Technical Information
Gamma radiation source FSG60, ^{137}Cs and FSG61, ^{60}Co

Radiometric level measurement

For level, point level, density and interface measurement

Application

Radioactive gamma-emitting isotopes are used as radiation sources for level, density and interface measurement as well as for point level detection.

The gamma radiation radiates evenly from the radioactive source in all directions. For radiometric measurements, however, only radiation in one direction - i.e. the radiation passing through the container or pipe - is of interest. The radiation in all other directions is undesired and must be shielded off (attenuated).
For this reason, the radioactive sources are inserted into source containers, which ensure practically unattenuated gamma radiation in one direction only.

Your benefits

- Point source in source container ensures simple handling and easy installation
- Double-walled source capsule complies with the strictest safety requirements: typical classification 66646 according to ISO2919
- Choice of isotope (^{137}Cs or ^{60}Co) and activity ensures optimized dosage for your application.

Endress+Hauser
People for Process Automation

Table of contents

Gamma radiation source

Safety

The radioactive isotopes, both ^{137}Cs and ^{60}Co, are sealed in double-walled, welded stainless steel capsules. The ruggedness of the radiation sources is classified according to DIN 25426, Part 1 or ISO 2919. Classification C 66646 provides maximum protection against temperature, pressure, impact, vibrations and puncture.

Class	Test				
	Temperature	**Pressure**	**Impact**	**Vibrations**	**Puncture**
1	Not tested	Not tested	Not tested	Not tested	Not tested
2	▪ -40 °C (-40 °F) (20 min) ▪ +80 °C (+176 °F) (1h)	25 kPa	50 g (1.764 oz) from height of 1 m (3.3 ft)	3 x 10 min ▪ 25 to 500 Hz at 5 g (0.176 oz) acceleration amplitude	1 g (0.035 oz) from height of 1 m (3.3 ft)
3	▪ -40 °C (-40 °F) (20 min) ▪ +180 °C (+356 °F) (1h)	25 kPa_{abs} to 2 MPa_{abs}	200 g (7.054 oz) from height of 1 m (3.3 ft)	3 x 10 min ▪ 25 to 50 Hz at 5 g (0.176 oz) acceleration amplitude, ▪ 50 to 90 Hz at 0.635 mm (0.03 in) deflection amplitude, ▪ 90 to 500 Hz at 10 g (0.353 oz) acceleration amplitude	10 g (0.353 oz) from height of 1 m (3.3 ft)
4	▪ -40 °C (-40 °F) (20 min) ▪ +400 °C (+752 °F) (1h) and thermal shock from +400 °C (+752 °F) to +20 °C (+68 °F)	25 kP_{abs} to 7 MPa_{abs}	2 kg (4.41 lbs) from height of 1 m (3.3 ft)	3 x 30 min ▪ 25 to 80 Hz at 1.5 mm (0.06 in) deflection amplitude, ▪ 80 to 2000 Hz at 20 g (0.705 oz) acceleration amplitude	50 g (1.764 oz) from height of 1 m (3.3 ft)
5	▪ -40 °C (-40 °F) (20 min) ▪ +600 °C (+1112 °F) (1h) and thermal shock from +600 °C (+1112 °F) to +20 °C (+68 °F)	25 kPa_{abs} to 70 MPa_{abs}	5 kg (11.03 lbs) from height of 1 m (3.3 ft)	-	300 g (10.581 oz) from height of 1 m (3.3 ft)
6	▪ -40 °C (-40 °F) (20 min) ▪ +800 °C (+1472 °F) (1h) and thermal shock from +800 °C (+1472 °F) to +20 °C (+68 °F)	25 kPa_{abs} to 170 MPa_{abs}	20 kg (44.10 lbs) from height of 1 m (3.3 ft)	-	1 kg (2.21 oz) from height of 1 m (3.3 ft)

The manufacturer tests the leak-tightness and decontamination of each radiation source before delivery. After this test, the radiation source can be considered as a sealed radioactive source as defined in the Radiation Protection Regulation. Only tested radiation sources with a leak test certificate are supplied.

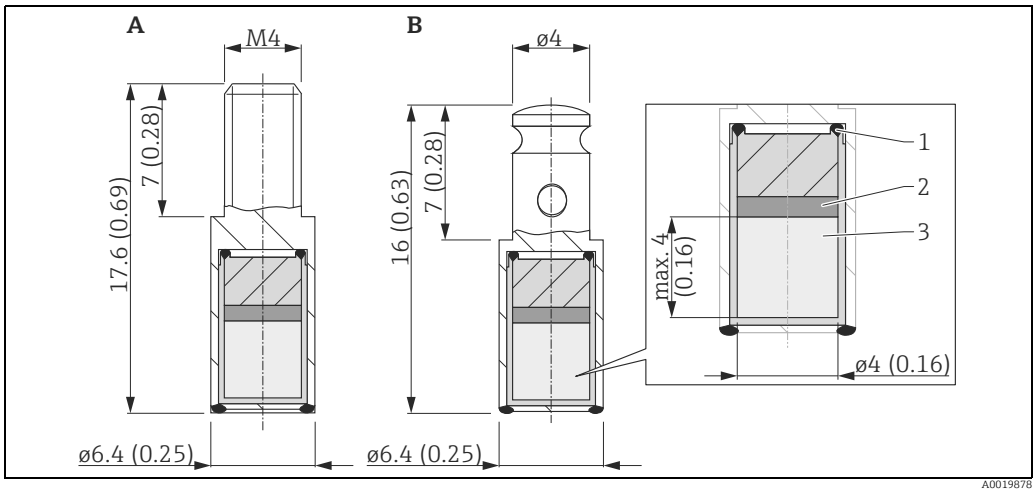
- The ^{60}Co is enclosed in the capsule as a solid metal.
- The ^{137}Cs is enclosed in the capsule in the form of a ceramic substrate.

NOTICE

The radiation sources may only be used in environmental conditions that guarantee the tightness and integrity of the capsule.

Technical data

Standard radiation source



Dimensions: mm (in)

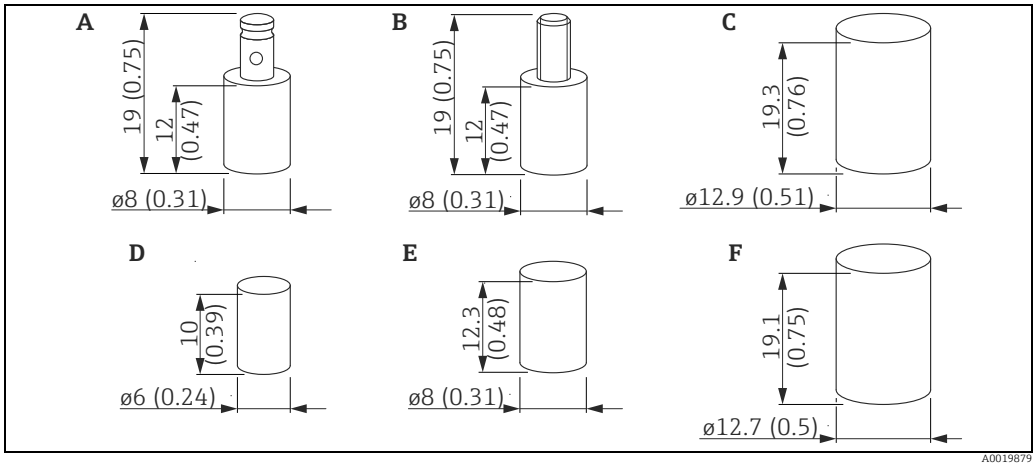
Examples
A VZ1508-001 (CDC.P4), VZ1486-001 (CKC.P4)
B VZ79-001 (CDC.P4), VZ64-001 (CKC.P4)

1 Argon-arc welded
2 Empty volume filled with stainless steel screen
3 ^{60}Co as metal or ^{137}Cs as ceramic

- Weight: approx. 0.005 kg
- Double encapsulation: 2 welded stainless steel capsules
- Classification typically C66646 according to ISO 2919 or DIN 25426, Part 1
- Degree of protection: IP68
- Operating temperature range:
  - VZ64-001, VZ79-001, VZ1508-001, VZ1486-001, VZ357-001, VZ3579-001, P17, P17-1: -55 to +400 °C[1)] (-67 to +752 °F)
  - IGI-Z-3, IGI-Z-4: -60 to +150 °C (-76 to +302 °F)
  - X.9, X.38/4: -40 to +200 °C (-40 to +392 °F)

  Other capsule types on request.
- Isotope material:
  - ^{60}Co: metal
  - ^{137}Cs: ceramic
- Radiation energy:
  - ^{60}Co: 1.173 MeV and 1.333 MeV
  - ^{137}Cs: 0.662 MeV

Alternative source capsule types



Dimensions: mm (in)

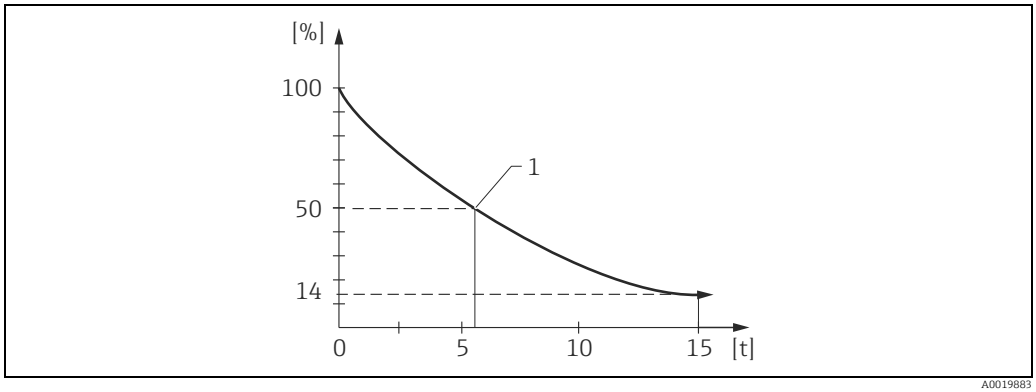
A VZ357-001
B VZ3579-001
C X.38/4
D IGI-Z-3
E X.9 (CDC.93), IGI-Z-4
F P17, P17-1

1) US version (NRC license) limited to +200 °C (+392 °F)

Application

When to use ^{60}Co?

Decline in activity of a ^{60}Co radiation source over time



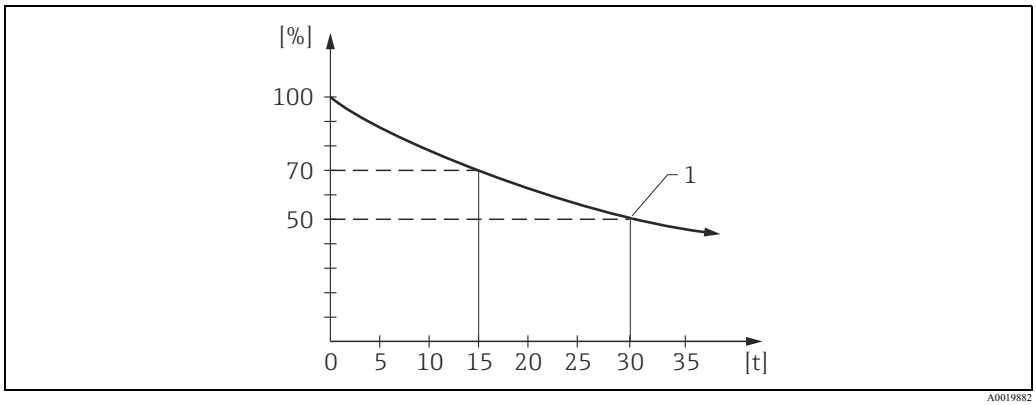
% Activity
t Time in years
1 Half-life 5.3 years

The ^{60}Co radiation source (radiation energy 1.173 and 1.333 MeV; half-life 5.3 years) is mostly used for point level measurement if the activity required by ^{137}Cs is too high. Its advantage lies in its high penetration capacity, which enables measurement over large distances or through thick container walls. The ^{60}Co source should also be used for continuous level measurements if the use of ^{137}Cs would require activities that are too high.

Example:
Remaining activity after 15 years of operation: 14% → replacement of radiation source is required.

When to use ^{137}Cs?

Decline in activity of a ^{137}Cs radiation source over time

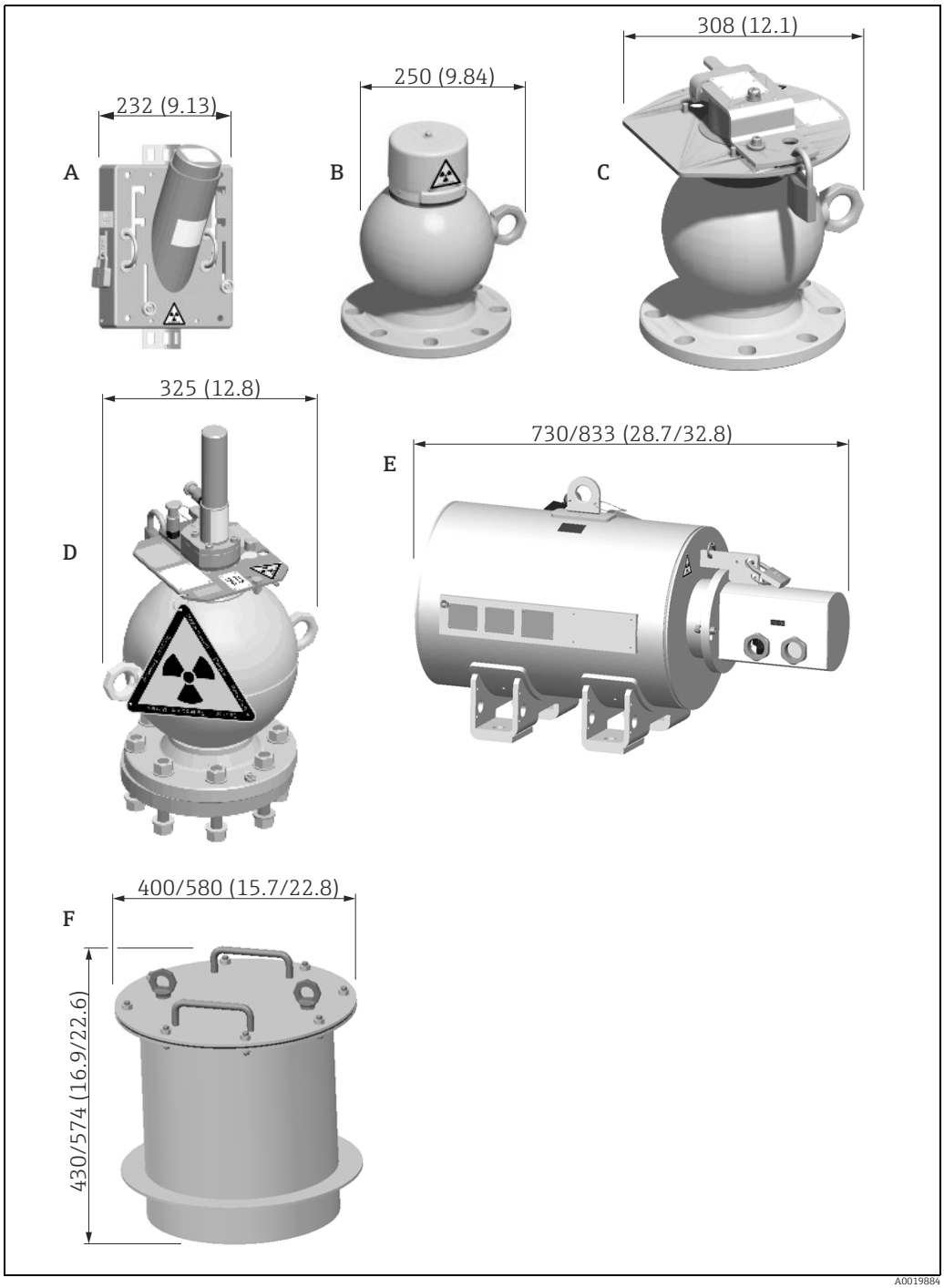


% Activity
t Time in years
1 Half-life 30 years

The ^{137}Cs source (radiation energy 0.662 MeV) is ideal for continuous level measurement, point level detection and density measurement systems. Its long half life (30 years) ensures a long operation time without the need for costly source replacement or subsequent recalibration. As the radiation is readily absorbed, there is generally no control zone.

Example:
Remaining activity after 15 years of operation: 70% → no replacement of radiation source is required.

Delivery and transportation of the gamma radiation source in source containers or transportation casks



A	*FQG60*	*C*	*FQG62*	*E*	*FQG66*
B	*FQG61*	*D*	*FQG63*	*F*	*Transportation cask T40/T75/T110*

For additional information, see:
- FQG60, TI00445F/00 "Mechanical construction" section
- FQG61, FQG62, TI00435F/00 "Mechanical construction" section
- FQG63, TI00446F/00 "Mechanical construction" section
- FQG66, TI01171F/00 "Mechanical construction" section
- Transportation cask T40/T75/T110, SD01316F/00 "Delivery of a loaded transportation cask" section

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 center. For safety reasons and to save costs, we usually supply the source container loaded, i.e. with the radiation source installed. If the user requires the source container to be delivered first and if the source must be delivered subsequently, transportation casks are used for shipping.
Other countries	We can only ship radioactive sources once we have received a copy of the import license. Endress+Hauser is more than happy to assist in procuring the necessary documents. Please contact your local sales center. Radioactive sources must be installed in the source container for delivery abroad. The source container is in the "OFF" position when the container is delivered. This switch position is secured by a lock. The loaded source containers are transported by a company commissioned by Endress+Hauser and officially certified to perform this type of transportation work. Following successful testing, all FQG6x source containers are suitable as a Type A package (IATA regulations) for the radiation source.

What to do in an emergency

Objective and overview

In the interests of protecting personnel, the emergency procedure described here must be put into effect immediately to secure an area where an exposed radiation source is known, or suspected, to exist.
An emergency exists if a radioisotope has escaped from the source container or if the source container cannot be set to the "OFF" position.
The procedure is designed to safeguard persons affected until the competent radiation safety officer can attend the site and advise on corrective action.
The custodian of the radioactive source (i.e. the customer's designated "authorized person") is responsible for observing this procedure.

Emergency action

1. Determine the unsafe area by on-site measurement.
2. Cordon off the affected area with yellow tape or rope and post international radiation warning signs.

The source container cannot be switched to the "AUS - OFF" position

See the "What to do in an emergency" section of the Technical Information:
- TI00445F/00 (FQG60)
- TI00435F/00 (FQG61, FQG62)
- TI00446F/00 (FQG63)
- TI01171F/00 (FQG66)

The radiation source has escaped from the source container

In this case, the radiation source must be kept secure in another location or additional screening must be provided. The radiation source should only be handled using tongs or a gripper and held as far away from the body as possible. The time needed for the transport should be estimated and minimized by rehearsing without a radiation source prior to execution.

⚠ WARNING

High-level nuclear radiation

▸ Observe radiation protection regulations!

Notifying the competent authority

1. Pass on all the necessary information to the responsible local and national authorities immediately.
2. After a thorough assessment of the situation, the competent radiation safety officer must agree, together with the local authorities, on appropriate corrective measures for the problem.

National regulations may specify other procedures and reporting obligations.

Procedures after termination of the application

Internal measures

As soon as a radiometric measuring device is no longer required, the radiation source must be switched off at the source container. The source container must be removed in accordance with all relevant regulations and stored in a lockable room having no through-traffic. The competent authorities must be informed of these measures. The access area to the storage room must be measured and marked accordingly. 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.

⚠ CAUTION

Removal of the source container

- The source container may only be removed according to local regulations and/or the handling permit by certified, specially trained personnel whose radiation exposure is monitored. Ensure that this is allowed by the handling permit.
- All local conditions must be taken into consideration.
- All work should be carried out as quickly as possible and as far away as possible from the radiation source (screening!).
- Suitable measures (e.g. blocking of access) must be taken to protect other individuals from all possible risk.
- The source container may only be removed if the radiation is switched off.
- Make sure that the OFF position is secured with a padlock.

Return

Federal Republic of Germany

Contact your Endress+Hauser sales center to organize the return of the radiation source for inspection with a view to reuse or recycling by Endress+Hauser.

Other countries

Contact your Endress+Hauser sales center or the appropriate authority to find a way of returning the radiation source domestically. If it is not possible to return the device domestically, the next steps to be taken must be agreed with the Endress+Hauser sales center/representative concerned. The destination airport for returns is
Frankfurt, Germany.

Conditions

If necessary, Endress+Hauser will provide a suitable container for return transportation.

The following conditions must be met before returning the material:

- An inspection certificate no more than three months old and confirming the leak-tightness of the radioactive source must be submitted to Endress+Hauser (wipe test certificate).
- The serial number of the source capsule, type of radiation source (^{60}Co or ^{137}Cs), activity and model of the radiation source must be specified. These data can be found in the documents that were supplied with the radiation source.
- There must be no signs of corrosion on the container, particularly at the welded seams.
- The container must not be damaged in any way.
- ON/OFF mechanism must be corrosion-free and must function properly.
- Source containers must be shipped in the OFF position.
- For shipment, the source holder must be put in the OFF position and secured with a lock.

The Type A labeling on the radiation source container itself is, however, no longer valid for any subsequent device returns.

Information regarding Type A packages

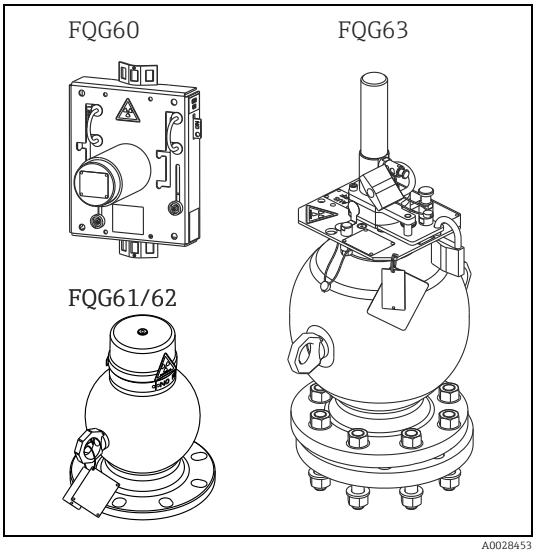
FQG60, FQG61, FQG62, FQG63

Material:
- FQG60: see TI00445F/00
- FQG61/62: see TI00435F/00
- FQG63: see TI00446F/00

Dimensions (L x B x H):
- FQG60
  349 x 232 x 197 mm (13.7 x 9.13 x 7.76 in)
- FQG61/62:
  ø220 x 362 x 500 (8.66 x 14.3 x 19.7 in)
- FQG63:
  ø232 x 325 x 540 mm (9.13 x 12.8 x 21.3 in)

Weight:
- FQG60 max. 18 kg (39.69 lbs)
- FQG61: max. 46 kg (101.43 lbs)
- FQG62: max. 90kg (198.45 lbs)
- FQG63 max. 105 kg (231.53 lbs)

Additional information → SD00309F/00



A0028453

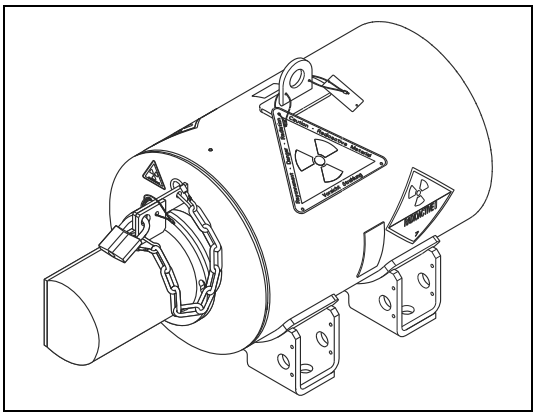
FQG66

Material:
- 316L (1.4404)

Dimensions (L x B x H):
- Manual version
  730 x 345 x 456 mm (28.7 x 13.6 x 18 in)
- Manual version with proximity switch or pneumatic version
  833 x 390 x 456 mm (32.8 x 15.4 x 18 in)

Weight: max. 435 kg (959.18 lbs)

Additional information → SD00309F/00


A0028444

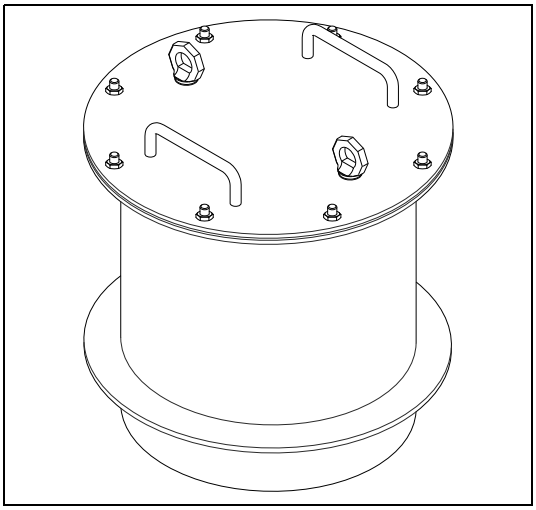
Transportation cask for radioactive sources

Material
- 304 (1.4301)
- PUR 2K texture paint RAL1003

Dimensions:
- Transportation cask T40:
  ø400 mm (15.7 in), H = 430 mm (16.9 in)
- Transportation cask T75/T110:
  ø580 mm (22.8 in), H = 574 mm (22.6 in)

Weight:
- Transportation cask T40:
  max. 75 kg (165.38 lbs)
- Transportation cask T75/T110:
  max. 175 kg/300 kg (385.88 lbs/661.5 lbs)

For additional information, refer to SD01316F/00


A0022736

Examples of Type A packages

For additional information, refer to SD00311F/00

Information regarding secondary packaging upon delivery

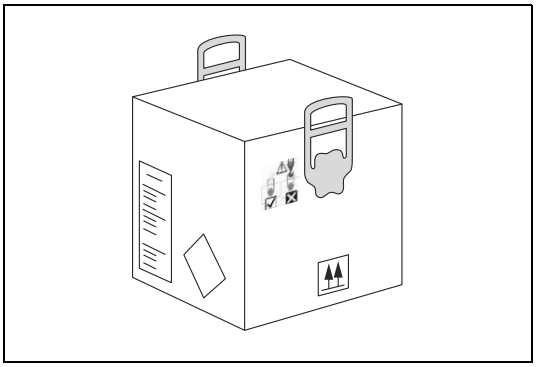
FQG60

Material:
- Cover: corrugated cardboard 2.91

Dimensions:
- 360 x 360 x 260 mm (14.2 x 14.2 x 10.2 in)

Weight: max. 1.1 kg (2.43 lbs)

Dimensions: L x B x H



A0028443

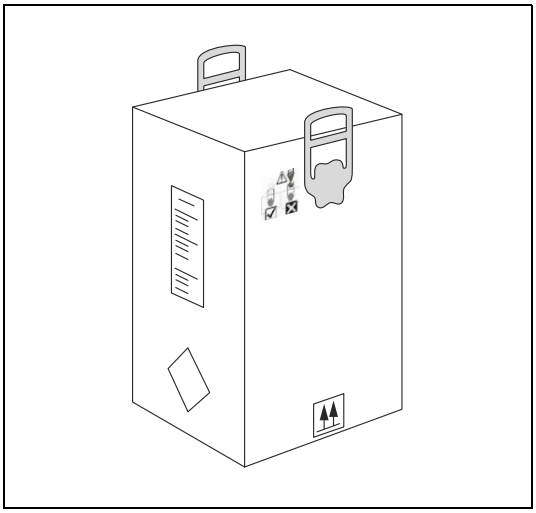
FQG61, FQG62, FQG63

Material:
- Cover: corrugated cardboard 2.91

Dimensions:
- 360 x 360 x 580 mm (14.2 x 14.2 x 22.8 in)

Weight: max. 1.54 kg (3.40 lbs)

Dimensions: L x B x H



A0028442

FQG66

Secondary packaging for loaded/unloaded containers

Material
- Special pallet: wood (spruce), heat-treated according to IPPC
- Cover: corrugated cardboard 2.91

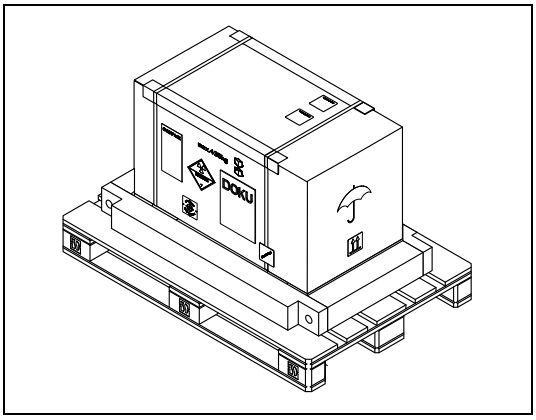
Dimensions:
- 1200 x 800 x 800mm (47.2 x 31.5 x 31.5 in)

Weight: 58,3 kg (128.55 lbs)

- Fixed with strap
- Dimensions: L x B x H

CAUTION

The cardboard packaging is an outer, secondary packaging and does not replace Type A packaging.



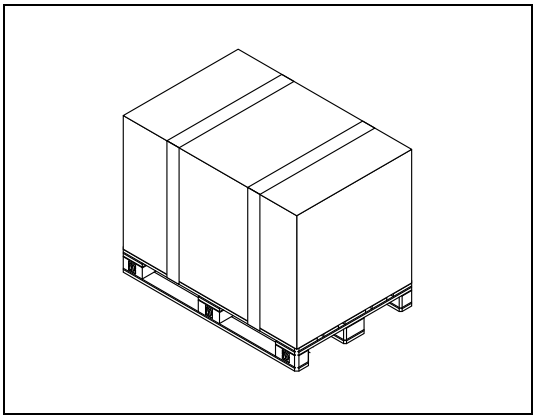
A0043291

Seaworthy secondary packaging

Material
- Special pallet: wood (spruce), heat-treated according to IPPC
- Cover
  - inside: corrugated cardboard 2.91
  - outside: wood (spruce), heat-treated according to IPPC

Dimensions:
- 1200 x 800 x 870mm (47.2 x 31.5 x 34.3 in)

Weight: 95.3 kg (210.14 lbs)



A0042722

- Fixed with strap
- Dimensions: L x B x H

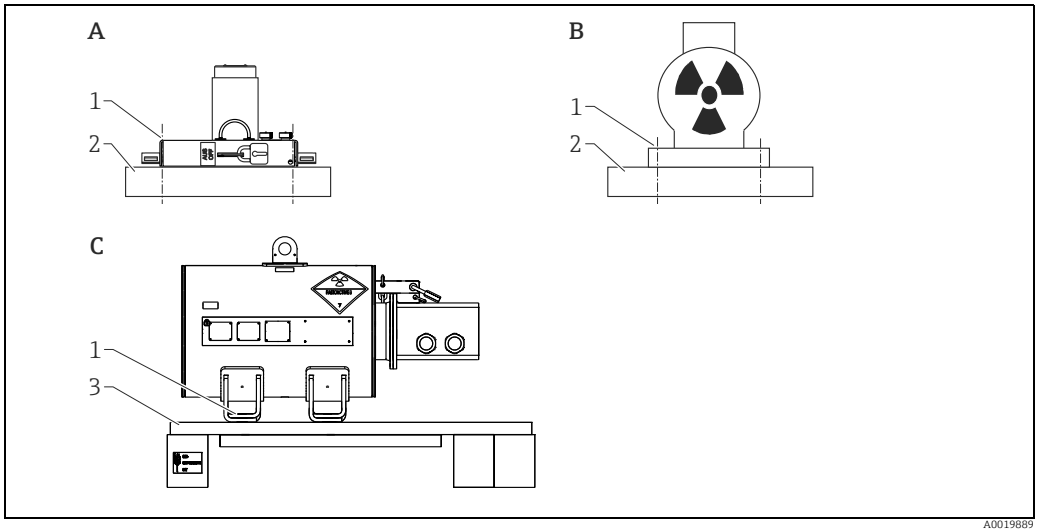
CAUTION

The packaging is an outer, secondary packaging and does not replace Type A packaging.

Packaging and shipment when returning the product

General

Refer to SD00309F/00.
These source containers meet the requirements of a Type A package and therefore do not require separate Type A packaging. However, it is preferable to use the return packaging kits and labeling kits for return transportation.



A FQG60
B FQG61, FQG62, FQG63
C FQG66
1 Fastened with 4 screws and nuts
2 Base plate
3 Special plate

Ordering information

Ordering information

Detailed ordering information is available as follows:
- In the Product Configurator on the Endress+Hauser website: www.endress.com → Select country → Instruments → Select device → Product page function: Configure this product
- From your Endress+Hauser Sales Center: www.endress.com/worldwide

Product Configurator - the tool for individual product configuration
- Up-to-the-minute configuration data
- Depending on the device: direct input of information specific to the measuring point, 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

Supplementary documentation

Source container FQG60	▪ TI00445F/00 Technical Information and Operating Instructions for source container FQG60
Source containers FQG61/ FQG62	▪ TI00435F/00 Technical Information and Operating Instructions for source containers FQG61 and FQG62
Source container FQG63	▪ TI00446F/00 Technical Information and Operating Instructions for source container FQG63
Source container FQG66	▪ TI01171F/00 Technical Information for source container FQG66 ▪ BA01327F/00 Operating Instructions for source container FQG66
Additional safety instructions	▪ SD00142F/00 Supplementary instruction manual for radiation sources and source containers that are approved for use in Canada (in English). ▪ SD00292F/00 Supplementary instruction manual for Canada ▪ SD00293F/00, SD00313F/00, SD00335F/00, SD01561F/00 Supplementary instruction manual for the United States ▪ SD00297F/00 Instructions for loading and changing the source ▪ SD00276F/00 Supplementary instruction manual for the United States, particularly for QG020/100 and QG2000 ▪ SD00309F/00 Special Documentation for the return of source containers and gamma radiation sources

Manufacturer Declaration for the Acceptance of Returned Radiation Sources

Herstellerbescheinigung
Manufacturer Declaration

Endress+Hauser
People for Process Automation

Company **Endress+Hauser SE+Co. KG, Hauptstrasse 1, 79689 Maulburg**

erklärt als Hersteller, dass das folgende Produkt
declares as manufacturer, that the following product

Product

BESTÄTIGUNG DER RÜCKNAHME VON DOPPELT UMSCHLOSSENEN STRAHLENQUELLEN

REACCEPTANCE CONFIRMATION OF DOUBLE ENCAPSULATED RADIOISOTOPES

Hiermit wird bestätigt, dass eine Rücknahme von Strahlenquellen zum Zweck der Prüfung auf Wiederverwendung/ Verwertung von Endress + Hauser SE+Co. KG (im weiteren Verlauf wie folgt abgekürzt: E+H LP), basierend auf der aktuell gültigen Ausgabe der Strahlenschutzverordnung der Bundesrepublik Deutschland, zu den folgenden Bedingungen erfolgen kann:

- E+H LP wird nur Strahlenquellen annehmen, die von E+H LP geliefert wurden und die vom Kunden nicht weiterverwendet werden. Die Strahlenquellen müssen im Originalzustand und unbeschädigt sein.
- Ein Abnahmeprüfzeugnis, dass nicht älter als 3 Monate ist und die Dichtigkeit der Strahlenquellen bestätigt, muss E+H LP vorliegen (Wisch-Test-Zertifikat).
- Alle Strahlenquellen-Daten müssen angegeben werden (diese Daten finden sich in den Dokumenten, die mit der Strahlenquelle mitgeliefert wurden). Das sind, Serien-Nummer, Type der Strahlenquelle (Co60 oder Cs137) Aktivität und Bauart.
- Die Rücksendung muss in einem zugelassenen Schutzbehälter zur einfachen Manipulation und in einer typgeprüften Typ-A-Verpackung (IATA-Regeln) sowie nach geltenden Gefahrgutvorschriften erfolgen.
- Alle Transportkosten und die aktuellen Bearbeitungskosten sind vom Kunden zu tragen, (Luftfracht ist unabdingbar). Angebot über aktuelle Preise und Kosten auf Anfrage.
- Der Bestimmungsflughafen für die Rücksendung ist Frankfurt (IATA: FRA), Deutschland. Zu benachrichtigen ist Endress + Hauser SE + Co., 79689 Maulburg, Deutschland.
- Die Strahlenquelle geht mit der Rücknahme wieder in den Besitz von E+H LP über.

This is to confirm that Endress + Hauser SE+Co. KG (further abbreviated as follows: E+H LP) will take back radioisotopes for their check of re-use/utilization, based upon the regulation for radiation protection of the F.R.G. (Strahlenschutzverordnung der B.R.D.), valid version, and on the following conditions:

- E+H LP will only accept radioisotopes supplied by E+H LP, which the customer no longer requires. The radioisotopes must be original and undamaged.
- An inspection certificate not older than 3 month verifying non-leakage of the radioisotope must be submitted to E+H LP (wipe test certificate).
- All source-specific data must be stated (this data is supplied in the documents furnished with the source) i.e. serial number, isotope type (Cs137 or Co60), activity and design type.

HE_01270_02.20 1/2

Herstellerbescheinigung
Manufacturer Declaration

Endress+Hauser
People for Process Automation

- The return has to be in Type-A certified transport package (IATA regulations) in an approved Gamma Ray protective container for the easy manipulation.
- The cost for all transportation and the actual cost for the processing are to be borne by the customer (air shipment is obligatory). Quotation on actual prices/cost on request.
- The Airport of Destination for the shipment must be Frankfurt Airport , F.R. Germany, notify Endress + Hauser SE + Co., D – 79689 Maulburg , F. R. Germany.
- The radioisotopes will then once again become the sole property of E+H LP.

Maulburg, 7-September-2020
Endress+Hauser SE+Co. KG

i.A. Dr. Armin Hummelbrumm
Group Leader Product Safety
Research & Development

HE_01270_02.20 2/2

Source Container Certificate of Suitability

Eignungsbescheinigung
Manufacturer Declaration

Endress+Hauser
People for Process Automation

Company **Endress+Hauser SE+Co. KG, Hauptstraße 1, 79689 Maulburg**

erklärt als Hersteller, dass das folgende Produkt
declares as manufacturer, that the following product

Product **Strahlenschutzbehälter/ Radiation Source Container**
Typ FQG60, FQG61, FQG62, FQG63, FQG66

den Anforderungen über die internationale Beförderung gefährlicher Güter ADR/RID (2020) und IATA/DGR (2020) an ein Typ A Versandstück entspricht. Die Strahlenschutzbehälter sind für den Transport von umschlossenen radioaktiven Stoffen und von umschlossenen radioaktiven Stoffen in besonderer Form vorgesehen.

Die Eignung als Typ A Versandstück wurde durch eine Baumusterprüfung nach den Anforderungen von IAEA-TS-R-1 (2005) Kapitel 6 nachgewiesen und in den internen Dokumenten 961000072, 960009590, 961000169, 961000170 niedergelegt.

Die Qualitätssicherung während der Entwicklung, der Herstellung und der Prüfung der Strahlenschutzbehälter erfolgt gemäß BAM-GGR016 Rev. 0 vom 10. Nov. 2014. Der Ablauf ist im Qualitätssicherungsprogramm für Typ A Versandstücke (Dokumenten-ID GL_0372) beschrieben

confirms the requirements on international transportation of hazardous materials ADR/RID (2020) and IATA/DGR (2020) for Type A packaging and is suitable for the transportation of sealed radioactive material and sealed special form radioactive material.

The qualification as type A packaging is tested by an type approval according to IAEA-TS-R-1 (2005) section 6 and documented by the internal reports 961000072, 960009590, 961000169, 961000170.

The quality management during development, manufacturing and testing of the source containers is following the requirements of TRV006 and BAM-GGR016 Rev. 0 from 2014.Nov.10. It is described in the quality program for Type A packaging (document-ID GL_0372).

Maulburg, 4-März-2020
Endress+Hauser SE+Co. KG

i.A. Dr. Karl Barton
Gefahrgutbeauftragter
Safety advisor for the
transport of dangerous goods

HE_00042_03.20 1/1

A0037353

www.addresses.endress.com

Endress+Hauser

People for Process Automation