

# NF02

## Miniature needle type heat flux and temperature sensor

*NF02 measures temperature and heat fluxes. It is a small version of model NF01, and is typically used in (injection) moulds. Measuring heat flux as well as temperature with one sensor is much more accurate and practical than using distributed temperature measurements. The same technology is used to manufacture heat flux sensors for different applications.*



**Figure 1** NF02 with high temperature metal sheathed cable



**Figure 2** NF01: the large-diameter equivalent of NF02, special design with positioning piece and connection head

### Introduction

NF02 is used for monitoring the energy balance of industrial installations, in particular in steel moulds. The sensors inside NF02, a thermopile and a thermocouple, are protected by a fully sealed stainless steel “needle” body. 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 450 °C. Optionally the sensor and cable temperature range can be extended to 700 °C. The low temperature extension cable is made of PTFE. The sensor outputs are heat flux (an analogue voltage signal in the millivolt range) and temperature (using a thermocouple type K). The user must know the thermal conductivity of the surrounding material to calculate the heat flux.

### What is better about NF02

The usual approach to measurement of heat flux is to estimate it from distributed temperature measurements. This leads to large measurement errors and is not practical.

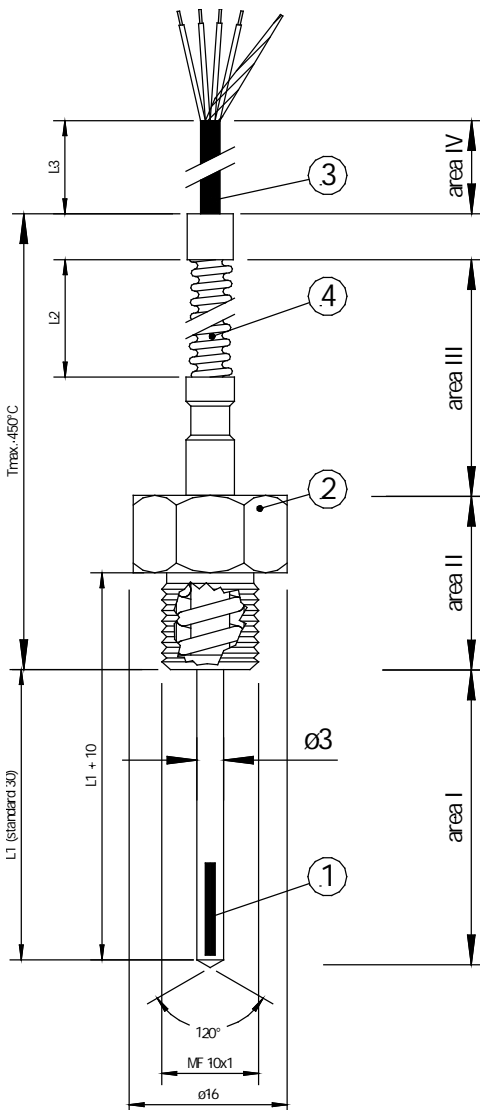
- NF02 creates a single temperature difference signal. This is much more accurate than calculating a heat flux by subtracting two individual temperature measurements.
- NF02 sensors can be quickly installed; contrary to spatially distributed temperature sensors, the relative position of the sensors used for the temperature difference measurement is already determined during manufacturing. The exact depth of insertion is not a critical factor determining the accuracy of this relative position. Installation can be done quickly with little training.
- NF02 sensors are fully exchangeable. Contrary to spatially distributed temperature sensors, the sensors in the NF01 are “matched pairs”. This is essential to attain

the best possible temperature difference measurement.

- NF02 has a fast heat flux response time: the high accuracy makes it possible to measure a temperature difference across a small distance.

### User-specific design

NF02's standard diameter is  $3 \times 10^{-3}$  m and its standard temperature range is 450 °C. NF02 design is user-specific; needle diameter, needle length and temperature range are designed in cooperation with the user for the specific application.



**Figure 3** NF02 miniature needle type heat flux and temperature sensor is used for high temperature applications.

- (1) heat flux sensor & thermocouple location
- (2) spring loaded bolt (MF10 x 1)
- (3) low temperature extension cable
- (4) high temperature cable with metal interlocked spiral armour. Dimensions in  $\times 10^{-3}$  m

### NF02 specifications

Measurand	heat flux
Measurand	temperature
Heat flux sensor	thermopile
Sensitivity (nominal)	$1.2 \times 10^{-6}$ V·m/K
Temperature measurement	thermocouple type KX
Needle diameter	$3 \times 10^{-3}$ m
Rated measurement range	0.05 to 50 $\times 10^3$ W/m <sup>2</sup> (typical)
Rated operating temperature range:	
Sensor and high temperature cable	-30 to +450 °C
Sensor optional (no spring)	-30 to +700 °C
Low temperature extension cable	-30 to +240 °C
Standard cable lengths:	
High temperature cable	0.1 m (see options)
Low temperature extension cable	2.5 m (see options)
Product order code	NF02/L1/L2/L3 L1 to L3 in $\times 10^{-3}$ m
Standard version	NF02/30/100/2500

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### Suggested use

- studies of energy balance of industrial processes
- studies of the energy balance in moulds

### See also

- view our complete [product range of heat flux sensors](#)
- our [industrial sensors](#)
- [NF01](#) needle type heat flux and temperature sensor (large version of NF02)

### Options

- longer cable (specify total cable length for both cable types L2 and L3)
- needle lengths (specify L1)
- needle rated operating temperature range up to 700 °C (no spring)
- connector at NF02 cable end

### About Hukseflux

Hukseflux Thermal Sensors offers measurement solutions for the most challenging applications. Hukseflux sensors, systems and services are offered worldwide via our office in Delft, the Netherlands and local distributors.

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