

# Window Seal Failures

## INTRODUCTION

Windows fail for a number of reasons. Sometimes the cause of failure can be attributed to a single main cause. Other times failure can only be concluded to be a combination of causes.

When evaluating window seal failure, it is important to understand all causes of failure and to have a good understanding of the conditions of the building.

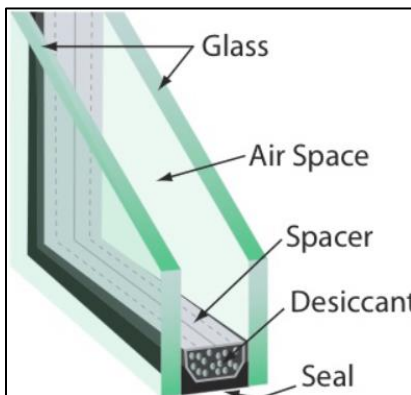
This document explains the problem of a fogged window and lists the usual causes of window fogging.

By a process of elimination and using the scientific method, along with a thorough inspection, the proximate cause(s) of a failed window can be concluded.

## INSULATED GLASS

In order to understand what happens when a window fogs, it is essential to understand insulated glass.

Insulated Glass is composed of two panes of glass (sometimes referred to as glazing). The window has an interior glazing and an exterior glazing separated by an air space. The air space gives the glass window its thermal qualities by separating the cold and warm temperatures.



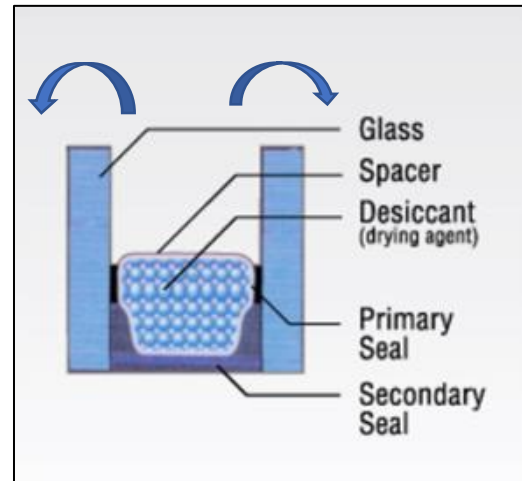
## THE SPACER

The two panes of glass are separated by a spacer around the perimeter. The spacer is sealed tightly to the two glass panes making the individual pieces one inseparable piece of insulated glass.

The spacer is a plastic or metal piece that is fitted between the two panes of glass. It is rigidly connected to each pane with sealant materials. The spacer is filled with a desiccant (an absorbing substance). The desiccant absorbs moisture and keeps the air space dry.

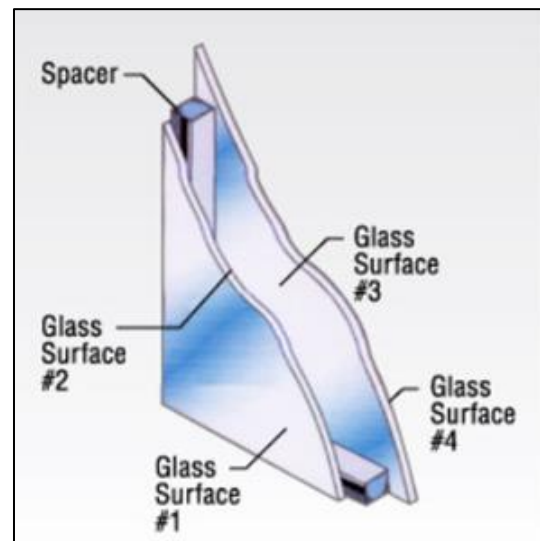
## WINDOW SEALS

A spacer has a primary seal and a secondary seal. As windows age the seals break down. The seals must remain flexible as the individual glass moves. The seals must also remain airtight to prevent air from coming into the space.



## PROCESS OF FOGGING

Eventually, the outside air enters between the glass. The outside air would have moisture. Once moisture enters between the two pieces of glass, the inside glass surfaces (surfaces #2 and #3) are prone to fogging that cannot be cleaned. Moisture condenses on the surfaces depending on the moisture content of the air, the air temperature, and surface temperature.



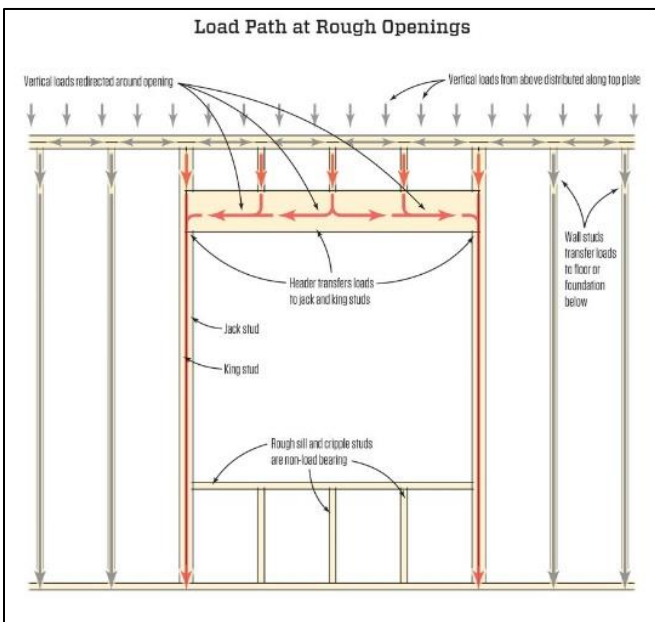
### GLASS MOVEMENT – TEMPERATURE CHANGES

IG glass moves constantly with temperature changes. The seals are forced to flex and hold the air in or prevent the air from escaping depending on temperature changes. The movement is cyclical day to day eventually weakening the seals. Once the seals fail the pumping action moves air in and out of the air space bringing in more and more moisture and small particles.

Therefore, fogging of a window takes place over a period of time starting immediately after the seal is broken. Condensation takes place as moisture enters the air space, and the fogging becomes more evident over time as more particles are deposited on the glass surfaces.

### ROUGH OPENING – GRAVITY LOAD PATH

Window openings in a wall start with a rough opening that is formed by jack studs, king studs, a header. Vertical and horizontal loads are transferred through these members back to the structure and eventually down into the ground.



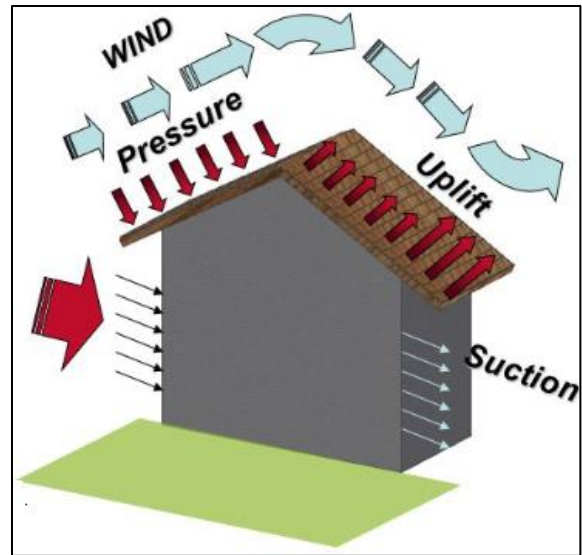
### WINDOW FRAME INTERACTION WITH ROUGH OPENING

Most windows have a window frame. The frame fits within the rough opening. It has a head, side jambs, and a sill. Shims are placed between the rough opening and the window frames, and the space between is often insulated.

### WIND LOAD PATH

A wall and window must also resist lateral loads inward and outward as wind pushes or pulls on the wall system. As air travels over and around a building it creates positive pressures (inward) and suction pressures (outward).

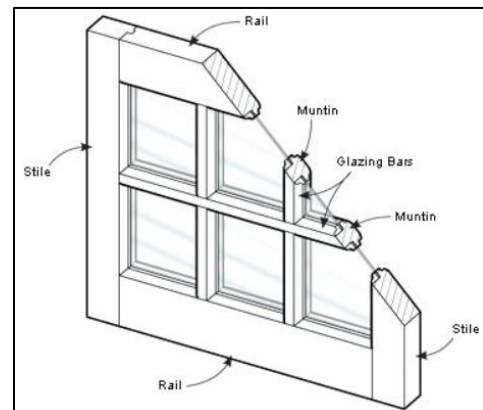
The frame must be adequately connected to the rough opening to transfer load; however, the rough opening must not load the window.



### SASH GENERAL WINDOW TERMINOLOGY

Below is a view of a typical window sash. A sash could be referred to as an upper (top) sash, a lower (bottom) sash, an inner sash, an outer sash, or a fixed sash. A sash will have an upper and lower rail (horizontal part of the sash) with side stiles (vertical part of the sash).

Window sashes can be fixed (stationary) as opposed to operational. There are many different makes and models of windows. Fixed windows have many different pieces that fit together. A fixed window can have a sash or not have a sash. A window without a sash is called a direct set window.



## CAUSES of SEAL FAILURE

Windows fail for several reasons. The following is a short list of common causes of window seal failure.

1. **Old Age.** A seal must remain flexible as materials expand and contract. The seal must remain attached to the glass to prevent air movement into and out of the space between the glass. A window is exposed to extreme cycles of temperature that eventually cause seals to dry and crack.
2. **Excessive Exposure to Water.** The seal on the bottom edge of the window can be exposed to moisture as water enters between the glass and the rail. If the water is not able to leave the system through weeps, the seal can be exposed to water for long periods of time.
3. **Mold.** Window seal materials are not indestructible. The seals can be adversely affected by mold. Mold is a living organism that thrives in certain conditions. Mold needs the right temperature, moisture, and something to eat.
4. **Excessive Heat.** Windows with direct sun exposure often fail prior to north-facing windows. Seals soften due to heat. Air between the panes of glass expands and pushes out through the seal.
5. **Lack of Maintenance.** Windows need to be cleaned. Dirt and other air-borne particles mixed with condensation can seep into a window and deteriorate a seal.
6. **Movement.** If a window is not installed adequately, or is installed in a wall that has settlement or excessive movement from other causes, it can distort the glass causing the window to fail. Strong wind forces can cause a seal to fail.
7. **Fabrication Error.** Mistakes are made during manufacturing. The material may have been contaminated or defective. Failure rates are low, but they still occur.
8. **Deliver Mishandling.** Mistakes are made during delivery. Windows are moved several times from the time they are fabricated to the time they are installed.
9. **Installation Error.** Mistakes are made during installation.
10. **Impact.** Nothing is impact resistant depending on the size of the impacting object. Very large hail can damage an edge of a window, or crack a window causing the seal to be ineffective. For impact to be concluded as the cause of a window failure, an impact location must be visible. Small hail does not harm healthy window seals.

## WINDOW INSPECTION

A window inspection should note all aspects of possible window distress. The following is a short list of items to look for during a window inspection.

1. Age of the windows
2. Exposure to water
3. Exposure to sun
4. Fogging
5. Condensation
6. Discoloration
7. Impact
8. Distortions
9. Seal movement
10. Spacer movement
11. Collateral evidence of wind
12. Collateral evidence of flying debris
13. Impact damage
14. Broken glass
15. Maintenance
16. Window identification

## WARRANTIES AGAINST SEAL FAILURE

Different manufacturers have different warranties. Typical warranties against seal failure are 20 years.

Some windows fail due to manufacturing error. Some report that premature window seal failure is on order of 1 to 3 percent.

## SUMMARY

The inspection of a failed window should include inspecting:

1. the interior of window.
2. the exterior of the window
3. similar windows on the property, and
4. the surroundings.

The success of identifying the correct cause of a specific window failure is dependent on ruling out known causes and finding evidence to support a remaining cause.

Eventually, all windows fail. Materials cannot last forever. If a window is not significantly past a warranty period, something other than old age may have been a contributing factor.

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