

APPLICATION GUIDELINE GLASS- & FACADE MARKETS FINOTECH SWITZERLAND SWISS QUALITY MANAGEMENT

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APPLICATION GUIDELINES FOR THE INDUSTRIAL USAGE OF FINOTECH SQ SEALANTS & ADHESIVES

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INTRODUCTION:

Even in modern times the chemical bonding process seems to be still a miracle for quite a few of us. Although widely being used as a replacement for mechanical fixations, randomly interviews giving the choice of using screws or adhesives are showing the sealants and adhesive industry has still to build confidence for their technology. Our Swiss Quality Management initiative should contribute to this objective.

Sealants & Adhesives had always been used since mankind and starting the end of the 19th century many industrialized systems had been introduced which are still the backbone of this industry. Sealants and adhesives are an essential part of many modern technologies in almost all areas of our daily life. Just to name a few functions. Tightness of buildings against water, air, dust, fire and thermal insulations. Further load bearing structures like used in Facades, Cars, Trains, Trucks, Ships, not talking about all the applications relevant to our personal daily routines.

The relevance for sealants and adhesives quality can be summarized in a few words. The products should simply stick to the surfaces and keeps their bonding promise for the duration of the original design and meaning. Easy said and to fulfill this desire quite some industrial partners has to work together.

The meaning of this information leaflet is to share our Swiss Quality Management system amongst the industrial partners being involved in the process.



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TESTING OF SUBSTRATES

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An important first step is to check the adhesion profile and to exclude any chemical incompatibility between The following picture illustrates the adhesion test substrates and adhesives providing physical contact during and after bonding. Finotech Switzerland offers it`s lab service for clients. Those are requested to submit original samples in a sufficient amount and quality to Finotech Switzerland.

A) SUBMITTAL OF SAMPLES

The contractor should contact his local Finotech sales representative to be advised about the shortest and fastest way to submit his samples. Alternatively, an email could be send to Lab_Service@finotech.ch. Pls. be prepared to provide additional information about the intended project and the test requests like as:

- Name and location
- Size and time schedule
- Contractor and customer details
- Account number at Finotech Switzerland
- Samples and application information
- Particular service requests

The process and schedule of the tests will be provided by Finotech Switzerland in return.

All samples to be tested should be clearly described and labelled by the customer. Samples size of originally extruded profiles must be longer than 20 cm for each sealant to be tested. Flat substrate like as glass, panels or stone should be 20 x 20cm as a minimum. A minimum of 5 pieces of each sample is requested to be send.

After the tests are finished a SQM test report will be given to the client by Finotech Switzerland.

B) ADHESION AND COMPATIBILITY TEST BY FINOTECH **SWITZERLAND**

Standard test according to ASTM C719 / ASTM C 794 / ISO 9047 will be applied to check the adhesion properties. After cleaning the test sample provided by the customer, a sealant bead will be applied and cured for 14 days. Afterwards the test specimen will be stored in water for 7 days.

after water immersion:



For compatibility the Finotech test procedure will follow the ASTM C1087 and further standards in order to determine the durability of the sealants after prolonged UV exposure. Test duration will take 5 weeks after the samples had arrived in the test center.



Stain tests are offered following the ASTM C 1248 and further standards to be expected by our customers. Particular for stain sensitive stone panels like as granite, marble, limestone this service is offered. Between the original samples a horizontal sealants bead will be applied and fully cured for 21 days. Afterwards the samples are compressed to 50% of the original size and stored at 70°C for 14 days. As the result of this test any migration from the sealants should be visually inspected and reported.



C) FINOTECH SQM REPORT

The sealants being used for the test are described in the Finotech technical datasheets of each product. After the test process is through a written report will be The sealants properties are guaranteed by Finotech. The responsibility for substrate submittals and for the given to the clients. The samples material, the sealants functionality of the bonded elements remains at the used, all test standards and test description including of the test results in terms of adhesion and compatibility will applicator of the sealants. be send to the client.



Now after the ideal partners like the correct sealant and Structural Glazing consists of a façade constructed with appropriate substrates had been found and tested, the glass or panels that are bonded to treated or coated next step to a perfect bonding result is a proper joint metals that are normally anodized, powder coat or PVDF coated aluminum or high-grade stainless steel. design. Some golden rules are leading the subject:

- Three-flank adhesion must be avoided to allow the They are bonded with high performance structural glazing sealant to accommodate movements
- One component sealants can be used for max. 15mm and then to the building structure. These loads are used each joint for height and depth of the joint. Larger than 15mm a two component system has to be used
- Joint height : Joint depth are minimum 1:1 and maximum 3:1
- Minimum joint height and joint depth are each 6mm
- External loads not being specified like as building settlements, material shrink, creeping etc. cannot be accommodated by the sealant.

PRODUCT			ETAG		ASTM		
		σdyn	τdyn	τstat	σdyn	τstat	Movement ability (ASTM C719)
Finotech®SQ-10	IG-Silicone	0.12 MPa	0.08 MPa	0.08 MPa	0.138 MPa 20 psi	0.007 MPa 1 psi	± 12.5%
Finotech®SQ-50	IG-HM Silicone	0.17 MPa	0.13 MPa	0.013 MPa	0.138 MPa 20 psi	0.007 MPa 1 psi	± 12.5%
Finotech®SQ-110	SG-Silicone	0.14 MPa	0.10 MPa	0.010 MPa	0.138 MPa 20 psi	0.007 MPa 1 psi	± 12.5%
Finotech®SQ-150	SG-ETAG Silicone	0.16 MPa	0.11 MPa	0.011 MPa	0.138 MPa 20 psi	0.007 MPa 1 psi	± 12.5%
Finotech®SQ-200	1 part SG-SIL	0.18 MPa	0.12 MPa	0.012 MPa	0.138 MPa 20 psi	0.007 MPa 1 psi	± 25%

silicone sealant. Loads that are placed on the glass are transferred through the silicone sealant to the frame to calculate the required sealant joint and include wind loads, thermal expansion and contraction. Other loads can be snow loading, impact loads being point or line loads or bomb blast may also be considered. Depending on the façade design the Insulating Glass unit being sealed with high performance sealants contributes to the load management and the structural properties.

The façade builder is responsible for any joint calculation, whereas Finotech takes the liability for the mechanical values of its sealants once properly mixed and applied by the applicator:

Let us go through the most common calculation the facade **STRUCTURAL SEALANT GLUELINE THICKNESS** builder has to conclude before bonding the elements. First case is showing the calculation for a design which is The allowable movement of a glass unit in the frame will dead load supported:

STRUCTURAL SEALANT BITE



Structural Selant Rite –	0.5 x Short Span Length (mm) x Windload (kPa)
(mm)	Sealant Design Strength (140 kPa)

In case where the dead load isn't mechanically supported the following formula is being used to calculate the joint bite:

	Structural	2.500 kg/m x 9.81 m/s X Glass Thickness Glass Cross Area X (m) X (m)
Selant Bite ⁼	[2 x Height (m) + 2 x Width (m)] X Allowable Design Stress	
(mm)	(Pa) for DL is 7.000 Pa	

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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.

Movement (mm)	=	Panel Lengh (mm)	Х	CTE (mm/mm/degC)	Х	Temperature Change (degC)
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The following formula is used to determine the differential movement for glass and aluminium.

Differential Thermal Movement of Thermal Movement of Movement = Aluminium Glass (mm)

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



WEATHERPROOFING JOINTS

Joints between elements may be effectively sealed with Finotech SQ in order to preserve the performance and For granting a long term warranty the glass manufacturer optical appearance of the facades. UV and weathering for the insulating glass units (IGU) considers the loads resistance, outstanding movement absorption, to be taken by the sealant using the following formulas impermeability to air an rain, fire resistance and non-stain for symmetric configurations acc. To EOTA ETAG 002 properties should be the decisive factors for the optimal sealants.

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A FEW PRINCIPALS TO BE CONSIDERED:

• The joint edges must run parallel to a depth of twice the joint width, but at least 30 mm. This gives the backing material sufficient grip.

 Considering the movement capability of the sealant, the joint width should be at 4 to 8 times the expected joint movement

• The optimal ratio of joint width to depth is 2:1

 Backer should be installed under 20% compression. Watch out not to puncture or rupture the surface of the PE backer rod as this could cause gassing and bubbling of the sealants. Alternatively use open-cell PE.

SEALANTS HEIGHT JOINT CALCULATIONS FOR **INSULATING GLASS**

A) When the thickness of the outer glass pane >thickness of the inner glass pane:

$$r = \frac{axW}{2 \times O_{dyn}}$$

B) When the thickness of the outer glass pane < thickness of the inner glass pane:

$$r = \frac{axW}{4 \times O_{dyn}}$$



height of the insulating glass secondary seal (mm) longest of the short glass edges of the project (mm) maximum wind load to be expected (kN/m) permissible adhesive stress for supported constructions.

SURFACE PREPARATION

WORKING PLACE CONDITIONS

The working place should be as dust-free as possible. Ideal conditions are 23° C (73 °F) and 50% relative humidity. As these conditions are usually attainable only in laboratory, one should try to make the plant conditions properly using the "two-cloth method": as close as possible. Although FINOTECH® IG sealants & adhesives may be processed within 5 – 40 °C (40 – 105 • Use a clean, dry, oil-free and lint-free cloth or pater °F), the optimum application temperature of the products and moisten it with the cleaner. Rub it over the surface is between 15 °C and 30 °C (60 – 85 °F).

All substrates (glass and spacers) must be stored under wiping residues back onto the surface. the same conditions (i.e. between 5 and 40 °C; 40 – 105 °F) at least 24 hours prior to the application of FINOTECH IG • Before the cleaner on the surface has been evaporated products in order to avoid condensation on the surfaces.

SURFACE PRE-TREATMENT

For perfect adhesion of FINOTECH® SQ products the respective substrates must be free of all contamination • Drying time before bonding is >2 minutes at 5-40°C and foreign substances such as grease, oil, drilling fluids, dust, water or frost.

Most relevant for Structural Glazing façade applications are the following substrates where cleaning agents, activators and/or primers should be used for a perfect adhesion. The following list presents a general guidance **APPLICATION OF FINOTECH SQ-ACTIVATORS** only as further or different agents could be recommended after testing of the original substrates.

SUBSTRATE	SURFACE PRE-TREAT- MENT
PVDF - coated Aluminium	Finotech SQ-Primer 2
Polyester powder - coated	Finotech SQ - Activator 1
Stainless steel	Cleaner
Anodized Aluminium	Cleaner
Ceramic - coated glass	Finotech SQ-Activator 1
Pyrolytically - coated glass	Cleaner
Float glass	Cleaner

For insulating glass units in structural glazing facades, the glass manufacturer is obliged to test the adhesion of insulating glass secondary sealing on project basis on production-run samples of the original materials (e.g. glass coatings) used in the specific project. For more information and FINOTECH support, please contact our Technical department.

APPLICATION OF RECOMMENDED CLEANERS

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Cleaners recommended are solvent-based cleaning agents like as Isopropanol purity >99%. Any oil/grease being at the surface of the substrates should be removed

and secure to turn the cloth or paper to expose new and clean surface. Replace the cloth / paper regularly to avoid

use the "second" clean, oil-free and lint-free cloth and wipe-off the surface.

- Repeat step 1 and step 2 until surface is clean.

 If a longer break before bonding is unavoidable, protect the substrates against subsequent contamination. Should the break be longer than 120 minutes, always repeat the cleaning process before bonding.

Moisten a clean, dry, oil-free and lint-free cloth or paper with Finotech SQ-Activators and apply it on the surface. Make sure to turn the cloth or paper to expose new surface, or replace it regularly in order to avoid wiping residues back onto the surface. If the surface is not free of contaminant, the process has to be repeated.

• Unlike ordinary cleaning agents, the surface treated with Finotech SQ-Activators must not be dried subsequently with a cloth or paper!

Drying time

The required minimum drying times are as follows (depending on the temperature in the workshop):

- 5 10°C (41 51°F): 10 minutes
- 10 15°C (51 60°F): 5 minutes
- ->15°C (>60°F): 2 minutes

• If pretreated parts are not bonded/sealed immediately, protect them against subsequent contamination.

• Adhesives should be applied within 2 hours after the application of Finotech SQ-Activators. Otherwise the procedure as described above has to be repeated before bonding.

APPLICATION OF FINOTECH SQ-PRIMERS

• Ideal application and surface temperature is between To obtain the ultimate physical properties indicated in 15°C and 25°C (60°F - 75°F). the corresponding product data sheets, FINOTECH SQ two part sealants and adhesives have to be thoroughly Surfaces must be clean, dry and free from grease, oil mixed with commercially available two-part mixing and and dust. Clean the surface wipe-on/wipe-off and leave dispensing equipment with static or dynamic mixers. For recommendations please contact the Technical to dry. Department of FINOTECH Switzerland AG.

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Apply a thin but covering coat of Finotech SQ-Primer with a brush, felt, clean lint-free cloth or foam applicator. It shall be applied once only. Make sure that this single application gives adequately dense coverage.

Drying time

The required drying conditions are as follows:

- < 15°C (60°F): 30 minutes
- ->15°C (>60°F): 10 minutes
- maximum: 24 h



PREPARATORY WORK

• FINOTECH SQ Sealants A-part as well as B-part has a paste-like consistency. To process the two components, a • Apply a cone of mixed FINOTECH® SQ sealant to a pump system with follower plates is required. transparent glass plate.

• After opening the drum containing the A-part (base) • Take a second glass pane and press it onto the pane unwire and open the inliner bag and put the top of the with the adhesive, taking care to exclude air bubbles. plastic bag over the edge of the drum. Use an adhesive tape to fix the plastic bag to the outside of the drum. This If you see white or deep-black stripes or distinct lightgray marbling, the adhesive is not properly mixed or an will avoid the plastic in liner will get inserted coincidentally into the pumping and dosing system. Before the follower insufficient amount of material was discharged after the plate will be inserted into the drum, remove the fixed last shutdown. Never use such material for bonding. To plastic cover first. eliminate the defect, follow the equipment manufacturer's instructions. If a static mixer is used, it may have to be After opening the pail containing the B-part cut the cleaned or replaced.

inserted aluminum inliner bag using a knife and secure a circular opening of 15cm in the middle of the pail. Afterwards insert the follower plate of sealants pump into the pail.

• Due to its reactivity with atmospheric moisture, the B-part should not be exposed to air. Should a thin layer of a resinous material have been formed on top, it has to be removed with a spatula or a similar tool before reinstalling the pail under the pump.

MIXING

For mixing ratio by weight and volume, refer to the corresponding Product Data Sheet. Only deviations of max. \pm 10% from the mixing ratio indicated in the Product Data Sheet are tolerated. For a proper adjustment of the mixing ratio consult the manual of the pump equipment. If further assistance is required, contact the equipment manufacturer. Lot matching of FINOTECH® SQ catalyst and base is not required.

Before the application and the production can work a few tests using already the sealant pump to secure a proper application result should be done.

MARBLE TEST FOR HOMOGENEITY

The mixture must be homogeneous to ensure that Finotech SQ sealant and adhesive has the ideal properties.

This can be tested by the marble test (glass plate test):

Figure 2: Positive test = ideal mixing



Figure 3: Negative test = inadequate mixing



BUTTERFLY TEST FOR HOMOGENEITY

The butterfly test is an alternative to the marble test.

• Fold a paper or plastic foil along its center and open it again.

• Apply mixed FINOTECH® SQ sealant over the fold

• Fold the foil again and press it so that the adhesive spreads out. Always press the foil in the direction perpendicular to the fold. Hint: a cartridge can be used to roll over the paper.

• Unfold the foil. The adhesive must have a homogeneous colour and must not show cured particles (wrinkles). If you see white or deep-black stripes or distinct light-grey marbling or wrinkles, the adhesive is not properly mixed, or an insufficient amount of material was discharged after the last shutdown. Never use such material for bonding. To eliminate the defect, follow the equipment manufacturer's instructions. If a static mixer is in use, it has to be cleaned or replaced.

• After an adequate curing time, double-check the mixing quality by cutting open the thicker centre section of the adhesive and check it for streaks, marbling and bubbles.

Figure 4: Apply the bead in the fold direction

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Figure 5: Press the bead only in direction perpendicular to fold



Figure 6: Unfold the foil - Positive test = ideal mixing



Figure 7: Unfold the foil - Negative test = inadequate mixing



POT LIFE (SNAP TIME) TESTING

• Extrude 30 - 75 ml freshly mixed 2 part adhesive (purge mixer sufficiently) from the machine into a small plastic cup, e.g. made of polyethylene.

• Start the timer. Then stir it briefly and vigorously with a wooden spatula.

• Repeat this operation every 5 minutes.

Above mentioned times significantly vary with different If the vigorous stirring is repeated too often, especially temperatures and must be verified by tests under at the beginning of the test, the build-up of mechanical actual conditions. If the alarm time is set too long cured strength is disturbed and simulates a longer pot life. rubber particles are visible in the extruded material.

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• The pot life or snap time is the time from extrusion of During shutdown, it is recommended to purge the adhesive until the point at which it no longer forms the dispensing and mixing equipment with the Along strings (Figure 8) when the spatula is removed, but component in order to retard sealant cure in the breaks off in short lengths (Figure 9). mixer. Usually, the necessary amount of A-part to purge corresponds to the threefold volume of the • The measured value has to be in line with the mixing system (for systems with a static mixer).

recommended values for guality control. Please be aware of the fact that the snap time strongly depends on the Alternatively, a freezer can be used for downtimes up temperature of the material. Hand mixed material can to 24 hours (temperature of -40 °C / -40 °F or below). have a longer snap time than mixtures from the static However, the reaction will not stop at -40 °C / -40 °F but mixer. will only be slowed down.

Figure 8: Material shows paste-like behavior:



Figure 9: Material shows rubber-like behavior: snap time is reached

Now everything is set properly for the application of Finotech SO.

APPLICATION

The mixer open time, i.e. the time the material can remain in the mixer without flushing or extrusion of product is significantly shorter than the snap time (pot life) indicated in the Product Data Sheets. Because of this fact and in order to maintain a long lifetime of the static mixer, the alarm on the equipment has to be set to the values shown in the following table:

PRODUCT	MIXER OPEN TIME	ALARM TIME EQUIPMENT
FINOTECH SILICONES	APPROX. 7 - 9 MIN	APPROX. 6 MIN
FINOTECH POLYSULFID	APPROX. 5 - 7 MIN	APPROX. 4 MIN

Table 1: Mixer-open times and alarm times of 2-part FINOTECH® SQ adhesives at 23 °C / 73 °F

During prolonged production breaks additional flushing with a cleaning agent is recommended. Cleaning the mixer by burning the silicone residues is not advisable.

When restarting production after shutdown, mixed sealants must be purged until obtaining a homogeneous mixture. Depending on the equipment, between 1 and 3 litres of FINOTECH SQ products are needed for that purpose if static mixers are used. The quality of the mixing and the correctness of the mixing ratio must be checked (butterfly or marble test, snake test, mixing ratio by weight.

Finotech SQ adhesives must be applied evenly and free of air bubbles. Tooling of the joint should be carried out as soon as possible after adhesive application but not later than half the pot life (snap time) indicated in the product data sheet. It must be ensured that the joint is completely filled and that the joint dimensions correspond to the calculated values.

Detergent or soap and water treatments are not recommended for tooling.

HANDLING OF BONDED SUBSTRATES

STORAGE AFTER BONDING

After bonding any mechanical stress has to be avoided A sealants bead of at least 150mm of Finotech SO should until the adhesive has built a certain strengths level allowing the sealants to accommodate movements.

Storage after bonding should be always in horizontal 1-part : 72 h) an peel adhesion test should be arranged: position of the bonded element for a duration as to be seen in the following matrix. Depending on type of • Cut with knife or glass scraper from one end of the sealant (1 part or 2 part) and if the bonded element is bead for about 30mm enjoying a dead load support at vertical storage, the transportation to site and the installation of the elements • Fold back the loose end at an acute angle of 30° and try should be arranged after the time frame given as below: to pull the bead

DURATION	HANDLING ADVI- SE FOR BONDED ELEMENT	CHECK SEALANT
1 day	STORE UNITS STRESS FREE IN HORIZONTAL POSITION	INITIAL CURING AND ADHESION BUILD UP
3 days	APPLY DEAD LOAD SUPPORT AND STORE VERTICAL	FURTHER STRENGTH BUILD UP
4 days	TRANSPORTAION OF UNITS VERTICALLY WITH DEAD LOAD SUPPORT	FURTHER STRENGTH BUILD UP AND ADHE- SION INCREASE
> 7 days	INSTALLATION OF ACADE UNITS	ULTIMATE STRENGTH AND ADHESION IS REACHED

The structurally glazed units must not be moved to the job site until the adhesive has fully cured and it can be demonstrated through quality control testing that the adhesive has achieved full adhesion.

Transportation of elements is possible earlier than stated in the table above if tensile adhesion tests on H-specimens kept under the same conditions as the bonded elements give a value of ≥ 0.7 N/mm2 and the failure mode is $\geq 95\%$ cohesive.

Depending on the factory conditions and organization of the production process, different times for movement of bonded elements can be agreed upon. This requires an audit of the customer's production by the Technical Service Department of Finotech Switzerland.

PEEL ADHESION TEST

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be extruded onto a clean and original used substrate and tailor the sealants to a uniform size of about 15 mm wide and 6mm height. After storage for curing (2-part : 24h /

CUSTOMER QC TESTS DURING AND AFTER BONDING

• If the bead cannot be detached from the substrate, cut through to the substrate with a knife while still pulling

• Repeat the process until 50% of the bead lengths has been tested

After 24 hours and 72 hours, respectively, the bead must not detach from the substrate during pull-



Picture 13: Peel adhesion test

TENSILE ADHESION TESTS ON H-SPECIMENS

H-test specimens with a joint dimension of 12 x 12 x 50 mm should be produced for the tensile test. For this purpose, use original materials that have been pretreated like on the production line and fill the Finotech SQ bubble free into a mold made out of PTFE as to be seen on the following pictures:







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TENSILE TEST EQUIPMENT

A Roman Scale can be used to test sealant cure rate and adhesion. Pls. secure a proper curing time for the H-specimen before running this test.



According to EOTA ETAG 002 the tensile strength at rupture should be a minimum of 0.70 MPa. A ratio of b/a of 10 (see Roman scale pic) translates the weight times 10 to the test specimen. This value corresponds to strength applied to the test specimen of $12 \times 50 \times 0.7 = 420$ N and to a load of 42 kg. The weight load (4.2 kg) should be applied for 10 seconds and if no H-specimen rupture observed, increased by 0.5kg each step until the H piece ruptures. The final result should be noted in the QC logbook.

Pls. note to stop the bonding process if the 4.2 kg weight leads to cohesive or adhesive failure result and call Finotech Technical Service.

DEGLAZING

Last check before bonded elements should be shipped and installed at the construction site is the deglazing of a few elements. The contractor should check in the beginning of a production cycle 1 of 10 panels and should be decreasing the deglazing frequency to 1 of 100 panels for each building project.

The purpose of deglazing is to check on adhesion, complete filling of the joint space, potential air bubbles due to mixing problems in the Sealant pump and the quality of the cure through process of the sealant. The process of deglazing is part of the production and QC staff training carried out during the SQM factory audit process.

)7 SQM FACTORY AUDITS

SWISS QUALITY FACTORY AUDIT

Quality never results randomly and beside a well described quality process and state of the art pumping and process equipment the constant training of the production and QC staff is mostly relevant for a zero-defect bonding process.

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As part of the Swiss Quality Management program Finotech Switzerland offers to its regular customers an Audit and training program. Customer may apply for an audit sending an request to Technical_Service@finotech.ch at any time.

The audit will be scheduled together with the customer and should leave enough time to go through the SQM process being installed at the customers side. Further an extensive training for the production and QC staff will follow. Updates on training will be offered using social media tools.

After a successful factory audit a Swiss Quality Certification will be given to the Finotech clients, being valid for 12 months only. Extension of the certificate can be given after constantly follow up trainings guided by Finotech Switzerland AG.

SWISS QUALITY MANAGEMENT

This factory audit service is part of the Finotech Swiss Quality Management system confirmed with the SQ appreciations in the product names.









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