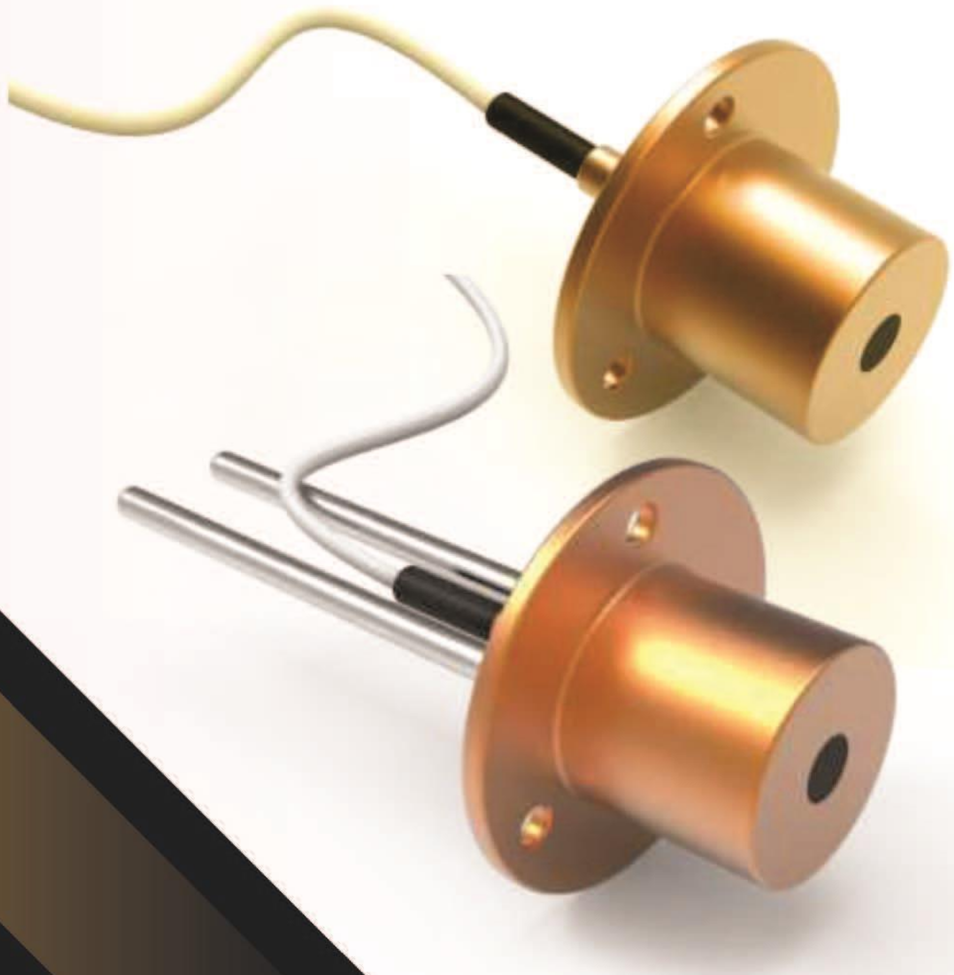
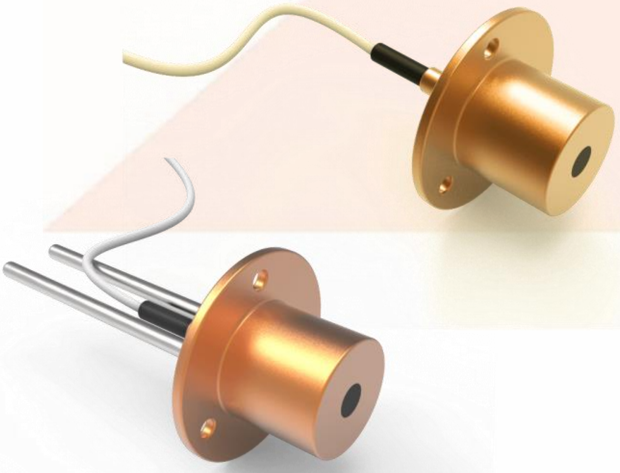
TEMPSENS

HEAT FLUX SENSOR

ADVANCING THERMAL INSIGHTS



Heat Flux Sensor



Temperature (°C, °F, and K) is a relative measure of thermal energy, whereas heat (J) is the actual energy transferred between objects due to a temperature difference. Heat Transfer refers to the process of thermal energy moving from a region of higher temperature to a region of lower temperature.

Heat Flux (W/m^2) is the amount of heat transfer from or to a surface per unit time per unit area. This heat flux is measured by the temperature change bought by the effect of heat flux sensor. A Heat Flux Sensor is a state of the art device designed to measure the rate of heat transfer through a surface. This versatile tool provides valuable data on heat flow, enabling users to analyze, control, and optimize thermal processes across various industries.

Applications

Our Heat Flux Sensors find applications across diverse industries:

- Building and Construction
- Electronics
- Medical and Metallurgical Industrial Processes
- Fire Safety
- Aerospace and Space Exploration
- Environmental Monitoring
- Solar Power Sector

Conduction and convection requires medium for heat transfer while on the other hand radiation does not require any medium. High-intensity radiations cannot be measured directly by fragile thermopiles and bolometer as these instruments could be burned out. Depending on the applications the heat flux sensors are classified as:

- **Gardon gauge (circular-foil gauge)**
- **Schmidt Boelter gage**

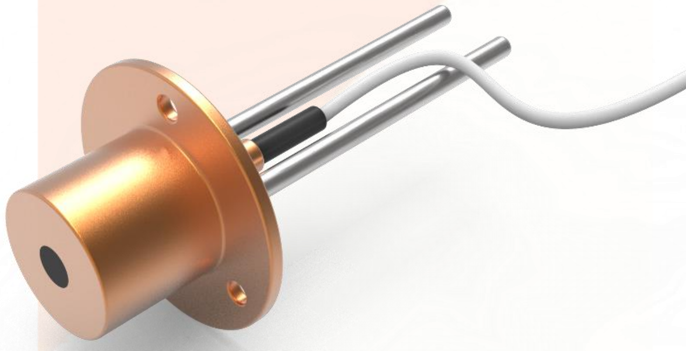
Heat Flux Sensor

Gardon gauge (circular-foil gauge)

A Gardon Gauge heat flux sensors can measure the high thermal radiation intensities. These sensors majorly measure the heat transfer through radiation mode and account for the heat's effect due to convection and radiation heat. Each transducer will provide a self-generated 10-millivolts (nominal) output at the design heat flux level. A single differential generates the emf output thermocouple between the foil center temperature and foil edge temperature.

The ranges include **10, 20, 30, 50, 70, and 90 W/cm².**

Schmidt Boelter gage



The Schmidt-Boelter heat flux sensor operates based on the principle of convective and radiative heat transfer from a heated surface. A Schmidt-Boelter heat flux meter features a thick thermopile positioned on a heat sink. When the heat flux meter is exposed to a radiant heat source, it produces a direct current voltage proportionate to the incoming heat, which is transformed into a measured heat flux level by reading the voltage through the instrument.

The ranges include **0.5, 1, 2.5 and 5 W/cm².**

Heat Flux Sensor

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Technical Parameters

Parameters	Cooled and Uncooled both type of sensor
Heat Flux (maximum)	0.5, 1, 2.5, 5, 10, 20, 30, 50, 70 & 90 W/cm^2
Sensor Type	Gardon Gauge (10-90 W/cm^2) Schmidt Boelter Gauge (0.5-5 W/cm^2)
Sensor Output	Linear output, 10 mv nominal at full range
Over Range	25% of Rated Heat Flux
Accuracy	±5% or Better
Repeatability	2%
Measurement Duration	60s for 10 W/cm^2
Sensor	Differential Thermocouple and Thermopile Sensor
Dimension	Diameter 25mm, Length 25mm
Mounting	Flange
Cable Length	Specify either 3 meter
ISO Standard	ISO17025 Accredited calibration certificate (Optional)

Features

- Measures intensity directly.
- Measure it calorimetrically, i.e., without reference to spectral quantity.
- Less time constant.
- Give signals that are capable of being recorded without amplification.
- Linear Output Proportional to Heat Transfer Rate.
- Accurate, Rugged, Reliable.
- Convenient Mounting.
- Measure Total Heat Flux (Radiation & Conduction).
- Measure Radiant Heat Flux via window attachment

Heat Flux Sensor

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Standard Mounting Configurations

There are various mounting configurations according to the industry requirements.

- All mounting flanges are 42 mm dia. with 3.8 mm dia. mounting holes equally spaced on a 35 mm dia. bolt circle.
- Water cooling tubes (when specified) of 4 mm dia. and 100 mm long made with stainless steel tube (Other tube diameters and fittings are available).
- All threaded bodies have 1-12 UNF-2A threads.

Accessories

Voltage source meter: provided with sensor as per customer requirements.
Window: It allows the user to measure only the radiative component of the heat flux.

- Removable window attachments, with the standard sapphire or optional window materials, are available to limit the essential transducer to the measurement of radiation heat flux only.
- To measure the convection heat transfer, one can take the measurements with (Radiation) and without (Radiation + Convection) a window and subtract the heat flux readings.
- View restrict attachments are available to limit the angle of view for the basic transducer to 150°,120°,90°,60°,30°,15°or7°for narrow view angle measurements.
- The standard window is a sapphire window.
- Other types of windows are also available at customer request. The different window works on different wavelengths.

The detailed wavelength range of different windows are specified in the following table:

TO SUBSTITUTE WINDOW ON RADIOMETER INSTEAD OF SAPPHIRE (CUSTOMIZED)

(Approximate Transmittance Data, Details Available)

Substitute Window, (1mm unless noted)	Symbol, Insert in P/N	Useful Wavelength Range, micrometers	"Flat" Wavelength Range, micrometers
Sapphire (0.5mm)		0.2-5.5	0.4-4.2
Quartz (0.5mm)	QW	0.12-4	0.27-3
Calcium Fluoride	CaF2W	0.3-11.5	0.7-9
KRS-5	KRS-5W	0.6-50	0.6-30
Zinc Sulfide	ZnSW	0.5-14.5	0.8-12
Barium Fluoride	BaF2W	0.5-12.5	0.3-10
Zinc Selenide	ZnSeW	0.5-22	0.7-17
Cadmium Telluride	CdTeW	0.8-30	1.0-20

Heat Flux Sensor

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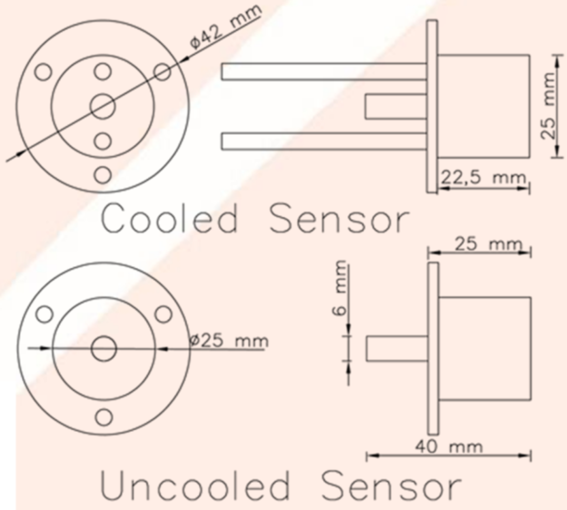
Standard configuration of cooled/uncooled models

- The sensor is provided with or without provision for water cooling of transducer body.
- Basic uncooled sensor nominal temperature will be 200°C.
- Water cooled should be specified if cooled sensor expected to achieve above 200°C.
- Thermocouples can be mounted on the surface of Gard on Gauge heat flux sensor as per customer requirement.



Technical Specifications

- **The Gardon Gauge Heat Flux Sensor is available in five different configurations namely Smooth body with flange, smooth body without flange, partial threaded body with flange, partial threaded body no flange, threaded body with flange.
- Selection of the Tempsens make Heat Flux Sensor
    - TGG: Gardon Gauge
    - TSB: Schmidt Boelter Gauge
- The sensor comes with model number as mentioned below

TGG – XX-YY-ZZ-WW

Where,

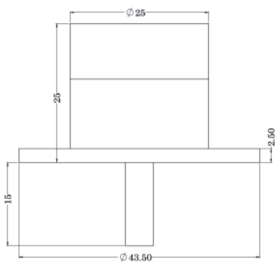
XX –Heat flux magnitude, W/cm^2

YY – Cooled (C) or Uncooled (U) type,

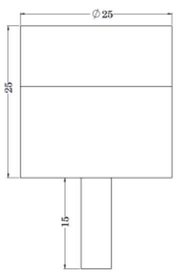
ZZ – With (W) or Without (N) window,

WW – Type of Thread I.e. Full (F) or Partial (P) or No (O), Type of Flange i.e. With (W), Without (N).

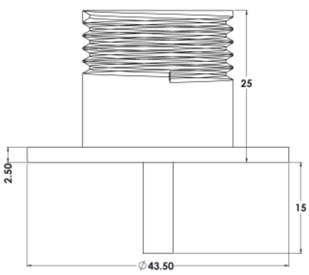
For example: The *TGG–10-C-W-PN* shows a Tempsens make cooled Gardon Gauge heat flux sensor of magnitude 10 W/cm2, with window attachment, partially threaded without flange.



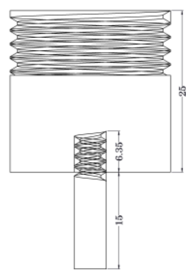
Smooth Body with Flange



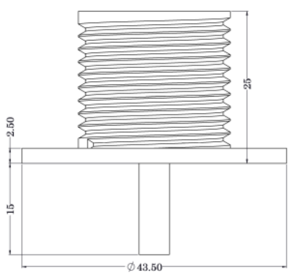
Smooth Body No Flange



Partial Threaded Body With Flange



Partial Threaded Body Without Flange

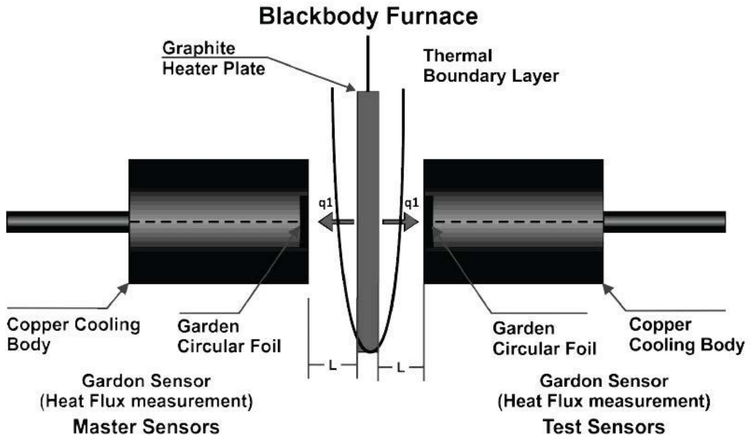


Threaded Body with Flange

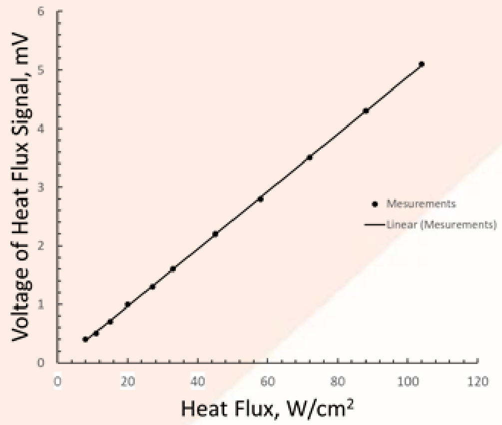
Heat Flux Sensor

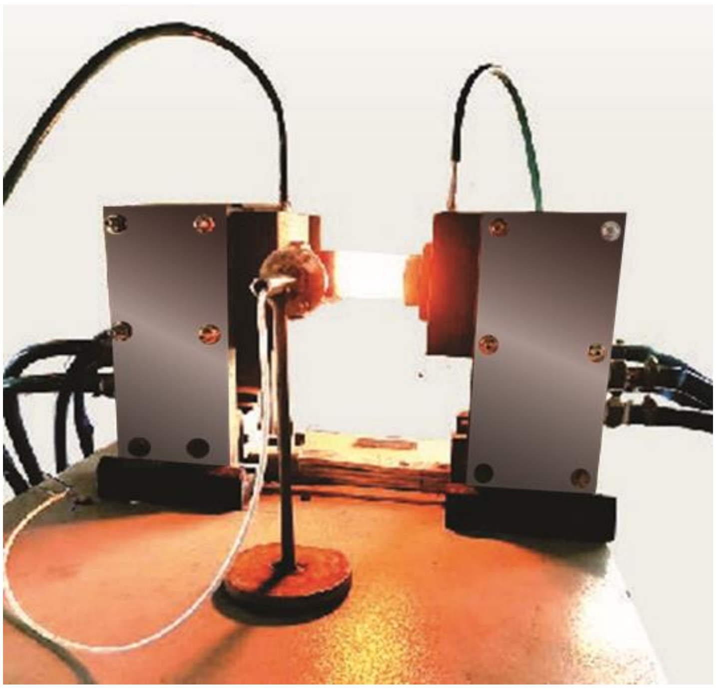
Heat Flux Sensor Calibration Method

- It works on the principle of axial one-dimensional heat flow.
- It measures the temperature difference across a thin, thermally insulating layer to determine the incident heat flux. Due to the axial flow of heat, the temperature distribution across the sensing surface is uniform.
- The maximum body temperature is limited to about 200°C when the sensor is not water-cooled.
- All of the calibrations show a linear response of the sensor, with regression factors close to unity.



Heat Flux Measurement

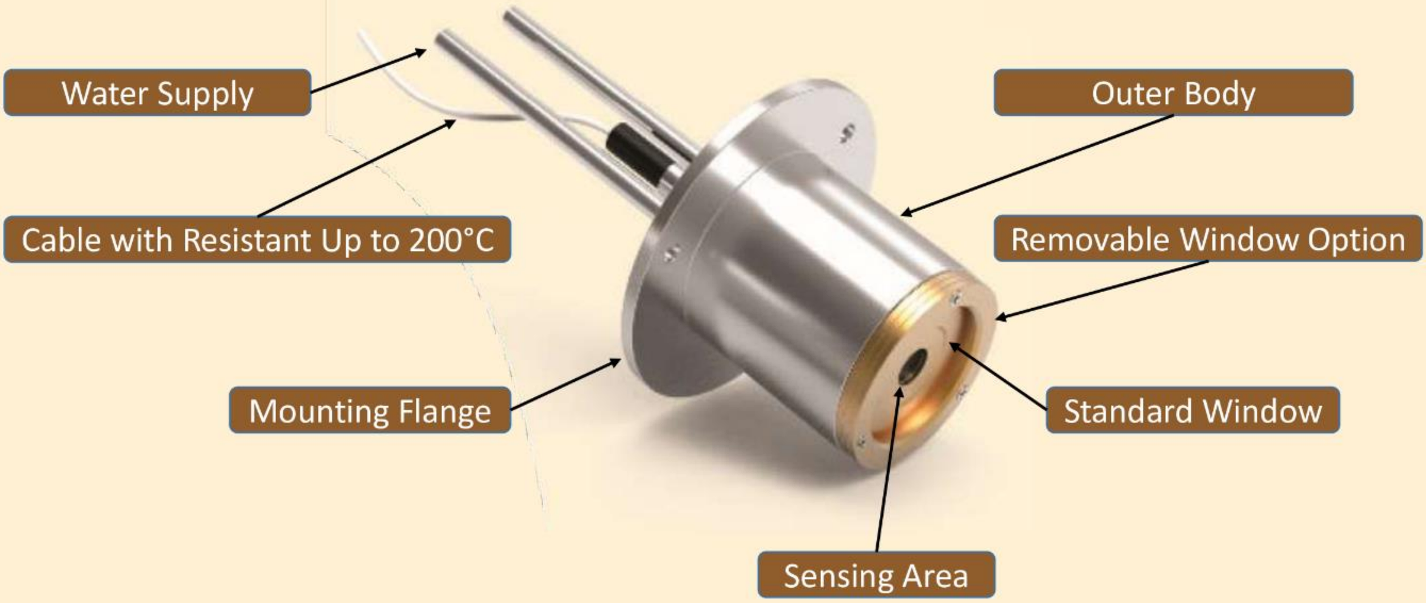




- Heat flux sensor mainly used for fire and fire resistance.
- We have designed our heat flux sensors according to the theoretical analysis with suitable foil thickness and diameter of foil.
- To calibrate heat flux sensor, an experimental setup is prepared.
- The experimental apparatus consists of a heat flux sensor, a data acquisition unit, and a PC.
- The calibration of gauge is dependent on the radiated flux and measuring output or response of the sensor.
- The sensor based upon thermocouple response and output measured with precise volt-meter (measuring unit).

Heat Flux Sensor

Over View



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