



METHOD STATEMENT

SikaWrap® Manual Dry Application

03.01.2023 / VERSION 2.3 / SIKA® LIMITED / ROB DOHERTY

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1 SCOPE

This Method Statement is written as a guideline for the use of the SikaWrap® Composite System. This document must be used and referred to, in combination with all other relevant Product Data Sheets (PDS), Material Safety Data Sheets (MSDS) and the specific Project Specifications.

Structural strengthening must only be carried out by trained and experienced specialists, if additional clarification or advice is needed, please do not hesitate to contact your local Sika® Technical Services Department who will be pleased to assist you.

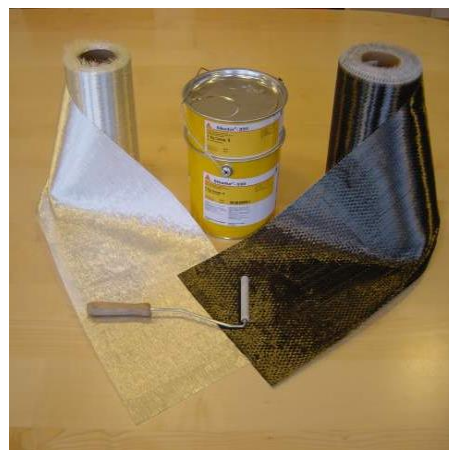
This document only describes the dry application process. For manual wet application or wet application using a saturator, please refer to their respective Method Statements.

2 SYSTEM DESCRIPTION

The SikaWrap® Composite System is a high-performance Strengthening System comprising FRP fabrics and impregnation resins. They are applied on the strengthening site and formed into a fibre composite. The picture below shows glass- (left) and carbon- (right) fibre fabrics, with the two-part epoxy-based impregnation resin in the middle.

The main range of applications is as follows:

- Increasing the load bearing capacity of structural elements
- Shear strengthening
- Flexural strengthening
- Masonry strengthening
- Column strengthening (for Confinement and / or Ductility)
- Changes of building use
- Structural upgrading to comply with current standards
- Improved functionality
- General seismic upgrading and / or retrofitting
- Prevention of damage by seismic action
- Improved seismic performance for masonry walls
- Blast mitigation (accident or terrorism)
- Impact protection
- Structural design construction defects
- To replace and substitute missing rebars



2.1 REFERENCES

This method statement has been written in accordance with the recommendations contained in **fib Technical Report Bulletin No. 14**, especially Chapter 8: “Practical execution and quality control” and also considers the advice contained in **ACI 440.2R-17** and Chapter 10 of **TR55 – Design Guidance for Strengthening Concrete Structures Using Fibre Reinforced Composite Materials**.

Pull-off tests shall be performed according to **BS EN 1542**, and considering the values mentioned in the text below.

2.2 LIMITATIONS

- The products must only be used in accordance with their intended applications. The System configuration as described in the Product Data Sheets must be fully complied with and may not be changed.
- The SikaWrap® Systems may only be used by experienced professionals. All strengthening works must be carried out as directed by a suitably qualified Structural Engineer as the Supervising Officer.
- For any other specific construction / build information please refer to the relevant Engineer’s specifications, details, drawings, and risk assessments.
- Local differences in product may result in performance variations. The most recent and relevant local Product Data Sheets (PDS) and Material Safety Data Sheets (MSDS) apply.

- Always record the batch numbers for the SikaWrap® Fabrics and Sikadur® resins that are used each day. Additionally at the end of each working day, also check to make sure that the fabric application is uniform and smooth.
- Large mixing quantities of the Sikadur® resins and / or high temperatures result in shortening of the pot-life. In order to prolong the pot-life, reduce the quantity of the mixing components and/or the material's temperature (i.e. store the sealed units in cool conditions until immediately prior to mixing and application).
- For application in cold or hot conditions, pre-condition the resin materials for at least 24 hours in temperature-controlled storage facilities to improve the on-site mixing, application and pot-life limitations.
- Special attention should be paid to the ambient environment and conditions. Observe the minimum / maximum temperatures for substrate, atmosphere and the materials, as well as taking care to avoid application in dew point conditions (Application temperature must be at least +3 °C above the dew point).
- The substrate moisture content must be less than 4% (percentage by weight). All of the concrete surfaces to be treated must be dry and free of surface water or ice.

3 PRODUCTS

3.1 SYSTEM COMPONENTS

Fabrics:

The Table below gives an overview of the different fabric types, weights and widths available in the UK:

Sika® Brand	Description	Area Weight [g/m ²]	Available Widths [mm]
SikaWrap®-231 C	Unidirectional woven carbon fibre fabrics.	230	600
SikaWrap®-301 C		300	600

The fabric rolls are wrapped in PE sheets and packed in cardboard boxes. The standard roll length is 50 m.

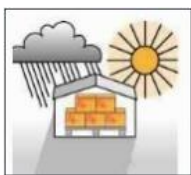
Impregnation Resin:

Sika® Brand	Description
Sikadur®-330	Sikadur®-330 is a two-part, thixotropic, mid-viscous, filled epoxy-based primer / impregnation resin / adhesive with standard pot-life and curing speed. It is designed to be used for SikaWrap® Fabric installation by the dry application method.

Additional Products:

Sikadur®-300	Epoxy-based primer and impregnation resin.
Sikadur®-30	Epoxy-based structural adhesive paste.
Sikadur®-41 CF Normal / Rapid	Epoxy-based mortar.
Sikadur®-52 Injection Normal	Epoxy-based injection resin.

3.2 MATERIALS STORAGE



Materials must be stored properly in undamaged, original sealed packaging, in dry and cool conditions at temperatures between +5°C and +25°C (Resins), or between +5°C and +35°C (Fabrics). Protect all of the products from direct sunlight. Please refer to the specific information contained in the respective Product Data Sheets regarding the minimum and maximum storage

temperatures and times. All of the Sikadur® epoxy resin-based products can be stored for up to 24 months from the date of production.

4 EQUIPMENT

4.1 TOOLS



Concrete
Grinder



Vacuum Cleaner



Brush



Application Trowels



Notched Spatula /
Trowel



Sika® Plastic
Impregnation
Roller



Mixing
Container



Mixing Spindle



Mixing Paddle



Hand-Held Mixer

4.2 CLEANING

Clean all tools and application equipment with Sika® Thinner C (or an Isopropanol based cleaner) immediately after use. Any uncured epoxy should be wiped up with a rag wetted with solvent. Hardened material can only be removed mechanically.

5 HEALTH AND SAFETY

5.1 RISK ASSESSMENT



The risks to health and safety from everything including any defects in the structure, working procedures and all of the chemicals used during the materials' installation must be properly assessed and safely accommodated.

Any working areas on platforms and temporary structures must also provide a stable and safe area to work. All work and working procedures must be carried out fully in accordance with the relevant local health and safety legislation.

5.2 PERSONAL PROTECTION

Work Safely!

Safety boots, gloves and other appropriate skin protection should be worn at all times. The use of disposable or new / clean protective clothing during the materials' preparation and application is strongly recommended.

Always wear nitrile based protective gloves when handling epoxy adhesives / impregnating resins, as they can otherwise cause skin irritation. Additionally apply barrier cream to hands and any unprotected areas of skin before starting work.

Appropriate eye protection should be worn at all times whilst handling, mixing and installing the products. Carrying an eye wash with you at all times is recommended.

Always wash hands with suitable soap and clean water after handling the products and before food consumption, smoking, visiting the toilet and after finishing work.

The work area needs to be well ventilated, and operatives should take frequent breaks in fresh air to avoid any other health issues.

Silica dust produced by the grinding or blast cleaning of concrete can be hazardous. Protect yourself and others by using a vacuum grinder or vacuum blast cleaning equipment with dust extraction and abrasive recycling attachments respectively. Always wear a dust mask / respirator when grinding concrete. Do not inhale the concrete dust.



5.3 FIRST AID

If the epoxy resin-based adhesive products come into contact with eyes or mucous membranes, remove any glasses or contact lenses and rinse with clean warm water for 10 to 15 minutes then seek medical attention. Any chemical spillages on skin must be cleaned immediately and rinsed thoroughly with clean warm water.



5.4 WASTE DISPOSAL



Do not empty any surplus material into drainage or water systems; dispose of all waste materials and packaging responsibly through licensed waste disposal facilities or contractors, fully in accordance with local legislation and the relevant authorities' requirements. Also avoid any chemical materials run-off into soil or into waterways, drains or sewers.

Any uncured adhesive waste, spillages and / or leftover Sika® Thinner C must be disposed of as hazardous waste and according to local regulations. Cured adhesive waste can be disposed of safely as normal building materials waste according to local regulations.

For more detailed health and safety information, please refer to the relevant Material Safety Data Sheet (MSDS)

6 PREPARATION

6.1 PRE-PROJECT

Review the project specifications in detail. Inspect the site conditions and the concrete surfaces to receive the treatment and report immediately in writing to the responsible Engineer if anything is unsuitable for proper execution of the works.

Obtain all of the necessary tools and equipment, plus materials required (for a checklist example, see Section 9.2), together with any special project requirements. It is recommended that the SikaWrap® Fabrics to be applied are cut into their prescribed lengths with sharp scissors in advance of the mixing of the Sikadur® resin. Caution should be taken when handling the fabrics to ensure that the fibres are not bent or broken. **Do not fold the fabrics.**

Protect any adjacent surfaces, vehicles etc., surrounding the work area from any dust or damage due to the preparation and execution of the strengthening works.

6.2 SUBSTRATE

The SikaWrap® Strengthening System can be used on concrete, masonry and wooden structures. Where none of these are specifically mentioned below, the statements refer to concrete.

Before preparing the substrate for the application, it must be thoroughly inspected and any unsound material (such as any areas of damaged concrete, pieces of formwork or tie-wires etc.) must be removed.

Where concrete repairs are necessary on a structure prior to the application of a SikaWrap® Strengthening System, it is important that the repair materials are designed and installed to be fully compatible with the Sikadur® adhesive and suitable for use in a structural situation (i.e., they must have low shrinkage, compatible modulus of elasticity, good interface bond, adequate strength and an appropriate finished surface).

Repairs to concrete surface irregularities such as blowholes or voids must be made with a suitable repair mortar such as Sikadur®-41, or Sikadur®-31+. Sikadur®-30 adhesive must also be used as a bonding bridge layer for both of these surface repair options, to ensure a good bond with the substrate and no voids in the repairs. Any non-moving structural cracks can be filled by injection with Sikadur®-52 Injection Normal or other suitable Sikadur® injection resin with the Structural Engineer's agreement.

Further advice on all aspects of concrete repairs can be obtained from your local Sika® Technical Services Department.

The actual strength of the concrete substrate must be verified on all projects by pull-off testing (see Section 8.1). If the concrete has to be repaired, then further pull-off tests must be performed after the repairs are completed and adequately cured. Please refer to Section 8 of this Method Statement for more details of testing procedures and the necessary concrete strengths.

Concrete must normally be older than 28 days (dependent on the environmental situation, the mix design and effective strength requirements).



The concrete, stone and masonry substrates must be prepared mechanically using abrasive blast cleaning or grinding equipment. During this preparation work, an integrated vacuum system (see picture on the left) should be used, in order to reduce the risk of contamination, plus a dust mask should be worn to prevent the inhalation of concrete dust.



The mechanical preparation is carried out to remove cement laitance, any loose and friable materials and achieve a profiled, open textured surface. Any surface defects such as honeycombing, blowholes and voids must be fully exposed.

Timber substrates must be planed or sanded to remove all dust and any loose or friable materials completely from all surfaces.



All prepared surfaces must be brushed, air blasted and vacuumed to achieve a dust free condition (see pictures). No loose particles should be left on any of the substrate surfaces.

External corners and arrises must be rounded to a **minimum radius of 20 mm**, or as required by the Engineer's specification. This can be achieved either by grinding, or by building up with Sikadur® mortars. Internal corners must be made smooth by trowel application of Sikadur® epoxy mortar into the prepared corners.

The surfaces to be strengthened must be levelled to ensure that the specified tolerances are achieved and maintained as detailed in the Table below. The plane and level of the substrate is to be checked with a suitable straight edge. The tolerance required depends on the specified standards to be achieved. The recommended Sika® values are given in the right-hand column of the Table below; however, these tolerances, their method of measurement and testing can be varied on different projects and structures according to any local guidelines and requirements. Obviously, any testing must only be carried out in relation to one standard or another.

Standard	fib Bulletin No. 14	Sika® Recommendation
Tolerance for 2 m length	10 mm	-
Tolerance for 0.3 m length	4 mm	2 mm
Maximum formwork marks	-	0.5 mm



The final surface must be smooth, dry and free of damaged concrete and any other contaminants as dust, foreign particles, cement laitance, oil, grease, surface coatings, curing compounds, waxes and impregnations etc., which could adversely affect or inhibit the bond of the Strengthening System to the concrete.

The substrate moisture content must be less than 4% pbw (percentage by weight).

6.3 RESIN

For the dry application of the SikaWrap® System, Sikadur®-330 is normally used for the resin priming coat and as the impregnating resin, whilst Sikadur®-300 can be used as the resin primer on smoother concrete surfaces (see below). The resins should be mixed and used as described below. Avoid aeration during all mixing actions.

The pot-life begins when the resin and hardener are mixed. It is shorter at high temperatures and longer at low temperatures. The greater the quantity that is mixed, the shorter the pot-life becomes. To obtain longer workability at high temperatures, the mixed adhesive may be divided into portions. Another method is to chill components A and B before mixing them.

The sequence of operations must be planned to ensure that the adhesive can be applied and the work with it completed within one hour of mixing, or within 80% of the pot-life, whichever comes first.

For details on the performance, pot-life and other characteristics of the Sikadur® resin products, please refer to the relevant Product Data Sheet.

Resin Primer Coat

Ground substrates are generally 'smoother', abrasive blast cleaned ones are generally 'rougher'. This difference is the deciding factor for the selection of the most appropriate Sikadur® primer resin. For 'smoother' surfaces, the more liquid resin products such as Sikadur®-300 can be used. When dealing with rough surfaces, the more filled resins such as Sikadur®-330 are best suited to accommodate the surface profile and irregularities.

Sikadur®-330

Sikadur®-330 serves as both primer and impregnation resin for the fabrics. It is supplied in pre-batched units.

Pre-Batched Units:

Continuously mix all of Part A in its container at a low speed (maximum 300 rpm) then gradually add all of Part B until a fully homogeneous mix, with a uniform grey colour and appearance has been achieved (3 minutes). Then pour the whole mix into a clean container and mix for a second time (1 minute, maximum 300 rpm).

Sikadur®-300

Sikadur®-300 has an extended, longer pot-life and a slow curing speed. It is also supplied in pre-batched units and larger bulk packaging.

Pre-Batched Units:

Continuously mix all of Part A in container then gradually add all of Part B continuing to mix at a low speed (maximum 500 rpm) for 3 minutes.

For Partial Quantities:

Accurately weigh (to 1g accuracy) the correct proportions of Parts A and B and pour into a clean container before mixing by the same process as outlined above for the pre-batched units.

Consumption:

The actual consumption, especially of the priming layer, is primarily dependent on the roughness of the substrate and the type and amount of SikaWrap® Fabric to be impregnated. The Table below shows the estimated consumption for the different fabric weights (excluding loss and wastage).

SikaWrap® Product	Area Weight [kg/m²]	Resin Type	Resin Consumption [kg/m²]	
			First Layer Including Priming	Following Layers
SikaWrap®-231 C	230	Sikadur®-330	0.7-1.2	0.5
SikaWrap®-301 C	300	Sikadur®-330	1.0-1.5	0.8

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7 APPLICATION

7.1 GENERAL

Prior to starting the application, measure and record the substrate moisture content (to be less than 4% pbw, percentage by weight), the relative humidity and determine the dew point. **The temperature must be >10°C and at least 3°C above the dew point.** Cut the SikaWrap® Fabric to the desired dimensions for the installation.

Always work in the same direction as the fibres. Avoid excessive force and moving the roller back and forth when laminating, to prevent any folding or creasing of the SikaWrap® Fabric.

Overlapping pieces of fabric must be installed in the same direction as the fibres and the overlap must be at least 100 mm, or according to the project specifications.

When placing several unidirectional SikaWrap® Fabrics side-by-side, no overlapping in the weft direction (perpendicular to the fibres) is generally required, unless specified otherwise in the strengthening design. For multi-directional fabrics, overlapping in the weft direction must be by at least 100 mm (dependent on the SikaWrap® Fabric type) or again according to the project specifications.

After application, protect the finished installation of SikaWrap® FRP Reinforcement from rain, sand, dust and any other contaminants using protective plastic sheets or other barriers. Do not allow the protective sheets to come into contact with the finished SikaWrap® installation.

7.2 THE DRY APPLICATION PROCESS

The name of the 'dry' application method comes from the state of the fabric at the time it is applied in its final position. For this process, Sikadur®-330 is normally used both as the substrate primer and as the fabric impregnating resin.

The dry application method is suitable for woven fabrics with an area weight of up to 430 g/m², dependent on the fibre type.

Primer / Resin Application

Apply Sikadur®-330 to the prepared substrate using a trowel, roller or brush. Only one application step is necessary here, because the same product is used as primer and as impregnating resin.

The resin consumption depends on the fabric type and substrate roughness, an estimate is given as a guide in the Table in Section 6.3.



Fabric Positioning / Lamination



Place the pre-cut dry SikaWrap® Fabric in the required direction onto the Sikadur®-330 priming layer. Carefully work the resin into the fabric with the Sika® Plastic Impregnation Roller, working parallel to the fibre direction and until the resin is squeezed out between and through the fibre strands, and it is distributed evenly over the whole of the SikaWrap® Fabric surface (see picture left). The fabric has to be completely 'wetted' with the Sikadur® resin; there must be no dry spots and the fabric must be pressed firmly onto the substrate. Squeeze out any entrapped air in the fibre direction to ensure there are no bubbles or blisters between the fabric and the substrate.

Application of Additional Fabric Layers

To meet the Engineer's specified requirements for the total number of fabric layers required, subsequent layers of SikaWrap® Fabric are installed by applying the Sikadur®-330 onto the previously applied layer 'wet on wet' and within 60 minutes (at +23°C) of the previous layer before repeating the laminating procedure outlined above for the

first layer of fabric. If it is not possible to apply the subsequent layers of fabric within 60 minutes of the previous one, then a waiting time of at least 12 hours must be observed before application of the next layer. The overlapping sections of the additional layers should be distributed around the circumference.

At low temperatures and / or in high relative humidity, a 'tacky' residue (blush) may form on the surface of the cured Sikadur®-330. If an additional layer of fabric or a coating is subsequently to be applied onto the cured epoxy layer, then this residue must first be removed to ensure adequate bond. The residue can normally be removed with warm soapy water. In all situations where application is onto a cured layer of the epoxy resin, the surface must be thoroughly dry prior to the application.

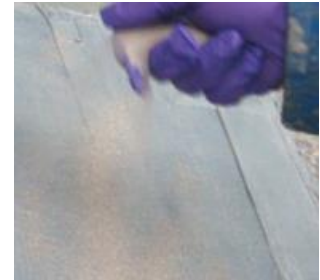
The quantity of additional Sikadur®-330 to be applied to the previously installed layers depends on the fabric type; an estimate is given as a guide in the Table in Section 6.3.

Preparation for Cementitious Overlays / Coloured Coatings

If a residue, as mentioned above, has formed on the surface of the cured epoxy, it must be removed with warm soapy water and the surface must be wiped until it is completely dry before application of any coatings to ensure an adequate bond.

If a cementitious overlay is to be applied over the SikaWrap® Fabric, then an additional layer of Sikadur®-330 resin must be applied over final laminating layer (maximum 0.5 kg/m²) and broadcast whilst still wet with a suitable kiln-dried quartz sand, which will improve the adhesion of the overlay (see picture right).

If a colored coating is to be applied, the 'wet' Sikadur®-330 surface can also be smoothed with a brush.



7.3 ADDITIONAL OVERCOATING

The applied and cured SikaWrap® Fabric can be coated with a colored protective coating for aesthetic and / or protective purposes. Selection of the appropriate product will be dependent on the exposure requirements. The Table below illustrates some common demands and suitable coating products. Please refer to the relevant Product Data Sheet for specific information on application, properties and performance.

Situation	Special Need	Sika® Solutions
Direct sunlight	UV protection	Sikagard®-550 W Elastic Sikagard®-675 W GB ElastoColor
Application in water	Immersion of product in water, constantly wet substrate	Sikagard®-63 N
Increased fire resistance required	Fire protection	Sikacrete®-213 F

If the top layer of resin was broadcast with a suitable kiln-dried quartz sand, a mortar coat can be applied over the Strengthening System after curing (for example Sikacrete®-213 F for increased fire resistance).

8 INSPECTION AND TESTING

8.1 BEFORE APPLICATION

The substrate strength (concrete, masonry, natural stone) must always be checked and verified in all situations. This is done by means of a series of pull-off tests as outlined in **BS EN 1542**. **The mean adhesive tensile strength of the prepared concrete substrate must be minimum 1 N/mm² (Sika® minimum recommendation) unless otherwise detailed in the Engineer's specifications.**

If the strengthening work must be performed according to the fib Bulletin No. 14, then the concrete must have a minimum adhesive tensile strength of 3 N/mm². Concrete substrates must generally be at least 28 days old.

If the substrate is damaged and needs to be repaired, a repetition of the substrate strength tests is necessary after repair.

8.2 SITE INSPECTION

On site, all aspects of preparation, mixing, and application of materials should be continuously observed and recorded, including the following:

- Surface preparation and testing
- Materials' labels and batch numbers
- Mixing of the resin materials
- Application of the resin to the substrate and the fabric
- Temperature, dew point and other environmental data
- Curing of the materials
- System testing
- All other details relating to the strengthening requirement and System specification

Upon completion of the curing process the installed System should be checked again for any areas where the impregnation resin has not fully penetrated, or where any resin has not completely cured. Any such areas covering more than 25 x 25 mm on the surface must be repaired. Any repairs must be made subject to the same application, curing and quality control specifications as the original work.

Small areas of delamination and / or bubbles can be injected with a compatible Resin System to re-establish bond between the substrate and the Strengthening System.

If large defects are found, removal of the applied System and re-application, or the application of additional layers of CFRP Reinforcement may be necessary. The repair type, the preparatory works, the number of layers to be added and the overlapping lengths must all be approved by the responsible Structural Engineer.

9 APPENDIX

9.1 CONSTRUCTION RECORDS

Throughout the installation process, records should be maintained that detail all aspects of the works involved in the preparation, mixing and application, including:

- Surface preparation
- Materials' delivery / batch numbers
- Mixing and application of resin
- Ambient conditions (ambient temperature, substrate temperature, humidity, dew point)
- Any possible contamination
- Details of all test samples and results
- Any significant vibration
- Any other points of note or concern on site

9.2 ON-SITE CHECKLIST: EQUIPMENT AND MATERIALS

- Brushes
- Vacuum
- Brush roller
- Sika® Plastic Impregnation Roller
- Mixing container
- Hand-held mixer
- Mixing spindle
- Mixing paddle
- Grinding / blast cleaning equipment (dependent on substrate)
- Fabric scissors
- Concrete core drill
- Steel dollies
- Pull-off tester
- Adhesive for dollies
- Thermometer
- Moisture meter
- SikaWrap® Fabric
- Sikadur®-330 resin
- Sikadur®-300 resin
- Suitable kiln-dried quartz sand
- Sika® Thinner C (or an Isopropanol based cleaner)
- Safety boots
- Safety goggles
- Safety hard hat
- Skin protection cream
- Protective gloves
- Nitrile gloves
- Clean water
- Eye wash kit

9.3 ON-SITE CHECKLIST: QUALITY ASSURANCE

Substrate preparation:	YES	NO
Have 3 pull-off tests been carried out?		
Average value measured at minimum 3 locations: [N/mm ²] (minimum should be 1.0 N/mm ²)		
Are there any cracks above 0.2 mm wide in the concrete?		
Have any cracks been injected?		
Has any damage to the structure been repaired?		
Is the concrete surface even? (see Table in Section 6.2)		
Environment:		
Does the air and surface temperature exceed 10 °C?		
The actual average temperature is: [°C]		
Is the ambient temperature at least 3° above the dew point?		
Is the average moisture content of the concrete below 4% (percentage by weight)?		
Are the surfaces to be bonded clean?		
Is there any dust or other contaminants present?		
After installation:		
Are there any voids in the composite above 25 x 25 mm?		
Is there any adhesive with areas of discoloration?		
Have there been any deviations or changes from the initial specification and schedule?		
If Yes, please describe them below:		

10 LEGAL NOTE

The information contained herein, and any other advice 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. The information only applies to the application(s) and product(s) expressly referred to herein and is based on laboratory tests which do not replace practical tests. In case of changes in the parameters of the application, such as changes in substrates etc., or in case of a different application, consult Sika®'s Technical Services prior to using Sika® products. The information contained herein does not relieve the user of the products from testing them for the intended application and purpose. 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.

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