25 Year Field Correlation Study

Presented by: Margaret Webb. CHRP
IGMA Executive Director
IGMA 25 Year Field Correlation Study

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IGMA 25 Year Field Correlation Study

- Introduction
- Purpose of Study
- 10 Year Data
- Glazing System Study
- Second Study of CBA Units only
- 15 Year Data
- 25 Year Data
- Summary Comments on Study
- Future Research
- Conclusions
Insulating Glass Units are unique in the realm of manufactured products:

- They are a large product with a hermetic seal - no pressure relief (compare: CRT, vacuum flask)
- They are installed in a harsh environment - UV, water, temperature changes and oscillating loads
- They use exposed organic “adhesive” materials
- They are often fixed in place by an unknown product (frame)
- AND
- Small problems are easily seen
- Comparisons are difficult as they are always installed in different environments (frames, locations and facing directions)
Example of a Seal Failure
What is an IG Failure?

- **Fogged Unit:**
  - Sealant adhesive loss;
  - No sealant adhesive loss;
- **Cracked Glass;**
- **Damaged Coating;**
- **Displaced Spacer;**
- **Any Other Impairment:**
  - Contaminants
  - Argon Loss
  - Non-flat Glass (visual or thermal issue)
IGMA 25 Year Field Correlation Study

Introduction

- The IGMA field correlation study was continued at the 25 year mark to obtain information and data relating to the insulating glass performance over a period of time from 1980 to 2005. The information obtained has been useful to help upgrade testing standards, determine performance criteria of insulating glass units, set glazing guidelines for the industry, as well as have a better understanding of the expected life of insulating glass.

- The principle investigator throughout the 25 year project was James L. Spetz, P. E.
IGMA 25 Year Field Correlation Study
Purpose of the Study

• To determine the correlation of actual in-service insulating glass unit failures to the ASTM E 773 test method and ASTM E 774 specification for classifications C, CB, and CBA

• Summary of Accelerated Weathering Test Specification

<table>
<thead>
<tr>
<th>Class</th>
<th>High Humidity (days)</th>
<th>Accel. Weathering (cycles)</th>
<th>Frost Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>14</td>
<td>140</td>
<td>-34°C(-30°F)</td>
</tr>
<tr>
<td>B</td>
<td>+14</td>
<td>+56</td>
<td>-29°C(-20°F)</td>
</tr>
<tr>
<td>A</td>
<td>+14</td>
<td>+56</td>
<td>-29°C(-20°F)</td>
</tr>
</tbody>
</table>
IGMA 25 Year Field Correlation Study
Introduction

Two Studies

– 1980 - 2005
  • Original study of 2,400 units, commissioned by SIGMA and HUD

– 1990 - 2005
  • additional profiles added
  • Only CBA units were tracked
IGMA 25 Year Field Correlation Study

• In the 1980 original study sample size of 2,400 units in 140 buildings in the following 14 areas were included:

  Boston       Atlanta       Tampa
  Cleveland    Minneapolis   Dallas
  Montana      Denver        Phoenix
  Sacramento   Lake Tahoe   Seattle
  Portland     San Francisco

• 40 manufacturing plants were represented
IGMA 25 Year Field Correlation Study
Participating IG Manufacturers

Marvin       Temp Glass       Glass Temp
AFG          AFGD            HGP
Interpane    PPG Industries   Dykstra
Hurd         Weathershield   Cardinal IG
Guardian     Seaway Aluminum  Indepane
Edgewater    Pearlstein      Viracon
Hoffers      SNE             Custom Glass
Berkowitz    Coolidge Glass  ACI
Pozzi        Acorn           EFCO
Caradco      Oldcastle
IGMA 25 Year Field Correlation Study
Seal Systems In 1980 Study

• Single seal
  – Polysulfide
  – Permapol
  – Hot melt butyl

• Dual seal
  – Polyisobutylene/polysulfide
  – Polyisobutylene/silicone
  – Polyisobutylene/hot melt butyl
  – Hot melt butyl/silicone
IGMA 25 Year Field Correlation Study 1980-2005

- The original 1980 study has certified units to class C, class CB and class CBA tested to the ASTM E 774 standard (equivalent to CGSB 12.8)

- Frost points taken on the first seven years and visual inspections taken at 10, 15 and 25 years

- Some buildings not accessible in 2005, some replaced, security issues prevented inspection

- Approximately 75% of the original population was captured in the final inspection
IGMA 25 Year Field Correlation Study
Field Study At 10 Years 1980-1990

2,100 units accessible

<table>
<thead>
<tr>
<th>Class</th>
<th>Total Fogged</th>
<th>% Fogged</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLASS C</td>
<td>69 of 809</td>
<td>8.5%</td>
</tr>
<tr>
<td>CLASS CB</td>
<td>8 of 242</td>
<td>3.3%</td>
</tr>
<tr>
<td>CLASS CBA</td>
<td>26 of 1049</td>
<td>2.5%</td>
</tr>
</tbody>
</table>

- Total Failure Rate all units 103 of 2,100 = 4.9%

- Summary included all jobs. Two jobs that were found to have inadequate weep systems accounted for approximately one half of the failures. Without those two jobs the CBA rate is 1.2%
IGMA 25 Year Field Correlation Study
Glazing System Types In Study

• Residential 40% of study (in plant glazed)
  – Aluminum – marine gasket
  – Aluminum – dry interior and wet interior
  – Aluminum – both wet seals
  – Wood – marine gasket
  – Wood - both wet seals

• Commercial 60% of study (field glazed)
  – Aluminum – lockstrip
  – Aluminum – dry exterior and wet interior
  – Aluminum – tape exterior and dry interior
  – Wood – both wet seals
IGMA 25 Year Field Correlation Study
Glazing System Types In Study

Notes:

1. Wet seal exterior had 10% the number of failures as dry seal on the exterior 1990 survey of original study

2. Aluminium with marine gaskets and on site glazed units with lock strip gaskets demonstrated much higher failure rates, due to trapping water against the unit edge seal at the sill
**IGMA 25 Year Field Correlation Study**

*2nd Study: 1990 - 2005 Study (CBA Units Only)*

- Newer seal and edge technologies were added,
- 15 year inspection of certified CBA units took place in Ohio, Arizona, Georgia, the Carolinas, Florida, Wisconsin and Minnesota
- A review of the dual seal and single seal systems is shown in the data accumulated
- 15 year results of over 10,000 units (additional profiles added in 1990) show a failure rate of CBA units at 1%
- 10 year results of same population show a 0.12% failure rate
IGMA 25 Year Field Correlation Study  
1980 – 1995 Results (15 years)

2,043 units accessible

<table>
<thead>
<tr>
<th>Class</th>
<th>Total Fogged</th>
<th>% Fogged</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>77 of 807</td>
<td>9.5%</td>
</tr>
<tr>
<td>CB</td>
<td>35 of 218</td>
<td>12.1%</td>
</tr>
<tr>
<td>CBA</td>
<td>42 of 1,018</td>
<td>4.1%</td>
</tr>
</tbody>
</table>

Total Failure Rate 153 of 2,043 = 7.5%

Summary included all jobs. Eliminating the two projects with known problem glazing systems brought the CBA failure rate to 2.9%.
### IGMA 25 Year Field Correlation Study
#### 1980 – 2005 (25 years)

1,714 units accessible

<table>
<thead>
<tr>
<th></th>
<th>CLASS C</th>
<th>CLASS CB</th>
<th>CLASS CBA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Fogged</td>
<td>85 of 791</td>
<td>43 of 126</td>
<td>29 of 797</td>
</tr>
<tr>
<td>% Fogged</td>
<td>10.7%</td>
<td>34.1%</td>
<td>3.6%</td>
</tr>
</tbody>
</table>

Total Failure Rate all units (157 of 1714) = 9.2%

Summary did not include the two previous jobs with known glazing system problems. Therefore no adjustment required to remove these two jobs.
IGMA 25 Year Field Correlation Study
1980 – 2005 (25 years)

1,700 units were examined in the following areas at the 25 year mark:

Atlanta
Cleveland
Tampa
Dallas
Phoenix
Minneapolis
Boston
**IGMA 25 Year Field Correlation Study**  
*15 Year and 25 Year Field Correlation Studies*

### Summary Survey Failure Rates

<table>
<thead>
<tr>
<th>Year</th>
<th>25 Years</th>
<th>15 Years</th>
<th>15 Years</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C+CB</td>
<td>CBA</td>
<td>C+CB</td>
</tr>
<tr>
<td>1980</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Failure rate</td>
<td>14.0%</td>
<td>3.6%</td>
</tr>
<tr>
<td></td>
<td># of Units</td>
<td>917</td>
<td>797</td>
</tr>
</tbody>
</table>
IGMA 25 Year Field Correlation Study
Summary Comments

- Systems with marine gaskets and lock strip gaskets demonstrated high failure rates due to poor or lacking weep systems

- The 1990 study looked at over 10,000 CBA unit in 102 buildings from units made in 52 manufacturing plants with a failure rate of 1% at 15 years
• Based on the 25 year data it is estimated that failure rate of the C + CB units is in excess of 20% due to the number of buildings re-glazed and known systems that were not properly performing to keep water away from the insulating glass edge

• The C + CB units (14%) in the 1980 study had 3 to 4 times the failures than the CBA units (3.6%)
IGMA 25 Year Field Correlation Study
Conclusions

• Certification to class CBA of ASTM E 774 demonstrated much higher level of field performance than class C and CB.

• Units certified to class CBA had failure rates of 1 to 1.2% at 15 years for systems that were properly weeped for the 1980 and 1990 studies

• The 1990 study resulted in a 1% failure rate for class CBA units with 1990 seal technologies glazed in areas that encompass all the normal and severe weather conditions in the USA.
• Certification to class CBA in comparison to C and CB was in part justification for one level of testing as developed for ASTM E 2190.

• IGMA must encourage use of published glazing guidelines, minimum sealant dimensions for insulating glass assembly and following a quality assurance program

• Insulating glass shall be certified to ASTM E 2190 (replacing ASTM E 774) for assurances of long term durability against fogging (seal failure) and glazed in accordance to IGMA standards
IGMA 25 Year Field Correlation Study

Conclusions

To Avoid this:

Test and Certify Insulating Glass Units to the ASTM Standard E 2190
IGMA Current Research

Determination of the Gas Permeability of Edge Seal Assemblies

• To develop an improved test method for measuring the gas loss rate from a sealed insulating glass unit

• To develop a test method using a standard test size insulating glass unit that offers greater speed and reproducibility that the current tests.
Phases

1. Evaluation of the permeability of sheet materials.
2. Evaluation of the gas permeability of edge seal assemblies.
3. Evaluation of gas permeability of sealant systems in a strained condition both physically and environmentally.
Phase 1: Evaluation Of The Permeability Of Sheet Materials

• to develop technical information on the gas permeability rate through different sealant membranes for the purpose of using the data as an aid in predicting the gas loss rate from sealed insulating glass units.

• Use of the data will be to produce a library of transmission rates for most of the available sealants on the market and fill gases and mixtures.

• Data could be used in selecting sealants for use in gas filled IG units or in the development of mathematical models to predict the gas loss from sealed insulating glass units.
### 1.5 mm samples tested at 25 C

<table>
<thead>
<tr>
<th>Material</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polysulfide (2)</td>
<td>0.083</td>
</tr>
<tr>
<td>M-Polysulfide (1)</td>
<td>0.33</td>
</tr>
<tr>
<td>Polyurethane (2)</td>
<td>0.59</td>
</tr>
<tr>
<td>Silicone 2K (2)</td>
<td>7.75</td>
</tr>
<tr>
<td>Silicone 1K (2)</td>
<td>9.53</td>
</tr>
<tr>
<td>Hot Melt Butyl (2)</td>
<td>0.055</td>
</tr>
<tr>
<td>Hot Melt Butyl Spacer (2)</td>
<td>0.033</td>
</tr>
<tr>
<td>Hot melt reactive - Silane (3)</td>
<td>0.073</td>
</tr>
<tr>
<td>Hot melt reactive - Butyl (1)</td>
<td>0.085</td>
</tr>
<tr>
<td>PIB (2)</td>
<td>0.005</td>
</tr>
</tbody>
</table>

### 3.0 mm samples tested at 25 C

<table>
<thead>
<tr>
<th>Material</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polysulfide (2)</td>
<td>0.045</td>
</tr>
<tr>
<td>M-Polysulfide (1)</td>
<td>0.19</td>
</tr>
<tr>
<td>Polyurethane (2)</td>
<td>0.28</td>
</tr>
<tr>
<td>Silicone 2K (2)</td>
<td>3.43</td>
</tr>
<tr>
<td>Silicone 1K (2)</td>
<td>4.48</td>
</tr>
<tr>
<td>Hot Melt Butyl (2)</td>
<td>0.03</td>
</tr>
<tr>
<td>Hot Melt Butyl Spacer (2)</td>
<td>0.023</td>
</tr>
<tr>
<td>Hot melt reactive - Silane (3)</td>
<td>0.045</td>
</tr>
<tr>
<td>Hot melt reactive - Butyl (1)</td>
<td>0.053</td>
</tr>
<tr>
<td>PIB (2)</td>
<td>0.005</td>
</tr>
<tr>
<td>Composite PS/PIB</td>
<td>0.03</td>
</tr>
<tr>
<td>Composite S/PIB</td>
<td>0.015</td>
</tr>
</tbody>
</table>
Phase 2: Gas Permeability of Edge Seal Assemblies, Stage 1 Development of Test Cell

Approach:

• Test Cell Development - completed
• IG Preparation - Clean Edge and Stabilize, 5 iGU’s can be tested
• Cell Purging - with Helium
• Cell Validation - Extraneous Permeation – in process
• Argon Testing 1 - IG purging and testing the cell for argon – in progress
• Argon Testing 2 - Periodic testing for repeatability of measurements – TBD
• Argon Testing 3 - Calculation of Argon Permeability – TBD
• GC Calibration - Very Low Argon Concentrations - completed
Margaret Webb
IGMA® Office

Telephone: 613.233.1510
Fax: 613.482.9436
Email: mwebb@igmaonline.org
www.igmaonline.org