LUCOBIT
THERMOPLASTIC POLYOLEFINS

LUCOBIT WATERPROOFING

Instruction manual for laying

Table of contents

_ 1 Introduction

LUCOBIT AG is a competent and helpful partner for high-quality sealing products, offering professional customer-oriented solutions since 1908. Planners, building owners and tradesmen all benefit from high-quality ExtruBit and ExtruPol roofing and sealing systems, since LUCOBIT AG solutions are user-friendly and offer all the advantages of long-term experience. Whether it's flat roofs, sealing or special applications, new construction or renovation, LUCOBIT AG is the specialist. Our wide range of services and solutions for ever-growing challenges is further proof of our company's proficiency and customer focus.

This instruction manual applies to plastic sealing membranes made from ECB (ethylene copolymer bitumen) and FPO (flexible polyolefins). These membranes are produced from either Lucobit® or Lucofin® and reinforced with a glass non-woven or glass mesh middle layer, a glass non-woven middle layer with an additional polyester non-woven lamination or a cold self-adhesive layer on the underside. They are monitored according to DIN 16729 and EN 13956 and tested for compliance with DIN 16726 and EN 13956. These assessments include labelling and packaging of ExtruBit and ExtruPol roofing and sealing membranes.

_ 2 Products

2.1 Lucobit®

Lucobit® is a roofing and sealing membrane made of ECB (ethylene copolymer bitumen). It consists of polyethylene and special bitumen. These roofing and sealing membranes provide long-lasting security. They are extremely user-friendly products, since they can be applied immediately. No cleansing or any other pre-treatment of the welding area is required.

Lucobit® properties

Durable

- bitumen compatible
- weather and aging resistant
- root resistant
- UV radiation and ozone resistant
- resistant to acidic and basic water solutions

Easy to apply

- no pre-treatment of welding area required
- fast application
- single-layer application
- uniform welding
- lies absolutely flat with excellent dimensional stability

Environmentally friendly

- recyclable and ecologically sound
- contains no plasticizers, chlorine or heavy metal
- harmless for water and soil

Security

- product experience since 1970
- 15 or 20 year system warranty
- remarkably perforation-proof
- annual in-house training sessions for laying

Product	Lucobit® M		Lucobit®	Lucobit®		Lucobit®
Thickness (mm)	1,8 / 2,0		1,8 / 2,0	2,1 / 2,3		2,4
Width (m)	1,05	1,50 / 2,00	1,50	1,05	1,50	1,05
Length (m)	20	15	15	20	15	15
Inlay	Glass non-woven (middle)		Glass mesh	Glass non-woven (middle) and polyester non-woven (underside)		Glass non-woven (middle) and a cold self-adhesive layer (underside)
Laying method	Loosely laid, mechanically fastened	Loosely laid with ballast	Loosely laid, mechanically fastened	Glued or loosely laid		Cold self-adhesive
Application	Flat roofs, water-proofing of buildings / ponds / industrial water and acid tanks		Flat roofs	Flat roofs		Flat roofs, underground work, hydraulic engineering, road and bridge construction

2.2 Lucofin®

Lucofin® is a FPO (flexible polyolefin) roofing and sealing membrane made from a proven mixture of polyolefins. On the market since 1990, Lucofin® ensures dependable security. The roofing and sealing membranes are very user-friendly, since no pre-treatment of the welding area is necessary.

Lucofin® properties

Durable

- weather and aging resistant
- root resistant
- UV radiation and ozone resistant
- cold resistant to -55°C

Easy to apply

- no pre-treatment of welding area required
- fast application
- single-layer application
- uniform welding
- lies absolutely flat with excellent dimensional stability

Environmentally friendly

- recyclable and ecologically sound
- contains no plasticizers, chlorine or heavy metal
- suitable for drinking water tanks

Security

- product experience since 1990
- 15 or 20 year system warranty
- annual in-house training sessions for laying

Product	Lucofin®		Lucofin®	Lucofin®		Lucofin®
Thickness (mm)	1,5 / 1,8 / 2,0		1,5 / 1,8 / 2,0	1,8 / 2,1 / 2,3		2,4
Width (m)	1,05	1,50 / 2,00	1,50	1,05	1,50	1,05
Length (m)	20	15	15	20	15	15
Inlay	Applications		Glass mesh	Glass non-woven (middle) and polyester non-woven (underside)		Glass non-woven (middle) and a cold self-adhesive layer (underside)
Laying method	Loosely laid, mechanically fastened	Loosely laid with ballast	Loosely laid, mechanically fastened	Glued or loosely laid		Cold self-adhesive
Applications	Flat roofs, ponds, drinking water tanks, swimming pools		Flat roofs	Flat roofs		Flat roofs, underground work, hydraulic engineering, road and bridge construction

2.3 Key standards and guidelines for these application instructions

- DIN 1055, part 4 (wind loads)
- DIN 18338
- DIN 18195, parts 1-10 (waterproofing of buildings)
- DIN 18531 (roof sealing)
- DIN 18807, parts 1-3 (corrugated steel sheets)
- Flat roof guidelines (for building flat roofs, published by the ZVHD, Germany's central roofing trade association) (2003)
- Special regulations of the ZVSHK (Germany's central sanitation, heating and air-conditioning trade association)
- Building regulations of the respective German states
- Technical memoranda from Zinkberatung, a Düsseldorf-based consulting association
- FLL guidelines for planning, construction and maintenance of rooftop gardens, issued in 2008

2.4 Permission, testing and inspection

- DIN EN 13856 (including testing standards)
- DIN 16729 (material standards)
- DIN 16726 (testing standards)
- DIN 4102, Teil 7 (fire resistance)
- Root resistance in compliance with FLL guidelines
- Testing for physiological and ecological compatibility

2.5 Weitere Anforderungen nach Stand der Technik

- Requirements according to ddDach 2005 (European association for durable leak-proof roofs)

2.6 Combination with other materials

Lucobit® and Lucofin® roofing and sealing membranes cannot be permanently fixed to other synthetic materials. The same materials (Lucobit®/ECB or Lucofin®/FPO) should be used for joining and repairing.

2.7 Recycling

Old roofing and sealing membranes can be shredded and the derived material used for new products, such as to enrich asphalt to increase the durability of streets or as an additive for weldable polymer bitumen membranes.

2.8 Lucobit®/Lucofin® and the environment

Wastewater is not contaminated with any product derivatives during the production of Lucobit® and Lucofin®, and no hazardous or environmentally harmful gases or dust particles materialize. The roofing and sealing membranes have been categorized in water hazard class 0. They contain neither extractable plasticizers nor pose any risk to groundwater. Inflammability of these roofing and sealing membranes is normal (B2 fire class in accordance with DIN4102-7). When burning with a sufficient air supply, the emissions are mostly carbon dioxide and water. The energy content of Lucobit® and Lucofin® is similar to that of heating oil. Increased carbon monoxide concentrations can occur only if there is an oxygen deficit, e.g. with a smouldering fire. There can be no formation of chlorinated or brominated dioxins and furans or corrosive gases. Roofing and sealing membranes can also be disposed and burned together with household waste. These products are not considered hazardous waste or special refuse, and are not classified as "construction waste containing harmful contaminants". Due to UV radiation, strong exposure to sunlight can cause minor oxidation of diffusing bitumen oils, creating a water-soluble brown film on the surface of Lucobit® roofing and sealing membranes. This, however, presents no traceable risk to groundwater, the environment or municipal sewage. As a precaution, there should be sufficient ventilation when working with Lucobit®/Lucofin® roofing and sealing membranes in enclosed spaces.

3 Equipment and tools

3.1 Tools

The following tools are necessary for laying Lucobit®/Lucofin® roofing and sealing membranes: wire brush, hand-held hot-air welder, 40mm-wide silicon pressure roller (20 mm-wide roller for precision work only), carpet knife with hook blade, scissors and other tools commonly used for joining work.

Tools

3.2 Hand-held hot-air welder*

Complying with VDE standards, the 220V hand-held hot-air welder has a variably adjustable temperature (up to 600°C) and an air volume controller with a 40mm wide slot nozzle and perforations on the rear side (see image). Consistent seam connections are not possible without the perforated nozzle; smooth nozzles should not be used. Heat output: ≥ 1,400W. The normal application temperature is 400-500°C.

- The digital temperature display shows suggested and actual value for optimal welding quality.
- It is necessary to keep the air filter clean to ensure sufficient air supply.

Wide slot nozzle

Air filter

Caution: Consistent, uniform welding is only possible using this nozzle.

*3.3 Automatic welder**

This self-propelled 220V/380V automatic hot air welder conforms to VDE standards, has output of 3,500W/5,200W and adjustable temperature (up to 600°C), air supply and variably adjustable travel speed. The nozzle and pressure roller should be 50mm wide. Edge welding devices (side welders) with integrated air partitioning and electronic temperature measurement and control device are also recommended.

* Caution: it is advisable to use a generator to avoid power drops with cables ≥ 50m long (220V) or ≥ 100m long (380V).

Automatic welder

3.4 Testing the welding temperature

A manual testing instrument capable of recording temperatures up to 1000°C should be available to test the welding temperature.

Temperature measurement

Practical advice: weld samples should be collected for all objects on a daily basis to record the process.

3.5 Power screwdriver for manual mounting

The VDE-approved power screwdriver comes with forward and reverse drive and an attachment for surface irregularities (bit stop) together with automatic screwing and seating as well as efficient magazining.

Automatic power screwdriver

_ 4 Seam joints

4.1 General information

Lucobit® and Lucofin® roofing and sealing membranes are thermally bonded without using any additional foreign substances. The membranes are evenly plasticized in the overlap area using hot air and joined together under pressure. Temperature, contact pressure and welding speed need to be aligned during the welding process.

Seam joint

Important notes:

- Trial welds should be performed.
- Overlaps must be at least 5 (11) cm wide for both hand and automatic welding.
- If polystyrene insulation (or similar) is laid directly beneath the sealing, suitable measures (e.g. the use of protective strips) should be taken to prevent welding devices from causing heat damage to the thermal insulation.
- Overlapping / welding areas should be kept clean.
- Lucobit® and Lucofin® roofing and sealing membranes are welded by means of a seam joining technique that is widely weather-resistant. Hot-air welding creates a permanent bond.
- Minimum roller pressure should be around 5-6 kp. Membrane folds and creases should be avoided in seam areas.
- No harmful vapours are created during the Lucofin® and Lucobit® membrane application process. (Confirmed by the Hanover-based Bau-BG, an occupational safety organisation for the building trade).

No cleaning of the seams is necessary with Lucobit® and Lucofin®.

Characteristics of thermal welding:

- No additives are used. Both sides of the joint are evenly heated to a plastic state.
- Joining pressure is applied immediately upon reaching the plastic state.
- The welding speed varies with the hot-air temperature, which is dependent on the surrounding temperature.

4.2 Welding

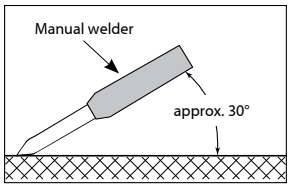
Practical training is necessary!

4.2.1 Manual welding

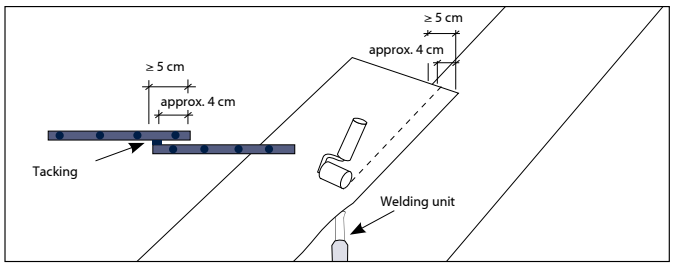
a) Instructions

Turn on a hand-held welder and check the temperature (approx. 450-500°C). Welding of Lucobit® and Lucofin® roofing and sealing membranes is done in two steps: Turn on a hand-held welder and check the temperature (approx. 450-500°C). Welding of Lucobit® and Lucofin® roofing and sealing membranes is done in two steps:

1. The upper membrane is tacked onto the lower membrane in the overlap area about 5 (11) cm from the edge. Initial adhesion along one line (and not just at isolated spots) is achieved by pressing against the edge with a silicon roller. This procedure ensures that the proper temperature is maintained in the welding area for the subsequent welding process. Moreover, it ensures faultless positioning of the seal joint.



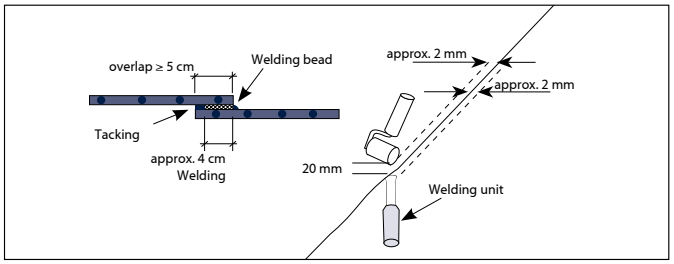
Angle to the membrane during welding.



Tacking


Tacking

2. Welding is then carried out over a width of about 4 cm. The welding unit and pressure roller are continually moved in the welding direction so that both surfaces of the seam are heated evenly and bonded uniformly with the pressure roller.



Seam welding


Seam welding

b) Seam bonding

If done correctly, the welding bead along the seam will reflect an optimum joint. After the work is completed, switch off the welding unit heater. To protect the heating elements, however, the blower has to continue running until no more warm air comes out of the nozzle (see 4.1).

4.2.2 Automatic welding

Turn on the automatic welder and check the temperature (approx. 450-600°C). Automatic welding is carried out in one step, since the air partitioning on the automatic welder eliminates the need for preliminary tacking. Welding speed is adjustable and determined by the temperature of the surroundings. Welding takes place over a width of around 5 cm. The welding bead along the seam is a visible indication that welding has been carried out correctly. The welding bead should not exceed 1 mm. (see 4.1) See the manual welding instructions (4.2.1) for the procedure after the work is completed.


Working with the automatic welder

4.3 Checking the joint

Seams and butt joints performed at a building site should be checked for leaks and defects, particularly with loosely laid roofing and sealing membranes. One or a combination of the following methods can be used for this purpose:

- Scriber test: a scriber is guided along the welding seam. This should not be done until at least six hours after welding.
- Visual inspection: this is to visually determine whether a continuous welding bead along Lucobit® and Lucofin® roofing and sealing membranes exists. It should not exceed 1 mm.
- Compressed air test: a test channel formed by a double welding seam is filled with compressed air. The test channel should be 10-20 mm wide, the test pressure about 200 kPa, and test duration at least five minutes. (This method is employed mainly for underground and landfill construction.)
- Vacuum inspection: after applying a test liquid to the seam, a transparent testing bell is placed on it that sucks out the air underneath. The test pressure should be about 40 kPa. (This method is employed mainly for underground and landfill construction.)

4.4 Repairs

Lucobit® and Lucofin® roofing and sealing membranes are made of materials that do not lose their thermoplastic properties and weldability, even after long-term weathering. Repairs can therefore be carried out without any problems for many years. New material can also be joined with old material without difficulty; only the surface of the old material needs to be mechanically pre-treated. Patina and dirt in the weld area should be removed using a wire brush, grinding wheel, etc. For a description of the welding process, see 4.2.

_ 5 Protective measures

5.1 Separation layers

Lucobit® and Lucofin® roofing and sealing membranes are plasticizer-free and generally do not require separation layers when in contact with other low-solvent, plasticizer-free materials. Due to solvents, however, a separation layer should be used on fresh paint or impregnated wood. This layer could be (e.g.) a bituminous membrane, polyester or glass mesh non-woven.

5.2 Heat protection

When laying Lucobit® and Lucofin® roofing and sealing membranes as a sealing layer under hot asphalt (roads and bridges), membranes with double-sided non-woven lamination or an additional raw glass mesh non-woven layer should be used.

5.3 Protective layers (see DIN 18195)

A protective layer should be applied where the base is rough with sharp edges. A protective layer may also be necessary when reconstructing bituminous surfaces. Polyethylene foam mats are suitable for this purpose, as are synthetic or glass non-wovens. An additional layer of thermal insulation can also be used. Protective layers may be necessary above the sealing if the ballast employed consists of rough stone. Non-wovens or other protective mats are useful here.

5.4 Anti-friction layers

When applying concrete directly onto Lucobit® and Lucofin® roofing and sealing membranes, a layer of 0.2mm PE film should be laid as an anti-friction layer.

5.5 Corrosion protection for metals

As a result of intense UV radiation and weather-related moisture (dew), organic substances on the surface of the seal can lower the pH value of the water and, under unfavourable conditions, cause metals to corrode.

Note: In the case of metal gutters, fascia and downpipes, the flat roof guidelines, metalworking regulations for the roofing trade and plumbing trade guidelines should be observed.

We recommend using downpipes made of plastic or stainless steel (or plastic-coated gutters and downpipes).

5.6 Occupational safety

When laying Lucobit® and Lucofin® roofing and waterproofing membranes, general trade association accident prevention regulations should be observed. Ensure good ventilation when welding in enclosed spaces.

5.7 Hazard classification

Lucobit® and Lucofin® roofing and sealing membranes are not classified as hazardous materials and therefore do not require special labelling. They are environmentally neutral and can be categorised in water hazard class 0 (meaning there is no danger to groundwater or animal life). The absence of halogens means that neither chlorinated or brominated dioxins or furans nor corrosive gases are produced during combustion and welding.

5.8 Fire classification

Lucobit® and Lucofin® roofing and sealing membranes have been tested for all customary roof structures and meet the requirements for “hard roofs”. This means they are resistant to flying sparks and radiant heat in accordance with DIN 4102, part 7. Test certificates are available on request.
As building materials, the membranes are classified as B2 according to DIN 4102, part 1.

5.9 Storage

On building sites and in the open, the roofing and sealing membranes should be stored in an upright position (or in a single layer if horizontal), a dry place and on a clean and level surface. Lucobit® KSK and Lucofin® KSK have to be stored on pallets in an upright position and protected against light, since the adhesive layer cannot be continually exposed to UV radiation. KSK membranes need to be installed within six months.

_ 6 Base

6.1 General base conditions

Lucobit® and Lucofin® roofing and sealing membranes can be laid quickly and economically on any subsurface. However, the base (and particularly its surface) should be tested first to determine its suitability before starting work. Any

discernable defects from prior work have to be reported if they could affect the present work. The supporting structure must satisfy all technical requirements, especially in relation to load-bearing capacity, deflection, bracing, water drainage facilities, etc. Expansion joints should have been provided for by the planner and must be visible in the base structure (see flat roof guidelines). A slight gradient (2°) should be fashioned to allow rainwater run off, particularly for inlying channels and gutters. The base has to be solid, clean and free of loose particles such as dust, dirt, oil and grease. Surface water should also be removed and the surface dried.

6.2 Trapezoidal steel base

Only galvanized trapezoidal steel profiles with corrosion protection applied by the manufacturer and conforming to DIN 18807 should be used. The steel should be at least 0.88 mm thick, and the top flanges of the trapezoidal steel profiles have to be on the same level. The deflection or sage at mid-span cannot exceed L/300, so the load must be evenly distributed when transporting the material. Shear areas are statically operative discs, and the overall stability of a structure depends on these. Therefore, no alterations can be made without conducting a static calculation. Roof openings such as fans, gullies, etc. are to be stabilized with reinforcing metal sheeting. The suitability of replacement domelights, chimneys, ventilation systems, and the like needs to be statically verified.

6.3 Concrete roofs

Concrete roofs (including gradient layers) must be sufficiently hardened and dry on the surface. The surface should be scraped down, continuous, and free of gravel, cracks and ridges.

6.4 Pre-cast concrete

If pre-cast concrete slabs were laid, a uniform surface should result. The joints between the slabs should be closed, and protective strips placed on the support joints to prevent movement. This applies to all joints with large slabs (TT slabs) if no other measures have been taken.

6.5 Wooden roof boards

The wooden substructure should be installed with a minimum gradient of 2% and subsequently protected against moisture. The expansion of the wood has to be taken into consideration when laying the material. Wooden base planking must be at least 24 mm thick or at least 22 mm with materials containing wood (e.g. chipboard). If the rafter spacing is more than 75 cm, the thickness of the boards should be increased accordingly. Closely butt the 8-16 cm wide boards when laying them. They should be waterproofed, although the chosen preservative should not negatively impact the roof structure. Caution: the chipboard selected should comply with DIN 68763! The boards are tongued and grooved and should be laid in an interlocking fashion only. The length of the boards should not exceed 2.50 m.

6.6 Reconstructing on bituminous membranes

Before starting to re-roof, always examine the soundness of the existing roof structure by opening it up in several places down to the supporting structure (to check the vapour barrier integrity, thermal insulation thickness and moisture content, the possibility of a dried-up roof structure, etc.). Corrugations, blisters and other irregularities should be cut open and removed. Check whether an additional protective layer is necessary or if Lucobit® and Lucofin® membranes with an extra underside synthetic or glass non-woven layer would suffice. During the planned roof reconstruction, a physical roof structure calculation should also be carried out to determine if the amount of thermal insulation can be increased, if necessary, in line with the applicable regulations.

6.7 Reconstructing on PVC membranes

PVC membranes should be removed or an appropriate separation layer applied. In the case of plastic membranes made from different materials, consult the roofing membrane manufacturer.

6.8 Re-roofing on ECB and FPO membranes

No special measures are required when laying new ECB / FPO membranes onto existing ECB / FPO membranes. Take the physical values into consideration.

6.9 Vapour barriers

Vapour barriers are necessary since unforeseeable changes in building usage can take place. A PE vapour barrier film or an aluminium vapour barrier foil can be used when lying on a base consisting of trapezoidal steel profiles. The vapour barrier membranes should be laid loosely, overlapping by about 10 cm and sealed tightly with double-sided adhesive tape. For concrete bases, an aluminium-lined bituminous vapour barrier membrane is recommended. It should also function as emergency waterproofing during the early stages of construction. At all connections, borders and roof openings, the vapour barrier needs to reach at least to the upper edge of the thermal insulation and be sealed in accordance with the flat roof guidelines.

6.10 Thermal insulation materials

Only thermal insulation materials which are heat-resistant, dimensionally stable, shape-retentive and treadable should be used underneath the roof sealing materials. Rigid foam boards should have a rabbet edge or be staggered in two layers. Mineral fibre insulation materials should be closely butted or staggered in two layers. The thermal insulation used must have a compressive strength of ≥ 100 kN/m2 with a maximum buckling of 10% and 98% retraction. Gradients may only be created with thermal insulation materials above the vapour barrier (exception: cold storage).

Recommended / approved insulation materials:

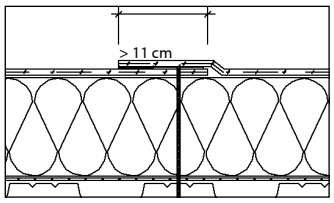
- expanded polystyrene (EPS)
- extruded polystyrene (XPS)
- mineral fibre boards, compressive strength ≥ 60 kN/m^2

Recommended insulation materials for inverted roofs:

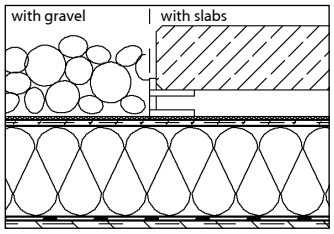
- extruded polystyrene (XPS)

_ 7 Laying methods

7.1 Loose laying and mechanical fastening



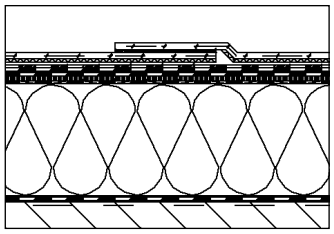
7.2 Loose laying with ballast



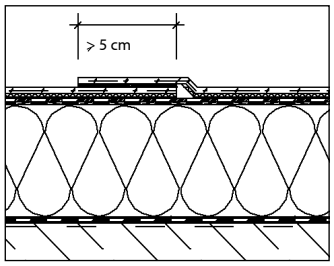
7.3 Strip or full surface adhesion

using

- bitumen
- cold setting adhesives
  (PUR roofing membrane adhesive)



7.4 Cold self-adhesive membranes



_ 8 Laying roofing and sealing membranes

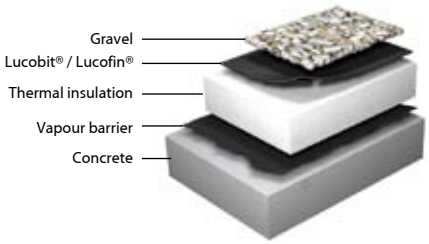
8.1 General information

Lucobit® and Lucofin® are thermoplastic membranes for sealing roofs and buildings. They can be deformed and welded using heat. To stabilize the membranes from the effects of heat and cold, they come with a middle layer of glass or glass mesh non-woven. Avoid creasing or folding. They are extremely resistant to UV radiation and ozone effects. Protective layers of gravel, concrete slabs, vegetation or soil are recommended to reduce the impact of temperature changes on the roof structure. Lucobit® roofing membranes are bitumen compatible and can be laid directly on to bitumen or polymer bitumen roofing membranes. Lucobit® membranes with an additional polyester non-woven or glass non-woven layer on the underside have been developed for this purpose.

8.2 Loose laying with ballast

8.2.1 New sealing

Roll out, align and smooth out the Lucobit® and Lucofin® roofing and sealing membranes. Do not stretch. Lay, align and smooth out the next membrane with a ≥ 5 cm overlap. Repeat with the next membrane. These steps are mandatory. The roof sealing must be laid flat and bonded firmly to the supporting base at the joints and borders in line with the flat roof guidelines. If laid loosely on polystyrene insulation, appropriate measures (e.g. applying protective strips) must be taken so that the subsurface is not damaged by heat during welding. Large prefabricated membranes (80-250m2) are available through the factory to speed up the laying process. The ballast must be applied immediately after laying! Ballast loads should comply with the flat roof guidelines or DIN 1055, part 4. Increased ballast (such as board covers and/or additional mechanical fastening) may be necessary at the edges and corners. A wide range of pre-moulded components enable secure sealing in problematic areas such as corners and outlets.



Roof structure with gravel ballast

8.2.2 Renovation

Due to chemical incompatibility, it is necessary to apply a separation layer between an existing bituminous sealing and Lucobit®/Lucofin® roofing and sealing membranes. Roof coverings containing tar (a product produced by coking or carbonising mineral coal) need to be removed. Reconstructing with mechanical fastening: when using ballast, follow laying procedures as described in 8.2.1. Beforehand, however, check whether additional thermal insulation or a protective layer is necessary.

The ballast must be applied immediately after laying!
Ballast loads should comply with the flat roof guidelines or DIN 1055, part 4.

Protection layer on old bituminous sealing

Laying and welding new roofing and sealing membranes

Returning the ballast

8.2.3 Inverted roofs

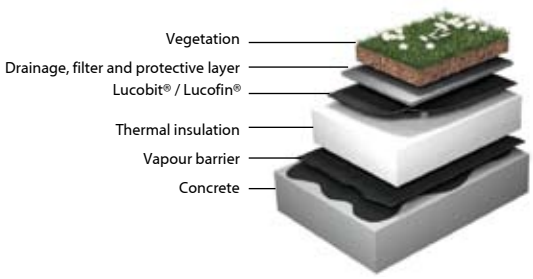
Check first if a protective layer is required! Laying Lucobit®/ Lucofin® roofing and sealing membranes follows the same procedure described in 8.2.1. Thermal insulation boards made of extruded polystyrene (XPS) are laid on top of the seal. The boards have rabbet edges and must be closely butted. A synthetic non-woven is laid on top of the thermal insulation, overlapping by about 8cm.

The ballast must be applied immediately after laying! Ballast loads should comply with the flat roof guidelines or DIN 1055, part 4.

8.2.4 Planted and walkable areas

Lucobit® and Lucofin® roofing and sealing membranes are laid as described in 8.2.1. Thoroughly check whether separation, anti-friction or protective layers will be required later (e.g. for later developments). For planted roof systems, a system sheet or protective non-woven is sufficient.

The ballast must be applied immediately after laying! Ballast loads should comply with the flat roof guidelines or DIN 1055, part 4.



Roof structure with vegetation

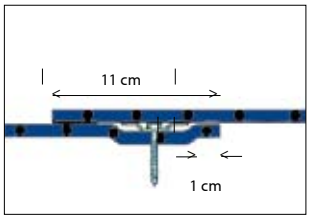
8.3 Loose laying with mechanical fastening

For loose-laying membranes with mechanical fastening, all layers of the roof structure are firmly anchored to the supporting structure in a single operation. If it is not certain that the insulation sheets will be kept in position by fixing the overall structure, additional mounting of the thermal insulation is necessary. With trapezoidal steel profiles, the insulation sheets should be laid so that their long sides are at right angles to the top corrugations. The insulation boards should be thick enough so that the lower corrugation is not impacted or penetrated when walked upon (see flat roof guidelines 9/2001, table 1, recommended minimum thickness of trapezoidal profiles).

Mechanical fastening

8.3.1 Asymmetrical fastening

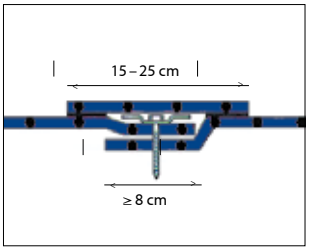
The seam joint provides a seal and at the same time holds the membrane in position. Fastening takes place at the edge of the membrane. The fasteners should be placed at equal intervals and parallel to the edge of the membrane. Membrane overlap should be 11 cm.



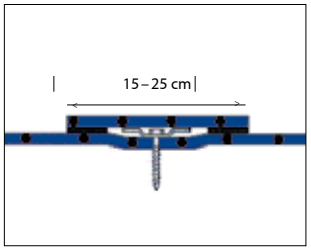
Spacing between the disc and membrane edge .

8.3.2 Symmetrical fastening: strip welding / fastening system

a) Both parallel membranes overlap by at least 8 cm and are not welded. The fasteners are arranged evenly in the middle of the overlap. A strip of material (15-25 cm wide) is used to seal the area around the fasteners on to the existing surface sealing.



b) This system is also used in lightweight roof construction to form the edge and corner regions in the longitudinal direction of the corrugations. The fasteners are arranged as prescribed along the laid membrane and covered with 15-25 cm wide strips of material.



8.3.3 Fasteners

For fasteners, only use self-drilling screws, woodscrews or anchor systems (with the appropriate load distribution discs) that have been tested and approved for this application. The systems need to be corrosion-protected and made of non-ferrous metals or non-ageing and heat-resistant plastic.
Fasteners include:

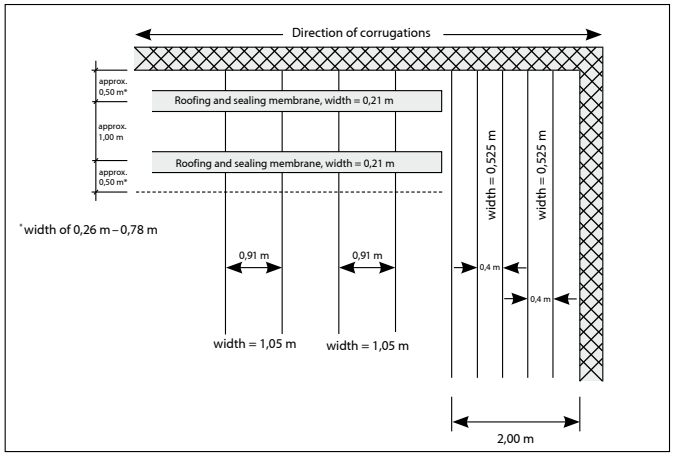
- metal fastening discs
- disc anchors with expanding mandrel
- plastic discs with counter-sinkable screw (telescopic fasteners)
- flat strips, bars (etc.) or linear fastening
- special disc fasteners and screws for wood sheeting and porous concrete sub-surfaces.

Caution: sealing membranes may not be fastened with nails.

Laying according to calculations on wind load exposure.

8.3.4 Laying on trapezoidal steel profiles

Membranes should be laid on trapezoidal steel profiles at right angles to the upper corrugations. For edges and corners, narrow membranes (52.5 cm wide) are used to accommodate more fastening points. Lucobit®/Lucofin® roofing and sealing membranes come in type M 1.05 m and type MK 1.50 m. Both types can be laid in the central area. Type M (1.05 m wide) or MK (1.50 m wide) Lucobit®/Lucofin® roofing and sealing membranes can be laid in the central area. Edge and corner regions are laid in a longitudinal direction to the corrugations using additional fasteners as shown in the diagram below. Additional fastening points are covered with strips (approx. 20 cm wide).



Sample diagram for laying Lucobit® / Lucofin®. Other sample diagrams are available upon request.

Additional fastening

8.3.5 Number of fastening positions

Wind uplift forces are determined according to DIN 1055, part 4. The calculations are based on the length, width and height of the building. When calculating, a distinction is made between the central, edge and corner regions. Individual calculations in accordance with DIN 1055, part 4, are necessary to dete rmine the minimum number of fasteners for buildings exposed to high winds (e.g. in coastal regions), internal pressure or for those over 20 m high. This applies to enclosed buildings and non-windy locations.The values extracted during reconstruction need to be determined. Wind load calculations are part of LUCOBIT AG's services and help reduce costs.

Please note: it is essential to observe wind load calculations conducted by LUCOBIT AG if they diverge from the normally applicable guidelines. If fewer fasteners are employed than the number calculated, a properly functioning system cannot be guaranteed.

8.4 Laying with adhesives

When using adhesives, all layers of the roof structure must bond to one another. Hot bitumen, cold bitumen and polyurethane adhesives are used. When selecting an adhesive, the purpose should be determined and the LUCOBIT AG instructions observed. For adhesive bonding to a suitably prepared base, roofing membranes with a synthetic non-woven or glass non-woven underside layer are to be used. The non-woven lamination and the base have to be dry before bonding. The membranes should overlap by at least 5 cm (observe section 8.2.1). Since the membrane seams are welded using hot air, the welding area must be free of adhesives. If modernising, adhesive bonding is only possible if adhesion of the old roof structure to the supporting base and existing roof seal can be ensured.

Before: leaky bitumen roof surface

After: roof surface modernised with Lucofin®

Working with roofing membrane adhesives

8.4.1 Strip bonding with LUCOBIT AG roofing membrane adhesive

The roofing membrane adhesive is applied to the prepared surface strip by strip. Manufacturer requirements are valid in regard to the base (LUCOBIT AG adhesive for roofing membranes PUR 6.0 kg, application: 250-300 g/m^2). If employing trapezoidal steel profiles or newly delivered metal sheets, the base should be examined accordingly to ensure proper adhesion of the layered roof structure (use primer if necessary). The amount of adhesive needed generally depends on the suction calculated according to DIN 1055, part 4, and is specified by the adhesive manufacturer. In the central region of the roof, three or four strips of adhesive are applied per metre of width. More adhesive is required around edges and in corners. The adhesive is applied using a suitable tool or by hand (around domelights, ventilation units, etc.). At least one strip of adhesive must be applied to each upper corrugation on trapezoidal steel profiles. Roofing membranes with an additional synthetic or glass non-woven layer on the underside are rolled on to the viscous adhesive and properly pressed down. Observe the adhesive manufacturer's technical specifications. Prepare areas for bonding only if they can be sealed within 5-10 minutes. Repositioning of the membrane is normally possible for up to 15 minutes. The surface sealing is firmly anchored to the supporting base at the edge of the roof and at junctions and borders.

Please note: since the adhesive does not bond strongly at first, ballast should be used to secure the membranes against wind uplift.

8.4.2 Full-area adhesive bonding with bitumen: it's only possible with Lucobit®

Lucobit® roofing membranes with an additional synthetic or glass non-woven layer on the underside can be bonded with hot bitumen (full or partial surface application). Additional measures may be necessary with roof gradients (see flat roof guidelines). The temperature of the bitumen adhesive should not exceed 185°C at the area of application. The kind of bitumen used depends on the roof incline. Here, a low-solvent, polymer-modified bitumen can be employed. Follow the manufacturer's instructions for amount and method of application.

a) Flame melting method

The hot bitumen is poured on to the base and evenly spread using sliders. After the hot bitumen has cooled off, the membranes are rolled out halfway, aligned and rolled back again. The cooled layer of bitumen (but not the Lucobit® membrane) is melted to a sticky or liquid state over the entire width of the membrane using gas burners, and the membranes are rolled into this adhesive bed, ensuring no air bubbles are formed.

b) Brush application method

Lucobit® roofing and sealing membranes are rolled out halfway, aligned and rolled back again. The hot bitumen is applied with a brush to the prepared base parallel to the axis of the Lucobit® rolls. The Lucobit® membrane is rolled into the liquid bitumen bed so that accumulated bitumen is continuously pushed forward in front of the roll. The roofing membranes are then thermally welded as described in 4 ("Seam joints").

8.4.3 Lucobit®/Lucofin® KSK - cold self-adhesive membranes

Laying self-adhesive KSK membranes is easier and quicker than ever. With a special adhesive layer on the underside, they can now be applied up to 50% faster under optimal conditions. KSK membranes can also be laid cold.

KSK membrane

8.5 Junctions and borders

Fundamentally, Lucobit® and Lucofin® roofing and sealing membranes have to be mechanically fastened to the substructure (e.g. trapezoidal steel sheets, concrete, wood) in front of all vertical or horizontal structural components. Individual or line fasteners should be chosen from among the LUCOBIT AG system accessories. Fastening elements should be mounted every 25 cm.

8.5.1 General information

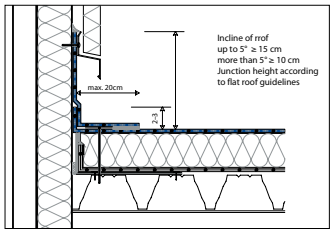
A distinction is made between rigid and flexible junctions. Avoid rigid connections between a seal and statically separate components at all costs. Excess stress in the connection area resulting from tensile, transverse or shear forces should be prevented using constructive measures. Junctions and borders need to be windproof! Fundamentally, the same material should be used as for surface sealing. The surface sealing of Lucobit® roofing membranes must be firmly fastened to the substructure at all junctions and borders as well as roof openings using individual fasteners (approx. every 25 cm), in line with the flat roof guidelines. The flat roof guidelines also specify that junctions must go at least 15 cm (or 10 cm with borders) above the water line (meaning 15 cm above the upper layer if gravel and another layer are used) and be constructed so that no water can seep in behind. In some cases, seams facing the direction of water flow cannot be avoided at junctions, but this does not represent a disadvantage for hot-air welding. Border subsurfaces have to be waterproof (leak-proof joints and areas with driving rain).

8.5.2 Rigid wall junctions

Lucobit®/Lucofin® surface sealing needs to be mechanically fastened at the edge of the roof. Lucobit®/Lucofin® connection strips are loosely and mechanically fastened to the rising structural component using a wall connection bar. The other side of the strip is then applied to the roof surface to cover the existing edge fastening in accordance with the guidelines. The seal is to be pressed against the rising wall. The connection strip is welded on to the sealing no further than 20 cm from the edge of the roof.

Warning: the material cannot be creased!

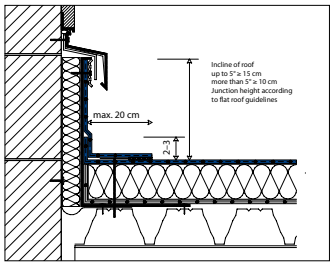
The wall connection bar is sealed with a suitable sealing strip or sprayable sealant. One proven solution is a pre-compressed sealing strip that is installed together with the wall connection bar and prevents water from running behind the junction.



Rigid wall junction

8.5.3 Flexible wall junction

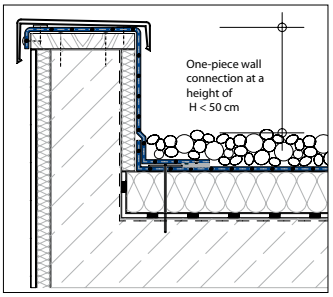
Here, in contrast to the rigid wall connection, the Lucobit®/ Lucofin® connection strip is mechanically fastened to an auxiliary structure, such as a galvanized angle plate (or similar) instead of the rising structural component.



Flexible wall junction

8.5.4 Rigid parapet junction

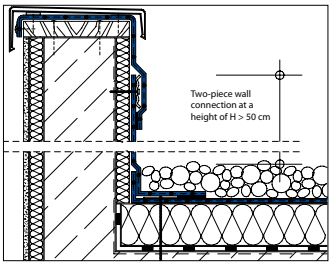
The procedure is basically the same as for the rigid wall junctions. In this case, however, the Lucobit®/Lucofin® strip is mechanically fastened to the top of the masonry and continues on to the roof surface. A wall capping profile is properly mounted on top of the parapet.



Rigid parapet junction

8.5.5 Junctions and borders for greater heights

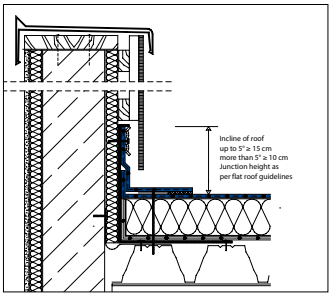
If the parapet is higher than 50 cm, the connecting membrane should also be divided and fastened. A wall connection (individual fasteners or connection bar) mounted horizontally on the rising wall prevents fluttering. The wall connection can be applied directly to the seal or as a hidden two-piece connection (see illustration).



Parapet height of more than 50 cm

8.5.6 Flexible parapet junctions

The procedure is the same as with the flexible wall junction. A wall capping profile should be mounted correctly on top of the parapet. If parapets are higher, the wall cladding or an angled Z-profile is used to cover the flexible connection. The wall cladding must be resistant to driving rain.



Flexible parapet junction

8.5.7 External and internal corners

The parapet or wall junction seal is placed into the destination corner and cut as shown in the images to the right. The seal is fastened in the corner using strips of Lucobit® and Lucofin® roofing membrane without a middle glass non-woven layer. Ready-made internal and external elements from the factory may also be used for securing corners. The seal cannot take on static forces from the structure or its movement. Moulded elements from the LUCOBIT AG range of accessories or 3 mm material (without inlay) can be used for precision work.

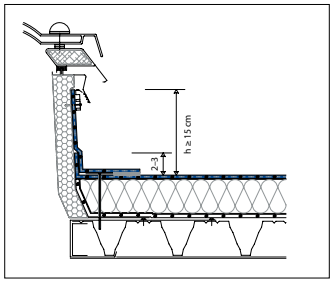
Welding a moulded corner piece

External corner

Internal corner

8.5.8 Connections to domelights, skylight strips and smoke & heat ventilation systems

Lucobit®/Lucofin® roofing membranes are brought up to the curb (e.g. on a domelight) and fastened at the edge. The Lucobit®/Lucofin® connecting strip is mechanically fastened to the curb using a wall connection bar. The connecting strip is loosely laid, fitted tightly against the curb, and brought on to the roof surface. The connecting strip must cover the existing fastened edge as per the guidelines. To fasten, fix the seal in the corner. The strip is cut to size as shown in the sketch below. The connecting membrane is welded no more than 20 cm from the upturn of the curb. The junction at the corner between the roof surface and the curb can be secured at points using Lucobit®/Lucofin® roofing and sealing membrane (without 3 mm glass non-woven inlay) or corner pieces from the LUCOBIT AG moulded parts range. The connecting strip can also be fastened to the curb mechanically or by using a clamping strip at the top.

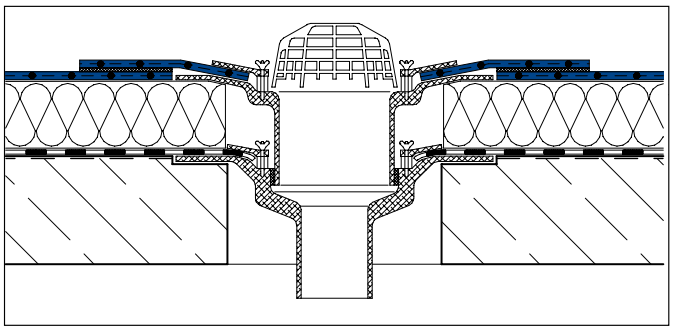


Domelight connection

8.5.9 Drainage system connections

a) Internal drainage

We recommend gullies with a mechanical clamping ring for secure connections to internal drainage systems. Gullies with a foam-sealed flange can also be used. However, only the same type of material may be used for the flange. Pieces of Lucobit®/Lucofin® strips (approx. 50 x 50 cm, without glass non-woven inlay) or a gully flange are wedged into the correctly installed gully body or riser unit and welded on to the surface sealing. First, the gully flange is bonded to the existing seal radially from the inside outwards using the hand welder. This prevents folds from forming during welding.



Internal drainage

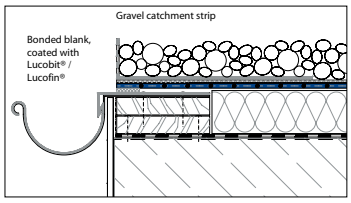
Caution: The gully body should be mechanically fastened to the base structure (taking future work into account) Gullies need to be installed at least 50 cm from rising structural elements. Structural elements separated by joints are to be drained independently of one another.

When reconstructing, roof drains can be produced in suitable shapes and sizes by hand. The ventilation bordering described in 8.5.9 is inserted into the existing gully inversely. Always make sure there is no back-pressure. Of course, prefabricated moulded elements can also be used as flat roof gullies.

Roof gully

b) External drainage

When creating a gutter inlet, one option is to mechanically fasten the gutter inlet sheet, a metal sheet coated with Lucobit®/Lucofin® (bonded blank), on to the existing wooden plank. The individual metal sheets are overlapped and the joint area covered with Lucobit®/Lucofin® strips (without glass non-woven inlay). The surface sealing is welded directly on to the Lucobit®/Lucofin®-coated metal sheet.



External drainage

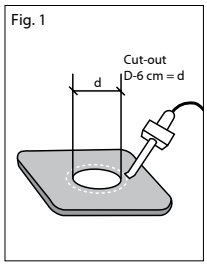
Welding on to fascla

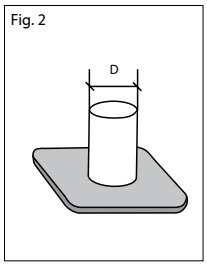
8.5.10 Roof projections connections

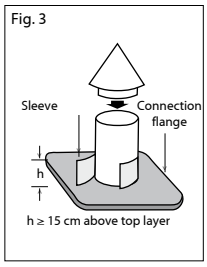
Rectangular roof projections (e.g. chimneys, trapdoors, ventilators) are handled the same way as wall junctions. Make sure the surface sealing is mechanically fastened in front of all vertical or horizontal structural components. Pipe openings are made with a flange and an Lucobit®/Lucofin® membrane sleeve (without a middle glass non-woven layer). A hole is cut out of the middle of the flange, which is approx. 50 x 50 cm. The diameter of the hole should be about 6 cm less than the pipe diameter. The region around the hole is heated with the hand welder so that the top and the underside are heated to the same extent. The hole is widened to the necessary size and pulled over the pipe.

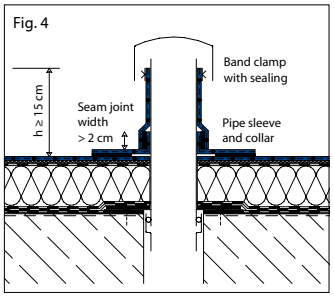
If this procedure cannot be carried out on the pipe on-site, the flange can be prepared using a pipe of the same diameter.

The smaller cut-out diameter on the flange (fig. 1) leaves a small collar around the pipe. The sleeve is then formed around the pipe (fig. 2) and uniformly welded to the "collar" (fig. 3). The flange is fixed to the surface seal and correctly welded on. The sleeve is then pressed onto the pipe above the water zone using (e.g.) a hose clamp. (The vapour barrier should be brought up and fastened at the breaches.)





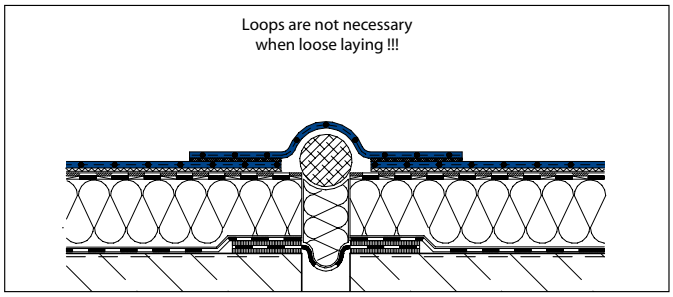




Roof projection connection

8.5.11 Structural/expansion joints

Joints in the layered roof structure have to be in the same position as the joints in the structure of the building. Their style depends on anticipated movement. Generally, structural and expansion joints should be placed at high points. They cannot run through roof projection openings or within 50 cm of them.

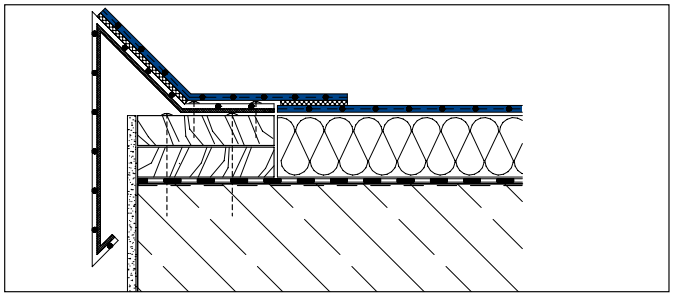


Structural / expansion joints

8.5.12 Verge boards

The verge board is a roof border-finishing element constructed with Lucobit®/Lucofin® roofing and sealing membranes and a finishing profile made from a bonded blank. It is loosely laid and mechanically fastened.

Lucofin® verge board



Construction of verge board

_ 9 Additional Lucobit® application areas

9.1 General information

Lucobit® roofing and sealing membranes have been developed to guarantee the lasting functionality of synthetic sealing while also taking the respective structural conditions into consideration. Environmental protection is the most demanding application area for Lucobit® processing, welding and testing technology. A comprehensive presentation of all details related to civil engineering applications would go beyond the scope of this manual. However, LUCOBIT AG would be pleased to provide answers to open questions.

9.2 Sealing buildings and structures (see the DB's AIB, "Sealing of Engineering Works" from German Railways)

Lucobit® roofing and sealing membranes are particularly suitable for building and structure waterproofing to protect them from:

- ground moisture
- non-pressurized water
- external water pressure

Structure sealing

9.2.1 Sealing structural joints

Structures with surface sealing made of bitumen-bonded ECB sealing membranes generally do not require any additional sealing of the structural joints. If structures are sealed with loosely laid ECB sealing, the structural joints should also be sealed using an exterior sealing strip, which is incorporated into the sealing system on the structural concrete side. Structural joints on structures made of waterproof concrete can be sealed with an exterior strip of Lucobit®.

Sealing of structural joints

9.2.2 Flexible vertical sealing for foundations and masonry with soil contact

Flexible vertical seals can be applied to the masonry without any major cleaning or drying of the foundation. This system considerably reduces time and costs and also has excellent thermal insulation properties.

Vertical sealing

9.3 Bridge construction

Lucobit® roofing and sealing membranes are also used in underpasses and overpasses during bridge construction. Their root resistance ensures optimum protection for elements that are in contact with soil.

9.4 Landfill construction

As basic sealing above the geological barrier for hazardous waste landfills, Germany's "TA-Abfall" (technical instructions on waste management) recommends a combination seal consisting of a 2.5 mm thick plastic sealing membrane pressure-moulded to a mineral seal. In the long run, chlorinated hydrocarbons can permeate through plastic sealing membranes. The permeation rate for HDPE plastics is particularly low, tending toward zero when used in a combination seal. The Contrep® sealing system goes beyond the requirements specified in "TA-Abfall" in regard to the following points:

- multi-mineral base seal instead of a seal composed of only one type of clay.
- manageable and repairable Contrep® system double-layer plastic sealing membrane instead of single-layer plastic sealing membrane on a mineral seal.

Lucobit® sealing membranes have extremely high biaxial stretchability. Therefore, they adapt more easily to deformations on the base of a landfill caused by settling. This also enables a superior pressure bond between the mineral seal and plastic sealing membrane — important for an effective combination seal. Because of their formability, it is easier to lay these sealing membranes on the construction site than stiffer HDPE membranes.

Sealing of landfills

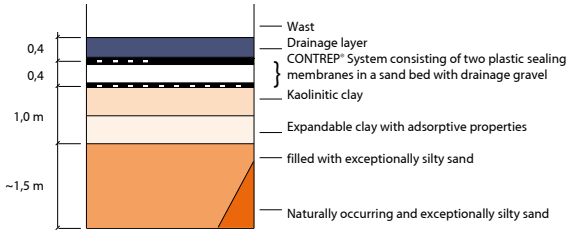
9.4.1 Contrep® sealing

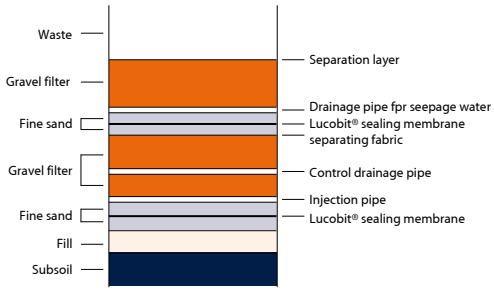
The upper sealing layer of the multi-mineral base sealing with kaolinitic clay minerals provides a durable seal against seepage water. Kaolin is highly resistant to seepage water. The underlying expandable clay mineral sealing layer also serves as a sealing, but is able to filter and bind certain pollutants from the landfill seepage water, too.

Contrep® seals consist of two plastic sealing membranes. A 30 cm layer of coarse gravel and two 10 cm layers of protective sand are located between these membranes. The two membranes are connected every 50 m in both longitudinal and lateral directions by diagonally welded plastic webs to form air-tight sealing compartments.

Contrep® is a Bilifinger + Berger AG brand.

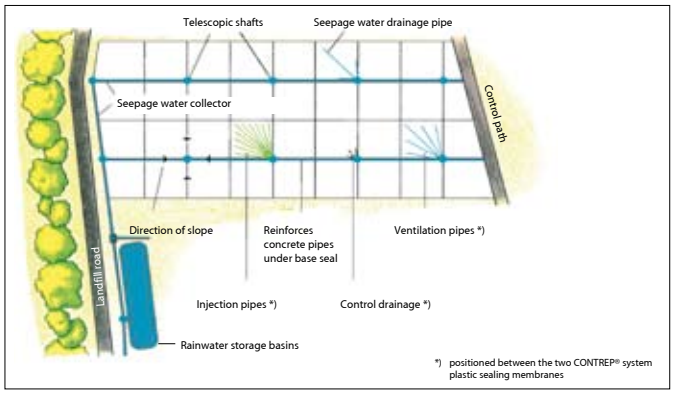
This system is used at BASF's Flotzgrün landfill (near Heidelberg).





Layer structure

9.4.2 Schematic diagram of the base seal with telescopic shafts



Telescopic shaft

9.4.3 Landfill surface sealing

The landfill surface needs to be sealed after filling the landfill to avoid endless maintenance due to the extensive seepage water, as well as to enable the discharge of the methane gas being produced. The cover should also make cultivation of the landfill surface possible. For hazardous waste landfills, "TA-Abfall" specifies that "the landfill surface sealing system shall be designed in such a way that leaks can be localized and repaired for as long as necessary".

Landfill surface sealing

9.5 Sealing of tunne

There are many requirements for sealing membranes in tunnels. They have to be

- able to withstand the difficult installation conditions that come with rough, irregular subsurfaces and the generally tough working conditions that exist during tunnelling operations
- reliable and easy to work with to avoid unforeseen problems at the construction site as much as possible
- capable of enduring concrete pressure (400-600 kPa) un scathed during inner shell installation while lying evenly on the sprayed concrete backing
- highly resistant to aging, since the average lifespan of a tunnel structure is at least 70 years

9.6 Hydraulic structures

Lucobit® membranes are a proven technical solution for:

- large-scale channel and ditch systems for irrigating and cultivating areas of land
- dams supplying drinking water and regulating water flow
- ponds and watercourses for landscaping
- collection and retention basins for water storage at (e.g.) plant nurseries, or as rainwater retention basins to relieve runoff systems
- basins for sewage treatment and in agriculture, e.g. liquid manure basins

Sealing for hydraulic structures with an expected lifespan

of 50 years or more requires careful planning. The chosen material has to match the structure's specific requirements. Sealing membrane production and installation is usually put in the hands of one subcontractor. The latter should take a critical look at the construction plans in respect to feasibility and, if necessary, propose changes and/or enhancements. Lucobit® and Lucofin® offer versatile solutions for even the most difficult problems. LUCOBIT AG products can help ensure an economical and durable structure over the long term. Design and construction errors, in contrast, can have catastrophic consequences and can lead to spiralling budget overruns. Therefore, safety and attention to detail always has to take precedent in every phase of hydraulic engineering planning and implementation.

Sealing a creek system

Sealing a pond

_ 10 Please note

The information in this manual is based on our current knowledge and experience. It does not reduce the need for users to conduct their own tests and trials, due to the abundance of potential influences that exist when working with our products. A legally binding guarantee of certain properties or suitability for a specific application cannot be derived from this information. The recipient of our products is solely responsible for observing any trademarks as well as existing laws and regulations.

_ 11 *Appendix: Testing Standards*

- DIN EN 1850-2 (Determination of visible defects)
- DIN EN 1848-2 (Determination of length, width, straightness and flatness)
- DIN EN 1849-2 (Determination of thickness and mass per unit)
- DIN EN 1928: 2000 Method B (Determination of water tightness)
- DIN EN 1847, 28d/23 C with DIN EN 12311-2 (Methods for exposure to liquid chemicals, including water)
- DIN EN 1847, 28d/23 C with DIN EN 12311-2 (Methods for exposure to liquid chemicals, including water)
- ENV 1187, prEN 13501-5 (Test methods for external fire exposure to roofs)
- ENV 1187, prEN 13501-5 (Test methods for external fire exposure to roofs)
- ENV 1187, prEN 13501-5 (Test methods for external fire exposure to roofs)
- DIN EN 1850-2 (Determination of visible defects)
- DIN EN 1850-2 (Determination of visible defects)
- ENV 1187, prEN 13501-5 (Test methods for external fire exposure to roofs)
- DIN EN 13501-1 or DIN EN ISO 11925-2 (Fire classification of construction products and building elements)
- DIN EN 13583 (Determination of hail resistance)
- DIN EN 12316-2 (Determination of peel resistance of joints)
- DIN EN 12317-2 (Determination of sheer resistance of joints)
- DIN EN 1931 (Determination of water vapor transmission properties)
- DIN EN 1931 (Determination of water vapor transmission properties)
- For sheets with inlays: DIN EN 12311-2 Method A (Determination of tensile properties)
- For homogeneous sheets: DIN EN 12311-2 Method B (Determination of breaking strength and elongation at break)
- DIN EN 12691 (Determination of resistance to impact)
- DIN EN 12730, Method B (Determination of resistance to static loading)
- DIN EN 12310-2 (Determination of resistance to tearing)
- DIN EN 13948 (only for green roofs: Determination of resistance to root penetration)
- DIN EN 1107-2 (Determination of dimensional stability)
- DIN EN 495-5 (Determination of foldability at low temperatures)
- DIN EN 1297, Ind. B.1 with 500 UV for A, B with 500h UV for C,D subsequently DIN EN 495-5 (Method of artificial aging by long term exposure to the combination of UV radiation, elevated temperature and water)
- DIN EN 1844 (only for elastomers sheets: Determination of resistance to ozone)
- prEN 1548:2000 (Method for exposure to bitumen)

Status: August 2008

LOCATIONS

LUCOBIT
THERMOPLASTIC POLYOLEFINS

LUCOBIT Aktiengesellschaft
Brühler Str. / LyondellBasell • B100
D-50389 Wesseling
Telefon +49 (0) 22 36 / 3 78 59 0
Telefax +49 (0) 22 36 / 3 78 59 99
info@lucobit.de • www.lucobit.com