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SOLUTIONS FOR A SUSTAINABLE WORLD™

SILICONES FOR BUILDING !

QUALITY CONTROL & APPLICATION GUIDELINES

UltraGlaze™ Structural Silicone Glazing Sealants

siliconesforbuilding.com

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INTRODUCTION

Since the 1960s, silicone sealants have been used as adhesives to bond glass/glass and glass/metal assemblies in facades and buildings and a unique construction type evolved around this time that came to be known as Structural Silicone Glazing (SSG). In these systems the silicone rubber sealant acts both as an elastomeric adhesive transferring applied glazing loads to supportive metal framing as well as a continuous seal maintaining system air and watertightness. Since this method of construction can – in some system designs - rely entirely on adhesive bonding to maintain the integrity of the system, it is prudent to implement a system of Quality Control checks during the use and application of the silicone to help assure that a safe and effective product is being constructed.

This document therefore contains information, recommendations, requirements, and guidelines for the proper use of silicone sealants when used in SSG applications. The information contained within is relevant to the following products:

- UltraGlaze two-component silicones: SSG4650, SSG4600, SSG4400
- UltraGlaze one-component silicones: SSG4000, SSG4000AC, SSG4000E, SSG4800J
- And, in limited situations: SCS1200 Construction sealant and SCS2000 SilPruf™ sealant

PROJECT REVIEW SERVICE (PRS)

The Momentive Performance Materials (MPM) Project Review Service is applicable when considering the utilization of a structural silicone product on a commercial project in which a warranty is desired upon project completion. This service provides technical support based on decades of SSG experience to aid in the specification, selection and use of the proper sealant(s) for a specific design or project. The PRS is required for all SSG applications that utilize structural silicones and is provided as a free service to users of structural silicones.

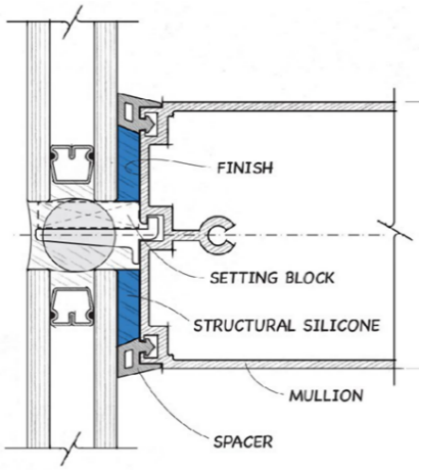
The PRS consists of a series of steps taken in advance of construction to assist users and design professionals in the selection and use of sealants for a specific glazing design. The process also is used to assess, prior to assembly, sealant adhesion and/or compatibility with project-specific materials according to standardized industry tests or protocols (typically ASTM or ISO standards). The main components of the PRS are as follows:

1. Specification Review:

When requested, MPM can review relevant project specifications to identify sealant product(s) and/or offer other comments for consideration in meeting specified criteria and requirements.

2. Drawing Review:

Shop drawings of suitable clarity and sufficient detail showing the overall curtainwall system and relevant SSG details must be submitted along with a completed SSG Project Submittal Form to MPM for review prior to application of structural silicone. MPM will not provide a warranty on projects that have not been reviewed prior to assembly. Upon review MPM will:



- Provide comments pertaining to the specific silicone under consideration for the project.
- Provide comments as to the suitability of any given design to the specific silicone under consideration for the project. Verify that the designed adhesive contact widths are adequate for the glass size(s) and design wind load(s).
- Verify that the designed adhesive thickness is sufficient to provide the flexibility to perform as intended.
- Issue a project review letter confirming such points of review.

3. Laboratory Testing:

Project-specific substrates, of sufficient size and quantity, must be submitted to MPM by filling out the online ***Lab Test Request Form*** and following the ***Online Lab Submittal Instructions*** for testing prior to application of structural silicone. All items to which sealant adhesion is intended must be submitted for adhesion testing. All accessories and items which will or may come in contact with the sealant products to be used on the project (ex., gaskets, spacers, setting blocks, tapes, etc.), must be submitted for compatibility testing. MPM will not provide a warranty on projects that have not been tested prior to assembly. Upon receipt MPM will:

- Perform adhesion, compatibility and/or stain testing (as applicable) with candidate sealant(s) and upon completion, will issue a report of relevant findings along with requirements and recommendations for surface preparation and/or priming, as applicable.
- Provide comments as to the suitability of any given substrate or submitted material with the specific silicone under consideration for the project. Some substrates may not be suitable or sufficiently durable for structural adhesion.

4. Project Warranty:

MPM can offer a project-specific warranty for SSG projects, in both new and/or remedial applications. The warranty options available may be obtained by contacting your MPM sales representative. To obtain a warranty, all steps of the PRS must have been completed prior to project start and at the time of substantial project completion a Warranty Request Form must be submitted to MPM for review. MPM may, at its option, require copies of quality control logs and time-dated photographical documentation to determine if recommended quality control procedures were followed and conducted throughout the project in accordance with standard industry practice and MPM's quality control guidelines and recommendations contained within this document.

NOTE: Due to the endless variability of project designs, substrate types and conditions of use, neither the PRS nor the test results provided my MPM, should be a substitute for a continuous quality control program throughout the fabrication of the reviewed project. Quality control guidelines are provided later in this document.

REFERENCES

Other documents relevant to, or supplemented by, the information contained in this document:

- Industry Standards:
  - ASTM C1401 - Standard Guide for Structural Sealant Glazing
  - ASTM C1135 – Standard Test Method for Tensile Adhesion Properties of Structural Sealants
  - ASTM C794 - Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants
- MPM Documents:
  - Project-specific adhesion & compatibility test report(s)
  - Batch Code Shelf Life & Storage Information
  - UltraGlaze Project Submittal Form
  - Laboratory Test Request Form
  - UltraGlaze SSG4600 Part B Material Preparation
  - Catalyst Pail Changing Procedures
  - Product datasheet – SSG4400, SSG4600, SSG4650, SSG4000, SSG4000AC, SSG4000E, SSG4800J, SCS2000
  - Product datasheet –SS4179, SS4044P, SS4004P, SS44UV, SS41UV, SS80 primers
  - Manufacturer's Safety Datasheets (SDSs) for products noted above, as relevant
  - Manufacturer's Safety Datasheets (SDSs) for cleaning solvents used

NOTE: It is recommended that users obtain and read the ASTM C1401 Guide for Structural Glazing. This document provides a state-of-the-art overview of Structural Silicone Glazing and is routinely kept current by members of ASTM's C24 committee on Building Seals and Sealants; formed in 1959. Copies may be obtained from www.astm.org.

MATERIALS

Any substrates to which silicone adhesion is intended should be verified as being the same as those that were submitted to and tested by MPM test lab(s) as part of the Project Review Service mentioned earlier. Such substrates are predominantly the finished aluminum extrusions which comprise the curtainwall frame and the glazing infill (typically glass) which is then bonded to the frame by the structural silicone. Other substrates can include: opacifiers, ceramic-enamel frits, porcelain, aluminum panel, stainless steel and fiberglass pultrusions, among other less frequent possibilities. Any such materials showing physical damage or other abnormal conditions should be rejected or reviewed for acceptability prior to assuming that any such abnormality is acceptable for structural adhesion.

Aluminum Extrusions

Finished production run samples should be tested by QC personnel for structural adhesion prior to production (to validate results from MPM project-specific adhesion test reports) as well as throughout the production process. Such testing can assist in screening potential variability in received finishes (i.e., batch-to-batch variability in paint, powder or anodizing process, change in supplier, etc.). MPM will not be responsible for adhesion issues caused by variation or changes in substrates. The customer is responsible for notifying MPM of any change in substrate finish or processing that may alter original test results. MPM should be provided with a change notification so that we may retest the adhesion to the substrate.

Glass

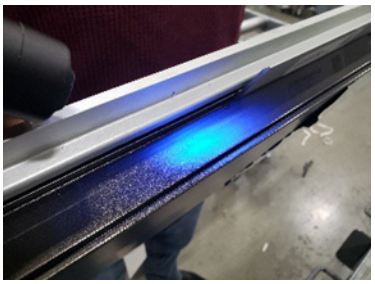
Only insulating glass units constructed with a silicone edge sealant should be used in SSG applications. Insulating glass units should be inspected to verify that they have a silicone secondary edge seal and not polysulfide, polyurethane, or other non-silicone material. Insulating glass secondary seals should also be checked for minimum structural contact width requirements. Monolithic, laminated, insulated and other fabricated glass should be suitably fabricated without sharp or damaged edges.

Glazing Accessories

All accessory materials (spacers, tapes, gaskets, setting blocks, etc.) received should be marked for the specific project and noted as to manufacturer, part or ID number, and compound type. These specifics must be confirmed as identical to what was tested by the MPM test lab(s) as part of the Project Review Service mentioned earlier. Any accessories that are to be in permanent contact with the structural silicone must be made from silicone rubber to minimize possible incompatibility issues. Neoprene and EPDM are not recommended. Spacer gaskets and setting blocks are in permanent and continuous contact with the structural silicone and because of this intimate proximity should only be of 100% silicone composition to eliminate potential longer-term incompatibility issues. Non-silicone compounds should be avoided in these locations. Incompatibility with glazing accessories may not be apparent in shorter term testing, but could manifest itself over longer terms as color change or adhesion loss (which, in SSG applications, must be avoided at all costs).

Silicone & Primer

- All silicone materials (including primer, when applicable) to be used in fabrication should be verified as the correct product(s) as tested by MPM in the project-specific test reports.
- Upon delivery it is recommended to check the Use Before Date to assure that delivered product is within shelf life.
- Store all received silicone according to the prescribed storage conditions for each product.
- Prior to consumption, all containers must be checked for Use Before Date to avoid use of expired product in production.



SS44UV Fluorescing Primer

NOTE: SSG4400, SSG4600 and SSG4650 are two-component products and have a separate Batch Code for both the "A" component (base) and "B" component (catalyst).

The Batch Code of all silicone materials consumed on a project must be recorded in a suitable logbook. Recorded batches and daily QC information must be retained and provided to MPM as it may be requested before issuance of the project warranty.

For general information including primer selection, physical properties, and installation instructions refer to Primers Technical Data Sheet.

NOTE: Silicone materials have a defined shelf life typically based on package type and product chemistry. The use of a silicone product after expiration may not yield intended performance and expired materials should never be used in an SSG application. If in doubt, consult MPM for advice.

Cleaning Agents

Solvent or other cleaning agents to be utilized for substrate preparation should be verified as being the type tested and recommended by the project-specific MPM Adhesion & Compatibility test reports. The substrate supplier or manufacturer may also be contacted to confirm compatibility with their product

APPLICATION & USE

Prior To Assembly

1) Verify, that MPM has performed adhesion and compatibility testing to any/all substrates to which the silicone will need to adhere to or will come in contact with.
2) Check, for each substrate, the MPM project-specific adhesion tests report(s) for surface preparation and/or priming requirements.
3) Review, the installation and use information of relevant product datasheets.

Structural silicone may not adhere and/or maintain the intended long-term adhesion to substrates if the surfaces are not prepared and cleaned properly prior to product application. Using proper materials and following prescribed surface preparation and cleaning procedures is vital for durable adhesion.

Surface Preparation & Cleaning Procedures

Reference respective product datasheets in combination with the project-specific MPM laboratory test reports for prescribed cleaning and priming instructions. Product datasheets can be located here: SSG Product Datasheets.

Dispensing Equipment

SSG4400/SSG4600/SSG4650 are two-component products that are supplied as a base (part A) and a catalyst (part B) and require suitable equipment that can properly process (meter, mix and dispense) them accurately as to ratio and without introducing air into the mixed material. Pumping systems suitable for use with these products should be based on a follower-plate-type delivery system for both the base and catalyst. “Pressure pot” or “piston transfer” suction-type systems are not suitable for these materials and are not recommended. There are several equipment manufacturers that cater to the glass/glazing industry and additional information is available from their websites and/or via their distribution network.

Common manufacturers include: Graco Inc., Reinhardt-Technik GmbH & Co., LiSEC, Erdman Automation Corp., HG Adhesive Dispensing, CYH, among a few others.

Whichever manufacturer of equipment is selected for use, it should be trialed with the silicone material to verify that the equipment is capable of processing these products correctly. In some cases, adjustments to the equipment may be necessary to optimize delivery of mixed product. The equipment manufacturer or their authorized network of distributors are the best sources to solicit advice as to proper use, maintenance, and operation of such equipment.

Regarding mixing, as a generalization the materials being mixed (part A + part B) must pass through a minimum of thirty (30) common (spiral/helical) mixing elements to achieve a mix quality which is uniform in color and free of streaks. Alternatively, there are other types of static mixers that are acceptable which are not

based on spiral/helical elements; contact MPM Technical Services for more information if interested. Dynamic mixing has also proven to be effective.

Sealant Use

For comprehensive information regarding application and use of UltraGlaze structural silicones reference the respective product datasheet(s). Such information includes: mixing, pumping, dispensing and curing details, among other items.

Catalyst Separation: Relevant to SSG4600 or SSG4650, settling of components may occur over time during shipment and storage of the catalyst. For information on how best to reincorporate the product see REFERENCE DOCUMENT: UltraGlaze SSG4600 Part B Material Preparation.

Catalyst Change Procedure: The catalyst is sensitive to moisture; therefore, it is important to avoid leaving the pail in an open state longer than necessary or a crust will begin to form on the surface of the exposed product. For information on how best to avoid this, see REFERENCE DOCUMENT: Catalyst Pail Changing Procedures. Crust formation can also occur on the underside of the follower plate while changing pails. Consideration should be taken on this aspect as well to avoid hardened material entering the new pail when loading onto the equipment. If crust formation does occur, it should be skimmed or removed prior to loading.

Base Change Procedure: Base material (Part A) is not sensitive to moisture, therefore information above on catalyst change procedure regarding crystallization is not relevant. Base material is supplied in drums with a plastic liner. To prevent slippage of the liner into the drum as the material is consumed, the liner must be firmly secured around the upper perimeter of the drum using strapping or duct tape. Failure to secure the liner could result in pump blockage or damage to the pumping system.

Weatherseal: In addition to structural silicone, a weatherseal sealant is also commonly specified as part of the curtain wall system. One-component sealants such as SCS2000, SCS2700, and SCS2350 are often used as a primary weathersealant as well as for general screw head and internal frame sealing. Two-component sealants including SSG4400, SSG4600, and SSG4650 are also suitable as weatherseal sealants, while offering faster curing times than one-component sealants.

SCS2350 Frame Sealant

Weatherseal adhesion testing requirements as shown in the Quality Control Testing table and must be documented and retained in a suitable log sheet.

Consult ASTM C1193 Standard Guide for Use of Joint Sealants at: http://www.astm.org for weatherseal preparation and application guidelines.

Handling and Storage of Finished Units

Units glazed with SSG4400/SSG4600/SSG4650 should experience little or no movement until sufficient adhesive bonding and sealant strength has developed. Tipping or moving of units prior to adequate cure could cause disruption of the adhesive bond and/or may cause the curing sealant(s) to creep, distort or shift position potentially compromising the integrity or the air/water seal of the assembly. In colder months, it is preferable that glazed units be kept inside for a day or more to allow the curing process to advance without being hindered by colder temperatures which can slow the adhesion development and strength build.

Tipping of units: In general, an overnight curing duration has shown to be sufficient for most designs when glass or panel is tipped onto edge where permanent supportive blocking does not exist or is not designed for.

However, a check should be made to assess stress on the sealant via a force/area calculation. Force = weight of glazed part. Area = total area of structural silicone supporting glazed part.

Overly heavy glass or glazed infill may need extra curing time prior to tipping.

In some cases, tipping of units can occur within hours but only when supportive blocking exists that is intended to bear the full load of glazing without deformation. In this case, tipping should not occur until sufficient time has elapsed such that the structural silicone has adhered to all substrates. Bead Adhesion Testing can be used to verify proper adhesion development. Consult MPM Technical Services for advice on any specific design or application.

Two-component sealants develop adhesion over time and this time can vary across substrates. It should be noted that adhesion development can be substrate/sealant/batch/primer/climate dependent. It is recommended to establish an Adhesion Development Time for each substrate on a project prior to tipping or moving of finished units.

Units glazed with SSG4000/SSG4000AC/SSG4000E/SSG4800J or SCS2000 should not see any movement, which will cause the sealant to deform while the sealant is curing. Cure times will vary with system design and sealant contact width / thickness dimensions, but 14 days is likely a required minimum for most systems. Contact MPM Technical Services for an estimation of cure time for each specific project.

Storage: It is recommended that finished structurally glazed curtainwall units be treated with the same amount of protection afforded to other assembled/manufactured products. Inside storage is preferable. When units are stored outside, rainwater, snow or sleet should not be allowed to collect and remain for longer durations unless in a drained position. Plastic shrink wrap or similar covering is commonly used to protect the units during storage and shipping.

QUALITY CONTROL – SILICONE TESTING GUIDELINES

The tests shown in the table below are recommended to be performed throughout the project on a routine basis. The test results should be documented, retained, and provided to MPM if requested. In addition, the physical test specimens should be dated, suitably labeled, and retained for the duration of the project.

QUALITY CONTROL TESTING			
Test	**Test**	**Frequency**	**Minimum Requirements**
Shop Conditions	Record shop conditions	Daily	Temp & %RH
Butterfly	SSG4400, SSG4600, SSG4650	Morning and afternoon pump start-up	Uniform mixing
Snap Time	SSG4400, SSG4600, SSG4650	Morning and afternoon pump start-up	Consult ratio graphs on respective product datasheets
Hardness (Measured using a Durometer, Type Aindentor)	Weatherseal: Drawdown of one-component sealants on solid surface.Also check on deglazed units.	Suggested, once weekly (7-day reading) to confirm batches of sealantused are curing as intended.	See respective datasheet fortarget value [all +/-5]
	SSG4400, SSG4600, SSG4650	Daily, 24-hour reading	Report values
Weight Ratio Check	SSG4400, SSG4600, SSG4650	Daily	Range: 9:1 to 14:1
Curing Test	One-component sealants	All batches, weekly	Cure to tack-free elastomer
Bead Adhesion	Both one- and two-componentsealants on each substrate	Weekly for weatherseal. Daily for structural silicone. Test weatherseal beads on deglazed units	> 95% adhesion
Unit Deglazing	All structural products	See unit deglazing section below	> 95% adhesion

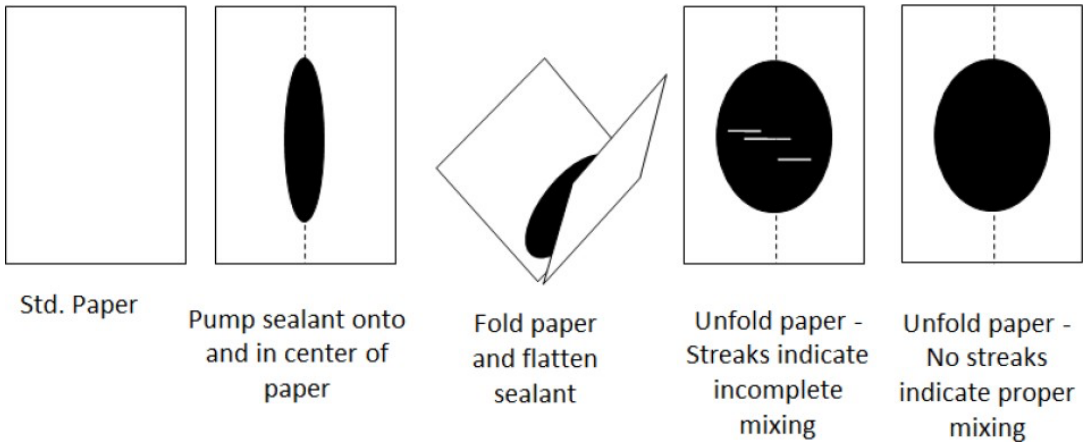
Optional Tensile Adhesion Test: For SSG4400, SSG4600, SSG4650 make three TA specimens weekly, pull after minimum 48 hours cure, target > 95% adhesion. See appendix A for more information.

Butterfly Test – a visual check of mix quality

SSG4400/SSG4600/SSG4650 are two-component products and must be properly mixed within an acceptable ratio range for them to cure and attain their desired material properties. This mixing must be thorough and is performed by static or dynamic mixing elements via the pumping equipment. The mix must be checked at every pump startup and confirmed as acceptable prior to dispensing into production. The mix should be checked whenever the mixers have been purged and re-started. The mix should be regularly monitored on a daily basis throughout production. To check the thoroughness of the mix, the following "Butterfly" test procedure can be used:

- Have pumping equipment in a mode which is ready for production.
- Lay out a piece of paper (8 x 11 or 11 x 17 in. / 20 x 28 or 28 x 43 cm) and dispense a bead of silicone [approximately 1/2 in. deep x 3/4 in. wide (13 x 20 mm)] down the center of the paper.
- Fold the paper in half so the silicone is in the center of the crease - push on the bead so the silicone is flattened out to approximately 1/8 to 1/4 in. thick (3 to 6 mm).
- Pull the paper apart and visually examine the material. There should be no white, gray or dark black streaks or lines in the silicone. If any of these conditions exist, pump more silicone through the mixers and repeat the above procedure until proper mixing has been attained. Do not start assembly / production of curtainwall units until thorough mixing of the silicone has been attained.
- The results of the Butterfly test must be recorded and retained* throughout the project for examination upon request. This information may be requested by MPM at time of warranty issuance.

*Alternately, time-stamped photographs can be substituted in lieu of physical retainment.



NOTE: If thorough and uniform mixing of the material cannot be attained, it may be necessary to clean the dispense valve mechanism and/or replace the mixing elements. Improperly seated check and ball valves, leaky valves, and/or worn packing can also cause abnormalities in mixing. Refer to pump manufacturer for troubleshooting steps to improve the mix quality.

NOTE: Some occasional and minor levels of mix irregularity is to be expected over the course of a project. If concerned, contact the MPM technical representative to review mix quality for acceptance or rejection.

Snap Time Test – a check of mixed product work life

The A/B ratio at which the silicone is mixed is important in obtaining the desired final cured mechanical properties. As such, the quantities of part A and part B must be monitored to ensure the proper amount of each component is incorporated during the mixing process. The following procedure will give an indication of the cure rate of the silicone and when monitored daily, can be a good indicator of correctly (or incorrectly) ratioed material.

STEP 1 - Fill a suitable cup of 5 oz. (150 ml) size or greater with the mixed silicone approximately 3/4 full.

STEP 2 - Place a tongue depressor in the center and to the bottom of the cup.

STEP 3 - After 15 minutes, and at 5-minute intervals thereafter, pull the tongue depressor out of the cup. If the sealant is still 'stringy' and is easily stretched, it has not yet reached its Snap Time.

Repeat STEP 3 every so often (about 5-minute intervals) until STEP 4 condition has been reached.

STEP 4 - This photo shows sealant that has reached its Snap Time. The time is when the sealant is no longer stringy, but partially cured and at the onset of elastic -like behavior. The sealant is no longer workable with a tool and the tongue depressor can recede back to somewhat into the cup if stretched and released.

Step 1&2 **Step 3 (still stringy)** **Step 3 (near snap)** **Step 4 (snapped)**

NOTE: The Snap Time Test is subjective, and snap-times will vary from person to person based on individual perception of the developing rubber properties. The test however, can alert to a change in ratio if a significant deviation from daily test results has been observed. Between SSG4400, SSG4600 and SSG4650 the snap time can vary from 10 minutes to 90 minutes, depending upon the: sealant base/catalyst combination in use, mix ratio, temperature & RH conditions, and on the individual performing the test. A deviation of more than 20 minutes from day-to- day testing (assuming the ratio wasn't purposely changed) should trigger a confirmation of ratio by weight measurement. See section below: Ratio Check (by Weight).

Hardness Testing

Checking the indentation hardness of a sealant gives an indication that the proper cure profile is being developed. Testing is performed using a durometer with a type A indentor. Take three hardness readings per specimen by pressing the device firmly onto a flat sealant surface of at least 1/4 in. (6mm) thickness.

Assure that the durometer cylinder at the probe is not obstructed by adjacent metal, glass or other material so as to obtain an accurate reading. For one-component sealants test after seven days. For two-component sealants test after 24-hours and on deglazed units. Average the three readings and record in the QC log. Consult MPM Technical Services for durometer recommendations.

Ratio Check (by weight)

Before starting sealant application using two-component pumping/mixing equipment, a ratio check of the weight-of-Part A to weight-of-Part B must be done to assure that the equipment is delivering the material at the correct ratio. Proceed as follows:

- Have the pumping equipment in a mode which is ready for production.
- Dispense and collect Part A and Part B according to pumping equipment manufacturer's instructions.
- Weigh the two components separately with a digital scale and record the data (be sure to exclude the weight of the empty container; see NOTE below).
- Calculate the mix ratio (Base-to-Catalyst) by dividing the dispensed weight recorded for Part A by that recorded for Part B.

NOTE: For the most accurate measurement of mix ratio, it is important to tare the containers into which the base & catalyst are collected. The following example shows the difference in accuracy between taring and not-taring.

Weight Ratio Check Example:

Performing a weight ratio check using cups that weigh 2 grams

Weighed base = 200 grams & weighed catalyst = 20 grams with equipment ratio set point @ 10:1

- Without taring the cups: 202/22 = 9.2:1 by weight
- With taring the cups: 200/20 = 10:1 by weight

Acceptable ratios for UltraGlaze structural sealants can be found in the respective Technical Data Sheets. Lower base-to-catalyst ratios (e.g. 9:1, 10:1) will result in faster snap and curing times than higher (and thus, leaner) ratios such as 13:1 or 14:1 by weight.

NOTE: Some pumping equipment is scaled or set by Volume. If a corresponding ratio by Weight is desired, a Volume-to-Weight correlation can be found on the respective product datasheet.

Curing Test (for one-component sealants)

This test is used to verify that sealants are curing properly before being used in production. Drawdown a 1-2 inch (25 to 50 mm) wide bead of sealant onto a non-stick surface (PTFE, PE, wax paper, etc.) and tool to approximately 1/16 inch (2 mm) thickness. Suggested length is 6-10 inches (150 to 250 mm). After 24 hours remove the sealant from the substrate and stretch/flex it. When stretched and released the sealant should return rapidly to its original dimension. If sealant breaks or does not elongate and/or is tacky, do not use this material. Properly cured sealant should be non-tacky and exhibit elastomeric properties.

Adhesion Testing

Adhesion testing must be continuously performed throughout production as part of a continuous Quality Assurance program. The routine testing is intended to verify that the silicone sealant(s) used are performing as intended. It is recommended that all received lots or batches of aluminum be tested for adhesion as lot-to-lot variability may occur. Adhesion testing results must be recorded and retained and may be requested by MPM for review prior to issuance of a project warranty.

- Prepare surfaces as prescribed in MPM project-specific adhesion reports.
- Bead Adhesion (similar to Peel Adhesion) - Dispense and tool 1/4 to 3/8 in. (6-10 mm) thick and ~1 in. (25 mm) wide bead @several inches long onto substrate(s) to be tested. Allow the sealant to cure*. After curing, cut sealant at bond line to form a tab to pull on. Pull sealant tab in direction of the uncut bond line at a peeling angle between 130 and 160 degrees. Sealant will fail cohesively when acceptable adhesion is developed. If adhesion loss is noticed, notify the Project Manager or Shop Supervisor for instruction on how to rectify. Record adhesion test results, temperature, relative humidity, and any other pertinent information in a suitable project- specific QC Test Log. ASTM C794 Standard Test Method for Adhesion-In-Peel of Elastomeric Joint Sealants may also be used in place of this described procedure.

Example Showing Acceptable Adhesion

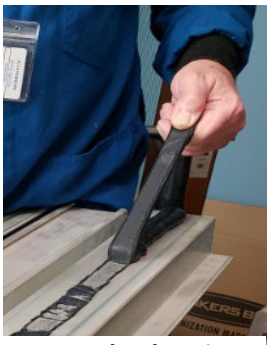
*Allow for the following curing durations prior to adhesion testing:

SSG4400/SSG4600/SSG4650

- Cure and test at 4 hours; test again at 24 hours.

SSG4000, SSG4000AC, SSG4000E, SSG4800J & SCS2000

- Cure 3 to 5 days prior to testing. Beads thicker than 1/4 inch (6 mm) may need additional cure time during the cooler less-humid months. Cure time will vary by temperature and humidity conditions at location.



Example Showing Poor Adhesion

Finished Unit Deglazing

MPM and industry recommendations (ASTM C1401) strongly recommend that adhesion testing of installed sealants on completed units (i.e. deglazing) be tested routinely throughout the duration of the assembly of a project. Adhesion testing of the installed sealants (structural silicone and weatherseals) should be complete and thorough. These tests provide a certain level of confidence that the entire start-to-finish SSG application process (i.e., cleaning/prep/priming/application/cure/adhesion, shop or plant conditions, etc.) is producing an acceptable finished product that is safe to install onto the façade of a building. Deglazing must be documented using date-stamped photography and logged into a suitable report for MPM review. Deglazing is required for warranty purposes per the following frequency: 1 out of the first 10 finished units (units 1 to 10)

- 1 out of the next 40 finished units (units 11 to 50)
- 1 out of the next 50 finished units (units 51 to 100)
- 1 of each subsequent 100 units (until project completion)

The deglazing procedure is as follows:

a) Check production records to confirm that there has been sufficient cure time prior to proceeding with the deglazing. For units glazed with two-component structural silicone (SSG4400, SSG4600, SSG4650) allow a minimum of 24 hours prior to deglazing. For units glazed with one-component structural silicone (SSG4000, SSG4000AC, SSG4000E, SSG4800J, SCS2000) cure times will vary greatly depending upon the specific design, contact width of the silicone as well as the on current climatic conditions that the unit has been exposed to. Consult MPM Technical Services for estimated cure times.

b) When applicable, cut through the Primary Weatherseal bead and test for adhesion using the following procedure:
   - Cut through the sealant approximately 3-5 in. (75-125 mm) along the bond line at both substrates
   - Cut across the sealant bead to create a tab to pull on
   - Pull the tab at a peeling angle between 130 and 160 degrees to the substrate
   - Review and report failure mode is project test log

c) Cut through the structural silicone around the perimeter of the unit and remove the glass or glazing infill. When cutting through the silicone make the cut close to the glass on three of the four sides of the unit leaving the bulk of the silicone thickness available for pull-testing to the metal finish. On the

remaining side, make the cut close to the metal thereby leaving the bulk of the silicone thickness available for pull-testing to the glass (or other infill) surface. Remove the glass or glazed infill.

d) Remove or cut the spacer gasket or glazing tape around the perimeter of the unit such that the edge(s) of the structural silicone are not adhering to these components.

e) When removing the silicone thoroughly inspect to verify that the silicone has proper adhesion to the substrates. Cut a tab of the structural silicone long enough to exert a pulling force from, approximately 3-5 in. long (75-125 mm). Pull the tab approximately 130-150° backwards with force to assess the sealant adhesion to the substrate. Pull the tab with sufficient force to test the adhesion bondline but not with enough force to break the sealant cohesively. Whenever the tab may break, cut another tab and continue undercutting and pulling until the entire perimeter has been tested. Document results in a report using time-dated photography for MPM review. Report should include: production date of unit, date of deglaze, unit identifying number, hardness of silicone, % adhesion, and photos thereof. Video reporting may be alternately utilized in lieu of photography. A successful deglaze must have <5% of void or adhesion loss.

Cut at bond line to create tab

Pull tab to assess adhesion

f) If adhesion is not good (>5% of tested surface area), stop glazing and troubleshoot the glazing process to identify and resolve the cause. Contact MPM Technical Services for assistance.

g) When applicable, repeat step e on the glass or infill that was removed in step c above.

h) If any other conditions exist or appear abnormal that become evident during the deglazing test, notify Project Supervisor or Manager. Possible conditions may include: excessive voids, air- entrapment, bubbles, poorly mixed silicone (marbling/streaking), incomplete cure, etc.

i) Once the adhesion assessment has been completed, proceed to prepare the silicone surfaces for reglazing.

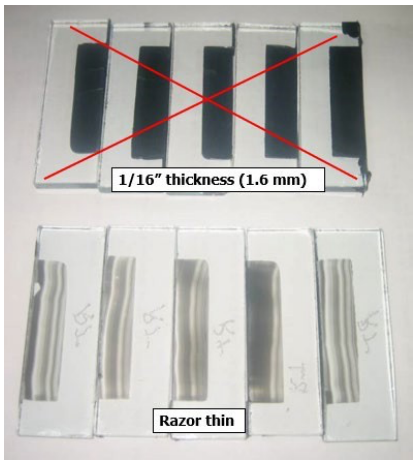
Reglazing Procedures

This section addresses the procedures for reglazing of structurally glazed units in a factory setting. For field reglazing refer to ***Field Reglazing Procedures.***

NOTE: Do not proceed until you have contacted MPM Technical Services to determine the correct product to use for reglazing.

a. Surfaces to be reglazed can be prepared using either Method 1 of Method 2 below. Use caution when cutting away the silicone so as not to damage the substrate finish. Damage of the finish could interfere with the adhesion performance of the reglazed silicone.

Method 1 - Using a suitable flat blade or razor tool remove silicone down to a continuous 'razor thin' layer as shown in the photograph aside.



OR

Method 2 - Remove all existing structural silicone, restoring the virgin substrate surface. Removal of the silicone can be accomplished in a variety of ways, but is commonly done by cutting away the majority of the existing silicone with a flat razor and then removing the remaining silicone residue using synthetic abrasive pads (such as kitchen sponge type pads) wetted with a suitable solvent.

NOTE: If using Method 1, never use silicone primer on the 'razor thin' residue as this will prevent adhesion of the new silicone upon subsequent reglazing.

NOTE: If using Method 2 it must be determined if the silicone to be used for reglazing requires primer on the particular finish(es). Consult MPM project-specific laboratory adhesion test reports.

b. When cleaning newly exposed silicone surfaces (i.e., the razor thin silicone residue from Method 1), use clean lint-free rags dampened with the recommend solvent (reference project-specific MPM Adhesion & Compatibility test reports). A list of pre-tested rags suitable for use can be found here Cleaning Rags. A quick wipe will suffice and is intended to remove any dust or debris that may have accumulated and to remove silicone particles loosened during cutting. The rags should be damp with solution but not dripping wet as this could allow excess solvent to remain on the sealant. Change the rags frequently as they accumulate dirt/dust, etc.

c. When cleaning new or restored original substrates (i.e., Method 2) use a dual-rag IPA wipe procedure (see product datasheet for procedure).

d. Adjacent surfaces in close proximity to the structural joint can be masked if desired such that excess sealant applied during the reglaze operation may be easily removed.

e. Position the glass or panel into position and if needed, use suitable means to keep the glass/panel in continuous contact with the spacer (gasket or tape). **Use care not to contaminate the silicone bond line areas of the IGU or panel (underside perimeter) during the handling and setting process.**

f. Apply the structural silicone into the cavity and in sufficient amount such that no voids or air pockets exist in the glazing pocket. Tool the silicone to ensure that the cavity is completely filled and with sufficient pressure such that the contact surfaces are fully "wetted" with the structural silicone.

g. Maintain pressure, by use of clamps, fasteners, special equipment, etc., on the glass or panel until the structural sealant has reached sufficient cure and adhesion. Contact MPM Technical Services for assistance in cure time estimation, which are reviewed on a case-by-case basis.

h. As an alternative to cure time estimation, utilize project extrusion and glass (or other substrate with representative project finishes) to create mock-up sample assemblies, replicating or simulating the installed structural joint configuration. These assemblies are left to cure under similar site conditions as the installed panel and used as a model to check for full cure and adhesion of the structural silicone. Multiple assemblies may be required as each check is a destructive break down of the assembled section to check for cure status of the silicone. For additional information reference UltraGlaze REGLAZING MOCKUP.

NOTE: Contact MPM Technical Services for advice in field glazing operations when the ambient conditions are below 40°F (5°C). Any frost or condensation on the substrates will interfere with adhesive bonding.

APPENDIX A

Tensile Adhesion (optional)** – Assemble two Tensile Adhesion (TA) specimens using representative substrate (see Appendix for TA specimen diagram). Allow the sealant to cure*. Test the specimens using a suitable tensile testing device (contact MPM Technical Services for available devices). Set the rate-of-pull at 2 in./minute (50 mm/minute). Sealant will fail cohesively when acceptable adhesion is developed. If adhesion loss is noticed, notify the Project Manager or Shop Supervisor for instruction on how to proceed. Record adhesion test results (percent cohesion), failure load (psi/MPa) or if not pulled to destruction, if target load was achieved (Yes/No), temperature, relative humidity, and any other pertinent information in a suitable project-specific QC Test Log.

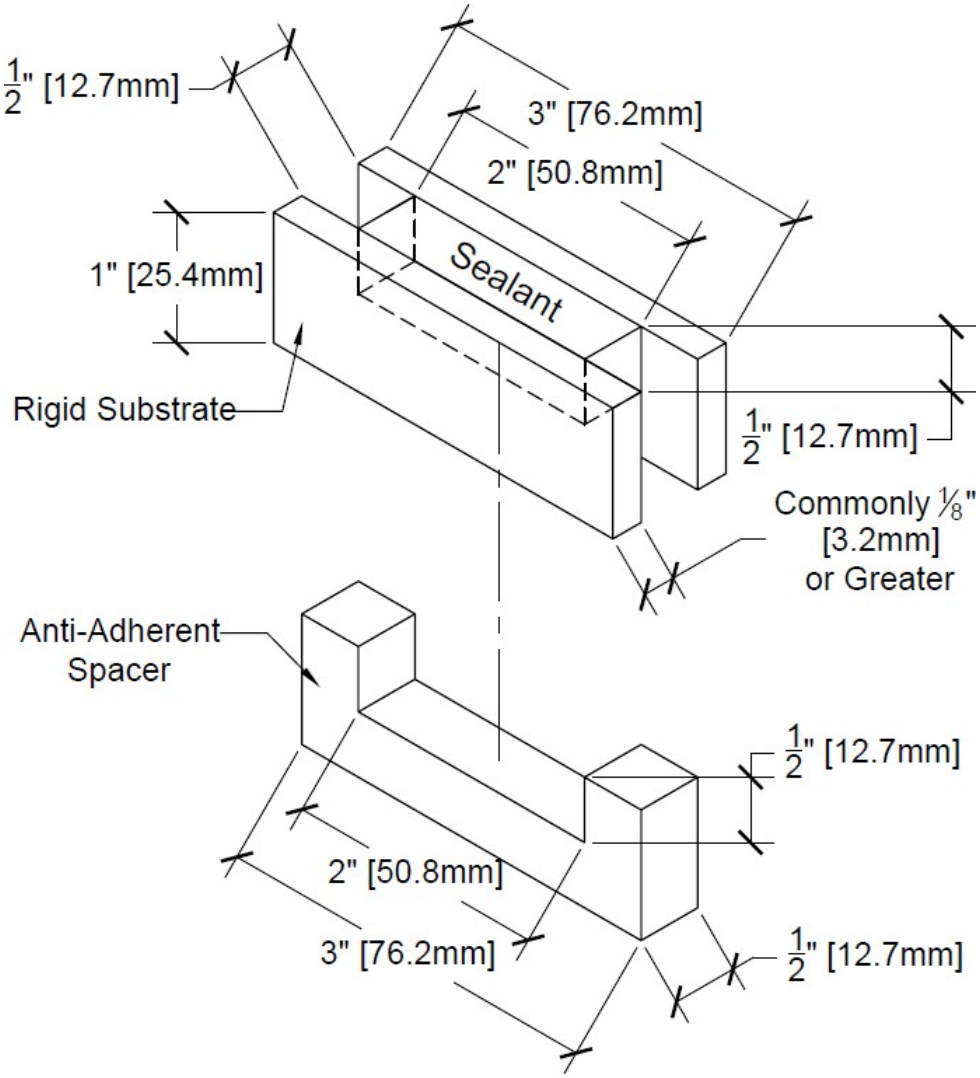
This test is modeled after ASTM C1135 *Standard Test Method for Determining Tensile Adhesion Properties of Structural Sealants*.

*Cure Time SSG4400/SSG4600/SSG4650 - 48 hours

*Cure Time SSG4000, SSG4000AC, SSG4000E, SSG4800J & SCS2000 - 14 days minimum. Full cure time will vary by temperature and humidity conditions in shop.

** Tensile Adhesion testing may be required for some specific warranties.

Diagram of the Tensile Adhesion Sample Assembly



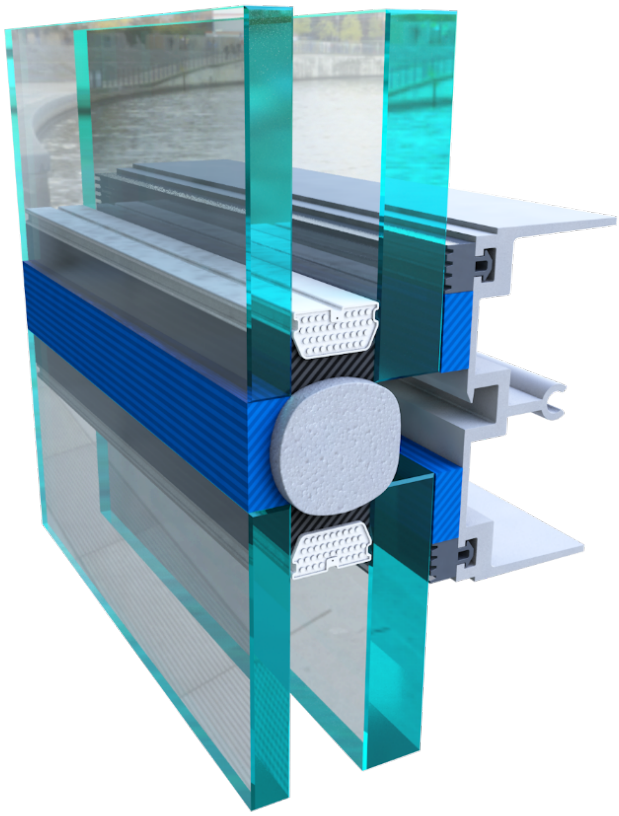
(See also ASTM C1135 Std. Test Method for Determining Tensile Adhesion Properties of Structural Sealants)

APPENDIX B

Suggested log sheet for plant QC

Project:					**Weight Ratio Check:** 3X per drum, and at every drum and/or pail change over. **Snap Time and Butterfly:** every pump start					Pump #			
Base product:										Line #:			
Catalyst product:				Primer:			Weight Ratio Check			Adhesion and Hardness			
Date	Time	Temp/RH	Base Batch #	Catalyst Batch #	Butterfly Test Pass/Fail	Snap Time minutes	Base Weight	Catalyst Weight	Mix Ratio	Cured after 24 hours?	% Adhesion (Peel Test)	Hardness	Initials

NOTES



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