

Insulating Glass Durability

In the approximately 70 years of insulating glass use, it has been determined there are three basic requirements to make a long lasting insulating glass unit. These are:

1. Material selection
2. Workmanship
3. Glazing conditions

Material Selection

The sealants used to bond glass to the spacer system are the most important material selection in the IG unit construction. The sealant(s) must be resistant to temperature extremes, UV radiation, moisture ingress into the airspace and retain any inert gas in the airspace i.e. argon. Cardinal has chosen a dual seal system with polyisobutylene (PIB) as the primary seal, and silicone as the secondary seal as shown in as number 1 and 2 respectively in Fig. IG20-1.

The PIB primary seal stops moisture from entering the airspace, and has one of the lowest moisture vapor transmission and argon permeation of all sealants used in the manufacturing of insulating glass. The secondary seal is a specifically designed silicone for Insulating Glass sealing. Silicone is an inorganic sealant while other sealants used in the manufacturing of insulating glass are organic sealants. Silicones are recognized as the best sealant for weathering and adhesion to glass substrates. Inorganic sealants in general are known for their resistance to high temperatures and UV aging.

In addition to sealant choice, spacer design and processing are also very important in the overall long term weatherability of the IG unit. Cardinal uses four bent corners in our IG unit construction with connections made on the legs of the IG unit. Cardinal's utilizes thin gauge stainless steel for its spacer systems (number 3 in Fig. IG20-1 below). This reduces the amount of heat transfer across the spacer.

Cardinal fully fills the spacer cavity (number 4 in Fig IG20-1) with molecular sieve desiccant. By fully filling this area, Cardinal supplies a desiccating capacity many times that of most of its competitors.

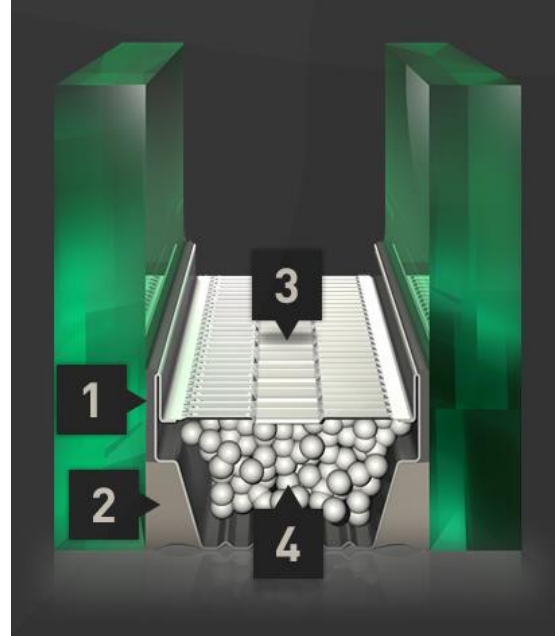


Fig. IG20-1 Typical Cardinal IG cross section

Workmanship

To have a long lasting Insulating Glass Unit, the fabrication of the unit must be consistent. Cardinal's iQ quality control system reduces the opportunity to have anomalies in the fabrication process. Cardinal manufactures our own insulating glass production equipment to assure our units are fabricated with consistent high quality.

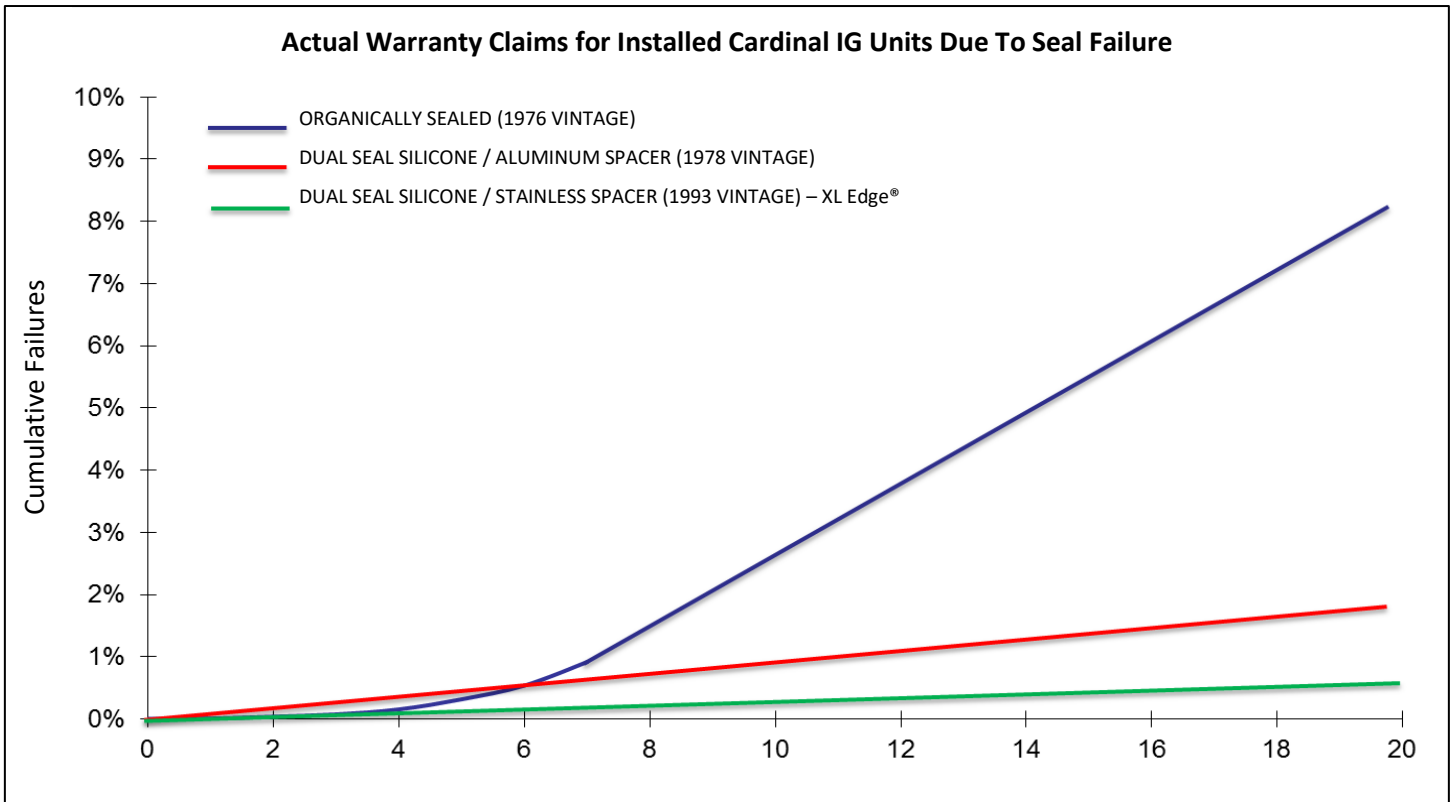


Figure IG20-2 Warranty Claims Chart

How Units Are Glazed

If the window manufacturer permits the insulating glass unit to sit in water or over stress the seal system, there is no insulating glass unit construction that will give long term performance. Cardinal believes their dual system construction is the most versatile of IG seal systems because of the excellent weatherability of the PIB primary and silicone secondary seal. Cardinal’s IG unit construction is most likely over designed for some window manufacturers that use good glazing practices. However, Cardinal believes its unit construction is not under designed for any window manufacturer because it has been shown Cardinal’s dual seal system will outperform other IG unit constructions when exposed to simulated weathering conditions.

Results (Cardinal’s Field Experience)

Cardinal has evolved our products knowing the importance of these design requirements. Cardinal’s original construction was a dual seal IG

with PIB primary seal and polysulfide (organic) secondary seal with aluminum spacer. In 1978 Cardinal converted to a Silicone secondary seal and PIB primary seal. In 1993 Cardinal made another fundamental change from aluminum spacer to stainless steel spacer.

Fig IG20-2 illustrates how each of these fundamental changes lowered our reported seal failures rates. The data in Fig IG20-2 is actual field failure reports based on a population of hundreds of thousands IG units. Based on Cardinal’s current design of a stainless spacer with a PIB primary and silicone secondary seal a low 0.2% failure rate after 20 years is expected.

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