# Thermal Conductivity according to EN 12667:2001

Test report No.: F3-19-1425-01

**Applicant:** **K-FLEX POLSKA Sp. z.o.o., 99-210 UNIEJOW, Poland**
**Name of product:** **K-FLEX SOLAR HT Sheet**
Declared thickness: 25 mm Declared density: ---
Description: (as given by applicant) Sheet made of flexible elastomeric foam (FEF) according to EN 14304:2009+A1:2013, colour: black
Sampling: Sent by applicant
Sample receipt: WE19-4925 on Jun 25, 2019 (internal no. 01)
Test equipment: Two specimen guarded hot plate apparatus according to EN 12667:2001, horizontal installation
Metering section 250 mm x 250 mm with guard section 500 mm x 500 mm
All values of measured properties are mean values of two specimens.

**Dimensions:**
Thickness: ---
Density: ---

**Mounting:**
Tested thickness: 24.0 mm Tested mass: 0.480 kg
Tested density: 80.0 kg/m³ Specimen area: 0.2500 m²
Start of testing: Jul 01, 2019

Remark: ---

**Measured values:** Test protocol No.: F3-19-1425:0001:01

| Test No. | Heat flow W | Temperature of the Warm side °C | Temperature of the Cold side °C | Temperature-difference of the specimen K | Mean temperature of the specimen °C | Thermal conductivity W/(m·K) |
|---|---|---|---|---|---|---|
| 01 | 7.44 | -26.0 | -39.9 | 13.9 | -32.9 | 0.0380 |
| 02 | 7.41 | 5.9 | -7.3 | 13.2 | -0.7 | 0.0399 |
| 03 | 3.20 | 64.2 | 50.4 | 13.8 | 57.3 | 0.0439 |
| 04 | 7.70 | 121.0 | 91.6 | 29.4 | 106.3 | 0.0494 |
| Uncertainty: < 3 % | | | | Thermal conductivity at a given temperature difference on the specimen | | |

**Dismounting:** Properties of the material after measurement up to 121.0 °C warm side temperature:
Thickness: 21.5 mm Mass: 0.475 kg
Density: 103 kg/m³ Change in mass: -1.1 %
End of testing: Aug 14, 2019

Remark: The specimens were shrunk 2,5 mm (mean value over the specimens) in thickness and 25 mm to 50 mm in length/ width and were dished after the thermal conductivtiy test.

**Evaluation:** (thermal conductivities rounded upwards to next 0.001 W/(m·K) according to EN ISO 13787:2003)

Polynomial: $\lambda(\vartheta) = +3.9734E\text{-}02 + 5.9193E\text{-}05 \cdot \vartheta + 2.8777E\text{-}07 \cdot \vartheta^2$

| Temperature *) $\vartheta$ in °C | -40 | -20 | 0 | 20 | 40 | 50 | 100 | --- | --- | --- |
|---|---|---|---|---|---|---|---|---|---|---|
| Thermal conductivity $\lambda$ in W/(m·K) | 0.038 | 0.039 | 0.040 | 0.041 | 0.043 | 0.044 | 0.049 | --- | --- | --- |

These thermal conductivity values are material values applicable to material in a dry state.The operational thermal conductivity depends on the given temperature of warm and cold sides of the installed thermal insulation and is obtained from the integral mean value of the thermal conductivity as given in appendix 1 with supplementary values as given in the guideline VDI 2055 part 1.

*) For temperature differences of less than 50 K the given temperature corresponds to the arithmetical mean of warm and cold side temperature.

**Remark:** ---

Gräfelfing, Oct 11, 2019

Department Specialist: Dipl.-Ing. K. Wiesemeyer

Tester: S. Tana

Forschungsinstitut für Wärmeschutz e. V. München FIW MÜNCHEN 1516 www.fiw-muenchen.de





Forschungsinstitut für Wärmeschutz e. V. München
Lochhamer Schlag 4 · 82166 Gräfelfing
Institute Director: Prof. Dr.-Ing. Andreas H. Holm
Phone +49 89 8 58 00 0 · Fax +49 89 8 58 00 40
info@fiw-muenchen.de · www.fiw-muenchen.de

**Appendix 1 to the Test report No.: F3-19-1425-01**

**Determination of the integral mean value of the thermal conductivity $\lambda_{mi}$ of an installed thermal insulation with given temperatures $\vartheta_2$ and $\vartheta_1$ of the warm and cold side according to formula or table below**

**Applicant:** **K-FLEX POLSKA Sp. z.o.o., 99-210 UNIEJOW, Poland**
**Name of product:** **K-FLEX SOLAR HT Sheet**

**Mounting:** Tested thickness: 24.0 mm Tested density: 80.0 kg/m³

**1. Formula:**

$$\lambda_{mi} = \frac{1}{\vartheta_2 - \vartheta_1} \cdot \int_{\vartheta_1}^{\vartheta_2} \lambda(\vartheta) d\vartheta$$

Valid in the temperature range of 0 °C to 120 °C: $\lambda(\vartheta)$ = + 3.9734E-02 + 5.9193E-05·$\vartheta$ + 2.8777E-07·$\vartheta^2$

**2. Table:**

| $\vartheta_1$ in °C → | 0 | 5 | **10** | 15 | 20 | 25 | 30 | 35 | 40 | 50 | 60 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| $\vartheta_2$ in °C ↓ | $\lambda_{mi}$ in W/(m·K) | | | | | | | | | | |
| 30 | 0.041 | 0.041 | 0.041 | 0.041 | 0.041 | 0.042 | ---- | ---- | ---- | ---- | ---- |
| 40 | 0.041 | 0.041 | 0.041 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | ---- | ---- | ---- |
| 50 | 0.041 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.043 | 0.043 | 0.043 | ---- | ---- |
| 55 | 0.042 | 0.042 | 0.042 | 0.042 | 0.042 | 0.043 | 0.043 | 0.043 | 0.043 | 0.044 | ---- |
| 60 | 0.042 | 0.042 | 0.042 | 0.042 | 0.043 | 0.043 | 0.043 | 0.043 | 0.043 | 0.044 | ---- |
| 65 | 0.042 | 0.042 | 0.042 | 0.043 | 0.043 | 0.043 | 0.043 | 0.043 | 0.044 | 0.044 | 0.045 |
| 70 | 0.042 | 0.042 | 0.043 | 0.043 | 0.043 | 0.043 | 0.043 | 0.044 | 0.044 | 0.044 | 0.045 |
| 75 | 0.042 | 0.043 | 0.043 | 0.043 | 0.043 | 0.043 | 0.044 | 0.044 | 0.044 | 0.045 | 0.045 |
| 80 | 0.043 | 0.043 | 0.043 | 0.043 | 0.043 | 0.044 | 0.044 | 0.044 | 0.044 | 0.045 | 0.045 |
| 85 | 0.043 | 0.043 | 0.043 | 0.044 | 0.044 | 0.044 | 0.044 | 0.044 | 0.045 | 0.045 | 0.046 |
| **90** | 0.043 | 0.043 | 0.044 | 0.044 | 0.044 | 0.044 | 0.044 | 0.045 | 0.045 | 0.045 | 0.046 |
| 95 | 0.043 | 0.044 | 0.044 | 0.044 | 0.044 | 0.044 | 0.045 | 0.045 | 0.045 | 0.046 | 0.046 |
| 100 | 0.044 | 0.044 | 0.044 | 0.044 | 0.044 | 0.045 | 0.045 | 0.045 | 0.045 | 0.046 | 0.046 |
| 105 | 0.044 | 0.044 | 0.044 | 0.045 | 0.045 | 0.045 | 0.045 | 0.045 | 0.046 | 0.046 | 0.047 |
| 110 | 0.044 | 0.044 | 0.045 | 0.045 | 0.045 | 0.045 | 0.045 | 0.046 | 0.046 | 0.046 | 0.047 |
| 115 | 0.044 | 0.045 | 0.045 | 0.045 | 0.045 | 0.045 | 0.046 | 0.046 | 0.046 | 0.047 | 0.047 |
| 120 | 0.045 | 0.045 | 0.045 | 0.045 | 0.046 | 0.046 | 0.046 | 0.046 | 0.046 | 0.047 | 0.047 |

Key: $\lambda_{mi}$: Effective mean thermal conductivity in W/(m·K), $\vartheta_1$: Temp. on the cold side in °C, $\vartheta_2$: Temp. on the warm side in °C

**Example:**

For an installed thermal insulation with $\vartheta_2$ = **90** °C on the warm side and a cold side of $\vartheta_1$ = **10** °C (corresponding to a mean temperature of 50 °C) the integral mean value of the thermal conductivity of the insulation material results from the the formula or table above to $\lambda_{mi}$ = **0.044** W/(m·K).

**Integral mean value of the thermal conductivity as a function of the mean temperature and cold side temperature of 50 °C:**

| Mean temperature °C | 30 | 40 | 50 | 60 | 70 | 80 |
|---|---|---|---|---|---|---|
| Thermal conductivity W/(m·K) | 0.042 | 0.043 | 0.044 | 0.045 | 0.046 | 0.047 |

The mean temperature is the arithmetical mean of warm and cold side temperature
The operational thermal conductivity is obtained from the integral mean value of the thermal conductivity with supplementary values as given in the guidline VDI 2055 Part 1.






Forschungsinstitut für Wärmeschutz e. V. München
Lochhamer Schlag 4 · 82166 Gräfelfing
Institute Director: Prof. Dr.-Ing. Andreas H. Holm
Phone +49 89 8 58 00 0 · Fax +49 89 8 58 00 40
info@fiw-muenchen.de · www.fiw-muenchen.de