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The primary purpose of a luting cement is to aid in retaining and sealing fixed prosthetic devices to prepared teeth. The better the crown prep (long axial walls and about a 6° taper) and the better the crown fit (<30 micron marginal gap), the less a clinician has to rely on the retentive properties of a cement. With the introduction of 3M™ Vitremer™ Luting Cement, there are now five types of permanent cements available in the marketplace today. They are zinc phosphate, polycarboxylate, glass ionomers, resins and now, hybrid glass ionomers. Many doctors have more than one permanent cement in their offices, one for routine crown and bridge procedures (usually zinc phosphates, polycarboxylates or glass ionomers) and one or more for special circumstances. Resin cements are frequently a secondary cement used for special cases.

**Zinc phosphate**

Zinc phosphate (which, when mixed, combines orthophosphoric acid and zinc oxide powder) is one of the oldest cement types. The reasons this system has maintained popularity include a long history of clinical success and its adjustable working time. It is also reported to have high impact resistance and high rigidity which is needed for long span bridges. However, mixing of this cement is technique sensitive and time consuming. A typical mix requires 1 minute, 20 seconds with the powder incorporated in 6 parts. The cement also causes a relatively high incidence of postoperative sensitivity (presumably due to the acid content of the liquid), has a long set time and is soluble in the oral environment. This cement provides some mechanical but no chemical retention. Clean up is accomplished by chipping the cement away from the margins once it is set.

**Polycarboxylate Cements**

Polycarboxylate cements also enjoy a long clinical success history. Polycarboxylate cements are based on polyacrylic acid (like glass ionomers) and zinc oxide. Some of these materials also release low levels of fluoride. Their popularity stems from a lack of postoperative sensitivity and the fact that they are tolerant of some mild contamination. Polycarboxylate cements also achieve chemical adhesion to tooth structure. An additional feature of this product type is the change in appearance, from shiny to dull, when the working time is over. Clean up of this cement is more difficult than zinc phosphate. Timing is critical. If the cement is removed while it is in a rubbery stage, the marginal integrity of the cement may be compromised. Once completely set, the adhesion to the tooth structure increases the difficulty of excess removal. Users of polycarboxylate cements have reported failures after several years in service probably due to the cement’s solubility in the oral environment.

**Resin Cements**

Resin cements are a new entrant on the cement market. These cements rely on the acid etch technique and dentin conditioning, similar to composite restorations, to achieve high bond strengths. They have high compressive strengths, tensile strengths and fracture toughness. Resins are not soluble in the oral environment. They are especially useful for cases where the preparation is short or extremely tapered. Resin cements do suffer some drawbacks. They are technique sensitive and the techniques are complicated, involving several steps. As with composite restorations, moisture control is critical. If instructions are not closely followed, clean up is extremely difficult, if not impossible to accomplish without use of a bur (as most margins of porcelain-fused-to-metal crowns are subgingival, this is not a preferred procedure). Frequently, crown removal is only accomplished by grinding off the crown. In market research, resins were most often cited as the secondary cement used in offices. They are not typically used for routine crown and bridge procedures.
Glass Ionomers

Glass ionomers, the last category of permanent cement used in dental offices today, are growing in popularity. Glass ionomers do exhibit some adhesion to enamel and dentin and release fluoride. These materials have higher compressive strengths and lower solubility than either zinc phosphate or polycarboxylate cements. As with other glass-ionomer products, they suffer from a history of high incidence of postoperative sensitivity and moisture intolerance during the setting reaction. The most often cited reasons for postoperative sensitivity are:

- Desiccation of the tooth—glass ionomers require water for their setting reaction and may have a tendency to draw moisture out of a desiccated tooth by pulling liquid up through the dentinal tubules.
- The thin viscosity of glass-ionomer cement mixtures—the cement may be forced down the dentinal tubules during seating of the prosthesis.
- The initial pH of the material (although it increases rapidly) may irritate the pulp.
- Moisture contamination during setting could result in compromised margins (enabling leakage).

Improved techniques for use and better understanding of the setting mechanism have diminished these drawbacks.

Vitremer luting cement consists of two components, a powder and a liquid like the other products in the 3M glass-ionomer line. The powder is mixed with the liquid in a 1:1 drop:scoop ratio within 30 seconds. The resulting mix is mousse-like and is easily scooped off the pad for placement in the crown or bridge retainers. Working time is 2.5 minutes. After placement of the crown or bridge, excess cement may be removed from the margins after a minimum of 3 minutes.

This product passes all ISO 9917:1991 (E) requirements for glass-ionomer luting cements. These requirements include a maximum film thickness of 25 microns, setting time between 2.5 and 8 minutes, minimum compressive strength of 70 MPa, and acid erosion of less than 0.05 mm/hour.

This system is based on the chemistry of Vitremer Core Buildup/Restorative product. However, Vitremer luting cement is not light curable. Two setting reactions do take place in this system, an acid-base reaction between the fluoroaluminosilicate glass and the polycarboxylic acid (i.e., a true glass ionomer setting reaction) and a free radical polymerization of the pendant methacrylate groups of the polymer and HEMA (2-hydroxyethylmethacrylate). The free radical polymerization reaction takes place without the need for light activation (a methacrylate dark cure) via the same patented water-activated redox catalyst system (US Patent 5,154,762) found in 3M Vitremer Core Buildup/Restorative. FTIR (Fourier Transform Infrared) spectroscopy confirms the presence of both a glass ionomer and a methacrylate cure during setting. Because of this chemistry, Vitremer luting cement can, therefore, be classified as a hybrid glass-ionomer cement.
The Vitremer luting cement powder is composed of a radiopaque, fluoroaluminosilicate glass. It contains a microencapsulated potassium persulfate and ascorbic acid catalyst system providing the methacrylate cure without the need for light (i.e., methacrylate dark cure). The powder also contains small amounts of an opacifying agent to aid in distinguishing the cement from tooth structure.

The glass-ionomer liquid is an aqueous solution of polycarboxylic acid modified with pendant methacrylate groups, i.e., the copolymer used in Vitrebond liner/base and Vitremer Core Buildup/Restorative. It also contains HEMA and water and small amounts of tartaric acid (which initially slows the glass ionomer reaction, affording a snap set). This can be considered a type of hydrous glass ionomer cement because the polycarboxylic acid moiety is contained in the aqueous liquid.

The powder and liquid are mixed in a 1.6:1 (w/w) ratio (1 scoop:1 drop). While the composition of both the powder and the liquid is similar to Vitremer Core Buildup/Restorative, the actual concentration of each component differs. As such, combining these systems is not recommended. Final properties of the cement, e.g., low film thickness, strength, solubility, etc., have been optimized in this cement formulation. These properties, and many more, may be adversely effected if the two systems are combined.

Vitremer luting cement is indicated for:

- permanent cementation of porcelain fused-to-metal crowns and bridges to tooth structure, amalgam, composite or glass ionomer core buildups.
- luting metal inlays, onlays or crowns.
- pre-fabricated and cast post cementation.
- luting orthodontic appliances.

Vitremer luting cement is not indicated for composite or porcelain inlays or onlays, composite or all porcelain crowns. However, it may be used for luting porcelain jacket crowns.

The following guides illustrate the simple technique required to use Vitremer luting cement.
Vitremer™ Luting Cement

**Indications:**

- Luting porcelain-fused-to-metal crowns and bridges to tooth structure, amalgam, composite or glass ionomer core buildups.
- Metal inlays, onlays or crowns
- Pre-fabricated and cast posts.
- Orthodontic appliances.

**Tooth Preparation:**

- Remove provisional restoration.
- Remove all temporary cement.
- Clean tooth with oil-free pumice paste, rinse and dry.
- **Do not desiccate the tooth.**

**Dispense the powder:**

- Fluff the powder.
- Dispense 3 level scoops.

**Dispense the liquid:**

- Keep the vial tip clean.
- Hold vial vertically and dispense 3 drops.

**Mixing:**

- Mix all of the powder aggressively into the liquid.
- Continue mixing until all of the powder is incorporated into the liquid, about 30 seconds.

**Load the crown:**

- Spread the cement over all of the interior surface of the crown.
- Working time is 2.5 minutes.

**Placement:**

- Seat the crown.
- Wait at least 3 minutes after placement.
- Remove excess with an appropriate instrument.

Please refer to instructions for more detailed information as well as, precautionary and warranty information.
Indications:
• Luting porcelain-fused-to-metal crowns and bridges to tooth structure, amalgam, composite or glass ionomer core buildups.
• Metal inlays, onlays or crowns
• Pre-fabricated and cast posts.
• Orthodontic appliances.

Tooth Preparation:
• Remove provisional restoration.
• Remove all temporary cement.
• Clean tooth with oil-free pumice paste, rinse and dry.
• Do not desiccate the tooth.

Dispense the powder:
• Fluff the powder.
• Dispense 6 level scoops.

Dispense the liquid:
• Keep the vial tip clean.
• Hold vial vertically and dispense 6 drops.

Mixing:
• Mix all of the powder aggressively into the liquid.
• Continue mixing until all of the powder is incorporated into the liquid, about 30 seconds.

Load the bridge:
• Spread the cement over all the interior surface of the retainers.
• Working time is 2.5 minutes.

Placement:
• Seat the bridge.
• Wait at least 3 minutes after placement.
• Remove excess with an appropriate instrument.

Please refer to instructions for more detailed information as well as, precautionary and warranty information.
Vitremer luting cement was designed to be the cement of choice for routine crown and bridge procedures. As such, comparisons will be made with the major competitive products that are used for routine cementations. These are:

**Conventionally setting glass ionomer luting cements**
- KETAC-CEM® RADIOPAQUE (ESPE)
- Fuji I (GC International)
- GlasIonomer Cement, Type I (Shofu, Inc.)
- AquaCem (Dentsply)

**Zinc phosphate**
- Fleck’s® (Mizzy)

**Polycarboxylate cement**
- DURELON® (ESPE)
- Poly-F Plus (Dentsply)

The fourth class of cements, resins (e.g., Panavia®, Kuraray Co., LTD. and C & B Metabond™, Parkell), are more frequently used as a secondary cement in the office. Resin cements are not typically used for routine cementation procedures, however comparisons, where appropriate, are given.

For the purposes of this profile, the following abbreviations are used:

<table>
<thead>
<tr>
<th>Name</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>KETAC-CEM RADIOPAQUE</td>
<td>KETAC-CEM</td>
</tr>
<tr>
<td>Fuji I (old formulation)</td>
<td>Fuji I</td>
</tr>
<tr>
<td>Fuji I (new formulation)</td>
<td>Fuji I (new)</td>
</tr>
<tr>
<td>GlasIonomer Cement, Type I</td>
<td>GlasIonomer</td>
</tr>
<tr>
<td>C&amp;B Metabond</td>
<td>C&amp;B</td>
</tr>
<tr>
<td>3M Vitremer Luting Cement</td>
<td>Vitremer LC</td>
</tr>
</tbody>
</table>
Solubility

It is common knowledge that all cements, excluding resins, erode over time in the oral environment. This wash out can lead to leakage at the margins providing an avenue for bacterial entry resulting in secondary caries, sensitivity or even loosening of the prosthetic device. One of the key features of resin cements is their lack of erosion. Lactic acid erosion was measured in accordance with ISO 9917:1991 (E). In this test, a jet of an aqueous solution of lactic acid impinges on the test specimen. Conventional glass ionomers, polycarboxylates and zinc phosphate are soluble. Resin cements and Vitremer luting cement did not exhibit any measurable solubility (Figure 1).

Figure 1. Lactic Acid Erosion

Fracture Toughness

Fracture toughness is defined as the ability of a material to resist propagation of an initiated crack. As shown in Figure 2, the conventional glass-ionomer products and polycarboxylate cements and are very brittle, i.e., have a low fracture toughness. The zinc phosphate specimens all broke during sample preparation, as such, the fracture toughness could only be estimated. The fracture toughness of Vitremer luting cement is more than double the values of these products. In fact, it is more similar to typical resin systems such as Panavia EX or 3M Restorative Z100.

Figure 2. Fracture Toughness
Radiopacity

Radiopacity was determined in accordance with ISO specification 4049. In this specification, the radiographic density of the test material is compared and normalized to that of a 2 mm thickness of aluminum. A value greater than or equal to one indicates the material is radiopaque. A value less than one indicates the material is radiolucent. Radiopacity is important during crown and bridge procedures for two reasons, it allows the doctor to discover any residual excess material subgingivally and allows the doctor to discover any marginal discrepancies. As shown in Figure 3, Vitremer luting cement is radiopaque, whereas several other cements (i.e., AquaCem, GlasIonomer and C&B Metabond) are not. In the field evaluation, 98% of the respondents stated Vitremer luting cement was distinguishable from tooth structure under X-ray.
Fluoride Release

One of the key features of true glass-ionomer cements is their sustained fluoride release. It is generally believed that this release of fluoride aids in the prevention of secondary caries which may be difficult to detect under a crown or bridge. Fluoride release was measured in-vitro in a buffer solution using a fluoride-ion-specific electrode. As evidenced by Figures 4 and 5, the fluoride release of Vitremer Luting Cement is typical of true glass-ionomer cements. Figure 4 is a composite of two separate fluoride release studies. As the fluoride release of Ketac-Cem in both of these studies was similar, the data was combined to produce this summary graph. Figure 5 demonstrates the fluoride release of Vitremer luting cement is not effected by differing powder liquid ratios.
Adhesion

Another advantage of glass-ionomer cements is their inherent ability to bond to tooth structure without utilizing acid etch or dentin conditioning techniques. While this adhesion is lower than that of properly placed resin systems, clinical experience has proven it to be adequate for retention of most fixed prostheses. The shear adhesion was measured by cementing a sandblasted, 5 mm Rexillium III (a common non-precious alloy, Jeneric Pentron) button to an appropriate substrate. Bovine dentin and enamel substrates were prepared by potting teeth in methylmethacrylate, then grinding and polishing these to expose dentin or enamel. Cements were mixed, according to manufacturers’ instructions, and sandwiched between the Rexillium III and the substrate with a moderate amount of pressure. The samples were placed in a 37°C/95%RH environmental chamber for 2-3 minutes prior to clean-up of the excess. After the excess was removed, the samples were replaced in the environmental chamber for an additional 15 minutes. They were then stored in distilled water at 37°C for 24 hours and shear adhesion values were measured. Figure 6 demonstrates that different powder liquid ratios do not effect adhesion. Additionally, the adhesion of Vitremer luting cement was found to be similar to that of other glass ionomer and polycarboxylate cements and higher than zinc phosphate. Properly placed resin cements exhibit the highest shear adhesion values (Figure 7).

Figure 6. Shear Adhesion to Bovine Enamel and Dentin

Figure 7. Shear Adhesion to Bovine Enamel
Cements are also used to bond to other substrates, i.e., core buildup materials. Figure 8 reveals the shear adhesion of Vitremer luting cement to a variety of core buildup materials. These samples were prepared by substituting the core buildup for the bovine teeth in the procedure detailed above.

Figure 8. Vitremer Luting Cement/Rexillium III Adhesion to Various Core Buildup Substrates
As stated earlier, one of the proposed causes of postoperative sensitivity is low pH (acidic) when the cement contacts tooth structure. Vitremer luting cement and KETAC-CEM were mixed at room temperature (23°C/50%RH). The pH electrode was placed directly into the uncured cement. pH was measured as a function of time. Figure 9 demonstrates the relatively constant, less acidic pH (7 is considered a neutral pH) of Vitremer luting cement compared to the highly acidic, slow rising pH of KETAC-CEM. In Figure 10, the two cements were mixed and held for at 23°C/50%RH for 2 minutes. Samples were placed in a test chamber (37°C/95%RH) where the surface pH was measured as a function of time. Measurements were made by touching the sample with the pH electrode with 100 microliters of distilled water (pH 6.0-7.5) interfacially. The curves show a rapid rise in pH of the KETAC-CEM to a less acidic pH. Although the pH of Vitremer luting cement starts out closer to neutral, it still gradually rises.
Ease of use

Glass-ionomer cements are easy to use. The products are simply mixed, placed in the crown and excess cement is chipped away after set. No additional steps are required to prepare the tooth. In field evaluations, it has been reported that Vitremer luting cement has advantages even over traditional glass-ionomer cements. The powder and liquid are dispensed in an easy to remember 1:1 ratio. The mixture size is adjustable for the variety of applications encountered in routine crown and bridge procedures (less waste).

Traditional glass ionomers may be stringy which may make the crown loading procedure messy. This stringiness is often used as a measure of mix consistency. The cement is considered properly mixed when it strings between the pad and the spatula about 1 inch. The mousse-like consistency of Vitremer luting cement makes placement in the crown easier as the cement is readily scooped from the pad. However, in field evaluations, a few doctors have reported this lack of flow as a negative because they feel they have to take more time to coat the inner aspects of the crown. Clean up of Vitremer luting cement is easily accomplished by removal of the excess in a waxy state, during which time the cement is dislodged from the margins in large sections.

The ease of clean up and ease of mixing offers significant advantages over polycarboxylate and zinc phosphate cements. As stated earlier, there is a window of opportunity to clean up polycarboxylate cements. If excess cement is removed too quickly, while the material is in a rubbery stage, marginal integrity may be compromised by pulling some material away from the margins. If excess is removed too late, sharper, more aggressive instruments are required to scale the material away from the tooth structure because of the adhesion to tooth structure. Zinc phosphate is not an easy cement to mix. In typical mixes, powder is slowly incorporated into the liquid over a period of 1 minute, 20 seconds. Too rapid incorporation results in a limited working time. The cement must also be mixed on a cold glass slab to maximize working time.

Field Evaluation

In a field evaluation, doctors were asked to rate the performance of their current cement and Vitremer luting cement for 6 parameters (ease of mix, length of working time, length of time to set, flow, pressure to seat crown and ease of clean up). Evaluators rated all 6 parameters as good to excellent for Vitremer luting cement (Figure 11). Doctors did not report any advantage or disadvantage for Vitremer luting cement when the ratings for set time, working time or flow were compared. However, most doctors felt the ease of mix and the pressure required to seat a crown was slightly better with Vitremer luting cement than with their current cement. Most doctors also confirmed that the clean up of Vitremer luting cement was easier than their current product.

![Figure 11. Field Evaluation of Vitremer Luting Cement](image-url)
A comparison of typical placement procedures of resin cements to Vitremer luting cement is listed below. Use of resin cements requires more steps and takes longer than use of the Vitremer luting cement. In addition moisture control, via use of a rubber dam, is recommended with the resin cements.

<table>
<thead>
<tr>
<th>3M™ Vitremer™ Luting Cement</th>
<th>C&amp;B Metabond™ Adhesive Cement</th>
<th>Panavia® Dental Adhesive</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 chemical components</td>
<td>6 chemical components</td>
<td>5 chemical components (+ a dentin/enamel bonding agent should be used)</td>
</tr>
<tr>
<td>Prophylaxis</td>
<td>Prophylaxis</td>
<td>Prophylaxis</td>
</tr>
<tr>
<td>Etch Enamel (30 seconds). Rinse and dry.</td>
<td>Etch enamel, Rinse and dry.</td>
<td>Rubber dam is recommended.</td>
</tr>
<tr>
<td>Rubber dam is recommended.</td>
<td>Apply dentin activator (10 seconds). Rinse and lightly dry.</td>
<td>Seal dentin with a dentin/enamel bonding agent.</td>
</tr>
<tr>
<td>Apply lubricant to adjacent teeth and prosthesis.</td>
<td>Mix 4 drops of base and 1 drop of catalyst (less than 5 seconds). Paint tooth.</td>
<td>Mix 1 scoop of powder to 1 drop of liquid (60-90 seconds). After mix spread evenly over pad surface.</td>
</tr>
<tr>
<td>Mix 3 drops of liquid and 3 scoops of powder (30 seconds).</td>
<td>Mix 4 drops of base and 1 drop of catalyst (less than 5 seconds). Add 2 level scoops of powder and stir (5-10 seconds).</td>
<td></td>
</tr>
<tr>
<td>Line prosthesis with mix and seat (1 minute).</td>
<td>Apply cement to restoration and seat (1 minute).</td>
<td>Apply thin layer of cement on casting. Apply thin layer of cement to tooth structure. Seat (1.5 minutes).</td>
</tr>
<tr>
<td>Remove excess with a cotton pledget wet with base.</td>
<td>Remove excess cement.</td>
<td></td>
</tr>
<tr>
<td>Hold casting on tooth until cement is set (3 minutes).</td>
<td>Hold casting on tooth until cement is set (10 minutes).</td>
<td>Apply Oxygard to margins. Wait (3-4 minutes). Wash Oxygard away from margins.</td>
</tr>
<tr>
<td>Clean excess cement from restoration and adjacent teeth with an explorer or scaler.</td>
<td>Clean any cured cement from restoration and adjacent teeth with a scaler.</td>
<td>Clean excess cured material with an explorer and or a disc.</td>
</tr>
<tr>
<td>5 steps</td>
<td>11 steps</td>
<td>9 steps</td>
</tr>
<tr>
<td>Total Time 1=270 seconds</td>
<td>Total Time 1=840 seconds</td>
<td>Total Time 1= 500 seconds</td>
</tr>
</tbody>
</table>

1 Total Time is an approximation without including prophy or, in the cases of resin cements, rubber dam placement.
Strength

In addition to fracture toughness, strength of a cement may be represented by compressive and diametral tensile strengths. ISO 9917:1991 (E) lists a minimum compressive strength needed for a cement as 70 MPa, no corresponding requirements have been set for diametral tensile strengths. A porcelain-fused-to-metal restoration gains much of its supporting strength from the metal coping, not the cement used. The compressive and diametral tensile strengths are depicted graphically (Figures 12 & 13). As expected, the compressive and diametral tensile strengths of the resin cement category are highest. Zinc phosphate and polycarboxylate cements have the lowest strengths. Glass ionomers, including Vitremer luting cement exhibit moderate strength.

![Figure 12. Compressive Strength](image1)

![Figure 13. Diametral Tensile Strength](image2)
Q. Why isn’t Vitremer luting cement light curable like other 3M glass ionomer products?

A. In early market research, doctors were asked to categorize various cement attributes as Musts, Wants or Unnecessary with respect to porcelain-fused to metal crowns. Ability to light cure was considered unnecessary, and, because it created some difficulties in clean up, this path was abandoned.

Q. Does this product produce postoperative sensitivity?

A. Field evaluation reports have indicated very little postoperative sensitivity while using this cement. As stated several times, the root cause(s) of postoperative sensitivity haven’t been defined. However, as technique may play a role in creating postoperative sensitivity (eg. desiccation of the tooth), we cannot categorically make this claim.

Q. Since this cement contains a resin component, what will be the effect of using a eugenol containing temporary cement?

A. Generally speaking, it has long been reported that eugenol containing materials will impede the crosslinking of resin based systems. Because a methacrylate cure plays an important role in Vitremer luting cement, the effect of eugenol contamination was tested. Adhesion to bovine dentin, compressive strength and diametral tensile strengths were measured with slight and heavy contamination from a eugenol containing cement. These values were compared to noncontaminated samples. There was no significant difference between the contaminated and noncontaminated values. However, removal of all temporary cement is critical regardless of temporary or permanent cement used. Temporary cements are very weak materials which reduce the overall strength of the restoration. As such, prophylaxis of the tooth preparation is recommended prior to permanent cementation.

Q. Can the working time be adjusted?

A. Yes. As shown in several earlier figures (Figures 1, 3, 5, 6, 7, 12, 13), there is a very slight effect on the performance properties of Vitremer luting cement when different powder:liquid ratios are used (ranging from 1.2:1 to 1.8:1). However, working time and the corresponding set time can be adjusted by changing these ratios. A lower powder:liquid ratio, e.g. 1.4:1 will lengthen working and set time, while a higher ratio (1.8:1) will shorten them.

Q. Can this cement be used for porcelain or composite crowns, inlays or onlays?

A. Yes and no. Porcelain veneer crowns, composite crowns, porcelain or composite inlays and onlays rely on the tooth structure and the overall restoration for much of their strength. Frequently, these restorations are translucent and cement shade is an important characteristic of the total restoration. As such, we cannot recommend the use of Vitremer luting cement for these applications. There are more appropriate cements for these bonded restorations. On the other hand, glass-ionomer cements have long been
used for permanent cementation of porcelain jacket crowns. Porcelain jacket crowns have thicker walls, use alumina reinforced core porcelain or are specially fired to increase the strength of the prosthesis over other porcelain restorations. These are typically anterior restorations. Vitremer luting cement can be used in this application.

**General Information**

3M™ Vitremer™ Glass Cement is a glass-ionomer system comprised of two parts: a powder and a liquid. The powder is a radiopaque, fluoroaluminosilicate glass. The liquid is an aqueous solution of a modified polyalkenoic acid. Vitremer luting cement provides the major benefits of glass-ionomer cements—adhesion to tooth structure and fluoride release, along with additional benefits of low solubility, improved fracture toughness and a low viscosity, non-stringy, slump-resistant mix.

Vitremer luting cement is a self-cure system using two dark-cure reactions to provide the improved properties.

**Indications**

Vitremer luting cement is indicated for use when luting:

- porcelain-fused-to-metal crowns and bridges to tooth structure, amalgam, composite or glass ionomer core build ups.
- metal inlays, onlays or crowns.
- pre-fabricated and cast post cementation.
- orthodontic appliances.

Vitremer luting cement is not indicated for composite or porcelain inlays or onlays, composite or all porcelain crowns. However, it may be used for luting porcelain jacket crowns.

**Precautions for Dental Personnel and Patients**

Liquid contains HEMA (2-hydroxyethylmethacrylate). HEMA is severely irritating to the eye and is a known contact allergen. A small percentage of the population is known to have an allergic response to acrylate resins. To reduce the risk of allergic response, minimize exposure to these materials. In particular, exposure to uncured resin should be avoided. **Use of protective gloves and a no-touch technique is recommended.** If skin contacts liquid or powder/liquid mix, wash skin immediately with soap and water. Acrylates may penetrate commonly used gloves. If glove contacts liquid or powder/liquid mix, remove and discard glove, wash hands immediately with soap and water, and then reglove.

Liquid and powder/liquid mix may cause eye irritation upon contact and may be mildly irritating to oral soft tissue upon contact. Avoid contact with eyes and minimize contact with oral soft tissue. If accidental contact with eye occurs, flush immediately with large amounts of water. If irritation persists, consult a physician.
Instructions for Use

1. **Remove the provisional** restoration and all residual temporary cement. Thoroughly clean the preparation with an oil-free pumice paste. Rinse with water and let dry.

   **Note:** Do not desiccate the tooth. Desiccation of tooth structure is believed to cause postoperative sensitivity in some individuals.

2. **Pulp protection:** Use a hard setting calcium hydroxide material with near exposures.

3. **Casting preparation:** Thoroughly clean interior surfaces of cast crown, inlay or onlay.

4. **Dispense powder and liquid:**

   The standard powder/liquid ratio of 1.6:1 by weight can be obtained by using an equal number of level scoops of powder and liquid drops.

   Three scoops of powder and three drops of liquid will provide an adequate amount of material to seat 1 typical crown.

   Shake the jar to fluff the powder before dispensing. Insert the scoop into the jar. Overfill it with loosely packed powder and withdraw it against the plastic leveler to remove excess powder and obtain a level scoop. Dispense the desired number of powder scoops onto the mixing pad.

   **Note:** The glass-ionomer powders are sensitive to high humidity. Store with jar caps securely tightened and away from high humidity.

   To obtain a proper liquid drop size, hold the Vitremer luting cement liquid vial vertically with the dropper tip down and without the tip contacting the mixing pad. Squeeze the vial to dispense the desired number of liquid drops onto the mixing pad.

5. **Mixing:** Using a cement spatula, mix the powder into the liquid. To minimize water evaporation and maximize working time, confine spatulation of the powder and liquid to a small area of the mixing pad. All of the powder should be incorporated into the liquid within 30 seconds.

6. **Working time** of the standard powder/liquid ratio is at least 2.5 minutes from the start of mix at a room temperature of 73°F (23°C). Higher temperatures and vigorous spatulation will shorten working time. Lower temperatures will lengthen working time.

   **Note:** Working time can be lengthened by using refrigerated liquid or by mixing on a cold slab.

7. **Crown placement:** Load the crown by spreading a layer of the cement over all the interior surfaces of the crown. Seat crown. Maintain pressure on crown to maintain position during setting process.

8. **Clean up excess.** Excess material can be removed when cement reaches a waxy stage after a minimum of 3 minutes from placement in the mouth (37°C or 98°F). Use a suitable instrument for this process.
Storage and Use

1. Shelf life at room temperature is 24 months. See outer package for expiry date.

2. The glass ionomer system is designed to be used at room temperatures of approximately 70-75°F (21-24°C).

3. Glass ionomer powders are sensitive to high humidity. Store with jar caps securely tightened and away from high humidity.

4. Do not substitute 3M™Vitremer™ Core Buildup/Restorative System powder or liquid for Vitremer luting cement powder or liquid.

Warranty

3M will replace such product that is proved to be defective. 3M does not accept liability for any loss or damage, direct or consequential, arising out of the use of or the inability to use these products. Before using, the user shall determine the suitability of the product for its intended use and user assumes all risk and liability whatsoever in connection therewith.
## Competitive Permanent Cement Product Comparison

<table>
<thead>
<tr>
<th></th>
<th>Hybrid GI</th>
<th>Conventional Glass Ionomers</th>
<th>Polycarboxylic Acid</th>
<th>Zinc Phosphate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Vitremer</td>
<td>ESPE KETAC-CEM</td>
<td>GC Fuji I</td>
<td>GC Fuji I (new)</td>
</tr>
<tr>
<td>Solubility (µ/hr)</td>
<td>0</td>
<td>6</td>
<td>2</td>
<td>3.2</td>
</tr>
<tr>
<td>Adhesion to Enamel (MPa)</td>
<td>8.9</td>
<td>8.7</td>
<td>7.8</td>
<td>N/A</td>
</tr>
<tr>
<td>Adhesion to Dentin (MPa)</td>
<td>4.3</td>
<td>2.9</td>
<td>4.3</td>
<td>N/A</td>
</tr>
<tr>
<td>Diametral Tensile Strength (Psi)</td>
<td>3373</td>
<td>3264</td>
<td>3038</td>
<td>3014</td>
</tr>
<tr>
<td>Compressive Strength (Psi)</td>
<td>19222</td>
<td>22406</td>
<td>24578</td>
<td>23409</td>
</tr>
<tr>
<td>Fracture Toughness (MN/m3/2)</td>
<td>0.78</td>
<td>0.34</td>
<td>0.33</td>
<td>0.35</td>
</tr>
<tr>
<td>Powder:liquid ratio</td>
<td>1.6:1</td>
<td>3.8:1</td>
<td>1.8:1</td>
<td>1.8:1</td>
</tr>
<tr>
<td>Mix Time</td>
<td>30 sec</td>
<td>1 min</td>
<td>20 sec</td>
<td>20 sec</td>
</tr>
<tr>
<td>Working Time 23°C/50%RH</td>
<td>2.5 min</td>
<td>3.5 min</td>
<td>2.25 min</td>
<td>2 min</td>
</tr>
<tr>
<td>Set Time @37°C/95%RH</td>
<td>3 min</td>
<td>5 min</td>
<td>5 min</td>
<td>4 min</td>
</tr>
<tr>
<td>Radiopacity</td>
<td>1.12</td>
<td>1.18</td>
<td>1.45</td>
<td>0.87</td>
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<tr>
<td>Fluoride Release</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>High</td>
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