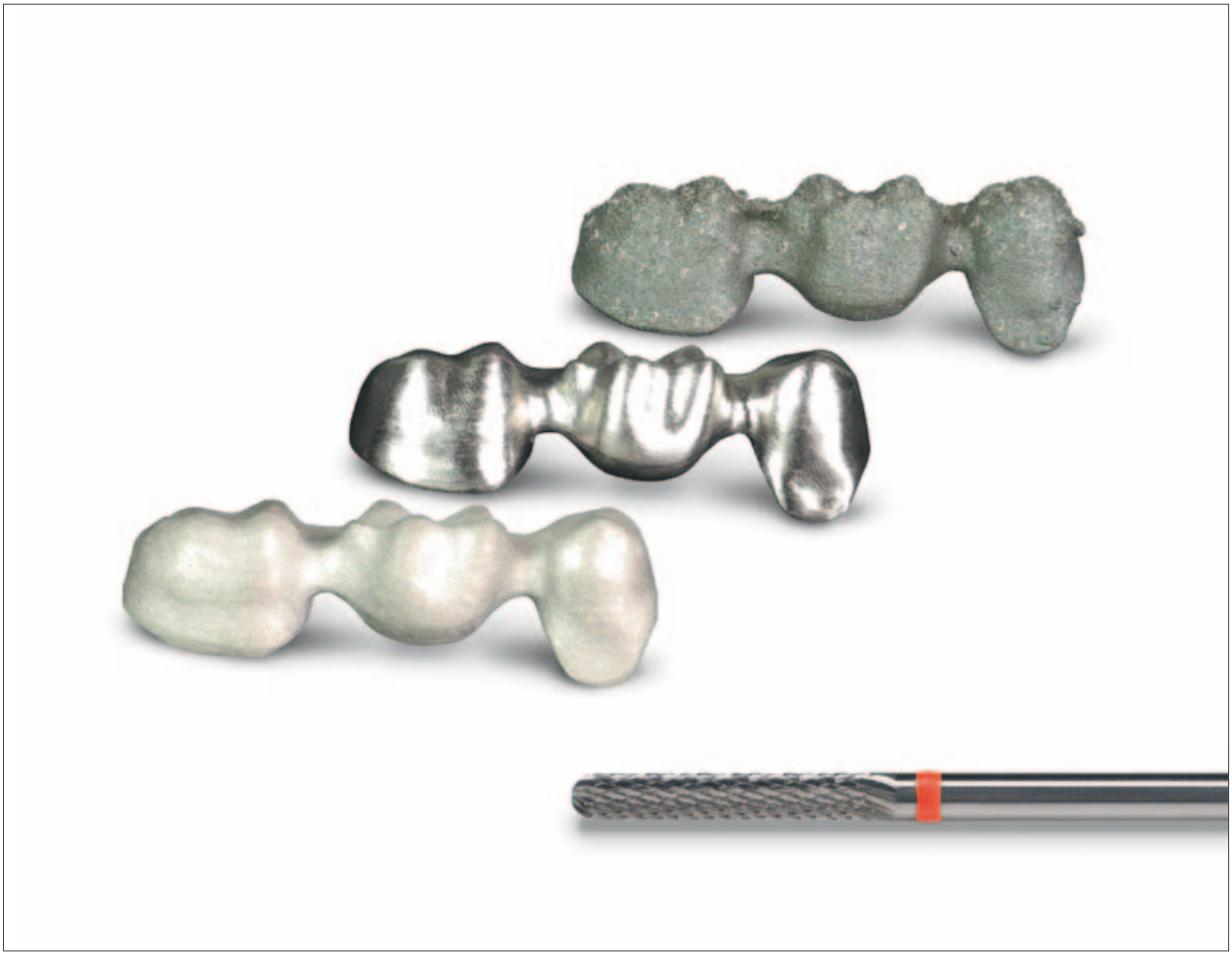
VITA Guide



VITA shade taking | VITA shade communication | VITA shade reproduction | VITA shade control

Date of issue: 05.12

VITA shade, VITA made.

VITA

Step-by-step
to metal ceramic framework design

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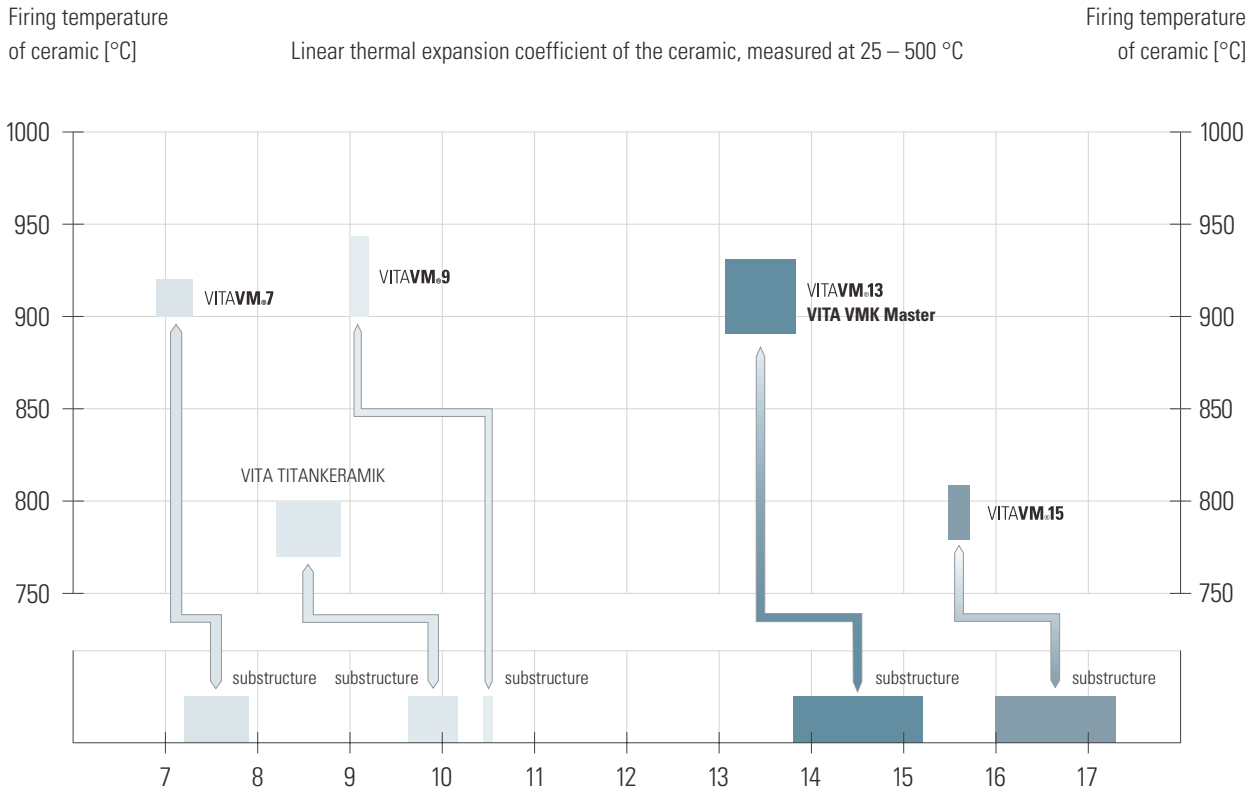
Area of application

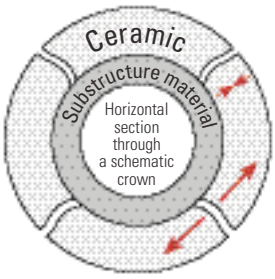
For alloys in the CTE range of approx. 13.8–15.2 · 10^{-6} · K^{-1}



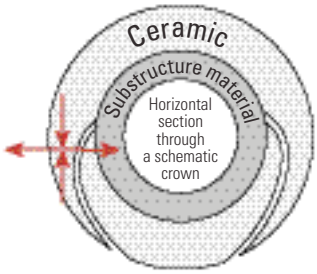
Linear thermal expansion coefficient of the substructure material, measured at 25 – 500 °C
(alloys measured at 25 – 600 °C)

VITA VM 7 CTE (25–500°C) 6.9–7.3 · 10^{-6} · K^{-1}	VITA In-Ceram ALUMINA, CTE (25–500°C) 7.2–7.6 · 10^{-6} · K^{-1} VITA In-Ceram SPINELL, CTE (25–500°C) 7.5–7.9 · 10^{-6} · K^{-1} VITA In-Ceram ZIRCONIA, CTE (25–500°C) 7.6–7.8 · 10^{-6} · K^{-1} VITA In-Ceram AL, CTE (25–500°C) approx. 7.3 · 10^{-6} · K^{-1}
VITA TITANKERAMIK CTE (25–500°C) 8.2–8.9 · 10^{-6} · K^{-1}	For titanium and titanium alloys CTE of titanium (25-500°C), approx. 9.6 · 10^{-6} · K^{-1} CTE of Ti6Al4V (25-500°C), approx. 10.2 · 10^{-6} · K^{-1}
VITA VM 9 CTE (25–500°C) 9.0–9.2 · 10^{-6} · K^{-1}	VITA In-Ceram YZ CTE (25–500°C), approx. 10.5 · 10^{-6} · K^{-1}
VITA VM 13 CTE (25–500°C) 13.1–13.6 · 10^{-6} · K^{-1} VITA VMK MASTER CTE (25–500°C) 13.2–13.7 · 10^{-6} · K^{-1}	High gold content, reduced precious metal content, palladium-based and non-precious alloys CTE (25–600°C) 13.8–15.2 · 10^{-6} · K^{-1}
VITA VM 15 CTE (25–500°C) 15.3–15.7 · 10^{-6} · K^{-1}	Multi-indication alloys CTE (25–600°C) 16.0–17.3 · 10^{-6} · K^{-1}

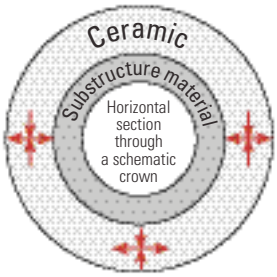
* For further information on alloys see under downloads in the internet.



If the CTE of the substructure material is considerably lower than the CTE of the veneering ceramic, tangential tensile stress will increase and form radial cracks that run to the outside.
This may result in late cracks.



If the CTE of the substructure material is considerably higher than the CTE of the veneering ceramic, tangential compressive stress will increase and form cracks that run almost parallel to the substructure.
This may result in flaking.



The ideal tangential and radial tensile stress is ensured if the CTE of the ceramic has been optimally matched with the CTE of the substructure material.

Optimal preconditions are given if the veneering ceramic features a somewhat lower CTE value than the substructure material. Due to adhesive bonding, the ceramic must follow the thermal behavior of the substructure material. If cooled down, the ceramic is exposed to slight tangential compressive stress.

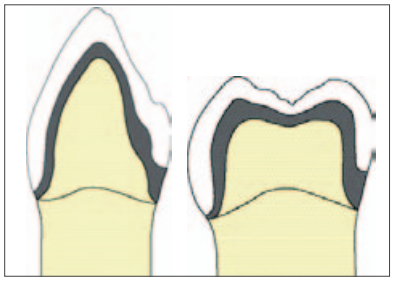
If a substructure material is veneered with ceramic, the layer thickness of the veneer is a decisive factor in addition to the CTE value. Accordingly, differences in strain (radial tensile stress) are obtained, which will grow in case of increasing layer thickness.

General information
A chamfer or shoulder with rounded inner angle should be prepared for crowns. The aim should be a circumferential cutting depth of one millimeter. The vertical preparation angle should be at least 3°.
All transitions from the axial to the occlusal or incisal surfaces should be rounded. Uniform and smooth surfaces are recommended.

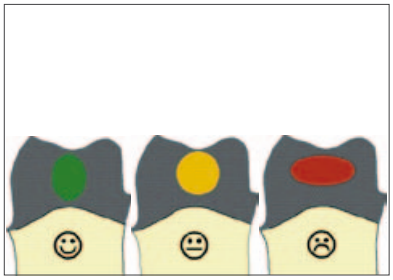
A: B: Shoulder preparation or chamfer preparation

C: Tangential preparation - contraindicated for ceramic shoulders

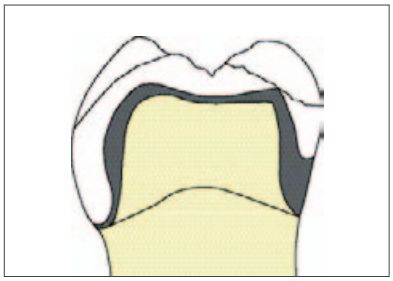
D: Incorrect chamfer preparation - generally contraindicated



Substructure design
The substructure reflects the shape of the tooth in a reduced size (design supporting the tooth shape). It must be ensured to apply the ceramic material in a uniform layer thickness (max. 2 mm). During the application, the requirements for the various alloys must be observed:
– Substructures with insufficient dimensions cause higher shrinkage of the veneering ceramics and hence require additional firing processes.
– Substructures with insufficient dimensions do not provide adequate support for the veneering ceramic which may result in cracks and chipping in the case of very thick layers.



Cross-section of connectors
The cross-section of the interproximal connectors has a major influence on the stability of the restoration. Therefore the interproximal connectors must have adequate dimensions depending on the alloy in use!

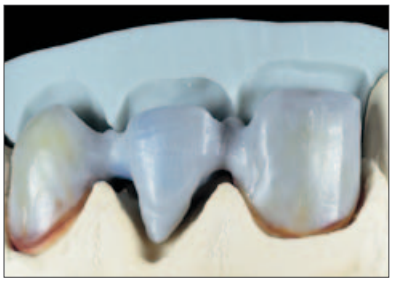


Crown substructures and bridge units to be veneerd with ceramic materials must be designed in a way to ensure that wall thicknesses of crowns are at least 0.3 mm and wall thicknesses of bridges are at least 0.5 mm.
For more information, refer to the working instructions of the respective alloy.
Transition areas between metal and veneering ceramic must not be located in the area of contact points and on surfaces involved in masticatory function.
The transition area in the interproximal area should be designed in a way to allow careful cleaning.

Design of a metal margin
The transition area of the metal substructure to the veneering material must be clearly defined and a right angle should be prepared whenever it is possible.
Transitions between metal and veneering ceramic should not be in the vicinity of contact points and on occlusal surfaces.
When preparing the interdental space, the transition should be designed in a way to allow easy cleaning.

Layer thickness of ceramics
When designing a ceramic restoration, the layer thickness should be distributed homogeneously over the entire surface to be veneered.
The entire thickness of the ceramic layer, however, should not exceed 2 mm (the optimum layer thickness ranges from 0.7 to 1.2 mm).

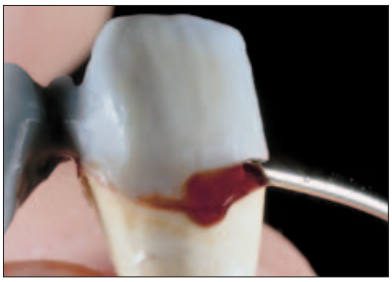
Metal frameworks to be veneered with porcelain must always be designed in a reduced anatomical tooth shape. In this way controlled absorption and distribution of acting compressive and tensile forces will be ensured.



General facts:
- missing die substance must always be compensated for with metal
- transition zones in the area of metal/ceramic must be outside the contact zones towards the antagonist
- sharp transition zones, angled edges and undercuts must be avoided
- the total framework design should be marked by smooth transition zones.

Adequate stability of the framework mainly serves for correct absorption of the acting forces. Additionally, stable design avoids any deformation during firing and contributes to the retention of dimensional stability.

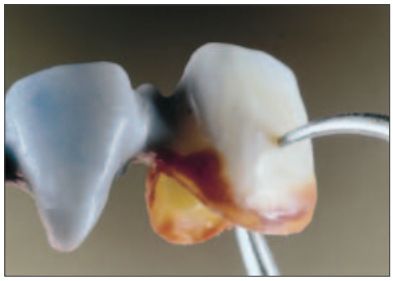
Design of the interdental connectors
Sufficiently stable modellation of the interdental connecting areas must be ensured. A design featuring adequate depth is to be prepared that takes periodontal-hygienical aspects into consideration.
Large-span bridges can be stabilized with a thin metal collar or at least with inlay-like proximal reinforcements.
Such reinforcements do not only support stability but also serve to control cooling during the firing process.
The cooling behaviour of a ceramic bridge is more constant and thermal stress is avoided.



Design of the marginal areas

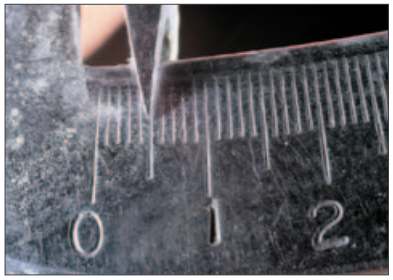
- Use a special wax with suitable characteristics in order to model the cervical marginal areas. Model resins are very common for framework design due to their enhanced stability properties.
  Since these resins tend to swell considerably during the preheating cycle of the muffle, a thin wax coating is required.

  Please adhere to the information provided by the manufacturer to avoid errors and imprecise modelling.



Thickness of the framework

- A thickness of the framework of at least 0.3 mm is required for ceramic veneering.
  Non-precious 0.3 mm after finishing
  Gold-alloy 0.4 mm after finishing



Waxing-up

- Single crown - precious metal alloy at least 0.5 mm
- Abutment crown - precious metal alloy at least 0.5 mm
- Single crown - non-precious alloy at least 0.4 mm
- Abutment crown - non-precious alloy at least 0.4 mm

Golden rules of the sprue system

Because the object should solidify first during casting, the liquid melt needs to be pulled out of the sprue reservoir.
For this purpose the following rules must be observed:

Rule 1: Casting from thick to thin parts

Distribution bar must be sufficiently large; on each side it must be approx. 2-3 mm longer than the bridge and have more volume than the object. In the area of the massive pontics the bar always needs to be reinforced towards the center of the muffle.

Rule 2: Indirect casting

Attach distribution channel to bridges and a small „stick" to single crowns. The molten metal should not flow directly into the object but fill the distribution channel or the „stick" first.

Rule 3: Casting from the inside to the outside

The distance from the object to the bottom of the muffle and from the object to the wall of the muffle must be at least 5 mm. Bridges must be placed in a circle at the muffle wall.
Single crowns with „stick" should be tilted towards the wall.
Fill investment material only 5 mm above the crown margin into the muffle.

Rule 4: No vents

During condensing the compressed air is not directed correctly through vents.

Rule 5: No casting button

Generally, casting buttons are not required. The material quantity to be used is obtained by multiplying the weight of the wax pattern by the density of the alloy (see manufacturer's instructions).

Rule 6: Observe sprue dimensions

Sprues for all alloys with high palladium content and for all non-precious alloys require larger dimensions.

Rule 7: Use original sprue former base

The additional and product-specific instructions of manufacturers of investment materials, preheating furnaces, alloys and casting machines must be strictly adhered to.

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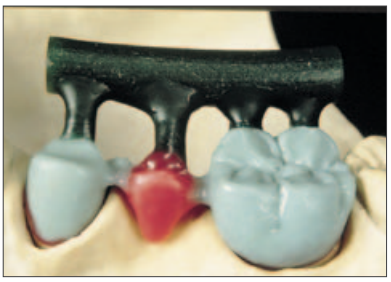
- There are very different concepts about attaching the sprues; therefore this chapter is restricted to the description of general, approved basic rules. The type and design of the sprue system depends on the casting method and must be carried out precisely according to the manufacturer's instructions.



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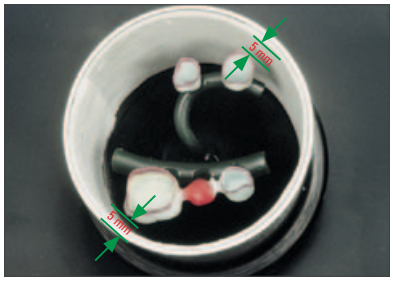
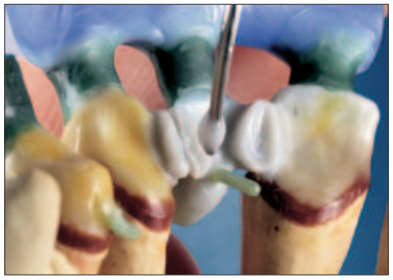
General principles for attaching the sprues to castings

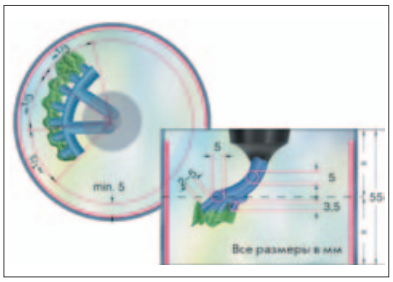
- the sprue is attached to the thickest point/area
- the molten metal flows from thick to thin parts
- the sprue is placed at an angle of 45° towards the occlusal surface
- the casting lies outside the center of the heat
- all sprues are smoothly coated with wax and lead to the casting without any edges to avoid entraining of investment material particles



- Since massive pontics require more metal than the remaining bridge units, the bar must be reinforced in this area so that it features at least the same volume as the pontic.
- The distance from the object to the wall of the muffle must be at least 5 mm.

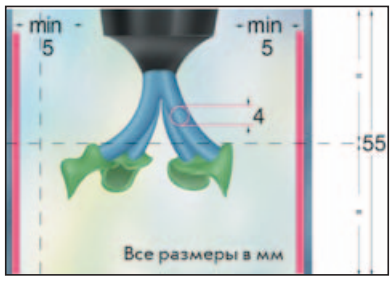


- **Tip:**
  Waxing-up of the bridge elements after the contraction of the wax results in clearly reduced stress in the framework.



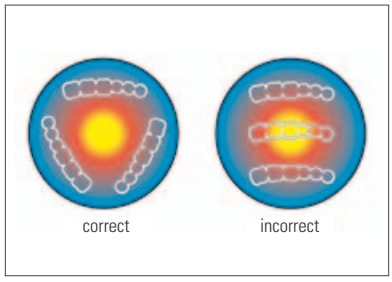
Heraeus Kulzer

- Schematic illustration of bar casting, dimensions for ceramic bonding alloys.



Heraeus Kulzer

- Schematic illustration of the single sprueing, dimensions for ceramic bonding alloys



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- Correct and incorrect position of several bridges in the casting mould.

- The crowns are close to the wall of the muffle outside the center of the heat and are able to cool first. On each side the distribution channel (bar) should be approximately 2-3 mm longer than the bridge.

Direct sprueing of single crowns

- Direct supply through a sprue with a diameter of 4-5 mm depending on the mass of the object.
- The length is approx. 10-15 mm and leads out of the center of heat.
- The connecting point is not tapered. Sprueing with „lost head".
- Distance to the object is approx. 1.5 mm.
- Sprue design for bar casting: head diameter approx. 6 mm or larger. For casting of bridges bar casting is recommended.
- Connecting sprues of 2-5 mm in length and a diameter of 3.5 mm, placed palatally or lingually, are connected to each unit of the wax pattern at an angle of 45°.
- Each bridge unit has a separate sprue.
- It is recommended to have two sprues for large molars.
- All feeding sprues are connected with a bar featuring a diameter of 5 mm.
- The bar runs parallel to the casting.
- Two sprues proceeding from the sprue base former end between the first and second resp. second and third third.
- These sprues have the same diameter as the bar.

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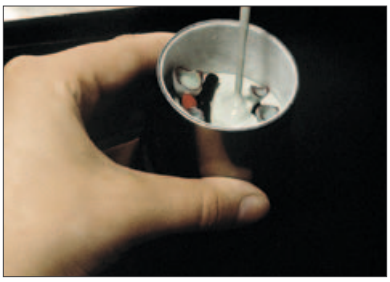
For mixing ratios and mixing times for the investment material, please read the instructions provided by the manufacturer.

The following applies to all investment materials (except of speed investment materials):

- The longer the mixing time, the smoother the surface of the casting
- Only small quantities of wetting agent should be used since they influence the investment material.
- Wetting agents must not be applied to model resins, respectively prefabricated plastic elements.



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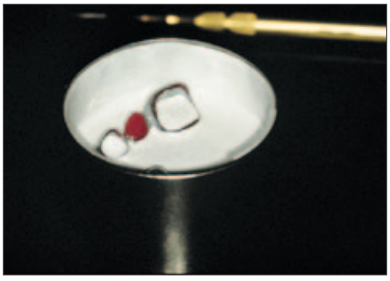
- The investment must be poured in thinly from a height of approximately 20 to 30 cm.

- To avoid bubbles inside the crown, investment material is filled into the crown pattern using a brush or a probe.



- Floating of the wax pattern in the investment material reduces surface tension, removes small bubbles and provides the casting with a smoother surface.
- The investment material is filled up to the upper rim of the ring and the surface is ground in accordance with the respective instructions of the manufacturer (with plaster trimmer or plaster knife).

- When placing the rings in the preheating furnace ensure that the muffles do not come into contact with each other and the furnace wall. Elimination of the wax from the rings must also be ensured.

Vacuum pressure casting

- The dimensions of the sprue system must ensure that the cavity is filled quickly and entirely. Additionally, it must be ensured that controlled rigidification of the molten metal removes all shrinkage cavities and porosities from the casting. The sprue is always connected to the thickest point of the pattern.

Centrifugal casting unit for flame melting

- Place casting cylinders or ingots closely to each other in the **preheated crucible.** Rotate the flame in the reduced flame zone about 7 cm away from the to be melted object. As soon as the cylinders or ingots have melted, start the centrifugal casting unit immediately.

High frequency induction centrifugal casting unit

- Place casting ingots into the **preheated crucible** and melt swiftly using the power level given for the respective alloy. For details regarding the exact casting point in time please read the alloy manufacturer's instructions.

Trouble-shooting, casting

- It is known that the quality of a dental ceramic veneer depends directly on the quality of the casting. Frequently, sources of errors of the bond can be attributed to low quality of the casting and incorrect processing of materials.
- If old metal is used, the mixing ratio is max. 50% of old metal to at least 50% of new metal.
- Only new metal must be used for non-precious alloys.
- Old metal is cleaned through sandblasting and rinsing with water.
- It must be ensured that no graphite particles of the crucible reach the alloy.
- Each alloy requires a separate marked crucible.
- The casting equipment must ensure reliable temperature control and - if possible - automatic monitoring.
- Above all, when melting with the open flame, uniform and careful heating must be ensured. During this melting process there is a particularly high risk of overheating the casting alloy.

- After casting, the muffle cools down to room temperature and devesting can be carried out subsequently.

- A devesting unit is recommended if a metal ring is used.
- Soak the muffle shortly to reduce dust and cut investment material into pieces using plaster pliers.
- This way investment material can be removed from the casting without the formation of dust.

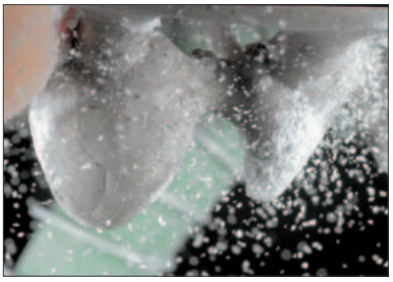
- Carefully devesting with plaster pliers.

- To avoid any deformation, do not use a hammer for devesting.

Sandblasting

- Investment material residues remaining at the casting can be removed in the sandblasting unit. Generally, only clean disposable corundum (110 µm-125 µm) for precious metal alloys and 250 µm for non-precious alloys should be used to clean surfaces to be veneered with ceramic.

- To avoid the penetration of corundum particles into the surface, sandblasting must be carried out at an obtuse angle.
- The correct blasting pressure is ensured by regularly checking the quality of the blasting nozzle.
- Low-quality corundum is not suitable.
- The repeated use of abrasives must be avoided.



- The max. working pressure must be selected in a way that the sensitive margins will not be damaged. Impacting of precious corundum into the surface may result in serious errors during firing.
  Recommended working pressure for precious metal alloys: 2 bar; non-precious alloys: 3-4 bar.

Pickling of precious metal alloys

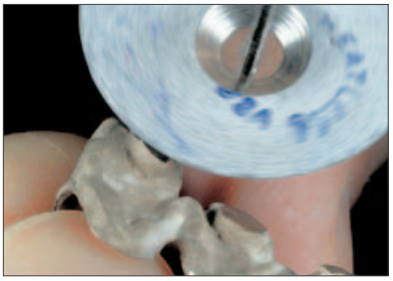
The surface can be cleaned through the additional use of a suitable pickling agent. Pickling agents are ready for use and the manufacturer's instructions must be strictly adhered to when using them.

- Each alloy requires a specific pickling process to avoid contamination of the surface to be veneered by pickling agent residues of different alloys.
- To ensure correct concentration, the pickling agent must be changed regularly.
- The pickling time must be calculated exactly and must not be estimated.

- The casting is separated with ceramic bonded discs mounted in the handpiece ...

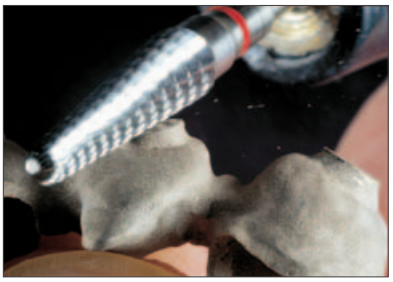
... or the rapid grinder.

Important:
Always wear safety goggles, work behind a protective screen and switch on the dust extraction system.
During grinding, gold dust is collected by special filters.



- Ceramic bonded discs are used for coarse grinding of the sprues.
- Adequate stability of the mandrel and correct concentric running must be ensured.
- Sharpen the grinding discs with a whetstone prior to grinding.

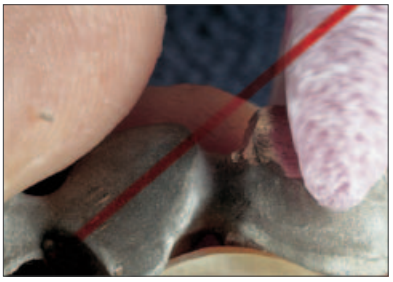
- Never use a bolt cutter to cut off the casting.



Finishing

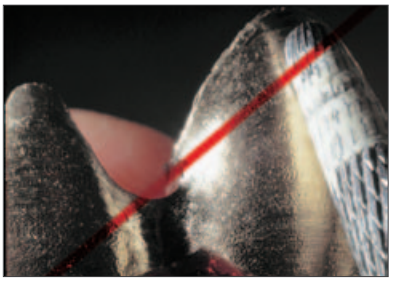
- Finishing of surfaces to be veneered with ceramics is subject to strict requirements. Fine bonding values can be achieverd only if the surfaces are prepared correctly.
  Tungsten carbide burs are perfectly suitable for finishing.
  Controlled working is ensured due to cutting removal.

Cross-cut tungsten carbide burs are recommended for finishing.

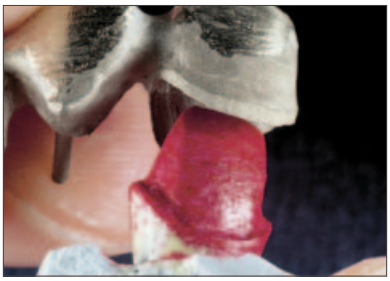


Removal with the help of diamond grinding tools or ceramic bonded stones includes various sources of errors that affect a reliable bond:

- Framework porosities are sealed and riveted.
- Residues of the ceramic binders on the surface are hard to remove. The contaminated surface causes the formation of pores and gas in the ceramic.
- Diamond grinding tools normally leave metallic contaminations on the surface of the framework.

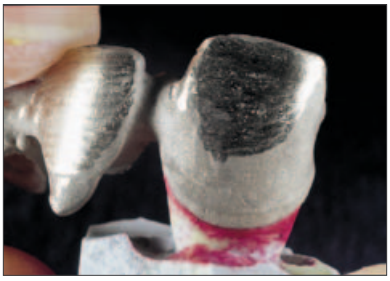


- Tungsten carbide burs should exclusively be used for processing *a single* material to ensure that no foreign alloy components can penetrate into the sensitive surface.
- When shaping the object, the bur should be moved in one direction using uniform movements.
- The burs must regularly be cleaned with the steam jet or in the ultrasonic unit.



- When fitting on the framework, a fine auxiliary material that burns out without any residues (lipstick, Occluspray) is used.

- Contact spots and premature contacts are removed under the stereomicroscope using suitable burs.

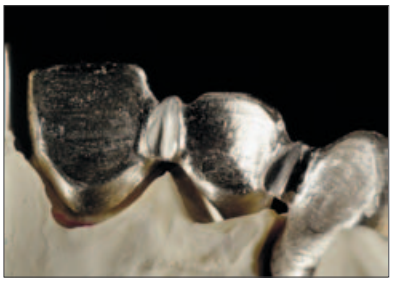


- If the primary fit is satisfactory, the framework is finished.

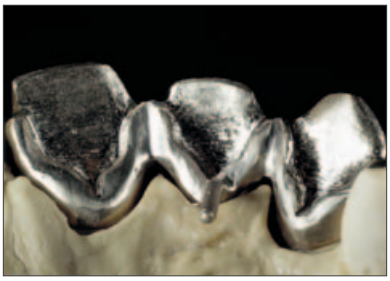
- The cross-cut tungsten carbide bur ensures perfect removal of material.

- The perfect basis of an optimal metal-ceramic bond is provided by finishing with diamond-coated tungsten carbide burs featuring bevelling cut.

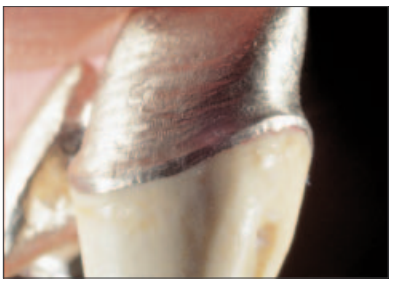
Correctly prepared framework



- Completed metal framework with inlay-like reinforcement ...



- ... or small collar.

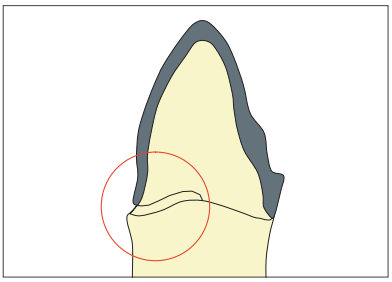


- Perfect preparation of the metal margins is carried out at the end of the finishing process.

Cast-on auxiliary elements

- Cast-on elements are frequently used especially in the field of implants and combined techniques. These materials do not form any bonding oxides which are required to form a bond with the ceramic. Therefore it is necessary that surfaces needing to be veneered must be covered with an castable alloy. **Accordingly, an adequate wax quantity must be used when shaping the framework.**

Substructure after finishing - prepared to fabricate a ceramic shoulder.



When fabricating ceramic shoulders, it must be ensured that the substructure (not the veneer) is supported by the prepared tooth (stump). Therefore the substructure is reduced exactly to the inner edge of the chamfer or shoulder preparation. This way, functional support of the substructure is achieved.

To achieve perfect, esthetic integration of the crown into the relevant esthetic areas and to avoid shadow areas, sufficient reduction of the substructure, in particular in the interproximal area, is required. Make sure to obtain a round and thin metal edge after the reduction.

To achieve even contours, it is recommended to use a pen to mark the reduction of the shoulder on the substructure (black line in the figure).

Completely reduced crown.

⚠ **Note:** It must be ensured that the shoulder is adequately supported by the metal substructure.

- Investment residues are removed with disposable corundum in the fine sandblasting unit at a pressure of 2 bar for precious metal alloys and 3-4 bar for non-precious alloys.
- Pickling is carried out strictly according to the manufacturer's instructions.
- Fine-cut tungsten carbide burs are used for coarse finishing.
- Finishing and final shaping is carried out using diamond-coated tungsten carbide burs.
- A reliable metal-ceramic bond requires sandblasting of the framework surface with precious corundum, grain size 125 µm, at a pressure of 2 bar for precious metal alloys resp. grain size 250 µm at a pressure of 3-4 bar for non-precious alloys.
- After sandblasting, the surface must not be contaminated with grease or similar material.
- The framework is cleaned with the steam-jet unit or boiled in distilled water.
- After cleaning, the framework may only be touched with tweezers or a similar tool.

⚠ **Important:** Bonding alloys containing zinc (Zn) must be sandblasted, oxidized, and after the oxidation firing etched in a clean, warm acidic bath for approx. 5 min. Steam off all traces of etching residue.

Guidelines for reliable veneering of non-precious alloys

Since substructures made of non-precious alloys are poor heat conductors and demonstrate a different behavior to precious metal alloys, the following points must be heeded when veneering non-precious metal alloys with VITA VM 13 or VITA VMK Master:

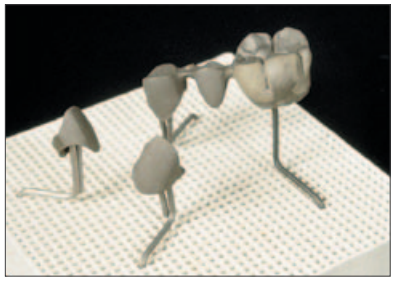
- When veneering non-precious alloys use only special ceramic crucibles.
- Use only new metal for casting.
- Sharp edges must be avoided when finishing the frameworks.
- Sandblast with 250 µm aluminum oxide at a pressure of 3-4 bar. Please follow the alloy manufacturer's instructions!!!
- To avoid discoloration, all surfaces not to be veneered should be sandblasted or polished with rubber polishers after each firing process. Then the substructure needs to be cleaned thoroughly.
- In order to achieve secure bonding between a non-precious alloy and VITA VM 13 or VITA VMK Master, the wash opaque firing temperature must be increased by 50 °C and the opaque firing by 30 °C. This allows better coating of the surface and improves bonding.

⚠ **Note:** The fired opaque demonstrates a high degree of surface glaze and a glassy, transparent appearance.

- If precious metal alloys are used, the surface to be veneered must be cleaned with the blasting nozzle at a pressure of 2 bar (grain size 110 µm - 125 µm). Non-precious alloys are sandblasted with aluminium oxide, grain size 250 µm, at a pressure of 3-4 bar.
- After sandblasting, the framework must be cleaned under running water or with the steam jet unit.
- Do not touch the framework with your fingers to avoid contamination with grease.
- Each metal surface must become subject to thermal treatment prior to applying the opaque. The temperatures of the alloys have been matched individually and the manufacturer's instructions must be observed.

Targets of oxid-firing:

- Non-precious alloy components oxidize at the surface and serve as retention elements of the metal ceramic bond.
- Contaminations and porosities can be seen on the surface and can be removed.
- Optimum support during the firing processes avoids possible thermal deformation.
- Stain-free and uniform oxide colour is required.
- The framework must be supported adequately and uniformly to avoid thermal distortion.
- A moderate heating rate is required to avoid exceeding the final temperature.
- Uniform heating ensures perfect fit of the framework.
- Slow cooling avoids stress in the framework.



Some alloys require a further pickling process or sandblasting process after oxide baking. Precise working according to the instructions is required to avoid possible interactions with the opaque material. Then acid residues must be thoroughly removed from the framework using the steam jet unit.

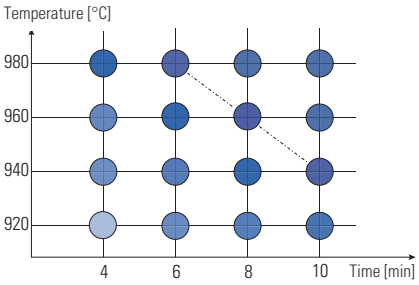


Fig. 1: Schematic view of the fired firing samples

In addition to the firing temperature, the correct degree of firing of a veneering ceramic depends on other parameters such as:
– Preheating temperature and time
– Heat-up time until firing temperature is reached
– Holding time of the ideal firing temperature
– Vacuum (level and duration)
– Position of the firing object in the furnace

Figure 1 shows that firing samples with the same degree of firing can be prepared at different firing temperatures by changing the holding time and the heat-up time. Of course, firing temperature and the heat-up times need to be adapted to the respective veneering ceramic and furnace.

This test clearly demonstrates that the same degree of firing can be achieved both with higher temperatures and shorter heat-up times and lower temperatures and longer heat-up times.

The temperature and the heat-up time for the furnace in use have been correctly adjusted, if the firing sample is transparent and has an intensive shade and sharp edges.

If the end temperature is too high, the sample will have a „greasy" gloss and rounded edges (to the right, above the diagonal).
If the end temperature is too low and the heat-up time too short, the firing sample appears to be milky and „dull" (to the left, below the diagonal).

During laboratory use, correct firing is indicated if the surface of the ceramic has a slight gloss (fig. 2, to the right). If the ceramic appears to be milky and non-homogeneous, the correct degree of firing could not be achieved (fig. 2, to the left). If the desired result is not achieved, approach the correct firing temperature in steps of 5-10°C.

Fig. 2

The following aspects must be observed:

- Ceramic furnaces in which different alloys are fired must be cleaned regularly (once a week).
- Cleaning is carried out in several firing processes at maximum power (1100 °C, 10 min).
- Considerable oxide deposits may cause weakening of the bond and discolouration of the ceramic (a clear evidence is the discolouration of the fireclay base).
- Furnaces with large temperature fluctuations are unsuitable.
- Damaged fireclay bases and contaminated lining material of the furnace must be exchanged before firing.
- Complete function of all filament resp. quartz windings must always be ensured.

To mask the shade of the alloy and to ensure perfect bonding to the metal substructure, opaque material is applied. The decisive element in the chain of processes is the combination of washbake and opaque firing which has a decisive influence on the quality of the bond. The opaque material is used to create the basis of the shade of an esthetic restoration.

⚠ **Note:** To achieve a more intense and warmer shade, the respective OPAQUE can be mixed with wash opaque (WO). However, the final result of the restoration may differ from the shade sample.

Gold-colored wash opaque and the respective opaque material (OP) are available for the washbake. One opaque material is required for reproducing the VITA SYSTEM 3D-MASTER shades (one for each lightness level) and the VITA classical A1–D4 shades (one for each shade).

WO and OP have the same chemical-physical properties and hence are perfectly suitable for the washbake.

Function - washbake:
Organic components are burned out through the base material.

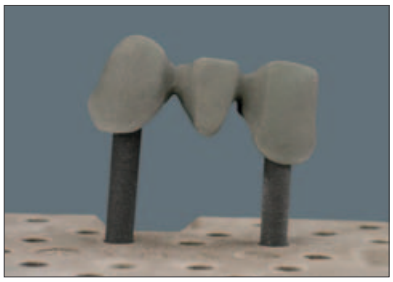
- The opaque material sinters on the bonding oxides of the metal surface and provides the bond.
- Additional bonding oxides are formed on the surface.
- Obtaining the bonding oxides and supporting the chemical bond
- Creating ceramic zones on the surface and strenghtening the retentions for the ceramic
- Coloring

Three variations are available for the application of the wash opaque or opaque materials:

- Powder: the opaque powder is mixed with the VITA OPAQUE FLUID and applied to the clean and dry substructure using a brush or glass instrument.
- Pastes: The paste opaque is supplied in a ready-to-use consistency and can also be applied using a brush or glass instrument.

⚠ **Note:** Pastes must be stirred with an instrument before they are used. If the paste can no longer be stirred after extended storage, the original consistency can be restored by adding a specific quantity of VITA PASTE FLUID. Please make sure that the paste opaque will not come into contact with water to avoid the formation of bubbles and cracks in the opaque during firing.

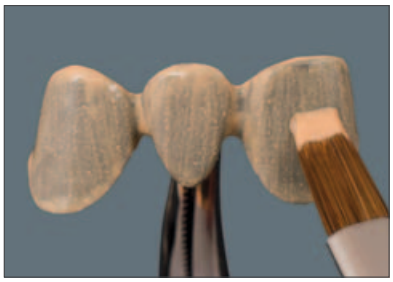
- VITA SPRAY-ON technique: the opaque powder is mixed with VITA SPRAY-ON LIQUID in the respective glass jar and then sprayed evenly onto the substructure surface. Please observe the information in the separate working instructions for VITA SPRAY-ON (No. 492).



The substructure that has been pretreated and oxidized in accordance with the parameters given by the alloy manufacturer.

The information of the respective alloy manufacturer must be observed!

Prior to further processing, clean the metal substructure under running water using a brush.
Then, thoroughly clean it with steam.

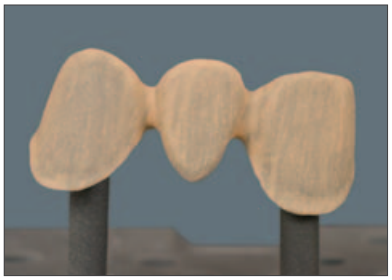


⚠ **Note:** After cleaning, the substructures must not be picked up with the fingers but with clean tweezers or clips.

Wash bake
A thin coat of paste opaque must be brushed on the surface of the substructure and an extended predrying time is required for drying the paste.

The paste material that is supplied in cups is gently brushed onto the framework surface using the special brush. It must be ensured that the paste opaque is mixed in the cup with a plastic instrument prior to the application. Even after extended storage the correct consistency can be obtained again by mixing with a specific quantity of Paste Opaque Liquid.

Information:
- Solid opaque material readily deposits at the bottom of the cup after extended storage.
- Uniform material consistency must be ensured for materials that are used less frequently.



Alternatively, the mixed opaque powder can be applied thinly and evenly (semi-masking) on the bridge substructure or sprayed on thinly using the VITA SPRAY-ON technique. Please make sure not to apply a first layer too thick.

Use the recommended firing tabel of the used veneering material (for VITA VMK Master see instructions for use no. 1645, for VITA VM 13 see no. 1180 and for VITA VM 15 see no. 1365)

⚠ **Note:** Substructures which reveal considerable formation of oxides need to be cleaned with a toothbrush under running water or with the steam jet after each firing process.

Opaque firing
Mix powder opaque to a creamy consistency with OPAQUE FLUID. Apply with a brush or a glass instrument to mask the surface of the veneer and fire according to the appropriate firing cycle. Paste opaque is applied in the same way to mask the surface of the clean and dry substructure or, alternatively, sprayed on with VITA SPRAY-ON.

Avoid excessive condensation and avoid thick opaque layers from flowing into the occlusal, approximal or marginal areas especially when fabricating bridges. Thick opaque layers may crack during firing.

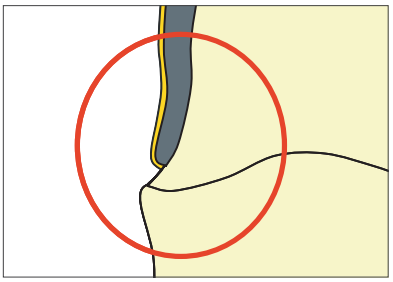
Before opaque firing, it must be ensured that the material is applied evenly and the entire metal substructure is adequately covered. After firing, the metal structure must be no longer visible; if required, the opaque must be applied and fired again.

Use the recommended firing tabel of the used veneering material (for VITA VMK Master see instructions for use no. 1645, for VITA VM 13 see no. 1180 and for VITA VM 15 see no. 1365)

⚠ **Note:** Problems can also occur if the opaque is dried too quickly. If the recommended pre-drying and drying times are not adhered to, small cavities may form or the opaque may flake off. In such cases the opaque liquid or the paste were converted too quickly from the liquid to the gaseous state.

The correct surface of the fired opaque exhibits a slight „egg shell" luster.

The WASH material is applied in the same way as for a bridge.



Difference to the opaque firing
To achieve good bonding to the shoulder material, the opaque needs to be applied across the reduced metal margin (see graphic).

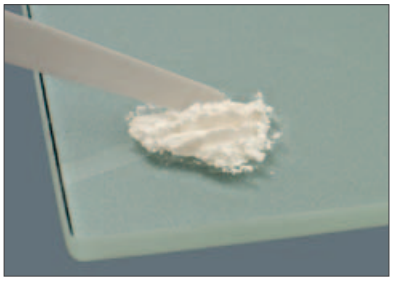
⚠ **Note:** Excess opaque material must not penetrate into the crown in order not to affect the fit.

Substructure with completely applied opaque - prepared for the application of shoulder material.

The application of a shoulder material is explained in the section „Application of a ceramic shoulder“.

The ceramic shoulder supports the natural effect of light in the transition area from the prepared tooth to the gingiva. The gingival margin of metal-ceramic restorations, which is frequently grey, can be rarely attributed to metal that is shining through but in most cases to the „shadow" caused by the missing light effect of the gingiva. Thanks to high fluorescence, VITA shoulder (MARGIN) materials support the natural distribution of light in the gingival area.

The MARGIN powders feature clearly different plastification than all other VITA powder materials. Thanks to the patented procedure for the manufacture of VITA shoulder (MARGIN) materials, the veneering ceramic can be processed in a similar way as acrylic materials.
The plasticity of the mixed material is almost identical to that of veneering resins/composites so that a spatula is perfectly suitable for the application.

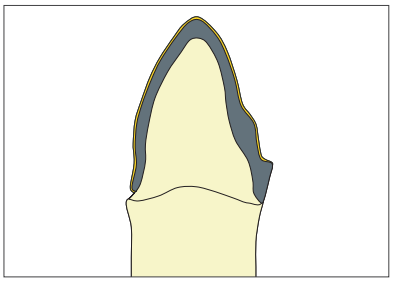


Thanks to plastification, no special liquid is required for mixing. The material is mixed with the VITA MODELLING FLUID enclosed in the assortment. To achieve a homogeneous mixing ratio of the MARGIN materials, it is recommended to mix the powders first (see „Classification tables").

The modelling fluid is repelled due to plastification of the MARGIN materials (hydrophobic effect).

Therefore the material must be mixed with the liquid using a spatula to obtain a dough-like consistency.

⚠ **Note:** The use of an ever-wet tray is not recommended since the capillary effect of the tray may be adversely affected by the plastification. Dried MARGIN material can not be mixed again.



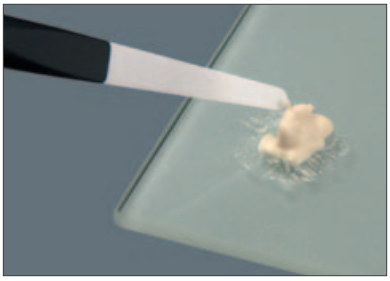
The opaque material is applied as shown in the figure.
See also the information in the section „Application of the opaque for a ceramic shoulder".

It is recommended to seal the plaster die before the shoulder materials are applied.

Then the dry and pretreated die is carefully insulated with VITA Modisol and the prepared coping is placed on the model.

⚠ **Note:** Make sure that the surface to be veneered will not come into contact with the insulating agent.

Opaque-coated coping on the model.



It is recommended to apply and evenly spread the material (dough-like consistency) using a plastic or ceramic spatula before the first MARGIN firing is carried out.

The material should be slightly condensed on the model.

To ensure accurate fit after firing, the shoulder material must not be applied beyond the preparation margin. Consequently, any excess material must be removed. Then the crown is completely dried with a hairdrier or with radiated heat at the furnace chamber.

⚠ **Note:** Excess liquid can be absorbed using a paper towel.

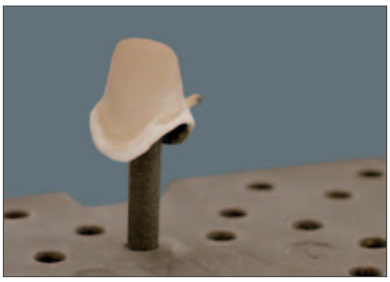
Use the recommended firing tabel of the used veneering material (for VITA VMK Master see instructions for use no. 1645, for VITA VM 13 see no. 1180 and for VITA VM 15 see no. 1365).

Check the shoulder area in the inside of the crown and carry out minor corrections without exerting any pressure. Then place the fired crown carefully on the model.

The model is insulated with VITA Modisol again. A creamy consistency is required for a second firing process.

Use a brush to apply small amounts of material to the bottom of the shoulder and place the crown (coping) on the model.

Then complete the missing areas by carefully applying the shoulder material in the space resulting from the 1st shoulder firing, thus providing optimum accuracy of fit of the ceramic shoulder. Then the shoulder is completed.



Dry the coping (crown) as described, carefully remove it from the model and place it on a ceramic firing tray.

⚠ **Note:** The shoulder (MARGIN) material must not come into contact with the firing tray.

Use the recommended firing tabel of the used veneering material (for VITA VMK Master see instructions for use no. 1645, for VITA VM 13 see no. 1180 and for VITA VM 15 see no. 1365).

After the second MARGIN firing, the fired coping may have to be adjusted to the model.

Completely fired shoulder on the model.

Next steps:
Please follow the instructions for use of accordingly the veneering material used (VITA VMK Master no.1645; VITA VM 13 no. 1180 and VITA VM 15 no. 1365).

- The crowns are fixed on the model using adhesive wax.
  The soldering gap should be approx. 0.05 - 0.2 mm.

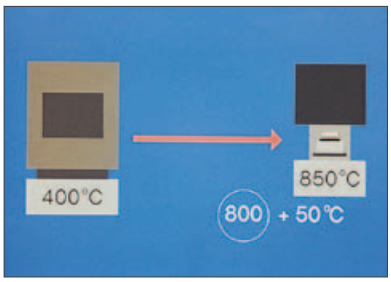
- Prior to fixing with adhesive wax, the soldering gap should be filled up with **casting wax** to enhance boiling out resp. Burning out behaviour. For reasons of stability it is recommended to connect the crowns with a stable wire and adhesive wax.

- The entire ceramic surface is now coated with pink base wax to avoid contact of ceramic and solder investment material.

- To keep the soldering block as small as possible, the crowns are filled up with a small quantity of solder investment material and then fixed with firing pins G in the actual soldering block as a remote center of heat.

- Then the connection and the wax layer are boiled off.

- A small quantity of flux is added into the soldering gap without wetting the ceramic.
  The **solder** is shaped into a ball, dipped into flux and attached to the soldering object.



- Preheat object in the preheating furnace with flux and solder for 15-20 min at 400°C.
  Working temperature of the respective solder + 50°C.
  Predrying: 5 min
  Heating: 5 min
  Hold the temperature: 4 min
- For solderings after ceramic firing the same cooling rate must be adhered to as for ceramic firing. After cooling, the investment material is removed and the object is cleaned under running water.
  Flux residues and oxides are removed with a clean pickling agent.
  Then the material is finished once more and polished.

Soldering as well as lasering of frameworks is a very complex and difficult process which strongly depends on the experience of the dental technician. If a strict processing routine is not followed, the technician may endanger successful completion of the ceramic veneer.

Trouble-Shooting / Soldering and lasering

- To ensure precision of fit, the framework must not be overheated.
- Fluxes and soldering pastes must be completely removed with pickling agent.
- Soldering after ceramic firing must always be carried out in the ceramic furnace.
- Surface contamination by carbon must be thoroughly removed with burs and sandblasting.
- Ceramically veneered surfaces must not be coated with solder across large areas.

Laser welding with cospecific additional materials ensures a maximum degree of biocompatibility. Laser welding can be carried out prior to firing if adequate preparation of the framework is ensured even after firing.

Working steps:

Clean the point/area of fracture and bevel. If necessary, prepare and insert a complementary element from the same alloy. Sandblast with aluminium oxide 110 µm.
Small cross-sections require depth welding with additional material (spot size Ø 0.3 - 0.4 mm). Larger cross-sections must be connected with a circular tube welding and additional material (spot size Ø 0.8 mm).

For successful and safe laser welding please observe the following:

- Sufficient amount of argon floats around the weld seam - distance approx. 1 cm.
- Discolouration of welding spots is evidence of excess energy combination or insufficient argon floating.
- Formation of cracks in the welding spot indicate excessive energy or too much exposure to the laser beam.
- In case of repair work it may be necessary to model parts to be replaced (e.g. crown margin).
- Compressed or overstretched framework parts must not be reused.

The following products require hazard label information:		
VITA VM OPAQUE FLUID / VITA OPQUE FLUID	**Corrosive** Causes burns. Keep product well sealed and out of children's reach. When using, do not eat or drink. In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. Do not empty into drains; dispose of this material and its container at hazardous or special waste collection point. Wear suitable protective clothing, gloves and eye / face protection. In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).	
VITA SPRAY-ON LIQUID VITA SPRAY-ON INDICATOR LIQUID	**Highly flammable** Keep container tightly closed at a well-ventilated place. Keep away from sources of ignition - no smoking. Do not empty into drains. This material and its container must be disposed of as hazardous waste.	

For detailed information please refer to the respective safety datasheets!

Safety clothing	Wear suitable safety goggles / face protection, gloves and safety clothing. In case of formation of dust, use an extraction system or wear a face mask.	

The development of alloys for metal ceramics, a survey

Gold-platinum alloys
The first alloys for largescale fabrication of metal ceramic dentures were simple gold-platinum alloys with the addition of a few other components.

Mechanical properties
The mechanical properties had not been matched perfectly and dental technicians first had to get used to processing the new alloys and porcelains. Gradually, however, improved alloys were introduced allowing veneers that featured considerable reliability and aesthetics. These alloys were not only suitable for the production of single crowns but also small and large bridges.

Cobalt-chromiumbased alloys
For some years cobalt-chromium alloys have been setting the trend for non-precious ceramic bonding alloys. These alloys represent a good alternative if a cobalt-based alloy is used because of the similiarity of materials with model casting alloys or any other dental indication.

CTE
In the early stages of development it was unknown that the CTE of the ceramic had to be matched with the alloy. It took quite some time until controlled cooling of the ceramic was recognized as a means to match the two materials.

Reduced gold content alloys
In the beginning of the 80s reduced gold content alloys were developed. After the introduction of these alloys with a gold content of approximately 50 %, palladium alloys were offered which contained only minor quantities of gold or no gold at all. Numerous processing methods had to be developed for these alloys and introduced in the laboratories.

Titanium
For some years titanium has also been used as a basic material for ceramically veneered restorations. The low, specific gravity and the favourable price of titanium render it a very attractive material for dental use. The comprehensive processing method of titanium, however, is responsible for the fact that this material has mainly been used in special laboratories. (see also VITA Titankeramik, directions for use, no. 858 D/E).

Palladium alloys
Over many years palladium alloys were by far the most common ceramic alloys used in Germany. These alloys, which produce fine results, are still used in many countries today.

Nickelbased alloys
Low-cost ceramic bonding alloys based on non-precious metals, in particular nickel and cobalt, were also developed.
First, only nickel-based alloys were available. Later on materials suitable for veneering could also be produced from the more resistant cobalt. Simple nickel-based alloys are sold worldwide as a favourably-priced basis for metal ceramic work.

Bio alloys
As a result of discussions about the biological compatibility of palladium alloys, more and more alloys were developed under the aspect of optimized biocompatibility in the 90s.

SUMMARY

„Small things matter most“
The previous pages provide a guide to correct framework design. You may have recognized that we have put special emphasis on the possible sources of errors. It is the small things which sometimes make life difficult in our already hectic daily life. When we continued our search for the “small things” we noticed that it was necessary to take a separate look at differences among the groups of alloys in order to meet the highly specific requirements of different dental alloys.

For dental-technical use four types of alloys can be mentioned; they reveal considerable differences in their composition.

Cobaltchromium alloys
- Very high stability and hardness
- Compared to AuPt alloys, the E-modulus is approximately twice as high
- High heat resistance due to high solidus point
- Low ductility (brittle)
- No cold-forming possible

Attaching the sprues
- It may be necessary to attach pressure compensation channels

Casting
- Perfectly suitable for flame or high frequency centrifugal casting
- Use only ceramic crucibles with special melting powder or protective gas

Oxidizing
- Not applicable!

Long-term cooling
- Long-term cooling with slightly opened furnace chamber down to 450°C (5-7 min)

Peculiarities:

High gold content alloys (palladium-/copper-free)

Biocompatibility
- Resistant
- Corrosion-resistant
- Neutral taste, can be combined with existing restorations without causing adverse reactions
- Plaque-resistant

Casting
- The casting temperature is approximately 1300 °C.
- Graphite is the preferable material for the crucible.

Oxidizing
- 10 min at 950°C with vacuum

Cooling behavior
- Long-term cooling must be carried out from a TEC of the alloy of $> 14.4 \cdot 10^{-6}\ K^{-1}$. (max. $15.2 \cdot 10^{-6}\ K^{-1}$)

Firing
- Low heat resistance
- During ceramic veneering (across the entire temperature range) safe and stable support of the frameworks on the firing tray must be ensured

Palladiumbased alloys
- Palladium-based alloys reveal a tendency to absorb carbon and hydrogen
- There is a risk of formation of bubbles since carbon reduces the bonding oxides
- CO forms gas bubbles
- Silver component may have a considerable effect on the reproduction of shade

Casting
- The casting temperature is approximately 1400°C.
- Use melting powder or protective gas (only small quantities)
- Melting with the open flame may result in the undesired absorption of carbon
- Ceramic crucibles must be used: each alloy requires a separate crucible!
- Do not use graphite crucibles

Reduced gold content alloys
- Reduced gold content alloys have a higher palladium content
- This fact may have a negative effect on the shade
- Increased silver content may result in contamination of the firing chamber
- Small tendency towards two-phase separation.

Oxidizing
- Uniform oxidation firing
- Bright oxide colour

Firing
- Possibility of slight contamination of the firing chamber due to non-precious alloy components
- Greenish discolouration possible if other ceramic systems are used

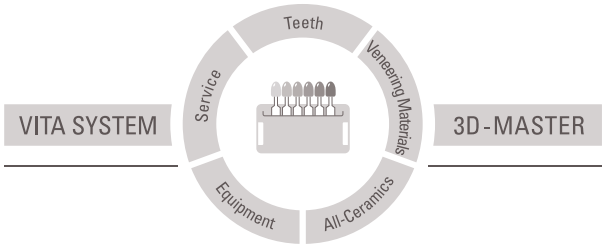
Oxidizing
- 10 min at approx. 900°C to 950°C
- Major oxide discolourations must be removed by sandblasting

Pickling
- Commercially available pickling agents
  Use separate acid bath!

Cooling behaviour
- Long-term cooling must be carried out from a TEC of the alloy of $> 14.4 \cdot 10^{-6}\ K^{-1}$. (max. $15.2 \cdot 10^{-6}\ K^{-1}$

Additional information
- Grease-free surfaces must be ensured since carbon residues affect the bond
- Large oxide deposits after firing can be removed by sandblasting at low pressure.

With the unique VITA SYSTEM 3D-MASTER, all natural tooth shades can be systematically determined and perfectly reproduced.



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After the publication of these working instructions any previous versions become obsolete. The current version can be found at www.vita-zahnfabrik.com

VITA Zahnfabrik is certified according to the Medical Device Directive and the following products bear the CE mark CE 0124:

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VITA

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