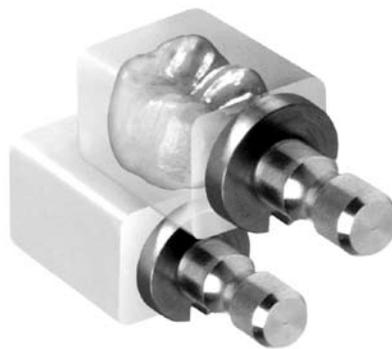


VITA[®]
VITABLOCS[®] MARK II
for
CEREC[®]

**Materials Science
and
Clinical Studies**



VIDENT[™]

Materials Science

Background

The CEREC method is a system which has proved its clinical suitability for the production of ceramic restorations in millions of cases. The CEREC system of Sirona Dental Systems GmbH (previously Siemens Dental) has been used for clinical applications since 1986. A second generation of fine-particle feldspar ceramic blocks, called CEREC VITABLOCS Mark II, have been available since 1991; they are considered to be one of the most abrasion-resistant dental ceramics. The clinical survival rate after ten years for bonded restorations is approximately 95%. More than 6 million restorations have been prepared from VITABLOCS for CEREC.

The abrasion properties are highly similar to those of natural enamel. This is attributable to the industrial sintering process as well as to the small particle size (an average of 4µm) of this ceramic system. The feldspar particles are uniformly embedded in the glass matrix; a detrimental "sanding (abrading) effect" on the antagonist is avoided. Standardized, controlled and industrial manufacturing using the industrial sintering process under vacuum at 1170°C, which can be reproduced at any time, ensures a more homogenous microstructure with consistent material quality compared to laboratory sintered and lab-processed ceramic restorations. The results are a high flexural strength of 150 MPa prior to processing in the CEREC unit and a highly uniform and retentive etching pattern due to selective etching of the feldspar matrix with hydrofluoric acid. Accordingly, safe and extremely durable adhesive bonding to the tooth substance is provided.

The relatively high translucency of the Mark II ceramic blocks guarantees excellent integration of the shade into the residual tooth substance in most clinical situations without the need to individualize the shade. The VITABLOCS ESTHETIC LINE is an even more translucent version of the Mark II ceramic with increased glass phase content, which makes it particularly suitable for anterior restorations.

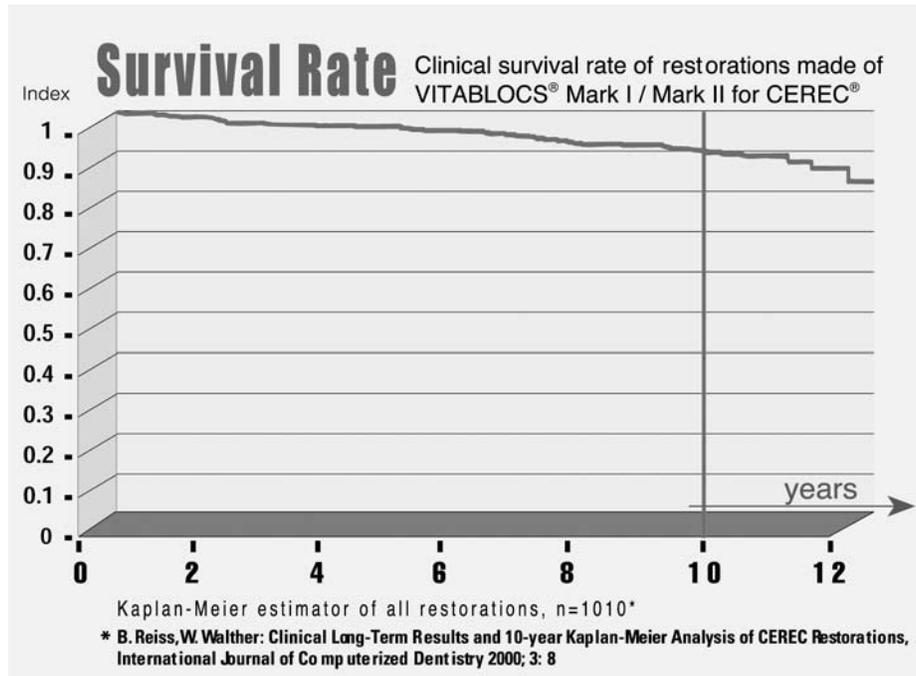
The requirements for proper machinability are perfectly fulfilled by the Mark II ceramic – during the mechanical grinding process as well as during dental reworking (corrections) where adjustments or corrections of the shape can be easily and accurately performed intraorally using diamond grinding tools.

Composition and Mechanical Properties

Property	Unit of measure	Value
Mixture of feldspathic crystalline particles embedded in a glassy matrix	Vol %	≈30
Density	g/cm ³	2.44 ± 0.01
Refractive Index	–	1.501 ± 0.001
Expansion Coefficient $\alpha_{500^{\circ}\text{C}}$	10 ⁻⁶ K ⁻¹	9.4 ± 0.1
Transformation Area	°C	780 – 790
Knoop Hardness HK 0.2/30	–	521 ± 8
Vickers Hardness HV 0.1/15	–	640 ± 20
Flexural Strength (H. Schwickerath, The Strength Characteristics of CEREC, Quintessenz 43, 669-677, 1992)	MPa	154 ± 15
Flexural Strength (1.2 x 4 x 15mm surface prepared by the CEREC 2 machine 0.5mm/min.)	MPa	113 ± 10
Toughness (SENB method)	MPa√m	1.7 ± 0.1
Toughness (Vickers indentation)	MPa√m	2.2 ± 0.1
Young's Modulus	GPa	63.0 ± 0.5

The above values should not be considered in isolation and are only of limited validity to clinical behavior. The given physical and technical values are typical values and apply to testing samples manufactured on our premises and in-house measuring equipment. If samples manufactured elsewhere and/or other measuring instruments are used, differing results are to be expected.

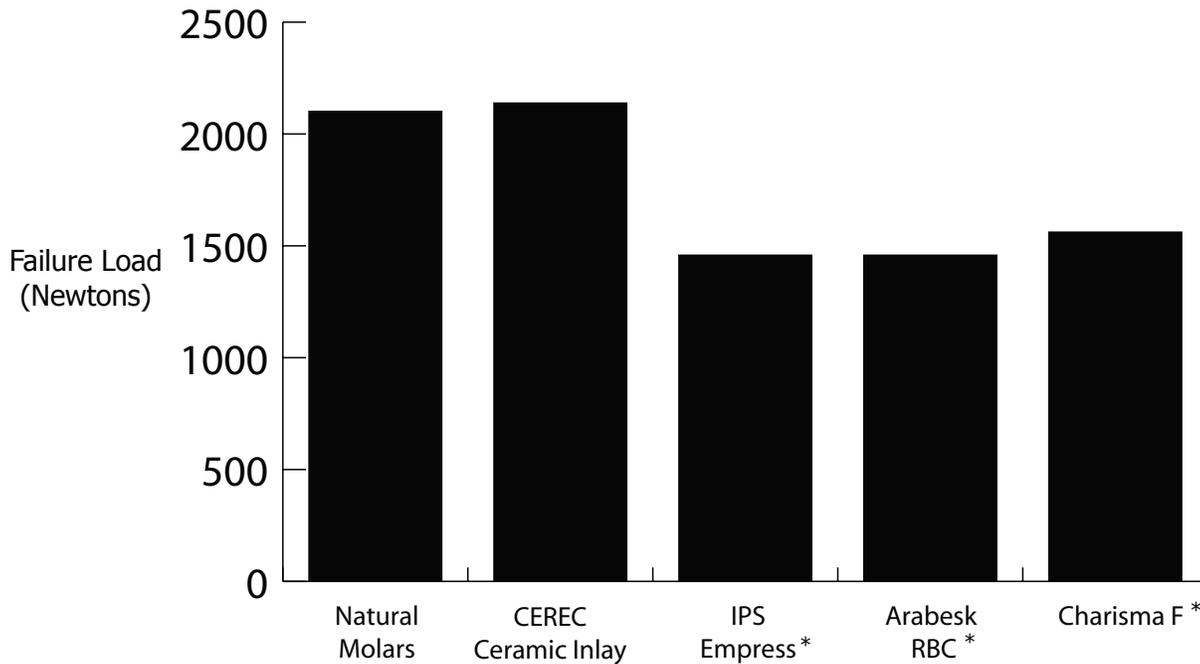
Reliability



This study analyzed clinical trial data of over 1000 inlays and onlays fabricated using Vita Mark I and Mark II blocks which were examined 9 – 12 years after placement. A statistical analysis of the data demonstrates that at 5 years over 95% of the restorations are still clinically successful and at 10 years at least 90% should still be functioning successfully. The success rate is even higher if only those restorations which were bonded are considered.

Reiss, B., Walther, W. "Clinical long-term results and 10-year Kaplan-Meier analysis of CEREC Restorations" Int. Journal of Computerized Dentistry 2000 Sep; 3:8

Tooth Reinforcement

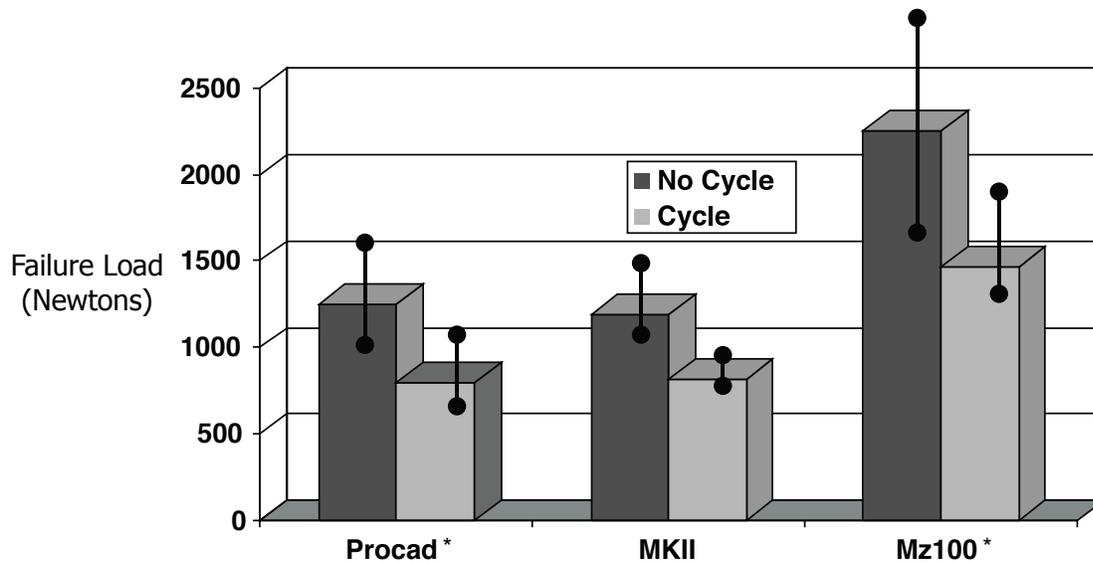


* Not a registered trademark of Vident or VITA Zahnfabrik

Teeth restored with bonded CEREC inlays were as resistant to fracture as natural sound (not restored) teeth. Teeth restored with Empress 1 inlays or composite resin were significantly weaker than natural teeth or those restored with CEREC inlays. Thus clinical survivability of teeth restored with the CEREC inlays may be enhanced as compared to those restored with Empress or composite resin.

Bremer BD, Geurtsen W.J "Molar fracture resistance after adhesive restoration with ceramic inlays or resin-based composites" Dent 2001 Aug;14(4):216-20

Fatigue Testing



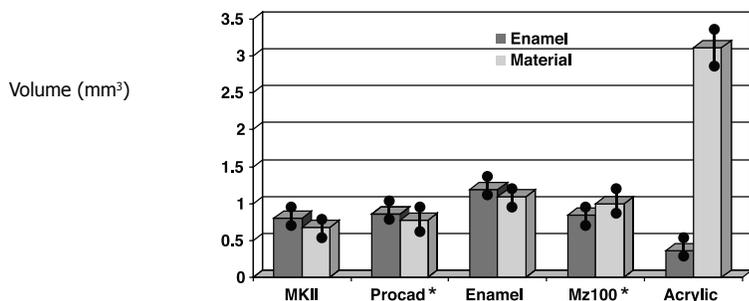
* Not a registered trademark of Vident or VITA Zahnfabrik

Crowns fabricated from Procad, Vita Mark II and Paradigm MZ 100 were tested before and after fatigue to simulate clinical conditions. All materials were less resistant to failure after fatigue testing but all failed at loads higher than the generally accepted maximum biting load.

Tyan, B; Pober, R; Giordano, "Fatigue of CAD/CAM milled crowns" R. J. Dent. Res. 2002 Special Issue MAR, VOL 81 Abstract #3963

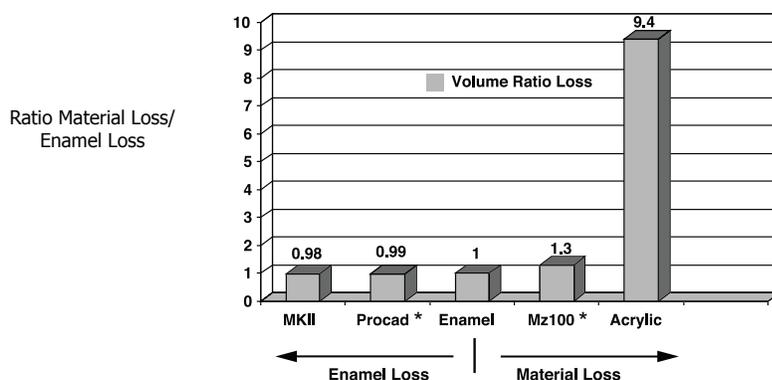
Wear Testing

Mean Volume Loss



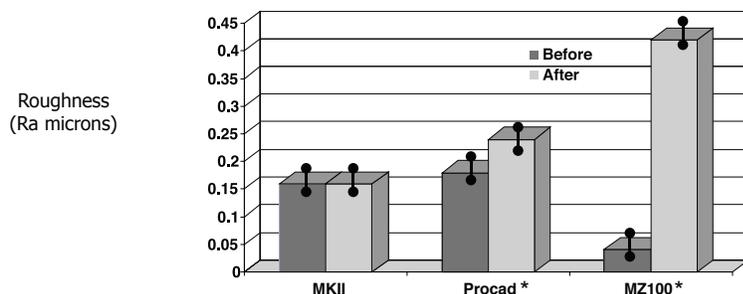
Wear testing of polished materials against natural human tooth structure was performed. The volume loss of the material and the natural tooth enamel was measured. The enamel loss of Vita Mark II, Procad and Mz100 were all statistically equivalent. The loss of material itself was higher with Mz100.

Enamel Wear Ratio



If the enamel versus enamel test is normalized to a value of one, then we may rank the test materials relative to enamel versus enamel wear loss. Values close to one indicate wear behavior similar to enamel versus enamel. Values higher than one indicate loss of the material itself. The data indicates that Mark II is a wear-kind material, which does not deteriorate during tooth contact.

Surface Roughness

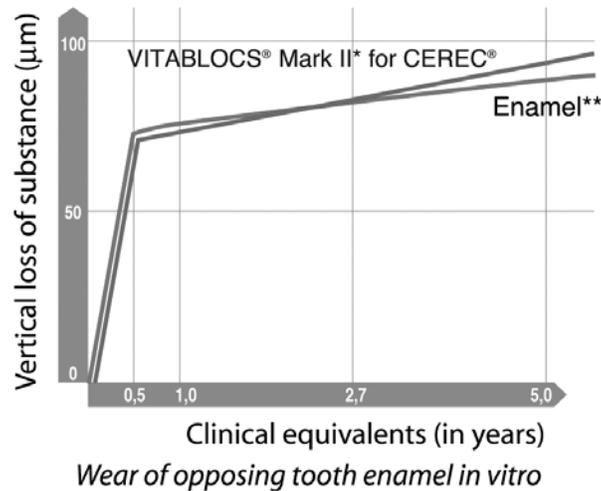


* Not a registered trademark of Vident or VITA Zahnfabrik

The surface roughness of materials was measured before and after the wear test. There was no change in surface roughness of the Mark II. Procad became about 30% rougher and Mz100, although initially the smoothest became 700% rougher. As surfaces become rougher they may become dull and also may tend to accumulate more plaque than smooth surfaces.

Abozenada, B, Pober, R, Giordano, R. "In-vitro wear of restorative dental materials"
J. Dent. Res., Special Issue, VOL 81, MAR 2002, Abstract #1693

Abrasion and Chipping



A complex chewing simulator was used to test the wear kindness of Vita Mark II blocks. This simulator replicates chewing motion, chewing loads, and fluid and thermal changes. The data reveals that after 5 years of simulated chewing the wear pattern of Mark II against enamel is similar to that of enamel against enamel. This further demonstrates the wear kindness of Vita Mark II blocks.

Krejci, I., Wear of ceramic and other restorative materials. International Symposium on Computer Restorations. Quintessence, 245-251, 1991.

**Krejci, I. (German translation) Wear of enamel and amalgam and their enamel antagonists in a computer-simulated chewing simulation. Schweiz Monatsschr Zahnmed 100: 1285, 1990

Material	Chipping Rank
In-Ceram Alumina	1
Mz100*	1
MKII	2
Procad*	3

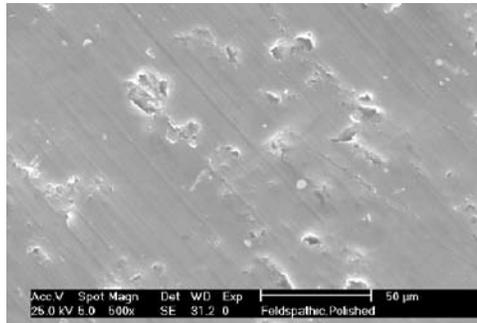
Standard pyramidal shapes were milled using Mark II, Procad, Mz100 and In-Ceram Alumina blocks. Edge chipping was categorized into three levels and ranked (< 75 microns, 75 - 200 microns, > 200 microns). Mz100 and Vita In-Ceram Alumina demonstrated the lowest degree of chipping, followed by Mark II. Procad demonstrated the greatest degree of chipping primarily due to the higher number of large chips produced during milling.

* Not a registered trademark of Vident or VITA Zahnfabrik

Lee, Dal Ho, "Accuracy of Milled Porcelain, Ceramic and Composite Resin Materials," Masters Thesis Boston University, Goldman School of Dental Medicine, 2000

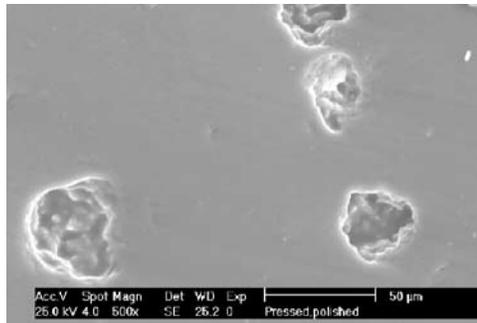
Surface Finish

Comparison of the structure of different ceramics. All samples enlarged x500 and polished in the same way using diamond-coated rubber polishers.



Veneering Ceramic

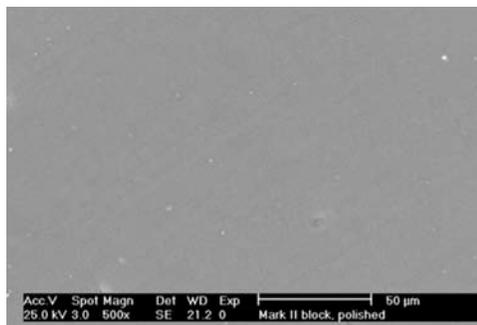
Note the porosity in the veneering porcelain which is commonly seen due to remaining air pockets or excess water remaining prior to firing.



Pressed Ceramic

Note similar defects commonly seen in pressed porcelain likely due to incomplete flow or pressure during pressing.

(The defects seen in the veneering porcelain and pressed ceramic are almost unavoidable due to processing techniques.)



VITABLOCS Mark II for CEREC

The Vitablocs are essentially free of these defects due to the reproducible, mechanical fabrication procedures that are employed at the Vita factory.

Clinical Data

Clinical data, including a comprehensive analysis of multiple clinical trials demonstrate the high success rate of restorations milled from VITA Mark II blocks.

"The data available (from 15 separate studies) establishes ceramic intra-coronal restorations machined by the CEREC system as a clinically successful restorative method with a mean survival rate of 97.4% over a period of 4.2 years...Machinable ceramics, as used by the CEREC system provide a useful restoration with a high success rate. These restorations are color stable and wear at a clinically acceptable rate..."

Martin N, Jedyakiewicz NM. "Clinical performance of CEREC ceramic inlays: a systematic review" 24: Dent Materials, 1999 Jan; 15(1):54-61

OBJECTIVE: The aim of this investigation was to evaluate the clinical performance of 4 types of tooth-colored inlays.

METHOD AND MATERIALS: Fifteen direct ceramic inlays (Cerec Cos 2.0), 15 direct resin composite inlays (Brilliant Direct Inlay), 14 indirect ceramic inlays (Vita Dur N), and 14 indirect resin composite inlays (Estilux) were made in 37 patients, according to the manufacturers' instructions. The inlays were evaluated 1 week (baseline) and 6, 12, 36, 48, and 60 months after cementation (modified CDA Quality Evaluation System). **RESULTS:** Two Vita Dur N inlays fractured after 1 and 4 years in function, and one Cerec inlay fractured after 4.5 years. Two Brilliant DI inlays needed replacement because of secondary caries (after 1 and 5 years), and one inlay (Estilux) needed replacement due to persisting hypersensitivity. Three inlays (1 Estilux and 2 Brilliant DI) were repaired due to chipping or minor fractures. During the observation period, the surface texture of Brilliant DI and Vita Dur N inlays became significantly rougher. After 5 years, the Estilux inlays had significantly lower ratings for morphology compared to baseline ratings. In general, the occlusal marginal adaptation did not show further disintegration of the luting cement after 1 year. **CONCLUSION:** Eighty-eight percent of the inlays were in function after 5 years. No significant differences were revealed among the survival rates of the different types of inlays.

Thordrup M, Isidor F, Horsted-Bindslev P. "A 5-year clinical study of indirect and direct resin composite and ceramic inlays." Quintessence Int., 2001 Mar;32(3):199-205

Clinical Data

PURPOSE: The present follow-up study aimed to evaluate the clinical quality and longevity of 3 ceramic inlay systems and compare them with gold inlays. **MATERIALS AND METHODS:** Twenty patients were treated with one Cerec, one Mirage, one Empress, and one gold inlay, respectively, inserted in a randomly selected order in the mandible. The inlays were examined independently by 2 calibrated examiners immediately after and 1, 3, and 5 years after luting. The inlays were rated using the California Dental Association (CDA) quality evaluation system.

RESULTS: Two Empress inlays required replacement because of fracture between examination (Ex) 1 and Ex 2, and 2 Empress inlays were fractured between Ex 3 and Ex 4. One Cerec inlay had to be recemented after 3 months, and one Cerec inlay fractured between Ex 3 and Ex 4 and was replaced with a gold inlay. Examination showed that the mismatch of color increased from 15% to 50% between Ex 1 and Ex 4 for all ceramic systems. Visible evidence of ditching along the margin increased from 5% at Ex 1 to 70% at Ex 4, and an apparent discoloration of the margin between the tooth and the restoration was seen in 0% to 5% at Ex 1 compared to 30% to 55% at Ex 4.

CONCLUSION: Eight percent of the ceramic inlays were fractured during the follow-up period of 5 years. Based on the criteria of the CDA quality evaluation system, 92% of the 60 ceramic inlays and 100% of the 20 gold inlays were rated satisfactory 5 years after luting.

Molin MK, Karlsson SL. "A randomized 5-year clinical evaluation of 3 ceramic inlay systems." *Int. Journal of Prosthodontics*, 2000 May-Jun;13(3):194-200

PURPOSE: To evaluate Cerec CAD/CAM inlays processed of two industrially made machinable ceramics during an 8-year follow-up period. Each of 16 patients received two similar ceramic inlays. Half the number of the inlays were made of a feldspathic (Vita Mark II) and the other of a glass ceramic (Dicor MGC) block. The inlays were luted with a dual resin composite and evaluated clinically using modified USPHS criteria at baseline, 8 months, 2, 3, 5, 6 and 8 yr, and indirectly using models. At baseline, 84% of the inlays were estimated as optimal and 16% as acceptable. Postoperative sensitivity was reported by one patient for 8 months. Of the 32 inlays evaluated during the 8 years, 3 failed due to fracture of the material. No secondary caries was found adjacent to the inlays. No significant differences in the clinical performance were found between inlays made of the two ceramics. It can be concluded that the CAD/CAM inlays processed of the two ceramics functioned well during the 8-year follow-up period.

Pallesen U, van Dijken JW. "An 8-year evaluation of sintered ceramic and glass ceramic inlays processed by the Cerec CAD/CAM system." *European Journal of Oral Science*, 2000 Jun;108(3):239-46

VITABLOC® BLANKS FOR CEREC®											
Material		Vitablocs Mark II/3D-Master System									
Marking	Size in mm										
I8	8 x 8 x 15	–	1M1C	1M2C	2M1C	2M2C	2M3C	3M1C	3M2C	3M3C	4M2C
I10	8 x 10 x 15	–	1M1C	1M2C	2M1C	2M2C	2M3C	3M1C	3M2C	3M3C	4M2C
I12	10 x 12 x 15	0M1C	1M1C	1M2C	2M1C	2M2C	2M3C	3M1C	3M2C	3M3C	4M2C
I14	12 x 14 x 18	0M1C	1M1C	1M2C	2M1C	2M2C	2M3C	3M1C	3M2C	3M3C	4M2C
V5-12	5 x 12 x 15	0M1C	1M1C	1M2C	2M1C	2M2C	2M3C	3M1C	3M2C	3M3C	–
Material		Vitablocs Mark II/VITAPAN Classical									
Marking	Size in mm										
I8	8 x 8 x 15	A1C	A2C	A3C	A3.5C	B3C					
I10	8 x 10 x 15	A1C	A2C	A3C	A3.5C	B3C					
I12	10 x 12 x 15	A1C	A2C	A3C	A3.5C	B3C					
I14	12 x 14 x 18	A1C	A2C	A3C	A3.5C	B3C					
V5-12	5 x 12 x 15	A1C	A2C	A3C	A3.5C	B3C					
Material		Vitablocs Esthetic Line									
Marking	Size in mm										
K12	10 x 12 x 15	EL1M1C									
K14	12 x 14 x 18	EL1M1C									
V7	7 x 12 x 18	EL1M1C									
Material		Vitablocs TriLuxe									
Marking	Size in mm										
TRI-12	10 x 12 x 15	1M2C	2M2C	3M2C							
TRI-14	12 x 14 x 18	1M2C	2M2C	3M2C							



3150 E. Birch Street
 Brea, CA 92821
 800-828-3839
 800-263-4778 in Canada
 www.vident.com