## Mechanical Properties

### Material Specifications

***Lava™ Frame framework ceramic***

| | |
|---|---|
| Density (ρ): | 6.08 g/cm³ |
| Weibull strength (σB): | > 1200 MPa |
| Fracture toughness ($K_{IC}$): | 10 MPa $m^{1/2}$ |
| (Youngs) Modulus of elasticity (E): | 210 GPa |
| CTE: | 10 x $10^{-6}$ 25-500°C |
| Melting point: | 2700°C |
| Grain size: | 0.5 µm |
| Vickers hardness (HV 10): | 1250 |

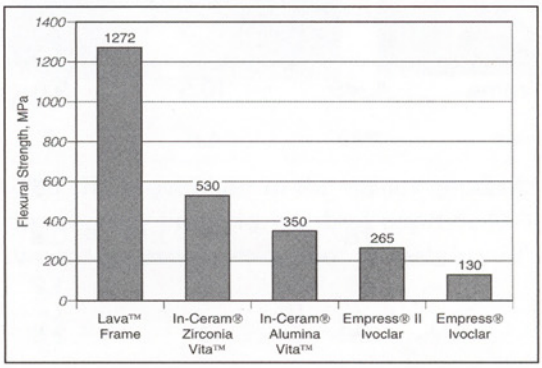
***Lava™ Ceram veneer ceramic***

| | |
|---|---|
| Density (ρ): | 2.5 g/cm³ |
| Weibull strength (σB): | 95 MPa |
| Fracture toughness ($K_{IC}$): | 1.2 MPa $m^{1/2}$ |
| (Youngs) Modulus of elasticity (E): | 80 GPa |
| CTE: | 10x$10^{-6}$ 25-500°C |
| Firing temperature: | 810 °C |
| Grain size ($d_{50}$): | 25 µm |
| Vickers hardness (HV 0.2): | 530 |

*Data in accordance with standard ISO 6872*

### Material Specifications - Lava Frame framework ceramic

***4-point bending test (biaxial: piston-on-three-balls)***

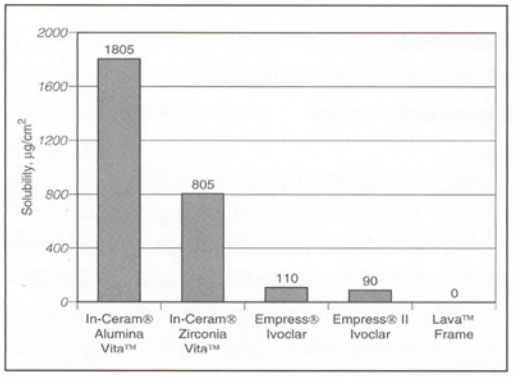



A competitive product, In-Ceram® Zirconia, which is a glass-infiltrated ceramic based on a zirconium oxide and aluminium oxide combination, has only about half the flexural strength of Lava System Frame, but has been indicated for bridges in posterior applications.

The flexural strength (ISO 6872) in the 3-point bending test was also determined by Dr. Simonis (Berlin)[10]: 1625 MPa.

*Data in accordance with standard ISO 6872*

***Chemical Solubility***

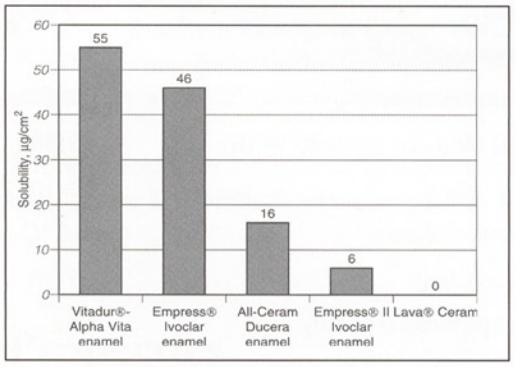



The fact that there is no detectable solubility of the Lava™ zirconium oxide framework is an indication of its high biocompatibility.

*Data in accordance with standard ISO 6872.*

## Material Specifications - Lava Ceram veneer ceramic

***Chemical Solubility***




As with the framework ceramic, here too the solubility cannot be measured. This is an indication of excellent biocompatibility.

## Long-term strength

| Ceramic | Weibull strength $\sigma_0$ [MPa] | Weibull modulus m [ - ] | Fracture toughness $K_{IC}$ [MPa$\sqrt{m}$] | Crack growth coefficient n [ - ] | Crack growth coefficient B [MPa²sec] |
|---|---|---|---|---|---|
| Lava™ System Frame | 1345 | 10.5 | 9,6 | 50* | - |
| In-Ceram® Alumina | 290 | 4.6 | 5 | 18 | $6.0 \cdot 10^{1}$ |
| CEREC® (Vita™ Mark II) | 88 | 24 | 1.3 | 26 | $1.8 \cdot 10^{1}$ |
| Dicor® | 76 | 6 | 0.8 | 25 | $2.9 \cdot 10^{1}$ |
| Empress® I | 89 | 9 | 1.2 | 25 | $5.8 \cdot 10^{1}$ |
| Empress® II | 289 | 9 | 2.5 | 20 | $2.3 \cdot 10^{3}$ |
| HiCeram® | 135 | 9 | 2.5 | 20 | $1.2 \cdot 10^{3}$ |
| Hydroxyapatite | 114 | 6 | 0.9 | 17 | $2.2 \cdot 10^{2}$ |
| Vita™ Omega Opaker | 69 | 12 | 1.4 | 21 | $7.2 \cdot 10^{1}$ |

*Prof. Marx and Dr. Fischer, Aachen.*[19]
** = 3M ESPE internal data*