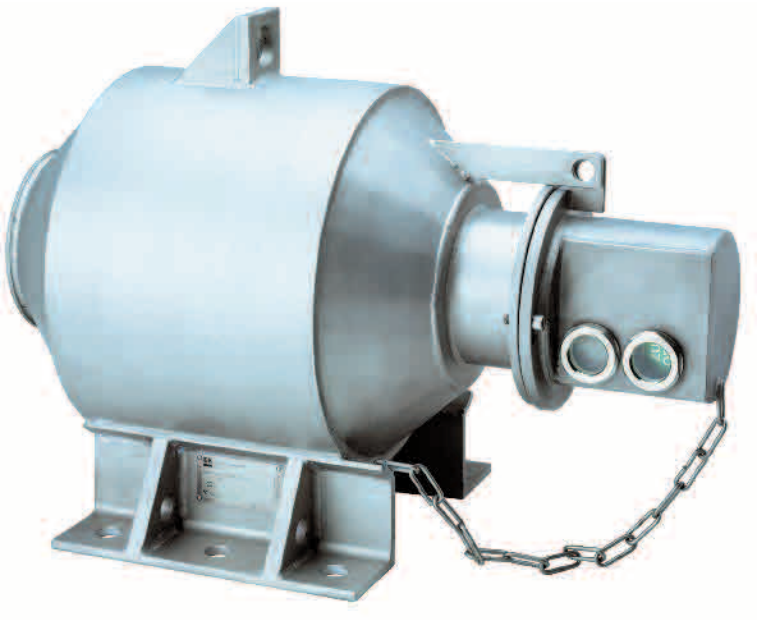
Technical Information
TI 346F/00/en

Radiometric Measurement
Source Container QG 2000

Container with sliding source support rod for manual or pneumatic ON/OFF switching



Application

The source container QG 2000 encloses the radioactive source used for radiometric limit, level and density measurement. It allows the beam to emerge unattenuated only in one direction and gives an extremely high attenuation in all other directions.
When operating with very high sensitivity rod scintillation detectors, the QG 2000 provides the lowest possible radiation loads in the surrounding.
It is therefore always used if the shielding effects of smaller source containers (QG 020/100) are too low due to the high activity of the source or if no control area is permitted.
The QG 2000 complies to all international standards and fulfils the strict requirements of the chemical industry.

Features and Benefits

- Extremely high shielding combined with low weight ensure that no control areas are generally required and that installation in accessed areas is possible.
- Simple and safe source replacement
- Highest safety classification for the source supplied (DIN 25426/ISO 2919, Classification C 66646)
- Additional metallic protective capsule with O-ring seal to protect the source against mechanical and chemical influences
- Low space requirement and simple mounting
- Various angles of emission for optimum adaption to the application
- Padlock for fixing the ON/OFF switch position and to protect against theft
- Easy identification of switch status through sight glasses on the cover or by remote display with proximity switches

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Function and System Design

Function

The radioactive source is surrounded by a lead sheating in the QG 2000 source container to screen the gamma radiation. The radiation can only be emitted along one channel almost unattenuated. The limit values set for local dosages are not exceeded even with maximum activity.

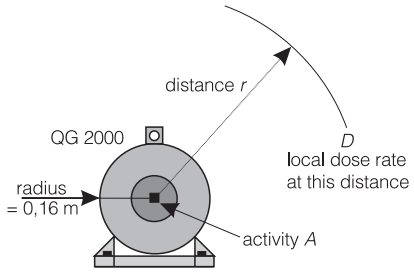
System Design

The stainless steel housing ensures that the radiation source and lead shielding cannot be lost when the housing is heated above the melting point of lead (tested to DIN VDE 0412-1, Section 6.4, i.e. 30 min at 800 °C).
The source itself is protected from mechanical and chemical influences by a stainless steel protective capsule with an O-ring seal and can be placed in the emission channel (switching on the radiation) and removed from it (switching off) by sliding the source support rod. The mechanical resistance of the switching device has been tested according to DIN VDE 0412-1, Section 9.4.
The switch position is secured by a padlock. It can easily be observed through the sight glasses from outside the container or can be transmitted to a remote electronic display in the control room.
The QG 2000 can also be optionally supplied with a pneumatic ON/OFF switching device.

Attenuation factor and half-value layers

	^{60}Co	^{137}Cs
Attenuation factor F_S	4.096	8.388.000
Number of half-value layers	12	23

Calculating the local dose rate or control area



$$D = K\frac{A}{r^2 F_S}$$

$$r = \sqrt{\frac{KA}{DF_S}}$$

D: local dose rate [µSv/h]
r: distance from source (contol area) [m]
A: activity of source [GBq]
F_S: attenuation factor (s. above table)

K = 357 µSv m^2 / h GBq (= 13.200 µSv m^2 / h Ci) for ^{60}Co
K = 96 µSv m^2 / h GBq (= 3.550 µSv m^2 / h Ci) for ^{137}Cs

The control area is defined as that particular distance *r* from the source by which the local dose rate is attenuated to a value *D* when using an activity *A*.

Examples for calculating using ^{60}Co

a)

A = 11 GBq (300 mCi) *r* = 0,21 m (≙ 0,05 m above the surface)	⇒ *D* = 22 µSv/h

b)

A = 11 GBq (300 mCi) *D* = 2,5 µSv/h	⇒ *r*= 0,62 m (≙ 0,46 m above the surface)

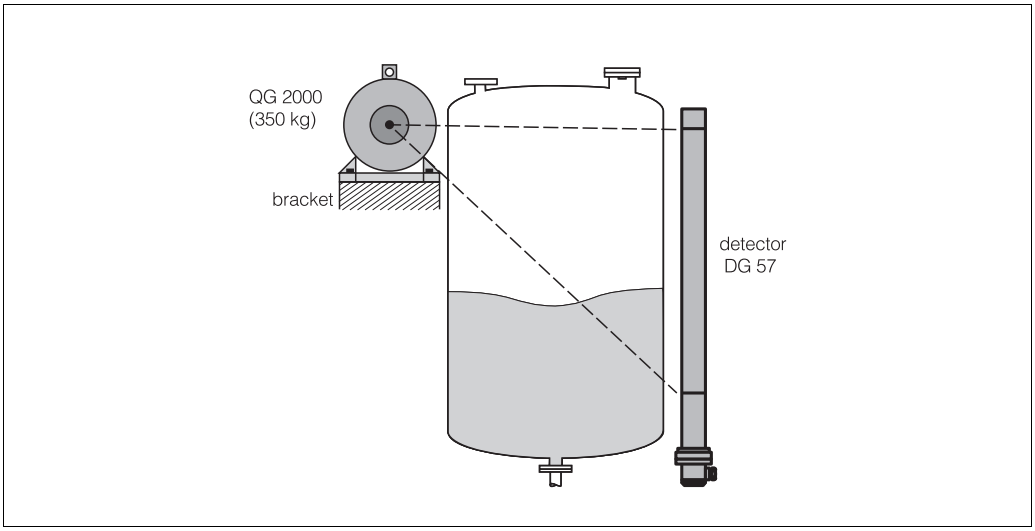
Example for calculating using ^{137}Cs

A = 185 GBq (5 Ci) *r* = 0,21 m (≙ 0,05 m above the surface)	⇒ *D* = 0,048 µSv/h (far below all limit values)

There is no control area for any activities of Caesium sources used in radiometric measurement.

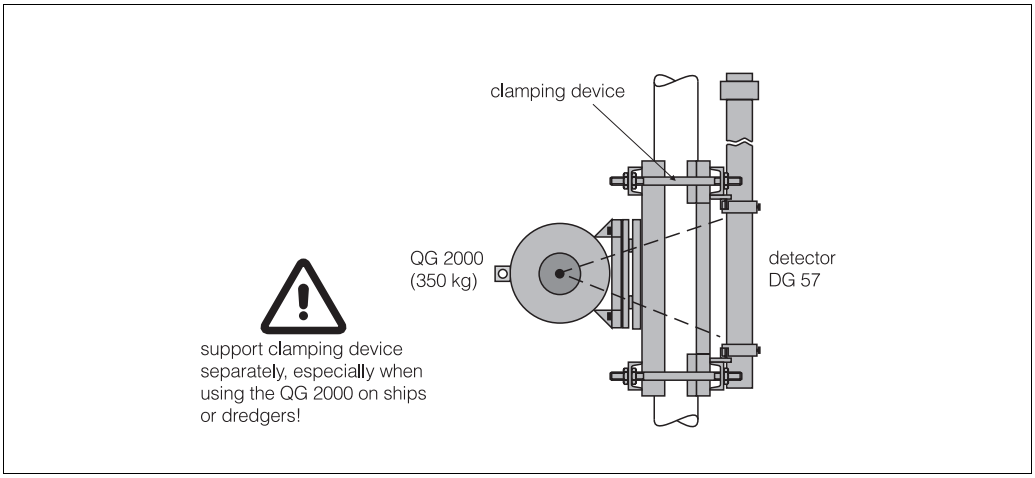
Operating Conditions

Level Measurement



In order to ensure stable measurement and lasting radiation protection, the QG 2000 must be tightly screwed onto a rugged, low-vibration bracket that can withstand a weight of 350 kg under all operating conditions. Additional supports are generally required when mounting directly onto the vessel. A fastening for a crane on the QG 2000 is provided or transporting it.

Density measurement



For density measurements, a clamp connection is available for pipe mounting.
The clamp connection must be separately supported to ensure that the weight of the source container (350 kg!) does not cause the pipe to bend.
When using the QG 2000 on ships or dredgers, the fastenings on the piping must be suited to the loads occuring and appropriate supports should be provided.

Ambient conditions

Entry of particles or water
The source support rod of the QG 2000 has an additional metallic capsule with an O-ring seal to prevent particles and streams of water from entering
(Ingress protection IP 65 to DIN 40050, page 1).

Ambient temperature (without proximity switches for remote display):
T = -20 °C ... 200 °C (Class 3 to DIN VDE 0412-01)

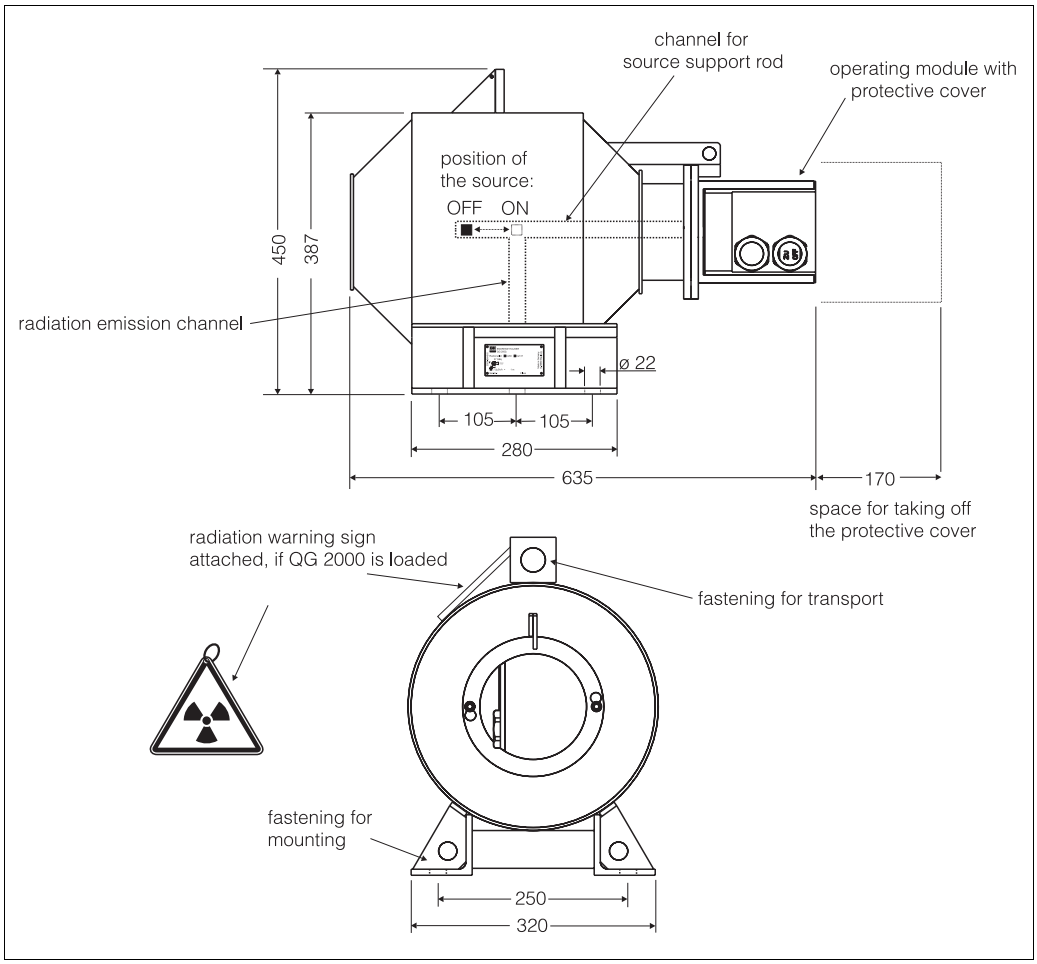
Ambient temperature (with proximity switches for remote display):
T = -20 °C ... 100 °C (Class 2 to DIN VDE 0412-01)

Fire resistance
tested to DIN VDE 0412-01, Section 6.4, i.e. 30 min at 800 °C

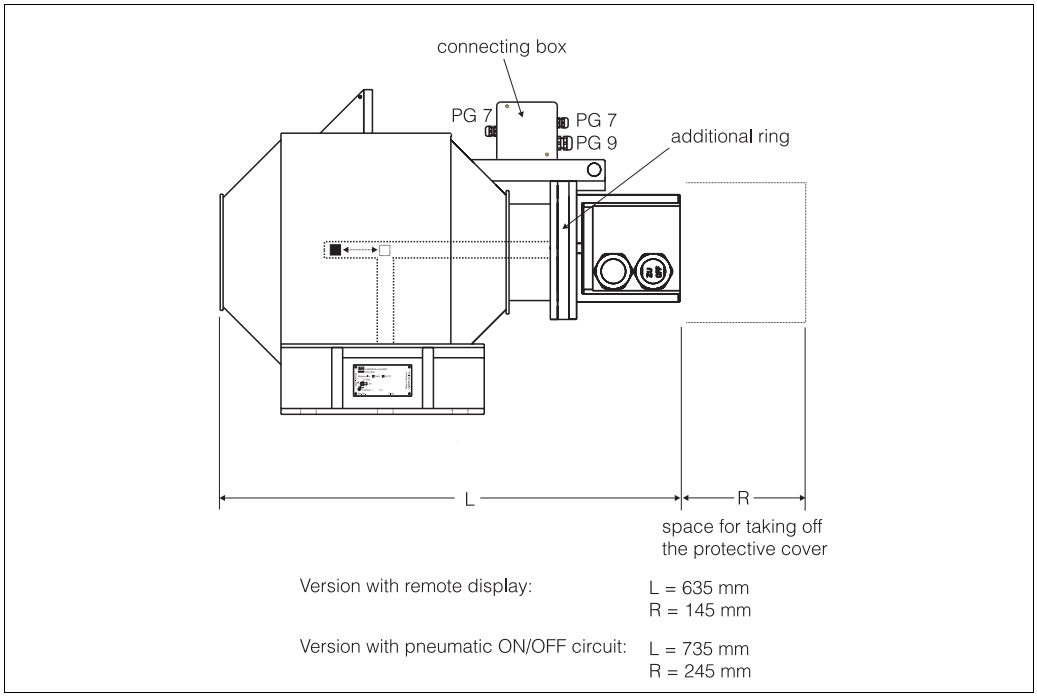
Mechanical Construction

Design, size

Standard design

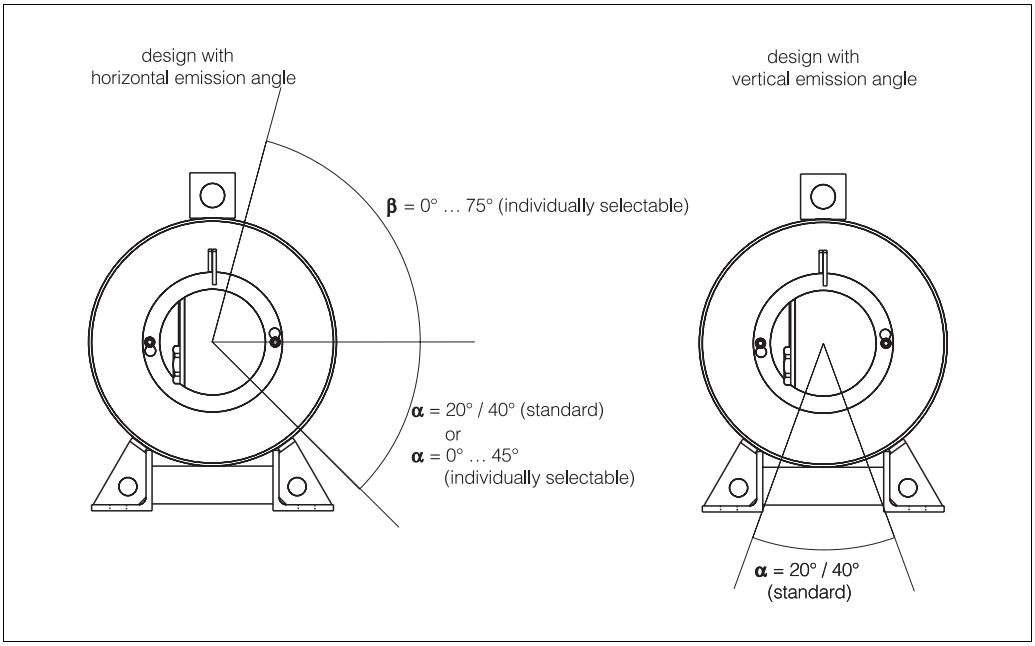


Design with remote display / with pneumatic ON/OFF circuit



The standard design can be upgraded to the designs with remote display and pneumatic ON/OFF circuit by a set.

Fitting position/emission angle (when switched on):
- **standing/horizontal**
- **standing/vertical**

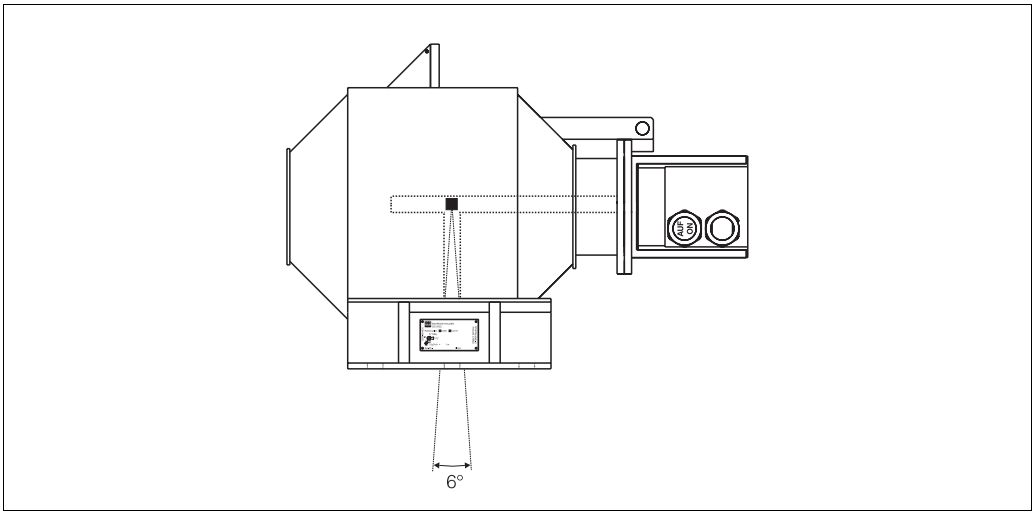


with horizontal beam emission with one angle (standard):
α = 20° or α = 40° (measured from the horizontal downwards)

with horizontal beam emission with two angles (individually selectable):
α = 0° ... 45° (measured from the horizontal downwards)
β = 0° ... 75° (measured from the horizontal upwards)
Both angles can be selected in steps of 5°.

with vertical beam emission with one angle (standard):
α = 20° or α = 40°

Width of the beam emission channel (when switched on)



The width of the emission channel is 6° for all designs.
The emission channel is marked on the external container wall.

Weight

approx. 350 kg (for all designs)

Housing materials

Stainless steel SS 316Ti (1.4571), for surface treated versions:
- sand-blasted
- epoxy enamel coated
- seawater-resistant coated

Shielding material:

Lead

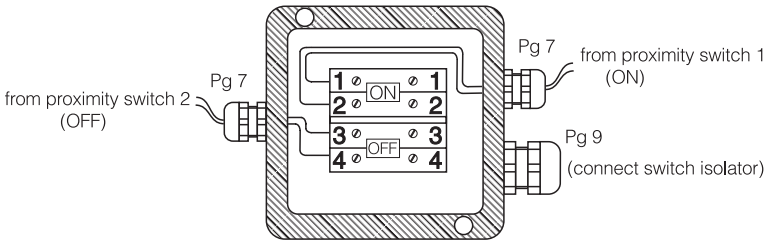
Operating elements

Standard design

- ON/OFF switching by manually sliding the source support rod
- Fixing and securing the switching status with a padlock
- Reading off the switching status through the sight glasses

Design with proximity switches for remote display of switch status

In addition to the sight glasses supplied, with this design the switching status is also detected by two proximity switches NJ4-12GM-N supplied by Pepperl+Fuchs.
For signal evaluation, the following isolating switch amplifiers from, e.g. Pepperl+Fuchs can be used:
KFA6-SR2-Ex2.W (230 V AC)
KFD2-SR2-Ex2.W (24V DC)
The Pg 7 cable glands on the connecting box are assigned to the proximity switches on delivery.
The Pg 9 cable gland connects the isolating switch amplifier.



Design with pneumatic ON/OFF circuit

In this design:

- The beam is switched ON by compressed air, 4 - 6 bar, to be connected to a G1/8" thread in the additional ring.
- When the pressure falls below 4 bar, the beam is automatically switched OFF.
- There should be a pressure relief hole to ensure automatic switch-off in all cases.
- Proximity switches for remote display of the switching status are built in (see above).

Certificates and Approvals

PTB

Isodose curve with ^{60}Co (37GBq/1000 mCi)

Germanischer Lloyd

in preparation

Proximity switches supplied by Pepperl+Fuchs

- Ingress protection IP 67 to IEC 60529
- EEx ia IIC T6 or EEx ib IIC T6 (PTB No. Ex 83/2022 X)

Ordering information

Product structure

Design							
R	Standard, manual ON/OFF						
U	Standard, manual ON/OFF, EExia IIC T6 remote indication						
T	Standard, manual ON/OFF, non-Ex remote indication						
P	Standard, pneumatic cutoff, EExia IIC T-6 remote indication						
Q	Standard, pneumatic cutoff, non-Ex remote indication						
	Radiation shielding						
	1	Standard shielding					
		Fitting position/Emission angle					
		A	Standing/horizontal				
		B	Standing/vertical				
			Emission angle				
			1	20°			
			2	40°			
			3	Specified in 5°-steps (α and β)			
				Material			
				A	SS 316Ti (1.4571) sand-blasted		
				B	SS 316Ti (1.4571) epoxy enamel coated		
				C	SS 316Ti (1.4571) seawater-resistant coated		
					Additional options		
					1	Option not selected	
						Documentation	
						A	No documentation
						C	PTB isodose curve with ^{60}Co (37 GBq/1000 mCi)
						D	Isodose curve for ^{60}Co
						E	Isodose curve für ^{137}Cs
						G	Test certificate Germanischer Lloyd (in preparation)
QG 2000							Product designation

Delivery

Germany
Radioactive sources may only be delivered when we have received a copy of the authorisation for handling radioactive materials. Endress+Hauser will gladly help you acquire the necessary documents. Please contact your nearest Sales Organisation.
For reasons of safety and cost, the radioactive source is usually shipped already loaded in the source container. Arrangements can also be made to ship the source seperately in a special transport drum.
They will only be transported by approved shipping agents according to current GGVS/ADR guidelines, with all safety regulations being observed.

Other countries
Radioactive sources may only be delivered when we have received a copy of the import license. Endress+Hauser will gladly help you acquire the necessary documents. Please contact your nearest Sales Organisation.
We can only deliver radioactive sources in their source containers.
They will only be transported by approved shipping agents according to current GGVS/ADR and DGR/IATA guidelines, with all safety regulations being observed.

Supplementary Documentation

System Information

SI 016F/00/en
Radiometric measurement of level, interface layers and density

PK 001F/00/en
Radiometric measurement - Applications in all industries

Operating Instructions

BA 223F/00/en
Operating instructions for the source container QG 2000

Technical Information

TI 213F/00/en
Technical Information on gamma radiation sources

TI 264F/00/en
Technical Information for the source container QG 020/100
(Standard design)

TI 194F/00/en
Technical Information for the source container QG 020/100
(Chemical, Euro and Swedish design)

TI 218F/00/en
Technical Information for Gammapilot FTG 470 Z

TI 177F/00/en
Technical Information for Gammapilot FTG 671

TI 219F/00/en
Technical Information for Gammasilometer FMG 671 (P)

TI 110F/00/en
Technical Information for measurement system FMG 573 Z/S + DG 57 - density

TI197F/00/en
Technical Information for detectors DG 17(Z) / 27(Z)

TI 180F/00/en
Technical Information for detectors DG 57

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