

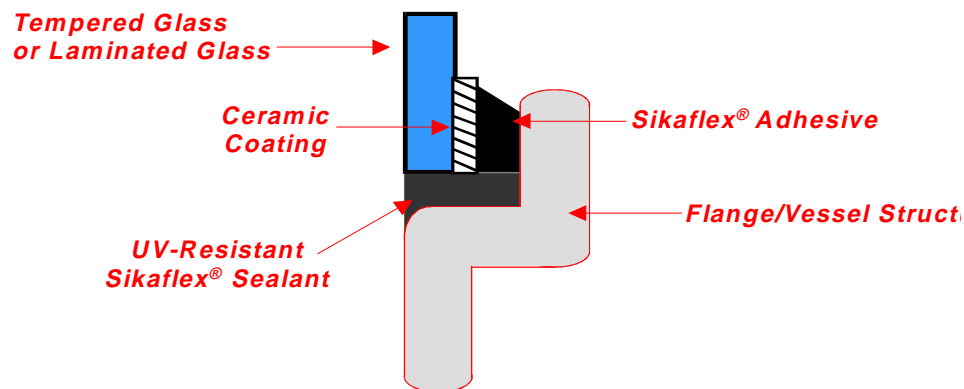
Marine Window Bonding using Sikaflex[®]

A Water Tight Concept

The bonded window goes beyond the conventional function of a window, providing protection from rain and wind. It not only provides better protection against the weathering elements than the framed window, but it also significantly improves the design of the vessel. Every car manufacturer bonds the windshield, because of the numerous benefits it provides to the overall design of the vehicle. Bonding windows in the automotive industry is referred to as “direct glazing” and worldwide, **Sikaflex[®]** has been the brand of choice for direct glazing of automobiles for many years. The use of **Sikaflex[®]** is now making its way into direct glazing applications of marine vessels all over the world.

What is Window Bonding?

The system is a thermally tempered glass or laminated glass bonded to the structure of the vessel using **Sikaflex[®]** adhesive. **Sikaflex[®]** is a moisture curing polyurethane designed for various bonding and sealing applications. **Sikaflex[®] adhesives** are high-strength elastic adhesives designed to absorb the dynamic stress and thermal movements that are incurred on the marine window.



The indentation where the glass is bonded is referred to as the **flange**. The flange surface can be fiberglass, aluminum, or steel. The glass is coated with a black ceramic border fused to the glass. The **ceramic coating** is of a high-density formulation specifically manufactured to protect the urethane adhesive from damaging UV radiation and to provide the ideal bonding surface. You can look at any late model car where you’ll notice a similar border. **Sikaflex[®] sealants** that exhibit good resistance to UV light and outside weathering are used in the open joints.

All-round Benefits

The benefits of bonding Marine Windows are the following:

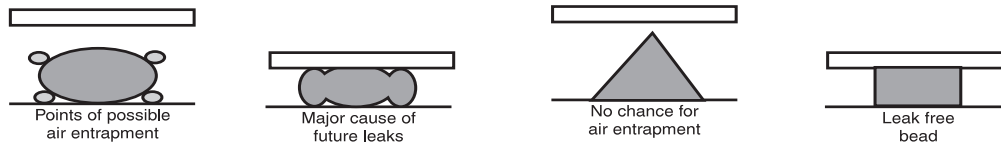
- **Increased torsional stiffness.**
Studies and tests carried out on direct-glazed vessels show that the glass areas effectively function as stress panels within the overall structure. In this way, they contribute significantly to the structural rigidity of the vessel, allowing designers to enlarge the window area. Passenger comfort is therefore increased from providing a better view of the sea. Useful savings in materials and weight can also be achieved, resulting in a greater speed potential of the vessel.

- Improved ride comfort.**
Direct glazing has a positive impact on ride comfort for the passengers. Elastic adhesives reduce the natural or inherent frequencies, and hence the vibrations, in commercial vessel body shells. Similarly, the use of elastic-bonded side windows in marine vessels produces a dramatic reduction in vibration and noise.
- More styling freedom.**
Direct-glazed vessels open up all kinds of new styling possibilities for the designer. The use of elastic adhesives makes it possible to integrate dramatically curved areas of glass into the overall body shape. Curved glass, especially tight radius corner windows do not require custom frames that can be difficult and very expensive to manufacture. Direct-glazed vessels create a modern sculpted look that is also aerodynamically efficient. The elimination of the trim ring and screws result in a sleek appearance inside and out.
- Increased Gap Tolerances**
Direct glazing allows for larger gap tolerances, because Sikaflex® is able to accommodate for small variations of the design. The burden of having a precise design connection is significantly reduced.
- Eliminates Leakage**
Single step bonding eliminates any chance of leaking that can occur when using the conventional framed units.

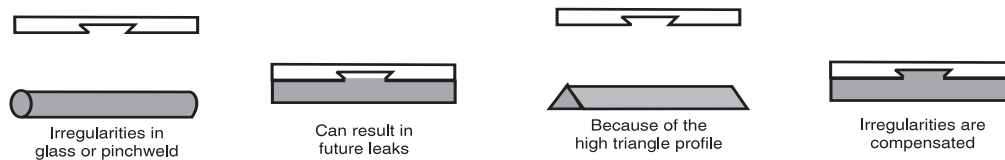
Triangular Bead --> A Leak-Proof System

Sika recommends Sikaflex® be applied using a triangular bead whenever possible. A round bead can trap air, causing future leaks. A triangular bead minimizes this risk and facilitates in a precise glass fitting.

Side Views



Front Views

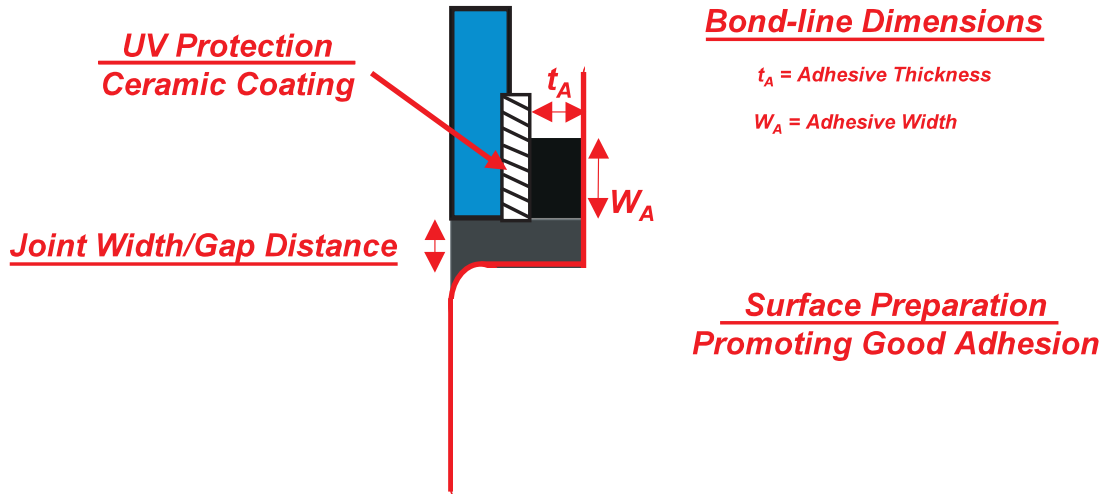


- Reduced Installation Time**
Those who have implemented window bonding into their vessel design have reported a significant reduction of the installation time.

Sika Corporation
30800 Stephenson Hwy.
Madison Heights, MI 48071
(248) 577-0020
Fax (248) 577-0810

Marine Window Bonding using Sikaflex® Design Directives

Implementing direct-glazed windows into a vessel structure is a very simple process, with only a few essential directives to abide by. These design directives are in compliance with the *Rules for High Speed Light Craft, Pt. 0, Ch. 1, Sec. G300 Glued Windows*. Marine classification services, such as DNV, have used the *Rules for High Speed Light Craft, Pt. 0, Ch. 1, Sec. G300 Glued Windows* for their approval process.



- 1.0 Joint Width/ Gap Distance
- 2.0 Bond-line Dimensions
- 3.0 UV Protection - Ceramic Coating
- 4.0 Surface Preparation – Promoting Good Adhesion
- 5.0 Corrosion Resistance
- 6.0 Marine Window Bonding - Project Sheet

1.0 Joint Width/ Gap Distance

The joint width/gap distance between the flange and the window should be large enough to accommodate the mechanical movement and thermal movement of the windscreen.

The ideal joint width/ gap distance is:

<u>Ideal Joint Width/ Gap Distance</u>	→	<u>Largest Dimension of Windscreen</u>
3/8 - 5/8" (10 - 15 mm)	→	0 - 5 ft (0 - 1.5 meter)
5/8 - 3/4" (15 - 20 mm)	→	5 - 10 ft (1.5 - 3 meter)

2.0 Bond-line Dimensions

It is important to make certain the correct bond-line dimensions are used for each window design. The **width** and **thickness** of each adhesive bead needs to account for:

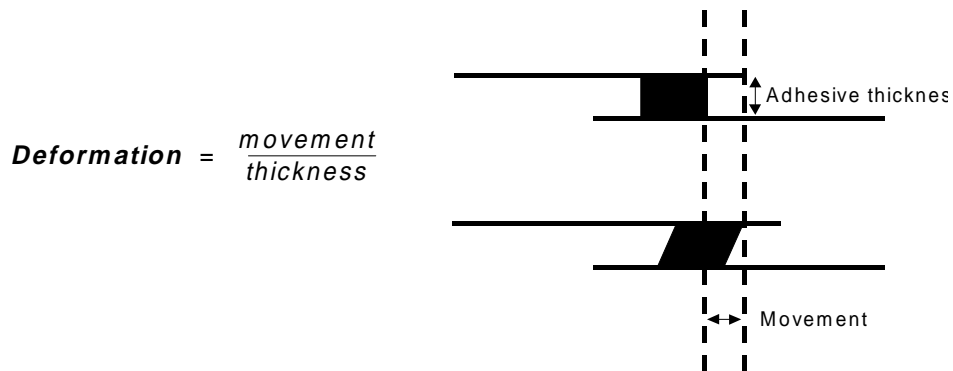
- the weight of the windscreen
- mechanical movement caused from operation of the vessel
- thermal expansion difference of the glass pane and flange
- the head pressure and wind suction load that is incurred on a marine window

The adhesive absorbs the stress from thermal, mechanical, dynamic, and high-impact movements that are incurred on marine vessels, thus relieving the structure from these stresses. The stress is uniformly distributed over the entire bonding surface, which therefore contributes to the structural rigidity of the design.

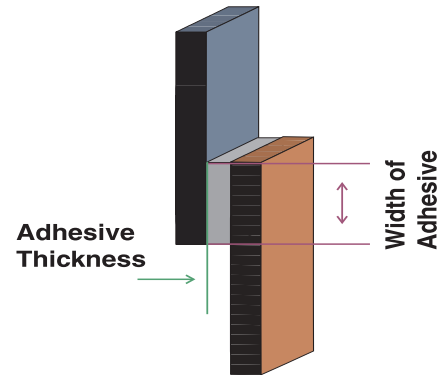
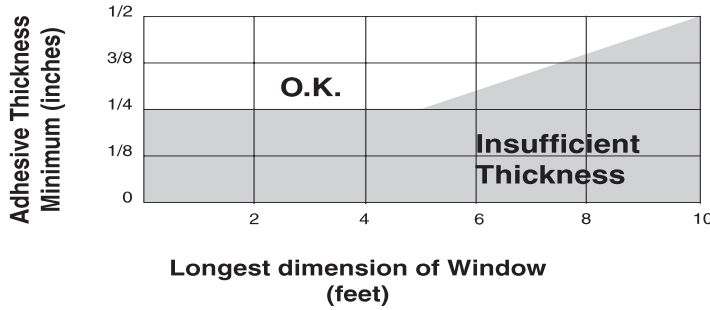
2.1 Adhesive Thickness

The adhesive thickness needs to be specified in order to minimize the deformation of the bond-line.

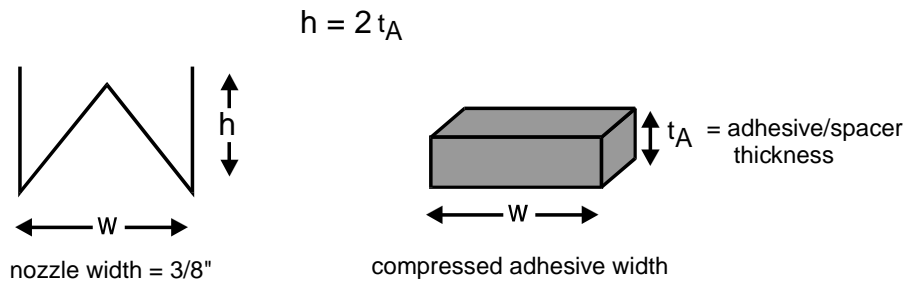
The deformation of the bead is decreased as the thickness is increased. The larger windscreens result in more



movement of the bond-line. Therefore, the larger windscreens require a greater adhesive bead thickness. Below is the minimum adhesive thickness required for each window dimension.



Nozzles and spacers with specified dimensions must be provided for the installers to ensure the correct bond-



line dimensions are maintained. The height of the triangular bead applied must be twice the size of the adhesive thickness required to ensure full contact of the bonding area.

2.2 Adhesive Width

The *Rules for High Speed Light Craft, Pt. 0, Ch. 1, Sec. G 300 Glued Windows* specifies the compressed adhesive width must be the following:

$$\begin{aligned} \text{Compressed Adhesive Width} &\leq 2 \times \text{adhesive thickness} \\ \text{or} \\ \text{Adhesive thickness} &\geq \frac{\text{Compressed Adhesive Width}}{2} \end{aligned}$$

If the nozzle height is made twice the size of the recommended adhesive thickness, as specified, it should be relatively easy to attain a compressed adhesive width that is in compliance with the *Rules for High Speed Light Craft, Pt. 0, Ch. 1, Sec. G 300 Glued Windows*.

3.0 UV Protection - Ceramic Coating

Polyurethane sealants and adhesives are extremely resistant to the effects of weathering and to the cleaning solutions and methods used in the marine industry. However, when bonding transparent materials, the glass/adhesive interface must be shielded against exposure to UV light, since UV light impinging on the boundary layer can destroy the molecular layer responsible for adhesion within a comparatively short time.

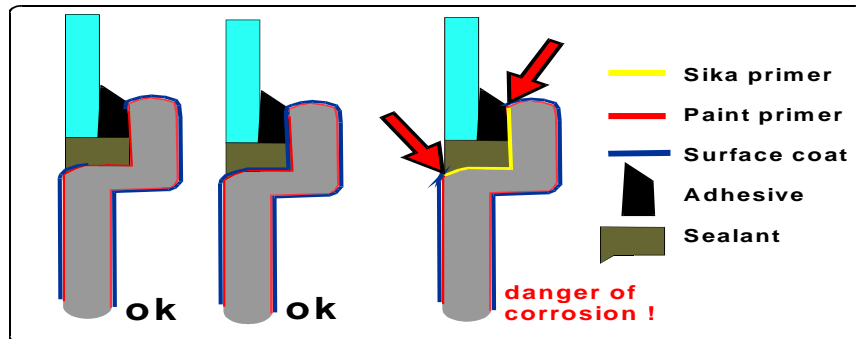
Therefore, it is recommended to have a ceramic coating on the perimeter of the glass protecting the bond-line. Sika® must approve the ceramic coating for sufficient UV blockage. The visible light transmission of the coating must be less than 0.0001% (Gretag D200 380-630 nm) for use on commercial vessels that require approval from a marine classification such as DNV. Consult your Sika® Representative for a recommended glass supplier.

4.0 Surface Preparation à Promoting Good Adhesion

Preparing the bonding surface area correctly is the most important design directive. Adhesion of Sikaflex® to the ceramic coated glass and the flange must be verified. Sika® only recommends bonding and sealing with a surface treatment that has been verified through testing by Sika®'s Technical Service Department. Refer to Sika®'s Surface Preparation Guidelines for the Sika® Cleaners, Adhesion Promoters, and Primers available and how they are applied.

5.0 Corrosion Resistance

Sikaflex® products contain no active anti-corrosion additives. Their corrosion-inhibiting effect depends on the exclusion of water and oxygen, both of which must be present for oxidation of the metal to take place. The protective effect can be enhanced by the use of Sika® Primers. Long – term protection, particularly against rusting beneath the paint finish, is normally attainable only by applying a good quality anti-corrosion paint/ primer system. In such cases it is important to use a paint system that is compatible with Sikaflex®, and whose effectiveness as an anti-corrosion system is specifically warranted by the manufacturer. The window surroundings should be given the same full paint treatment as the rest of the vessel body, in order to provide sufficient corrosion protection.



Sika Corporation
 30800 Stephenson Hwy.
 Madison Heights, MI 48071
 (248) 577-0020
 Fax (248) 577-0810

Marine Window Bonding using Sikaflex® An Installation Guide

- 1.0 Preparation
- 2.0 Positioning the Window
- 3.0 Installing the Window
- 4.0 Sealing the Window

1.0 Preparation

1.1 Products

	<u>Ceramic Coated Glass</u>	<u>Flange</u>
Sika®-Aktivator:	Sika®-Aktivator	Sika®-Aktivator
Sika® Primer:		
Sikaflex® Adhesive:		
Sikaflex® UV Resistant Sealant:		

1.2 Equipment/ Supplies

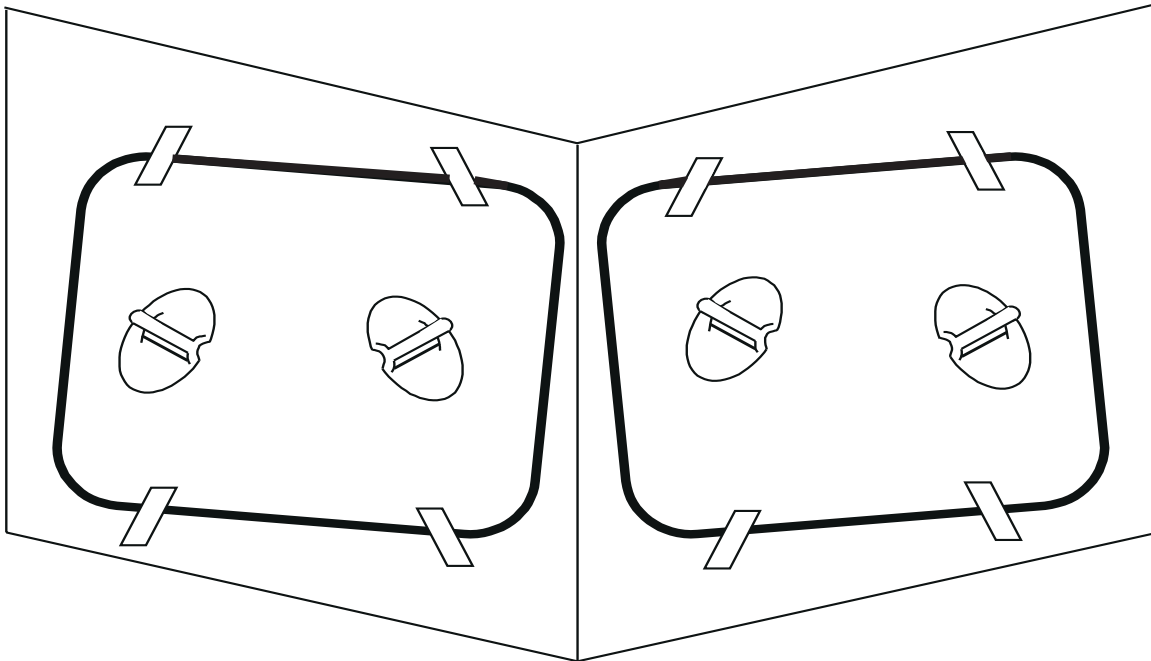
<i>Cleaning/Application</i>		<i>Tools</i>	
Scrubs-in-a-Bucket, mineral spirits, MEK, or acetone for cleaning uncured adhesive.		Fixing aids for assembled glass (clamps, suction cups, wooden blocks) to prevent movement of glass while adhesive is curing.	
Lint-free paper towels or cotton cloth.		Spacers and support blocks.	
Non-absorbent, tear resistant, smooth edge masking tape.		Manual, battery or pneumatic gun.	
Plastic blade for tooling off adhesive.		Screwdriver to open cartridges.	
Dauber or brush for applying primer.		Sharp knife to trim nozzles.	

1.3 Work environment

Make certain the work environment is cordoned off and vacuum cleaned. It must be free from dust, metal shims, wood shavings, silicone, or other foreign materials that would inhibit adhesion.

2.0 Positioning the Window

- 2.1 Place spacers on the flange. Spacers should be used to ensure the installer maintains the correct bond-line thickness. A spacer that remains in the adhesive bond must be of the same hardness (Shore A 40-70), as the adhesive. Rubber spacers, coated with pressure sensitive adhesive on one side are commercially available. Foam tape with adhesive on one side only may also be used to maintain proper adhesive thickness as well as to prevent excessive adhesive flow into the window opening as the glass is pressed against the structure. Never use cyan-acrylic adhesives to fix the spacers. Volatiles from this type of adhesive can contaminate the adhesion surface and interfere with adhesion build-up.
- 2.2 Offer the glass to the opening and hold in correct position. Place wooden support blocks (of the correct dimensions) under the edge of the glass to help align the window correctly.
- 2.3 Place strips of masking tape across flange and windscreen. Then cut through masking tape along the edge of the glass. The masking tape is then used for final alignment once the adhesive has been applied.



3.0 Installing the Window

- 3.1 Make a final check to ensure you have all the required materials and equipment. Once the bonding surface is prepared, the adhesive should be applied within the next 2-3 hours. This is to avoid having the bonding surface contaminated with dust or debris.

Sikaflex®-296

Marine Window Adhesive

How to use:

Always refer to the Sika Window Bonding Guide for complete instructions and guidelines.

Surface preparation for glass and ceramic-coated glass:

- If the bonding surface is contaminated with oils or other organic substances, initial cleaning using solvents or high-pressure water cleaning with detergents is necessary.
- Soak a lint-free paper towel with Sika-Aktivator. Wipe the glass and immediately wipe off to provide a very thin layer. Change and turn the towel often to avoid transferring dirt, oil, etc. from one area to another.
- Allow a 10 minute drying time. Install the window within 2 hours.
- Prepare the bonding surface that the glass is bonding to using the cleaner, primer and procedure **recommended for that substrate**.

Adhesive Application:

- Insert uni-pac into gun. Open uni-pac by cutting off clip as close to the bottom of clip as possible. Thread endcap onto gun barrel.
- Apply a triangular bead onto the glass. Install glass and align in correct position. Glass must be installed within 10 minutes of adhesive application.
- Use a plastic tool to remove excess

adhesive. Clean up using mineral spirits, SCRUBS™-IN-A-BUCKET, acetone or MEK.

- Allow a 4 hour cure time before subjecting the unit to rigorous movement.

Limitations:

- Do not apply on frozen surfaces or through standing water or under water.
- Do not apply over silicones or in the presence of curing silicones.
- Alcohol inhibits the cure of Sikaflex® or any other polyurethane based material. Do not allow Sikaflex® to contact alcohol and alcohol-containing solvents during cure.
- Allow a minimum of 1 week full cure prior to total water immersion situations.
- Maximum chlorine exposure 2.5 ppm.
- Do not use as a deck seam sealant.
- Do not use to bond organic glass (i.e. polycarbonate and acrylic).

Important Considerations:

- Always protect the bond-line from sunlight. The perimeter of the glass where bonded should have a ceramic coating or an exterior opaque trim. Refer to the Window Bonding Guide for further information.
- When applying sealant, avoid air entrapment.
- Protect from action of water during cure period.

CAUTION:

Irritant; Sensitizer: Contains polyisocyanate prepolymer. May cause skin/eye/respiratory irritation. May cause skin and/or respiratory sensitization after prolonged or repeated contact. Avoid contact. Use of safety goggles and chemical resistant gloves is recommended. In case of exceedance of PELs, use an appropriate, properly fitted NIOSH approved respirator. Remove contaminated clothing.

First Aid:

In case of skin contact, wash immediately and thoroughly with soap and water. If symptoms persist, consult physician. For eye contact, flush immediately with plenty of water for at least 15 minutes, contact a physician. For respiratory problems, remove person to fresh air; if symptoms persist, contact a physician. In case of ingestion, dilute with water and consult physician. Remove contaminated clothing.

Clean Up:

Uncured sealant may be removed with solvent. Cured sealant is only removed mechanically. In case of spills or leaks, wear suitable protective equipment, remove physically and transfer to suitable container. Ventilate area. Avoid contact. Dispose of in accordance with current, applicable local, state, and federal regulations.

IN CASE OF EMERGENCY CALL CHEMTREC, 1-800-424-9300

Consult Material Safety Data Sheets and Surface Preparation Guidelines available through SikaFax: 740-375-0063

Visit our website at <http://www.sikausa.com>

Sika® and Sikaflex® are registered trademarks of Sika AG. © Sika Corporation. October, 1999. All Rights Reserved.

Rev.10/21/99

KEEP OUT OF REACH OF CHILDREN

NOT FOR INTERNAL CONSUMPTION

CONSULT MATERIAL SAFETY DATA SHEET FOR MORE INFORMATION

KEEP CONTAINER TIGHTLY CLOSED

FOR INDUSTRIAL USE ONLY

Sika warrants its products to be free of manufacturing defects and that they will meet Sika's current published properties when applied in accordance with Sika's directions and tested in accordance with ASTM and Sika standards. **USER DETERMINES SUITABILITY OF PRODUCT FOR USE AND ASSUMES ALL RISK. MANUFACTURER'S LIABILITY FOR DAMAGES SHALL BE LIMITED TO THE PURCHASE PRICE OR REPLACEMENT OF PRODUCT. THIS REMEDY IS THE EXCLUSIVE REMEDY AND EXCLUDES LABOR AND COST OF LABOR. THERE ARE NO OTHER WARRANTIES BY SIKA OF ANY NATURE WHATSOEVER, EXPRESSED OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE IN CONNECTION WITH THIS PRODUCT. SIKA CORPORATION SHALL NOT BE LIABLE FOR DAMAGES OF ANY SORT, INCLUDING REMOVAL OR CONSEQUENTIAL DAMAGES, RESULTING FROM ANY CLAIMED BREACH OF ANY WARRANTY, WHETHER EXPRESSED OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR FROM ANY OTHER CAUSE WHATSOEVER. SIKA SHALL ALSO NOT BE RESPONSIBLE FOR USE OF THIS PRODUCT IN A MANNER TO INFRINGE ON ANY PATENT HELD BY OTHERS.**



Sika Corporation
30800 Stephenson Highway
Madison Heights, MI 48071
(248) 577-0020
Fax (248) 577-0810

I N D U S T R Y