GUIDELINES FOR GOOD GLASS EDGE QUALITY

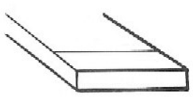
The as-cut quality of glass edges is the single most important factor affecting the edge strength of glass. Poor cut-edge quality can reduce the glass edge strength by 50% or even more, depending on the severity of the edge damage resulting from poor cutting techniques.

Glass edge quality, and the resulting glass edge strength, is particularly critical to the performance of the glass under thermal loading, and in applications where one or more edges is not supported (such as butt glazing).

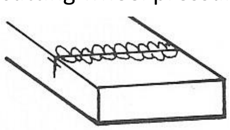
The pictures can be used for comparative purposes to provide a relative judgement of cut edge quality.

Some Terminology

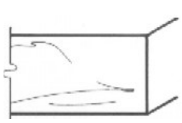
Score: The furrow made by the glass cutting tool.



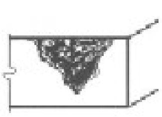
Wings: Glass flakes originating on each side of the score. They may fly out under excessive cutting wheel pressure.



Convolutions: Smooth rolling surfaces on the glass edge - not a weakening factor.



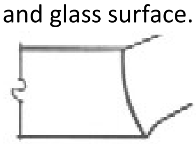
V-chips: Rough, penetrating chips.



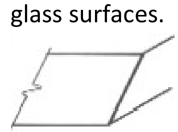
Shark Teeth: Dagger-like imperfections which start from the score surface. The edge strength and resulting potential for glass breakage increases as the depth, roughness, and number of shark teeth increases.

Serration Hackle: Edge imperfections, usually perpendicular to glass surface, which occur at surface opposite the score. The edge strength and resulting potential for glass breakage increases as the density and depth increases.

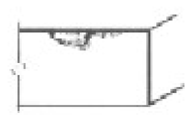
Flare: Sharp protrusion at junction of the edge and glass surface. Susceptible to further damage



Bevel: An edge that is not perpendicular to the glass surfaces.



Flake Chips: Smooth shallow chips.



GUIDELINES FOR GOOD GLASS EDGE QUALITY

Acceptable Clean-Cut Edges may have:

- ✓ Score, if wings do not fly out.
- ✓ Convolutions
- ✓ Serration Hackle, only within 152mm of the corners.
- ✓ Flare or Bevel, if not more than 0.79mm on 3.2mm or thinner glass and 1.59mm on thicker glass. Flare is not allowed where setting blocks contact the glass.
- ✓ Chips, only within 204mm of corners and if not longer than 6.4mm across and not deeper than ½ the glass thickness.
- ✓ Run lines, if smooth and rolling.
- ✓ Frost/Rubble, a fine grain effect that is typical on the cut edge.

Borderline Edges may have all the defects acceptable for clean-cut edges plus:

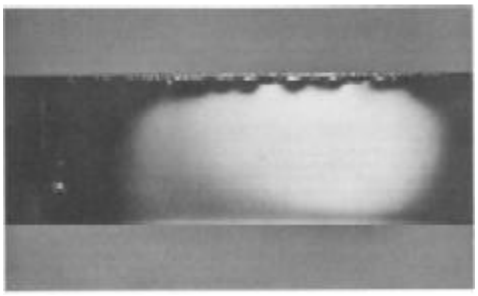
- ✓ Shark Teeth, if penetration does not exceed ½ the glass thickness.
- ✓ Serration Hackle, if not deep or dense and if spalling is not present.
- ✓ Chips, if not larger than 6.4mm across and not deeper than ½ the glass thickness.

<u>Some Glass Cutting Best Practices</u>

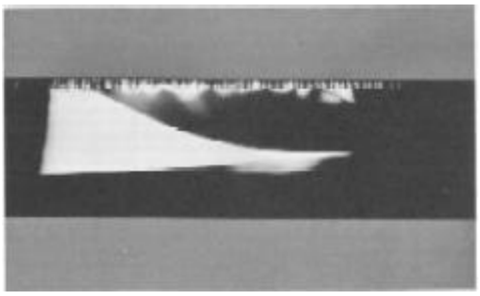
- ✓ Good housekeeping – keep area, table top, and equipment clean.
- ✓ Use the proper wheel for the glass thickness being cut.
- ✓ Ensure that a good quality, sharp wheel is being used.
- ✓ If cutting fluid is used, use quality fluids in the proper quantity.
- ✓ Keep cutting bridge properly aligned.
- ✓ Use proper score pressure.
- ✓ Use proper breakout procedures.

GUIDELINES FOR GOOD GLASS EDGE QUALITY

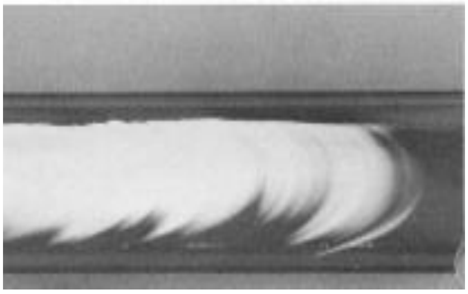
Acceptable Clean Cut Edges



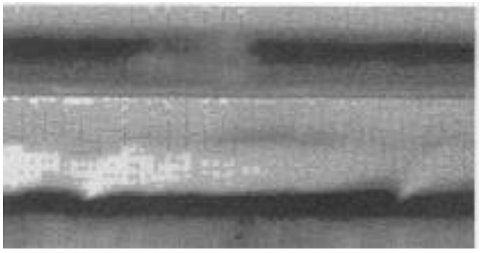
IDEAL



ACCEPTABLE - Convolutions

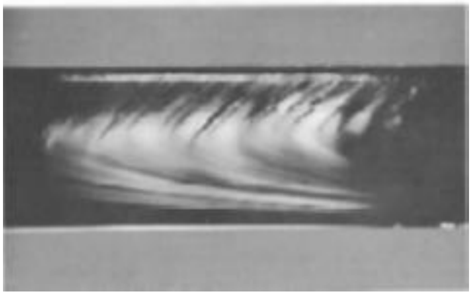


ACCEPTABLE – Run Lines

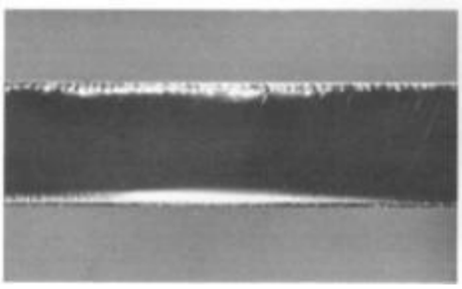


ACCEPTABLE – Frost/Rubble

Borderline Edges



BORDERLINE – Shark Teeth

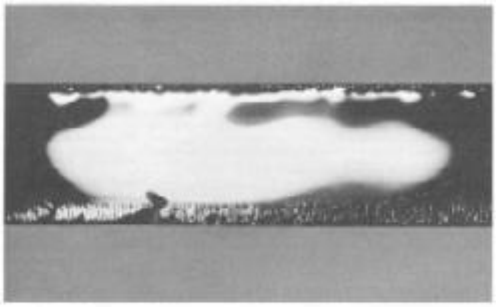


BORDERLINE – Light Serration Hackle

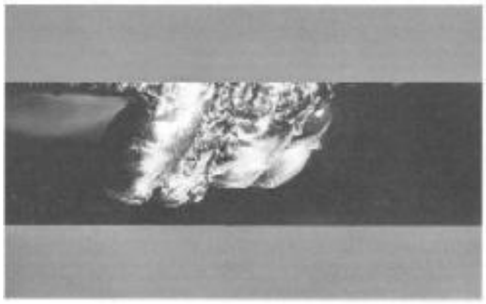
BORDERLINE – Light Serration Hackle Chips

GUIDELINES FOR GOOD GLASS EDGE QUALITY

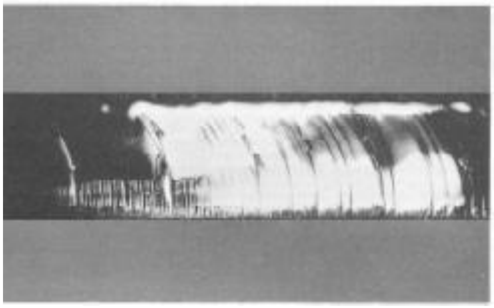
UNACCEPTABLE EDGES



UNACCEPTABLE –
Deep Serration Hackle
Deep Shark Teeth



UNACCEPTABLE – Impact Damage



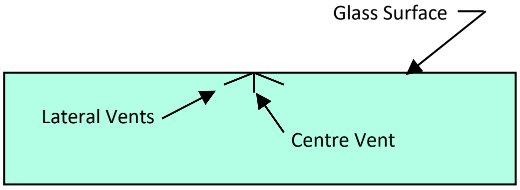
UNACCEPTABLE –
Serration Hackle with Spalls

GUIDELINES FOR GOOD GLASS EDGE QUALITY

The information presented here is intended as a starting point only, and may not give you the desired result for your specific glass cutting situation. For a detailed analysis of your particular glass cutting wheel needs, we recommend that you contact the various manufacturers of glass cutting wheels.

What is a score?

A score is a fracture that is put into the glass by the action of the cutting wheel. When a cutting wheel scores the glass, actually 3 fractures are made in the glass.



The centre vent penetrates into the glass body to a certain depth, depending on wheel angle and pressure. A lateral vent is always created on each side of the centre vent. The lateral vents go into the glass at roughly right angles to the angle faces of the wheel edge. This means that the lateral vents go much deeper into the glass body on a 148° wheel than on a 120° wheel. These lateral vents usually cannot be seen. If they are visible, then the pressure was too high on that particular wheel. With excessive wheel pressure, these lateral vents will actually propagate some depth into the glass, then curve back out to the glass surface, resulting in sliver chips along the score line.

A good score is a solid line across the top surface of the glass, with no skips, and should appear as a continuous line reflection off the bottom surface of the glass. There should be no plowing, digging, or crush, and no sliver chips.

Skips in the score line reflection are a good visual indicator that the score needs adjustment.

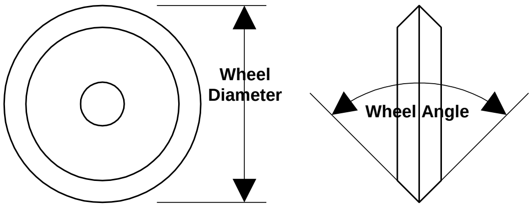
The use of cutting oils often masks an overpressure condition, by hiding sliver chips that may fly out along the score line when too much wheel pressure is applied. Dry cutting makes it much easier to quickly recognize an overpressure condition, reducing the chance of a large quantity of glass being cut before realizing that it has poor edge cut quality.

However, dry cutting can lead to shorter wheel life. Also, cutting fluid has been shown to improve the ease of "breaking out" the cut glass.

GUIDELINES FOR GOOD GLASS EDGE QUALITY

Glass Cutting Wheels

Glass cutting wheels are available in a variety of combinations of wheel diameter and edge angle (see below).



Larger wheel edge angle means the wheel has a flatter edge.

Different diameters and different edge angles produce different results relative to edge cut quality. Also, wheel load (wheel force against the glass) will affect edge cut quality.

It has been said that getting good edge cut quality is more of an art than a science. However, as the table below indicates, there is some logic to it. Although not an exact answer, these numbers will give you a good starting point, and should help you produce fissure depths in the target range of 6% to 10% of glass thickness.

	Glass Thickness				
Wheel Diameter (mm)	2mm	3mm	4mm	5mm	6mm
3.56	134°	145°	145°	148°	154°
3.96, 4.44	128°	140°	140°	145°	152°
4.98, 5.46, 5.56	124°	134°	134°	138°	145°
5.79, 5.84, 6.22	120°	128°	128°	128°	140°
Wheel Load (Kg)	1.35 to 1.8	1.8 to 2.25	2.25 to 2.70	2.70 to 3.15	4.50 to 5.40

GUIDELINES FOR GOOD GLASS EDGE QUALITY

As a general rule, for any given glass thickness, as wheel diameter increases, wheel angle should decrease to produce good edge cut quality. Also, for any given wheel diameter, or range of diameters as listed in the table, as glass thickness increases, wheel angle should increase to produce good edge cut quality. You can also see from the table, that as glass thickness increases, wheel load should be increased, to produce the desired 6% to 10% fissure depth.

Although not indicated in the table, it should be noted that increasing either the wheel diameter or angle generates deeper fissures at higher wheel loads, while maintaining score quality.

Coated glasses and specialty glasses may require sharper wheel angles than indicated in the table.

Once you discover the right wheel diameter, angle, and pressure combination, your glass edge cut quality should improve. And better edge cut quality means stronger glass edges.

GUIDELINES FOR CUTTING AND POLISHING LAMINATED GLASS

Laminated glass, or safety glass as it is also known, is used in a wide range of installations where safety is paramount. Solar absorption glasses shall not have any panes with shelled or vented edges, for glazing in orientations subject to direct sunlight. It is highly recommended to machine polish any laminated glass with a total solar absorption of ≥ 50%, to avoid any shells, chips or vents to expand and creating fractures.

With high solar absorption laminated glass it is of utmost importance to ensure a quality cut and polished edges, to prevent the installed laminated panels from forming fractures. Where clean-cut edges are not permitted, seaming shall be created by a wet/dry process, working parallel to the edge and not across the thickness.

Cutting safety glass can be trickier than cutting normal glass, but follow the below complete guide to cutting laminated glass to find out how to get the best results.

You will need:

- Safety gloves
- A tape measure
- A steel ruler / straight edge
- Felt tip marker
- Rotary glass cutter (ideally one with an internal oil reservoir)
- Lighter fluid
- Lighter
- Utility knife or razor blade
- Rough sandpaper
- Sturdy, flat, flame-resistant purpose-made laminated glass cutting bench.

Step 1: Measure

- Begin by placing your laminated glass on your work bench. Using your tape measure, felt tip and straight edge, mark out where you want to cut your glass.

  Remember! Measure twice, cut once!

Step 2: Score

Using your straight edge as a guide, score the laminated glass with your rotary wheel glass cutter. Apply pressure while moving the glass cutter to ensure you get a nice deep score.
Tip! Using a glass cutter with an internal oil reservoir will give you a much smoother cut.

- Apply a coating of lighter fluid to the cut line, then go over the line again with your glass cutter.
- Turn your sheet of laminated glass over and repeat this process on the flip side, ensuring you score the glass in exactly the same place on each side.

Step 3: Break the glass

- Making sure to wear your safety gloves, move the glass up and down and to the left and right with your hands until it snaps along your scored line. Flip the glass over and repeat the process to break the other side too.
- The sheet will now be held together by only the laminate.

Step 4: Cutting the laminate

- Apply another coating of lighter fluid to the broken edge of your glass. Using your lighter, light the fluid to create a controlled flame along the length of the cut edge.
- The heat will soften up the plastic laminate, so immediately after the flame burns itself out, use your sharp razor blade to cut the weakened laminate.
- Use your rough sandpaper to smooth out the edge of the laminate so it is flush with the edge of the glass.

Step 5: Laminated Glass edge polishing

Laminated Glass edges can be polished up to an angle of 45° and must have no unacceptable edge quality as described in the first part of this document.

GUIDELINES FOR GOOD GLASS EDGE QUALITY

What is Glass Seaming?

Glass seaming can be performed wet or dry. These methods vary due to preference and application. Both methods are designed to achieve the same result, but inherently have their own advantages and drawbacks. There are also numerous automated systems utilizing other grinding or sanding methods that again are typically selected due to application and preference.

When you’re dealing with laminated glass, strength and durability are key, but safe handling is also very important. All of these factors are enhanced by glass seaming, or sanding the edges of sharp, cut glass.

If seaming is poorly executed, small fractures can occur in the glass where it meets the seaming machine belt.

When using a glass seaming machine, use a slow, steady speed. A good rule of thumb is to limit speeds to no more than 305mm per second across the belt. Poor edge quality and damage may occur if the glass travels too quickly or too slowly past the glass seamer belt. Damage may also occur if inconsistent pressure against the belt is applied. Speed and feed are the normal terms used just as in machining or grinding other materials.

Sanding belt grit is very important because the wrong grit can damage your glass. As a general rule, don’t use a glass seaming belt coarser than 100 grit. Use 120 grit belts for fine seaming work. Change the belts frequently and use a good quality silicon carbide belt.

Finding the proper pressure can be tricky to figure out. But for most glass, use light pressure. Anything stronger may damage it.

To get a good seam, polish the edges in the direction shown in **Fig. 1**, to minimize chipping and shelling of glass. With light pressure, slowly slide the glass to the left past the seamer. When done, pull the glass away

From the belts, move the glass back to the starting point, and seam the other edges by moving the glass to the right.

Keep the glass travel linear and avoid seaming in an arc type movement.

For thick glass, move it past the belt slowly in order to get a heavier seam, especially at the corners. Be careful not to accidentally burn the corners. Courser belts are normally used for thicker glass.

Thin glass is very sensitive to seaming. Again, use light pressure but an even slower speed. Never use a belt over 100 grit on thin glass.

GUIDELINES FOR GOOD GLASS EDGE QUALITY

FIG. 1

There are many different factors that can contribute to damaged glass, all of which are controllable.

- **Speed:** This is the major factor in controlling shattered edges.
- **High belt tensions:** Increases pressure and the chance of a belt breaking. Doesn't allow the belt to "wrap the edge of the glass.
- **Pressure against the belt:** Causes the belt to hammer the edge of the glass, not allowing the grit to cut the edge.
- **Belt quality:** Cheap belts tend to be more expensive in the long run. Use high-quality belts, and change them often.
- **Grit:** If a belt is too coarse, it can make a cut that's too heavy, resulting in extra particles.
- **Burning or overheating:** High belt wear, glass-to-belt pressure, allowing the glass to contact the belts in an arc by not keeping the edge parallel to the belt surface, and a lack of coolant flow at the point of contact can overheat the glass. The hot surface cools instantly, but microscopic cracks can form, causing breakage.
- **Edge Prep**: Appropriate edgework preparation is essential for laminated glass. Improper techniques will dramatically increase breakage, especially during and after installation.

GUIDELINES FOR GOOD GLASS EDGE QUALITY

Edge defects to avoid in laminated glass when seaming or polishing the glass

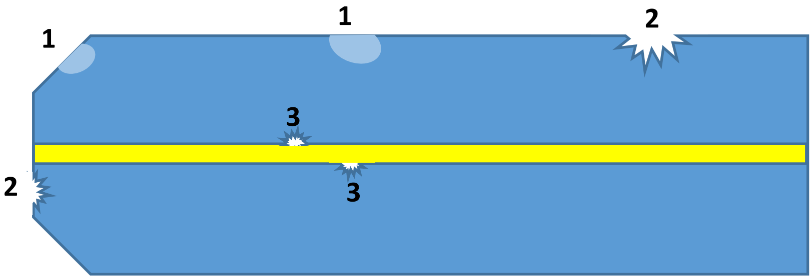


FIG. 2

1. Edge Shells
2. Edge Chips
   2.1 Edge chips resulting into fractures
3. Small edge chips between the PVB interlayer and the glass

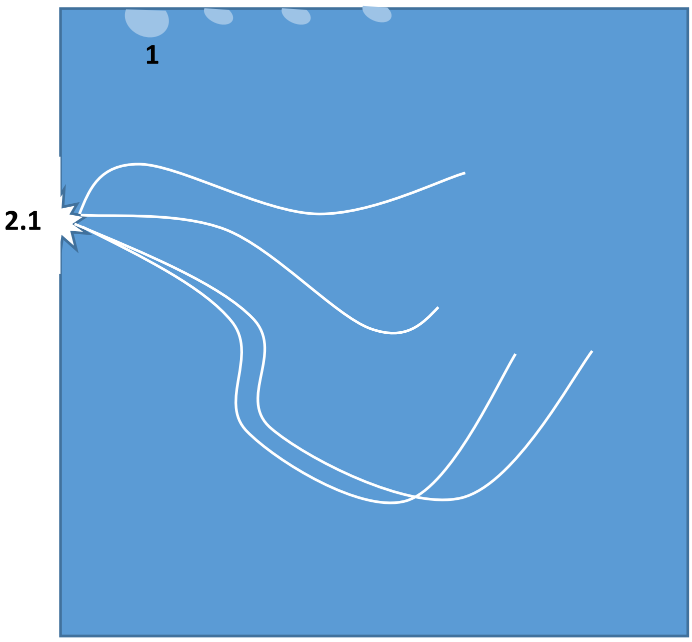


FIG. 3