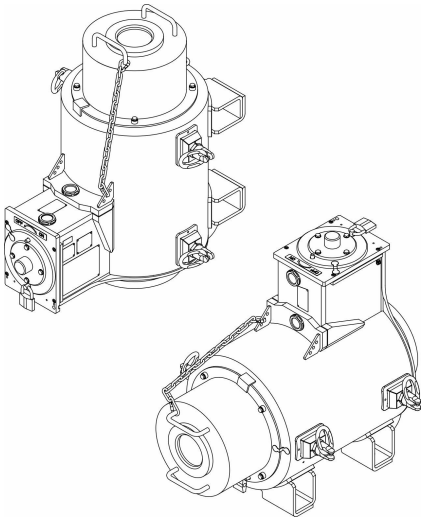
TI01798F/00/EN/04.24-00
71685313
2024-10-31

Technical Information
Source container FQG74

Radiometric level measurement



Source container with up to 20 radiation sources

Application

The measuring system consists of the FQG74 source container, several FSG60 radiation sources and several Gammapilot FMG50 detectors.

The FQG74 source container is designed for 12 or 20 radiation sources.

Hydrocracker, PTA plants, Density profiling systems, HF storage tanks.

The maximum activities which the FQG74 can accommodate are as follows:
FSG60: Cs^{-137}: 740 GBq (20 Ci)

Cs^{-137} radiation sources, no nuclide mixture

Your benefits

- Up to 20 radiation sources (in straight or curved protection pipes)
- Up to 30 m (98 ft) cable length
- Optimized shielding for high activity
- Highest safety classification for the radiation sources supplied (ISO 2919, typical classification C66646)
- Manual switch-on and switch-off ("ON/AN" or "OFF/AUS")
- Retaining element/padlock to fix switch position ("ON/AN" and "OFF/AUS")
- Switch state easily identified
- The FQG74 source container meets the design requirements of IEC 62598 for a category B storage container

Endress+Hauser
People for Process Automation

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About this document

Symbols

Safety symbols

DANGER
This symbol alerts you to a dangerous situation. Failure to avoid this situation will result in serious or fatal injury.

WARNING
This symbol alerts you to a potentially dangerous situation. Failure to avoid this situation can result in serious or fatal injury.

CAUTION
This symbol alerts you to a potentially dangerous situation. Failure to avoid this situation can result in minor or medium injury.

NOTICE
This symbol alerts you to a potentially harmful situation. Failure to avoid this situation can result in damage to the product or something in its vicinity.

High radiation warning sign

Warning symbol for highly radioactive source according to ISO21482

Highly radioactive source

- Warns of highly radioactive substances or ionizing radiation
- Highly radioactive sources are marked separately on the source containers with the wording "highly radioactive source" and the additional warning symbol in accordance with ISO21482

Symbols for certain types of information and graphics

Radiation symbol
Warns against radioactive substances or ionizing radiation

Permitted
Procedures, processes or actions that are permitted

Forbidden
Procedures, processes or actions that are forbidden

Tip
Indicates additional information

Reference to documentation

Reference to graphic

▶
Notice or individual step to be observed

1., 2., 3.
Series of steps

Result of a step

1, 2, 3, ...
Item numbers

A, B, C, ...
Views

⚠ → 📖 **Safety instructions**
Observe the safety instructions contained in the associated Operating Instructions

Documentation

For an overview of the scope of the associated Technical Documentation, refer to the following:
- *Device Viewer* (www.endress.com/deviceviewer): Enter the serial number from the nameplate
- *Endress+Hauser Operations app*: Enter serial number from nameplate or scan matrix code on nameplate.

Function and system design

Function

Function of the source container

The radiation sources are surrounded by a lead-filled steel jacket in the source container, which shields the gamma radiation. The radiation sources can be brought into the process on separate ropes in a protection pipe. The radiation from the radiation sources is used for the radiometric measurement.

Switching the radiation ON and OFF

- The current switch position ("ON/AN" or "OFF/AUS") of the shutter and radiation sources concerned can be viewed from the outside via a window.
- The current switch position ("ON/AN" or "OFF/AUS") is secured by a lock.

System design

The FQG74 source container is mounted vertically on the vessel via the connecting flange

The gamma radiation is detected by several FMG50s

Container types

Typical container types for FQG74 applications
- Horizontal container, for example for interface measurement
- Vertical container, for example for level measurement

Attenuation factor and half-value layers

In the direction of radiation (in the direction of the connecting flange)
- Attenuation factor F_s:
  for Cs^{-137}: 32600
- Number of half-value layers:
  for Cs^{-137}: 15

In the direction opposite to the beam (in the direction of the shutter)
- Attenuation factor F_s:
  for Cs^{-137}: 52500
- Number of half-value layers:
  for Cs^{-137}: 15.6

These are typical values that do not take into account production-related variations in the activity and tolerances of the measuring instruments.

Maximum activity of the radiation sources

The maximum admissible activity can be further restricted by country-specific approvals.

	Feature 025; option "B1", "B2", "B3"	Feature 025; option "A1"
Maximum load	20 000 mCi (740 GBq) Cs^{-137}	20 000 mCi (740 GBq) Cs^{-137}
Maximum single load	1 000 mCi (37 GBq) Cs^{-137} or 5 000 mCi (185 GBq) Cs^{-137} 1)	1 000 mCi (37 GBq) Cs^{-137} or 5 000 mCi (185 GBq) Cs^{-137} 2)
Drainable source magazine (feature 025)	▪ YES (Option "B2") ▪ NO (Option "B1") ▪ NO (Option "B3")	NO (Option "A1")
Number of radiation sources	1-12	1-20

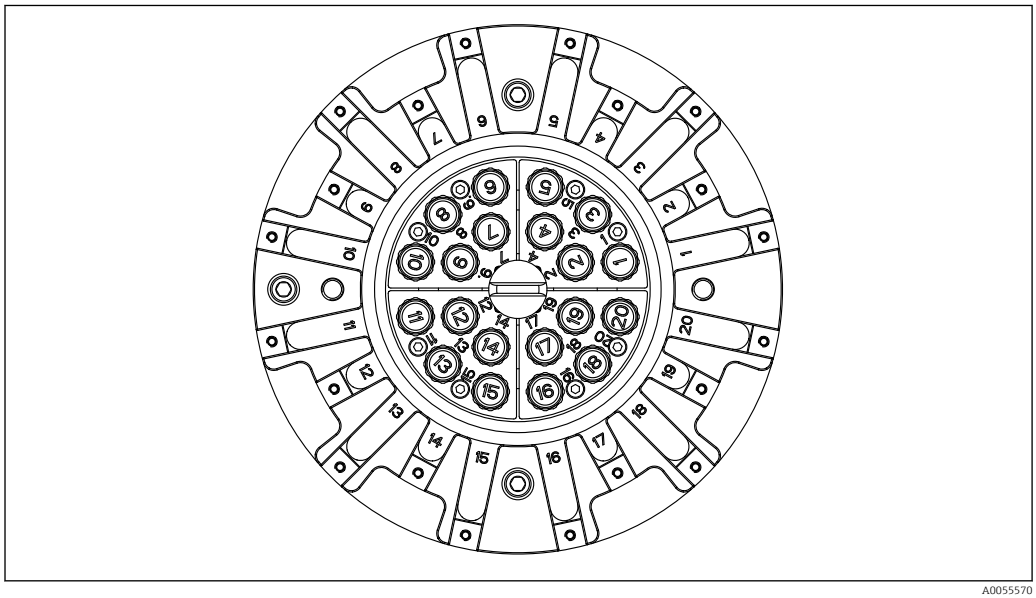
1) for assembly positions P2, P7, P12 and P17: 5 000 mCi (185 GBq) $^{Cs-137}$
2) for assembly positions P2, P5, P8 and P11: 5 000 mCi (185 GBq) $^{Cs-137}$

Determining the position of the source magazines

The tables show the positions (P1-P20) on the source magazines (vertical column) in which the source holders (horizontal row) are located when the magazine is not completely filled.

Positions not occupied by source holders are loaded with dummy rods.

Source magazine (20-position)



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1 *Loading overview, source magazine (20-position)*

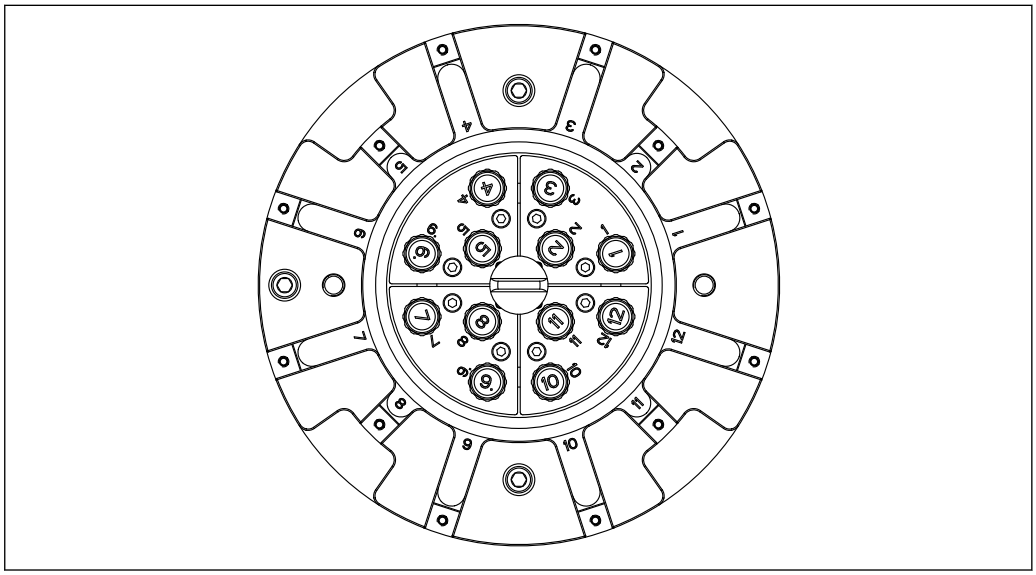
	Number of radiation source (depending on characteristic 100)																		
	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
P1	-	-	-	-	-	-	-	x	x	x	x	x	x	x	x	x	x	x	x
P2	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
P3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	x	x	x
P4	-	-	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
P5	-	-	-	-	-	-	-	-	-	-	-	x	x	x	x	x	x	x	x
P6	-	-	-	-	-	-	-	-	-	x	x	x	x	x	x	x	x	x	x
P7	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
P8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	x
P9	-	-	-	-	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x
P10	-	-	-	-	-	-	-	-	-	-	-	-	-	x	x	x	x	x	x
P11	-	-	-	-	-	-	-	-	x	x	x	x	x	x	x	x	x	x	x
P12	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
P13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	x	x
P14	-	-	-	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
P15	-	-	-	-	-	-	-	-	-	-	-	-	x	x	x	x	x	x	x
P16	-	-	-	-	-	-	-	-	-	-	x	x	x	x	x	x	x	x	x
P17	-	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
P18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x
P19	-	-	-	-	-	-	x	x	x	x	x	x	x	x	x	x	x	x	x
P20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	x	x	x	x

P1-P20: Positions in source magazine

x: loaded with source holder

-: loaded with dummy rod

Source magazine (12-position)



2 *Loading overview, source magazine (12-position)*

	Number of radiation source (depending on characteristic 100)										
	2	3	4	5	6	7	8	9	10	11	12
P1	-	-	-	x	x	x	x	x	x	x	x
P2	x	x	x	x	x	x	x	x	x	x	x
P3	-	-	-	-	-	-	-	x	x	x	x
P4	-	-	-	-	-	x	x	x	x	x	x
P5	-	x	x	x	x	x	x	x	x	x	x
P6	-	-	-	-	-	-	-	-	-	x	x
P7	-	-	-	-	x	x	x	x	x	x	x
P8	x	x	x	x	x	x	x	x	x	x	x
P9	-	-	-	-	-	-	-	-	x	x	x
P10	-	-	-	-	-	-	x	x	x	x	x
P11	-	-	x	x	x	x	x	x	x	x	x
P12	-	-	-	-	-	-	-	-	-	-	x

P1-P12: Positions in source magazine

x: loaded with source holder

-: loaded with dummy rod

Dose rate diagrams

A dose rate diagram specifies the local dose rate at a specified distance from the surface of the source container.

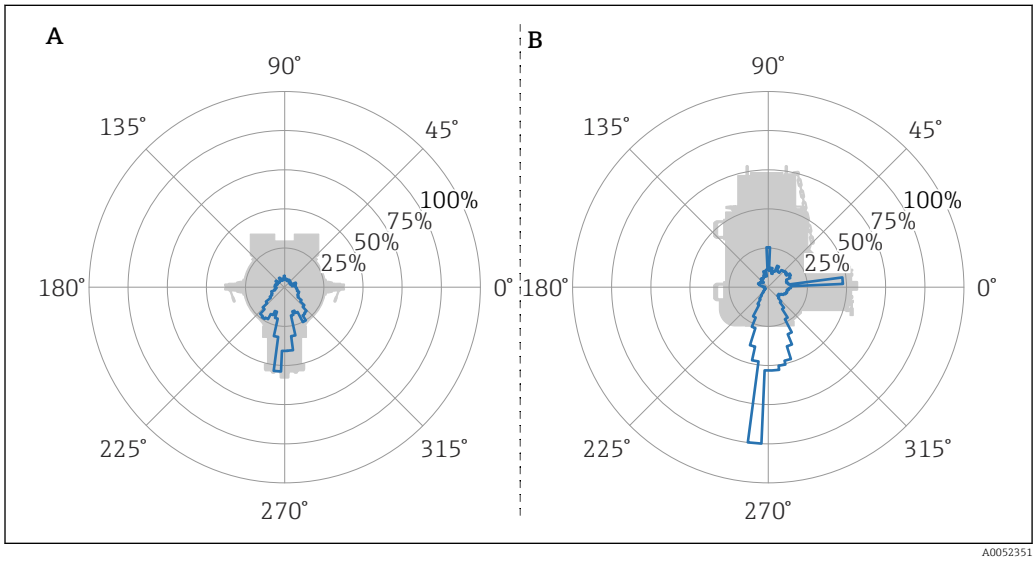
The following are examples of dose rate diagrams for a distance of 1 m (3.3 ft).

All dose rate diagrams and maximum values refer to the "OFF/AUS" switching position and are without a transportation lock.

Dose rate diagrams for individual assembly with radiation sources are available on request

Dose rate diagrams for Cs-^{137} in the 20-position source magazine

1 m (3.3 ft) distance to the surface



3 20-position source magazine (feature 25; option A1) in "OFF/AUS" position

A equipped with 20 Cs-^{137} radiation sources of equal nominal activity (shutter at the bottom)
B equipped with 20 Cs-^{137} radiation sources of equal nominal activity (shutter at the top)

Calculation of the maximum local dose rate (µSv/h) at a 1 m (3.3 ft) distance to the surface

Maximum local dose rate (µSv/h): Sum of the loaded individual activities (GBq) · 0.0052 (µSv/h / GBq)

Formula: $\mathbf{D_{max} = \sum A \cdot k_{20}}$

D_{max}: Maximum local dose rate (µSv/h)

A: Individual activity (GBq)

Factor k_{20}: 0.0052 (µSv/h / GBq)

Example:

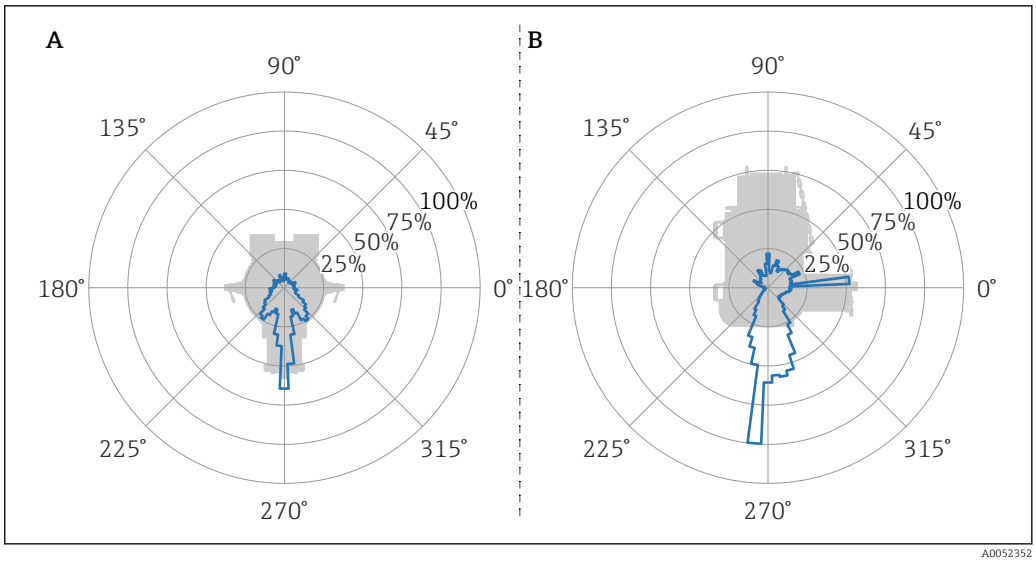
Application with 20 radiation sources each with an individual activity of 37 GBq

D_{max}: 20 · 37 GBq · 0.0052 µSv/h / GBq: **3.848 µSv/h**

The maximum local dose rate corresponds to the 100% value of the diagram

Dose rate diagrams for Cs-^{137} in the 12-position source magazine

1 m (3.3 ft) distance to the surface



4 *12-position source magazine (feature 25; option B1, B2, B3) in "OFF/AUS" position*

A equipped with 12 Cs-137 radiation sources of equal nominal activity (shutter at the bottom)
B equipped with 12 Cs-137 radiation sources of equal nominal activity (shutter at the right)

Calculation of the maximum local dose rate (µSv/h) at a distance of 1 m (3.3 ft) to the surface

Maximum local dose rate (µSv/h): Sum of the loaded individual activities (GBq) · 0.0056 (µSv/h / GBq)

Formula: $\mathbf{D_{max} = \sum A \cdot k_{12}}$

D_{max}: Maximum local dose rate (µSv/h)

A: Individual activity (GBq)

Factor k_{12} : 0.0056 (µSv/h / GBq)

Example:

Application with 12 radiation sources each with an individual activity of 37 GBq

$\mathbf{D_{max}}$: 12 · 37 GBq · 0.0056 µSv/h / GBq: **2.4864 µSv/h**

The maximum local dose rate corresponds to the 100% value of the diagram

Mounting

Mounting instructions

NOTICE

Corrosion or damage to the protection pipes

Leaks in protection pipes can endanger the integrity of radiation sources, thus increasing the risk of contamination

- ▶ It is recommended to use double-walled protection pipes

NOTICE

Errors in the planning and implementation of the internal diameters and bending radii of the protection pipes

Source holders can become obstructed in the protection pipe or can get stuck in the protection pipe

- ▶ The recommended distance between two consecutive radiation sources should be at least 400 mm (15.75 in). This restriction does not apply if the protection pipe has an internal diameter >.38 mm (1.5 in)
- ▶ For 20 radiation sources, only straight protection pipes should be used (feature 25: option "A1")
- ▶ For 12 radiation sources, only straight protection pipes may be used (feature 25: option "B1" or "B2")
- ▶ For 12 radiation sources, curved protection pipes may also be used (feature 25: option "B3"). Flexible source holders must be used for curved protection pipes.

For designing and ordering corrugated conduits and any mounted parts required for curved protection pipes:

Contact the Endress+Hauser sales organization

Orientation

The source container is mounted vertically on the product vessel via the connecting flange for measurement

DANGER

Risk of accident due to high total weight

Incorrectly installed source containers can lead to fatal injuries to persons and serious damage to objects in the event of a fall.

- ▶ Only vertical flange mounting is permitted

The protection pipe must be double-walled and already supplied by the customer

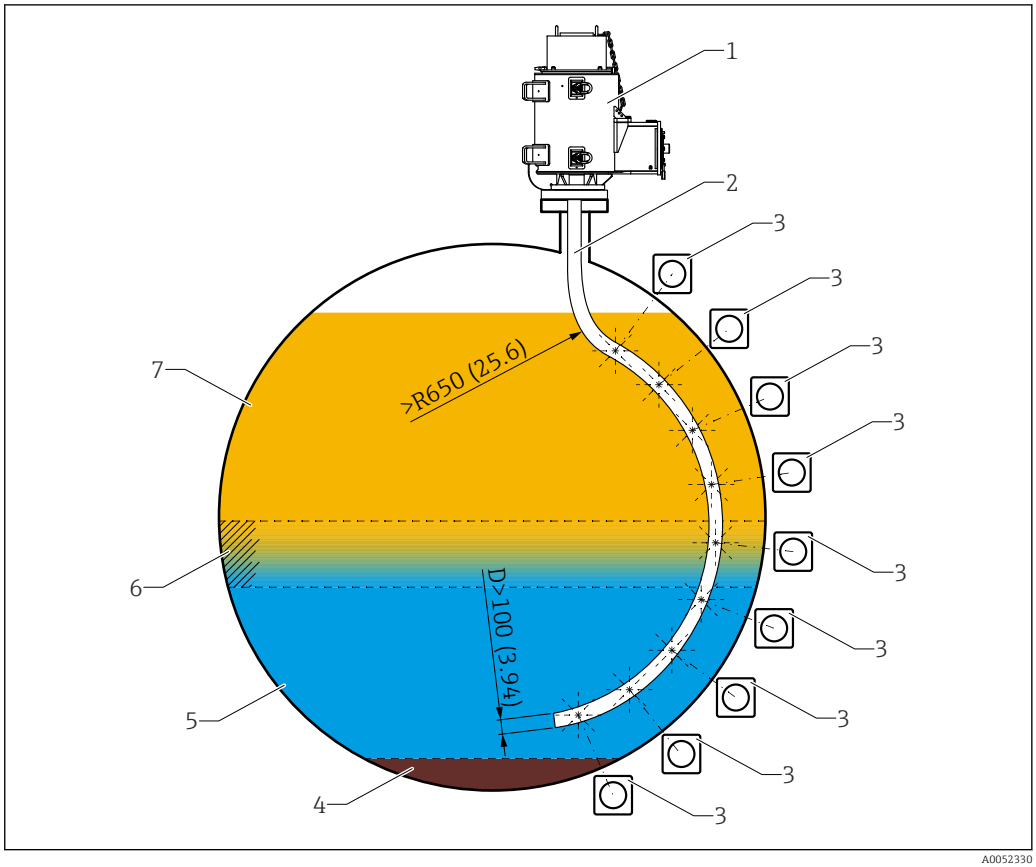
Provide the necessary mechanical stability for long protection pipes

Do not install the protection pipe near the agitator

For feature 025

- Option "A1": Minimum internal diameter of the protection pipe D= 70 mm (2.75 in)
- Option "B1": Minimum internal diameter of the protection pipe D= 38 mm (1.5 in)
- Option "B2": Minimum internal diameter of the protection pipe D= 38 mm (1.5 in)
- Option "B3": Minimum internal diameter of the protection pipe D= 100 mm (4 in)
  Minimum bending radius for the curved protection pipe R= 650 mm (25.6 in)

Interface measurement

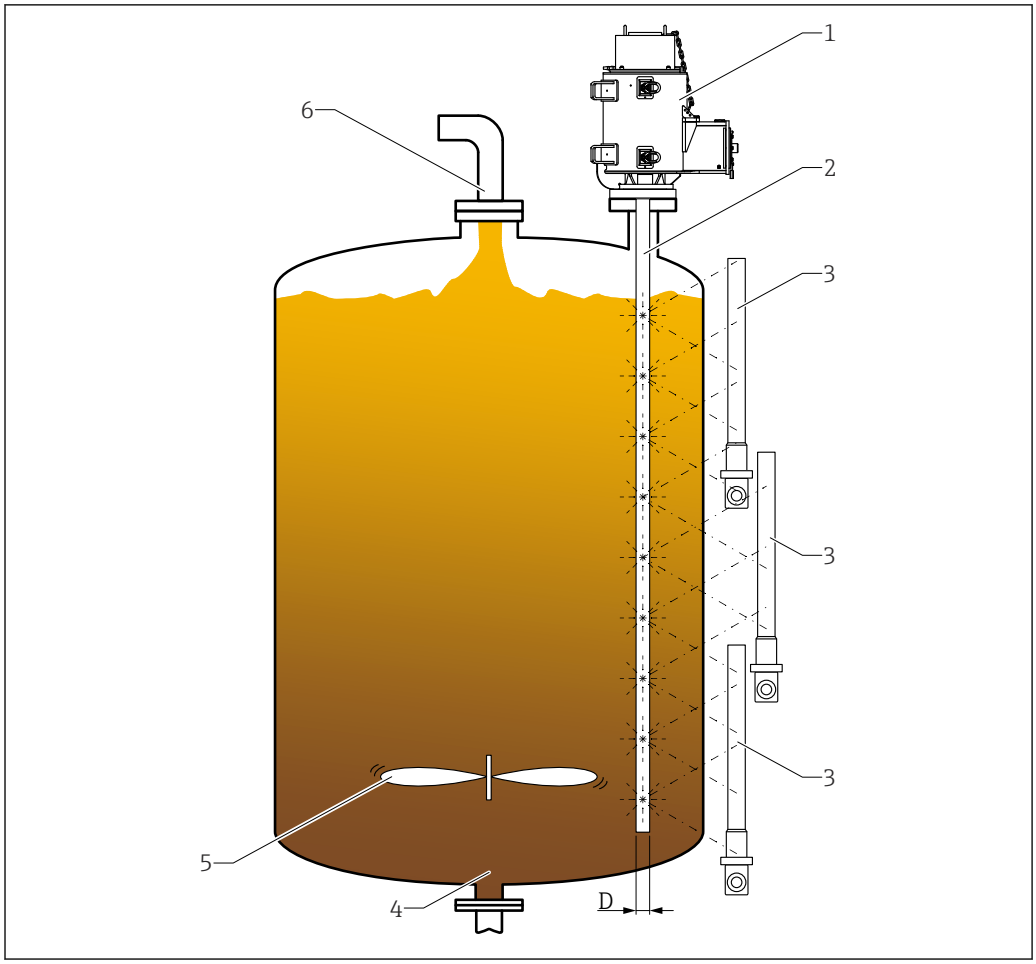


5 *Interface measurement*

1 FQG74
2 Curved protection pipe
3 Gammapilot FMG50
4 Medium: Sand/sludge
5 Medium: Water
6 Medium: Emulsion
7 Medium: Oil
R Minimum radius: 650 mm (25.6 in)
D Minimum internal diameter of the protection pipe

For the version with curved protection pipes:
Contact the Endress+Hauser sales organization

Level measurement



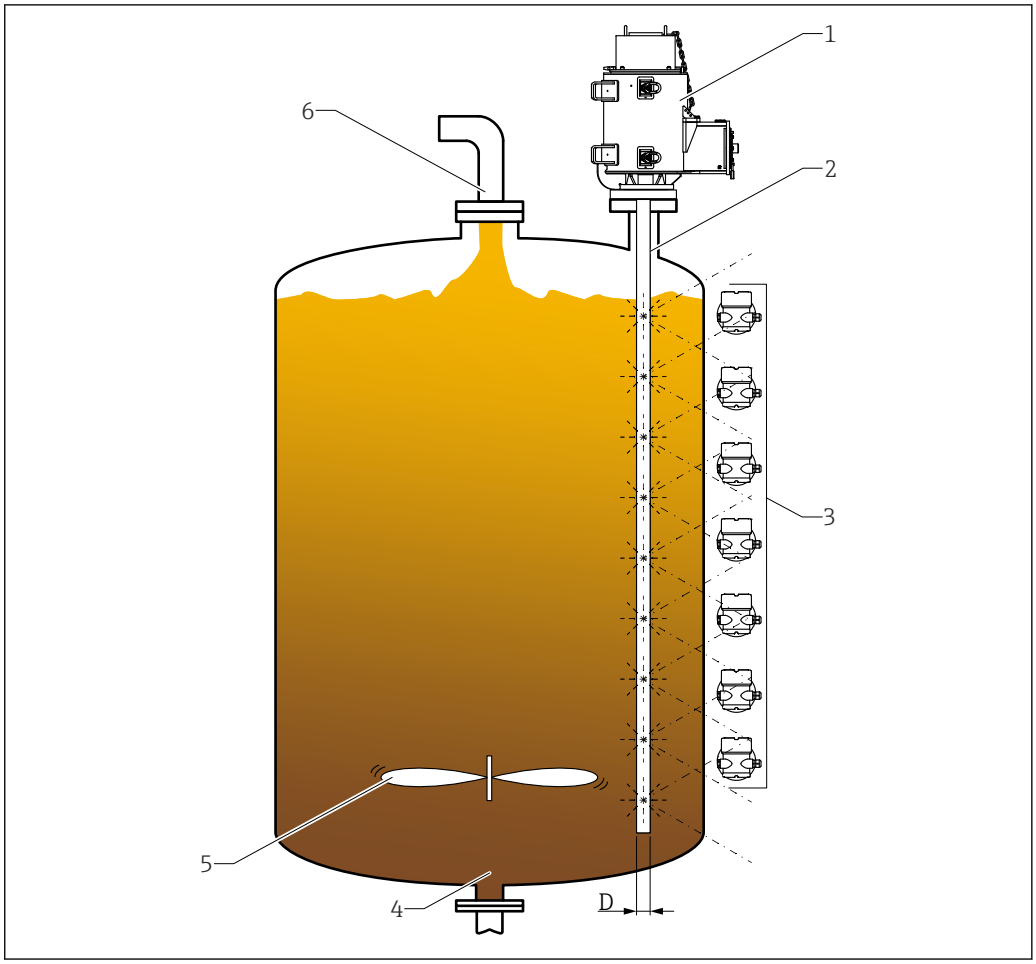
6 *Level measurement*

1 FQG74
2 Straight protection pipe
3 Gammapilot FMG50
4 Medium
5 Agitator
6 Inlet
D Minimum internal diameter of the protection pipe

Observe the notes for long measuring ranges in the FMG50 operating instructions ("Cascading operation" section)

BA01966F, operating instructions FMG50

Density measurement (multipoint)



7 *Density measurement (multipoint)*

1 *FQG74*
2 *Straight protection pipe*
3 *Gammapilot FMG50 (horizontal mounting)*
4 *Medium*
5 *Agitator*
6 *Inlet*
D *Minimum internal diameter of the protection pipe*

Mounting dimensions

NOTICE

Errors in the design of the application can lead to measurement errors and avoidable radiation exposure

- ▶ Endress+Hauser assists with designing and planning the application
- ▶ Contact the Endress+Hauser sales organization

DANGER

Risk to health due to ionizing radiation

Ionizing radiation can increase the risk of cancer and genetic defects in offspring. High doses of ionizing radiation cause immediate physical harm which, depending on the dose, can lead to nausea, vomiting, hair loss, changes in the blood count and severe tissue damage or even death.

- ▶ The application must be planned and executed in such a way that all radiation sources are inside the product vessel when lowered.
- ▶ Determine the danger area and plan and implement barrier measures for the danger area in accordance with national requirements

DANGER

Health and environmental hazards due to contamination and ionizing radiation

Hazard due to potential contamination, loss of the radiation sources or inadequate shielding of the ionizing radiation in the source container.

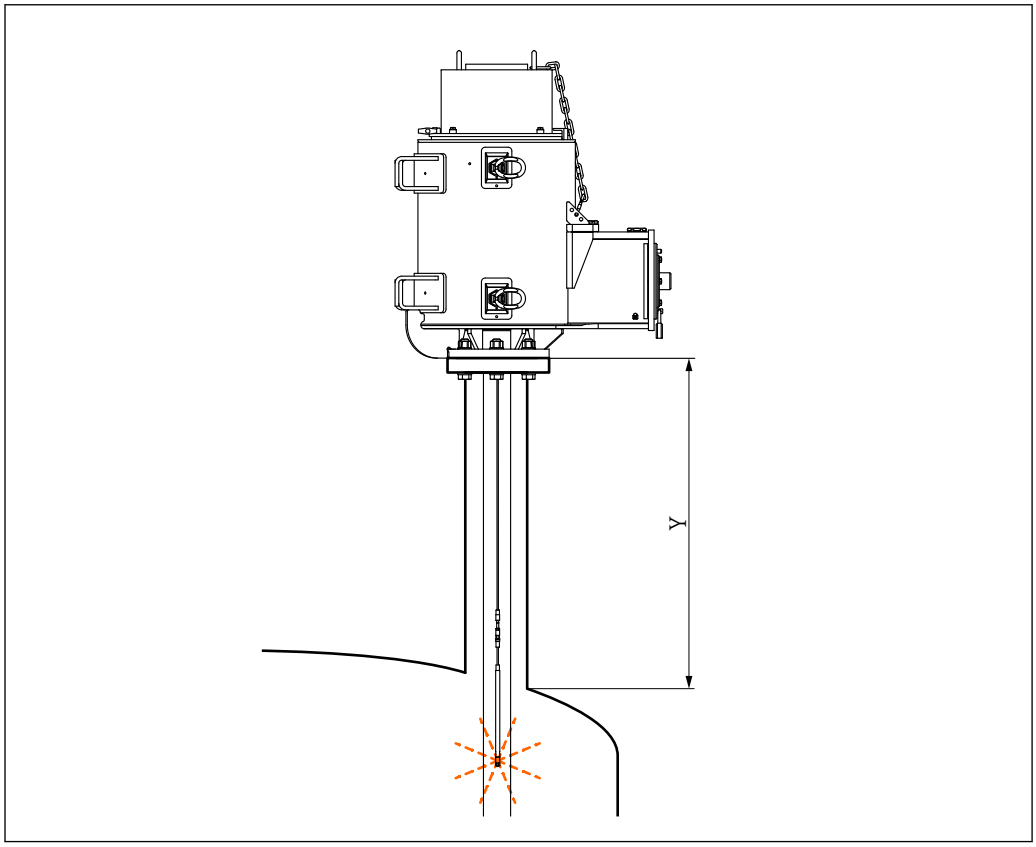
- ▶ Nationally applicable requirements for theft and fire protection measures for radioactive radiation sources must be taken into account when planning the application

DANGER

Risk of accident due to high total weight

Incorrectly installed source containers, incorrectly installed or damaged lifting points and improper transportation can lead to fatal injuries to persons and serious damage to objects in the event of a fall.

- ▶ Source containers may only be mounted and transported in accordance with the specifications of the Operating Instructions for the source container
- ▶ The supporting structure must be designed for the total weight of the source container and the vibrations that occur during operation



8 Mounting dimensions, y < LN

y: The dimension "y" must be selected so that the radiation sources are inside the product vessel when lowered.
LN: Variable cable length, depending on the version

Flange mounting screws (customer-supplied)

Screw diameter M20 or G1/2

- **Material:** A4
- **Min. tensile strength:** Strength class 70; 700 N/mm² (157.36 lbf)

Environment

Ambient storage temperature

Ambient temperature range: −52 to +120 °C (−61 to +248 °F)

Temperature range during mounting or disassembly: −40 to +120 °C (−40 to +248 °F)

NOTICE

The process temperature can be outside the permitted ambient temperature range

This may cause damage to the source container

- The operator must ensure that the permissible temperature at the source container is not exceeded by heat transfer from the process.
- The ambient temperature range applies to the source container up to the connecting flange

Radiation sources

The operating temperature range and temperature class depend on the radiation source.

TI00439F/00

Ambient pressure

Atmospheric pressure

Vibration resistance

IEC 60068-2-64 test Fh; 5 to 200 Hz; 0.01 $(m/s^2)^2/Hz$

Shock

IEC 60068-2-27 test Ea (15 g; 11 ms; 3 shocks/direction/axis)

Degree of protection

IP66

Fire resistance

IEC 62598 Fire resistance class D: +945 °C (+1 733 °F) / 60 min

The specification can be restricted by country-specific approvals.

Process

Process temperature range

−52 to +450 °C (−61 to +842 °F)

The process temperature can be exceeded for a short period of time

⚠ WARNING

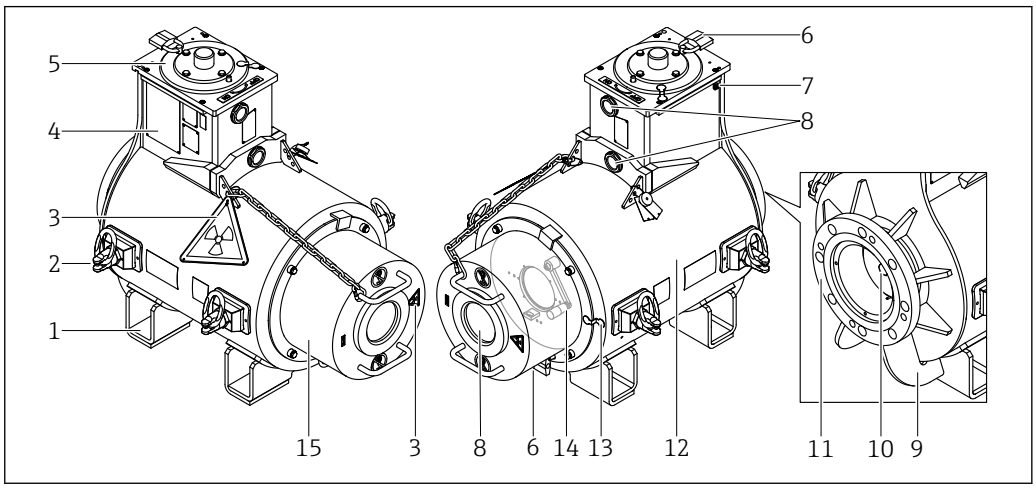
Radioactive contamination from leaking radiation sources
Health and environmental hazards
▶ Observe the operating temperature range of the radiation sources

Process connection

- Flange: ANSI 6" 150 lbs
- Other process connections (optional): Contact Endress+Hauser sales organization

Mechanical construction

Design



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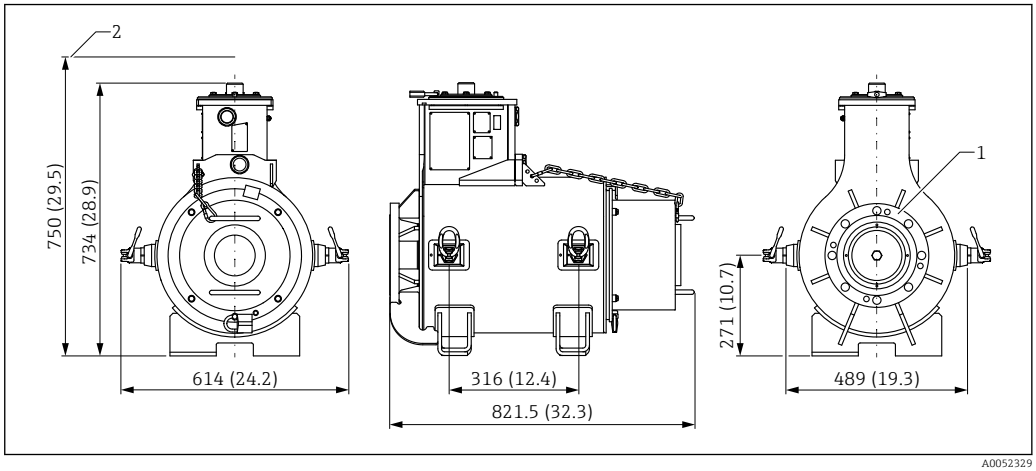
1 *Transport feet*
2 *Lifting point (RUD PP-B-1.5t-M16)*
3 *Warning signs*
4 *Sign holders (for fitting nameplates and connection for potential equalization)*
5 *Twist protection/cover shutter*
6 *Lock*
7 *Ground terminal*
8 *Window*
9 *Skids for setting up the source container*
10 *Transportation lock*
11 *Connecting flange*
12 *Source container housing*
13 *Protective seal*
14 *Crank for shutter*
15 *Cover*

The switching position is indicated directly via the shutter. The shutter is held in position by the twist protection device.

Dimensions

FQG74 dimensions



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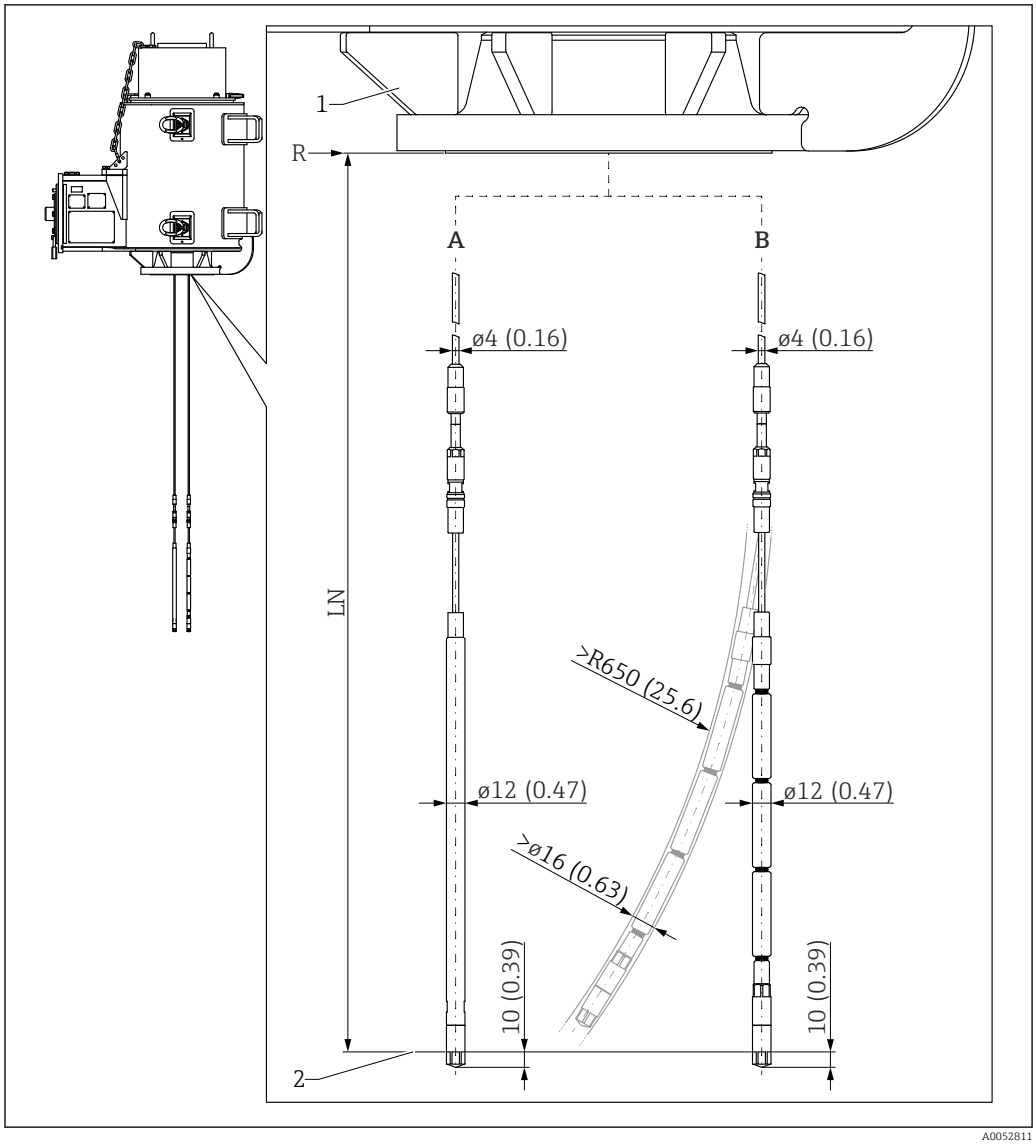
9 *Dimensions. Unit of measurement mm (in)*

Maximum total weight: 780 kg (1 720 lb)
1 *Flange: ANSI 6" 150 lbs*
2 *Overall length dimension with operating clearance for the crank*

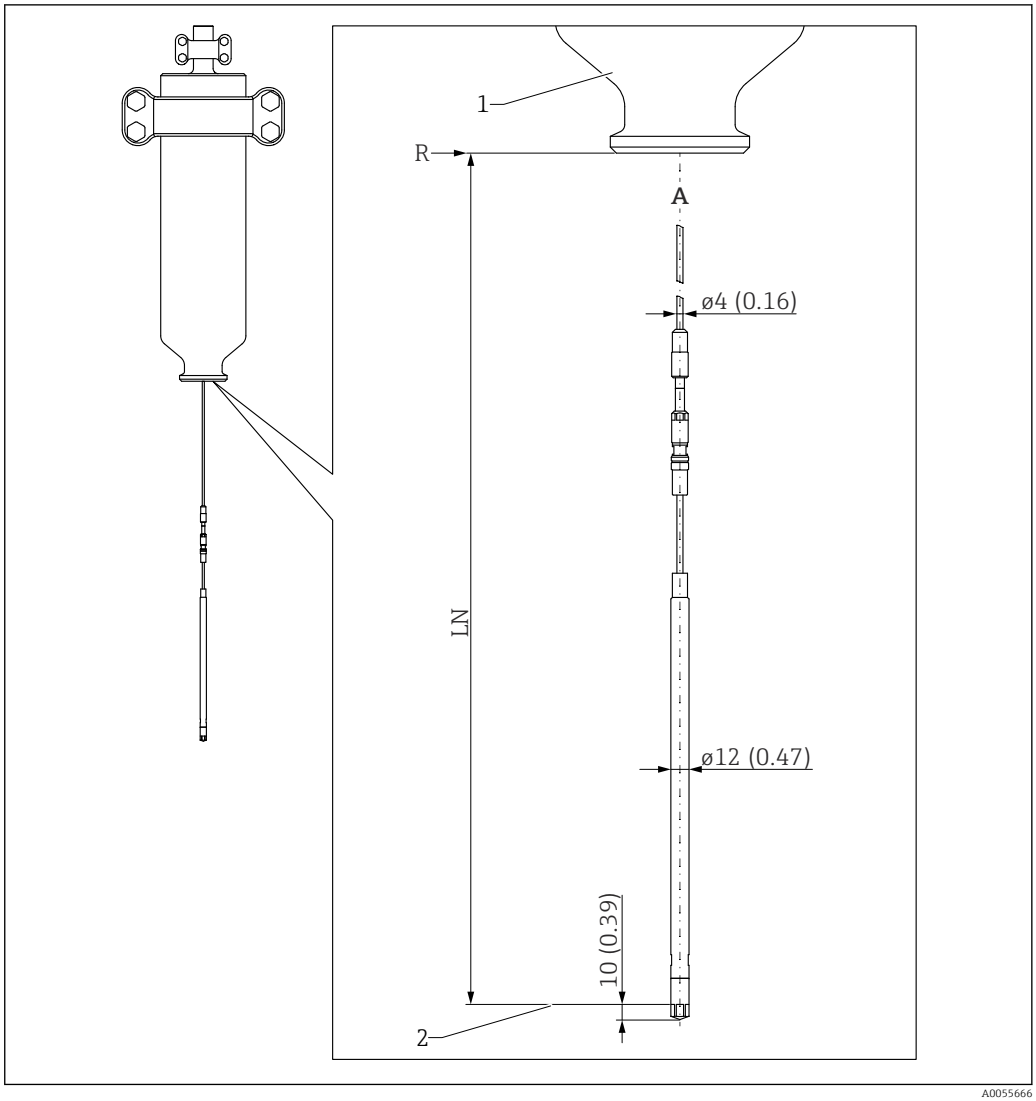
Dimensions of cable extension and source holder



1 Source container
2 Center of the radiation source
A Rigid source holder (feature 025; option "A1", "B1", "B2")
B Flexible source holder (feature 025; option "B3")
R Reference point
LN Variable length, depending on the version

When using an adapter between the source container and the product vessel, take into account the offset arising from the adapter dimension

Dimensions of cable extension and source holder (source magazine can be lowered)



1 Process adapter
2 Center of the radiation source
A Rigid source holder (feature 025; option "B2")
R Reference point
LN Variable length, depending on the version

Weight

- FQG74 source container: Max. 780 kg (1 720 lb)
- Cable extension: 0.1 kg/m (0.067 lb/ft)

Materials

Housing:
316L (1.4404)

Source container:
This device contains approx. 43 l (11.36 gal) Lead with CAS No. 7439-92-1

Shutter:
316L (1.4404)

Source holder:
316L (1.4404)

Cable extension:
2.4602 (Alloy C22)

Wave spring of the flexible source holder (characteristic 025; option "B3"):
17-7PH (1.4568)

Nameplates:
A2 (1.4301)

Warning signs:
A2 (1.4301)

Padlock:
- **Lock body:** brass
- **Shackle:** Hardened steel

Seals:
FKM

Screws and nuts:
A4

Safety equipment

- Twist protection and padlock to secure the "ON/AN" or "OFF/AUS" switch position.
- Lockable cover provides protection from theft.

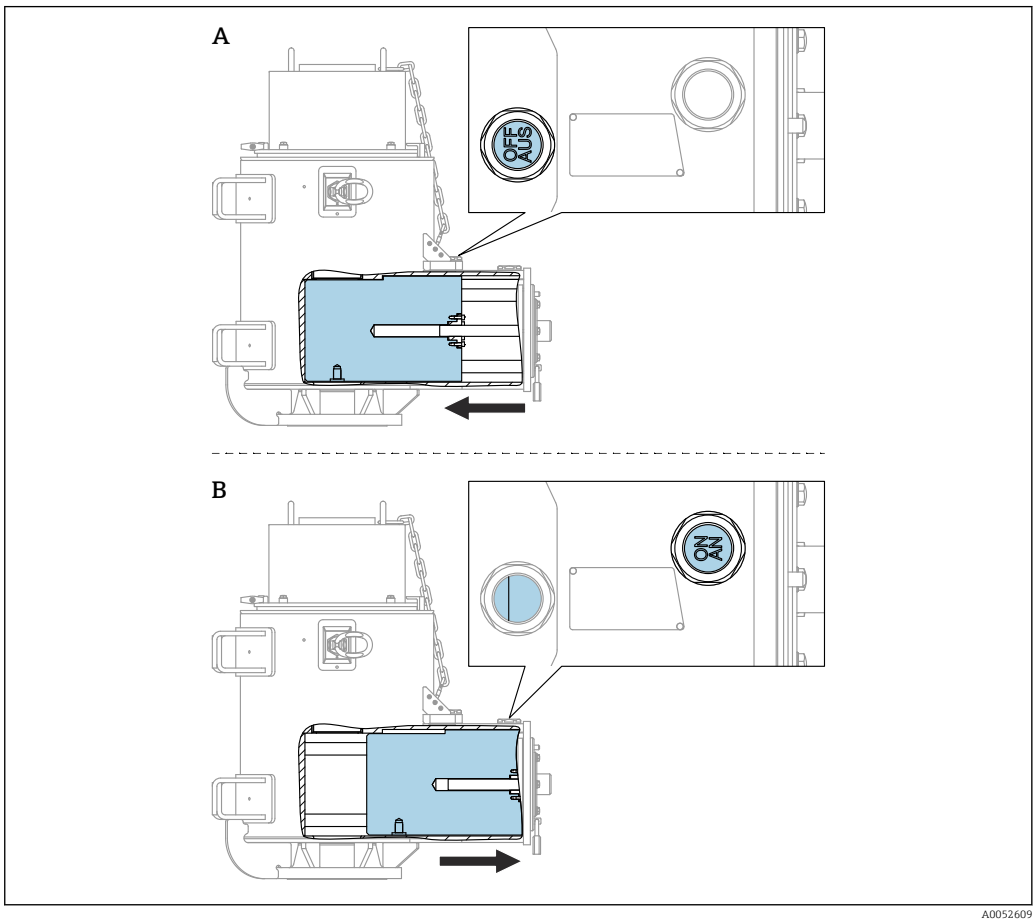
The anti-theft protection does not meet the requirements of DIN25422.

Alternative solutions to theft protection must be implemented in accordance with DIN25422.

For example, by securing the installation site.

Operability

Operation concept



A "OFF/AUS" switch position: switched-off state
B "ON/AN" switch position: switched-on state

Switching on and off

For additional information about switching the device on and off, refer to the operating instructions

Ordering information

Ordering information

Detailed ordering information is available from your nearest sales organization www.addresses.endress.com or in the Product Configurator at www.endress.com :

1. Click Corporate
2. Select the country
3. Click Products
4. Select the product using the filters and search field
5. Open the product page

The Configuration button to the right of the product image opens the Product Configurator.

Product Configurator - the tool for individual product configuration
- Up-to-the-minute configuration data
- Depending on the device: Direct input of measuring point-specific information such as measuring range or operating language
- Automatic verification of exclusion criteria
- Automatic creation of the order code and its breakdown in PDF or Excel output format
- Ability to order directly in the Endress+Hauser Online Shop

Scope of delivery

- Source container FQG74
- FSG60 radiation source (built-in; depending on the variant)
- Radiation symbol (depends on specific version)
- Accessories enclosed:
  - Cable extensions (number depending on characteristic 100)
  - Radiation warning sign
  - Optional: Mounting flange
- Documentation:
  - Operating Instructions
  - Type A acceptance certificate and certificate of suitability for Type A
  - Copy of the recognition of the quality assurance program for Type A
  - Instructions for installing the anchor points
  - Optional: Wipe test certificate
  - Optional: Dose rate diagram

Delivery

Germany

Delivery conditions (mainland only):
- Radiation sources can only be delivered upon presentation of a handling permit (copy)
- Source containers are always supplied with built-in radiation sources
  - The source container is in the "OFF/AUS" position when delivered
  - The "OFF/AUS" switch position is secured by a lock
- If the operator requests advance delivery of the source container and subsequent delivery of the radiation sources, the radiation sources will then be delivered in a transportation cask

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

Contact the Endress+Hauser sales organization

Other countries

Export conditions:
- Radiation sources can only be delivered upon presentation of an import license (copy)
- Radiation sources are delivered in source containers
  - The source container is in the "OFF/AUS" position when delivered
  - The "OFF/AUS" switch position is secured by a lock
- The source containers loaded with the radiation sources are transported by a company commissioned by Endress+Hauser and officially certified to perform this type of transportation work.
  Following successful testing, source container FQG74 is suitable for shipment as a Type A package (IATA rules) for radiation sources.

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

Contact the Endress+Hauser sales organization

Accessories

The following accessories are to be provided by the customer:
- Seal
- Connecting flange (ANSI 6" 150 lbs)
- Double-walled protection pipe; inner protection pipe separable

Documentation

The following document types are available in the Downloads area of the Endress+Hauser website (www.endress.com/downloads):

For an overview of the scope of the associated Technical Documentation, refer to the following:
- *Device Viewer* (www.endress.com/deviceviewer): Enter the serial number from the nameplate
- *Endress+Hauser Operations app*: Enter serial number from nameplate or scan matrix code on nameplate.

Operating Instructions (BA)

Your reference guide
These Operating Instructions contain all the information that is required in various phases of the life cycle of the device: from product identification, incoming acceptance and storage, to mounting, connection, operation and commissioning through to troubleshooting, maintenance and disposal.

Supplementary documentation

FQG74 Operating Instructions

BA02361F

FQG74 Operating Instructions (source magazine can be lowered)

BA02365F

FMG50 Operating Instructions

BA01966F

FMG50 Technical Information

TI01462F

FSG60/FSG61 radiation source Technical Information

TI00439F

Special Documentation: Type A

SD00311F

Technical Information for attachment points (RUD PP-B-1.5t-M16)

Technical information is available via the manufacturer's homepage:

https://www.rud.com

Special Documentation: Returning source containers

Detailed description for returning source containers, radiation sources:

SD00309F

Special Documentation: Loading, unloading and replacing radiation sources

SD03325F

Type A certificate of suitability

This source container is suitable as a type A package. The certificate of suitability and the approval of the German supervisory authority for the quality assurance program for the development and production of type A shipping packaging are available via the *Device Viewer* (www.endress.com/deviceviewer).

These are an integral part of the Operating Instructions.

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