

3M ESPE

Adper™ Easy Bond
Self-Etch Adhesive

technical product profile

Adper



Table of Contents

Introduction	5
Product Description	5
Composition	6
Background	6
Mechanism of Adhesion to Enamel for Total-Etch Adhesives	6
Mechanism for Adhesion to Dentin for Total-Etch Adhesives	7
Bonding Mechanism for Adper™ Easy Bond Self-Etch Adhesive	8
Test Results	10
Bond Strengths to Dentin and Cut Enamel	10
Microtensile Study from Professor Nara	10
Shear Bond Study from Loma Linda University	11
3M™ ESPE™ Shear Bond Study	12
Dentist Panel Study	13
Marginal Integrity	14
Nanoleakage	15
Low Post-Operative Sensitivity	15
Step-by-Step Technique Guides	17
Direct Light Cure Restoration	16
Porcelain Repair	17
Root Surface Desensitization	18
Dispensing Unit Dose	19
Instructions for Use	20

Introduction

Product Description

3M™ ESPE™ has a strong reputation in adhesives dating back to the development of Concise enamel bonding agent in the 1970s. The launch of Adper™ Scotchbond™ Multi-Purpose adhesive provided phosphoric acid etching to dentin and dramatically improved dentin bond strengths. Adper™ Single Bond adhesive combined the primer and adhesive of Adper™ Scotchbond™ Multi-Purpose adhesive into one bottle, simplifying the procedure and reducing application time. This product was followed by Adper™ Single Bond Plus adhesive, which added a bonded nanofiller to provide enhanced bond strength. Adper™ Prompt™ adhesive was 3M ESPE's first self-etch bonding agent and featured the convenient L-Pop™ unit dose delivery system.

Building upon this strong tradition in bonding agents, 3M ESPE has developed a new 7th generation self-etch adhesive. Incorporating over 25 years of adhesive technology in a single bottle, Adper™ Easy Bond Self-Etch Adhesive offers fast application time along with the reduced risk of post-operative sensitivity inherent to self-etch adhesives.

Adper Easy Bond Self-Etch Adhesive is a light-curing bonding agent used in combination with light-curing composite or compomer filling materials, cements and core-build-up materials. This bonding agent can be polymerized using halogen, LED, or plasma curing lights.

Adper Easy Bond Self-Etch Adhesive can be used for the following indications:

- All classes of fillings with light-curing composite or compomer
- Core build-ups made of light-curing composite
- Root surface desensitization
- Repair of composite or compomer fillings
- Intraoral repair of existing composite, porcelain fused to metal, and all ceramic restorations
- Cementation of indirect restorations made of composite or compomer, ceramic, and metal using RelyX™ ARC Adhesive Resin Cement, manufactured by 3M ESPE

Contraindications:

- Cementation of veneers and adhesive cementation of self-curing and dual-curing composites

In addition to vials, Adper Easy Bond Self-Etch Adhesive is also offered in a convenient and hygienic unit dose delivery system. Simply pressing the single foil package advances adhesive to the self-contained applicator.



Figure 1: Adper Easy Bond Self-Etch Adhesive Unit Dose Delivery System

Composition

The Adper™ Easy Bond Self-Etch Adhesive formulation includes a carefully balanced combination of phosphoric acid esters, water and methacrylates in order to optimize stability. In addition, a bonded nanosilica filler gives enhanced bond strength and does not require shaking before use. Adper Easy Bond Self-Etch Adhesive contains the following components.

2-hydroxyethyl methacryate (HEMA)

Bis-GMA

Methacrylated phosphoric esters

1,6 hexanediol dimethacrylate

Methacrylate functionalized Polyalkenoic acid (Vitrebond™ Copolymer)

Finely dispersed bonded silica filler with 7 nm primary particle size

Ethanol

Water

Initiators based on camphorquinone

Stabilizers

Storage under refrigeration is recommended if the product is not in use. If the material is depleted within 6 months, no refrigeration is needed.

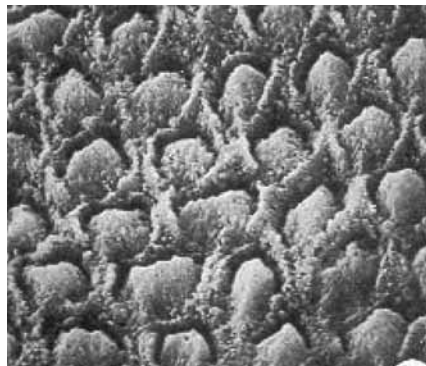
Background

The majority of dental adhesives fall into two categories, total-etch and self-etch. In total-etch adhesives, a phosphoric acid etchant is typically used to etch the surfaces of dentin and enamel. The adhesive subsequently forms a micromechanical bond with these etched surfaces, which provides a substrate upon which a composite material can be chemically bonded.

Mechanism of Adhesion to Enamel for Total-Etch Adhesives

Untreated enamel does not provide a suitable surface for dental adhesive bonding due to minimal porosities and a surface energy poorly suited for wetting with monomers. For total etch adhesives, a phosphoric acid etchant is used to superficially demineralize the hydroxyapatite of enamel. The demineralization greatly increases the surface area available for bonding, as shown in Figure 2.

Figure 2: Enamel etch pattern – 35% phosphoric acid.



This allows the low viscosity, polymerizable resins of the adhesive to penetrate the porosities revealed by the etching procedure to form an interlocking mechanical bond after curing. These interlocking resin tags are shown in Figure 3.

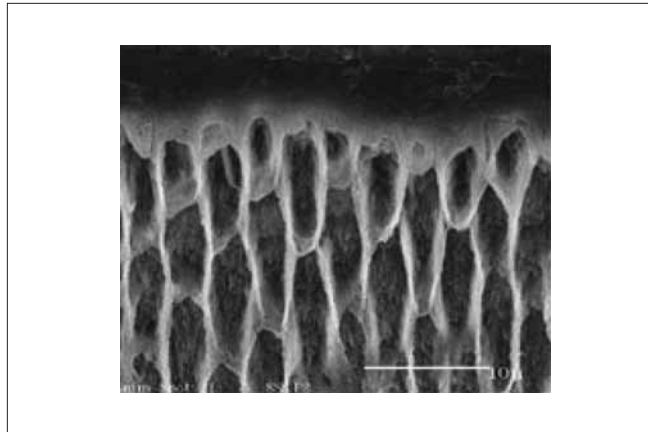


Figure 3: Image courtesy of Dr. Patricia Pereira, University of North Carolina

Mechanism for Adhesion to Dentin for Total-Etch Adhesives

For dentin bonding with total etch adhesives, a similar process is involved to form the micromechanical bonding. A typically prepared dentin surface will contain a smear layer as shown in Figure 4.

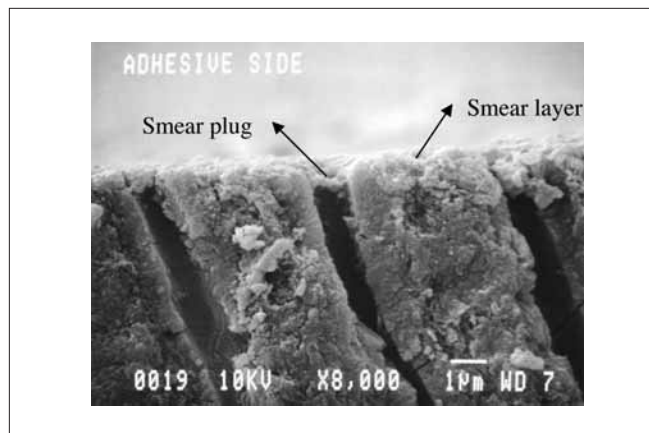


Figure 4: Smear layer seen through a scanning electron microscope

Upon acid etching the dentin surface, the smear layer is removed opening the dentin tubules. In addition, the intertubular dentin is demineralized, leaving a layer of collagen fibers as shown in Figure 5.

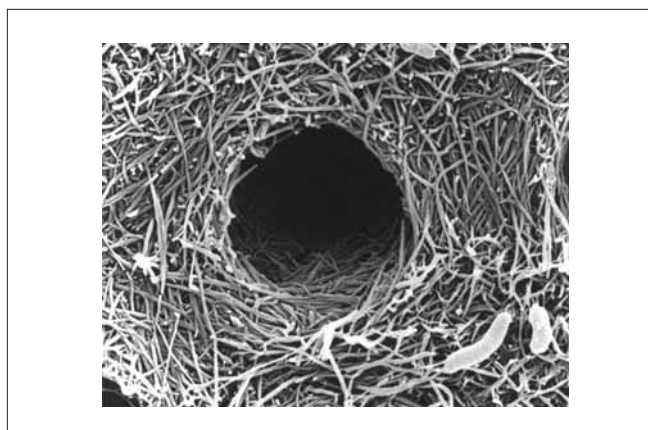
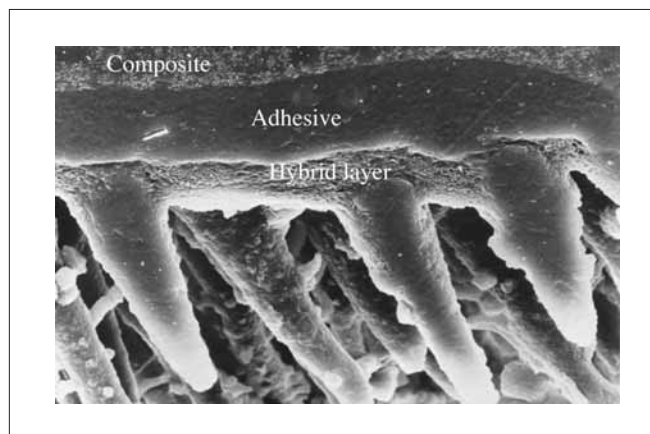


Figure 5: Dentin tubule with surrounding collagen fibers. Image courtesy of Dr. J. Perdigao, University of Minnesota

Figure 6: Scanning electron micrograph showing hybrid layer and resin tags.



Provided the collagen layer remains hydrated, these fibers will remain expanded and the infiltration of adhesive resin monomers is maximized. Upon desiccation, however, the collagen layer collapses limiting the infiltration of resin monomers and impairing the formation of a hybrid layer. In this situation, localized adhesion may be compromised during polymerization contraction of the composite restorative material, contributing to gaps between the adhesive and dentin substrate. A possible outcome of this is post-operative sensitivity.

Bonding Mechanism for Adper™ Easy Bond Self-Etch Adhesive

Unlike the total-etch systems described in the previous section, the etching and subsequent penetration of resin monomers into the demineralized dentin and enamel is carried out as one step with Adper™ Easy Bond Self-Etch Adhesive. A major benefit of this procedure for dentin bonding is that the etching depth and the depth of penetration of the adhesive are identical.

Eliminating the need for a separate etching step allows for the simultaneous etching and adhesive penetration. In the case of dentin bonding, this keeps the collagen fibers from collapsing and eliminates dependence on “moist” bonding which is characteristic of the 5th generation “one-bottle” systems. This is important because technique sensitivity associated with bonding systems requiring a “moist” bonding technique may be associated with post-operative sensitivity.

A possible adhesion mechanism for the original Prompt™ L-Pop™ adhesive was described by Professor Reinhardt (University of Münster) and can also be used to describe, in part, the mechanism of Adper Easy Bond Self-Etch Adhesive.

Adper Easy Bond Self-Etch Adhesive includes phosphoric esters, which under aqueous conditions will etch the surfaces of dentin and enamel to allow for the micromechanical bonding of a restorative material. Moreover, the phosphoric esters and the Vitrebond™ Copolymer in Adper Easy Bond Self-Etch Adhesive form a chemical bond to the hydroxyapatite by forming a complex with the calcium ions.

Bonding to dentin with Adper Easy Bond Self-Etch Adhesive involves dissolving the inorganic smear layer and the demineralization of the intertubular dentin. Simultaneously the adhesive penetrates the demineralized dentin to form the hybrid layer and flows into the dentin tubules to create resin tags. The depth of the demineralized zone corresponds to the depth of penetration of the monomers to be polymerized. Nanoleakage, resulting from an insufficient penetration depth of the adhesive can be prevented by this mechanism.

Figure 7 shows the hybrid layer formed from Adper Easy Bond Self-Etch Adhesive. This image was created using Transmission Electron Microscopy (TEM) methodology. Adhesive and dentin are clearly labeled, while H indicates the acid-resistant hybrid layer. Adper Easy Bond Self-Etch Adhesive displays a well defined, submicron hybrid layer.

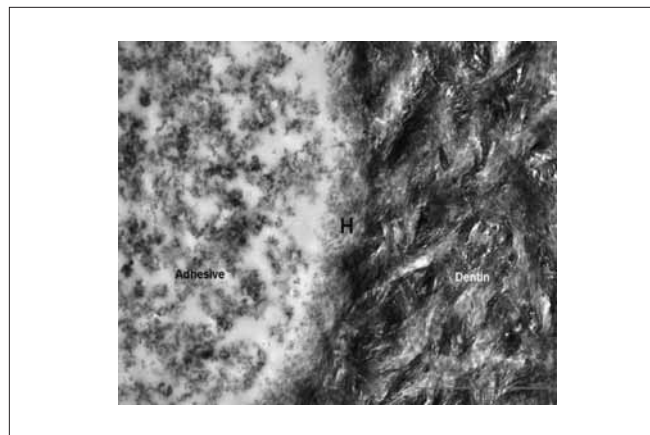


Figure 7: Hybrid layer for Adper Easy Bond Self-Etch Adhesive. Image courtesy of J. Perdigao, G. Gomez, S. Duarte, University of Minnesota

Test Results

Bond Strengths to Dentin and Cut Enamel

Adper™ Easy Bond Self-Etch Adhesive demonstrates bond strengths on dentin and cut enamel comparable to the leading self-etch adhesives.

Tensile Study from Professor Nara

A tensile bond strength study was performed by Professor Nara, Nippon University. A tensile measurement device invented at Nippon University was used to measure bond strengths. Human teeth were used for this study, and the bond strengths were measured immediately after sample preparation. Data from this study is shown in Figures 8-1 and 8-2.

Figure 8-1: Bond strength to cut enamel

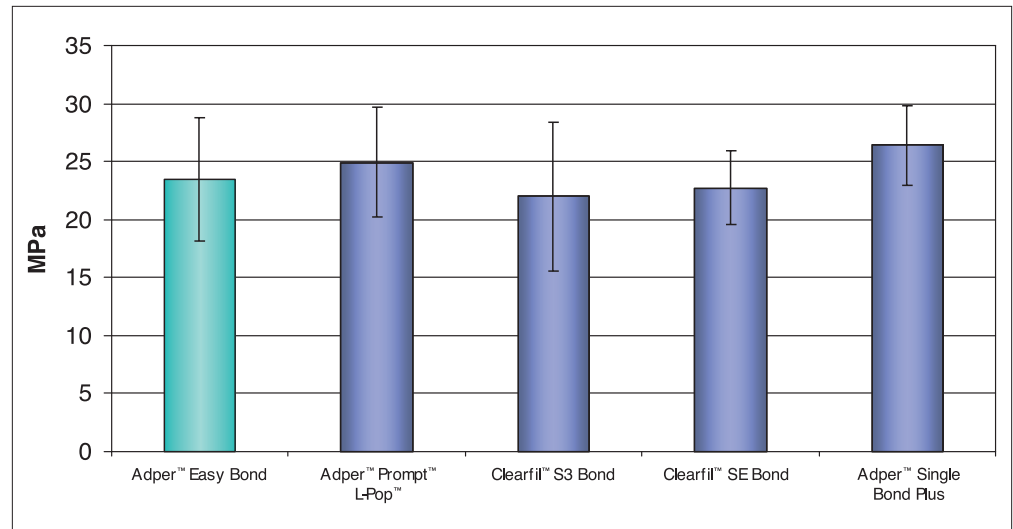
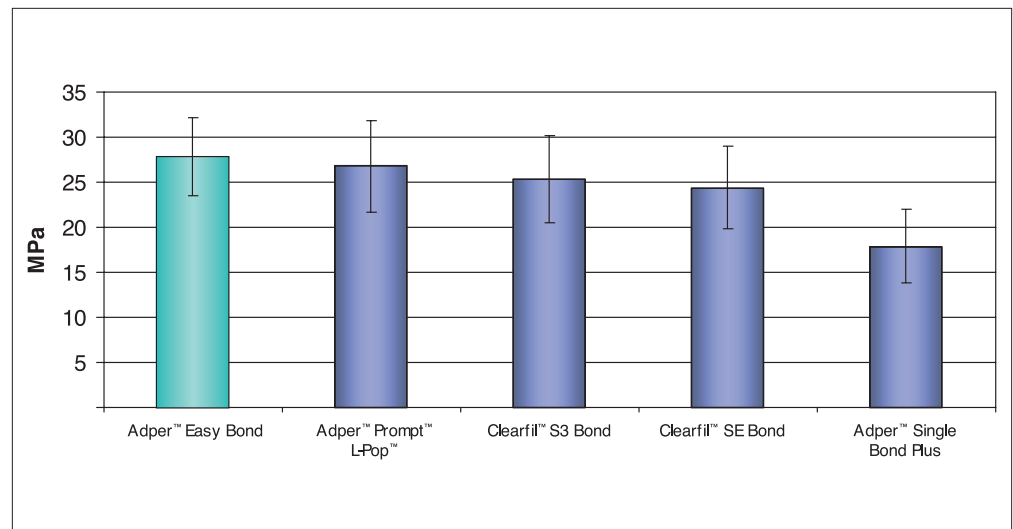


Figure 8-2: Bond strength to dentin



Shear Bond Study at Loma Linda University

A notched-edge shear bond strength test was conducted by Lu H, Dunn JR at Loma Linda University comparing Adper™ Easy Bond Self-Etch Adhesive to other one-bottle self-etch adhesives. Human teeth were used in this investigation. Data from this study is shown in the following graphs (Figures 9-1 and 9-2).

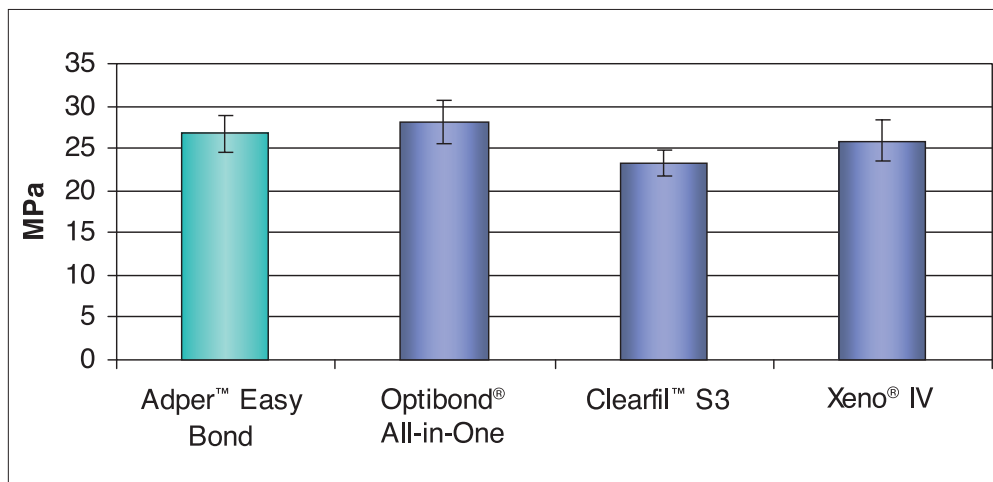


Figure 9-1: Shear bond strength to cut enamel

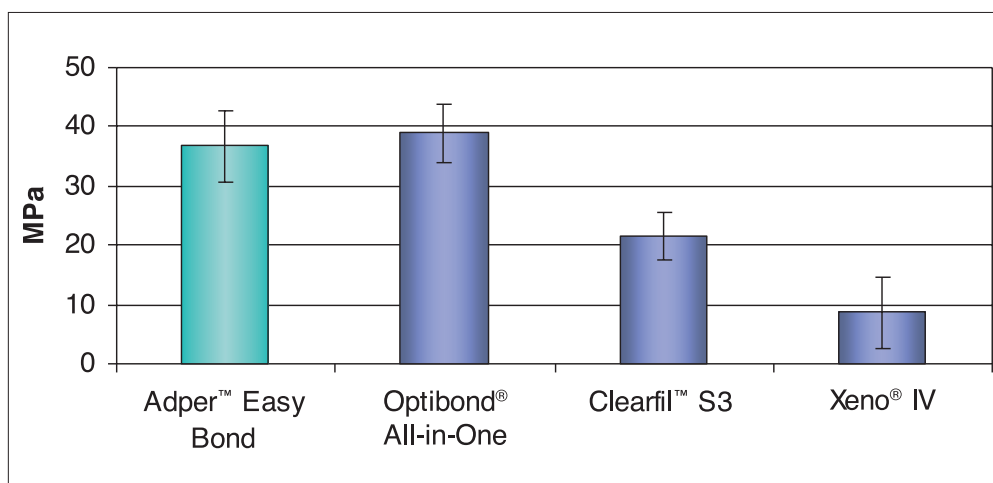


Figure 9-2: Shear bond strength to dentin

3M™ ESPE™ Shear Bond Study

An internal study was conducted comparing Adper™ Easy Bond Self-Etch Adhesive to leading 7th generation self-etch adhesives on bovine cut enamel and dentin (Figures 10-1 and 10-2). A notched-edge shear test method was used with Filtek™ Z250 Universal Restorative. The data shows that Adper™ Easy Bond Self-Etch Adhesive has statistically higher bond strengths to dentin than the other adhesives studied in this investigation.

Figure 10-1: Shear bond strength to cut enamel

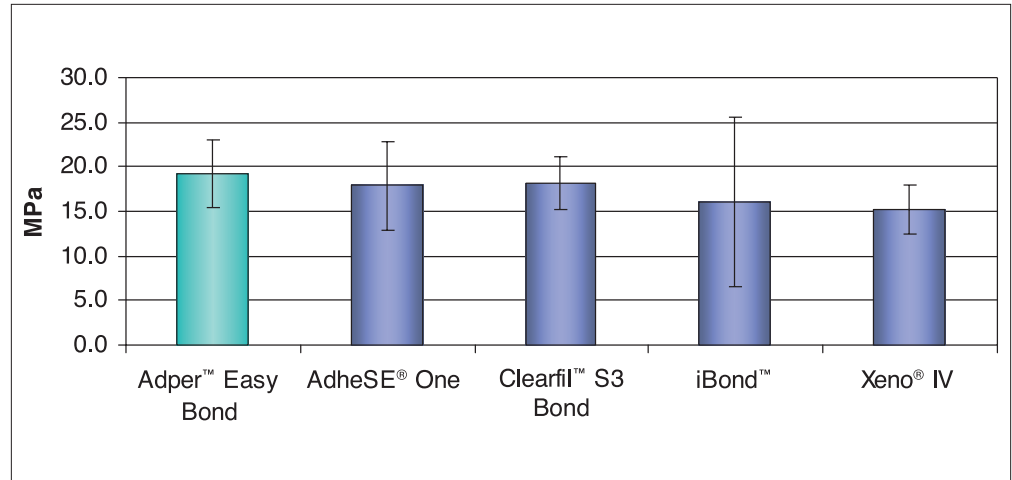
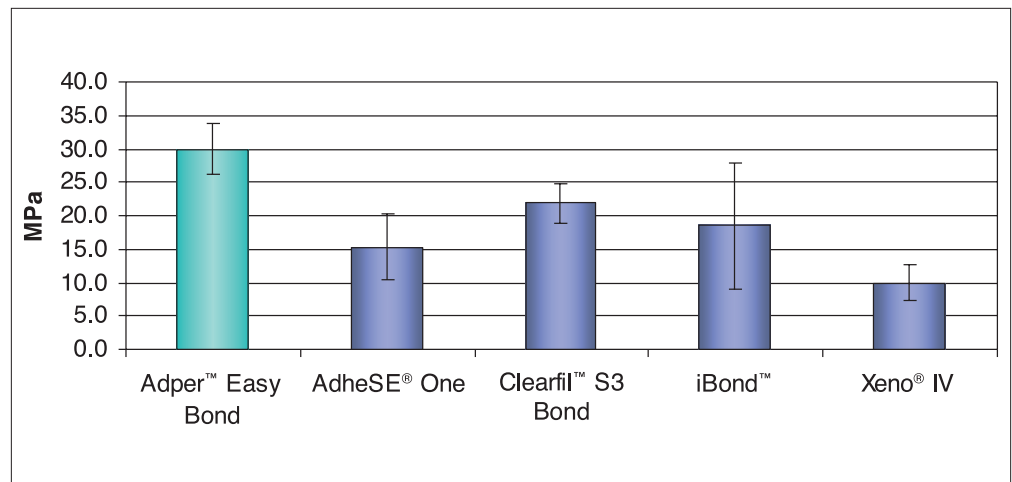


Figure 10-2: Shear bond strength to dentin



Dentist Panel Study

A panel of 30 dentists participated in a study with Adper™ Easy Bond Self-Etch Adhesive and selected other adhesives. Each dentist placed a set of three adhesives on bovine cut enamel and dentin according to their instructions for use for a total of 180 specimens. A notched-edge shear test was then conducted using Filtek™ Z250 restorative. Data from this study is shown in Figures 11-1 and 11-2. The data helps to demonstrate the robustness of Adper Easy Bond Self-Etch Adhesive over a large group of dentists.

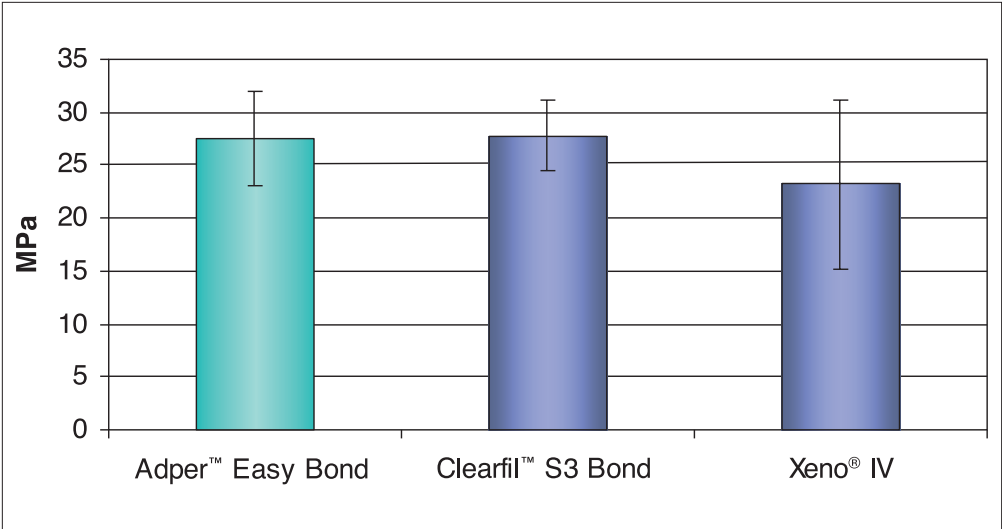


Figure 11-1: Shear bond strength to cut enamel

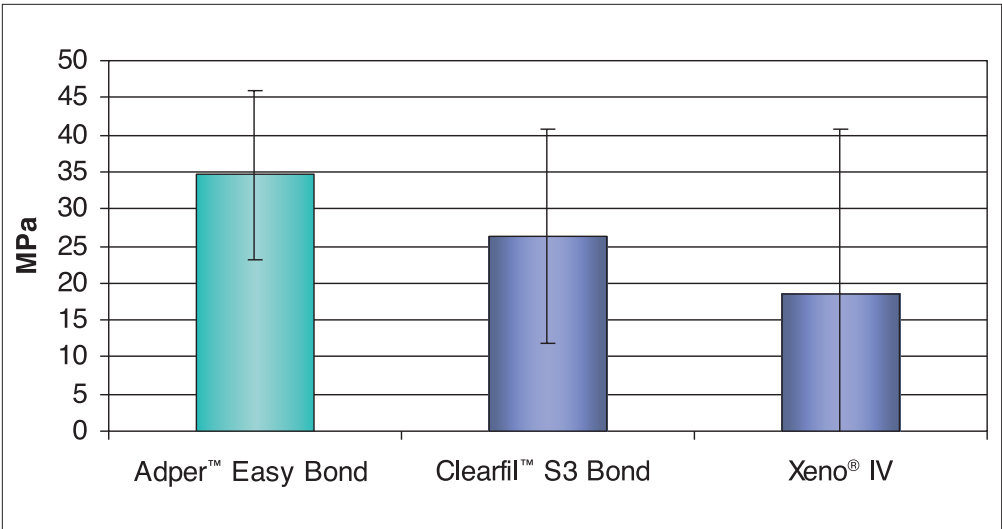


Figure 11-2: Shear bond strength to dentin

Marginal Integrity

Professor Dr. B. Haller, University of Ulm measured several parameters pertaining to Class V restorations before and after thermal cycling to determine marginal integrity. Adper™ Easy Bond Self-Etch Adhesive displayed very good marginal adaptation.

The following graphs show the percent continuous margins with dentin and cut enamel before and after thermal cycling for Adper Easy Bond Self-Etch Adhesive and other adhesives (Figures 12-1 and 12-2). The percent continuous margin after thermal cycling is very high for Adper Easy Bond Self-Etch Adhesive (99.9% for enamel, 97.7% for dentin).

Figure 12-1: Continuous margin, cut enamel

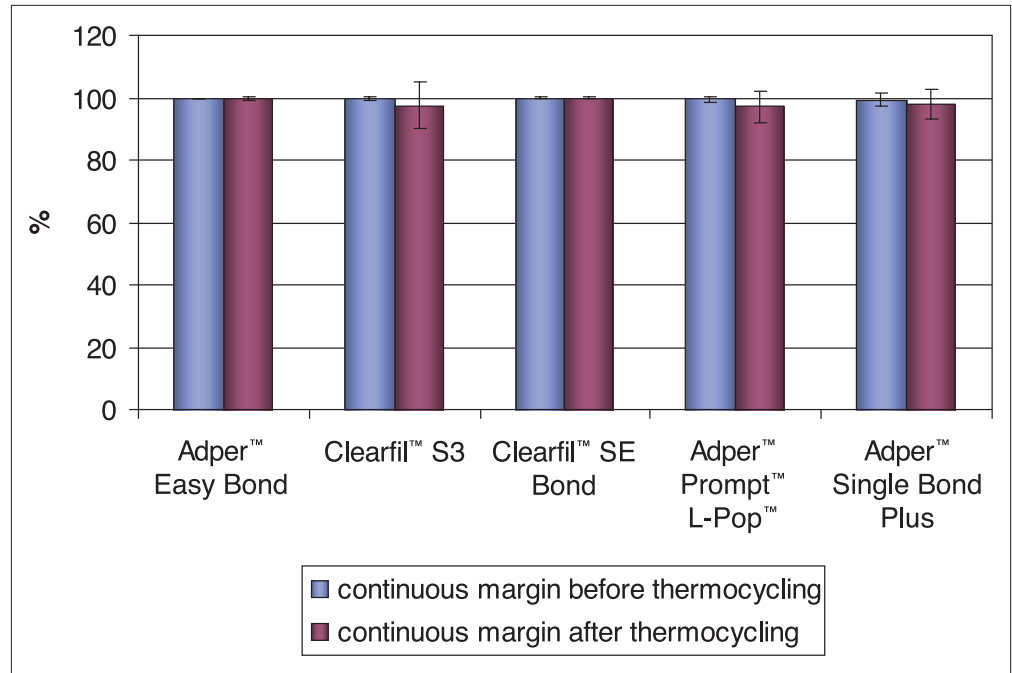
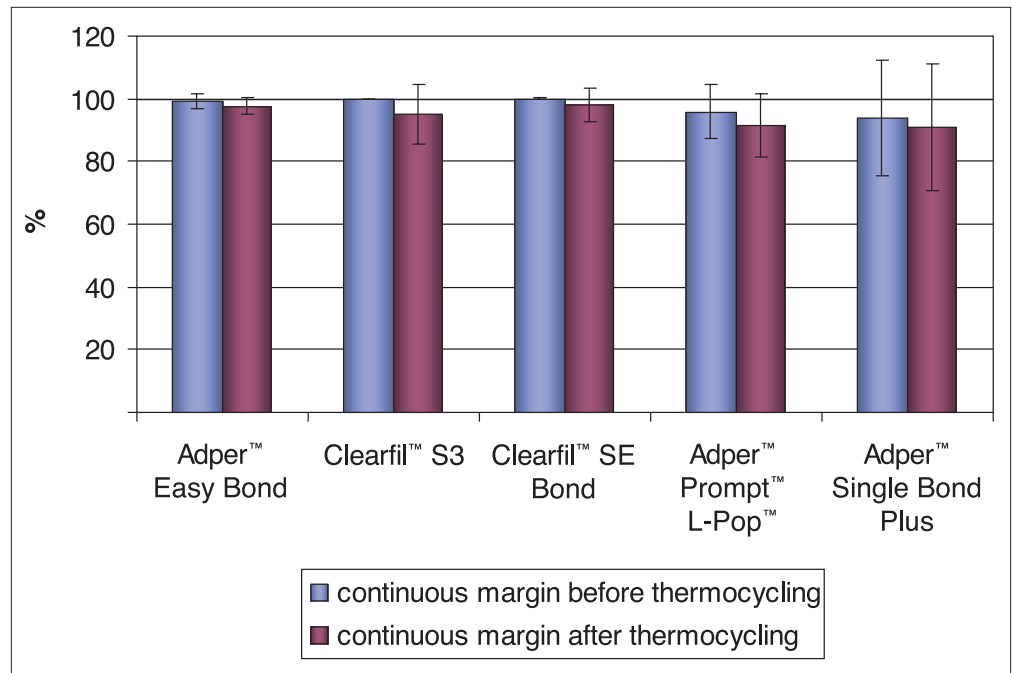


Figure 12-2: Continuous margin, dentin



Nanoleakage

Dr. Perdigao conducted a nanoleakage study on human teeth with Adper™ Easy Bond Self-Etch Adhesive and selected other adhesives. Class V cavities were prepared, and the adhesive was applied per manufacturer’s instructions, followed by Filtek™ Z250 restorative. The prepared specimens were immersed in an ammoniacal silver nitrate solution for 24 hours, followed by eight hours in a photo-developing solution. After further specimen processing, the specimens were cross-sectioned through the center of the restoration. The cross-sections were viewed using field-emission scanning electron microscopy (FE-SEM). Nanoleakage was calculated as a percentage of the dye penetration into total preparation wall length. The study indicated a low percentage of nanoleakage for Adper Easy Bond Self-Etch Adhesive. Figure 13 shows the nanoleakage results.

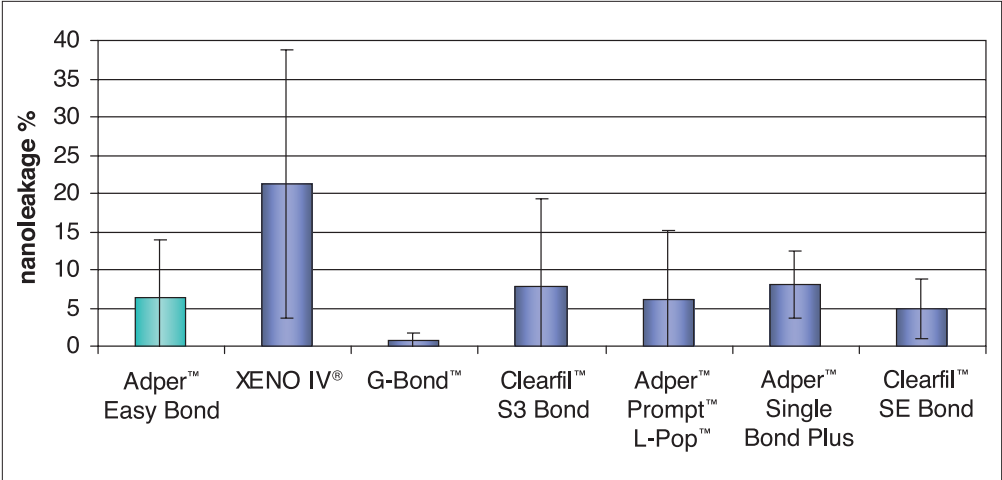


Figure 13: Human teeth nanoleakage

Low Post-Operative Sensitivity

An *in vivo* field evaluation was conducted in Germany and the U.K. involving 100 dentists. Over 5,500 restorations were placed using Adper™ Easy Bond Self-Etch Adhesive. Dentists were asked to record instances of post-operative sensitivity. Table 1 shows the results, in which a very low rate of post-operative sensitivity was observed for Adper Easy Bond Self-Etch Adhesive.

Total number of dentists	100
Number of dentists encountering post-operative sensitivity	7
Total number of cases of post-operative sensitivity	26
Total number of restorations placed	5572
Percentage of restorations having post-operative sensitivity	0.47%

Table 1: Post-operative sensitivity results

Step-by-Step Technique Guides

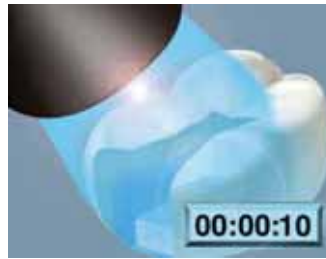
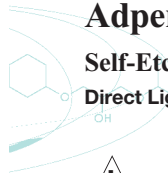
Direct Light Cure Restoration

3M ESPE

Adper™ Easy Bond

Self-Etch Adhesive

Direct Light Cure Restoration



3M ESPE

3M ESPE AG
Dental Products
82229 Seefeld
Germany

3M ESPE
Dental Products
St. Paul,
MN 55144-1000

3M, ESPE and Adper are trademarks of 3M or 3M ESPE AG.
 © 3M 2007. All rights reserved.

CE 0123
 44-0007-5359-8/01 (April 2007)

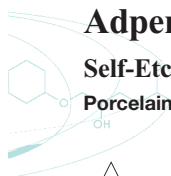
Porcelain Repair

3M ESPE

Adper™ Easy Bond

Self-Etch Adhesive

Porcelain Repair



1



2



3



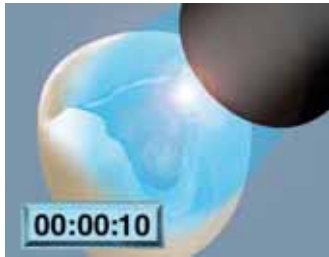
4



5



6



7

3M ESPE

3M ESPE AG
Dental Products
82229 Seefeld
Germany

3M ESPE
Dental Products
St. Paul,
MN 55144-1000

3M, ESPE and Adper are trademarks of 3M or 3M ESPE AG.
© 3M 2007. All rights reserved.



0123 44-0007-5390-3/01 (April 2007)

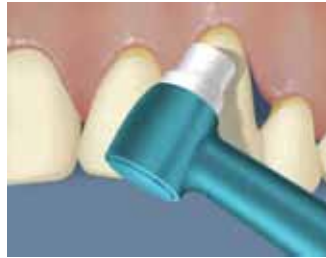
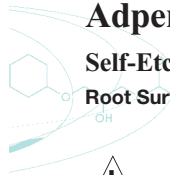
Root Surface Desensitization

3M ESPE

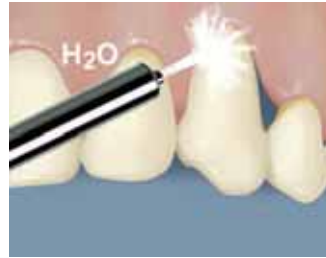
Adper™ Easy Bond

Self-Etch Adhesive

Root Surface Desensitization



1



2



3



4



5



6



7

3M ESPE

3M ESPE AG
Dental Products
82229 Seefeld
Germany

3M ESPE
Dental Products
St. Paul,
MN 55144-1000

3M, ESPE and Adper are trademarks of 3M or 3M ESPE AG.
© 3M 2007. All rights reserved.



44-0007-5389-5/01 (April 2007)

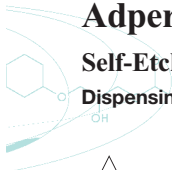
Dispensing Unit Dose

3M ESPE

Adper™ Easy Bond

Self-Etch Adhesive

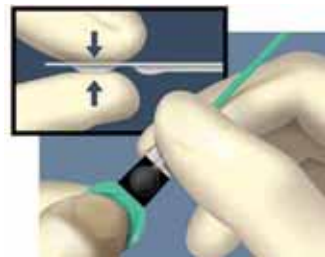
Dispensing Unit Dose



1



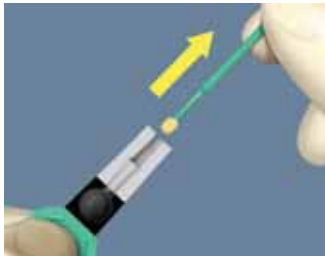
2



3



4



5

3M ESPE



3M ESPE AG
Dental Products
82229 Seefeld
Germany

3M ESPE
Dental Products
St. Paul,
MN 55144-1000

3M, ESPE and Adper are trademarks of 3M or 3M ESPE AG.
© 3M 2007. All rights reserved.



0123
44-0007-5281-4/01 (April 2007)

Instructions for Use

Adper™ Easy Bond Self-Etch Adhesive, manufactured by 3M ESPE, is a light-curing self-etch adhesive. It is used in combination with light-curing composite or compomer filling materials, cements and core build-up materials. The adhesive can be polymerized using halogen, LED, or plasma curing lights. Two delivery options are available: bottles for free dosing and L-Pop dispenser blisters for single use.

These instructions for use must be kept for reference for the duration of product use.

Indications

- All classes of fillings (according to Black) with light-curing composite or compomer
- Cementation of indirect restorations made of composite or compomer, ceramic, and metal using RelyX™ ARC Adhesive Resin Cement, manufactured by 3M ESPE
- Core build-ups made of light-curing composite
- Root surface desensitization
- Repair of composite or compomer fillings
- Intraoral repair of existing composite, porcelain fused to metal, and all ceramic restorations

Contraindications:

- Cementation of veneers and adhesive cementation of self-curing and dual-curing composites

Precautionary Measures

During Use

- A rubber dam is recommended for processing the adhesive. Superficial changes of the gingiva, which may occur in some cases, are reversible.
- Temporaries should be seated with non-eugenol temporary cements, as eugenol containing temporary cements can adversely affect the setting of Adper Easy Bond.
- **Pulp Protection:** To prevent pulpal irritation, cover areas in close proximity to the pulp by applying small amounts of hard-setting calcium hydroxide material (e. g., Alkaliner™ calcium hydroxide liner, manufactured by 3M ESPE).

For Patients

Adper Easy Bond contains substances that may cause allergic reactions by skin contact in certain individuals. Avoid use of this product in patients with known acrylate allergies.

If prolonged contact with oral tissue occurs, flush with large amounts of water. If an allergic reaction occurs, remove the product, and discontinue future use; seek medical attention as needed.

For Dental Personnel

Adper Easy Bond contains substances that may cause allergic reactions by skin contact in certain individuals. To reduce the risk of allergic response, avoid exposure to these materials; in particular, avoid exposure to uncured materials. If skin contact occurs, wash skin with soap and water.

The use of protective gloves and a no-touch technique is recommended. Acrylates may penetrate commonly used gloves. If the liquid contacts the glove, remove and discard the gloves. Wash the hands immediately with soap and water and re-glove. If an allergic reaction occurs, seek medical attention as needed.

Adper™ Easy Bond is flammable.

3M ESPE MSDSs can be obtained at www.mmm.com or from your local subsidiary.

Preparatory Steps

For Direct Restorations and Core Build-Ups

- Thoroughly remove loose preparation debris by spraying with water.
- Dry the cavity with gentle stream of air free of water and oil, or by blotting with cotton pellets. Do not over dry!

Before Cementing Indirect Restorations with RelyX™ ARC Resin Cement

- Completely remove any temporary cement remaining on the cavity and the restoration.
- Prepare the restoration for cementation as is needed for the respective material.
- Dry the cavity with gentle stream of air free of water and oil, or by blotting with cotton pellets. Do not over dry!

For Uncut Enamel

- Clean the enamel as usual (e. g., with polishing paste or powder blasting), and thoroughly rinse by spraying with water.
- Etch for 15 sec with a commonly used phosphoric acid etching gel; then thoroughly rinse again.

Before Desensitization of Root Surfaces

- Clean the root surface as usual (e. g., with polishing paste or powder blasting), thoroughly rinse by spraying with water, and dry with air free of water and oil.

For the Repair of Fillings or Restorations

- Roughen the composite or compomer filling, or the composite or ceramic veneer respectively; with ceramic remove the glaze 1 mm beyond the margin.
- Thoroughly clean the surface with water and dry it with air.
- Silanate ceramic veneers using RelyX™ Ceramic Primer, manufactured by 3M ESPE. Cover any visible metal using Masking Agent, manufactured by 3M ESPE, after applying Adper Easy Bond Self-Etch Adhesive. Please refer to the Instructions for Use of the respective product during processing.

Cavity Liner/Base

Self-adhesive materials such as glass ionomer cements (e. g., Ketac™ Bond, manufactured by 3M ESPE) or resin-modified glass ionomer cements (e. g., Vitrebond™, manufactured by 3M ESPE) can be used as a cavity liner or as a base. After applying Adper Easy Bond, flowable composites and flowable compomers can be used as cavity liner.

Dosing from the Vial

- Unscrew the cap of the vial.
- Dose the necessary amount of Adper Easy Bond to a mixing well and protect the liquid from light.
- Carefully close the vial tightly after dosing. If necessary, disinfect the vial in accordance with local hygiene regulations.

Dosing from the L-Pop Dispenser Blister

Attention: Do not squeeze the L-Pop blister without disposable applicator.

- Hold the shaft of the disposable applicator with one hand, covering the blister opening with your thumb. This will prevent the etching liquid from splashing out.
- With the thumb and index finger of the other hand, squeeze the reservoir of the L-Pop blister, starting with the outer end, in the direction of the disposable applicator.
- Turn the disposable applicator back and forth in the liquid to wet it completely.
- For easy application in the cavity, the disposable applicator can be bent while it is still in the L-Pop blister. In order to do so, only pull the disposable applicator out of the blister far enough so that the narrow section of the applicator shaft can be seen. Fold the applicator shaft at this location over your thumbnail.
- During treatment, move the liquid into the open end by fully squeezing out with the thumb and index finger.

Application

- Avoid any contamination with blood, saliva, or sulcus fluid during application. A rubber dam is recommended to keep the treated area sufficiently dry.
- Apply the adhesive with the disposable applicator for 20 sec to all surfaces of the cavity.
- Rewet the disposable applicator as needed during application. Avoid contact of the adhesive with mucosal tissue.
- Subsequently, air thin the liquid for approx. 5 sec until the film no longer moves, indicating complete vaporization of the solvent.
- Cure the adhesive with a commonly used curing light for 10 sec.
- Depending on the indication, continue to work with the desired composite or compomer material as indicated in the pertinent Instructions for Use.

Disposal

Only dispose of completely empty packages. The residue of the etching fluids – if heavily diluted with water or neutralized – can be poured down the drain.

Storage and Shelf Life

To achieve the maximum amount of shelf life, store the product at 2-8°C/36-46°F.

Refrigeration is not required if the product is depleted within six months. Do not use after the expiration date.

Customer Information

No person is authorized to provide any information which deviates from the information provided in this instruction sheet.

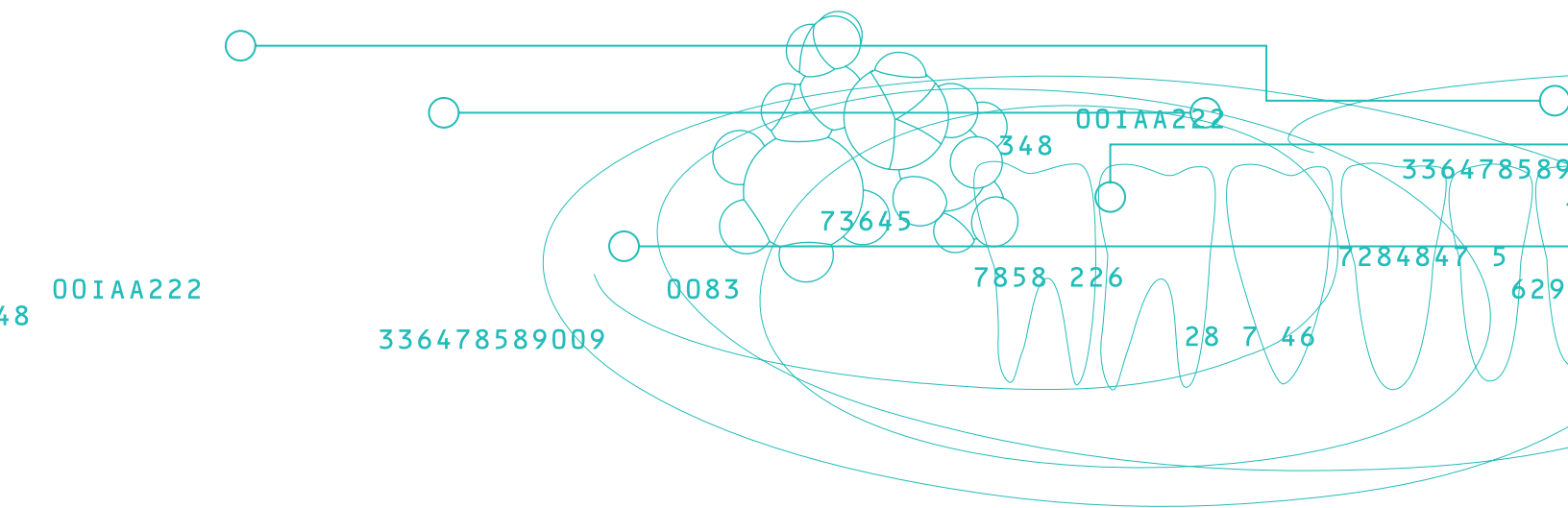
Warranty

3M ESPE warrants this product will be free from defects in material and manufacture. 3M ESPE MAKES NO OTHER WARRANTIES INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. User is responsible for determining the suitability of the product for user's application. If this product is defective within the warranty period, your exclusive remedy and 3M ESPE's sole obligation shall be repair or replacement of the 3M ESPE product.

Limitation of Liability

Except where prohibited by law, 3M ESPE will not be liable for any loss or damage arising from this product, whether direct, indirect, special, incidental or consequential, regardless of the theory asserted, including warranty, contract, negligence or strict liability.

Information valid as of May 2007



3M, ESPE, Adper, L-Pop, Prompt and Scotchbond are trademarks of 3M ESPE.
Clearfil, Xeno, iBond, AdheSE, G-Bond, and Optibond are not trademarks of 3M ESPE.

3M ESPE

Dental Products
3M Center
Building 275-2SE-03
St. Paul, MN 55144-1000
USA

3M Canada
Post Office Box 5757
London, Ontario N6A 4T1
Canada
1-800-265-1840 ext. 6229

Please recycle. Printed in USA.
© 3M 2007. All rights reserved.
70-2009-3948-9