Heinrichs

Magnetic-Inductive Flow Velocity Sensor

PIT

Device Description

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1 Identification

1.1 Manufacturer/supplier

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Phone: +49 (221) 49708 - 0
Fax: +49 (221) 49708 - 92
Internet: http://www.heinrichs-mt.com/
E-mail: mailto:info@heinrichs-mt.com

1.2 Product type

Magnetic-inductive flow sensor based upon Faraday's law of induction

1.3 Product name

PIT-520, PIT-580, PIT-571 and PIT-573

1.4 Issue date

23/02/2005

1.5 Version no.

3.0
File: PIT_GB_ 03_eng.doc

2 Applications

The magnetic-inductive PIT flow velocity sensor is used to measure or monitor the volume flow of liquids with and without solids concentration, slurries, pastes and other electrically conductive media while minimizing pressure drops. The conductivity of the medium must be at least 20 µS/cm.

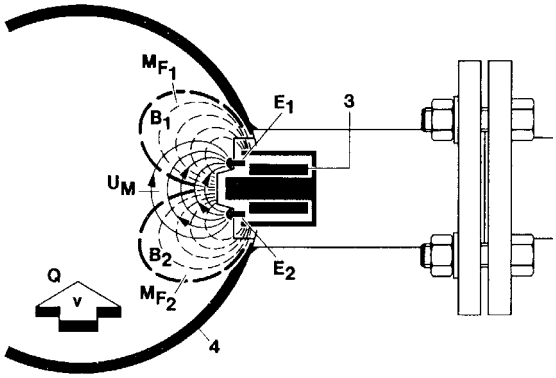
Pressure, temperature, density and viscosity do not affect the volume measurements. Smaller portions of solid particles and small gas pockets are also measured as part of the volume flow. A larger number of solid particles or gas pockets will lead to failures. Special electrodes are available for media that tend to form greasy films or crusts.

3 Operational mode and system design

3.1 Operational mode

It was back in 1832 that Faraday suggested utilizing the principle of electrodynamic induction for measuring flow velocities. His experiments in the Thames, though unsuccessful due to superimposed polarization effects, are nonetheless regarded as the first ones in the field of magnetic-inductive flow measurement.

According to Faraday's law of electromagnetic induction, an electrical field E is produced in a conductive liquid moving through a magnetic field B at a velocity v in accordance with the vector product E = [v x B]. A liquid at flow velocity v and a flow rate Q flows through a meter tube (4), producing a measuring-circuit voltage Um at the two electrodes (E1 and E2) at right angles to the direction of flow and the magnetic field B generated by the field coils (3). The size of this measuring-circuit voltage is proportional to the mean flow velocity and thus the volume flow rate.



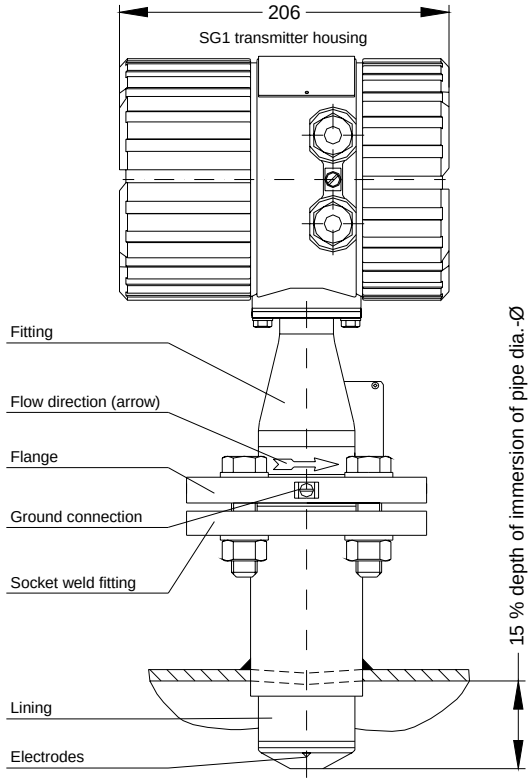
3.2 System design

The magnetic-inductive PIT-*** flow measurement system consists of a sensor, which picks up an induced measuring signal from the medium flowing through the pipe, and a transmitter, which transforms this signal in standardized output signals (4-20 mA or pulses).

The PIT-*** sensor can be operated with all transmitters for magnetic-inductive flowmeters manufactured by Heinrichs Messtechnik. The sensor is installed in the pipe while the transmitter is mounted directly on the sensor or separately on the outside, depending on the equipment design.

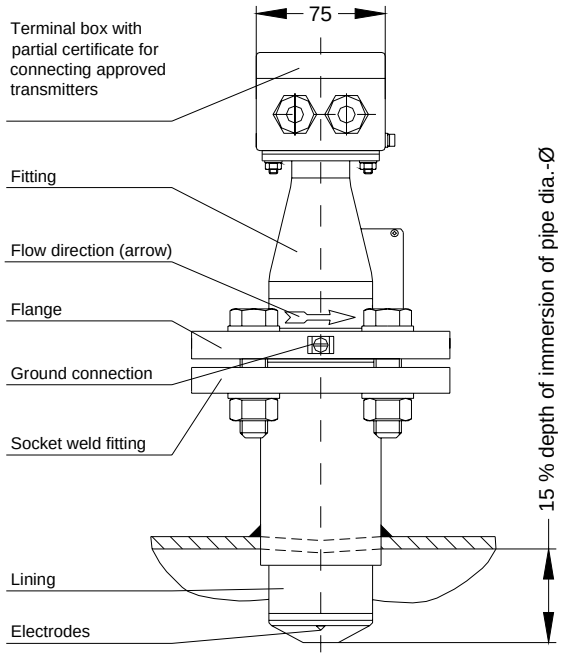
3.2.1 Transmitter mounted on the sensor

This type of construction ensures easy and trouble-free installation.



3.2.2 Transmitter installed separately

Heinrichs Messtechnik recommends this type of installation when there is little space or the medium temperatures are high. The sensor and the transmitter are connected by a field coil and an electrode cable. The electrode cable must be shielded and protected against disturbing interferences.



3.2.3 PIT-520

Socket of sensor housing and flange are made of stainless steel.

3.2.4 PIT-580

Socket of sensor housing and flange are made of Hastelloy.

3.2.5 PIT-571

Socket of sensor housing and flange are made of stainless steel. The wetted parts of the housing are PFA-coated.

3.2.6 PIT-573

Socket of sensor housing and flange are made of stainless steel. The wetted parts of the housing are PFDF-coated.

4 Characteristic values

4.1 Measuring accuracy

± 1.5 % of measured value plus ± 0.5 % of URV

4.2 Conductivity of the medium

≥ 20 µS/cm

4.3 Influence of ambient temperature

See transmitter

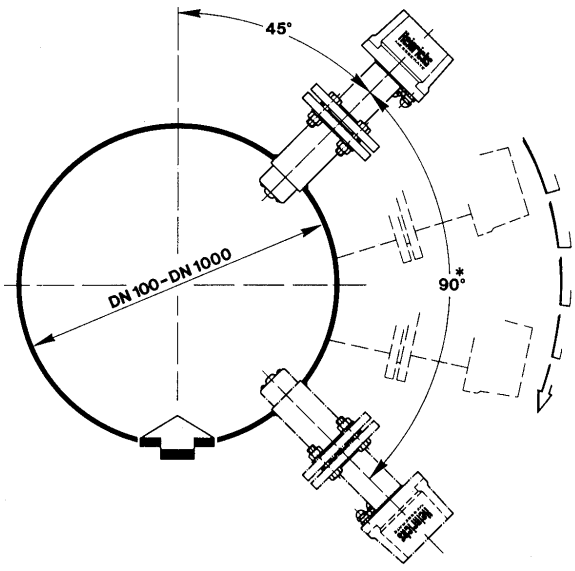
4.4 Influence of medium temperature

None

5 Conditions of use

5.1 Installation conditions

Disturbing elements (e.g. shut-off and control devices) are to be arranged downstream from the sensor. If this is not possible, flow straighteners must be installed so that no vortexes can reach into the pipe section of the sensor. The mounting location in the pipe system should be selected so that the sensor is continually filled with the medium. This requirement can be met by using drains and non-return valves.



In order to stay within the indicated error limits, the installation must be performed according to EN 29104 "Measurement of Fluid Flow in Closed Conduits – Methods of Evaluating the Performance of Magnetic-Inductive Flowmeters." Based on this standard, the minimum straight run of pipe ahead of the inlet must be 10 pipe diameters **(> 10 x DN)** and 5 pipe diameters following the outlet (**> 5 x DN)** [DN = nominal diameter of pipe].

In order to prevent serious measuring errors when the pipe is partially filled or when there are gas pockets or sediment deposits, the mounting position described above should be chosen.

The limit values for the product and ambient temperature must be met at the mounting location. Corrosive atmospheres must be avoided. Please also take into account the space requirement for a possible removal of the device.

5.1.1 Depth of immersion of the PIT-*** in the pipe

In order to suppress the influence of the flow profile as much as possible, the depth of immersion of the measuring head in the pipe must be **15 % of the inside diameter of the pipe**. The socket weld fitting must not cover the top of the measuring head and must be shortened if necessary.

5.1.2 Dismounting/reinstalling the device under process pressure

For easily dismounting and reinstalling the device under process pressure, a version with a special mechanism is available. When using this mechanism, the measuring head must not be damaged by closing the valve.

For details, see the Additional Operating Instructions for Dismounting and Reinstalling the Device under Process Pressure (see also Section 14 "Options").

5.1.3 Grounding

For safety reasons and to ensure faultless operation of the magnetic-inductive flowmeter, grounding the flow sensor is important. In accordance with VDE 0100, Part 540, the ground connections must be at protective conductor potential. For the hazardous area version, they must be equipotentially bonded. For metrological reasons, the potential should be identical to the potential of the medium.

When using insulated and lined pipes or plastic pipes, the metrological grounding of the medium for PIT-520/580 is carried out via the wetted part of the measuring head.

All wetted parts of PIT-571 are coated with PFA (PIT-573 with PVDF). It is therefore not possible to ground the medium via the housing parts. In this case, a special version of PIT-571/PIT-573 equipped with a grounding electrode is necessary.

5.2 Use in hazardous areas

The PIT-520 and PIT-571 flowmeters can also be used in **Zone 1** hazardous areas. Only devices with a corresponding mark on their type plate may be operated in these areas. The special conditions with regard to the relationship between the thermal data and the medium temperature, ambient temperature and the temperature class in accordance with the EC Type Examination Certificate BVS 03 ATEX 150 X must be observed.

When installing and operating the device in hazardous areas, the applicable national rules must be followed.

5.3 Ambient conditions

5.3.1 Ambient temperature ranges

-40°C to +60°C

For the hazardous area version, take note of the maximum ambient temperatures depending on the temperature class as specified in the Type Examination Certificate.

5.3.2 Storage temperature

The storage temperatures are identical to the ambient temperature ranges.

5.3.3 Climatic category

- In accordance with IEC 654-1
- Not weather-protected **Class D locations** exposed directly to open-air climate

5.3.4 Degree of protection

- Standard version: IP 65
- Special version: IP 68
- Weather-protected and/or unheated locations, class C

5.3.5 Shock resistance/vibration resistance

The meter should be protected from extreme shocks and vibrations, which could cause damage.

5.4 Medium temperature and pressure

5.4.1 Transmitter is mounted on the sensor

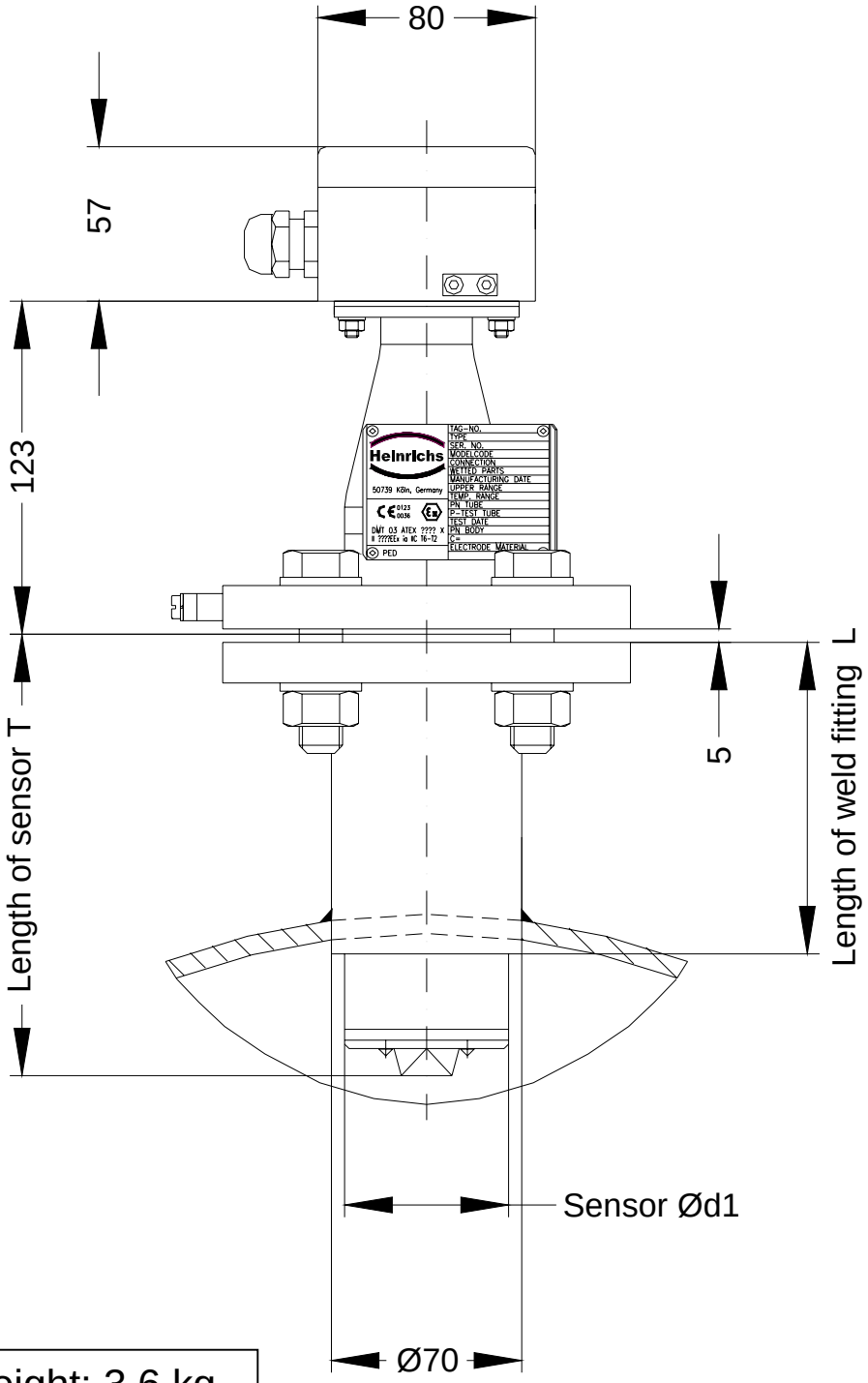
Version	Medium temperature	Pressure
PIT-520/580 standard	-20°C to 80°C	16 bar
PIT-571 standard	-20°C to 80°C	40 bar
PIT-573 standard	-20°C to 80°C	40 bar

5.4.2 Transmitter is mounted separately

Version	Medium temperature	Pressure
PIT-520/580 standard	-40°C to100°C	16 bar
PIT-571 standard	-40°C to 140°C	40 bar
PIT-573 standard	-20°C to 80°C	40 bar

6 Dimensions/weight

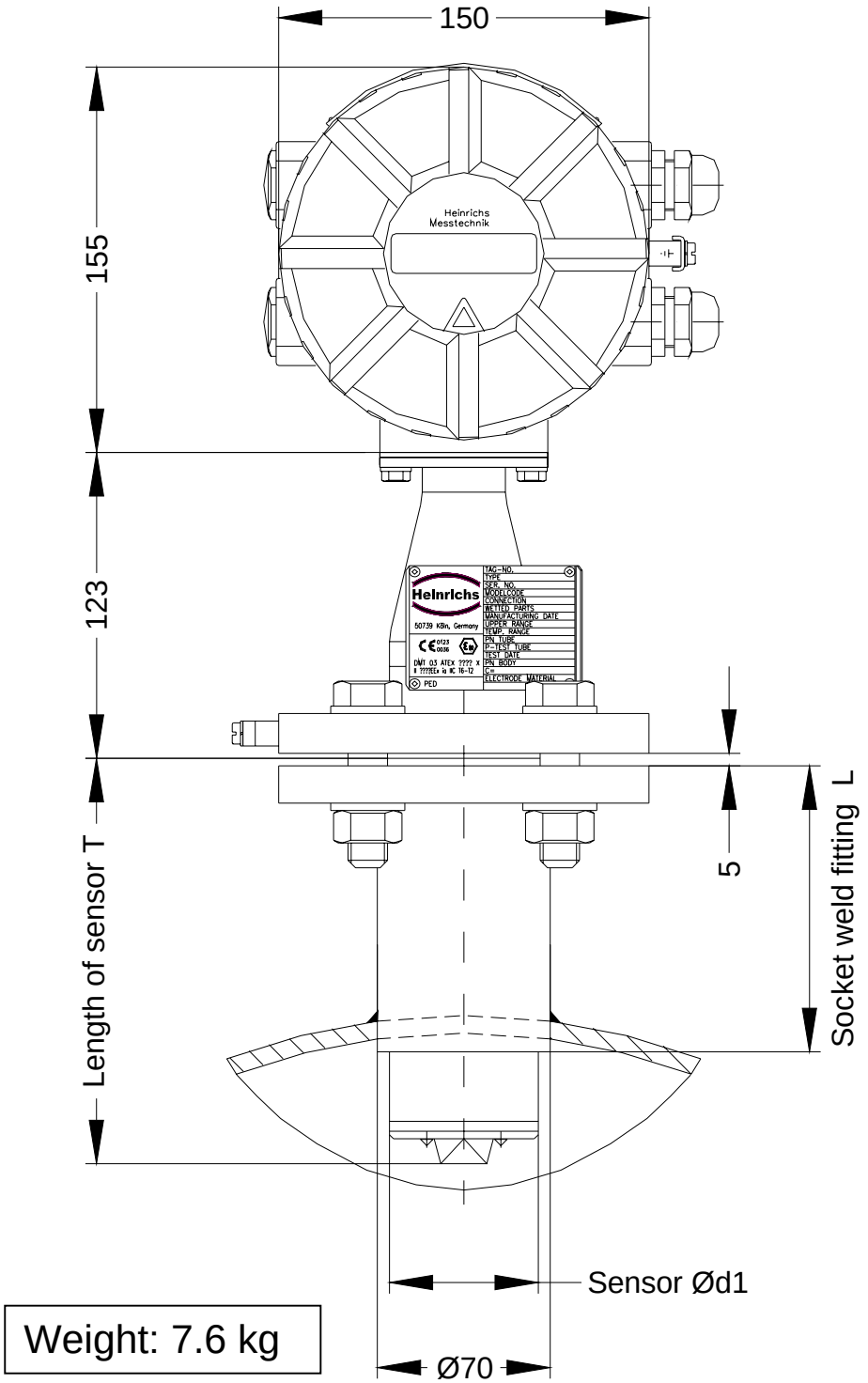
6.1 PIT-5** dimension drawing for separate transmitter



Weight: 3.6 kg

Version	DN	Sensor lining	Length of sensor T	Sensor-Ø	Length of weld fitting L
PIT-571	150 - 600	PFA	163	62	145
PIT-573	150 - 600	PVDF	163	62	145
PIT-520	150 - 600	1.4571	163	60,3	145
PIT-520	700 - 1200	1.4571	263	60,3	170
PIT-520	1400 - 2000	1.4571	363	60,3	170

6.2 PIT-5** dimension drawing with mounted transmitter in SG1 housing



Version	DN	Sensor lining	Length of sensor T	Sensor-Ø	Length of weld fitting L
PIT-571	150 - 600	PFA	163	62	145
PIT-573	150 - 600	PVDF	163	62	145
PIT-520	150 - 600	1.4571	163	60,3	145
PIT-520	700 - 1200	1.4571	263	60,3	170
PIT-520	1400 - 2000	1.4571	363	60,3	170

7 Auxiliary power/electrical connection

See type plate or Operating Instructions of the corresponding transmitter

8 CE Mark

The measuring system complies with the legal requirements of the following EU Directives: *94/9/EC (Equipment and Protective Systems for Use in Potentially Explosive Atmospheres)*, Directive 89/336/EEC *(EMC Directive)* and Directive 97/23/EC *(Pressure Equipment Directive)*.

Heinrichs Messtechnik confirms compliance with the directives by attaching the CE mark to the device.

9 Standards and directives, certificates and approvals

Certified to DIN-EN 9001
Production in accordance with AD guidelines and HPO approval (TRB200/TRD201)
TÜV approval for welding requirements in accordance with DIN-EN 729-2

Directive 94/9/EC	(Equipment and Protective Systems for Use in Potentially Explosive Atmospheres)
EN 50014:1997+A1-A2	General requirements
EN 50019:2000	Increased safety "e"
EN 50020:1994	Intrinsic safety “i”
Directive 89/336/EEC	(EMC Directive)
EN 61000-6-2:1999	Immunity industrial environment
EN 50 081-1	Emitted interference residential environment
EN 55011:1998+A1:1999	Group 1, Class B
Direcitve 97/23/EC	(Pressure Equipment Directive)

AD guidelines

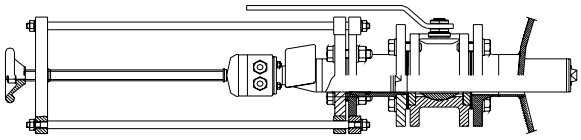
NAMUR recommendation NE 21
EN 60529 – Degrees of protection through housing (IP code)
EN 61010 – Safety requirements for electrical measuring, control and laboratory devices

10 Options

10.1 Dismounting/reinstalling the device under process pressure

In some cases it might be necessary to dismount and reinstall the PIT for cleaning when the pipe is under process pressure. A special mechanism can be used for this purpose.

When using this mechanism, it is important to ensure that the measuring head will not be damaged by closing the valve. For a detailed description of this process, see the Additional Operating Instructions for Dismounting/Reinstalling the Device under Process Pressure (Section 5.1.2).



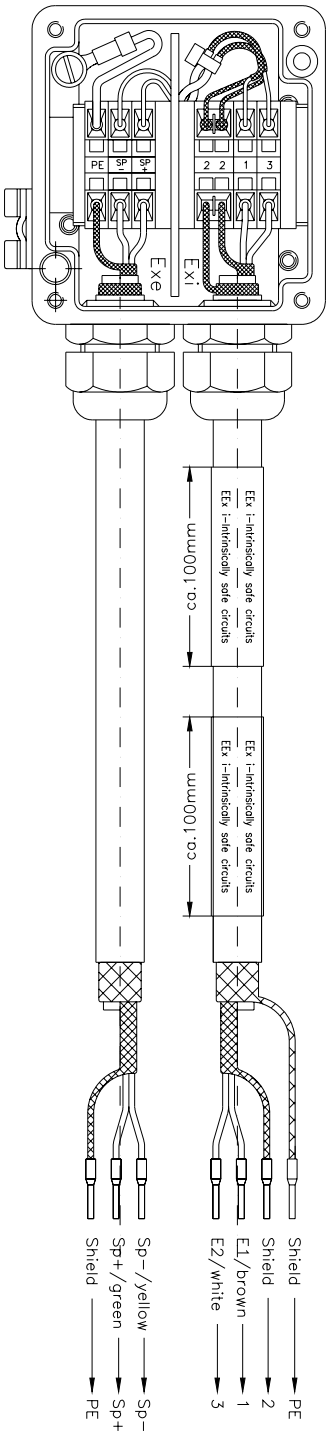
10.2 PIT with IP 68 degree of protection

A special version of PIT is available with the IP 68 degree of protection. This version is equipped with a special terminal box, special cable glands and a special cable. The length of the cable must be specified when placing the order. The terminal box does not need to be opened during the installation. If this should be necessary, the cover must be remounted carefully. This is the only way to ensure the IP 68 degree of protection.

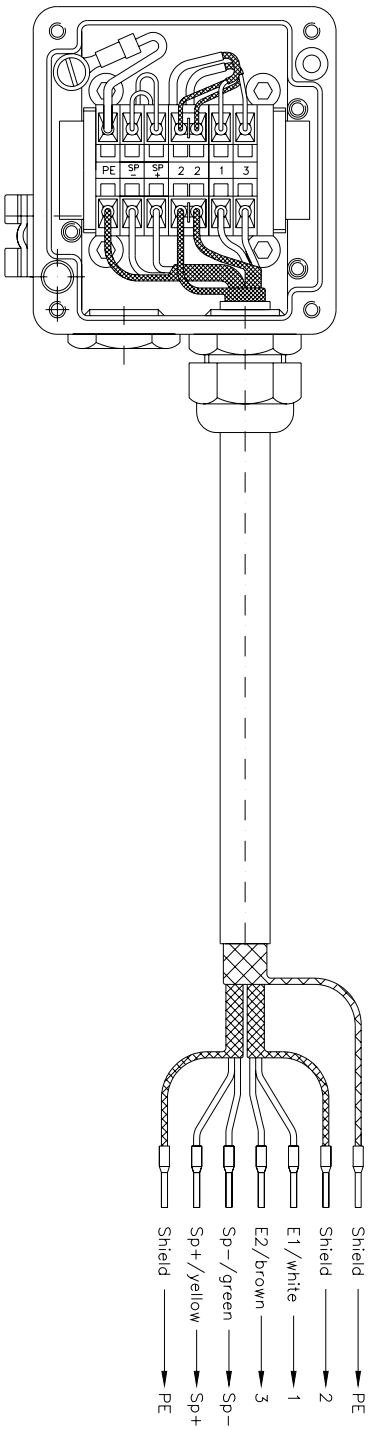
The maximum depth of immersion is **5 m**.

Due to the separate wiring arrangement of intrinsically safe and not intrinsically safe circuits for hazardous area applications, two cables are available for this version.

10.2.1 Wiring diagram for IP 68 hazardous area version



10.2.2 Wiring diagram for IP 68 standard version



Translation

(1) # EC-Type Examination Certificate

(2) **- Directive 94/9/EC -**
Equipment and protective systems intended for use in potentially explosive atmospheres

(3) ## BVS 03 ATEX E 150 X

(4) **Equipment:** **Flow Sensor Type PIT-520, Type PIT-571 and Type PIT-580**

(5) **Manufacturer:** **Heinrichs Messtechnik GmbH**

(6) **Address:** **D 50739 Köln**

(7) The design and construction of this equipment and any acceptable variation thereto are specified in the schedule to this type examination certificate.

(8) The certification body of Deutsche Montan Technologie GmbH, notified body no. 0158 in accordance with Article 9 of the Directive 94/9/EC of the European Parliament and the Council of 23 March 1994, certifies that this equipment has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of equipment and protective systems intended for use in potentially explosive atmospheres, given in Annex II to the Directive.
The examination and test results are recorded in the test and assessment report BVS PP 03.2097 EG.

(9) The Essential Health and Safety Requirements are assured by compliance with:

EN 50014:1997+A1-A2	General requirements
EN 50019:2000	Increased safety
EN 50020:1994	Intrinsic safety

(10) If the sign "X" is placed after the certificate number, it indicates that the equipment is subject to special conditions for safe use specified in the schedule to this certificate.

(11) This EC-Type Examination Certificate relates only to the design, examination and tests of the specified equipment in accordance to Directive 94/9/EC.
Further requirements of the Directive apply to the manufacturing process and supply of this equipment. These are not covered by this certificate

(12) The marking of the equipment shall include the following:

II 2G EEx e [ia] IIC T3-T6

Deutsche Montan Technologie GmbH
Essen, dated 16. May 2003

Signed: Jockers
DMT-Certification body

Signed: Eickhoff
Head of special services unit

This certificate may only be reproduced in its entirety and without change
Am Technologiepark 1, 45307 Essen, Telefon (0201)172-1416, Telefax (0201)172-1716

(13) Appendix to

(14) # EC-Type Examination Certificate

BVS 03 ATEX E 150 X

(15) 15.1 Subject and type
Flow Sensor Type PIT-520 , Type PIT-571 und Type PIT-580

15.2 Description
The flow sensor, using the principle of magnetic induction, serves for the flow measurement of conductive fluids. The mounting flange of the sensor is laterally attached to the pipe containing the fluid.

For power supply and for signal evaluation, the sensor is used in conjunction with a signal transducer type UMF (DMT 99 ATEX E 107 X) which is directly mounted to the sensor (compact version).

Alternatively, the sensor is provided with a connection box; the associated signal transducer, separately certified, is connected to the sensor by means of a cable (separated version).

15.3 Parameters

15.3.1 Electrical parameters

15.3.1.1 Field coil circuit

Rated voltage	up to	60	V
Rated current		200	mA
Maximum current		250	mA
Pulse frequency		25	Hz

15.3.1.2 Electrode circuit (separated version), intrinsically safe category ia

Voltage U_i	24	V
Current i_i	160	mA
Capacitance C_i	negligible	
Inductance Li	negligible	

15.3.1.3 Electrode circuit (compact version), intrinsically safe

As defined in the relevant EC-Type Examination Certificate for the signal transducer

15.3.1.4 Transducer circuits

As defined in the relevant EC-Type Examination Certificate

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DMT

15.3.2 Thermal data

Type designation and version	Maximum fluid temperature (°C)	Ambient temperature (°C)	Temperature class
PIT-520/PIT-580 separated version	60	-40 up to +50	T6
PIT-520/PIT-580 separated version	80	-40 up to +60	T5
PIT-520/PIT-580 compact version	60	-20 up to +50	T6
PIT-520/PIT-580 compact version	80	-20 up to +55	T5
PIT-571 separated version	60	-40 up to +45	T6
PIT-571 separated version	60	-40 up to +60	T5
PIT-571 separated version	100	-40 up to +60	T4
PIT-571 separated version	130	-40 up to +60	T3
PIT-571 compact version	60	-20 up to +45	T6
PIT-571 compact version	60	-20 up to +55	T5
PIT-571 compact version	100	-20 up to +50	T4
PIT-571 compact version	130	-20 up to +50	T3

Thermal data of the separate transducers in accordance with the EC-Type Examination Certificate of the transducers.

15.3..3 Permissible fluid pressure

Sensor type PIT-520 and type PIT-580 16 bar
Sensor type PIT-571 40 bar

(16) Test and assessment report
BVS PP 03.2097 EG as of 16.05.2003

(17) Special conditions for safe use

17.1 It shall be ensured that there are no detrimental effects to the materials of the sensor caused by the fluids.

17.2 The flow sensor is designed for use in an ambient temperature range of –40°C up to +60°C.

It shall be ensured that the data as defined under 15.3.2 for the ambient temperature, the fluid temperature and the temperature class are met.

17.3 For sensors of the separate version which are used at an ambient temperature of less than -20 °C suitable cables and cable entry devices certified for this condition shall be used.

17.4 The special conditions for safe operation as defined in the relevant EC-Type Examination Certificate for the signal transducers shall be observed.

17.5 If the mass flow transmitter is connected by conduit entries they must be certified for this purpose and the associated stopping boxes must be mounted immediately to the enclosure.

17.6 The control device type BE is designed for use in an ambient temperature range of –20°C up to +70°C.

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12 Sales representatives

See Internet: http://www.heinrichs-mt.com/

13 Notes