

## Note

subject: Homebox, the insulated postbox; calculation of the U-value.  
date: 7 mei 2020  
reference: GH/GH//H 5636-3E-NO  
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To: TRIM Trading BV in Dordrecht/The Netherlands

### 1 Introduction

By order of TRIM Trading BV in Dordrecht/The Netherlands the thermal transmittance ( $U$ -value) of the insulated postbox - designed by Promea Industrial Design in Breda/The Netherlands - has been determined . It concerns a postbox with a (gross) outer size ("Outer- or Inner Flap") of width x height = 338 x 78 mm and an internal opening ("hole-opening" for the mail) of width x height = approx. 265 x 35 mm.

This document presents the principles and results of the  $U$ -value calculation of the postbox.

### 2 The assumptions of the calculations

Annex I shows part of the data used for the calculations and supplied by TRIM Trading BV.

In the image below 1 and 2 a projection respectively the vertical and horizontal cross sections are shown.

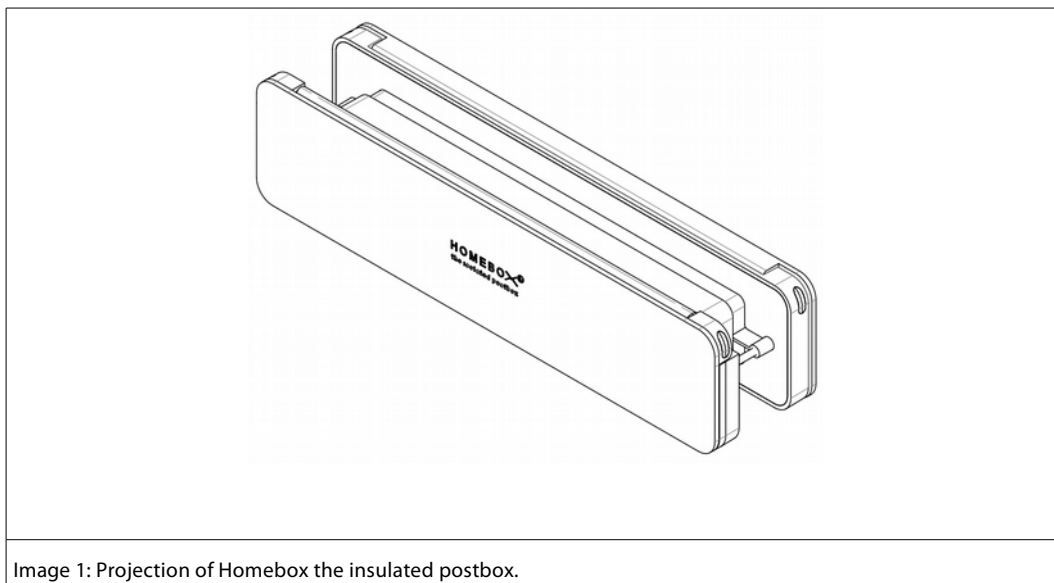


Image 1: Projection of Homebox the insulated postbox.

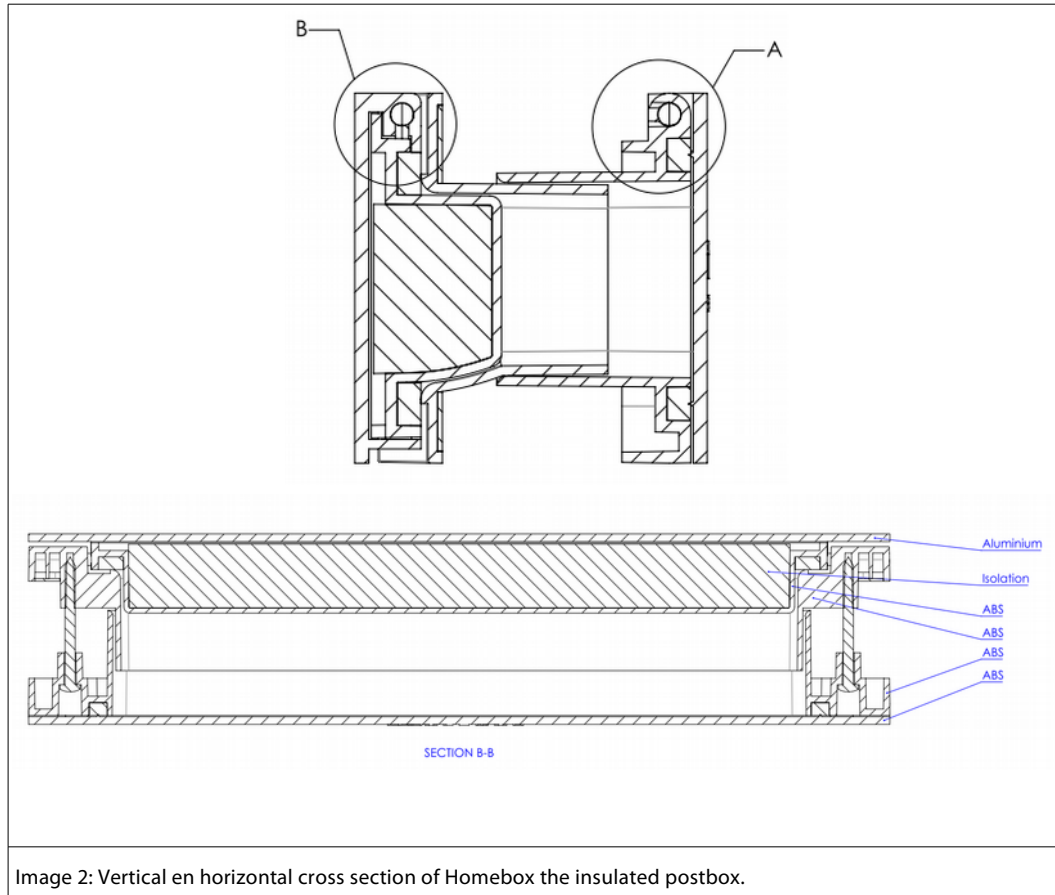


Image 2: Vertical en horizontal cross section of Homebox the insulated postbox.

As for the sizes, including the thickness of the flaps, etc., the drawings supplied by TRIM Trading BV have been used.

With regard to the thermal conductivity ( $\lambda$ -value) of the various materials, the values in table 1 have been used in the calculations, i.e. in accordance with NEN 1068: 2012\_ appendix F, NEN-EN-ISO 10077-2\_Annex A and partly communicated by TRIM Trading BV.

Table 1: Heat conductivity of materials used.

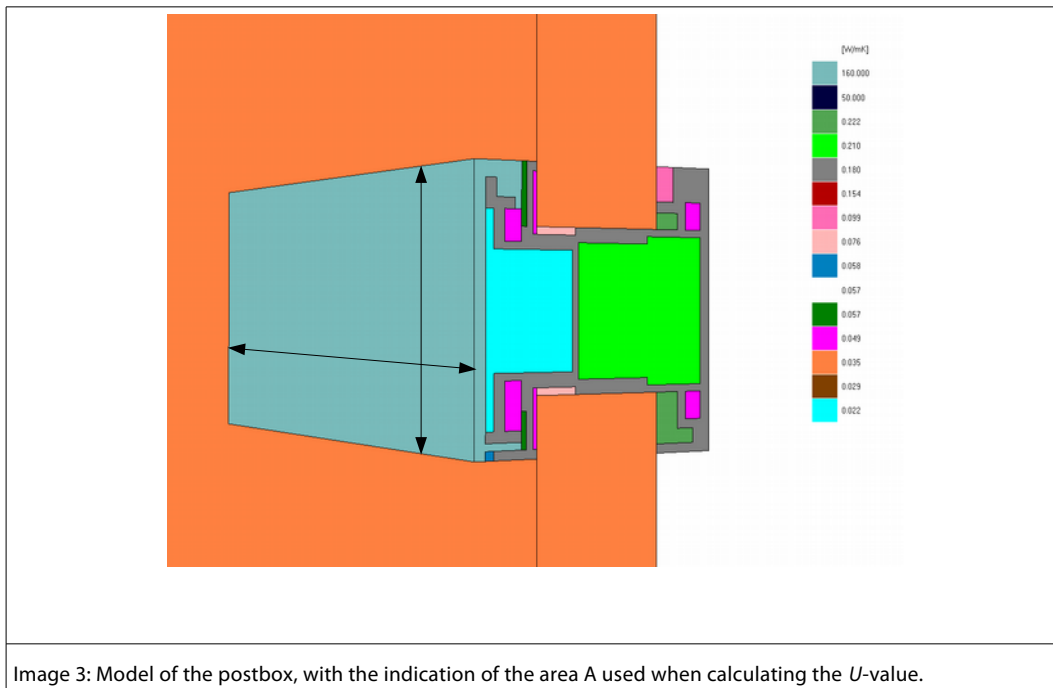
Material	$\lambda$ [W/(m·K)]
Aluminium	160
Steel	50
EPDM cellular rubber	0,05
PIR-isolation foam	0,022
ABS (kind of plastic)	0,18

The calculations are performed with the program Trisco, version 11.0w, from Physibel. This calculation software is based on the finite element method. This method divides a construction into a limited number of (finite) elements and links these elements together by means of nodes. This method makes it possible to approximate the behavior of a complex

construction by means of a matrix equation, in which various variables can be solved (for example the temperature). The program is based on a rectangular coordinate system. Sloping or round surfaces/parts are therefore entered in a calculation model gradually.

NB: in the present situation, a schematization has been carried out: the rounded corners of the valves etc. are implemented straight. Hereby it is ensured that the outdoor resp. internal areas in the calculation model are equal to a corresponding area of the actual situation in such a way that the model provides a reliable physical representation of the actual mailbox.

Given the symmetry, half of the postbox construction is simulated. Image 3 shows the computer model of the (half) postbox with a legend denoting the used thermal conductivity-coefficients of the various materials.



The connection of the postbox to the door leaf, the latter represented by a thermally insulated panel, is shown in image 3. In the model as well as with regard to the calculation of the  $U$ -value of the postbox, the relevant transmission area i.e. calculation boundary is shown by means of the arrows in picture 3.

The thermal transmission coefficient ( $U$ -value) of the postbox construction is calculated according to NEN 1068: 2012 "Thermal insulation of buildings – calculation methods".

In accordance with the NEN 1068 standard, adhering conditions are  $T_i = 18\text{ °C}$  on the inside and  $T_e = 0\text{ °C}$  on the outside.

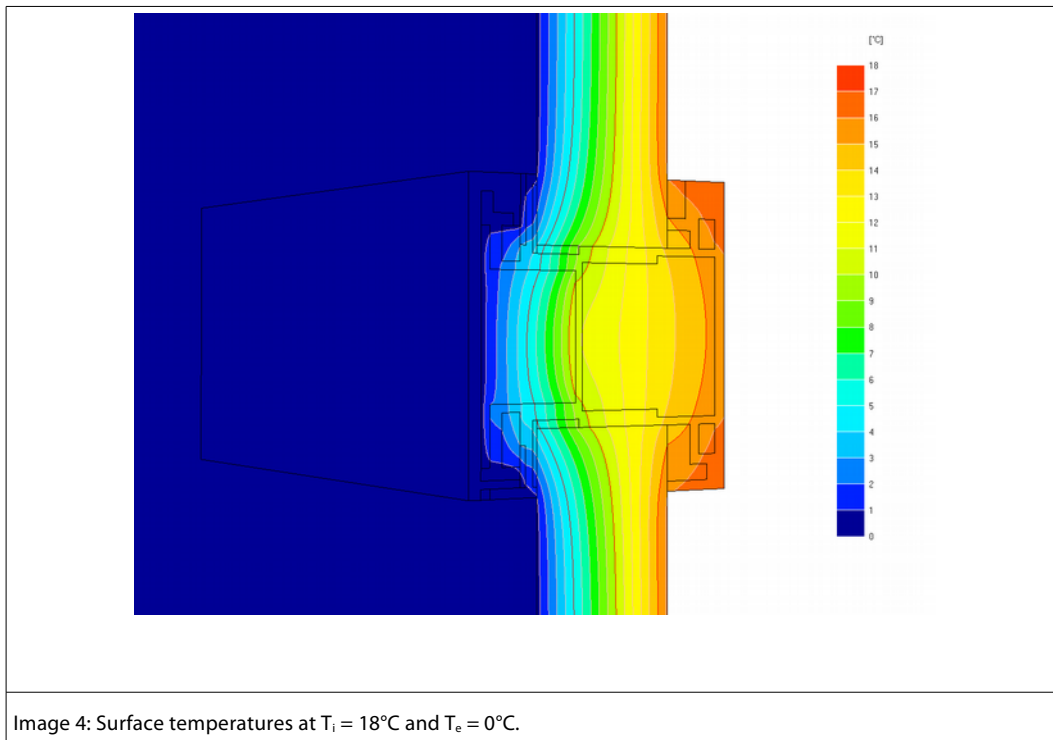
The thermal resistance coefficients used are (NEN-EN-ISO 10077-2\_Annex B):

- on the inside:  $R_{si} = 0,13\text{ m}^2\text{K/W}$ ;
- on the outside:  $R_{se} = 0,04\text{ m}^2\text{K/W}$ .

In closed position the postbox contains both ventilated and non-ventilated (tubular) air cavities. The equivalent thermal conductivity of these air cavities is determined in accordance with Appendix D of NEN 1068: 2012.

### 3 The results of the calculations

The results of the calculation with respect to the present thermally insulated postbox, with the (external) flap dimensions width x height = (½ x 338) x 78 mm = 169 x 78 mm, are shown in image 4 with the surface temperatures at  $T_i = 18\text{ °C}$  and  $T_e = 0\text{ °C}$  as well as the isotherms (the red lines refer to 15 °C, 10 °C and 5 °C).



The  $U$ -value of the postbox is determined according to the formula:

$Q = U \times A \times \Delta T$  with:

- $Q$  = the total calculated heat flow (flux in Watt) via the inside or outside of the postbox construction (indicated in image 3 with the black arrows), with the exception of the heat flux via the adjoining part of the (insulated) door construction;
- $\Delta T$  = the temperature difference inside versus outside,  $\Delta T = 18\text{ °C}$ ;
- $A$  = the projected area of the flap of the (half) postbox :  
 $A = (0,5 \times 0,338) \times 0,078 = 0,0132\text{ m}^2$ ; see also the black arrows in image 3.

The total heat flow calculated via the postbox section at  $\Delta T = 18\text{ °C}$  amounts to  $Q = 0,29\text{ Watt}$ .

According to the formula, the  $U$ -value of postbox can now be determined:

- based on the projected surface of the postbox:  $U = 1,23\text{ W/m}^2\cdot\text{K}$ .

Mook,

This note contains:

- 4 pages and 1 annex

