CNCGLASS
CNC Ucolin Interlayer Technology Co., Ltd.
SHENZHEN, GD, CHINA
Peter Lin · cnc@cncglass.com · WhatsApp / Mobile +86 15013829504
WeChat wecan365 · www.cncglass.com

How to Trace Bubbles in Laminated Glass

Every bubble is a record of a process imbalance

In daily lamination, whether the interlayer is EVA, PVB, or an ionoplast (SGP) sheet, bubbles are among the most costly defects. A small field may only force a downgrade; a serious one can scrap a whole lite. Physically and chemically, a bubble is leftover evidence: a parameter that was out of range, a room that was too wet, or a piece of hardware that was no longer doing its job.

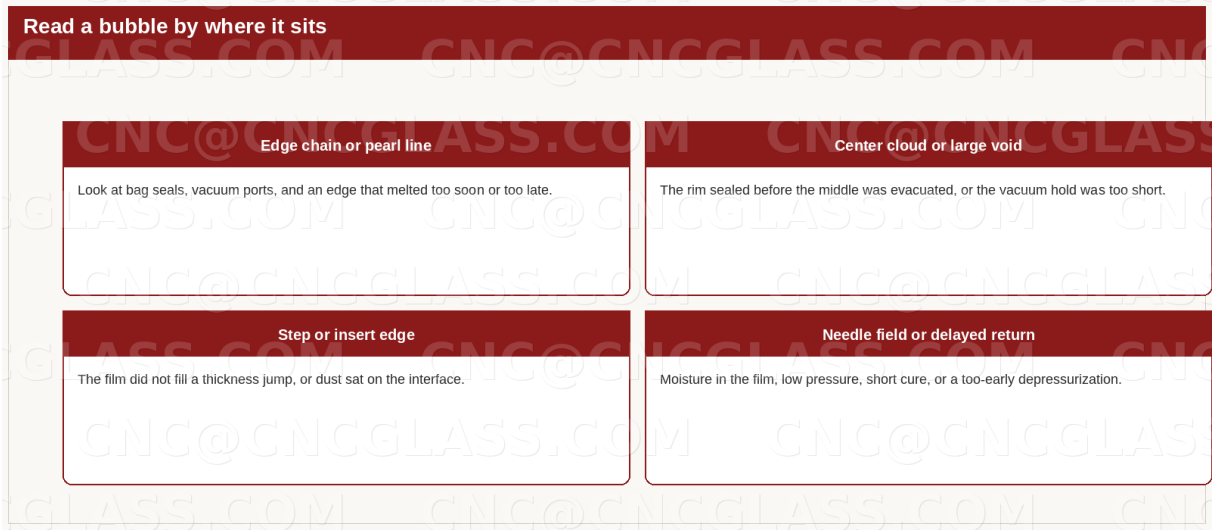


Figure 1. First diagnosis by location: edge chains, a center cloud, a step at an insert, or a fine needle field.

The fastest path to a correction is to read the defect in three dimensions: where it sits in the pack, what shape it has, and how it is distributed. That reading is closer to a clinical examination than to a guess, and it shortens the time spent changing the wrong setting.

Start with location

Edge bubbles sit along the perimeter, sometimes as a string of small pearls, sometimes as a continuous chain, sometimes as a hollow tape-like band. They usually mean air came back in, or the edge never closed properly. Typical causes are a damaged vacuum bag, a tired port gasket, uneven edge pressure, a heat ramp that sealed the rim too soon, a rim that never flowed enough, or a messy trim and an incompatible edge tape that left a small air path.

Face or center bubbles sit in the middle of the plate, often larger and irregular, sometimes with a white or hazy, de-bonded look. Residual gas has been trapped. A short vacuum hold, an inadequate vacuum level, or a heat ramp that melted the perimeter into a closed ring will pack air and volatiles in the middle, where later autoclave pressure cannot remove them.

Bubbles at a structural interface or at an insert sit on the glass-to-film face, or along the edge of a copper tab, an electrode, a PET layer, or a fabric. A thickness step that the molten film could not fill, a film that was too thin for the insert, or a dust fiber that broke contact are the usual causes.

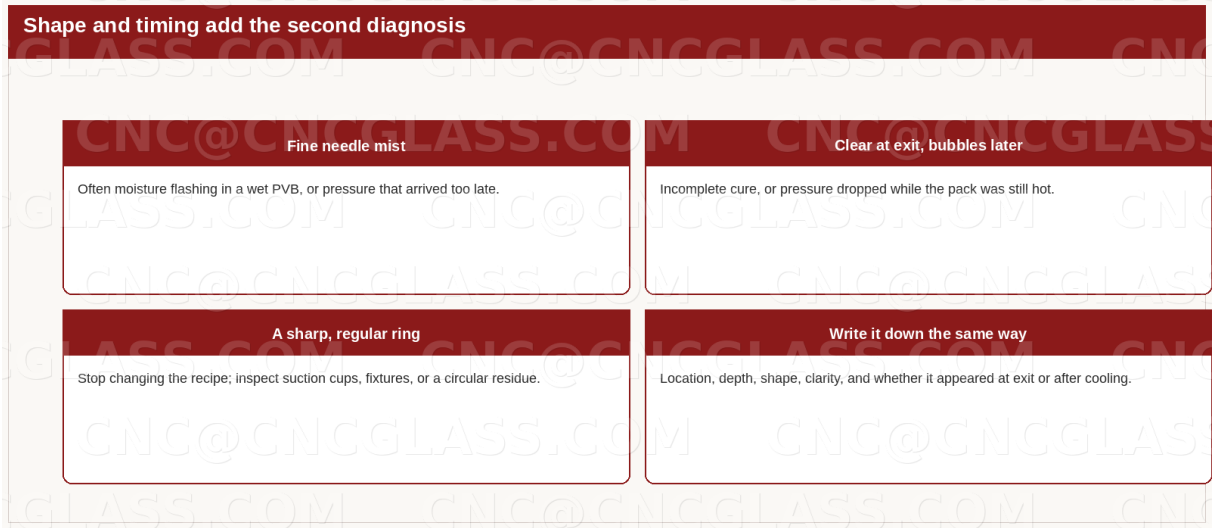


Figure 2. Shape and timing complete the reading: a needle mist, a delayed return bubble, a sharp regular ring, and a consistent way to record what was seen.

Then read shape, timing, and a common language

A field of needle-fine bubbles that gives a slight mist is often moisture flashing in a wet PVB, or pressure that arrived too late to dissolve the gas while the film was still fluid. A lite that leaves the autoclave clear and then develops bubbles after hours, days, or a thermal cycle is a return bubble: the network was not fully set, or pressure was released while the pack was still above a safe temperature, commonly before the glass has fallen below about 50 to 60 degrees Celsius.

A sharp, almost perfectly circular ring of fine bubbles, with a clearer center, is not a natural moisture pattern. It usually points to a mechanical or residue mark: an over-hard suction cup, a circular fixture, or a round tape residue that changed local flow. In that case, stop changing the recipe and inspect the handling equipment.

A short, standard description helps the line, the engineer, and quality staff talk about the same defect: location (edge, center, or insert), depth (interface or inside the film), shape (needles, a band, or a regular ring), appearance (clear or cloudy), and timing (present at exit, or only after cooling). A compact rule follows from that: edge chains point to bag seals and edge heat; a center cloud points to vacuum time and premature rim seal; a needle field points to film moisture and pressure; a regular geometric mark points to hardware, not to a new set-point.

Bubbles become solvable when they are read by place, shape, and timing, and when they are written down in the same language every time. That habit shortens the search and raises yield, whether the interlayer is EVA, PVB, or SGP.

Contact Us

Brand: CNCGLASS

Company: CNC Ucolin Interlayer Technology Co., Ltd.
Address: SHENZHEN, GD, CHINA
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Email: cnc@cncglass.com
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WeChat: wecan365
Website: www.cncglass.com

If a recurring bubble pattern is slowing a line, we can help read location and shape and suggest a process or hardware check.