then produce the smallest possible block of solder. When doing so, make sure that the parts to be soldered do not touch. Soldering gap max. 0.2 mm.

Soldering process:

- Predry block of solder for 10 min at 300 °C
- Preheat for 3–5 min (depending on size of block) at 800 °C
- Heat to soldering temperature of 860 °C and hold for 1 min

BEGO Gold solder I (Liquidus 790 °C, REF 61017) (flux Minoxyd REF 52530) flows into the soldering gap and fills it completely.

Solders and flux

Wirobond®	Profil-Form	REF
Wirobond® solder	▼	52622
Wiron®/Wirocer plus		
Wiron® solder	●	52625
Minoxyd		52530

2



Wiron® solder (REF 52625)



After processing with Wirobond® or Wiron® solder and with platinum foil underlay



Margin extension with Wirobond® or Wiron® solder and with platinum foil underlay

Images and illustrations are examples. Colors, symbols, designs and information on the depicted labels and/or packaging may differ from reality.

3

Non-precious alloys

Non-precious alloys

Non-precious alloys have been part of the standard repertoire for fixed and removable restorations for many years. The alloys typical of this group are either nickel- or cobalt-based. Cobalt-based alloys have been used for medical applications involving implants for around a hundred years. In the first half of the 20th century CoCr alloys were introduced to dentistry for the partial denture technique. Nickel-based alloys were adopted slightly later in the crown and bridge technique. They are generally venerable and are characterised by simple casting and easy finishing as well as high strengths in comparison with precious-metal alloys. In 1968 BEGO launched this type of alloy in Germany – the birth of Wiron!

BEGO Nickel-chrome alloy

Although allergies to nickel are common, the use of nickel-chrome alloys in the oral cavity does not inevitably result in allergic reactions. Nickel is an essential element, with approx. 10 mg being contained in the human body. We are said to consume 0.16–0.9 mg nickel per day as part of our diet. These comparatively high levels are not matched even by the initial release of nickel following the incorporation of nickel-chrome alloys. However, where a patient is known to have an allergy to nickel, the dentist should refrain from using nickel alloys in the oral cavity as a precautionary measure. Nickel is the main constituent of nickel-chrome alloys, which contain up to approx. 75 % of nickel (Wiron® 99: Ni 65.6 %). It is not the amount of nickel but the chromium content that is the decisive factor for approving the use of nickel.

Clinical trials and experimental investigations have shown that a content of min. 20 percent by mass is necessary to guarantee sufficient intra-oral biocompatibility!

Wiron® 99

Wiron® 99 Premium-NiCr alloy for metal-to-ceramic work or composite veneering

- Beryllium-free
- Proven reliability in use worldwide for over 25 years
- Secure metal-ceramic bond, minimising the risk of subsequent flaking or chipping
- Low hardness of 195 (HV10) – for fast, easy finishing and polishing to a high lustre
- Simple casting point recognition – problem-free processing in all induction casting machines
- High modulus of elasticity for greater protection against deformation caused by masticatory forces
- No marked sensation of hot/cold thanks to low thermal conductivity – high level of wearing comfort for the patient
- Biocompatible and highly corrosion-resistant

Wirocer plus

Nickel-chrome metal-to-ceramic alloy

- Beryllium-free
- Tried and tested cobalt-chrome alloy from BEGO – inexpensive thanks to an optimised manufacturing process
- Secure bond to ceramic
- Low hardness – easy and time-saving finishing
- Normal cooling – for economical veneering
- High wearing comfort for the patient thanks to low thermal conductivity
- Biocompatible and corrosion-resistant



Wirocer plus (REF 50080)



Wiron® 99 (REF 50225)

BEGO non-precious alloys without beryllium!

Nickel-chrome alloys with a chromium content of well below 20 percent by mass cannot be deemed resistant to the oral environment due to their high level of ion release (corrosion). Beryllium-containing alloys also fall into this category. Beryllium is known to be a highly toxic, carcinogenic substance which is harmful to health even after many years. Dental technicians are already at risk from the vapours produced when melting beryllium-containing alloys. The risk to the health of dental technicians is the greatest during finishing, due to the unavoidable creation of dust. Beryllium is a toxin that is liable to accumulate, i.e. unlike all other alloy constituents it is not excreted, but builds up in particular in the bone substance and lungs. All BEGO alloys are of course free of beryllium and biocompatible. The relevant biocertificates are available for download at www.bego.com.

Physiological information: Beryllium (Be) is a carcinogen and toxin liable to accumulate and is classified in category A 2 of carcinogenic substances in the German "MAK-Liste" (maximum workplace concentration). Beryllium vapour causes severe damage to the lungs (a disease known as berylliosis), frequently resulting in fatalities. It can cause irritation to the skin and mucous membranes while chronic exposure results in damage to the liver and enlargement of the spleen. After a longer period – latency may be up to 30 years, as beryllium is not excreted by the organism – granulomatosis may occur.

Quote: RÖMPPS Chemie Lexikon

Wiron® light

The non-precious alloy for metal-to-ceramic work with light-colored oxide

- Beryllium-free
- Simple casting, easy finishing, reliable working
- The outstanding melting properties of the alloy ensure reliable filling of the mould
- The oxide of Wiron® light is considerably lighter in colour in comparison with conventional NiCr alloys and can be removed very quickly and easily
- The reduced preheating temperature of 800 °C means that a very smooth surface of the cast object is achieved
- Normal cooling with many of the ceramics – for time-saving, economical veneering
- The favourable CTE value permits reliable ceramic veneering
- Biocompatible and highly corrosion-resistant thanks to a firmly adhering passive layer



Wiron® Light (REF 50270)

Oxide colour after deflasking



Wiron® light

Conventional NiCr alloy

Images and illustrations are examples; colours, symbols, designs and information on the depicted labels and/or packaging may differ from reality.

Venerable cobalt-chrome alloys from the Wirobond® product family

Venerable cobalt-chrome alloys have established themselves as a standard material in dentistry. Wirobond® alloys are characterised by advantageous parameters in terms of their material properties and are highly biocompatible. Wirobond® alloys are always suitable when a nickel-free alloy is needed with high strength, a secure metal-ceramic-bond, great corrosion resistance and biocompatibility combined with an affordable price. Processing is largely identical to the Wiron® alloy group. The material properties are similar except for the slightly increased hardness level. Otherwise, Wirobond® is melted and processed in the same way as Wiron®. It bonds securely to dental ceramics and is a tried and tested material (see: Processing dental ceramics). Like Wiron®, Wirobond® can of course also be veneered with composites.

Wirobond® 280

The non-precious premium alloy – a benchmark

- Nickel- and beryllium-free
- Wirobond® 280 sets a benchmark in the non-precious metal-to-ceramic alloy segment because, with a Vickers hardness of 280 HV10, it can be finished to a particularly high standard
- Extremely corrosion-resistant thanks to the optimal interaction of the indispensable elements chrome and molybdenum
- Excellent melting and casting properties
- No prolonged cooling necessary*, even with large spans
- Secure bond to ceramic
- High strength in all span sizes, and therefore a wide range of indications
- Reliable processing in accordance with the proven BEGO system
- Biocompatible and highly corrosion-resistant

* Exceptions: Creation (Willi Geller), Reflex® (Wieland Dental + Technik GmbH & Co. KG)



Wirobond® bridge

Wirobond® C

Cobalt-chrome metal-to-ceramic alloy

- Nickel- and beryllium-free
- Simple processing thanks to reliable casting point recognition
- Carbon-free composition – particularly well suited for laser welding
- The element cerium ensures high bond strength with the ceramic, minimising the risk of subsequent flaking or chipping
- Low thermal conductivity – protects the pulp and ensures high wearing comfort for the patient
- Biocompatible and corrosion-resistant thanks to a firmly adhering passive layer



Wirobond® 280 (REF 50134)



Wirobond® C (REF 50115)

Wirobond® SG

Cobalt-chrome metal-to-ceramic alloy

- Nickel- and beryllium-free
- Reliable use even in problematic cases and restorations with large bridge spans
- Simple and reliable casting point recognition thanks to optimal silicon content
- Normal cooling facilitates economical and effective working
- Reliable metal-ceramic bond with no need for an additional expensive bonder
- Biocompatible and corrosion-resistant

Wirobond® LFC

Venerable cobalt-chrome alloy with a wide range of indications

- Nickel- and beryllium-free
- Cobalt-chrome metal-to-ceramic alloy for high-expanding ceramics (low-fusing ceramic materials)
- The CTE value of 15.6 [10⁻⁶ K⁻¹] enables normal cooling – for economical and effective working
- Strong bond with the low-fusing ceramic – even when subjected to multiple firing
- Controlled carbon content – very well suited to soldering and laser welding
- Biocompatible and corrosion-resistant



Wirobond® SG (REF 50127)



Wirobond® LFC (REF 50255)

CAD/CAM – what you should know about BEGO Medical GmbH

- As an SLM pioneer, we provide market-leading CAD/CAM process expertise – from high-performance scanners through to high-tech production
- With our diverse range of production processes and materials for all indications, we offer flexibility and cost effectiveness – ensuring the ideal platform for open production
- BEGO is the first dental company to manufacture all its implantological structures from a single source – and that in a unique range of materials for a unique range of indications
- Moreover, our User Support, our scanning and design service, our guarantee services and our BEGO TRAINING CENTER provide you with the best possible support

Wirobond® C+

The cobalt-chrome alloy for SLM technology

- This very fine-grained powder guarantees a homogeneous and extremely dense structure. Single crowns and bridges with up to 14 units can easily be produced using Wirobond® C+
- Extremely corrosion-resistant thanks to the optimal interaction of the indispensable elements chrome and molybdenum
- Wirobond® C+ can be reliably veneered with commercially available ceramics with an appropriate CTE – dependable ceramic veneering using familiar ceramics without the need for any adjustment by the dental technician
- Controlled fabrication process – for stress-free frames and excellent accuracy of fit
- The extremely low ion release minimises the risk of undesirable biological reactions – Wirobond® C+ has been shown to have no cytotoxic or allergic potential

Wirobond® M+

The cobalt-chrome alloy for milling work

- Wirobond® M+ is the milling alloy for crown and bridge frames as well as abutments and bars for implantology.
- Simultaneous 5-axis milling guarantees optimal precision of fit – with every unit.
- High strength in all span sizes, and therefore a very wide range of indications.
- Wirobond® M+ can be reliably veneered with commercially available ceramics with an appropriate CTE – dependable ceramic veneering using familiar ceramics without the need for any adjustments.

Wirobond® C+ and Wirobond® M+ are highly corrosion-resistant, nickel- and beryllium-free and have shown to have no cytotoxic potential.

Advantageous properties of non-precious alloys

A prerequisite for corrosion-resistant, biocompatible alloys is their composition and the purity of the elements used. Wirobond® and Wiron® produce an extremely dense and firmly adhering passive layer with exceptional resistance. This claim has been verified by numerous studies into loss in mass from chrome- and molybdenum oxides of non-precious alloys in response to mechanical and chemical stresses.

A quote from original research by J. Geis-Gerstorfer, H. Weber and K.-H. Sauer:

"If we compare the nickel concentrations absorbed in the diet and through medication with nickel release from crowns, release by crowns seems negligible, at least when using the alloys which performed well."

Biocompatibility

Biocompatibility, i.e. the compatibility of a material with an organism, is exceptionally high.

BEGO non-precious alloys have been scientifically monitored and studied for many years like virtually no other group of alloys. The reliability of this alloy group has been verified time and time again.

Even after being placed in corrosive solution for five years, Wiron® 99 still showed sharp grinding grooves under a scanning electron microscope. This means that Wiron® 99 offers excellent passivation, and the passive layer is highly resistant to corrosion (Fig. 1).

In contrast to Wiron® 99, the surface of a NiCr alloy belonging to a competitor with only 13 % chrome is completely destroyed (Fig. 2, note enlarged scale).

This observation also correlates with the very high ion release of this alloy. **This type of alloy (chromium content below the 20 % mark) should therefore not be used.**

Ion release in 7 days

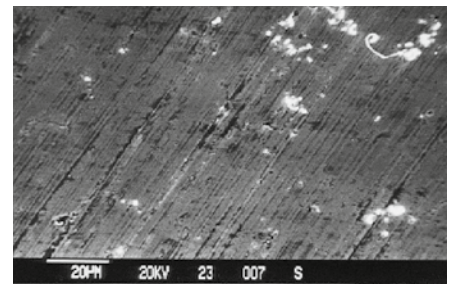
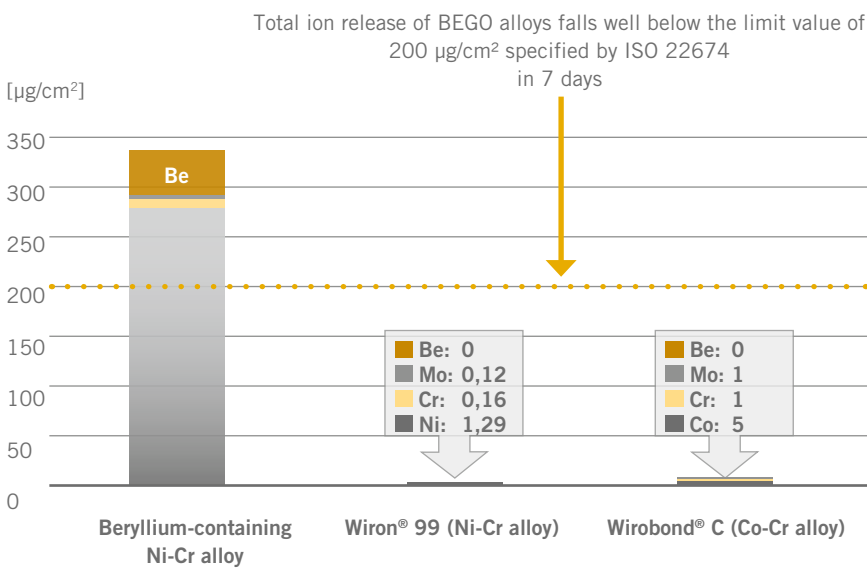


Fig. 1: Wiron® 99

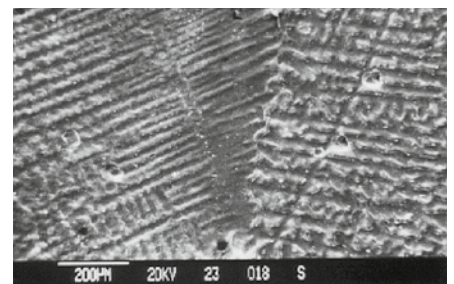


Fig. 2: Ni-Cr alloy with a chrome content which is too low

Modulus of elasticity

This is a decisive factor for the load rating of a crown and bridge construction and for the bond of the ceramic to the metal frame. The modulus of elasticity for non-precious alloys is almost double that of metal-to-ceramic alloys containing precious metals.

With an identical wax-up they thus also offer twice the resistance to deformation due to masticatory force. The possible size of the bridge construction depends solely on the indications in terms of dentistry.

- Wirobond® 280 approx. 220 GPa
- Bio PontoStar® XL approx. 100 GPa

Tip

The higher the modulus of elasticity, the greater the force that will be required for elastic deformation. The material is rigid and dimensionally stable.

Bond strength

The bond between Wirobond®, Wiron®, Wirocer plus and dental ceramic is extremely strong. This is the result of close cooperation with leading dental ceramic manufacturers.

These ceramics and the properties of BEGO non-precious alloys have been so carefully coordinated that the metal-ceramic bond can stand up to any comparison, however critical.

Wirobond® LFC is venerable with high-expanding, low-melting special ceramics (known as low-fusing ceramic materials).

Heat resistance

Both during soldering and fusing of the ceramic, Wirobond®, Wiron® and Wirocer plus all offer excellent resistance to deformation, as the modulus of elasticity at the fusing temperature of 960 °C is considerably greater than for a high-gold metal-to-ceramic alloy. The dentist can thus rely on the frame also fitting perfectly after veneering.

The mechanical properties of Wirobond®, Wiron® and Wirocer plus guarantee dimensional stability with ceramic firing. This applies even more to Wirobond® LFC, as here firing temperatures for the dental ceramics are significantly lower (typically below 800 °C).

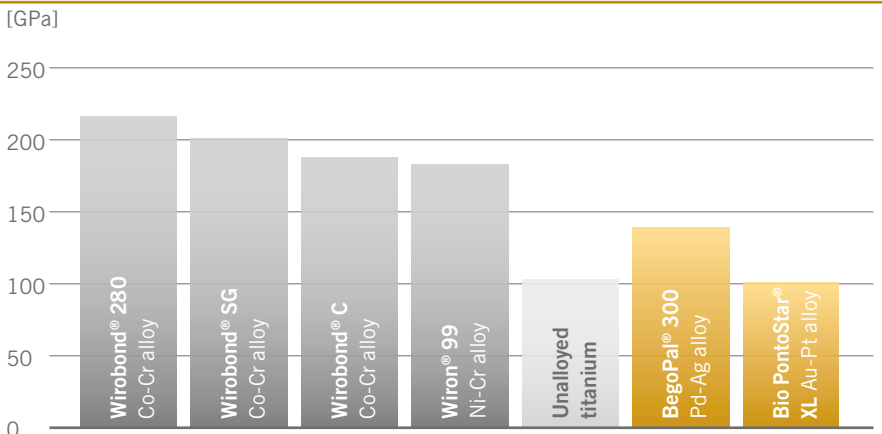
Thermal conductivity

The thermal conductivity of BEGO non-precious alloys is extremely low and protects the pulp of the abutment teeth from major temperature stimuli. This also enhances wearing comfort for patients, who are not subject to any marked sensation of hot/cold.

Tip

The coefficient of thermal expansion (CTE) is important for the bond between metal and ceramic. It indicates the expansion of a substance when heated by 1 °C. The CTE values between metal and ceramic must be in line with each other. The CTE of the veneering ceramic should be lower than that of the alloy to ensure that the ceramic shrinks onto the metal frame.

Modulus of elasticity



Non-precious alloys for veneering with ceramic and composites

Non-precious alloys

Guide values	Wirobond® 280	Wirobond® C	Wirobond® SG	Wirobond® LFC	Wiron® 99	Wiron® light	Wirocer plus
Color	silver	silver	silver	silver	silver	silver	silver
Typ (ISO 22674)	5	4	4	5	3	4	3
Density g/cm ³	8.6	8.5	8.6	7.9	8.3	8.2	8.3
Solidus; liquidus temperature °C	1,355; 1,430	1,360; 1,420	1,385; 1,420	1,335; 1,435	1,310; 1,360	1,210; 1,280	1,295; 1,360
Casting temperature °C	1,500	1,500	1,480	1,480	1,450	1,350	1,450
CTE 25–500 °C	14.3	14.3	14.3	15.6	13.9	13.7	13.8
Elongation after fracture (A ₅) %	9	16	11	17	43	9	34
Proof strength (R _{p0.2}) MPa	480	440	485	655	335	460	355
Young's modulus GPa	220	180	200	205	170	185	175
Vickers hardness HV10	280	315	305	315	195	280	220

Composition in %

Nickel (Ni)	–	–	–	–	65.6	64.6	65.2
Cobalt (Co)	60.2	63.3	63.8	33.9	–	–	–
Chromium (Cr)	25.0	24.8	24.8	28.5	22.5	22.0	22.5
Molybdenum (Mo)	4.8	5.1	5.1	5.0	9.5	10.0	9.5
Tungsten (W)	6.2	5.3	5.3	–	–	–	–
Silizium (Si)	x	1.0	1.0	1.0	1.0	2.1	1.5
Niobium (Nb)	–	–	–	–	x	x	x
Iron (Fe)	–	–	–	30.0	–	–	x
Manganese (Mn)	x	–	–	1.0	x	x	x
Cerium (Ce)	–	x	–	–	x	–	–
Carbon (C)	–	–	–	x	–	–	–
Nitrogen (N)	–	–	–	x	–	–	–
Gallium (Ga)	2.9	–	–	–	–	–	–
Boron (B)	–	–	–	–	–	x	–

Scope of delivery	REF	REF	REF	REF	REF	REF	REF
250 g	50135	50116	50127	50256	50226	50272	–
1,000 g	50134	50115	50128	50255	50225	50270	50080

4

Specialist literature

Precision Milling and Partial Denture Constructions

Modern design – Efficient production

- Guidelines for dental laboratories and surgeries specialising in prosthetics
- Ideal preparation for examination as 'Master' technician
- Practice-oriented guide and reference work
- Restorations using partial dentures with telescopic constructions and clasp-retained tooth replacement
- Systematic planning and design
- Efficient dental fabrication
- Various stages of restoration with partial denture techniques
- Clear step-by-step description of key sequences
- Historical overview
- Appendix dealing with material properties
- Many practical tips for users
- Processing errors and their consequences
- Author: Henning Wulfes

Product details

Realization

280 pages · 210 × 260 mm · incl. images · approx. 1,000 color illustrations · hardcover

Availability

German

English

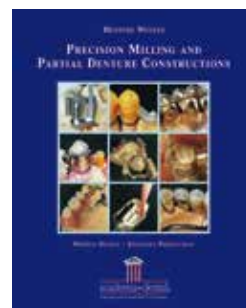
Russian

REF

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5

**Preventive
error management**

Tips and information for processing investment materials for BEGO crowns and bridges

Problem	Cause	Solution
Investment material is not setting or only very slowly	The working temperature of the powder and/or liquid was too low.	<ul style="list-style-type: none"> The ideal temperature is approx. 20 °C for powder and liquid – if it is colder, the working time is longer, and if warmer, it is shorter
	The mixing time was too short.	<ul style="list-style-type: none"> Observe instructions for use of investment material! Generally mix with a spatula for 15 s, and then mix for another 60 s under vacuum
	The wrong liquid or wrong concentration was used.	<ul style="list-style-type: none"> Observe instructions for use! <ul style="list-style-type: none"> Bellavest® SH/DR = BegoSol® HE Bellastar/XL = BegoSol® K Bellavest® T = BegoSol®/HE
	The mixing ratio of powder/liquid was not observed.	<ul style="list-style-type: none"> Observe instructions for use! Observe mixing ratio and adjust concentration to alloy and indication
Investment material is setting too quickly	The working temperature was too high.	<ul style="list-style-type: none"> Optimise working temperature (20 °C)
	The mixing time was too long.	<ul style="list-style-type: none"> Base the mixing time on the instructions for use
	The interior surface of the mixing bowl is dry/rough.	<ul style="list-style-type: none"> Moisten the mixing bowl on the inside before starting mixing (rinse out)
Casts too large or too small	The concentration of liquid was not sufficiently adjusted to the casting alloy.	<ul style="list-style-type: none"> Observe instructions for use of investment material! The concentration of liquid for non-precious alloys must be higher than for precious metal, e.g. Bellavest® SH: for non-precious alloys 80–90 %, for precious-metal alloys 50–60 % concentration of liquid. High concentration = high expansion Low concentration = low expansion
	<ul style="list-style-type: none"> Mixing times not according to instructions for use Different mixing times Major fluctuations in the working temperature – e.g. summer/winter 	<ul style="list-style-type: none"> Base the mixing times on the instructions for use: Longer mixing will reduce expansion, and shorter mixing increase it in an uncontrolled manner! To ensure comparable work results it is important to standardise all working parameters: <ul style="list-style-type: none"> Working temperature Mixer Size of mixing bowl to quantity of material being mixed Use climate cabinet for powder and liquid
Bridge is rocking	Wax-up subject to stresses due to temperature-related contraction of wax.	<ul style="list-style-type: none"> Make sure wax temperature is as uniform as possible during modelling Disconnect bridge wax-up to relieve stress and only reconnect before investing. Allow distributor bar made from wax or acrylic to cool down completely after shaping, before waxing up
Mould has fractured or cracked during conventional preheating	The mixing ratio of powder/liquid was not correct. The mixing times according to the instructions for use were not observed.	<ul style="list-style-type: none"> Observe instructions for use! Generally mix with a spatula for 15 s, and then mix for another 60 s under vacuum
	If a metal ring is used, the mould fleece is not flush with the wall of the mould. The investment material flows behind the fleece, creating an indentation. Forces caused by setting expansion may lead to cracking here.	<ul style="list-style-type: none"> Transition (overlapping) of mould fleece should be covered with wax
	The cast object is placed too close to the wall of the mould or to the floor.	<ul style="list-style-type: none"> Minimum distance to floor / wall of mould 5 mm, 5–10 mm is ideal
	The casting mould was removed from the silicone ring too early (not fully hardened).	<ul style="list-style-type: none"> Allow investment material to set completely, remove carefully

Images and illustrations are examples. Colors, symbols, designs and information on the depicted labels and/or packaging may differ from reality.

Tips and information for processing investment materials for BEGO crowns and bridges

Problem	Cause	Solution
Mould has fractured or cracked during conventional preheating	The mould was placed in the still warm furnace too early.	<ul style="list-style-type: none"> Allow investment material to set completely
	Plastic parts used for wax up not coated with wax.	<ul style="list-style-type: none"> Plastic parts (Adapta, modelling acrylic, solid plastic channels) should be lightly coated with wax as the plastic expands first during heating and may cause the casting mould to break
	The insertion temperature for the mould was too high.	<ul style="list-style-type: none"> Limit insertion temperature to max. 80–100 °C
	The heating rate of the preheating furnace is too high.	<ul style="list-style-type: none"> Optimum heating program: <ul style="list-style-type: none"> 5 °C/min to 250 °C Hold for 30 min at 250 °C 7 °C/min to 575 °C Hold for 30 min at 575 °C 7 °C/min to final temperature Hold final temperature for at least 30 min depending on mould size
Mould has fractured or cracked during fast (shock) preheating	The insertion times were not observed.	<ul style="list-style-type: none"> Insertion times differ depending on the investment material. Ensure you observe the recommendations in the instructions for use. Bellavest® SH/DR after 20–30 min. If insertion is too early, material will still be too soft. If insertion is too late, the mould will dry out and cracks will form
	Mould formers are too large.	<ul style="list-style-type: none"> Only mould former sizes 1, 3 and 6 can be heated quickly (shock heat)
	The furnace temperature (insertion temperature) was too high/low.	<ul style="list-style-type: none"> Select insertion temperature depending on investment material used: <ul style="list-style-type: none"> Bellavest® SH/DR = 900 °C BellaStar/XL = 700–900 °C
Bubbles in the investment material	The vacuum during mixing was insufficient.	<ul style="list-style-type: none"> Check mixer, mixing bowl, vacuum hose. Clean seal and rim of bowl!
Rough casting surfaces	Melt is overheated.	<ul style="list-style-type: none"> Observe melting and casting temperatures specified by alloy manufacturer
	The content of old metal is too high.	<ul style="list-style-type: none"> Reduce old metal content
	Too much wetting agent applied, has not dried.	<ul style="list-style-type: none"> Apply wetting agent evenly in precise quantities and then blow dry immediately
	The casting mould was held too long at the final temperature.	<ul style="list-style-type: none"> Do not hold the casting mould for longer than 60 min at the final temperature
Inclusions of investment material in the cast object	Sharp points of investment material between sprues were detached from the melt.	<ul style="list-style-type: none"> Round off sharp points between modelled sprues
	Foreign body incorporated during setting/preheating phase.	<ul style="list-style-type: none"> Ensure casting mould sets at a protected location. Place in the preheating furnace with the funnel former facing downwards. Always keep the furnace clean



Casting flash on casting



Mould with crack



Rough casting due to overheating

Tips and information for reliable veneering with BEGO alloys

Problem	Cause	Solution
Horizontal cracks or flaking/chipping of ceramic in incisal and cervical areas	Ceramic is not sufficiently supported by metal frame.	<ul style="list-style-type: none"> Model a reduced anatomical tooth shape! Frame collars and metal margins created cervically will act as reinforcement! A rounded, “ceramic-supporting” frame design is especially important at the incisal edges (incisal angles)! Sharp edges should be avoided!
Crescent-shaped flaking/chipping in basal area on pontics	Metal frame distorted after firing.	<ul style="list-style-type: none"> Observe the minimum wall thicknesses specified for the frame Wall thickness min. 0.3 mm after finishing, interdental connectors should be taller than they are wide
	Heat build-up occurred during cooling after ceramic firing.	<ul style="list-style-type: none"> Basal veneer of pontics is critical (greater susceptibility to cracking – crescent-shaped cracks). Creating pronounced chamfers offers additional reliability! Do not omit them with purely vestibular veneering!
	The ceramic layer is too thick.	<ul style="list-style-type: none"> Support ceramic by anatomically reduced frame shape, max. ceramic layer thickness 1.5 mm!
	CTE of alloy too high for ceramic.	<ul style="list-style-type: none"> Observe CTE values! Carry out prolonged cooling to increase CTE of ceramic Prolonged cooling is advisable for very solid objects! For bridges with larger span sizes it is recommended to moderately increase the firing temperature by approx. 10–20 °C
	The oxide layer is too thick.	<ul style="list-style-type: none"> After oxide firing/control firing carefully blast the oxide again in its entirety with Korox® 250 µm at 3–4 bar
<p>Note: Before each new work step carefully steam-clean the surface! The surface should then be allowed to dry through self-heating. Drying with compressed air entails the risk of contamination with condensates from the compressed air system.</p> <p>Do not use non-system components. With appropriate indications use native non-precious bonders or wash opaquers according to the instructions for use of the ceramic manufacturer!</p>		
Porosities and bubbles in the ceramic	Alloy is overheated, individual constituents burn, a rough surface results.	<ul style="list-style-type: none"> Do not overheat melt (alloy)! With flame casting: Heat casting ingot evenly! Aim for homogeneous, pore-free casting!
	On recasting, alloy was contaminated by residues of investment material and oxides.	<ul style="list-style-type: none"> Only use new material!
	Overlaps/inclusions have occurred on the surface of the alloy.	<ul style="list-style-type: none"> Surface should be finished in one direction only – preferably with sharp carbide cutters Make sure carbide cutters are not blunt and have a good cutting action! Do not use instruments with which precious metals have been processed!



Cracks in the ceramic



Bubbles in the ceramic



Cracking and flaking due to insufficient frame preparation

Images and illustrations are examples. Colors, symbols, designs and information on the depicted labels and/or packaging may differ from reality.

Tips and information for reliable veneering with BEGO alloys

Problem	Cause	Solution
Porosities and bubbles in the ceramic	The frame surface was not adequately finished.	<ul style="list-style-type: none"> • During finishing avoid sharp corners, edges and transitions – round off cleanly • No deep notches or holes! No sharp edges!
	Frames were not sandblasted sufficiently.	<ul style="list-style-type: none"> • See flaking/chipping
	The vacuum power of the ceramic furnace is too low.	<ul style="list-style-type: none"> • Check the effective firing temperature in the firing chamber of the ceramic furnace and its vacuum power
Ceramic flaked/chipped off down to the metal frame	Unsuitable blasting material / insufficient blasting pressure used.	<ul style="list-style-type: none"> • Blast finished frame with Korox® 250 µm using an angle of approx. 45° at 3–4 bar • Low-capacity compressors as sometimes sold by DIY stores may not be sufficient here! • Only use new, sharp-edged blasting material • Do not use a recycling sandblaster! Use a pencil blaster! • Risk of contamination by residues of investment material
	Excessive oxide formation by control firing.	<ul style="list-style-type: none"> • If carrying out oxide firing (5 min with vacuum) as control firing at 950–980 °C, blast oxide again in its entirety with Korox® 250 µm at 3–4 bar!
	Oxide formation and detachment of opaquer.	<ul style="list-style-type: none"> • Wet the base well with opaquer – rub in, particularly when using paste opaquers! • As an alternative: Use powder opaquer instead of paste opaquer!
<p>Note: The retention of ceramic veneering also depends on mechanical retention! It is reinforced by shrinkage of the ceramic to the metal frame, which results from the different coefficients of thermal expansion (CTE). The chemical bond in itself does not guarantee sufficient retention.</p>		
Bridge rocking after oxide / wash firing	The frame design is too lightweight and slender.	<ul style="list-style-type: none"> • Dimension transitions and connectors sufficiently in relation to their height – particularly with pontics (T-support principle)!
Protruding crown margins	The design of the crown margins is too thinly tapered. This results in deformation due to contraction of the ceramic.	<ul style="list-style-type: none"> • Dimension crown margins sufficiently, if necessary provide ceramic shoulders • Check CTE values in terms of their compatibility! Only use suitable veneering materials
	With large objects residual stresses are caused by uneven cooling.	<ul style="list-style-type: none"> • To relieve stresses, hold the metal restoration (not separated) at 950–980 °C under vacuum for 5 min (oxide firing)



Bubbles and flaking/chipping



Incorrect frame design

The frame is insufficiently dimensioned at the pontics, while the ceramic layer is too thick. Flaking/chipping due to insufficient surface conditioning (Korox® 250 not used), in addition to sharp edges and points in the frame.

Tips and information for reliable veneering with BEGO alloys

Problem	Cause	Solution
Detachment of individual opaquer layers	The wash opaquer was applied too thick.	<ul style="list-style-type: none"> • Create wash firing (1st opaquer firing) with a thin consistency, only complete coverage with 2nd application of matrix! • If the wash firing temperature is increased by 50 °C, this will have a positive effect on bonding! • See also ceramic manufacturer's instructions for use
	The drying temperature is too high, the drying time too short.	<ul style="list-style-type: none"> • Distinguish between powder opaquer and paste opaquer. With paste opaquer observe longer drying times! • Allow coated frame to dry for approx. 8 min! (Glycerine only evaporates slowly at higher temperatures at approx. 250 °C!). Caution: When the firing chamber is closed, plumes of vapour should no longer be seen! Extend drying manually if necessary!
Cracks in the opaquer	The paste opaquer was applied too thick.	<ul style="list-style-type: none"> • Do not dilute paste opaquer with water! Fire exactly as specified by the manufacturer – never lower! Do not apply too thick! To attain the coverage required, it is better to apply lightly three times and fire
Discolouration due to oxides, especially at the margin	Oxide formation during ceramic firing too great.	<ul style="list-style-type: none"> • Before each new work step carefully steam-clean the surface! • During firing the edge of the frame must not come into contact with the carrier of the firing material • Completely cover the crown margin with opaquer!
Cracks in the ceramic layers	The ceramic becomes too dry during layering.	<ul style="list-style-type: none"> • Swift layering will prevent the ceramic drying out, i.e. keep ceramic moist when layering using a paper towel
Cracks in the interdental space	Separation not carried out before firing.	<ul style="list-style-type: none"> • With ceramic layering use a moistened scalpel to ensure sufficient interdental separation – down to the opaquer • Objective: controlled shrinkage!
Round edges, no brilliance in veneering	Temperature on object too low.	<ul style="list-style-type: none"> • Clean ceramic furnaces at regular intervals, check and calibrate firing chambers (temperatures) • Note: Some ceramics must be ground (roughened) lightly each time before being fired! • Do not apply glaze paste too thick! • Note: When using non-precious metal-to-ceramic alloys, some ceramic manufacturers recommend increasing firing temperatures • For example, by 20–50 °C depending on the carrier of the firing material used and the size of the object • Please consult manufacturers directly about their firing recommendations. Some ceramic suppliers provide firing charts for different furnaces.
	<p>Note: Bubbles form, for example, due to gases escaping during the various heat treatments. Possible cause:</p> <ul style="list-style-type: none"> • Casting errors such as overheating (e.g., foreign bodies trapped in the material, shrinkage cavities, pores) • Application of ceramic (bubbles incorporated and contamination from foreign particles) • Glycerine not evaporated completely • Vacuum of ceramic furnace insufficient <p>Ask ceramic manufacturer for recommendations when firing non-precious alloys!</p>	

Tips and information for reliable veneering with BEGO alloys

Problem	Cause	Solution
Flaking/chipping of ceramic during finishing	Speed is too high, pressure of grinding stone too great.	<ul style="list-style-type: none"> • Finish ceramic at a lower speed and a reduced pressure level
	Pressure of grinding stone is too high.	<ul style="list-style-type: none"> • Take care when grinding down ceramic projections on interior surface of crowns!
	Temperature development too high during finishing.	<ul style="list-style-type: none"> • Take care when finishing: Metal parts must not become too hot = lower pressure level! • Avoid high heat generation, e.g., as with hard rubber polishers!
Cracks when cleaning veneered frames	<ul style="list-style-type: none"> • Cleaning in ultrasonic cleaner • Cleaning selectively with steam blaster (overheating!) 	<ul style="list-style-type: none"> • Preferably perform final cleaning under running water with a brush. • No ultrasonic bath! When using a steam blaster, make sure it is applied over the entire area – avoid localised overheating!
Flaking/chipping of ceramic or cracks in inserted restorations	Oxide formation during ceramic firing too great.	<ul style="list-style-type: none"> • Remove oxide from the interior of crowns before insertion – blast again with Korox® 50 µm! • Avoid applying any pressure to the interior of the crowns • During cementation ensure complete seating in the final position free of stress • Tip: Prepolishing parts of the frame not being veneered will avoid excessive oxidation during ceramic firing
	Unfavourable occlusion conditions.	<ul style="list-style-type: none"> • Work in the articulator • Check jaw relationship • Avoid premature contacts • Do not create antagonistic contacts in the metal/ceramic transition area



Bubbles in opaquer due to casting errors or incomplete evaporation of glycerine



Bubbles in ceramic and insufficient ceramic bond to frame due to inadequate drying of paste opaquer



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