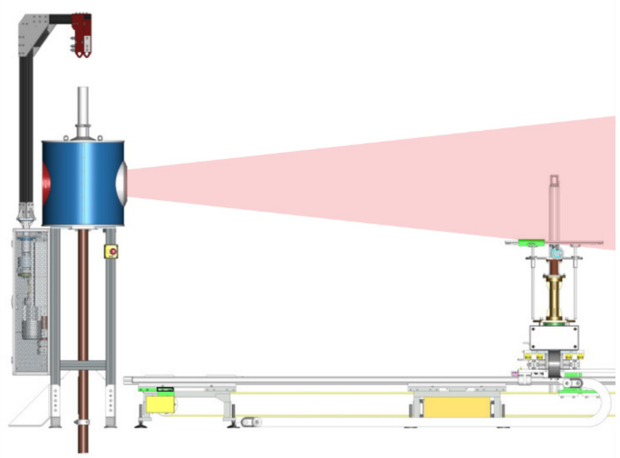
NEUTRON IRRADIATION CALIBRATION SYSTEM PM9200

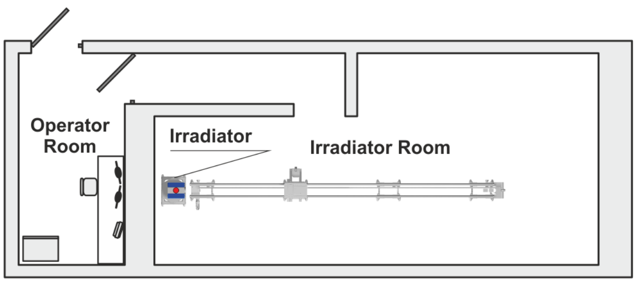


Purpose

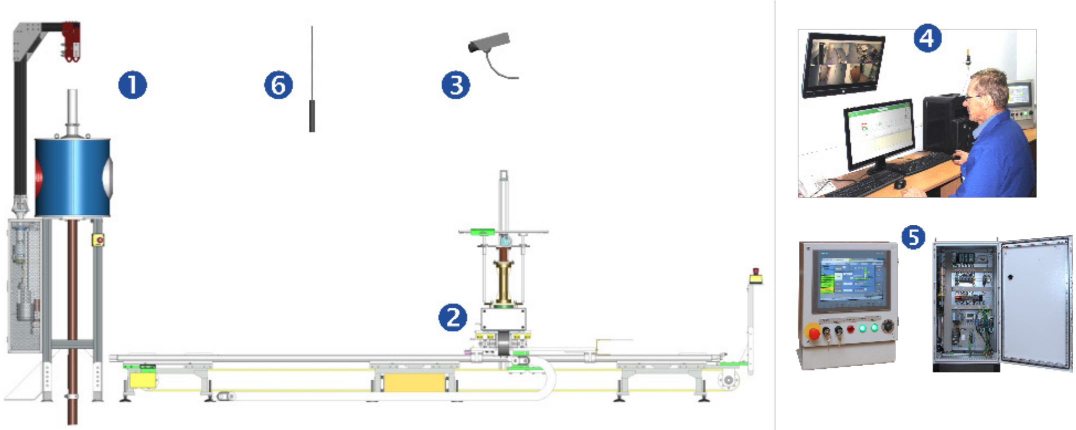
Neutron Irradiation Calibration System PM9200 is designed for automated verification, calibration, graduation, and testing of the instruments that measure flux density, ambient dose equivalent rate, and personal dose equivalent rate of neutron radiation.

PM9200 provides the field of fast and thermal neutrons in a collimated beam as well as in an open geometry. The field is created by sealed neutron sources ^{238}Pu-Be, ^{239}Pu-Be, ^{241}Am-Be, and ^{252}Cf used in the system irradiator.

PM9200 is available in three models which differ in irradiators.



System components



1 Neutron irradiator
- NI-201 (for PM9201)
- NI-201H (for PM9201H)
- NI-204 (for PM9200)

2 Linear positioning system

3 Video surveillance system
4 Operator workstation
5 Control system
6 Radiation monitoring system PM520

Operating principle

The system provides a wide range of reference dosimetric values by using the neutron sources of different activity and changing the distance between the source and the instrument. The sources are stored in a fixed irradiator equipped with one or multiple compartments for them.

A special metrological software installed on the operator's workstation allows selecting the required source, setting the distance between the source and tested instrument, adjusting the instrument position in the collimated beam, and calculating the exposure duration either automatically or manually.

Irradiator

The remote-control irradiator ensures storage and operation of sealed neutron radiation sources ^{238}Pu-Be, ^{239}Pu-Be, ^{252}Cf, ^{241}Am-Be (by the customer's request).

NI-201 irradiator provides underground location and storage of one neutron source with maximum neutrons flux of up to 5×10^{8} cps

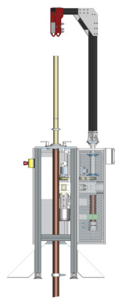
NI-201H irradiator provides ground location and storage of one neutron radiation source with maximum neutrons flux of up to 1×10^{7} cps

NI-200 irradiator provides underground location and storage of four neutron sources with total maximum neutrons flux of up to 1×10^{9} cps.

In the installations, a remote selection of the neutron radiation source and its transfer from the storage position to the working position is carried out.

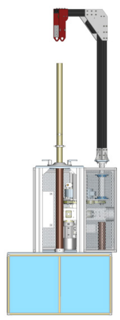
Installations provide the formation of a neutron field:
- collimated beam of fast neutrons in the geometry of the collimation node using a collimator insert made of 5% borated polyethylene
- collimated beam of thermal neutrons using a thermal insert made of polyethylene and using a cadmium screen
- non-collimated beam of fast neutrons in an "open" geometry (OG) using a shielding cone made of steel and borated polyethylene
- non-collimated of thermal neutrons using thermal spheres made of polyethylene or D2O in accordance with ISO 8529-2.

Irradiator NI-201/NI-204



Non-collimated geometry

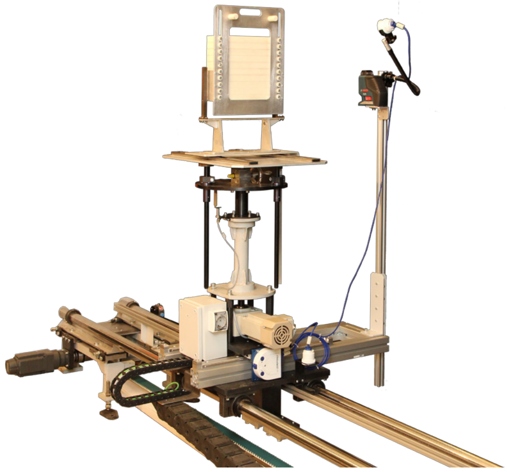
Irradiator NI-201H



Non-collimated geometry

Linear positioning system

The linear positioning system is designed to move the table with the tested instruments along three axes (X, Y, Z) and rotate it.
The table positioning in a specified coordinate is ensured by a special drive and logical programmable controller.
Positioning can be additionally controlled with the laser or mechanical ruler via video camera.



Remote control system

The control of all the system mechanisms is performed from the remote panel installed in the operator room. The panel is equipped with a touchscreen LCD display with 304 mm diagonal. The panel enables control in a semi-automatic mode or an adjustment mode and allows monitoring the mechanisms positions. The LCD indicates different text messages about the mechanisms operation and the results of temperature, humidity, and dose rate measurement.

Radiation monitoring system

The system is designed to continuously monitor the radiation situation and consists of two smart gamma detectors and two neutron detectors. One pair of gamma and neutron detectors is installed on a wall in the irradiator room, another pair, in the operator room.
The control panel indicates current dose rate readings taken from each detector and warning messages about the excess of pre-set dose rate thresholds

Video surveillance system

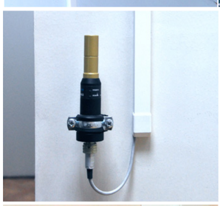
The system allows the operator to remotely monitor the readings of the tested instruments, position of the linear positioning system, and processes in the irradiator room.

Alarm and interlock system

The system represents a complex of mechanisms and devices that, in combination with the control system, ensure the personnel protection from radiation.

Optional system accessories

are available on the customer request.



NEUTRON IRRADIATION CALIBRATION SYSTEM PM9200

radmetron

Specifications

Specifications	PM9201	PM9200H	PM9200
Number of sources	1	1	up to 4
Maximum dimensions of source, Øxh, mm	35 × 45	35 × 45	35 × 45
Maximum activity of source, fast neutrons flux to solid angle of 4 π cp, cps ^{252}Cf ^{238}Pu-Be ^{239}Pu-Be ^{241}Am-Be	 5×10^8 5×10^7 1×10^7 5×10^7	 1×10^7 1×10^7 1×10^7 1×10^7	 5×10^8 5×10^7 1×10^7 5×10^7
Total flux of fast neutrons from sources placed in irradiator, no more, cps	5×10^8	1×10^7	1×10^9
Density of fast neutrons flux, cps·cм$^{-2}$	2.5–24.0·10^3	2.5–400	2.5–24.0·10^3
Density of thermal neutrons flux, cps·cм$^{-2}$	1.0–5.6·10^3	1.0–160	1.0–5.6·10^3
Ambient dose equivalent rate (ADER), μSv/h	3.5–3.4·10^4	3.5–800	3.5–3.4·10^4
Personal dose equivalent rate (PDER), μSv/h	3.5–3.4·10^4	3.5–800	3.5–3.4·10^4
Confidence limits of relative errors at 0.95 probability, no more: • at reproduction of neutrons flux density • at reproduction of ADER and PDER	 5 % 7 %	 5 % 7 %	 5 % 7 %
Time of source transfer from storage/expose position to expose/storage position, no more, seconds	15	10	15
Maximum activity of sources during creation of wide non-collimated neutron beam	5×10^8	1×10^7	1×10^9
Radiation background level created by irradiator with maximum activity source in storage position at 1 m from irradiator surface, μSv/h, no more: • gamma radiation • neutron radiation • total radiation	 1.0	 0.2 1.0 	 1.0
Irradiator dimensions, H×W×D, mm	2550×730×700	2550×930×865	2550×730×700
Irradiator mass, kg	190	840	190
Power consumption from single-phase AC mains of (230±23) V, (50±1) Hz, no more, V·A	600	600	600
Total weight of instruments installed on table, no more, kg	70	70	70

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