



**DANISH
TECHNOLOGICAL
INSTITUTE**

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Seite 1 aus 3
Anlagen 2
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Prüfbericht

- Probekörper: Isolierte Dachbodenluke, **Model CF76 Thermo**, weitere Details sind auf Seite 2 zu finden.
- Entnahme: Der Probekörper wurde vom Auftraggeber geliefert und 2017-09-28 am Technologischen Institut erhalten. Den Probekörper wurden vom Labor "757378a" gekennzeichnet.
- Verfahren: EN ISO 8990:1997 Thermal insulation – Determination of steady-state thermal transmission properties – Calibrated and guarded hot box.
EN ISO 12567-1:2010 + Thermal performance of windows and
EN ISO 12567-1:2011/AC: doors – Determination of thermal transmittance by hot box method – Part 1: Complete windows and doors.
- Zeitraum: Die Prüfung wurde von 2017-10-17 bis 2017-10-20 durchgeführt.
- Ergebnis: U-wert (U_{sp}): **0,38 W/m²·K** (vertikale Dachbodenluke)
Unsicherheit: $\pm 10\% \sim \pm 0,04 \text{ W/m}^2 \cdot \text{K}$
Das Ergebnis ist in Anlage 1 und 2 gezeigt.
- Bedingungen: Die Prüfung wurde auf die beigefügten Bedingungen nach den von DANAK (Dänische Akkreditierung) vorgeschriebenen Richtlinien durchgeführt. Die Prüfung gilt nur für das geprüfte Material. Der Prüfbericht darf nur wiedergegeben werden, wenn das Labor das Extrakt genehmigt hat.

2017-12-20, Dänisches Technologisches Institut, Glas und Fenster

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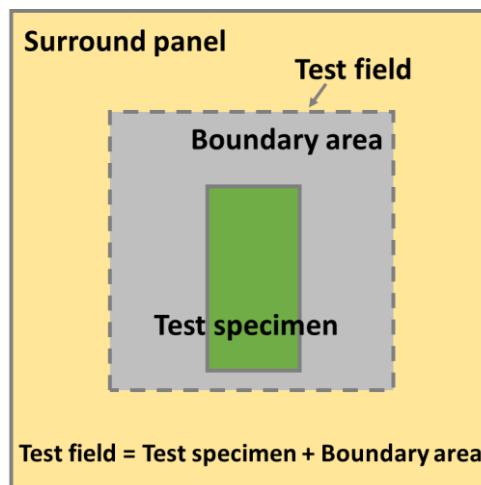
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Construction and assembly of test specimen

The Hot-box measurement is performed on a test field consisting of a test specimen with corresponding boundary area adapted to the total area of the test field. The measured value is therefore a total value for both areas (test specimen and boundary area).

When the test specimen is smaller than the test field itself, the area between the test specimen and the test field (boundary area) is insulated with EPS.

Test field = Test specimen + boundary area



Placement of test specimen

In all the following places the joints are covered with tape:

- Between test specimen and and insulation in the boundary area
- Between the insulation in the boundary area the surround panel
- Joints in the insulation in the boundary area

Comments to the construction

No further comments.

Dimensions of test specimen

The dimensions of the test aperture, the test specimen and the edge insulation was measured by the laboratory and appear from the table below.

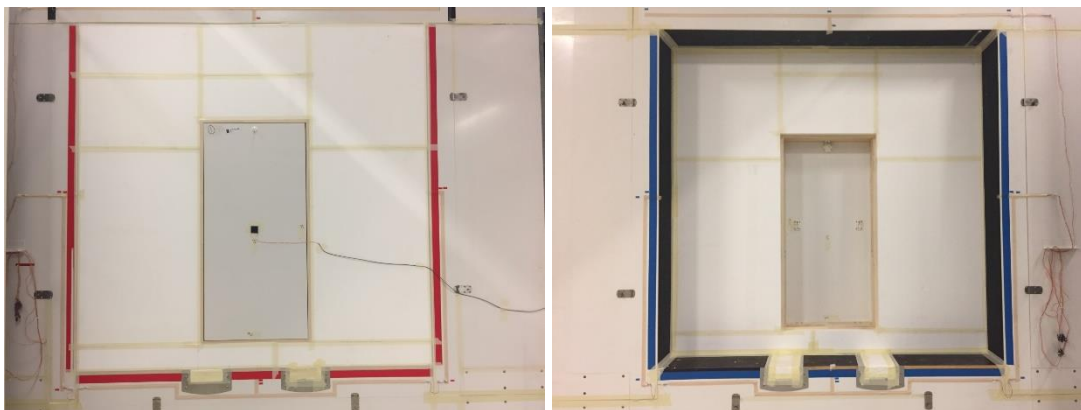
	Bredde [mm]	Højde [mm]	Tykkelse [mm]	Areal [m ²]
Test field	2150	2120	590	4,558
Test specimen	700	1400	240	0,980
Boundary area	-	-	300	3,578

Description of the test specimen

The test specimen consists of a loft hatch inserted in a wooden frame, see drawings in Appendix 2.

Pictures of the test specimen and installation

The test specimen was mounted vertical in the test aperture so that the warm side surface was level with the test specimen surface, see pictures below.



Test specimen seen from the warm side

Test specimen seen from the cold side

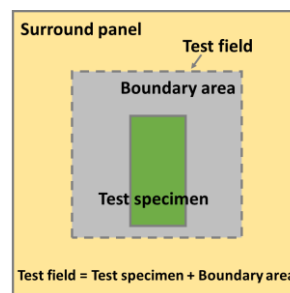
Results

The determination of the U-value of the combined construction, which consists of the test specimen and the boundary insulation, is conducted according to EN ISO 8990 and EN ISO 12567-1 is shown as the parameter U_{st} the first part of appendix 1.

The above-mentioned U-value is valid for the combined construction only. The U-value for the test specimen is calculated in the last part of appendix 1 and the result of this calculation is called U_{sp} .

Important note for measurement results

The numbers below apply to a test specimen mounted in a test field. The test specimen is a combined area for test specimen and boundary insulation. It requires a separate calculation to determine the U-value of the test topic alone, which is not included in table belowt.



Hotbox test: CF76 Thermo

Start	17-10-2017 09:15
End	20-10-2017 08:33

Specimen

Area of specimen	Asp	m ²	4,558
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Calibration data

Thermal resistance of surround panel, regression coefficient, $R_{sur} = a \cdot \theta_{me,sur} + b$	m ² ·K/W	$-0,1814 \cdot \theta_{me,sur} + 6,9215$
Total surface thermal resistance, regression coefficient, $R_{s,t} = b \cdot q_{cal}^a$	m ² ·K/W	$0,2143 \cdot q_{sp} \exp(-0,0796)$
Convective fraction, warm side, regression coefficient, $F_{c,i} = a \cdot q_{cal} + b$	-	$0,0037 \cdot q_{sp} + 0,4655$
Convective fraction, cold side, regression coefficient, $F_{c,e} = a \cdot q_{cal} + b$	-	$0,0001 \cdot q_{sp} + 0,7222$

Results

Air temperature, warm side	θ_{ci}	°C	20,16
Air temperature, cold side	θ_{ce}	°C	-0,23
Baffle temperature, warm side	$\theta_{si,b}$	°C	19,95
Baffle temperature, cold side	$\theta_{se,b}$	°C	-0,14
Surround panel temperature, warm side	$\theta_{si,sur}$	°C	19,90
Surround panel temperature, cold side	$\theta_{se,sur}$	°C	-0,11
Reveal temperature, warm side	$\theta_{si,p}$	°C	19,74
Reveal temperature, cold side	$\theta_{se,p}$	°C	-0,13
Air flow warm side	v_i	m/s	1,17
Air flow cold side	v_e	m/s	1,81
Input power	θ_{in}	W	21,729
Air temperature difference	$\Delta\theta_c$	K	20,39
Surround panel temperature difference	$\Delta\theta_{s,sur}$	K	20,01
Mean temperature of surround panel	$\theta_{me,sur}$	°C	9,90
Thermal resistance of surround panel	R_{sur}	m ² ·K/W	5,127
Thermal conductivity of surround panel	λ_{sur}	W/(m·K)	0,115
Linear thermal transmittance of edge between specimen and surround panel	Ψ_{edge}	W/(m·K)	0,000
Heat flow through surround panel	Φ_{sur}	W	6,604
Heat flow through edge zone	Φ_{edge}	W	0,000
Heat flow density of specimen	q_{sp}	W/m ²	3,32
Convective fraction, warm side	$F_{c,i}$	-	0,478
Convective fraction, cold side	$F_{c,e}$	-	0,723
Total surface thermal resistance	$R_{s,t}$	m ² ·K/W	0,195
Environmental temperature, warm side	$\theta_{n,i}$	°C	20,05
Environmental temperature, cold side	$\theta_{n,e}$	°C	-0,20
Environmental temperature difference	$\Delta\theta_n$	K	20,26
Overall thermal transmittance	U_{st}	W/(m ² ·K)	0,16

Test specimen: CF76 Thermo

To determine the U-value of the test specimen, then heat loss through the overall design must first be determined. Hereafter the heat loss through edge insulation and line loss can be deducted.

The heat loss through the overall construction is calculated as follows: $\Phi_{\text{total}} = U_{\text{total}} \cdot A_{\text{total}} \cdot \Delta T$

The U-value of the overall construction (Appendix 1)	$U_{\text{total}} = 0,164 \text{ W/m}^2 \cdot \text{K}$
The area of the overall construction	$A_{\text{total}} = 4,558 \text{ m}^2$
Temperature difference between cold and hot side	$\Delta T = 20,26 \text{ K}$
The heat loss through the overall construction	$\Phi_{\text{total}} = 15,14 \text{ W}$

The U-value of the edge insulation is calculated from this formula:

$$U_{\text{ins}} = \frac{1}{R_i + R_e + \frac{s}{\lambda}}$$

Internal surface resistance	$R_i = 0,04 \text{ m}^2 \cdot \text{K/W}$
External surface resistance	$R_e = 0,13 \text{ m}^2 \cdot \text{K/W}$
Thickness of the boundary insulation	$s = 0,300 \text{ m}$
Heat conductivity of the boundary insulation	$\lambda = 0,0316 \text{ W/m} \cdot \text{K}$
The U-value of the boundary insulation	$U_{\text{ins}} = 0,103 \text{ W/m}^2 \cdot \text{K}$

The heat loss through the boundary insulation is calculated from this formula: $\Phi_{\text{ins}} = U_{\text{ins}} \cdot A_{\text{ins}} \cdot \Delta T$

The area of the boundary insulation	$A_{\text{ins}} = 3,578 \text{ m}^2$
The heat loss through the boundary insulation	$\Phi_{\text{ins}} = 7,50 \text{ W}$

Heat loss due to line loss:

$$\Phi_{\text{edge}} = \Psi_{\text{edge}} \cdot l_{\text{edge,ins}} \cdot \Delta T$$

Linear transmission coefficient for construction	$\Psi_{\text{edge,ins}} = 0,0000 \text{ W/m} \cdot \text{K}$
Length of line loss	$l_{\text{edge,ins}} = 4,200 \text{ m}$
Line loss along edge of test piece and edge insulation	$\Phi_{\text{edge}} = 0,00 \text{ W}$

The heat loss through the test specimen:

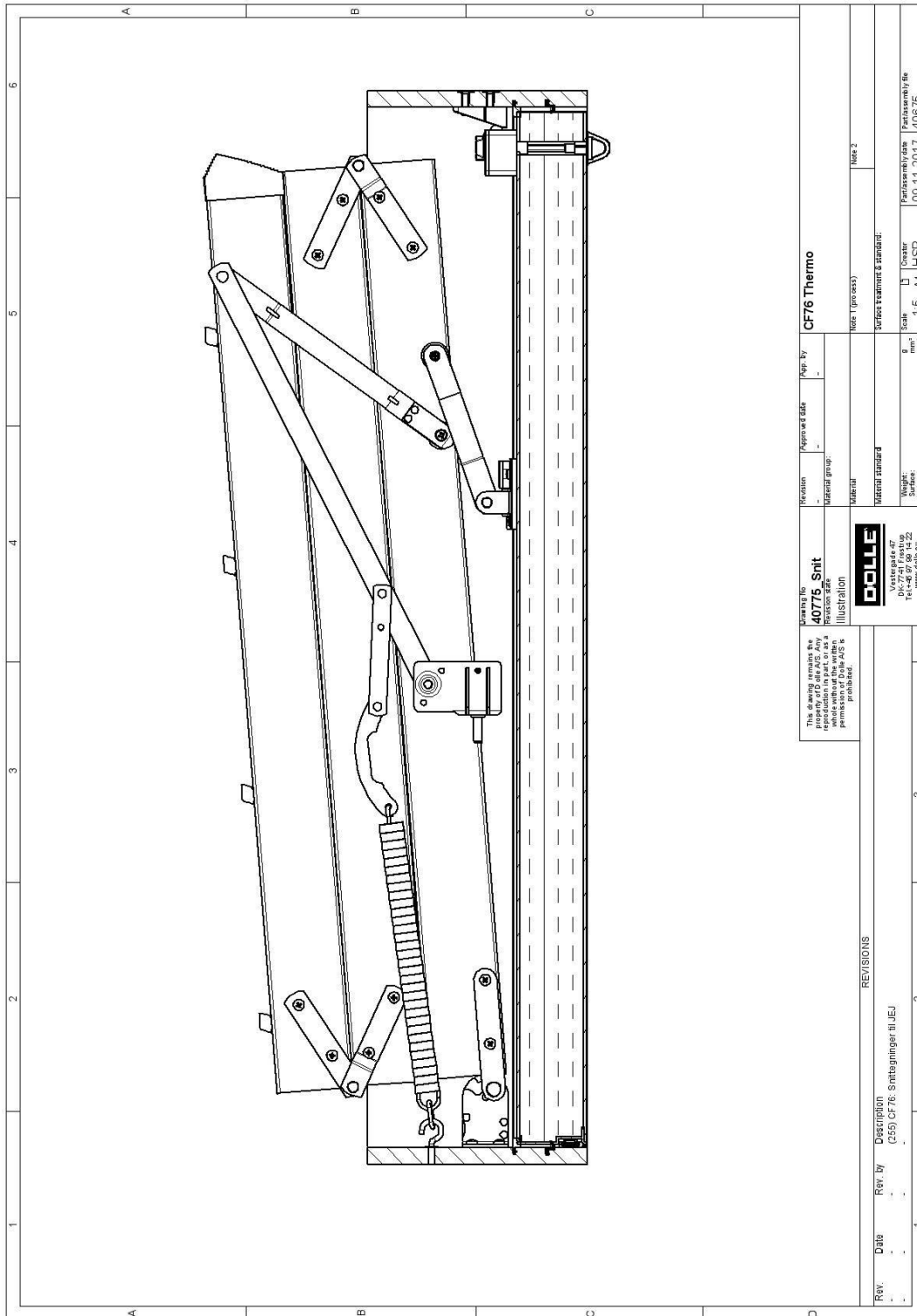
$$\Phi_{\text{sp}} = \Phi_{\text{total}} - \Phi_{\text{ins}} - \Phi_{\text{edge}}$$

The heat loss through the test specimen:	$\Phi_{\text{sp}} = 7,64 \text{ W}$
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The U-value of the test specimen is determined by the formula:

$$U_{\text{sp}} = \frac{\Phi_{\text{sp}}}{A_{\text{sp}} \cdot \Delta T}$$

The area of the test specimen	$A_{\text{sp}} = 0,980 \text{ m}^2$
The U-value of the test topic	$U_{\text{sp}} = \mathbf{0,38 \text{ W/m}^2 \cdot \text{K}}$



Section of CF76 Thermo – The ladder was not mounted during the measurement.

The general conditions pertaining to assignments accepted by Danish Technological Institute shall apply in full to the technical testing and calibration at Danish Technological Institute and to the completion of test reports and calibration certificates within the relevant field.

DANAK

The Danish Accreditation and Metrology Fund - DANAK - is managing the Danish accreditation scheme based on a contract with the Danish Safety Technology Authority under the Danish Ministry of Economics and Business Affairs who is responsible for the legislation on accreditation in Denmark.

The fundamental criteria for accreditation are described in DS/EN ISO/IEC 17025: "General requirements for the competence of testing and calibration laboratories". DANAK uses guidance documents to clarify the requirements in the standards, where this is considered to be necessary. These will mainly be drawn up by the "European co-operation for Accreditation (EA)" or the "International Laboratory Accreditation Co-operation (ILAC)" with a view to obtaining uniform criteria for accreditation worldwide. In addition, the Danish Safety Technology Authority issues Technical Regulations prepared by DANAK with specific requirements for accreditation that are not contained in the standards.

In order for a laboratory to be accredited it is, among other things, required:

- that the laboratory and its personnel are free from any commercial, financial or other pressures, which might influence their impartiality;
- that the laboratory operates a documented management system, and has a management that ensures that the system is followed and maintained;

- that the laboratory has at its disposal all items of equipment, facilities and premises required for correct performance of the service that it is accredited to perform;
- that the laboratory has at its disposal personnel with technical competence and practical experience in performing the services that they are accredited to perform;
- that the laboratory has procedures for traceability and uncertainty calculations;
- that accredited testing are performed in accordance with fully validated and documented methods;
- that accredited services are performed and reported in confidentiality with the customer and in compliance with the customer's request;
- that the laboratory keeps records which contain sufficient information to permit repetition of the accredited test;
- that the laboratory is subject to surveillance by DANAK on a regular basis;
- that the laboratory shall take out an insurance, which covers liability in connection with the performance of accredited services.

Reports carrying DANAK's accreditation mark are used when reporting accredited services and show that these have been performed in accordance with the rules for accreditation.