Roofing

# KÖSTER TPO Installation Instructions

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KÖSTER
Waterproofing Systems


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# 1 KÖSTER TPO General

## 1.1 Product Overview

| Product name | Thickness (mm) | Loose laying | Mechanical fastening | Strip bonding | Full-surface bonding |
|---|---|---|---|---|---|
| KÖSTER TPO<br>with central glass fiber reinforcement | 1,5<br>1,8<br>2,0 | ● | ● | | |
| KÖSTER TPO FR<br>with central glass fiber reinforcement | 1,5<br>1,8<br>2,0 | ● | ● | | |
| KÖSTER TPO F<br>with a central glass fleece reinforcement and polyester fleece backing | 1,5<br>1,8<br>2,0 | ● | ● | ● | ● |
| KÖSTER TPO SK<br>with a central glass fiber insert and a self-adhesive layer on the underside | 1,5<br>1,8<br>2,0 | | | | ● |
| KÖSTER TPO Pro<br>with a central glass fiber insert, made from recycled polymers | 1,5<br>1,8<br>2,0 | ● | ● | | |
| KÖSTER TPO U<br>Homogeneous (unreinforced) material | 2,0 | For the manufacture of gully and vent flanges, as well as for corner protection | | | |

Length: 20 m
Standard color TPO / TPO F / TPO SK = light grey
Standard color TPO FR / TPO Pro = white
Special colors such as white, grey, slate grey, black, some in stock – available on request

## 1.2 Product Characteristics KÖSTER TPO

**For various requirements and properties**

- High material quality (no differences between top and bottom layers)
- Plasticizer-free
- High cold flexibility (down to ≤ -50 °C)
- UV-stable
- Root and rhizome resistant (FLL tested)
- Bitumen-compatible
- Polystyrene-compatible
- CE certified
  - EN 13956 (plastic and elastomer membranes)
  - EN 13967 (plastic membranes for building waterproofing)
- Complies with SPEC 20,000 - 201/202
- Quality assurance certified according to ISO 9001:2015
- Environmentally friendly, recyclable
- Resistant to flying sparks and radiant heat (hard roofing)

## 1.3 Tools


**The basic equipment includes:**

| | | |
|---|---|---|
| **1** | Hand Welding Machine | (RT 992 001 / 002) |
| **2** | Scissor | |
| **3** | Knife | |
| **4** | KÖSTER Weld Seam Tester | (RT 929 001) |
| **5** | KÖSTER Brass Roller | (RT 998 004) |
| **6** | KÖSTER Kehlfix | (RT 997 001) |
| **7** | KÖSTER Silicone Roller 20 mm | (RT 998 002) |
| **8** | KÖSTER Silicone Roller 40 mm | (RT 998 001) |
| **9** | Wire Brush | |
| **10** | KÖSTER Ballpoint Pen | (PR 126 001) |
| **11** | KÖSTER Folding Ruler | (PR 128 001) |
| **12** | Automatic Welding Machine* | (RT 991 001 / 004 ) |

# 2 Seam connection

## 2.1 General

- The seam area must be clean and dry
- All corners must be rounded
- Welding temperature + 400 °C to + 620 °C, depending on membrane thickness and ambient conditions; machine settings depend on the type of device
- Professional hot air welding guarantees a homogeneous seam connection
- Min. 2 cm homogeneous weld seam width
- Seam overlaps against the water flow are permissible at connections and terminations as well as for accessories
- Seam pretreatment is not necessary for new roofing membranes
- The instructions for seam preparation in the section 2.8 Connection Weathered Membranes must be observed

## 2.2 Automatic Welding

For fast and economical welding of roof surfaces, we recommend the use of an automatic welding machine. In a single operation, the controlled advancement and constant welding temperature ensure weld seams of the highest consistent quality. Perforated smooth nozzles should be used as welding nozzles.

Particular attention must be paid to the start and end of the automatic seam: capillary formation can be prevented by using metal sheets in the start/end area or by retracting the surface web before the automatic welding machine continues working. The welding parameters must be adjusted according to the device type/size, external conditions, the product used, and the substrate. Test welds are essential for finding the appropriate parameters.

**Guideline value for initial test welds with 440 V automatic machines (e.g., Varimat): approx. 580°C and 2.8 m/min**
(Note: Parameters are guidelines and must be adjusted to the environmental conditions of the construction site!)

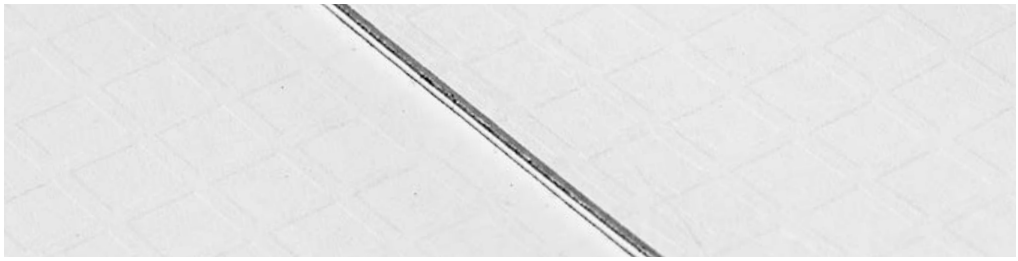
## 2.3 Manual Welding

When welding by hand, always pre-weld first. The sheets should be welded within the overlap at approx. 4 cm from the edge of the sheet. The resulting continuous pocket ensures that there is no temperature loss during the welding process.

**Guideline value for hand-held devices: 540-580 °C** (for analog devices according to table)
For detailed work, the temperature should be reduced appropriately to avoid damage from heat build-up (not below 350°C).

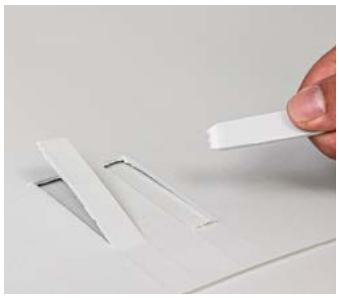
After pre-welding, the flat area of the welding nozzle is pulled evenly through the overlap area at a 45° angle. The seam is closed by evenly applying pressure. The roller is guided over the entire surface of the membrane edge. The distance between the nozzle and the roller should be approx. 1 cm.

When welding with a hand-held welding device, the escape of molten material serves as a visual check of the seam joint. The resulting weld bead should be approx. 1 mm.
Avoid excessive material escaping.



## 2.4 Test Welding and Seam Inspection

- Weld samples must be taken daily on site to determine the correct welding parameters. If conditions change, the settings must be checked and readjusted if necessary.
- The seam must be tested by means of a peel and shear test on a weld seam sample approx. 2 cm wide and approx. 5 cm long. The seam should not be able to separate without material failure, i.e., tearing outside the joint seam or delamination of the product.
- Important: The test sample must be cooled before the test (e.g., by placing it in cold water)!
- If the weld samples are of poor quality, the welding parameters such as temperature, speed, pressure, and air volume must be adjusted. Work on the roof may only begin once the sample results are satisfactory. The samples must be documented with the settings used and kept for the site management.
- The seam of the installed roofing membranes is checked > 24 hours after processing using a test needle.



*Peel test (2 cm with tear-off outside the joint)*

*Peel test (5 cm strip)*

*Seam inspection with test needle*

If problems arise, consult the roofing membrane application technology department at KÖSTER BAUCHEMIE AG. (info@koster.eu; +494941 9709 0)

## 2.5 T-joint Design

T-joints must be welded very carefully to avoid capillary defects.
Preparation of the membrane edges is necessary and can be done by

- Heating and rolling out using a hand pressure roller
- Heating and peeling off using a hand welding machine
- Using an edge planer

Care must be taken to ensure that no material escapes in the area of the T-joint and that the area is not damaged. Once the roofing membranes have cooled down, the T-joint must be checked with the seam tester.

## 2.6 Execution of an End Overlap

End overlaps are made in the same way as the longitudinal joints. To ensure that the sheets are welded together correctly, all corners at the end of the sheet must be rounded off.
This step applies to both the lower and upper layers. The overlap must be at least 6 cm.

KÖSTER TPO F and SK (FR) membranes laminated on the underside are butt-jointed at the ends. The butt joint is made using a > 20 cm wide strip of KÖSTER TPO.
The strip must extend at least 5 cm beyond the front seam edge and be welded all around.

## 2.7 Execution of Cross Joints

Cross joints should be avoided (at a distance of less than 30 cm). This can be achieved by staggered joints or by welding on a cover strip. If a cross joint is unavoidable, it should be welded over with a TPO cut-out (Ø > 20 cm) to divide the cross point into four areas.

*Rounded cover flange*

*TPO strip applied over a longer distance*

## 2.8 Connection Weathered Membranes

Old and weathered KÖSTER TPO membranes can be welded to new TPO membranes. Patina and dirt can be removed with water, KÖSTER TPO Cleaner, or a suitable burnishing device. When welding to older or longer weathered TPO membranes, a test weld will show whether pre-treatment is necessary.

If the welding results are not satisfactory, it is necessary to clean or mechanically roughen the laid membranes in the area of the weld seam.

**The following sequence must be observed:**

- Remove coarse dirt and rinse with water
- Use a burnishing machine if necessary
- Prepare the area using KÖSTER TPO Cleaner
  (Note: approx. 5 airing time)

# 3 Installation Methods

## 3.1 General

Polymeric waterproofing membranes must be installed in a manner that ensures permanent positional stability and wind suction resistance. There are various installation methods available. KÖSTER Application Technology provides a wind load calculation service for each respective installation. To this end, the completed "Wind Load Calculation Request Form" must be submitted in writing.

For all installation methods, the roofing membranes must be mechanically fastened to all rising and descending components, connections and terminations, as well as built-in parts and penetrations, with at least 3 suitable fasteners per meter. The fasteners must be evenly distributed over the entire surface.

**This linear edge fastening can be achieved with:**

- KÖSTER Bar for Membrane Fastening strips (horizontal/vertical)
- TPO Metal Composite Sheet brackets (horizontal/vertical)
- Individual fasteners (vertical)

*Note: Individual fasteners are not permitted for insulation heights >200 mm.*
*The bar or metal compsoite sheet bracket must be used.*

## 3.2 Installation Method: Loosely Laid, Mechanically Fastened

KÖSTER TPO waterproofing membranes can be laid loosely on various substrates and mechanically fastened. The membranes are anchored in the substructure using special fasteners. The substrate and the insulation used determine the type and length of the fasteners and retaining plates. Fasteners with a European Technical Approval must be used.

**Mechanical method of seam fastening** (Linear fastening in the overlap area)

Fastening is carried out in the overlap area of the roofing membranes. The roofing membrane fasteners are covered by the seam overlap, which must be a minimum of 11 cm. The fasteners must be positioned linearly and at a distance of 10 mm from the edge of the membrane.

The distance between the fasteners and the width of the roofing membranes are determined by the specifications of DIN EN 1991-1-4/NA 2010-12 and the existing substructure.

The fasteners must not be pressed too deeply into the insulation material. At least 2 fasteners per $m^2$ must be used. The roofing membranes are laid transversely to the upper chords of the trapezoidal sheets or wooden formwork.

**Method of rail fastening**
(Line fastening with KÖSTER rail for membrane fastening)

For rail fastening, the roofing membranes are laid loosely and the seams are welded. The KÖSTER rails for membrane fastening are then installed according to the fastening plan. The rails are covered with a 250 mm wide strip of KÖSTER TPO and welded on both sides. The rails are installed transversely to the upper flanges of the trapezoidal sheet substrate or the wooden formwork. The use of a 2.10 m membrane width is recommended.

**Method of field fastening (e.g., induction welding process)**
(Information on this can be obtained from the system manufacturers)

In the induction process, the fasteners, including suitable induction plates, are first set in place using the field method. The waterproofing membrane is then laid and secured from above using induction with appropriate equipment and plates.

## 3.3 Loose laying with Ballast

Loose laying of KÖSTER TPO roofing membrane always requires sufficient ballast to protect the roofing membrane against the effects of wind suction forces. Suitable ballasts include: round gravel 16/32, slab coverings, green roofs with sufficient dry weight, etc. When loose laying with ballast, a suitable protective layer, such as a rot-proof plastic fleece, geotextile, or similar must be used.

## 3.4 Adhered Installation

For bonded roof structures, it is essential to ensure that the entire roof structure is securely positioned. The layers beneath the KÖSTER TPO waterproofing membrane can also be bonded or mechanically fastened. The waterproofing membranes have a single-sided welding edge that must be welded using hot air (see previous section).

### 3.4.1 Adhered F-Membranes

KÖSTER TPO F has a polyester fleece backing on the underside, which allows it to be bonded to various substrates and approved insulation layers.
The use of

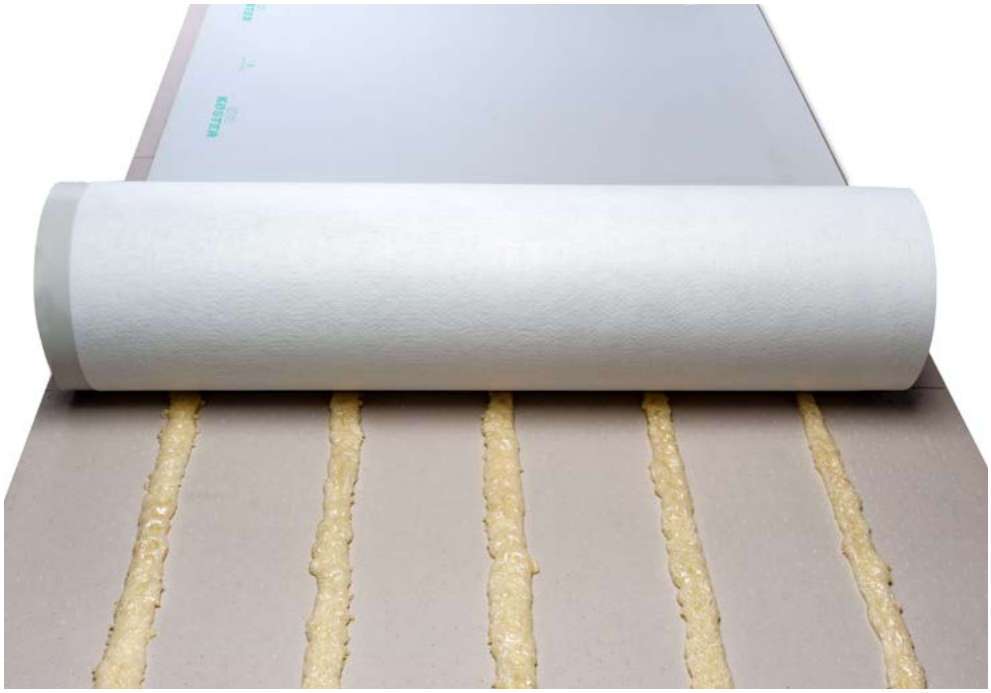
- KÖSTER 2C PUR Membrane Adhesive (RT 104 001)
- Hot bitumen Adhesive

is approved. The required adhesive quantities are specified in accordance with the manufacturer's instructions, a project-specific wind load calculation, or the information provided in the flat roof guideline.

PUR adhesives are applied in strips, while bitumen hot melt adhesives are applied over the entire surface. Suitable substrates include laminated insulation materials approved by the manufacturer for bonding, concrete, and bitumen roofs. Note: Please consult KÖSTER regarding other substrates.

**Bonding with PUR roofing membrane adhesives:**

- The adhesive should be applied in strips
- The membranes must be pressed down to prevent the adhesive strips from showing through (this can be done with a roller or a broom)
- With KÖSTER 2C PUR Membrane Adhesive, secure bonding occurs after approx. 10 minutes



## 3.4.2 SK Self-Adhesive

KÖSTER TPO SK is laminated on the underside with a special self-adhesive fleece. The substrate must be stable, clean, dry, free of grease and oil, and may require pretreatment with KÖSTER SK Primer. Do not apply at outside temperatures below +5 °C.

**Not suitable are:**

- Insulation materials not approved for bonding by the manufacturer
- Rough plank formwork
- Pressed gravel roofs
- Old plastic roofs

Information on the absorption of wind suction forces can be obtained from KÖSTER BAUCHEMIE AG.

Pre-treatment of the substrate with KÖSTER SK Primer in an additional step may be necessary. The primer is applied to the existing substrate using for example a short-napped roller, for example, to increase the adhesive strength as a bonding agent.

KÖSTER TPO SK membranes are rolled out and aligned, then rolled back halfway to remove the protective film from the underside and bond the roofing membranes to the substrate. The roofing membrane must then be pressed down over the entire surface . Ideally, a pressure roller should be used for this purpose.

## 3.5 Overlapping

The side overlap of KÖSTER roofing and waterproofing membranes is always at least 6 cm. The width of the overlap depends on the type of installation and the insulation material used.

**KÖSTER TPO waterproofing membranes have a factory-applied edge marking at 11 cm to aid installation.**

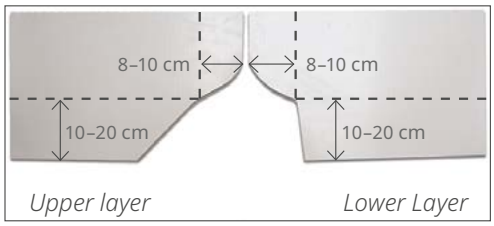
# 4 Detailed Connections

## 4.1 Corner Details

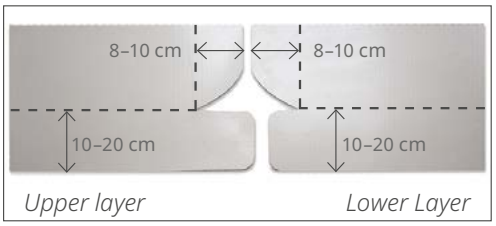
When forming corners, it is essential to ensure that the connecting strips and corner reinforcements are installed in such a way that there is at least a 2 cm joint seam in all surrounding areas.

Recommendation for preparing connections in the corners:

**Cut inner corner**



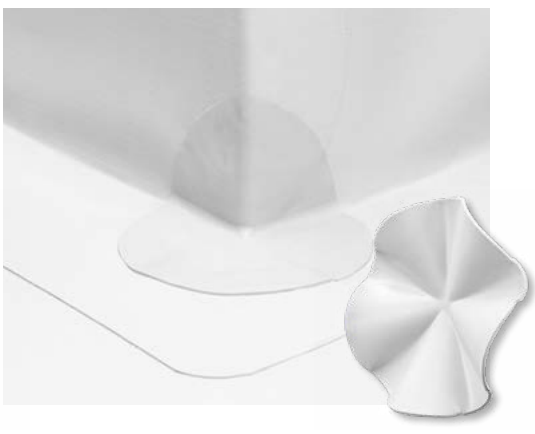

**Cutting outer corner**




The cut also applies to the formation of corners on skylights and similar superstructures.
If it is not possible to use prefabricated parts, KÖSTER TPO 2.0 U should be used.
It is important to ensure that the weld seam width of at least 2 cm is always maintained.

**Inner corner with prefabricated part**

**Outside corner with prefabricated part**



For non-right-angled corners, KÖSTER Universal External Corner RT 901 003 or KÖSTER Universal Internal Corner RT 902 003 are suitable.

## 4.2 Connections

Roof membrane connections and terminations at penetrations and components must always be two-part. They must be mechanically fastened at the upper termination and protected against water ingress. The connection height must be at least 15 cm. This also applies to roof coverings such as slabs, gravel, or green roofs. For connection heights of up to 50 cm, the roofing membranes can be laid loosely at the connection. Above 50 cm, they must be mechanically fastened in the middle with at least three fasteners per meter.

**This temporary fixation can be achieved with:**

- KÖSTER Wall Connection Profile 60 mm
- Metal Composite Sheet
- Individual fasteners

The separate connecting strip is guided >10 cm and <20 cm onto the surface strip, fastened in the valley, and welded.

**Wall connection:**

We recommend using KÖSTER MS Joint Sealant (J 236) as the caulking material for the upper edge.

**Attica connection < 50 cm**

The design of the parapet connection is essentially the same as that of the wall connection, except that the mechanical fastening is carried out on the wall coping.

The wall coping must be properly finished with a parapet flashing. Alternatively, a folded composite sheet with a drip edge and cover strip can be used. To ensure wind tightness, an expanding sealing tape must be installed under the composite sheet

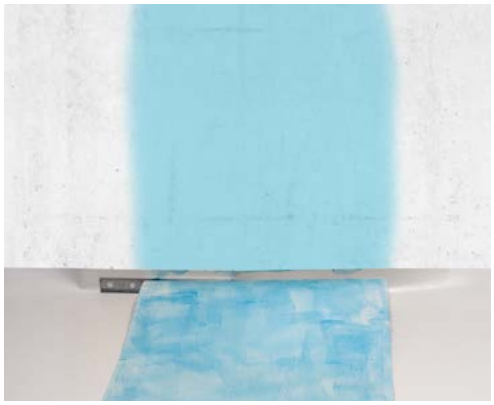
**Attica connection > 50 cm**

For parapet connections over 50 cm, the connection strip must be mechanically fastened in the center with at least 3 fasteners or the KÖSTER Bar for Membrane Fastening and covered with a 25 cm wide strip. Alternatively, the parapet waterproofing can be carried out in two parts.
This intermediate fastening must be repeated every 50 cm.

*Note: a properly executed "tensioned connection" is permitted up to a height of 1.20 m.*

## 4.2.1 Contact Bonding

Alternatively, the membrane can be bonded over its entire surface using KÖSTER Contact Adhesive. The contact adhesive must be applied over the entire surface of both the component and the connecting strip to be bonded. The adhesive must be allowed to dry completely; this can be checked by touching it with your finger. The adhesive should no longer be sticky.
The maximum height is 75 cm.



## 4.3 Round Penetrations

Round penetrations in flat roofs are constructed in two parts. The roofing membrane is fixed around the component and raised at least 15 cm above the upper edge of the roof covering or enclosed by a factory-fitted TPO flange.

A wide range of molded parts/sleeves in sizes DN10 to DN175 are available for the correct waterproofing of round penetrations.
The upper end must be sealed.

If it is not possible to use prefabricated collars, pipe penetrations can be created using a 50 x 50 cm flange and a collar made from KÖSTER TPO U membrane. A hole is cut into the flange with a diameter at least 4 cm smaller than the pipe. The flange is then placed over the pipe.

The sleeve is then welded to the collar, which is at least 2 cm wide and fits snugly against the pipe. The membrane must extend vertically at least 15 cm above the roof penetration. The upper end must be secured with a stainless-steel clamping band and a suitable sealing compound, or a PE heat-shrink sleeve.

Prefrabricated TPO parts from the KÖSTER range are made of hard PE and can be connected directly to the pipe with a heat-shrink sleeve.

**Examples:**

- KÖSTER Roof Drain
- KÖSTER Water Spout
- KÖSTER Emergency Overflow

## 4.4 Metal Composite Sheet Connection

TPO-laminated composite sheets are used, for example, as drip edges, verge boards, or wall connections. The TPO membrane can be connected directly to the sheet metal by welding.

The composite sheet metal edges are not overlapped, but are joined with a gap of approx. 1 cm to accommodate longitudinal expansion. The fastening must not be done with nails. The joints are then sealed with a strip of KÖSTER TPO U that is at least 10 cm wide. The strip must be welded all around. The TPO membrane is then welded directly to the composite sheet metal.

## 4.5 Liquid Polymer / KÖSTER MS-Flexfolie

Liquid polymers can be used in combination with KÖSTER TPO. We recommend the use of KÖSTER MS-Flexfolie and refer to the corresponding installation instructions.


KÖSTER MS-Flexfolie is an environmentally friendly, single-component, solvent-free, highly elastic and crack-bridging waterproofing based on MS polymers. MS-Flexfolie is characterized by very good adhesion to a variety of substrates, such as PVC roofing membranes, TPO roofing membranes based on PE and PP, ECB roofing membranes, bitumen membranes, plastics, clinker, concrete, and metals.

If a third-party product is used as liquid polymer, the corresponding manufacturer should be consulted for installation instructions.

About the product KÖSTER MS-Flexfolie: https://www.koester.eu/?productId=2519&p=95&c=de_en

# 5 Afterword

These installation instructions serve as technical guidance for the proper installation of KÖSTER TPO waterproofing membranes. However, they do not replace individual planning that takes into account project-specific conditions and compliance with all relevant standards, guidelines, and building regulations.

KÖSTER TPO membranes may only be installed by trained specialists. All work steps must be carried out in accordance with the technical data sheets, the respective national regulations (e.g., DIN, ÖNORM, SIA), and the recognized rules of technology.

We reserve the right to make technical changes as part of the further development of our products. The current version of these installation instructions and all associated technical documentation are available for download at **www.koster.eu**.

For project-specific questions or detailed designs, we recommend consulting with the technical field service or application engineering department of the KÖSTER BAUCHEMIE AG.

We are there for you - worldwide

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