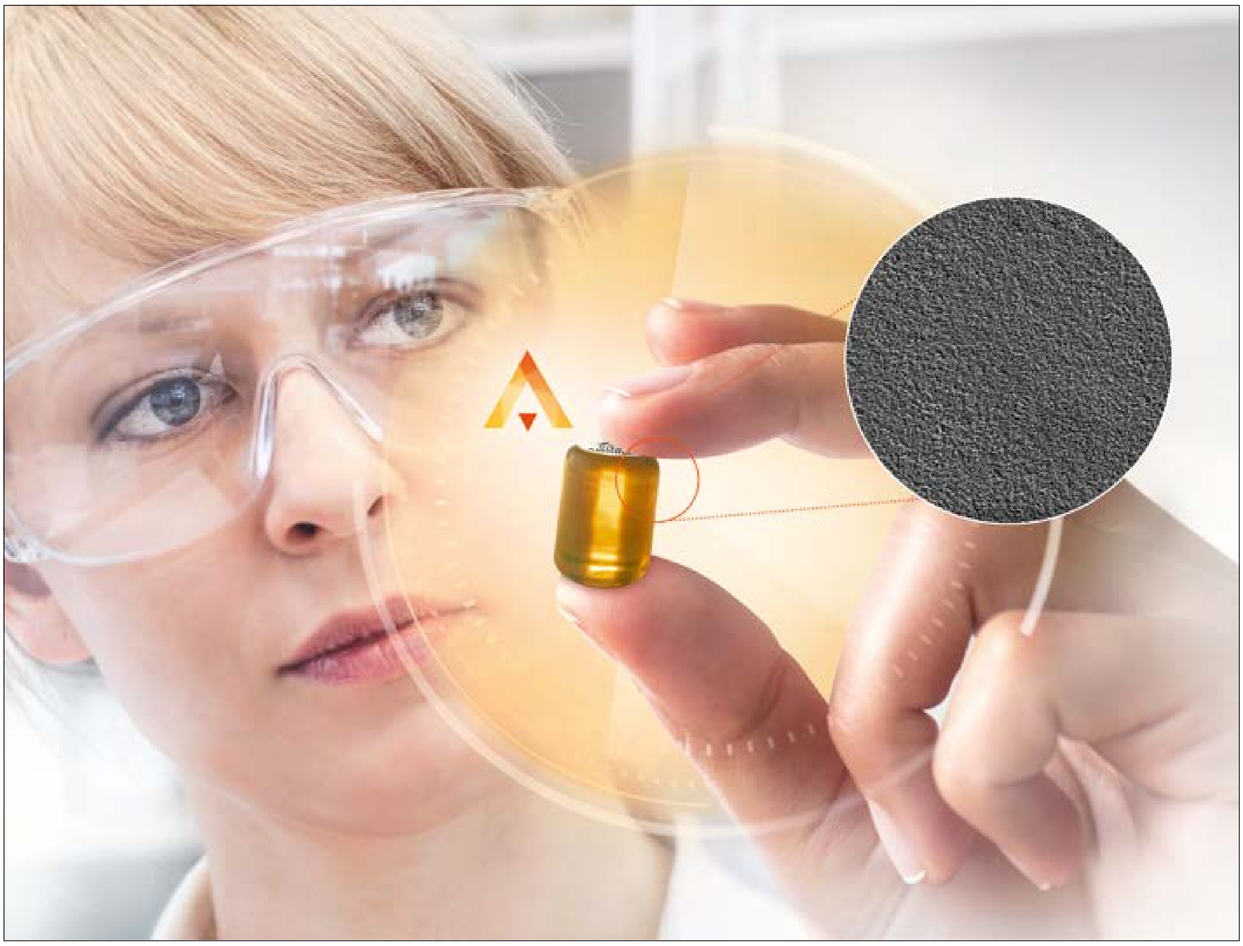
VITA AMBRIA® PRESS SOLUTIONS
Technical and scientific documentation



VITA shade determination | VITA shade communication | VITA shade reproduction | VITA shade control

Date of issue: 08.20

VITA – perfect match.

VITA

1. Introduction

Despite increasing digitalization in all technical and dental fields, processes that are predominantly analog, such as pressing, continue to be very popular. Press ceramics are particularly impressive because of their high-processing precision, which is difficult to achieve with other methods. At the same time, by developing innovative manufacturing processes and new, promising materials, pressing has become a future technology with potential.

VITA AMBRIA is a new pressing material that fits this future technology. Based on a classic lithium disilicate glass ceramic, the press ceramic offers optimized mechanical and physical properties to meet the growing challenges of the future.

This technical and scientific documentation provides an overview of how VITA AMBRIA differs from existing press materials, the special features it provides and how it can be optimally used in daily dental work routines.

1.1 Chemical composition

Components	Wt%
SiO_2	58 – 66
Li_2O	12 – 16
ZrO_2	8 – 12
Al_2O_3	1 – 4
P_2O_5	2 – 6
K_2O	1 – 4
B_2O_3	1 – 4
CeO_2	0 – 4
Tb_4O_7	1 – 4
V_2O_5	< 1 %
Er_2O_3	< 1 %
Pr_6O_{11}	< 1 %

1.2 Physical/mechanical properties

Test/Property	Unit	Measurement value
Biaxial strength [1] (after pressing)	MPa	approx. 400
Biaxial strength [1] (after tempering)	MPa	approx. 550
CTE [1] (at 500 °C)	10^{-6}/K	approx. 9.4
Chemical solubility [1]	µg/cm²	approx. 30
Vickers hardness [2]	HV 10	approx. 580
Fracture toughness [3] (K_{1c} using CNB method)	MPa√m	approx. 2.3
Modulus of elasticity [4] [HV 10]	GPa	approx. 100
Poisson number [4]	–	approx. 0.20

[1] Determination according to DIN EN ISO 6872
[2] Determination according to DIN EN 843-4
[3] Determination according to ISO 24370
[4] Determination according to DIN EN 843-2

1.3 Manufacturing and quality standards

VITA Zahnfabrik uses high process standards and strict test criteria for the production of VITA AMBRIA, and only well top-quality materials are processed in its production. To ensure the high quality, each new batch of raw materials is analyzed, and detailed quality controls are also carried out to ensure reliability.

The zirconia reinforced lithium disilicate ceramic blanks are produced in three stages. After the first process of moulding, the pellet is in the glass state. In order to ensure controlled crystal growth, the still amorphous pellets are subjected to industrial thermal pre-treatment. After initial nucleation, crystals start to form and grow. As a result, the glass increasingly acquires ceramic properties and offers the ideal basic conditions for the final pressing process at the user's facilities. Only after pressing are the crystals available in the appropriate size, which then ensures the desired mechanical and optical properties.

Final tempering of the finished restoration can increase the strength of the material.

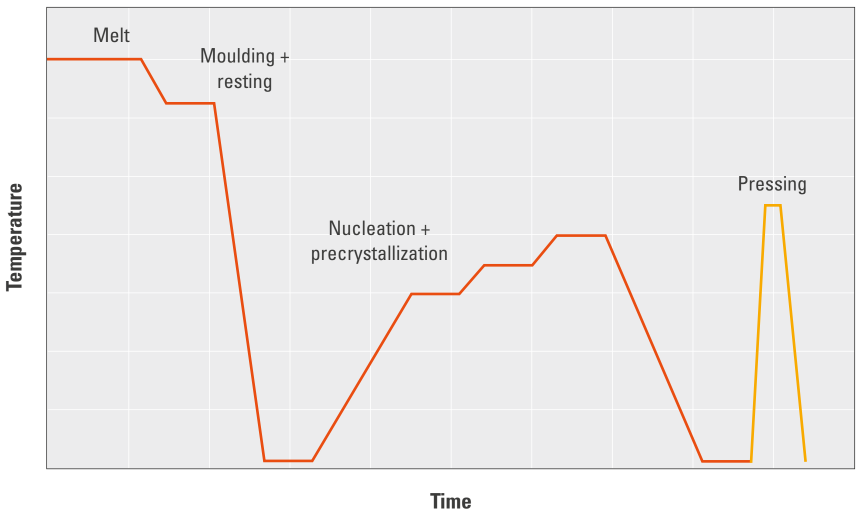


Figure 1: Temperature and time curve of **VITA AMBRIA**

1.4 Material and microstructure

a) Material and method

For this test setup, a VITA AMBRIA pellet was separated in the middle (case 1), and another material sample was pressed from a VITA AMBRIA pellet according to the manufacturer's instructions (case 2). Then the specimens were lapped and polished and the surface was etched with diluted hydrofluoric acid. Following, the surface was examined under the scanning electron microscope (SEM) with the same magnification level.

b) Source

Internal study, VITA R&D, (Gödiker, 01/2019, [1] see p. 19)

c) Result

Figure 2: VITA AMBRIA at 20,000x magnification (case 1)

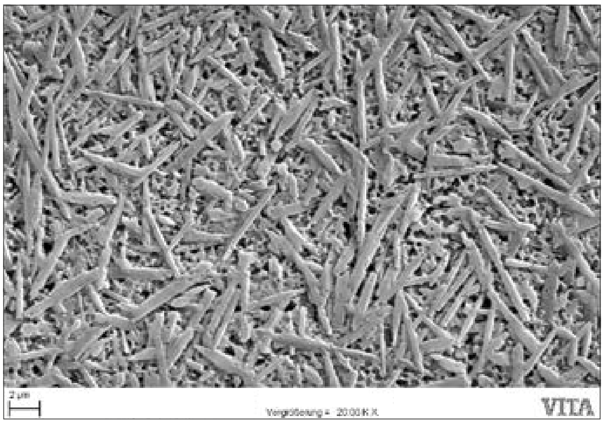
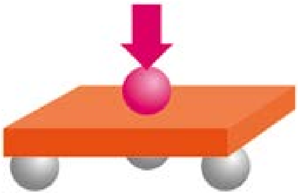


Figure 3: VITA AMBRIA at 20,000x magnification (case 2)

d) Conclusion

A particularly homogeneous and fine-particle structure of the VITA AMBRIA glass ceramic is achieved, thanks to the addition of zirconia and the ensuing nucleation process (case 1). During the subsequent pressing process, crystal growth is further stimulated and a needle-shaped structure with an average crystal size of approx. 2.5 to 3.5 µm is formed (case 2).



2. Physical/mechanical properties

2.1 Biaxial strength

a) Materials and methods

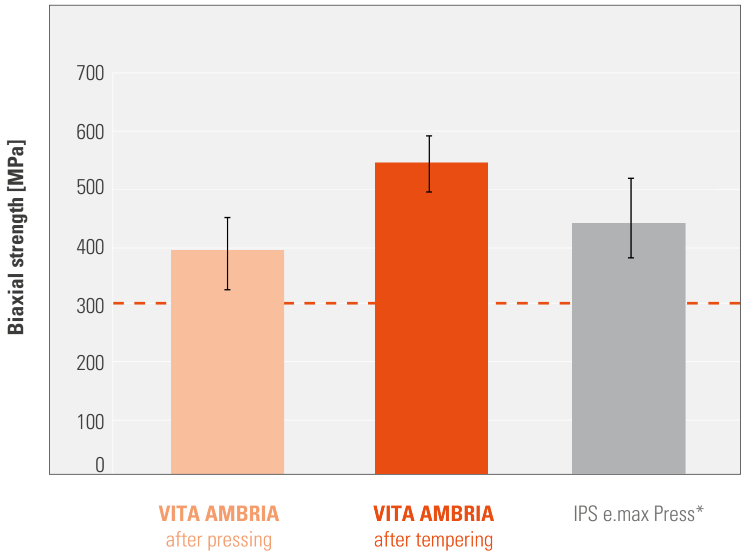
This test setup was based on DIN EN ISO 6872 with a modified geometry of specimens. Initially, square specimens with dimensions of 13 mm x 13 mm x 1.4 mm were produced, invested and pressed, according to the manufacturer's specifications. Then a uniform layer of thickness of approx. 1.2 mm was milled using a lapping machine. With the VITA AMBRIA press ceramic, additional tempering was carried out for some of the specimens. The manufacturer does not specify this for the comparison material. Ten specimens of each material or production type were produced, loaded to fracture using a universal testing machine (Zwick Z010, ZwickRoell GmbH & Co. KG) and the biaxial strength was determined.

b) Source

Internal study, VITA R&D, (Gödiker, 01/2019, [1] see p. 19)

c) Result

Biaxial strength

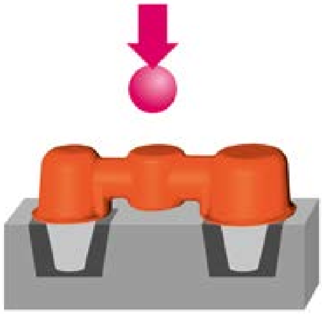


*) Level of strength after pressing process. Tempering is not specified by the manufacturer.

- - - Standard value class 3, according to DIN EN ISO 6872

d) Conclusion

In this series of tests, VITA AMBRIA achieves a level of stability with an average biaxial strength of 396 MPa (± 63 MPa), which is clearly above the standard requirements. The strength can be increased to 547 MPa (± 48 MPa) by subsequent tempering. In the comparison, the strength of IPS e.max Press (Ivoclar Vivadent AG, Schaan) is 448 MPa (± 68 MPa). Tempering is not specified by the manufacturer for this material.



2.2 Static fracture load

a) Materials and methods

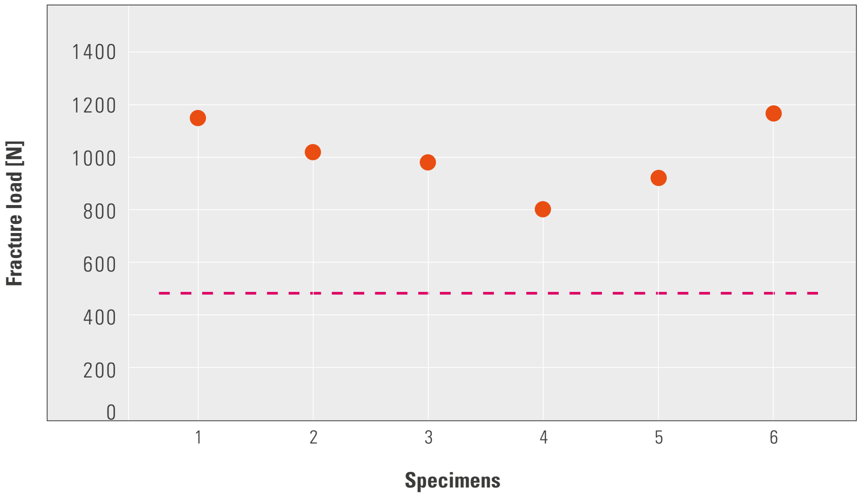
Six stylized, three-unit posterior bridges were milled from PMMA blanks using a CAM system, invested and then pressed from VITA AMBRIA, according to the manufacturer's instructions. The thinner "mesial" connector had a radius of 2.3 mm (~ 16.0 mm² cross-sectional area), the thicker "distal" a radius of 2.5 mm (~ 19.6 mm²). The abutments had a uniform wall thickness of 1.2 mm. All bridges were bonded to steel stumps using zinc-phosphate cement, and using a universal testing machine, were subjected to loading until fracturing occurred.

b) Source

Internal study, VITA R&D, (Gödiker, 03/2020, [1] see p. 19)

c) Result

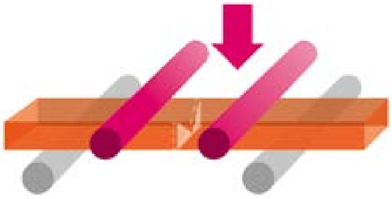
Static fracture load on three-unit bridges



Average max. fracture load

d) Conclusion

The average fracture load for this bridge geometry is 1010 N (±140 N). This means that the average maximum occlusal force of approx. 490 N mentioned in the literature [2] is clearly exceeded. Fracture always occurred in the "gingival" area of the connectors under tensile stress. The fact that the connector with the smaller cross-section did not always trigger the fracturing, shows the importance of careful manual reworking.



2.3 Fracture toughness

a) Materials and methods

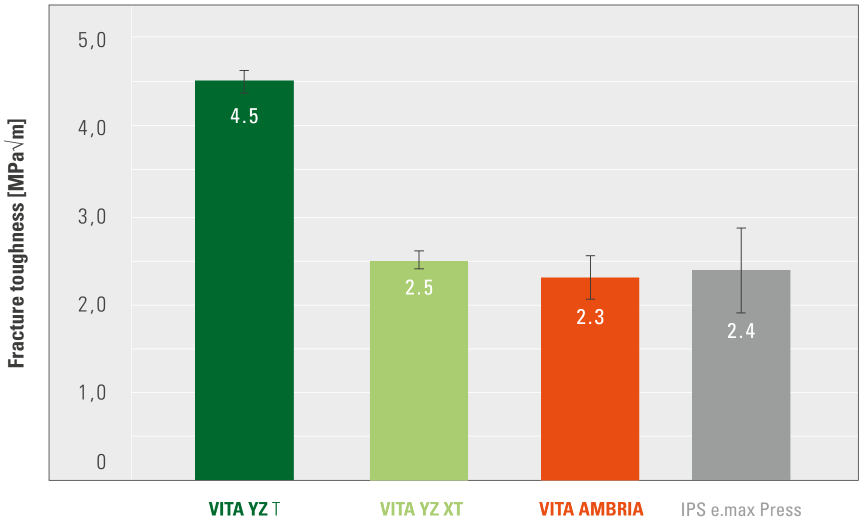
The fracture toughness test was carried out using the chevron-notched beam method, according to ISO 24370 (Fine ceramics [advanced ceramics, advanced technical ceramics] – Test method for fracture toughness of monolithic ceramics at room temperature by chevron-notched beam [CNB] method). For this purpose, defined notches were prepared on bending specimens (3 mm x 4 mm x 30 mm) made from VITA YZ T, VITA YZ XT, VITA AMBRIA and IPS e.max Press using a diamond saw, and then the specimens were loaded to fracture using a universal testing machine (see sketch on the left). Five specimens per series were tested.

b) Source

Internal study, VITA R&D, (Gödiker, 05/2019, [1] see p. 19)

c) Result

Fracture toughness with the CNB method, according to ISO 24370



d) Conclusion

The fracture toughness of VITA AMBRIA with a value of 2.3 MPa√m is clearly above normal glass ceramics (approx. 1.8 - 2.1 MPa√m), and is therefore almost on the level of 5Y-stabilized zirconia (VITA YZ XT). The specimens made from IPS e.max Press show comparable fracture toughness, but with a higher standard deviation. In combination with the high strength of the lithium disilicate glass-ceramic, the increased fracture toughness is the basis for the approval of the indication for three-unit bridge restorations.

2.4 Press behavior

a) Materials and methods

Determining the correct firing or press temperature is essential for successful processing of a press ceramic. In addition to the type of calibration, the position or age of a thermocouple, as well as the dimensions of the furnace chamber, can have an influence on the temperature treatment of the muffle. Various restorations and specimens were pressed at different maximum temperatures to provide the user with a simple orientation guide. The temperature for achieving the optimum material properties can be determined with the help of the illustrations below.

b) Source

Internal study, VITA R&D, (Gödiker, 12/2019, [1] see p. 19)

c) Result

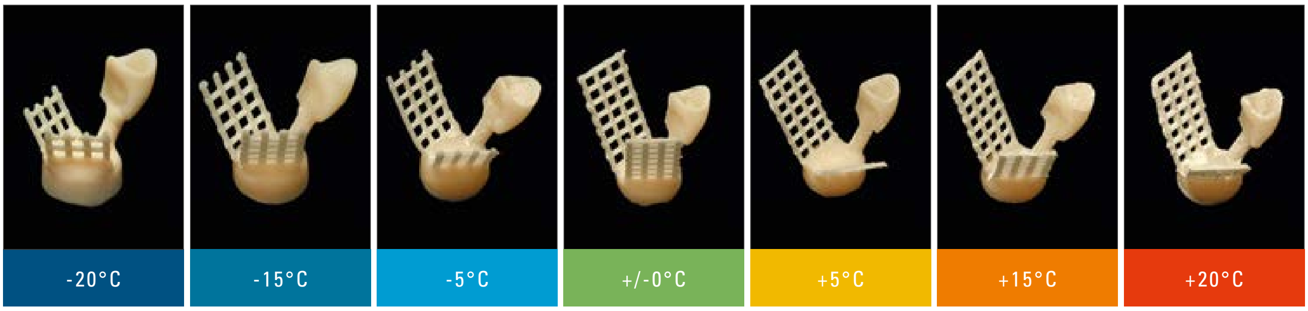


Figure 4: VITA AMBRIA grid retentions and crown at different firing temperatures

d) Conclusion

While normal crowns can still flow out even when the ideal firing temperature falls below 20 °C, the higher viscosity is clearly evident in the example of grid retentions. Overfiring, on the other hand, can be recognized by the more strongly formed reactive layer. This can have a negative effect on reworking, especially the polishing of the surface, and can also be reflected in a resulting poorer fit. In order to achieve perfect press results, the press furnace can be adjusted to an accuracy of ±5 °C using the grid retentions. The pressing temperature must then be adjusted up or down, depending on the result.

2.5 Shade stability

a) Materials and methods

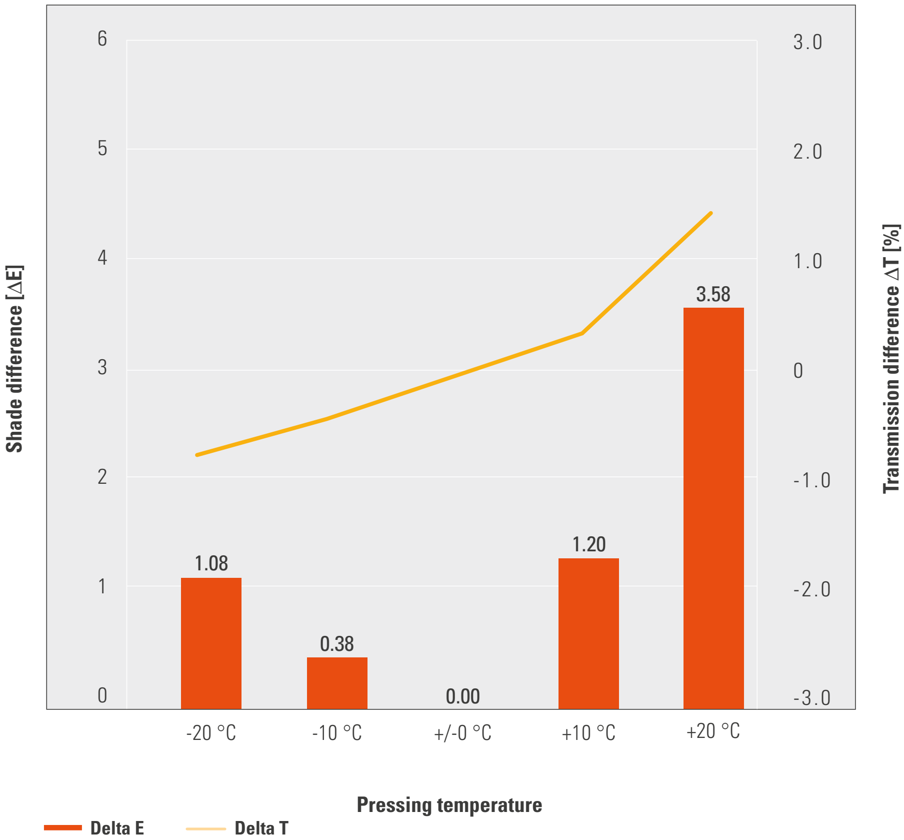
To evaluate shade and transmission, wax plates measuring 12 mm x 12 mm x 1.4 mm were sprued and invested in different investment rings. Then the pellets of the shade A3-HT were pressed according to the processing instructions. The maximum temperature, however, was specifically changed. The pressed samples were lapped to an exact thickness of 1.0 mm. Shade measurement in transmission was carried out with a photospectrometer (Color i7, xRite).

b) Source

Internal study, VITA R&D, (Gödiker, 07/2019, [1] see p. 19)

c) Result

Shade measurement in transmission



d) Conclusion

Within a range of +/- 10 °C of the recommended press temperature, there are no visible differences, or very few, in shade and translucency to the corresponding reference. Underfired specimens show strongly increasing opacity with decreasing temperature. Overfiring, on the other hand, is noticeable by an increase in translucency, as well as a significant change in chroma. These values are directly related to the pressing behavior (see item 2.4).

2.6 Fluorescence

a) Materials and methods

To evaluate the fluorescence, crowns with identical geometry were fabricated from three different lithium disilicate press ceramics (VITA AMBRIA, IPS e.max Press (Ivoclar Vivadent), Celtra Press (Dentsply Sirona)), from a feldspar ceramic (VITABLOCS), each in a bleach shade, and from non-colored zirconia (VITA YZ HT). Additional crowns made from VITA AMBRIA were additionally glazed with VITA AKZENT PLUS GLAZE LT and VITA AKZENT PLUS FLUOGLAZE LT, or individualized with VITA LUMEX AC. Then the crowns were viewed and photographed in a light box with a UV lamp (wavelength 340 - 380 nm, Osram black glass lamp).

b) Source

Internal study, VITA R&D, (Gödiker, 02/2020, [1] see p. 19)

c) Result

Comparison of fluorescence under UV high pressure lamp

Fluorescence images, unglazed

Fig 5: Fluorescence image - VITABLOCS Mark II

Fig. 6: Fluorescence image - VITA AMBRIA

Fig. 7: Fluorescence image - competitor (IPS e.max Press)

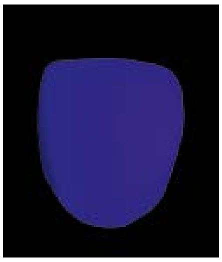


Fig. 8: Fluorescence image - competitor (Celtra Press)

Fig. 9: Fluorescence image - VITA YZ HT

Fluorescence images, characterized/individualized

Fig. 10: Fluorescence image - VITA AMBRIA with VITA AKZENT PLUS GLAZE LT

Fig. 11: Fluorescence image - VITA AMBRIA with VITA AKZENT PLUS FLUOGLAZE LT

Fig. 12: Fluorescence image - VITA AMBRIA with VITA LUMEX AC

d) Conclusion

The VITABLOCS feldspar ceramic demonstrates the highest inherent fluorescence. Due to the manufacturing method, this class of materials can be enriched with special fluorescent pigments. Zirconia exhibits almost no fluorescence. The existing fluorescence of VITA AMBRIA can be significantly increased by using (special) glaze materials or by applying veneering ceramics.

2.7 Manual reworking/surface treatment

a) Materials and methods

Various coarse and fine polishers were tested in the course of the material development of VITA AMBRIA press ceramic. The tools with the best performance were used for polishing tests. Material samples with an area of 12 mm x 12 mm were prepared for these tests. Manual polishing was carried out. Three tools were used for reworking: fine diamond grinder, prepolisher and fine polisher. The processing time for each stage was 30 seconds.

b) Source

Internal study, VITA R&D, (Gödiker, 08/2019, [1] see p. 19)

c) Result

VITA AMBRIA	IPS e.max Press

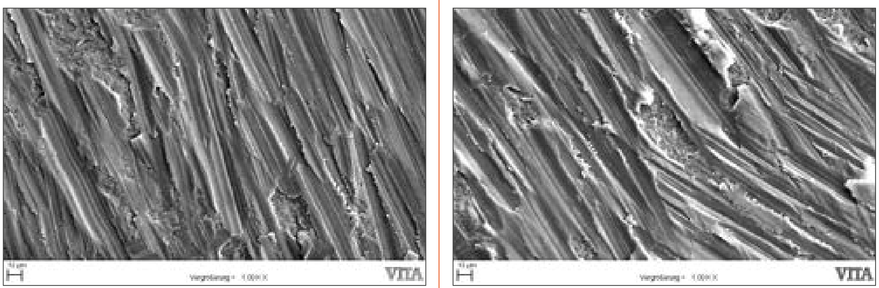


Figure 13: Surface after machining with blue diamond grinder at 1,000x magnification

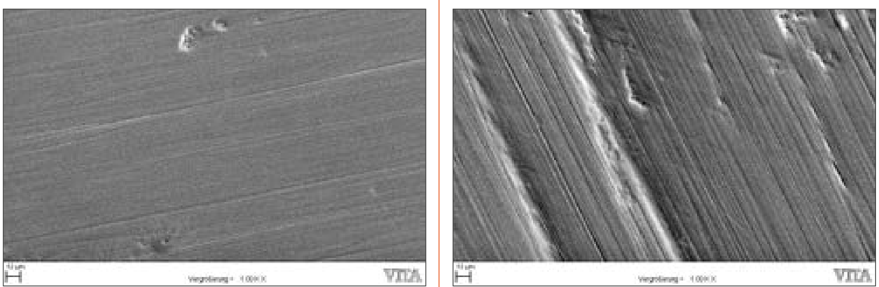


Figure 14: Surface after machining with pink prepolisher (SUPRINITY PC Polishing Set; VITA) at 1,000x magnification

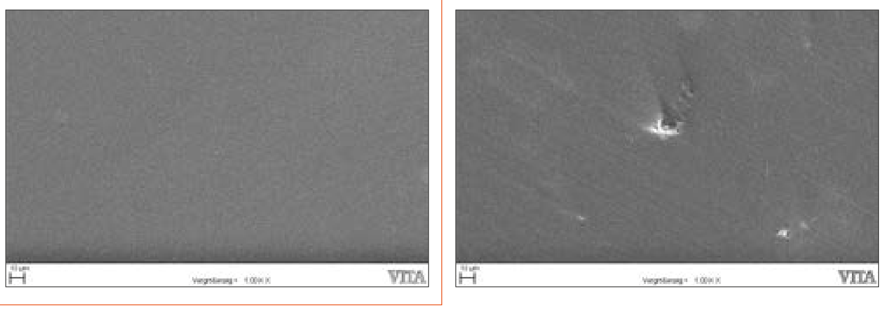


Figure 15: Surface after machining with grey fine polisher (SUPRINITY PC Polishing Set; VITA) at 1,000x magnification

d) Conclusion

In the case of VITA AMBRIA, the test geometry can be polished to high gloss within 90 seconds using the instruments recommended.

2.8 Biocompatibility

VITA AMBRIA is tested and evaluated by independent institutes according to ISO 10993-1: 2018, ISO 10993-5: 2009, ISO 10993-12: 2012 and ISO 7405: 2018.

The following points, among others, were evaluated in this context:
- Cytotoxicity
- Sensitization
- Irritation
- Subchronic systemic toxicity
- Genotoxicity

VITA AMBRIA is deemed biocompatible in all aspects.

3. Combination with VITA LUMEX® AC veneering ceramic

3.1 Dilatometer measurement

a) Materials and methods

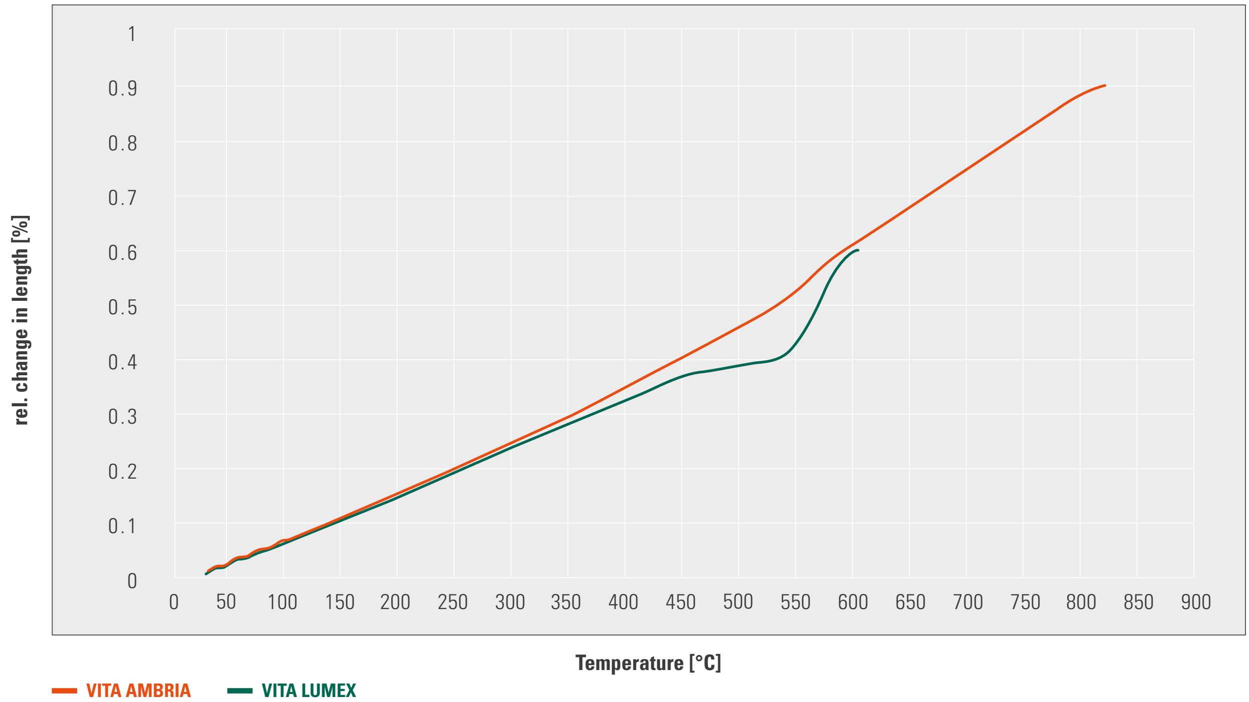
In a direct comparison, specimens made of VITA AMBRIA and VITA LUMEX AC were measured in the dilatometer (Netzsch). The specimens were heated up to the softening temperature with a heating rate of 5 °C/min. The coefficient of thermal expansion (CTE) for the respective material was obtained from the measured, relative change in length, up to a defined temperature (400 °C or 500 °C).

b) Source

Internal study, VITA R&D, (Gödiker, 01/2019, [1] see p. 19)

c) Result

Dilatometer measurement of VITA AMBRIA and VITA LUMEX AC



d) Conclusion

VITA AMBRIA has a CTE of approx. $9.4 \cdot 10^{-6}$/K. To ensure optimal stress ratios, the CTE of VITA LUMEX AC veneering material is slightly lower at approx. $8.8 \cdot 10^{-6}$/K*. This is to ensure that long-term reliable bonding between the veneer and the substructure can be achieved. The softening temperature of the veneering ceramic was found to be approx. 600 °C when measured using this method, which is almost 200 °C below the temperature of the VITA AMBRIA substructure material.

*) Detailed information on the subject of "stress ratios" can be found in the working instructions of the VITA veneering materials.

3.2 Bonding area – VITA AMBRIA and VITA LUMEX AC

a) Materials and methods

In order to examine the bonding area of VITA AMBRIA and VITA LUMEX AC, a substructure made of VITA AMBRIA was pressed according to the manufacturer's instructions and veneered with VITA LUMEX AC veneering material. Then the restoration was separated in the middle, and after the preparation of a cut, the bonding area between VITA AMBRIA and VITA LUMEX AC was analyzed in the scanning electron microscope.

b) Source

Internal study, VITA R&D, (Gödiker, 01/2019, [1] see p. 19)

c) Result

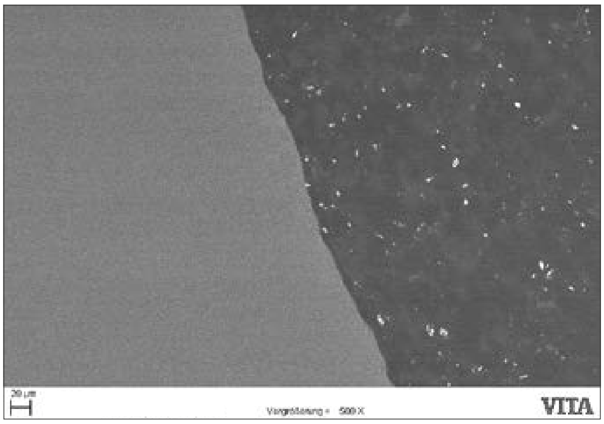


Figure 16: VITA AMBRIA bonding area after veneering, magnification 500x

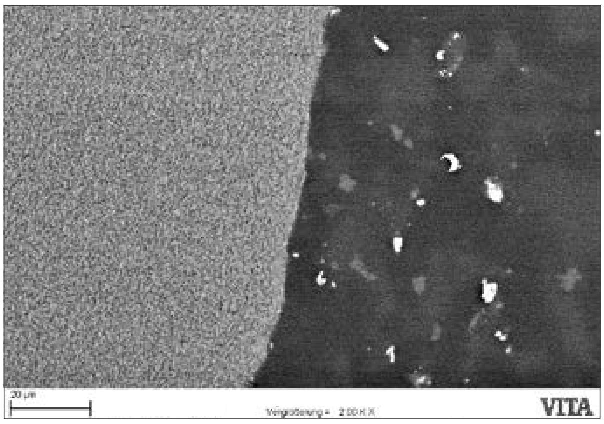
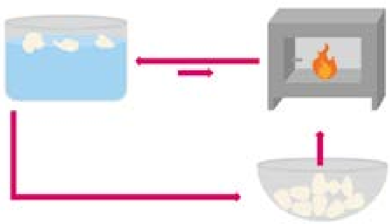


Figure 17: VITA AMBRIA bonding area after veneering, magnification 2,000x

d) Conclusion

The low-fusing VITA LUMEX AC veneering material demonstrates very good wetting behavior on VITA AMBRIA, even without washbake. No defects are visible in the bonding area, even at 2,000x magnification.

3.3 Thermal shock resistance



a) Materials and methods

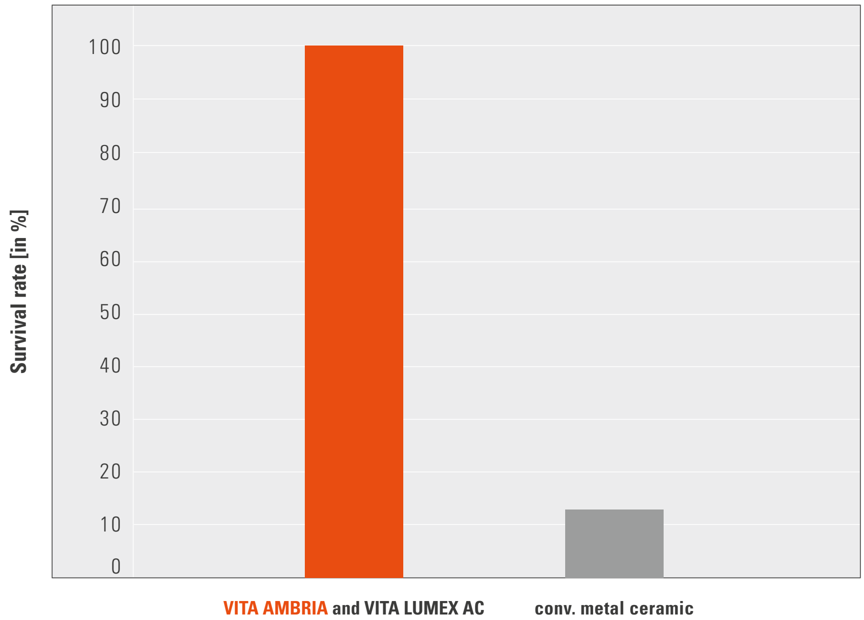
The thermal shock resistance (TSR) test is a proven internal test procedure according to DIN EN ISO 9693, and used to evaluate the interaction of substructure material and veneering material, or of the residual stress in the overall system. For the test setup, six crowns were fabricated using VITA AMBRIA in accordance with the working instructions, and then they were veneered with VITA LUMEX AC. In the next step, the crowns were heated to 105 °C in a furnace and the temperature was maintained for 30 minutes. Finally, the restorations were quenched in ice water and checked for cracks and chipping. Undamaged restorations were subsequently heated to the next temperature level (120 °C) in steps of 15 °C until the maximum temperature of 165 °C was reached.

b) Source

Internal study, VITA R&D, (Gödiker, 12/2018, [1] see p. 19)

c) Result

Thermal shock resistance



d) Conclusion

The higher the survival rate in this test, the lower the risk of cracks or chipping of the veneering material, based on long-term experience in daily use in practices/ laboratories. In combination with VITA LUMEX AC, VITA AMBRIA demonstrates a clearly higher survival rate than veneered metal ceramic in this test setup. The values determined for VITA AMBRIA, in combination with VITA LUMEX AC, were compared with the average results of tests of non-precious metal studies of past years. When using conventional metal ceramics, in most cases the first cracks are formed at temperatures starting at 135 °C.

4. Bibliography

1. Internal studies, VITA R&D: VITA Zahnfabrik H. Rauter GmbH & Co. KG
   Ressort Forschung und Entwicklung, Spitalgasse 3, 79713 Bad Säckingen
   Dipl.-Ing. Michael Gödiker, Projektleiter F&E, Bad Säckingen
2. Körber K, Ludwig K (1983). Maximale Kaukraft als Berechnungsfaktor zahntechnischer Konstruktionen. Dent-Labor XXXI, Heft 1/83: 55 – 60.

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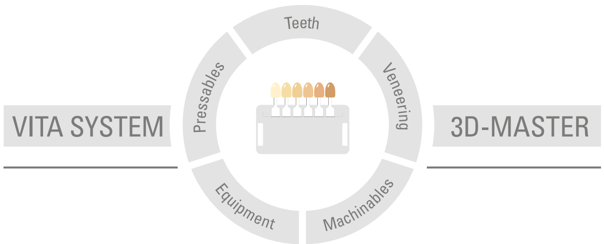

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VITA Zahnfabrik has been certified and the following products bear the mark:

CE 0124:

VITA AMBRIA®, VITA LUMEX® AC

10624E – 0820 (X) S – Version (02)

VITA

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