Winterizing the RHU
The Relief Housing Unit (RHU) is an all-weather shelter modular for global use.

For use in cold climate, the shelter needs to be winterized, i.e. insulated and heated.

Better Shelter has collaborated and supported several partners in winterizing the RHU:

- MSB / DG-ECHO winterization of family shelters in Ukraine, Q3-Q4 2022.
- EuroRelief winterization of ca. 240 family shelters in Mavrovouni camp Lesvos, Greece, 2021-2022.
- UNHCR winterization of reception centres in the Balkans, 2015-2016.
“A few women came up to us to say thank you because it’s been making a huge difference. One woman has arthritis and it’s been getting less painful because it’s warmer inside her place. Some women don’t even use their heater anymore and can live in t-shirts in the wintertime in their RHUs.”

Statement by EuroRelief, January 2022
RHU winterization approach for Ukraine

Design objective
Together with MSB, Better Shelter has developed and tested a winterization approach for the Ukraine response, which:

- provides adequate indoor temperatures during winter
- is possible to retrofit to already installed RHU (and thereby enable a phased approach where the RHU is provided in phase 1 and winterization in phase 2)
- consists of standard building materials commonly available in the supply chain in and around Ukraine.
- Cost of approximately 1000-1500 Euro for 1 shelter of 17.5m²
- Installation time of less than six hours

General description

Foundation and floor
- Raised floor/deck made of joists and plywood
- 50mm hard insulation below floor
- RHU installed on top
- Plastic sheeting floor

Externally
- Wooden frames around openings
- Tarpaulin skirts for water proofing
- Wooden frame over RHU walls and roof with a 1200mm distance
- Stone wool 100mm
- Tarpaulin to cover gable, walls and roof
- RHU door, window and ventilation frames installed

Please see Annex 1 for BoQ and Annex 2 for a more step-by-step description. Appendix 3 shows a more durable cladding alternative to the plastic sheeting.
Climate chambre test

Conclusion

Climate testing indicates that the winterized RHU will achieve a 30-degree difference between the inside and outside temperate, i.e., at -15°C outside the RHU will maintain an indoor temperature of +15°C.

Better Shelter has tested the winterized RHU (17.5m²) in a climate chambre, where it was built and winterized, and equipped with sensors and heaters.

Winterization: wood framing around openings and C-C every 1200mm, 100mm stone wool on walls and roof, plastic sheeting, 50mm of stone wool/polystyrene on floor, 15mm plywood floorboards, 50mm of stone wool in door opening.

The internal and external temperatures were measured, while the climate chambre temperature was lowered to -20°C.

Results from the tests show:
• a temperature difference of 37-degrees between the interior and the exterior can be achieved with insulation and the use of a 2100W heater.
• Since there was no soil nor wind affecting the temperature in the chambre, it is estimated that a temperature difference of around 30-degree can be reached in the field. E.g., 15°C outside and +15°C inside.
• To compensate for heat loss while opening the door a bigger heater than 2100W is recommended.

The difference in temperature can be increased if the heater power is increased.
Appendixes
## Winterization of a 3 bay, 17.5m² RHU (single unit), estimated quantities

<table>
<thead>
<tr>
<th>Element</th>
<th>Material</th>
<th>Specifications</th>
<th>Unit</th>
<th>Amount</th>
<th>Comment</th>
<th>Link to product</th>
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</thead>
<tbody>
<tr>
<td>Floor, construction, footing</td>
<td>Concrete tiles</td>
<td>350 x 350 x 50mm (or a local available equivalent)</td>
<td>pcs</td>
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<td>Floor, structural, beams</td>
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<td></td>
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<td>Floor, structural, beams</td>
<td>Wood</td>
<td>alternative, 45 x 145 x 4200mm, pressure impregnated</td>
<td>pcs</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Floor, structural, floor</td>
<td>OSB</td>
<td>1220 x 2440 x 18mm</td>
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<tr>
<td>Floor, insulation</td>
<td>Polystyreen</td>
<td>50mm thick, 600 x 1200mm</td>
<td>pcs</td>
<td>29</td>
<td>Please consider fire safety</td>
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<tr>
<td>Floor, plastic sheeting</td>
<td>HDPE tape fabric, LDPE coating</td>
<td>delivered with RHU</td>
<td>pcs</td>
<td>0 incl. in RHU box B</td>
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<td></td>
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<tr>
<td>Floor, plastic sheeting</td>
<td>HDPE tape fabric, LDPE coating</td>
<td>Size: 2.3x4m, 180 gram/m², 100Kly</td>
<td>m²</td>
<td>-</td>
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<tr>
<td>Walls, insulation</td>
<td>Stonewool</td>
<td>Stone insulation panels 95X580X1170mm – 0.035W/mK</td>
<td>pcs</td>
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<td>Walls &amp; roof, frame</td>
<td>Wood</td>
<td>28 x 95 x 4200mm, impregnated wood</td>
<td>pcs</td>
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<td>Window, frame</td>
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<td>pcs</td>
<td>2</td>
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<tr>
<td>Ventilation, frame</td>
<td>Wood</td>
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<td>pcs</td>
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<td>Door, frame</td>
<td>Wood</td>
<td>28 x 95 x 4200mm, impregnated wood</td>
<td>pcs</td>
<td>1 plus left overs window and ventilation frames</td>
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<td>Fastening &amp; Fitting</td>
<td>Screws</td>
<td>80 x 5mm, galvanised</td>
<td>pcs</td>
<td>60</td>
<td>Floor beam screws</td>
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<td>Fastening &amp; Fitting</td>
<td>Screws</td>
<td>65 x 4mm, galvanised</td>
<td>pcs</td>
<td>116</td>
<td>Screws for insulation</td>
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<td>Fastening &amp; Fitting</td>
<td>Screws</td>
<td>40 x 4mm, galvanised</td>
<td>pcs</td>
<td>840</td>
<td>OSB to floor beams screws</td>
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<tr>
<td>Fastening &amp; Fitting</td>
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<td>Tarpaulin screws</td>
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<td>Fastening &amp; Fitting</td>
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<td>Screws for opening</td>
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<td>Disks to fixate insulation by screw</td>
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<td>Fastening &amp; Fitting</td>
<td>Washers</td>
<td>M5, 25mm, galvanised</td>
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<td>282</td>
<td>Openings, tarpaulin, panel</td>
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<td>Fastening &amp; Fitting</td>
<td>Gaskets</td>
<td>Rubber, 25mm</td>
<td>pcs</td>
<td>186</td>
<td>For water tightening of the tarpaulin</td>
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<td>Ducttape 50mmx50m</td>
<td>pcs</td>
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<td>Window, Glass</td>
<td>Plexiglass</td>
<td>Plexiglas windows 2mm, single window panel</td>
<td>pcs</td>
<td>4ca. 333x297mm / pcs</td>
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</tr>
</tbody>
</table>
Appendix 2 – RHU winterization approach
Step by step RHU Winterization

Place concrete tiles
Place wooden beams

Step by step RHU Winterization
Step by step RHU Winterization

Attach tarpaulin to floor beams: tarpaulin from RHU
Step by step RHU Winterization

**Install floor sheets** and continue with placing skirting and floor insulation as described in the ‘standard’ design.
Step by step RHU Winterization

Flip the floor upside down. This can be done in as one or multiple pieces depending on the weight and amount of people available.
Step by step RHU Winterization

Flip the floor with the right side up
Install foundation of the frame following the standard assembly manual.

Step by step RHU Winterization
Step by step RHU Winterization

**Install roof**: following the RHU manual install the roof including roof panels and gable panels on the structure.*

* The ventilation windows will be installed at a later time (4 x)
* Ridge hats not installed (6x)
Step by step RHU Winterization

Wall panels: according to RHU manual*

*leave windows out at this point in the assembly
Wood framing: creates attachment points for tarpaulin and openings and prevents insulation from being compromised.
Step by step RHU Winterization

Roof and Wall insulation: install stone wool insulation, 100mm on all walls and roof surfaces
**Step by step RHU Winterization**

**Install tarpaulin:** Attachments according to plastic-sheeting guideline. Pay extra attention to waterproofing: use washers and rubber gaskets to close off attachments.

Quality of tarpaulin and attention to detail is of the utmost importance. The insulation is sensitive to moisture to preventing water from passing through the tarpaulin is imperative.

Plastic-sheeting guideline at: [www.plastic-sheeting.org](http://www.plastic-sheeting.org)
Appendix 3 – RHU winterization approach upgrade roof/walls
Step by step RHU Winterization

Please see slide 10 to 20 for previous steps
Upgrade

*Place vapor open membrane* such as Tyvek on the insulation according to the product specifications

*Tape off membrane* on wooden window and door frames and reassemble frames
Upgrade

Place wooden battens vertically on top of the membrane at the locations of the wooden frames.

Place wooden battens horizontally on top of the previous battens.
Upgrade

Install lightweight finishing layer such as CGI on roof and walls or wood on the walls.
The purpose of this document is to show implementing partners the options for using structures or RHUs.

If you find any inconsistency in the content of this document or have any suggestions, we would love to hear from you.

Miguel Acebron Garcia de Eulate
Technical Support Manager

miguel.eulate@bettershelter.org
+46 702 99 18 24