

Radiometric Measuring *Source Container QG 020/100*

**Container with rotary insert for holding source
and for manual switch-ON/switch-OFF**



Europe and Sweden
Design



Standard Design



Chemical Design

Application

The QG 020 and QG 100 source containers are designed to hold the radioactive source during radiometric level limit measurement, level measurement and density measurement. The radiation is emitted almost unattenuated in one direction only and is damped in all other directions. QG 020 and QG 100 differ from each other in terms of size and screening effect.

In addition to the standard versions, both source containers are available in Sweden-design, Europe-design and chemical-design versions which each fulfill special safety specifications as regards handling the radiation source.

Features and benefits

- Lightweight device provides best possible screening thanks to almost spherical design
- Safe and easy source replacement
- Highest safety classification for the source supplied (DIN 25426/ISO 2919, classification C 66646)
- Compact device that is easy to mount
- Various angles of emission for optimum adaptation to the application
- Lock or padlock for fixing the ON/OFF switch position and to protect against theft
- Switch status easily identified
- Double O-ring seal for source in chemical design
- Extension of the inspection period up to 15 years for the Chemical Design according to PTB statement

Endress + Hauser

The Power of Know How



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Safety Instructions

Basic Instructions for Use and Storage

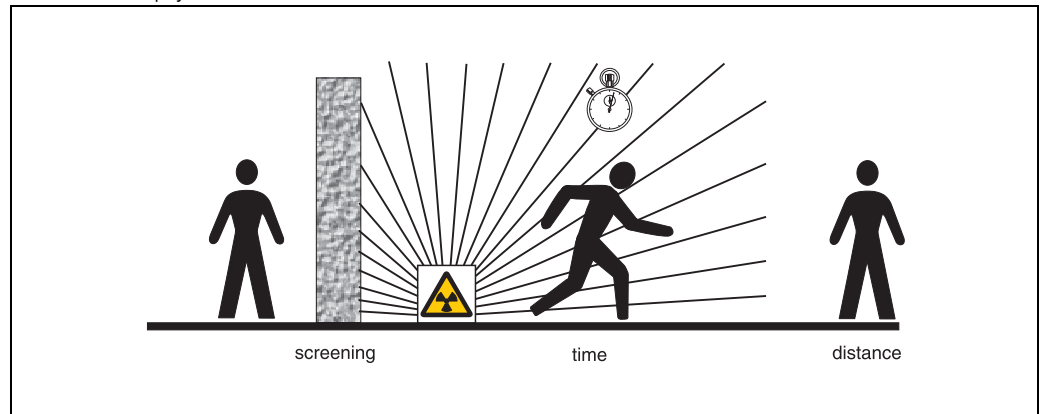
- Observe the applying rules and national/international regulations.
- Observe the radiation protection regulations in use, storage and for work on the radiometric measuring system.
- Observe warning signs and safety areas.
- Install and operate the device according to the manufacturer's instructions.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

Caution!

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 protection officer.

General instructions on radiation protection

When working with radioactive sources, any unnecessary exposure to radiation must be avoided. Unavoidable exposure to radiation must be kept to as low a level as possible. Three important measures help you achieve this:



Screening

Ensure the screening between the radiation source and you and all other persons is as good as possible.

Source containers (e.g. QG 020/100) and all high-density materials, (lead, iron, concrete etc.), can be used for effective screening purposes.

Time

Time spent in the exposed area should be kept to a minimum.

Distance

Keep at as large a distance as possible from the radiation source.

The local dose rate of the radiation decreases with the square of the distance from the radiation source.

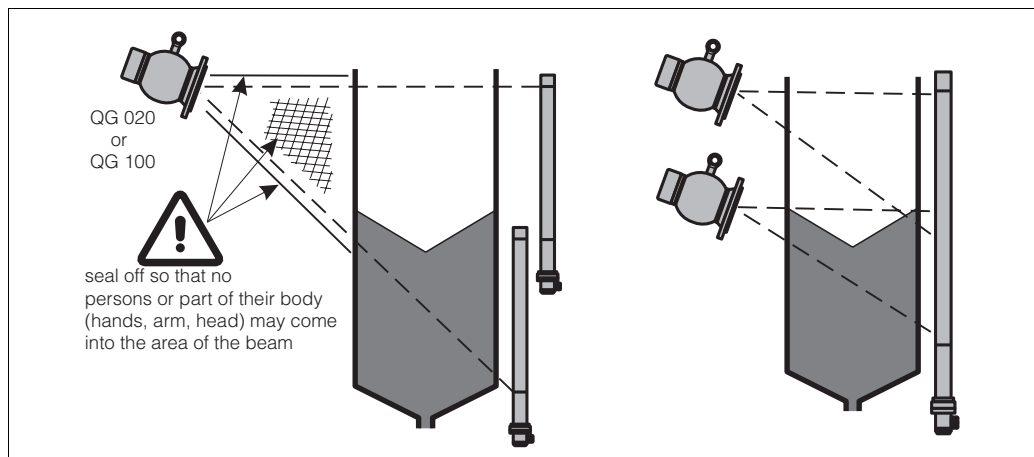
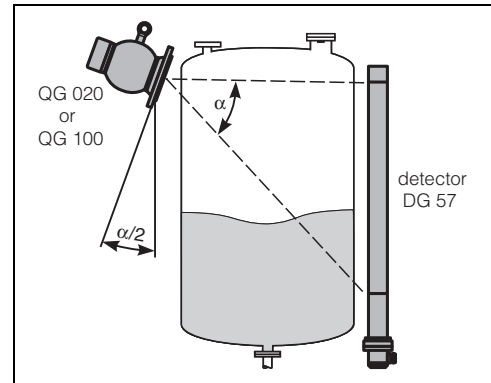
Safety instructions for switching on the radiation

- Before switching on the radiation, ensure that no-one is in the range of radiation or within the product container.
- The radiation may only be switched on by instructed personnel.

Operating Conditions

Level measurement

The source container must be mounted at the height of, or slightly above, the maximum level for continuous level measurement. The radiation must be aligned exactly with the detector mounted opposite. The source container and detector should be mounted as close as possible to the product container to avoid control zones.

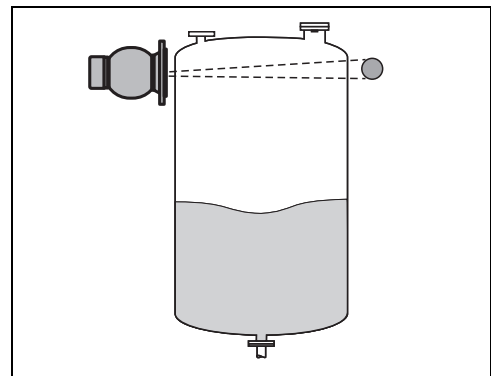


A distance between the source container and the product container often cannot be avoided if the measuring range is large and the container diameter small. This space must then be blocked off and marked.

In general, however, two or more source containers are used for large measuring ranges. The use of several sources can be necessary not only from the aspect of large measuring ranges but also for accuracy reasons.

Level limit detection

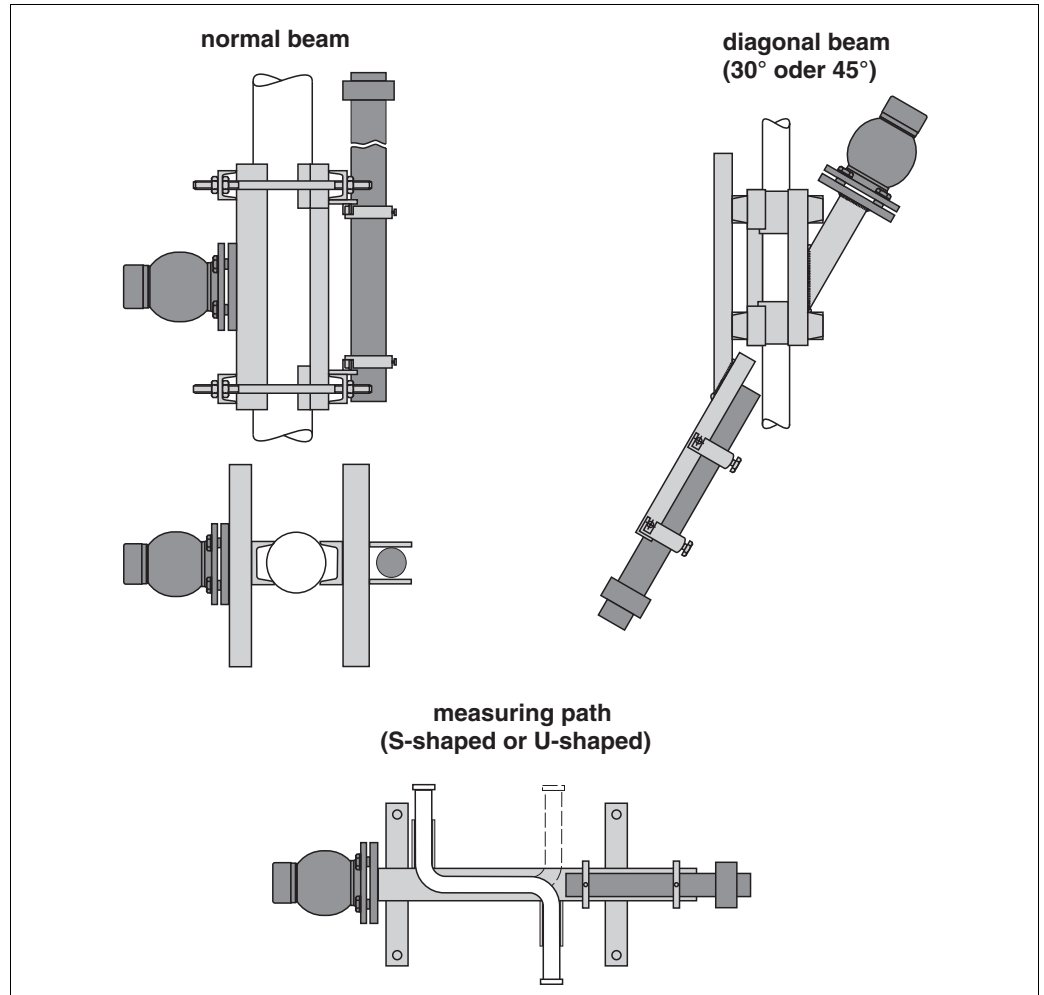
The version of QG 020/100 with the angle of emission $\alpha = 5^\circ$ is recommended for level limit detection. If larger angles of emission (20° or 40°) are used, ensure that the ray is horizontal. For this purpose, mount QG 020/100 in such a way that the eyelet is positioned horizontally.



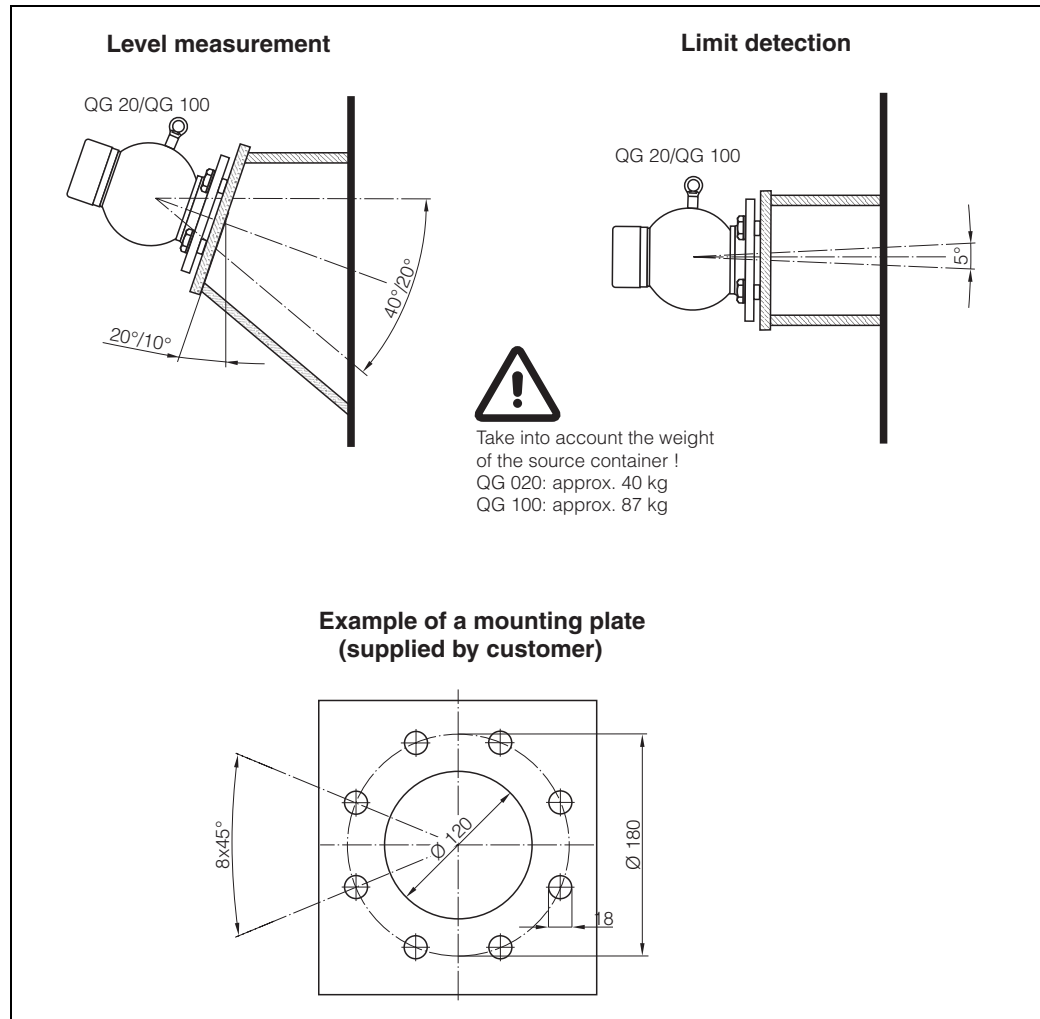
Density measurement

The most constant conditions for density measurement in pipes are achieved if the unit is mounted on vertical pipe lines and the feed direction is from bottom to top. If only horizontal pipes are accessible, the path of the ray should also be arranged horizontally to reduce the influence of air bubbles and build-up.

The following clamping devices are available for mounting the source container together with the compact transmitter FMG60 or the detector DG57 on pipe lines:



Mounting



The container can be mounted:

- by a nozzle directly on the container or pipe, (pay special attention to the weight of the QG)
- on an external construction with minimum vibration

A hole must be provided on the mounting plate for the ray to pass through.

Safety Instructions for Operation

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:

- visual check regarding corrosion of housing, weld seams, outer parts of source insert, lock/padlock
- check of the movability of the source insert (on/off function)
- visual check of the readability of the labels and the condition of the warning symbols.

Country specific regulations may require frequent inspections of the radiation source container. For the Chemical Design of QG 020 and QG 100 the inspection periods may be extended up to 15 years according to a PTB statement. In order to examine the state of the sealing material a reference O-Ring of the same material is fixed to the rotary bracket (see page 14).

Caution!

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

Safety instructions for changing the radiation source

- All maintenance work, such as removing or replacing the radioactive source, may only be carried out by authorised, supervised, specialised personnel in accordance with local legislation or the handling permit. Ensure that such work is permitted by the handling permit. All local factors must be taken into account.
- All work may only be performed from a protected position, (screening!). Take appropriate measures to avoid endangering other persons (e.g. cordoning off area etc.).
- Prepare in detail to ensure that the radiation source is replaced as fast as possible. Make sure the tools and resources required (screened container for replaced source etc.) are at the ready before commencing the task.
- When changing the source, strictly observe all instructions given in this manual.

Operation: Standard Design

Switching radiation on and off

Remove the covering cap:

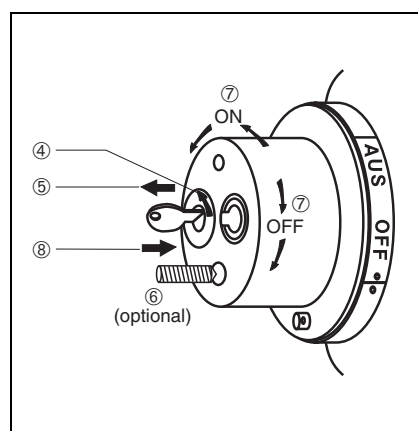
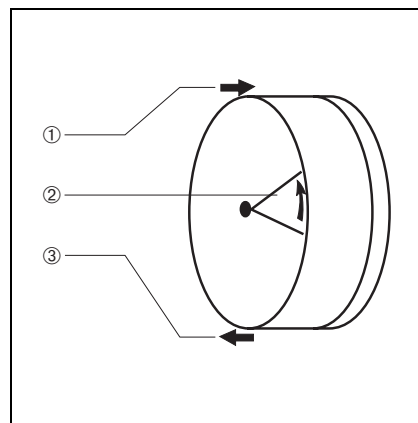
1. Press the covering cap hard against the source container ①
2. Turn the covering cap approx. 45° counterclockwise until the limit stop ②
3. Remove the covering cap ③

Switch radiation on or off

4. Unlock lock with key: Turn closing cylinder with key approx. 45° counterclockwise ④
5. Pull out lock until the limit stop ⑤
6. If present, loosen setscrew ⑥ using Allen key AF 5, (only for versions with density modification)
7. To **switch on** radiation: Turn insert 180° counterclockwise ⑦
To **switch off** radiation: Turn insert 180° clockwise ⑦
8. Press in lock with key, turn approx. 45° clockwise ⑧; if present, screw in setscrew ⑥, (only for versions with density modification).

Put on the covering cap

9. Put on the covering cap and press hard against the source container.
10. Turn the covering cap approx. 45° clockwise until the limit stop.



Reading the switch status

Radiation ON

The red "EIN - ON" sign is visible (the green "AUS - OFF" sign is covered by the covering cap). The arrow points to "EIN - ON"

Radiation OFF

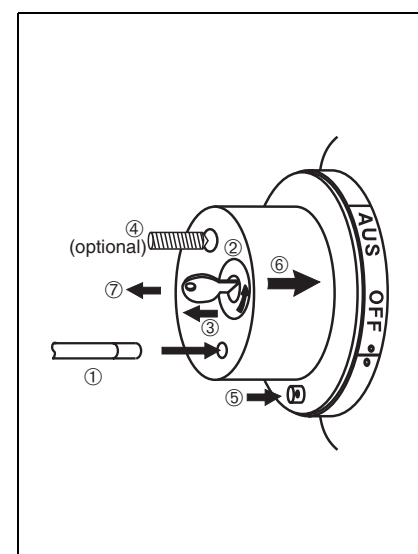
The green "AUS - OFF" sign is visible (the red "EIN - ON" sign is covered by the covering cap). The arrow points to "AUS - OFF"

Replacing the radiation source

(only by trained specialised personnel)

Remove the insert

1. Remove the covering cap, (see above).
2. If necessary, screw extension rod with M8 thread into the threaded bush of the insert (beside the lock) ① to achieve as large a distance as possible from the radiation source during transportation.
3. Unlock the lock (②,③, see above)
4. If present, loosen setscrew ④ using Allen key AF 5, (only for versions with density modification)
5. If present, remove leading from locking pin (⑤) and press in locking pin.
6. Turn insert until the arrow ⑥ is pointing to the locking pin.
7. Remove insert ⑦
To protect against contamination, place the covering cap on the source container until the insert is reinstalled.

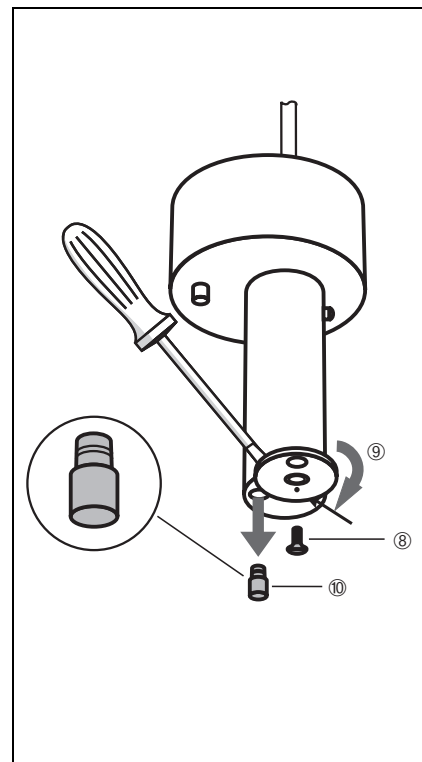


Replace the radiation source

8. If present, remove the safety screw (⑧).
9. Move the cover plate (⑨) at the front of the thin cylinder of the insert to the side, (to do so, use a screwdriver at the bore to lift the cover plate slightly from the cylinder, for example).
10. Slide the source out downwards and let it drop into a screened container ⑩.
11. Insert new source, close cover plate.
12. Screw in safety screw (optional)

Inserting insert

13. Push insert into the source container and turn until the locking pin pops out.
14. Continue turning the insert until the required position is reached ("ON" or "OFF").
15. Press in lock with key and lock. Remove key. For density modification: Screw in setscrew (only in ON position).
16. If necessary, remove extension rod.
17. If necessary, put new leading on the locking pin.
18. Put on the covering cap (see above).
19. Correct nameplate if necessary, (activity of source, local dose rate)



Operation: Europe and Sweden Design

Switching radiation on and off

1. Remove padlock; in addition for density modification, loosen setscrew using Allen key AF 5 (see diagram below).
2. To **switch on** radiation: Turn rotary bracket 180° counterclockwise
To **switch off** radiation: Turn rotary bracket 180° clockwise
The visible sign displays the current switch status ("EIN - ON" or "AUS - OFF"). The other sign is covered by the rotary bracket.
3. Insert padlock into the hole provided and lock; in addition for density modification, insert setscrew.

Replacing the radiation source

(only by trained specialised personnel)

Remove the insert

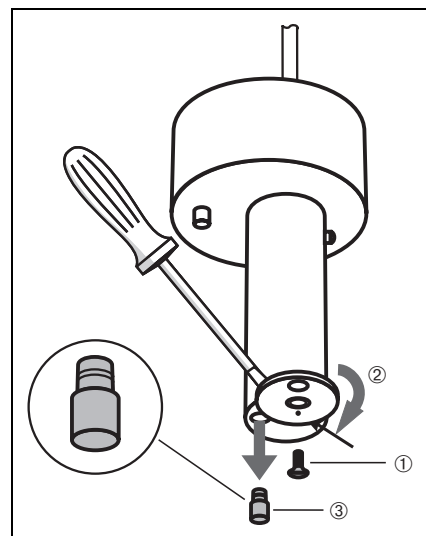
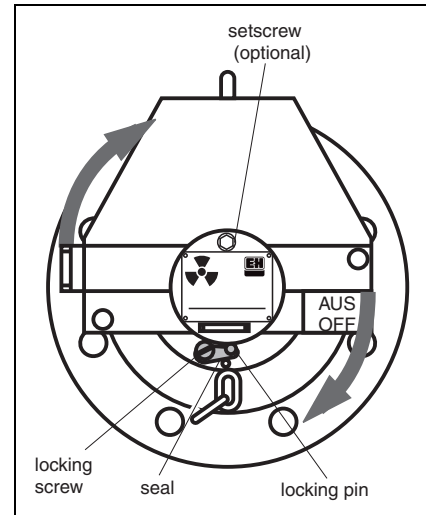
1. Remove padlock.
2. In addition for density modification, remove setscrew using Allen key AF 5.
3. If present, remove leading from the locking screw and the locking pin.
4. Unscrew locking screw and press in pin. Turn rotary bracket.
5. Remove insert

Replace the radiation source

6. If present, remove the safety screw ①
7. Move the cover plate (②) at the front of the thin cylinder of the insert to the side, (to do so, use a screwdriver at the bore to lift the cover plate slightly from the cylinder, for example).
8. Slide the source out downwards and let it drop into a screened container ③.
9. Insert new source, close cover plate.
10. Screw in safety screw (optional)

Insert insert

1. Push insert into the source container and turn until the locking pin pops out.
2. Continue turning the insert until the required position is reached ("ON" or "OFF").
3. Insert padlock into the hole provided and lock.
4. Screw in locking screw and provide the locking pin with new leading if necessary.
5. In addition for density modification, screw in setscrew (only in ON position).
6. Correct nameplate if necessary, (activity of source, local dose rate)



Operation: Chemical Design

Switching radiation on and off

1. Remove padlock. In addition for density modification, remove locating screw right beside the padlock.
2. To **switch on** radiation: Turn rotary bracket 180° clockwise
To **switch off** radiation: Turn rotary bracket 180° counterclockwise
The visible field displays the current switch status ("AUF - ON" or "ZU - OFF"). The other sign is covered by the rotary bracket.
3. Insert padlock into the hole provided and lock. In addition for density modification, insert locating screw right beside the padlock (only in ON position).

Replacing the radiation source

(only by trained specialised personnel)

Remove the source holder

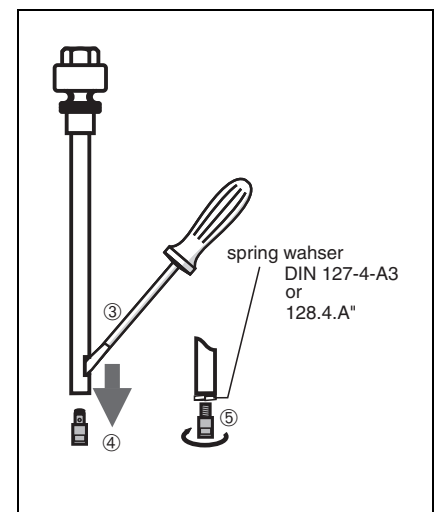
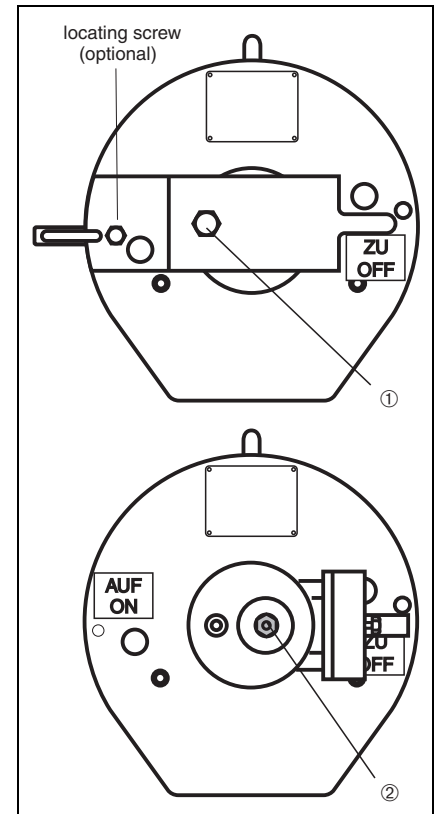
1. Remove padlock.
2. In addition for density modification, remove locating screw right beside the padlock.
3. Turn fastening bracket to the "ZU - OFF" position
4. Unscrew screw ① until it can be pulled up.
5. Fold up fastening bracket.
6. If necessary, screw extension rod with M8 thread into the threaded bush of the source holder (②) to achieve as large a distance as possible from the radiation source during transportation.
7. Unscrew source holder using wrench AF 13 and remove.

Replace the radiation source

1. Hold source holder over a screened transportation container.
2. Insert the blade of a screwdriver (width 4mm) into the slit in the source holder ③ and press out the source capsule ④ (or for threaded version, unscrew using a tool ⑤).
3. Let source capsule drop into the transportation container.
4. Insert new source capsule: Press capsule into the source holder until it engages, (screw in for threaded version; torque $2^{+0.5}$ Nm).

Insert the source holder

1. Screw source holder into the source container.
2. Tighten source holder with wrench AF 13. Loosen extension rod if necessary.
3. Fold down fastening bracket
4. Tighten screw ① with screwdriver or wrench AF 13.
5. Insert padlock into the hole provided and lock.
6. In addition for density modification, insert locating screw right beside the padlock (only in ON position).
7. Correct nameplate if necessary, (activity of source, local dose rate)



Behaviour in the Event of an Incident

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 protection 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 may 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.

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 protection officer.

Procedures after termination of the application

Internal measures

As soon as a radiometric measuring device is no longer required, the radiation source on the source container must be switched off. The source container shall be removed in accordance with all relevant regulations and saved in a lockable room having no through traffic. The responsible authorities shall be informed of these measures. The access to the storage room shall be measured out and signed. The radiation protection officer is responsible for protecting against theft. The radiation source in the source container must not be scrapped with the other parts of the plant. It should be returned as quickly as possible.

Return

FR Germany

Contact your E+H Sales Centre to organise the return of the radiation source for inspection with a view to reuse or recycling by Endress+Hauser.

Other countries

Contact your E+H Sales Centre or the appropriate authorities (government ministry) or regulating authority to find a way of returning the radiation source nationally. If return is not possible domestically, the further procedure must be agreed with the sales centre concerned. The destination airport for potential returns is Basle, Switzerland.

Conditions

The following conditions must be met before returning the material:

- An inspection certificate no more than three months old confirming the leak-tightness of the radiation source must be in the possession of E+H (wipe test certificate).
- The serial number, type of radiation source (^{60}Co or ^{137}Cs), activity and model of radiation source must be specified. This data may be found in the documents supplied with the radiation source.
- The material must be returned in an approved secondary containment suitable for simple manipulation and in type-tested type-A packaging (IATA rules).

Function and System Design

Function

In the QG 020 or QG 100 source containers, the radioactive source is surrounded by a lead covering encased in steel which screens off gamma radiation. The radiation is emitted, almost unattenuated, in one direction only through a channel (focussed narrow ray path). By turning the insert 180°, the radiation source is positioned in the radiation emission channel (radiation is switched on) and removed from the channel (radiation is switched off). The particular switch position is fixed by a mortise lock or padlock. The position can be easily identified externally.

Attenuation factor and half-value layers

Source container	QG 020		QG 100	
Source	⁶⁰ Co	¹³⁷ Cs	⁶⁰ Co	¹³⁷ Cs
Attenuation factor F_s	37	294	181	3100
Number of half value layers	5.2	8.2	7.5	11.6

The QG 2000 source container is available for even stronger screening. Please refer to Technical Information TI 346F/00/en for more information.

Local dose rate or control zone (calculated according to formula)

distance r

local dose rate at this distance D

activity A

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

D : Local dose rate [$\mu\text{Sv/h}$]

r : Distance from the source (control zone) [m]

A : Activity of the source [GBq]

F_s : Attenuation factor (see table above)

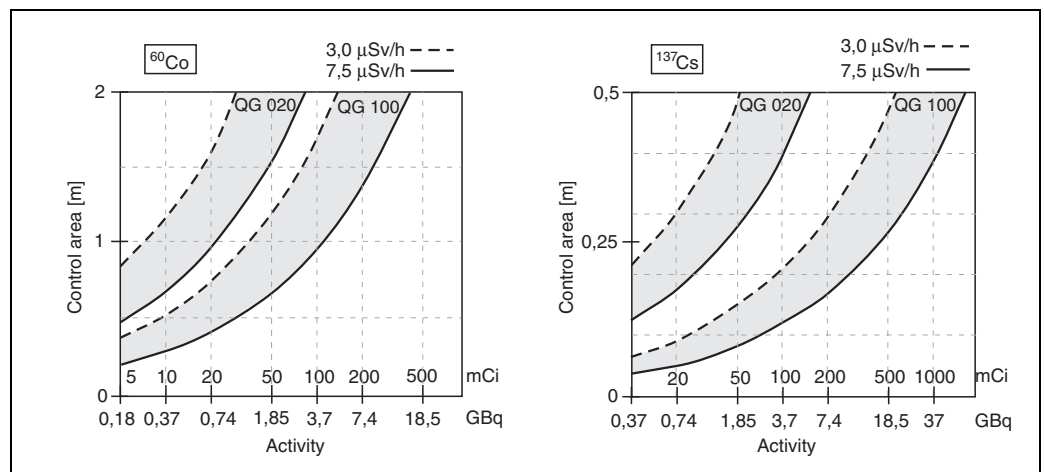
$$r = \sqrt{\frac{KA}{DF_s}}$$

$K = 357 \mu\text{Sv m}^2 / \text{h GBq}$ ($= 13,200 \mu\text{Sv m}^2 / \text{h Ci}$) for ⁶⁰Co

$K = 96 \mu\text{Sv m}^2 / \text{h GBq}$ ($= 3,550 \mu\text{Sv m}^2 / \text{h Ci}$) for ¹³⁷Cs

The control zone specifies at which distance r from the source container the local dose rate is attenuated to the value D at a specified load (activity) A . When calculating, always use the current limit values specific to the particular region or country. Please also take into account the fact that the activity of the sources is subject to production-related variations. For this reason, the local dose rate must always be measured on site.

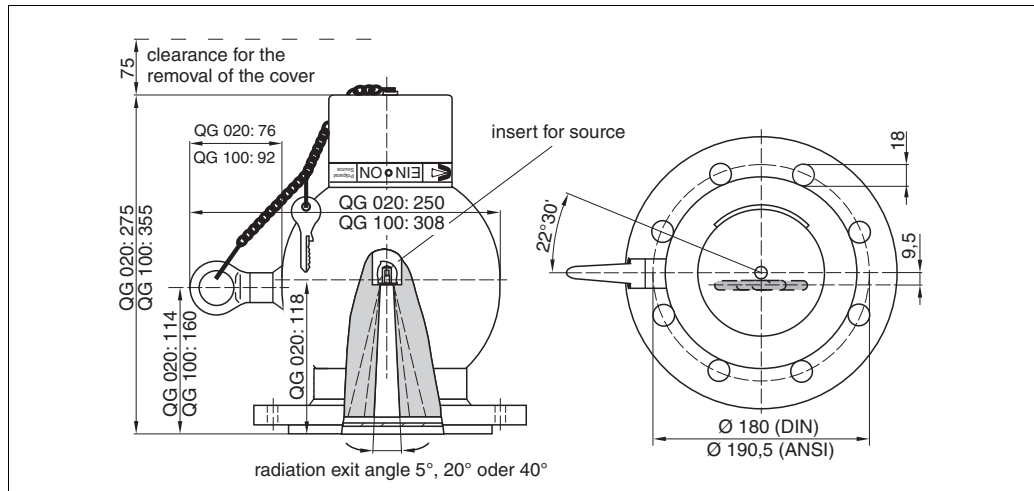
Control zone (determined from the diagram)



Mechanical Construction

Standard design

(with covering cap and lock)

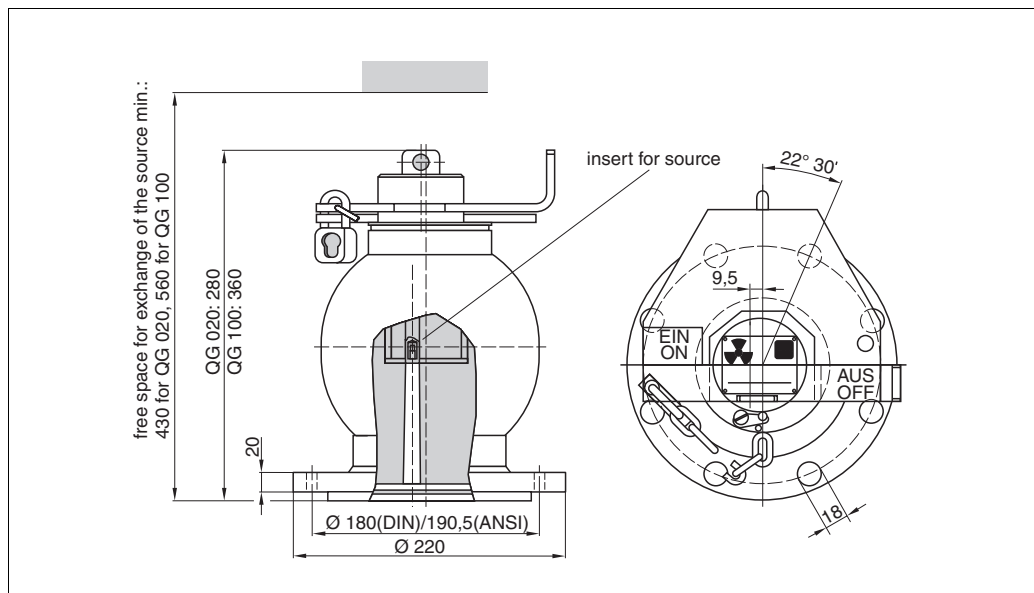


Europe and Sweden design

(with rotary bracket for switching ON and OFF and padlock)

Europe design:
Labelling in English

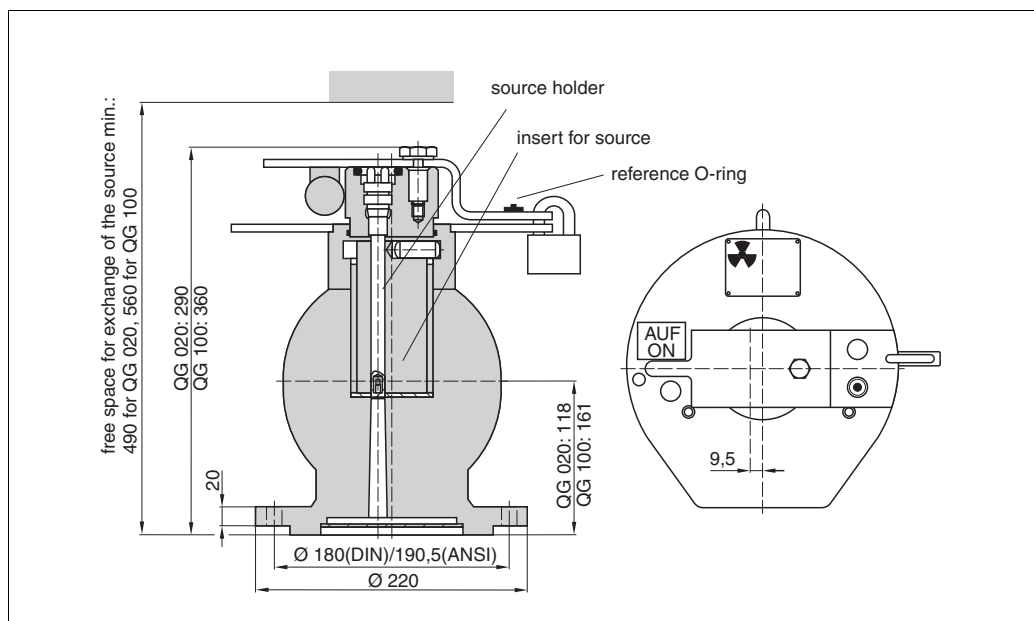
Sweden design:
Labelling in Swedish



Chemical design

(with rotary bracket for switching ON and OFF, removable source carrier, double O-ring seal and padlock)

According to a PTB statement the reference O-ring can be used to check for damage due to influence of aggressive media.



Container	Weight
QG 020	approx. 40 kg
QG 100	approx. 87 kg

5°, 20° or 40°

The emission channel is on the same level as the eyebolt of the source container. It is also marked on the outlet opening.

approx. 0.3 HWS ($F_s = 1.2$) via the cover plate

1.4571

Yellow paint RAL 1004 with black warning symbol

Lead

$$T_{\max} = 200\text{ }^{\circ}\text{C}$$

- Density modification
With additional fixing of the source insert. This rules out any possibility of the source changing position inside the container which could have an affect on the measurement result.
- Fireproof version, BAM-tested, 1h at 1000°C
- Version with pneumatic switch-on/switch-off
- Version with electric switch-on/switch-off (on request)

The diagram illustrates two different labeling schemes for the Endress+Hauser GG 1 radiation monitor. The top part shows a standard design with fields for activity (1), radiation exit angle (3), dose rate (4), isotope (5), radionuclide (6), Bq (7), and a second field (8). The bottom part compares two specific designs: the Euro/Swedish design and the Chemical industry design. The Euro/Swedish design includes fields for Nuklid (5), Aktivitet (6) in Bq, and a second field (7) in mCi. The Chemical industry design includes fields for Radionuklid (6) with checkboxes for Co60 and Cs137, Bq (7), dose rate (4) in µSv/h at 1 m, and Class (8). Both designs show the radiation symbol, manufacturer logo, and model number D-998900.

1: Order code
2: activity in mCi
3: radiation exit angle
4: dose rate at 1 m distance
5: isotope of source
6: activity in Bq
7: month/year
8: Ser.-No.

Certificates and Approvals

Local dose rate	A PTB test report on measurements of the local dose rate (QG 020 or QG100 each loaded with a certain source of a certain activity) is available on request.
Leak test	A PTB report for the chemical design versions, according to which the inspection period for leak testing can be extended up to 15 years, is available on request.
Fireproof version	A BAM certificate (test over 1h at 1000°C) is available and can be provided on request.
CNSC Certificate	<p>For application in Canada, the following CNSC Certificates are available:</p> <ul style="list-style-type: none">• QG 020: No. 094-0104-0-2017• QG 100: No. 094-0115-0-2017 <p>Note! When using the CNSC Certificates, the additional Safety Instructions SD 142F have to be observed.</p>

Ordering Information

Source container QG 020 / QG 100

	Design		
	C	Chemical design	
	D	Chemical design, density modification	
	B	Chemical design, with pneumatic cutoff	
	E	Europe design	
	H	Europe design, density modification	
	R	Standard design	
	M	Standard design, fireproof, BAM-tested	
	P	Standard design, with pneumatic cutoff (see Technical Information TI 157F/00/en)	
	Q	Standard design, density modification	
	S	Sweden design	
	V	Sweden design, density modification	
	Y	Special version	
	Process connection		
	P1	DN100 PN16, flange + container steel	
	P2	DN100 PN 16, flange + container SS316Ti	
	R1	ANSI 4" 150lb, flange + container steel	
	R2	ANSI 4" 150lb, flange + container SS316T	
	Emission angle		
	A	5°	
	B	20°	
	C	40°	
	D	Special version	
QG 020 -			Complete product designation
QG 100 -			Complete product designation

Delivery

Germany

We can only ship radioactive sources once we have received a copy of the handling permit. We are more than happy to assist in procuring the necessary documents. Please contact our local sales centre.

For safety reasons and to save costs, we generally supply the source container loaded, i.e. with the radiation source installed. If the user requires the source container be delivered first and if the source must be delivered subsequently, transportation drums are used for shipping.

Other countries

We can only ship radioactive sources once we have received a copy of the import licence.

Endress+Hauser is more than happy to assist in procuring the necessary documents.

Please contact your local sales centre.

Radioactive sources must be installed in the source container for delivery abroad.

Supplementary Documentation

System Information

IN 002F/00/en

Innovation brochure for Gammapiot M FMG60

SI 016F/00/en

Radiometric measurement of level, separation layer and density

PK 001F/00/en

Radiometric measuring technology - applications in all areas

Technical Information

TI 346F/00/en

Technical Information for source container QG 2000

TI 213F/00/en

Technical Information for gamma emitter

TI 363F/00/en

Technical Information for Gammapiot M FMG60

TI 218F/00/en

Technical Information for gamma pilot FTG 470 Z

TI 177F/00/en

Technical Information for gamma pilot FTG 671

TI 219F/00/en

Technical Information for gammasilometer FMG 671 (P)

TI 197F/00/en

Technical Information for detectors DG 17(Z) / 27(Z)

TI 180F/00/en

Technical Information for detector DG 57

Special Documentation

SD 142F/00/en

Supplementary Safety Instructions for Radioactive Sources and Source Containers approved for Use in Canada

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The Power of Know How

