

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 Gammapiot 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 Gammapiot 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

Endress + Hauser

The Power of Know How



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.

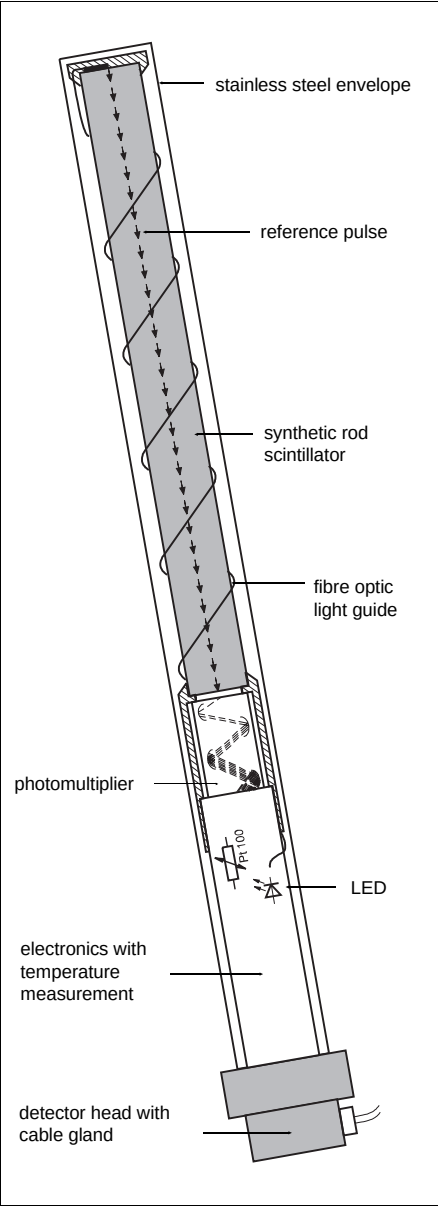
The detector comprises a rod scintillator, a photomultiplier and a control unit. The ionising radiation falling on the scintillator consists of individual particles, so-called γ -quanta. On entering the scintillator each particle is attenuated, thereby generating a tiny flash of light. A certain proportion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

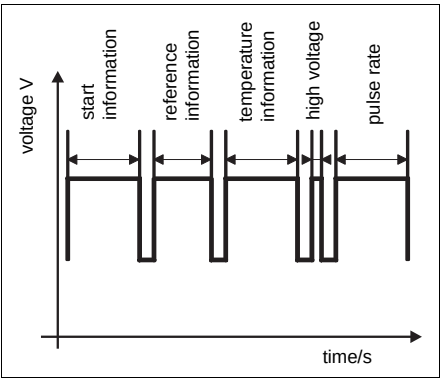
Reference Light Pulse

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 ($2 \times \text{ca. } 250 \text{ ms} = 500 \text{ ms}$), allowing a plausibility check to be made.



Schematic diagram of DG 57 detector



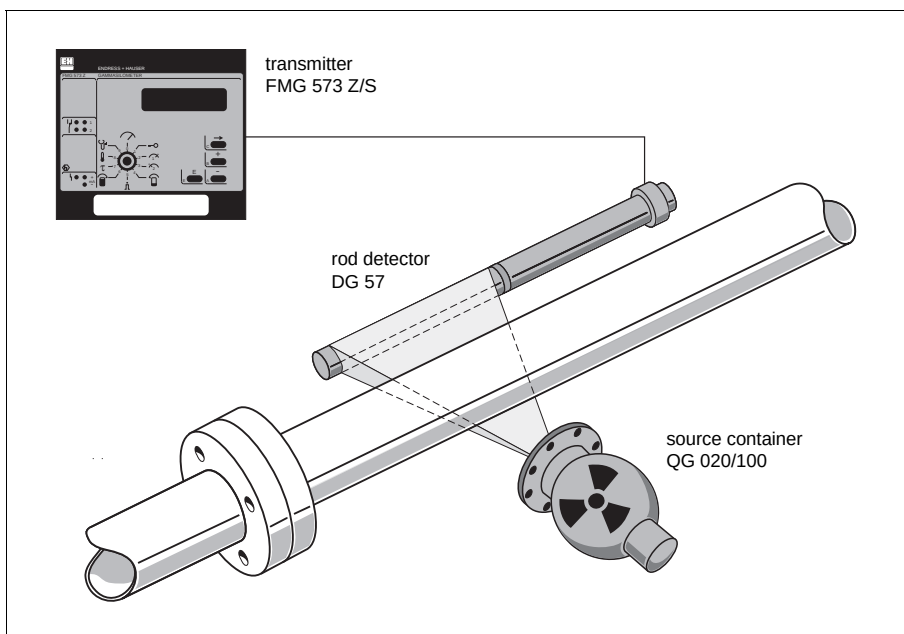
Schematic diagram of pulse signal

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.

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, attenuation by medium and projected service life)	100	0.2	0.1	910	1560
	400	0.1	0.05	2270	3900
Density ↔ and separation layer ↗ (Local dose rate dependent upon density range to be measured, path and response time) Projected values apply always to min. density values (ρ min)	↔ 100	ca. 7.5	ca. 7.5	910	1560
	↔ 400	ca. 2.0...7.5	ca. 2.0...7.5	2270	3900
Level (Local dose rate dependent upon response time and projected service life)	↗ 400			see level values	
	↗ 2000				
	400	1.1	0.45	2620	4500
	600	1.0	0.4	3430	5900
	800	0.95	0.35	4070	7000
	1000	0.83	0.3	4770	8200
	1200	0.69	0.25	5410	9300
	1500	0.55	0.2	6460	11100
	2000	0.45	0.16	8150	14000

Minimum dose rate for different applications

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.

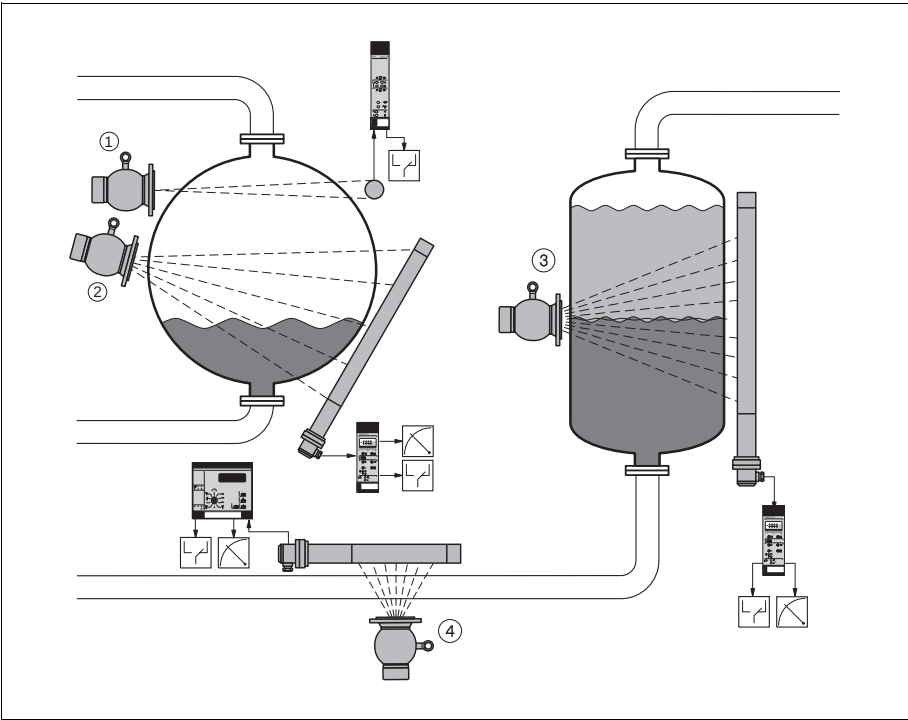
- For measuring ranges greater than 2 m, two or more detectors must be connected in cascade
- When impacts and vibrations are to be expected, the measuring system should not be attached to the vessel.
- If the ambient temperature exceeds +50 °C (122 °F), install a detector with a water jacket.

Limit Value Detection

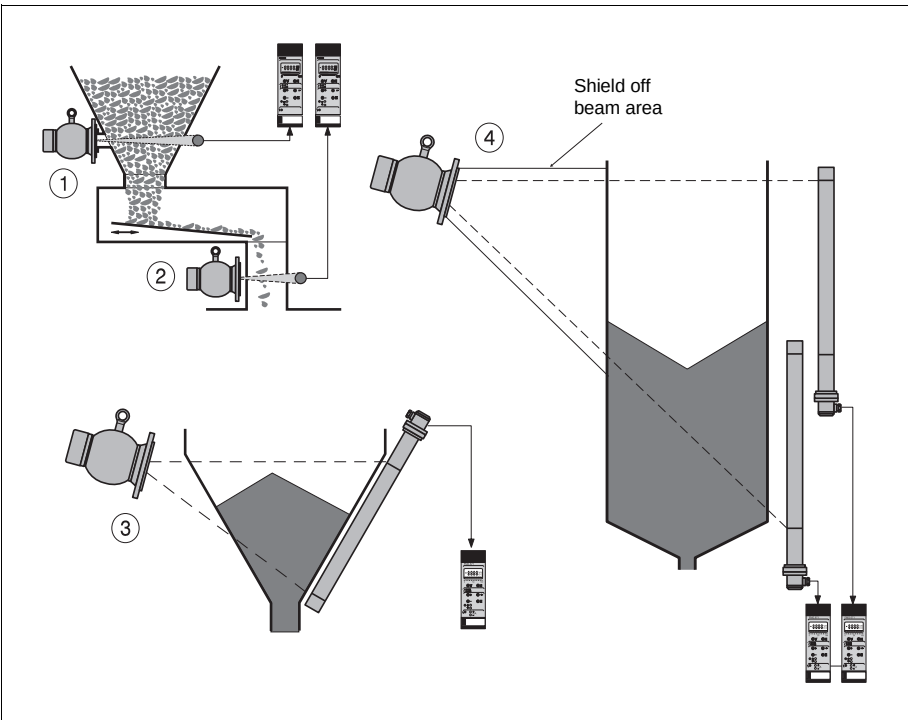
For limit value detection, it is usual to mount the detector horizontally on the vessel wall.

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

- ↔ Limit detection
↗ Continuous level measurement
➡ Measurement of separation layers
↑ Density measurement



- ↔ Minimum limit detection
↗ Maximum limit detection
➡ Level measurement (with head at top)
↑ Level measurement with two detectors



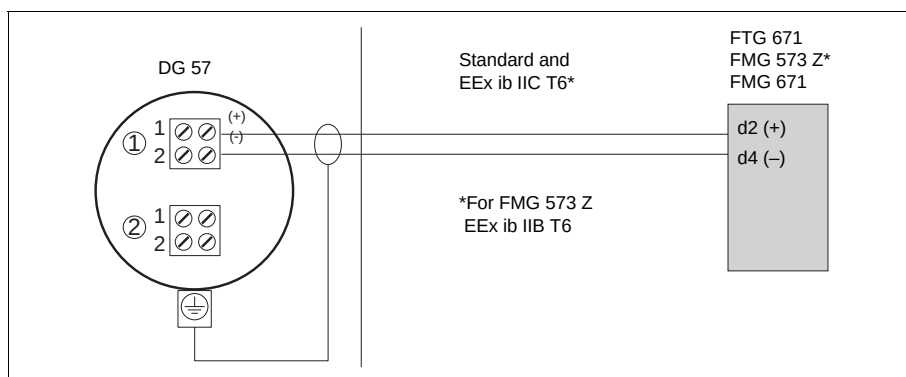
Electrical Connection

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.

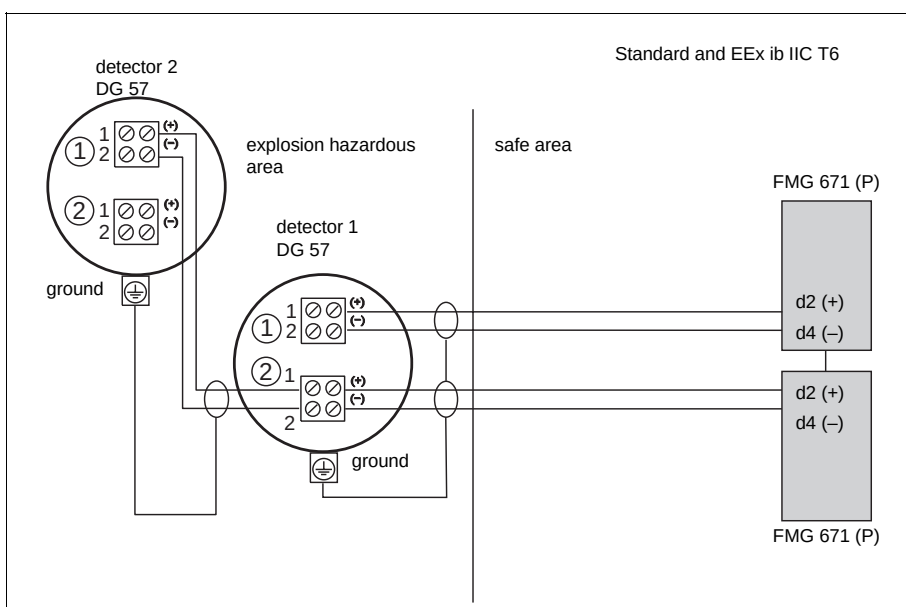
For the FMG 573 S:

- 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.

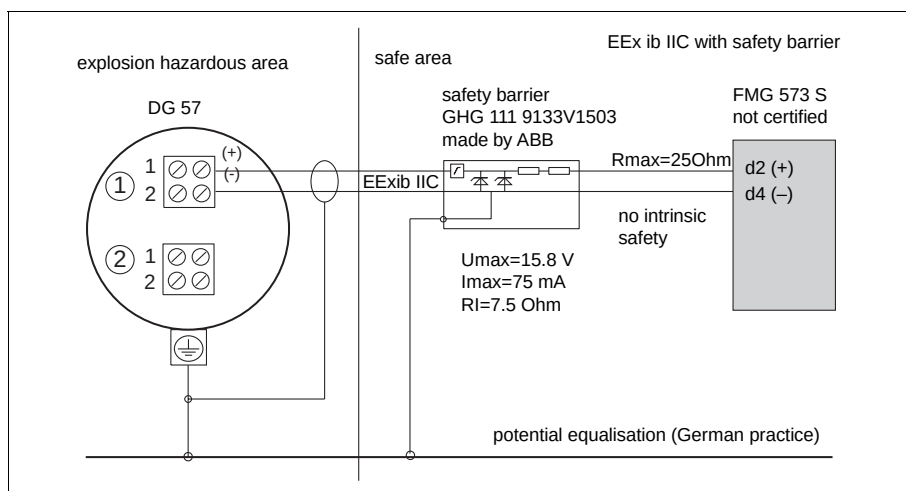
Electrical connection for DG 57 – FTG 671 and DG 57 – FMG 573 Z and DG 57 – FMG 671



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

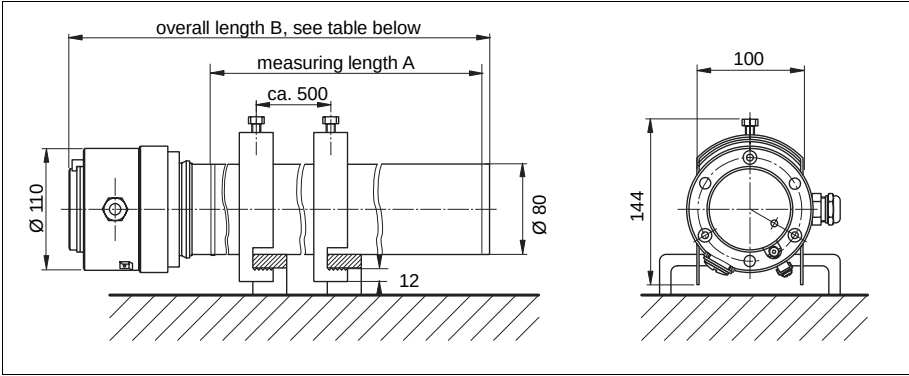


Connection of DG 57 to FMG 573 S when detector located in explosion hazardous areas IIC

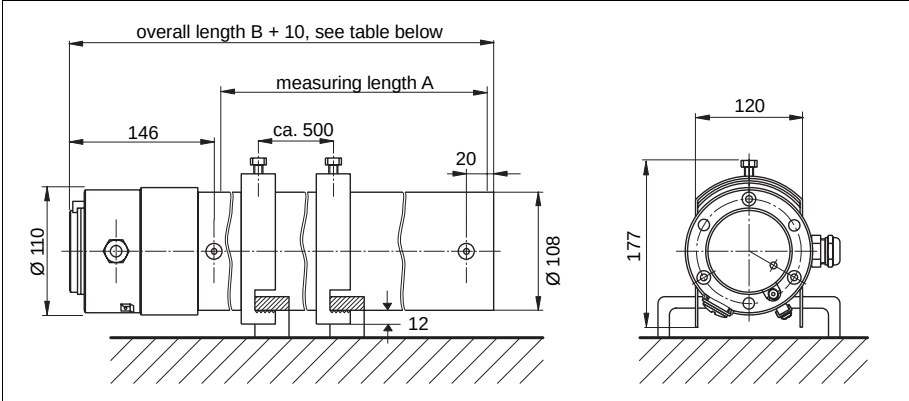


Technical Data

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
- 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
- Water connection:
2 G1/4" A to DIN ISO 228
- Flow rate: 40...200 l/h
- max. water temperature 40 °C
- water pressure 4...6 bar.

Operational data

- Permissible ambient temperature:
-20 °C...+50 °C
+40 °C...+120 °C with water jacket. In
explosion hazardous areas note the
instructions of the appropriate XA
(s.p.8)

- Interference Emission to EN 61326;
Electrical equipment Class B
Interference Immunity to EN 61326,
Annex A (Industrial) and NAMUR
Recommendation NE 21 (EMC)
- 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/cm³ as a function
of range, path length and time
constant for 7.5 µSv/h at detector.

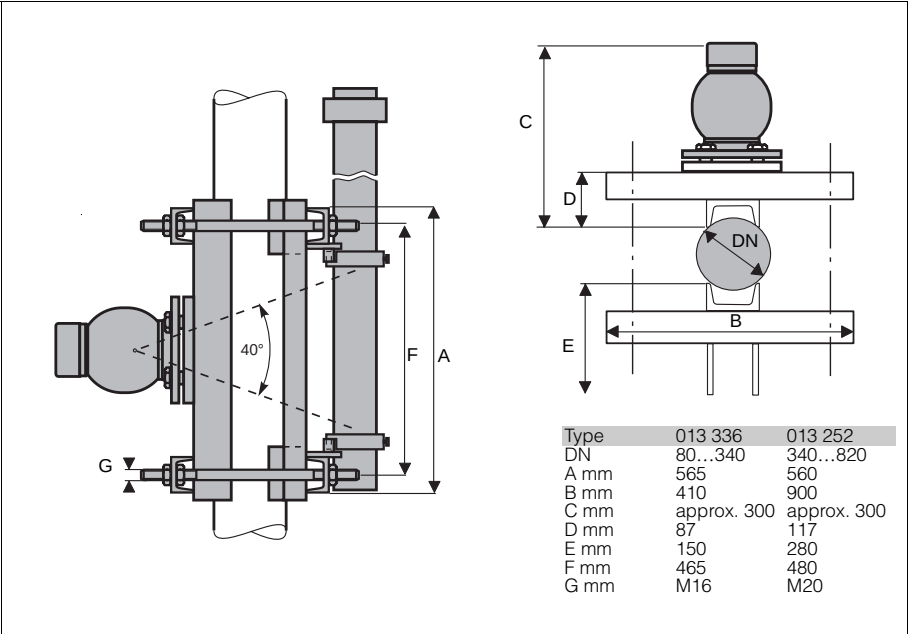
Measuring length A	Overall length B (+ 10 mm with water jacket)	Weight	Weight with jacket
100 mm (4")	773 mm (30")	12.6 kg (27.7 lb)	18.0 kg (39.6 lb)
400 mm (16")	1073 mm (42")	14.0 kg (30.8 lb)	19.5 kg (42.9 lb)
600 mm (24")	1273 mm (50")	15.0 kg (33.0 lb)	21.5 kg (47.3 lb)
800 mm (32")	1473 mm (58")	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

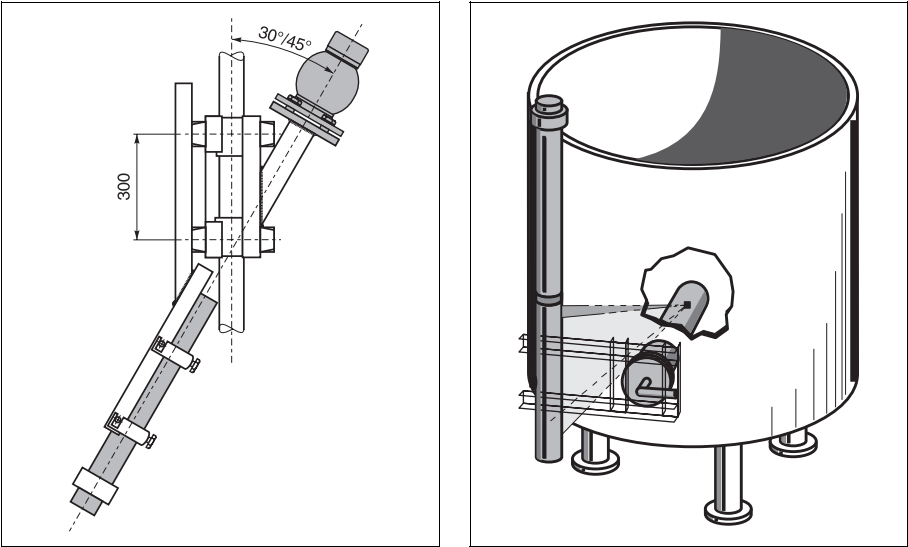
Positioning for normal beam

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.

Product structure for clamps

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

Detector DG 57									
Certificate/Approval									
A ATEX II 2G / EEx d ib IIC T6, s. XA 057F-A									
H ATEX II 2G / EEx d IIC T6, s. XA 057F-A									
M ATEX II 2G / EEx de IIC T6, s. XA 057F-A									
D ATEX II 2D IP65 T60°C, s. XA 112F-A									
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
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Supplementary Documentation

☐ Gamma Measurements SI 016F/00/en or PK 001F/00/en	☐ Gamma Radiation Sources Technical Information TI 213F/00/en
☐ Gammapilot FTG 671 Technical Information TI 177F/00/en	☐ Source containers QG 020/100 Technical Information TI 264F/00/en
☐ Gammasilometer FMG 671 Technical Information TI 219F/00/en	☐ Source container QG 2000 Technical Information TI 346F/00/en
☐ Radiometric Density Measurement with Gammasilometer FMG 573 Z Technical Information TI 110F/00/en	

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