Liners
1. Fuji Lining LC Paste Pak
   GC
2a. Fuji Lining LC
   GC
2b. Vitrebond
   3M ESPE
3. Ionosit MicroSpand
   DMG/Zenith

Bases, Buildups, and Restoratives
1a. Fuji II LC Improved/
   Fuji II LC Capsules
   GC
1b. Fuji IX GP
   GC
2. Fuji Triage
   GC
3. Geristore Syringeable
   Den-Mat
4. Vitremer Core Buildup/
   Restorative System
   3M ESPE

Luting Cements
1. Fuji Plus/Fuji Plus Capsules
   GC
2a. FujiCEM
   GC
2b. Rely X Luting Plus
   3M ESPE
3. RelyX Luting
   3M ESPE
4. PermaCem Dual
   DMG/Zenith
5. PermaCem
   DMG/Zenith
# Resin/Glass Ionomers

<table>
<thead>
<tr>
<th>Liners</th>
<th>Cost</th>
<th>Curing Mechanism</th>
<th>Extraoral Working Time (minutes)</th>
<th>Dentin Conditioning</th>
<th>Shades</th>
<th>Flow</th>
<th>Hardness (Knoop)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fuji Lining LC</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GC</td>
<td>$10.12</td>
<td>Dual-cure</td>
<td>2.5</td>
<td>Cavity Conditioner</td>
<td>1</td>
<td>5.0</td>
<td>19.6</td>
</tr>
<tr>
<td><strong>Fuji Lining LC</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paste Pak GC</td>
<td>N/A</td>
<td>Dual-cure</td>
<td>2.0</td>
<td>Not Recommended</td>
<td>1</td>
<td>1.0</td>
<td>28.5</td>
</tr>
<tr>
<td><strong>Vitrebond 3M ESPE</strong></td>
<td>$11.74</td>
<td>Dual-cure</td>
<td>2.5</td>
<td>Not Recommended</td>
<td>1</td>
<td>1.0</td>
<td>22.1</td>
</tr>
<tr>
<td><strong>Ionosit MicroSpand</strong></td>
<td>N/A</td>
<td>Light-cured</td>
<td>Unlimited</td>
<td>Not Recommended</td>
<td>1</td>
<td>4.5</td>
<td>30.1</td>
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<tr>
<td>DMG/Zenith</td>
<td>$42.75</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

## Bases, Buildups, and Restoratives Delivery

<table>
<thead>
<tr>
<th>Cost</th>
<th>Curing Mechanism</th>
<th>Resin or Glass</th>
<th>Extraoral Working Time (Minutes)</th>
<th>Rock-Hard Extraoral Set Time in T/H Chamber (minutes)</th>
<th>Flow</th>
<th>Shades</th>
<th>Hardness (Knoop)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fuji II LC Improved/Fuji II LC Capsules GC</strong></td>
<td>$5.51</td>
<td>Dual</td>
<td>Resin</td>
<td>3.0 Hand-mixed</td>
<td>15–17</td>
<td>5.0</td>
<td>10</td>
</tr>
<tr>
<td><strong>Fuji IX GP</strong></td>
<td>$5.45</td>
<td>Self</td>
<td>Glass</td>
<td>2.5 Capsules</td>
<td>12–13</td>
<td>5.0</td>
<td>6</td>
</tr>
<tr>
<td><strong>Fuji Triage</strong></td>
<td>N/A</td>
<td>Self</td>
<td>Glass</td>
<td>1.5</td>
<td>4.5–4.75</td>
<td>5.0</td>
<td>2</td>
</tr>
<tr>
<td><strong>Geristore Syringeable Den-Mat</strong></td>
<td>N/A</td>
<td>Dual</td>
<td>Resin</td>
<td>1.5 Hand-mixed: 5</td>
<td>5.0</td>
<td>4</td>
<td>19.9</td>
</tr>
<tr>
<td><strong>Vitremer Core Buildup/Restorative System 3M ESPE</strong></td>
<td>$11.52</td>
<td>Dual</td>
<td>Resin</td>
<td>2.5</td>
<td>4</td>
<td>5.0</td>
<td>9</td>
</tr>
</tbody>
</table>

## Bases, Buildups, and Restoratives Delivery

<table>
<thead>
<tr>
<th>Delivery</th>
<th>Radiopaque</th>
<th>Match Shades of Natural Teeth</th>
<th>Best Polishers</th>
<th>Fluorescence</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fuji II LC Improved/Fuji II LC Capsules GC</strong></td>
<td>Powder-Liquid Capsules</td>
<td>Yes</td>
<td>4 of 6</td>
<td>Groovy, Hawe HiLuster, Hawe Occlurbush</td>
</tr>
<tr>
<td><strong>Fuji IX GP</strong></td>
<td>Powder-Liquid Capsules</td>
<td>Yes</td>
<td>0 of 4</td>
<td>Groovy, Hawe HiLuster, Hawe Occlurbush</td>
</tr>
<tr>
<td><strong>Fuji Triage</strong></td>
<td>Capsules</td>
<td>Yes</td>
<td>N/A</td>
<td>Astropol, Groovy, Hawe HiLuster, Hawe Occlurbush</td>
</tr>
<tr>
<td><strong>Geristore Syringeable Den-Mat</strong></td>
<td>Automix Syringe</td>
<td>Yes</td>
<td>2 of 4</td>
<td>Groovy, Hawe HiLuster</td>
</tr>
<tr>
<td><strong>Vitremer Core Buildup/Restorative System 3M ESPE</strong></td>
<td>Powder-Liquid</td>
<td>Yes</td>
<td>3 of 3</td>
<td>Groovy</td>
</tr>
</tbody>
</table>
### Resin/Glass Ionomers

<table>
<thead>
<tr>
<th>Luting Cements</th>
<th>Cost</th>
<th>Curing Mechanism</th>
<th>Delivery</th>
<th>Extraoral Working Time (minutes)</th>
<th>Cement Removal Time in T/H Chamber (minutes)</th>
<th>Rock-Hard Extraoral Set Time (minutes)</th>
<th>Flow</th>
<th>Translucency/Opacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuji Plus Hand Mixed</td>
<td>$3.98/$6.48/N/A</td>
<td>N/A</td>
<td>Powder-Liquid Hand-Mixed</td>
<td>2.5</td>
<td>2.5</td>
<td>4.0</td>
<td>4.5</td>
<td>10/10/36.1</td>
</tr>
<tr>
<td>Fuji Plus Capsules GC</td>
<td>N/A/$3.12/N/A</td>
<td></td>
<td>Powder-Liquid Automix Capsules</td>
<td>2.25</td>
<td>3.5</td>
<td>4.5</td>
<td>5.0</td>
<td></td>
</tr>
<tr>
<td>FujiCEM GC</td>
<td>N/A/N/A/$5.99</td>
<td>Self</td>
<td>Paste-Paste Hand-Mixed</td>
<td>3.0</td>
<td>1.5</td>
<td>4.5</td>
<td>5.0</td>
<td>3/10/30.6</td>
</tr>
<tr>
<td>RelyX Luting Plus 3M ESPE</td>
<td>N/A/N/A/N/A</td>
<td>Self</td>
<td>Paste-Paste Hand-Mixed</td>
<td>2.5+</td>
<td>2.5</td>
<td>10.0</td>
<td>5.0</td>
<td>15/15/50.5</td>
</tr>
<tr>
<td>RelyX Luting 3M ESPE</td>
<td>$3.77/$6.70/N/A</td>
<td>Self</td>
<td>Powder-Liquid Hand-Mixed</td>
<td>2.5+</td>
<td>6.5</td>
<td>15.0</td>
<td>5.0</td>
<td>13/20/71.8</td>
</tr>
<tr>
<td>PermaCem Dual Automix Cartridges</td>
<td>$3.48/$7.77/N/A</td>
<td>Dual</td>
<td>Past-Paste Automix Cartridges</td>
<td>2.0+</td>
<td>1.75–2.0</td>
<td>3.0</td>
<td>4.5</td>
<td>15/20/13.0</td>
</tr>
<tr>
<td>PermaCem DMG/Zenith</td>
<td>N/A/N/A/N/A</td>
<td>$3.48</td>
<td>Past-Paste Automix Cartridges</td>
<td>2.0+</td>
<td>1.75–2.0</td>
<td>3.25</td>
<td>5.0</td>
<td>17/20/32.6</td>
</tr>
</tbody>
</table>

1. **Flow test**: MOST FLOW (1) to LEAST FLOW (5)
2. **Translucency/Opacity**: 0% TRANSLUCENT to 100% OPAQUE

**Flow test**

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Although dismissed as having low bond strength, possessing poor esthetics, and being old-fashioned, the ionomer family of materials continues to be used by many dentists, especially for luting purposes. This group of materials basically consists of glass ionomers, which have been with us for three decades, and resin ionomers, the more recent addition to the clan. Both types presumably form a chemical bond to tooth structure and release more fluoride than any other class of materials. While all glass ionomers are self-cure, their resin cousins are available in both self-cure and dual-cure versions and form a chemical bond with overlaid composite when used as a liner or base. Etching a resin ionomer to increase its bond strength to resin is neither necessary nor advantageous. On the other hand, inadvertent etching will not interfere with the bond of a resin ionomer to composite.

**Indications**

Resin/glass ionomers are versatile materials, which can be used as cavity liners, bases, core buildups, definitive restorations, and luting cements. In many instances, the same product can be mixed to different viscosities for different uses, especially those used for liners and those used for bases. This simplifies product selection and inventory control. However, we have divided the products between those specifically indicated for liners, those for bases, buildups, and restorations, and those for luting, if you desire the added convenience of dedicated use products.

**Liners**

The need to use liners has decreased tremendously due to the nearly universal acceptance of bonding directly to dentin. Resin adhesives have even been placed over frank mechanical pulp exposures without negative sequelae, just as long as the cavity is properly sealed. However, sealing a vital exposure with a resin ionomer liner is another treatment option that has proved anecdotally to be very effective. Nevertheless, there is no doubt liners are being used less now than in the past.

**Buildups and Cores**

When small to medium sections of a crown preparation need to be rebuilt, a glass or resin ionomer works well due to its flowable consistency (in most cases) and not needing to etch and/or apply an adhesive to the tooth, as you would with a bonded composite buildup. There is also the speculation that fluoride release will render the tooth preparation more caries-resistant.

**Restorations**

Mainly used in Class V in permanent teeth and Class I/II in primary teeth. Even though composites are more sculptable and polishable, restoring Class V carious lesions seems to be the main indication for these materials due to their fluoride release. Because they can be placed without etching, that clinical shortcut makes them attractive for pediatric use. However, they can also be very helpful when used for fast, self-adhesive provisional restorations in fractured teeth.

**Shade Matching**

We prepared Class V preparations in extracted natural teeth in the following shades: A1, A2, A3, A3.5, B1, B3, and B4. Each material’s corresponding Vita shades were then used to restore these preparations. We then determined by a consensus of at least three observers, each viewing the restored teeth under color-corrected light in a neutral gray box, if the material matched the teeth, was lighter than the teeth, or was darker than the teeth. Since these restorations were not bonded (to allow easy removal so the teeth could be reused), some have white lines at the coronal margins. Clinically, these lines would not occur. Therefore, we discounted these white lines when viewing the shades. We also discounted the excessive translucency in the incisals of some of the teeth. Our results plus the photos of the restored teeth are presented in each product’s commentary.

**Fluorescence**

This test shows how the material appears in vivo under black light. A veneer is used only for testing purposes—we are not suggesting these materials are suitable for this type of restoration. Materials exhibiting fluorescence that does not match that of natural teeth would not be a good choice in the mouth of patients with high esthetic needs.
Luting Primarily self-cure for cementing metal or ceramometal restorations. They have also been suggested to cement posts and orthodontic appliances. However, we believe resin cements are more applicable for posts, especially prefabricated ones.

Other than adhesives, there are few categories of materials that produce more uncertainty than cements. Ever since we exposed the expansion problem with resin ionomer cements over 10 years ago (original versions caused metal-free restorations to fracture), there still remains anxiety when it comes using any ionomer-based product with these types of restorations.

The newer versions seemed to have overcome the problem and can probably be used for ceramic restorations with high strength cores such as Lava. Nevertheless, we still believe resin cements are superior for metal-free restorations. For those restorations supported by metal, resin ionomer or compomer cements offer a contemporary alternative to more conventional zinc phosphate, zinc polycarboxylate, and glass ionomer cements.

Delivery Alternatives

Hand Mixing

**ADVANTAGES**

+ Vary viscosity.
+ Blend shades.
+ Vary volume of material mixed.
+ Does not require extra equipment (amalgamator, activators, guns, etc.).
+ Less expensive.

**DISADVANTAGES**

– Inconsistent mixes with powder/liquid types (have to depend on assistant to dispense and mix properly).
– Paste/paste versions are much easier to mix.
– Less convenient.
– Powder/liquid types can be messy. Paste/paste versions are much neater.

Automix Cartridges and Syringes

**ADVANTAGES**

+ May even be easier than capsules.
+ Mixing and dispensing with same gun/syringe.
+ Can vary volume of material mixed.

**DISADVANTAGES**

– Encapsulated material is significantly more expensive than a hand-mixed version.
– Activation of the capsules, while not difficult, still must be done properly to assure an accurate mix. Capsules that are not properly activated will be wasted, which is expensive and time-consuming.

Pre-Dosed Capsules

**ADVANTAGES**

+ Very convenient.
+ Consistent mixes.
+ Since capsules are disposable, asepsis procedures are eliminated (except for any instruments required to activate the capsules and dispense the material).

**DISADVANTAGES**

– Have to accept viscosity as determined by the manufacturer. There is no opportunity to mix it thicker or thinner than the standard mix.
– More expensive than hand mixing.
– Material remaining in tip is wasted.

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*The Ratings* 1029
Composition
Paste A  Aluminofluorosilicate glass, HEMA, UDMA, pigment.
Paste B  Polyacrylic acid, distilled water, and HEMA.

Radiopaque
Yes

Dentin Conditioning
Not recommended.

Consistency and Handling
1.0 Mixes easily and flows well into the cavity, but is somewhat runny, making it difficult to coat axial walls without pooling at line angles.

Hardness (Knoop)
28.5

Extraoral Working Time
(from the beginning of mixing)
Manufacturer claims almost 2.25 minutes, but the test disk thickness had already doubled at that time. We suggest not exceeding 2.0 minutes.

Curing
Dual-cure, but should be light-cured for 20 seconds to maximize physical properties. Limit layers to 2mm.

Shade
1  Medium yellow

Packaging
Cardboard box containing two smaller cardboard boxes, one containing the cartridge and mixing pad, while the other box has the dispenser. The mini-cartridge, which is blue with a moisture-resistant label that includes the expiration date, has two separate chambers. The cartridge is then inserted into a metal, lever-type extruder called the Paste Pak Dispenser. This apparatus is merely for dispensing equal lengths of base and catalyst, but not for mixing, which is still done the old-fashioned way—by hand.

Directions
Plain paper printed in eight languages, annoying foldout design, tiny font—get your loupes! Straightforward, easy to follow.
Composition

Powder  Aluminofluorosilicate glass.
Liquid  Polyacrylic acid, tartaric acid, distilled water, camphorquinone, dibutyl hydroxy toluene, and three resin complex (mainly HEMA).

Radiopaque
Yes

Dentin Conditioning
Cavity Conditioner or Dentin Conditioner.

Consistency and Handling
5.0 Mixes easily and flows well into the cavity without being too runny.

Hardness (Knoop)
19.6

Extraoral Working Time
(from the beginning of mixing)
Manufacturer claims 3.0 minutes, but it was already setting in the dispensing tip by this time.

Curing
Dual-cure, but should be light-cured for 30 seconds to maximize physical properties. Limit layers to 2mm. Has a good dark cure property.

Shade
1  About A3.5

Packaging
Cardboard box containing glass bottle of powder and plastic squeeze bottle of liquid. The powder bottle has an integral powder leveler for the dispensing spoon. Liquid is in plastic squeeze bottle. Box is perforated so the top portion can be removed if you want to use the bottom part to keep the contents secured in their white plastic stand. There are moisture-resistant expiration dates on both bottles and the box.

Directions
Plain paper printed in eight languages, annoying foldout design. Straightforward, easy to follow.
Vitrebond
3M ESPE
www.3mespe.com

Composition
Powder  Fluoroaluminosilicate glass, photoinitiator.
Liquid  Methacrylate-modified polycarboxylic acid, water, HEMA, photoinitiator.

Radiopaque
Yes

Dentin Conditioning
Not recommended.

Consistency and Handling
1.0  Fairly runny, adding a small amount of extra powder will improve viscosity.

Hardness (Knoop)
22.1

Extraoral Working Time
(from the beginning of mixing)
Manufacturer claims 3.0 minutes, but the test disk thickness had already increased substantially at that time. We suggest not exceeding 2.5 minutes.

Curing
Dual-cure, but 2mm thick increment of material should be light-cured for 30 seconds to maximize physical properties. Has a poor dark cure.

Shade
1  Best color (a dentin-like yellow).

Packaging
Cardboard box with lid that opens to the rear. Contents secured in removable white plastic tray. Powder is packaged in a small glass jar with a flip top that has a convenient built-in holder for the dispensing scoop and a built-in scoop leveler to remove the excess powder. Liquid is in plastic squeeze bottle. The expiration date is on a sticker attached to the bottom of the box as well as on the labels of the powder and liquid bottles. The printing on the labels is moisture-resistant.

Directions
Thin plain paper, easy to understand, annoyingly printed in 12 languages in our least favorite foldout format. There is also a single coated paper instruction sheet with color illustrations summarizing the mixing, application, and curing. Much better than the main directions.

Cost: $193.50
Includes:
• 1 jar of powder (9g)  $105.70/jar ($11.74/g)
• 1 btl of liquid (5.5ml)  $105.70/btl ($19.22/ml)
• Mixing pads and spoon

Shelf life: 3 years
MSDS: Not included
Composition
Polymethacrylate polycarbonic acid, PAA, Bis-GMA, triethylenglycoldimethacrylate, amine/camphorquinone catalyst, ionomer cement filler, barium glass, silicon dioxide.

Radiopaque
Yes

Dentin Conditioning
Not recommended.

Consistency and Handling
4.5 Single component, no mix. Non-runny but slightly tacky.

Hardness (Knoop)
30.1

Extraoral Working Time
Unlimited

Curing
Light-cured, 40 seconds for each 2mm increment.

Shade
Does not match any shade on Vita guide, but it's in the range of A2–A3.

Packaging
Cardboard box with rear-hinged, attached lid containing two separate and removable cardboard sections, each containing five black mini syringes and a dispensing pad. These unique syringes are not designed, however, for direct intraoral placement. The material is packaged in the syringes merely as a convenient dispensing mechanism. The expiration date is on the bottom of the box.

Directions
Coated paper, easy to understand, with excellent color photos showing the steps. The indications listed include using as a liner for porcelain restorations and eliminating undercuts in inlay/onlay preparations. However, due to its expanding nature, Microspand is probably not the material of choice for any indirect restoration—it may expand during the provisional phase and you will not get your restoration to seat.

RAVES & RANTS
- No mixing
- Highest hardness
- Is it really an ionomer?
- If it expands, what about the inlay?

Cost: $128.25/3g ($42.75/g)/$12.83/syringe
Includes:
• 10 syringes (0.3g ea)
Shelf life: 3 years
MSDS: Included

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The Ratings
Composition

**Powder** Aluminofluorosilicate glass. Improved version has smaller glass particles for better polishing.

**Liquid** Polyacrylic acid, tartaric acid, distilled water, camphorquinone, dibutyl hydroxy toluene, and three resin complex (mainly HEMA).

**Cavity Conditioner** 20% PAA, 3% aluminum chloride.

Radiopaque

Yes

Enamel/Dentin Etching/Conditioning/Priming

Use Cavity Conditioner on both enamel and dentin for 10 seconds. Rinse and dry, but do not desiccate.

Mixing

Capsules do not require an activator. You merely push the plunger with your thumb so it is flush with the body of the capsule. Place in a triturator and mix. When the hand-mixed version is dispensed in the recommended one scoop to two drops, the powder does not incorporate into the liquid easily; aggressive spatulation, using a "stropping" technique, is necessary.

Consistency and Handling

5.0 (capsules and hand-mixed). Medium viscosity with adequate flow, but no real sculptability, somewhat sticky. We recommend using a matrix whenever possible. The directions tell you to insert the material with a placement instrument. We have found loading the material into a NeedleTube and injecting it much simpler, faster, and easier. With the capsules, you can inject directly.

Hardness (Knoop)

- **Capsules** 38.7
- **Hand-Mixed** 36.4

Extraoral Working Time

(from the beginning of mixing)

- **Hand-mixed** Manufacturer claims 3.75 minutes, but the test disk thickness had already increased substantially at that time. We suggest not exceeding 3.0 minutes.
- **Capsules** Manufacturer claims 3.25 minutes, but it was already setting in the dispensing tip by this time. We suggest not exceeding 2.5 minutes.

Curing

Dual-cure, but 2mm thick increment of material should be light-cured for 20 seconds to maximize physical properties. Chemical cure took 15–17 minutes extraorally for Improved and 12–13 minutes for the Capsule.
Finishing and Polishing
Improved and Capsules can be polished to a moderate shine with Groovy, Hawe HiLuster, and Hawe Occlbrush, while Astropol was not very effective. Finishing (as opposed to polishing) should be done under water spray with either highspeed finishing burs or diamonds.

Shades

<table>
<thead>
<tr>
<th>Vita Shade Designation</th>
<th>Appears in Natural Tooth</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>Good match</td>
</tr>
<tr>
<td>A2</td>
<td>Good match</td>
</tr>
<tr>
<td>A3</td>
<td>Good match</td>
</tr>
<tr>
<td>A3.5</td>
<td>Lighter</td>
</tr>
<tr>
<td>B3</td>
<td>Lighter</td>
</tr>
<tr>
<td>B4</td>
<td>Good match</td>
</tr>
</tbody>
</table>

In addition, the Core is medium blue (we did not receive for evaluation).

Fluorescence

Packaging
Available in both hand-mixed and encapsulated versions. For the hand-mixed material, the one bottle of powder and one bottle of liquid are packaged in a small cardboard box with a measuring spoon. Expiration dates can be found on the moisture-resistant bottle labels and on the side of each small box. The pre-dosed capsules come in a cardboard box with the expiration date on the side. The capsules are packaged in individually sealed foil wrappers imprinted with the expiration date and the shade. There is an indicated tear spot for relatively easy opening.

Directions
Hand-mixed variety is plain paper, printed in eight languages, annoying foldout design. Information, however, is straightforward and easy to understand. The capsules are on a single sheet of plain paper in one language; the information is simple and line drawings illustrate the proper way to operate the capsules.

Capsule Assortment Starter Package
Cost: $247.85/50 capsules ($4.96/capsule)
Includes:
• 50 Capsules $186.50 ($3.73/capsule)
• Applier
• 1 btl of Cavity Conditioner (5.7ml)
• 1 btl of Fuji Coat LC (5.2ml)

Powder/Liquid Starter Package
Cost: $208.35
Includes:
• 1 jar of powder (15g) $81.75/jar ($5.45/g)
• 1 btl of liquid (6.4ml) $49.10/btl ($7.67/ml)
• 1 btl of Cavity Conditioner (5.7ml)
• 1 btl of Fuji Coat LC (5.2ml)

Shelf life: 2 years
MSDS: Not included

RAVES & RANTS
+ Very fast
+ Works well for kids and emergencies
- Still cracks when polished unless it's kept wet
- Forget hand-mixed version

Composition
Powder Aluminofluorosilicate glass, polyacrylic acid powder.
Liquid Polyacrylic acid, distilled water, polybasic carboxylic acid.
Cavity Conditioner 20% PAA, 3% aluminum chloride.

Radiopaque
Yes
Enamel/Dentin Etching/Conditioning/Priming

Use Cavity Conditioner on both enamel and dentin for 10 seconds. Rinse and dry, but do not desiccate.

Mixing

With the Capsules, you push the plunger against the countertop so it is flush with the back of the capsule, place it into the Applier II, click once to activate, remove and place in a triturator and mix for 10 seconds. Place it back in the Applier II and inject into the preparation. The Applier II is the activator/injector. Made of stainless steel, it has a good, solid feel to it, but the release button is difficult to push. The hand-mixed version is dispensed in the recommended one scoop to one drop. It is reasonably easy to mix, but messy just like all powder/liquid products.

Consistency and Handling

5.0 Capsule material is medium-thick for an ionomer, while the hand-mixed version in the suggested 1:1 ratio has a medium viscosity. As it begins to set, it can be packed similar to an amalgam.

Hardness (Knoop)

39–41

Extraoral Working Time
(from the beginning of mixing)

Hand-mixed Manufacturer claims 2.0 minutes and the test disk thickness had only increased slightly at that time. We suggest not exceeding 2.0 minutes.

Capsules (Regular) Manufacturer claims 2.0 minutes and the test disk thickness had only increased slightly at that time. We suggest not exceeding 2.0 minutes.

Capsules (Fast) Manufacturer claims 1.25 minutes, but it was already setting in the dispensing tip by this time. We suggest not exceeding 1.0 minute.

Rock-Hard Extraoral Set Time in T/H Chamber
(from beginning of mixing)

Regular 6 minutes (listed). We found 4 minutes.

Fast 3 minutes (listed). We found 2 minutes.

Finishing and Polishing

Finishing should be done under water spray with either highspeed finishing burs or diamonds. It can be polished to a reasonably high shine with with Astropol, Groovy, Hawe HiLuster and Hawe Occlurbush. We found that it is easier to achieve a high shine when using brushes rather than rubber instruments. Even after polishing, apply a final coat of Fuji Coat LC and light cure for 10 seconds to protect the surface during its early maturation stage.

Shades

6 Vita shades (A1, A2, A3, A3.5, B2, and B3).

<table>
<thead>
<tr>
<th>Vita Shade Designation</th>
<th>Appears in Natural Tooth</th>
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</thead>
<tbody>
<tr>
<td>A1</td>
<td>Lighter</td>
</tr>
<tr>
<td>A2</td>
<td>Lighter</td>
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<tr>
<td>A3</td>
<td>Lighter</td>
</tr>
<tr>
<td>A3.5</td>
<td>Lighter</td>
</tr>
<tr>
<td>B3</td>
<td>Lighter</td>
</tr>
</tbody>
</table>

Fluorescence

Packaging

Available in both hand-mixed regular set and encapsulated regular and fast set versions. For the hand-mixed material, a corrugated cardboard box with absolutely no indication of the shade holds a smaller cardboard box, which contains the glass bottle of powder and plastic squeeze bottle of liquid. The powder bottle has an integral powder leveler for the dispensing spoon. The liquid is in a plastic squeeze bottle. The box is perforated so the top portion can be removed if you want to use the bottom part to keep the contents secured in their clear plastic stand. There are moisture-resistant expiration dates on both bottles and the box.

The pre-dosed capsule package comes in a corrugated cardboard box with individual boxes of capsules, an Applier II, Cavity Conditioner, and Fuji Coat LC. This large box is marked for fast set, but there is nothing on the regular set box to indicate its setting status. The cardboard box actually housing the capsules is also marked for fast set and has the expiration date on the side.

The capsules are packaged in individually sealed foil wrappers imprinted with the expiration date and the shade. Again, fast set is identified, but regular set has no indication of its setting time. There is an indicated tear spot for relatively easy opening. The capsules themselves are black with a color-coded section to indicate if they are regular set (gray) or fast set (off-white). There is no other identification on the capsules, so don’t take them out of their wrapper until you are ready or you could get them mixed up when it comes to shades.

Directions

Hand-mixed variety is plain paper, printed in eight languages, annoying foldout design. Information, however, is straightforward and easy to understand. The directions for the capsules are also on plain paper, printed in eight languages, annoying foldout design.
The information is simple and line drawings illustrate the proper way to operate the capsules. There is also a single language, double-sided, coated paper color sheet illustrating and summarizing the activation and insertion technique. This is much better than the regular directions. However, neither type of instructions tells you anything about finishing other than it should be done under water spray after three minutes for the fast set and six minutes for the regular set.

---

**Composition**
**Powder** Aluminofluorosilicate glass, pigment (ferric oxide-only in pink version, not in white).
**Liquid** Polyacrylic acid, distilled water, polybasic carboxylic acid.

**Radiopaque**
Yes

**Enamel/Dentin Etching/Conditioning/Priming**
Dentin Conditioner (optional).

**Mixing**
Push the plunger of the capsule against the countertop so it is flush with the back of the capsule, place it into the Applier II, click once to activate, remove and place in a triturator and mix for 10 seconds. Place it back in the Applier II and inject into the preparation. The Applier II is the activator/injector. Made of stainless steel, it has a good, solid feel to it, but the release button is difficult to push.

**Consistency and Handling**
**Pink**
5.0 Creamy consistency, more like a flowable than a sealant.

**White**
5.0 Creamy consistency, more like a flowable than a sealant.

**Hardness (Knoop) @ 10 minutes**
Pink 18.9
White 18.4

**Extraoral Working Time (from the beginning of mixing)**
Pink Manufacturer claims almost 1.75 minutes, but it was already setting in the dispensing tip by this time. We suggest not exceeding 1.5 minutes.
White Manufacturer claims almost 1.75 minutes, but it was already setting in the dispensing tip by this time. We suggest not exceeding 1.5 minutes.

**Rock-Hard Extraoral Set Time in T/H Chamber (from beginning of mixing)**
Pink 2.5 minutes (listed). We found 2.75 minutes.
White 2.5 minutes (listed). We found 2.5 minutes.

**Finishing and Polishing**
Finishing should be done under water spray with either highspeed finishing burs or diamonds. It can be polished to a reasonably high
shine with Astropol, Groovy, Hawe HiLuster, and Hawe Occlubrush, although the brushes are easier to use on the occlusal surface. Even after polishing, apply a final coat of Fuji Coat LC and light cure for 10 seconds to protect the surface during its early maturation stage.

Shades
2 Pink (more salmon-like) and white.

Packaging
Corrugated cardboard box with individual boxes of capsules and the Applier II. The box holding the pink shade has “Command Set”, while the white shade’s box merely has “Triage”. This is due to the fact that the white shade does not contain the ferric oxide pigment, which is responsible for the accelerated set of the pink shade when exposed to a curing light.

The capsules are packaged in individually sealed foil wrappers imprinted with the expiration date. There is an indicated tear spot for relatively easy opening. The pink shade capsules, conventional in design, are black with a pink color-coded section. There is no other identification on the capsules. The white shade capsules are the new design with a solid body, whereas the conventional capsules have two sections with a seam. The new capsule is gray with a pink plunger, even though this is for the white shade. As far as activation and performance of the new capsule compared to the conventional one, we did not find much differences between the two designs, except the weight of the mixed pink material in the conventional capsule was 0.31g, while the mixed white material was slightly less at 0.28g. Note: Despite the new slimmer, mono-body design of these capsules, there is still no identification on them once they are removed from their foil wrapper.

Directions
Plain paper, printed in eight languages, annoying foldout design. The information is simple and line drawings illustrate the proper way to operate the capsules. There is also a single language, double-sided, coated paper color sheet illustrating and summarizing the activation and insertion technique. This is much better than the regular directions.

Composition
Filler Barium fluorosilicate glass, submicron silica. Filled 50% by weight, average particle size 3.5µ.
Resin Aromatic dimethacrylate, HEMA, initiators and stabilizers.

Radiopaque
Yes

Enamel/Dentin Etching/Conditioning/Priming
Even though it is supposed to bond without etching, we still advise a 15-second etch with 35% phosphoric acid. Adhesive is supposed to be Tenure, but any all-purpose should be adequate.

Composition
Filler Barium fluorosilicate glass, submicron silica. Filled 50% by weight, average particle size 3.5µ.
Resin Aromatic dimethacrylate, HEMA, initiators and stabilizers.

Radiopaque
Yes

Enamel/Dentin Etching/Conditioning/Priming
Even though it is supposed to bond without etching, we still advise a 15-second etch with 35% phosphoric acid. Adhesive is supposed to be Tenure, but any all-purpose should be adequate.

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Hardness (Knoop)
19.9

Extraoral Working Time
(from the beginning of mixing)
Manufacturer claims 1.5–2.0 minutes, so we used 2.0 minutes, but the test disk thickness had already increased substantially at that time. We suggest not exceeding 1.5 minutes.

Curing
Dual-cure, but self-cure takes seven minutes from the beginning of mixing.

Shades
4 A1, A2, A3, and A3.5.

<table>
<thead>
<tr>
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<tr>
<td>A1</td>
<td>Lighter</td>
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<tr>
<td>A2</td>
<td>Lighter</td>
</tr>
<tr>
<td>A3</td>
<td>Good match</td>
</tr>
<tr>
<td>A3.5</td>
<td>Good match</td>
</tr>
</tbody>
</table>

Finishing and Polishing
Polishes to a moderate gloss with Groovy and Hawe HiLuster. Astropol and Hawe Occlubrush give a somewhat lower level of shine.

Packaging
White plastic tray securing the contents with a clear plastic lid. Black, dual-barrel, push-type syringe has a label that wants to unpeel and does not have the expiration date, which is nowhere in the kit. The shade is indicated in a yellow band next to the plunger. This yellow gets progressively darker as you go from A1 to A3.5, which is actually bronze.

Directions
Laminated card. Straightforward and easy to follow.

Resin/Glass Ionomers

Vitremer Core Buildup/Restorative System

3M ESPE

4

Cost: $525.50
Includes:
- 6 jars of powder (5g ea)
- 2 btls of liquid (8ml ea)
- 1 btl of primer (6.5ml)
  - $136.10/btl ($20.94/ml)
- 1 btl of finishing gloss (6.5ml)
  - $136.10/btl ($20.94/ml)
- Accessories

Refills
Powder
Cost $103.70/9g ($11.52/g)
Liquid
Cost: $103.70/8ml ($12.96/ml)

Shelf life: 3 years
MSDS: Not included

RAVES & RANTS

- Strong chemical set
- Does not have to be layered
- No option of capsules
- Standard mix much too dry

Composition
Primer Methacrylate-modified polycarboxylic acid, HEMA, ethanol, photoinitiators. Modifies the smear layer and wets the tooth surface to allow better adaptation of Vitremer to the tooth.
Powder Fluoroaluminosilicate glass, potassium persulfate, ascorbic acid.
Liquid Methacrylate-modified polycarboxylic acid, water, HEMA, and photoinitiators.
Finishing Gloss Unfilled BIS-GMA.


Radiopaque
Yes

Enamel/Dentin Etching/Conditioning/Priming
Use primer on dentin and enamel for 30 seconds followed by drying for 15 seconds and curing for 20 seconds.

Mixing
Half of our evaluators complained that the standard mix was overly dry. If your mix is too dry, squeeze the bottle hard, so you will have more liquid with which to mix the powder.

Consistency and Handling
5.0 Not as sculptable as a composite, but was found to handle reasonably well. Loading the mixture into NeedleTube and injecting the material into the cavity minimizes voids. A dry mix will not go through a NeedleTube.

Hardness (Knoop)
15.8

Extraoral Working Time
(from the beginning of mixing)
Manufacturer claims 3.0 minutes, but the test disk thickness had already increased substantially at that time. We suggest not exceeding 2.5 minutes.

Curing
Dual-cure, but should be light-cured for 40 seconds to maximize physical properties. Chemical cure took nine minutes extraorally and four minutes in the mouth, significantly faster than the other dual-cure resin ionomers.

Finishing and Polishing
Recommended finishing with conventional finishing burs and diamonds under water spray, although we have finished it dry without any obvious negative sequelae. Can be polished to a moderate shine with Groovy, somewhat less with Astropol, Hawe Hiluster, and Hawe Occlubrush. For a better immediate surface finish on definitive restorations, the finishing gloss (a conventional unfilled resin) is applied and cured for 20 seconds. For crown builds, do not use the gloss.

Shades
9 7 Vita, four in kit (A3, A4, C2, and C4) plus a blue core shade and pedo shade. In addition to the shades in the kit, A3.5, B2, and B3 are available separately.
Resin/Glass Ionomers

The Ratings

Fuji Plus/Fuji Plus Capsules
GC

Capsules No Etch Package
Cost: $212.25 ($4.25/capsule)
Includes:
- 50 capsules $155.75 ($3.12/capsule)
- Applier
Hand-Mixed
Cost: $118.10
Includes:
- 1 jar of powder (15g) $59.70/jar ($3.98/g)
- 1 btl of liquid (7ml/8g) $45.35/btl ($6.48/ml)
- 1 btl of conditioner (6.5ml/7g)

Shelf life: 2 years
MSDS: Not included

Description
Hand-mixed or automix, powder/liquid, self-cure.
Powder Aluminofluorosilicate glass.
Liquid Polyacrylic acid, HEMA, tartaric acid, dimethacrylate, water.
Conditioner Citric acid, ferric chloride, water. Meant to be placed on preparation passively for 20 seconds and rinsed off. It presumably cleans the preparation and seals the tubules, reducing sensitivity.

Consistency and Handling
Hand-mixed 4.5 Typical powder-liquid. Easy to dispense, mix, and load crowns. However, one evaluator reported it took longer to create a thorough mix compared to RelyX Luting while another evaluator felt the liquid was prone to dispense too quickly and the powder was messy. Full crowns seat effortlessly with minimal to no rebound. Preparations should be free of visible moisture, but not desiccated.
Capsules 5.0 Capsules do not require an activator. You merely push the plunger with your thumb so it is flush with the body of the capsule. Place in a triturator and mix.

Film Thickness (µ)

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>RRL</th>
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<tbody>
<tr>
<td>Hand-mixed</td>
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</tr>
<tr>
<td>Automix</td>
<td>10</td>
</tr>
</tbody>
</table>

RAVES & RANTS
- Capsule or hand-mixed
- Very low film thickness
- Need triturator to mix Capsules
- Hand-mixing is still messy

Extraoral Working Time using Disk Thickness (µ)

<table>
<thead>
<tr>
<th>Version</th>
<th>Control</th>
<th>Manufacturer</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Thickness</td>
<td>Time (min)</td>
</tr>
<tr>
<td>Hand-mixed</td>
<td>10</td>
<td>2.5</td>
</tr>
<tr>
<td>Automix</td>
<td>10</td>
<td>2.25</td>
</tr>
</tbody>
</table>

Cement Removal Time in T/H Chamber (from beginning of mixing)
Hand-mixed About 2.5 minutes (directions nonspecific).
Capsule About 3.5 minutes (directions nonspecific).

Rock-Hard Extraoral Set Time in T/H Chamber (from beginning of mixing)
Hand-mixed About 4.0 minutes (directions say 4.0 minutes).
Capsule About 4.5 minutes (directions say 4.0 minutes).

Shade
1 Labeled as “yellow”, but really about B1, fairly translucent.

Translucency/Opacity (T/O)
36.1%
Packaging

Hand-mixed Cardboard box, with contents secured in plastic tray. Box is scored to allow removal of its top half. The remaining bottom half becomes a handy container for the bottles, powder scoop, and mixing pad, although there is also a removable plastic insert that can serve as its stand for the three bottles. The powder bottle has an integral scoop leveler and a helpful label on its cap with icons reminding you to mix one large scoop of powder with three drops of liquid or one small scoop of powder with one drop of liquid. The labels on the powder and liquid bottles are moisture-resistant and include the expiration date, which is also printed on the side of the box.

Capsules No Etch Package (curious name, since all ionomers are “no etch”) comes in a corrugated cardboard box with the smaller cardboard boxes individually holding the capsules and applicer inside. Both the package and capsule boxes have labels with the expiration date on the front and side respectively. The capsules are packaged in individually sealed foil wrappers imprinted with the expiration date and the shade. Opening the foil wrapper is very easy. New-style capsules are streamlined and have no seams other than where the plunger is pushed into the body.

Directions

Hand-mixed kit has a single sheet of plain paper in one language. Instructions are straightforward. Capsule instructions are also on a single sheet of plain paper in one language.

Description

Paste/paste, self-cure.

Paste A Fluoroluminosilicate glass, 2-hydroxyethylmethacrylate, dimethacrylate, pigment, and initiator.

Paste B Polyacrylic acid, distilled water, silica powder, and initiator.

Consistency and Handling

5.0 Easy to mix, to load crown, and to clean excess.

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>RRL</th>
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<tr>
<td>FujiCEM</td>
<td>2a</td>
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</tbody>
</table>

Starter Package

Cost: $186.35/26.6g ($7.01/g or $12.94/ml)
Includes:
- 2 cartridges (13.3g/7.2ml ea)
- $159.45/2 cartridges ($5.99/g or $11.07/ml)
- Paste Pak dispenser ($60.60)
- Mixing pad and spatula

Shelf life: 2 years

MSDS: Not included

Film Thickness (µ)

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>RRL</th>
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<tr>
<td>Control</td>
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Extraoral Working Time using Disk Thickness (µ)

<table>
<thead>
<tr>
<th>Thickness</th>
<th>Time (min)</th>
<th>Thickness</th>
<th>% Increase</th>
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<tbody>
<tr>
<td>10</td>
<td>3.0</td>
<td>20</td>
<td>100</td>
</tr>
</tbody>
</table>

Cement Removal Time in T/H Chamber (from beginning of mixing)

About 1.5 minutes (directions say 1.5 minutes after seating).
**Resin/Glass Ionomers**

**Rock-Hard Extraoral Set Time in T/H Chamber (from beginning of mixing)**
About 4.5 minutes (same as directions).

**Shade**
1 Yellow

**Translucency/Opacity (T/O)**
30.6%

**Packaging**
Cardboard box with expiration date, with contents secured in smaller cardboard boxes. In one of the smaller internal boxes is the mini-cartridge, which houses the base and catalyst pastes. This mini-cartridge, which is pink with a moisture-resistant label that includes the expiration date, has two separate chambers. The cartridge is then inserted into a metal, lever-type extruder called the Paste Pak Dispenser. This apparatus is merely for dispensing equal lengths of base and catalyst, but not for mixing, which is still done the old-fashioned way—by hand.

**Directions**
Plain paper in eight languages in annoying foldout design. Additional coated paper insert with 13 illustrations and separate dispenser instructions on plain folded paper in eight languages. It states this material is indicated for porcelain inlays, while we disagree. Information is straightforward and easy to understand.

---

**RelyX Luting Plus**
3M ESPE
www.3mespe.com

**NEW**

**Trial Kit**
Cost: $99.00 ($9.00/g)
Includes:
- 1 dual-chamber “clicker” of cement (11g)

**Shelf life:** 2 years

**MSDS:** Not included

**RAVES & RANTS**
+ Much less mess than powder/liquid
+ Plenty of working time
- Mousse-like mix does not coat crown easily
- Most expensive

**Description**
Hand-mixed, paste/paste, self-cure.

**Paste A**
Fluoroaluminosilicate glass, opacifying agent, HEMA, water, proprietary reducing agent.

**Paste B**
Zirconia silica filler, methacrylated polycarboxylic acid, HEMA, BIS-GMA, water, potassium persulfate.

**Consistency and Handling**
5.0 Easy to dispense and mix, produces a mousse-like (cake-frosting) viscosity, which seems at first glance to be too thick to allow full seating of the restoration, but this was achieved without resistance and with no visible rebound off the preparation. However, this consistency makes loading crowns not as easy compared to more flowable materials. It has an inherent tackiness or stickiness—you may not like this consistency if you prefer creamier-like materials. Cleanup after setting is quick and easy, although it tends to come off in smaller sections rather than in large chunks.

**Film Thickness (µ)**

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<tr>
<th>Manufacturer</th>
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**Extraoral Working Time using Disk Thickness (µ)**

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<th>Thickness</th>
<th>Time (min)</th>
<th>Thickness</th>
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The Ratings 1043
Resin/Glass Ionomers

Cement Removal Time in T/H Chamber (from beginning of mixing)
About 2.5 minutes (directions say 3.0 minutes after seating).

Rock-Hard Extraoral Set Time in T/H Chamber (from beginning of mixing)
10 minutes (not stated in directions).

Shade
1  Off-white opaque. For cementing ceramometal restorations with facial porcelain butt joint margins that are equigingival, a more translucent, less obvious shade would be more esthetic.

Translucency/opacity (T/O) 50.5%

Packaging
White cardboard box, which seems much too large for what’s inside. Cement and dispenser are in a sealed foil pouch on the inside of the box. The expiration date is printed on the box, foil pouch, and on the clicker dispenser. However, it also states that the material needs to be used within six months of opening the foil pouch. This six-month period may conclude earlier than the expiration date. If you or your assistant did not write the date you opened the foil pouch, you could potentially be using outdated material although the expiration date still tells you that the material is not outdated.

This dispenser is essentially a dual-barrel cartridge, with the catalyst in one barrel and the base in the other that is activated by a white plastic lever, which controls the plungers. Using a pencil grasp, depress the lever with your index finger to extrude the paste. This method controls the amount of paste dispensed, with two clicks the starting point for small restorations or more clicks for larger ones. On the undersurface of the plunger, there are numbers to help you determine the number of clicks remaining in the syringe. There is also a pink plastic cover for the ends of the Clicker, which comes off very easily by depressing the pinch valve on its top surface.

Directions
Typical thin paper in only three languages. There is also a plastic laminated card, punched to fit into the 3M ESPE technique binder, summarizing the cementation technique. The chairside card has three color illustrations and is detailed enough to forego the paper version.

3 RelyX Luting
3M ESPE

RAVES & RANTS
+ Good clinical success
+ Plenty of working time
- Mousse-like mix does not coat crown easily
- Most opaque

Description
Hand-mixed, powder/liquid, self-cure.
Powder  Fluoroaluminosilicate glass with microencapsulated potassium persulfate and ascorbic acid.
Liquid  Aqueous solution of polycarboxylic acid modified with pendant methacrylate groups, HEMA, water, tartaric acid.

Consistency and Handling
5.0 Easy to dispense and mix, although the powder has a tendency to clump when loading the dispensing scoop, causing uncertainty on whether the scoop was full or not. Standard powder to liquid ratio produces a mousse-like (cake-frosting) viscosity, which seems at first glance to be too thick to allow full seating of the restoration, but this was achieved without resistance and with no visible rebound off the preparation. However, this consistency makes loading crowns not as easy compared to more flowable materials. Cleanup after setting is quick and easy, although it tends to come off in smaller sections rather than in large chunks.

Film Thickness (µ)

<table>
<thead>
<tr>
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Extraoral Working Time using Disk Thickness (µ)

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<th>Control</th>
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<tbody>
<tr>
<td>Thickness</td>
<td>Time (min)</td>
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<tr>
<td>20</td>
<td>2.5</td>
</tr>
</tbody>
</table>
Cement Removal Time in T/H Chamber (from beginning of mixing)
About 6.5 minutes (directions say 3.0 minutes after seating).

Rock-Hard Extraoral Set Time in T/H Chamber (from beginning of mixing)
15 minutes (directions say 10 minutes).

Shade
1 Off-white opaque. For cementing ceramometal restorations with facial porcelain butt joint margins that are equigingival, a more translucent, less obvious shade would be more esthetic.

Translucency/Opacity (T/O)
71.8%

Packaging
Cardboard box with lid that opens to the rear, with contents secured in a removable white plastic tray. Brown glass bottle of powder has large opening with integral scoop leveler, but we would have preferred a flip-top instead of the screw-on cap.

Liquid is in plastic squeeze bottle. The label on powder has icons indicating the suggested three scoops of powder to three drops of liquid dispensing for each unit to be cemented. We found this volume of material to be more than adequate for each unit, but having to dispense all those scoops is a nuisance. Why not just have a larger scoop?

The paper label on the powder is moisture-resistant. The imprinting on the liquid is moisture-resistant. The expiration date is on the label of both the powder and liquid and on the bottom of the box.

Directions
Typical thin paper in only three languages. There is also a coated paper (but not plastic laminated) single sheet summarizing the cementation technique. The full instructions still include the advice to use a hard setting calcium hydroxide material with near exposures. However, this information is “too little, too late” by the time you are ready to cement a restoration. If you needed calcium hydroxide (which is just about obsolete anyway), it would have been during the preparation of the tooth, not at the cementation.

In addition, we are told to rinse the preparation with water prior to cementation and “let dry”. However, we are not exactly sure what “let dry” means.

Description
Automix, paste/paste, dual-cure. Barium alumino-silicate glass (particle size 4.5µ), pyrogenic silica, ethoxylated Bis-phenol-A dimethacrylate (EBPADMA), Bis-GMA, triethylene glycol dimethacrylate (TEDMA), trimethylolpropane trimethacrylate (TMPTM), benzoyl peroxide, camphorquinone, amine. Chemistry indicates this product is probably more compomer than ionomer.
Resin/Glass Ionomers

Consistency and Handling
4.5 Not runny, consistency is good, placement no problem, restoration seats well, removal of excess is easy. Obviously very easy to mix.

Description
Automix, paste/paste, self-cure. Barium aluminosilicate glass (particle size 4.5µ), pyrogenic silica, ethoxylated Bis-phenol-A dimethacrylate (EBPADMA), Bis-GMA, triethyleneglycol dimethacrylate (TEDMA), trimethylolpropane trimethacrylate (TMPTM), benzoyl peroxide, amine. Chemistry indicates this product is probably more compomer than ionomer.

Film Thickness (µ)

<table>
<thead>
<tr>
<th>Manufacturer</th>
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Extraoral Working Time using Disk Thickness (µ)

<table>
<thead>
<tr>
<th>Version</th>
<th>Control</th>
<th>Manufacturer</th>
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<tbody>
<tr>
<td></td>
<td>Thickness</td>
<td>Time (min)</td>
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<td>Cartridge</td>
<td>20</td>
<td>2.0</td>
</tr>
<tr>
<td>Smartmix</td>
<td>20</td>
<td>2.0</td>
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Cement Removal Time in T/H Chamber (from beginning of mixing)

- Cartridge: About 1.75–2.0 minutes (directions say 1.5–2.0 minutes after seating).
- Smartmix: About 1.5–1.75 minutes (directions say 1.5–2.0 minutes after seating).

Rock-Hard Extraoral Set Time in T/H Chamber (from beginning of mixing)

- Cartridge: About 3.0 minutes (directions say 5.0 minutes).
- Smartmix: About 3.5 minutes (directions say 5.0 minutes).

Shade
1 B1 translucent, but the excess was easy to detect.

Translucency/Opacity (T/O)
13.0%

Packaging
Automix Dual Cardboard box with cartridge loose and tips in Ziploc bags. The 1:1 nonclogging cartridge has the expiration date on the label, but it is not moisture-resistant.

Smartmix Dual Triangular cardboard box with contents loosely packed inside. Nonclogging syringe is a typical dual-chamber syringe in a 1:1 ratio of base to catalyst. Straight mixing tips are reasonably small, but it would be nice to have a contra-angle design to facilitate injecting the cement directly into an inlay or onlay preparation. The expiration date is printed on the label of the syringe and on the back of the box. The label, however, is not moisture-resistant.

Directions
Coated paper booklet in six languages. Good information, but you are told to rinse and dry with air syringe or cotton pellets, being careful to avoid pooling. This probably refers to pooling water, but it is ambiguous.

PermaCem
DMG/Zenith

RAVES & RANTS
- Squeeze the trigger and go
- Very easy cleanup
- Be sure to use an adhesive
- Slightly runny

Description
Automix, paste/paste, self-cure. Barium aluminosilicate glass (particle size 4.5µ), pyrogenic silica, ethoxylated Bis-phenol-A dimethacrylate (EBPADMA), Bis-GMA, triethyleneglycol dimethacrylate (TEDMA), trimethylolpropane trimethacrylate (TMPTM), benzoyl peroxide, amine. Chemistry indicates this product is probably more compomer than ionomer.

Consistency and Handling
5.0 Homogeneous, bubble-free mix, good flow due to very low viscosity, easy to seat restorations, easily removed from restorations after setting. However, one evaluator found it to be too runny.
LINERS

Fuji Lining LC Paste Pak is the paste-paste version of the product with which it shares a name, but this version is substantially lower in viscosity. This means it has a tendency to pool in line angles. On the other hand, it has the second highest hardness in this subcategory and, being paste/paste, much easier to mix than powder/liquid.

Fuji Lining LC has the highest viscosity in this category. If you want a liner that is not runny, this is it. It also has a good dark cure and is the least expensive in this subgroup.

Vitrebond is a classic product that has stood the test of time. For a powder-liquid product, it mixes easily, but its standard consistency makes it somewhat runny. For less flow, add slightly more powder.

Ionosit MicroSpand is certainly the easiest of the liners to use, since it doesn’t require any mixing at all. It has unlimited working time, good consistency, the highest hardness, and the best delivery system, as its small syringes make dispensing a breeze. The “micro-expansion” that it provides under a bonded restoration may help combat polymerization shrinkage gaps, but it is difficult to calibrate this property. With this expansion in mind, using it under an indirect restoration is probably not a prudent decision. And it is, by far, the most expensive material in this category.

BASES, BUILDUPS, AND RESTORATIVES

Fuji II LC Improved still leads the resin ionomers in this subgroup. It has the most shades, highest hardness, and hand-mixed or capsule packaging. Four of the six shades match our test teeth. And it does not fluoresce.

Fuji IX is a niche product that, in its fast set variation, doesn’t take any longer than a light-cured restoration. It is very useful in pediatric applications and even core buildups, but its resin ionomer sibling, Fuji II LC, is still preferred for Class V. In addition, it works well as a quick provisional restoration when time constraints keep you from establishing a perfectly isolated field for a composite. In other words, this is a good choice for emergency situations. The capsules are far superior to the hand-mixed version and the fast set is much better than the regular set unless you are doing a series of simultaneous restorations and need the extra time. The fast set version is very fast — this is not a product for leisurely dentistry. However, none of its Vita shades match our test teeth and it doesn’t fluoresce.
**Fuji Triage** is a chemically-cured, glass ionomer niche product that is aimed at the pediatric dentistry market for those teeth where isolation is difficult. This means partially erupted molars that are already suspected of being carious or having frank lesions with limited access. Instead of subjecting the child to aggressive restorative measures and/or sedation techniques, this material could be placed even in a wet environment and still have a good possibility of being retained for a reasonable period of time, allowing the tooth to erupt more fully for better access and for the child to get older.

As such, its viscosity, which is closer to a flowable rather than a sealant (although it is being touted for this use) helps it to adapt to unprepared tooth surfaces as well as preparations. And, since it is a true glass ionomer, it will self-bond and release more fluoride than other materials, protecting the tooth as a major benefit.

It is now available in both the original muted pink (salmon-like) color and white, the latter of which may overcome the resistance factor for using it in the mouths of some children who have parents looking for esthetic perfection. And the fact that it is not light-cured may doom its utilization by fast operators.

As far as using a curing light to provide heat to accelerate the set (ferric oxide pigment in the pink version helps to absorb heat), this goes against the trend of minimizing heat. And note that the directions indicate that a "halogen light curing device" can accelerate the initial set, but it never explicitly states that it is the heat from the light that accomplishes this task and not photoactivation. This is somewhat misleading, since it is in addition to calling the material "command set". Since it requires heat, LEDs won't work.

The white version, which does not have the heat-absorbing pigments, will still set in about 2.5 minutes. While this is not as fast as light-cured products, that's the time from the beginning of mixing. If it takes about one minute or so to mix, inject, and smooth, then the curing time would be just about 1.5 minutes.

**Geristore** is the only paste-paste, automix material. It has been used successfully to repair root perforations, which indicates it is very biocompatible. Half of the shades matched our test teeth, but it does not fluoresce. It also only has about 1.5 minutes of working time, so this is not a material for the leisurely-minded.

**Vitremer** has the strongest chemical set of the powder/liquid products. This means it does not have to be layered, thus saving time when restoring deeper lesions. It matched all three of our test teeth, and while you cannot consider it to fluoresce at the level of tooth structure, it was better than the other products in this section. However, it is only available as a powder-liquid, hand-mixed product, is the most expensive, and has the lowest hardness.

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**Luting**

**Fuji Plus** tops the list primarily due to the fact that it offers the choice between the hand-mixed version and the streamlined capsules, which most evaluators preferred as the ultimate in convenience. While you must maintain a triturator in your treatment room to achieve this level of convenience, it still beats hand-mixing, even if you are mixing two pastes. It has a nice consistency and very low film thickness, allows easy seating of restorations, has reasonably translucency so it won't show as a white line on a visible butt joint porcelain margin, and is not runny. And be sure to stay within the working time.

**FujiCEM**, being a paste/paste instead of powder/liquid, garnered high marks for its ease of use and not having to mess with dispensing and mixing powder and liquid. With its unique dispenser, you never have to worry about not having the right base to catalyst ratio. It mixes quickly, coats the inside of restorations easily, doesn't flow out after loading, and seats without any significant resistance, probably due to its low film thickness. Cleanup was also uncomplicated, although its set time in the mouth was somewhat slow for a single unit. No restorations dislodged during the evaluation phase and its translucency should keep exposed butt joint ceramic margins free of white cement lines. One evaluator, however, complained about the odor. And be sure to stay within the working time, which, at three minutes, should be acceptable for most uses.

**Rely X Luting Plus** is the paste/paste version of the product with which it shares a name. As with virtually all paste/paste products, it is much simpler and less messy than powder/liquid. Couple this with the clicker device and you get a significant improvement over its older sibling. The clicker even allows you to calibrate how much cement is dispensed per restoration, taking most of the guesswork out of this task, which will inevitably save money by not overdispensing.

The material itself mixes easily and loads into restorations without any problems, assuming you are aware that it retains the mousse-like consistency of the original version. This means that it won’t just flow by itself into a restoration—you must load a crown, for example, as if you are applying frosting to a cake. It
just doesn’t seem like it is wetting out the inside of the crown. Regardless of what seems like a thicker consistency, it still allows seating without any significant resistance.

Cleanup was also uncomplicated, although its set time in the mouth was somewhat slow for a single unit. No restorations dislodged during the evaluation phase and no post-luting sensitivity was reported. In addition, there is more than adequate working time, even for bridges. However, it is the second most opaque material in this section and, as such, could cause a white cement line at an exposed butt joint ceramic margin. And, of course, it still must be mixed by hand.

With RelyX Luting and its extended working and set times, there is no rush to load and seat restorations, even longspan bridges. You also don’t need to hurry to remove the excess, since it doesn’t initially set as hard or as quickly as others in this category. Even though it still seems relatively soft three minutes after seating, which is the recommended wait time before beginning to remove the excess, our clinical experience has been positive, with no incidences of crown dislodgment or sensitivity. However, waiting 6.5 minutes for it to gel may actually be safer.

While its mousse-like consistency is different from most cements, loading restorations does require actively painting the material against the inner walls instead of just picking up the cement with an instrument and allowing it to flow in by itself. However, we had no problem seating restorations completely and there is minimal or no lift off once a restoration is seated. On the other hand, its paste-paste younger sibling has basically stolen the thunder from this product—why mix messy powder and liquid when you have a relatively easy paste/paste version available? And it is the most opaque material in this section by far and would be most likely to cause a white cement line at an exposed butt joint ceramic margin.

PermaCem Dual is the dual-cure version of the product with which it shares a name. Available in both automix cartridges and dual-barrel, automix syringes, it is the easiest product in this category to use. It combines the attributes of the self-cure version with dual-curing capabilities. The obvious advantage of the dual-cure version is to gel the excess quickly and not wait for the chemical set to activate. The flow is slightly higher than the self-cure version. Handling with both the cartridge and Smartmix systems was easy, with less waste with Smartmix. It is also the most translucent cement in this section. We have had one report of a minor incidence of post-operative sensitivity.

PermaCem is the original automix cement. Cleanup is also very easy and quick. Our own in vitro study found it did not fracture 100 metal-free crowns using different ceramics and resins. More compomer than ionomer, it definitely needs to be used with an adhesive. However, even though our evaluation was performed under the old directions that did not mention an adhesive, we have had no reports of sensitivity, although we have received one report of stained margins. It also has plenty of working time.

Remember: The original versions of resin ionomer luting cements had high expansion rates that lead to fracturing metal-free restorations. This was first reported by REALITY in 1995. We have cautioned against using these products since that time for metal-free restorations. However, since we have not experienced any failures in recent years nor have we received any reports that this phenomenon is still occurring, it appears the problem no longer exists. Nevertheless, we still believe resin cements are superior to resin ionomers for luting metal-free restorations and endodontic posts.

OTHER PRODUCTS IN THIS CATEGORY

<table>
<thead>
<tr>
<th>Ana Norm Liner</th>
<th>Infinity/Infinity Syringeable</th>
<th>Photac-Fil Quick Aplicap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nordiska</td>
<td>Den-Mat</td>
<td>3M ESPE</td>
</tr>
<tr>
<td>CX Plus</td>
<td>Lime-Lite</td>
<td>Principle</td>
</tr>
<tr>
<td>Shofu</td>
<td>Pulpdent</td>
<td>Dentsply/Caulk</td>
</tr>
<tr>
<td>Fuji II LC Core</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GC</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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