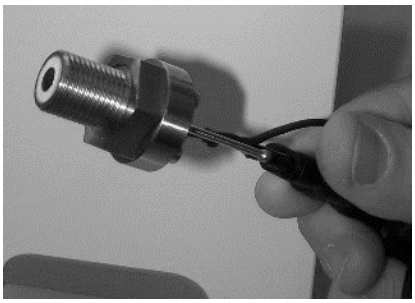


Cooled Heat Fluxmeters: the CHF series

Sensors of the CHF (*Cooled Heat Fluxmeters*) series are intended for long duration measurement or continuous thermal monitoring. CHF devices are derived from the IHF series, and are characterized by an optimized circulation cooling system integrated in the sensor body. CHF sensors can be declined in radiative (radiometers), convective and total fluxmeters. They are supplied with a dedicated thermostatic circulating bath.

STANDARD CHF SENSORS

CHF sensors are characterized by a continuous measurement capability, allowing thermal heat flux monitoring in industrial processes (*e.g.* power generation, fluidized bed, fluid flow, heat exchanger, burners, etc.), but also where usual IHF sensors reach their duration limit (see IHF series datasheet for more information).

A single configuration can cover a wide range of heat flux measurement needs, from "low" intensities (some kW/m²) up to ultra-high flux (>10MW/m²). Nevertheless, some applications needs more time-resolution, which in turns require low rise-time. To achieve this, three standard models are available with different sensitive element thicknesses, ranging from 2mm to 6mm thickness. Three version are also available:

- In their convection-type version, the sensitive element of the sensor is made of a highly reflecting surface treatment (emissivity <0.05) in order to suppress any radiative contribution.
- In their radiation-type version (radiometers), the sensitive element of the sensor is isolated from the external environment by the means of a window, so as to suppress any convective contribution. Window transmissivity in characterized in our laboratory over a large spectrum. In that case, the sensitive element is made of a highly absorbing surface treatment (emissivity >0.95), also spectrally characterized.
- In their total-type version, the sensitive element is analogous to the radiation-type version, but directly exposed to the external environment so as to catch combined radiative-convective heat transfers. If convection can be neglected in your application, this version can be turned into a large view angle radiometer.

CHF sensors are liquid-cooled by an internal heat exchanger fed by a remote thermostatic circulating bath (thermocryostat) connected by two insulated flexible hoses. Internal exchanger allows the backside of the sensor to be perfectly maintained at a set-point temperature, even for the most elevated heat flux (>10MW/m²). Length of flexible hoses can be adapted to your application up to a few dozen meters. Their thermal insulation is achieved by a multilayer sheath made of a silicon-coated fiberglass core.

CHF sensors are equipped with fast connectors for easy dismounting of the cooling circuit.

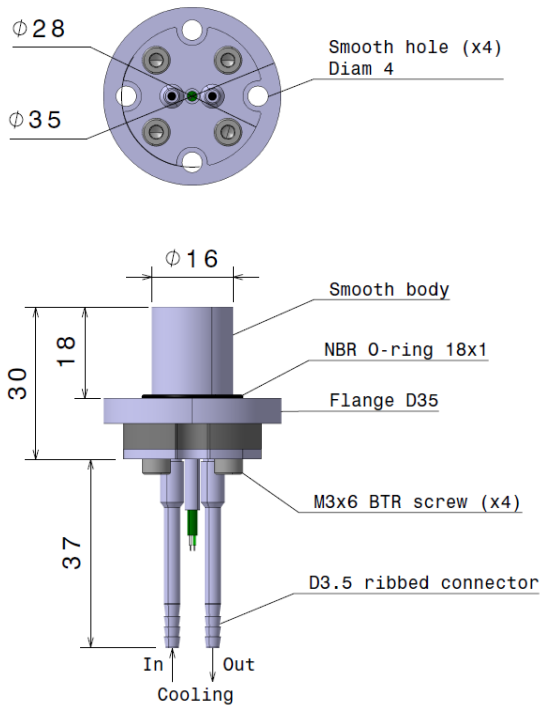
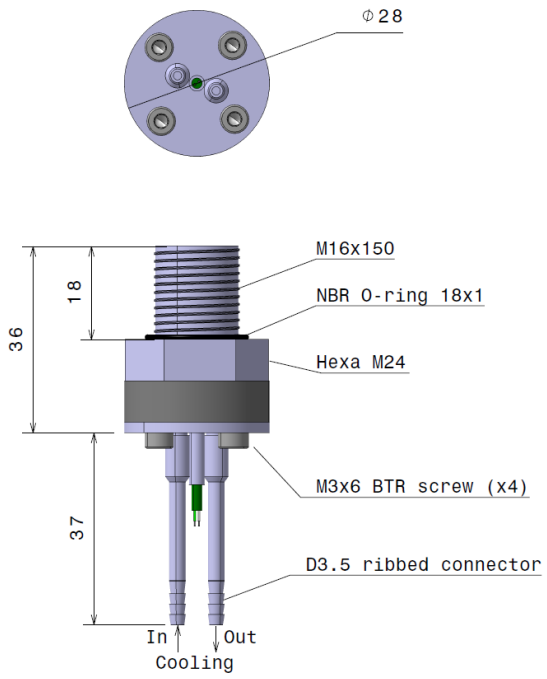
NexTherm recommends the use of LAUDA® LOOP circulation thermostat devices for their compactness, flexibility and reliability. With its cooling output of 120W at 20°C, the LOOP L100 model is a cost-effective solution using a low consumption Peltier cooling unit.

Each CHF sensor is calibrated* using the LOOP L100 thermocryostat. If you intend to use another cooling device, please inform us before any calibration.

** Specification 5%FS max. Real error determined by certified calibration.*

MECHANICAL INTERFACE

NexTherm fluxmeters can be integrated in various housings. Tailored interfaces can also be designed to answer you special needs (miniature support, lateral lead wire routing, adhesive mounting, etc.). Baseline support material is stainless steel 316L. Other materials on request. Every unit is delivered with a rigid metal outlet filled with a resin potting for lead wire leak-tightness.

Flange mounting	Thread mounting
	
Very simple mounting method, by screwing four points of a flat flange. Sealing by NBR (nitrile) O-ring (copper and graphite flat-ring also available). Other flange shape and smooth hole diameter on request.	Hexagonal head bolt-type fastening. Sealing by NBR (nitrile) O-ring (copper and graphite flat-ring also available). Other diameter, length and thread pitch on request.
Mounting reference : M1	Mounting reference : M2

ELECTRICAL INTERFACE

In standard version, CHF heat flux sensors are equipped with type K (chromel-alumel) thermocouple lead wires (0.5mm diameter). Baseline finish is silicon sheathing with glass silk insulation (reference W4), which constitutes a good compromise between thermomechanical resistance (480°C) and flexibility. Standard wire length is 1 meter. Miniature type K connector with flat plug (reference C1) completes the baseline version.

Lead wire type	View	Reference
PFA insulation, SS braid shielding		W1
Glass fiber insulation, SS braid shielding		W2
Fire-proof Mica-PR / low smoke composite		W3
Standard glass silk insulation (480°C)		W4
High temperature glass silk insulation (800°C)		W5
Ultra-high temperature ceramic fiber insulation (1400°C)		W6

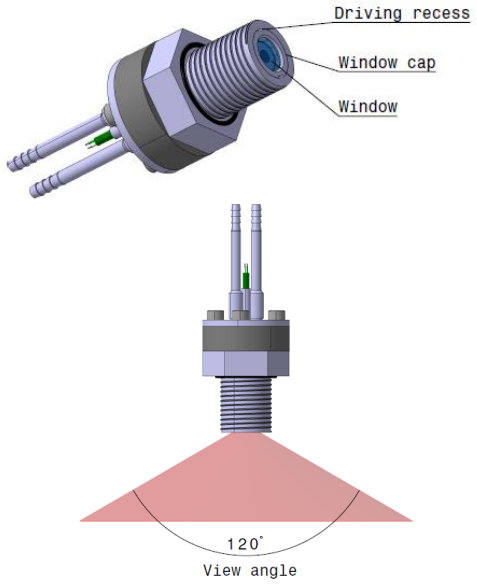
Connector type	View	Reference
Miniature plastic body, flat plugs, standard temperature (220°C)		C1
Miniature ceramic body (cast alumina), flat plugs, high temperature (650°C)		C2
Flat plugs, cable gland reinforcement		C3

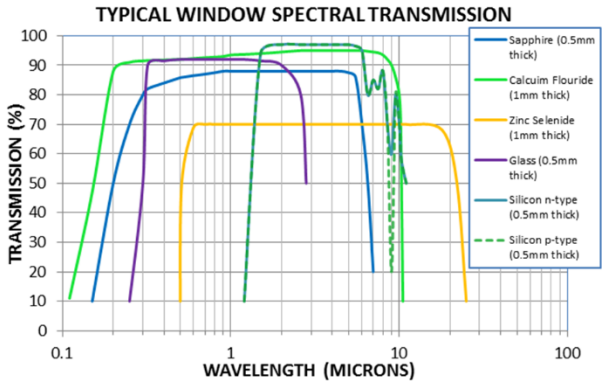
On request, other cable finishes are possible (*e.g.*: ceramic or metallic rigid sheath, multi-pair bundles, etc..), as well as other type K connectors (*e.g.* panel mounting, cable gland, ...).

TAILORED CHF SENSORS

On request, we can build specific and optimized CHF sensors matching your application in terms of response time, interfaces, etc.

In their radiometer version, NexTherm masters advanced optical solution (glasses and surface treatments) allowing to target peculiar spectral band (*e.g.* near IR, far IR, singular wave length filtering).





Window material	Full transmission range	Max. transmission / range (for a 2mm thickness)	Melting point
Sapphire (Al_2O_3)	0.22 to 5.5 µm	85% @ [0.22,4.2] µm	2040°C
KRS-5 ($TiBr_{42}I_{58}$)	0.6 to 40 µm	65-71% @ [0.6,30] µm	414.5°C
Calcium fluoride (CaF_2)	0.13 to 10 µm	90-95% @ [0.2,7.0] µm	1360°C
N-BK7 (borosilicate)	0.35 to 2.5 µm	90% @ [0.35,2.1] µm	557°C
Quartz (fused SiO_2)	0.18 to 3.5 µm	92% @ [0.5,3.4] µm	1710°C
Zinc selenide (ZnSe)	0.55 to 15 µm	70% [1.1,15] µm	1525°C

Sapphire, quartz, ZnSe, … As many glass types allowing to target specific radiative bands in your application © Infrared Materials

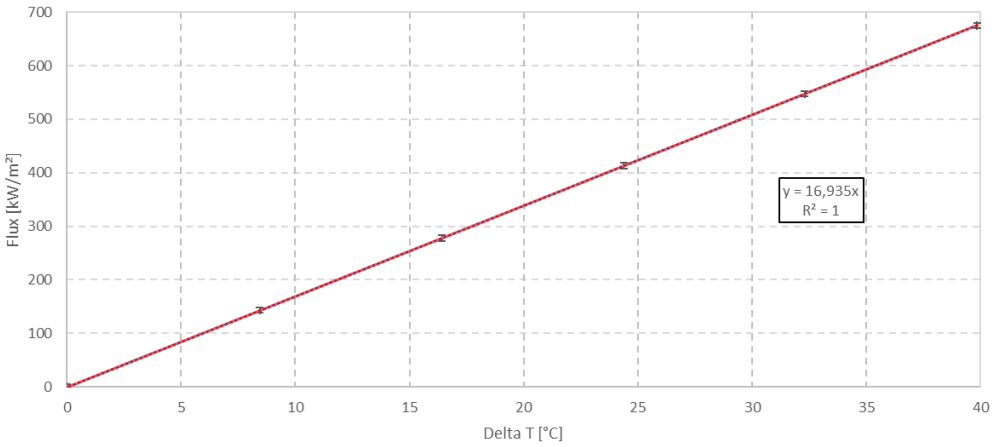
In addition to these various substrates, custom coatings can be envisaged to obtain interferential narrow bandpass filters with very high optical density (up to 4) in the rejection band, along with a better than 91% transmission in the pass region.

View restriction: Note that the integration of a window generates a reduction of the sensitive element view angle (ideally a hemispherical field of 180°). NexTherm radiometers are provided with many possible view angles, from 10° to 120°.

CALIBRATION

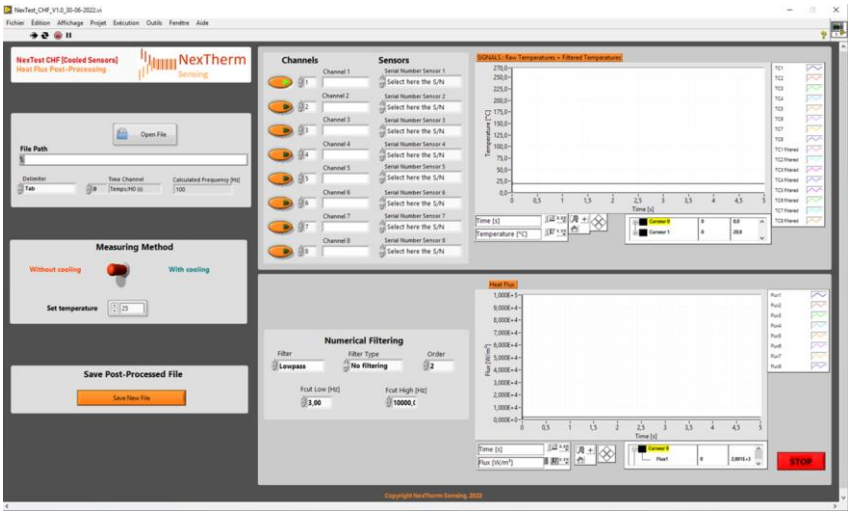
CHF sensors are based on an instantaneous temperature measurement*. As a consequence, they are directly calibrated by the application of a reference flux, which, in turns, basically provides a law in the form *heat flux = f(temperature)*. However, CHF sensors are liquid-cooled and are sensitive to the set-point temperature applied. It is thus mandatory to practice a calibration at various set-point temperatures. Each CHF sensor is provided with a calibration look-up table and associated analytical calibration law.

**Systematic error on sensor temperature in lower than 0.1°C.*



DATA ACQUISITION & POST-PROCESSING: THE NEXTEST™ TOOL

Measurement is now an easy task thanks to our proprietary analysis tool called NexTest™, powered by National Instrument LabView®. In three steps, you will be able to register you sensor, run measurement and post-process it. Measurements are immediately available as both raw data and graphics. Advanced analysis can be carried out to get signals numerically filtered, when your process is highly instable for example.



ORDERING

Note that each unit is supplied with its own thermostatic bath in order to guarantee the quality of the calibration. For the very same reason, we highly recommend to use the same flexible hose length as supplied, in order to minimize head loss and thermal loss variation.

For standard model ordering, please use the following referencing:

CHF-M-W-C-F-L

with the corresponding coding:

- M : mounting (flange M1, thread M2)
- W : wire type (W1 to W6)
- C : connector type (C1 to C3)
- F : sensor finishing (TF : total flux, CF: convective flux)
- L : length of flexible hoses (meters)

Example: for a convective flux sensor with a standard flange mounting, glass fiber insulated lead wire and standard connector, equipped with a 2 meters cooling circuit: CHF-M1-W2-C1-CF-2.

For other configurations (including window selection for radiometers), please contact us.

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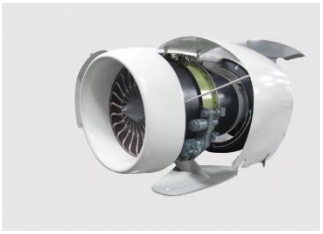
Aerospace/Defense

Nuclear/Power plant



Turbomachines

Furnaces/Foundry

Fire safety

Braking systems