

Gamma Calibration Laboratory



Gamma Calibration Laboratory facilitates the whole calibration process with its state-of-the-art concept, technology, and many optional features. Various gamma radiation sources can be used to generate a range of dose rates, up to 10 Gy/h.

Purpose

VF's gamma calibration laboratory facilitates the whole calibration process with its state-of-the-art concept, technology, and many optional features. Various gamma radiation sources can be used to generate a range of dose rates, up to 10 Gy/h.

A broad range of meters can be calibrated, typically area gamma monitors, gamma survey meters, and electronic personal dosimeters.

Description

The laboratory can be divided to two separate parts – rooms:

Irradiation Room, which consist of:

- OG-8 Gamma Irradiator with radionuclide sources
- CB-50 Calibration Bench with optical measuring system and laser positioning system
- Elements of the safety system to prevent any unacceptable personnel exposure
- Elements of the control system
- Optional elements of the digital measuring system, intended for digital and automated acquisition of the measured data

Operator's Control Room, which consist of:

- Main control unit to control the equipment of the irradiation room
- Operator's PC workstation for process control and data presentation
- Elements of the safety system to prevent any unacceptable personnel exposure
- Optional General Information Panel GIP-01.

Main Advantages

- Modular system which can be optimized to specific clients' needs
- Can be used as a secondary standard dosimetric laboratory
- Can be accredited according to ISO 17025
- Sturdy safety interlocks
- Irradiator for up to 7 gamma sources with an activity up to 200 TBq of ¹³⁷Cs
- Low dose rate on the irradiator's surface
- Fully automatic or semi-automatic calibration bench with various customizable holders
- Laser positioning system for precise detector placement
- Fully automated operation of the laboratory, software applications completely manage the calibration process
- Predefined calibration procedures and reports
- User-friendly graphic interface
- Possibility of integration with the neutron and beta calibration laboratory.
- Possibility of a connection to external information systems via LAN.

OG-8 Gamma Irradiator

The OG-8 irradiator is the primary section of the calibration system for the gamma dose / dose rate meters. When fitted with appropriate radionuclide sources, it can serve as a gamma dose rate source in a very wide range from tenths of $\mu\text{Gy/hr}$ up to units of Gy/hr .

It generates a homogeneous and collimated ionizing radiation beam with an angle of 15 degrees and with the axis at a height of 1.5 m above the ground level as standard.

The collimator is designed in accordance with requirements of the ISO4037-1 standard.

The irradiator has a horizontal carousel holder with 8 slots for placing sealed radionuclide sources; one must be kept empty for safety reasons. Their maximum individual activity is 100 TBq of ^{137}Cs . The basic shielding material is lead.

Each of the sealed radionuclide sources is fixed inside a special holder designed for being used with the OG-8 irradiator. The holders are made of stainless steel.

The source is moved into the exposure position electromechanically, in two steps. The chosen source arrives in the working position by carousel rotation and then is electromechanically ejected through a vertical transport pipe to the exposure position inside the collimator.

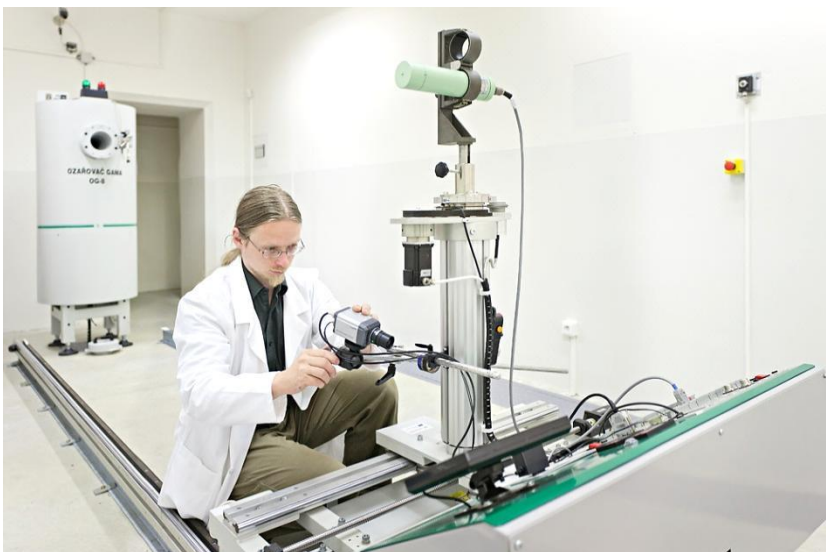
The sources selected and indicated in the control system can be verified by an independent mechanical indicator and camera located on top of the irradiator.

The operation of the OG-8 irradiator is controlled by the PLC, placed in the local control switchboard cabinet. Communication between the cabinet and the host system is ensured via Ethernet or RS-485 serial interface.

If any failure occurs, the source will automatically return to the safe position in the holder.



OG-8 Gamma Irradiator



Gamma Calibration Laboratory

Specifications

Number of sources	up to 7
Maximum source activity	100 TBq of ^{137}Cs (2700 Ci) 100 GBq of ^{60}Co (2.7 Ci)
Maximum total activity	200 TBq of ^{137}Cs (5400 Ci)
Dose rate on the surface	$\leq 1 \mu\text{S/h}$ (1 mRem)
Beam axis height	app. 1.5 m (59.06 in)
Source positioning accuracy	$\pm 0.3 \text{ mm}$ (0.012 in)
Power supply	230 VAC (optionally 110 VAC)
Communication with host system	Ethernet, RS-485
Weight with standard dual shield	app. 3.5 t (7720 lb)
Diameter	700 mm (27.56 in)
Total source adjustment time	$< 10 \text{ s}$
Collimators angle	15° (optionally 20°)
Maximum source dimension	diam. 40 x 80 mm (1.57 x 3.15 in)

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Common Parts Description



Main parts of OG-8 Irradiator

- Green and red status indicators
- Mechanical indication of the source position
- Collimator directing the photon beam
- Lead shielding ensuring low dose rate on the surface
- Motor with a transmission for vertical movement of the source
- Supporting frame

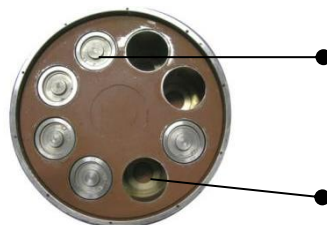
Set of recommended calibration sources

OG-8 is able to store and safely operate up to seven sources of various activities. All activities indicated are nominal. Real activities can vary within a range indicated by the manufacturer.

Loading of the sources into the irradiator is usually performed in a hot cell.

Activities are recommended for a 10 m long bench in the laboratory.

Radionuclide	Activity (Bq)	Activity (Ci)
^{137}Cs	44.4 TBq	1 200 Ci
^{137}Cs	800 GBq	22 Ci
^{137}Cs	12 GBq	0.32 Ci
^{137}Cs	200 MBq	0.01 Ci
^{137}Cs	spare	spare
^{241}Am	37 GBq	1 Ci
^{60}Co	37 GBq	1 Ci



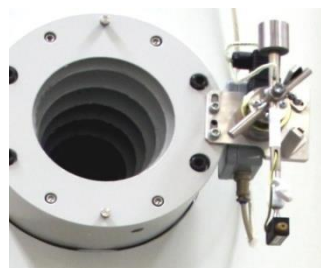
Occupied slot with source in holder

Empty slot

Top view of a carousel

Optional Accessories and Services

- A set of laser sources for the precise positioning of the calibrated meter, one source (two as an option) is located on the wall and one source is located in the collimated gamma beam axis (centre).
- A set of ion chambers and electrometer for the characterization of gamma beam, calculation of the dose rate correctional polynomial and for regular quality checks.



Laser beams for precise adjustment



Set with ion chambers and electrometer

CB-50 Calibration Bench

The bench is intended for the precise positioning of the meter within the horizontal ionizing radiation beam during calibration. A trolley, a key part of the bench, moves on rails parallel to the beam axis. It is used to position the tested instrument at the desired distance from the source (or desired dose rate). The bench makes it possible to change the distances of the tested instrument from the source automatically in a range from app. 0.7 m to 10 metres (27.6 in to 393.7 in) as standard. The adjustment of the moveable trolley along X axis, the detector-source distance, is controlled by a power unit that secures its smooth start and stop.

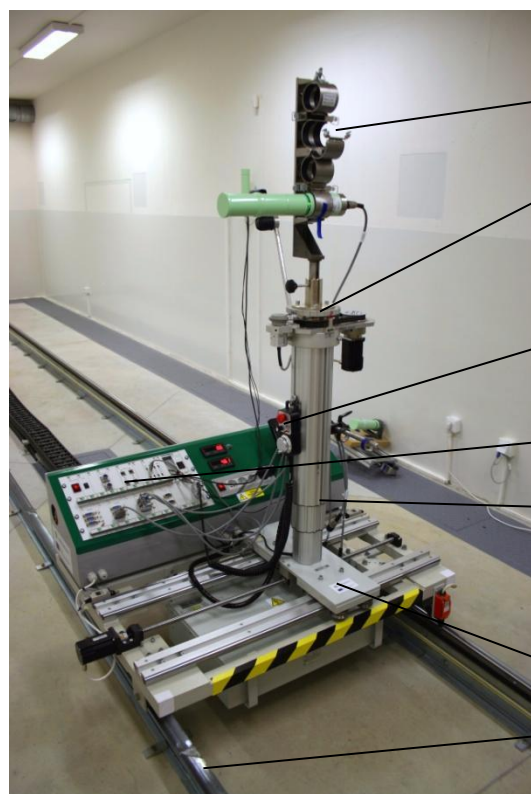
A mechanical scale attached to one rail and camera are used for independent verification of the bench position.

In the basic version, the adjustment of the detector in the horizontal/vertical direction perpendicularly to the source collimator axis is done manually, by rotating the adjustable knob with a resolution of 0.1 mm. Optionally, the motion along Z and Y axis (perpendicularly to the source collimator axis) and the rotation of the instrument table can be motorized and operated by the controller.

The calibration bench controller is installed in a box fixed to the trolley.



Basic option of calibration bench trolley



Fully equipped trolley with optional features

● Custom made holder for instruments being calibrated

● Optional rotating head of instrumentation table

● Axes motion controller

● Data acquisition system

● Axis Z

● Axis Y

● Rails (Axis X)

Specifications

Standard detector-source distance	0.7 ~ 10 m (27 ~ 394 in)
Detector horizontal movement	± 300 mm (± 12 in)
Detector vertical movement	
▪ mechanical	± 150 mm (± 6 in)
▪ electromechanical	± 300 mm (± 12 in)
Repeatability of position adjustment	less than 1 mm (0.04 in)
Trolley weight	70 kg (176 lb)
Maximum detector weight	10/80* kg (22/154* lb)
Trolley speed	0 ~ 200 mm/s (0 ~ 7.9 in/s)
Trolley dimensions without Z axis	1115 x 900 x 280 mm (43.9 x 35.4 x 11 in)
Instrument table dimensions	300 x 300 mm (12 x 12 in)
Power supply	230 VAC (optionally 110 VAC)
Communication with host system (PC)	Serial (RS-485)

* with electrically driven Y and Z axes

Measuring and Power Supply Systems

The Measuring System reads the data from the meters during the calibration (test) process. The power supply system provides for the meters being tested.

The measuring system can receive the readouts in two ways:

- Optically through a camera and a video monitor
- Digitally (option) through integrated ratemeters and/or digital interfaces directly to the host system (RS-232, RS-485, Ethernet, etc.).

Optional Accessories

- Electrically driven motion along Y and Z axes
- Electrically driven rotating instrument table
- Custom made holders and jigs for calibrated meters
- Digital measuring system for automated data acquisition

Safety System

The purpose of the safety system is to prevent any unacceptable exposure of the personnel. The technical components of the safety system are installed inside the irradiation room and in the operator's control room as well. All components are hardwired i.e. the signals have higher priority than any signal from control PC.

The technical means are:

- An electromagnetic door lock installed on the entry door to the irradiation room
- A passive open/close entry door sensor
- An entry door opening push button with a key lock
- A set of two active motion sensors (PIR) inside the entry labyrinth (corridor) and the irradiation room
- A camera which views the entire irradiation room status
- A visual and acoustic signalization unit placed at the entry door (and one on the top of the irradiator)
- Set of three emergency breakers for equipment

Basic functions of the safety system:

- Prevents starting the irradiation procedure if the entry door to the irradiation room is opened
- Prevents the opening the entry door to the irradiation room if irradiation process is in progress
- Moves the source into the irradiator shielding if the entry door to the irradiation room is opened during irradiation
- Moves the source into the irradiator shielding if any person is moving in the irradiation room
- Moves the source into the irradiator shielding after pressing one of emergency push-buttons
- Moves the source into the irradiator shielding in case of power failure
- Controls the visual and acoustic signalization – when starting the exposure, a short acoustic warning signal is provided and the light on the signalization unit goes red. The visual warning is constant throughout the exposure



Visual and acoustic signalization unit



Emergency breakers



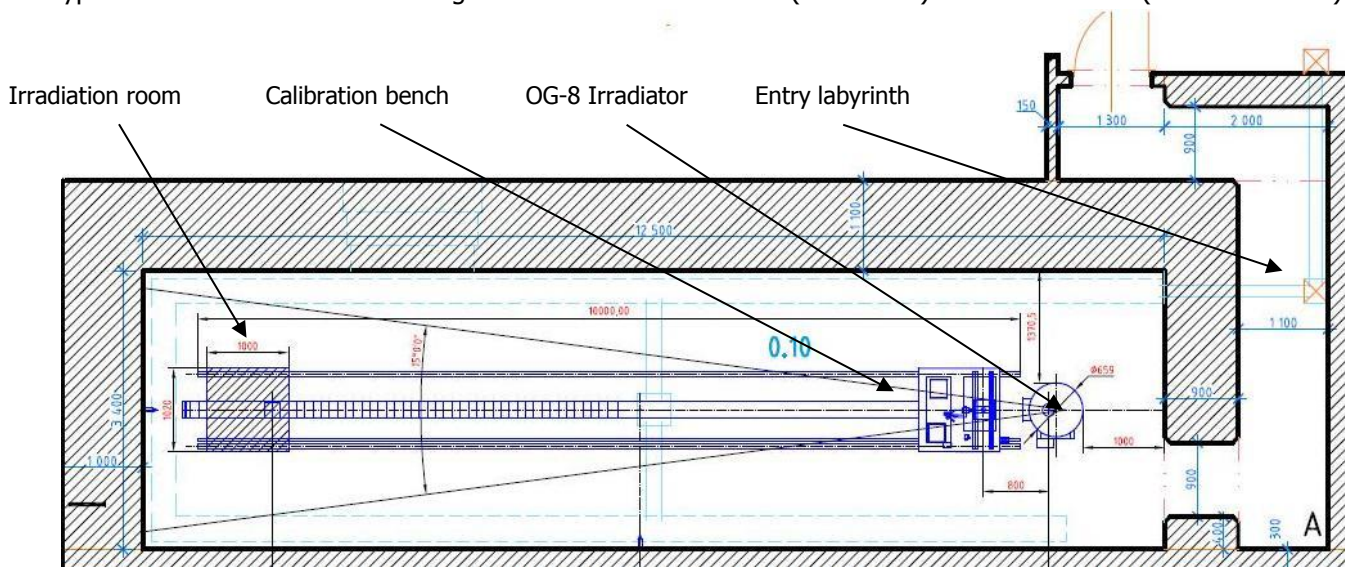
Entry door opening button with a key lock



Overall surveillance camera

Layout of the Calibration Laboratory

As part of the gamma calibration laboratory supply, VF provides its lengthy experience with design, construction, and operation of such facilities. The project can be designed on an individual basis and customized to meet specific customers' needs and expectations. An integrated calibration facility with gamma calibration laboratory and other calibration laboratories (such as panoramic gamma, beta and/or neutron) can be designed and supplied as well. The typical internal dimensions of the gamma irradiation room are (H x W x D) 3.4 x 3.4 x 12 m (11 x 11 x 40 ft.)



Typical layout of the irradiation room with entry labyrinth

Measurement of the Environmental Parameters

A system for the measurement of environmental parameters is located in the gamma irradiation room. All measured values are forwarded to the host system, which checks that the environmental conditions are within the acceptable limits.

The environmental measurement system consists of:

- A temperature sensor
- A pressure sensor
- A relative humidity sensor



Switchboard with environmental measurement system

Radiation Monitoring System

Radiation monitoring system ensures radiation safety in both the operator's and irradiation room. Its basic version consists of two MDG type smart dose rate probes and one LZJ-22 local display unit. For larger calibration laboratories, it can feature bigger amount of dose rate probes, alarm slave units and/or can be connected to a host Radiation Monitoring System.



MDG-04 Dose Rate Probe



LZJ-22 Local Display unit

General Information Panel GIP-01

The General Information Panel provides the overall status of the calibration laboratory with source indicator calibration bench position, ambient conditions, dose rate values etc. can optionally be supplied and installed in the operator's room.



General Information Panel GIP-01

Electronic Personal Dosimetry System SEOD-MP

The Electronic Personal Dosimetry System SEOD-MP is designed for operative monitoring of persons and for assessment of their personal doses by means of electronic personal dosimeters. It allows dose record-keeping in accordance with legislative requirements. The user-friendly and compact Electronic Dosimeters Terminal is part of the Electronic Personal Dosimetry System SEOD-MP. It allows acquiring information on persons and their personal doses from electronic personal dosimeters of various types.



Standards and Certification

OG-8 irradiator is **type approved** by the State Office for Nuclear Safety of the Czech Republic. The design of the irradiator's collimator meets the requirements of the standard **ISO 4037-1**: X and gamma reference radiation for calibrating dose meters and dose rate meters and for determining their response as a function of photon energy - Part 1: Radiation characteristics and production methods. The whole laboratory meets the requirements and can be accredited in accordance with the **ISO/IEC 17025:2005** standard for testing and calibration laboratories.

Basic Control Software



The Basic Control Software is provided as standard to enable remote control of the laboratory technology. Optionally, a complete Data and Control System (DaRS), which manages completely the calibration laboratory operation, can be supplied. The Basic Control Software provides the user interface for the laboratory hardware. The application can run on the different Microsoft Windows operating systems such as XP, Vista, 7 and others.

Optional DaRS software is a modular based system which consists of several dependent and several independent modules. The modules control individual parts of the system which operates using the SQL database running on a server. For more information please see DaRS data sheet.

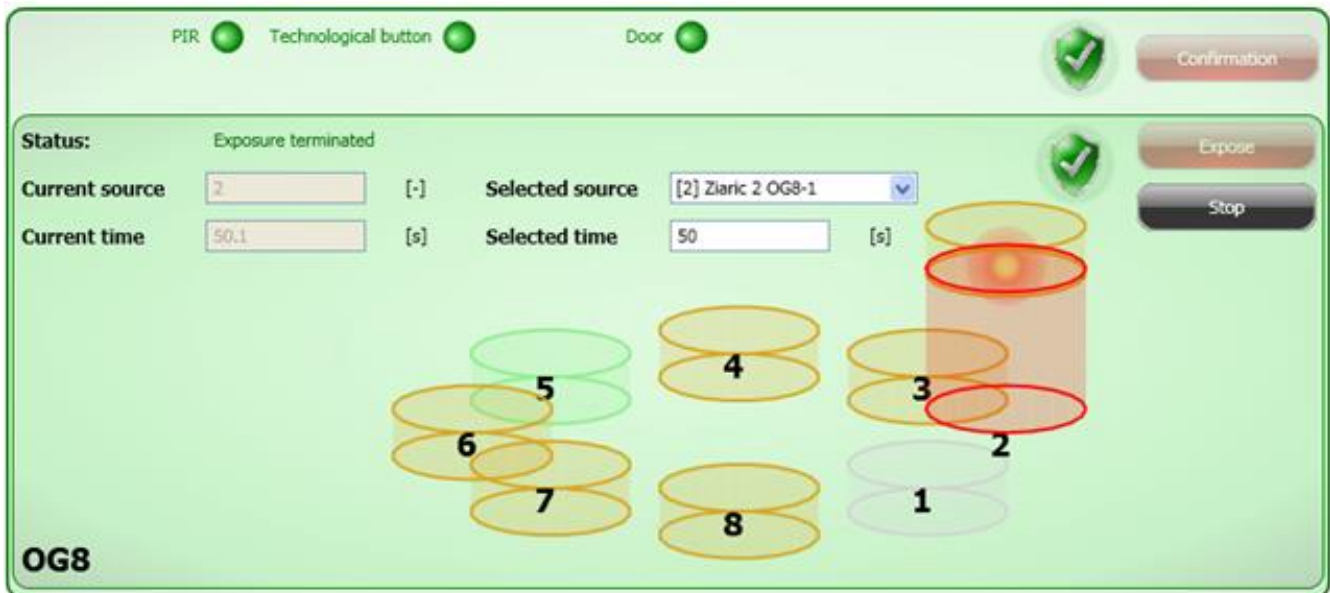
Laboratory Control Module
Source Inventory Module
Loans Inventory Module

Basic Control Software

■ incorporated □ optional

Modules description

- **Laboratory Control Module** – for the laboratory technology control
- **Source Inventory Module** – to record calibration sources data, their types, calculations of the distance for a given dose, and dose calculation for a given distance, calculation of the up to date activity, taking into account the half-life of sources
- **Loans Inventory Module** – enables inventory loan management and process control of calibration sources and tools for measurement



Basic Control software screen

Models and Accessories

Type	Description		
K0123	OG-8 Gamma Irradiator		
K0124	CB-50 Calibration Bench		
N/A	Optical Measuring and Power Supply System installed on the bench		
K0250	Safety System		
N/A	Measurement of the environmental parameters		
S1309	Basic Control Software		
N/A	Radiation Monitoring System of the calibration laboratory		
Optional Accessories			
▪	Laser positioning system with two laser beams		
▪	Laser positioning system with three laser beams		
▪	Set with two ion chambers and electrometer		
▪	General information panel GIP-01		
▪	Electrical driven motion along Y and Z axes for calibration bench		
▪	Electrical driven rotating instrument table of calibration bench		
▪	Custom made holders and jigs for calibrated items		
▪	Digital measuring system		
Related Products			
S1111	DaRS Database and Control System	K0743	LZJ-22 Local Display Unit
S0803	RMS Radiation Monitoring System	S1112	SEOD-MP Personal Electronic Dosimetry System
K0104	MDG-04 Smart Dose Rate Probe	K0043	TED-MP Electronic Dosimetry Terminal
K0830	ASU-50 Alarm Slave Unit	K145X	DPD Dispenser of Personal Dosimeters



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