

# QUALIFICATION FOR INSTALLER

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## 1. QUALIFICATION FOR INSTALLER

### Recommendations:

The installation team must be familiar with BENFELT installation guidelines and be trained in GCL installation.

Installer shall have experience installing GCLs on at least 5 projects and have installed a minimum of 500 thousand m<sup>2</sup> of GCL materials.



### The manual is based on experience and standards:

- The suitability of the materials used as documented by certificates and statements from authorized testing institutes.
- Documentation of the specific attestations or delivery notes of the materials used at the construction site involved.
- Control during the execution itself according to the manufacturer's technology:
- visual inspection of the underlayment before the actual installation,
- visual inspection of the connections with inspection of the width of the coverage of the BENFELT bentonite mats,
- visual inspection of detail workmanship,
- step-by-step handing over of the insulation system as a covered structure before installation of the following layers.

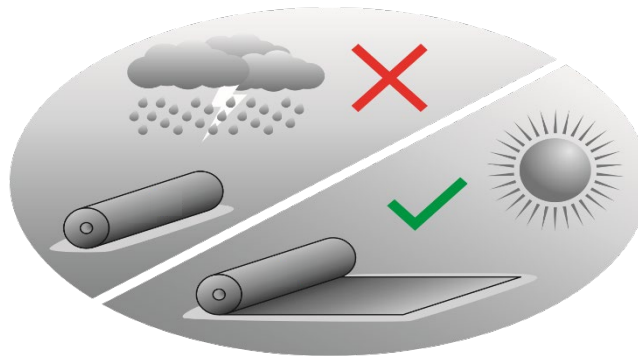


# WEATHER CONDITIONS FOR INSTALLATION

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## 2. WEATHER CONDITIONS FOR INSTALLATION



Light rainfall should not affect the BENFELT installation provided that the deployed panels are covered and protected with 300 mm of topsoil (or equivalent) within 2 hours from first contact with light rain. During heavy rainfall BENFELT panels shall be covered with a tarpaulin or plastic sheet if there is not enough time to complete the top layer deployment on the mat.

Avoid placing BENFELT panels in areas where water runs off unless the panels can be immediately covered (with 300 mm soil cover or equivalent).

In the event of BENFELT GCL gets wet before it is covered, it is best to contact Geofelt team. to determine if the GCL may still be useful. It depends on the degree of swelling of the bentonite inside the mat.

Puddles should be removed prior to soil application on the GCL. Slight movement on the wet bentonite mat during installation is possible, but should be minimized as much as possible.

Special care must be taken to ensure that the panels have not shrunk, thereby reducing the overlap area. If this is the case the overlaps must be filled in following the guidelines of the repair section GCL of this manual.

As demonstrated by freeze-thaw -and heat and rain tests, GCL does not change its properties under their influence.



# SUBGRADE PREPARATION

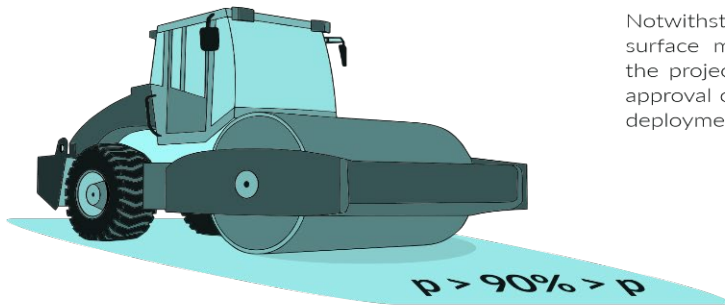
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### 3. SUBGRADE PREPARATION

When installing BENFELT GCL on a soil subgrade, the finished surface should be smooth without any abrupt elevation changes, voids, cracks, ice, or standing water. In addition, it should be firm and unyielding, and compacted to a degree so that deployment or other construction equipment does not leave tracks or ruts greater than 25 mm in depth.

Surface, on which you plan to install the BENFELT GCL must be free of sharp rocks, organic matter and other objects larger than 50 mm. The subgrade should be compacted at least 90% of its proctor density. While compacting with a smooth-wheeled or rubber-tired roller, try to keep the surface free of water. The GCL may be installed on a frozen subgrade, however only if the subgrade soil in the unfrozen state meets the requirements listed above.



Notwithstanding the above requirements, the subgrade surface must also be prepared in strict accordance with the project drawings and specifications, and the engineer's approval of the subgrade must be obtained prior to material deployment.



SUBGRADE PREPARATION



# INSTALLATION

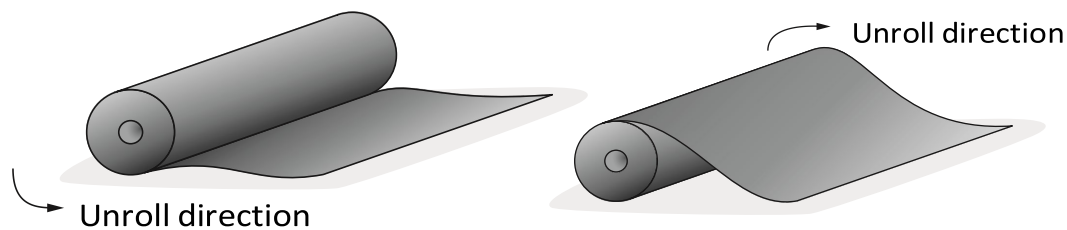
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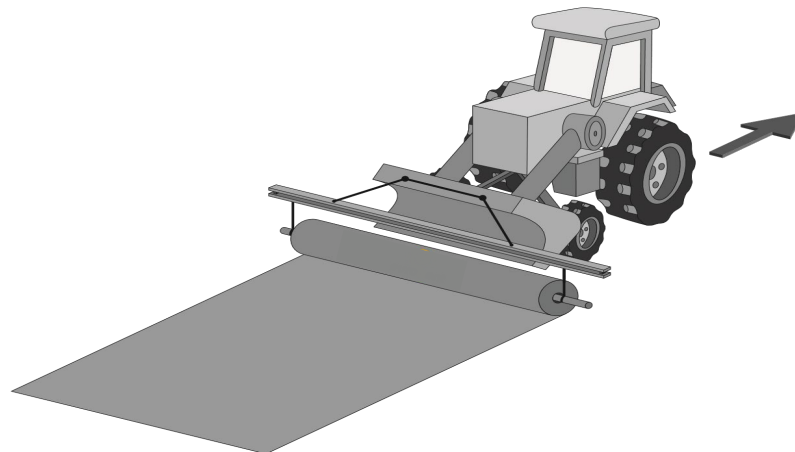


## 4. INSTALLATION

BENFELT GCL rolls should be transported to the point of application in their original packaging with label identification and in accordance with the guidelines. The surface placement of the GCL (i.e. which side faces up) may be important if the GCL contains different types of geosynthetics. Always check with the designer or project manager to determine which face up GCL to lay. If a specific orientation is not indicated or required, unroll the GCL from the bottom rather than pull the flap from the top. Care should be taken when removing the packaging to avoid damaging the rolls. GCL rolls should not be freely unrolled down the slope.



Equipment which could damage the GCL should not be allowed to move directly on it. Allowable equipment which may be utilized on the GCL is limited to lightweight ATVs with a maximum bearing capacity of 5 psi (21.5 kPa). Care should always be taken in the operation of any equipment on the GCL so as to avoid sudden starts and stops, abrupt turns, or other manoeuvres that could damage the GCL.



To minimize the traffic on BENFELT GCL, installation can be accomplished by unrolling the GCL in front of a vehicle traveling backwards. If ruts or other damage to the substrate occurs at the installation site, these should be repaired before further laying of GCL or other material. Alternatively, if sufficient access is available, the GCL roll can be unrolled by hanging it from a spreader bar at the top of the slope and using a group of workers and equipment to unroll the material from the roll and pull it down the slope.





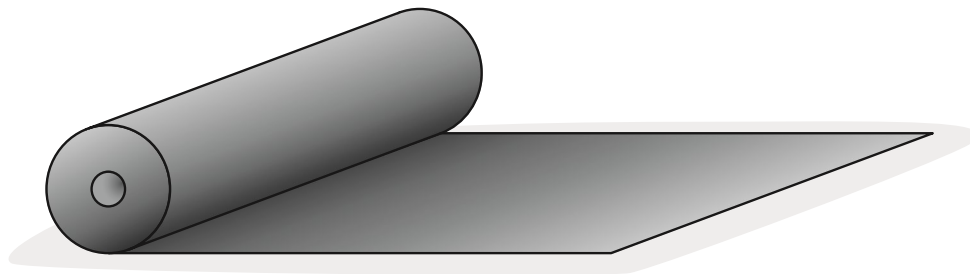
Regardless of the deployment method, care must be taken to minimize the extent to which the roll is dragged across the subgrade or other surface in order to prevent damage to the GCL. Care must also be taken when adjusting the GCL panels to avoid damage to the geotextile surface by the subgrade or another adjacent geosynthetic material such as a textured geomembrane. A temporary geosynthetic/geomembrane sheet, commonly known as a slip sheet or rub sheet, may be used to prevent or reduce friction damage during placement.

## GCL PLACEMENT

BENFELT GCL shall be placed in a way that longitudinal joints are parallel to the slope direction. Transversal joints should also be located a minimum of 1 m from the toe and crest of any slopes steeper than 4H:1V. End seams on slopes should be used only if the liner is not expected to be in tension and interface friction testing confirms this.

BENFELT GCL should be placed to lie flat, without any folds, especially at the exposed edges.

Panels should not be installed in standing water or during rain. To ensure proper GCL performance, panels shall be covered with soil, geomembrane or other cover layer at the end of the working day.



## PANEL OVERLAPS AND SEAMING

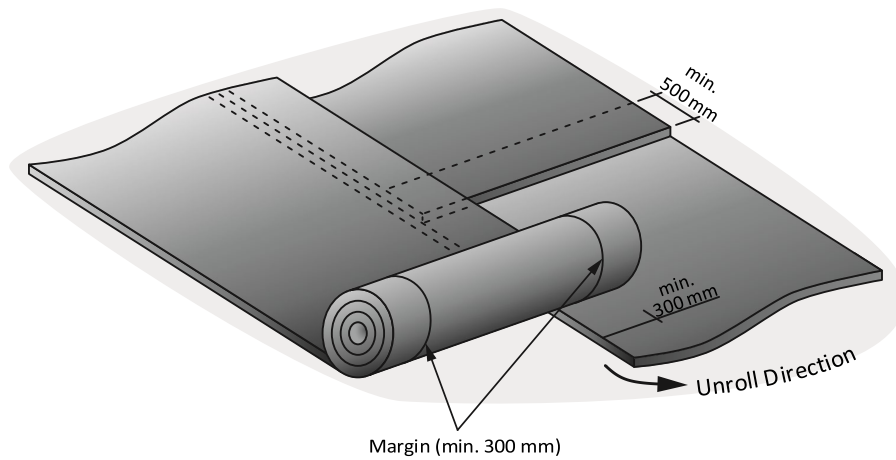
GCL overlaps are formed by overlapping adjacent edges. Ensure that the overlap area is not contaminated with loose soil or other debris.

Do not walk or drive over overlap areas.

Overlaps shall be designed to be arranged in the direction of the slope in a manner that prevents the possibility of flow into the overlap zone (tile application principle).

T-shaped overlaps (cross-connecting three or four panels at one point) should be kept to a minimum. Two adjacent overlaps at the ends (cross overlaps) are not permitted. Overlaps at low points should be avoided.

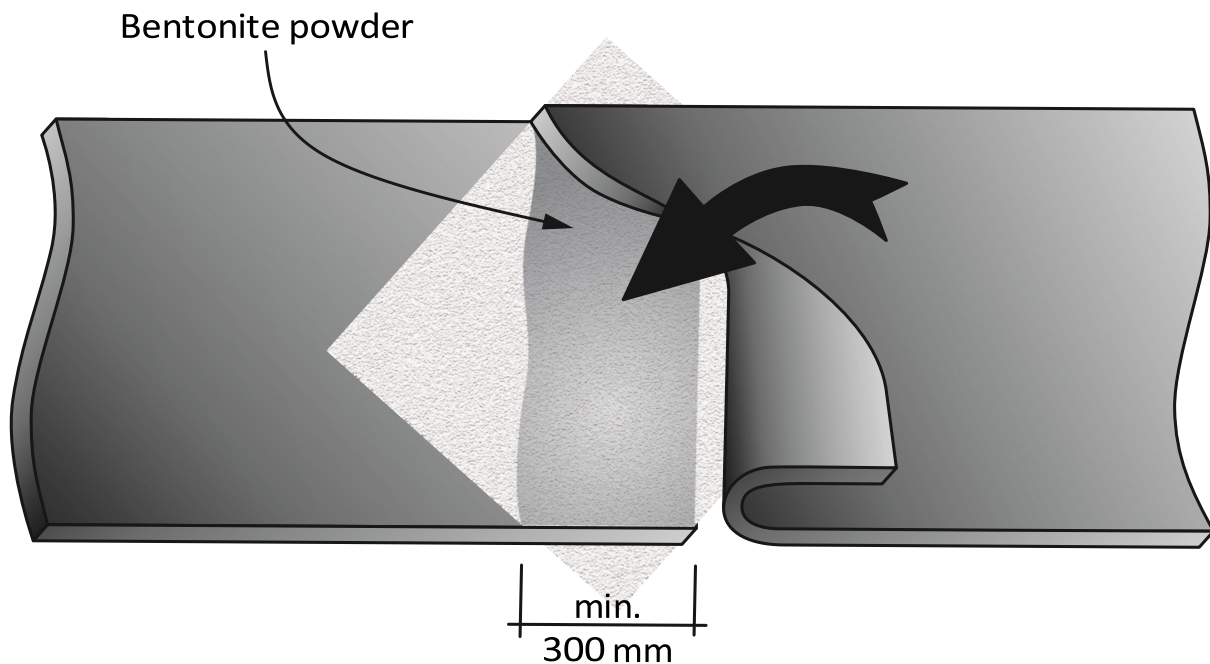




Unless otherwise specified, the minimum longitudinal overlap dimension should be 300 mm. BENFELT edge lapping lines allow alignment during unrolling. The lines can be printed by the manufacturer if required by the project specification.

Transverse overlaps should be similar but the minimum overlap should be 500 mm.

BENFELT edges can be printed according to customer's request. The standard overprint is two lines, where one of them is 15 cm from the longitudinal edge of the mat, but this can be customized. At Eurobent it is possible to print the name of the product or the project on the edge of the mat.



Care should be taken to maintain these overlap dimensions during covering, in all climatic conditions.

It may be necessary to place sandbags or other approved ballast over the overlap areas to prevent uplift in strong winds. Rolls should be adjusted to smooth out wrinkles or folds between adjacent panels, leaving adequate overlap and should be free of wrinkles, folds when covered.

#### **Longitudinal overlaps:**

It is necessary that the woven side of BENFELT types overlaps at least 300 mm of nonwoven side, that has to be first impregnated with bentonite delivered in bags.

#### **Transverse overlaps:**

It is necessary that the woven side of BENFELT types overlaps at least 500 mm of nonwoven side, that has to be first impregnated with bentonite delivered in bags.

#### **NOTE:**

In case of design requirement, the longitudinal edges of BENFELT rolls can be prefabricated with bentonite powder at the production stage.

#### **Bentonite powder:**

These overlapping edges are rolled upwards and bentonite similar to that used in the product shall be poured in a suitable manner over the width included in the design (200 - 300 mm) continuously along all edges of the seam, typically 0.8 kg/m.

After placing the bentonite powder in the overlap zone, place the adjacent EUROBENT roll in this area. If using a bentonite paste, this should be done shortly after applying it to avoid drying out the wet bentonite.

BENFELT GCL is also available in a CS version (with an additional PE geomembrane layer), which ensures complete water impermeability. The geomembrane can be fixed in three ways, depending on customer guidelines:

- The membrane is glued over the whole surface (no free welding areas)
- As attached sketch No 1 – on one side free welding strip (area without glue)
- As attached sketch No 2 – on both sides free welding strip (area without glue)



## Overlapping

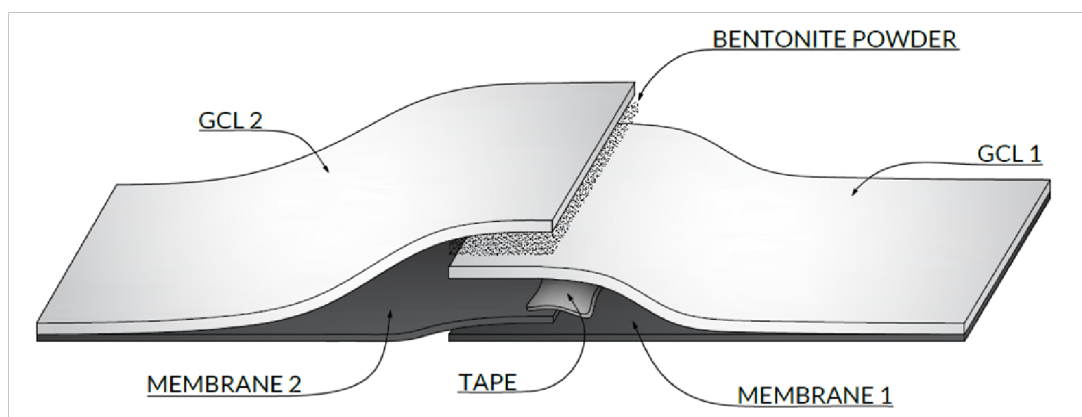
One of the most important parts of the GCL assembly is connecting the individual panels together. To do this, the overlap joints must be made correctly. Here we will focus on joining GCL CS to each other.

### NOTE:

The membrane in CS shall always face the side of water pressure, therefore two scenarios can occur during installation and assembly:

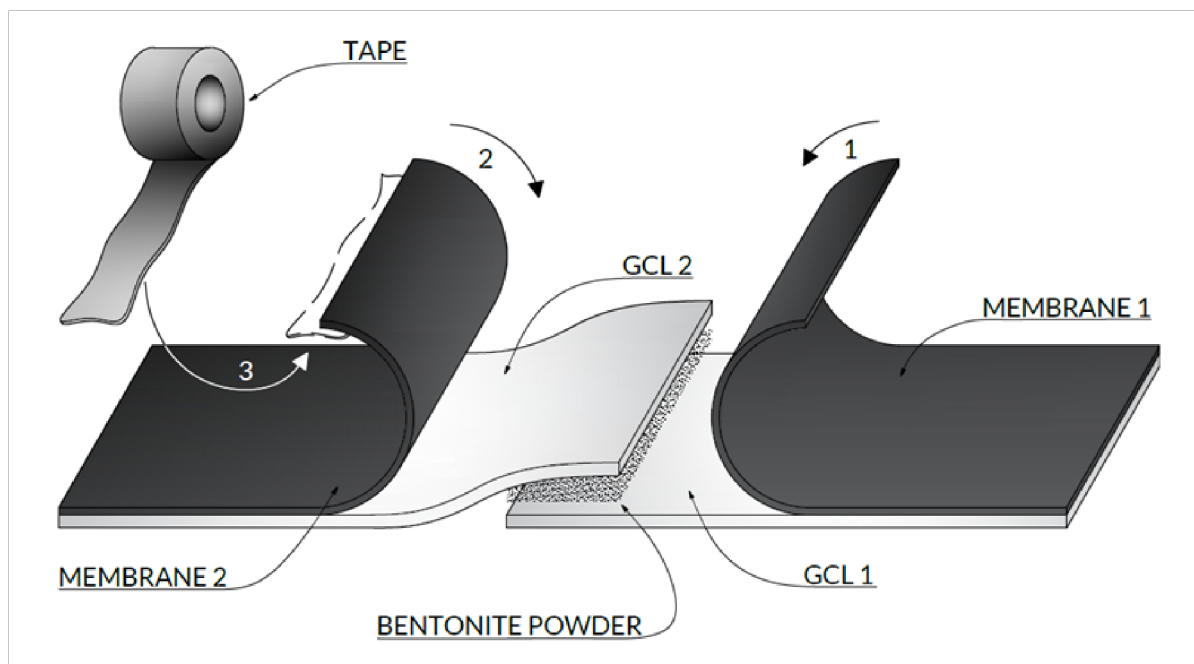
### Geomembrane on the bottom

1. The GCL shall be folded so that the geomembrane can be visible.
2. The surface of the geomembrane shall be cleaned with acetone or similar agent. This action secures then integrity of combining. Clean and dry membrane surface before combining is a must.
3. The geomembrane of the panel 1 shall be covered with geomembrane of the panel 2, creating overlap.
4. The tape shall be placed in the middle of the combining spot, so that the half of the tape shall be on side 1 and the other half on the side 2 of the combining line.
5. After combining the geomembranes, left GCL shall be unfolded, covering the geomembranes.
6. The bentonite shall be poured on the edge of one panel (in this case 1 one).
7. The panel 2 shall be unfolded, covering the layer of bentonite and left panel.
8. Now the panels are ready for the next phase of the combining. There shall be some space without bentonite for the leister.
9. The overlap shall be combined with leister in order to secure the Integrity of the bond and avoid the separation.



### Geomembrane on the top

1. To combine the two panels, the foil shall be folded. Both edges of the liner are not glued, so there shall be no problem with folding the whole panel (40 m). The width of the glue-free margin is 300 mm.
2. The bentonite shall be poured on the edge of one panel (in this case on panel 1).
3. The panels shall be combined by placing the panel 2 on the margin of panel 1. There is a layer of bentonite between those two panels. Now the panels are ready for phase two of combining.
4. The surface of the foil shall be cleaned with acetone or similar agent.
5. This action secures the integrity of combining. Clean membrane surface before combining is a must. The membranes of the two panels shall be overlapped in the same order. First the membrane from the panel 1 and then from the panel 2.
6. The tape shall be placed in the middle of the combining spot, so that the half of the tape shall be on a left side and the other half on the right side of the combining line.



#### NOTE:

To combine two panels of GCL CS we recommend single-sided, self-adhesive bitumen waterproofing tape which maintains excellent adhesion even at low temperatures. Recommended width: approx. 100 mm.

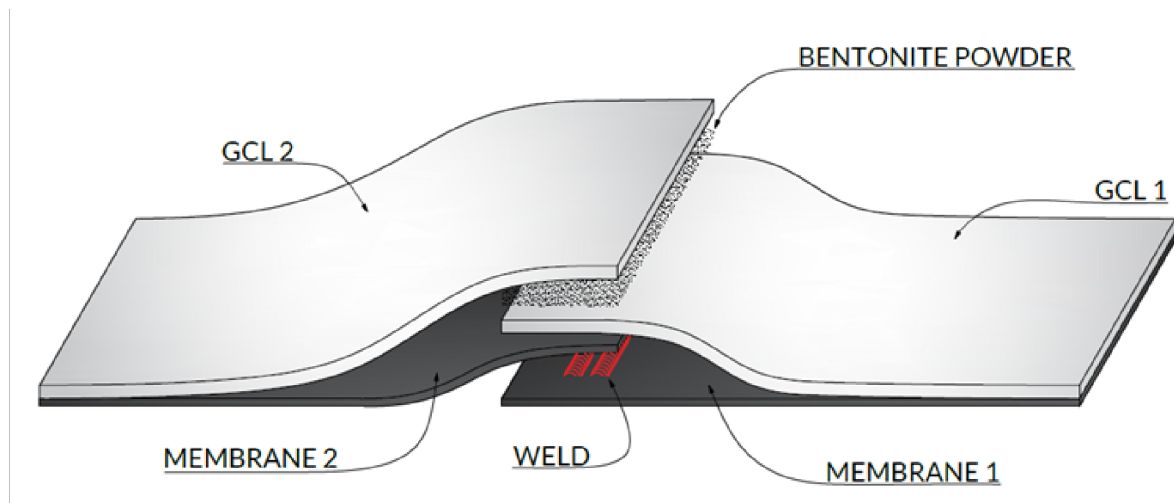


## Geomembrane welding

When using GCL with a geomembrane that is thick enough to allow welded joints (from 0,6 mm and up), follow the instructions above with scenarios one or two. In principle, the steps for laying the individual layers do not change, only the form of joining the geomembrane is different.

## Geomembrane on the bottom – welding

1. The GCL shall be folded so that the Geomembrane can be visible.
2. The surface of the Geomembrane shall be cleaned using acetone or similar agent. This action secures the integrity of combining. Clean membrane surface before combining is a must.
3. The Geomembrane of the panel 1 shall be covered with Geomembrane of the panel 2, creating overlap.
4. Welding shall be done in accordance with geomembrane welding principles.
5. After combining the Geomembranes, left GCL shall be unfolded, covering the geomembranes.
6. The bentonite shall be poured on the edge of one panel (in this case 1 one).
7. The panel 2 shall be unfolded, covering the layer of bentonite and left panel.
8. Now the panels are ready for the next phase of the combining. There shall be some space without bentonite for the leister.
9. The overlap shall be combined with leister In order to secure the Integrity of the bond and avoid the separation.

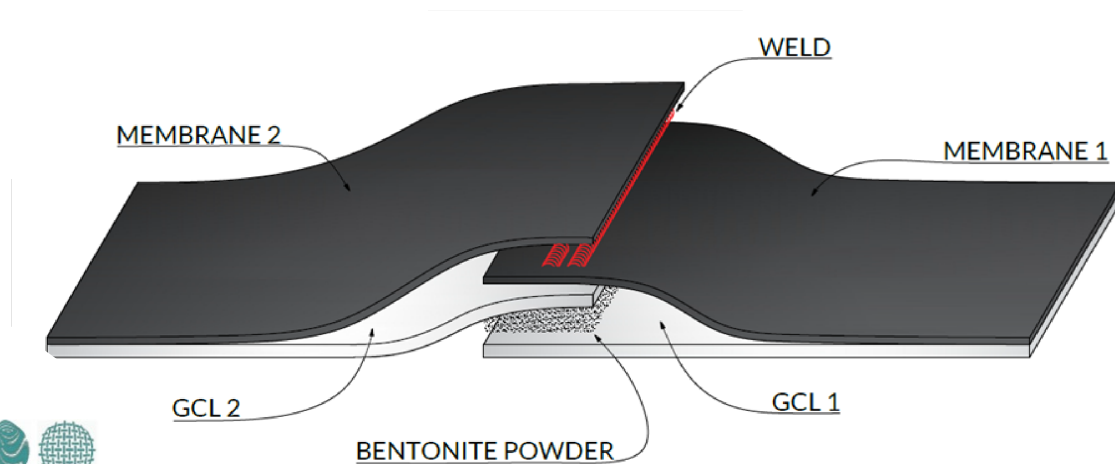






### Geomembrane on the top – welding

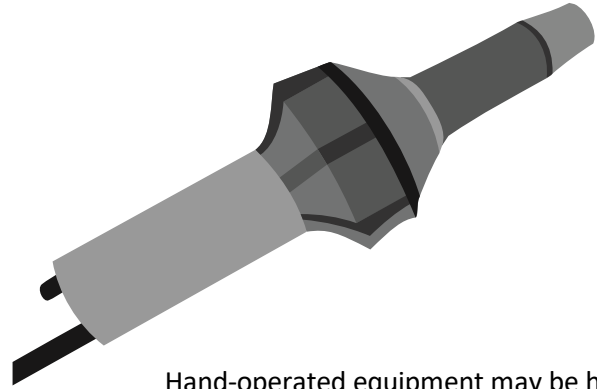
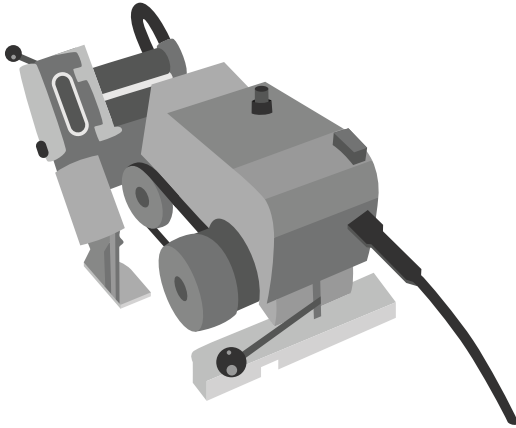
1. To combine the two panels, the foil shall be folded. Both edges of the liner are not glued, so there shall be no problem with folding the whole panel (40 m). The width of the glue-free margin is 300 mm.
2. The bentonite shall be poured on the edge of one panel (in this case on panel 1).
3. The panels shall be combined by placing the panel 2 on the margin of panel 1. Between those two panels is a layer of bentonite. Now the panels are ready for phase two of combining.
4. The surface of the foil shall be cleaned with acetone or similar agent.
5. This action secures the integrity of combining. Clean membrane surface before combining is a must. The membranes of the two panels shall be overlapped in the same order. First the membrane from the panel 1 and then from the panel 2.
6. Welding shall be done in accordance with geomembrane welding principles.





**NOTE:**

For welding waterproofing membranes, we recommend machines with adjustable parameters: temperature, speed and air flow.



Hand-operated equipment may be helpful to seal difficult areas.

