The concept

The formula for success: strength + elasticity = reliability²
MILESTONES OF DENTAL CAD/CAM MATERIALS

1985: Feldspar ceramic
First clinical use of VITABLOCS made of feldspar ceramic

2005: Lithium disilicate for CAD/CAM
Practical use of lithium disilicate begins

2007: CAD/CAM composites
CAD/CAM composite materials are used
"Hybrid ceramic provides a new definition of strength" *

VITA ENAMIC is the first hybrid dental ceramic in the world with a dual-network structure. In this dental material, the dominant ceramic network is strengthened by a polymer network, with both networks fully integrated with one another. VITA ENAMIC is a dental hybrid material that combines the positive characteristics of a ceramic and a composite.

*) In addition to a high degree of elasticity, this innovative hybrid ceramic guarantees particularly high strength after adhesive bonding. As a result, this material is perfectly suited for posterior crown restorations and also enables the reduction of wall thicknesses for minimally-invasive restorations.

The superior reliability of VITA ENAMIC, as well as its precision, edge stability and corresponding milling accuracy are also excellent features. Finally, this tooth-colored hybrid material offers material properties that are almost identical to those of natural teeth, ensuring a natural play of colors thanks to its excellent light conductivity.

The \( E_n \) formula for success: strength + elasticity = reliability\(^2\)
VITA ENAMIC® Hybrid ceramic: Advantages for you

VITA ENAMIC – overview of the benefits

Enormous strength
After bonding to the remaining tooth substance, VITA ENAMIC exhibits enormous strength and guarantees perfect distribution of masticatory forces. The polymer network offers outstanding absorption of intraoral load. As a result, this material is suited especially for posterior crown restorations.

Excellent reliability
VITA ENAMIC is a very reliable material, and, as a hybrid ceramic, offers an integrated crack stop function thanks to its special dual-network structure.

Restorations that are gentle on oral substance
In addition to greater strength, VITA ENAMIC also guarantees the necessary elasticity, enabling minimally-invasive treatment so that healthy tooth substance can be retained by reducing the wall thickness.

Precise and accurate restorations
Following the milling process, the VITA ENAMIC hybrid ceramic shows excellent edge stability – particularly in the case of thin restoration margins – and allows accurate morphology as well as an end result that offers a perfect fit.

Fast and efficient fabrication
The excellent milling properties of VITA ENAMIC guarantee that restorations can be fabricated more quickly and wear and tear on milling tools can be minimized. The hybrid ceramic is also already at full strength and can be inserted immediately after milling.

Natural results that match the tooth shade
VITA ENAMIC is a tooth-colored dental material that offers superb light conductivity. As a result, VITA ENAMIC restorations blend in perfectly with the remaining tooth substance, enabling a natural play of colors.
**VITA ENAMIC® Indications and shades**

**Range of indications:**

In addition to classic single tooth restorations (inlays, onlays, veneers and crowns), VITA ENAMIC is particularly suitable for minimally invasive restorations and crown restorations exposed to high masticatory forces (molar area).

<table>
<thead>
<tr>
<th>Indication</th>
<th>VITA ENAMIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crowns</td>
<td><img src="image" alt="Crown Icon" /></td>
</tr>
<tr>
<td>Onlays/Inlays</td>
<td><img src="image" alt="Onlay/Inlay Icon" /></td>
</tr>
<tr>
<td>Veneers</td>
<td><img src="image" alt="Veneer Icon" /></td>
</tr>
</tbody>
</table>

*recommended by VITA*

**Esthetic results in two translucency levels**

**Shades:**

VITA ENAMIC is available in the translucency levels HT (HT = high translucent) and T (T = translucent) and in the five VITA SYSTEM 3D-MASTER shades 0M1, 1M1, 1M2, 2M2 and 3M2.

Primary indication - high translucent (HT): inlays/onlays, veneers, partial and full crowns
Primary indication - translucent (T): masking discolored dies, in particular for crowns

```
<table>
<thead>
<tr>
<th>Shade</th>
<th>HT</th>
<th>0M1</th>
<th>1M1</th>
<th>1M2</th>
<th>2M2</th>
<th>3M2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<tr>
<td>T</td>
<td></td>
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</tr>
</tbody>
</table>
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VITA ENAMIC® STAINS KIT

Benefits

**Fast processing:**
Simply apply the VITA ENAMIC stains to the restoration, polymerize and that's it! With this process, the shade of VITA ENAMIC restorations can be quickly characterized.

**High level of individuality:**
The anomalies and shade nuances of natural teeth can be individually reproduced with the six VITA ENAMIC stains.

**Simple processing:**
The shade intensity of the VITA ENAMIC stains can be perfectly controlled by the ratio of liquid to shade powder. As a result, the good flow characteristics ensure precise application of the stains.

Natural play of colors in a very simple manner

The VITA ENAMIC Stains Kit includes six stains and accessories for the reproduction of natural shade nuances of restorations made of hybrid ceramic.

The stains are bonded to the restoration as part of a polymerization process. Surface sealing can be performed using the chemical glaze material VITA ENAMIC GLAZE, which increases the durability and brilliance of the shade in the oral environment.

Processing is based on a simple 5-step principle: condition the surface, mix and apply the shades, carry out intermediate polymerization, apply chemical glaze material and perform final polymerization.
VITA ENAMIC® Polishing Set (clinical / technical)

All instruments to achieve excellent results

The VITA ENAMIC sets of polishing instruments were developed for reliable, efficient and material-specific surface treatment of hybrid ceramic restorations in dental practices and laboratories.

The sets include various polishing instruments for pre- and high-gloss polishing. These instruments are suitable for careful and gentle polishing of occlusal surfaces, cusps, fissures and restoration contact points. The use of these polishing instruments results in surfaces with exceptional gloss.

Benefits

Excellent final results:
Excellent and plaque-resistant surfaces are produced with these instruments. Precise concentricity, matched grit sizes and the individual geometries of the instruments guarantee results with superior precision.

Simple and safe handling
The instruments guarantee superior material removal performance. Good handling and the ability to use without polishing paste enables simple and fast processing. Safe use of the clinical instruments is guaranteed since they can be sterilized.

Gentle and careful processing
These instruments, which were developed especially for VITA ENAMIC, ensure gentle and careful reworking. As a result, the risk of possible formation of micro-cracks is reduced.
Technical and scientific documentation of the hybrid ceramic

The hybrid ceramic is comprised of a porous ceramic matrix with the pores being filled with a polymer material. The mass percentage of the inorganic ceramic part is approx. 86 wt%, while the mass percentage of the organic polymer part is 14 wt%.

The advantages that distinguish VITA ENAMIC from others are based on its unique properties. The high strength, exceptional reliability and quality of the very natural restorative material, as well as high precision and economic efficiency are documented on the basis of the technical and material-scientific results.

Short overview of physical/mechanical properties of VITA ENAMIC

<table>
<thead>
<tr>
<th>Property</th>
<th>VITA ENAMIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Static fracture load [N] (SD)</td>
<td>2890 (232)</td>
</tr>
<tr>
<td>Flexural strength [MPa]</td>
<td>150 – 160</td>
</tr>
<tr>
<td>Modulus of elasticity [GPa] (SD)</td>
<td>30 (2)</td>
</tr>
<tr>
<td>Weibull modulus</td>
<td>In the same range as Mark II, veneering ceramics</td>
</tr>
<tr>
<td>Weibull-Modul</td>
<td>20</td>
</tr>
<tr>
<td>Hardness [GPa]</td>
<td>2.5</td>
</tr>
<tr>
<td>Shade stability</td>
<td>Excellent, ΔE &lt; 2</td>
</tr>
<tr>
<td>Machinability, edge stability</td>
<td>Excellent</td>
</tr>
<tr>
<td>Milling times, fast milling mode MC XL</td>
<td>Inlay: 4:40 min</td>
</tr>
<tr>
<td></td>
<td>Anterior crown: 4:19</td>
</tr>
<tr>
<td></td>
<td>Posterior crown: 5:13 min</td>
</tr>
<tr>
<td>Milling tool service life: posterior crowns</td>
<td>Normal: 148</td>
</tr>
<tr>
<td></td>
<td>Fast: 132</td>
</tr>
</tbody>
</table>
Unsurpassed strength even for thin walls

### Static fracture load

![Graph showing static fracture load comparison between VITA ENAMIC, IPS e.max CAD HT, Lava Ultimate, and IPS Empress CAD. VITA ENAMIC has the highest fracture load.]

**Test method:**
- Molar crowns from the respective materials were milled using the inLab MC XL milling system and then polished/crystallized.
- Cemented to hybrid ceramic dies (e-modulus similar to dentin) using RelyX Unicem.
- Stored in warm water (37 °C) for one week.
- Loaded statically in a testing machine until fracture occurred (the bars represent the average value obtained based on 6 crowns).

**Summary:** In this test setup, VITA ENAMIC demonstrates the highest fracture load of approx. 2890 N and the lowest standard deviation.

### Dynamic fracture load

![Graph showing survival rate comparison between Enamic (normal wall thickness) and Enamic (minimal wall thickness). VITA ENAMIC has a 100% survival rate.]

**Test method:**
- Following etching, 14 VITA ENAMIC crowns were cemented to composite dies using Variolink II.
- The crowns were embedded in Technovit 4000 (Heraeus Kulzer) and immersed in warm water (37 °C) for 24 hours.
- Exposed to a cyclic load in the chewing simulator: 198 N for 1.2 million cycles at a frequency of 1.6 Hz, with 3 mm steatite beads as the antagonist, TC 5 – 55 °C.
- Following the dynamic tests, static load was applied to the crowns until fracture occurred.

**Summary:** The survival rate of VITA ENAMIC crowns with walls of normal and reduced thickness is 100%.
**VITA ENAMIC®** Findings of materials science

**Utmost reliability and integrated crack-stop function**

**Test method:**
- The Weibull modulus describes the reliability of a material in a way that cannot be fully described based solely on flexural strength.
- The Weibull modulus was determined based on the flexural strength of 30 bending bars.

**Summary:** Of the materials examined in this test, VITA ENAMIC offered the greatest reliability. The Weibull modulus is 20. When evaluating the Weibull modulus, the flexural strength (in-house measurements of VITA R&D: VITA ENAMIC: 153.82 MPa (SD 7.56 MPa), Lava Ultimate: 188.42 MPa (SD 22.29 MPa), IPS Empress CAD: 157.82 MPa (SD 17.33 MPa), IPS e.max CAD LT: 344.05 MPa (SD 64.5 MPa)) should always also be taken into account.

**Test method:**
- In the Vickers test, an indentation in a polished surface is made using a pyramidal tip to determine the hardness of the material.

**Summary:**
In this test, ceramics exhibit a clearly limited indentation with sharp edges defined by crack formation and mostly straight-running cracks at the margins. However, for VITA ENAMIC, the dual network structure results in an indentation that is not limited at the margins - a smooth transition is found. Cracks that are typical for ceramics generally occur in the corners of the indentations, but they run only through the ceramic substructure and are always stopped by the polymer network.

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Source: Internal study, VITA R&D
Modulus of elasticity and abrasion behavior

Test method:
- The modulus of elasticity was determined based on the stress–strain curves of the measurements of flexural strength.

Summary:
With an elasticity of 30 GPa, VITA ENAMIC is in the same range as human dentin. Up until now, no dental restorative material was in this elastic range.
Note: There are big differences concerning the modulus of elasticity of human dentin in literature.

Test method:
- In chewing simulator (Zurich), 1.2 million cycles, 1.7 Hz, load: 49 N, 6000 thermocycles
- Natural enamel as antagonist.

Summary:
The abrasion level of VITA ENAMIC is 49 µm. The level of abrasion to the antagonist enamel caused by VITA ENAMIC is 30.2 µm. Mark II causes a slightly higher level of antagonist abrasion of 38.1 µm. As a control group, the abrasion of enamel to enamel was measured in the study. The goal with VITA ENAMIC was to further improve on the antagonist-friendly properties of Mark II without abandoning the ceramic behavior of the material.
Machinability and edge stability

Test method:
- Using the Sirona MC XL milling system, 30° wedges were milled from various materials in normal milling mode.

Summary: VITA ENAMIC exhibits high edge stability also in areas with thin margins.

Test method:
- Using the Sirona MC XL milling system, non-prep veneers were milled from various materials in normal milling mode with a wall thickness of approx. 0.2 mm. The material manufacturer of IPS Empress CAD and IPS e.max CAD has not approved the use of these products with a wall thickness of approx. 0.2 mm.

Summary: The perfect edge stability of VITA ENAMIC is demonstrated by the non-prep veneers. The geometry in this case with a wall thickness of approx. 0.2 mm could only be fully milled using VITA ENAMIC.
Service life of milling tools and milling times

Number of milled molar crowns

Test method:
- Using the Sirona MC XL milling system, one pair of milling tools in each case was used to grind as many molar crowns as possible from a variety of CAD/CAM materials in normal milling mode and in fast milling mode.
- The lives of the milling tools indicate the results of a series of measurements.

Summary: VITA ENAMIC enables more efficient milling than comparable materials. The milling time for VITA ENAMIC restorations is by far the shortest and also ensures a long milling tool service life of approx. 148 / 132 milled crowns for each set of milling tools.

Test method:
- The milling tests were performed using the Sirona MC XL milling system. The block selection of the corresponding material was selected and five restorations of each material were milled. The milling times were taken from the log files. The times correspond to the average value determined on the basis of five measurements.

Summary: Compared to Mark II, Lava Ultimate and IPS e.max CAD, VITA ENAMIC restorations can be milled more quickly.

<table>
<thead>
<tr>
<th>Material</th>
<th>Normal</th>
<th>Fast</th>
<th>Normal</th>
<th>Fast</th>
<th>Normal</th>
<th>Fast</th>
<th>Normal</th>
<th>Fast</th>
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</thead>
<tbody>
<tr>
<td>VITA ENAMIC</td>
<td>7:56</td>
<td>4:40</td>
<td>7:10</td>
<td>4:19</td>
<td>9:07</td>
<td>5:13</td>
<td>10:27</td>
<td>5:26</td>
</tr>
<tr>
<td>IPS e.max CAD</td>
<td>12:17</td>
<td>10:00</td>
<td>12:36</td>
<td>8:11</td>
<td>14:58</td>
<td>12:14</td>
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</tr>
</tbody>
</table>
VITA ENAMIC® Accessories

VITA ENAMIC
The first hybrid dental ceramic in the world with a dual network structure creates a new definition of strength. VITA ENAMIC is the dental material of the future since it enables fast and efficient processing and produces perfect results for users and patients alike.
- Enormous strength achieved by combining elasticity and stability
- Unsurpassed reliability thanks to an integrated dual network structure with crack-stop function
- Efficient processing thanks to long service life of milling tools and short milling times
- Precise and accurate restorations also in cases of thin walls
- Excellent translucency results in natural restorations that match the tooth shade

VITA ENAMIC POLISHING SET
The VITA ENAMIC sets of polishing instruments were developed for reliable, efficient and material-specific surface treatment of hybrid ceramic restorations in dental practices and laboratories. The sets include various polishing instruments for pre- and high-gloss polishing.
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- Good handling and the ability to use without polishing paste enables simple and fast processing.
- These instruments, which were developed especially for VITA ENAMIC, ensure gentle and careful reworking. As a result, the risk of possible formation of microcracks is reduced.

VITA ENAMIC STAINS KIT
The VITA ENAMIC STAINS KIT includes six stains and accessories for the reproduction of natural shade nuances of restorations made of hybrid ceramic. The stains are bonded to the restoration as part of a polymerization process. Surface sealing can be performed using the chemical glaze material VITA ENAMIC GLAZE.
- Simply apply the VITA ENAMIC stains to the restoration, polymerize and that’s it! With this process the shade of VITA ENAMIC restorations can be quickly characterized.
- The shade nuances and anomalies of natural teeth can be individually reproduced with the six VITA ENAMIC stains.
- The shade intensity of the VITA ENAMIC stains can be perfectly controlled by the ratio of liquid to shade powder. As a result, homogeneous and smooth application of shades is ensured.
Clinical studies

In-vivo studies

a) Clinical study, University of Freiburg, PD Dr. Güß: VITA ENAMIC crowns
Start of the study: November 2011
Number of restorations fitted: 71

b) Clinical study, University of Freiburg, PD Dr. Güß: VITA ENAMIC inlays, onlays, partial crowns, table tops
Start of the study: November 2011
Number of restorations fitted: 100

c) Acceptance phase: VITA ENAMIC crowns, implant crowns, partial crowns, inlays, onlays, veneers; approx. 594 restorations (as of December 2012) were inserted by various pilot users
With the unique VITA SYSTEM 3D-MASTER, all natural tooth shades can be systematically determined and perfectly reproduced.