

Functional Sealants

Technical Manual



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1. Sealant Considerations

The performance and long term durability of an application involves careful consideration so that the product(s) of choice meets not only the specification but also is able to continue to accommodate the movement, temperature changes and have long term adhesion and compatibility to the chosen substrates and ancillary products to ensure optimum performance. Shin-Etsu Silicone will give recommendations for each application or project as required upon request.

The information within this manual must be strictly followed in order for the sealant to attain its maximum performance and post cure properties.

Shin-Etsu Silicone Project Support Service (PSS) must be used for each individual project and application that utilizes Shin-Etsu Silicone structural and insulated glazing sealants and for weather sealants that require a performance or non-stain warranty. It includes a drawing or project print review to confirm and or calculate the structural or insulated glazing sealant bite and glue line and also when required the joint dimensioning of weather sealant applications. This service also includes adhesion and compatibility testing that is detailed below.

Please refer to 3. Project Support Service (PSS) should more information be required.

Adhesion is a critical requirement not only for structural and insulated glazing applications but also for weather sealing and is measured by two important factors.

Adhesion failure is described as the sealant ability to bond, adhere or stick to the intended substrate and if failing leaves little or no trace of sealant on the surface. It can be measured against the remaining sealant left against the area where adhesion has failed. 50% adhesion failure means that 50% has bonded to the surface and 50% has failed.

The area where the sealant remains but the forces applied to it have caused it to rupture or tear is considered as cohesive failure. When considering structural glazing applications cohesive failure is required to be 100%. Simply put, the adhesive force of the sealant to the substrate is so strong that when testing is carried out that the sealant breaks within its structure maintaining 100% adhesion to the substrate.



Abeno Harukus (Japan)

Therefore adhesion testing is a crucial first step in the quality control process to ensure that the long term durability of the project is maintained. Laboratory testing is carried out to a modified ASTM C794 specification that tests both the dry and water immersed adhesion of the sealant to the intended substrate. Thereafter further project testing is required to ensure that the application and substrates meet the desired results until completion of the fabrication of an individual project. Both peel testing and deglaze testing are used to ensure this and are detailed later in this manual.

A movement accommodation factor (MAF) is also an important consideration when selecting a particular sealant for an application. It describes the sealant's capacity to accommodate and transfer movement within and from the joints of buildings via compression, expansion and shear deformation. These include thermal movements, wind load, snow load, impact or point loads or may include greater forces such as typhoon, earthquake or bomb blast. The sealant through its life expectancy will then be subjected to fatigue. It will require resistance against all of the loads and movements placed upon it as well as variable climate conditions including exposure to extreme variations in temperature, rain, snow and UV. It should be able to maintain its elasticity and adhesion without failure or breaking down. It must maintain its performance to ensure that the expected life of the sealant and its intended function is maintained.

The information confirming the MAF of a particular sealant can be found on each of the products TDS.

Purpose of This Manual

The intension of this manual is to provide information and guidance to property developers, architects, consultants, structural engineers, fabricators and end users to assist them with the specification, use and quality control for the products and services offered by Shin-Etsu Silicone.

Due to the complexity of the designs and the number of different products and substrates available, this manual is intended as a guide for the specification, the correct sealant selection and application of products and also for the management of a project quality assurance program from Shin-Etsu Silicones called Project Support Services (PSS) that will assist with the management of projects from conception through to their completion. If there are questions related to our products, services or applications that are not covered within the contents of this manual please contact a member of our staff.

Shin-Etsu Silicone is able to offer a selection of both sealants and primers tailored to fulfill the requirements of architectural façade applications including structural and insulated glazing, high performance weather sealants and specialized low stain sealants for

natural stone facades where the long term visual ascetics of a building are an important consideration. Further information for sealants and primers is given in the product information guide as well as giving guidance on acceptable substrates suitable for specific applications. The information contained within this manual is offered in good faith and is believed to be accurate. However, because conditions and methods of application and use of our products are beyond our control, this information cannot be used as a substitution for customer's tests to ensure the suitability of an individual application. Shin-Etsu Silicone sole warranty is that the products supplied meet with the current sales specification.

The customer has a responsibility to confirm that a product and application meets with the requirements detailed in this manual, and that when required the drawing or project print review as well as testing of the substrates and ancillary products has been done to comply with the Project Support Services or PSS. Failure to meet these requirements will not only mean that a performance warranty cannot be issued but will also be the sole responsibility of the customer. Thereafter Shin-Etsu Silicone will not be held responsible or have any liability in a claim for either incidental or consequential loss or damages.

2. Products We Offer

Our silicone sealants and primers may be used for a variety of applications on many substrate types on a wide range of building designs and will enable enhanced performance, sustainability and durability. Please make sure that your sealant selection meets the intended application purpose.

Within this section you will find details of some of the products from Shin-Etsu Silicones. For detailed data on a specific product, please also refer to the Technical Data Sheet. For information on other products which are not included within this manual please contact a Shin-Etsu Silicone representative within your area. Contact information is listed on the back cover of this manual.

2-1 Structural Glazing Sealants (SSG Application)

To meet the varied requirements of different construction applications, Shin-Etsu Silicone has developed a range of high performance silicone structural glazing sealants. These sealants are able to comply and meet with the international standards related to these applications, and have third party testing which confirms their suitability. The following information in this section will assist you with making a sealant selection that is best suited for your project and application type.

SEALANT-90N

SEALANT 90N is a high modulus one part neutral curing structural glazing sealant intended for use in either factory applications or site applications for stick and post or bespoke curtain wall applications fabricated on site. It has excellent resistance to UV, variations in temperature, weather and movement. It meets the requirements of ASTM C1184 and ASTM C920 type M Grade NS Class 50 and has a high movement capability and movement accommodation factor (MAF) of +/- 50% and has excellent adhesion to a wide variety of substrates.

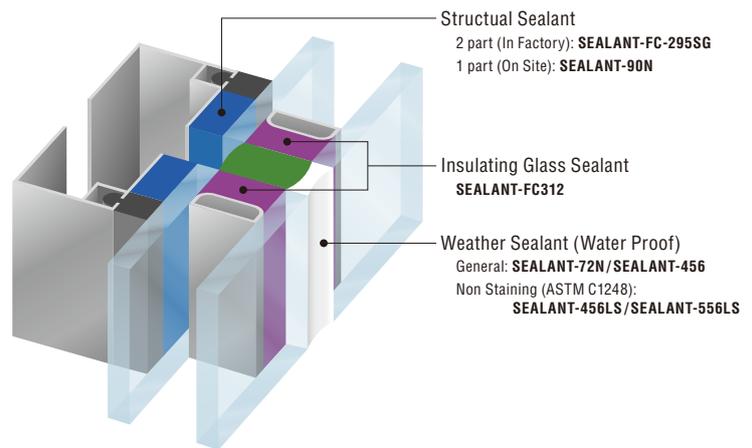
SEALANT-FC-295SG

SEALANT -FC-295SG (fast Cure) is a high modulus two part neutral curing Structural Glazing Sealant intended for use in factory applications for the fabrication and weather sealing of unitized curtain wall panels and bonding metal and glass substrates together to form curtain wall panels. Once cured it forms a long lasting structural bond that is able to resist UV, variations in temperature, weather and movement. It meets the requirements of ASTM C1184 and ASTM C920 type M Grade NS Class 25 and has a high movement capability and movement accommodation factor (MAF) of +/- 25% and has excellent adhesion to a wide variety of substrates. This product requires the use of specialized metered pumping equipment for its application.



SEALANT-FC-295SG is divided into two containers.

Joint Dimension Including SSG



2-2 High Performance Weatherproofing Sealants (Weather Sealants)

SEALANT-72N

SEALANT 72N Weather sealant is a medium modulus neutral alkoxy silicone sealant with good unprimed adhesion to most common building substrates including porous and non-porous substrates and is intended for sealing curtain wall and unitized curtain wall joints., window and door perimeters, building connection and expansion joints and has excellent adhesion to most plastics and polycarbonate. This high performance sealant has excellent weather ability when exposed to a wide range of temperature variation, UV, ozone and moisture. It meets the requirements of ASTM C920 type S Grade NS Class 50, KS F 4910, F-25HM and has a high movement accommodation factor (MAF) of +/- 50%. Sealant 72N is not suitable to be used as a structural or insulated glazing sealant.

SEALANT-456

SEALANT-456 is a one-part medium modulus neutral-curing silicone sealant with good unprimed adhesion to a wide variety of substrates including but not limited to Fluoro-polymer coatings on conventional glazing and weather seal applications. This high performance sealant has excellent weather ability when exposed to a wide range of temperature variation, UV, ozone and moisture. It meets the requirements of ASTM C920 type S Grade NS Class 50, KS F 4910, F-25LM and has a high movement accommodation factor (MAF) of +/- 50%. Sealant 456 is not suitable to be used as a structural or insulated glazing sealant.

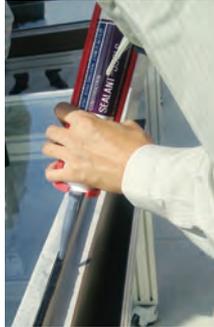
SEALANT-456LS

SEALANT-456LS is a premium medium modulus low stain low bleeding silicone specifically designed and manufactured for the sealing of natural stone facades, including granite, marble, limestone and sandstone. It may also be used for weather sealing conventional and unitized glazing, curtain wall and window and door perimeters and cladding where the long term aesthetic appearance of a building or façade needs to be maintained. It has a large elongation to break and an MAF of +/- 50%. It has been tested and meets the requirements of ASTM C1248. Sealant 456LS

is not suitable to be used as a structural or insulated glazing sealant.

SEALANT-556LS

SEALANT-556LS is a medium modulus low stain low bleeding silicone specifically designed and manufactured for the sealing of natural stone facades, including granite, marble, limestone and sandstone. It may also be used for weather sealing conventional and unitized glazing, curtain wall and window and door perimeters and cladding where the long term aesthetic appearance of a building or façade needs to be maintained. It has a MAF of +/- 50%. It has been tested and meets the requirements of ATM C1248. SEALANT 556-LS is not suitable to be used as a structural or insulated glazing sealant.



One component sealants are easy-to-apply.

2-3 Insulated Glass Sealants

SEALANT-FC-312

SEALANT-FC-312 is a two-part high modulus silicone sealant especially designed for Insulated Glass application. It meets the requirements of ASTM C1184 and ASTM C920 type M Grade NS Class 12.5 and has a high movement capability and movement accommodation factor (MAF) of +/- 25% and has excellent adhesion especially to a wide variety of glasses.

2-4 Primers

Shin-Etsu Silicone primers are one part ready to use products that require no mixing and will dry at room temperature and at ambient humidity. They are intended to promote adhesion too difficult to bond to surfaces as well as contributing to faster adhesion buildup.

When used all primers should be decanted into smaller containers that will allow for them to be applied within 10 minutes. Ensure that the screw cap is replaced each time the primer is decanted to stop any moisture and contaminants from entering the primer. All primer applications should be left for a minimum of thirty minutes (30 minutes) with the exception of PRIMER AQ-P which should be left for a minimum of 10 minutes and checked to ensure that they have dried before the application of any sealants.

PRIMER-AQ-P

PRIMER AQ-P improves adhesion to various substrates. Due to the drying time is shorter than conventional primers, it makes the productivity improved.

PRIMER-AQ-1

PRIMER AQ-1 is a one-part silicone resin-based primer for use with Shin-Etsu sealants in many applications.



One component sealants and the primer

X-33-253

X-33-253 is a one-part film-forming primer for use with Shin-Etsu sealants on painted and plastic surfaces to promote fast adhesion. X-33-253 should not be applied to glass substrates of any kind.

PRIMER-MT

PRIMER-MT is a one-part, film-forming primer for use with Shin-Etsu sealants on porous and cementitious surfaces to promote adhesion.

PRIMER-MT should not be applied to glass substrates of any kind.

2-5 Storage Condition

Shin-Etsu Silicone sealants must be stored at the recommended temperature and conditions as confirmed on the technical data sheet (TDS). These conditions include a temperature controlled and low humidity environment and storage out of direct sunlight. Expiry dates for all products are printed onto each item and these should be checked and confirmed prior to use. If the products are stored incorrectly or are out of shelf life then this may have a detrimental effect on the sealants ability to cure, their physical properties and performance.



Temperature and humidity must be controlled.



Sealants and primers must be stored under a controlled condition.

3. Project Support Service (PSS)

Shin-Etsu Silicone Project Support Services (PSS) is a managed quality control system to assist with the design, sealant selection, drawing or project review, adhesion and compatibility testing as well as in factory testing and support services that include daily control sheets, peel adhesion testing and deglazing to contribute to the project quality. Through this service Shin-Etsu are able to assist with the selection of a suitable sealant for a project and contribute to the project quality and use of its sealants.

In the event that a performance warranty is required the consumer must comply with PSS process and workflow standards and be in compliance with the instructions given in this Technical Manual.

Project Review

By completing and submitting a project review and drawing details, Shin-Etsu Silicones are able to confirm the sealant selection and the joint dimension for a project based upon the information given for the details, please refer to 4. Project Review.

Laboratory Testing Service

Shin-Etsu Silicone conducts adhesion, compatibility and stain testing to the relevant ASTM standard to all the substrates and accessories that contacted or are close to the sealant. These tests are carried out in our technical center and thereafter Shin-Etsu Silicone reports the test results, recommended materials, and any pre-treatment required related to each sample for each individual project. For the required sample numbers and dimensions, please refer to the sample submissions form or 4-3.Pre-Testing.

Quality Control

Shin-Etsu Silicone will visit the fabricator or manufacturer either at their factory or project site and confirm the appropriate quality control and application environment. More information can be found in section 6 of this manual titled Quality Control.

In the event that a performance warranty is required the consumer must comply with PSS process and workflow standards and be in compliance with the instructions given in this Technical Manual.

Ginza Six (Japan)



4. Project Review

Drawing or Project Review

Shin-Etsu Silicone, preferably at the design stage of a project is able to work with the appropriate design professionals to ensure that the sealant specification, joint dimensioning, application and curing conditions related to joint design can all be achieved. Shin-Etsu calculates or confirms the structural bite for structural sealant applications and the width and depth for weather sealant applications. This is done based upon the information given in the Check List form which is completed by the customer and includes elevation, transom and mullion drawing details the actual wind load, the glass dimension as detailed and the sections marked with an * that is the minimum information required to complete the review.

Thereafter this will be confirmed in a drawing/project review report.

Shin-Etsu Silicone will not be responsible for calculating any of the design loads or the expected joint movement that will be used to determine the joint width. Shin-Etsu Silicone offers the movement capacity of the sealants and the optimal joint configuration to accommodate the required movement.

4-1 Sealant Selection

Multiple factors may influence the selection of a sealant including but not limited to the type of substrate material, its coating or finish, climatic conditions and the expected movement of each material. Please ensure that the sealant selected is able to accommodate the requirements placed upon them. For Structural Sealant Glazing (SSG) applications where the sealant is expected to manage and accommodate structural loads the sealant must be approved by Shin-Etsu Silicone.

The Sealants approved by Shin-Etsu are those which have been presented as SSG sealants in this manual and only these can be used for structural glazing applications. To select the optimal sealant, the following eleven questions must be answered.

Important criteria to consider when selecting both sealants and substrates.

1. Are the sealants approved for the application, have they been tested and approved? For instance sealants to be used for structural glazing applications should be tested and approved to ASTM C1184 or other international standards.
2. Are the substrates approved for the application? There are a selected number of substrates that may or may not be approved for structural glazing application. For instance mill finished aluminum is not approved.
3. Is the proposed joint to be sealed accessible allowing for the sealant to be tooled to ensure that it fully 'wets' out onto the substrate surfaces?
4. Is the sealant exposed to air on a minimum of at least one side? Does the joint design allow for the by-products that develop whilst the sealant is curing to escape?
5. Is the cure time an important factor, will the joint be subjected to large amounts of movement before the sealant has had chance to fully cure which may deform the surface? If a structural glazing application is being carried out, will the sealant have enough time to reach its required adhesive strength prior to the units being shipped?
6. What is the required movement, will the joint be subjected to expansion, compression or shear?
7. Is the sealant compatible with the products or substrates that it will contact?
8. What environmental conditions will the sealant be required to manage?
9. If the sealant is intended for a remedial application then will it be compatible with any residue that may remain on the joint surfaces from the previous application?
10. Do the substrates require testing and approval for adhesion, compatibility and staining to meet the requirements of the Project support services (PSS) quality assurance program?
11. Is the minimum contact area for both the width and depth of the sealant is 6 mm?

4-2 Joint Consideration

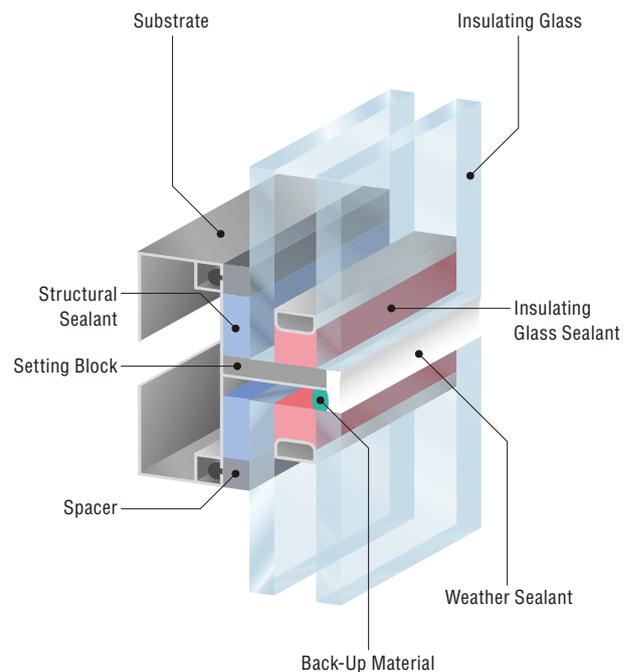
Structural Glazing

Structural Glazing consists of a façade constructed with glass (coated or untreated) or panels that are bonded to treated or coated metals that are normally anodized, powder coat or PVDF coated aluminum or high grade stainless steel. They are bonded with high performance structural glazing silicone sealant. Loads that are placed on the glass are transferred through the silicone sealant to the frame and then to the building structure. These loads are used to calculate the required sealant bite and glue line and include wind loads, thermal expansion and contraction most commonly termed as live loads. Other loads can be snow loading, impact loads being point or line loads or bomb blast may also be considered. Structural glazing allows for the bonding of insulated glass units as well as single glass units and spandrel panels to a frame. Applications are normally four sided or two sided but some corner details allow for three sided applications.

It is therefore very important that prior to the commencement of the project that the required adhesion and compatibility testing and drawing/print review are done to confirm that the long term durability and integrity of the application. Thereafter the entire process is done under a managed quality control process. The results must be kept for future reference and referral.

There are many advantages to using structural glazing when designing and installing facades such as better thermal performance and design freedom and flexibility as well as reducing the time and ease of installation.

Joint Component Including SSG



4-2-1 Structural Sealant Joint Design

The use of structural glazing has agreed safety factors applied to it which are defined by the ratio of the structural glazing sealants ultimate strength (typically in tension) used against the sealant design strength of 20 psi or 0.14 Mpa. The safety factor of 6:1 has been used from the very first projects done in the seventies in the US and eighties in Europe and are those specified by the majority of global standards across the world.

The following are factors which may affect the adhesion, strength or overall performance of the sealant and must be considered for each application.

Is the sealant still in shelf life?

Ensure that the substrates have been prepared in accordance with the recommendations in this manual and if required a primer has been applied and allowed to dry prior to the application of the sealant.

There is no air entrapment or formation of bubbles in the sealant. If there are bubbles forming at the interface between the sealant and the substrates then the expected and allowable area of adhesion will be greatly reduced.

Allow for the sealant either in a factory or site application to fully cure before removing any temporary fasteners or restraints. This may be confirmed by peel adhesion and deglaze testing.

Carry out sealant peel testing to all new or different batches of glass or metal substrates originally tested to confirm the required adhesion before final application can be maintained.

Ensure that the environmental conditions will allow for the required time for the sealant to cure and reach full strength prior to being exposed to high temperature, wind, rain or excessive dust.

Any one of these factors could affect the adhesive strength and long term durability of the sealant when applied to the substrates and commonly glass unit.

Management of all the factors above is therefore crucial.

4-2-2 Structural Sealant Bite

When carrying out a structural glazing or insulated glazing application and prior to the start of any fabrication Shin-Etsu Silicone must review the sealant specification and drawings to ensure that the specification meets the desired requirements. The drawings required show the transom and mullion sealant detail and an elevation drawing confirming the total number of panels and their orientation on each elevation. Sealant bite and glue line can be calculated according to the live or wind loads if the glass is supported. If the glass is not supported then the weight of the glass must be considered when carry out the calculation to determine the required sealant bite and glue line. Shin-Etsu Silicone will give recommendations for the sealant movement accommodation factor, structural sealant bite and glue line that should be confirmed by the design engineer prior to the commencement of any project. Shin-Etsu Silicone will not be responsible for calculating or confirming the anticipated joint movement.

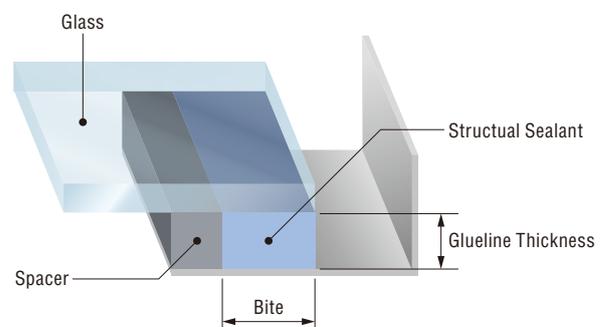
The contact width (bite) and thickness of the structural sealant must be at least 6 mm. The ratio of the bite to the thickness should be between 1:1 and not greater than 3:1. The sealant bite must always be greater than the thickness or glue line.

Following is the calculation used to determine the required bite for structural sealants.

$$\text{Structural Sealant Bite (mm)} = \frac{0.5 \times \text{Short Span Length (mm)} \times \text{Windload (kPa)}}{\text{Sealant Design Strength (140 kPa)}}$$

The result should always be rounded up to the nearest millimeter, never rounded down.

■ Structural Sealant Bite



Akasaka Inter City Air (Japan)



4-2-3 Dead Load

Designs in which the sealant will constantly carry the weight of panels or glass in dead loads are not recommended. It is important that the applicator understand that Shin-Etsu structural sealants are designed to support the dead load of panels and glass only when used in accordance with the guidelines below, and that these guidelines must be followed to ensure the required performance.

For SEALANT-90N and SEALANT-FC-295SG, the design allowable stress for dead load is 0.007 MPa. The quotient of the dead load imposed by panels and glass divided by the total contact area of the structural sealant must not exceed the value for allowable stress.

Following is the calculation used to determine the structural sealant bite required for a given dead load.

$$\text{Structural Sealant Bite (mm)} = \frac{2,500 \text{ kg/m}^3 \times 9.81 \text{ m/s}^2 \times \text{Glass Thickness (m)} \times \text{Glass Cross Area (m}^2)}{\left[2 \times \frac{\text{Height (m)}}{\text{m}} + 2 \times \frac{\text{Width (m)}}{\text{m}} \right] \times \text{Allowable Design Stress (Pa) for DL is 7,000 Pa}}$$

4-2-4 Structural Sealant Glueline Thickness

The allowable movement of a glass unit in the frame will be regulated by the thickness of the application of the structural sealant.

A minimum glueline thickness of 6 mm is required. To facilitate the filling of structural joints, the ratio of bite to glueline thickness should be kept below 3:1. In the design set the application thickness based on the thermal movement of the panels and frames. Thermal movement can be determined by the length and type of the material (e.g. glass, aluminum) and its coefficient of thermal expansion (CTE).

Following is the calculation used to determine the thermal movement of a given panel.

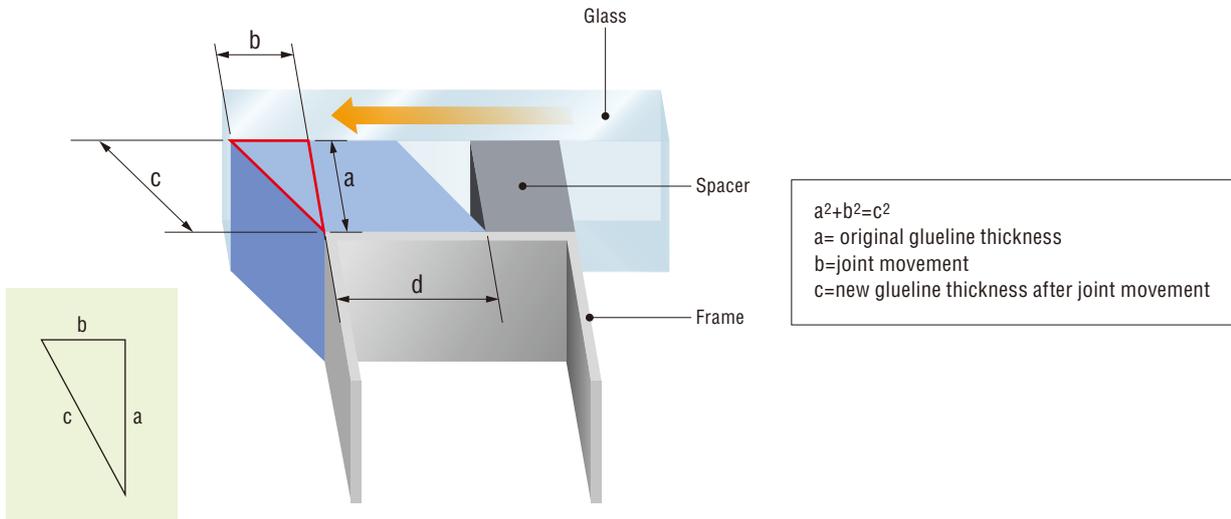
$$\text{Movement (mm)} = \frac{\text{Panel Length (mm)}}{\text{mm}} \times \frac{\text{CTE (mm/mm/degC)}}{\text{mm/mm/degC}} \times \frac{\text{Temperature Change (degC)}}{\text{degC}}$$

The calculation below is used to determine the differential movement for glass and aluminum.

$$\text{Differential Movement (mm)} = \text{Thermal Movement of Aluminum} - \text{Thermal Movement of Glass}$$

The dimension of glueline thickness required (a) for the differential movement (b) can be calculated using the Pythagorean Theorem as in the diagram below.

Joint Calculation for Differential Movement



$$\text{Allowable Extension Value of Sealant} > \frac{\{ c \text{ (mm)} - a \text{ (mm)} \} \times 100}{a \text{ (mm)}}$$

For SEALANT-90N and SEALANT-FC-295SG, the maximum elongation due to thermal movement is 15% in any type of structural joint.

4-2-5 Weather Sealant Joint Design

Silicone sealants have a unique ability to withstand large variations in temperature and UV radiation and can be used to seal joints in a wide range of substrates including both porous and non-porous application. The envelope or façade of a building is under constant attack from the above elements and so sealing the joints both internally and externally will add to the buildings durability and increase its life expectancy whilst protecting the occupants from water ingress and saving energy by restricting heat loss in colder climates or by maintaining the desired temperature in hotter climates..

When considering which sealant to use for a specific application it is important to select the appropriate sealant based upon the type of substrate material to be sealed and the expected movement. Therefore through the correct design and specification the right sealant can be selected to meet the requirements placed upon it.

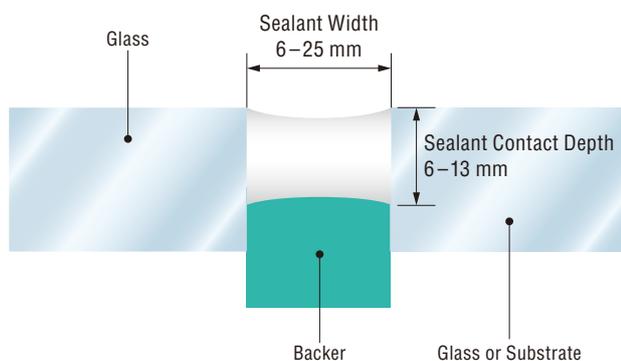
The following information should be used to ensure that the selection and application of a weather sealant is done correctly.

- The sealant should adhere to the 2 sides of the joint only.
- Sealant width to depth ratio = 1:1 – 2:1
- Sealant contact depth (Joint depth) should be a minimum of 6 mm and a maximum of 13 mm
- Sealant width should be a minimum of 6 mm and a maximum of 25 mm.

For joints wider than 25 mm please contact Shin-Etsu Silicone technical staff for information on the application technique to be used.

- That the application of the sealant can be completed before the skin over time is reached.
- When using closed-cell polyethylene foam (PE) as a backup material install it under 20% compression and ensure that the application is carried out in such a way that does not rupture or puncture the surface of the foam. If the foam becomes damaged this may lead out gassing and the formation of bubbles in the sealant. Be sure therefore to install the backup material with a blunt tool.
- Flexible open-cell PE will not cause outgassing or foaming and is thus recommended as the backup material.

■ Weather Sealant Joint Dimension



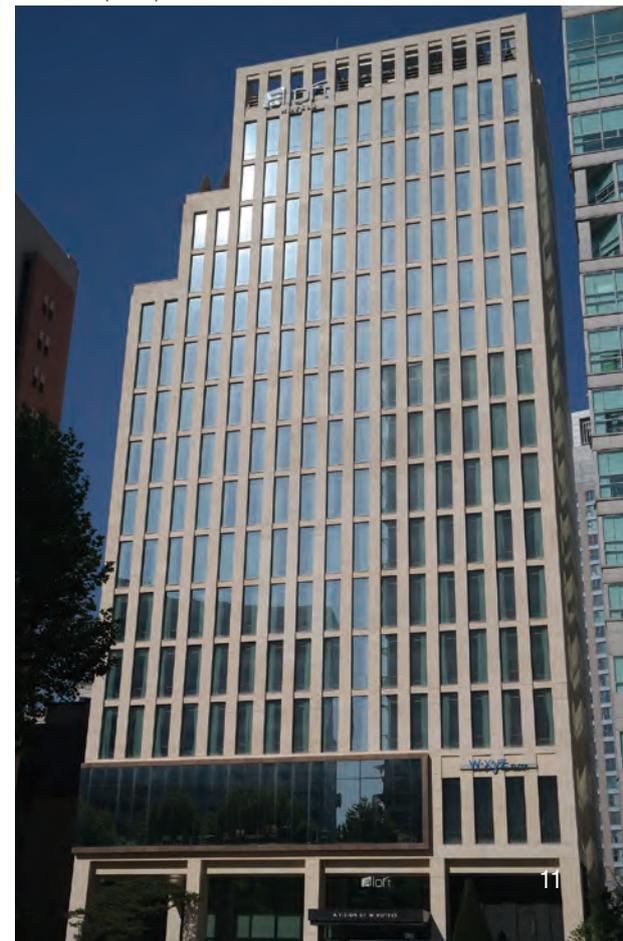
For all weather sealant joints, the ratio of sealant width to contact depth should be 1:1–2:1 with the sealant contact depth being maintained at a minimum of 6 mm to ensure proper sealant performance. Ensure that a backup material or bond breaker tape is installed to stop three sided adhesion of the sealant within the joint. If three sided adhesion does occur then the MAF will be dramatically reduced causing either a rupture of the sealant or a loss of adhesion..

Determine the amount of movement to which structural sealants / weather sealants will be subjected and design joint configuration accordingly. Then conduct compatibility tests and adhesion tests with the substrates and accessories to be used in construction. The methodology for these tests and discussions of their effectiveness can be found below.

Be sure you have a thorough grasp of the information in this chapter and perform the tests as indicated. Also, be sure to keep the results of these tests and be prepared to submit them to Shin-Etsu if requested to do so.

Shin-Etsu will not be responsible if the pre-application tests are not performed and the sealant fails to achieve adhesion. Further, this manual does not cover what to do in those situations.

Aloft Hotel (Korea)



4-3 | Pre-Testing

It is crucial that the required adhesion, compatibility or stain tests be performed before the actual application of the sealant begins. Shin-Etsu Silicone will conduct each test at our Tech-Center. For all substrate materials and accessories that are to be used in an SSG project, the fabricator or applicator must get prior approval for their use in SSG projects from the suppliers of said materials.

Be sure to test with samples of substrates and accessories that are finished in the same manner as those to be used in the actual project. Submit samples with same specification and surface finishing to Shin-Etsu Silicone. Materials may be finished differently on different production lines or supplied from different material batches and so their suitability should be confirmed with the suppliers prior to testing. If any samples differ from those originally submitted retesting will be required to confirm their suitability.

a. Aluminum and Other Metals

The shapes and finishes (surface treatments, coatings) of the units must be the same as those that will actually be used (i.e. produced on the same line to the same specifications).

b. Glass

The sample must be of the same specification and also made on the same production line as used in the actual project. For insulating glass, the secondary sealant must be checked to ensure it is silicone based and is compatible with the other materials in the system. It is essential that the secondary sealant must be checked to determine the structural bite. If sealants are to be in contact with laminated glass, we can offer supportive documents confirming that testing has been carried out previously by Shin-Etsu Silicone. Please contact your laminated glass supplier for further information related to the above.

c. Accessories (e.g. spacers, gaskets, setting blocks)

Conduct preliminary tests with samples of those accessories (e.g. spacers, gaskets, setting blocks) which are identical (same specifications, and produced in the same plant on the same production line under the same conditions) to those likely to come in contact with the sealant.

If possible, spacers, gaskets, setting blocks should be made of silicone. Neoprene rubber and EPDM must be tested to ensure their compatibility. If testing is not done then adhesive failure and yellowing may occur in case silicone sealant contacts the EPDM, neoprene rubber, sheet or coating made of asphalt or other organic materials. When using a dark colored sealant any discoloration may not be visible and so compatibility testing is normally carried out with a light colored or white sealant. In the event that the compatibility test confirms any discoloration that will affect the long term adhesion or durability of the sealant a change in the ancillary material will be required and a retest will be required before issuing a report.

In this section, we offer more information about Adhesion, Compatibility and Stain Testing, being the most important and principal 3 tests in Pre-Testing. Shin-Etsu Silicone is able to conduct other specialized or customized testing upon request. If required please contact your local Shin-Etsu Silicone representative or country distributor for further information.

4-3-1 Adhesion Test

This test, based on the peel adhesion test is used to confirm the adhesion of a sealant to a chosen substrate. This test is carried out in accordance with modified ASTM C794. If required a tensile/adhesive test based on modified ASTM C1135 may also be carried out. Once the test has been completed and the results confirmed then the application of the sealant can be started. As noted earlier we will also record the cohesive failure observed and record the results accordingly. Tests will be performed on samples with and without primers in both dry and water immersed conditions. For substrates and materials used for structural and weather sealing applications as well as the standard 14 to 28 day testing a further requirement of the test method is a 7 day water immersed test which is carried out to confirm the long term adhesion.



Testing Sample of ASTM C794

To conduct the test the sample size of extruded profile must be longer than 20 cm for each sealant to be tested. Shin-Etsu Silicone can cut the aluminum if the sample is big. Glass samples sizes of 30 cm*30 cm are required for testing. Tempered glass samples cannot be cut and so please ensure that they are the required size before sending. If the substrates are panel or stone then samples sizes of 20 cm*20 cm as the contact surface area are required. Based on modified ASTM C794 the adhesion test will take approximately 4 weeks to complete once the samples have been received at our tech-center.

4-3-2 Compatibility Test (UV Resistance)

Compatibility testing is required for each individual project before the fabrication begins. The purpose of this test is to determine if the sealant is chemically compatible with various materials (gaskets, spacers, setting-blocks). Testing is carried out to all of the ancillary products such as spacers, setting blocks, gaskets, tapes and any other material that contact the sealant. Incompatible materials may cause discoloration or affect the mechanical properties of the sealant and in some cases lead to a loss of adhesion. Testing is done in accordance with modified ASTM C1087 in order to determine the durability of sealants after prolonged UV exposure. The light source is to be a UVA340 bulb. For details on the UV light source and chamber temperature, please contact the UV light manufacturer.

To conduct the test based on modified ASTM C1087, a minimum sample length of 10 cm is required. The test takes approximately 5 weeks after our Tech-Center receives the samples.

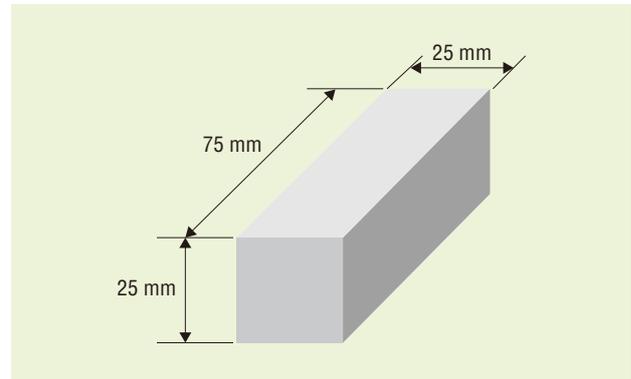
4-3-3 Stain Test

This test is used to determine whether the plasticizers and non-reactive fluids contained in some sealant formulations are likely to migrate and stain porous materials such as marble, granite, limestone, sandstone, mortar and concrete. Specialized silicone sealant are available that have been manufactured to be low stain and low bleed to protect the long term aesthetics of a building façade.

Testing is carried out in accordance with modified ASTM C1248. The test requires that the sealants are to be cured at room temperature for 21 days and then subjected to 70°C conditions for 14 days.

The samples are compressed to 50%, of their original size regardless of the movement class in ASTM C920.

To conduct the test 8 samples with the size of 25 mm, 75 mm and over 20 mm thickness are needed. The test takes approximately 6 weeks after our Tech-Center receives the samples.



4-4 Extended Project Warranty

Shin-Etsu Silicone can warrant the performance of Structural Sealant and Weather Sealant.

To be able to apply for a warranty all elements of the PSS and contents of this manual must be used and understood. At the completion of a project all the required documentation must be received and once reviewed and agreed a warranty can then be issued. Even after Shin-Etsu silicone has issued the warranty letter and in the case it is discovered that some matters don't comply with this manual or Shin-Etsu Silicone PSS, the warranty becomes invalid.

For further details, please contact to Shin-Etsu Silicone.

The Prince Gallery Tokyo Kioicho (Japan)



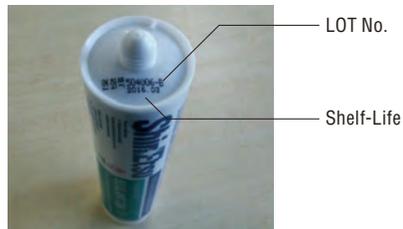
5. Application Guidance

This chapter contains information on the correct storage, handling and application of our sealants.

The applicator must read and thoroughly understand this chapter, and strictly follow the requirements outlined herein.

If you have any questions related to this section please contact Shin-Etsu Silicone before the application starts.

When using Shin-Etsu Silicone sealants always keep a record of the batch numbers for all of the sealants and primers applied. This will enable not only for a record to be kept for quality control and assurance purposes but will also facilitate ease in checking retained samples and other information if required. Manufacturing dates and batch numbers can be read as follows.



Lot. 0 12 345
 Year month No.

* "Year" means the end number of production year.

When using sealants and primers always confirm that there is a batch number visible and that the material is within its stated shelf life. It is always advisable to manage stock on a first in first out basis and therefore have available the freshest material.

Products that are within shelf life should be kept out of direct sunlight and away from high heat and humidity. Store each product in accordance with the recommended storage conditions for that product.

The optimum temperature for any application should be between 12°C and 35°C (54°–95°F). Application can however be done at temperatures between 5°C and up to 40°C (41°–104°F) but care should be taken if the ambient air temperature is 5°C or lower as condensation and moisture may form or be present on the substrate leading to a loss of adhesion. Therefore checking the condition of the substrate prior to application is vital. It should be confirmed that the substrate temperature is not above 50°C due to thermal transmission and heat gain which will lead to poor curing and adhesion and may result in the material cured properties being adversely affected. If the conditions noted above are found then all application should be stopped until such times as the recommended application and substrate temperatures can be achieved.

Below is the recommended substrate preparation and application procedure used for the application of sealants.

1. Ensure that the substrate as well as the solvent, primer and sealant are the same as those that have been tested and that they match the adhesion, compatibility or stain test reports and recommendations. Substrates should be in a good condition and undamaged and be representative of those tested.
2. For non-porous surfaces use the two cloth cleaning method as detailed below and ensure that the surface is free from dust, dirt, oil and grease and all other contamination.
 The two cloth cleaning method has proven to give the best results for non-porous substrates. Firstly apply the correct chosen cleaning solvent to the first cloth. This should be done after the solvent has been dispensed into a container with a long narrow nozzle which allows for the solvent to be dispensed onto the cloth without allowing any contamination to be introduced into the solvent. Use the first cloth to clean the substrate and then wipe the substrate with the second cloth. If there is any dirt or contaminants on the second cloth then the entire procedure needs to be repeated. When the first or second cloth becomes dirty they need to be reversed to expose a clean area. Once all

areas of the cloth are contaminated the cloth needs to be discarded and changed. Confirmation that the substrate is cleaned correctly is when the second cloth is used and there is no visible sign of dirt or contaminants present.

When cleaning a porous substrate the use of solvents is not recommended as they can be absorbed into the substrate and have an adverse effect on the adhesion of the sealant and may also affect the cured properties. Ensure that all dust and loose materials are removed by either manual or mechanical cleaning with a brush or grinder to leave a sound solid joint. In the event that there is contamination from oils, grease or other materials that will affect the adhesion of the sealant, if the area cannot be cleaned, it should be cut back until a clean non-contaminated area can be seen. Alternatively the use of high-pressure water cleaning is an effective method but because water is accumulated in the porous substrate ensuring that the entire area is completely dry prior to any application must be ensured.

3. Apply a primer if required to give optimum adhesion or if one is required following pre-testing.
 Confirmation of the required adhesion can be done either by deglazing or by carrying out a site adhesion test which are described later in this manual.
4. If sealants are applied to unitized curtain wall panels fabricated in a factory ensure that when the glass is being positioned onto the frame that there are no contaminants on the area to be sealed. Therefore avoid touching either the glass or frame on the areas to be sealed once they have been cleaned. Once the glass has been positioned the sealant should be applied within six hours. If there are signs of dirt or contamination before sealing then the units require cleaning again and any primer required being reapplied. Units left unsealed for more than six hours should be cleaned again and primer applied if recommended.
5. When applying the sealant ensure that the joint is completely filled and that there is no air entrapment. This can be achieved by applying a continuous pressure and by pushing the sealant into the joint by having a small amount of sealant in front of the application nozzle at all times.
6. It is recommended to dry tool the sealant and not to use any liquids but at times and for certain applications (excluding structural and insulated glazing application) wet tooling may be required and so ensure that any liquids used are compatible with the sealants. If necessary use a spatula or other tooling implement to smooth and shape the sealant surface. Ensure that the tooling solution is not applied directly to the substrate. Tool the sealant so that it is pressed into the joint. It is not recommended to scoop excess sealant from the joint until it has been firstly tooled into the joint ensuring that the sealant fully wets out the joint interfaces.
 When using masking tape, be sure to remove the tape immediately after tooling.
7. Inspect the unit or sealing location when application work is complete. Make sure that the units are stored in the required conditions and the sealed joints at the site are allowed to properly cure. Inspect to verify that the sealant is curing properly. To confirm that the sealant has reached its optimum cure use the quality control tests described in this manual before, during and after application.

Additional information on the curing of sealants is presented in "5-4. "Curing procedure".

5-1 Surface Preparation for Sealant Application

5-1-1 Recommended Cleaning Procedures

To ensure complete adhesion of the sealant clean the surface following the procedures below using the recommended solvents and tools. If the surface is dirty or not properly prepared before application the sealant can't be expected to maintain the required long term performance.

1. Use a solvent that was found in advance to be compatible with the selected sealants and always use clean solvent. The following solvents are typically used before application of a sealant to clean the most common substrates.

- Isopropyl Alcohol (IPA).
Only pure industrial grade IPA shall be used (99.9% wt, purity).
- Methyl Ethyl Ketone (MEK).
- Xylene
- Toluene.
- Acetone.

The solvents above are commonly used for a variety of purposes. In practice, the applicator will need to choose the right solvent, substrate and sealant for their application. It is therefore necessary to conduct adhesion tests prior to application through Shin-Etsu Silicone PSS or by the applicator themselves. When using any other adhesion test that is not part of Shin-Etsu Silicone PSS ensure that a water immersion test is carried out as detailed in modified ASTM C794.

2. Have ready a supply of clean, white, lint-free cloths.
Please ensure that the cleaning cloth is cotton and lint free. Do not use synthetic materials which may dissolve or breakdown when in contact with cleaning solvents or which may deposit coloring dyes onto the surface of the substrates to be cleaned.
3. Clean the surface where the sealant will be applied to remove dirt and dust, oils, and other contaminants.
4. Clean the surface with a "two-cloth wipe". As previously described to maximize adhesion.
5. To clean narrow joints, use a cloth wrapped around a clean, narrow putty knife. Take special care to ensure the entire adhesion surface has been cleaned.
6. For joints other than unitized curtain wall factory applications clean only those surfaces on which the primer or sealant can be applied within one hour of cleaning.
7. Change cloths frequently as they start to get dirty. (The use of white cloths will assist with the visual inspection of the cloths)
8. After the surface is cleaned it is important to keep it that way. If the surface becomes dirty or contaminated repeat the cleaning and priming process.

9. Take steps to ensure that the working area where the joints are to be sealed is free from dust and dirt and that this is maintained at all times. In factory areas where fabrication and sealant work takes place ensure that they are cleaned daily to maintain the required cleanliness.
10. Once the joints have been cleaned and primed the application of the sealant should be carried out within 30 minutes and not after 6 hours provided that the joints remain uncontaminated. Any application that cannot be completed within this time frame will require that the areas to be sealed are cleaned once again with solvent and the primer reapplied.



Two-cloth wipe

5-1-2 Important Points on Using Solvents

1. Always put solvents in clean containers for use and storage.
2. Do not smoke or weld in areas where solvents are being used, and keep away sources of spark and flame.
3. Follow all precautions and health and safety instructions listed on the warning labels of solvents.

Ootemachi-Financial City (Japan)



5-1-3 Primer Selection

A primer is used as a surface conditioner or coating to improve the adhesion of a silicone sealant to various materials. Shin-Etsu Silicone offers a range of primers especially developed for different types of materials and applications. We recommend that when required you prepare the application surface with a primer designed especially for that surface in order to enhance the durability of the application.

By choosing and applying appropriate primers, strong and stable adhesion is achieved on the surface of substrates which may have been difficult to previously bond to without the use of a primer. Before starting a project perform adhesion test on the required substrate and confirm whether or not a primer is necessary. Through PSS this can be confirmed and a project specific report can be issued.

Below is a primer application guide that details the use of Shin-Etsu Silicone primers. If the application or substrate is not mentioned then please request more information from Shin-Etsu Silicone.

Product name	PRIMER-AQ-P	PRIMER-AQ-1	X-33-253	PRIMER-MT
Application	Glass, Metal, Plastic, Vitreous surfaces, Coated or painted aluminum	Glass, Metal, Enamel, Tile, Vitreous surfaces Plastic, Coated or painted aluminum	Various plastic, Coated or painted aluminum including hard to bond to PVDF and Powder coat	Mortar, Concrete, Stone, Marble and timber
Appearance	Clear pale yellow liquid	Clear pale yellow liquid	Clear pale yellow liquid	Clear, liquid
Solvent	n-hexane	n-hexane	Ethyl acetate, IPA, Hydrocarbon	Toluene, IPA
Viscosity	Low	Low	Low	High
Coverage rate	50 g/m ²	50 g/m ²	50 g/m ²	200 g/m ²
Drying time at 23°C	Over 10 minutes	Over 30 minutes	Over 30 minutes	Over 1 hour

PRIMER-AQ-P

PRIMER-AQ-P improves adhesion to various substrates. Drying time is needed over 10 minutes.

PRIMER-AQ-1

PRIMER-AQ-1 improves adhesion to a wide range of substrates including metals (aluminum, copper, steel, and stainless steel), ceramics, glass and coated aluminum.

X-33-253

Use **X-33-253** on coated aluminum and plastics. This product is cannot be used for application to glass.

PRIMER-MT

PRIMER-MT is for use on porous substrate such as mortar, concrete, natural stone, marble and granite. This product is cannot be used for application to glass, metal, or coated aluminum.

5-1-4 Recommended Priming Procedure

1. If required apply masking tape to the surfaces near the joint to keep these areas free of primer and sealant.
2. Before using the primer carry out a visual inspection to ensure that there are no contaminants within the original container and that the primer doesn't contain any milky droplets or white discoloration. If either can be seen then the primer should be discarded and not used for any application. Transfer a small amount of the primer to a smaller container and replace and tighten the cap on the primer container immediately. This will help to prevent both moisture and other contaminants from entering or reacting with the primer which may affect its performance. The amount of primer in the small container should not exceed that which can be applied within 10 minutes. Ensure that the container used to decant the primer does its self not contain any contaminants and will not be affected by any of the chemicals used in the manufacture of the primer.
3. Apply a thin coat of primer to the adhesion surface in the joint using a clean, dry, lint-free cloth. For porous applications a natural fiber small paint brush may be required. Applying the primers with brushes is allowed, but it may increase the risk of uneven priming. Do not allow primer to collect in grooves and corners.

Note: If too much primer is applied, it can cause adhesion loss or chalking and so apply an amount suitable for the substrate and primer being used.

* When using Primer-MT for porous substrates the primer may be absorbed into substrates. Once the primer has dried a further application may be required to ensure that the required adhesion can be achieved. During the application of the primer continually inspect the container to ensure that the primer has not become cloudy or contaminated. In the event that any problems are encountered replace both the primer and the container with fresh materials. Visually inspected the primed substrates and if the primer turns opaque or corrosion of the substrate surface is observed suspend the application and contact Shin-Etsu Silicone technical services.

4. Ensure that the primer has dried before applying the sealant. The drying time will vary depending on the type of application and substrate but usually full cure can be achieved in approximately 30 minutes. It should be noted that primer will take longer to cure in cold conditions. Examining the surface from a near horizontal angle will make it easier to see whether the solvent has evaporated. If the primer is still wet do not apply sealant.
5. After applying the primer ensure that the application area remains free of dust and dirt and all other contaminants.

5-1-5 Check Points on Using Primers

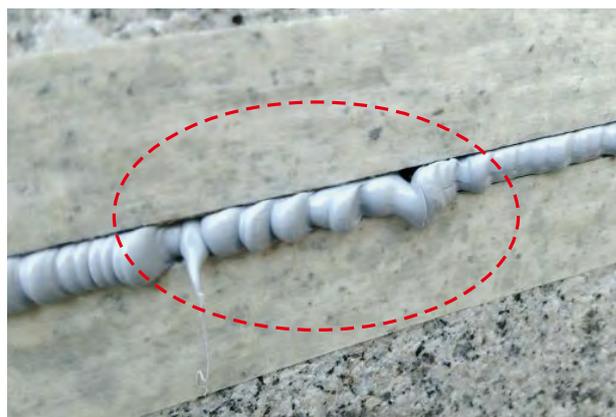
Do not touch primer treated surfaces. Primers should always be stored in their original closed container and hermetically sealed. Primers are flammable and should be stored correctly. For specific information please refer to each SDS.

5-2 Sealant Application Procedures

1. After cleaning and if necessary the application of primer has been completed fill the joint with sealant. Work slowly and deliberately keeping the nozzle tip pressed against the surface as the bead is extruded from the nozzle tip. Take care to prevent entrapment of air and make sure the joint is sufficiently filled.



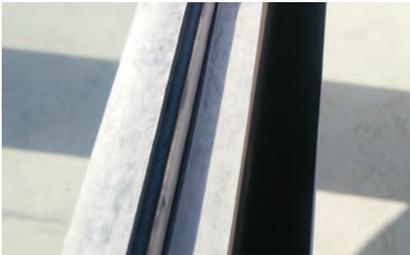
The joint must be filled with no gaps or air.



NG Mode (The joint with gap)

- * It is crucial that the worker be able to visually confirm that the sealant has been applied without leaving any gaps. For areas where this is difficult to see we recommend the use of a torch or light to illuminate joints.
2. Once the joint has been filled tool the sealant before it starts to cure or a skin has formed on the surface. Correct tooling will help press the sealant against spacers and back-up materials and ensure that good contact and wetting out with both sides of the joint leaving no gaps has been achieved. Tooling should be done within 5 minutes of applying the sealant.
 3. Remove masking tape immediately upon completion of tooling. When doing so take care not to disturb the tooled sealant.
 4. Sealant that unintentionally is on areas around the joint can be removed after it cures using a razor blade or other sharp tool.

When sealants are to be applied on site the work must be planned taking into account the movement that might occur in the joints while the sealant cures. For example, during the initial phase of curing, temperature fluctuations should be as far as possible minimized and work should not be done on days when inclement or bad weather is forecast. For applications that require a shorter curing time the use of opened cell backing material will allow for air and moisture to reach the back of the joint more easily and speed up the cure time. There will always be some movement in the joints while the sealant is curing and in cases where the movement is server may result in poor adhesion or cause wrinkling or cracking of the sealant surface. These problems are difficult to eliminate entirely but may be reduced by correct management of the joint dimension. For specific advice with regards to this please contact Shin-Etsu Silicone technical staff.



Remove masking tapes immediately after tooling.

5-3 Setting of Glass & Panels

The setting of glass and panels in the frames of curtain wall or unitized panels is not covered in this manual. In most cases the glass is set after the joint has been cleaned and primer applied and before the application of the sealant. The following precautions should be considered.

1. Once the adhesion surface has been cleaned and primed ensure that the joint faces remain clean.
2. Before setting the glass clean the surface in the same manner that aluminum surfaces are cleaned.

※ It is not advisable to try to clean the joints or apply primer once the glass has been positioned into the frame. Excess solvent maybe absorbed into the structural spacer tape which may have an adverse effect on the adhesion and final properties of the cured sealant.

Setting glasses on the unit



5-4 Curing Procedure

All room-temperature-cure silicone sealants including both one and two-component materials require contact with moisture in the air to cure. Both the temperature and level of moisture should be controlled to optimize the sealant cure. Humidity levels greater than 80% are not recommended and the sealant cure rate may be negatively impacted at levels close to above this figure.

One part or single component silicone sealants cure from the outside on the surfaces that are exposed to the air and the cure goes inwards. In the case of two-component silicone sealants the material cures throughout at the same rate once the base and curing agent are mixed together at the recommended mixing ratio. The time required for complete curing will be dependent on the size of the joint, the temperature and humidity during the cure.

In closed or confined conditions where the sealant is not exposed to moisture in the air or where the sealant cure byproducts cannot be released may not only lead to a much slower cure but may possibly not allow the sealant to cure and reach the required physical properties at all.

Confirmation of the required cure and adhesion properties being achieved will require firstly checking the peel adhesion test samples and thereafter doing a deglazing of the unitized panel to check the application has been done successfully. Only once a successful deglaze has been carried out and the complete cure of the sealant confirmed can the units be moved from their storage racks and packed ready for shipping to the project site.

Storage of completed units fabricated with SEALANT-FC-295SG

Units fabricated with SEALANT-FC-295SG must be stored horizontally on curing racks until the sealant has reached its required cure as noted in the previous paragraph this can be confirmed by carrying out a deglaze of the unitized panel. Only once this has been confirmed can the panel be moved. Prior to the packaging or shipment the curing time for two component sealant is normally between 24 and 72 hours dependent on the temperature and humidity levels. Sealants applied in colder climates will take longer to cure.

Units fabricated with SEALANT-90N

Due to the risk of deformation while the sealant is curing units fabricated with SEALANT-90N must not be moved or if the sealant has been applied at the project site the stick plates that are used to retain the glass during the curing process cannot be removed until verifying that the sealant has cured fully and achieved complete adhesion.

The curing time will vary depending on the size of the joint, the temperature and humidity and also the type of structural spacer tape that has been used. For one part or single component applications it is recommended to use open cell structural spacer tape that will allow for the sealant to have access to the air on both sides of the joint. The minimum cure time for SEALANT-90N is from 7 to 28 days but this can only be confirmed by carrying out deglazing of the panel.

Curing and storage of units should be done in a controlled environment which include the temperature and humidity and the storage out of direct sunlight.

Shin-Etsu Silicone can visit your factory or site and give advice on all aspects of our PSS and quality control procedures. For more information please contact to Shin-Etsu Silicone.

6. Quality Control Methods

The management and use of Shin-Etsu Silicone PSS detailed in this manual will help to ensure that both the application of the various sealants used and the quality control procedures and record keeping confirming the correct procedures have been systematically followed and have been managed in a controlled manner. If required a fabricator or customer may use their own quality control program but Shin-Etsu Silicone must be allowed access to the specific documents to ensure that these are acceptable. Maintain and keep the records for projects in line with country or the required standards.

6-1 General Daily Control

The daily control sheet will require information such as the date and time of the application, the temperature and humidity, the sealant and if required the primer batch numbers, the panel ID number and the applicator and tester who is applying the sealant and finally the skin over time and if using a one component sealant the elastomeric test. All of the above information is required at the start of each production run or when there is a need to change any of the materials being used allowing for a compressive record relating to the association between the sealant and the panels that it is to be used on. When installing the completed units on site keep a record of the location and position of each unit or panel. This information should then be marked onto elevation drawings confirming the location of each panel on each elevation of the building and may be used for future reference in the event of glass breakages or unforeseen problems.

6-2 Factory (Shop) Application and PSS

6-2-1 Butterfly Test

This test is performed to check and confirm how well two-component sealants are mixed.

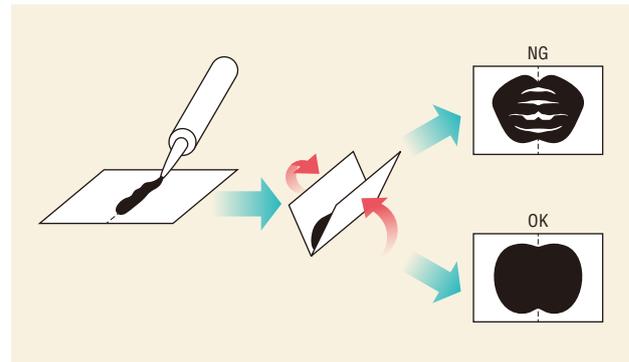
The two-component sealant SEALANT-FC-295SG must be mixed completely prior to it being used or applied to the joints. This test is required every time there is a machine start up, most commonly in the morning and then after lunch and when there is either a change of the base or catalyst.

The following steps are used to perform the Butterfly Test to confirm the correct mixing has been achieved.

1. Check that the glazing pump is in good working order and that all the connections are secure. Turn on the pump and gun the sealant base and catalyst mixture into a waist container until the color looks homogenous.
2. Fold a sheet of A4 paper in half to make a crease.
3. Apply a suitable amount of sealant in a bead along the crease.
4. Fold the paper in half. Press down on the paper, flattening the sealant to a uniform thickness of approximately 1–2 mm.
5. Open the folded paper and examine the sealant. Check that there are no white or grey streaks visible and that there is no significant variation in color, and record the result. If variations in color are observed go back and repeat point one of the test. then repeat the steps above. If problems persist, the gun, mixer or check valve (check nozzle) need to be cleaned or the parts replaced. For specific information related to this check the manual from the pump manufacturer. Mixing problems may be caused by check valves which are in poor condition, leaking valves, or worn out gaskets.

It is always advisable to have routine pump maintenance confirming the condition of hoses pipes and other elements and to have this recorded in the "Pump Maintenance Record".

■ Butterfly Test Methods



NG Mode
(Not enough mixed)

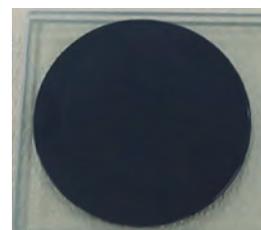


OK Mode
(Enough mixed)

The glass test can be performed in conjunction with the butterfly test if required as an alternative method to confirm how well a sealant is mixed (i.e. homogeneity). In the glass test the sealant is pressed between two glass plates and once again a visual inspection is carried out to confirm an acceptable and consistent color has been achieved.



NG Mode
(Not enough mixed)



OK Mode
(Mixed enough)

6-2-2 Factory (Shop) Snap Time Test

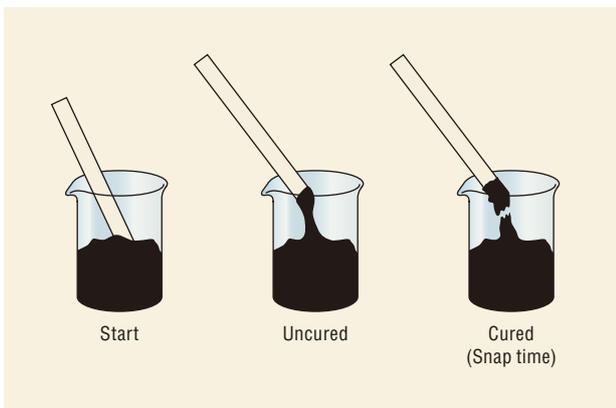
When using two-component sealants the mix ratio of the base to the curing agent is critical. The applicator must check and strictly monitor the mix ratio of the sealant extruded from the mixer making sure it is within the correct range. The Snap Time Test, which measures the time it takes for a mixed sealant to change from a paste-like material to one with elastomeric properties, is used to determine whether the mix ratio of base to the curing agent is in the correct range.

The procedure for the Snap Time Test is as follows. Once the butterfly test has been confirmed then,

1. Fill a small container (e.g. paper cup) to around 3/4 full with sealant.
2. Place a stick in the center of the cup with the tip touching the bottom.
3. After 15 minutes start pulling out the stick and thereafter every 5 minutes until the sealant breaks or snaps once this occurs the sealant has reached the "snap time". Record the time.

The Snap Time Test is a subjective test and the snap time can vary depending on a number of conditions which may even include changes in the applicator or quality control person doing the test. The Snap Time Test can help alert the applicator to changes in conditions. Snap time usually ranges from 20 to 70 minutes and can be affected by changes in temperature and humidity and also more serious pump issues. If the same person is doing the test consistently and the working conditions have not changed and there is a time difference of more than 10 minutes then there will be a need to check the mixing ratio of the pump to ensure that this has not change. Application of all sealant works should be suspended until such times that the correct pump mixing ratio and sealant snap time can be confirmed to be correct.

■ Snap Time Test Methods



Uncured (The sealant doesn't reach snap time)



Uncured (The sealant reached snap time)

If the applicator is concerned about the mix ratio, the Snake Test can be performed in conjunction with the Snap Time Test. The Snake Test lets the applicator detect changes in the mix ratio continuously as the sealant is being extruded. Some glazing pumps come with valves or attachments that can measure the mix ratio, but in most cases, due to poor metering accuracy, the Snake Test cannot be substituted for the Snap Time Test. For details, please refer to the manual from the dispenser manufacturer. Sections 6-2-1 and 6-2-2 cover methods for checking the quality of two-component sealants. In 6-2-3, we discuss how to check the quality of one-component sealants.

6-2-3 Skin-Over Time / Elastomeric Test in Factory (Shop)

For applications using one-component sealants we test the Skin-Over Time. This test should be performed once per week, and on each new batch of sealants to be applied and especially on sealants that are close to reaching their shelf life. This test measures the time it takes for a skin to form on one-component sealants that have been extruded from a cartridge or sausage and checks that they have typical elastomeric properties. An excessively long skin-over time may indicate that the sealant has been stored in conditions that are too hot, or that the product is out of shelf life.

The test procedure is as follows.

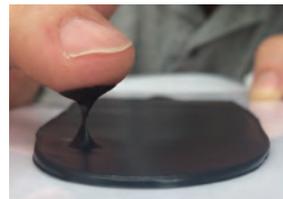
1. Extrude the one-component sealant from the cartridge or sausage onto a polyethylene sheet, and spread it into a roughly 1 mm thick layer.
2. Every 10 minutes, lightly touch the sealant surface with the ball of a finger or a tool.
3. When the sealant no longer adheres to the finger or tool, record this time as the skin-over time.
4. To check the elastomeric properties wait 24 hours after spreading the sealant. Peel the sealant from the polyethylene sheet. If the sealant has cured to form an elastomeric material then it is judged to have good elastomeric properties and the result is recorded.
5. If the skin-over time exceeds 3 hours or the sealant does not become an elastomeric material after 24 hours with the properties being plastic like in their characteristics showing no elastic recovery or appear to be soft the entire batch should not be used.

■ Skin-Over Time Test



The sealant doesn't reach skin-over time.

The sealant reached skin-over time.



The sealant doesn't become elastomeric.

The sealant became elastomeric.



Kyobashi Edogrand (Japan)



6-2-4 Factory (Shop) Peel Adhesion Test

This peel adhesion test is performed with substrates that are representative of those to be used on the actual production of the panels and that have been cleaned and prepared in the same manner as those carried out and confirmed in the adhesion test report from Shin-Etsu Silicone or as recommended within this manual. The testing should be carried out at every change of either the base or catalyst materials and with any new batches of the substrate materials.

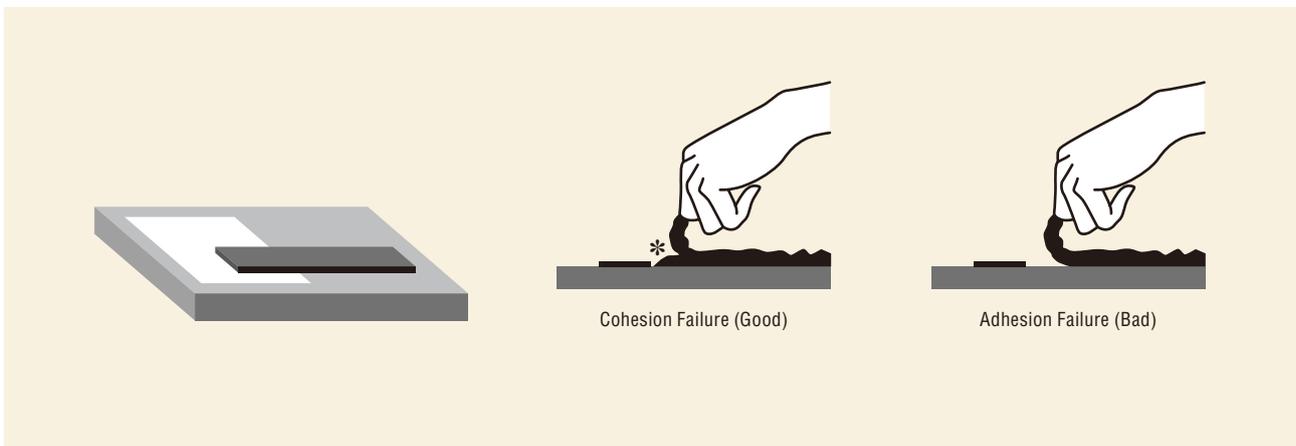
The following adhesion test must be performed for all substrates.

1. Clean the surface of the substrate and apply primer in a manner recommended by the Project Support Service of Shin-Etsu Silicone or that the applicator has found to be compatible.
2. Put release tapes (bond breakers, cellulose tapes) like the picture shown below.
3. Apply a bead of sealant and tool it to form a 6 mm layer that is 15 mm wide by 200 mm long.
4. Allow the sealant to cure. For SEALANT-FC-295SG, we recommend testing in stages, first after a minimum of 4 hours, then after 8 hours, 24 hours, 48 hours, and 7 days. For SEALANT-90N, we recommend first testing after a minimum of 7 days, then every 7 days until the 21st day. Note that if the bead is thicker than 6 mm, additional curing time will be required.
5. Grab the end of the sealant, and pull up. Pull toward the end opposite the one that has been cut. If adhesion is good, there will be a cohesive failure.
6. Record the test result and relevant information such as temperature and relative humidity.

- * For the peel adhesion test the cleaning and application of the primer and sealant should be done in the same manner as for actual production units.
- * Units should only be transported to the installation site if the sealant has passed the adhesion test in both conditions, i.e. after curing and after immersion in water. And factory deglazes testing of the completed panel. The condition for passing each test is 100% cohesive failure.
- * Shin-Etsu Silicone may request an additional water immersion test on substrate that have been found to be difficult to adhere to during the testing at our Tech-Center. The test may be conducted after 1 hour to 1 day of water immersion.



OK Mode (Cohesive failure)



With a sharp knife, cut the sealant at a 45° angle at the point marked " *" and repeat.

6-2-5 Factory (Shop) H-Type Tensile Test

The H-Piece Tensile Test is another effective test that can be performed at the factory in conjunction with the Peel Adhesion Test described in 6-2-4. It can be carried out using specialized equipment or a purpose built roman scale. If information is required on either piece of equipment please contact Shin-Etsu Silicone technical staff for assistance.

The H-Piece Test is performed with substrates that are representative of those to be used on the actual production of the panels and that have been cleaned and prepared in the same manner as those carried out and confirmed in the adhesion test report from Shin-Etsu Silicone or as recommended within this manual. The testing should be carried out at every equipment or pump start up and every change of either the base or catalyst materials and new batches of the substrate materials

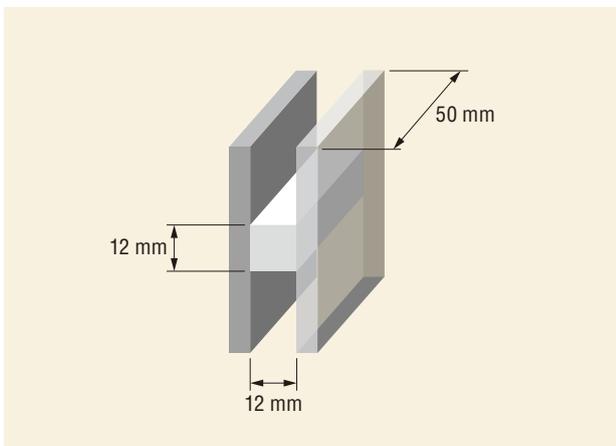
The H-Piece Test also allows for confirmation that the curing conditions have been met and that the physical properties of the sealant have been achieved. Although this test is not mandatory it does give the required confirmation that the sealant has reached the required strength prior to packing and shipping the completed units.

We recommend preparing at least three H-piece samples as shown in the picture below.

The procedure is as follows.

1. SEALANT-FC-295SG should be allowed to cure for a minimum of 4 hours, SEALANT-90N for a minimum of 14 days to 21 days. The cure time may be affected by the joint configuration, the nature of the structure around the joint, and the temperature and relative humidity inside the factory. Shin-Etsu recommends you perform the H-Piece Tensile Test before completed units are moved within the factory or shipped out. (With normal curing, SEALANT-FC-295SG will achieve complete adhesion after 1–3 days, while SEALANT-90N will achieve complete adhesion after 2–4 weeks. In conducting the H-Piece Test units must not be moved at all until H-piece testing has been done and strength of 0.70Mpa has been achieved.
 2. After curing place a test piece in the mounting fixture and conduct the tensile test.
 3. When testing tensile force is to be applied gradually and continuously. The test piece should not be pulled apart in a rapid motion. For reference, the tensometer will normally be set at 50 mm/min and a weight of 4.2 kilograms will be added to the roman scales if the ratio of the scales is manufactured to be 1-10 and thereafter at 0.5 kilograms until the sealant ruptures and the figure recorded. For more information related to this please contact Shin-Etsu Silicone technical staff
 4. Record the adhesive strength (tensile stress) at the point that the sealant fails and other relevant information.
- * If the results of the tensile adhesion test for the cured sealant show 100% cohesive failure and adhesive strength of at least 0.70 MPa then the units are ready to be moved.

■ H-Piece Testing Sample



■ H-Piece Testing Jig



6-2-6 Factory (Shop) Deglazing Test

The deglazing test is part of the Shin-Etsu Silicone PSS process and confirms that the sealant has achieved the correct cure and material properties as well as meeting the requirements detailed in the Shin-Etsu Print review document that confirms the sealant joint dimensions based upon the glass size and loads that are to be placed upon the sealant. Perform this deglazing test randomly on selected completed units.

Completed units will need to be disassembled in order to perform the deglazing test.

We recommend the following frequencies for performing the test. Perform the deglazing test to all structural sealants on both aluminum frames and glass surfaces.

- Perform once for the first 10 units (units 1–10)
- Once for the next 40 units (units 11–50)
- Once for the next 50 units (units 51–100)
- Once for every 100 units thereafter (all remaining units) providing that there has been no material failures and the required cohesive failure has been achieved in all prior tests.

The follow procedure and checks are required also to complete a deglaze test

1. Check that the structural bite and thickness (glueline) of the sealant are the same as those given in the Shin-Etsu Silicone print review or those given by the design professional.
 2. Check that all cleaning solvents, sealants, primers and substrate materials are those that have been tested and confirmed in the Shin-Etsu Silicone adhesion test report.
 3. Use the Shin-Etsu Silicone deglaze test report to record the name of the fabricator and project name and location. The sealant and primer batch numbers, the sealant application date and deglazing date. Also carry out a visual inspection of the cured sealant to ensure that the sealant is mixed properly and has elasticity and that there are no air bubbles present. Also record the frame ID and the person who is present when the deglazing has been carried out and that representatives from all companies have signed the deglazing report once completed.
 4. There is also a comments section at the base of the form that allows for anything unusual or not detailed in the report to be mentioned including the amount of cohesive failure. Make sure you have allowed sufficient time for the sealant to cure before proceeding with the deglazing test or with confirmation from the peel adhesion test and or H Piece tests
 5. Cut the structural sealant around the unit, leaving a layer of 1–3 mm on the substrate.
- * Take care not to damage the substrate surface, as it could interfere with re-glazing after completion of the deglazing test and be sure to leave a layer of sealant on the substrate.
7. Remove the glass using suction lifters or similar tools.

8. Remove gaskets and spacer tape from the inner side around the unit so that the sealant does not adhere to them.

9. Cut the sealant to create a tab big enough that it can be pulled with the fingers.

10. Pull back 180° and check how the sealant is adhered to the substrate. If adhesion is good (Cohesion failure: 100%), cut and pull the sealant again.

If adhesion is bad (Cohesion failure: less than 100%), suspend the sealant application work and review all of the steps in the process. Thereafter select other units that can be deglazed to see if the loss of adhesion is replicated on them also or confined to just one single frame.



Check the joint configuration for both glass and substrates.

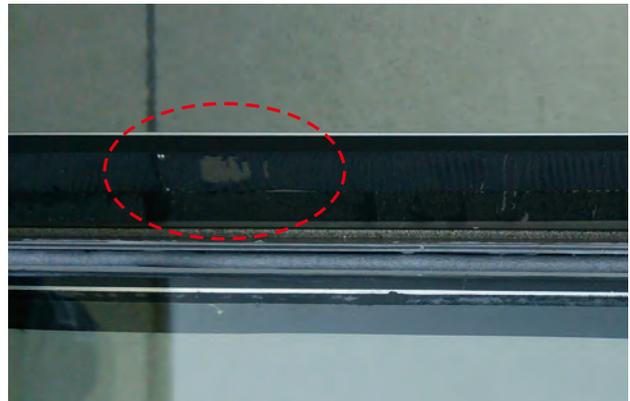


Check the sealant adhesiveness for both glass and substrates.

Deglaze Testing is recommended to be conducted in the presence of Shin-Etsu Silicone technical staff or by its authorized distributors.



NG Mode (Insufficient mixing)



NG Mode (Adhesive failure)

6-2-7 Glazing Pump Maintenance

When problems are found with the Butterfly Test (6-2-1) and Snap Time Test (6-2-2), the cause will often be incorrect settings or lack of maintenance of the dispensing equipment. In the event of problems refer to the manual for instructions on preventative maintenance of the equipment and how to clean or replace parts. By continuing to service and have regular maintenance checks on the pump will dramatically reduce the down time. Keep records of all maintenance and providing that the butterfly test and snap time test are within the acceptable range detailed within this manual then production may be resumed. If the problems are not solved sealant application must be totally suspended and the pump equipment manufacturer contacted with a copy of the communication sent to Shin-Etsu Silicone. Only when the pump is working correctly can the sealant application resume.



Glazing Pumps should be maintained regularly.



Pumps maintenance

From left: Tamara Center / Lippo Plaza / BCD Tower / Bank Bali (Indonesia)



6-3 On-Site

Sealant applications carried out on site with one component structural glazing material requires that the sealant be allowed to cure for a minimum of one week and at times beyond four weeks. It is therefore important that the site application and curing is done in strict accordance with this manual and the information found on the technical data sheet (TDS) in terms of managing the temperature and humidity throughout the curing period and by minimizing the amount of contaminants that are allowed to access the joint. The stitch plates that are used to retain the glass must not be removed until confirmation that the sealant has fully cured and reach its desired properties and adhesion has been confirmed. When apply weather sealants and structural sealants ensure that the proper surface cleaning and sealant application procedures on site are done to ensure that the cure properties movement accommodation, adhesion and durability of the sealant are as required.

6-3-1 Pre-Application on Site Adhesion Test

On the project site before starting application the applicator must check that the sealants to be applied have been properly stored and are within shelf life and that as part of the Shin-Etsu Silicone PSS that the adhesion test has been completed and that the applicator has a copy of the report which confirms the preparation process and also any priming recommendations.

Carry out a Skin-Over Time/Elastomeric Test (6-2-3) and the Peel Adhesion Test (6-2-4). Performing these tests on site will help the applicator determine what preparations will be necessary to ensure compatibility and good adhesion to the substrates to be used at the actual site and the conditions found there. These tests are required before the start of any application.

6-3-2 Post -Application on Site Adhesion Test

Perform the Hand-Pull Test after the sealant has fully cured (normally 7–21 days) to check adhesion.

We recommend the following frequency for performing the test.

- Every 30 m for the first 300 m
 - Every 300 m thereafter
- OR
- For each floor, if approved by the designer

Following is the procedure for the Hand-Pull Test.

1. Select the joint to be tested, cut the sealant horizontally with a knife from one side of the joint to the opposite side.
2. Make two vertical cuts of 50–75 mm along the substrate on both sides of the joint so that these cuts meet up with the horizontal cut. To make the subsequent repair easier leave approximately 1-2 mm of the existing sealant on the substrate surface.
3. Hold the sealant with the 50–75 mm cuts and pull it out at or over a 90° angle so that the uncut sealant is pulled from the joint.

4. If adhesion is good, the sealant will fail cohesively before it fails adhesively.

5. Check the depth of the center of the sealant is not too thin.

* Poor adhesion can be caused by the following.

1. Moisture on the substrate when the sealants are applied or during the curing period
2. The substrate is fragile or the surface is dirty with dust, oil, or other contamination
3. Insufficiently skilled workers

To confirm that sealant applied on the project site is performing properly is to carry out site adhesion test. For assistance with this please contact Shin-Etsu Silicone or its appointed representatives.

6-4 Sealant Repair in Adhesion Test Area

1. If sealant has passed the deglazing test carried out in the factory and has shown 100% cohesive failure or on the substrate surface after the Hand-Pull Test on site the area where sealant has been removed can be repaired by applying new sealant.
2. When making repairs, use the same sealant as that which was initially used.
3. Cut back the sealant to leave between 1 and 2 mm of the existing sealant on the substrate. If the application of new sealant is made immediately or with 30 mins then there will be no need to carry out any further preparation as the new sealant will adhere to the old. If the sealant is left for longer then full cleaning of the existing sealant will be required but it should be noted that any solvents used to clean the surface of the existing sealant must be given time to evaporate as they will be absorbed into the sealant and this will have a direct and detrimental impact on the final adhesion. Therefore the best and recommended practice is to only cut back the existing sealant no more than 30 minutes before installing the new one

Hong Kong International Terminal (Hong Kong)



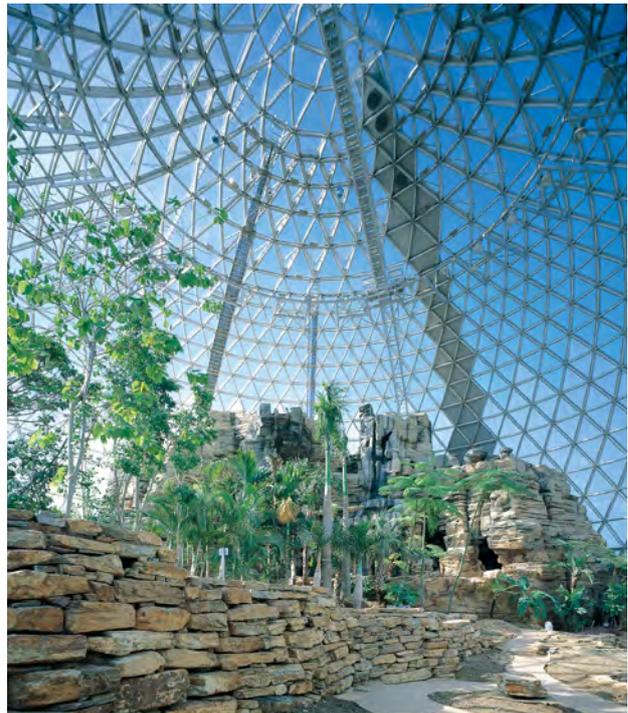
7. Maintenance, Repair and Inspection

Generally maintenance is not required for SSG with Shin-Etsu functional sealants.

What is important and that has a direct relation to the longevity of a project is that the design, sealant selection, application standard have all been managed within the Shin-Etsu Silicone PSS Project Support Services. Once completed regular inspections of the joints sealed with functional sealants can be carried out. Typically these inspections should be done at the completion of construction, then once again after 1 year, 2 years, 5 years, and every 5 years thereafter.

The inspections can be done by visual check, by pressing with the hands to check adhesion, and using an inspection procedure like that outlined in ASTM C1394 and ASTM C1392

If you have questions, please contact to Shin-Etsu Silicone



Niigata Greenery (Japan)

About Shin-Etsu Silicone

In 1953, Shin-Etsu Chemical became the first company in Japan to invest and realize the potential of silicone. In the decades since, Shin-Etsu has created a diverse and innovative range of products designed to maximize the diverse and unique properties of silicones. Today this includes over 5,000 products that deliver excellence and meet the requirements for a wide range of applications including, general construction, high performance facades and green building applications, the cosmetics and automotive industries, and also electrical and electronic applications.

The Company's operations have spread beyond Japan's shores; we now have production facilities and offices in countries around the world, including the USA, South Korea, China, Taiwan, Singapore, Thailand and the Netherlands. We have organized our supply network to enable direct access to the world's markets and enhance our responsiveness to customer needs wherever they may be located. As a result, we have grown to become the No.1 silicone manufacturer in Japan and one of the leading companies within the silicone industry worldwide.



Shin-Etsu Silicone Check List

Control No.
Date

The Contents * Must be filled. Please submit to Shin-Etsu Silicone.

Project Name*	
Address*	
State / Province / Country	
Contact Person*	

Architect Name	
Address	
State / Province / Country	
Contact Person	

Consultant Name	
Address	
State / Province / Country	
Contact Person	

Fabricator Name*	
Address*	
State / Province / Country	
Contact Person*	

Distributor Name*	
Address*	
State / Province / Country	
Contact Person*	

Project Start and Completion Date*	Start:	Complete:
Application Start and Completion Date*	Start:	Complete:

Usage Estimation

Sealant Name*				
Packing Size				
Quantity*				

Panel's Dead Load Supported

Max Negative Wind Pressure in KPa* _____ KPa

Dimension of the largest piece of glass* H: _____ mm x L: _____ mm

Is the application 2, 3 or 4 sided* 2 3 4

No. of SSG panels _____ Units

Are the panels vertical* Yes No

At which angle inward or outward* Inward Outward Degrees: _____

Are the panels dead load supported? * Yes No

Panels in Dead Load

In the event that your application includes panels in dead load, please contact to Shin-Etsu Silicone.

Type of Sealant Application: *

<input type="checkbox"/>	Weather Sealant	<input type="checkbox"/>	In-Factory	<input type="checkbox"/>	On-Site
<input type="checkbox"/>	Structural Sealant	<input type="checkbox"/>	In-Factory	<input type="checkbox"/>	On-Site

Type of Warranty Requirement: *

<input type="checkbox"/>	Factory applied structural glazing warranty
<input type="checkbox"/>	Site applied structural glazing warranty
<input type="checkbox"/>	Weather sealing warranty
<input type="checkbox"/>	Non-staining warranty
<input type="checkbox"/>	General product warranty (only weather sealant)
<input type="checkbox"/>	No warranty

Note

- To complete this project Check List, detailed drawings are required confirming all sealant locations and dimensions. They must include mullion and transom details as well as all elevation drawings.
- If at any time in future the project details change you must notify to Shin-Etsu Silicone of all changes.
- The warranty will be invalid if any detail(s) changes or deficiency are found without notification, even after the warranty has been issued.

Fabricator Representative (Signature) (Name)*		Date
Distributor Representative (Signature) (Name)*		Date
Shin-Etsu Representative (Signature) (Name)*		Date



Shin-Etsu Silicone Project Sample Testing Form



Control No.
Date

All samples submitted are to be representative of those that are to be used on the actual project or fabrication. If at any time any of the materials are changed or replaced by others then the new samples should be submitted for testing. There can be no material substitution without testing.

All of the adhesion testing carried out will be done both with and without primer and the adhesion report will confirm if primer is required for each specific application.

Project Name	
Company Name and Address	
Contact Person	
Email Address	

Material Description and Testing Requirement

Substrate Description (Manufacturer/Code)	Coating Type and Color	Sealant and Color to be Tested	Testing Required i.e. Adhesion, Compatibility or Stain (Cut or Polish Face)

The Solvent You Usually Use

IPA
 Xylene
 Toluene
 MEK
 Acetone
 Other (details)

The size and number of samples required are as follows;

- For adhesion testing of coated or painted aluminum, stainless steel, glass and stone we require five (5) 200 mm x 300 mm for each sample to be tested.
- For compatibility testing of gaskets, setting blocks and ancillary products we require average size to be 300 mm long for each sample to be tested
- For stain testing we need eight (8) samples 75 mm x 25 mm x 25 mm

Contact Details for Local Distributor.

Signed on Behalf of Company		Date of Signature:	
Signature		Title:	



Shin-Etsu Silicone Deglazing Test Form



Control No.
Date

Company / Fabricator Name	
Project Name / Location	
Contact Person	

Frame / Panel ID		Recommended Sealant Bite and Glueline	
Base Lot No.		Catalyst Lot No.	
Sealant Bite and Glueline to Frame		Sealant Bite and Glueline to Glass	
Primer and Lot No.		Cleaning Solvent	
Sealant Application Date		Deglaze Date	

The Solvent You Used

IPA
 Xylene
 Toluene
 MEK
 Acetone
 Other (details)

Is the sealant free from air and bubbles ? Yes No

Has the sealant successfully filled the joint ? Yes No

Is the sealant mix and cure consistent ? Yes No

Comment on sealant adhesion to both frame and glass giving cohesive failure %

Signed on Behalf of Company		Date of Signature	
Signature		Title	



Shin-Etsu Silicone Job for Completed and Warranty Requirement



Control No.
Date

We hereby certify that we met the latest Shin-Etsu Silicone’s published Functional Sealants Technical Manual.

Customer Name and Address	
Project Name and Location	
Distributor Name	
Project Start and Completion Date	Start: _____ Complete: _____
Application Start and Completion Date	Start: _____ Complete: _____

Type of Warranty Required (✓)	Sealant Name and Color	Sealant Lot Number(s)	Primer Name	Primer Lot Number(s)
Factory Applied Structural Glazing				
Site Applied Structural Glazing				
Weather Sealant				
Non Staining				
General Product				

Signed on Behalf of Company:		Date of Signature:	
Signature:		Title:	

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Naoetsu Plant	ISO 9001 (JCQA-0018)	ISO 14001 (JCQA-E-0064)
Takefu Plant	ISO 9001 (JQA-0479)	ISO 14001 (JQA-EM0298)