

# Neutron detector

# CFUC06

## High-temperature fission chamber

### Application

- ✓ Detection of neutrons at temperature up to 600°C

### Features

- ✓ High sensitivity
- ✓ Very high immunity against interferences

Nuclear characteristics at 20°C			
Sensitivity to thermal neutrons <sup>1</sup> :	Pulse mode	1	$\text{c.s}^{-1}/\text{n.cm}^{-2}.\text{s}^{-1}$
	Fluctuation mode	$4 \times 10^{-26}$	$\text{A}^2.\text{Hz}^{-1}/\text{n.cm}^{-2}.\text{s}^{-1}$
	Current mode	$2 \times 10^{-13}$	$\text{A}/\text{n.cm}^{-2}.\text{s}^{-1}$
Neutron flux range :	Pulse mode <sup>2</sup>	1 - $10^5$	$\text{n.cm}^{-2}.\text{s}^{-1}$
Gamma sensitivity:		$7 \times 10^{-9}$	$\text{A}/\text{Gy}.\text{h}^{-1}$
Exposure limits:	Thermal neutrons <sup>3</sup>	max $2 \times 10^{19}$	$\text{n.cm}^{-2}$
Gamma radiation:	Exposure	max $10^9$	Gy
	Dose rate	max $10^4$	$\text{Gy.h}^{-1}$

### Electrical characteristics

Insulating resistance at 600V <sup>4</sup> :	Between signal and outer shell	min $10^{12}$	$\Omega$
	Between HV and outer shell	min $10^{12}$	$\Omega$
	Between signal and HV	min $10^{13}$	$\Omega$
Operating voltage:	Nominal up to 600°C	400	V
	Maximum at 20°C	600	V
	Limit with no radiation	1300	V
Charge collection time <sup>5</sup> :		350	ns
Cable:	Capacitance	170	pF/m
	Characteristic impedance	50	$\Omega$
	Attenuation	0.34	dB/m

### Mechanical and physical characteristics

Detector:	Materials:	Case, electrodes Insulator Brazing	Inconel (Co<0.05%) $\text{Al}_2\text{O}_3$ NiCuAu
	Sensitive layer:	Uranium enriched in $^{235}\text{U}$ Mass	>90% 1.4 $\text{mg.cm}^{-2}$
Filling gas <sup>6</sup> (pressure)			Argon (at 350 kPa)
Dimensions:	Nominal diameter	48	mm
	Detector length	372	mm
	Overall length, on request <sup>7</sup>	max 12	m
	Sensitive length	230	mm
Cable:	Type <sup>8</sup> : high immunity, mineral insulator	6 coax	
	External diameter	6 mm	
	Insulator	MgO	
	Curvature radius <sup>9</sup>	min 60 mm	
Connector:	Type <sup>10</sup>	HN, watertight	
	CFUC06/F <sup>7</sup>	female	
	CFUC06/M <sup>7</sup>	male	
	Insulator	$\text{Al}_2\text{O}_3$	

### Notes.

Unless otherwise stated, all characteristics are given at 20°C

<sup>1</sup> Values depending on the characteristics and the calibration of the measurement equipment. The pulse sensitivity is calculated from the ( $\alpha$ -neutron) discrimination curve for a discriminating threshold corresponding to a counting rate of 1 c.s<sup>-1</sup>.

<sup>2</sup> Pulse mode operating range for a measurement equipment with a resolution shorter than the collection time of the detector.

<sup>3</sup> Flux corresponding to a 1% sensitivity loss of the detector.

<sup>4</sup> For sensible fission chambers ( $s > 0.1 \text{ c.s}^{-1}/\text{n.cm}^{-2}.\text{s}^{-1}$ ), the  $\alpha$ -current is predominant in relation to the leakage current from the insulators. The insulating resistance is then measured by the ratio  $\Delta U/\Delta I$  of the  $I=f(U)$  curve determined without any ionizing radiation.

<sup>5</sup> Charge collection time: the measured value depends on the electronics and on the cable capacitance. Shorter collection times are reached with the CFUC07 detector.

<sup>6</sup> For other gas filling, refer to CFUC07.

<sup>7</sup> The type of connector (male or female) and the overall length (detector + cable + connector) constitute the version code to be mentioned in the detector reference after the basic type number. For example CFUC06/F5 indicates a female connector and 5 m overall length.

<sup>8</sup> Our "6 coax" cable is the 1 Zs FCAc 60 referenced cable from Thermocoax.

<sup>9</sup> This is the smaller curvature radius allowing one reversible deformation.

<sup>10</sup> In order to avoid humidity penetration during storage, the connector is closed with a cap to be removed just before use. As a general rule, prevent any humidity penetration at the connection level (refer to "Instructions for use and handling" in the package). Other connector types are possible on special request.

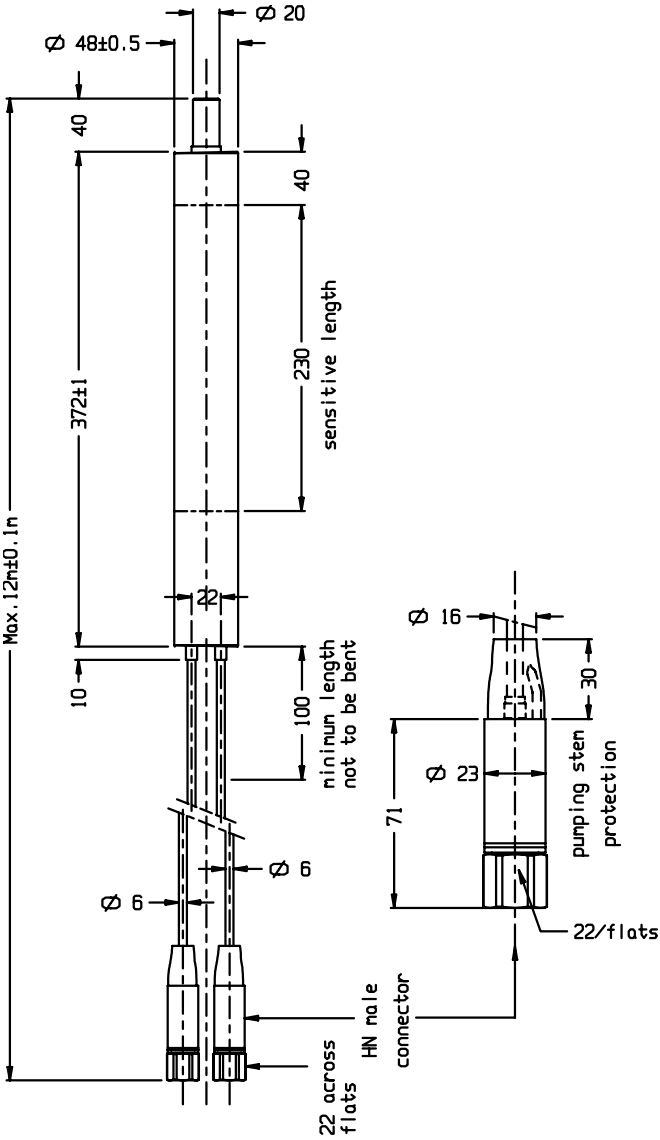
<sup>11</sup> Including temperature increase due to gamma radiation (effective above  $10^4 \text{ Gy.h}^{-1}$ ). The maximum operating temperature is indicated for pulse operating mode. The leakage current in the cables increase rapidly with temperature. It is therefore necessary to take into account this characteristic, which limits the maximum temperature so that the ratio of wanted signal/parasitic signal remains acceptable.

<sup>12</sup> Vibration test conditions: frequency 60 Hz, amplitude  $\pm 1.5 \text{ mm}$ .

# Neutron detector

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Outline (dimensions in mm)



Limiting values	Max
Operating temperature <sup>11</sup>	600 °C
Vibration (any axis) <sup>12</sup>	200 m.s <sup>-2</sup>
Shock (perpendicular axis)	500 m.s <sup>-2</sup>

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