

Operating Instructions

Source Container QG2000

US version

Radiometric Measurement

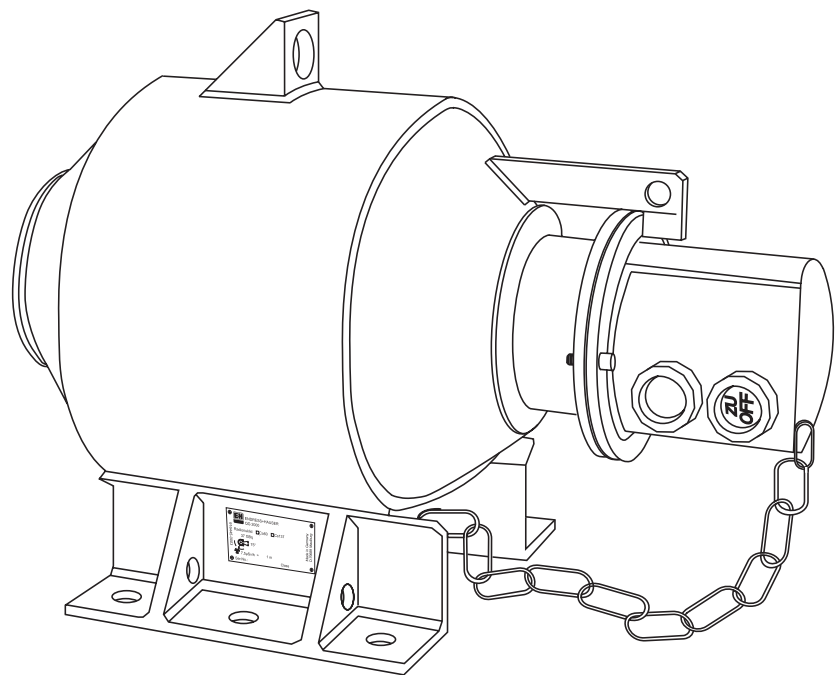


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1 Safety instructions

1.1 Radioactive Source



Warning!

This source container contains radioactive material.

For safety instructions see Radiation Safety Manual SD276F/00/en.

1.2 Designated use

The source container QG2000 described in these safety instructions contains the radioactive source, which is used for radiometric measurement of level, interface and density. It screens the radiation towards the surrounding and allows it to be emitted almost unattenuated and only in the direction of measurement.

In order to guarantee the screening effect and to exclude damage of the radiation source, all instructions given in this operating manual for mounting and operating as well as all regulations for radioactive protection are to be followed exactly. Endress+Hauser accepts no responsibility for any damage caused by incorrect use.

1.3 Basic Instructions for use and storage

- Observe the applying rules and national regulations.
- Observe the radiation protection regulations in use, storage and for work on the radiometric measuring system.
- Observe warning signs and safety areas.
- Install and operate the device according to the manufacturer's instructions.
- The device shall not be operated or stored outside the designated parameters.
- Protect the device against extreme influences (i.e. chemical products, weather, mechanical impacts, vibrations) when operated or stored.
- Always safe the OFF position of the source insert using the padlock.
- Do not operate or store damaged or corroded devices. Contact the responsible radiation safety officer for appropriate instructions and measures when damage or corrosion occurs.
- Conduct the required leak testing procedure according to the applying regulations and instructions.



Note!

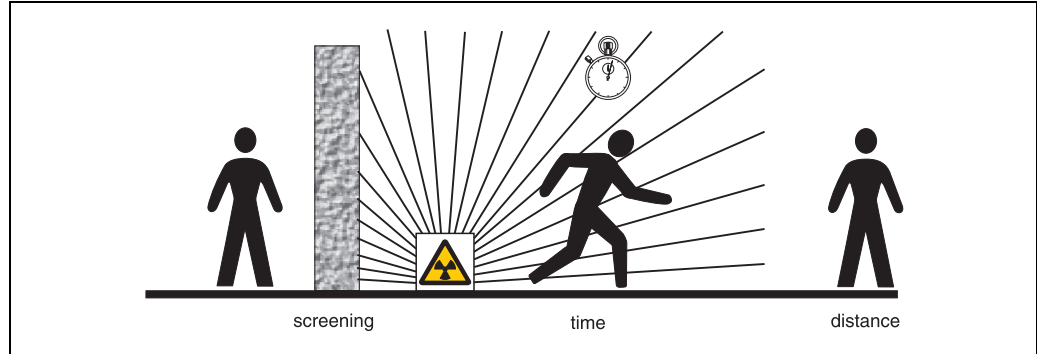
In case of doubt about proper condition of the device check the area around the device for leakage radiation and/or contact immediately the responsible radiation safety officer.

1.4 Basic regulations on radiation protection



Warning!

When handling radioactive sources, all unnecessary radiation exposure should be avoided. All unavoidable radiation exposure should be kept as low as possible. Three measures are used for this:



Distance

Keep the largest possible **distance** from the radiation source.

The local radiation dose rate decreases at the square-root of the distance from the radiation source.

Screening

Ensure the best possible **screening** between the radiation source and yourself as well as all other individuals.

Effective screening is provided by radiation protection containers and all high-density materials (lead, iron, concrete).

Time

Stay **as short as possible** in the area exposed to radiation.

1.5 Legal requirements for radiation protection

Handling radioactive emitters is legally controlled. The radioactive protection regulations of the state in which your plant is located are to be complied with.

License Requirements

A general or specific license is required for operating a plant which uses gamma radiation. Application for the License must be made to the NRC or the agreement state in which the plant resides.

Radiation Safety Officer

The operator of the plant must select an individual to become the Certified Radiation Safety Officer (RSO).

The goal of the RSO is to develop and maintain the radiation safety program with procedures to keep the occupational doses to all people as low as possible.

The RSO will administer and or oversee site- specific safety training for all workers.

Control Areas

All control areas containing Nuclear gauges are to clearly marked for all people to easily read.

All people entering to do any type of work within the control area should be badge monitored per all safe practices as per NRC / State guideline dose limitations.

1.6 Servicing and Inspection

In designated use, operated under the specified ambient and operation conditions, no inspection or servicing of the device is required.

If nevertheless inspection is considered as necessary - i.e. within the framework of routine inspections of the installation - following checks are recommended on demand:

- For vibrations and mechanical impacts: check of the stability and tightness of the source holder.

Maintenance/Cleaning



Note!

Non-routine repair or maintenance must be performed by the gauge manufacturer or distributor or a person specially authorized by NRC or an Agreement State.

Maintenance:

- Not required when operated within specification.

Cleaning:

- Clean from substance which may have impact on safety functions.
- Keep labels in legible condition.
- Maintain cleaning in appropriate intervals.



Caution!

If there is any doubt about correct function or proper condition of the device contact immediately the responsible radiation safety officer for advice.

1.6.1 Routine Leak Test Procedure



Note!

Leak tests are not only required as routine checkup but also whenever an incident occurs that may damage the sealed source or the shielding.

In such a case the leak test procedure shall be defined by the responsible radiation safety officer observing the applicable regulations and considering the source container and all involved parts of the process vessel.

The leak test shall be conducted as soon as possible after the incident.

The following leak test procedure is intended to be conducted routinely during continuous operation, during continuous storage or when placing back the source container into operation after storage. It does not consider incidents that may have damaged the sealed source or shielding.

Frequency for Leak Testing

Leak tests shall be performed every 6 months or according to the interval specified in the associated sealed source and device registration certificate following the procedures stated in this manual.

Leak Test Procedure

Leak tests shall be performed by a person or an organization authorized by NRC or an Agreement State to provide leak test services or using a leak test kit supplied by an organization authorized by NRC or an Agreement State to provide leak test kits. Leak test kits shall be used according to its supplier's instructions.

Records of the leak test results shall be maintained.

Perform following procedure unless otherwise instructed:

1. Wipe along the annular gap (see figure 1) between the protection pipe and the source holder rod. This may be conducted when the source holder is in ON position acc. to the operation manual.

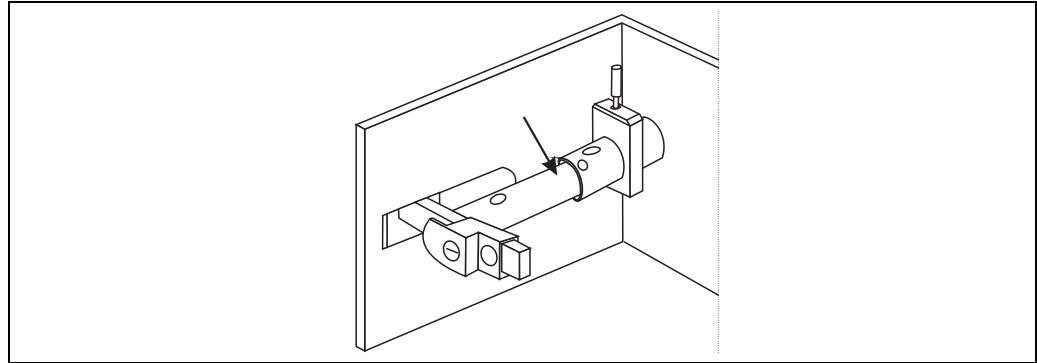


Figure 1: Source holder rod

2. Analysis of the samples by an organization authorized by NRC or an Agreement State.
A source is considered to be leaking if more than 185 Bq (5 nCi) is detected on a leak test sample.

In case of an indeed leaking source:

- Immediately discontinue use of the device.
- Contact the responsible radiation safety officer for instructions
- Take appropriate measures to control a potential spread of radioactive contamination from the source. Secure the source.
- Notify NRC that a leaking source has been detected.

1.6.2 Routine Tests

Visible Check

If considerable corrosion is visible at the housing measure the radiation level around the device. If values occur exceeding the normal operation level, cordon off the area and contact immediately the responsible radiation safety officer for instructions.

In every case corroded devices should be exchanged as soon as possible.

Source containers with corroded interlocks or a source holder rod require immediate exchange.

Routine Test of the Shutter Mechanisms

Remove cover acc. to operation manual

Perform the following procedure:

1. Move the source holder several times from ON to OFF or from ON to OFF position acc. to the instruction manual.
The source holder shall be easily moveable and must not show corrosion at the visible area.
 - If the source holder is not movable from ON to OFF position follow the instruction in section "Emergency Procedure".
 - If the source holder is rough-running or indicating potentially malfunction secure the source holder in OFF position and contact the responsible radiation safety officer for further instructions.
 - In case of corrosion follow the instructions in section "Visible Check".
2. When found the shutter mechanism in acceptable condition follow the instruction manual for correct positioning in ON or OFF position.

1.7 Behaviour in the Event of an Incident

1.7.1 Emergency measures

If the source container or the radiation source is damaged by accident or another unforeseen event or if the radiation source is lost by other means, the following emergency measures shall be initiated immediately:

- Inform the radiation safety officer immediately.
- All employees must leave the danger area immediately. The area around the measuring point must be barred to access and labelled.
- Production must be halted immediately if there is a risk that the radioactive material has got into the material being measured. Possibly contaminated material must be secured and must not be further used before it has been tested.
- All persons involved in cleaning up (fire brigade, works security, etc) must be informed of the hazards of radiation.

1.7.2 Emergency Procedure

Objective and Overview

This emergency procedure shall be put into effect immediately to secure an area in the interests of protecting personnel where an exposed source is known, or suspected, to exist. Such an emergency exists when a radioisotope is exposed either by it becoming separated from the source container or a source holder cannot be put into OFF position.

This procedure will safeguard an area until an appropriate radiation safety officer can attend site and advise on corrective action.

The custodian of the radioactive source (the customer's designated "authorized person") is responsible for observing this procedure.

Procedure

1. Determine the unsafe area by measurement (on site) or by calculation knowing the size and type of source installed from the records.
2. Cordon off the area at the boundary where the radiation level exceeds 20 $\mu\text{Sv/h}$ (2 mrem/hr) by yellow tape or rope and post international radiation warning signs.

In case of a shutter that will not close:

If part of the area is accessible (e.g. a vessel in the event of a level gauge installation where there is a possibility that a person might enter), the source housing should be unbolted from its mounting. Put emission channel towards a very thick wall (e.g. from steel or lead).

Personnel should at all times be behind the source housing, not in front of the emission channel (marked side of QG2000).

The eyebolt lifting on the housing should facilitate safe handling.

3. If it is not practical to cordon off the entire area or if the source is in immediate danger of moving, it may be necessary to secure the source by relocating it or adding shielding. Here the inverse square law should be observed, i.e. radiation reduces with distance quadratically.

The source should only be handled via pliers or tongs and held as far away from the body as possible. The time taken to fulfill the exercise should be minimized by rehearsal prior to execution.

4. Make necessary notifications to local authorities as well as the NRC within 24 h.

NRC's Operation Center: 301-816-5100 or 301-951-0550

5. After thorough assessment of the damage, the responsible radiation safety officer, in conjunction with NRC and/or local authorities and Endress+Hauser, shall agree a remedy to the specific problem.

1.7.3 Report to the responsible authority

As soon as the emergency measures have been initiated, the authorities responsible for radiation must be informed by the radiation safety officer.

1.8 Procedures after termination of the application

1.8.1 Internal measures

As soon as the radiometric device is no longer needed the shutter should be closed and locked. The source container should be removed, in accordance with the individual's License and stored in a out of the way dedicated secured room. The RSO is responsible for overseeing this is properly carried out.

1.8.2 Returns

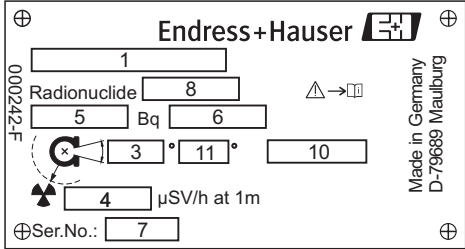
To address the disposal sources call your local Endress+Hauser office for assistance and service if needed.

There are no returns to Endress+Hauser from within the United States.

2 Identification

2.1 Nameplate

The following technical data are shown on the nameplate (Example):



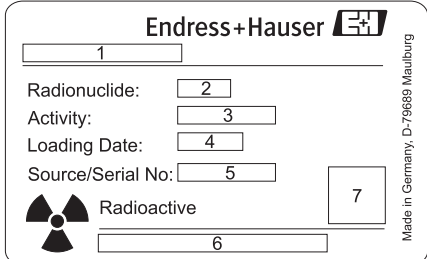
The nameplate diagram shows the following fields:

- 1: Order code
- 3: Angle of radiation
- 4: Dose rate at 1m
- 5: Activity in Bq
- 6: Month / year (completion label)
- 7: Serial no. of source container
- 8: Radionuclide of source
- 10: Jet direction (horizontal or vertical)
- 11: Angle of radiation

1	Order code
3	Angle of radiation
4	Dose rate at 1m
5	Activity in Bq
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10	Jet direction (horizontal or vertical)
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2.2 Location of adhesive label

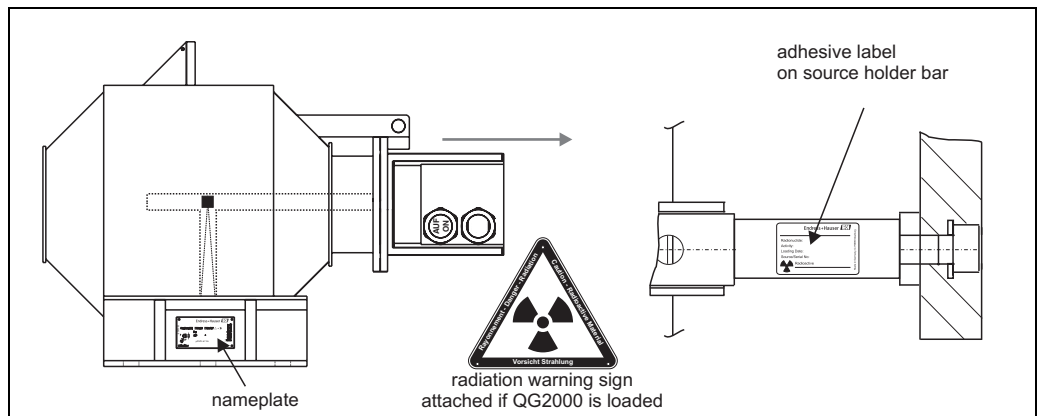
Following label can be found on the source holder rod:



The adhesive label diagram shows the following fields:

- 1: Order code
- 2: Radionuclide (Cs-137 or Co-60)
- 3: Activity in Bq
- 4: Month / year
- 5: Serial no. of source capsule
- 6: National advice if required
- 7: Field for bar code or data matrix code

1	Order code
2	Radionuclide (Cs-137 or Co-60)
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2.3 Scope of delivery

Scope of delivery includes:

- QG2000 source container
- Radiation source (built in)
- Radiation warning sign
- Operating instructions
- Radiation Safety Manual

3 Installation

3.1 Transport

Delivery and transport of loaded radiation protection containers are conducted by a company commissioned by Endress+Hauser and officially certified for executing this type of job. Transportation shall take place in a Type "A" package which complies with the regulations of the European Agreement on the International Transportation of Hazardous Substances on Roads (GGVS/ADR and DGR/IATA).

3.2 Installation conditions



Note!

The radiation source container QG2000 may not be mounted at a height greater than 27 feet.

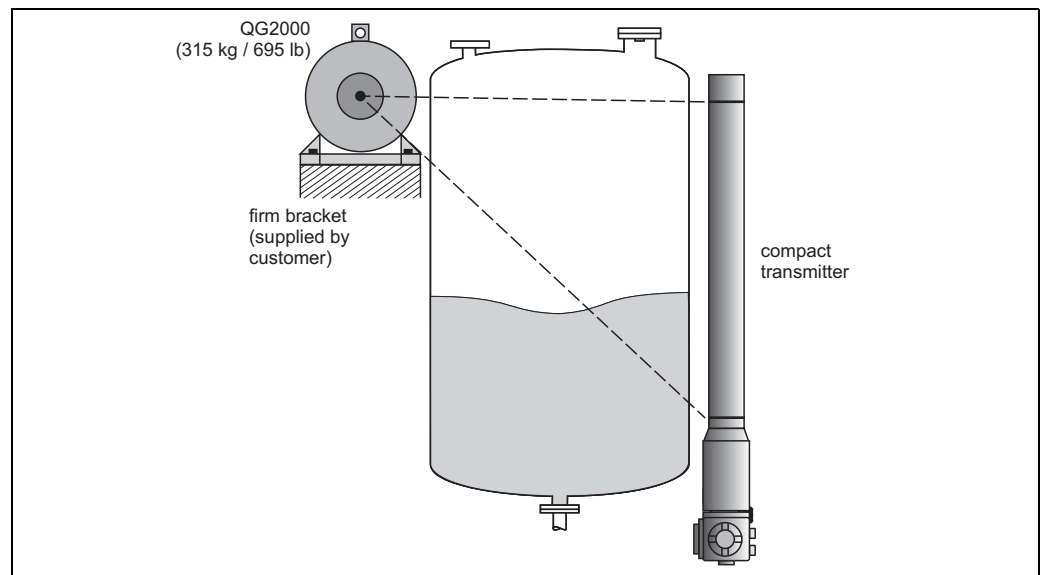


Caution!

For all applications, the mounting location for the QG2000 and the angle of emission should be selected so that the complete length of the compact transmitter is radiated.

3.2.1 Level measurement

Standard Configuration



The source container must be mounted slightly above or at the same height as the maximum level. The radiation must be exactly directed towards the compact transmitter mounted opposite. To avoid control areas, the source container and compact transmitter should be mounted as near to the vessel as possible.

3.2.2 Mounting plate

Example: L-profile (supplied by customer)

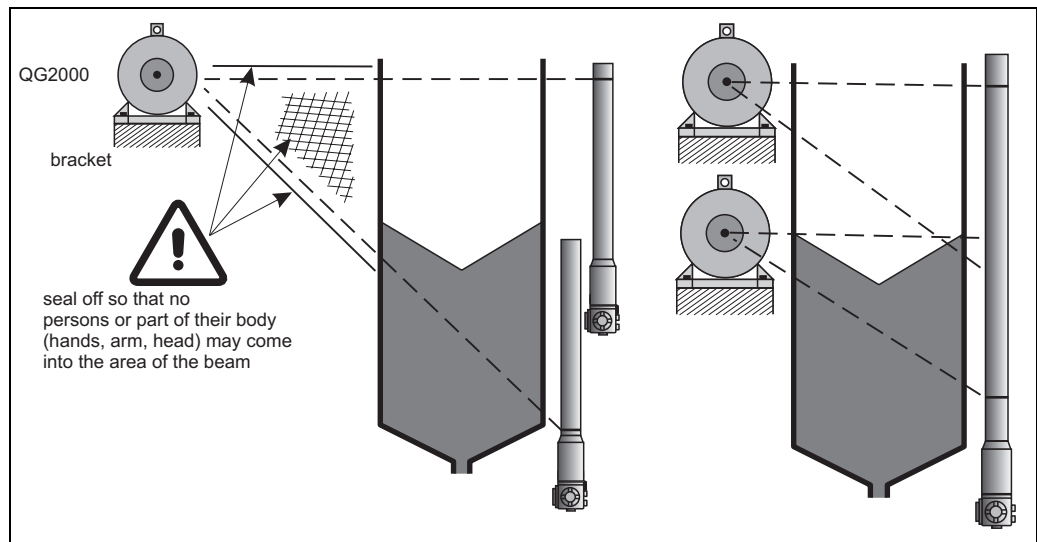
Dimensions: 22 (0.9) mm offset; 160 (6.3) mm, 250 (9.8) mm, 320 (12.6) mm horizontal spacing; 105 (4.1) mm, 280 (11) mm vertical spacing.

Max. permissible torque Nm (min. 6 x M 20 screws)

Material	property class	coefficient of friction (μ)	Tightness
SS	70	0.14	281 Nm
Steel	8.8	0.14	425 Nm

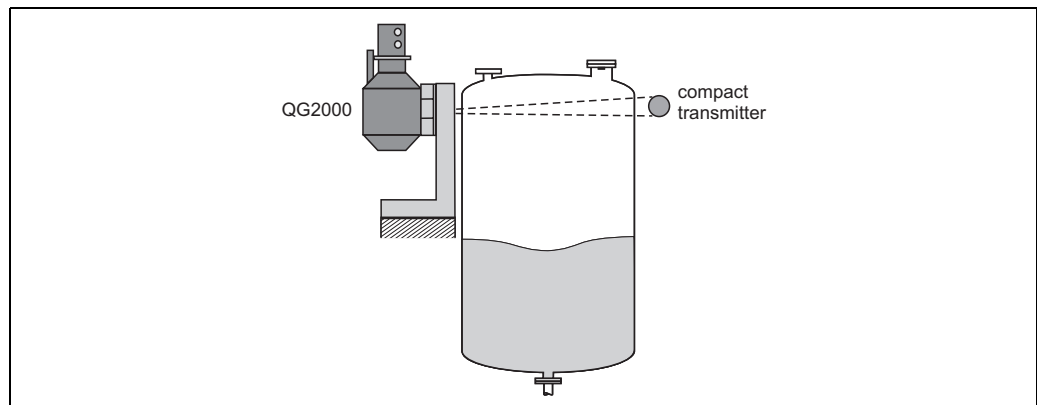
mm (inch)

High and narrow vessels



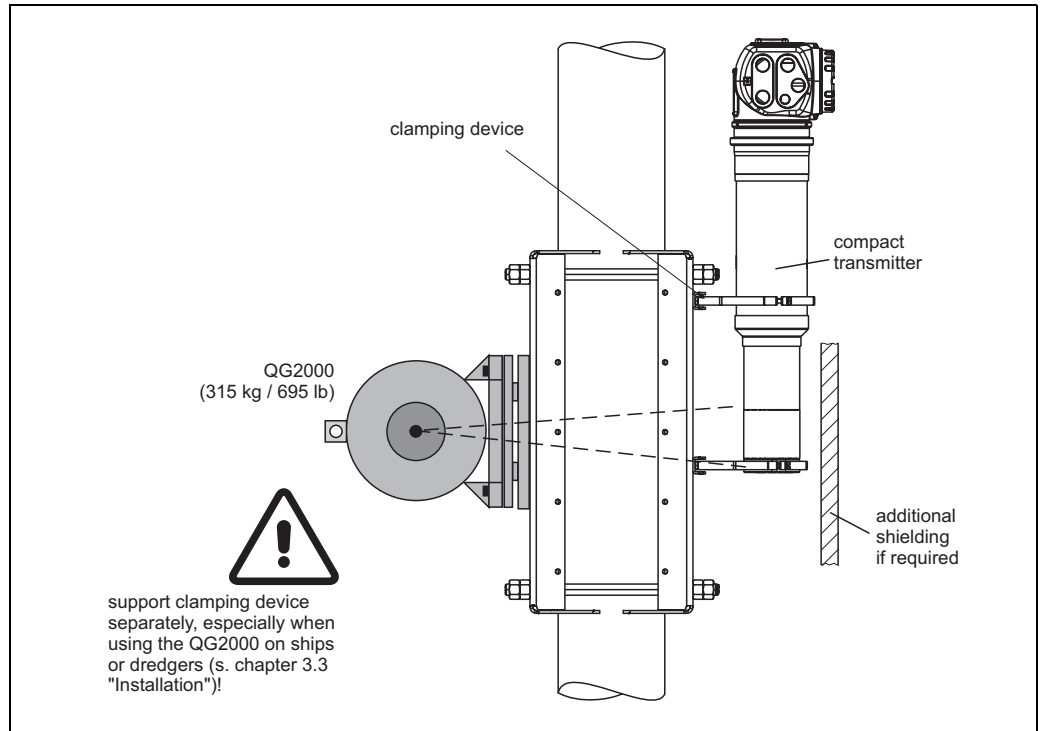
A space between the source container and vessel often can not be avoided for large measuring ranges or vessels with small diameters. The space must then be sectioned off and indicated. Two or more source containers are generally used for large measuring ranges. Using two source containers is not just a question of the measuring range but also of the increased accuracy they offer.

3.2.3 Level limit detection



Mount the compact transmitter in a horizontal position to detect the level limit. Also mount the QG2000 so that the radiation runs horizontally.

3.2.4 Density measurement



Mount the sensor to vertical pipelines with the direction of conveyance from bottom to top to obtain the most constant conditions for density measurements in pipes. If only horizontal piping is accessible, then the radiation path should be horizontal to reduce the effects of air bubbles and build-up of material. A clamping device is available for mounting on piping. Support the clamping device separately to avoid the weight of the QG2000 (315 kg / 695 lb) from acting on the pipe.

3.3 Installation

3.3.1 Fastening for transport

There is a fastening for a crane on the QG2000 for transporting it (see dimensional drawing, page 18).

3.3.2 Bracket

Note!

In order to ensure stable measurement and lasting radiation protection, the QG2000 must be tightly screwed onto a rugged, low-vibration bracket that can withstand a weight of 315 kg (695 lb) under all operating conditions. Additional supports are generally required when mounting directly on the vessel.

Especially when using the QG2000 on ships or dredgers, the fastenings on the piping must be able to take the weight of any loads placed on them and appropriate supports provided.

The screw joint dimensions are contained in the table (see page 12).

3.4 Post-installation check

The following measures are to be taken to ensure radiation protection after installation:

3.4.1 Measuring the local dose rate



Warning!

The local dose rate in the vicinity of the source container and the compact transmitter must be measured immediately after it has been mounted. Depending on the installation, radiation can also occur outside the actual beam-emitting channel through scattering. In such cases it must be screened by the use of additional lead or iron sheeting. Render or mark all control and exclusion areas as prohibited for unauthorised entry.

3.4.2 Limiting the area of the working beam



Warning!

Access to the working beam is to be sealed off. Parts of the body (hands, arms, head) must also not come into the area of the beam.

3.4.3 Behavior on empty vessels/inspection inside the process vessel



Warning!

After the proper mounting of the source container, the control area around the empty tank has to be measured. Control areas must be blocked off and marked. If there is an entry into the interior space of the tank, it has to be closed and marked with a sign "radioactive".

If any work has to be done inside the vessel during a shutdown situation, the source container has to be switched "OFF". The entry is only allowed after checking all safety regulations by the responsible radiation safety officer.

Control areas have to be measured!

Close off and mark any existing accesses to the vessel, reactor, etc. The radiation safety officer must keep the key. If control areas occur outside the working beam (to be measured!), then these must be sealed off, too.

4 Wiring



Note!

The instructions below apply only to the QG2000 version with initiators for remote switching state display (ON or OFF).

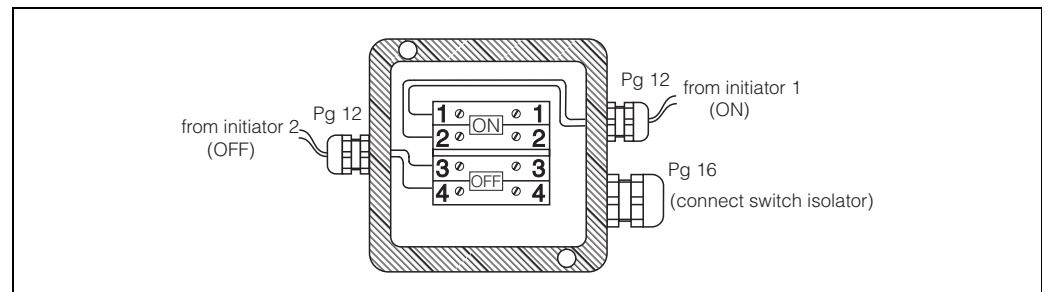
4.1 Initiators and isolated switch amplifier

In addition to the sight glasses supplied with this version, the switching status is also detected by two proximity switches NJ4-12GK-SN supplied by Pepperl+Fuchs.

For signal evaluation, the following isolating switch amplifiers from, e.g. Pepperl+Fuchs can be used:

- KFD2-SH-Ex1 (24V DC)

4.2 Connecting box



The Pg 12 cable glands on the connecting box are assigned to the initiators on delivery. The Pg 16 cable gland connects the isolating switch amplifier

The table below shows the pin assignment:

Terminals 1, 2	Initiator for position "radiation ON"
Terminals 3, 4	Initiator for position "radiation OFF"

The connecting diagram is also provided inside the connecting box cover.

5 Operation

5.1 Switching ON the radiation beam

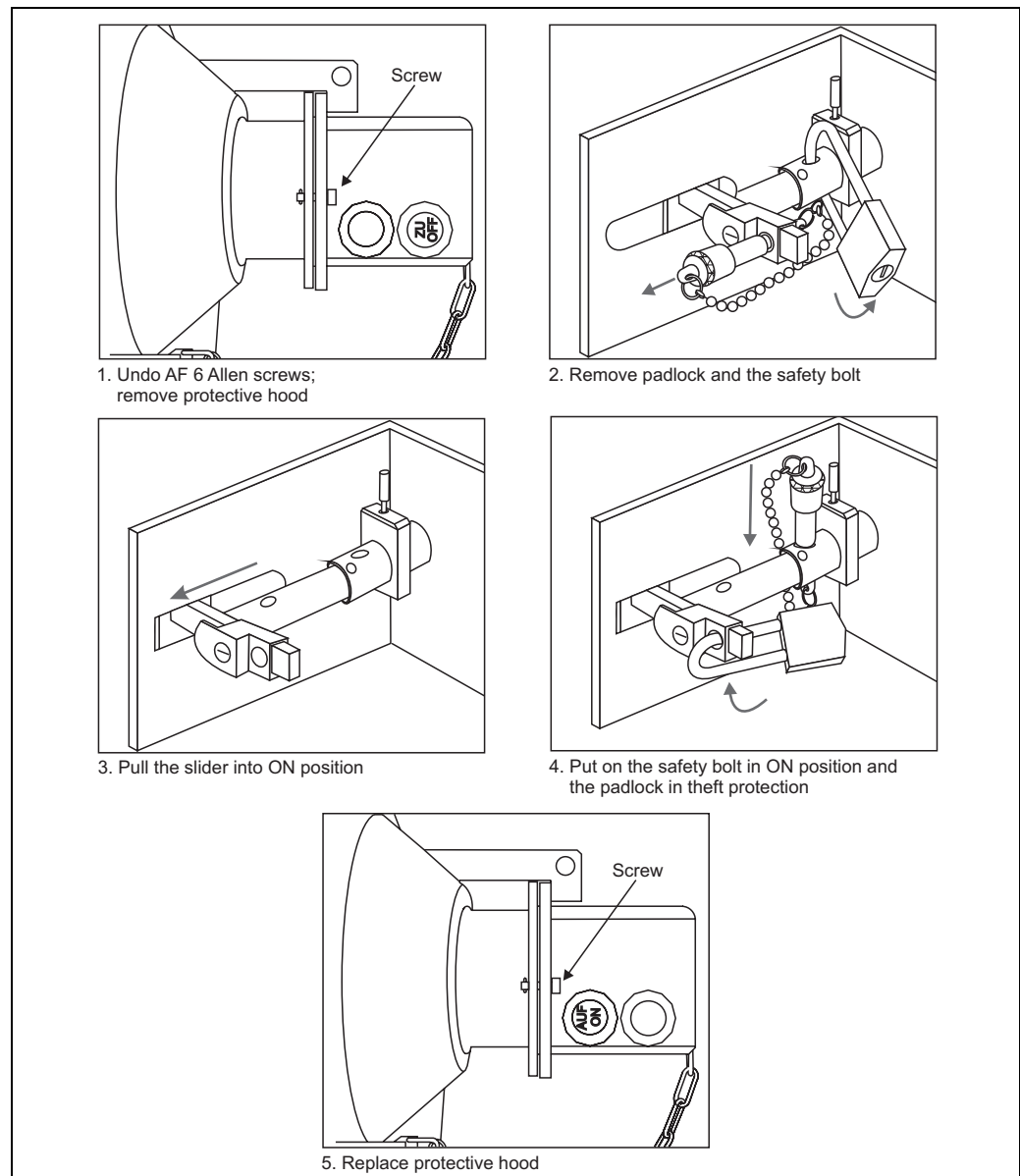


Warning!

Safety instructions for switching on the radiation

Before switching on the radiation beam it is necessary to ensure that no personnel are within the area of the radiation (or, indeed, inside the vessel). The radiation beam may only be switched on by specially trained personnel.

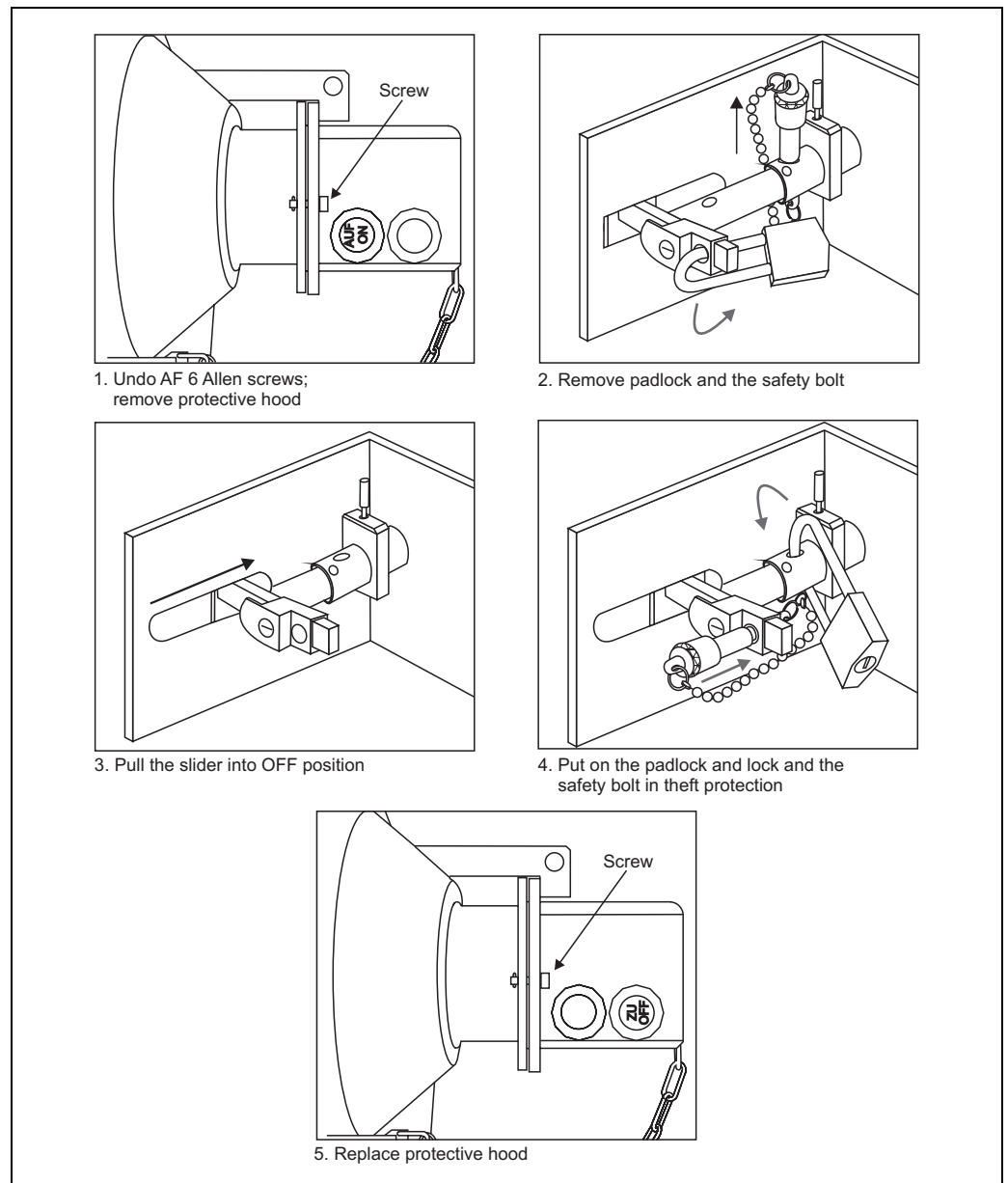
Procedure



1. Undo the 6 AF Allen screws of the protective hood and remove it.
2. Open and remove the padlock which puts the source holder rod in the "OFF" position.
3. Using the slider, pull the source holder rod into the desired "ON" position: Label "ON" is visible, label "OFF" is covered.
4. Do not lock source holder in ON position! Put on the safety bolt which puts the source holder rod in the "ON" position and the padlock in theft protection position.
5. Replace the protective hood and fasten securely with the screws.

5.2 Switching OFF the radiation beam

Procedure

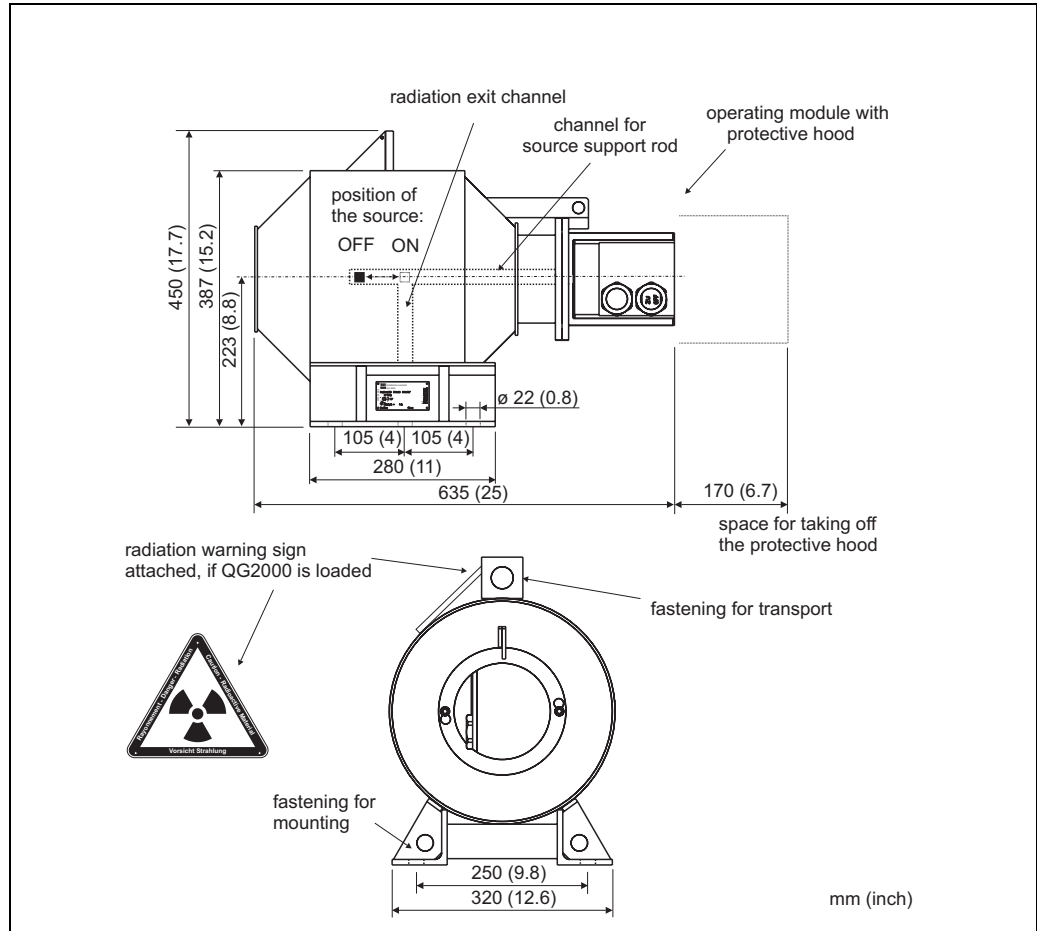


1. Undo the AF 6 Allen screws of the protective hood and remove it.
2. Remove the safety bolt from the source holder. Open and remove the padlock.
3. Using the slider, put the source holder rod into the desired "OFF" position: Label "OFF" is visible, label "ON" is covered.
4. Put on the padlock and lock, which fixed the source holder rod in the "OFF" position and fix the safety bolt.
5. Replace the protective hood and fasten securely with the screws.

6 Technical Data

6.1 Design

6.1.1 Dimensions



6.1.2 Additional data

Weight

approx. 315 kg (695 lb)

Housing materials

Stainless steel 1.4571 (SS 316Ti),

Surface treatment versions:

- glass bead blasted
- epoxy enamel coating
- seawater-resistant coating

Screening material:

Lead

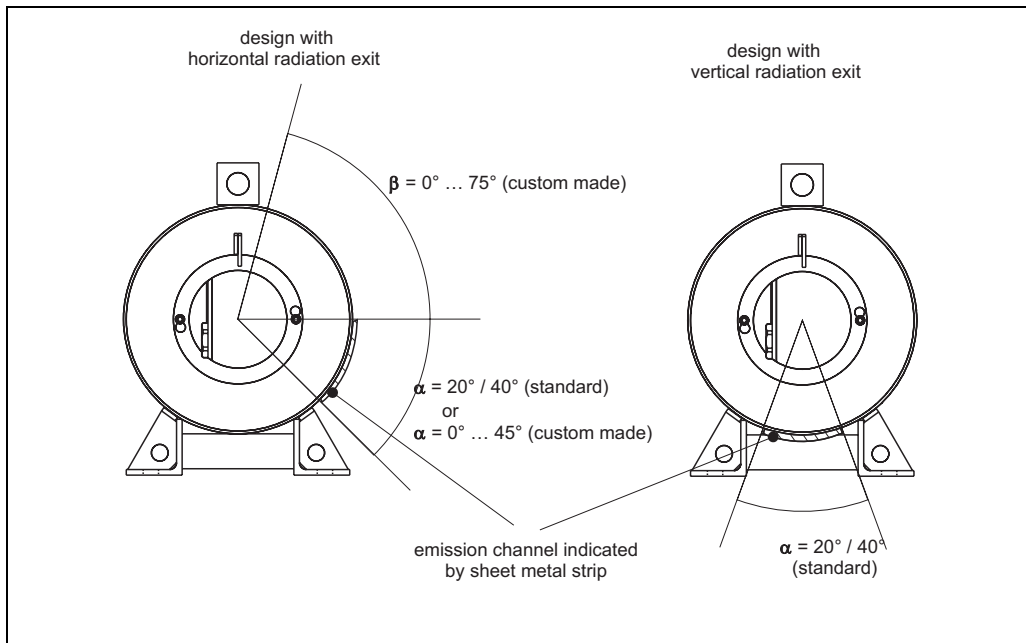
Switching device

The mechanical resistance of the switching device was tested to DIN VDE 0412-1, Section 9.4.

6.2 Radiation exit channel

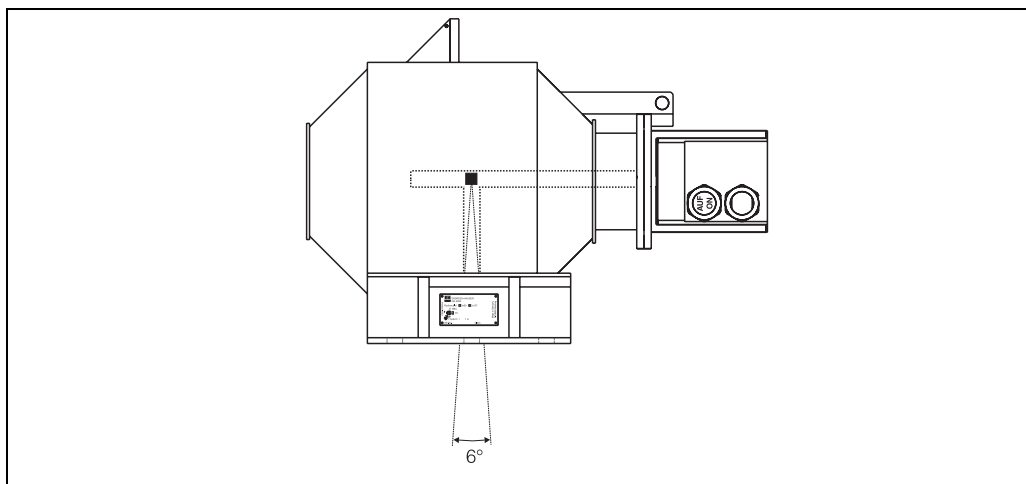
6.2.1 Position/angle of emission

standing/horizontal or standing/vertical



6.2.2 Width of beam emission channel

6° at all versions



6.3 Radiation protection effects

6.3.1 Attenuation factor/half-value layers (when switched off)

	⁶⁰ Co
Attenuation factor \mathcal{K} *	4.096
Number of half value layers *	12

* approximate values

6.3.2 Radioactive Source

The following table identifies the source model, isotope and activity level that can be used in the QG2000 series gauges:

QG Series	Source Model	Isotope	Maximum activity
QG2000	CKC.P4	Co-60	1 Ci (37 GBq)

6.4 Ambient conditions

6.4.1 Protection against external influences

The source holder rod of the QG2000 is protected from external influences by an additional metallic hood sealed by O-ring (ingress protection IP 65 IEC EN 650529).

6.4.2 Ambient temperature

without initiators for remote display

T = -20 °C...200 °C (-4 °F...392 °F)

with initiators for remote display

T = -20°C...100 °C (-4 °F...392 °F)

6.4.3 Fire resistance

Tested to DIN VDE 0412-1, Section 6.4, i.e. 30 min at 800 °C (1472 °F).

6.5 Certificates and Approvals

Specific license

The QG2000 series is only authorized to be distributed as a specifically licensed device.

PTB

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

GermanLloyd

For applications on dredgers.

Proximity switches supplied by Pepperl+Fuchs

- Ingress protection IP 67 acc. to IEC EN 60529

Supplementary Documentation

System Information	CP017F/00/en Radiometric measurement technology
Operating Instructions	BA370/00/en Operating instructions for the source container QG2000
Technical Information	TI213F/00/en Technical Information on gamma radiation sources TI428/00/en Technical Information for the source container QG020/100 TI363/00/en Technical Information for Gammapilot FMG60
Certificates	ZE251F/00/de Test certificate Germanischer Lloyd (for applications on dredgers)
Special documentation	SD142F/00/en Supplementary Safety Instructions for Radioactive Sources and Source Containers approved for Use in Canada
Safety manual	SD276F/00/en Radiation Safety Manual

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