A step by step guide and trouble shooting manual for a better windshield repair
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1. Know the benefits of Windshield Repair

According to the Repair of Laminated Auto Glass Standards, or ROLAGS® (National Glass Association, 2007), windshield repair is the process of removing air from a break, either by vacuum or displacement, and filling the break with resin.

There are multiple benefits of windshield repair that should be explained to your customers. First and most importantly, repairing a break restores the structural integrity of the glass by removing all of the air. Because the windshield is integral to airbag deployment systems, cabin structure, and to keep the occupants in the vehicle during an accident, having one that is structurally sound is important.

Secondly, repairing a windshield retains the strength of the original factory seal, assuming that it hasn’t been replaced before. 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. There is a wide range of quality in the windshield replacement industry and there are technicians that do a superb job.

A repaired windshield also improves the visibility and clarity of the break, often to the point where you really have to look to see the repair. While no repaired break in glass will ever disappear, a significant improvement in clarity can be achieved.

With the price of a windshield repair between $50 and $75 at the time of this writing, having a repair done is also more cost effective than a replacement. Replacement costs start at around $200 and go up from there depending on the type of vehicle. And while a replacement can take several hours or more, a repair is often completed in less than 30 minutes.

Finally, every repaired windshield is one less piece of glass that does not get sent to the landfill. Because windshields are made of laminated glass, it is currently very cost prohibitive to recycle them. This means that they are simply thrown away. With many consumers today concerned about their impact on the environment, windshield repair is seen as an environmentally friendly option.

2. Types of breaks

There are multiple types of breaks you will encounter. And while they are all different, there are some shared features. There are two ways that a windshield can be broken. One is through impact, when an object strikes the glass. The other is through stress. Stress occurs when either the frame of the windshield has been warped or a windshield has been forced into the frame and usually results in the windshield cracking.

Now let’s look at the types of breaks that result from impact. They each have distinct characteristics and present unique challenges in repairing. The terms and definitions used are industry standards as defined by ROLAGS®.
2.1. Bull’s eye
A bull’s eye (see Figure 1) is a separated cone in the outer layer of glass that results in a dark circle with an impact point. The dark circle you see is a bull’s-eye is an air pocket in the glass.

2.2. Star break
A star break 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 number of legs present. Figure 2 shows an example of a star break.

2.3. Combination break
A combination break is any break that exhibits characteristics of multiple breaks. This could be a bull’s eye with cracks radiating from it or a crack emanating from the damage. (Figure 3)

2.4. Surface pit
A surface pit is a nick in the glass associated with normal wear and tear. They do not have any cracks or air pockets.

2.5. 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 any impact point is was likely caused by stress.

3. Laminated Versus Tempered Glass
Note that only laminated glass can be repaired, not tempered glass. All windshields since 1939 are made of laminated glass because of federal law. While most other pieces of glass in a vehicle are tempered, some makes and models do contain laminated glass in the side and back windows. To be sure look for a stamp, called a bug, somewhere around the perimeter of the glass. The bug will tell you what type of glass the window is made from, and by what company it was manufactured.

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 plastic called Polyvinyl Butyral, or PVB. When the glass is damaged, this PVB layer keeps the windshield from breaking into multiple separate pieces.

4. Repair limitations
While you will be able to repair many different types of windshield damage with your new Delta Kits system, not all damage is repairable. Again, the industry standards for repair limitations are defined in ROLAGS® and those definitions are what 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 and will be within four inches of another repair as this can cause a blind spot for the driver,
- Edge cracks that intersect the edge in more than one place,
- If the repair will, in your judgment, will 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,
- Or the damage contains visual impurities that cannot be removed.
- Glass that has delaminated. This is a condition where the Polyvinyl Buteral inner layer has deteriorated.

![Delamination: Note the white line at the edge of the glass.](image)

5. Safety

5.1.
The resins contained in your windshield repair system contain acrylic acid, which etches glass and allows for a strong bond of the repair. Because resin contains acrylic acid and other chemicals, it is important to use personal protective equipment to prevent chemical contact with your skin and eyes. A barrier cream lotion, such as the one included with your system, 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 as well as small bits of glass.
Be sure to read the Material Safety Data Sheets (MSDS) included with your system for important safety information. Delta Kits recommends that you keep MSDS sheets for all chemicals you use in your tool box so that they are readily available in the event of an accident.

Resin spills should be cleaned immediately with warm soap and water to prevent damage to the surface. If the spill is not on paint, denatured alcohol may also be used to clean up resin. A hood protector is a great tool for protecting the client’s paint job from spills.

6. Preparation for repairing

6.1. Inspecting the damage
Before starting any repair it is important to assess the damage so that you know what you’re dealing with before you begin. If the damage is repairable, be sure to explain to your customer that there is a 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, not make the damage completely vanish.

6.2. Checking for hydrophobic coatings
Check for hydrophobic coatings that repel water as these coatings will prevent the pit resin from adhering. To check for these coatings, spray a small amount of water 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.

There are two ways to effectively remove these coatings. First, scrub the area of the repair with 0000 steel wool until you see the coating ball up. Secondly, if your system included a moisture evaporator, use it to apply heat to the damaged area for 15 seconds to burn the coating off.

6.3. Check for moisture in the break
Moisture in a break appears as a grey shadow that can be manipulated by applying pressure with your probe. If moisture is present, apply heat with moisture evaporator for 15 seconds. You should see the water boil and evaporate through the impact point.

6.4. Check the temperature of the glass.
Ideally the glass temperature should be between 70 and 100 degrees Fahrenheit (21 to 38 degrees Celcius) before repairing.

If the glass is too hot, it can be cooled by opening the cabin windows, turning cool air on through the defrost vents, or moving the vehicle into the shade. 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.

Use an infrared thermometer to gauge the temperature of the glass both before and during the repair process.

**7. Completing a repair**

With the inspection and preparation completed it’s now time to begin the actual repair. We’ll go through the process step-by-step for a standard repair and show each step in detail.

**7.1. Clean pit using scribe and brush/blower**
Begin by taking your scribe or spring hammer and gently clean the pit of loose glass and use the brush or blower to remove any debris that remains.

**7.2. Mount bridge with vacuum cup above damage**
Next, take the bridge assembly and make sure that the adjusting screws and injector barrel are retracted so as not to interfere with the vacuum cup setting completely on the glass.

Make sure the adjusting slot is centered so that you have the maximum range if any adjustments are necessary 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 with the rubber and damaging it. Also make sure that the injector is facing you for easy access.

The **B300** will be attached by activating the pump and the **B250** by flipping the locking lever to the horizontal position. Try and 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 until the injector is correctly positioned.

**7.3. Proper leveling of the bridge and tightening of the injector**
When the bridge is properly positioned screw the injector barrel down until the end seal just touches the glass and then advance it one half turn more.

Screw the leveling screws down until they just touch the glass. You will then advance the leveling screws and additional two turns.

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

Another way to check the compression of the end seal is to measure the distance between the glass and the bridge plate with a ruler. Each of the three corners of the bridge should be within 1/8” of
each other. Remember, this is a general guideline and may vary depending on the curvature of the glass.

7.4. Load the injector with approximately 7 drops of MagniBond resin. Be sure to get the resin to the bottom of the injector so it fills the end seal.

7.5. Put the injector plunger into the vacuum position (piston retracted) and screw it into the barrel until it stops. DO NOT OVER TIGHTEN.

7.6. Put the injector into the pressure cycle and apply a slight amount of thumb pressure. Leave in the pressure cycle for approximately 5 minutes and return to the vacuum cycle for 30 seconds.

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

<table>
<thead>
<tr>
<th>Cycle</th>
<th>Pressure:</th>
<th>Vacuum:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cycle 1</td>
<td>5 minutes</td>
<td>30 seconds</td>
</tr>
<tr>
<td>Cycle 2</td>
<td>2 minutes</td>
<td>30 seconds</td>
</tr>
<tr>
<td>Cycle 3</td>
<td>2 minutes</td>
<td></td>
</tr>
</tbody>
</table>

Always end your repair on a pressure cycle as this will 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.

7.8. 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.

7.9. Application of pit resin & curing tab
Remove the bridge and cover the injector to protect it from ambient UV light. Place one drop of pit resin just below the pit 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 push the pit resin into the pit and lay it flat. DO NOT push on the curing tab as this will force the pit resin you just applied out of the pit.

7.10. Cure the repair
Using your curing lamp, expose the finished repair to UV light for a period of 5 minutes.

7.11. 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.

7.12. Polish the pit
Finally, apply a drop of pit polish to the finished repair and rub vigorously until the pit shines. This will improve the cosmetic appearance of the repair.

8. Care of equipment

8.1. Injector assembly
   8.1.1. Do not turn the injector upside down during the removal or cleaning process
   8.1.2. Use denatured alcohol to clean the injector assembly between uses to prevent resin from curing in the equipment.

8.2. Change end seals approximately every ten repairs.

8.3. Care of bridge vacuum cup
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 denatured alcohol.