Technical Bulletin-IG: May 2012

WHAT IS AN INSULATING GLASS UNIT?

Insulating glass (IG) units are sealed combinations of two or more lites of glass, separated by a dry air space with the help of a spacer.

They are used to save energy and provide better comfort to occupants by offering superior thermal performance over a single lite of glass.

With the use of various low-E coatings and reflective coatings available in the market, IG will see improved performance ratings when combined with gas inside the air space cavity.

IG CONSTRUCTION TYPES

SINGLE SEAL

- Structural seal and vapor seal come from the same material.
- Ease of application – fast one step process
- Cost – labor and materials low
- Poor gas retention properties

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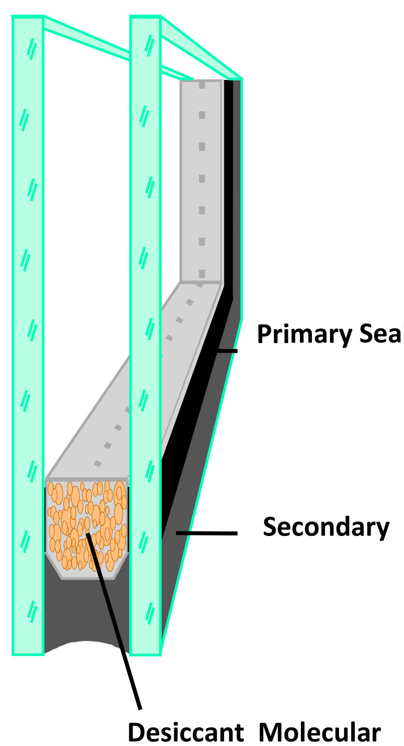
DUAL SEAL

- PIB primary vapor seal
- Secondary structural seal
- Improved gas retention
- Improved moisture barrier
- Reduced glass breakage

DUAL SEALED SYSTEM



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IG SEALANT USES

COMMERCIAL	RESIDENTIAL
Polysulfide	Polysulfide
Silicone	Silicone
Polyurethane	Polyurethane
	Hot Melts

WHAT DOES THE IG SEALANT DO?

- Gas and Moisture Barrier —retains gases inside air cavity and minimizes moisture to enter the airspace.
- Structural Capacity of Unit - shows adhesive properties to glass, metal and other thermo-plastic spacer materials.
- Long Term Durability—provides field performance for the life of the window.

GAS AND MOISTURE BARRIER

The secondary sealant must provide a high level of moisture vapor migration resistance and minimize gas migration to and from the insulating glass unit.

The primary sealant must provide the same resistance; however, there is a positive correlation between the secondary sealant's moisture vapor transmission rates (MVTR), IG durability and gas retention rates.

The MVTR and argon transmission for polysulfide, polyurethane and silicone sealants as a single and dual seal is shown in the table (top right).

By maintaining the argon, the secondary seal adds to the thermal performance of an insulating glass unit.

	PS	PU	SILICONE
MVTR ($g/m^2.24h$)	8.0	6	16.00
Argon Transmission ($10^{-10} cm^2/s.cmHg$) single seal	1.5	8	370.00
Argon Transmission ($10^{-11} cm^2/s.cmHg$) dual seal	6.8	8	8.33

A typical insulating glass unit, depending on the materials used, such as, low E glass and warm edge spacers, could yield a U factor of just around 0.300 (BTU/h.ft^2.F). See table below.

The same insulating glass with a 90 percent argon fill will provide a unit with a U factor of 0.250, also shown below. Note that as the level of argon gas drops, so does the performance of the IG unit.

Typical Dual Pane IG with 0.5" airspace and low E coating	U Factor (BTU/h.ft^2.F)
100% Air	0.300
90% argon	0.250
80% argon	0.255
70% argon	0.260

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STRUCTURAL CAPACITY OF A UNIT

Wind and pressure differentials create lateral loads on the glass which cause edge displacement in an insulating glass unit.

The edge seal offers elastic support, allowing controlled out-of-plane displacement. The degree of displacement is inversely proportional to the modulus of the sealant.

Modulus is the measure of stiffness of a sealant which is a measurement of stress in relationship to the strain. A minimal amount of stiffness is required to keep the lites of glass together; however, an additional amount is required to ensure that the displacement (as a result of the load) is manageable.

This will ensure that the primary seal is not compromised or permanently deformed. In the inevitable, a lower modulus sealant allows for the compromise of the primary seal and the unit effectively becomes a single seal product. The properties of the secondary seal are only left to defend the longevity of the unit. *See table below.*

	PS	PU	SILICONE
Modulus (15%strain) MPa	**2.07**	**2.3**	**1.5**

LONG TERM DURABILITY

Typically, insulating glass units are subjected to testing which are representative of the type of environments they will face. All components, including the secondary sealants, must prove their ability to pass mandatory tests, such as ASTM 2190 (US) CGCB 12.8 (Canada) and EN 1279 (Europe).

Even though both polysulfide and silicone sealants meet US and Canadian requirements, typical silicones do not pass the gas retention portion of the EN 1279/3 standard, which limits their application. (Only silicones can be used for structural glazing).

WORKING RANGES/MIXING RATIOS

Ease of processing is something that affects the IG manufacturer, but it is not a factor that designers, builders and architects typically care about, even though it can affect them as well.

All the sealants discussed here are two-component, room temperature, vulcanizing products that require a certain level of quality control.

These products have varying levels of working ranges. Polysulfides have a working range of +/- 20%, from their optimum mix ratio of 100:10 (base: catalyst) where the properties of the sealant are still acceptable for the IG manufacturer.

(continued on next page)

WORKING ... ***(from previous page)***

Silicones and polyurethanes, on the other hand, have a much tighter specification of +/- 10%.

As far as mixing ratios, there are two tests that are commonly used for polysulfide sealants. (Presently, there are no accurate and scientific methods that are being used commercially to determine mix ratios for polyurethane and silicone sealants.) One, which is both quick and accurate, determines if the dosing/mixing pump machines are within the target ratio. The other, a modern technique called X-ray fluorescence, determines the mix ratio. Users of polyurethane and silicone sealants, in the absence of industry acceptable methods, have been resorting to erroneous and archaic methods, such as cure rates, which are dependent on temperature and absolute humidity, independently.

The exceptional performance of polysulfide sealants, as measured by MVTR, gas transmission and structural capacity (coupled with ease of processing) makes it a logical choice for insulating glass sealants.

Polysulfide vs. Silicone

(Excerpted from a technical paper by Product Manager Paul Chackery)

In a study commissioned by the National Research Council of Canada, Dr. Hakim Elmahdy demonstrated that polysulfide sealants (using hardcoat low E glass) were better than silicone for containing argon. Test results showed that silicones lost on average 22.60% of argon during a typical aging cycling compared to 8.33% for polysulfide.

Test data that has been highlighted (see charts below) indicates the sample units that were omitted because unusual dew point readings reflected poor workmanship.

The paper concludes that silicone sealants are selected for their important role as the sole sealant for structural glazing. All other applications favour polysulfides, used historically for excellent mechanical properties.

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Polysulfide, Hardcoat, Dual Seal

Sample	Initial Argon	Final Argon	Gas Loss	Initial Dew Point	Final Dew Point
1	88.8	87.7	1.1	-70	-70
2	88.8	87.6	1.2	-70	-70
3	91.5	90.3	1.2	-70	-70
4	35.3	0.5	34.8	-70	5
5	**82**	**81.7**	**0.3**	**-70**	**-70**
6	92.8	91.5	1.3	-70	-70

Silicone, Hardcoat, Dual Seal

Sample	Initial Argon	Final Argon	Gas Loss	Initial Dew Point	Final Dew Point
1	84.4	79.1	5.3	-70	-70
2	83.3	75.3	8.0	-70	-70
3	80.6	76.5	4.1	-70	-70
4	77.4	74.3	3.1	-70	-70
5	82.4	1.1	81.3	-70	-10
6	71.6	65.0	6.6	-70	-70