

## Signum universal bond

### Laboratory study – University of Berlin, Charité, Germany

Shear bond strength test of veneering resins to PEEK

### Laboratory study – University of Munich, LMU, Germany

PEEK surface treatment effects on tensile bond strength to veneering resins

### Laboratory Study – University of Samsun, Turkey

Shear bond strength to zirconia

Determination of Resin Bond Strength to Zirconia Ceramic Surface Using Different Primers

In dentistry, a wide range of framework materials is used. Next to materials such as metal alloys, zirconia and methacrylate-based resin composites there are innovative materials such as high-performance polymers, e.g. polyether ether ketone (PEEK). Signum universal bond is an adhesive system developed to increase bonding strength of veneering resins to different framework materials including PEEK.

This scientific information summarizes different laboratory studies by various universities testing the bonding strengths on different framework materials.

PEEK high performance polymers offer a unique combination of mechanical properties like low density, high mechanical strength, high temperature resistance, biocompatibility, and good workability. Besides ceramics, it represents an alternative to metal-based materials for dental restorations. Controlled by additives its colour spectrum ranges from grey, white to gingiva coloured. Nevertheless, aesthetic dental restoration of PEEK frameworks can only be achieved by appropriate composite resin veneering. However, its low surface energy makes a reliable bond to the composite resins challenging.

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**KULZER**  
 MITSUI CHEMICALS GROUP

# Shear bond strength to PEEK – University of Berlin, Charité, Germany

## Shear bond strength test of veneering resins to PEEK

### Objective

One objective of the study was to evaluate the effect of surface treatment and storage conditions on shear bond strength of a veneering resin to PEEK. In the present report, only partial aspects of the study are considered.

### Materials & Methods

Four hundred and forty VESTAKEEP DC PEEK (Evonik) discs were prepared out of three different compounds: DC4420R (white), DC4450R (tooth coloured), DC4470R (gingiva coloured). Each of these groups was divided in half. Half of the PEEK surfaces were polished while the others were sandblasted (110  $\mu\text{m}$   $\text{Al}_2\text{O}_3$ ). After random measurement of the specimens' surface roughness the two groups were separated into three groups of different pre-plasma treatments. Group 1: no treatment, group 2: low pressure oxygen ( $\text{O}_2$ ) plasma treatment (35 min), group 3: low pressure argon (Ar) plasma treatment (35 min). Each of the groups was further split into a group with and without application of the adhesive system Signum universal bond (Kulzer). Both groups were then subsequently veneered with Signum opaque F and composite (Kulzer). After either water storage (24h at 37°C) or thermocycling (5000 cycles at 5–55°C) the specimens were examined in a Z010 universal testing machine (ZwickRoell) according to ISO 10477 and shear bond strength was calculated.

### Results

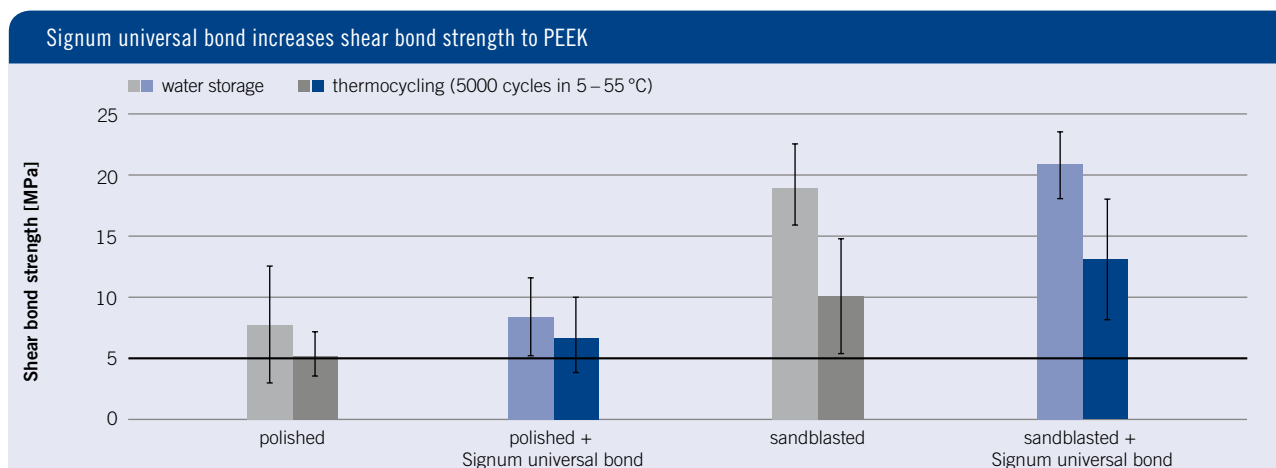


Figure 1: Comparison of overall mean shear bond strength values with standard deviation of Signum opaque F and composite to polished or sandblasted PEEK surfaces with and without Signum universal bond after water storage or thermocycling.

Shear bond strength values of all tested specimens were found to be higher than 5 MPa, meeting the requirements of ISO 10477 (Figure 1).

Independent of the PEEK compound tested, with or without Signum universal bond, initial shear bond strength values between 19 and 21 MPa were achieved for sandblasted surfaces. Even after thermocycling, surface conditioning with Signum universal bond significantly contributed to securing the bond of veneering resin to PEEK.

### Conclusion

Signum universal bond and sandblasting achieved excellent bond strength of veneering resins to PEEK.

### Source

With kind permission of Evonik Industries AG (Denseo GmbH) – University of Berlin, Charité. PEEK VfK Project 2017/18. Unpublished data. Data on file.

The study was abbreviated and summarised by Kulzer Scientific Affairs and diagrams and titles have been established by Kulzer. Signum universal bond is the chemical equivalent to the originally evaluated experimental bonding agent for PEEK.

# Tensile bond strength to PEEK – University of Munich, LMU, Germany

## PEEK surface treatment effects on tensile bond strength to veneering resins

### Objective

To evaluate the effect of chemical treatments of PEEK on tensile bond strength to veneering resins. In the present report, only partial aspects of the study are considered.

### Materials & Methods

Seven hundred fifty specimens were made from PEEK blanks Dentokeep (nt-trading) and divided into 3 pre-treatment groups. Group 1: sulfuric acid etching for 60 seconds, group 2: piranha acid etching for 30 seconds, group 3: unetched. After determining the surface free energy and roughness the remaining specimens (n=240 per group) were treated with either Signum universal bond (Kulzer) or visio.link (bredent) or left untreated. Half of each group was veneered with a different veneering resin (n=40 per group). Tensile bond strength was measured after storage in distilled water at 37°C for either 24 hours or 60 days. Data were analysed by 4-way and 1-way ANOVA followed by the Scheffe test and chi-square test ( $= .05$ ).

### Results

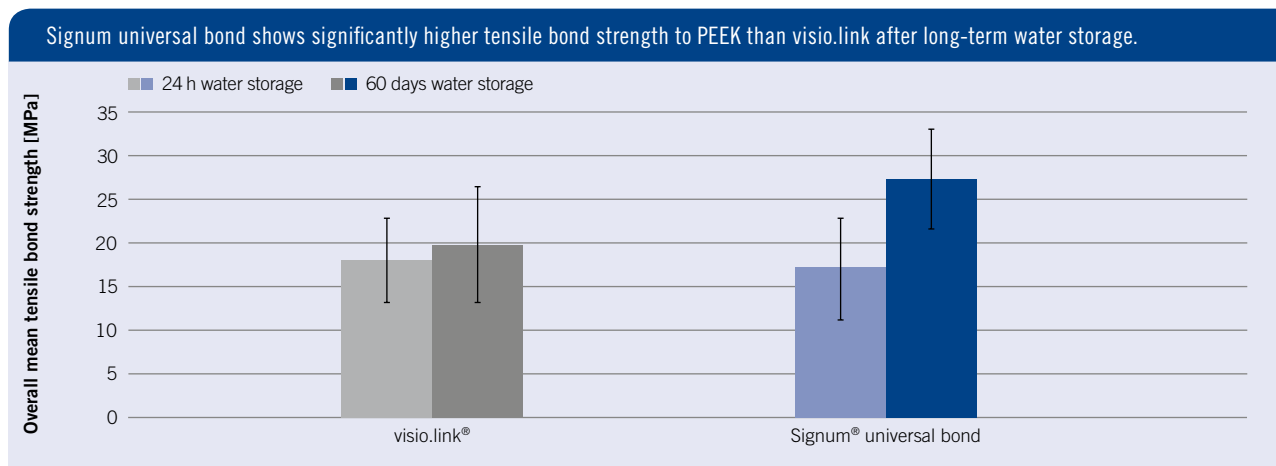


Figure 2: Comparison of overall mean tensile bond strength values with standard deviation of different veneering resins to unetched PEEK after using either Signum® universal bond or visio.link®

The initial measurement showed no differences between Signum universal bond and visio.link ( $P < .05$ ). After water storage for 60 days the groups treated with Signum universal bond showed significantly higher tensile bond strength in comparison to those treated with visio.link ( $P < .001$ , Figure 2).

### Conclusion

Adhesive systems (such as Signum universal bond and visio.link) should be used to achieve durable bonding of veneering resins to PEEK.

### Source

Stawarczyk B, Jordan P, Schmidlin PR, Roos M, Eichberger M, Gernet W, Keul C: PEEK surface treatment effects on tensile bond strength to veneering resins. J Prosthet Dent. 2014 Nov; 112(5):1278-88.

The study was abbreviated and summarised and diagrams and titles have been established by Kulzer. Signum universal bond is the chemical equivalent to the originally evaluated Signum PEEK bond.

Signum® is a registered trademark of Kulzer.

# Shear bond strength to zirconia – University of Samsun, Turkey

## Determination of Resin Bond Strength to Zirconia Ceramic Surface Using Different Primers

Zirconia is a well-established material in the dental field and is used for several indications. The application ranges from framework materials over monolithic veneers to fully anatomical crowns and bridges. Is there a positive effect for using zirconia bonders before adhesive cementation?

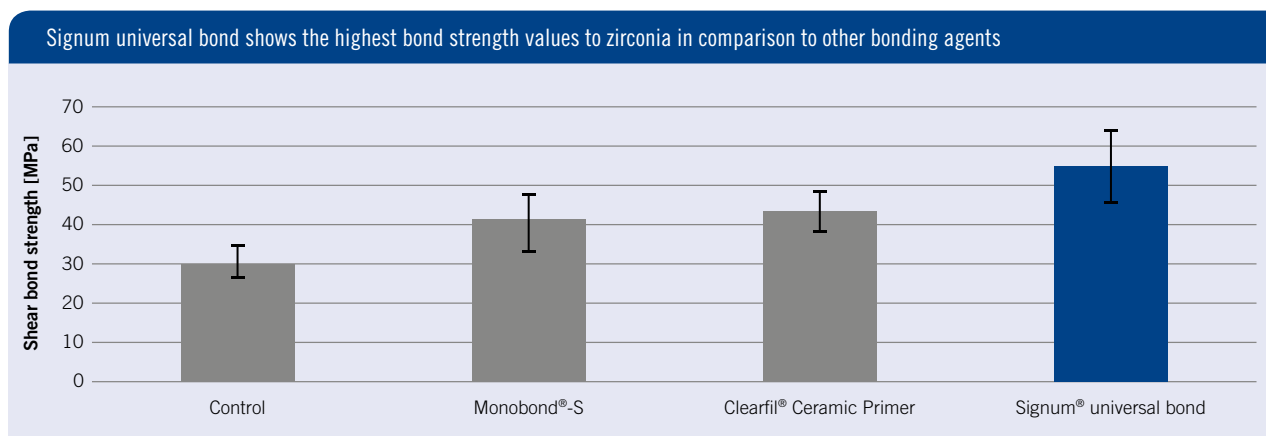
### Objective

To determine the influence of various bonders for zirconia on the shear bond strength in the context of adhesive cementation.

### Materials & Methods

In total 40 disc-shaped zirconia specimens were produced, and the surfaces were prepared with Al<sub>2</sub>O<sub>3</sub> (grit size of 110µm with 2,8bar). The specimens were divided into 4 groups for the examination of 3 different bonders: Monobond®-S (Ivoclar), Clearfil® Ceramic Primer (Kuraray) and Signum® universal bond (Kulzer) and one control group. Composite blocks (Filtek® Z250, 3M ESPE) were cemented on the zirconia discs with a resin cement (Panavia™ F 2.0 (Kuraray) after conditioning with one of the bonding agents respectively without bonding in the control group. The specimens were examined in a universal testing machine and shear bond strength was calculated.

### Results



Failure rates (%) of tested specimens			
Group	Adhesive	Cohesive	Adhesive + cohesive
Control	60	30	10
Monobond-S	40	40	20
Clearfil Ceramic Primer	30	50	20
Signum® universal bond	20	60	20

### Conclusion

Usage of zirconia bonders for the adhesive cementation of zirconia has a positive effect on the shear bond strength between ceramic and resin cement. Signum® universal bond showed the highest bond strength values in the present investigation.

### Source

Ural C, Külünk S, Kurt M, Baba S: Determination of Resin Bond Strength to Zirconia Ceramic Surface Using Different Primers. Acta Odontol Scand. 2011 Jan; 69(1):48-53.

The study was abbreviated and summarised and all diagrams and titles have been established by Kulzer. Signum® universal bond is the chemical equivalent to the originally evaluated Signum® zirconia bond.

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