Instruction Manual

Professional Windshield Repair Systems

A **Step by Step** Guide and Troubleshooting Manual for Better Windshield Repairs

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1. Benefits of Windshield Repair

According to the Repair of Laminated Auto Glass Standard, or ROLAGS™, windshield repair is the process of removing air from a break, either by vacuum or displacement, and filling the break with windshield repair resin. Compiled under ANSI guidelines, ROLAGS™ was developed to provide a voluntary standard for windshield repair industry professionals.

There are multiple benefits of windshield repair that should be explained to your customers. First and foremost, properly repairing a damaged windshield restores the structural integrity of the glass. Because the windshield is integral to airbag deployment systems, cabin structure, and to keep the occupants in the vehicle during an accident, ensuring that it is structurally sound is vital to occupant safety.

Secondly, repairing a windshield retains the integrity of the original factory seal. A windshield installed in a factory setting where human hands do not touch the glass and adhesives have ample time to cure cannot be duplicated with an aftermarket installation.

While no repaired break in glass will ever disappear completely, a significant improvement in clarity can be achieved, often to the point of being unnoticeable.

Windshield repair is more cost effective than replacement. At the time of this writing, the average price of a windshield repair insurance claim ranges between $50 and $75. Replacement costs start at around $200 and increase depending on the type of vehicle. And while a replacement can take several hours or more, a typical repair is completed in less than 30 minutes.

Finally, windshield repair conserves natural resources and reduces waste. Every repaired windshield is one less piece of glass that ends up in a landfill. Because windshields are made of laminated glass, it is currently very cost prohibitive to recycle them. Therefore, in most cases replaced windshields are simply thrown away. Alternatively, the waste from a windshield repair will fit in the palm of your hand.

2. Types of Breaks

There are multiple types of breaks you will encounter as a windshield repair technician. While they are all different, there are some shared characteristics to be aware of. A windshield can be broken in two ways. One is caused by impact, when an object strikes the glass. The other is through stress. Stress can be caused by damage to the frame of a windshield or by a windshield that has been improperly installed. In either case, the result of stress damage is typically a crack extending from an edge of the glass.

Now let's look at the types of breaks that result from impact. Each have distinct characteristics and present unique challenges in repairing. The terms and definitions used here are based on industry standards as defined by ROLAGS® with additional clarification by Delta Kits.

- **Bullseye**
  A bullseye (see Figure 1) is a separated cone in the outer layer of the glass that results in a dark circle with an impact point. The dark circle you see in a bullseye is an air pocket in the glass and/or air trapped between the glass and the laminate.

- **Star Break**
  A star break (see Figure 2) exhibits a series of legs that emanate from the break, giving it the appearance of a star. This type of break has multiple variations in size and the number of legs present.

- **Combination Break**
  A combination break (see Figure 3) is any break that exhibits characteristics of multiple breaks. This could be a bullseye with cracks radiating from it or a crack emanating from the damage.

- **Surface Pit**
  A surface pit is a nick in the glass associated with normal wear and tear. Surface pits do not have any cracks or air pockets and will not crack out if not repaired. Repairs on surface pits are for cosmetic improvement only.

- **Crack**
  Cracks are classified by their length. A short crack is anything six inches in length or less while a long crack is anything greater than six inches in length. An edge crack is one that extends to any edge of the windshield. If you have an edge crack that lacks an impact point it was likely caused by stress.

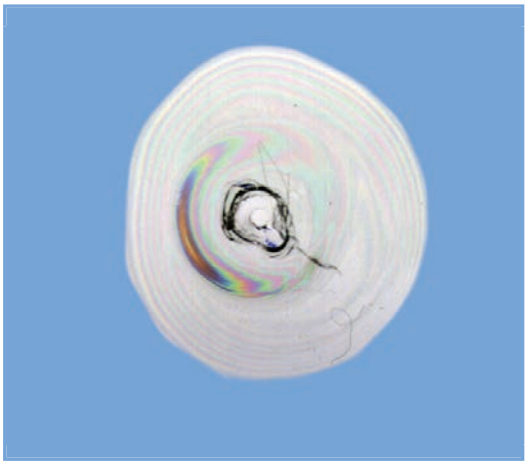


Figure 1: Bullseye

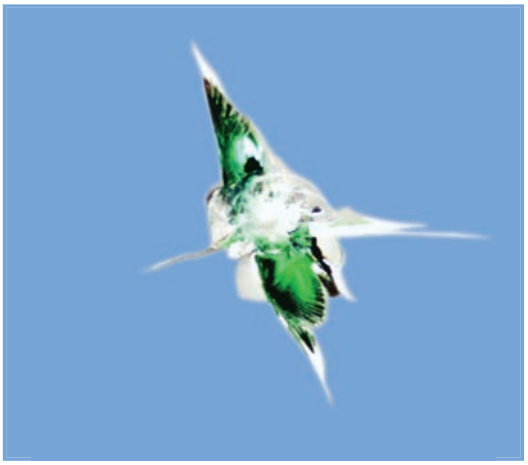


Figure 2: Star Break

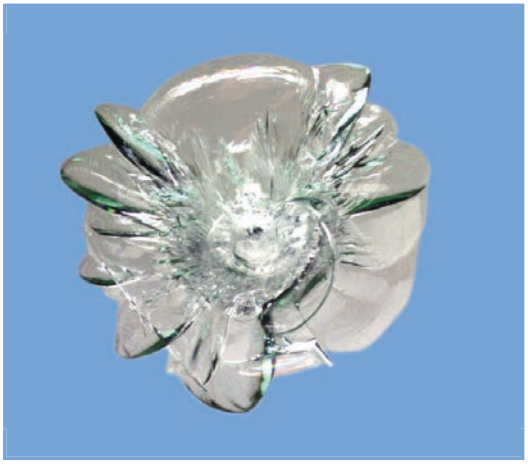
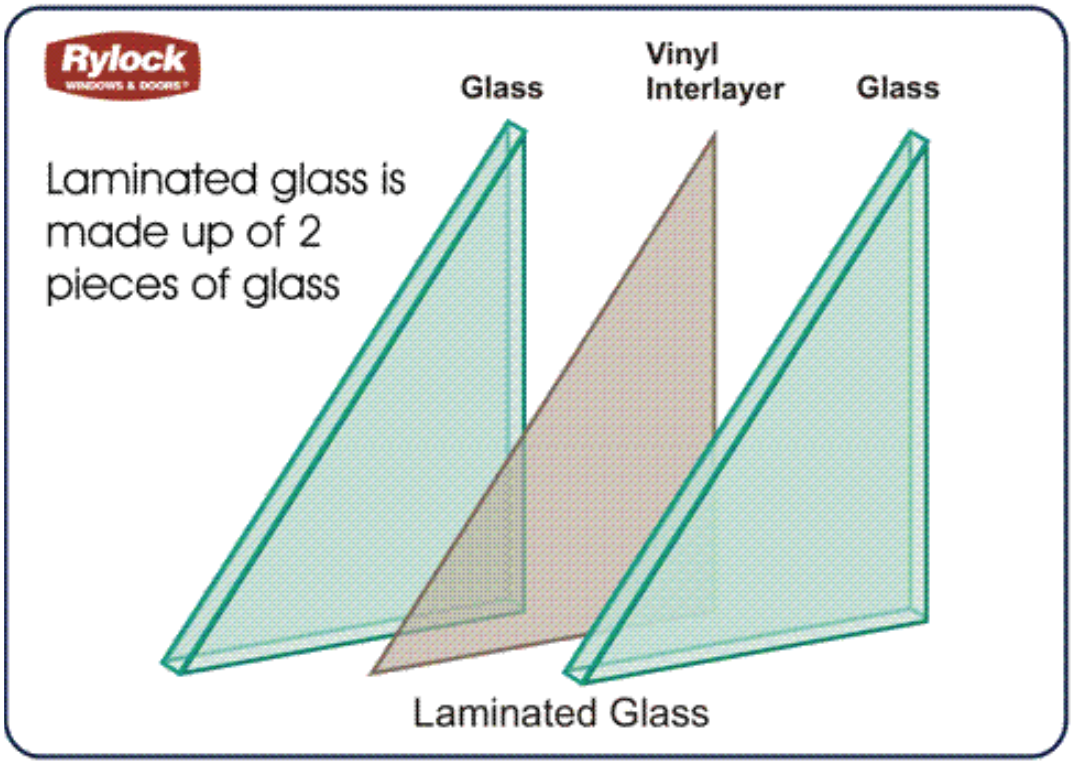


Figure 3: Combination Break

3. Laminated Versus Tempered Glass

Note that only laminated glass can be repaired. Tempered glass cannot be repaired. Auto manufacturers started using laminated glass for windshields in the 1920s. Today, by order of federal law, all windshields installed in vehicles sold in the USA are required to be laminated. While most vehicle glass is tempered, laminated glass is becoming increasingly popular in side and back window applications due to its insulating and sound reduction properties. To identify the type of glass used in front side and back applications, look for a stamp, commonly referred to as a “bug” in the auto glass industry; it can be found somewhere around the perimeter of the glass. The bug indicates whether the glass is laminated or tempered and contains additional information including the manufacturer and any special features the glass may have.

Laminated glass is constructed of three distinct layers. The layers of glass are called ***lites*** and there is an inner lite and an outer lite. Sandwiched between the lites of glass is a material called ***Polyvinyl Butyral***, or PVB. When the glass is damaged, this PVB layer keeps the windshield from shattering into multiple pieces.



4. Repair Limitations

While you will be able to repair many different types of windshield damage with your new Delta Kits Windshield Repair System, not all damage is repairable. Again, the industry standards for repair limitations are defined in ROLAGS® and those definitions are cited here. The windshield should not be repaired in the following situations:

- If the damage penetrates both the inside and outside layers of the windshield
- If the damage is in the Driver's Primary Viewing Area (DPVA) and:
    - The diameter of the damage is larger than one inch (25mm)
    - The finished pit will be greater than 3/16 inch (5mm)
    - The repair will be within four inches of another repair as this can cause binocular vision
- Edge cracks that intersect the edge in more than one place
- If the repair will, in your judgment, interfere with the safe operation of the vehicle
- Damage with a pit size greater than 3/8 of an inch
- Stress cracks
- Damage with three or more long cracks emanating from a single impact point
- The damage contains visual impurities that cannot be removed
- Delaminated glass (See Page 8). This is a condition where the Polyvinyl Butyral inner layer has deteriorated, causing the glass to separate from the PVB. The result is air and/or moisture trapped between the glass and the PVB.

Delamination: Note the watery looking area above the windshield wiper.

5. Safety

The resins contained in your windshield repair system contain acrylic acids that etch glass to improve bonding strength. It is important to use personal protective equipment to prevent chemical contact with your skin and eyes. A barrier cream or nitrile (not latex) gloves should be used together or independently to protect your skin.

Safety glasses will provide protection for your eyes from chemicals and glass fragments.

Be sure to read the Safety Data Sheets (SDS) included with your windshield repair system for additional important safety information. Keep these SDS in your tool box where they will be readily available in the event of an emergency.

Resin spills should be cleaned immediately with warm soapy water to prevent damage to plastic, metal, and painted surfaces. Denatured alcohol may also be used to clean up resin and will not harm most plastic, metal and painted surfaces, but be sure to test on an inconspicuous spot before use. A hood protector is recommended for protecting delicate surfaces from scratches and chemical spills.

Keep your SDS in your tool box where they will be readily available in the event of an emergency.

6. Preparation for Repair

6.1. Inspecting the Damage

Before starting any repair it is important to carefully assess the damage. If the damage is repairable, explain to your customer that there is a slight risk of the damage spreading during the repair process due to the fact that broken glass is inherently unstable. It is also important for your customer to understand that a completed repair will not make the damage disappear and that a scar will always be visible. Remember that the number one goal of windshield repair is to restore the structural integrity of the glass, cosmetic improvement is secondary.

6.2. Checking for Hydrophobic Coatings

Check for hydrophobic coatings that repel water, as these coatings will prevent the pit resin from adhering to the glass surface. To check for these coatings, spray a small amount of water or glass cleaner on an area of the windshield away from the damage and see if it beads up. If it does, there is a coating on the glass. If you are still not sure, proceed as if a coating exists that needs to be removed.

There are two ways to effectively remove hydrophobic coatings:

- Use 0000 steel wool to scrub the surface of the glass for a minimum of 20 seconds over and around the pit area, then re-test as instructed above. Repeat if necessary. Be sure to scrub about ¼” beyond any area where the damage reaches the surface.
- The second option is to use a moisture evaporator to heat the damaged area for 20 seconds. This method not only nullifies the non-stick properties on the exterior glass surface, but also on the inside of the damage, and of course removes any moisture within the damage (see section 6.3).

6.3. Check for Moisture in the Break

Moisture in a break may appear as a grey shadow or can be completely clear, making it difficult to identify. To determine if moisture exists within the damage, apply intermittent pressure to the surface of the glass with a probe causing the water to move within the damage. If you see movement within the damage, moisture is present and should be removed by applying heat with a moisture evaporator for 20 seconds. You should see the water boil at approximately 15 seconds and then quickly evaporate. Allow the glass to cool to the proper working temperature before proceeding (see section 6.4).

6.4. Check the Temperature of the Glass

Ideally the glass temperature should be between 70 and 100 degrees Fahrenheit (21 to 38 degrees Celsius) before repairing. Use an infrared thermometer to monitor the temperature of the glass both before and during the repair process. If you do not have an infrared thermometer, carefully place your hand against the glass. If the glass is too hot to keep your hand on it continually, it will need to be cooled before proceeding. If the glass feels cold to the touch, the glass should be warmed before proceeding.

If the glass is too hot, it can be cooled by opening the cabin windows, running the air conditioner through the defrost vents, covering the glass with a hood protector, moving the vehicle into the shade or indoors. You can also use the heat exchanger to spot cool a small area of the glass.

If the glass is too cold, it can be warmed by turning warm air on through the defrost vents, bringing it indoors, or using a hair dryer. Whenever possible, heating from the outside of the glass and maintaining a consistent temperature throughout the repair process is preferable.

Important: The glass and resin temperature should be within 10 degrees Fahrenheit (5 degrees Celsius) of each other to minimize the risk of thermal shock when the resin is injected into the glass.

7. Completing the Repair

With the inspection and preparation completed it's now time to begin the actual repair.

7.1. Inspection Mirror

Placing the inspection mirror on the inside of the windshield will allow you to monitor the progress of the repair from outside the vehicle.

7.2. Clean the Impact (Pit) Area

Use a scribe or spring hammer to gently remove any loose glass and contaminants from the pit area and use a brush or dust blower to remove the remaining fine dust.

7.3. Prepare the Bridge

Retract the adjusting screw and injector cylinder so they do not contact the glass as the bridge assembly vacuum cup is mounted to the glass and remove the injector plunger.

Loosen the center adjustment knob and center the vacuum cup on the bridge base to provide maximum adjustment range once the bridge has been attached to the windshield.

Orient the bridge so that the vacuum cup is above or to the side of the damage to prevent resin from coming into contact and damaging the rubber vacuum cup pad. If possible, position the injector so it is as close to you as possible for easy access.

Attach the **B150** and **B250 Bridge** by flipping the locking lever to the horizontal position. The **B300** will be attached by activating the pump. Center the injector end seal hole directly over the pit when placing the bridge on the glass. You can check the injector's orientation by looking down the barrel or by using a centering tool, and making small adjustments by using the adjustment knob under the locking lever until the injector is correctly positioned over the impact point.

7.4. Leveling the Bridge and Tightening of the Injector

When the bridge is properly positioned, screw the injector cylinder down until the white end seal just touches the glass. If using the **B150 Bridge,** then advance it an additional quarter (1/4) of a turn. For the **B250** and the **B300 Bridge**, advance it one half turn more.

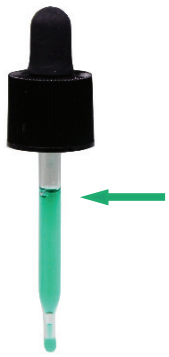
Turn the leveling screw, located on the back of the bridge, down until the black rubber shoe just touches the glass. Then for the **B150 Bridge,** advance it an additional quarter (1/4) of a turn. For the **B250** and the **B300 Bridge**, advance the leveling screws an additional two turns.

The goal is to uniformly compress the white end seal against the glass. The amount of the end seal visible between the glass and injector barrel should be equal on all sides.

Another way to check the compression of the end seal is to measure the distance between the glass and the bridge base with a ruler. The distance between the glass and the base should not vary more than 1/8” or 3mm from front to back. Remember, this is a general guideline and may vary depending on the curvature of the glass.

7.5. Loading the Injector with Resin

Load the injector with .2 ml (approximately 14 drops) of Premuim Bond 20 resin. Be sure to get the resin to the bottom of the injector so it fills the end seal. Use of an eye dropper or syringe will make it easier to fill the end seal and reduce resin waste.



Green resin used to illustrate the recommended fill line of the glass resin dropper.

Load the Injector with .2 ml (approximately 14 drops) of Premuin Bond 20 Windshield Repair Resin

7.6. Use of the Screw Type Injector (B150 Standard)

7.6.1 Pressure Cycle

To initiate the pressure cycle, screw the plunger into the cylinder. As the tip of the plunger enters the end seal you will notice increased resistance. Continue screwing the plunger into the cylinder until you begin to see resin flowing into the break and there is a slight outward expansion of the outer perimeter of the end seal.

Leave it in the pressure cycle for approximately five minutes.

7.6.2 Vacuum Cycle

To initiate the vacuum cycle, slowly unscrew the plunger until you see bubbles rising up through the resin and into the injector. Allow 30 seconds, or until you can no longer see air movement in the damage. Continue unscrewing the injector until you feel significantly less resistance, indicating that the tip of the plunger has cleared the top of the end seal, allowing trapped air to escape. At this stage, the distance between the two knobs will be approximately 1/4” or 6mm.

If after the first pressure and vacuum cycles have been completed there is no visible change in the appearance of the repair, call Delta Kits for assistance. Possible remedies include, increasing plunger pressure, reducing cylinder pressure, adding resin, flexing the damage, adjusting the temperature of the glass, re-positioning the bridge, removing the bridge, and starting over at step 7.3, etc.

7.6.3 Repeat Pressure and Vacuum Cycles

Repeat pressure and vacuum cycles until air is removed and replaced with resin.

7.7. Use of the Spring Type Injector (B250 & B300 Standard B150 Optional)

7.7.1 Pressure Cycle

To initiate the pressure cycle, hold the cylinder knob with one hand and lift the plunger with the other hand, then turn it 1/4 turn clockwise until it locks into the vacuum position (piston retracted). ***This is not a misprint***, you must first set the plunger to the vacuum position in order to initiate the pressure cycle!

Turning clockwise, screw the plunger into the cylinder until it stops. DO NOT OVER TIGHTEN. While holding the cylinder knob to keep it from moving, lift the plunger and turn it 1/4 turn clockwise again, this time allowing the spring to extend the piston to the top of the end seal. Apply a slight amount of thumb pressure forcing the plunger tip into the end seal until you see the resin flow and there is a slight outward expansion of the white end seal. Caution: Keep a minimum 1/8” or 3mm distance between the top of the cylinder and the bottom of the plunger knob. Failure to heed this caution may result in leakage, damage to the seal or damage to the glass.

Leave in the pressure cycle for approximately five minutes.

7.7.2 Vacuum Cycle

To initiate the vacuum cycle, hold the cylinder knob firmly with one hand and slowly pull up on the plunger until you see bubbles rising up through the resin and into the injector. Continue pulling up the plunger until you can rotate clockwise and lock into the vacuum (piston retracted) position. Allow 30 seconds, or until you can no longer see air movement in the damage.

If after the first pressure and vacuum cycles have been completed there is no visible change in the appearance of the repair, call Delta Kits for assistance. Possible remedies include, increasing plunger pressure, reducing cylinder pressure, adding resin, flexing the damage, adjusting the temperature of the glass, re-positioning the bridge, removing the bridge and starting over at step 7.3, etc.

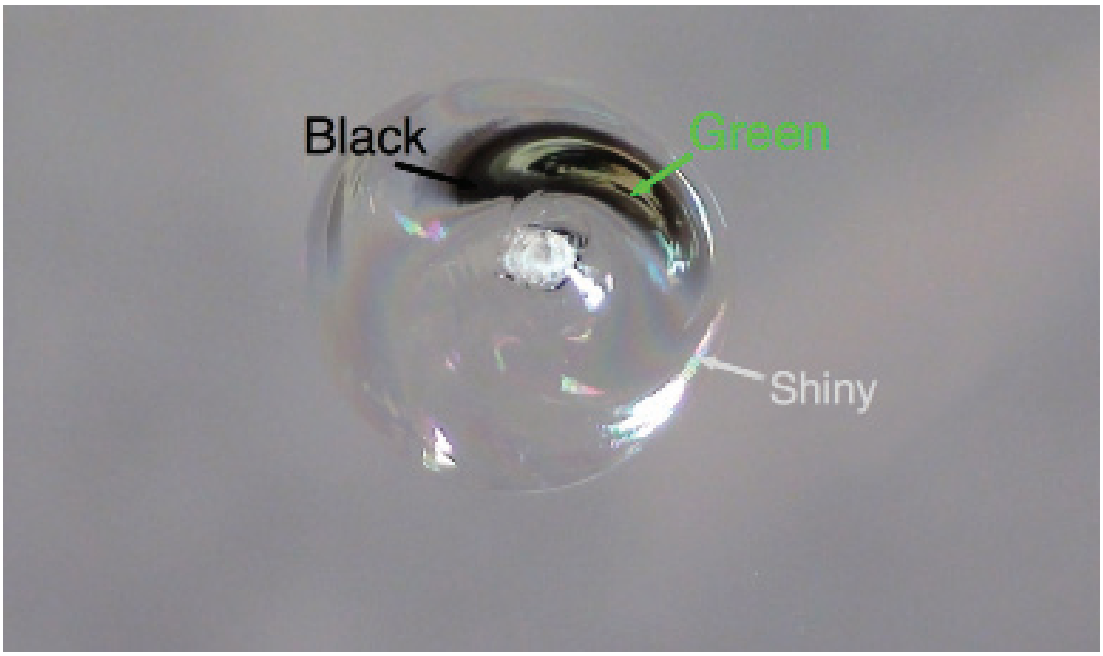
7.7.3 Repeat Pressure and Vacuum Cycles

Repeat pressure and vacuum cycles until air is removed and replaced with resin.

7.8. In general, the pressure and vacuum cycles should break down as follows, though more may be necessary. Two to four complete cycles is the average.

Cycle 1	Pressure: 5 minutes	Vacuum: 30 seconds
Cycle 2	Pressure: 2 minutes	Vacuum: 30 seconds
Cycle 3	Pressure: 2 minutes	

Always end your repair on a pressure cycle to insure that the break is filled completely. Keep repeating cycles until you see no more black, green, or shiny pockets in the break, as these indicate air. The image below shows air pockets in a break.



Visible air pockets in a break.

7.9. Before removing the bridge assembly from the glass, inspect the break from multiple directions to insure all the air has been removed. Air may not be visible from certain angles so this step is crucial.

7.10. Application of Pit Resin and Curing Tab

Remove the bridge by placing the flip lever in the vertical position and use your fingernail or a plastic stick to lift the edge of the rubber pad, then remove the bridge from the glass, cover the end of the injector with a clean paper towel to keep it from dripping and set it aside. Do not turn the bridge upside down at any time as resin may leak, causing damage to the injector, or the vehicle's surface. ***Cover the injector immediately to protect it from ambient UV light.*** Place one drop of pit resin just below the impact point, making sure there are no air bubbles present. If you see air bubbles use a straight pin to pop them. Use the curing tab to move the pit resin over the impact point and lay it flat, using care not to allow air bubbles into the resin. DO NOT push on the curing tab as this will force the pit resin you just applied out of the impact point, causing you to have to repeat this step.

7.11. Cure the Repair

Using your curing lamp, expose the finished repair to UV light for a period of five minutes. Depending on the lamp used, a surface cure may be achieved in a minute or less, however a full five minutes is recommended to ensure the resin is fully cured all the way through. Remember, the outer layer of glass blocks 70% of UV rays!

7.12. Scraping Repair Flush

Remove the curing tab, and with a new razor blade held at a 90 degree angle to the glass, use firm and quick strokes to scrape the resin flush with the surface of the glass. This will prevent the resin from interfering with the wipers.

7.13. Polish the Pit

Apply a drop of pit polish to the finished repair and rub vigorously with a paper towel for about 60 seconds or until the surface of the cured resin shines. Polishing improves the cosmetic appearance of the repair by removing scratches left in the cured pit resin and puts a protective coating on the surface.

8. Care of the Equipment

8.1. Injector Assembly

Do not turn the injector upside down during bridge removal and/or injector cleaning.

Separate plunger from cylinder prior to cleaning. Use denatured alcohol to clean the injector assembly between uses to prevent resin from curing in the equipment. Be sure all parts are completely dry and alcohol free prior to next use.

8.2. Change End Seals

Change end seals after approximately ten repairs.

8.3. Care of Suction and Vacuum Cups

A dirty or damaged vacuum cup will interfere with the bridge staying on the glass. Do not allow resin to contact the vacuum cup and wash it periodically with warm water or wipe with denatured alcohol, dry thoroughly. Do not soak rubber vacuum cup parts in alcohol.

Wipe bridge base clean with denatured alcohol.

Change End Seals after approximately ten repairs.

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