FHF03
Economical foil heat flux sensor with thermal spreaders, flexible, 30 x 15 mm, with temperature sensor

FHF03 is a general-purpose heat flux sensor. Looking for a relatively small sensor with the best price-performance ratio, this should be your first choice. FHF03 is very versatile: it has an integrated temperature sensor and thermal spreaders to reduce thermal conductivity dependence. It is applicable over a temperature range from -40 to +150 °C. FHF03 is designed for robustness with durable wire connections and cabling. Qualities like these are unmatched at this price level.

Introduction
FHF03 is an economical sensor for general-purpose heat flux measurement. It is small, thin and versatile. FHF03 measures heat flux through the object in which it is incorporated or on which it is mounted, in W/m². The sensor in FHF03 is a thermopile. This thermopile measures the temperature difference across FHF03’s flexible body.

A type T thermocouple is integrated as well. The thermopile and thermocouple are passive sensors; they do not require power. A thermal spreader, which is a conductive layer covering the sensor, helps reduce the thermal conductivity dependence of the measurement. With its incorporated spreaders, the sensitivity of FHF03 is independent of its environment. Many competing sensors do not have thermal spreaders. Equipped with well-protected wire connections and a sturdy, shielded cable, FHF03 is designed for robustness. Qualities like these are unmatched at this price level.

Using FHF03 is easy. It can be connected directly to commonly used data logging systems. The heat flux in W/m² is calculated by dividing the FHF03 output, a small voltage, by the sensitivity. The sensitivity is provided with FHF03 on its product certificate. For increased sensitivity, robustness and a larger sensing area, consider using model FHF02 and, in particular for building physics and soil heat flux, model HFP01, the world’s most popular heat flux sensor.

Unique features and benefits
• flexible (bending radius ≥ 25 x 10⁻³ m)
• low thermal resistance
• wide temperature range
• fast response time
• integrated type T thermocouple
• robust: well-protected wire connections and a sturdy, shielded cable
• IP protection class: IP67 (essential for outdoor application)
• thermal spreader included, low thermal conductivity dependence
**FHF03 specifications**

<table>
<thead>
<tr>
<th>Measurand</th>
<th>heat flux</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurand</td>
<td>temperature</td>
</tr>
<tr>
<td>Temperature sensor</td>
<td>type T thermocouple</td>
</tr>
<tr>
<td>Thermal spreaders</td>
<td>included</td>
</tr>
<tr>
<td>Rated bending radius</td>
<td>≥ 25 × 10⁻³ m (repeated bending not recommended)</td>
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<tr>
<td>Rated load cable</td>
<td>≤ 10 kg</td>
</tr>
<tr>
<td>Outer dimensions foil with guard</td>
<td>(31 × 14.5) × 10⁻³ m</td>
</tr>
<tr>
<td>Sensing area</td>
<td>2.5 × 10⁻⁴ m²</td>
</tr>
<tr>
<td>Sensor thermal resistance</td>
<td>28 × 10⁻⁴ K/(W/m²)</td>
</tr>
<tr>
<td>Sensor resistance range</td>
<td>20 to 30 Ω</td>
</tr>
<tr>
<td>Sensor thickness</td>
<td>0.8 × 10⁻³ m</td>
</tr>
<tr>
<td>Uncertainty of calibration</td>
<td>± 5 % (k = 2)</td>
</tr>
<tr>
<td>Measurement range</td>
<td>(-10 to +10) × 10³ W/m²</td>
</tr>
<tr>
<td>Sensitivity (nominal)</td>
<td>2 × 10⁻⁶ V/(W/m²)</td>
</tr>
<tr>
<td>Operating temperature range</td>
<td>-40 to +150 °C</td>
</tr>
<tr>
<td>IP protection class</td>
<td>IP67</td>
</tr>
<tr>
<td>Standard cable length</td>
<td>2 m</td>
</tr>
<tr>
<td>Options</td>
<td>with 5 m cable</td>
</tr>
</tbody>
</table>

**Options**
- with 5 metres of cable
- LI19 hand-held read-out unit / datalogger

**See also**
- model FHF02 for increased sensing area and sensitivity
- model FHF02SC for a self-calibrating version of FHF02
- model HFP01 for increased sensitivity (also consider putting two or more FHF02's in series)
- Hukseflux offers a complete range of heat flux sensors with the highest quality for any budget

**About Hukseflux**
Hukseflux Thermal Sensors makes sensors and measuring systems. Our aim is to let our customers work with the best possible data. Many of our products are used in support of energy transition and efficient use of energy. We also provide services: calibration and material characterisation. Our main area of expertise is measurement of heat transfer and thermal quantities such as solar radiation, heat flux and thermal conductivity. Hukseflux is ISO 9001 certified. Hukseflux products and services are offered worldwide via our office in Delft, the Netherlands and local distributors.

**Figure 3** The flexible FHF03 being installed on a pipe

**Calibration**
FHF03 calibration is traceable to international standards. The factory calibration method follows the recommended practice of ASTM C1130-17.

**Working with heat flux sensors**
When used under conditions that differ from the calibration reference conditions, the FHF03 sensitivity to heat flux may be different than stated on its certificate. See the user manual for suggested solutions.

**Figure 4** FHF03 heat flux sensor: (1) sensing area with thermal spreader, (2) passive guard, (3) type T thermocouple, (4) sticker showing serial number and sensitivity, (5) strain relief, (6) cable, standard length is 2 m. Dimensions in × 10⁻³ m.

Interested in this product?
E-mail us at: info@hukseflux.com

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FHF series outperforms competing models: how?

FHF02 and FHF03 are Hukseflux' standard models for thin and versatile heat flux sensors. With its small footprint, the flexible FHF03 is the most economical one.

Flexible
FHF03 may be bent to a radius of 25 mm. FHF02 may be bent to a radius of 50 mm.

Large-area
Larger is better: FHF02's sensitive area of 30 x 30 mm offers good averaging, leading to increased sensitivity. FHF02 has a thermal guard around the sensitive area. The guard can also be used for mounting the sensor without disturbing the sensitive area.

Corrosion-proof plastic cover protecting the thermal spreader
Thermocouple type T included

Durable waterproof wires with metal strain relief, temperature resistant up to 150 °C

Sensitive area with thermal spreader reducing thermal conductivity dependence

Independent of environment:
Thermal spreader included
Unlike many competing sensors, FHF series sensors have thermal spreaders, i.e. conductive layers covering the sensor. These layers help reduce the thermal conductivity dependence of the measurement. By employing spreaders, the sensitivity of FHF series becomes independent of its environment.

Corrosion-proof plastic cover protecting the thermal spreader
Thermocouple type T included

Durable waterproof wires in a shielded cable, temperature resistant up to 150 °C

Stable: waterproof (IP67), corrosion-proof
FHF series sensor connection is glued, and waterproof. Its protection class is IP67. Competing sensors often have wire connections with open contact to the environment. This is a large potential source of damage, as well as a starting point for measurement errors, corrosion, and sensor instability.

Best paperwork
Hukseflux has the paperwork covered; all FHF series sensors are provided with formally traceable calibration certificates. We calibrate in accordance with ASTM.