

# **UNITED STATES WINDSHIELD REPAIR GUIDELINES**

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Written and Endorsed  
by Representatives Of the  
Windshield Repair Industry and  
the National Windshield Repair Association

# INTRODUCTION

The windshield repair industry has existed for more than 20 years, since the original development of the vacuum pressure techniques developed in 1972.

Repairing windshields is an economically, environmentally, and physically sound process that has the capability to virtually restore a windshield to its original condition. When properly performed, windshield repair can:

- Significantly reduce the visibility of the original damage.
- Improve the optical clarity within the damaged area.
- Reduce light scatter and haze within the damaged area.
- Restore the structural integrity and strength of the glass, thereby preventing further spread of the damage.
- Restore a smooth surface to the damaged area to avoid interference with proper operation of windshield wipers.
- Save the consumer money.
- Save the insurance company money.
- Save our environment by decreasing waste, preserving valuable landfill space, and reducing pollution from new glass fabrication.

Recognition of the viability of windshield repair has resulted in an increasing number of methods and processes for repair, an increase in the number of technicians performing repairs and, a widening range of capabilities of both the repair systems and the available chemicals used in repair.

To this date, with the millions of repairs performed around the country, there has not been a single accident injury which was attributable to the repaired windshield damage. Therefore, it is necessary to provide guidelines for windshield repair and the inspection of those repairs, so as to maintain that impeccable safety record by ensuring that repairs restore the structural integrity of the windshield and reduce the visibility of the damage.

## **PURPOSE**

It is the expressed intent of these guidelines to:

1. Provide a method by which inspectors, insurance representatives, windshield repair technicians and the general public can evaluate the repairability of a specific windshield damage, determine the ideal repair results possible for that damage and compare the finished repair with the ideal results.
2. Ensure that the inspectors and insurance representatives are educated in the properties of a properly performed repair so that they will be able to differentiate between deficient, unacceptable repair work and appropriate repair work.
3. Ensure that inspections in states where they are required, are unbiased and consistent to the greatest extent possible.
4. Ensure that new technicians understand the characteristics of a properly completed, high quality repair.
5. Ensure that the repair industry's unmarked safety record is maintained.
6. Encourage technicians to strive for the highest quality repair possible.
7. Provide consumers with an understanding of what the repair service has a capability of providing.

These guidelines are not intended to restrict the advancement or technological growth of the repair industry, that is, additional technological advancements may provide the technician with the ability to properly and completely repair damage more severe than those discussed herein.

## **GUIDELINES**

These guidelines have been developed and are endorsed by representatives of the windshield repair industry, including distributors, franchisors, manufacturers, inventors, patent holders and practicing repair technicians.

## SCOPE

These guidelines are designed to provide inspectors with the basic knowledge necessary to differentiate between a high quality, properly completed and structurally sound repair, i.e., the best possible repair results, and low quality, incomplete and structurally unsound repairs.

These guidelines include commonly used windshield repair terminology and concepts, recommended procedures for the inspection of repaired stone damage, including cracks, and similar impact damage on laminated glass windshields of road vehicles.

The guidelines are intended to apply to the repair of laminated glass windshields with the performance attributes embodied in "ANSI" impact and "ASTM" structural tests.

Recommendations are made regarding the following issues:

- Repair of damages within the “acute area” of the windshield.
- Types of breaks which should not be repaired in the acute area”.
- Methods to visually assess the quality of a completed repair.
- Chemical properties which are made available to the industry from chemical manufacturers or sellers.
- Equipment capabilities to be met by manufacturers or distributors of repair systems.

Repair information addressed in these guidelines is based on the following:

- Experience with commercial windshield repair techniques and inspection.
- Independent laboratory testing of structural strength and impact resistance.
- Field testing with a variety of commercial windshield repair techniques, systems, and chemicals.
- History of windshield repair pertaining to occupant safety.

## WINDSHIELD REPAIR TERMINOLOGY

**Acute area:** An approximately 8-1/2" wide by 11' high area starting at the top of the steering wheel encompassing the area which is directly in front of the driver. (see diagram)

**Bottom of crack:** The very fine visible hairline running along the lamination.

**Bullseye of stone break:** The dark circle encompassed by and surrounding the impact point. Typically any small radiating clucks will converge into the bullseye. This is an open air space. The darkness is caused by light refraction in this open area.

**Cosmetic blemish:** Small voids or air bubbles in the interior of any repair which appears as light refraction or dark spots. This specifically excludes the impact point.

**Crack:** A single line of separation in the outer layer of glass, with a microscopic gap, widest at the edge and narrowest at the point.

**Delamination:** Lamination deterioration usually exhibiting a foggy, whitish or yellowish appearance.

**Deterioration:** A tensile or adhesion failure of the resin which appears as an area not repaired or exhibiting refraction.

**Edge of crack:** Where the crack meets one of the four sides of the windshield. This is the widest, most stressful part of the crack. If not properly repaired, deterioration may begin at this area.

**Extending crack:** A leg of a stonebreak extending past the outer circumference of the bullseye, less than 3" in length.

**Head-on angle:** The view of the crack which is perpendicular to the profile of the crack. The head-on angle is a "seam" and is always visible at the conclusion of a repair. This angle is not used by the technicians when repairing damage and is not a valid angle from which to determine the quality of a repair for inspection purposes.

**Horizontal crack:** A short or long crack which commonly runs to the edge of the left or right side of the windshield. Also included would be unsurfaced cracks. A repair of this type may be acceptable across the acute area, provided that it does not contain any cosmetic blemishes as defined in these guidelines nor hinder the driver's vision.

**Impact point:** The actual location on the outside layer of glass which was struck, usually by a stone. Typically, a small piece of glass is missing. The impact point is the location for the chemical's passage into the break. It is the size of this area of missing, or pulverized glass that generally determines the visibility of the resulting repair.

**Interior of crack:** The largest area of the crack in between the top and bottom which is filled with the repair chemical. In a proper repair, this area should be clear, when viewed from the profile.

**L-shaped crack:** A short or long crack which typically comes off an edge and changes direction after a few inches.

**Leg:** Reference to a single crack usually less than 3" in length which emanates from the initial bullseye of the stone break. Star breaks are so called because of the multiple legs emanating from the center.

**Long crack:** A crack over 6" in length and usually surfaced.

**Point of crack:** The opposite of the edge, the tightest part of the crack terminating within the body of the windshield.

**Profile of crack:** The angle which allows view of the entire thickness of the crack, from the outer surface of the glass to the lamination. The profile of the crack appears as light refraction and is the angle a technician observes when performing a repair. This is also the angle from which the repair **MUST** be inspected to accurately evaluate the quality of the repair.

**Refraction:** The bending of light rays in passing from one medium to another; the mirroring (shiny) image seen along the profile of a crack. Refraction should have been significantly reduced when the completed repair is viewed from its profile.

**Short crack:** A crack under 6" in length.

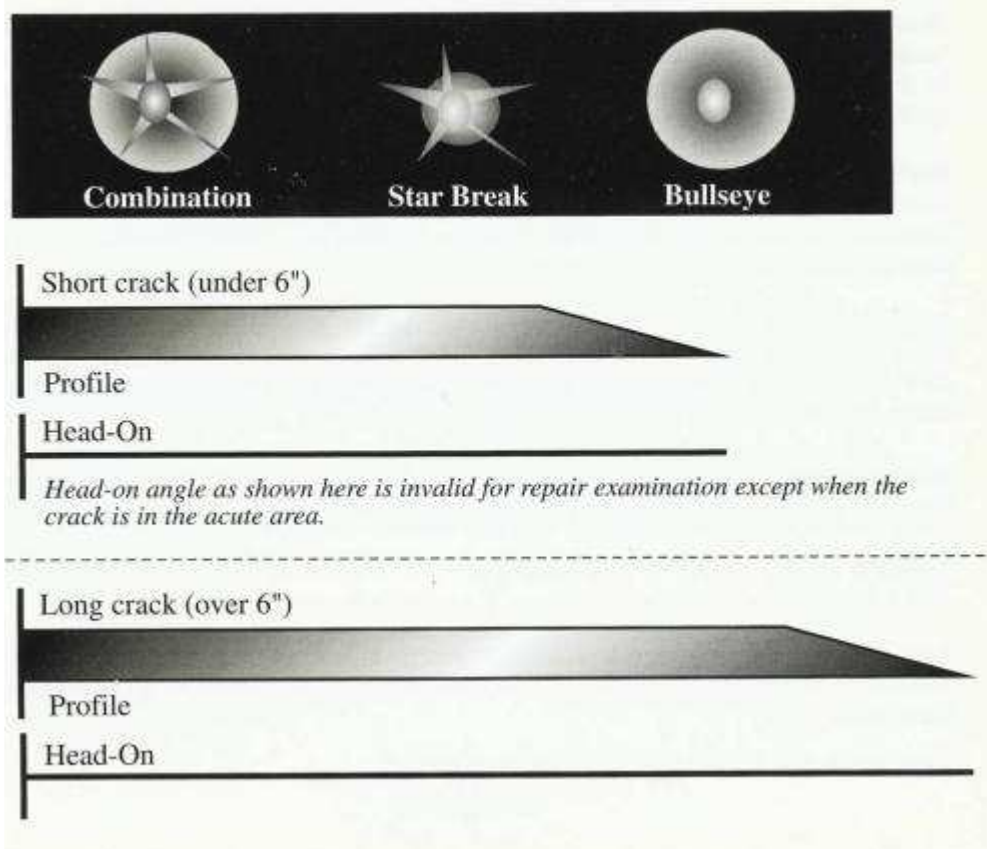
**Tip of crack:** The ends of the cracks radiating from a stone break.

**Stone break:** A sub-surfaced break on the outer layer of windshield glass, typically coin size and containing small radiating or extending cracks. Stone breaks are commonly referred to as star breaks, bullseyes, or combination breaks.

**Top of crack:** The very fine visible hairline at or near the outside surface of the glass.

**Vertical crack:** A short or long crack which runs up and down, typically off the top or bottom of the windshield. Repair of vertical cracks which traverse the acute area are not recommended.

### STONE BREAKS



## INSPECTION OF A REPAIRED BREAK

1. Inspector must know repair terminology.
2. Inspector must know how to differentiate between the profile of a crack and its head-on angle.
3. Inspect repair from the inside of the vehicle.

### Finding the Profile and Head-on Angle of a Crack

#### Horizontal Crack:

Sit directly in front of the repair, inside the vehicle, in a normal sitting position. From this angle you will see the profile of the repaired crack. It should be almost undetectable. If you lie down on the seat you will see the head-on angle.

#### Vertical Crack:

By sitting directly in front of the repaired crack you will see its head-on angle. Move to the left or right to observe its profile, it should almost disappear at its profile.

#### Note:

People do not focus on the windshield when driving they focus out the windshield.

A repair is less detectable than dirt, bugs or windshield wiper scratches that are almost always present on most vehicle windshields.

## REPAIR LIMITATIONS

Limitation on repairs defined by size or length of break could unreasonably restrict the industry's technological growth. Laboratory and field tests confirm windshield repair is a structurally sound process. Limitation should be based solely on the visible results and structural integrity of completed repairs.

1. Size and Length:  
None specified.

The size and/or length of the break is not the determining factor in whether or not a repair can or should be performed. Different tools, chemicals and methods make repair capabilities of one system different from another. However, it is known by industry experts that most repairable long cracks are less than eighteen inches. The most critical component is that the repair has been properly performed and should be judged by visual inspection.

2. Acute area:

Breaks within the acute area may be repaired provided that:

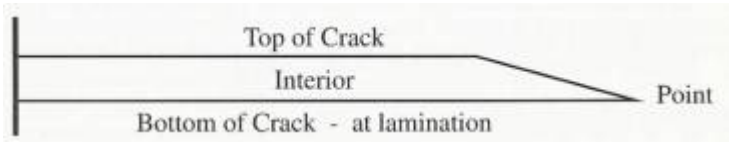
- A. The repaired damage does not hinder the driver's vision.
- B. The repair contains no cosmetic blemishes as defined in these guidelines.

Vertical cracks (short or long as defined in these guidelines) are not recommended for repair in the acute area.

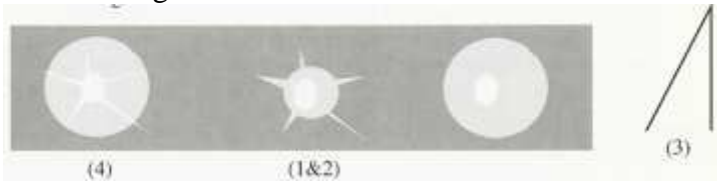
## GOOD REPAIRS

Crack:

Interior of crack is clear



Stone damage:



1. Bullseye of stone break is clear.
2. Profile of each leg is clear.
3. Tips are clear (filled).
4. A thin skeleton remains in all repairs, especially in a combination break.

## COSMETIC BLEMISHES

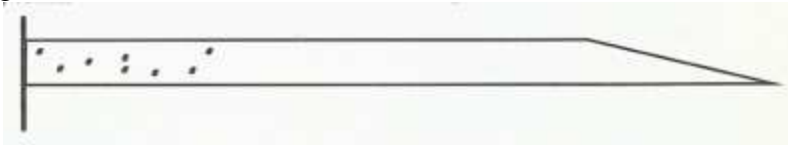
Cosmetic blemishes do not affect the structural integrity of the repair as long as they are in the middle area of the break and not at an end, tip or edge. If not in the acute area, blemishes are acceptable.

- Blemishes should constitute less than 15% of the repaired crack or break.



Examples –

Short or Long crack



Deterioration:

Will occur at the edge if: A) not properly repaired; B) improper repair chemical used; C) presence of dirt or moisture in crack when repaired.

- Evidence of deterioration is a reason to fail.



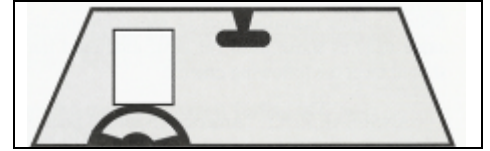
(Example)



## WHEN TO FAIL RECOMMENDATION:

### Acute Area

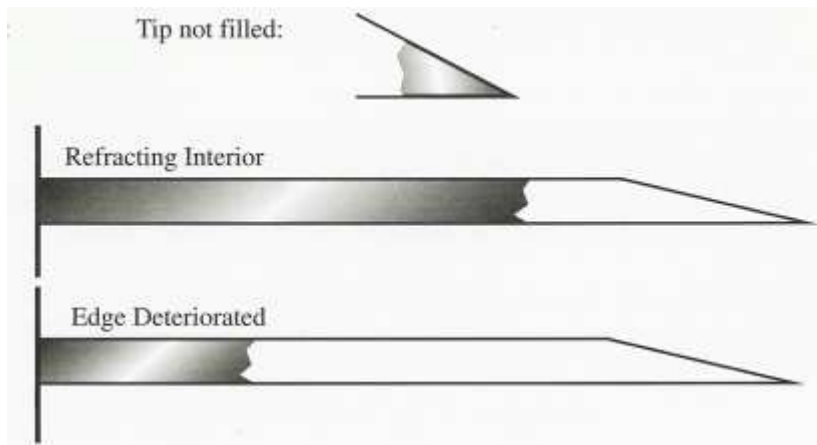
1. Fail all vertical cracks (long or short) in the acute area.
2. Fail all repairs with cosmetic blemishes as defined in the acute area.
3. Fail any repair which hinders driver's vision.



### Remaining Areas of Windshield

1. Fail if tips of cracks (including radiating cracks from stone breaks) are refracting from its profile.
2. Fail any long or short crack with signs of deterioration at the edge.
3. Fail if interior of any crack is refracting from its profile.
4. Fail any repair that contains cosmetic blemishes of more than 15%.

examples:



## TRAINING FOR REPAIR TECHNICIANS

It is strongly recommended that professional repairers be trained by the manufacturer/distributor of the repair system or their approved representative. However, most companies do supply their technicians with an adequate instruction manual, video and technical support.

## **RECOMMENDATIONS FOR SELLERS AND/OR MANUFACTURERS OF RELATING REPAIR EQUIPMENT AND CHEMICALS**

Sellers and/or manufacturers of repair chemicals should be required to pass the same tests as those used for new, unaltered laminated glass. Repair adhesives should meet the following criteria:

ANSI/SAE Z26.1, "American National Standard for Safety Glazing Materials for Glazing Motor Vehicles and Motor Vehicle Equipment Operating on Land Highways-safety Code".

- a. Impact, test 9 (dart drop, 30 feet).
- b. Impact, test 12 (ball drop, 30 feet).
- c. Penetration resistance, test 26.
- d. Boil, test 4.
- e. Humidity, test 3.
- f. Light stability, test 1 (at least 70% of the original transmittance).
- g. Luminous Transmittance, test 2 (at least 70% of the original transmittance).

ASTM C158-84, "Standard Methods of Flexural Testing of Glass (determination of Modules of Rupture)".

Refractive index of chemical should be near that of 1.52.

Distributors and/or manufacturers of repair equipment, should ensure that their equipment can remove the air from stone breaks and achieve a complete fill of the damages they promote their system will repair.

### **TECHNICIAN RECOMMENDATIONS**

Technicians should provide their customers with a written guaranty of work per- formed.

Repair guarantees which provide for credit towards the purchase of a new wind- shield can create an unethical situation due to a political conflict of interest and are therefore not in the best interests of the windshield repair industry or the customer.

## REFERENCED DOCUMENTS

- ANSI/SAE Z26 1- 1990 "American National Standard for Safety Glazing Materials for Glazing Motor Vehicles and Motor Vehicle Equipment Operating on Land Highways Safety Code.
- ASTM C 158-84 "Standard Methods of Flexural Testing of Glass (Determination of Modulus of Rupture).
- United States Testing Co., Inc. - Lab Reports of Ultra B-O-N-D, Inc., ANSI Z26 and ASTM C158-84.
- Training Manual - Ultra B-O-N-D, Inc., 1990, 1992, 1993.
- Training Videos - Ultra B-O-N-D, Inc. CrackMaster I and II.
- Field Tests - Ultra B-O-N-D, Inc., Chemical properties, durability and the effect of year round climate. Viscosity, wetting and ambient temperature. Prevention of deterioration in surfaced cracks. Controlled vs uncontrolled environments. Minimum properties per year round climate.
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- Training Manual, Novus - Use of equipment.
- Windshield Repair Magazine - Sept./Oct. 1994, and Nov./Dec. 1994.
- Field Test - Windshield Repair Specialist - Chemical viscosity and surfaced cracks.
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- Windshield Repair Journal, Feb. 1994, May 1994.
- Glas-Weld Systems Inc. British Standard Tests - BS AV 251: 1994 Edited by Joel Morse, practicing technician and trainer.
- Edited by Joel Morse, practicing technician and trainer.
- Written by Richard Campfield, a worldwide distributor and manufacturer of windshield repair equipment & chemicals, holder of five windshield repair patents, publisher, author and producer of numerous training manuals, videos, and newsletters, publisher of Windshield Repair Magazine, conductor of numerous field tests and practicing technician & trainer since 1986 .

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# QUICK REFERENCE

## Stone Damage

