

THE SECRET BEHIND A CONFIDENT SMILE

**THE ART AND SCIENCE
OF ZIRCONIA CERAMICS**



KEROX
DENTAL



**INDUSTRIAL
BACKGROUND**
**30 YEARS OF EXPERTISE
IN HIGH PRECISION
CERAMICS MANUFACTURING**



Kerox is located in the EU with a production facility in Hungary. The company has 30 years experience in high precision ceramics production based on unequalled industrial, technological and engineering capabilities. Our company holds numerous patents.

TODAY WE ARE PRODUCING MORE THAN 60 MILLION HIGH PRECISION CERAMICS PRODUCTS ANNUALLY

Widely recognized in offering the highest quality precision parts, and we are one of the leaders in our industry. Based on Kerox's functional ceramics manufacturing experience, in the recent years we extended our business with the production of advanced dental materials.

Kerox today has unique pressing and sintering experience, and Total Quality Management, combining the use of most advanced qualifying methods and automatic inspection machinery as well as demanding multi-stage quality control procedures including 100% inspection of parts.

Our motto is „**No technological compromise to quality**”.

Kerox has customers in more than 40 countries worldwide, including those in Europe, North-, South- and Latin America, Asia, Australia and Africa providing them superior customer service care, reliable on-time delivery and competitive prices.

MAIN MARKETS: **CHINA, GERMANY, USA, ITALY, TURKEY**
REP. OFFICES: **BUDAPEST, MILAN, VIENNA, ISTANBUL, CHICAGO, SHANGHAI, SAO PAULO**



KEROX GROUP

- Approximately 300 000 Zirconia blank capacity p.a. (1 work-shift)
- Approximately 600 employees
- More than 30 engineers
- More than 20 press machines
- Two tunnel kilns
- In-house tool shop
- Spark-cutting
- Four full automatized assembly line for complicated products & several assembly devices



PRESSING: DIFFERENCE IN TECHNOLOGIES

QUALITY VS. QUANTITY KEROX MULTI PRESSING

Kerox Dental Zirconia blanks are made Yttria stabilized on every single grain – manufactured by market leader Japanese company.

CHEMICAL PROPERTIES

Ingredients	Weight percentage (%)
ZrO ₂	> 94.10
Y ₂ O ₃	5.20
Al ₂ O ₃	0.25
HfO ₂	< 0.30
SiO ₂	≤ 0.02
Fe ₂ O ₃	≤ 0.01
Na ₂ O	≤ 0.04

PHYSICAL PROPERTIES

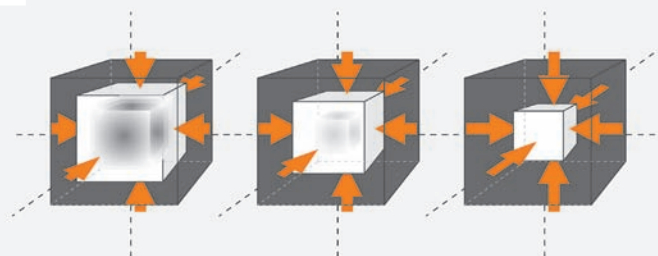
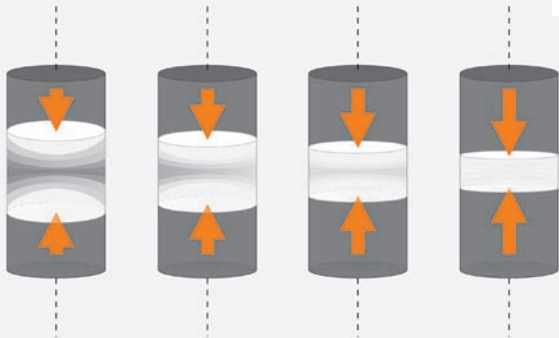
Typical properties of sintered body	
Density (g/cm ³)	6.05
Bending strength(MPa)	1500
Durezza (HV10)	1250
Radioattività (Bq/g)	< 0.01

AXIAL PRESSING ONLY IS INSUFFICIENT

- Pressure and mold densification are uneven
- Different density, shrinkage, hardness

COLD ISOSTATIC PRESSING

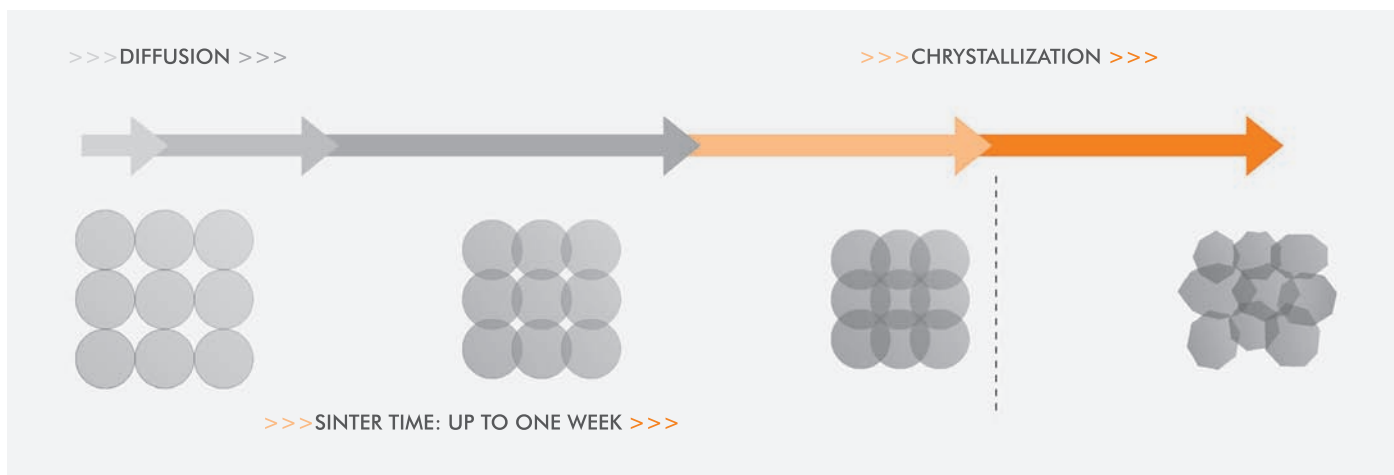
- Extreme pressure
- Even densification & mass
- Less porosity
- Less unevenness
- Homogeneity



KEROX DENTAL MULTI PRESSING⁺

Cold Isostatic pressing is time-consuming but it leaves less material stress and strain, than axial press. In Kerox Dental to the axially pre-pressed blocks an isostatic manufacturing process is applied – that's Kerox Dental Multi Pressing. The all around, extreme pressure during the isostatic pressing ensures a maximum homogenous density in all Kerox Dental blocks. Optimal blank porosity and density decrease amortization of both the milling machine and the milling heads of the dental laboratory.

SINTERING: THE BASICS



DE-BINDING

Ensure no organic contamination and water. Lubricants and additives (that ensure press ability) burned off.

PRE-SINTER

“Neck formation” by diffusion at pre-sinter. Ensure best crystal sizes and machining properties.

FINAL SINTER

Particles melted, density increased, pore sizes decreased at final sinter. Ensure final metastable tetragonal structure.

about STRENGTH

Low density + high sinter (t) >>> TOO HARD – rigid >>> CRACKINGS, CHIPPINGS
 High density + low sinter (t) >>> TOO SOFT – dusty >>> BREAKINGS

OPTIMAL PROCESS

Kerox Dental measures grain size and density, to optimize quality and lessen fatigue (by avoiding over-firing). Suboptimal press and sinter would lead to chipping or breaking during the milling process. Kerox Dental’s documented experience in pressing and sintering provide labs zirconia blanks with optimal/required combination of density, strength, millability, and with high bending strength, fatigue features, consistency.

The “Art” of producing Zirconia is in the Kerox Dental database of combinations of powder, particle sizes, press protocols and sintering curves.

Kerox Dental stores all parameters for every piece of ceramics for life.

AND THE FINAL PRODUCT IS AN INTENSE ZIRCONIA WITH A FLEXURAL STRENGTH OF UP TO 1500 MPA AND COME WITH 100 YEAR – LIFETIME WARRANTY

SORTIMENT OF KEROX DENTAL

SHAPES & COMPATIBILITIES

	NT (Natural Translucent) Dental Zirconia	ETHD (Extreme Translucent & High Density) Dental Zirconia	HT (High Translucent) Dental Zirconia
Benefit	- Highest strength on the Dental Market - Low translucency to cover abutments - Optimal milling properties	- High Translucent and High Strength at the same time	- Highest fracture toughness on the Dental Market - The most versatile material: low sinter temperature for increased strength, high sinter temperature for more translucency
Usage	- For frameworks	- For full contour and frameworks	- For full contour and frameworks
Colors	- White (NT) - Pre-shaded (K1, K2, K3 colors)	- White (ETHD) - Pre-shaded (80, 170, 260, 350 colors)	- White (HT)
System compatibilities	- 98-er (Wieland compatible) - 95-er (ZZ compatible) - 71-er (Ceramill/ AG compatible)	- 98-er (Wieland compatible) - 100-er (DentMill compatible) - 95-er (ZZ compatible) - 71-er (Ceramill/ AG compatible)	- 98-er (Wieland compatible)



NT

'98-ER CAD/CAM OPEN SYSTEM NATURAL TRANSLUCENT (NT) & PRE-SHADED ZIRCONIA (K1, K2, K3)

NT Zirconia blanks have the highest bending strength on the dental market. In case of abutments very thin layers have added durability while the metal does not shine through.

Advantages: The highest strenght on the Dental Market >> Low level of translucency covers abutments well >> Accepts porcelain layering exceptionally well



K1

K2

K3

98H10	10 mm
98H12	12 mm
98H14	14 mm
98H16	16 mm
98H18	18 mm
98H20	20 mm
98H25	25 mm



NT

K1

K2

K3

'95-ER CAD/CAM COMPATIBLE ZIRCONIA FOR FRAMEWORKS AND FULL CONTOUR. PRE-SHADED AVAILABLE

ETHD

ETHD 80

ETHD 170

ETHD 260

ETHD 350

95H10	10 mm
95H14	14 mm
95H18	18 mm
95H22	22 mm

NATURAL TRANSLUCENT FOR FRAMEWORKS (NT) EXTREME TRANSLUCENT FOR FULL CONTOUR (ETHD) HIGH TRANCLUCENT FOR MULTIPLE USE (HT)



HT

'98-ER CAD/CAM OPEN SYSTEM HIGH TRANSLUCENT (HT)

HT blanks have the highest fracture toughness on the dental market (up to 16MPa \sqrt{m})

Advantages: The most user-friendly Zirconia from Kerox >> Works with all major milling strategies >> Robust in the green state >> Can be sintered at wide temperature ranges >> Perfect shrinkage

98H10	10 mm	98H18	18 mm
98H12	12 mm	98H20	20 mm
98H14	14 mm	98H25	25 mm
98H16	16 mm		



ETHD

'98-ER CAD/CAM OPEN SYSTEM EXTREME TRANSLUCENT HIGH DENSITY (ETHD) & PRE-SHADED ZIRCONIA (80, 170, 260, 350)

ETHD blanks possess exceptional light transmission and high strength at the same time. Compared to standard Zirconia, 25% more light passes through, thus providing the best aesthetic look with natural appearance.

Advantages: Outstanding aesthetic qualities >> Extreme high level of translucency >> Standard sintering method can be applied >> No adjustment is needed in the normal sinter curve >> The most accurate shrinkage available on the market >> Fabrication of long dental structures and full arches >> Bending strength of up to 1500 MPa



ETHD 80

ETHD 170

ETHD 260

ETHD 350

98H12	12 mm
98H14	14 mm
98H16	16 mm
98H18	18 mm
98H20	20 mm
98H25	25 mm



NT

K1

K2

K3

ETHD

ETHD 80

ETHD 170

ETHD 260

ETHD 350

'71-ER CERAMILL COMPATIBLE ZIRCONIA FOR FRAMEWORK AND FULL CONTOUR. PRE-SHADED AVAILABLE

71H12	12 mm
71H14	14 mm
71H16	16 mm
71H18	18 mm
71H20	20 mm
71H25	25 mm

Custom shapes and sizes are available upon unique customer request.



**ON-SITE
TECHNICAL
SUPPORT
BY KEROX**
MAXIMIZING AESTHETICS
AND PRODUCTIVITY

**KEROX DENTAL TECHNICIANS
AND CERAMICS ENGINEERS
PROVIDE ON-SITE SUPPORT IN
OUR CUSTOMERS' DENTAL LABS**

- We adjust the milling strategies; advise on the burrs for improved aesthetics and burr costs.
- Labs often find coloring to be inconsistent. We help refining the coloring process no matter what coloring system they use.
- Sintering can determine the strength and translucency of the final product. Our ceramics engineers help setting the kilns not only to maximize strength and translucency but also to save on sinter times and energy used.



**KEROX DENTAL
PRE-SHADED
BLANKS**

Save our customers the coloring process before sintering. Units are finished by veneering or staining and glazing only.

Advantages:

- >> Before sintering, the pre-shaded blanks do not require additional coloring
- >> Same milling and sintering parameters with the standard zirconia blanks
- >> Pre-shaded zirconia blank provides an excellent basis for the perfect aesthetic look



QUALITY IS NOT IN THE SAMPLES – IT IS IN THE PROCESS

100% TQM WITH IN-HOUSE DEVELOPED SOFTWARE



QUALITY & INNOVATION COMMITMENT

Ongoing research, 100% quality checks and procedures ensure premium quality zirconia blocks for CAD/CAM dental restorations (crowns, bridges, long structures, inlays, and onlays).

Kerox Dental stores in a database not only lot numbers, but individual serial numbers for future traceability and claim handling.

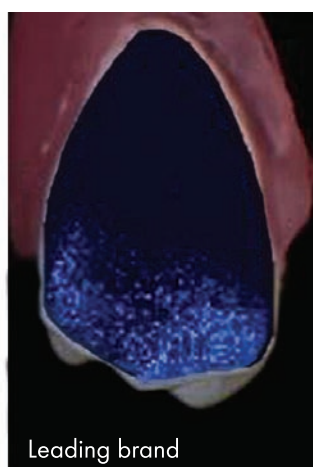
Our innovative efforts achieved that Kerox Dental's Extreme Translucent High Density blanks allow an exceptional 25-30% more light transmission than similar products of major brands.

This quality commitment contributes to our 100 year – lifetime warranty offer.

100 YEAR
LIFETIME WARRANTY

TOTAL QUALITY MANAGEMENT

- Failure Modes and Effects Analysis (FMEA) process
- Statistical Process Control
- Intranet manufacturing support and data for supervising Kerox and international standard measuring equipment
- Quality Control Procedures
- 100% computer aided visual control (density, volume and geometry)
- Quality Management acc. to ISO 13485 & CE1008



Kerox's own developed TQM equipment and software

CERTIFICATES, QUALIFICATIONS & TESTS

NATURAL AND EXTREME TRANSLUCENT PRODUCT ANALYSIS

INVESTIGATION OF CHEMICAL SOLUBILITY

B&B Analytix Ltd.

ANALYSIS OF MORPHOLOGY OF GRAIN STRUCTURE

Bay Zoltán Foundation for Applied Research Laboratory of Nano-metrology

DETERMINATION OF 4-POINT BENDING STRENGTH AND DETERMINATION OF FRACTURE TOUGHNESS

Forschungsinstitut Für Anorganische Werkstoffe Glas/Keramik GMBH

TEST REPORT FROM THE LABORATORY FOR THE DETERMINATION OF RADIONUCLIDE CONCENTRATION

Schweizerische Eidgenossenschaft

DETERMINATION OF LINEAR THERMAL EXPANSION COEFFICIENT

SZIKKTI Labor

BIOCOMPATIBILITY CERTIFICATE - CITOTOXICITY, GENOTOXICITY, SENSITIZATION

HygCen Centrum für Hygiene und medizinische Produktsicherheit

SAFETY DATA SHEETS

ZIRCONIA SAFETY DATA SHEET

Hungária Veszélyesáru Mérnöki Iroda Kft.

MODELLING FLUID SAFETY DATA SHEET

Hungária Veszélyesáru Mérnöki Iroda Kft.

Bay Zoltán Foundation for Applied Research
Laboratory of Nano-metrology

1 Analysis tasks: Morphology of grain structure, quantitative element analysis and crystal structure identification on Zirconia bulk material.

Customer: Kerax Kft., H-2049 Homokbánya út 77, Hungary

Specimen trade name: Kerax Zirconia Beams

Specimen parameters: Final sintered ceramic cylinders 409620 LOT No. M207-06

2 XRD Quantification: The final sintered material of Kerax Zirconia Beams contains the following weight composition: ZrO₂ 99.99%, Y₂O₃ 0.01%, H₂O 0.00%, SiO₂ 0.00%, Fe₂O₃ 0.00%, Al₂O₃ 0.00%, CaO 0.00%, MgO 0.00%, Na₂O 0.00%, K₂O 0.00%, TiO₂ 0.00%, PbO 0.00%, SnO₂ 0.00%, BaO 0.00%, SrO 0.00%, NiO 0.00%, CuO 0.00%, ZnO 0.00%, Ni₃S₂ 0.00%, Ni₃S₄ 0.00%, Ni₃S₆ 0.00%, Ni₃S₈ 0.00%, Ni₃S₁₀ 0.00%, Ni₃S₁₂ 0.00%, Ni₃S₁₄ 0.00%, Ni₃S₁₆ 0.00%, Ni₃S₁₈ 0.00%, Ni₃S₂₀ 0.00%, Ni₃S₂₂ 0.00%, Ni₃S₂₄ 0.00%, Ni₃S₂₆ 0.00%, Ni₃S₂₈ 0.00%, Ni₃S₃₀ 0.00%, Ni₃S₃₂ 0.00%, Ni₃S₃₄ 0.00%, Ni₃S₃₆ 0.00%, Ni₃S₃₈ 0.00%, Ni₃S₄₀ 0.00%, Ni₃S₄₂ 0.00%, Ni₃S₄₄ 0.00%, Ni₃S₄₆ 0.00%, Ni₃S₄₈ 0.00%, Ni₃S₅₀ 0.00%, Ni₃S₅₂ 0.00%, Ni₃S₅₄ 0.00%, Ni₃S₅₆ 0.00%, Ni₃S₅₈ 0.00%, Ni₃S₆₀ 0.00%, Ni₃S₆₂ 0.00%, Ni₃S₆₄ 0.00%, Ni₃S₆₆ 0.00%, Ni₃S₆₈ 0.00%, Ni₃S₇₀ 0.00%, Ni₃S₇₂ 0.00%, Ni₃S₇₄ 0.00%, Ni₃S₇₆ 0.00%, Ni₃S₇₈ 0.00%, Ni₃S₈₀ 0.00%, Ni₃S₈₂ 0.00%, Ni₃S₈₄ 0.00%, Ni₃S₈₆ 0.00%, Ni₃S₈₈ 0.00%, Ni₃S₉₀ 0.00%, Ni₃S₉₂ 0.00%, Ni₃S₉₄ 0.00%, Ni₃S₉₆ 0.00%, Ni₃S₉₈ 0.00%, Ni₃S₁₀₀ 0.00%

3 Phase detection: Powder diffraction pattern of final sintered Kerax Zirconia Beams showed perfect matching with tetragonal zirconia (PDF# 03-065-0885) phase, revealed from XRD data code of the ICDD Collection. Measurement were carried out by XRD method (X-ray diffraction).

4 Grain analysis: Typical grain sizes of final sintered Kerax Zirconia Beams are between 0.2µm and 0.3µm. Smaller grain sizes are recommended sintering conditions. The grain size measured by XRD method (Scherrer formula) is 0.2µm. Measurement were carried out by XRD method (X-ray diffraction).

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Test Report 0606-12-A for Kerax Kft. Homokbánya út 77, H-2049 Hungary

1. Test specimen: 41 beams labelled as 'Kerax Zirconia Beams, LOT number: L1007'

2. Date of arrival: 15/06/2012

3. Test realization: 15/06 - 06/09/2012

4. Testing method: Determination of 4-point bending strength according to DIN EN ISO 6872 incl. Weibull statistics according to ISO 20501. Determination of fracture toughness (K_{1C}) according to DIN EN ISO 6872 appendix A, SEVNB method (in accordance with ISO 15712).

5. Sampling/Sample preparation: Sampling and delivery to the FGK was under responsibility of the customer. **Determination of 4-point bending strength:** From the delivered specimens, 20 testing beams with the geometry 3 mm x 4 mm x 45 mm were prepared by a cooperation partner. Preparation was carried out in accordance with DIN EN ISO 6872, chapter 7.3.2.2.2. Beams were chamfered at the edges where tensile stress was applied during 4-point bending test. **Determination of fracture toughness:** From the delivered specimens 3 testing beams with the geometry 3 mm x 4 mm x 45 mm and a primary cut of 2.4 mm width and 0.5 mm depth (diamond saw) were prepared by a cooperation partner. Finishing of the cut was carried out in the FGK with a coarse blade (initial pressure 5 Nm) and a diamond paper of 6 µm, then resulting in a U-notch with a depth between 800 µm and 1200 µm. All preparation was done in accordance with DIN EN ISO 6872 appendix A.2.2. Finally specimens were cleaned in an ultrasonic bath and dried before testing.

6. Results: **4-point bending strength (standard deviation):** 1113.327 MPa (172.362 MPa)

Weibull parameters			
Number of tests	Confidence interval	Characteristic strength	Lower bound
30	95 %	1185 MPa	1134 MPa
upper bound	Weibull modulus	5.7	9.3

Fracture toughness (standard deviation): 19.78 MPa^{1/2} (8.64 MPa^{1/2})

7. Testing uncertainty: Testing uncertainty of the used load cell: 1% (class 1)
Testing uncertainty of the used micrometer gauge: 0.1 %
Testing uncertainty of the used microscope: 0.5 %

8. Epilogue: All investigations were done in view of the latest scientific-technical trends and to the best of our knowledge and belief. The testing results exclusively refer to the test specimens. In order to avoid misinterpretations, the present report primarily be copied and transmitted to its complement. To copy contents needs a written permission from the FGK.

Prep. by: Kati Csikó (Managing Director) HGW-Geschäftsamt, 06/08/2012 8/1
Contact person for enquiries: Dr. Marcell Zsák Test Report 0606-12-A Page 1 of 1
Phone: +36 (0)20 348 186-13 marcell.zsak@fgw.hu

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun Svizra

Federal Department of Defense,
Civil Protection and Sport (DDPS)
Confederation Systems
Federal Office for Civil Protection (FOCP)
SPZ LABORATORY

Reference number: NOV011.2 - NUC011
Contact: +41 30 338 18 18
Spzec, 16/02/2011

Laboratory for the determination of radionuclide concentration

Test Report NUC-11-016

Customer: Kerax Kft., Balazs FÉNYI, Homokbánya út 77, H-2049 Diosd

Order: Gamma spectrometric analysis of natural and artificial radionuclides in zirconium ceramic powder.

Summary: The powder was filled in a defined plastic geometry and measured with a high purity Ge gamma detector. The results are summarized in chapter 9. No artificial radionuclides could be found. The activity concentration of the natural radionuclides U-238 and Th-232 and their daughter products were less than 53 Bq/kg. Assuming radiological equilibrium between U-234 and Th-234, the U-238 activity concentration is < 20 Bq/kg.

Physics: Dr. Peter Roder, Head of Physics
Physics: Dr. Mario Burger, Radioactivity
Physics: Dr. Stefan Röllin, Radioactivity

— Kerax Kft., Balazs FÉNYI, Homokbánya út 77, H-2049 Diosd
— SPZ LABORATORY: RPE, BURG, SET, AST, ROF, SAHH, HO, BYF, ZEHR, WIG Reg.

The contents of this test report refer only to the test samples. It may be published in full without consent, however general publication requires permission from SPZ LABORATORY.

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EN 15026:2011
EN number 311.3 - NUC011
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100 YEAR – LIFETIME WARRANTY

KEROX DENTAL OFFERS A LIFETIME WARRANTY AGAINST MATERIAL MANUFACTURING DEFECTS.

Copings or substructures created made out from **Kerox Dental** Zirconium Oxide will not break if fabricated in compliance with the manufacturer's instructions and in accordance with the professional rules for processing.

The warranty regarding this Product may only be enforced if it is validated in accordance with the instructions indicated in the package of the Product using the link on **www.kerodental.net**.

DISTRIBUTION AUTHORIZATIONS

CE CERTIFICATE

TÜV Rheinland

FDA CERTIFICATE

Food and Drug Administration – Department of Health & Human Services

COMPANY CERTIFICATES

ISO 9001:2008 CERTIFICATE

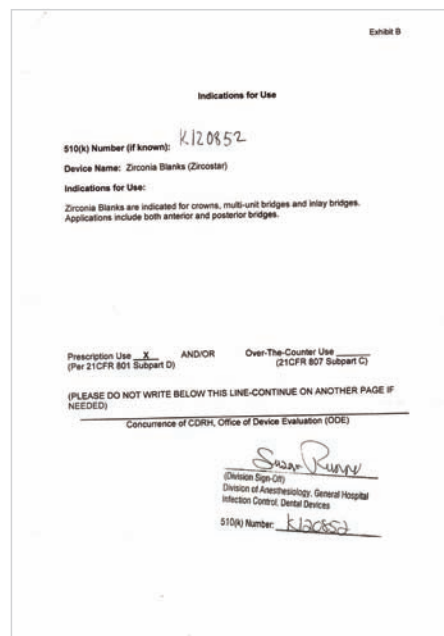
TÜV Rheinland

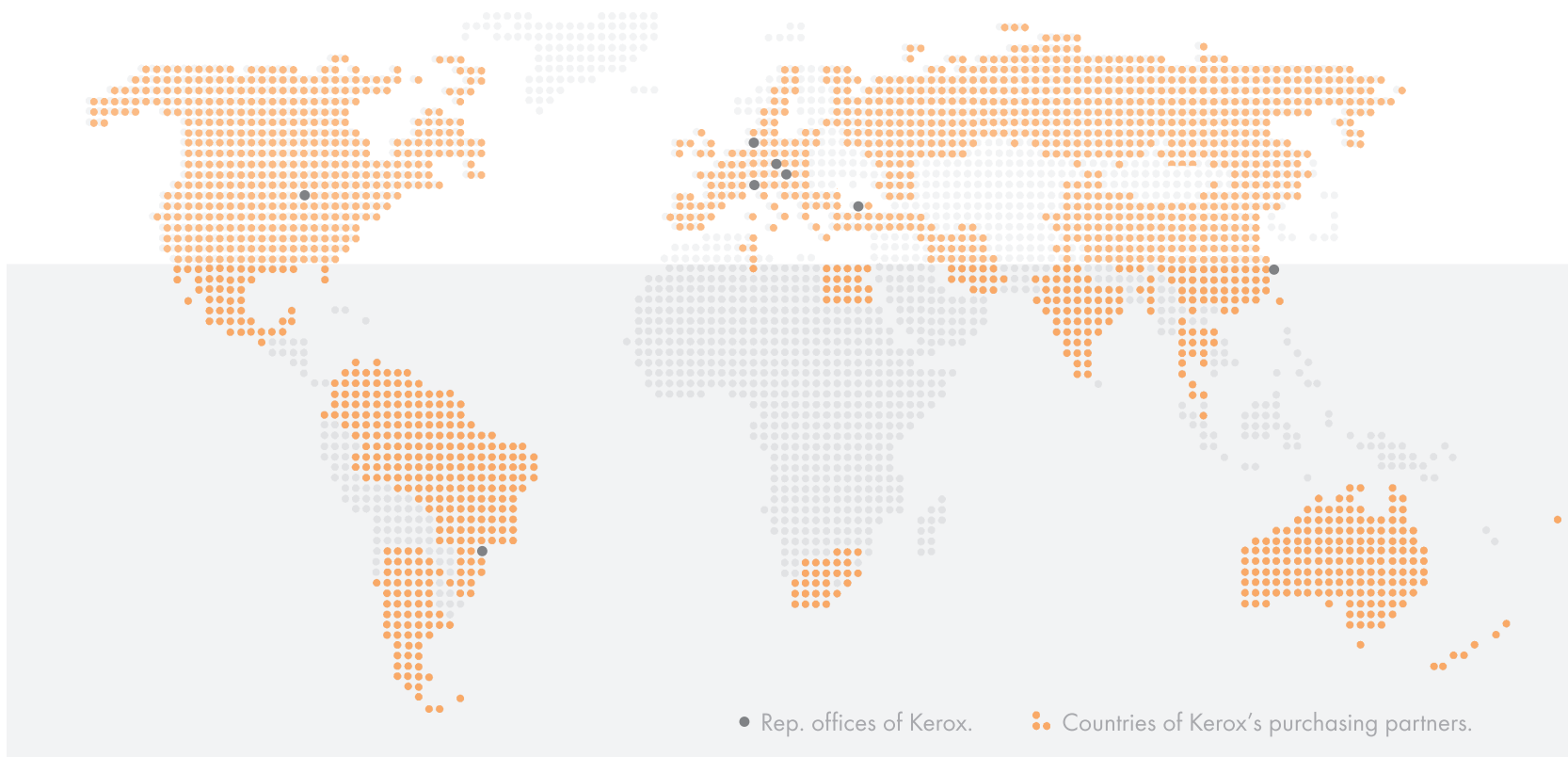
EN ISO 13485:2003 + AC:2009 CERTIFICATE

TÜV Rheinland

100 YEAR

LIFETIME WARRANTY





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