GENERAL GUIDELINE
Bonding and Sealing with 1-component Sikaflex®

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BUILDING TRUST

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PURPOSE AND SCOPE

This guideline contain information and recommendations on the correct use of Sikaflex® adhesives and sealants (and some SikaTack® products if not used for Aftermarket) in industrial applications. They must be read in conjunction with the relevant Product Data Sheets, Pre-treatment Charts and Working Instructions. Due to the different chemical composition of various Sikaflex® sealants and adhesives this guideline only contains general recommendations. For specific recommendations contact your local Sika Company (www.sika.com).

This document contains important Sika know-how. It may be handed out to qualified customers only.

1 INTRODUCTION

The quality and durability of an adhesive bond or seal is determined by a number of factors. Besides using the correct product and joint design, the most critical steps are proper surface preparation and an appropriate application.

2 SELECTING ADHESIVES AND SEALANTS

The choice of product has to be made based on the specific requirements of the application and information supplied in the current Product Data Sheets or upon advice given by qualified Sika employees.

3 DESIGN AND LIMITATIONS

DESIGN

For existing applications, the design and dimension of adhesive joints and seals is usually based upon currently available specifications. New applications, adhesive joint and seal designs are to be based on values of the current Product Data Sheet and other data available through Sika. If necessary, Sika employees can provide assistance. Given the specific nature of elastic adhesives, particular attention must be paid to the adhesive layer thickness. For extra deep joints it is recommended to use an accelerated one-component product (Sika Booster system) or a 2 component system (Sikaflex®-900 Series) which cures independently of air humidity. Further considerations must be taken into account such as the detailed production process, its intended application, expected service life, reparability of the final assembly and the joints. All these factors may be crucial for the joint design and geometry.

LIMITATIONS

Every technology has its advantages as well as limits. For standard polyurethanes and silane terminated polyurethanes (STP's, Sika's Sikaflex®-500 Series) the following needs always to be considered and respected. This list is not conclusive and is based on current knowledge and experience.

- The surface preparation is vital for a long lasting bond. Especially on transparent and translucent substrates the adhesion of the bond line will fail if exposed to UV radiation. It is important to have a sound UV protection of the bond line in form of a tight ceramic frit in case of windows for vehicles or by covering (masking) the bond line and protect it completely from UV. In case of the latter, contact the Technical Department Industry for specific information.
- The thermal resistance of these product technologies is usually up to 90 °C. There are a few exceptions where it might be lower or higher. Always refer to the most actual Product Data Sheet for specific values. If higher temperature is expected, further investigate and check for products or technologies that would be fit for purpose.

- Laminated safety glass windshields: The interlayer foil can consist of different materials. PVB (Polyvinyl butyral) is the most common type of foil used in laminated safety glasses. However, other types of foils can be used which may not be compatible with Sikaflex® adhesives and sealants. The compatibility of Sikaflex® and interlayer must be confirmed by the user prior the application.
- In case of installation of a laminated safety glass windshield with incorporated heating elements or radio aerial in the interlayer foil a special bonding procedure may be required. Contact Sika's Technical Department Industry for advice.
- Consider in the design of bond lines that standing water on the joints cannot occur.
- Non-ferrous metals: Bonding on copper and copper containing alloys can be challenging. Compatibility issues can occur which are, to a great extent, dependent from various factors (such as type of adhesive technology, composition of the metal / alloy, exposure to hot and humid environment and combinations of those factors). It is therefore recommended, for any project involving such metals, to perform specific project related testing. Furthermore, the use of a primer is a must.

4 MAINTENANCE OF SEALING JOINTS

Sealing joints fulfill an important role when it comes to protecting the bond line from environmental influences or simply prevention of moisture or water ingress. Therefore, sealing joints must be considered maintenance parts which require a periodical inspection. Sealing joints must be accessible and repairable. For demanding sealing applications it is recommended to define inspection plans and repair procedures.

5 WORK PLACE CONDITIONS

The work place should be as dust free as possible. Alcohol containing or alcohol releasing products will impair the polyurethane from curing. Therefore, keep such products and substances away from the bonding process. Contamination of substrates by silicone or silicone oil will inhibit polyurethanes from adhering to substrates. Keep silicone and polyurethane away from each other. For best practice the bonding and sealing area should be separated from other areas and clearly marked with corresponding signs.

Be aware that all values stated in the Product Data Sheets are based on standard conditions (23 °C / 50 % r.h.). Other conditions will influence these results / behavior in one or another way.

The environmental conditions as well as the temperature of substrates and adhesives play an important role for a successful application. If either adhesive, substrate or climate condition are below 5 °C or above 40 °C difficulties can occur.

The optimum application temperature for Sikaflex® (polyurethanes and silane terminated polymers) and the substrates is between 15 °C and 25 °C. Do not apply these products at temperatures below 5 °C and above
40 °C.

CAUTION

Using sealants and adhesives at significantly elevated temperatures may result in poor adhesion due to faster skinning and/or bubble formation at the interface between the substrate and the products. Application at lower temperatures can result in the following: the product is harder to extrude/gun and might lead to poor adhesion due to reduced wettability. Curing as well as the strength development will be delayed.

Details on handling, storage, transportation and other safety related issues are specified in the corresponding Safety Data Sheet (SDS). General recommendations for transportation and storage can be found in this document, point 14: Transport and storage conditions.

CURING OF 1C POLYURETHANE AND STP ADHESIVES AND SEALANTS

The curing of a Sikaflex® one-component product depends from the absolute air humidity (temperature and relative air moisture). In general the curing of such a Sikaflex® product varies between 2.5 and 4 mm in the first 24 hours. In areas (countries or regions) with high climatic variation the information in the Product Data Sheet (tested at 23 °C / 50 % r.h.) might not be sufficient. The following tables provide an indication about how the climatic conditions can affect the curing of Sikaflex® products.

Table 1 Absolute air humidity [g/kg] depending on temperature and relative air moisture*

Temperature [°C] \ Relative air moisture [%]	20 %	40 %	50 %	60 %	80 %
10 °C	1.5	3	3.8	4.7	6
20 °C	3	6	7.5	9	12
23 °C			9		
30 °C	5.4	11	13.5	16.2	22
40 °C	9	19	24	28	39

**source: mollier diagram*

Example

The below two tables show a curing behavior of a Sikaflex® adhesive or sealant with a curing rate of 3 mm in 24 hours at 23 °C / 50 % r.h. The stated values are approximate indications.

Table 2 Time [h] to cure 3 mm of Sikaflex®

Temperature [°C] \ Relative air moisture [%]	20 %	40 %	50 %	60 %	80 %
10 °C	170	70	60	50	40
20 °C	70	40	30	24	20
23 °C			24		
30 °C	40	20	15	15	10
40 °C	24	12	10	< 10	< 10

Table 3 Curing depth [mm] in the first 24 h.

Temperature [°C] \ Relative air moisture [%]	20 %	40 %	50 %	60 %	80 %
10 °C	< 1	1	1.5	1.5	2
20 °C	1	2	2.5	3	4
23 °C			3		
30 °C	1.5	3.5	4.5	4.5 - 7	
40 °C	2 - 3	3-5	5-6	6 - 7	7-8

The statements above only apply for the first 3 mm or 24 hours of the adhesive curing. Due to the regressive water vapor diffusion the time, the larger the layer, the longer it will take to cure.

6 SUBSTRATES

The Sika Pretreatment Charts serves as a general guide to the preparation of substrates prior to bonding. It also contains very important and useful information about substrate characteristics. In any case, it is mandatory to evaluate suitable surface preparation procedures by testing on original substrates. The surface characteristics of the substrates strongly affect the build-up of adhesion and the final bond strength.

Therefore, it is essential to ensure that surface characteristics of all bonded components are constant and uniform in terms of chemical composition, manufacturing processes, production aids such as mold release agents or preservatives such as waxes, oils, etc. Paint coatings must be carefully analyzed and identified. The chemical composition of the paint, type of substrate preparation, application parameters, and the presence of softeners and other additives in the paint modifying texture or finish, can affect final adhesion. Be aware that certain substrates such as engineered plastics require special attention.

We recommend making the substrate suppliers aware of these facts to ensure constant surfaces by means of agreements or contracts. Consider QC (quality control) of incoming substrates.

IMPORTANT NOTE

Different colors of the same brand of paint may also display a different adhesion behavior. Special attention must be paid in cases where thermoplastics (such as PMMA, PC, ABS, etc.) need to be bonded. These materials have a tendency toward environmental stress cracking (ESC). Only a few products are proposed as pretreatments, adhesives or sealants for these types of materials. Frozen stresses in thermoplastic substrates play a vital role and need to be considered. Preliminary ESC tests are mandatory.

7 SURFACE PREPARATION TECHNIQUES

IMPORTANT NOTE

Be aware that the flash-off time of primers, activators and other pretreatment agents are longer at lower temperature. Surface preparation typically consists of one or several of the following processes:

7.1 CLEANING

Even though it is often not visible, nearly every substrate contains loose or chemically unbound substances such as dust, rust deposits, oils, grease, etc. which must be removed prior to the bonding/sealing process. Many substrates can be prepared by simply scuffing lightly with an abrasive pad followed by vacuuming, a dry wipe or cleaning with a suitable solvent (non-porous substrates only). The method used must be selected according to the specific nature and composition of the substrate. Non porous substrates (e.g. metal, glass, etc.) that are heavily soiled can be cleaned with Sika cleaning agents (e.g. Sika® Remover-208, Sika® Cleaner P), or other suitable cleaning agents. For applications where activators are required and minor contamination is present, the cleaning step might be skipped. Sika activators have a good cleaning performance too, but leave adhesion promoters on the surface. It is therefore important to respect the correct application method for Sika activators.

IMPORTANT NOTE

Be aware that also Sika cleaning agents can contain alcohol. Never use alcohol containing products to clean areas with freshly applied adhesive. Alcohol will inhibit the curing of the polyurethane adhesives and sealants.

7.2 ACTIVATING (e.g. , Sika® Aktivator Series)

Activators consist mainly of solvents and small quantities of adhesion promoters. They are applied with a clean, lint free linen cloth or with a paper towel. Apply Sika activators sparingly to the cloth or towel and wipe the surface with a straight light stroke. Do not apply pretreatment agents with a rotary movement, like polishing. Turn the cloth to change the wiping surface often in order to not contaminate the surface with the “dirty” cloth. Dispose of used cloths in accordance with local environmental regulations. Unlike paints and primers, Sika activators do not leave a coherent film on the substrate, but a difference in shine of the treated surface can be noticed. Some Sika activators require a wipe off step, e.g the excess on the surface must be wiped off immediately with a clean, dry cloth or paper towel. Method of application of a specific Sika® Aktivator may be found in the corresponding Product Data Sheet.

Treat only the bond face. If Sika activators are accidentally used or splashed on surrounding surfaces, wipe off immediately using a clean, dry cloth or paper towel.

Each surface activator has a minimum and maximum flash-off time prior to the adhesive application. This time must be strictly observed. If the adhesive is applied too quickly, solvents or other substances in the activator are not fully evaporated and might reduce the bonding performance and if the adhesive is applied too late, active groups might not be present anymore and the performance is affected.

IMPORTANT NOTE

Most Sika activators and primers are moisture reactive systems. In order to maintain product quality it is important to reseal the container with the inner plastic liner immediately after use. Once the surface pre-treatment operation is completed the cap must be screwed on. We recommend disposing of the product within two months of opening if not stated differently in the Product Data Sheet. Change in appearance or increase in viscosity indicates loss of functionality for pre-treatment agents. As this is difficult to identify with Sika® Aktivator, it is essential to follow the recommendations mentioned above.

The adhesive or sealant has to be applied within the maximum flash-off time mentioned in the current pretreatment Product Data Sheet. If that time has elapsed the bond face must be reactivated. For further details contact the Sika Technical Department Industry.

7.3 PRIMING

Sika primers are clear or pigmented liquids which are applied on substrates and dry to form a covering film as an ideal surface for adhesion.

Primers are generally applied with a clean, dry brush, a special felt-pad or an open cell elastic melamine foam applicator. A broad selection of applicator systems is also available at www.designetics.com. Certain Sika® primers might be spray-applied. In such cases or for other specific needs, which cannot be met by one of the standard application methods, always contact Sika Technical Department for advice.

Each Sika® Primer has a minimum flash-off time and a maximum flash-off time prior to the adhesive application. This time must be strictly observed. If the adhesive is applied too quickly, solvents in the primer do not fully evaporate and might reduce the performance of the bond.

IMPORTANT NOTE PRE-TREATMENT WITH ACTIVATORS AND PRIMERS

Surfaces which have been treated with activators and/or primers must be protected from recontamination or soiling prior to application of the adhesive or sealant. To avoid cross-contamination, incompatible products such as silicone sealants, paints, solvents (in particular chemicals containing alcohol) and cleaning agents must be kept away from the bonding area.

Primers and activators are not designed to protect against corrosion. Depending on exposure and service conditions, substrates must be protected against corrosion by applying paint coatings specifically formulated for this purpose. One exception applies for small scratches in the Auto Glass Replacement business where this subject is addressed in the corresponding manual.

Primers are only partly capable of protecting the bond line against UV radiation (sun light). If a ceramic screen print is not dense enough Sika® Primer-206 G&P or Sika® Primer-207 can enhance the tightness of the screen print. Nevertheless, black primers are not suitable for transparent substrates (such as float glass, PMMA, PC, etc) if no primary UV protection is installed. For transparent substrates always use a proper UV protection, such as trims or covers. The same rule is valid for translucent substrates where a proper UV protection is required.

7.4 REACTIVATION

The adhesive or sealant has to be applied within the maximum flash-off time mentioned in the current pre-treatment Product Data Sheet. In case the flash-off time of activators or primers is exceeded or the pre-treated surface is contaminated, the pretreated bonding surface has to be reactivated. For further details contact Sika Technical Department Industry.

8 APPLICATION OF ADHESIVE AND JOINING

Sika adhesives and sealants supplied in cartridges and unipacks are applied with a pneumatic-, electric- or manually operated application gun. They may also be dispensed from drums and pails by means of a pump system. To limit air entrapment during the application and to apply the right amount, adhesives are best applied in the form of a triangular bead.

Do not exceed the skin time (skin formation) or the maximum open time mentioned on the Product Data Sheet. Cold temperature and low humidity considerably prolong the skin time. Conversely high temperature and high relative humidity accelerate the reaction resulting in shorter skin time and a significantly reduced open time. Skinning of the adhesive prior to assembly impairs adhesion, therefore never join bonding parts if the adhesive has built a skin! Where skinning has occurred, it is necessary to remove the bead and repeat the adhesive application.

The components are assembled by applying uniform pressure to the joint, either by hand or with the aid of a suitable clamping device, until the adhesive bead has been compressed to the specified thickness. The use of rubber spacers with the same or lower Shore A hardness as the adhesive is recommended. The spacers should either be embedded completely into the adhesive or positioned slightly away from the bead. Half spherical shaped, pressure-sensitive-adhesive-backed spacers are established as best practice. Those spacers are positioned in the bead and should be completely covered with adhesive to prevent any air entrapment and voids. Compatibility between spacers and adhesive must be checked in advance. Do not use “superglue” (cyanoacrylates based adhesives) to secure spacers since these products are not compatible with polyurethanes. The use of superglue would result is an adverse chemical reaction between the polyurethane and cyanoacrylate leading to loss of adhesion.

By using spacers, it can be assured that the minimum layer thickness (approx. 3 mm) is met.

CAUTION

If the adhesive has been compressed below the required thickness, do not pull the bonding parts back to the correct thickness, since this procedure could lead to reduce or lose contact area. Either leave it or take it apart and repeat the bonding procedure. Waiting and curing times must be strictly observed before the bonded assembly is released for further processing. Waiting times are determined by the load on the adhesive joint and the climatic condition.

IMPORTANT NOTE

In applications where the bonding and subsequent sealing of components are carried out in separate stages, it may be necessary to clean the substrate prior to the sealant application. It is vital to ensure that no voids are formed between the adhesive and sealant joints by making sure that the sealant completely fills the joint slot. The joint can also be designed in such a way that condensed humidity can escape from any voids (by using an interrupted bead or ventilation holes).

9 TOOLING / SMOOTHING

Tooling is performed using the most suitable tool for the desired shape, such as spatula, spoon etc. The procedure may be optimized using Sika® Tooling Agent N, Sika®-Slick or another appropriate tooling liquid. For paintability, consult the relevant Product Data Sheet.

IMPORTANT NOTE

Tooling products such as solvents, concentrated detergents or other cleaners may cause tacky surfaces or accelerated aging of the smoothed surface. **Under no circumstances use alcohol or alcohol containing products as a tooling agent** (it prevents the polyurethane from curing). Be aware that pretreatment agents might contain alcohol and are never to be used for cleaning or tooling of joints.

10 CLEAN-UP

Excess of uncured Sikaflex® can be removed with Sika® Remover-208 or mineral spirits in case of non-porous substrates. Alcohol based cleaning agents are not suitable because they permanently prevent Sikaflex® from curing. Cured products can only be removed mechanically. Never use solvents to clean hands. Instead, use Sika® Cleaner-350 H Handclean towels or similar products. Additional information is available in the respective Safety Data Sheet.

11 WASTE DISPOSAL

Disposal of waste materials is often determined by government regulations, which must be strictly complied with. Consult your national Safety Data Sheet for further details. In their fully cured state, Sikaflex® sealants and adhesives might be disposed of as domestic waste. Cleaners, activators and primers are generally classified as semi-hazardous waste requiring special treatment, and they must be disposed of in accordance with local government regulations.

12 QUALITY ASSURANCE

Quality assurance measures play a vital role in adhesive bonding technology. These include the following points:

- Record parameters such as batch numbers, temperature, humidity, date, object and staff names.
- Monitoring the substrate materials for consistency. Make the substrate supplier aware of the importance of the consistency of the surface and consider establishing a supply specification. Repeat adhesion tests on a regular basis (at least every two years) or if changes apply.
- Detailed Working Instructions must be clearly displayed at the workplace. Instructions should be easy to read and preferably based on the use of pictograms (no language problems and the information is easier to understand).
- A responsible person must be appointed to monitor compliance with these instructions. Regular audits must be carried out and recorded in writing.
- Periodic training for staff (internal and external). It is important to ensure that all adhesive bonding operations are carried out by trained staff only.
- It is recommended to check bonded parts on a regular basis to ensure the bonded parts meet your specification and expectations.

13 ADHESION TEST

Apply a triangular bead of approx. 10 cm on an original substrate which has been prepared in accordance with the corresponding Sika Pre-treatment Chart or Working Instructions (see Pic. 1). Use release paper, wax paper or polyethylene foil to press down the bead to approximately half of the bead height (see Pic. 2 and 3). Allow the bead to cure for 7 days at room temperature (23 °C / 50 % relative humidity) prior to evaluating the adhesion.

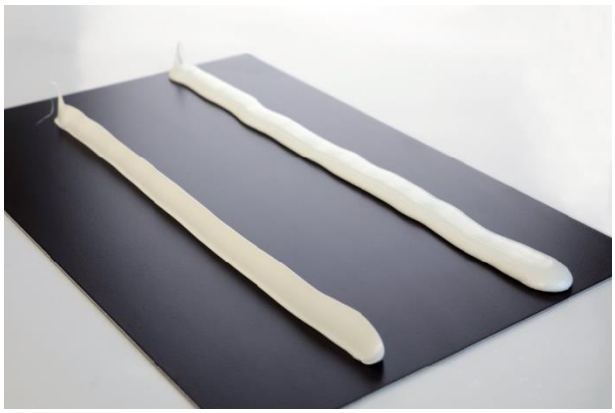
Secure the part to be tested to a table using suitable clamps. Then, using a sharp razor knife, separate the first 3 cm of the leading edge of the bead from the substrate (see Pic. 4). Grip the separated part of the bead with a pair of needle nose pliers and slowly turn the bead (applying peel stress) in order to separate it from the substrate. Cut the adhesive frequently on the bottom down to the substrate as shown in pictures 5.

There are three distinct types of failure.

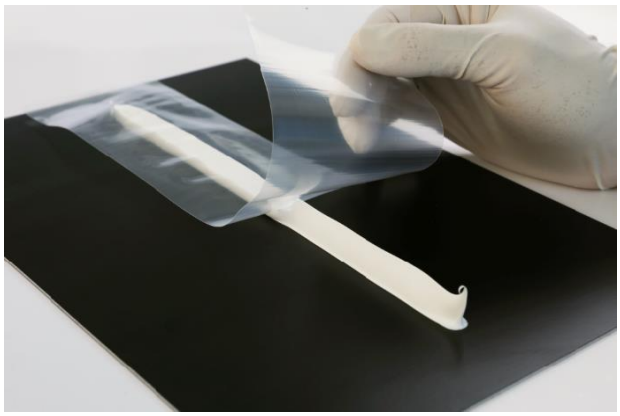
- Adhesion failure occurs when the Sikaflex® pulls cleanly off the substrate
- Substrate failure occurs when the substrate itself tears
- Cohesive failure, which is optimum, occurs when the Sikaflex® itself tears

A combination of failure modes is also possible.

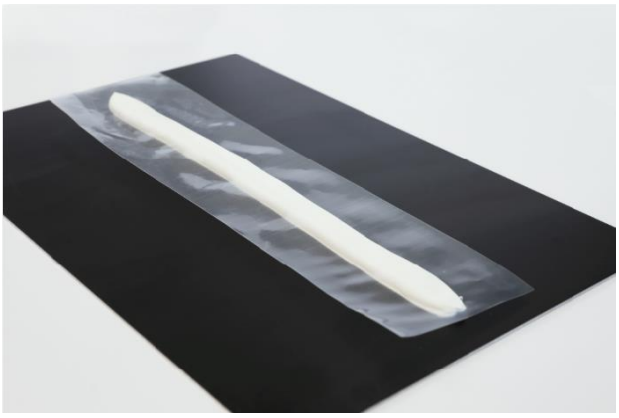
95 % or greater cohesive failure is considered excellent adhesion (see Pic 5 on page 11). A cohesive failure of 75 % is considered to be acceptable in many cases.



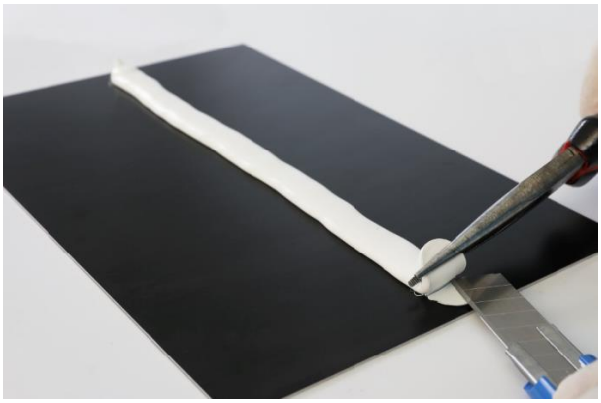
Pic 1: Applied beads (triangular and round shaped)



Pic 2: Apply release paper or PE foil



Pic 3: Press bead down to half height



Pic 4: After full curing separate first 3 cm of the bead

Pic 5: Turning the bead to get maximum tension and cut

IMPORTANT NOTE

This procedure may not sufficient to predict or ensure good adhesion during the entire service life. Contact Sika's Technical Department for further information.

14 TRANSPORT AND STORAGE CONDITIONS

The ideal transport and storage temperature for 1-component Sikaflex® is ≤ 25 °C. The products have to be protected from precipitation and direct sun light. For regular transport of the goods, this temperature condition cannot always be respected. Usual conditions which occur during regular transport methods such as shipping containers, airfreight or truck deliveries have been considered in the shelf life stated in the corresponding Product Data Sheet. For products at the production line, where during summer time the ideal application temperature cannot be maintained, Sikaflex® products can be used for up to 3 weeks if the ambient temperature does not exceed 35 °C. Exposing the product to higher temperatures for a long period of time will result in a faster aging of the products. This aging effect is usually only seen towards the end of the shelf life: certain application properties might change, such as more difficulty to gun or extrude, glossiness, longer cut off string, worse non-sag property, etc. but the final cured properties of the product would not be influenced. In case of a strong viscosity increase, the wetting properties could be compromised, thereby potentially having a negative influence on the adhesion behavior.

Storage at lower temperatures does not negatively influence the properties or the rate of aging of the products. If the products are exposed to very low temperatures it has to be ensured that the material is stored long enough in a warm environment to achieve the specified application temperature prior the application. Consider that the time for storage at “normal temperature” depends on the storage conditions, e.g. the lower the storage temperature, the longer the time required to achieve the material application temperature. Packaging is another factor which has to be considered, since it takes more time to get the material in a drum back to application temperature than in a pail or in a cartridge.

IMPORTANT NOTE

These guidelines for transportation are only valid for 1-component polyurethane Sikaflex® adhesives and sealants as well as for Sikaflex® STP systems (Sikaflex®-500 series). For auxiliary products such as SikaBooster® or Pre-treatment agents refer to the actual Safety Data Sheet.

15 LEGAL DISCLAIMER

The information, and, in particular, the recommendations relating to the application and end-use of Sika products, are given in good faith based on Sika's current knowledge and experience of the products when properly stored, handled and applied under normal conditions in accordance with Sika’s recommendations. In practice, the differences in materials, substrates and actual site conditions are such that no warranty in respect of merchantability or of fitness for a particular purpose, nor any liability arising out of any legal relationship whatsoever, can be inferred either from this information, or from any written recommendations, or from any other advice offered. The user of the product must test the products suitability for the intended application and purpose. Sika reserves the right to change the properties of its products. The proprietary rights of third parties must be observed. All orders are accepted subject to our current terms of sale and delivery. Users must always refer to the most recent issue of the local Product Data Sheet for the product concerned, copies of which will be supplied on request.

FOR MORE INFORMATION CONTACT YOUR LOCAL SIKA TECHNICAL DEPARTMENT INDUSTRY.