

# HF01

## High temperature heat flux sensor

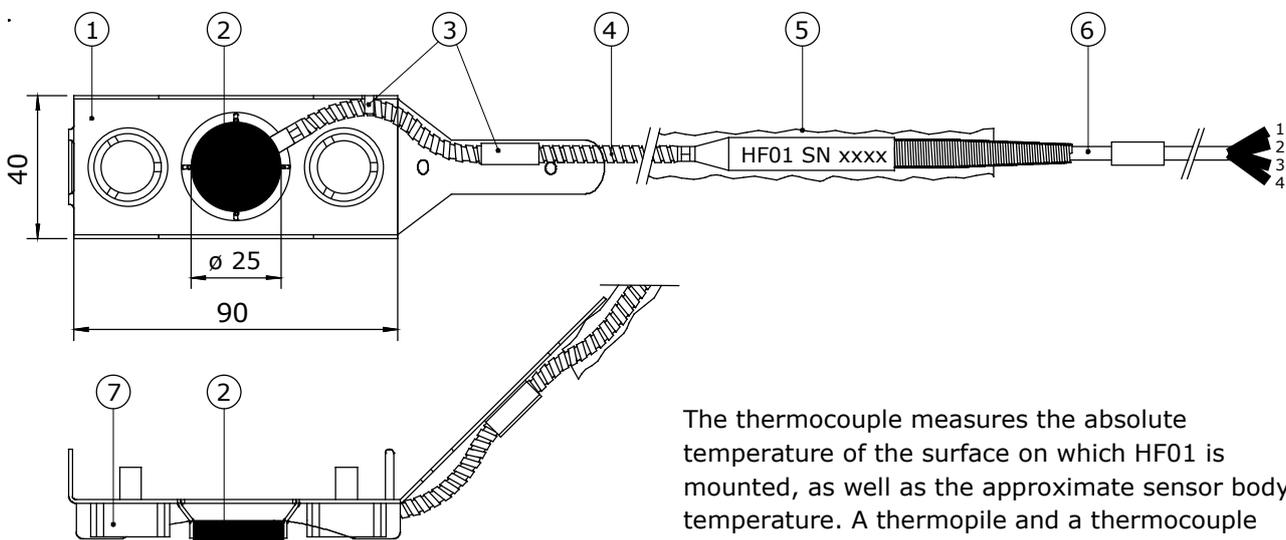
HF01 high temperature heat flux sensor measures heat flux and surface temperature at high temperatures, typically in industrial environments. It is particularly suitable for trend-monitoring and comparative testing. The same technology can be used to manufacture heat flux sensors for different applications.



**Figure 1** HF01 with frame with magnets

### Introduction

HF01 measures heat flux and surface temperature of industrial furnaces, boilers, fluidised beds, distillation columns and ovens. The sensors inside HF01, a thermopile and a thermocouple, are protected by fully sealed stainless steel body. It is suitable for long term use at one location as well as repeated installation when a measuring system is used at multiple locations. HF01 measures heat flux through the object on which it is mounted, in  $W/m^2$ , as well as its surface temperature in  $^{\circ}C$ . The sensors in HF01 are a thermopile and a type K thermocouple. The thermopile measures the local heat flux.



**Figure 2** heat flux sensor model HF01 with optional frame with magnets (2), connected to a high-temperature metal sheathed cable with interlocked spiral stainless steel armour (4) and low-temperature extension cable (6). The frame (1) with magnets (7) is an option intended for temporary mounting on carbon steel walls. It is provided with a cable strain relief (3). The armour may be electrically insulated by a silicone sleeve (5). Dimensions are in  $\times 10^{-3} m$ .

The thermocouple measures the absolute temperature of the surface on which HF01 is mounted, as well as the approximate sensor body temperature. A thermopile and a thermocouple are passive sensors; they do not require power.

The part of the cabling closest to the sensor is a special high-temperature metal sheathed cable with an interlocked spiral stainless steel armour. The sensor as well as the high temperature cable and armour withstand temperatures up to 800  $^{\circ}C$ . The temperature range is reduced to 600  $^{\circ}C$  in case the black coating is used, to 550  $^{\circ}C$  in case the frame with magnets is used.

To avoid leakage of current, a risk in aluminium reduction cells, a silicone plastic sleeve may be placed over the metal armour. The low-temperature extension cable has wire insulation and a jacket of PTFE type plastic.

Using HF01 is easy. It can be connected directly to commonly used data logging systems. The heat flux, in  $W/m^2$ , is calculated by dividing the HF01 output, a small voltage, by the sensitivity and by applying a linear correction based on the temperature measurement. The sensitivity and temperature dependence are provided with HF01 on its product certificate. Equipped with heavy duty cabling, and having a fully stainless steel casing so that moisture does not penetrate the sensor, HF01 has proven to be very reliable. It survives long-term outdoor installation and repeated installation using the frame with magnets.

## Trend monitoring and comparative measurement

HF01 is most suitable for relative measurements using one sensor, i.e. monitoring of trends relative to a certain reference point in time or comparing heat flux at one location to the heat flux at another location. If the user wants to perform accurate absolute measurements with HF01, as opposed to relative measurements, the user must make his own uncertainty evaluation and correction for systematic errors.



**Figure 3** HF01 with frame with magnets

## Traceability

HF01 calibration is traceable to international standards. The factory calibration method follows the recommended practice of ASTM C1130. The recommended calibration interval of heat flux sensors is 2 years.

## HF01 specifications

Measurand	heat flux
Measurand	temperature
Heat flux sensor	thermopile
Temperature sensor	thermocouple type K
Sensitivity (nominal)	$0.5 \times 10^{-6} V/(W/m^2)$
Calibration traceability	to SI units
Recommended number of sensors	2 per measurement location
Measurement range	- 50 to $50 \times 10^3 W/m^2$
Rated operating temperature ranges:	
sensor and high temperature cable	-30 to +800 °C
optional frame with magnets	-30 to +550 °C
black coating	-30 to +600 °C
low temperature extension cable	-30 to +240 °C
Standard cable lengths:	
high temperature cable	0.9 m (see options)
low temperature extension cable	3.5 m (see options)
Order code	HF01 / high temperature cable length in m / low temperature extension cable length in m

## Options

- longer cable (specify total cable length for both cable types in m)
- frame with magnets and silicone sleeve
- frame with 2 mounting holes (no magnets)
- thermocouple type N
- sensor and high temperature cable temperature range -180 to + 800 °C
- EC type examination certificate (ATEX) II 2 G EEx d IIC T6
- connector at HF01 cable end
- low temperature extension cable with 2 connectors, matching cable connector and chassis connector
- chassis connector with internal wiring (colour code of wiring identical to cable colour code)
- silicone protection sleeve around the high temperature cable (specify length in m, standard length 1 m, covering the standard 0.9 m high temperature cable)

## HF01 advantages

- robust
- suitable for use at high temperatures
- low thermal resistance
- high sensitivity
- IP protection class: IP68

## Suggested use

trend-monitoring and comparative measurement of heat flux and surface temperature in industrial installations.



**Figure 4** the ALUSYS measuring system, for trend - monitoring and comparative surveys of heat fluxes and surface temperature on industrial installations. Connected is one HF01 sensor, as well as the Keyboard Display.

## See also

- our complete product range of heat flux sensors
- ALUSYS measuring system
- HF05 industrial heat flux sensor for lower temperatures up to 170 °C
- needle type heat flux sensors NF01 and NF02

## About Hukseflux

Hukseflux Thermal Sensors offers measurement solutions for the most challenging applications. We design and supply sensors as well as test & measuring systems, and offer related services such as engineering and consultancy. With our laboratory facilities, we provide testing services including material characterisation and calibration. 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 9001:2008 certified. Hukseflux sensors, systems and services are offered worldwide via our office in Delft, the Netherlands and local distributors.

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