Metal ceramics

Instructions for use for precious metal ceramic bonding alloys and

HeraCam®
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**1.1 Competence for successful partnership**

We have been ranking among the leading dental manufacturers for decades. Our dental technical and dentists products which we manufacture and sell at 25 locations have repeatedly set standards. We gladly share this success with our partners.

Our definition of partnership includes to provide substantial support for the market position of our customers. This is a demand that has been frequently expressed since intensified competition has forced companies to redefine their strategies. In this situation, which is mainly defined by cost pressure, we provide dental laboratories with the opportunity to offer alternative types of restorations for all indications and to produce all types of dentures efficiently without any quality restrictions.

**1.2 Ceramic bonding alloys – proven for decades**

Our precious metal ceramic bonding alloys can be divided into four categories:

**Bio alloys**

Heraeus Kulzer especially recommends the group of Bio alloys. We make demands on the Bio alloys which exceed the standards by far:

- in addition to gold and platinum metals only contain additives considered to be harmless or absorbed daily by the body as essential trace elements with the food,
- pass clinical tests and biological material tests before they are introduced into the market,
- are biocompatible,
- are highly corrosion-resistant,
- allow safe and reproduceable processing since they were developed on the basis of the Herador alloys which have proven their reliability for decades.

**Herador special alloys**

These are high-gold content precious metal alloys with a special requirement profile which meets specifically defined preconditions and goals. The Herador special alloys are ceramic bonding alloys with a white to pale-yellow color and outstanding chemical and mechanical properties. They have proven their reliability for decades and successfully passed numerous clinical tests.
Reduced gold content ceramic bonding alloys and gold casting alloys

Special emphasis is also put on the development of precious metal dental alloys according to economic aspects. As far as their chemical-technological properties are concerned, these alloys almost reach the level of the high gold content Herador alloys; yet they are more favorably priced.

Pd-based alloys of the Albabond group

These alloys possess the advantageous chemical properties which are generally found in the group of precious metal dental alloys, however, with regard to their technological properties and the material price they represent a true alternative to non-precious metal alloys.

HeraCeram is suitable for bonding alloys in the CTE range of $\alpha_{25-500^\circ C} = 13.5 - 14.9 \, \mu m/mK$. Accordingly, a wide range of alloys can be selected and used.

With a maximum firing temperature of $880^\circ C$ HeraCeram offers particularly reliable processing also for high gold content Bio alloys.

HeraCeram is robust, features a wide processing tolerance and produces reliable, natural and esthetic results with reduced effort.

The firing times of HeraCeram are extremely short.

Time is saved thanks to:

- the high starting temperature ($600^\circ C$),
- the high rate of heating up ($100^\circ C/min$),
- the low firing temperature (max. $880^\circ C$),
- identical firing for all precious metal ceramic bonding alloys,
- the omission of long-term cooling or a tempering step. Restorations can simply be removed from the furnace at the end of the program and cooled down at room temperature.

Accordingly, HeraCeram can be fired using the same firing programs independent of the bonding alloy. This way firing programs used for a specific bonding alloy will no longer be confused! Time-consuming adapting of firing programs to the respective alloy is no longer required. If the Heramat C ceramic furnace is used which has been especially developed for HeraCeram, the programs have already been pre-stored.

HeraCeram will allow you to save a considerable amount of working time helping you to increase productivity and reduce costs. The robust firing behavior ensures reliable, high-quality and reproduceable results.
With HeraCeram you choose the simple way to natural esthetics.

For this purpose fluorescent powder and paste opaque materials in the 16 V shades are available. 20 HeraCeram stains with different fluorescence levels allow further individual characterization.

Special matching of colors of the opaque, dentine and incisal materials ensure that the color obtained is almost independent of the layer thickness. The opaque materials exhibit excellent coverage at low layer thicknesses (100 µm) and possess color-defining characteristics.

Special organic pigments in the materials allow excellent control of layering. The high stability of the materials during layering simplifies shaping of the restoration. Extremely low firing shrinkage results in high dimensional stability. Accordingly, corrections can frequently be avoided.

The perfection of natural esthetics and individual design of a tooth is achieved with the Matrix set which leads to reliable and reproducible results since it is easy to apply and based on a clear structure. These instructions for use include processing of the ceramic for standard layering as well as for the Matrix layering.
1.4 Two ceramics for unlimited possibilities

Two high-end ceramics

When choosing HeraCeramSun and HeraCeram you rely on two high-end ceramics with almost identical perfect properties: superior esthetics and utmost reliability during processing – in particular in combination with the corresponding Heraeus Kulzer alloys.

HeraCeramSun and HeraCeram: Together they cover the entire range of metal ceramic techniques.

The small difference is at the same time a considerable benefit: HeraCeramSun is a low-melting ceramic with a processing temperature of 790/760 °C and was especially designed for the HeraSun alloys.

The other ceramic, HeraCeram, is a high-melting material with a processing temperature of 880 °C/860 °C and is suitable for all classical ceramic bonding alloys.

If you use both ceramics, you will cover the entire range of metal ceramic alloys.

The same veneering technique is used with HeraCeramSun as with HeraCeram. This has the following advantages for HeraCeram users:

- The only difference when using HeraCeramSun is the lower firing temperatures.
- The techniques for standard layering and Matrix layering are identical.
- HeraCeram stains and glazing powder are compatible with both ceramic systems, so there is no additional outlay.
- HeraCeram ceramic liquids are also compatible.

HeraCeramSun and HeraCeram may be referred to as “twin sisters” which feature the same product and processing characteristics at different firing temperatures thanks to our experience and competence in the field of dental ceramics.

1.5 Important information:

The following information refers to the procedures, units and materials recommended by Heraeus Kulzer. If products of other manufacturers are used, the corresponding instructions for use and operating instructions must be observed.

Revision mark: This arrow (►) indicates all changes and supplements to the previous version. Furthermore, the relevant text has been printed in italic letters.

These instructions for use include all the current information on processing of our precious metal ceramic bonding alloys. In its previous version “Processing instructions – Precious metal dental alloys, Edition 11/98” it renders any information concerning the processing of precious metal ceramic bonding alloys obsolete. Previous publications referring to HeraCeram such as “HeraCeram – Instructions for use, Edition 07/2001”, HeraCeram margin materials – Instructions for use, Edition 08/2001” and the brochure “HeraCeram-Matrix: The discovery of the esthetic code, Edition 03/2001” have become obsolete and are updated in these instructions for use.

All information about the chemical composition, technical data and the preheating, casting and annealing temperatures of the alloys can be taken from the package slips or the “Table of technical data of precious metal dental alloys”. The information in these instructions are general in nature.
2.1 Waxing up

Crowns and pontics to be veneered with ceramic should be waxed up to a reduced anatomical shape. The thickness of the wax-up should not be less than 0.4 mm so that there is a minimum metal thickness of 0.3 – 0.35 mm after finishing. Sharp edges, undercuts and deep fissures must be avoided when waxing up. Every effort must be made to achieve smooth transition zones.

High gold content palladium-free ceramic bonding alloys:

Sufficiently stable wax-up of the approximal connections must be ensured (cross section at least 8 mm²). For stability reasons (especially for large span bridges) the palatal side of the pontics should be waxed up with a thin metal collar or at least with an inlay-like interdental reinforcement.

To provide subsequent support during ceramic firing, waxing-up of eyelets to crowns and pontics is recommended.
Implant suprastructures:

With implant suprastructures a sufficiently thick layer of wax (min. 0.3 mm) should be applied on the prefabricated precious metal copings to avoid the formation of fissures and cracks in the ceramic since the precious metal copings have a very low CTE.

We expressly point out that the recommendations of the implant manufacturers have to be observed.

Wax-up and indication range of the alloy

> When planning the span of bridges, the information about the type and the strength of the alloy to be used must be considered.

2.2 Attaching sprues, sprue thickness and geometry

Attaching sprues for bar casting

For bridge work we recommend the bar casting technique. Feeder sprues with a length of 2.5 – 5 mm and a Ø of 3.5 mm are attached at an angle of 45° to the palatal or lingual side of the wax object. Each pontic must be connected with a feeder sprue; for larger molar crowns the connection of two sprues is required. The feeder sprues are connected by a horizontal bar with a Ø of 5 mm.

The bar connects to the sprues and runs parallel to the casting. The sprues coming from the cone former are connected to the bar between the first and second third resp. between the second and third third of the bar. These sprues have the same diameter as the bar.

The distance of the castings to the casting ring wall should always be the same to ensure uniform cooling conditions (min. 5 mm).

The bar sprues must be exactly in the thermal center, i.e. the distance between the bar and the bottom of the casting rings should be 27.5 mm. Positioning of the sprue system in the casting ring can be easily checked using the Heraeus spruing aid (see Fig.16).

The feeder sprues must always be attached to the thickest parts of the wax-up.

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**Abb. 11: Schematic view of bar casting**

Dimensions for ceramic bonding alloys
Metal ceramics

If two or three bridge patterns are placed on a cone former, it must be ensured that they are placed in a circle equidistant to the wall of the casting ring.

**Fig. 12:** Correct and incorrect position of several bridges in the casting ring

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**Casting voluminous elements**

**How can voluminous castings be cast without any blowholes?**

Figures 13 and 14 illustrate the differences between a conventional “normal” sprue system which is used for all pontics and the type of sprue system required for “extreme” pontics (or voluminous elements) with thicknesses of more than 10–12 mm. The spruing for voluminous elements shown here may only be used when casting voluminous elements.

**Fig. 13:** Ø 5.0 mm, sprue bar Ø 3.5 mm, feeder sprues

**Standard sprue system:** In the case of ceramic bonding alloys with pontic constructions sprues featuring a horizontal bar with a diameter of 5.0 mm and a connector between the bar to the object (diameter 3.5 mm and length 2.5–5.0 mm) are attached. The connector (bar) is placed in the center of the casting ring.

**Fig. 14:** Ø 5.0 mm, connector Ø 3.5 mm, feeder sprues Ø 5.0 mm with reinforcements for voluminous elements

**Sprue system for extremely voluminous elements:** The thickness of 5.0 mm for the horizontal bar and 3.5 mm for the feeder sprues remain unchanged. The distance between the horizontal bar and the object is increased to 10.0 mm. Additionally, the bases of the sprues at the horizontal bar are increased to 5.0 mm (see drawing). The position of the horizontal bar remains in the center of the casting ring. This change allows to achieve directional solidification owing to the large melting quantity of the casting and the inherent shift of the thermal center.
2. Instructions for use for the ceramic bonding alloys

Attaching sprues for single units

Direct spruing can also be used for single crowns, inlays and onlays. The sprue should be attached to the wax pattern without tapering. The Ø of the sprues for direct spruing should be 4 mm. When determining the thickness of the sprues, the volume of the casting pattern and the casting temperature of the alloy should be taken into account. Thicker sprues are required for alloys with a higher melting temperature and voluminous casting patterns.

2.3 Determining the amount of alloy and reusability of casting buttons

Prior to waxing up the casting pattern onto the sprue former the required alloy quantity must be calculated. The wax pattern and the attached sprues are weighed.

There is no need to add any extra alloy for the casting button if the alloy is to be cast using the vacuum pressure casting technique.

Any sprues left over can be carefully cleaned and reused after adding new alloy. They are cleaned by sandblasting them with aluminium oxide and then rinsed under running water and dried.

Fig. 15: Schematic view of spruing for single units. Dimensions when used for ceramic veneering.

The required alloy quantity is obtained by multiplying the weight of the wax pattern with the density of the alloy, divided by the density of the wax (average 0.93 g/cm³).

The mixing ratio is a maximum of 2/3 of old material to at least 1/3 of new material.
2.4 Preparing the casting ring, investing, preheating

Waxing onto the sprue former

The completed wax patterns should only be placed on sprue formers which are compatible with the casting machine to be used.

 ► The wax pattern is attached so that the horizontal bar lies vertical and has a distance of 27.5 mm to the base of the casting ring. The horizontal bar, however, must never be taken through the center of the casting ring to avoid different cooling conditions in the casting pattern which will result in the formation of blowholes (see also Fig. 12, page 8). The horizontal bar must rather be shifted to the outside to ensure directional solidification and to avoid casting errors (blowholes) (see also Fig. 11, page 7).

Ensure the wax junction is smooth when waxing the sprues onto the sprue former.

Suitable investment materials

We recommend the use of phosphate-bonded investment materials from Heraeus Kulzer for all precious metal dental alloys.

 ► Please observe the processing instructions enclosed to the respective investment material.

 ► Palladium-containing ceramic bonding alloys which can only be melted in the ceramic crucible because of the risk of carbon absorption (see information on the packet) must not be cast in graphite-containing, phosphate-bonded investment materials either.

2.5 Melting and casting

Graphite crucibles

High gold content ceramic bonding alloys and the reduced gold content, silver-containing alloys can be melted in graphite crucibles resp. – if induction casting machines are used – in ceramic crucibles with graphite insert.

Melting should preferably be carried out in Heraeus Kulzer graphite crucibles. These crucibles are free from any additives that damage the alloy and feature a long service life.

Ceramic crucibles

All reduced gold content ceramic bonding and palladium-based alloys must be melted in ceramic crucibles by using melting powder. The reason for that is the tendency of alloys with a high palladium content to absorb carbon during melting which results in a deterioration of the mechanical properties and the formation of bubbles during ceramic veneering. That is why these alloys should not come into contact with carbon during melting and casting.

Suitable Heraeus Kulzer ceramic crucibles are available for all Combiabor casting machines. To melt the individual alloys, separate ceramic melting crucibles must be used.

 ► The recommendation for the suitable crucible material is stated on the alloy packet.

Suitable casting machines and melting methods

We recommend to melt and cast in the temperature-controlled, resistance-heated vacuum pressure casting machines CL-G 97, CL-G 94 or the induction-heated vacuum pressure casting machines Heracast iQ, CL-I 95 and CL-IG made by Heraeus Kulzer.

 ► The casting temperature and the preheating temperature of the casting ring are stated on the alloy packet.

As a guideline: casting temperature = liquidus temperature +150 °C.

Do not quench the casting ring in water after casting.
2. Instructions for use for the ceramic bonding alloys

2.6 Cleaning the castings

Mechanical removal of the investment materials

- If casting rings are used, the moulds are first pressed out of the casting ring after cooling down to room temperature and the investment is carefully removed from the casting with plaster nippers.

Do not devest castings with a hammer because of the risk of deformation!

Sandblasting

Investment material residues are removed by sandblasting with 50 µm aluminium oxide.

In particular the soft, high gold content palladium-free alloys should only be sandblasted at a maximum pressure of 2 bar.

Fig. 18 a: Suitable finishing tools for most ceramic bonding alloys

Fig. 18 b: Suitable finishing tools for high-gold content ceramic bonding alloys

Fig. 19: Finished crowns

2.7 Hardening

Hardening after casting

Most alloys harden automatically by slow cooling in the casting ring. Almost all alloys can also be hardened by additional heat treatment.

- The annealing parameters and the hardness and strength values that can be achieved are stated on the alloy packet.

2.8 Surface treatment

The sprues are cut off and the frameworks are finished using fine-cut tungsten carbide cutters.

The best basis for an optimal metal-ceramic bond is achieved by preparing with diamond-cut tungsten carbide cutters with a chamfer.

Suitable ceramic-bonded stones can also be used.

The information provided by the manufacturers must be observed.

Due to the risk of formation of bubbles during ceramic firing the contact with carbon and carbon-containing substances must be avoided.

Diamond-coated finishing tools must not be used.

Fig. 17: Annealing behavior of precious metal dental alloys
2.9 Preparing the framework

Sandblasting the surface of the framework

Ceramic veneering requires that the metal framework is sandblasted with aluminium oxide, grit size 125 µm.

The high gold content palladium-free alloys must only be sandblasted at a flat angle using a pressure of 2 – 3 bar to prevent the penetration of aluminium oxide particles into the surface of the framework.

All other alloys can be sandblasted using pressures between 3 – 4 bar.

Cleaning the surface of the framework before oxidation firing

We recommend to use a steam cleaner to clean the surface of the framework. Do not touch the frameworks with your fingers. Always use clean tweezers or clamps.

Oxidation firing

The conditions for oxide firing (temperature, time, vacuum or at air) are given on the alloy packet.

Among other aspects oxidation firing provides information on the purity of the surface. The oxide should have a uniform color without any blotches. If there are any blotches, the framework needs to be sandblasted with aluminium oxide, cleaned and oxidized again.

When working with high gold content palladium-free alloys it is recommended to ensure safe and adequate support of the framework on the firing tray.

In the case of pd-containing and pd-based alloys the oxide layer reaches deeper into the alloy than in high gold content alloys. Moreover the oxide is relatively dark. If – for reasons of limited space – the ceramic veneer has only a small layer thickness which causes shade problems, the oxide can be removed by sandblasting with aluminium oxide after oxidation firing. Then the base material (opaque) is applied directly on the cleaned objects.

Zinc-containing high gold content ceramic bonding alloys must be pickled after oxidation firing to remove the zinc oxide (e.g. using Hera AM 99, 10 min).

The microretentions obtained during sandblasting enhance the metal-ceramic bond and thus the quality of the dental restoration. Surface conditioning is the first step of ceramic veneering.
Cooling after ceramic firing

- Matching the coefficients of thermal expansion of the alloy and the ceramics by means of long-term cooling is no longer required when veneering with HeraCeram. Rapid cooling down is described in chapter 3.1.

If other ceramics are used, it is possible that the coefficients of thermal expansion and the resulting thermal expansion curves of alloy and ceramic only match to a certain degree. This may cause tensions in the metal/ceram bond after cooling down which result in the formation of cracks in the ceramic.

But adequate cooling speeds after firing can lead to balancing the thermal expansion curves of both materials. After cooling, the optimum final condition is when the ceramic is exposed to minor compressive stress. The cooling speeds have been determined for every ceramic bonding alloy and have been tested for several years in practice. Relevant data and information can be found in the “Table of technical data of precious metal dental alloys”.

Definition of the cooling rates for dentine firing and subsequent firing processes:

Normal cooling down (n)
The firing platform is driven down at the end of the program and the firing tray with the objects is removed after 2 – 3 minutes.

Slow cooling down (l)
Conditions vary depending on the type of furnace. Programs are e.g.: When the objects are driven down, a hold of 3 – 5 minutes at 800 °C is required or after the end of the program objects are cooled down slowly for 5 – 6 minutes until the initial temperature is reached. Please observe the operating instructions of the furnace and the instructions for use of the ceramic.

Rapid cooling down (s)
At the end of the program the firing table is driven down immediately. The firing tray with the objects can be removed immediately and is cooled at room temperature.

Cleaning the framework surface before ceramic firing

We recommend to use a steam cleaner for cleaning the surface of the framework. Do not touch the framework with your fingers after cleaning. Always use clean tweezers or clamps. After steam cleaning, the dry frameworks are ready for ceramic veneering.

2.10 Ceramic firing

- Temperatures and conditions of the ceramic firing processes for HeraCeram can be found in the firing charts (page 30 – 34).

- Refer to the instructions of the respective manufacturer when firing other ceramics.

Firing of high gold content palladium-free alloys: Safe and adequate support on the firing tray is generally recommended.

Ceramic firing after primary soldering: Surfaces to be veneered must not be wetted with solder across larger areas.

Veneering with HeraCeram

The working steps for layering the ceramic and final treatment of the alloys are included in chapter 3: Instructions for use for HeraCeram.

Soldering and laser welding

The working steps for carrying out soldering and laser welding are included in chapter 4 “Precision attachment techniques” of these instructions for use.
3.1 Applying opaque

Only for veneering non-precious metal alloys:

Pre-Opaque

HeraCeram Pre-Opaque supports processing of HeraCeram on non-precious metal ceramic bonding alloys (NPM). If Pre-Opaque is used, NPM-specific cooling is no longer mandatory!

Processing:
After finishing and sandblasting the a thin layer of the ready-to-use paste is applied on to the veneer surface of the metal framework using the paste opaque brush and fired under vacuum (!) with the recommended oxide firing program of the respective NPM alloy.
If oxide firing is not recommended, the Pre-Opaque ceramic is fired with the opaque firing program at 980 °C and a hold of 10 min under vacuum.

Paste opaque

The paste opaque is supplied in a ready-to-use consistency. The viscosity and the enclosed paste opaque brushes have been matched perfectly. The paste opaque is applied in two thin layers and fired.

The firing temperature for the paste opaque is also 880 °C, however the predrying phase must be adapted to the drying behavior of the paste liquid (see firing charts on page 30–34).

If the paste opaque has become drier and thus firmer due to extended storage, the ideal consistency can be reached by careful adding paste opaque liquid.

6 intensive opaque materials are available for individualization of the opaque layer. After firing, the opaque layer reveals a lustrous surface.

The ceramic firing tables can be found on page 30–34 of these instructions for use.

Cooling down after ceramic firing

At the end of the program the firing table is driven down immediately. The firing tray with the objects can be removed immediately and is cooled at room temperature.
3. Instructions for use for HeraCeram

Powder opaque

The powder opaque is mixed with the powder opaque liquid to obtain a varnish-like consistency and applied uniformly covering the entire surface to be veneered. It can be applied with ceramic brushes or ball-end instruments (e.g. made of glass) depending on the technique used.

Firing temperature 880 °C.

The opaque layer is silky matt after firing.

If a second layer is required, it is applied in the same way and fired at the same temperature.

There are 6 intensive opaque materials for individualization of the opaque layer:

- **Bleach**, a whitish opaque for very light tooth shades resp. for whitening the opaque shades.
- **Gold**, for a warmer hue owing to increased chroma from the depth of the veneer.
- **Gingiva**, pink-colored opaque for areas in which the Gingiva materials are used.
- **OCA**, **OCB**, **OCC**, opaques with intensified chroma for A, B and C shades, e.g. for characterization in the cervical area.
- **Approx. 10%** mamelon or secondary dentine shades are added when mixing the dentine ceramics.
- **OT1 – OT10; OTY; OTB; OTA; OTG and OT Ice** can each be used individually with any of the shades.

**Shade classification of HeraCeram ceramics**

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**Fig. 1**: Uniform application of the paste opaque

**Fig. 1a**: ... or powder opaque

**Fig. 2**: Silky matt surface of the opaque layer after firing

**Fig. 3**: Characterization of the opaque layer with intensive opaque (e.g. OCA)

Fig. 2:

3. Instructions for use for HeraCeram
3.2 Dentine incisal layering

To reproduce the shades on the shade guide, HeraCeram is built up using a simple 2-layer technique with dentine and incisal ceramics. The dentine core can either be built up directly or, to check the size and position of the tooth more easily, the full tooth can first be built up and then reduced. The veneer is then completed using the matching incisal ceramic (see shade chart).

Additional individualization of the incisal area can be achieved by inserting transparent wedges.

**Note:** A safety mask should be worn and a dust extractor used when grinding ceramics. Avoid inhaling the ceramic dust.

**Note:** If Pre-Opaque is omitted when working with non-precious metal alloys, cooling to reduce the stress is recommended since the alloys feature high hardness. For this purpose leave the firing tray with the ceramic restoration on the firing platform of the furnace for 1–2 minutes after firing or include a cooling time of 1–2 minutes in the program.
Corrective layering

After the ceramic firing, the surface of the veneer has a glazed texture. The approximal and occlusal contact points are adjusted by grinding in with rotary diamond tools. A layer of dentine, incisal or transparent ceramic is added to compensate for the firing shrinkage and fired using the dentine-2 firing program.

Glaze firing

If corrective firing of the ceramic is not required, the veneer is prepared using diamond tools, i.e. contours and surface texture are shaped. Any grinding dust and dirt are removed from the ceramic surface, e.g. with a steam cleaner. Finally, the veneer can also be characterized individually using glazing liquid and stains.

Since the refractive index of HeraCeram stain liquid is similar to that of the ceramic, layering and shade become visible when the surface is coated with stain liquid. This enables the characterization with glazing liquid and stains to be easily checked.

Firing temperature: 850°C

Depending on the desired degree of luster, the holding time can be extended or reduced or the temperature can be lowered.

Fig. 9: HeraCeram after the first firing

Fig. 10: Fine adjustment of the tooth contour

Fig. 11: Finishing the contours and surface texture

Fig. 12: Ceramic surface coated with HeraCeram stain liquid

Fig. 13: Final individualization with HeraCeram stains

Fig. 14, 14a: After glaze firing
3.3 Individual layering using the Matrix-Set

according to Paul A. Fiechter, Master Dental Technician

When individualizing a layering, priority is given to reproducing the shade and shade nuances of the patient’s tooth with all the optical light elements such as lightness, transparency, fluorescence and opalescence.

The Matrix Set not only provides ceramics with exceptional esthetic properties, it also offers a concept of esthetics that produces natural results with minimum layering effort. This concept is easy to apply since it is based on a clear structure.

The appropriate dentine powder is mixed with approx. 10% mamelon or secondary MD or SD dentine ceramics to emphasize the cervical area. These ceramics intensify the luminosity of the shades by balancing the chroma and fluorescence.

After fully building up the anatomical shape with dentine ceramics, the layering is reduced to the dentine core by cutting it back in a controlled manner.

Note: Individual layering is always based on the respective patient. Accordingly, the following layering is only an example. The practical use of the individual Matrix ceramics may vary from case to case and must be decided individually.

Matching of the Matrix materials (classification) can be found on page 20.
3. Instructions for use for HeraCeram

**Fig. 20:** Smooth transitions ensure there is no junction line with the core shade.

**Fig. 21:** The mamelon and dentine ceramics merge with the value ceramics ...

**Fig. 22:** ... and are contoured with a brush to resemble mamelons. The result is an impressive interplay between lighter and darker shaded areas. This creates mamelons that are also illuminated by the highly fluorescent value ceramics from the depth of the layering.

**Fig. 23:** A band of Opaltranspa (opal transparent) Ice is applied over the mamelons.

**Fig. 24:** The anatomical shape is completed using a matching opal incisal or various opal transparent ceramics.

To regulate the lightness or for partial whitening of the dentine, the value ceramics are layered slightly more thickly in the incisal area and gradually thin out towards the body of the tooth. Smooth transitions prevent a junction line at the core shade.

Mamelon and dentine merge into the value ceramics and can be contoured using a brush. This creates a natural interplay between lighter and darker shaded areas. The mamelon structures are emphasized since they are “illuminated” by the more fluorescent value ceramics from the depth of the built-up.

A band of Opaltranspa (opal transparent) Yellow emphasizes the halo effect.

The anatomical shape is completed with the matching opal incisal and/or opal transparent ceramics.

**See dentine firing for firing cycle (firing temperature 860°C)**

Firing shrinkage is compensated for after firing and fine adjustments are made to the shape and layering.

Finally, HeraCeram stains and glaze (glazing liquid) can be used for characterization.
Metal ceramics

The degree of glaze and texture of the ceramic surface can be regulated by the glaze firing using the temperature and holding time at final temperature. Other influencing factors are the surface preparation and preparation for glaze firing. Therefore the directions for glaze firing can only be used as a rough guide and should be amended to achieve the desired result.

See glaze firing for firing cycle (firing temperature 850°C)

HeraCeram can also be polished mechanically. Our HP paste is perfectly suitable for final polishing.

Description of the Matrix components

**MD** mamelon dentine; **SD** secondary dentine – Ceramics for creating natural luminosity in mamelons by balancing the croma and fluorescence.

**VL** value ceramics – Highly fluorescent ceramics for adjusting lightness in correlation to the chroma of the individual shade level (A1; A2; A3) with the 3-layer technique.

**OS** opal incisals – These incisal ceramics replace the corresponding standard incisal ceramics. They are classified and applied in the same way.

Fig. 25: Completed veneer after glaze firing
OT (Opaltranspa)
opal transparent ceramics –
Transparent ceramics for individual layering reflect the spectrum of natural tooth enamel.

OT1 – OT10: neutral opalescence increases in intensity and decreases in transparency from OT1 to OT10. OT1 is the most transparent of the opal ceramics. OT10 is whitish-opal.

OTY; OTB; OTA; OTG and OT Ice:
modified shades of opal transparent ceramics
OT Yellow yellowish
OT Blue bluish
OT Amber reddish
OT Grey greyish
OT Ice light bluish

Preciano Electroforming
In this context we would like to draw your attention to the Preciano electroforming system by Heraeus Kulzer since the working steps described for veneering with HeraCeram are identical with the ones for precious metal ceramic bonding alloys.

The use of Preciano allows to produce thin high-precision crown copings made of fine gold. This technique is particularly suitable above all in the area of anterior teeth if there is only limited space available. The fabrication of these crown copings and the preparation for ceramic veneering are described in separate instructions for use.

3.4 Corrections after glaze firing

The correction material with a firing temperature of 810 °C provides a sufficient temperature difference for corrections after glaze firing, e.g. optimizing contact points. Completed veneers are no longer impaired by these corrections.

The correction material is colorless and transparent. It can be mixed with any of the HeraCeram ceramics to adjust the shade.

Note! The firing resp. processing temperature of the correction material increases depending on the mixing ratio (e.g. with a ratio of 1:1 the firing temperature should be approx. 835 °C).
3.5 Layering of ceramic shoulders

The HM (high fusing margin) shoulder ceramics are applied in the usual way and fired at a temperature of 870 °C.

The LM (low fusing margin) shoulder materials are only used after the veneer has been completed (i.e. after glaze firing). Due to the low firing temperature of 790 °C LM shoulder ceramics can also be used as a correction material, e.g. for adjusting the contour, pontics or adding contact points.

HM and LM shoulder ceramics are contained in the Shoulder Ceramic Set. HM/LM 1–6 are combined with each tooth shade according to the shade chart. HM/LM 7 is also referred to as bleach. It is an opaque white shoulder ceramic with increased fluorescence and can be used for masking dark areas (discolored tooth substance) resp. for adjusting lightness and transparency of HM or LM ceramics.

Preparation requirements

The tooth should be prepared with a shoulder or at least a well-defined deep chamfer for fabricating metal-free crown margins.
3. Instructions for use for HeraCeram

Preparing the framework

The metal framework is reduced by approx. 1 – 1.5 mm at the margins, conditioned in the usual way and coated with opaque.

Preparing the stone dies

First separating liquid is applied to the shoulder areas of the stone dies. HeraCeram separating liquid should be applied directly onto the stone surface. Pre-sealing the stone surface impairs the effectiveness of the separating liquid!

Fig. 30: Anterior framework with full crown margin

Fig. 31: The crown margin is reduced by approx. 1 mm for the ceramic shoulder

Fig. 32: Prepared metal framework ready for ceramic application

Fig. 33: The opaque is applied in a way to include the metal margin of the ceramic shoulder

Fig. 34: Separating liquid must be applied to the model die before applying the shoulder ceramic
First layering with HM shoulder ceramic

The shoulder ceramic is mixed with SM liquid to obtain a sculptable dough and applied to the cervical area of the crown. Excess liquid is removed by slightly condensing it. After contouring and smoothing the ceramic surface, the crown can be removed from the model and fired.

Fig. 35: Shoulder ceramic is applied to the exposed area of the preparation and the cervical area of the crown

Fig. 36: Completed ceramic shoulder build-up with HM ceramic

Carefully drying with a hairdryer adds more strength to the shoulder material and improves its handling characteristics.

See page 30–34 for the firing cycle.
Correction layering

The marginal seal is checked after firing and changes caused by sintering are corrected.

Separating liquid is applied again to the model and the HM shoulder ceramic is mixed as for the first layering process.

The ceramic shoulder can be roughened by lightly grinding or sandblasting it (50 µm aluminium oxide; 1.0 – 1.5 bar) to improve adaptation of the shoulder ceramic to the baked ceramic shoulder.

After applying HM shoulder ceramic, the framework is placed on the model again by lightly tapping it.

Any excess is removed and the framework is removed from the model and fired once the shoulder ceramic is dry.

The veneer is then completed using HeraCeram ceramics.

---

**Fig. 37:** The shoulder ceramic is dried with a tissue or a hairdryer before it is removed from the model.

**Fig. 39:** Poorly fitting areas caused by sintering are corrected.

**Fig. 41:** After the correction the ceramic fits perfectly.

**Fig. 38:** Ceramic shoulder after the first firing.

**Fig. 40:** Placing the crown on the model after firing.

**Fig. 42:** The veneer is then built up in the usual manner.
LM (low fusing) shoulder ceramic

LM shoulder ceramics are used to fabricate ceramic shoulders after the veneer has been completed, i.e. after glaze firing.

The procedure is the same as that used for HM shoulder ceramics, however, the low firing temperature of 790 °C must be observed.

LM ceramics can be used not only for fabricating and correcting ceramic shoulders but also for any other type of corrections, e.g. corrections of contours or adding contact points.

---

**Fig. 43:** Completed ceramic-faced crowns with ceramic shoulder

**Fig. 44:** Ceramic-faced crown with a poor marginal seal

**Fig. 45:** Correcting the marginal fit with LM shoulder ceramic

**Fig. 46:** Ceramic-faced crown after correction layering
3. Instructions for use for HeraCeram

3.6 Final conditioning after completing the veneer

Polishing the ceramic

HeraCeram can be easily polished mechanically. Our HP paste has proved to be perfectly suitable for final polishing.

Polishing the metal surface

The hardness of the alloy should be taken into consideration when polishing to obtain a smooth shiny surface. The direction of the polishing heads should be continually changed during polishing. Only a small quantity of polishing agent is required when polishing to high luster with a rotary linen, cotton or wool buff. The restoration should be cleaned before any change of polishing agent. Cleaning is not required before changing the polishing head if the same polishing agent is being used.

Soft alloys are prepolished with a rubber polisher until the polished surfaces are free from streaks and striae. Then polishing is continued using a hard brush in the handpiece at low speed (5000 rpm) and a small quantity of Hera GPP 99 gold polishing paste and little pressure. High luster polishing is carried out with a soft goathair brush in the handpiece and Hera GPP gold polishing paste 99 at low speed (5000 rpm) and little pressure. Then the excess paste is removed using wool buffs.

Pickling the crown margins of completed restorations

Residual oxide on the margins of veneered crowns can cause gingival irritation. To improve patient safety, we recommend always pickling completed restorations to remove any residual oxide. For this purpose the restoration is pickled in Hera AM 99 for approx. 10 minutes at 70°C. (The solution used for removing the oxide after oxidation firing can also be used for pickling.)

Then acid residues are removed from the restoration with water and steam until the restoration is clean.

Fig. 47: LM shoulder ceramics can also be used for all other types of corrections

Fig. 48: Ceramic crown after the correction with LM shoulder ceramic
4.1 Soldering

The surfaces forming the solder gap should be sufficiently large, parallel-walled, shiny and clean for soldering. The surfaces should be rough but if they are too coarse, the risk of formation of gas bubbles in the solder joint will be increased. The optimum surface roughness is achieved with fine-cut tungsten carbide cutters or by sandblasting with 50 µm aluminium oxide.

With solder gaps and joints varying in width or v-shaped solder gaps there is the risk of the solder solidifying due to the formation of blowholes.

The width of the solder gap should be between 0.05 and 0.2 mm. Wider solder gaps should be filled with small pieces of alloy sprues that have been cut off. Soldering joints which are planned as part of the construction technique should be prepared already when waxing up the crowns or bridge frameworks.

Preparing for soldering

The size of the investment soldering block should be kept to a minimum. Ensure that the soldering block is completely dry and uniformly heated before soldering.

Recommended solders

We recommend the exclusive use of Heraeus Kulzer dental solders. The chemical composition of the solders are matched to the various groups of dental alloys.

When soldering to a framework made of a CrCoMo alloy, Stahlgoldlot 750 can be used directly. The solder surfaces should be precoated with Stahlgoldlot 910 if other solders are used.

Recommended fluxes

Hera UL 99 universal soldering paste is recommended as flux. Hera SLP 99 special soldering paste should be used when soldering gold casting alloys to CoCrMo frameworks.

Soldering procedure

Soldering before ceramic firing is normally carried out with a flame. Above all with primary solderings of bridge frameworks made of yellow, high gold content ceramic bonding alloys it must be ensured that the framework is not overheated since it will deform or start to melt. Solderings after ceramic firing should be preferably performed in the ceramic furnace to avoid flaking of the ceramic.

Removing flux residues after soldering

We recommend Hera AM 99 pickling agent for removing oxides and flux residues. The soldered framework is immersed and then thoroughly rinsed with water after the oxides and flux residues have been removed.
4.2 Laser welding

Laser welding with the Herapuls offers essential advantages compared with soldering. For almost all precious metal dental alloys laser welding wires (Ø 0.5 mm (and some with Ø 0.3 mm) x 200 mm long) are available; these wires have the same composition as the dental alloy.

For the alloys for which it is not possible to produce laser welding wires for technical reasons, we recommend to use a similar alloy. Relevant information can be found on the alloy packet.

Welding parameters to be entered into the Herapuls unit

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<th>Program Nr.</th>
<th>Alloys</th>
<th>Working step</th>
<th>Focus Ø [mm]</th>
<th>Power [kW]</th>
<th>Time [ms]</th>
<th>Welding wire</th>
<th>Other</th>
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To have the welding parameters readily available at the Herapuls unit, we included a tear-out page with parameters at the end of these instructions.
## Metal ceramics

### General firing program

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<th>Preheating resp.</th>
<th>Paste opaque</th>
<th>Powder opaque</th>
<th>HM1 shoulder ceramic</th>
<th>HM2 shoulder ceramic</th>
<th>1st Dentine firing</th>
<th>2nd Dentine firing</th>
<th>Glaze firing</th>
<th>Correction ceramic</th>
<th>LM shoulder ceramic</th>
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### Heramat C

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<th>HM1 shoulder ceramic</th>
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<th>2nd Dentine firing</th>
<th>Glaze firing</th>
<th>Correction ceramic</th>
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</table>

1 = Only for veneering non-precious metal ceramic bonding  
2 = Or at the oxidation firing temperature recommended by the manufacturer  
3 = Under vacuum

### Important information:

The firing temperatures given are guidelines only. Variations in temperature may occur with different furnaces and should be adjusted if required.
## 5. Firing charts

### Heramat 2002

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### Austromat 3001/Press-i-dent

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<td>Correction ceramic</td>
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</table>

1 = Only for veneering non-precious metal ceramic bonding alloys
2 = Or at the oxidation firing temperature recommended by the manufacturer
### Metal Ceramics

#### Gemini II resp. HT / HT Press

<table>
<thead>
<tr>
<th></th>
<th>Pre-Opaque</th>
<th>Paste opaque</th>
<th>Powder opaque</th>
<th>HM1 shoulder ceramic</th>
<th>HM2 shoulder ceramic</th>
<th>1st Dentine firing</th>
<th>2nd Dentine firing</th>
<th>Glaze firing</th>
<th>Correction ceramic</th>
<th>LM shoulder ceramic</th>
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<td><strong>Temp. delay [min]</strong></td>
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<tr>
<td><strong>Final temp. [°C]</strong></td>
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#### Multimat MC II / Mach 2 / Touch & Press

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<th></th>
<th>Pre-Opaque</th>
<th>Paste opaque firing</th>
<th>Powder opaque firing</th>
<th>HM1 shoulder ceramic</th>
<th>HM2 shoulder ceramic</th>
<th>1st Dentine firing</th>
<th>2nd Dentine firing</th>
<th>Glaze firing</th>
<th>Correction ceramic</th>
<th>LM shoulder ceramic</th>
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<td>600</td>
<td>600</td>
<td>600</td>
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#### Programat P90/P95

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<th>Firing temp. [°C]</th>
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<th>Holding time</th>
<th>Vac. ON</th>
<th>Vac. OFF</th>
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<td>6</td>
<td>1</td>
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<td>100</td>
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<td>1</td>
<td>500 °C</td>
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<td>500 °C</td>
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<tr>
<td>1st Dentine firing</td>
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<td>100</td>
<td>860 °C</td>
<td>5</td>
<td>1</td>
<td>500 °C</td>
<td>859 °C</td>
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<tr>
<td>2nd Dentine firing</td>
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<td>5</td>
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<tr>
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1 = Only for veneering non-precious metal ceramic bonding alloys
2 = Or at the oxidation firing temperature recommended by the manufacturer
## 5. Firing charts

### Programat X 1 / EP 600

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<td>980</td>
<td>10:00</td>
<td>100</td>
<td>500</td>
<td>T</td>
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<td>6:00</td>
<td>100</td>
<td>880</td>
<td>1:00</td>
<td>100</td>
<td>500</td>
<td>1° below T</td>
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<tr>
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<td>3:00</td>
<td>100</td>
<td>880</td>
<td>1:00</td>
<td>100</td>
<td>500</td>
<td>1° below T</td>
</tr>
<tr>
<td>HM1 shoulder ceramic</td>
<td>500</td>
<td>4:00</td>
<td>100</td>
<td>870</td>
<td>1:00</td>
<td>100</td>
<td>500</td>
<td>1° below T</td>
</tr>
<tr>
<td>HM 2 shoulder ceramic</td>
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<td>100</td>
<td>860</td>
<td>1:00</td>
<td>100</td>
<td>500</td>
<td>1° below T</td>
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<tr>
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<td>400</td>
<td>6:00</td>
<td>100</td>
<td>860</td>
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<td>100</td>
<td>500</td>
<td>1° below T</td>
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<td>810</td>
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<td>100</td>
<td>500</td>
<td>1° below T</td>
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<td>100</td>
<td>790</td>
<td>1:00</td>
<td>100</td>
<td>500</td>
<td>1° below T</td>
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</table>

1 = Only for veneering non-precious metal ceramic bonding alloys
2 = Or at the oxidation firing temperature recommended by the manufacturer

### Systomat

<table>
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<th></th>
<th>Left firing chamber Temp.</th>
<th>Time</th>
<th>Vac.</th>
<th>Right firing chamber Temp.</th>
<th>Time</th>
<th>Cooling phase</th>
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<td>600 °C</td>
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<td>Paste opaque firing</td>
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<td>3</td>
<td>2</td>
<td>600 °C</td>
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<tr>
<td>Powder opaque firing</td>
<td>880 °C</td>
<td>3</td>
<td>2</td>
<td>600 °C</td>
<td>2</td>
<td>–</td>
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<tr>
<td>HM1 shoulder ceramic</td>
<td>870 °C</td>
<td>5</td>
<td>4</td>
<td>600 °C</td>
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<td>HM 2 shoulder ceramic</td>
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<td>2</td>
<td>600 °C</td>
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<td>–</td>
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<td>1st Dentine firing</td>
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<td>2</td>
<td>600 °C</td>
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<td>2</td>
<td>600 °C</td>
<td>2–4</td>
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<td>2</td>
<td>600 °C</td>
<td>2</td>
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### Vacumat 200/250/300

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<th>Final temp.</th>
<th>Predrying time</th>
<th>Heat rate</th>
<th>Holding time</th>
<th>Vac. time</th>
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<td>600 °C</td>
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## Vacumat 2500

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<td>100</td>
<td>1.0</td>
<td>3.0</td>
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<td>600 °C</td>
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<td>100</td>
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<td>1st Dentine firing</td>
<td>860 °C</td>
<td>600 °C</td>
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<tr>
<td>2nd Dentine firing</td>
<td>850 °C</td>
<td>600 °C</td>
<td>5.0</td>
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<td>Glaze firing</td>
<td>850 °C</td>
<td>600 °C</td>
<td>4.0</td>
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<tr>
<td>Correction ceramic</td>
<td>810 °C</td>
<td>600 °C</td>
<td>5.0</td>
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<td>LM shoulder ceramic</td>
<td>790 °C</td>
<td>600 °C</td>
<td>4.0</td>
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### Cergo Press / Cergo Compact

<table>
<thead>
<tr>
<th>Pre-Opaque</th>
<th>Paste opaque</th>
<th>Powder opaque</th>
<th>1st HM</th>
<th>2nd HM</th>
<th>1st Dentine firing</th>
<th>2nd Dentine firing</th>
<th>Glaze firing</th>
<th>Correction ceramic</th>
<th>LM</th>
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<tr>
<td>Predrying [°C]</td>
<td>120</td>
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<td>Predrying [min]</td>
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<td>Closing time [min]</td>
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<tr>
<td>Preheating [°C]</td>
<td>600</td>
<td>600</td>
<td>600</td>
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<td>600</td>
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<tr>
<td>Preheating [min]</td>
<td>1:00</td>
<td>1:00</td>
<td>1:00</td>
<td>1:00</td>
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<tr>
<td>Heat rate [°C/min]</td>
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<td>100</td>
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<td>Vac. ON [°C]</td>
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<td>Vac. OFF [°C]</td>
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<td>830</td>
<td>830</td>
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<tr>
<td>Final temp. [°C]</td>
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<td>V HOLD [min]</td>
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<td>HOLD [min]</td>
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<td>TEMPER [min]</td>
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<tr>
<td>TEMPER [°C]</td>
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<td>COOL TIME [min]</td>
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1 = Only for veneering non-precious metal ceramic bonding alloys

2 = Or at the oxidation firing temperature recommended by the manufacturer
Laser welding parameters for ceramic bonding alloys to be entered into the Herapuls unit

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<tr>
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<td>9</td>
<td>Ceramic bonding alloys e.g.: Herador C, Herador H, Herador NH, Herador S, Herador G, Herador GG, Heraloy G, Herabond, Herabond N, Altabond A, Altabond B</td>
<td>bridge Ø 3 – 4 mm</td>
<td>0.8</td>
<td>1.9</td>
<td>7</td>
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<td>with wire</td>
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<td>1.4</td>
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<td>Smoothing</td>
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<td>Bio alloys e.g.: Bio Herador N, Bio Herador SG, Herador EC, Herador PF, Herador MP</td>
<td>bridge Ø 3 – 4 mm</td>
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