Section 07 54 23

TPO Waterproofing Membrane for flat roofs installation

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Waterproofing of flat and sloped roofs. Application by loose laying with ballast, mechanical fastening, full surface, or strip adhesion.

1.2 REFERENCES

A. EN 13956 waterproofing membranes for roof waterproofing
B. EN 13967 waterproofing membranes for structural waterproofing
C. DIN SPEC 20.000-201 Application of construction products in structures – Part 201: Application standard for flexible sheets for waterproofing according to European product standards for the use as waterproofing of roofs.
D. DIN SPEC 20.000-202 Application of construction products in structures – Part 202: Adaption standard for flexible sheets for waterproofing according to European standards for the use as waterproofing of elements in contact with soil, of indoor applications and of tanks and pools
E. DIN 18195 Waterproofing of buildings
F. DIN 18531 Waterproofing of roofs, balconies and walkways
G. DIN 18532 Waterproofing of concrete areas trafficable by vehicles
H. DIN 18533 Waterproofing of elements in contact with soil
I. DIN 18534 Waterproofing for indoor applications
J. DIN 18535 Waterproofing of tanks and pools
K. German roofing trade rules for waterproofing / Flat Roof Guidelines
L. EN 13501-1 Fire classification of construction products and building elements
M. EN 13501-5 Classification using data from external fire exposure to roofs tests
N. EN 1991-1-4 Eurocode 1: Actions on structures – Part 1-4: General actions – Wind actions
O. ETAG 006 Guideline for the European Technical Approval - Mechanically fastened roof sealing systems
P. Tank and tank-lining, according to the regulations of the DVGW, Tech. regulations for potable water.
Q. ISO 9001:2015 Quality management systems – Requirements
R. Certificate of conformity of the factory production control

1.3 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Preparation instructions and recommendations
2. Storage and handling requirements and recommendations
3. Installation methods

1.4 PERFORMANCE REQUIREMENTS

A. The waterproofing system shall be a TPO membrane with centered glass fleece reinforcement. The membrane shall be resistant to hail impact, flying sparks, radiated heat, ozone and radon aggression, PVC free, and chemical resilient and free of environmental harmful compounds. The roofing membrane shall be KÖSTER TPO, manufactured by KÖSTER Bauchemie AG, Aurich, Germany. The adhesive shall be KÖSTER PUR Membrane for the back fleece membranes and the KOSTER Contact Adhesive for the non-fleece back membranes. The metal sheet terminations and details shall be the KÖSTER TPO Metal Sheet and the accessories according to the KÖSTER list of TPO accessories.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications:
   1. Manufacturer shall have no less than five year experience in manufacturing TPO membranes. The system shall be specifically formulated and marketed for roofing waterproofing. System design shall not have changed for a minimum of five consecutive years prior to start of the work.
B. Installer Qualifications:
   1. Applicator shall be approved by the manufacturer, experienced in application of the material and system and shall be subject to inspection and control by the manufacturer.
   2. Installer shall have no less than three year experience installing the specified roofing membranes or have been factory certified and trained in the KOSTER Training Program.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the job site in their original unopened pallets and rolls, clearly labeled with the manufacturer's name and brand designation.
B. Store products in an approved ventilated dry area; protect from contact with soil, dampness, freezing and direct sunlight.
C. Handle products in a manner that will prevent damage of rolls and products.
D. Liquids should not be stored in areas with temperatures over than + 30 ºC or below + 5ºC.

1.7 PROJECT CONDITIONS

A. Maintain environmental conditions within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.
B. Security: Secure the installation of the membrane according to the wind load calculations, whether it is a mechanically fastened, strip adhesion or fully bonded system.

1.9 WARRANTY

A. Installer of the TPO membrane shall provide standard installation warranty for workmanship.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Acceptable Manufacturer: KÖSTER BAUCHEMIE AG • Dieselstraße 1-10 • D-26607 Aurich • Tel. 04941/9709-0 • Fax -40 • info@koester.eu • www.koester.eu
B. Substitutions: Not permitted.
C. Requests for substitutions will be considered in accordance with provisions section.
D. Provide the materials of one manufacturer throughout the project as specified.

. 2.2 ROOFING SYSTEM DESCRIBTION

A. Mechanical fastening system:
Is appropriate for all roofs, e.g. flat roofs, pitched roofs, green roofs and for all types of substrates such as concrete, metal deck or old membranes, as well as all types of insulation boards such as EPS, PUR/PIR, mineral wool, XPS or foam glass. The system is carried out by using the KOSTER TPO reinforced roofing membrane mechanically fastened according to the wind load calculation plan.

B. Loose laying with ballast system:

Is appropriate for flat roofs and , and for all types of substrates such as concrete, metal deck or old membranes, as well as all types of insulation boards such as EPS, PUR/PIR, mineral wool, XPS or foam glass. The system is carried out by using the KOSTER TPO with ballast for wind load safety.

1. Product: KÖSTER TPO 1.5
a. Approved CE Certification according to the DIN EN 13956 (waterproofing membranes for roof waterproofing)

b. Quality assurance according to ISO 9001:2008 certified.

2. Physical Properties:

a. Type: Polyolefin based waterproofing membrane with centrally embedded glass fleece
b. Total Thickness: 1.5 mm
c. Mass/ Weight: 1,59 kg /m² according to DIN EN 1849-2
d. Tensile strength: ≥ 7 N/mm² (Method B) according to DIN EN 12311-2
e. Elongation at break: ≥ 500% (Method B) according to DIN EN 12311-2
f. Resistance to static loading: ≥ 20 kg according to the DIN EN 12730 methods A and B.
g. Reaction to fire: Class E according to the DIN EN 13501-1
h. Exposure to external fire: B_{roof} (t1) according to the DIN CEN/TS 1187; DIN 4102-7; DIN EN 13501-5
i. Resistance to UV irradiation: Passed – Level 0 – according to the DIN EN 1297 (1000 h)
j. Coefficient of water vapor diffusion resistance (μ): 85,000 according to the DIN EN 1931

B. Adhesive Application System

Is appropriate for all roofs, e.g. flat roofs, pitched roofs, green roofs and for all types of substrates which are suitable for bonding such as concrete, metal deck or old bitumen membranes, as well insulation boards such as EPS and XPS or laminated insulation made of PUR/PIR, mineral wool or foam glass. The system is carried out by using the KOSTER TPO backing fleece membrane bonded with KÖSTER PUR adhesive according to the wind load calculation plan.

1. Product: KÖSTER TPO 1.5 F

a. Approved CE Certification according to the DIN EN 13956 (waterproofing membranes for roof waterproofing)
b. Quality assurance according to ISO 9001:2008 certified.

2. Physical Properties:

a. Type: Polyolefin based waterproofing membrane with centrally embedded glass fleece and fleece laminated underside
b. Effective thickness/Total thickness: 1.5 mm / 2,3 mm
c. Mass/ Weight: 1,7 kg /m² according to DIN EN 1849-2
d. Tensile strength: ≥ 1000 N/50mm (Method A) according to DIN EN 12311-2
e. Elongation at break: ≥ 50% (Method A) according to DIN EN 12311-2
f. Resistance to static loading: ≥ 20 kg according to the DIN EN 12730 methods A and B.
g. Reaction to fire: Class E according to the DIN EN 13501-1
h. Exposure to external fire: B_{roof} (t1) according to the DIN CEN/TS 1187; DIN 4102-7; DIN EN 13501-5
i. Resistance to UV irradiation: Passed – Level 0 – according to the DIN EN 1297 (1000 h)
j. Coefficient of water vapor diffusion resistance (μ): 85,000 according to the DIN EN 1931

C. Self-Adhesive Application System

Is appropriate for all roofs, e.g. flat roofs, pitched roofs, green roofs and for all types of substrates which are suitable for self-adhesive bonding such as concrete, metal deck or old bitumen membranes, as well insulation boards such as EPS and XPS or laminated insulation made of PUR/PIR, mineral wool or foam glass. The system is carried out by using the KOSTER TPO backing fleece membrane. It may be necessary to use KÖSTER TPO SK Primer.

1. Product: KÖSTER TPO 1.5 SK (FR)

c. Approved CE Certification according to the DIN EN 13956 (waterproofing membranes for roof waterproofing)
d. Quality assurance according to ISO 9001:2008 certified.

2. Physical Properties:

k. Type: Polyolefin based waterproofing membrane with centrally embedded glass fleece and special self-adhered fleece laminated underside
l. Effective thickness/Total thickness: 1.5 mm / 1,85 mm
m. Mass/ Weight: 1,78 kg /m² according to DIN EN 1849-2

n. Tensile strength: ≥ 850 N/50mm (Method A) according to DIN EN 12311-2
o. Elongation at break: ≥ 50% (Method A) according to DIN EN 12311-2
p. Resistance to static loading: ≥ 20 kg according to the DIN EN 12730 methods A and B.
q. Reaction to fire: Class E according to the DIN EN 13501-1
r. Exposure to external fire: B_{roof} (t1) according to the DIN CEN/TS 1187; DIN 4102-7; DIN EN 13501-5
s. Resistance to UV irradiation: Passed – Level 0 – according to the DIN EN 1297 (1000 h)
t. Coefficient of water vapor diffusion resistance (μ): 85,000 according to the DIN EN 1931

2.4 ADDITIONAL PRODUCTS

A. KÖSTER PUR-Adhesiv. Use for bonding KÖSTER TPO F on suitable grounds.
B. KÖSTER Contact Adhesive. Use for bonding the KÖSTER TPO without fleece on connections, for example walls, parapets, skylights an others.
C. KÖSTER TPO Metal Composite Sheet. Use where recommended by manufacturer for flashing, terminations and walls. The metal sheet has to be cut and folded with the dimension and shape according to the specific project.
D. KÖSTER TPO 2.0 U: Unreinforced 2.0 mm polyolefin membrane used where recommended by manufacturer for creating connections, corners and general details on site.
E. KÖSTER TPO Accessories: Customary accessories made of 2.0 mm polyolefin unreinforced membrane with specific shapes and sizes for detailed application such as roof drains, pipe flashing, roof ventilators, attica spouts, emergency overflows, corners, walkway mats or others, according to the dimension and shape of the specific project.
F. KÖSTER Vapor Barrier FR: Use as vapor barrier on trapezoidal sheets.

PART 3. EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.
B. If substrate preparation is the responsibility of another installer, notify architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
B. If the substrate has been previously prepared with specific systems, notify manufacturer before proceeding.
C. Insulation boards are chosen according to the project specifications regarding thickness and should be mechanically fastened onto the substrate according to the fasteners manufacturer guidelines.
D. Expansion joints are dimensioned according to the structurally calculated building member movement. Expansion joints may not be closer than 50 cm to roof penetrations. The Flat Roof Guideline suggests planning joints at the highest point of the roof.

3.3 INSTALLATION - MECHANICAL FASTENING

A. Install in accordance with manufacturer's instructions.
B. Installation without separating layers: KÖSTER TPO is free of plasticizers and generally can be applied on top of the insulation or old bituminous membranes without a separating layer. A fire protection layer can be specified, for this a glass matting is applicable.
C. Fasteners
    a. The amount and spacing of the fasteners are calculated according to the EN 1991-1-4.
    b. The amount are written into a fastening plan and can be provided by KÖSTER according to the wind load calculation plan for the project.
    c. The amount of mechanical fasteners used when affixing metal bands, flashing, TPO coated metal, should be over 4 pieces per linear meter.
    d. The distance between mechanical fastener and the membrane edge should always be 1 cm.

D. Substrate conditions
    a. Testing the substrate: noticeable defects in the surface must be repaired before installation.
    b. Supporting construction: must meet the requirements for strength, deflection, anchoring, and water run-off.
    c. Dilatation joints: are to be honored depending on the roof design.
    d. Slope: a minimum 2% slope is to be assured, for example through tapered insulation.
    e. Drainage: must always be situated at the lowest point of the roof.

E. Rolling out the membrane:
    a. Every membrane has markings printed onto it to ease positioning and orientation of the membrane.
    b. The width of the overlap depends on the type of installation.

F. Installation of mechanical fasteners:
    a. When mechanically fastening the membranes they are attached to the substrate with roof membrane fastener. They must be suitable for the existing substructure. When installing over sloped insulation, fasteners in various lengths must be at hand.
    b. The quantity and spacing of the anchors is given in the Fastening Plan.

G. Overlapping:
    a. The standard overlap should are 5 cm. Use by loose laying or bonding the membrane.
    b. When mechanically fastening the membranes the overlap must be 11 cm.

H. Installation onto old membranes
    a. Old and weathered membranes KÖSTER TPO can serve as a substrate for new TPO Membranes. Patina and contaminants are easily removed with an angle grinder.
    b. When welding older TPO Membranes make a test weld to see if a pre-treatment is required.

3.4 INSTALLATION – WELDING

A. Welding temperature:
   a. The welding temperature will vary according to weather and material thickness, the temperature of the exiting air should be between + 350 °C and + 620 °C. This should be readable on the display or tested and verified with a separate thermometer. Always conduct welding tests before beginning work.

B. Welding the overlaps
   a. Welding temperature: + 350 °C to + 620 °C, depending on the surrounding conditions.
   b. Welding speed: on automatic welding machines between 2 and 5 meters per minute depending on the power of the machine.
   c. Professional hot air welding guarantees a homogenous weld.
   d. Test Welds: The test welds are always to be performed before work begins
   e. Welding seam: the welding seam is carried out by a 40 mm nozzle whether on automatic or manual welding machines
   f. The minimal width of the homogeneous seam is 2 cm.
   g. Overlapping should always be according to the water flow. Welds against the water flow are allowed at connections, terminations, as well as when installing accessories.

C. Manual welding:
   a. When manually welding the membranes, the top layer is first pre welded. The hot air pistol is held in one hand and with the other the membrane is pressed down and affixed. This creates an air pocket, which traps hot air during final welding maintaining a constant and correct air temperature.
   b. After the initial pre welding, the hot air pistol is uniformly pulled through the overlap. A silicone roller is used to press the membranes evenly together. Do not press the membranes together too firmly. A welding thread of TPO material exiting the weld serves and an optical quality control. The welding thread should have a diameter of approximately 1 mm.
   c. During manual welding make sure that the silicone roller is held parallel to the seam edge and a uniform pressure is applied. Avoid too much material exiting the seam.

D. Automatic welding machine:
   a. When installing larger areas, an automatic welding machine is recommended. These machines combine pre and final seam welding into one work step, and the advancement drive speed can be regulated.
   b. It is suggested to use a mobile power generator at cable lengths greater than 50 m with 230 V or greater than 100m at 400 V to prevent power loss.

E. Test welds:
   a. Test welds are performed on site to determine the proper temperature and speed settings. During changing conditions this may have to be adjusted during work.
   b. The welds are tested at earliest 24 hours after completion and can be tested with a test needle or through a peel test. Membrane testing temperature must be < + 20 °C.

3.5 INSTALLATION – CONNECTIONS

A. Membrane end connections:
   a. Membrane end connections are accomplished just as the membrane side connections.
   b. To insure a flawless installation all corners (such as at the membrane ends) are rounded off with scissors. This step applies to both the lower and upper membrane.

B. T connections:
   a. T connections must be homogenously welded to avoid capillary active defects.

C. Connections to KÖSTER TPO coated sheet metal:
   a. KÖSTER TPO coated metal is used, for example, at wall connections and for drip edges.
   b. The KÖSTER TPO Membrane can be welded directly to the metal. Areas where the laminated metal sheets butt together are waterproofed with TPO pieces.

D. Connections and terminations:
   a. Horizontal forces must be absorbed according to the Flat Roof Guidelines.
   b. Flashings and KÖSTER TPO laminated metal must be mechanically fastened every 25 cm.
   c. Windproof: All connections and terminations must be windproof.
   d. Protection against water ingress: no water may seep behind connections and terminations.
   e. Changing the slope the membrane must be mechanically fastened every 25 cm, starting at an angle of 3° from horizontal.

E. Fastening edges:
   a. Angle profiles and flashing are used to form corner areas free of voids. For fastening the flashing special self-sealing screws such as Spengler screws are used.
   b. Optionally single fasteners can be used.

F. Wall connections:
   a. Up stands are always mechanically fastened. Water seeping behind the membrane is to be excluded by the use of flashing or parapet cover plates.

G. Parapet connections:
   a. < 50 cm: The installation of a parapet connection is largely similar to that of a wall connection, only that the mechanical fasteners are placed at the top of the parapet. The parapet is to be properly covered with parapet cover plates, either made from folded metal sheets or a cap.
   b. > 50 cm in one piece: When applying over a parapet > 50 cm, the membranes are mechanically fastened onto the vertical wall. When installing a single layer the membranes are fastened with strips of TPO coated metal or individual fasteners, covered and welded over with KÖSTER TPO Membrane.
   c. > 50 cm in tow pieces: Parapet connection >50 cm, in two pieces. Alternatively, the parapet connection can be installed in two pieces. The advantage is that during preparation the two membranes can be connected with an automatic welding machine and then be installed in the next step.

H. Roof penetrations:
   a. Pipe penetrations are waterproofed with a flange, 50 cm x 50 cm and a sleeve. A hole is cut into the flange 4 cm smaller than the pipe diameter. The flange is pulled over the pipe. The sleeve is then welded around the pipe overlapping the flange.
   b. Prefabricated accessories are also available for roof and pipe penetrations. Connections and penetrations are always installed in two layers at the base. The waterproofing is brought up the roof penetration at least 15 cm. If the diameter of the penetration is > 25 cm, a stainless steel ring clamp needs to be additionally installed. (Alternatively a suitable KÖSTER prefabricated accessory can be used).

I. Connection to skylights:
   a. The corners are always reinforced with a corner patch. The corner patches are made from a piece of KÖSTER TPO U with a diameter of 8 cm. (prefabricated accessories are also available for the skylight connection).
   b. Upstanding waterproofing, as here in the case of a skylight, are mechanically fastened at their base. Attention must be paid that the upper connection of the TPO Membrane to the skylight is executed with a cover plate according to the KÖSTER TPO guideline.

J. Connection to rain gutter:
   a. The waterproofing must be installed that no raised areas are created. Rainwater must be able to flow unrestricted.
   b. The KÖSTER TPO Coated Metal can also be used as an apron flashing. The KÖSTER TPO Membranes can be directly welded to the coated metal.
   c. The same procedure is valid for the eaves of a pitched roof.

K. Roof drainage:
   a. KÖSTER suggests using prefabricated connection sleeves for connecting drainage systems in the roof area. Roof drains are recessed into the insulation to guarantee unrestricted water flow.
   b. They must be positioned at least 30 cm from upstands.

L. Corners:
   a. Inside and outside corners: When waterproofing corners either prefabricated accessories or manually formed corners can be used. Before installing the corners the TPO membranes beneath them must be creased over the corners and welded.
   b. Pre-formed corners: Prefabricated accessories can be ordered from KÖSTER. They are faster and easier to use during installation. Alternatively inside and outside corners can be manually prepared.
   c. Manually prepared outside corners:
      i. Exterior corners can be prepared from roll material. For an exterior corner a diamond shaped piece of membrane is cut and the corners rounded.
      ii. Interior corners are manually prepared from a circular piece of KÖSTER TPO U with a diameter of 20 cm. A cross with right angles is drawn centered on the prepared circle. The circle is then cut once to the center. The cut is pulled to the next quadrant of the cross to create an inside corner.

The overlap is carefully welded. The inside corner is waterproofed and reinforced with a circular corner plug with a diameter of 5 cm. All seams must have an overlap of at least 2 cm.

3.5 PROTECTION

A. Decoupling layer: Generally no decoupling layer is required, as KÖSTER TPOs are free of plasticizers and will not react with the insulation.
B. Fire protection: Sometimes requires a decoupling layer, for this a glass fiber matting or synthetic matting is suitable.
C. Wood preservatives: May not negatively influence the roof construction or the roofing membrane.
D. UV irradiation: The KÖSTER TPO membranes are highly resistant to UV light, so no protection is needed in any case.
E. Walking areas: The KÖSTER TPO membranes are highly resistant mechanical stresses, but on areas that require foot traffic, the KÖSTER TPO walkaway mats should be installed according to the protection guidelines.