

IGMA 25-Year Field Correlation Study

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Session Overview

- Insulating Glass Manufacturers Alliance (IGMA)
 - Introduction
 - Industry Standards
 - Certification cycle: administration, manufacture, auditing / inspection, testing
- IGMA Field Correlation Study
 - Phase 1: 1980 to 2005
 - Phase 2: 1990 to 2005

Industry Standards and Programs

- Test Specification for Seal Durability
 - ASTM E 2188, E 2189 and E 2190 standards for insulating glass -current
 - ASTM E 773/E774 CBA standards for insulating glass – replaced with above



Test Specimens

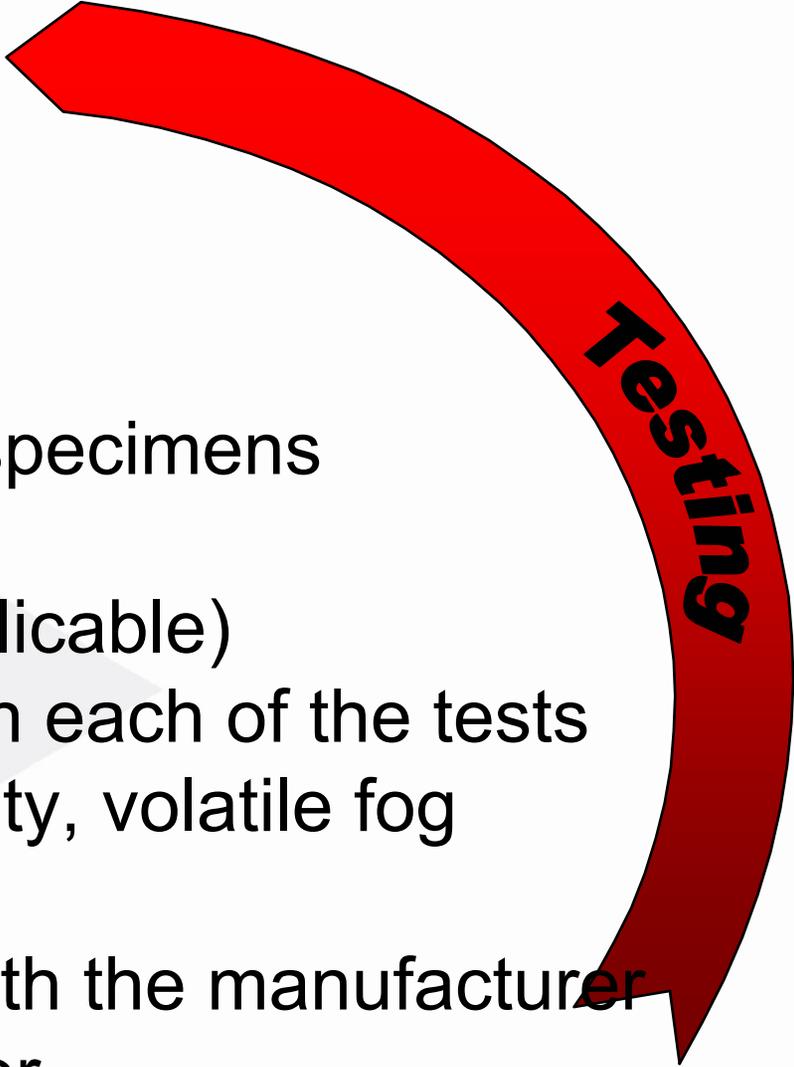
- Representative of manufacturers production
- 12 samples required for double glazed
- 14 samples required for triple glazed
- 14" X 20" samples
- Prescribed glass thickness to airspace width....why?
 - To establish set edge seal pressure

IG Construction vs. Edge Seal Pressure

INPUT DATA					
Outboard Lite Thickness, mm	4.7	4.7	5.7	5.7	4.0
Inboard Lite Thickness, mm	4.7	4.7	5.7	5.7	4.0
IG Air Space, mm	6.5	12.7	6.5	12.7	12.0
IG Width, in.	14.00	14.00	14.00	14.00	14.00
IG Height, in.	20.00	20.00	20.00	20.00	20.00
Design Pressure Change, psi	-2.0	-2.0	-2.0	-2.0	-2.0
Comments	3/16" glass 1/4" airspace	3/16" glass 1/2" airspace	1/4" glass 1/4" airspace	1/4" glass 1/2" airspace	CAN & Euro Spec Unit
OUTPUT DATA					
Exterior Lite M.P. Stress, psi	1617	2330	1437	1903	2434
Exterior Lite Deflection, in.	0.028	0.041	0.021	0.027	0.051
Interior Lite, M.P. Stress, psi	1617	2330	1437	1903	2434
Interior Lite Deflection, in.	0.028	0.041	0.021	0.027	0.051
Final Air Space Pressure, psi	13.462	13.761	13.779	14.061	13.491
Air Space Pressure Differential, psi	0.76	1.06	1.08	1.38	0.79
Maximum Edge Seal Load, psi	5.34	7.42	7.55	9.53	5.54

Note: 2 psi pressure change is equivalent to a 0.70F airspace temperature change

- Receives test specimens
- Records and identifies test specimens
- Records initial dew points
- Records initial gas fill (if applicable)
- Records success or failure in each of the tests (weather cycling, high humidity, volatile fog)
- Issues final report
- Maintains communication with the manufacturer and the program administrator



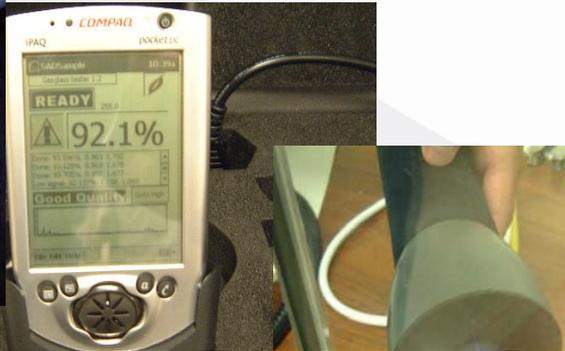
Testing

Test Facility:

- Acknowledges receipt of test samples
- Records dew points at appropriate intervals
- Issues final test report indicating pass or failure of test samples



Testing



- Initial Acknowledgement
- Dewpoints
- Initial gas content (if applicable)
- Weathercycling
- High Humidity Chamber
- Volatile Fogging Test
- Final gas content (if applicable)
- Final Test Report

Weather Cycling High Humidity Volatile Fog



<p>Accel. Weather Cycle test</p> <p>high temp low temp UV source UV output moisture time per cycle # of cycles total time</p>	<p>60+/- 3 C -29+/-3 C F72T12BL/HO 10 W/m² 30 min. spray 6 hr. 252 63 days</p>	<p>Fog Test</p> <p>type glass temp at corner glass temp other locations cooling plate temp cooling plate area UV lamp lamp output</p>	<p>full immersion box 50 +/-3 C 50 +/-3 C 21 +/-3 C 0.018m² (150mm dia) Osram Ultra Vitalux 300w 400 μW/cm² @ 355 nm</p>
<p>High Humidity Test</p> <p>Max temp. Min. temp. %RH total time</p>	<p>60+/- 3 C (constant temperature) 95% +/-5% 42 days (14 days + 28 days)*</p>	<p>Evaluation criteria</p> <p>Frost point test max. frost point visible fog</p>	<p>E546 w/ dry ice or CGSB 12.8 method -40 C no fog at arms' length</p>

IGMA Field Correlation Study Results

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The IGMA field correlation study was continued at the mark to obtain information and data relating to the insulating glass performance over a 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.

IGMA Field Correlation Study

- Introduction
- Purpose of Study
- Results
 - **10 years**
 - **15 years**
 - **25 years**
- Summary Comments on Study
- Conclusions

The Three Analytical Methods

- **Experience:**
 - **OK if there are a relatively small number of failures**
- **Laboratory Analysis / Investigations:**
 - **Analysis – e.g. is the glass clean enough?**
 - **Investigation – e.g.: would something occur under these conditions?**
 - **OK when variables are few and can be accurately modeled**
- **Data Analysis:**
 - **Extremely good method if the underlying data is good**

IGMA Field Correlation Study

Introduction

1980 -2005 (Phase 1)

***Original study commissioned by SIGMA and HUD**

***Comparison of C, CB and CBA units**

- The original 1980 study has certified units to class C, class CB and class CBA tested to the ASTM E 774 standard
- Frost points taken on the first seven years and visual inspections taken at 10, 15 and 25 years
- Some buildings not accessible, some replaced, security issues prevented inspection
- Approximately 75% of the original population was captured in the final inspection

1990 – 2005 (Phase 2)

***Additional profiles added**

***Only CBA units were tracked**

IGMA 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

Class	High Humidity (days)	Accel. Weathering (cycles)	Frost Point
C	14	140	-34°C(-30°F)
B	+14	+56	-29°C(-20°F)
A	+14	+56	-29°C(-20°F)

IGMA 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 *

Cleveland *

Montana

Sacramento

Portland

Atlanta *

Minneapolis *

Denver

Lake Tahoe

San Francisco

Tampa *

Dallas *

Phoenix *

Seattle

•40 manufacturing plants were represented

*** Cites examined in 2005**

IGMA Field Correlation Study

Seal Systems In 1980 – 2005 Study

- Single seal
 - Polysulfide
 - Permapol
 - Hot melt butyl
- Dual seal
 - Polyisobutylene/polysulfide
 - Polyisobutylene/silicone
 - Polyisobutylene/hot melt butyl
 - Hot melt butyl/silicone

IGMA 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

What is an IG Failure?

- The standard for visual failure was defined as “moisture, fog or dirt collection on the glass lite surfaces located within the air space,” exhibiting “permanent material obstruction of vision through the unit due to accumulation of dust, moisture or film on the internal surface of the glass.”

Example of an IG Seal Failure



Example of an IG Seal Failure



Example of an IG Seal Failure

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Example of an IG Seal Failure



Example of an IG Seal Failure



Large Commercial Building with Insulating Glass



Frost Point Testing on Insulating Glass



Results from the IGMA Field Correlation Study

*Phase 1 – 1980 to 1990
(10 Year Mark)*

City	Class C	Class CB	Class CBA
Atlanta	1 of 99	0 of 21	0 of 16
Boston	1 of 106	3 of 52	1 of 48
Cleveland	3 of 124	0 of 50	0 of 41
Dallas	36 of 144	1 of 12	1 of 163
Denver	2 of 68	-----	-----
Minneapolis	3 of 33	-----	3 of 216
Phoenix	8 of 49	1 of 20	0 of 60
Seattle	7 of 40	-----	0 of 130
Tampa	0 of 12	1 of 34	1 of 105
Portland, OR	5 of 95	-----	-----
Sacramento	-----	-----	2 of 74
San Fran. Santa Rosa, CA	-----	-----	18 of 113
Lake Tahoe	3 of 39	-----	0 of 12
Montana	-----	2 of 53	0 of 4
TOTAL FOGGED UNITS	69 of 809	8 of 242	26 of 1049
% FOGGED	8.5%	3.3%	2.5%

Total Failure Rate = 103 of 2100 = 4.9%

*Results from the IGMA Field Correlation
Study*

*Phase 1 – 1980 to 1995
(15 Year Mark)*

City	Class C	Class CB	Class CBA
Atlanta	7 of 101	0 of 21	1 of 16
Boston	1 of 106	3 of 72	2 of 28
Cleveland	9 of 123	-----	1 of 103
Dallas	24 of 129	-----	3 of 164
Denver	1 of 82\3	-----	0 of 47
Minneapolis	7 of 44	-----	5 of 217
Phoenix	2 of 43	3 of 21	0 of 66
Seattle	5 of 27	-----	0 of 133
Tampa	0 of 12	17 of 38	0 of 61
Portland, OR	18 of 92	-----	-----
Sacramento	-----	-----	3 of 56
San Fran. Santa Rosa, CA	-----	-----	27 of 114
Lake Tahoe	3 of 47	-----	0 of 9
Montana	-----	11 of 66	0 of 4
TOTAL FOGGED UNITS	77 of 807	35 of 218	42 of 1,018
% FOGGED	9.5%	12.1%	4.1%

Total Failure Rate = 153 of 2,043 = 7.5%

Phase 2 – 1990 to 2005

- New study started examining only “CBA” units incorporating new technology profiles to initial study:
 - Polyurethane and Swiggle® sealants
 - Warm edge technology spacer designs
 - Bent corners
 - Low E glass
 - Internal grid systems
 - Argon-gas content

Generalizations

- Little variation due to climatic conditions
- No failures in 80% of buildings
- 60% of failures were accelerated by glazing systems that held water at or near the edge sealant
- The findings of this study were one of the key determinants in eliminating the CBA system levels in the new ASTM standard E 2188, E 2189, E 2190

*Results from the IGMA Field Correlation
Study*

*Phase 1 – 1980 to 2005
(25 Year Mark)*

*Phase 2 – 1990 to 2005
(15 Year Mark)*

IGMA Field Correlation Study - Phase 1

Field Study At 10, 15, 25 Years

# of Units	Class C	Class CB	Class CBA	Total Failure Rate (all units)	Adjusted Failure Rate CBA
2,100	69 of 809 (8.5%)	8 of 242 (3.3%)	26 of 1049 (2.5%)	103 of 2,100 (4.9%)	1.2%
2,043	77 of 807 (9.5%)	35 of 218 * (12.1%)	42 of 1,018 (4.1%)	153 of 2,043 (7.5%)	2.9%**
1,714	85 of 791 (10.7%)	43 of 126 * (34.1%)	29 of 797 (3.6%)	157 of 1,714 (9.2%)	3.6%

•*Due to small sample size and large number of units concentrated at one job site.

•**Re-stated percentage due to removal the two jobs with failures due to poor glazing.

IGMA Field Correlation Study - Phase 1 & 2

Summary Survey Failure Rates

Years	<u>Phase 1</u> 1980 - 2005				<u>Phase 2*</u> 1990 - 2005
	25 Years		15 Years		15 Years
	<u>C+CB</u>	<u>CBA</u>	<u>C+CB</u>	<u>CBA</u>	<u>CBA</u>
Failure rate	14.0%	3.6%	5.9%	2.9%	1.0%
# of Units	917	797	1,025	1,018	10,944

* 10 years results of the same population show a failure rate of 0.12%

IGMA Field Correlation Study

Summary Comments

- **Glazing of insulating glass units is critical to long-term performance.**
 - **Wet seal exterior had 10% the number of failures as dry seal on the exterior 1990 survey of original study**
 - **Two projects included in the study one with aluminum framing having 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**
- **Based on the 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 Field Correlation Study

Conclusions

- **Certification to class CBA of ASTM E 774 demonstrated much higher level of field performance than class C and CB.**
- **The Phase 1 and Phase 2 studies had failure rates of 2.9% and 1.0% respectively at 15 years for units certified to class CBA systems that were properly weeped for the 1980 and 1990 studies.**
- **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.**

Based on 25 Years of Performance!

- Best practices, proper glazing:
 - TM-4000-02, IG Manufacturing Quality Procedures
 - TM-4100-02, Preventing IG Failures
 - TM-3000-04, North American Guidelines For Sealed Insulating Glass Units
 - TB-1201-05, Minimum Dimensions for Sealant
- 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 Field Correlation Study

A New Study!

- Include new seal technologies since 1990 or those not included previously
- Gas filled units
- US and Canada for North American study (Energy Star™ zones)
- Use units certified to ASTM E 2190 and include some recent ASTM E 774 and CGSB 12.8 for comparison.....Main emphasis on ASTM E 2190

Bridge Retrofitted with Insulating Glass



Questions, Comments, etc.



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