The Use of Window Films on Insulating Glass Windows

PUBLISHED BY THE
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MARTINSVILLE, VIRGINIA 24115

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THE WINDOW FILM COMMITTEE
ASSOCIATION OF INDUSTRIAL METALLIZERS
COATERS, AND LAMINATORS

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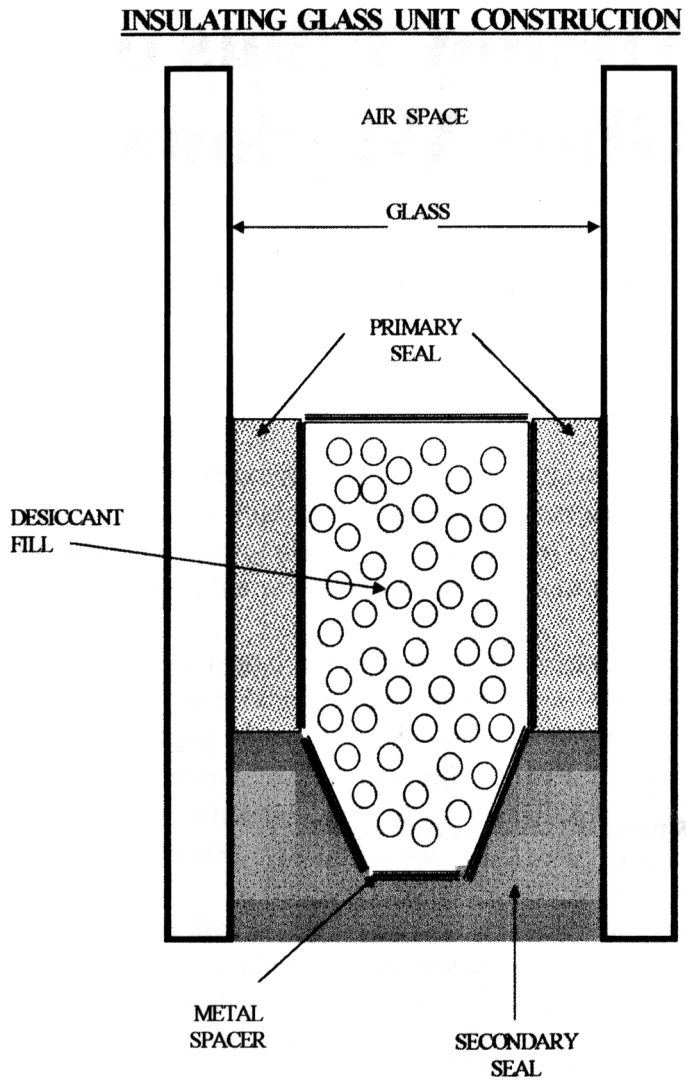
THE INCIDENCE OF SEAL FAILURE

Many residential and commercial architects are now specifying windows with improved insulation characteristics. These windows are commonly called dual pane windows, insulated glass (IG) windows, thermal windows, or just sealed units. These windows are constructed by enclosing a sealed space (which can contain air or a different gas) between two or more lites of glass. These lites are normally separated by spacers of constant thickness. The spacers will also contain the desiccant which is incorporated into the edge construction to adsorb moisture or gases which migrate **through** the seal or exist in the space during fabrication. The sealant is the material used to seal the glass on either side of the spacer material.



Seal Failure

If too much moisture moves through the seal and into the space the desiccant will eventually lose its ability to adsorb any more moisture. The result of the failure of the seal to keep out excess moisture is that condensation may occur causing the unit to have a fogged or hazy appearance.

Sealants

There are several different types of sealants used in dual pane windows. Many commercial window systems use a dual seal system where the primary seal is polyisobutylene and the secondary seal is silicone. Residential units often use a single sealant to provide both the structural bonding and the moisture barrier.

Premature Seal Failure

Premature failure of sealed units is usually caused by one of three reasons: (1) Poor design of the unit so that it will not pass the standard ASTM tests recommended by the Sealed Insulated Glass Manufacturers Association (SIGMA); (2) Poor workmanship on an individual unit during fabrication; (3) Poor frame design which will allow the unit to sit in a high moisture environment.

Rate of Premature Failure

A longevity study conducted by SIGMA which started in 1980 found that sealed unit designs which passed the highest level of performance testing failed at a rate of approximately 4% over 15 years. Units passing lower levels of performance failed at a rate of approximately 10% over 15 years. Sealed unit design has improved significantly since 1980 and SIGMA estimates that current high performance units may have a failure rate as low as 1% **if** all three of the major reasons for seal failure are eliminated. While 1% may seem like a low number it still means 1 in every 100 sealed units will fail before the warranty period. Unfortunately, many window manufacturers are not members of SIGMA and do not design and build their units to the high performance standards SIGMA suggests, and many frames do not utilize weep holes to properly drain water away from the sealed edge of the unit. Failure rates for these windows are undoubtedly much higher than for the high performance units.

Performance Testing for Sealed Units

Many architects specify compliance to American Standard Test Method (ASTM) E773 and ASTM E774 for accepting insulated units. Usually a level of CBA, which is the highest level obtainable, is required where the testing has been specified. (There are 3 testing cycles, referred to as C, B, and A. CBA rating means the unit tested survived all 3 cycles.) Unfortunately, windows are part of an entire building project and are not often specified by the home builder. The average consumer is usually not informed of the variations in quality among sealed unit manufacturers. Builders may even use lower quality windows to reduce construction costs.

TESTING OF WINDOW FILM USE ON SEALED UNITS

Sealed unit manufacturers, window manufacturers, and builders have often indicated to consumers that the installation of any window film on sealed units will cause or contribute to seal failure. While it is true that some window films are not suitable for sealed units, there are many films on the market today that are designed to be installed on these units. Some window manufacturers will void the consumer's warranty for the unit if any window film is installed on the glass. A written request to the major sealed unit manufacturers for the test results used to void these warranties found that no test data existed to substantiate these actions. The Window Film Committee of the Association of Industrial Metallizers, Coaters, and Laminators (AIMCAL) commissioned A. William Lingnell, P.E., a technical consultant to SIGMA, to conduct the standard ASTM tests (E773 and E774) on standard sealed units with and without window film.

These test were conducted by A. William Lingnell (B.S. Civil Engineering, M.S. Civil Engineering, M.S. Mechanical Engineering, M.S. Engineering Science) of Lingnell Consulting Services, the technical consultant to the Sealed Insulating Glass Manufacturers Association (SIGMA). He has over 30 years of experience in the technical field of glass and architectural products and is considered one of the world's foremost experts in the field. He is a member of American Architectural Manufacturers Association; American Association for Wind Engineering; American Society of Civil Engineers; American Society of Heating, Refrigerating, and Air Conditioning Engineers; American Society for Testing and Materials; American Welding Society; Association of Construction Inspectors, Building Officials and Code Inspectors; Construction Specifications Institute; International Conference of Building Officials; National Fenestration Rating Council; National Fire Protection Association; National Glass Association; National Society of Professional Engineers; and Southern Building Code Congress International.

Test Protocol

Commercial units: 1/4" clear glass with a 1/2" airspace. Specified size: 14" x 20".
Primary seal - polyisobutylene
Secondary seal - silicone
Film used: Reflective 20% Aluminum

Residential units: 3/16" clear glass with a 5/8" airspace. Specified size: 14" x 20".
Single seal - Butyl strip
Film used: Neutral 35% sputtered metal

In both tests, 6 units with film and 6 without were selected for the accelerated weathering test portion and two for the fog test.

Conclusions

Testing on commercial units: Results confirm all units with applied film and without applied film passed the CBA (highest rating) requirements of the ASTM E773 test method and E774 specification for sealed insulating glass. The indications show there were no observable differences between the insulating glass units with the film and without the film for the tests run on these samples.

Testing on residential units: Results confirm that 5 of the 6 units with applied film would have passed the CBA (highest rating) requirement of the ASTM E773 test method and E774 specification for sealed insulating glass. The one unit which passed the CB requirement but did not reach the CBA level was examined by the laboratory and the consulting engineer who concluded that the reason for this unit only achieving 2 of the 3 levels of testing was not the fault of the film or the sealant but of the assembly process of the unit itself.

Summary: Based on the testing conducted on these units, window film had no observable effect on the performance of high quality manufactured insulated units. Only in the single case of a suspected manufacturing assembly defect was there any observable difference in any units tested with or without applied film, and that unit still passed all but the most stringent of the levels of testing before failure. Although additional testing of much larger samples would be required to accurately examine all variables involved in seal failure, the limited ***quantitative results available shows no detrimental effects of the use of window films on quality manufactured sealed units.***