Data Sheet

Neutron detector

CFUL08

Out-core fission chamber with integral cable

Application

- ✓ Detection of thermal neutrons in a flux range of 1 to 10^{10} $n.cm^{-2}.s^{-1}$

Features

- ✓ High sensitivity
- ✓ Very high safety of use
- ✓ Also available in a LOCA-proof (Loss Of Coolant Accident) version

Nuclear characteristics

Sensitivity to thermal neutrons [1]:	Pulse mode Fluctuation mode Current mode	1 $4x10^{-26}$ $2x10^{-13}$	$c.s^{-1}/n.cm^{-2}.s^{-1}$ $A^2.Hz^{-1}/n.cm^{-2}.s^{-1}$ $A/n.cm^{-2}.s^{-1}$
Neutron flux range :	Pulse mode [2] Fluctuation mode [3] Current mode [4]	$1 - 10^6$ $8x10^4 - 2x10^9$ $10^4 - 10^{10}$	$n.cm^{-2}.s^{-1}$ $n.cm^{-2}.s^{-1}$ $n.cm^{-2}.s^{-1}$
Gamma sensitivity:		$7x10^{-9}$	$A/Gy.h^{-1}$
Exposure limits: Gamma radiation:	Thermal neutrons [5] Exposure Dose rate	max $2x10^{19}$ max 10^9 max 10^4	$n.cm^{-2}$ Gy $Gy.h^{-1}$

Electrical characteristics

Insulating resistance at 600V [6]:	Nominal at 20°C Detector + 9m cable at 250°C	min 10^{12} min $5x10^8$	Ω Ω
Operating voltage:	Nominal up to 250°C Maximum at 20°C Limit with no radiation	600 800 1300	V V V
Charge collection time [7]:		80	ns
Detector:	Capacitance	240	pF
Cable:	Capacitance Characteristics impedance Attenuation	170 50 0.34	pF Ω dB/m

Mechanical and physical characteristics

Detector:	Materials:	Case, electrodes Insulator Brazing	Aluminium Al_2O_3 AgCu	
	Sensitive layer:	Uranium enriched in ^{235}U	>90%	
Filling gas [8] (pressure)			Argon + 4% nitrogen (at 250 kPa)	
Dimensions:	Nominal diameter Detector length Overall length, on request [9] Sensitive length		48 345.5 max 12 211	mm mm m mm
Cable:	Type [10]: high immunity, mineral insulator External diameter Insulator Curvature radius [11]		6 coax 6 MgO min 60	 mm mm
Connector:	Type [12] CFUL08/F [9] CFUL08/M [9] Insulator		Watertight, HN Female Male Al_2O_3	

Notes.

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

[1] Values depending on the characteristics and the calibration of the measurement equipment. The pulse sensitivity is calculated from the (α–neutron) discrimination curve for a discriminating threshold corresponding to a counting rate of 1 $c.s^{-1}$.

[2] Pulse mode operating range for a measurement equipment with a resolution shorter than the collection time of the detector.

[3] Fluctuation operating range measured on an equipment with a 1 to 30 kHz band pass.

[4] Current mode operating range: the lower limit of the current mode operating range depends on the electronics (especially on the input amplifier) and on the signal / parasitic current ratio (parasitic current = leakage current + gamma current + α-current). The upper limit is depending both on the detector and electronics (loss of linearity).

[5] Flux corresponding to a 1 % sensitivity loss of the detector.

[6] For sensible fission chambers ($s > 0.1$ $c.s^{-1}/n.cm^{-2}.s^{-1}$), the α-current is predominant in relation to the leakage current from the insulators. The insulating resistance is then measured by the ratio ΔU/ΔI of the I=f(U) curve determined without any ionizing radiation.

[7] Charge collection time: the measured value depends on the electronics and on the cable capacitance.

[8] The use of a gas mixture (Ar + N_2) increases the electron velocity and therefore favours a short collection time.

[9] The type of connector (male or female) as well as the overall length (detector+cable+connector) constitute the version code to be mentioned in the detector reference after the basic type number. For example CFUL08/F5 indicates a detector with a female connector and a 5 m overall length.

[10] Our "6 coax" cable is the 1 Zs FCAc 60 referenced cable from Thermocoax.

[11] This is the smallest irreversible curvature radius.

[12] 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.

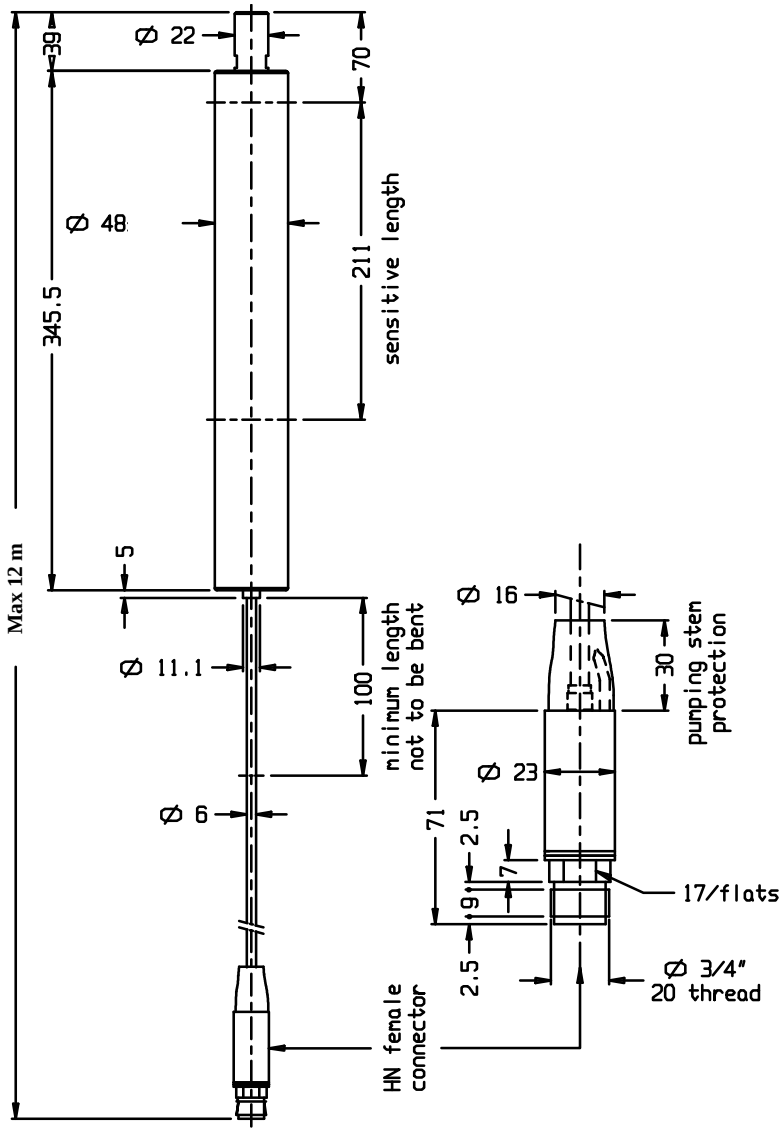
[13] Including temperature increase due to gamma radiation (effective above 10^4 $Gy.h^{-1}$). The maximum operating temperature is indicated for pulse operating mode. The leakage current in the cable increases rapidly with temperature. It is therefore necessary to take into account this characteristic,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

[14] Vibration test conditions: frequency 60 Hz, amplitude ± 1.5 mm.

Neutron detector

CFUL08

Outline (dimensions in mm)



Limiting values	Max
Operating temperature [13]	250 °C
Vibration (any axis) [14]	200 $m.s^{-2}$
Shock (perpendicular axis)	500 $m.s^{-2}$