Technical
Information
TI 180F/00/en

Operating Instructions
017277-1000

Radiometric Measurement
DG 57 scintillation detectors

Non-contact, non-invasive measurement
Highest sensitivity with lowest source strength
Suitable for use in explosion hazardous areas

DG 57 scintillation detector
left: standard version
right: with water jacket

Application
The DG 57 scintillation detector is used together with a Gammapilot or Gammasilometer transmitter and a QG 020/100 source container for level, density or interface layer measurement as well as for limit level detection. It is available in several lengths and is specially equipped for the application at hand.

Features and Benefits
- Non-contact, non-invasive and reliable measurement independent of changing process conditions such as pressure, temperature, viscosity, corrosion or fittings such as stirrers
- For use with Gammapilot FTG 671, Gammasilometer FMG 573 and Gammasilometer FMG 671 (P) transmitters
- Highest sensitivity with the lowest source activities: requires a much smaller dose rate than point scintillators or ionisation chambers, but still guarantees excellent statistical accuracy, even for short time constants
- Active self-monitoring by reference measurement provides measurement security and ageing compensation
- Robust, withstands vibration
- Lengths from 100 mm for limit detection and density measurement to 2000 mm for level measurement
- No requirement for special cabling, two-core cable is sufficient!
- RFI given by redundant digital signal transmission (plausibility check)
- Backed up by many years experience: over 10000 units successfully measuring in all branches of industry

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Functional Description

Rod Scintillators

The use of a rod scintillator for detection of the gamma rays allows the lowest source strengths to be used for level, separation layer and density measurement as well as limit switching.

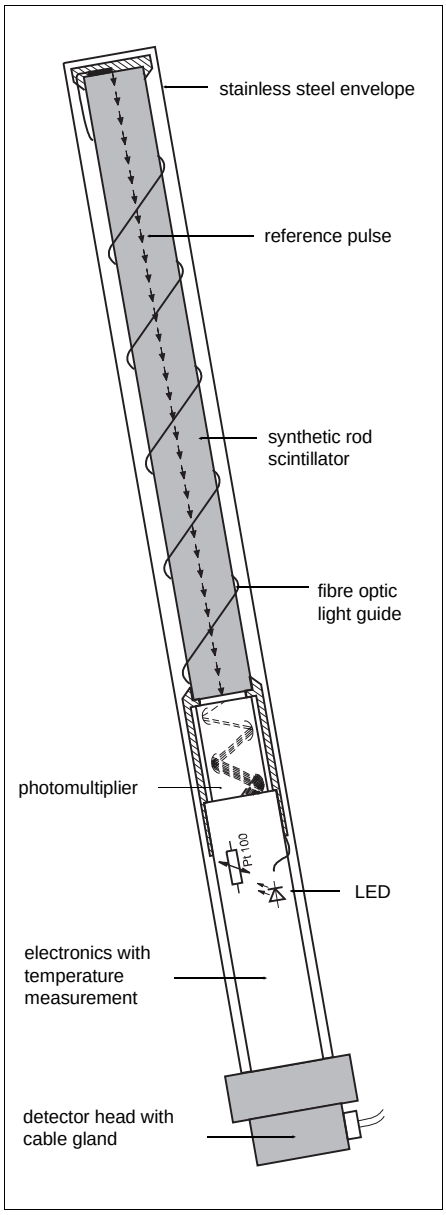
The detector comprises a rod scintillator, a photomultiplier and a control unit. The ionising radiation falling on the scintillator consists of individual particles, so-called γ-quanta. On entering the scintillator each particle is attenuated, thereby generating a tiny flash of light. A certain proportion of these flashes are picked up by the photocathode of the photomultiplier which is mounted on the face of the scintillator rod.

The photomultiplier multiplies the electrons released from the cathode, which are then converted into a voltage pulse. The signal processing unit then counts all signal pulses which lie above a pre-set threshold within a given time interval.

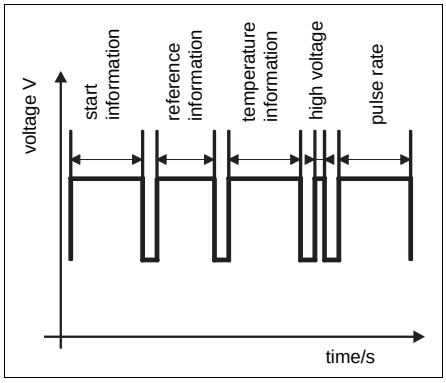
Reference Light Pulse

Before the start of every measuring cycle a reference light pulse is generated and transmitted through the fibre optic light guide to the head of the scintillator. The flash of light travels through the scintillator to the photomultiplier, where it is multiplied. In the converter stage it is coded into a data word which is then passed onto the transmitter.

The figure below shows the pulse diagram of the data word with its coded information. First to be transmitted is the self-monitoring information such as reference measurement (detector monitoring), temperature and high voltage supply of the photomultiplier, followed by the measurement information, i.e. the pulse rate. The same data word is transmitted twice every measurement cycle (2 x ca. 250 ms = 500 ms), allowing a plausibility check to be made.



Schematic diagram of DG 57 detector

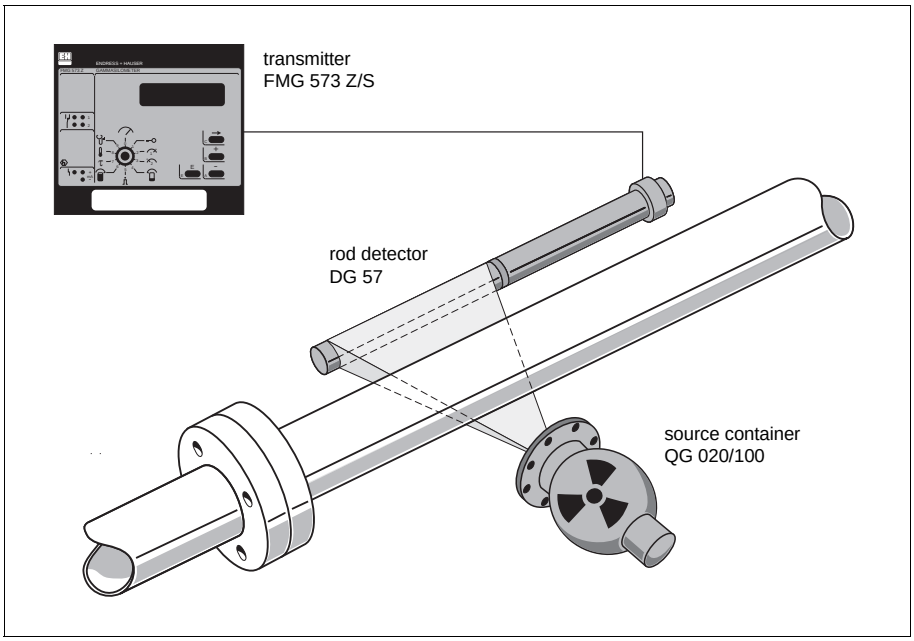


Schematic diagram of pulse signal

Self-Monitoring Circuit

In every measurement cycle, the reference pulse, temperature and pulse rate are passed to the transmitter over a two-core cable. A closed, active monitoring circuit checks the result and ensures that a message is immediately output if a detector module malfunctions. The reference pulse and temperature are used by the transmitter to compensate for temperature dependency and eliminate long-term drift.

Measuring System



Example of a measuring system: Density measurements

Sensitive Detection
DG 57 Scintillation detectors are so sensitive that the natural radiation to be found at an altitude of 3.000 m is higher than that required in a gamma typical application. Thanks to this high sensitivity, a high pulse rate is available for signal evaluation. This reduces statistical variations caused by physical effects from the source decay and ensures high measuring accuracy with lower time constants.

The strength (pulse rate) of the detector signal increases with the surface area of the detector. With a length of 2000 mm and a diameter of 48 mm the rod scintillator is extremely sensitive. For dense materials or for vessels of large diameter, the sensitivity can be doubled by connecting a second detector in parallel.

Measuring System
The measuring system comprises:

- Transmitter
  - Gammapilot FTG 671 for level limit detection or
  - Gammasilometer FMG 573 Z/S for density measurement
  - Gammasilometer FMG 671 and FMG 671 (P) for level and separation layer measurement
- Source container QG 020/100 with Co 60 or Cs 137 source
- Scintillation detector DG 57.

Minimum dose rate for different applications

Application	**Measuring length in mm**	**Local dose rate [μSv/h]**		**Sensitivity pulses/s per μSv/h**	
		Co 60	Cs 137	Co 60	Cs 137
Limit switching (Local dose rate dependent upon response time, attentuation by medium and projected service life)	100 400	0.2 0.1	0.1 0.05	910 2270	1560 3900
Density① and separation layer② (Local dose rate dependent upon density range to be measured, path and response time) Projected values apply always to min. density values (ρ min)	① 100 400 ② 400 : 2000	ca. 7.5 ca. 2.0...7.5	ca. 7.5 ca. 2.0...7.5	910 2270 **see level values**	1560 3900
Level (Local dose rate dependent upon response time and projected service life)	400 600 800 1000 1200 1500 2000	1.1 1.0 0.95 0.83 0.69 0.55 0.45	0.45 0.4 0.35 0.3 0.25 0.2 0.16	2620 3430 4070 4770 5410 6460 8150	4500 5900 7000 8200 9300 11100 14000

Installation

Level, Density and Interface Layer Measurement

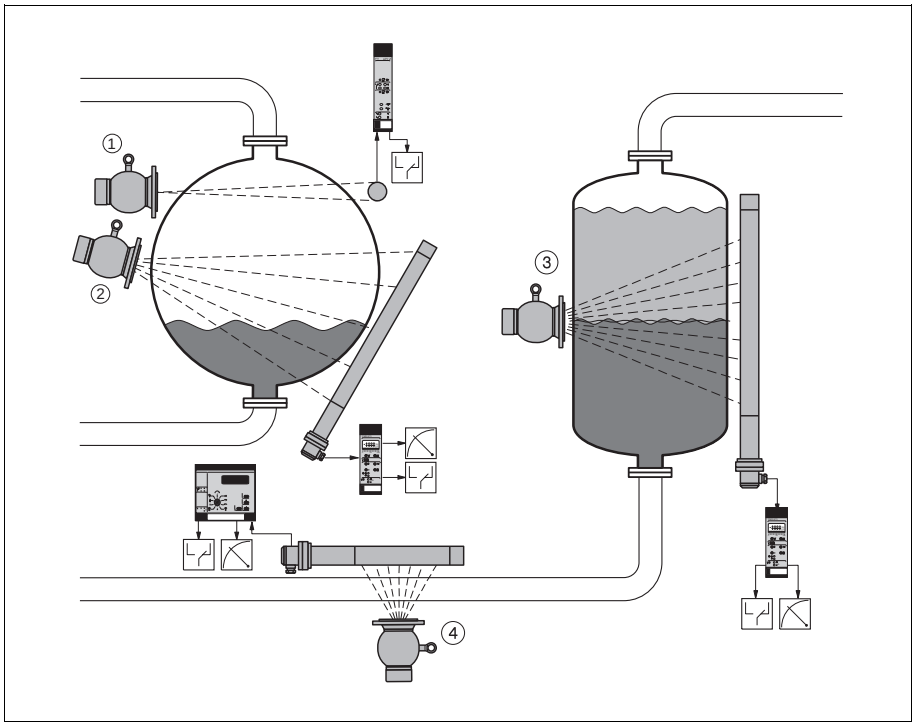
The DG 57 detector is delivered with mounting clamps and is usually installed vertically along the vessel wall.

- For measuring ranges greater than 2 m, two or more detectors must be connected in cascade
- When impacts and vibrations are to be expected, the measuring system should not be attached to the vessel.
- If the ambient temperature exceeds +50 °C (122 °F), install a detector with a water jacket.

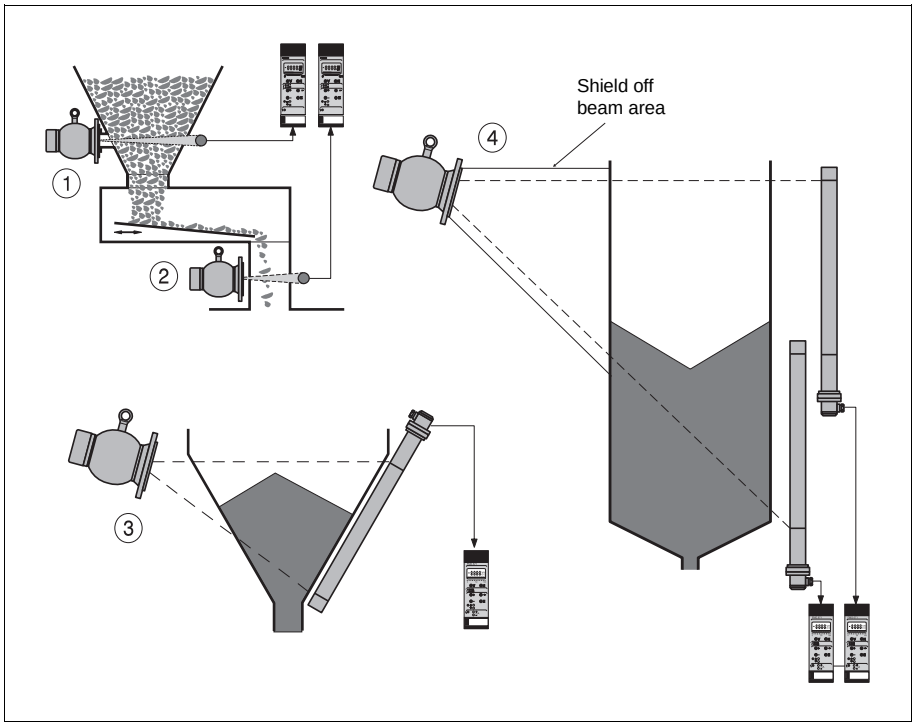
Limit Value Detection

For limit value detection, it is usual to mount the detector horizontally on the vessel wall.

- The DG 57/100 mm scintillation detector has been especially designed for this task



① Limit detection
② Continuous level measurement
③ Measurement of separation layers
④ Density measurement



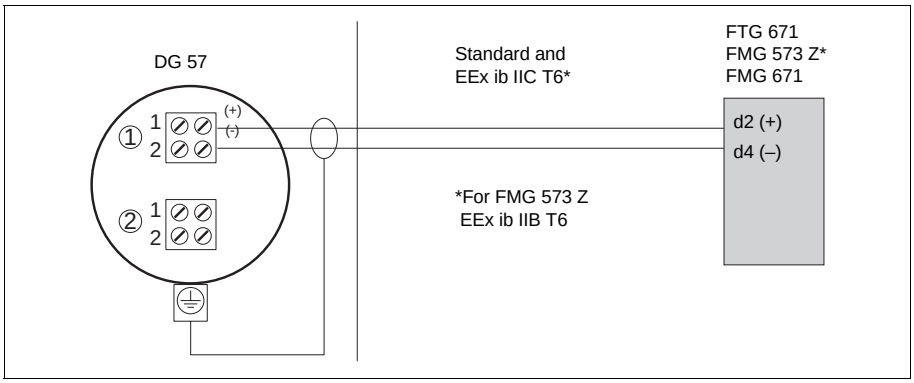
① Minimum limit detection
② Maximum limit detection
③ Level measurement (with head at top)
④ Level measurement with two detectors

Electrical Connection

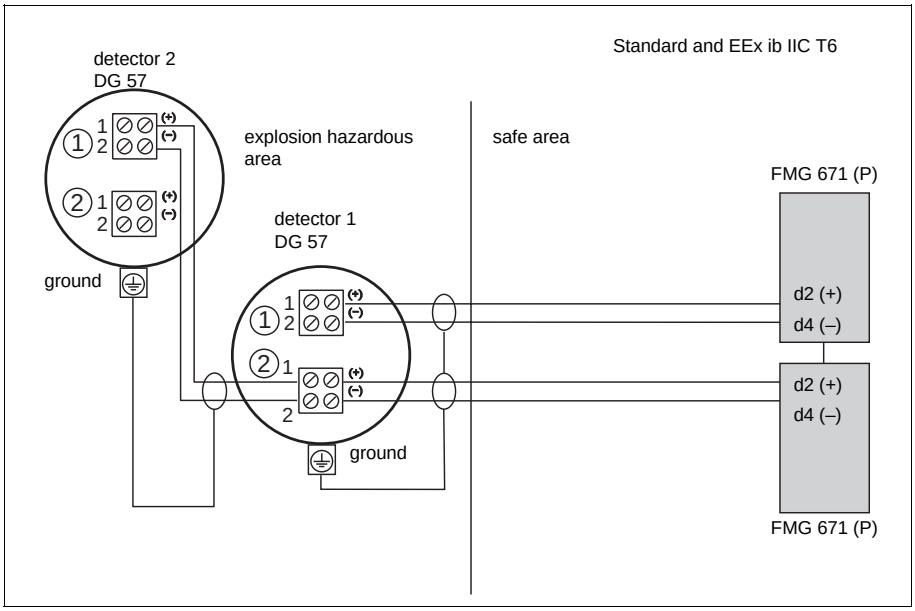
The DG 57 is connected to the FTG 671, FMG 671 (P) or FMG 573 Z/S transmitter by means of standard 2-core installation cable, max. resistance per core 25 Ω. The connection diagrams are shown below.

For the FMG 573 S:

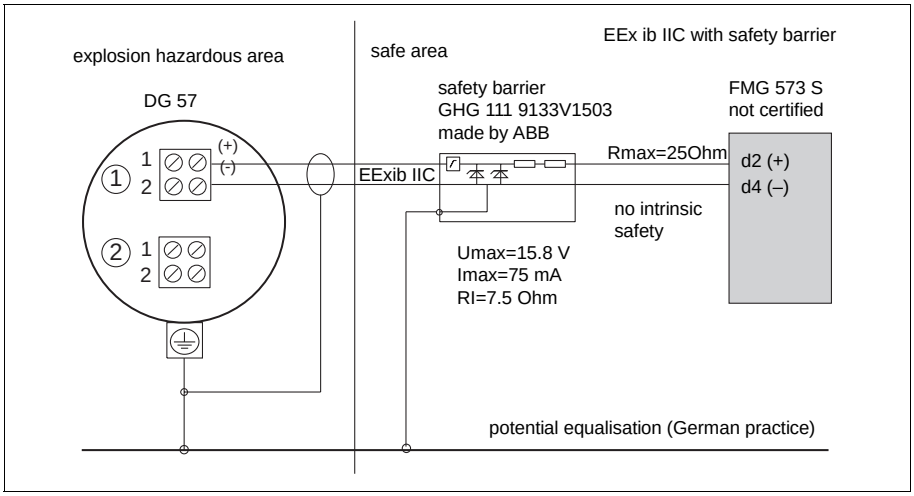
- explosion protection [EEx d ib] IIC is reached with a Zener barrier
- connections for density measurement with simultaneous temperature or flow measurement can be taken from the operating manual BA 107F.



Electrical connection for DG 57 – FTG 671 and DG 57 – FMG 573 Z and DG 57 – FMG 671

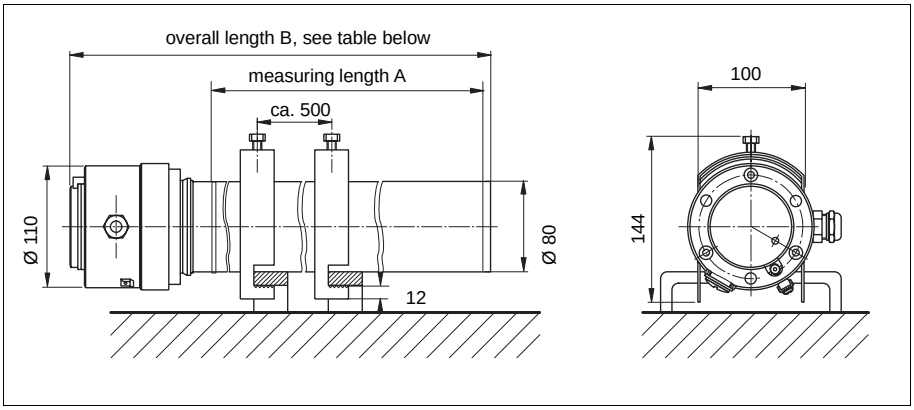


Connection of two DG 57 detectors to two FMG 671 (P) transmitters

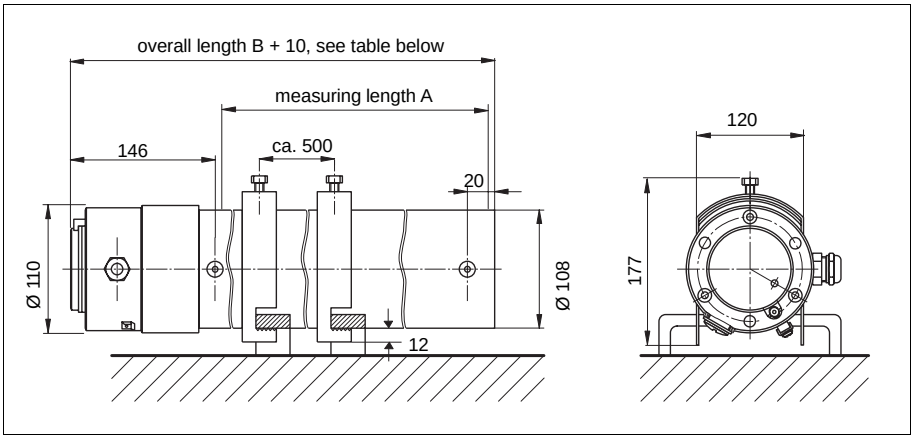


Connection of DG 57 to FMG 573 S when detector located in explosion hazardous areas IIC

Technical Data



Dimensions of detector DG 57 in mm
1" = 25.4 mm



Dimensions of water jacket in mm
1" = 25.4 mm

Construction

- Housing:
  acid resistant stainless steel, SS 304
- Protection:
  IP 65 to DIN 40 050
- Dimensions and weight:
  see table and figure
- Active measuring lengths:
  see table and figure
- Cable gland:
  WADI A PG 16, M 20 x 1.5 or G 1/2"
- Fittings supplied:
  of acid-resistant stainless steel, SS 304
  2 clamps for lengths ≤ 800 mm
  3 clamps for lengths ≥ 1000 mm

Water cooling jacket

- Material:
  acid-resistant, stainless steel, SS 304
- Dimensions and weight:
  see Figure and Table
- Water connection:
  2 G1/4" A to DIN ISO 228
- Flow rate: 20…40 l/h

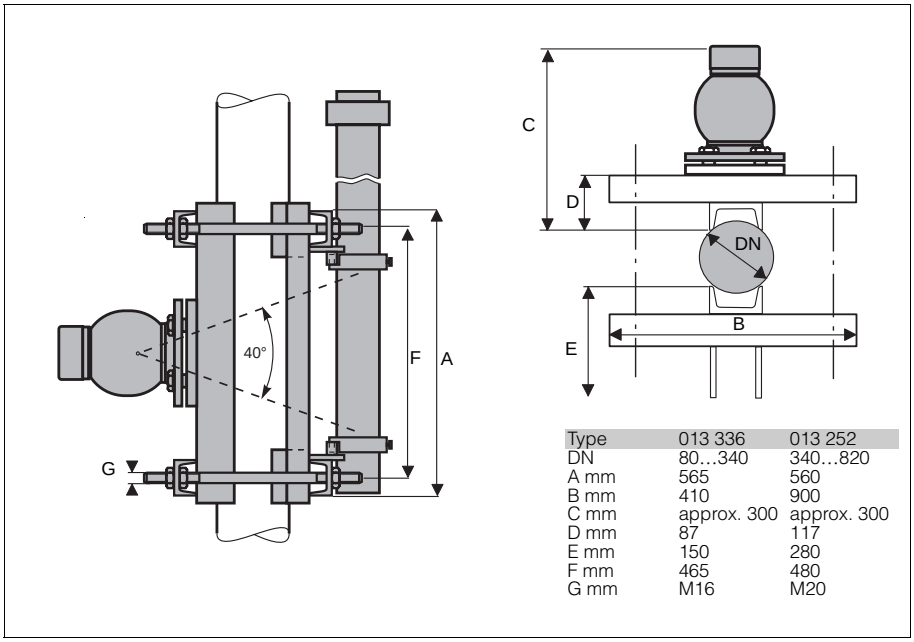
Operational data

- Permissible ambient temperature:
  –20 °C…+50 °C
  +40 °C…+120 °C with water jacket
- Sensitivity control and operability monitor: automatic, by means of reference pulses
- Certificate: PTB No. Ex-94.C.1019
  EEx d ib IIC T6 / ATEX II 2 G
  EEx d / ATEX II 2 G
  EEx de / ATEX II 2 G
  For FMG 573 S, IIC obtainable with safety barrier only
- Output:
  PCM signal, base current of 50 mA
  13.3 V with superimposed pulses of ca. 15 mA of duration ca. 200 µs
- Measurement precision:
  typically 1…2 % for level, interface layer or limit detection applications.
  For density measurement statistical precision ±0.0001 g/cm^3 as a function of range, path length and time constant for 7.5 µSv/h at detector.

Measuring length A	Overall length B (+ 10 mm with water jacket)	Weight	Weight with jacket
100 mm (4")	773 mm (30")	12.6 kg (27.7 lb)	18.0 kg (39.6 lb)
400 mm (16")	1073 mm (42")	14.0 kg (30.8 lb)	19.5 kg (42.9 lb)
600 mm (24")	1273 mm (50")	15.0 kg (33.0 lb)	21.5 kg (47.3 lb)
800 mm (32")	1473 mm (58")	16.3 kg (35.9 lb)	24.2 kg (53.2 lb)
1000 mm (40")	1673 mm (66")	17.5 kg (38.5 lb)	26.2 kg (57.6 lb)
1200 mm (48")	1873 mm (74")	18.8 kg (41.4 lb)	28.4 kg (62.5 lb)
1500 mm (60")	2173 mm (86")	20.4 kg (44.9 lb)	31.5 kg (69.3 lb)
2000 mm (80")	2673 mm (105")	24.0 kg (52.8 lb)	37.0 kg (81.4 lb)

Dimensions and weights of DG 57 detectors

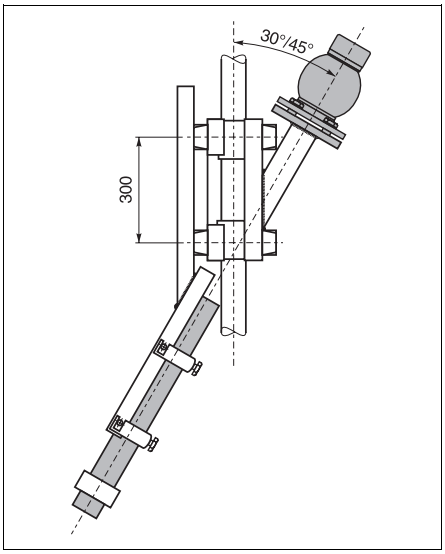
Clamping devices

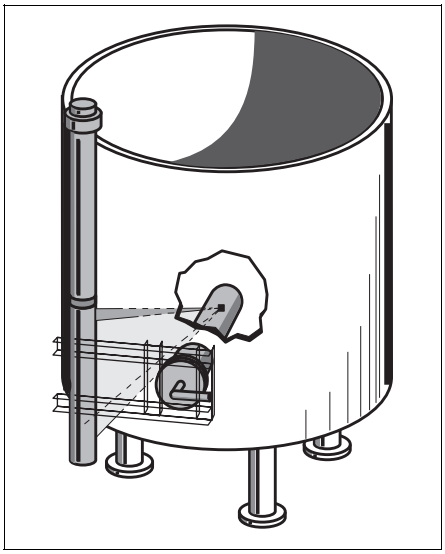


Type	013 336	013 252
DN	80…340	340…820
A mm	565	560
B mm	410	900
C mm	approx. 300	approx. 300
D mm	87	117
E mm	150	280
F mm	465	480
G mm	M16	M20

Positioning for normal beam

Clamping device dimensions (mm) type TSP 013 336/013 252





Left:
Positioning for diagonal beam, clamping device TSP 015354 for DN 80…200

Right:
Rig 013131-0000/1 for density measurement in vessels

Clamping devices

The following methods are available:

- Clamping devices for piping DN 80…340, Type 013336
- Clamping devices for piping DN 340…820, TSP 013252
- Rigs for measuring density or interface layers in tanks Type 013131-0000 or 013131-0001
- coated measuring pipes, fittings for diagonal beams through piping, clamps for pipes > DN 820 or complete measuring paths with small pipe diameters on request.

Clamping devices for density measurement

Nominal diameter

1 80…340 mm TSP 013336
2 340…820 mm TSP 013252
3 80…200 mm for diagonal radiation 30° with small diameters TSP 015354
4 120...300 mm for diagonal radiation 45°

Material, clamps

A Steel, epoxy lacquered
B Steel, galvanised

Material, mounting material

1 Steel, galvanised

KLEMM-				complete product designation

Product structure for clamps

Product Structure

Detector DG 57

Certificate/Approval
- A EEx d ib IIC T6 / ATEX II 2G
- H EEx d IIC T6 / ATEX II 2G
- M EEx de IIC T6 / ATEX II 2G
- D ATEX II 2 D (in preparation)

Material
- 1 Stainless steel tube, SS 304

Measurement length
- H 100 mm
- A 400 mm
- B 600 mm
- C 800 mm
- D 1000 mm
- E 1200 mm
- F 1500 mm
- G 2000 mm
- P 100 mm, with water jacket
- R 400 mm, with water jacket
- S 600 mm, with water jacket
- T 800 mm, with water jacket
- U 1000 mm, with water jacket
- V 1200 mm, with water jacket
- W 1500 mm, with water jacket
- Q 2000 mm, with water jacket

Electrical connection
- 1 1x WADI-PG 16 (for certificate A and M only)
- 2 Cable entry 1/2" NPT (for certificate H only)
- 3 M20x1.5 (for certificate H only)
- 4 G 1/2" (for certificate H only)
- 5 M20x1.5 gland (for certificates A, M and D only)

Application
- A For level measurement with FMG 573 Z/S (not 100 mm)
- B For density measurement with FMG 573 Z/S (only 100/400 mm)
- C For limit switching with FTG 671 (only 100/400 mm)
- D For level measurement with FMG 671(not 100 mm)

Radiation source
- 1 Cs 137 source
- 2 Co 60 source
- 3 Co 60 and Cs 137 source

DG57-							complete product designation

Supplementary Documentation

- ☐ Gammapilot FTG 671
  Technical Information TI 177F/00/e
- ☐ Gammasilometer FMG 671
  Technical Information TI 219F/00/e
- ☐ Radiometric Density Measurement with Gammasilometer FMG 573 Z
  Technical Information TI 110F/00/e
- ☐ Gamma Radiation Sources
  Technical Information TI 213F/00/e
- ☐ Source containers QG 020/100
  Technical Information TI 194F/00/e
- ☐ Gamma Measurements
  System Information SI 016F/00/e

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