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Preventing Insulating Glass Failures Manual

DRAFT

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0.0 Introduction

0.1 Guidelines for Preventing Insulating Glass Unit (IGU) Seal Failures

The intent of this document is to provide insulating glass fabricators with best practice recommendations for fabricating, shipping, and glazing insulating glass units (IGUs). All material in this document should be read carefully. A fabricator or user might choose to post a topic in a work area as-is or incorporate it into a training manual.

NOTE 1: *The term IGU appears frequently in this publication. IGU is the industry-accepted abbreviation for insulating glass unit.*

1.0 Scope

1.1 To develop guidelines to use for testing, fabrication, packaging, shipment and glazing of IGUs to assist in achieving long term performance.

1.2 To provide guidance to minimize seal failure using existing technology for edge seal design along with selection of sealants, desiccants, spacers, gases, glass and other components used for the fabrication of IGUs.

2.0 Glass Washing and Cutting Techniques

2.1 General Glass Washing Considerations

- Ensure your washer is functioning properly per the washer manufacturer's instructions and guidelines.
- Do not use excessively hot wash water (130 - 140 °F / 54 - 60 °C). Monitor water temperature minimum of hourly. Maintain wash water temperature per glass manufacturer recommendations, typically between 120 °F and 140 °F (49 °C - 60 °C). Avoid temperatures exceeding 140 °F (60 °C).
- Typically glass coating are placed face up on horizontal washers and facing outward on a vertical washers (away from rollers).
- Do not stop glass lites in the glass washer.
- On horizontal washers, feed the glass lites at an angle to the air knives.
- Use a clear freshwater rinse for the final rinse or de-ionized when required.
- Only use recycled rinse water if it is properly treated with a carbon filter or other treatment.
- Use sufficient freshwater to flood the lite of glass in the final rinse
- Inspect the glass cleanliness to ensure it is completely clean and dry.
- Avoid touching the surface of the glass lites that will contact the IGU sealants.
- Clean the washer on a regular basis.

2.2 Glass Cutting and Handling Considerations

- Wear proper personal protective equipment (PPE) while handling glass. At minimum, use gloves while handling glass to prevent bare hands from touching the glass surfaces.
- To prevent glass contamination, only use water soluble or evaporating cutting fluids. Consult the glass supplier for cutting fluid recommendations for coated glass substrates.
- To ensure good edge quality, maintain sharp cutting wheels, proper pressure, and speed on the glass cutter.
- Conduct frequent checks for accuracy of cuts, dimensions, squareness and glass damage. Ensure the glass edge is free of shell chips, hackle, and shark's teeth. Reference IGMA TR-3401 document for more information.
- Protect the glass edge to ensure it is not damaged during handling and packaging.
- Package the glass using separators between stacked glass. Ensure the glass is dry before stacking. Provide proper support along the rack bottom to prevent glass edge damage.
- When recommended by the glass and sealant supplier, ensure coated glass is fully edge deleted.

3.0 Muntins

3.1 Fabrication

- Ensure the muntins are cut accurately, square, without high spots, and to size.
- Do not touch, mar, or damage the sealant bonding surface.
- Wear gloves to avoid contamination.
- Consult the muntin supplier for acceptable cleaning solutions.
- Consult your muntin supplier for appropriate procedures regarding touch up of scratches and/or blemishes.
- Do not overspray spacers while touching up muntins (overspray could induce contamination).

- Only use the muntin end-clips specified by spacer system supplier
- Inspect and do not use defective muntin clips.
- Ensure the muntin clips / pins are inserted into the muntins / spacer properly.
- Prevent spacer deformation during end-clip hole punching and / or drilling. This can cause pressure points on the glass.
- Minimize contact with the IGU sealant.
- Avoid tilting flexible spacers while inserting the muntin assembly.
- When using flexible sealant spacers, align muntins properly with the reference grid.

4.0 General Desiccant Handling

4.1 Beaded Products

- Inspect the drums or bags for holes and seal damage due to mishandling during shipment
- Check desiccant daily for activity per supplier recommendations. Record the date, time, lot identification of the desiccant, and test results.
- Use only the desiccant test kit or method provided by the supplier of the desiccant being used.
- Wear protection for your eyes and hands during the fill operation.
- Ensure drum lid is sealed when not in use because the desiccant will readily adsorb atmospheric moisture.
- Consult desiccant supplier for proper desiccant for type of sealant being used. Be aware of components which may introduce an organic vapor into the airspace and which may require a desiccant change.
- Seal units within one hour of spacers being filled and locate your filling station away from humid areas such as the glass washing station.
- Use the proper amount of desiccant determined by an equivalency formula after certification testing. Consult certifying body and/or desiccant supplier for more information.
- Inspect spacer fill level to ensure the proper amount is being used.

4.2 Pre-Incorporated: Matrix or Spacer Products

- Ensure the desiccant matrix selected is compatible with the sealants.
- Reject any packages damaged in shipment or if the vapor seal is questionable.
- Check each package of desiccant/ desiccated material for activity per supplier recommendations. Record the data in a notebook including date, time, lot/batch number and the test result.
- Use the “first in, first out” inventory system when selecting a desiccated material.
- Complete unit construction within one hour of the matrix application on the spacer channel.
- Apply a consistent bead of matrix at a depth (or grams/ft) recommended by the supplier. Avoid skips or uneven application.
- Check the application rate once per shift and when the spacer width is changed.

5.0 Fabrication with Spacer Bar

The following general guidelines should be used when fabricating IGUs using rigid spacer bar-type spacers:

- Use spacer that is clean, dry, and contaminant-free.
- Use clean, dry gloves when handling spacer to avoid contamination.

- Ensure spacer lengths are dimensionally accurate, and cuts are smooth and burr-free.
- Spacers should be uniform in width within tolerances recommended in IGMA TM-2000.
- Ensure spacer has adequate air flow into its hollow core in order to ensure moisture access to desiccant. See IGMA TM-2000 for more information.
- If the spacer bar is bent to form the spacer frame, ensure dimensional growth (corner flare) in the corners is minimized to prevent excessive PIB thinning and glass to metal contact after IGU pressing.
- For bent spacer, use the correct inline connectors for the given application or assembly system.
- If the spacer frame is formed using corner keys, ensure the proper corner keys for the given application or assembly system are used, whether they are fixed or folding in nature.
- Ensure all corner keys and inline connectors fit snugly, so that they do not pull out of the spacer easily and do not cause significant spacer deformation. Seal joints with an appropriate material (e.g. PIB, foil tape, etc.)
- Ensure any muntin bars fit squarely and are appropriately secured in place. Do not allow muntin bars to cause high spots that may interfere with glass to primary sealant bonding.
- Ensure capillary or breather tubes inserted into spacers are not blocked with desiccant and allow gas exchange.
- Ensure that any holes created in the spacer to facilitate desiccant filling are well sealed using an appropriate sealant material.
- Ensure the spacer is properly positioned on the glass lite, after applying PIB on both sides of the spacer, taking care not to move or disrupt the PIB during the placement process.

6.0 Fabrication with PIB (Polyisobutylene) Primary Seal

- Inspect containers to ensure they are free of damage, dents, or contamination.
- Inspect opened packages to ensure the material is free from contamination.
- Confirm the material is within shelf life and record the lot number of the material being used. Ensure stock is rotated on a first-in, first-out basis to consume sealant prior to its expiration date.
- Confirm the PIB application temperatures comply with supplier recommendations.
- Confirm the extruder is set at the proper application pressure and the belt speed is properly adjusted to deliver the specified amount of PIB.
- Center the PIB application on the spacer, applying a bead with a convex or semicircular shape, free of cavities, depressions, or other surface defects. Ensure the PIB does not extend onto the shoulder of the spacer or into the interior of the unit.
- Perform periodic quality checks to verify the correct amount of PIB is applied to both sides of the spacer according to the specification.
- Inspect the PIB bead for skips or voids and repair them prior to pressing.
- Handle the PIB/spacer with proper techniques to avoid damage, fingerprints, or contamination. Avoid contact with other materials.
- Press the glass to ensure full and complete contact of the PIB to both the glass and the spacer. Do not over-compress.
- Inspect the PIB wet-out, width, thickness, and sightline position to confirm compliance with the specification.
- Inspect the finished units for skips, trapped air, or voids, and repair or reject them as necessary.
- Ensure products are stored and applied according to supplier recommended temperatures.

7.0 Fabrication with Ambient-Applied Sealants

7.1 Two-Component Sealants

- Inspect drums/pails of sealant components to be installed for large dents (steel) or tears (fiber). These could lead to improper seal of O-rings or wiper gaskets, or possible blow out of fiber containers.
- Document Batch numbers of Base and Catalyst being used and be sure the material is in shelf life. Ensure stock is rotated on a first-in, first-out basis to consume sealant prior to its expiration date.
- Open drums and inspect sealant components for any debris or a compromised seal, potentially leading to cured material at the surface, or significant separation (especially in catalyst).
- Install sealant components on their respective pumps, being sure to purge properly removing any potential trapped air from pail/drum changeover.
- Be sure equipment ratio settings, suggested by sealant supplier are targeted. Ratio control can be different based on equipment manufacturer, whether mechanically or by program settings. Sometimes the Specific Gravity of the sealant components are required in programming. Work with your sealant supplier and equipment manufacturer, if necessary, for support.
- Purge material out the application head, collect a wet butterfly sample to check for proper mix, looking for uniform color, no striations present of unmixed material.
- At the same time as wet butterfly, collect a sample in a cup to be tested for snap time. This is a quick check to verify sealant components are feeding at expected ratios, curing/snapping in expected time, based on sealant suppliers' recommendations. This can vary across sealant suppliers, ratio settings, including temperature and humidity having an effect. Ensure products are stored and applied according to the supplier's recommended temperatures.
- It is recommended a wet butterfly and snap times to be checked at start of shifts, after shutdowns for breaks, or any time there is a drum/pail Batch switch out. It is also recommended to log these checks with Base and Catalyst Batch, date, time, operator initials, pass/fail for wet butterfly, and time to snap (i.e. 30mins).
- Reference IGMA TM-2400 for more information.

7.2 One-Component Sealants

- Inspect drums/pails of sealant components to be installed for large dents (steel) or tears (fiber). These could lead to improper seal of O-rings or wiper gaskets, or possible blow-out of fiber containers.
- Document Batch numbers and be sure the material is in shelf life. Ensure stock is rotated on a first-in, first-out basis to consume sealant prior to its expiration date.
- Open drums and inspect sealant for any debris or a compromised seal, potentially leading to cured material at the surface, or significant separation.
- Purge sealant properly removing any potential trapped air from pail/drum changeover.
- Ensure products are stored and applied according to the supplier recommended temperatures.
- Reference IGMA TM-2400 for more information.

8.0 Fabrication with Hot Melt Butyl or Reactive Hot Melt Sealants

The following general guidelines should be used when fabricating any IGU using hot melt butyl or reactive hot melt sealants:

- Inspect drums or pails for dents or damage. Do not use drums or pails that may damage the hot melt unloader's platen or cause it to become stuck.
- Keep drums or pails sealed prior to use; ensure stock is rotated on a first-in, first-out basis to consume sealant prior to its expiration date.
- Store drums in accordance with sealant supplier's recommendations.
- Follow the sealant supplier's recommended guidelines for application temperature and sealant dimensioning. Failure to adhere to these recommendations may result in sealant degradation, slump, and/or poor adhesion to glass and spacer.
- Periodically test sealant adhesion to glass and spacer using sealant supplier's recommended test methods. Consult with your sealant supplier if poor adhesion is observed.
- Apply sealant consistently to avoid skips, voids, or cold joints in the edge seal.
- After gas fill, ensure the patch sealant is recommended by the sealant supplier and is applied hot enough to properly seal the gas filling ports. Follow your sealant supplier's recommended methods.
- Keep all spray lubricants and solvents out of the IGU assembly area. Overspray may result in contamination of spacer, glass, or sealant and result in adhesive failure. Only perform maintenance with these items when the line is shut down and production is paused.
- Implement quality control program monitoring such items as date, lot # of sealant, application amounts for example; consult with sealant supplier for recommendations.
- For further information, refer to the IGMA Insulating Glass Manufacturing Quality Procedures Manual (TM-4000).

8.1 Special Considerations for Using Linear Extruders in Combination with Rigid Box Spacer or U-Channel Spacer:

- Check the formation of the roll-formed spacer (if used) as compared to the equipment supplier's specifications. Common items to check are the spacer width, twist, splay, parting material, and corner and muntin punches.
- Apply the sealant manufacturer's recommended sealant amounts to the spacer sides and back. This amount should be periodically verified via direct measurement.
- Ensure sealant supplier-approved gloves are used to handle the spacer when sealant is applied. Take care to ensure the sealant is not deformed or damaged due to handling prior to pressing.
- Minimize the time spacer with sealant applied is allowed to remain open to the environment. Airborne contaminants may interfere with sealant adhesion to glass. Humidity present in the environment may cause premature saturation of the desiccant.
- Using the oven press manufacturer's suggested methods, periodically check that the sealant reaches an appropriate reactivation or melting temperature (as recommended by the sealant supplier) during heating and compression in the oven press.
- Periodically check the overall thickness and moisture vapor transition path (also referred to as "wet-out") of the IGU to verify proper oven/press settings and sealant compression. Over- and/or under-compression may result in poor edge seal durability.
- Vent and cool the IGUs prior to gas filling and sealing. Sealing while the IGU is hot may result in negative glass deflection and excessive stress on the edge seal.
- Ensure the patch sealant is recommended by the sealant supplier and is applied hot enough to properly seal the gas filling ports. Follow your sealant supplier's recommended methods.

9.0 Fabrication with Flexible Foam Spacer

The following general guidelines should be used when fabricating IGUs using flexible foam spacers:

- Apply spacer straight and parallel to edge of glass for maintaining a consistent sealant setback.
- Ensure spacer is applied without stretching the material or leaving acrylic adhesive residue in the bond line.
- Maintain minimum sealant depth as required for different industry approved sealants.
- Make corners at 90°, keeping them tight and square.
- Use properly sized tape in the final corner, if applicable
- Close IGU with matching lite shortly after spacer application to minimize spacer exposure to moisture.
- Apply pressure after IGU matching for proper wet-out of pressure sensitive adhesive.
- Check desiccant activity on open material periodically using fabricator's recommended test methods.
- Store partially used material in humidity-controlled areas or in a closed, air-tight container, per supplier specifications.
- Check material expiration date prior to use. Do not use expired material.
- Minimize contact with the acrylic pressure sensitive adhesive to prevent contamination.

10.0 Fabrication with Flexible Sealant/ Spacer Systems

The following general guidelines should be used when fabricating IGUs using Flexible Sealant/Spacer Systems:

- Inspect condition of the box, bag, and effectiveness of bag seal
- Ensure the desiccated spacer is protected from ambient moisture prior to use – store indoors.
- If needed, condition material for application per supplier recommendations.
- Check desiccant activity periodically using supplier's recommended test methods. Do not use material if fails testing.
- Check material adhesion periodically using the butterfly test method.
- Store partially used material in humidity-controlled areas or in a closed, air-tight container.
- Check material expiration date prior to use. Do not use expired material.

11.0 Racking, Packaging and Shipping

11.1 Racks

- Use stable, undamaged racks of appropriate size and construction, ensuring a 90° angle between the base and backrest, with a lean/tilt of approximately 3°-7°, free of protruding objects.
- Maintain rack cleanliness and avoid excess sealant bonding adjoining units together.
- Apply suitable cushioning on the racks bottom and backrest and use separator materials uniformly when applicable. Corner separators should be used when stacking units of different sizes.
- Place units parallel to the backrest and to each other, ensuring all lites of glass in IGU units are supported.
- Avoid overloading or tightly banding racks to prevent damaging the primary sealant.
- Secure the load only after sufficient cure of the secondary and prior to moving the rack.

11.2 Wooden Boxes

- Use stable boxes free from broken or low-quality wood.
- Apply cushioning at the corners and midpoints of the empty box.
- Ensure the load does not exceed the box's maximum weight limit.
- Place the first unit parallel to the back of the box and align all subsequent units accordingly.
- Only use nail or staple guns with proper training to avoid damaging the contents.
- Apply separator materials uniformly between units, and do not move the box until the units are secured.
- Ensure the box label matches the unit labels.
- Avoid over-tightening the banding around the box.
- Confirm packaging is suitable for the destination and shipping method.

11.3 Loading, Shipping and Storage

- Use appropriately sized forklifts and cranes to handle racks and boxes.
- Store finished goods in a clean, dry area, protected from the elements.
- Ensure personnel are trained in the safe handling of racks and boxes using forklifts, cranes, and four-wheelers.
- Load and brace racks and boxes securely in trailers.
- Prevent shrink-wrap from distorting window frames.
- Brace loads to restrict movement in all directions during shipment.
- Use lifting cables long enough to create at least a 45° angle from horizontal.

12.0 Glazing and Installation

12.1 Moving and Handling

- Use proper PPE when handling the IGU.
- Use suction cups and/or a rolling block to rotate glass if handling large and/or heavy units.
- When setting glass on hard surfaces (i.e., concrete, metal, hard plastics, etc.) always rest the glass on two non-metallic blocks at the quarter points of the IGU. This will help to prevent damage to the glass edges and the seal of the IGU.

12.2 Compatibility of Glazing Materials

- Test glazing materials for compatibility with the IGU sealants. *Consult the IGU sealant supplier for compatibility recommendations.
- Avoid using sealants that contain linseed, mineral or vegetable oils, or other plasticizer materials that release migrating organic compounds. Care should be used when glazing IGUs with materials that contain large amounts of organic solvents.
- Glazing sealants should remain pliable under the intended weather exposure of the final product.
- Select sealants, tapes, gaskets, etc. that will retain the proper seal in the glazing cavity.
- Ensure the edge pressures of the IGU do not exceed 10 lbs/linear inch (1751 N/m).
- For further information, refer to the IGMA Glazing Guidelines (TM-3000) and AAMA SSGDG-1-17-Structural Silicone Glazing (SSG) Design Guidelines.

12.3 Setting Blocks

- Use a minimum of two setting blocks that support both lites of the IGU
- Use setting blocks produced from materials that are compatible with the IGU edge seal system such as Neoprene, EPDM, silicone, or other elastomeric material.
- Use setting blocks with a Shore A hardness of 85 +/-5.
- Place the setting blocks at the quarter points of the IGU to obtain equal weight distribution of the glass on the blocks.
- Use setting blocks that are a minimum of 1/8" (3 mm) thick and are at least 0.1" (2.5 mm) in length per square foot of glass area (2.7 cm/m²)
- For further information, refer to the IGMA Glazing Guidelines (TM-3000).

12.4 Vent/Weep System

- Incorporate proper venting by using two or more 1/4" (7 mm) diameter holes or 3/16" x 3/8" (5 mm x 9 mm) slots, or larger. Ensure the holes/slots are equally spaced at the lowest point of the sill section of the sash or frame.
- Ensure the holes/slots remain clean and clear from any obstructions that could restrict or prevent water flow.
- For further information, refer to the IGMA Glazing Guidelines (TM-3000).

12.5 Glass Protection & Cleaning

- Ensure that all cleaning materials are compatible with the IGU sealant. *Consult the IGU sealant supplier for compatibility recommendations.
- Ensure that all cleaning materials are approved for use on glass surfaces.
- Protect the glass from damage during storage, installation, and building construction. Weld splatter, sand blasting, concrete, or other caustic materials will damage the glass surface.
- Ensure that any paint, plaster, sealant/solvent spills are cleaned and removed from the glass immediately.
- Avoid trapping abrasive particles like grit from stucco or dirt between the glass and cleaning materials as these can cause scratching of the glass.
- Avoid touching the glass with any metal parts of cleaning equipment such as razor blades, putty knives, or trowels as these can scratch the glass.
- For further information, refer to the IGMA Glazing Guidelines (TM-3000).

13.0 Industry Testing

- Refer to the certification agency's Certified Products Directory (CPD). Fabricate the test samples using the same method and materials that match the product listing that is to be tested.
- Fabricate the test samples according to the certification programs requirements for cavity space (gap) width and glass thickness.
- Follow all internal standard fabrication methodologies and/or written quality control procedures established by your company.
- Ensure compliance with all the requirements of the certification agency.
- Include a fabrication sheet with the test samples that documents the construction.

- Package samples for shipping in a secure wood crate surrounded with foam or equivalent packing materials, or as required by the certification agency. Refer to Section 11 Racking, Packaging and Shipping for additional guidance.
- Allow samples to condition for a minimum of 28 days from date of fabrication prior to the start of testing. (28-day hold may be waived by IGU fabricator).
- Ensure that your fabrication equipment is operating according to supplier specifications.
- Take appropriate steps to avoid large altitude changes when shipping to the lab. Reference IGMA/NGA TB-1601-24 for more guidance.
- For further information, refer to the appropriate certification program manual or contact your Certification Program Provider.

14.0 Referenced Standards

14.1 References to the standards listed shall be to the edition indicated. Any undated reference to a code or standard appearing in this section shall be interpreted as referring to the latest edition of that code or standard.

14.2 AAMA, Fenestration and Glazing Industry Alliance (FGIA) Standards

AAMA SSGDG-1-17-Structural Silicone Glazing (SSG) Design Guidelines

14.3 IGMA, Fenestration and Glazing Industry Alliance (FGIA) Standards

IGMA TR-3401, Preventing Glass Breakage During IG Design, Manufacture, Transport, Installation and Use

IGMA TM-2000, Test Methods and Quality Assurance Criteria for Box Spacers Used for Insulating Glass Units

IGMA TM-2400, Test Methods of Insulating Glass Sealants

IGMA TM-4000, Insulating Glass Manufacturing Quality Procedures

IGMA TM-3000, North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial & Residential Use

14.4 IGMA (Fenestration and Glazing Industry Alliance (FGIA) Standards) and National Glass Association (NGA)

IGMA/NGA TB-1601-24, Guideline for the Use of Capillary Tubes