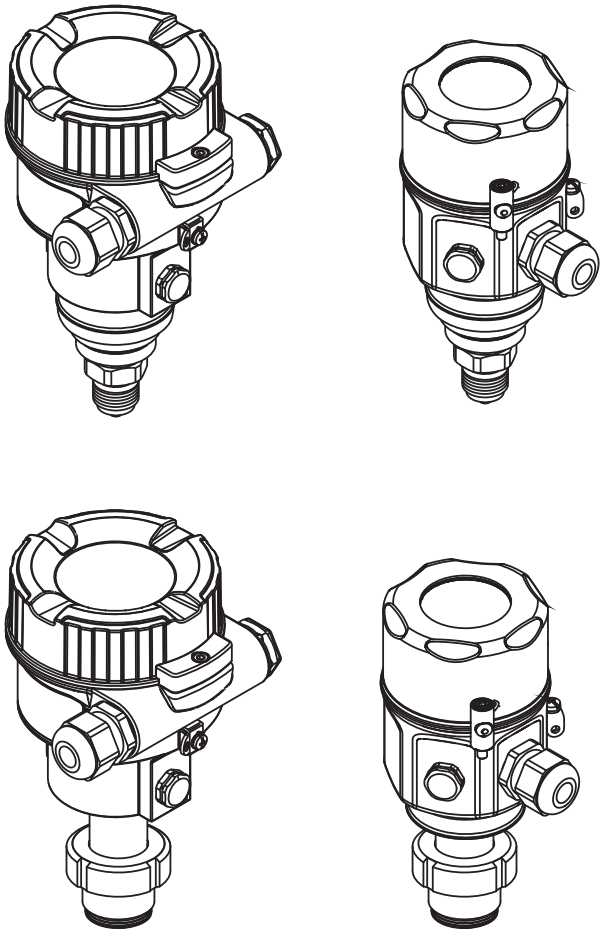
Operating Instructions
BA00382O/98/EN/17.12
71206945

Pressure Transmitter LHC-M51, PPC-M51, LHCR-51, LHCS-51

Process Pressure
Hydrostatic

With HART Electronics

HART® COMMUNICATION PROTOCOL



Valid from software version:
01.00.zz

PEPPERL+FUCHS

With regard to the supply of products, the current issue of the following document is applicable: The General Terms of Delivery for Products and Services of the Electrical Industry, published by the Central Association of the Electrical Industry (Zentralverband Elektrotechnik und Elektroindustrie (ZVEI) e.V.) in its most recent version as well as the supplementary clause: "Expanded reservation of proprietorship".

Overview of Documentation

	LHC-M51, PPC-M51	**LHCR-51, LHCS-51**	**Content**	**Remarks**
Technical Information	TI00436O	TI00437O	Technical data	The documentation is available on the Internet. → see: www.peperl-fuchs.com
Operating Instruction	BA00382O		• Identification • Installation • Wiring • Operation • Commissioning • Examples of configuration • Description of parameters • Maintenance • Troubleshooting • Appendix	• The documentation can be found on the documentation CD. • The documentation is also available on the Internet. → see: www.peperl-fuchs.com
Brief Operating Instruction	KA01030O	KA01033O	• Installation • Wiring • Local operation • Commissioning	• The documentation is supplied with the device. • The documentation can also be found on the documentation CD supplied. • The documentation is also available on the Internet. → see: www.peperl-fuchs.com

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1 Safety Instructions

1.1 Designated use

The LHC-M51 and PPC-M51 is a pressure transmitter for measuring level and pressure.

The LHCR-51 and LHCS-51 is a hydrostatic pressure sensor for measuring level and pressure.

The manufacturer accepts no liability for damages resulting from incorrect use or use other than that designated.

1.2 Installation, commissioning and operation

The device is designed to meet state-of-the-art safety requirements and complies with applicable standards and EU regulations. If used incorrectly or for applications for which it is not intended, however, it can be a source of application-related danger, e. g. product overflow due to incorrect installation or configuration. For this reason, installation, connection to the electricity supply, commissioning, operation and maintenance of the measuring system must only be carried out by trained, qualified specialists authorized to perform such work by the facility's owner-operator. The specialist staff must have read and understood these Operating Instructions and must follow the instructions they contain. Modifications and repairs to the devices are permissible only if they are expressly approved in the Operating Instructions. Pay particular attention to the technical data and information on the nameplate.

1.3 Operational and process safety

Alternative monitoring measures have to be taken while configuring, testing or servicing the device to ensure the operational and process safety.

WARNING Only disassemble the device in pressureless condition!

1.3.1 Hazardous areas (optional)

If using the measuring system in hazardous areas, the appropriate national standards and regulations must be observed. The device is accompanied by separate Ex documentation, which is an integral part of these Operating Instructions. The installation regulations, connection values and safety instructions listed in this Ex document must be observed.

Ensure that all personnel are suitably qualified.

1.3.2 Functional Safety SIL (optional)

If using devices for applications with safety integrity, the Manual "Safety Integrity Level" must be observed thoroughly.

1.4 Notes on safety conventions and icons

In order to highlight safety-relevant or alternative operating procedures in the manual, the following conventions have been used, each indicated by a corresponding icon in the margin.

1.4.1 Safety symbols

Symbol	Meaning
DANGER P0011189-EN	**DANGER!** This symbol alerts you to a dangerous situation. Failure to avoid this situation will result in serious or fatal injury.
WARNING P0011190-EN	**WARNING!** This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in serious or fatal injury.
CAUTION P0011191-EN	**CAUTION!** This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or medium injury.
NOTICE P0011192-EN	**NOTE!** This symbol contains information on procedures and other facts which do not result in personal injury.

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1.4.2 Electrical symbols

Symbol	Meaning
	**Explosion-protected, type-examined equipment** If the device has this symbol embossed on its nameplate, it can be used in a hazardous area or a non-hazardous area, depending on the approval.
	**Hazardous area** This symbol is used in the drawings of these Operating Instructions to indicate hazardous areas. • Devices used in hazardous areas must possess an appropriate type of protection.
	**Safe area (non-hazardous area)** This symbol is used in the drawings of these Operating Instructions to indicate non-hazardous areas. • Devices used in hazardous areas must possess an appropriate type of protection. Cables used in hazardous areas must meet the necessary safety-related characteristic quantities.

Symbol	Meaning
 P0011197	**Direct current** A terminal to which DC voltage is applied or through which direct current flows.
 P0011198	**Alternating current** A terminal to which alternating voltage (sine-wave) is applied or through which alternating current flows.
 P0011200	**Ground connection** A grounded terminal which, as far as the operator is concerned, is grounded via a grounding system.
 P0011199	**Protective ground connection** A terminal which must be connected to ground prior to establishing any other connections.
 P0011201	**Equipotential connection** A connection that has to be connected to the plant grounding system: This may be a potential equalization line or a star grounding system depending on national or company codes of practice
	**Connecting cable immunity to temperature change** Indicates that the connecting cables have to withstand a temperature of 85 °C at least.

1.4.3 Symbols for certain types of information

Symbol	Meaning
 P0011194	**Reference to documentation** Refers to the corresponding device documentation.
 P0011195	**Reference to page** Refers to the corresponding page number.
 P0011196	**Reference to graphic** Refers to the corresponding graphic number and page number.
	**Series of steps**
1., 2., 3. ...	**Several steps**
	Result of a sequence of actions
 P0013562	**Help in the event of a problem**

2 Identification

2.1 Device designation

2.1.1 Nameplate

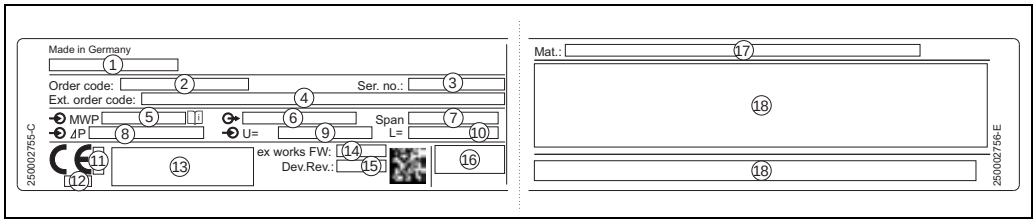
NOTICE

- The MWP (maximum working pressure) is specified on the nameplate. This value refers to a reference temperature of 20 °C (68 °F) or 100 °F (38 °C) for ANSI flanges.
- The pressure values permitted at higher temperatures can be found in the following standards:
  - EN 1092-1: 2001 Tab. 18 [1]
  - ASME B 16.5a – 1998 Tab. 2-2.2 F316
  - ASME B 16.5a – 1998 Tab. 2.3.8 N10276
  - JIS B 2220
- The test pressure corresponds to the over pressure limit (OPL) of the device = MWP x 1.5 [2].
- The Pressure Equipment Directive (EC Directive 97/23/EC) uses the abbreviation "PS". The abbreviation "PS" corresponds to the MWP (maximum working pressure) of the measuring device.

1 With regard to their stability-temperature property, the materials 1.4435 and 1.4404 are grouped together under 13EO in EN 1092-1 Tab. 18. The chemical composition of the two materials can be identical.

2 The equation does not apply for LHC-M51 with a 40 bar (600 psi) or a 100 bar (1500 psi) measuring cell.

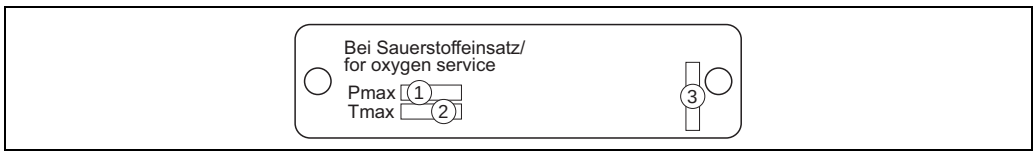
Aluminium housing



1 Nameplate

1 Device name
2 Order code (for re-orders)
3 Serial number (for identification)
4 Extended order code (complete)
5 MWP (maximum working pressure)
6 Electronic version (output signal)
7 Min./max. span
8 Nominal measuring range
9 Supply voltage
10 Unit of length
11 ID number of notified body with regard to ATEX (optional)
12 ID number of notified body with regard to Pressure Equipment Directive (optional)
13 Approvals
14 Software version
15 Device version
16 Degree of protection
17 Wetted materials
18 Approval-specific information

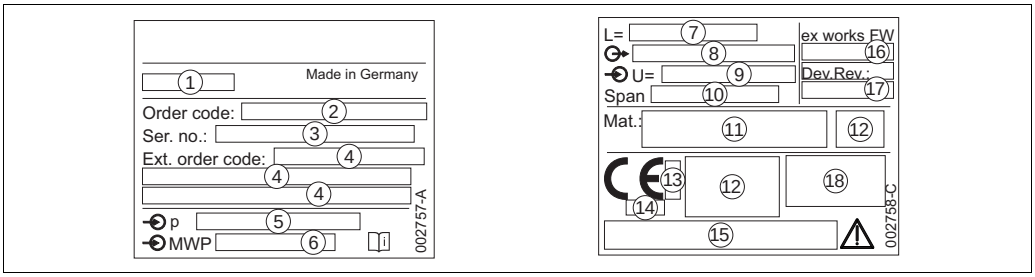
Devices suitable for oxygen applications are fitted with an additional nameplate.



2 Additional nameplate for devices suitable for oxygen application

1 Maximum pressure for oxygen applications
2 Maximum temperature for oxygen applications
3 Layout identification of the nameplate

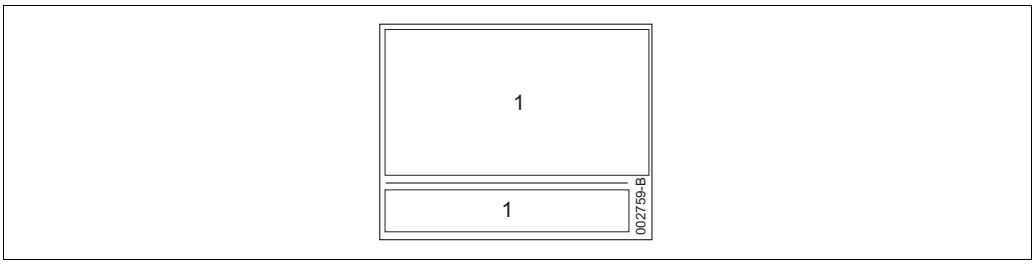
Stainless steel housing, hygienic



3 Nameplate

1 Device name
2 Order code (for re-orders)
3 Serial number (for identification)
4 Extended order code (complete)
5 Nominal measuring range
6 MWP (maximum working pressure)
7 Length data
8 Electronic version (output signal)
9 Supply voltage
10 Min./max. span
11 Wetted materials
12 Approval-specific information
13 ID number of notified body with regard to ATEX (optional)
14 ID number of notified body with regard to Pressure Equipment Directive (optional)
15 Approvals
16 Software version
17 Device version
18 Degree of protection

Devices with certificates are fitted with an additional plate.



4 Additional nameplate for devices with certificates

1 Approval-specific information

2.1.2 Identifying the sensor type

- In the case of gauge pressure sensors, the "Pos. zero adjust" parameter appears in the operating menu ("Setup" → "Pos. zero adjust").
- In the case of absolute pressure sensors, the "Calib. offset" parameter appears in the operating menu ("Setup" → "Calib. offset").

2.2 Scope of delivery

The scope of delivery comprises:

- Device
- CD-ROM with documentation
- Optional accessories

Documentation supplied:

- Operating Instruction BA00382O and the Brief Operating Instructions can be found on the documentation CD provided. → 2, "Overview of Documentation" section.
- Brief Operating Instruction: KA01030O (LHC-M51, PPC-M51), KA01033O (LHCR-51, LHCS-51)
- Final inspection report
- Additional Safety Instructions for ATEX, IECEx and NEPSI devices
- Optional: factory calibration form, test certificates

2.3 CE mark, Declaration of Conformity

The devices are designed to meet state-of-the-art safety requirements, have been tested and left the factory in a condition in which they are safe to operate. The devices comply with the applicable standards and regulations as listed in the EC Declaration of Conformity and thus comply with the statutory requirements of the EC Directives. Pepperl+Fuchs confirms the conformity of the device by affixing to it the CE mark.

2.4 Registered trademarks

KALREZ, VITON, TEFLON
Registered trademark of E.I. Du Pont de Nemours & Co., Wilmington, USA
TRI-CLAMP
Registered trademark of Ladish & Co., Inc., Kenosha, USA
HART
Registered label of the HART Communication Foundation, Austin, USA
GORE-TEX®
Registered trademark of W.L. Gore & Associates, Inc., USA

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3 Installation

3.1 Incoming acceptance, transport, storage

3.1.1 Incoming acceptance

- Check the packaging and the contents for damage.
- Check the shipment, make sure nothing is missing and that the scope of supply matches your order.

3.1.2 Transport

⚠ CAUTION

- Follow the safety instructions and transport conditions for devices of more than 18 kg (39.69 lbs).
- Transport the measuring device to the measuring point in its original packaging or at the process connection.

3.1.3 Storage

- The device must be stored in a dry, clean area and protected against damage from impact (EN 837-2).

Storage temperature range: See Technical Informations TI00436O (LHC-M51, PPC-M51) or TI00437O (LHCR-51, LHCS-51).

3.2 Installation conditions

3.2.1 Dimensions

- For dimensions, please refer to the Technical Informations TI00436O (LHC-M51, PPC-M51) or TI00437O (LHCR-51, LHCS-51), "Mechanical construction" section.
  See also → 2, "Overview of Documentation" section.

3.3 Installing pressure transmitters LHC-M51, PPC-M51

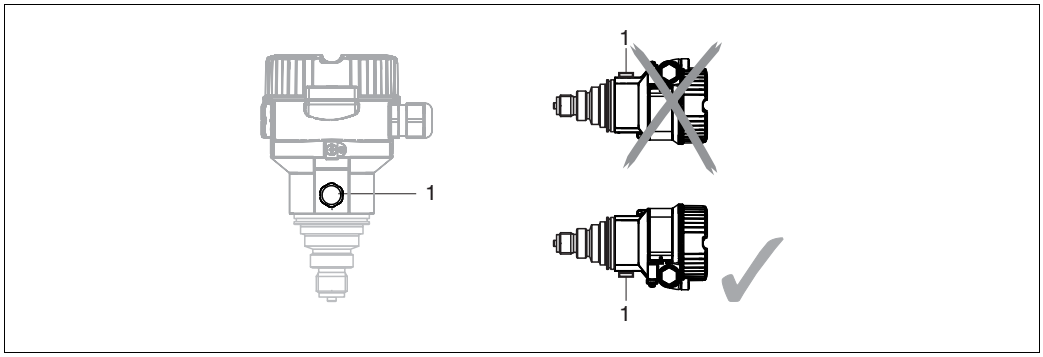
NOTICE

- Due to the orientation of the pressure transmitter, there may be a shift in the zero point, i. e. when the container is empty or partially full, the measured value does not display zero. You can correct this zero point shift, → 27, "Function of the operating elements" or → 40, "Position zero adjustment".
- Pepperl+Fuchs offers a mounting bracket for installing on pipes or walls.
  → 13, "Wall and pipe mounting (optional)".

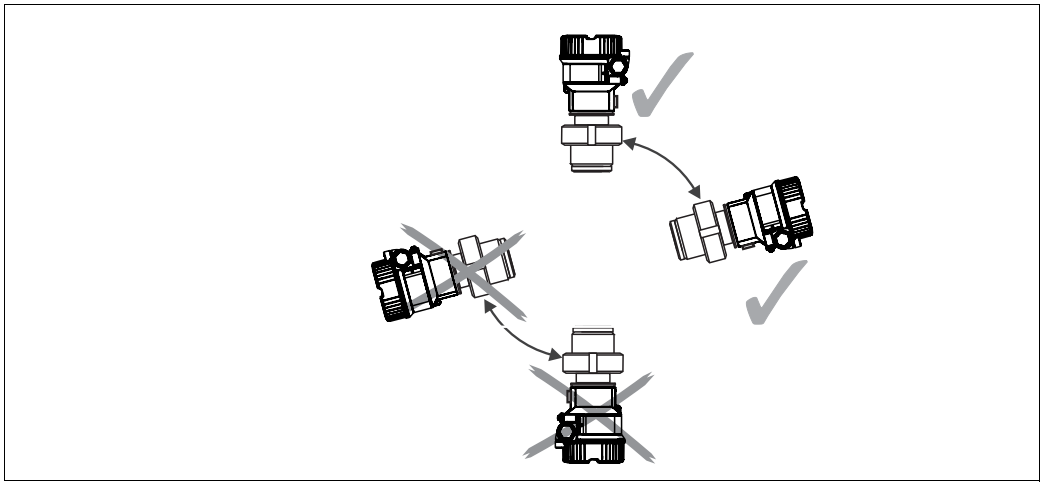
3.3.1 Installation instructions

NOTICE

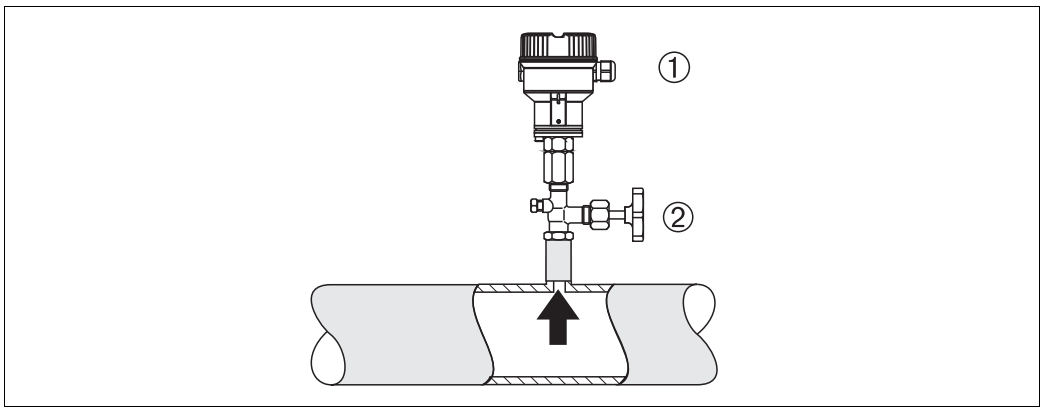
- If a heated pressure transmitter is cooled during the cleaning process (e. g. by cold water), a vacuum develops for a short time, whereby moisture can penetrate the sensor through the pressure compensation (1). If this is the case, mount the pressure transmitter with the pressure compensation (1) pointing downwards.



- Keep the pressure compensation and GORE-TEX® filter (1) free from contamination.
- pressure transmitters without diaphragm seals are mounted as per the norms for a manometer (DIN EN 837-2). We recommend the use of shutoff devices and siphons. The orientation depends on the measuring application.
- Do not clean or touch process isolating diaphragms with hard or pointed objects.
- The device must be installed as follows in order to comply with the cleanability requirements of the ASME-BPE (Part SD Cleanability):



Pressure measurement in gases



5 Measuring arrangement for pressure measurement in gases

1 Pressure transmitter
2 Shutoff device

- Mount the pressure transmitter with the shutoff device above the tapping point so that any condensate can flow into the process.

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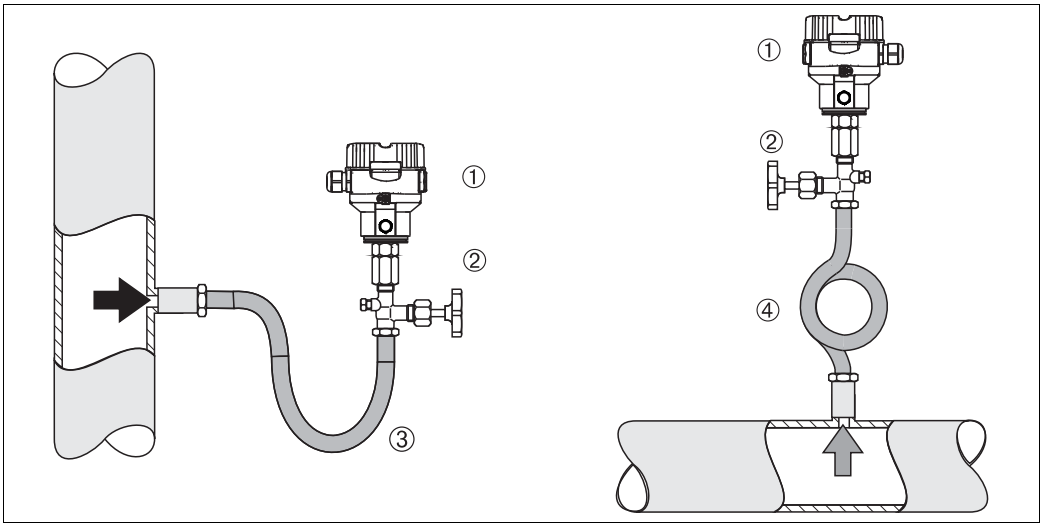
Pressure measurement in steams

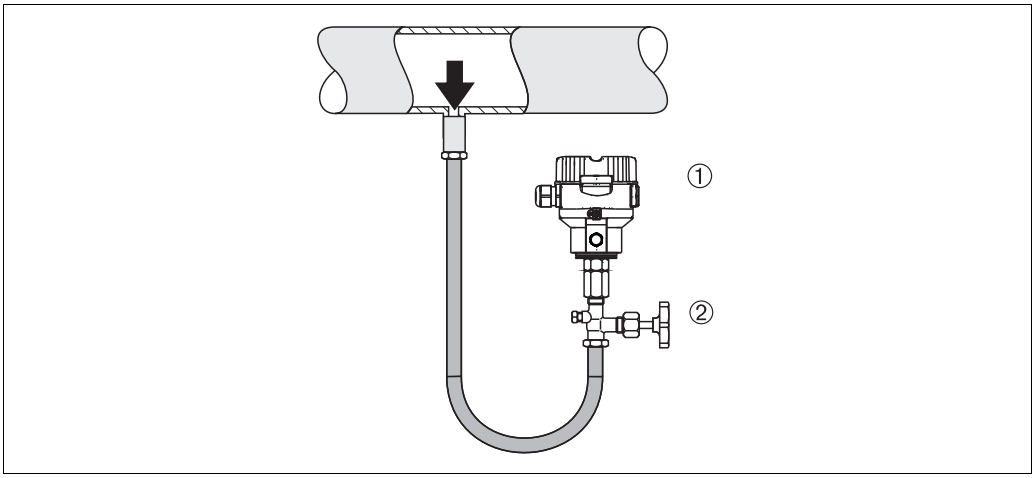


6 Measuring arrangement for pressure measurement in steams

1 Pressure transmitter
2 Shutoff device
3 U-shaped siphon
4 Circular siphon

- Mount the pressure transmitter with siphon above the tapping point.
- Fill the siphon with liquid before commissioning.
  The siphon reduces the temperature to almost the ambient temperature.

Pressure measurement in liquids

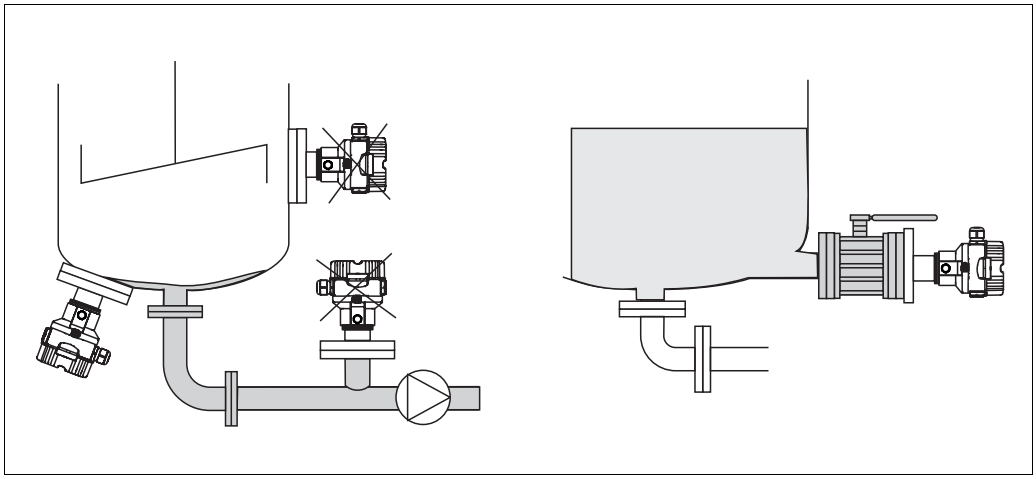


7 Measuring arrangement for pressure measurement in liquids

1 Pressure transmitter
2 Shutoff device

- Mount the pressure transmitter with shutoff device below or at the same level as the tapping point.

Level measurement



8 Measuring arrangement for level

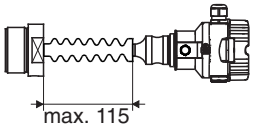
- Always install the pressure transmitter below the lowest measuring point.
- Do not mount the device in the filling curtain or at a point in the tank which could be affected by pressure pulses from an agitator.
- Do not mount the device in the suction area of a pump.
- The calibration and functional test can be carried out more easily if you mount the device downstream of a shutoff device.

PVDF interchangeable threaded boss

NOTICE

A maximum torque of 7 Nm (5.16 lbs ft) is permitted for devices with a PVDF interchangeable threaded boss. The thread connection may become loose at high temperatures and pressures. This means that the integrity of the thread must be checked regularly and may need to be tightened using the torque given above. Teflon tape is recommended for sealing the 1/2NPT thread.

Mounting with temperature isolator



Pepperl+Fuchs recommends the use of temperature isolators in the event of constant extreme medium temperatures which lead to the maximum permissible electronics temperature of +85 °C (+185 °F) being exceeded. To minimize the influence of rising heat, Pepperl+Fuchs recommends the device be mounted horizontally or with the housing pointing downwards.

The additional installation height also brings about a zero point shift of approx. 21 mbar (0.315 psi) due to the hydrostatic column in the temperature isolator. You can correct this zero point shift, → 27, "Function of the operating elements" or → 40, "Position zero adjustment".

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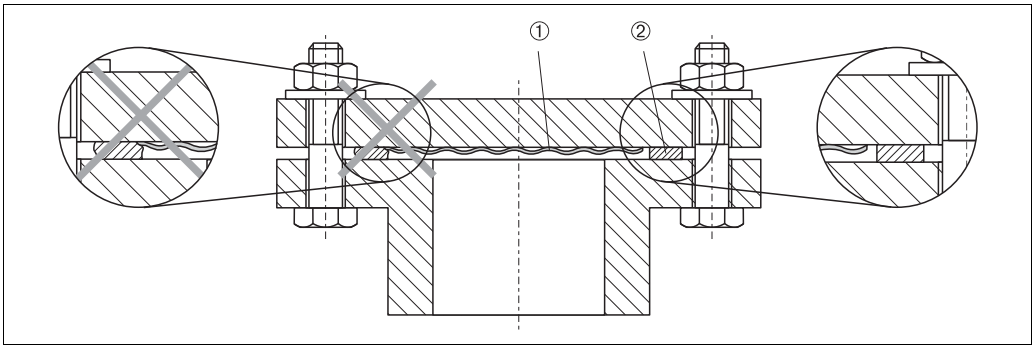
3.3.2 Seal for flange mounting



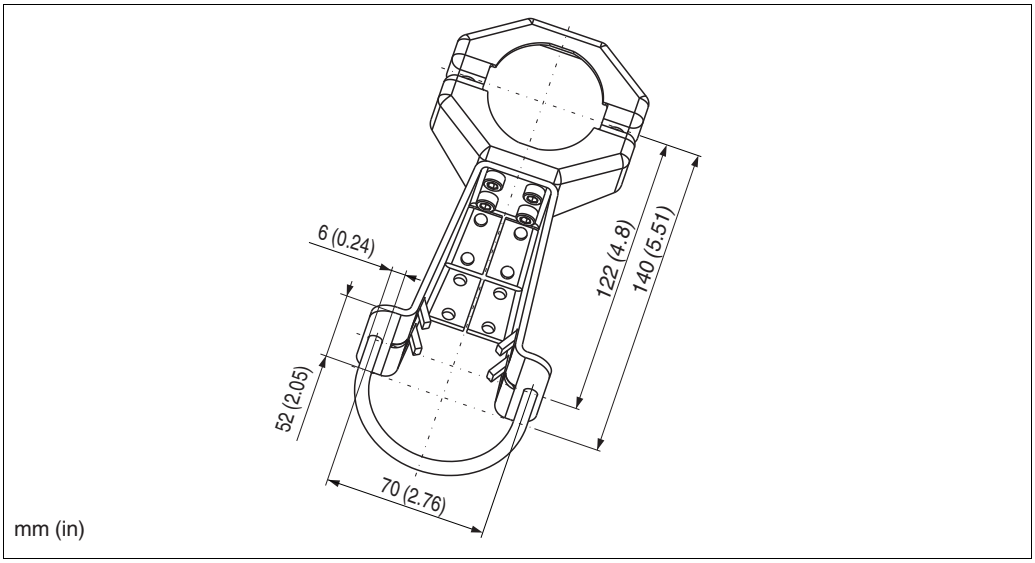
9 Mounting the versions with a flange

1 Process isolating diaphragm
2 Seal

WARNING The seal is not allowed to press against the process isolating diaphragm as this could affect the measurement result.

3.3.3 Wall and pipe mounting (optional)

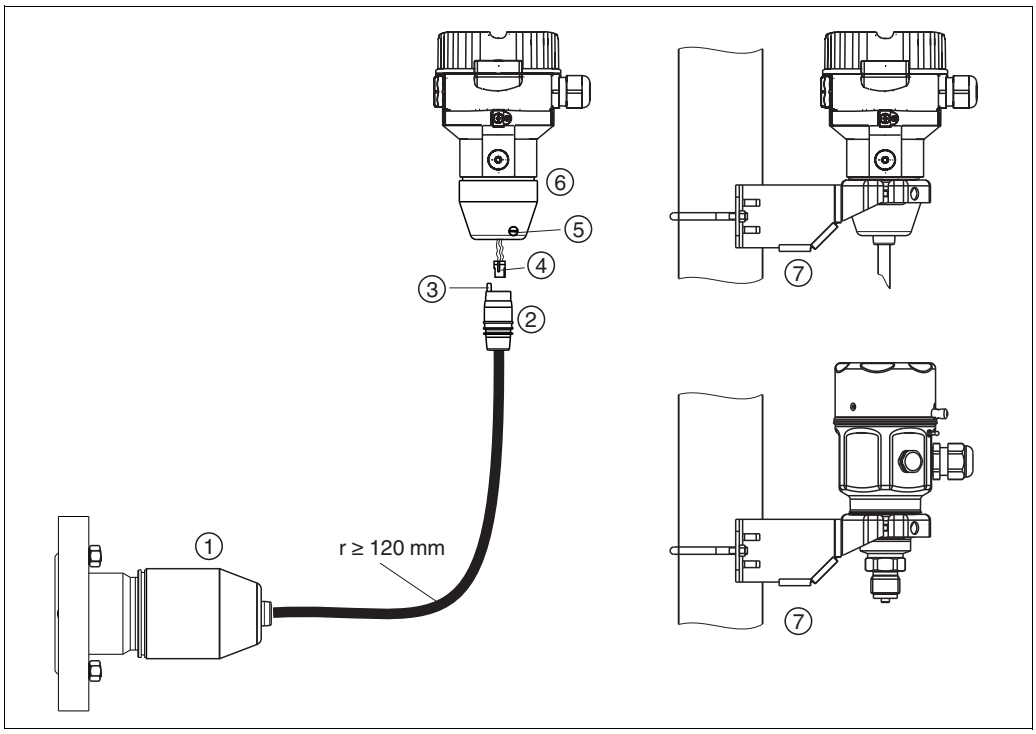
Pepperl+Fuchs offers a mounting bracket for installing on pipes or walls (for pipes from 1-1/4 in up to 2 in diameter).



Please note the following when mounting:

- Devices with capillary tubes: mount capillaries with a bending radius ≥ 100 mm (3.94 in).
- When mounting on a pipe, tighten the nuts on the bracket uniformly with a torque of at least 5 Nm (3.69 lbs ft).

3.3.4 Assembling and mounting the"separate housing" version



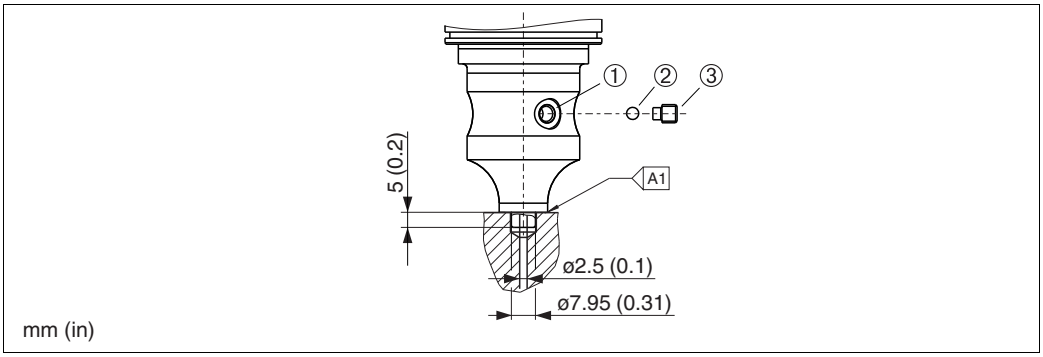
10 "Separate housing" version

1 In the case of the "separate housing" version, the sensor is delivered with the process connection and cable ready mounted.
2 Cable with connection jack
3 Pressure compensation
4 Connector
5 Locking screw
6 Housing mounted with housing adapter, included
7 Mounting bracket provided, suitable for pipe and wall mounting (for pipes from 1-1/4 in up to 2 in diameter)

Assembly and mounting

1. Insert the connector (4) into the corresponding connection jack of the cable (2).
2. Plug the cable into the housing adapter (6).
3. Tighten the locking screw (5).
4. Mount the housing on a wall or pipe using the mounting bracket (7).
   When mounting on a pipe, tighten the nuts on the bracket uniformly with a torque of at least 5 Nm (3.6 lbs ft).
   Mount the cable with a bending radius (r) ≥ 120 mm (4.72 in).

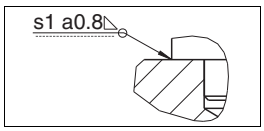
3.3.5 LHC-M51, version prepared for diaphragm seal mount – welding recommendation



11 Version XSJ: prepared for diaphragm seal mount

1 Hole for fill fluid
2 Bearing
3 Setscrew
A1 See the "Welding recommendation" table below

Pepperl+Fuchs recommends welding on the diaphragm seal as follows for the "XSJ" version in feature "Process connections" in the order code up to, and including, 40 bar (600 psi) sensors: the total welding depth of the fillet weld is 1 mm (0.04 in) with an outer diameter of 16 mm (0.63 in). Welding is performed according to the WIG method.

Consecutive seam no.	Sketch/welding groove shape, dimension as per DIN 8551	Base material matching	Welding process DIN EN/ISO 24063	Welding position	Inert gas, additives
A1 for sensors ≤40 bar (600 psi)		Adapter made of AISI 316L (1.4435) to be welded to diaphragm seal made of AISI 316L (1.4435 or 1.4404)	141	PB	Inert gas Ar/H 95/5 Additive: ER 316L Si (1.4430)

Information on filling

The diaphragm seal must be filled as soon as it has been welded on.

- After welding into the process connection, the sensor assembly must be properly filled with a filling oil and sealed gas-tight with a sealing ball and lock screw.
  Once the diaphragm seal has been filled, the device display should not exceed 10 % of the full scale value of the cell measuring range at the zero point. The internal pressure of the diaphragm seal must be corrected accordingly.
- Adjustment/calibration:
  - The device is operational once it has been fully assembled.
  - Perform a reset. The device then has to be calibrated to the process measuring range as explained in the Operating Instructions.
  - Once the device has been switched on, the total reset code (7864) must be entered in the path: "Expert" →"System" →"Management" →"Enter reset code (124)" (→ 36, section "Resetting to factory settings (reset)"). The electronics then read all the specific sensor data out of the sensor electronics. The device then has to be calibrated to the process measuring range as explained in the Operating Instructions.

3.4 Installing pressure transmitter LHCR-51, LHCS-51

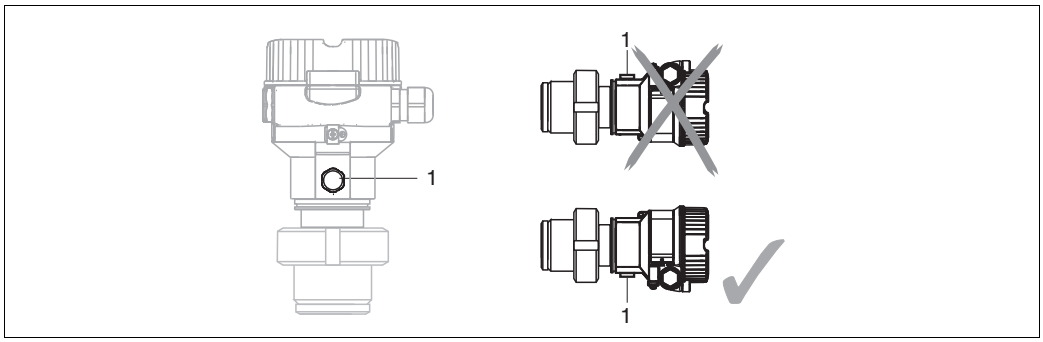
NOTICE

- Due to the orientation of the pressure transmitter, there may be a shift in the zero point, i. e. when the container is empty or partially full, the measured value does not display zero. You can correct this zero point shift, → 27, "Function of the operating elements" or → 40, "Position zero adjustment".
- The local display can be rotated in 90° stages.
- Pepperl+Fuchs offers a mounting bracket for installing on pipes or walls. → 17, section "Wall and pipe mounting (optional)".

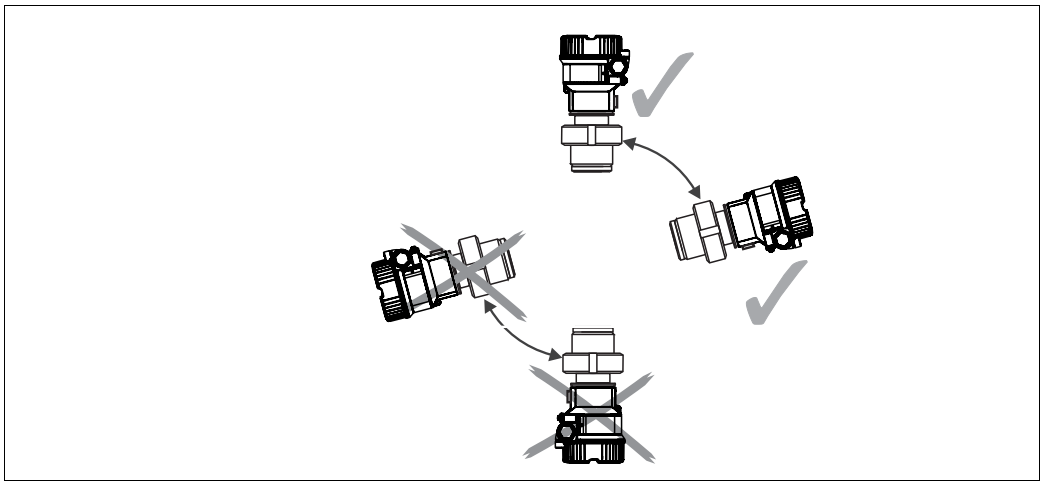
3.4.1 General installation instructions

NOTICE

- Do not clean or touch process isolating diaphragms with hard or pointed objects.
- The process isolating diaphragm in the rod and cable version is protected against mechanical damage by a plastic cap.
- If a heated pressure transmitter is cooled during the cleaning process (e. g. by cold water), a vacuum develops for a short time, whereby moisture can penetrate the sensor through the pressure compensation (1). If this is the case, mount the pressure transmitter with the pressure compensation (1) pointing downwards.



- Keep the pressure compensation and GORE-TEX® filter (1) free from contamination.
- The device must be installed as follows in order to comply with the cleanability requirements of the ASME-BPE (Part SD Cleanability):



- When mounting rod and cable versions, make sure that the probe head is located at a point as free as possible from flow. To protect the probe from impact resulting from lateral movement, mount the probe in a guide tube (preferably made of plastic) or secure it with a clamping fixture.
- In the case of devices for hazardous areas, comply strictly with the safety instructions when the housing cover is open.
- The length of the extension cable or the probe rod is based on the planned level zero point. The height of the protective cap must be taken into consideration when designing the layout of the measuring point. The level zero point (E) corresponds to the position of the process isolating diaphragm.
  Level zero point = E; top of the probe = L.

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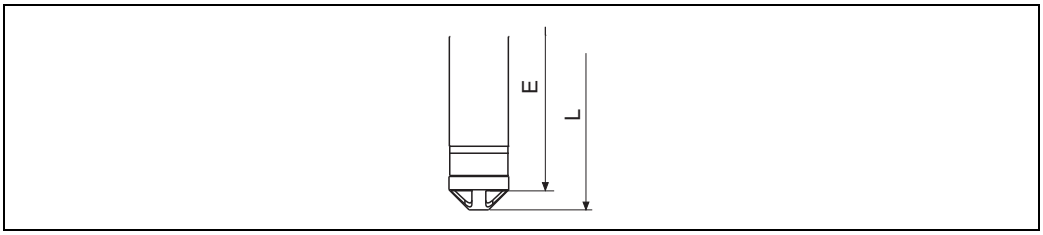
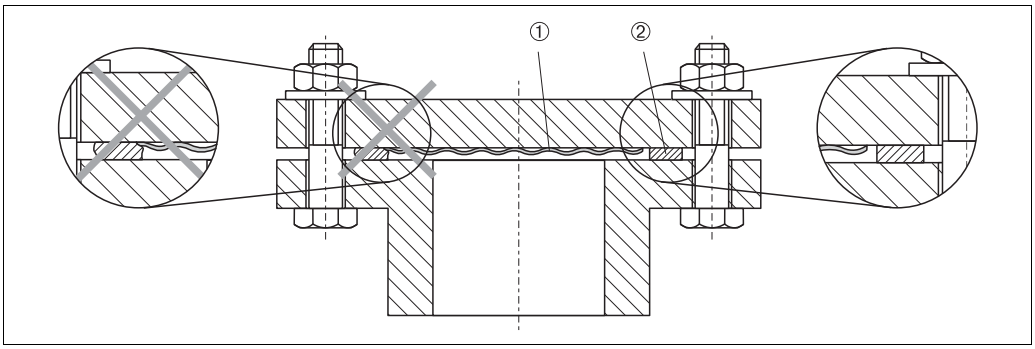


3.4.2 Seal for flange mounting



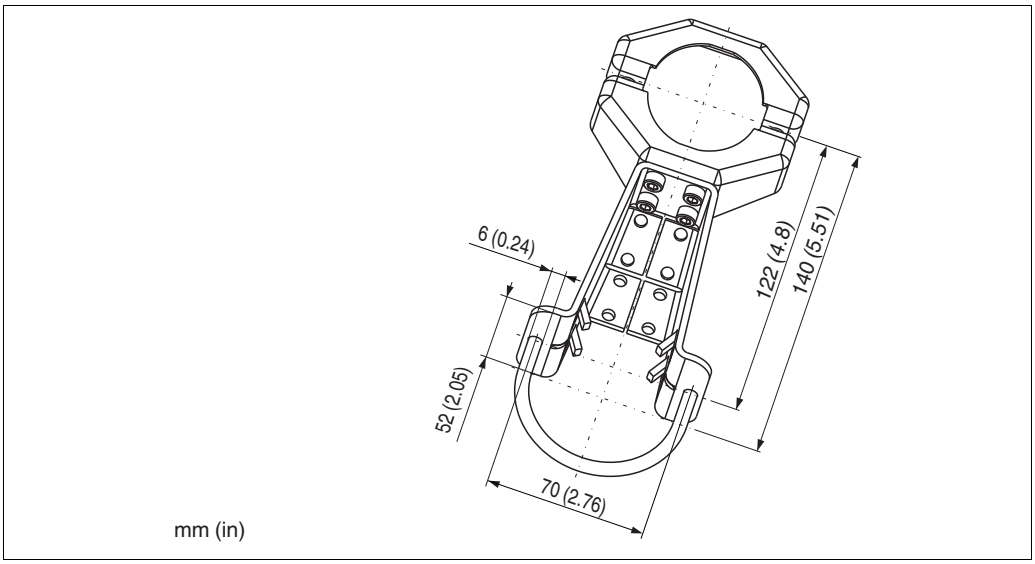
12 Mounting the versions with a flange

1 Process isolating diaphragm
2 Seal

WARNING The seal is not allowed to press against the process isolating diaphragm as this could affect the measurement result.

3.4.3 Wall and pipe mounting (optional)

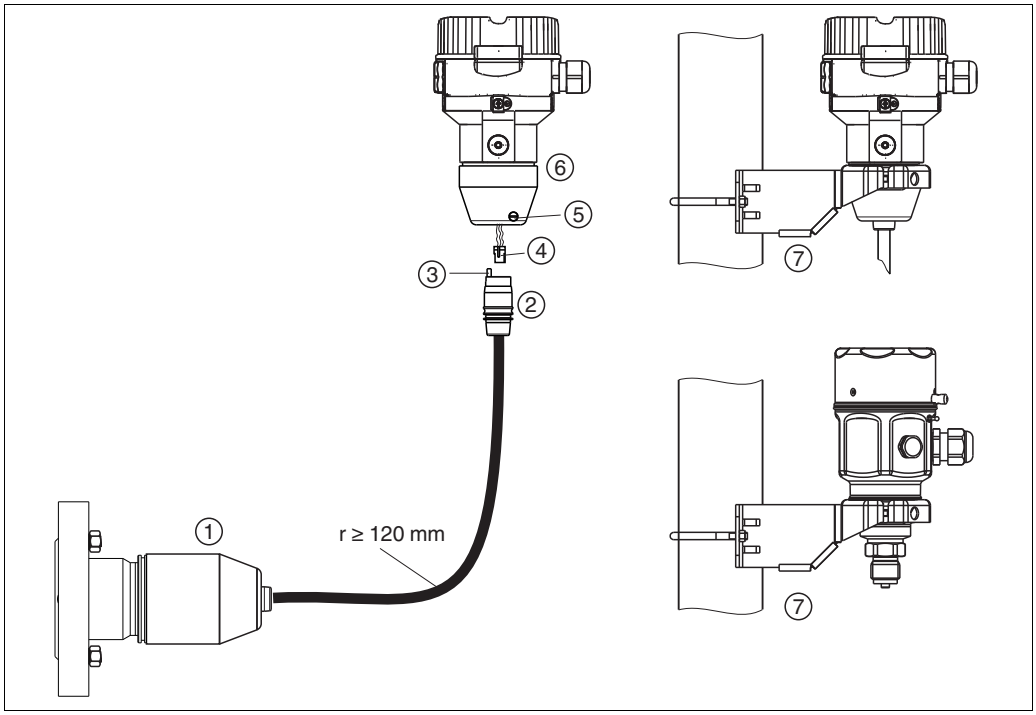
Pepperl+Fuchs offers a mounting bracket for installing on pipes or walls (for pipes from 1-1/4 in up to 2 in diameter).



In the case of pipe mounting

- The nuts on the bracket must be tightened uniformly with a torque of at least 5 Nm (3.69 lbf ft).

3.4.4 Assembling and mounting the "separate housing" version



13 "Separate housing" version

1 In the case of the "separate housing" version, the sensor is delivered with the process connection and cable ready mounted.
2 Cable with connection jack
3 Pressure compensation
4 Connector
5 Locking screw
6 Housing mounted with housing adapter, included
7 Mounting bracket provided, suitable for pipe and wall mounting (for pipes from 1-1/4 in up to 2 in diameter)

Assembly and mounting

1. Insert the connector (4) into the corresponding connection jack of the cable (2).
2. Plug the cable into the housing adapter (6).
3. Tighten the locking screw (5).
4. Mount the housing on a wall or pipe using the mounting bracket (7).
   When mounting on a pipe, tighten the nuts on the bracket uniformly with a torque of at least 5 Nm (3.69 lbf ft). Mount the cable with a bending radius (r) ≥ 120 mm (4,72 in).

Routing the cable (e. g. through a pipe)

You require the cable shortening kit.

3.4.5 Supplementary installation instructions

Seal

- LHCR-51, LHCS-51 with a G 1-1/2 thread:
  When screwing the device into the tank, the flat seal has to be positioned on the sealing surface of the process connection. To avoid additional strain on the process isolating diaphragm, the thread should never be sealed with hemp or similar materials.
- LHCR-51, LHCS-51 with NPT threads:
  - Wrap Teflon tape around the thread to seal it.
  - Tighten the device at the hexagonal bolt only. Do not turn at the housing.
  - Do not overtighten the thread when screwing. Max. torque: 20 Nm to 30 Nm (14.75 lbf ft to 22.13 lbf ft)

Sealing the probe housing

- Moisture must not penetrate the housing when mounting the device, establishing the electrical connection and during operation.
- Always firmly tighten the housing cover and the cable entries.

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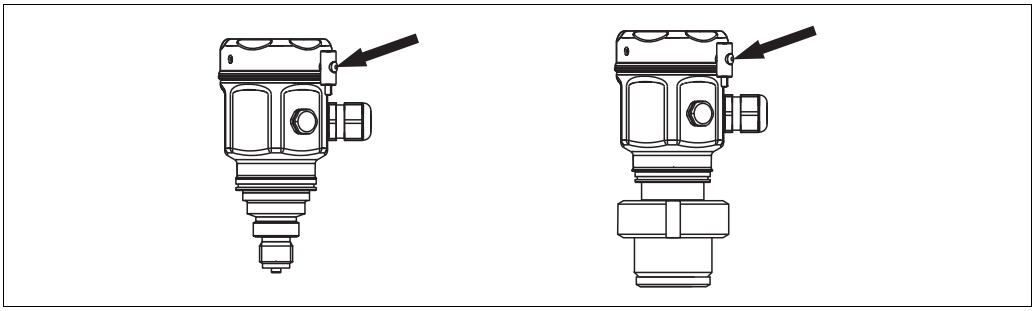
3.5 Closing the cover on the stainless steel housing



14 Closing the cover

The cover for the electronics compartment is tightened by hand at the housing until the stop. The screw serves as DustEx protection (only available for devices with DustEx approval).

3.6 Post-installation check

After installing the device, carry out the following checks:

- Are all screws firmly tightened?
- Are the housing covers screwed down tight?

4 Wiring

4.1 Connecting the device

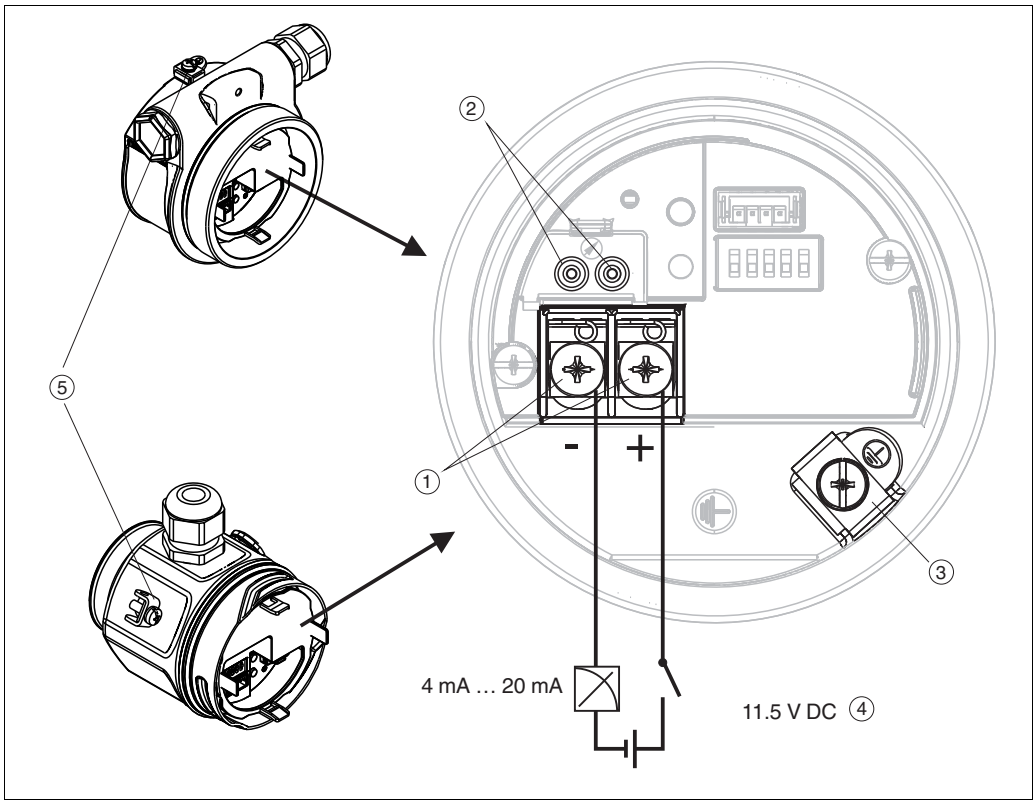
WARNING Risk of electric shock and/or explosion in hazardous areas! In a wet environment, do not open the cover if voltage is present.

NOTICE

- When using the measuring device in hazardous areas, installation must comply with the corresponding national standards and regulations and the Safety Instructions or Installation or Control Drawings.
- A suitable circuit breaker has to be provided for the device in accordance with IEC/EN 61010.
- Devices with integrated overvoltage protection must be earthed.
- Protective circuits against reverse polarity, HF influences and overvoltage peaks are integrated.

The procedure

1. Check if the supply voltage matches the specified supply voltage on the nameplate.
2. Switch off the supply voltage before connecting the device.
3. Remove housing cover.
4. Guide cable through the gland. Preferably use twisted, screened two-wire cable.
5. Connect device in accordance with the following diagram.
6. Screw down housing cover.
7. Switch on supply voltage.



15 Electrical connection 4 mA to 20 mA HART

1 Terminals for supply voltage and signal
2 Test terminals
3 Grounding terminal
4 Supply voltage: 11.5 V DC to 45 VDC (versions with plug connectors: 35 V DC)
5 External ground terminal

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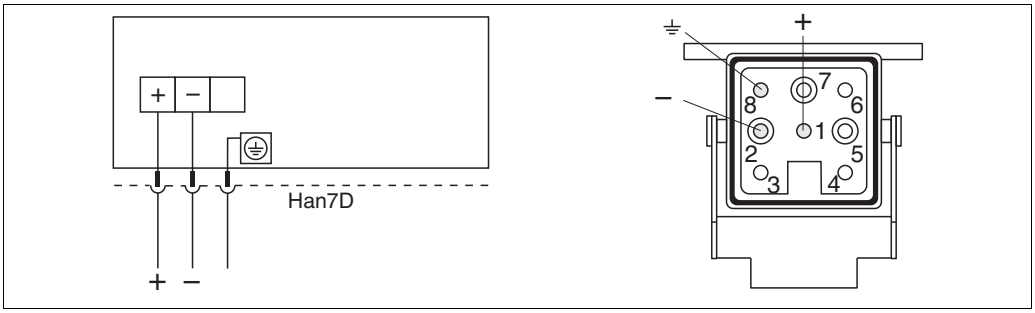
4.1.1 Connecting devices with a Harting connector Han7D

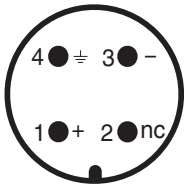


16

Left: electrical connection for devices with a Harting connector Han7D
Right: view of the connection at the device

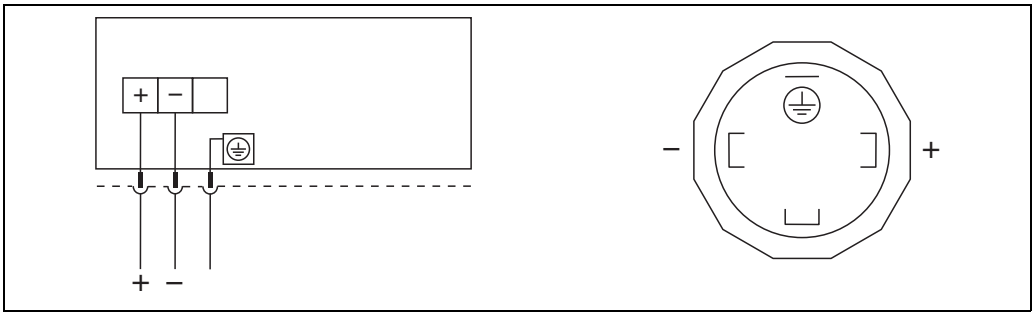
4.1.2 Connecting devices with an M12 connector

PIN assignment for M12 connector



PIN	Meaning
1	Signal +
2	not assigned
3	Signal –
4	Earth

4.1.3 Devices with valve connector



17

Left: electrical connection for devices with a valve connector
Right: view of the connector at the device

4.2 Connecting the measuring unit

4.2.1 Supply voltage

NOTICE

- When using the measuring device in hazardous areas, installation must comply with the corresponding national standards and regulations and the Safety Instructions or Installation or Control Drawings.
- All explosion protection data are given in separate documentation which is available upon request. The Ex documentation is supplied as standard with all devices approved for use in explosion hazardous areas.

Electronic version	
4 mA to 20 mA HART, for non-hazardous areas	11.5 V DC to 45 V DC (versions with plug-in connector 35 V DC)

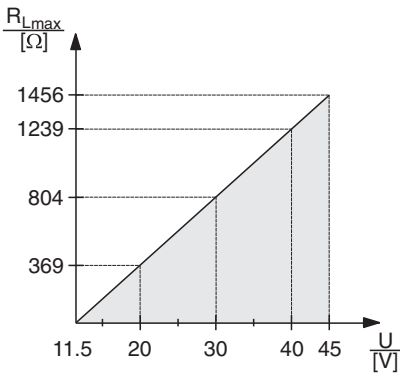
Taking 4 mA to 20 mA test signal

A 4 mA to 20 mA test signal may be measured via the test terminals without interrupting the measurement. To keep the corresponding measured error below 0.1 %, the current measuring device should exhibit an internal resistance of < 0.7 Ω

4.2.2 Cable specification

- Pepperl+Fuchs recommends using twisted, shielded two-wire cables.
- Terminals for wire cross-sections 0.5 mm^2 to 2.5 mm^2 (20 AWG to 14 AWG)
- Cable outer diameter: 5 mm to 9 mm (0.2 in to 0.35 in) depends on the used cable gland (see technical information)

4.2.3 Load



18 Load diagram, Supply voltage 11.5 V DC to 45 V DC (versions with plug-in connector 35 V DC) for other types of protection and for uncertified device versions

R_{Lmax} Maximum load resistance
U Supply voltage

NOTICE

When operating via a handheld terminal or via a PC with an operating program, a minimum communication resistance of 250 Ω must be taken into account.

4.2.4 Shielding/potential equalization

- A normal device cable suffices if only the analog signal is used. A shielded cable is recommended if using the HART protocol. Observe grounding concept of the plant.
- When using in hazardous areas, you must observe the applicable regulations. Separate Ex documentation with additional technical data and instructions is included with all Ex systems as standard. Connect all devices to the local potential equalization.

4.2.5 Connecting handheld

Compact, flexible and robust industry handheld terminal for remote parametrization and measured value inspection via the HART current output (4 mA to 20 mA).

4.2.6 Connecting HART modem

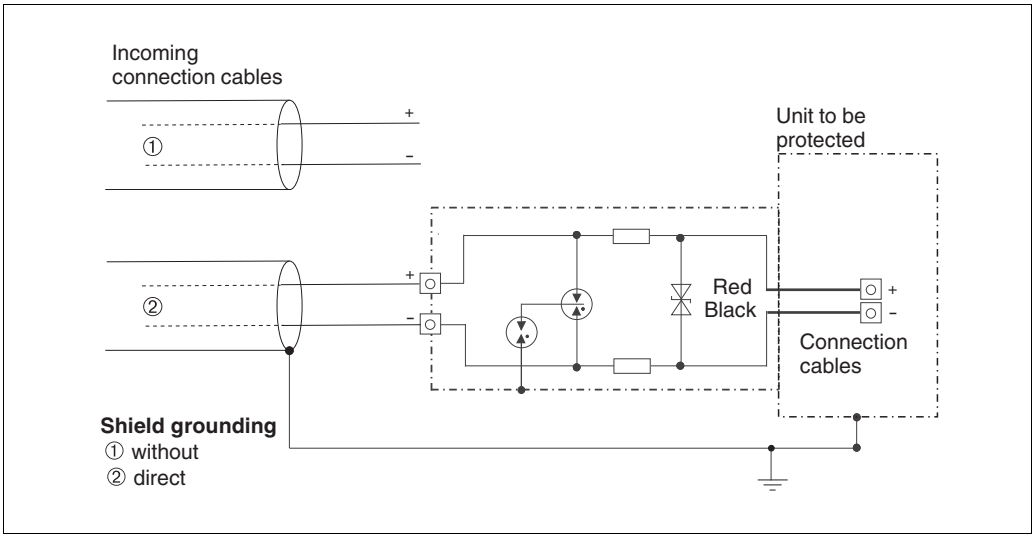
The HART modem connects intrinsically safe transmitters with the HART protocol to a computer's USB port. This allows remote operation of the transmitter using **PACT***ware*™ operating program. Power is supplied to the modem through the USB port.

4.3 Overvoltage protection (optional)

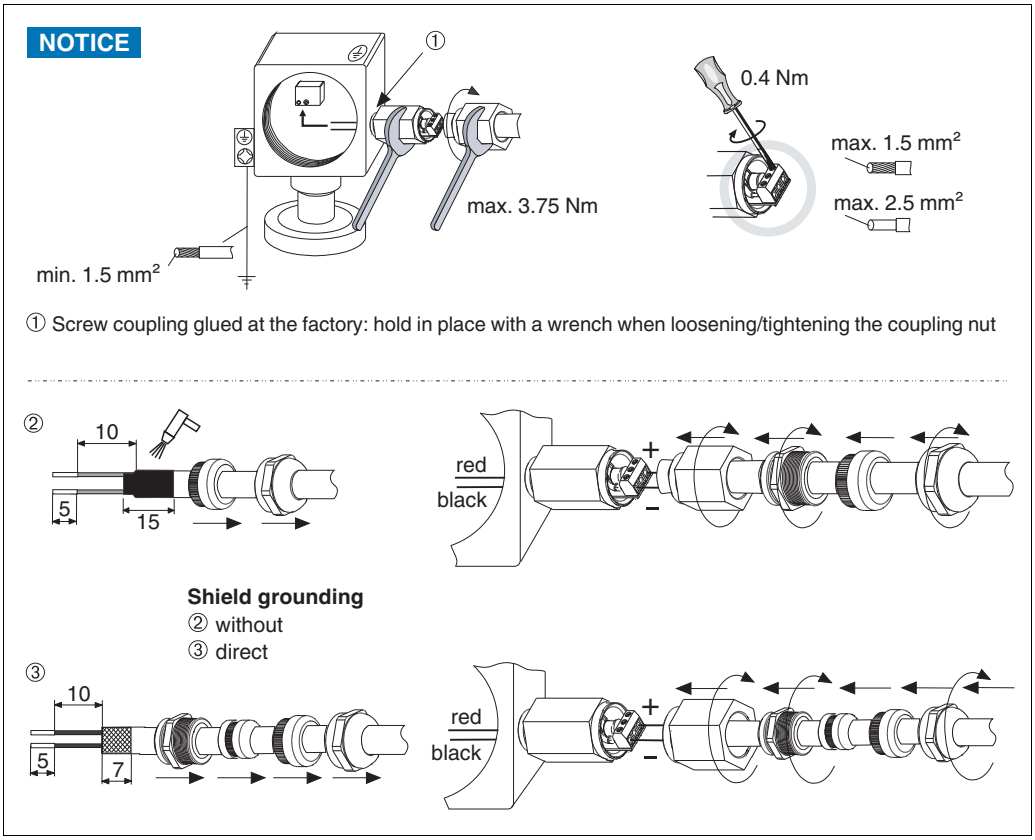
The device can be fitted with overvoltage protection. The overvoltage protection is mounted at the factory on the housing thread (M20x1.5) for the cable gland and is approx. 70 mm (2.76 in) in length (take additional length into account when installing).

The device is connected as illustrated in the following graphic.

4.3.1 Wiring



4.3.2 Installation



4.4 Post-connection check

Perform the following checks after completing electrical installation of the device:

- Does the supply voltage match the specifications on the nameplate?
- Is the device connected as per section 4.1?
- Are all screws firmly tightened?
- Are the housing covers screwed down tight?

As soon as voltage is applied to the device, the green LED on the electronic insert lights up for a few seconds or the connected local display lights up.

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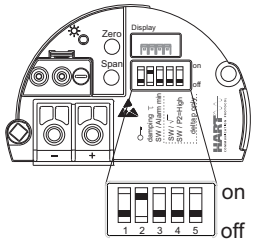
5 Operation

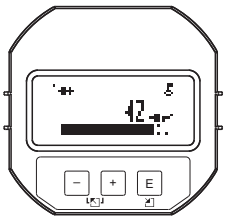
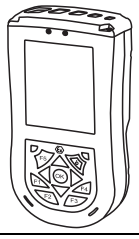
5.1 Operating options

5.1.1 Operation without operating menu

Operating options	Explanation	Graphic illustration	Description
Local operation without device display	The device is operated using the operating keys and DIP switches on the electronic insert.		→ 26

5.1.2 Operation with operating menu

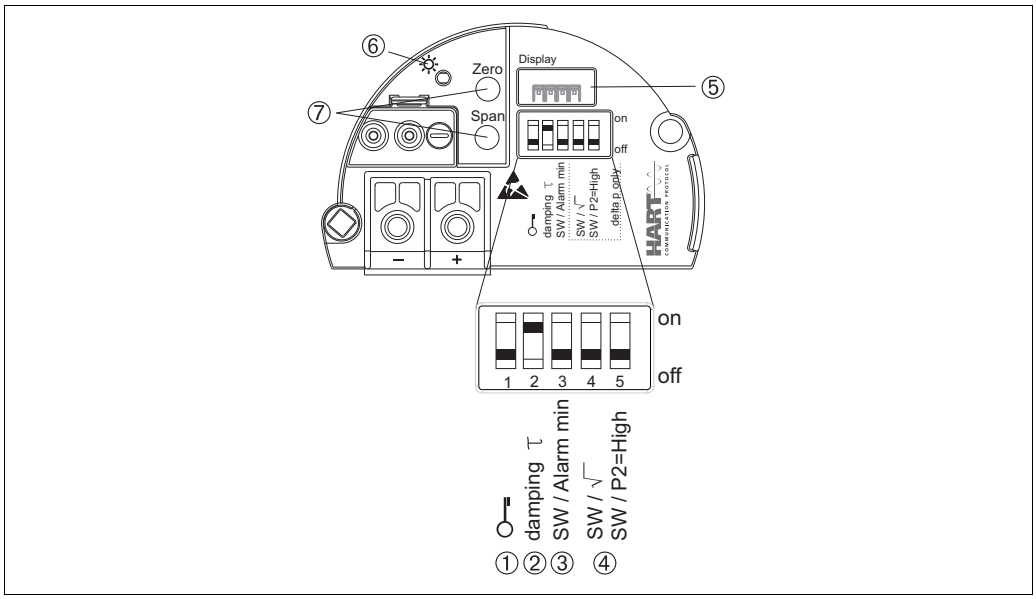
Operation with an operating menu is based on an operation concept with "user roles" → 28.

Operating options	Explanation	Graphic illustration	Description
Local operation with device display	The device is operated using the operating keys on the device display.		→ 30
Remote operation via HART handheld terminal	The device is operated using the HART handheld terminal.		→ 34
Remote operation via **PACT***ware*™	The device is operated using the **PACT***ware*™ operating tool.		→ 34

5.2 Operation without operating menu

5.2.1 Position of operating elements

The operating keys and DIP switches are located on the electronic insert in the device.



HART electronic insert

1 DIP switch for locking/unlocking parameters relevant to the measured value
2 DIP switch for switching damping on/off
3 DIP switch for alarm current SW/Alarm Min (3.6 mA)
4 DIP switch not used.
5 Slot for optional local display
6 Green LED to indicate successful operation
7 Operating keys for lower range value (zero) and upper range value (span)

5.2.2 Function of the DIP switches

Switch	Symbol/ labeling	Switch position	
		"off"	"on"
1	⚷	The device is unlocked. Parameters relevant to the measured value can be modified.	The device is locked. Parameters relevant to the measured value cannot be modified.
2	damping τ	Damping is switched off. The output signal follows measured value changes without any delay.	Damping is switched on. The output signal follows measured value changes with the delay time τ. [1]
3	SW/Alarm min	The alarm current is defined by the setting in the operating menu. ("Setup" → "Extended setup" → "Curr. output" → "Output fail mode")	The alarm current is 3.6 mA regardless of the setting in the operating menu.

[1] The value for the delay time can be configured via the operating menu ("Setup" → "Damping"). Factory setting: τ = 2 s or as per order specifications.

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5.2.3 Function of the operating elements

Operating key(s)	Meaning
"Zero" pressed for at least 3 seconds	**Set LRV** • **"Pressure" measuring mode** - The pressure present is accepted as the lower range value (LRV). • **"Level" measuring mode, "In pressure" level selection, "Wet" calibration mode** - The pressure present is assigned to the lower level value ("Empty calibration"). **NOTICE** No function is assigned to the key if level selection = "In height" and/or calibration mode = "Dry".
"Span" pressed for at least 3 seconds	**Set URV** • **"Pressure" measuring mode** - The pressure present is accepted as the upper range value (LRV). • **"Level" measuring mode, "In pressure" level selection, "Wet" calibration mode** - The pressure present is assigned to the upper level value ("Full calibration"). **NOTICE** No function is assigned to the key if level selection = "In height" and/or calibration mode = "Dry".
"Zero" and **"Span"** pressed simultaneously for at least 3 seconds	**Position adjustment** The sensor characteristic curve is shifted such that the pressure present becomes the zero value.
"Zero" and **"Span"** pressed simultaneously for at least 12 seconds	**Reset** All parameters are reset to the order configuration.

5.2.4 Locking/unlocking operation

Once you have entered all the parameters, you can lock your entries against unauthorized and undesired access.

NOTICE

If operation is locked by means of the DIP switch, you can only unlock operation again by means of the DIP switch. If operation is locked by means of the operating menu, you can only unlock operation again using the operating menu.

Locking/unlocking via DIP switches

DIP switch 1 on the electronic insert is used to lock/unlock operation.

→ 26, section "Function of the DIP switches".

5.3 Operation with an operating menu

5.3.1 Operation concept

The operation concept makes a distinction between the following user roles:

User role	Meaning
Operator	Operators are responsible for the devices during normal "operation". This is usually limited to reading process values either directly at the device or in a control room. If the work with the devices extends beyond value read-off tasks, the tasks involve simple, application-specific functions that are used in operation. Should an error occur, these users simple forward the information on the errors but do not intervene themselves.
Service engineer/ technician	Service engineers usually work with the devices in the phases following device commissioning. They are primarily involved in maintenance and troubleshooting activities for which simple settings have to be made at the device. Technicians work with the devices over the entire life cycle of the product. Thus, commissioning and advanced settings and configurations are some of the tasks they have to carry out.
Expert	Experts work with the devices over the entire product life cycle, but their device requirements are often extremely high. Individual parameters/functions from the overall functionality of the devices are required for this purpose time and again. In addition to technical, process-oriented tasks, experts can also perform administrative tasks (e. g. user administration). "Experts" can avail of the entire parameter set.

5.3.2 Structure of the operating menu

User role	Submenu	Meaning/use
Operator	Language	Only consists of the "Language" parameter (000) where the operating language for the device is specified. The language can always be changed even if the device is locked.
Operator	Display/operat.	Contains parameters that are needed to configure the measured value display (selecting the values displayed, display format, display contrast, etc.). With this submenu, users can change the measured value display without affecting the actual measurement.
Service engineer/ technician	Setup	Contains all the parameters that are needed to commission measuring operations. This submenu has the following structure: • **Standard setup parameters** A wide range of parameters, which can be used to configure a typical application, is available at the start. The measuring mode selected determines which parameters are available. After making settings for all these parameters, the measuring operation should be completely configured in the majority of cases. • **"Extended setup" submenu** The "Setup" submenu contains additional parameters for more in-depth configuration of the measurement operation to convert the measured value and to scale the output signal. This menu is split into additional submenus depending on the measuring mode selected.
Service engineer/ technician	Diagnosis	Contains all the parameters that are needed to detect and analyze operating errors. This submenu has the following structure: • **Diagnostic list** Contains up to 10 error messages currently pending. • **Event logbook** Contains the last 10 error messages (no longer pending). • **Instrument info** Contains information on the device identification. • **Measured values** Contains all the current measured values • **Simulation** Is used to simulate pressure, level, flow, current and alarm/warning. • **Reset**

User role	Submenu	Meaning/use
Expert	Expert	Contains all the parameters of the device (including those in one of the submenus). The "Expert" submenu is structured by the function blocks of the device. It thus contains the following submenus: • **System** Contains all the device parameters that neither affect measurement nor integration into a distributed control system. • **Measurement** Contains all the parameters for configuring the measurement. • **Output** Contains all the parameters for configuring the current output. • **Communication** Contains all the parameters for configuring the HART interface. • **Application** Contains all the parameters for configuring the functions that go beyond the actual measurement (e. g. totalizer). • **Diagnosis** Contains all the parameters that are needed to detect and analyze operating errors.

NOTICE For an overview of the entire operating menu: → 28.

Direct access to parameters

The parameters can only be accessed directly via the "Expert" user role.

Parameter name	Description
Direct Access (119) Entry Menu path: Expert →Direct Access	Enter the direct access code to go directly to a parameter. **Options:** • Enter the desired parameter code. **Factory setting:** 0 **Note:** For direct access, it is not necessary to enter leading zeros.

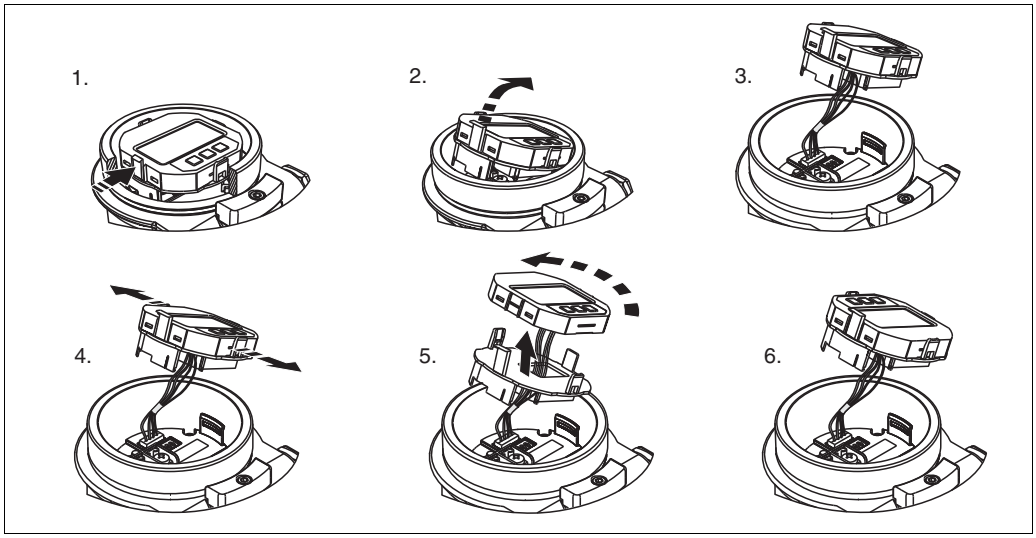
5.3.3 Operation with a device display (optional)

A 4-line liquid crystal display (LCD) is used for display and operation. The local display shows measured values, dialog texts, fault messages and notice messages.

For easy operation the display can be taken out of the housing (1) to (3). It is connected to the device through a 90 mm (3.54 in) cable.

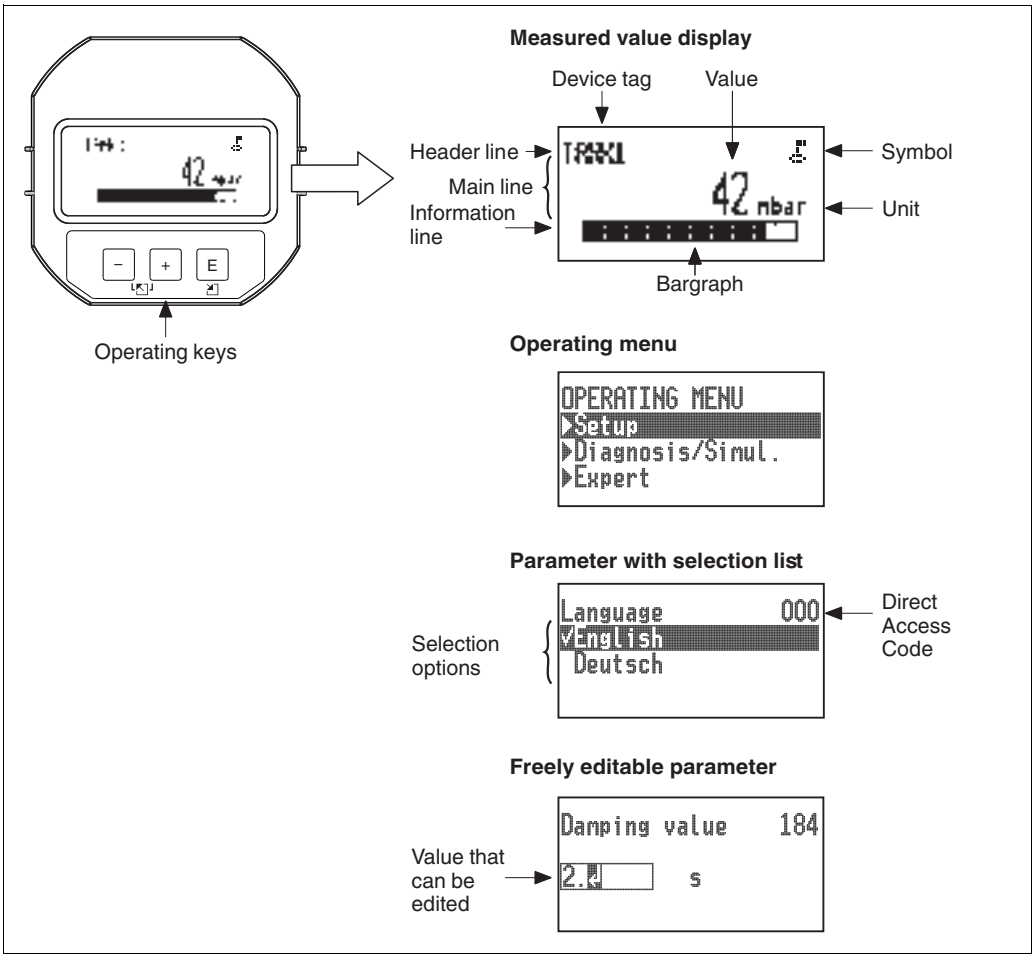
The display of the device can be turned in 90° stages (4) to (6).

Depending on the orientation of the device, this makes it easy to operate the device and read the measured values.



Functions:

- 8-digit measured value display including sign and decimal point, bargraph for 4 mA to 20 mA HART as current display
- Three keys for operation
- Simple and complete menu guidance as parameters are split into several levels and groups
- Each parameter is given a 3-digit parameter code for easy navigation
- Possibility of configuring the display to suit individual requirements and preferences, such as language, alternating display, contrast setting, display of other measured values such as sensor temperature etc.
- Comprehensive diagnostic functions (fault and warning message etc.)



The following table illustrates the symbols that can appear on the local display. Four symbols can occur at one time.

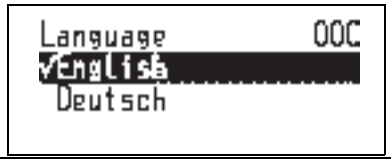
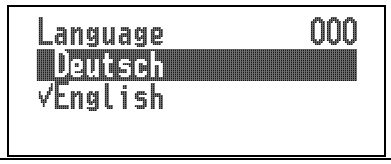
Symbol	Meaning
	Lock symbol The operation of the device is locked. To unlock the device, → 35, "Locking/unlocking operation".
	Communication symbol Data transfer via communication
S	**Error message "Out of specification"** The device is being operated outside its technical specifications (e. g. during warm-up or cleaning processes).
C	**Error message "Service mode"** The device is in the service mode (during a simulation, for example).
M	**Error message "Maintenance required"** Maintenance is required. The measured value remains valid.
F	**Error message "Failure detected"** An operating error has occurred. The measured value is no longer valid.

Operating keys on the display and operating module

Operating key(s)	Meaning
[+]	• Navigate downwards in the picklist • Edit the numerical values and characters within a function
[–]	• Navigate upwards in the picklist • Edit the numerical values and characters within a function
[E]	• Confirm entry • Jump to the next item • Selection of a menu item and activation of the editing mode
[+] and [E]	Contrast setting of local display: darker
[–] and [E]	Contrast setting of local display: brighter
[+] and [+]	**ESC functions:** • Exit the edit mode for a parameter without saving the changed value. • You are in a menu at a selection level. Each time you press the keys simultaneously, you go up a level in the menu.

Parameter with picklist

Example: selecting "Deutsch" as the language of the menu.

Local display	Operation
	"English" is set as the menu language (default value). A ✓ in front of the menu text indicates the active option.
	Select "Deutsch" with "+" or "–".
	1. Confirm your choice with "E". A ✓ in front of the menu text indicates the active option. ("Deutsch" is now selected as the menu language.) 2. Exit the edit mode for the parameter with "E" .

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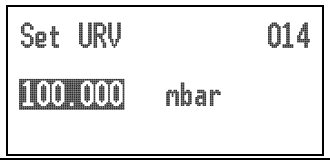
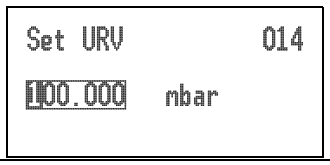
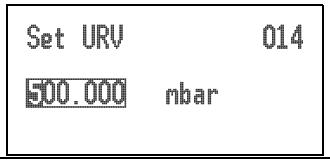
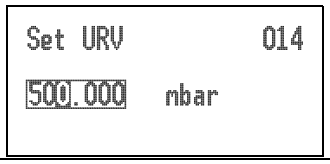
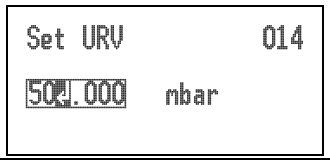
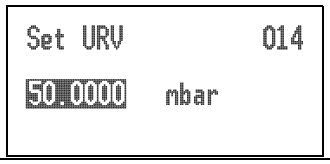
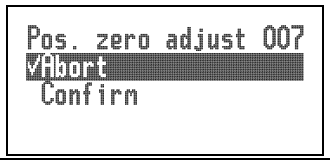
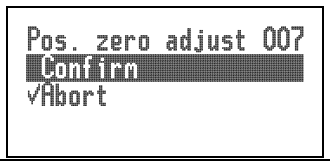
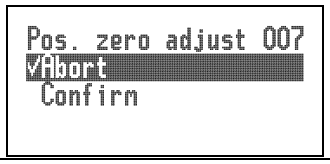
User-definable parameters

Example: setting "Set URV" parameter from 100 mbar (1.5 psi) to 50 mbar (0.75 psi).

Local display	Operation
	The local display shows the parameter to be changed. The value highlighted in black can be changed. The "mbar" unit is specified in another parameter and cannot be modified here.
	1. Press "+" or "–" to get to the editing mode. 2. The first digit is highlighted in black.
	1. Use "+" to change "1" to "5". 2. Confirm "5" with "E". The cursor jumps to the next position (highlighted in black). 3. Confirm "0" with "E" (second position).
	The third position is highlighted in black and can now be edited.
	1. Switch to the "↵" symbol with the "–" key. 2. Use "E" to save the new value and exit the editing mode. →See next graphic.
	The new value for the upper range value is 50.0 mbar (0.75 psi). • You exit the edit mode for the parameter with "E" . • You can get back to the editing mode with "+" or "–".

Accepting the pressure present

Example: setting position adjustment

Local display	Operation
	The pressure for position adjustment is present at the device.
	Use "+" or "–" to switch to the "Confirm" option. The active option is highlighted in black.
	Accept the pressure present as position adjustment with the "E" key. The device confirms the adjustment and goes back to the "Pos. zero adjust" parameter.
	Exit the edit mode for the parameter with "E".

5.3.4 Operation via field communicator

Compact, flexible and robust industry handheld terminal for remote parametrization and measured value inspection via the HART current output (4 mA to 20 mA).

5.3.5 Operation via PACT*ware*™

PACT*ware*™ is an asset management tool based on FDT technology. With **PACT***ware*™, you can configure all Pepperl+Fuchs devices as well as devices from other manufacturers that support the FDT standard. Hardware and software requirements you can find on the internet: www.pepperl-fuchs.com.

PACT*ware*™ supports the following functions:

- Configuration of transmitters in online/offline mode
- Loading and saving device data (upload/download)
- Documentation of the measuring point
- Offline parametrization of transmitters

Connection options via HART modem and USB port of a computer

NOTICE

- Further information on **PACT***ware*™ can be found on the Internet: www.pepperl-fuchs.com.
- As not all internal device dependencies can be mapped in offline operation, the consistency of the parameters must be checked before the parameters are transmitted to the device.

5.3.6 Locking/unlocking operation

Once you have entered all the parameters, you can lock your entries against unauthorized and undesired access.

Locked operation is indicated as follows:

- By the symbol on the onsite display
- The parameters are grayed out in **PACT***ware*™ and the HART handheld terminal, which means they cannot be edited. Indicated in the corresponding "Locking" parameter.

Parameters which refer to how the display appears, e. g. "Language" and "Display contrast", can still be altered.

NOTICE

If operation is locked by means of the DIP switch, you can only unlock operation again by means of the DIP switch. If operation is locked by means of the operating menu, you can only unlock operation again using the operating menu. The "Operator code" parameter is used to lock and unlock the device.

Parameter name	Description
Operator code (021) Entry Menu path: Setup → Extended setup → Operator code	Use this function to enter a code to lock or unlock operation. **User input:** • To lock: Enter a number ≠ the release code (value range: 1 to 9999). • To unlock: Enter the release code. **NOTICE** The release code is "0" in the order configuration. Another release code can be defined in the "Code definition" parameter. If the user has forgotten the release code, the release code can be visible by entering the number "5864". **Factory setting:** 0

The release code is defined in the "Code definition" parameter.

Parameter name	Description
Code definition (023) Entry Menu path: Setup → Extended setup → Code definition	Use this function to enter a release code with which the device can be unlocked. **User input:** A number between 0 and 999 **Factory setting:** 0

5.3.7 Resetting to factory settings (reset)

By entering a certain code, you can completely, or partially, reset the entries for the parameters to the factory settings. Enter the code by means of the "Enter reset code" parameter (menu path: "Expert" → "System" → "Management" → "Enter reset code").

The factory setting of each parameter is indicated in the parameter description (→ 68).

There are various reset codes for the device. The following table illustrates which parameters are reset by the particular reset codes. Operation must be unlocked to reset parameters (→ 35).

NOTICE Any customer-specific configuration carried out at the factory is not affected by a reset (customer-specific configuration remains). If you want to change the customer-specific configuration carried out at the factory, please contact Pepperl+Fuchs Service.

As no separate service level is provided, the order code and serial number may be changed without a specific unblocking code (e. g. after replacing the electronics).

Reset code [1]	Description and effect
62	**PowerUp reset (warm start)** • The device is restarted. • Data are read back anew from the EEPROM (processor is initialized again). • Any simulation which may be running is ended.
333	**User reset** • This code resets all the parameters apart from: - Device tag (022) - Linearization table - Operating hours (162) - Event logbook - Current trim 4mA (135) - Current trim 20mA (136) - Lo trim sensor (131) - Hi trim sensor (132) • Any simulation which may be running is ended. • The device is restarted.
7864	**Total reset** • This code resets all the parameters apart from: - Operating hours (162) - Event logbook - Lo trim sensor (131) - Hi trim sensor (132) • Any simulation which may be running is ended. • The device is restarted.

1 To be entered in "System" → "Management" → "Enter reset code" (124)

NOTICE After a "Total reset" in **PACT***ware*™ you have to press the "refresh" button in order to ensure that the measuring units are also reset.

6 Commissioning

WARNING If a pressure smaller than the minimum permitted pressure or greater than the maximum permitted pressure is present at the device, the following messages are output in succession:

- "S140 Working range P" or "F140 Working range P"
- "S841 Sensor range" or "F841 Sensor range"
- "S971 Adjustment"

The messages are depending on the setting in the "Alarm behavior" (050) parameter.

CAUTION The device is configured for the Pressure measuring mode as standard. The measuring range and the unit in which the measured value is transmitted correspond to the specifications on the nameplate.

6.1 Function check

Carry out a post-installation and a post-connection check as per the checklist before commissioning the device.

- "Post-installation check" checklist → 19
- "Post-connection check" checklist → 24

6.2 Commissioning without an operating menu

6.2.1 Pressure measuring mode

If no local display is connected, the following functions are possible by means of the keys on the electronic insert:

- Position adjustment (zero point correction)
- Setting lower range value and upper range value
- Device reset (→ 36)

NOTICE

- Operation must be unlocked. → 35, "Locking/unlocking operation".
- The device is configured for the "Pressure" measuring mode as standard. You can switch measuring modes by means of the "Measuring mode" parameter. → 39, "Measuring mode selection".
- The pressure applied must be within the nominal pressure limits of the sensor. See information on the nameplate.

1. Carrying out position adjustment.[1]	
Pressure is present at device.	
↓	
Press the "Zero" and "Span" keys simultaneously for at least 3 s.	
↓	
Does the LED on the electronic insert light up briefly?	
Yes	No
↓	↓
Applied pressure for position adjustment has been accepted.	Applied pressure for position adjustment has not been accepted. Observe the input limits.

2. Setting lower range value.	
Desired pressure for lower range value is present at device.	
↓	
Press the "Zero" key for at least 3 s.	
↓	
Does the LED on the electronic insert light up briefly?	
Yes	No
↓	↓
Applied pressure for lower range value has been accepted.	Applied pressure for lower range value has not been accepted. Observe the input limits.

3. Setting upper range value.	
Desired pressure for upper range value is present at device.	
↓	
Press the "Span" key for at least 3 s.	
↓	
Does the LED on the electronic insert light up briefly?	
Yes	No
↓	↓
Applied pressure for upper range value has been accepted.	Applied pressure for upper range value has not been accepted. Observe the input limits.

1 Observe warning on commissioning (→ 37)

6.2.2 Level measuring mode

The following functions are possible by means of the keys on the electronic insert:

- Position adjustment (zero point correction)
- Setting the lower and upper pressure value and assigning to the lower and upper level value
- Device reset (→ 36)

NOTICE

- The "Zero" and "Span" keys only have a function with the following setting:
  - "Level selection" = "In pressure", "Calibration mode" = "Wet"
    The keys have no function in other settings.
- The device is configured for the "Pressure" measuring mode as standard. You can switch measuring modes by means of the "Measuring mode" parameter. → 39, "Measuring mode selection"
  The following parameters are set to the following values at the factory:
  - "Level selection" = "In pressure"
  - "Calibration mode": wet
  - "Output unit": %
  - "Empty calib.": 0.0
  - "Full calib.": 100.0
  - "Set LRV": 0.0 (corresponds to 4 mA value)
  - "Set URV": 100.0 (corresponds to 20 mA value)
- Operation must be unlocked. → 35, "Locking/unlocking operation".
- The pressure applied must be within the nominal pressure limits of the sensor. See information on the nameplate.

Carrying out position adjustment.[1]	
Pressure is present at device.	
↓	
Press the "Zero" and "Span" keys simultaneously for at least 3 s.	
↓	
Does the LED on the electronic insert light up briefly?	
Yes	No
↓	↓
Applied pressure for position adjustment has been accepted.	Applied pressure for position adjustment has not been accepted. Observe the input limits.

Setting lower pressure value.	
Desired pressure for lower pressure value ("empty pressure") is present at device.	
↓	
Press the "Zero" key for at least 3 s.	
↓	
Does the LED on the electronic insert light up briefly?	
Yes	No
↓	↓
The pressure present was saved as the lower pressure value ("empty pressure") and assigned to the lower level value ("empty calibration").	The pressure present was not saved as the lower pressure value. Observe the input limits.

Setting upper pressure value.	
Desired pressure for upper pressure value ("full pressure") is present at device.	
↓	
Press the "Span" key for at least 3 s.	
↓	
Does the LED on the electronic insert light up briefly?	
Yes	No
↓	↓
The pressure present was saved as the upper pressure value ("full pressure") and assigned to the upper level value ("full calibration").	The pressure present was not saved as the upper pressure value. Observe the input limits.

1 Observe warning on commissioning (→ 37)

6.3 Commissioning with an operating menu

Commissioning comprises the following steps:

1. Function check (→ 37)
2. Selecting the language, measuring mode and pressure unit (→ 39)
3. Position adjustment (→ 40)
4. Configuring measurement:
   - Pressure measurement (→ 54 ff)
   - Level measurement (→ 41 ff)

6.3.1 Selecting the language, measuring mode and pressure unit

Language selection

Parameter name	Description
Language (000) Selection Menu path: Main menu → Language	Select the menu language for the local display. **Options:** • English • Another language (as selected when ordering the device) • Possibly a third language (language of the manufacturing plant) **Factory setting:** English

Measuring mode selection

Parameter name	Description
Measuring mode (005) Selection Menu path: Setup → Measuring mode	Select the measuring mode. The operating menu is structured differently depending on the measuring mode selected. **NOTICE** If the measuring mode is changed, no conversion takes place. If necessary, the device has to be recalibrated after the measuring mode has been changed. **Options:** • Pressure • Level • Flow **Factory setting:** Pressure

Pressure unit selection

Parameter name	Description
Press. eng. unit (125) Selection Menu path: Setup → Press. eng. unit	Select the pressure unit. If a new pressure unit is selected, all pressure-specific parameters are converted and displayed with the new unit. **Options:** • mbar, bar • mmH2O, mH2O, inH2O • ftH2O • Pa, kPa, MPa • psi • mmHg, inHg • kgf/cm^2 **Factory setting:** mbar or bar depending on the sensor nominal measuring range, or as per order specifications

6.4 Position zero adjustment

The pressure resulting from the orientation of the device can be corrected here.

Parameter name	Description
Corrected press. (172) Display Menu path: Setup → Corrected press.	Displays the measured pressure after sensor trim and position adjustment. **NOTICE** If this value is not equal to "0", it can be corrected to "0" by the position adjustment.
Pos. zero adjust (007) **(Deltabar M and gauge pressure sensor)** Selection Menu path: Setup → Pos. zero adjust	Position zero adjustment – the pressure difference between zero (set point) and the measured pressure need not be known. **Example:** • Measured value = 2.2 mbar (0.033 psi) • You correct the measured value via the "Pos. zero adjust" parameter with the "Confirm" option. This means that you assign the value 0.0 to the pressure present. • Measured value (after pos. zero adjust) = 0.0 mbar • The current value is also corrected. **Options** • Confirm • Abort **Factory setting:** Abort
Calib. offset (192) / (008) **(absolute pressure sensor)** Entry	Position adjustment – the pressure difference between set point and the measured pressure must be known. **Example:** • Measured value = 982.2 mbar (14.73 psi) • You correct the measured value with the value entered (e. g. 2.2 mbar (0.033 psi)) via the "Calib. offset" parameter. This means that you are assigning the value 980.0 (14.7 psi) to the pressure present. • Measured value (after calib. offset) = 980.0 mbar (14.7 psi) • The current value is also corrected. **Factory setting:** 0.0

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6.5 Level measurement

6.5.1 Information on level measurement

HINWEIS You have a choice of two methods for calculating the level: "In pressure" and "In height". The table in the "Overview of level measurement" section that follows provides you with an overview of these two measuring tasks.

- The limit values are not checked, i. e. the values entered must be appropriate for the sensor and the measuring task for the device to be able to measure correctly.
- Customer-specific units are not possible.
- There is no unit conversion.
- The values entered for "Empty calib./Full calib.", "Empty pressure/Full pressure", "Empty height/Full height" and "Set LRV/Set URV" must be at least 1 % apart. The value will be rejected, and a warning message displayed, if the values are too close together.

6.5.2 Overview of level measurement

Measuring task	Level selection	Measured variable selection	Description	Measured value display
Calibration is performed by entering two pressure-level value pairs.	"In pressure"	Via the "Output unit" parameter: %, level, volume or mass units.	• Calibration with reference pressure (wet calibration), see → 42 • Calibration without reference pressure (dry calibration), see → 44	The measured value display and the "Level before lin" parameter display the measured value.
Calibration is performed by entering the density and two height-level value pairs.	"In height"		• Calibration with reference pressure (wet calibration), see → 46 • Calibration without reference pressure (dry calibration), see → 48	

6.5.3 "In pressure" level selection
Calibration with reference pressure (wet calibration)

Example:

In this example, the level in a tank should be measured in "m". The maximum level is 3 m (9.8 ft). The pressure range is set to 0 mbar to 300 mbar (4.5 psi).

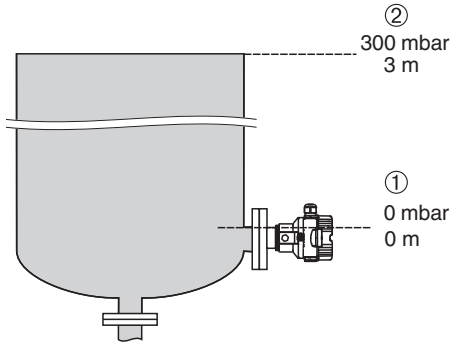
Prerequisite:

- The measured variable is in direct proportion to the pressure.
- The tank can be filled and emptied.

NOTICE

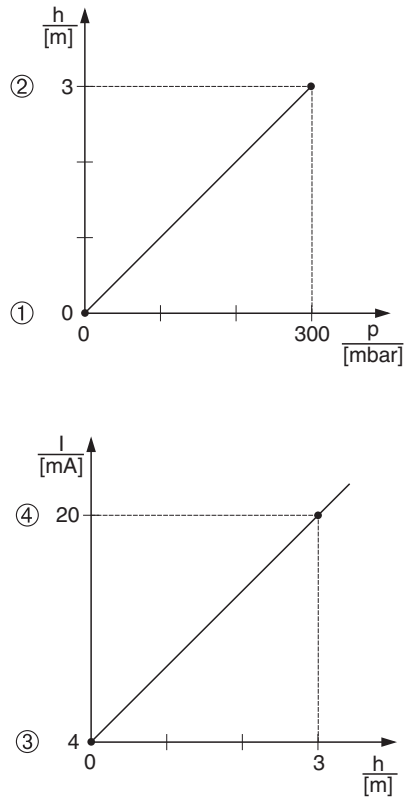
The values entered for "Empty calib./Full calib." and" Set LRV/Set URV" and the pressures present at the device must be at least 1 % apart. The value will be rejected, and a warning message displayed, if the values are too close together. Further limit values are not checked, i. e. the values entered must be appropriate for the sensor and the measuring task for the measuring device to be able to measure correctly.

	Description
1	Perform "position adjustment". See → 40
2	Select the "Level" measuring mode via the "Measuring mode (005)" parameter. Menu path: Setup → Measuring mode
3	Select the "In pressure" level mode via the "Level selection" parameter. Menu path: Setup → Extended setup → Level → Level selection.
4	Select a pressure unit via the "Press eng. unit" parameter, here "mbar" for example. Menu path: Setup → Press. eng. unit



Calibration with reference pressure – wet calibration

1 See table, step 8.
2 See table, step 9.

	Description	
5	Select a level unit via the "Output unit" parameter, here "m" for example. Menu path: Setup → Extended setup → Level → Output unit	 Calibration with refesrence pressure – wet calibration 1 See table, step 8. 2 See table, step 9. 3 See table, step 10. 4 See table, step 11.
6	Select the "Wet" option via the "Calibration mode" parameter. Menu path: Setup → Extended setup → Level → Calibration mode	
7	If calibration is performed with a medium other than the process medium, enter the density of the calibration medium in the "Adjust density" parameter. Menu path: Setup → Extended setup → Level → Adjust density	
8	The pressure for the lower calibration point is present at the device, here 0 mbar for example.	
	Select the "Empty calib." parameter. Menu path: Setup → Extended setup → Level → Empty calib.	
	Enter the level value, here 0 m for example. The pressure value present is assigned to the lower level value by confirming the value.	
9	The pressure for the upper calibration point is present at the device, here 300 mbar (4.5 psi) for example.	
	Select the "Full calib." parameter. Menu path: Setup → Extended setup → Level → Full calib.	
	Enter the level value, here 3 m (9.8 ft) for example. The pressure value present is assigned to the upper level value by confirming the value.	
10	Set the level value for the lower current value (4 mA) by means of "Set LRV". Menu path: Setup → Extended setup → Current output → Set LRV	
11	Set the level value for the upper current value (20 mA) by means of "Set URV". Menu path: Setup → Extended setup → Current output → Set URV	
12	If calibration was performed with a medium other than the process medium, specify the density of the process medium in the "Process density" parameter. Menu path: Setup → Extended setup → Level → Process density	
13	Result: The measuring range is set for 0 m to 3 m (9.8 ft).	

NOTICE The measured variables %, level, volume and mass are available for this level mode.
See → 73, "Output unit (025)".

6.5.4 "In pressure" level selection Calibration without reference pressure (dry calibration)

Example:

In this example, the volume in a tank should be measured in liters. The maximum volume of 1000 liters (264 US gal) corresponds to a pressure of 450 mbar (6.75 psi). The minimum volume of 0 liters corresponds to a pressure of 50 mbar (0.75 psi) since the device is mounted below the start of the level measuring range.

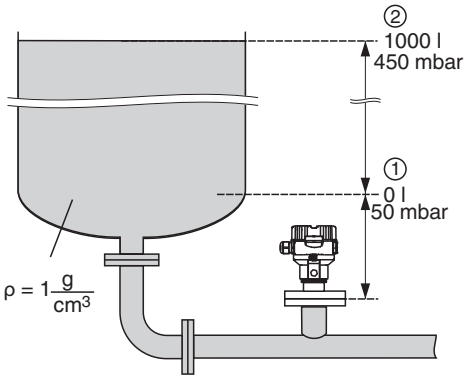
Prerequisite:

- The measured variable is in direct proportion to the pressure.
- This is a theoretical calibration i. e. the pressure and volume values for the lower and upper calibration point must be known.

NOTICE

- The values entered for "Empty calib./Full calib.", "Empty pressure/Full pressure" and "Set LRV/Set URV" must be at least 1 % apart. The value will be rejected, and a warning message displayed, if the values are too close together. Further limit values are not checked, i. e. the values entered must be appropriate for the sensor and the measuring task for the measuring device to be able to measure correctly.
- Due to the orientation of the device, there may be pressure shifts in the measured value, i. e. when the container is empty or partly filled, the measured value is not zero. For information on how to perform position adjustment, see → 40, "Position zero adjustment".

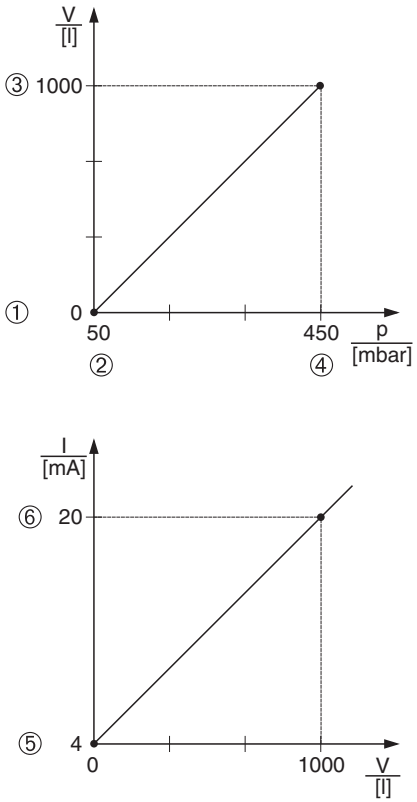
	Description
1	Select the "Level" measuring mode via the "Measuring mode" parameter. Menu path: Setup → Measuring mode
2	Select the "In pressure" level mode via the "Level selection" parameter. Menu path: Setup → Extended setup → Level → Level selection
3	Select a pressure unit via the "Press eng. unit" parameter, here "mbar" for example. Menu path: Setup → Press. eng. unit
4	Select a level unit via the "Output unit" parameter, here "l" (liters) for example. Menu path: Setup → Extended setup → Level → Output unit



Calibration without reference pressure – dry calibration

1 See table, steps 6 and 7.
2 See table, steps 8 and 9.

	Description
5	Select the "Dry" option via the "Calibration mode" parameter. Menu path: Setup → Extended setup → Level → Calibration mode
6	Enter the volume value for the lower calibration point via the "Empty calib." parameter, here 0 liters for example. Menu path: Setup → Extended setup → Level → Empty calib.
7	Enter the pressure value for the lower calibration point via the "Empty pressure" parameter, here 50 mbar (0.75 psi) for example. Menu path: Setup → Extended setup → Level → Empty pressure
8	Enter the volume value for the upper calibration point via the "Full calib." parameter, here 1000 liters (264 US gal) for example. Menu path: Setup → Extended setup → Level → Full calib.
9	Enter the pressure value for the upper calibration point via the "Full pressure" parameter, here 450 mbar (6,75 psi) for example. Menu path: Setup → Extended setup → Level → Full pressure
10	"Adjust density" contains the factory setting 1.0 but this value can be changed if required. The value pairs subsequently entered must correspond to this density. Menu path: Setup → Extended setup → Level → Adjust density
11	Set the volume value for the lower current value (4 mA) via the "Set LRV" parameter. Menu path: Setup → Extended setup → Current output → Set LRV
12	Set the volume value for the upper current value (20 mA) via the "Set URV" parameter. Menu path: Setup → Extended setup → Current output → Set URV
13	If calibration was performed with a medium other than the process medium, specify the density of the process medium in the "Process density" parameter. Menu path: Setup → Extended setup → Level → Process density
14	Result: The measuring range is set for 0 l to 1000 l (264 US gal).



Calibration with reference pressure – wet calibration

1 See table, step 6.
2 See table, step 7.
3 See table, step 8.
4 See table, step 9.
5 See table, step 11.
6 See table, step 12.

NOTICE The measured variables %, level, volume and mass are available for this level mode.
See → 73, "Output unit (025)".

6.5.5 "In height" level selection Calibration with reference pressure (wet calibration)

Example:

In this example, the volume in a tank should be measured in liters. The maximum volume of 1000 liters (264 US gal) corresponds to a level of 4.5 m (15 ft). The minimum volume of 0 liters corresponds to a level of 0.5 m (1.6 ft) since the device is mounted below the start of the level measuring range.

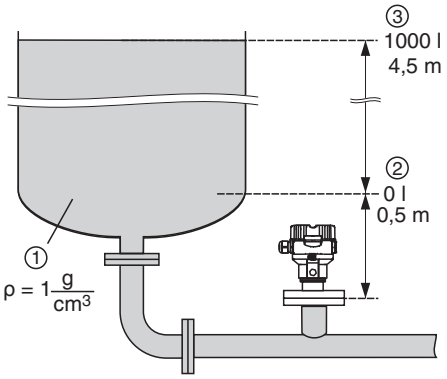
The density of the medium is 1 g/cm^3 (1 SGU).

Prerequisite:

- The measured variable is in direct proportion to the pressure.
- The tank can be filled and emptied.

NOTICE The values entered for "Empty calib./Full calib.", " Set LRV/Set URV" and the pressures present at the device must be at least 1 % apart. The value will be rejected, and a warning message displayed, if the values are too close together. Other limit values are not checked, i. e. the values entered must be appropriate for the sensor and the measuring task for the device to be able to measure correctly.

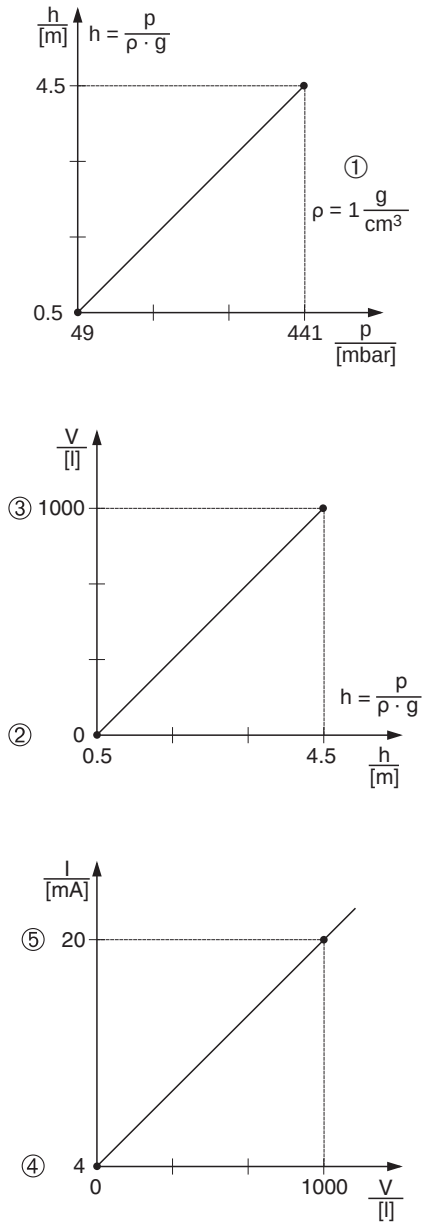
	Description
1	Perform position adjustment. See → 40.
2	Select the "Level" measuring mode via the "Measuring mode" parameter. Menu path: Setup → Measuring mode
3	Select the "In height" level mode via the "Level selection" parameter. Menu path: Setup → Extended setup → Level → Level selection
4	Select a pressure unit via the "Press eng. unit" parameter, here mbar for example. Menu path: Setup → Press. eng. unit
5	Select a level unit via the "Output unit" parameter, here "l" (liters) for example. Menu path: Setup → Extended setup → Level → Output unit



Calibration with reference pressure – wet calibration

1 See table, step 10.
2 See table, step 8.
3 See table, step 9.

	Description
6	Select a level unit via the "Height unit" parameter, here "m" for example. Menu path: Setup → Extended setup → Level →Height unit
7	Select the "Wet" option via the "Calibration mode" parameter. Menu path: Setup → Extended setup → Level → Calibration mode
8	The pressure for the lower calibration point is present at the device, here "50 mbar" (0.75 psi) for example.
	Enter the volume value for the lower calibration point via the "Empty calib." parameter, here 0 liters for example. (The pressure currently measured is displayed as the height, here 0.5 m (1.6 ft) for example.) Menu path: Setup → Extended setup → Level → Empty calib.
9	The pressure for the upper calibration point is present at the device, here "450 mbar" (6.75 psi) for example.
	Enter the volume value for the upper calibration point via the "Full calib." parameter, here "1000 liters" (264 US gal) for example. The pressure currently measured is displayed as the height, here "4.5 m" (15 ft) for example. Menu path: Setup → Extended setup → Level → Full calib.
8	If calibration is performed with a medium other than the process medium, enter the density of the calibration medium in the "Adjust density" parameter, here "1 g/cm³" (1 SGU) for example. Menu path: Setup → Extended setup → Level →Adjust density
11	Set the volume value for the lower current value (4 mA) via the "Set LRV" parameter. Menu path: Setup → Extended setup → Current output → Set LRV
12	Set the volume value for the upper current value (20 mA) via the "Set URV" parameter. Menu path: Setup → Extended setup → Current output → Set URV
13	If calibration was performed with a medium other than the process medium, specify the density of the process medium in the "Process density" parameter. Menu path: Setup → Extended setup → Level → Process density
14	Result: The measuring range is set for 0 l to 1000 l (264 US gal).



Calibration with reference pressure – wet calibration

1 See table, step 10.
2 See table, step 8.
3 See table, step 9.
4 See table, step 11
5 See table, step 12.

NOTICE The measured variables %, level, volume and mass are available for this level mode.
See → 73, "Output unit (025)".

6.5.6 "In height" level selection Calibration without reference pressure (dry calibration)

Example:

In this example, the volume in a tank should be measured in liters. The maximum volume of 1000 liters (264 US gal) corresponds to a level of 4.5 m (15 ft). The minimum volume of 0 liters corresponds to a level of 0.5 m (1.6 ft) since the device is mounted below the start of the level measuring range.

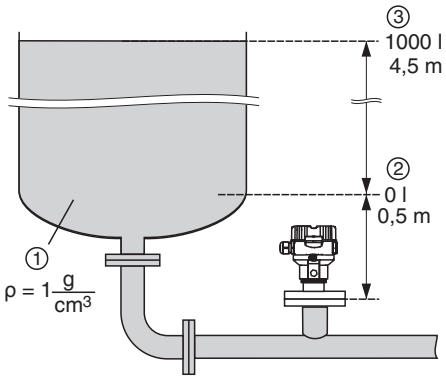
Prerequisite:

- The measured variable is in direct proportion to the pressure.
- This is a theoretical calibration i. e. the height and volume values for the lower and upper calibration point must be known.

NOTICE

- The values for "Empty calib./Full calib.", "Empty height/Full height" and" Set LRV/Set URV" must be at least 1 % apart. The value will be rejected, and a warning message displayed, if the values are too close together. Further limit values are not checked, i. e. the values entered must be appropriate for the sensor and the measuring task for the measuring device to be able to measure correctly.
- Due to the orientation of the device, there may be pressure shifts in the measured value, i. e. when the container is empty or partly filled, the measured value is not zero. For information on how to perform position adjustment, see → 40, "Position zero adjustment".

	Description
1	Select the "Level" measuring mode via the "Measuring mode" parameter. Menu path: Setup → Measuring mode
2	Select a pressure unit via the "Press eng. unit" parameter, here "mbar" for example. Menu path: Setup → Press. eng. unit
3	Select the "In height" level mode via the "Level selection" parameter. Menu path: Setup → Extended setup → Level → Level selection
4	Select a level unit via the "Output unit" parameter, here "l" (liters) for example. Menu path: Setup → Extended setup → Level → Output unit
5	Select a level unit via the "Height unit" parameter, here "m" for example. Menu path: Setup → Extended setup → Level → Height unit
6	Select the "Dry" option via the "Calibration mode" parameter. Menu path: Setup → Extended setup → Level → Calibration mode



Calibration without reference pressure – dry calibration

1 See table, step 11.
2 See table, steps 7 and 8.
3 See table, steps 9 and 10.

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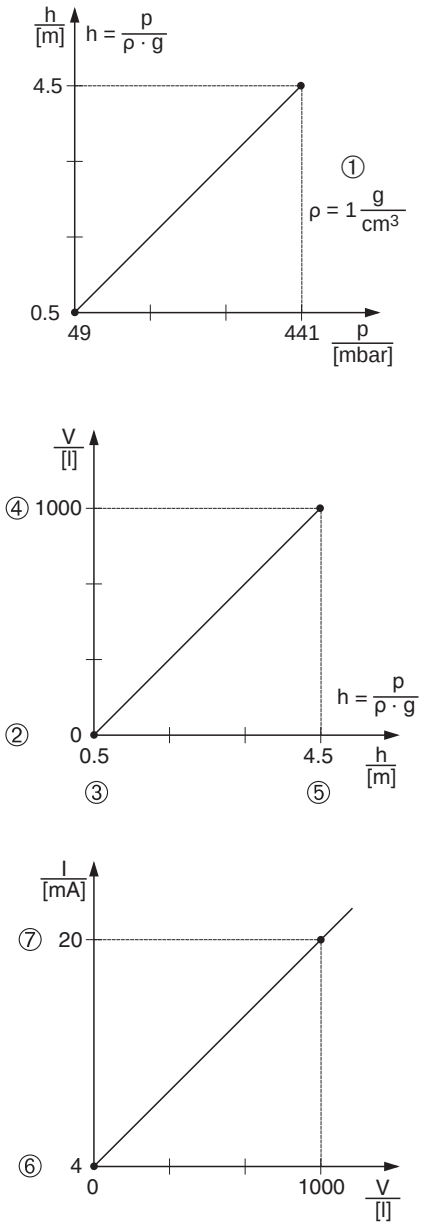
	Description
7	Enter the volume value for the lower calibration point via the "Empty calib." parameter, here 0 liters for example. Menu path: Setup → Extended setup → Level → Empty calib.
8	Enter the height value for the lower calibration point via the "Empty height" parameter, here 0.5 m (1.6 ft) for example. Menu path: Setup → Extended setup → Level → Empty height
9	Enter the volume value for the upper calibration point via the "Full calib." parameter, here 1000 liters (264 US gal) for example. Menu path: Setup → Extended setup → Level → Full calib.
10	Enter the height value for the upper calibration point via the "Full height" parameter, here 4.5 m (15 ft) for example. Menu path: Setup → Extended setup → Level → Full height
11	Enter the density of the medium via the "Adjust density" parameter, here "1 g/cm³" (1 SGU) for example. Menu path: Setup → Extended setup → Level → Adjust density
12	Set the volume value for the lower current value (4 mA) via the "Set LRV" parameter. Menu path: Setup → Extended setup → Current output → Set LRV
13	Set the volume value for the upper current value (20 mA) via the "Set URV" parameter. Menu path: Setup → Extended setup → Current output → Set URV
14	If the process uses a medium other than that on which the calibration was based, the new density has to be specified in the "Process density" parameter. Menu path: Setup → Extended setup → Level → Process density
15	Result: The measuring range is set for 0 l to 1000 l (264 US gal).



Calibration with reference pressure – wet calibration

1 See table, step 11.
2 See table, step 7.
3 See table, step 8.
4 See table, step 9.
5 See table, step 10.
6 See table, step 12.
7 See table, step 13.

NOTICE The measured variables %, level, volume and mass are available for this level mode.
See → 73, "Output unit (025)".

6.5.7 Calibration with partially-filled tank (wet calibration)

Example:

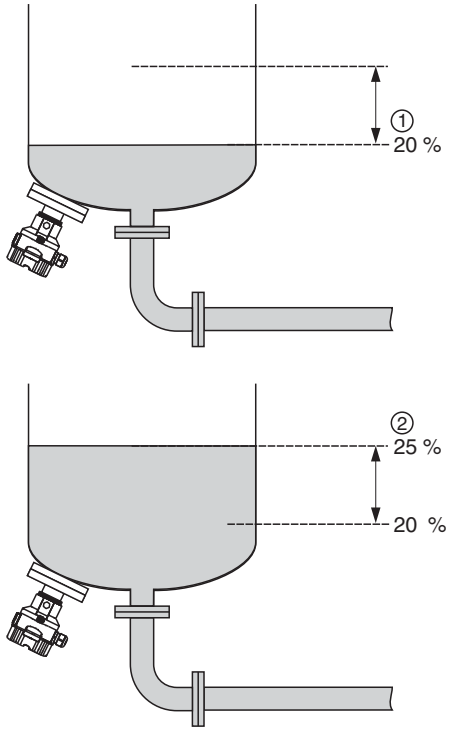
In this example a wet calibration is shown when it is not possible to empty the vessel and then fill it up to 100 %. Here a 20 % filling is used as “Empty” and a “25 %” filling is used as “Full” calibration point. The calibration is then extended from 0 % to 100 % and LRV/URV are adjusted accordingly.

Prerequisite:

The default value in the level mode for calibration mode is “Wet”.

However, it can be changed via: Setup →Extended Setup →Level →Calibration mode

	Description
1	Select the "Level" measuring mode via the "Measuring mode (005)" parameter. Menu path: Setup → Measuring mode (005)
2	Set value for "Empty calib." with acting pressure for Level e. g. 20 %. Menu path: Setup → Extended Setup → Level → Empty calibration
3	Set value for "Full calib." with acting pressure for Level e. g. 25 %. Menu path: Setup → Extended Setup → Level → Full calibration
4	The values for full and empty pressure are measured automatically at adjustment. As the transmitter automatically sets the pressure values that suit to empty and full calibration to min and max pressure that cause the output current, it is necessary to set the right upper range value (URV) and lower range value (LRV).



Calibration with partially-filled tank
1 See table, step 2
2 See table, step 3

NOTICE

It is also possible to use different liquids (e. g. water) for the adjustment. In this case you have to enter the different densities at following menu path:

- Setup → Ext. Setup → Level → Adjust density (034) (e. g. 1.0 kg/l for water)
- Setup → Ext. Setup → Level → Process density (035) (e. g. 0.8 kg/l for oil)

6.6 Linearization

6.6.1 Manual entry of the linearization table

Example:

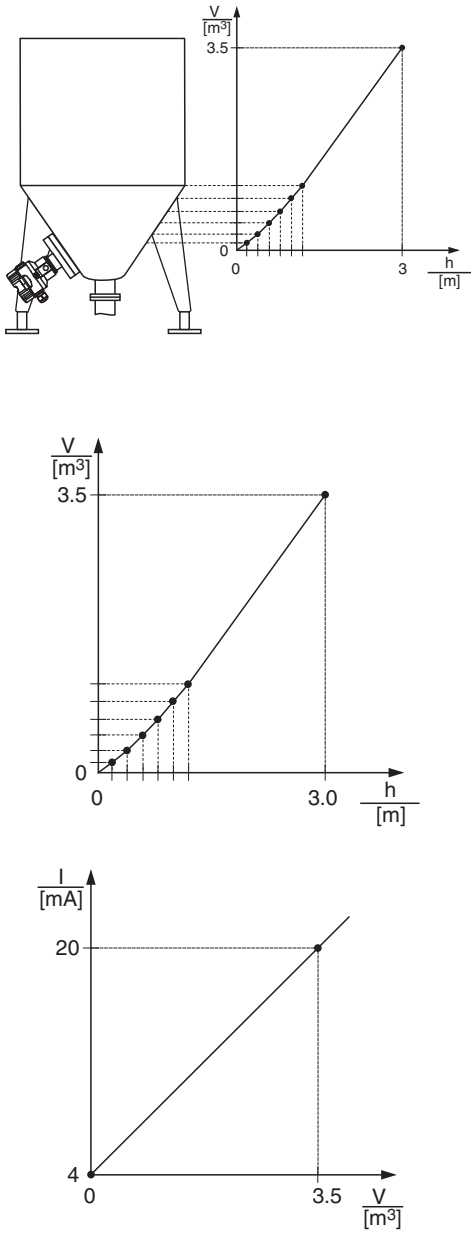
In this example, the volume in a tank with a conical outlet should be measured in m^3.

Prerequisite:

- This is a theoretical calibration, i. e. the points for the linearization table are known.
- The "Level" operating mode has been selected.
- A level calibration has been performed.

NOTICE For a description of the parameters mentioned, → 68, "Description of parameters".

	Description
1	Select the "Manual entry" option via the "Lin. mode" parameter. Menu path: Setup → Extended setup → Linearization → Lin. mode
2	Select the volume/mass unit via the "Unit after lin." parameter, e. g. m^3. Menu path: Setup → Extended setup → Linearization → Unit after lin.
3	Enter the number of the point in the table via the "Line-numb." parameter. Menu path: Setup → Extended setup → Linearization → Line-numb
	The level (e. g. 0 m) is entered via the "X-value" parameter. Confirm your entry. Menu path: Setup → Extended setup → Linearization → X-value
	Using the "Y-value" parameter, enter the associated volume value, here 0 m^3 for example, and confirm the value. Menu path: Setup → Extended setup → Linearization → Y-value
4	To enter another point in the table, select the "Next point" option via the "Edit table" parameter. Enter the next point as explained in Step 3. Menu path: Setup → Extended setup → Linearization → Edit table
5	Once all the points have been entered in the table, select the "Activate table" option via the "Lin. mode" parameter. Menu path: Setup → Extended setup → Linearization → Lin. mode
6	Result: The measured value after linearization is displayed.



Manual entry of the linearization table

NOTICE

1. Error message F510 "Linearization" and alarm current as long as the table is being entered and until the table is activated.
2. The 0 % value (= 4 mA) is defined by the smallest point in the table.
   The 100 % value (= 20 mA) is defined by the biggest point in the table.
3. You can change the allocation of the volume or mass values to the current values using the "Set LRV" and "Set URV" parameters.

6.6.2 Manual entry of the linearization table via the operating tool

With an operating tool based on FDT technology (e. g. **PACT***ware*™), it is possible to enter linearization via a module that has been specially designed for this. In doing so, you gain an overview of the selected linearization even while making the entry. Additionally, it is possible to call up pre-programmed tank shapes.

NOTICE

The linearization table can also be entered manually point for point in the menu of the operating tool (→ 51, "Manual entry of the linearization table".

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6.6.3 Semi-automatic entry of the linearization table

Example:

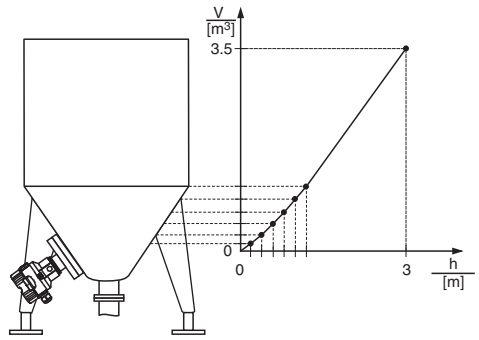
In this example, the volume in a tank with a conical outlet should be measured in m^3.

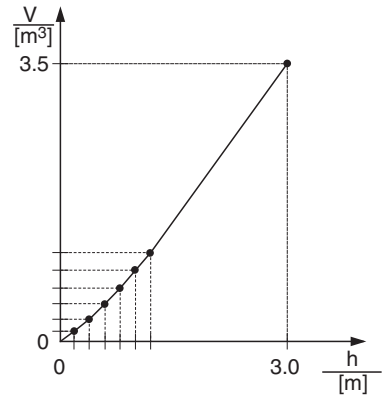
Prerequisite:

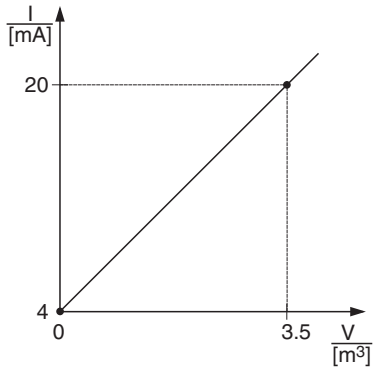
- The tank can be filled or emptied. The linearization characteristic must rise continuously.
- The "Level" operating mode has been selected.

NOTICE For a description of the parameters mentioned, → 68, "Description of parameters".

	Description
1	Select the "Semi-auto. entry" option via the "Lin. mode" parameter. Menu path: Setup → Extended setup → Linearization → Lin. mode
2	Select the volume unit/mass unit via the "Unit after lin." parameter, e. g. m^3. Menu path: Setup → Extended setup → Linearization → Unit after lin.
3	Fill the tank to the height of the 1st point.
4	Enter the number of the point in the table via the "Line-numb." parameter. Menu path: Setup → Extended setup → Linearization → Line-numb
	The actual level is displayed via the "X-value" parameter. Menu path: Setup → Extended setup → Linearization → X-value
	Using the "Y-value" parameter, enter the associated volume value, here 0 m^3 for example, and confirm the value. Menu path: Setup → Extended setup → Linearization → Y-value
5	To enter another point in the table, select the "Next point" option via the "Edit table" parameter. Enter the next point as explained in step 4. Menu path: Setup → Extended setup → Linearization → Edit table
6	Once all the points have been entered in the table, select the "Activate table" option via the "Lin. mode" parameter. Menu path: Setup → Extended setup → Linearization → Lin. mode
7	Result: The measured value after linearization is displayed.







Semi-automatic entry of the linearization table

NOTICE

1. Error message F510 "Linearization" and alarm current as long as the table is being entered and until the table is activated.
2. The 0 % value (= 4 mA) is defined by the smallest point in the table.
   The 100 % value (= 20 mA) is defined by the biggest point in the table.
3. You can change the allocation of the volume or mass values to the current values using the "Set LRV" and "Set URV" parameters.

6.7 Pressure measurement

6.7.1 Calibration without reference pressure (dry calibration)

Example:

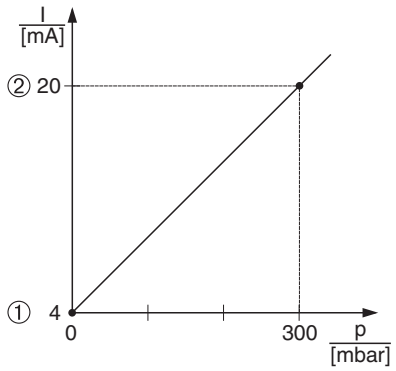
In this example, a device with a 400 mbar (6 psi) sensor is configured for the 0 mbar to +300 mbar (4.5 psi) measuring range, i. e. 0 mbar is assigned to the 4 mA value and 300 mbar (4.5 psi) to the 20 mA value.

Prerequisite:

This is a theoretical calibration, i. e. the pressure values for the lower and upper range are known.

NOTICE Due to the orientation of the device, there may be pressure shifts in the measured value, i. e. the measured value is not zero in a pressureless condition. For information on how to perform position adjustment, see → 40, "Position zero adjustment".

	Description
1	Select the "Pressure" measuring mode via the "Measuring mode" parameter. Menu path: Setup → Measuring mode
2	Select a pressure unit via the "Press eng. unit" parameter, here "mbar" for example. Menu path: Setup → Press. eng. unit
3	Select the "Set LRV" parameter. Menu path: Setup → Set LRV
	Enter the value for the "Set LRV" parameter (here 0 mbar) and confirm. This pressure value is assigned to the lower current value (4 mA).
4	Select the "Set URV" parameter. Menu path: Setup → Set URV
	Enter the value for the "Set URV" parameter (here 300 mbar (4.5 psi)) and confirm. This pressure value is assigned to the upper current value (20 mA).
5	Result: The measuring range is configured for 0 mbar to +300 mbar (4.5 psi).



Calibration without reference pressure

1 See table, step 3.
2 See table, step 4.

6.7.2 Calibration with reference pressure (wet calibration)

Example:

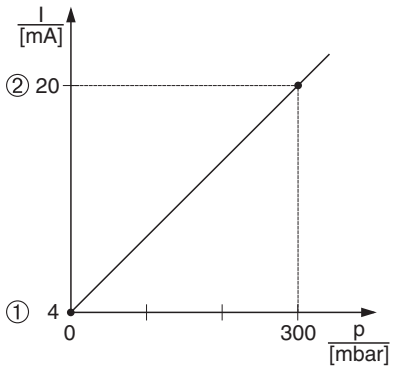
In this example, a device with a 400 mbar (6 psi) sensor is configured for the 0 mbar to +300 mbar (4.5 psi) measuring range, i. e. 0 mbar is assigned to the 4 mA value and 300 mbar (4.5 psi) to the 20 mA value.

Prerequisite:

The pressure values 0 mbar and 300 mbar (4.5 psi) can be specified. The device is already mounted, for example.

NOTICE For a description of the parameters mentioned, → 68, "Description of parameters".

	Description	
1	Perform position adjustment. See → 40.	
2	Select the "Pressure" measuring mode via the "Measuring mode" parameter. Menu path: Setup → Measuring mode	
3	Select a pressure unit via the "Press eng. unit" parameter, here "mbar" for example. Menu path: Setup → Press. eng. unit	
4	The pressure for the lower-range value (4 mA value) is present at the device, here 0 mbar for example.	
	Select the "Get LRV" parameter. Menu path: Setup → Extended setup → Current output → Get LRV.	
	Confirm the value present by selecting "Confirm". The pressure value present is assigned to the lower current value (4 mA).	
5	The pressure for the upper-range value (20 mA value) is present at the device, here 300 mbar (4.5 psi) for example.	
	Select the "Get URV" parameter. Menu path: Setup →Extended setup → Current output → Get URV.	
	Confirm the value present by selecting "Confirm". The pressure value present is assigned to the upper current value (20 mA).	
6	Result: The measuring range is configured for 0 mbar to +300 mbar (4.5 psi).	



Calibration with reference pressure

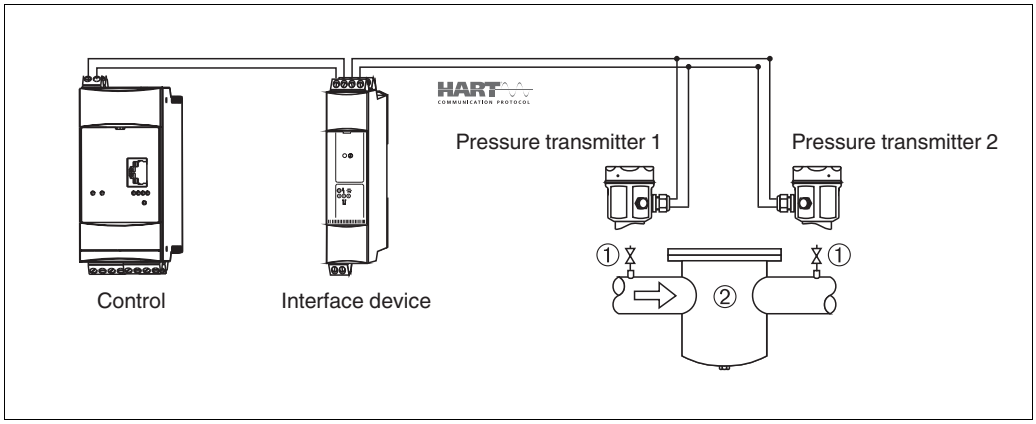
1 See table, step 4.
2 See table, step 5.

6.8 Electrical differential pressure measurement with gauge pressure sensors

Example:

In the example given, twopressure transmitters (each with a gauge pressure sensor) are interconnected. The pressure difference can thus be measured using two independent pressure transmitters.

NOTICE For a description of the parameters mentioned → 68, "Description of parameters".



19 Shut-off valves

2 e. g. filter

	Description **Adjustment of the pressure transmitter on the high pressure side**
1	Select the "Pressure" measuring mode via the "Measuring mode" parameter. Menu path: Setup → Measuring mode
2	Select a pressure unit via the "Press eng. unit" parameter, here "mbar" for example. Menu path: Setup → Press. eng. unit
3	The pressure transmitter is unpressurized, perform position adjustment, see → 40.
4	Switch on burst mode via the "Burst mode" parameter Menu path: Expert → Communication → HART Config.
5	Set the output current to "Fixed" 4.0 mA via the "Current mode" parameter. Menu path: Expert → Communication → HART Config
6	Configure an address ≠ 0 via the "Bus address" parameter, e. g. bus address = 1 (HART 5.0 master: Range 0 to 15, where address = 0 calls up the "Signaling" setting; HART6.0 master: range 0 to 63) Menu path: Expert → Communication → HART Config.

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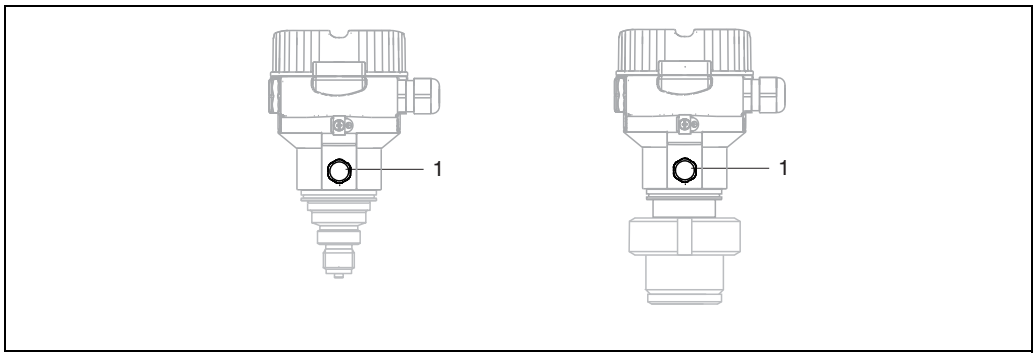
	Description **Adjustment of the pressure transmitter on the low pressure side** **(the differential is generated in this device)**
1	Select the "Pressure" measuring mode via the "Measuring mode" parameter. Menu path: Setup → Measuring mode
2	Select a pressure unit via the "Press eng. unit" parameter, here "mbar" for example. Menu path: Setup → Press. eng. unit
3	The pressure transmitter is unpressurized, perform position adjustment , see → 40.
4	Set the output current to "Fixed" 4.0mA via the "Current mode" parameter. Menu path: Expert → Communication → HART Config.
5	Configure an address <> 0 via the "Bus address" parameter, e. g. bus address = 2 (HART 5.0 master: Range 0 to 15, where address = 0 calls up the "Signaling" setting; HART 6.0 master: range 0 to 63) Menu path: Expert → Communication → HART Config.
6	Activate the reading of a value sent externally in burst mode via the "Electr. Delta P" parameter. Menu path: Expert → Application
7	Result: The measured value output by the pressure transmitter on the low pressure side equals the differential: high pressure - low pressure, and can be read out by means of a HART request of the address of the pressure transmitter on the low pressure side.

NOTICE

It is not permitted to reverse the assignment of the measuring points to the direction of communication. The measured value of the transmitting device (via burst) must always be greater than the measured value of the receiving device (via the "Electr. Delta P" function).
Adjustments that result in an offset of the pressure values (e. g. position adjustment, trim) must always be performed in accordance with the individual sensor and its orientation, irrespective of the "Electr. Delta P" application. Other settings result in non-permitted use of the "Electr. Delta P" function and can lead to incorrect measured values.

7 Maintenance

Keep the pressure compensation and GORE-TEX® filter (1) free from contamination.



7.1 Exterior cleaning

Please note the following points when cleaning the device:

- The cleaning agents used should not corrode the surface and the seals.
- Mechanical damage to the diaphragm, e. g. due to sharp objects, must be avoided.
- Observe the degree of protection of the device. See the nameplate if necessary (→ 6 ff).

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8 Troubleshooting

8.1 Messages

The following table lists the messages that can occur. The Diagnostic code parameter shows the message with the highest priority. The device has four different status information codes according to NAMUR NE107:

- F = failure
- M (warning) = maintenance required
- C (warning) = function check
- S (warning) = out of specification (deviations from the permitted ambient or process conditions determined by the device with the self-monitoring function, or errors in the device itself indicate that the measuring uncertainty is greater than what would be expected under normal operating conditions).

Diagnostic code	Error message	Cause	Measure
0	No error	–	–
C412	Backup in prog.	Downloading.	Wait for download to complete
C482	Current simul.	Current output simulation is switched on, i. e. the device is not measuring at present.	End the simulation
C484	Error simul.	Fault state simulation is switched on, i. e. the device is not measuring at present.	End the simulation
C485	Measure simul.	Simulation is switched on, i. e. the device is not measuring at present.	End the simulation
C824	Process pressure	• Electromagnetic effects are greater than specifications in the technical data. • Overpressure or low pressure present. This message normally only appears briefly.	1. Check the pressure value 2. Restart the device 3. Perform a reset
F002	Sens. unknown	Sensor does not suit the device (electronic sensor nameplate).	Contact Pepperl+Fuchs Service
F062	Sensor conn.	• Cable connection between sensor and main electronics disconnected. • Sensor defective. • Electromagnetic effects are greater than specifications in the technical data. This message normally only appears briefly.	1. Check sensor cable 2. Replace electr. 3. Contact Pepperl+Fuchs Service 4. Replace sensor (snap-on Version)
F081	Initialization	• Cable connection between sensor and main electronics disconnected. • Sensor defective. • Electromagnetic effects are greater than specifications in the technical data. This message normally only appears briefly.	1. Perform a reset 2. Check sensor cable 3. Contact Pepperl+Fuchs Service
F083	Permanent mem.	• Sensor defective. • Electromagnetic effects are greater than specifications in the technical data. This message normally only appears briefly.	1. Restart the device 2. Contact Pepperl+Fuchs Service
F140	Working range P	• Overpressure and low pressure present. • Electromagnetic effects are greater than specified in the technical data. • Sensor defective.	1. Check the process pressure 2. Check the sensor range
F261	Electronics	• Main electronics defective. • Fault in the main electronics.	1. Restart the device 2. Replace electr.
F282	Data memory	• Fault in the main electronics. • Main electronics defective.	1. Restart the device 2. Replace electr.
F283	Permanent mem.	• Main electronics defective. • Electromagnetic effects are greater than specifications in the technical data. • The supply voltage is disconnected when writing. • An error occurred when writing.	1. Perform a reset 2. Replace electr.
F411	Up-/download	• The file is defective. • During the download, the data are not correctly transmitted to the processor, e. g. because of open cable connections, voltage peaks (ripple) on the supply voltage or electromagnetic effects.	1. Download again 2. Use another file 3. Perform a reset
F510	Linearization	The linearization table is being edited.	1. Conclude entries 2. Select "linear"

Diagnostic code	Error message	Cause	Measure
F511	Linearization	The linearization table consists of less than 2 points.	1. Table too small 2. Corr. table 3. Accept the table
F512	Linearization	The linearization table is not monotonic increasing or decreasing.	1. Tab. not monotonic 2. Corr. table 3. Accept the table
F841	Sensor range	• Overpressure or low pressure present. • Sensor defective.	1. Check the pressure value 2. Contact Pepperl+Fuchs Service
F882	Input signal	External measured value is not received or displays a failure status.	1. Check the bus 2. Check source device 3. Check setting
M002	Sens. unknown	Sensor does not suit the device (electronic sensor nameplate). Device continues measuring.	Contact Pepperl+Fuchs Service
M283	Permanent mem.	• Cause as indicated for F283. • Correct measurement can continue as long as you do not need the peakhold indicator function.	1. Perform a reset 2. Replace electr.
M431	Adjustment	• The pressure applied is outside the set measuring range (but within the sensor range). • The calibration carried out would result in the sensor nominal operating range being undershot or overshot.	1. Check the measuring range 2. Check position adjustment 3. Check the setting
M434	Scaling	• Values for calibration (e. g. lower range value and upper range value) are too close together. • Lower range value and/or upper range value undershoot or overshoot the sensor range limits. • The sensor was replaced and the customer-specific configuration does not suit the sensor. • Unsuitable download carried out.	1. Check the measuring range 2. Check the setting 3. Contact Pepperl-Fuchs Service
M438	Data record	• The supply voltage is disconnected when writing. • An error occurred when writing.	1. Check setting 2. Restart the device 3. Replace electr.
M515	Configuration Flow	Max. flow out of nominal range of sensor	1. Recalibrate the device 2. Restart the device
M882	Input signal	External measured value displays a warning status.	1. Check the bus 2. Check source device 3. Check setting
S110	Working range T	• Electromagnetic effects are greater than specifications in the technical data. • Sensor defective. • Overtemperature and low temperature present.	1. Check proc. temp. 2. Check temperature range
S140	Working range P	• Electromagnetic effects are greater than specifications in the technical data. • Sensor defective. • Overpressure and low pressure present.	1. Check proc. pressure 2. Check sensor range
S822	Process temp.	• The temperature measured in the sensor is greater than the upper nominal temperature of the sensor. • The temperature measured in the sensor is lower than the lower nominal temperature of the sensor. • Loose connection at the sensor cable.	1. Check the temperature 2. Check the setting
S841	Sensor range	• Overpressure or low pressure present. • Sensor defective.	1. Check the pressure value 2. Contact Pepperl+Fuchs Service
S971	Adjustment	• The current is outside the permitted range 3.8 mA to 20.5 mA. • The pressure applied is outside the set measuring range (but within the sensor range). • The calibration carried out would result in the sensor nominal operating range being undershot or overshot.	1. Check the pressure value 2. Check the measuring range 3. Check the setting

8.2 Response of output to errors

The response of the current output to errors is defined in the following parameters:

- "Alarm behav. P (050)" → 77
- "Output fail mode (190)" → 77
- "High alarm curr. (052)" → 77

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8.3 Repair

The Pepper+Fuchs repair concept assumes that the devices have a modular design and that repairs can be done by the Pepperl+Fuchs service or specially trained customers.

NOTICE

- For certified devices, please see the "Repair of Ex-certified devices" section.
- For more information on service and spare parts, contact the Service Department at Pepperl+Fuchs.

8.4 Repair of Ex-certified devices

WARNING When repairing Ex-certified devices, please note the following:

- Only specialist personnel or Pepperl+Fuchs may repair certified devices.
- Relevant standards, national hazardous area regulations and safety instructions and certificates must be observed.
- Only genuine Pepperl+Fuchs spare parts may be used.
- When ordering spare parts, please check the device designation on the nameplate. Identical parts may only be used as replacements.
- Electronic inserts or sensors already in use in a standard device may not be used as spare parts for a certified device.
- Carry out repairs according to the instructions. Following a repair, the device must fulfill the requirements of the specified individual tests.
- A certified device may only be converted to another certified device version by Pepperl+Fuchs.
- All repairs and modifications must be documented.

8.5 Spare parts

An overview of the spare parts for your device is available in the Technical Information TI00436O and TI00437O.

When ordering spare parts, always quote the serial number indicated on the nameplate. As far as necessary, the spare parts also include replacement instructions.

8.6 Return

The measuring device must be returned if repairs or a factory calibration are required, or if the wrong measuring device has been ordered or delivered. According to legal regulations, Pepperl+Fuchs, as a ISO-certified company, is required to follow certain procedures when handling returned products that are in contact with process fluids.

To ensure swift, safe and professional device returns, please read the return procedures and conditions on the Pepperl+Fuchs website.

8.7 Disposal

When disposing, separate and recycle the device components based on the materials.

8.8 Software history

Device	Date	Software version	Software modifications	Operating Instruction
LHC-M51 PPC-M51	08.2009	01.00.zz	Orginal software. Compatible with: • **PACT***ware*™ • Field communicator	BA00382O/98/EN/17.12
LHCR-51 LHCS-51	10.2009	01.00.zz	Orginal software. Compatible with: • **PACT***ware*™ • Field communicator	BA00382O/98/EN/17.12

9 Technical data

For the technical data, please refer to the Technical Information TI00436O and TI00437O.

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10 Appendix

10.1 Overview of operating menu

All the parameters are listed in the following table. The page number refers to where a description of the parameter can be found.

Level 1	Level 2	Level 3	Level 4	Direct access	Page
Parameters in italics are read-only parameters and cannot be edited. Specific settings, such as the measuring mode, dry or wet calibration, or hardware locking, determine whether these parameters are displayed.					
Language				000	69
Display/operat.	Display mode			001	69
	Add. disp. value			002	69
	Format 1st value			004	69
Setup	Measuring mode Measuring mode (read only)			005 182	70
	Press. eng. unit			125	71
	Corrected press.			172	72
	Empty calib. (level measuring mode and "Calibration mode" = wet)			011	74
	Full calib. (level measuring mode and "Calibration mode" = wet)			012	74
	Set LRV (pressure measuring mode and flow linear)			013	72
	Set URV (pressure measuring mode and flow linear)			014	72
	Damping switch (read only)			164	71
	Damping Damping (read only)			017 184	71
	Level before lin (level measuring mode)			019	75
	Pressure af. damp			111	72
	Extended setup	Code definition		023	68
		Device tag		022	69
		Operator code		021	68
		Level (level measuring mode)	Level selection	024	73
			Output unit	025	73
			Height unit	026	73
			Calibration mode	027	73
			Empty calib. Empty calib.	028 011	74
			Empty pressure Empty pressure (read only)	029 185	74
			Empty height Empty height (read only)	030 186	74
			Full calib. Full calib.	031 012	74
			Full pressure Full pressure (read only)	032 187	74
			Full height Full height (read only)	033 188	74
			Adjust density	034	74
			Process density	035	75
			Level before lin	019	75
		Linearization	Lin. mode	037	75
			Unit after lin.	038	75
			Line-numb.:	039	75
			X-value:	040	75
			Y-value:	041	75
			Edit table	042	76
			Tank description	173	76
			Tank content	043	76
		Current output	Alarm behavior P	050	77
			Alarm cur. switch	165	77
			Output fail mode	190	77
			High alarm curr.	052	77
...	...	...	Set min. current	053	77

Level 1	Level 2	Level 3	Level 4	Direct access	Page
... Setup	**... Extended setup**	**... Current output**	Output current	054	77
			Get LRV (pressure measuring mode)	015	77
			Set LRV	013	72
			Get URV (pressure)	016	78
			Set URV	014	72
Diagnosis	Diagnostic code			071	81
	Last diag. code			072	81
	Min. meas. press.			073	81
	Max. meas. press.			074	81
	Diagnostic list	Diagnostic 1		075	82
		Diagnostic 2		076	82
		Diagnostic 3		077	82
		Diagnostic 4		078	82
		Diagnostic 5		079	82
		Diagnostic 6		080	82
		Diagnostic 7		081	82
		Diagnostic 8		082	82
		Diagnostic 9		083	82
		Diagnostic 10		084	82
	Event logbook	Last diag. 1		085	82
		Last diag. 2		086	82
		Last diag. 3		087	82
		Last diag. 4		088	82
		Last diag. 5		089	82
		Last diag. 6		090	82
		Last diag. 7		091	82
		Last diag. 8		092	82
		Last diag. 9		093	82
		Last diag. 10		094	82
	Instrument info	Firmware version		095	69
		Serial number		096	69
		Ext. order code		097	69
		Order identifier		098	69
		Cust. tag number		254	69
		Device tag		022	69
		ENP version		099	69
		Config. counter		100	81
		LRL sensor		101	76
		URL sensor		102	76
		Manufacturer ID		103	79
		Device type code		105	79
		Device revision		108	79
	Measured values	Level before lin		019	75
		Tank content		043	76
		Meas. pressure		020	72
		Sensor pressure		109	72
		Corrected press.		172	72
		Sensor Temp.		110	71
		Pressure af. damp		111	72
	Simulation	Simulation mode		112	83
		Sim. pressure		113	83
		Sim. level		115	83
		Sim. tank cont.		116	83
		Sim. current		117	83
		Sim. error no.		118	83
	Reset	Enter reset code		124	70
Expert	Direct access			119	68
...	**System**	Code definition		023	68

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Level 1	Level 2	Level 3	Level 4	Direct access	Page
... Expert	**... System**	Lock switch		120	68
		Operator code		021	68
		Instrument info	Cust. tag number	254	69
			Device tag	022	69
			Serial number	096	69
			Firmware version	095	69
			Ext. order code	097	69
			Order identifier	098	69
			ENP version	099	69
			Electr. serial no.	121	69
			Sensor serial no.	122	69
		Display	Language	000	69
			Display mode	001	69
			Add. disp. value	002	69
			Format 1st value	004	69
		Management	Enter reset code	124	70
	Measurement	Measuring mode Measuring mode (read only)		005 182	70
		Basic setup	Calib. offset (absolute pressure sensor)	008	71
			Damping switch (read only)	164	71
			Damping Damping (read only)	017 184	71
			Press. eng. unit	125	71
			Temp. eng. unit	126	71
			Sensor temp.	110	71
		Pressure	High pressure side (read only)	183	72
			Set LRV	013	72
			Set URV	014	72
			Meas. pressure	020	72
			Sensor pressure	109	72
			Corrected press.	172	72
			Pressure af. damp	111	72
		Level	Level selection	024	73
			Output unit	025	73
			Height unit	026	73
			Calibration mode	027	73
			Empty calib. Empty calib.	028 011	74
			Empty pressure Empty pressure (read only)	029 185	74
			Empty height Empty height (read only)	030 186	74
			Full calib. Full calib.	031 012	74
			Full pressure Full pressure (read only)	032 187	74
			Full height Full height (read only)	033 188	74
			Density unit	127	74
			Adjust density Adjust density (read only)	034 189	74
			Process density Process density (read only)	035 181	75
			Level before lin	019	75
		Linearization	Lin. mode	037	75
			Unit after lin.	038	75
			Line-numb.:	039	75
			X-value:	040	75
			Y-value:	041	75
...	**...**	**...**	Edit table	042	76

Level 1	Level 2	Level 3	Level 4	Direct access	Page
... Expert	**... Measurement**	**... Linearization**	Tank description	173	76
			Tank content	043	76
		Sensor limits	LRL sensor	101	76
			URL sensor	102	76
		Sensor trim	Lo trim measured	129	76
			Hi trim measured	130	76
			Lo trim sensor	131	76
			Hi trim sensor	132	76
	Output	**Current output**	Output current (read only)	054	77
			Alarm behavior P	050	77
			Alarm cur. switch (read only)	165	77
			Output fail mode Output fail mode (read only)	190 051	77
			High alarm curr.	052	77
			Set min. current	053	77
			Get LRV (pressure measuring mode)	015	77
			Set LRV	056 013 166 168	72 77
			Get URV (pressure measuring mode)	016	78
			Set URV	057 014 067 169	72 78
			Start current	134	78
			Curr. trim 4mA	135	78
			Curr. trim 20mA	136	78
			Offset trim 4mA	137	78
			Offset trim 20 mA	138	78
	Communication	**HART config**	Burst mode	142	79
			Burst option	143	79
			Current mode	144	79
			Bus address	145	79
			Preamble number	146	79
		HART info	Device type code	105	79
			Device revision	108	79
			Manufacturer ID	103	79
			Hart version	180	79
			Descriptor	139	79
			HART message	140	79
			HART date	141	79
		HART output	Primary value is	147	80
			Primary value	148	80
			Secondary val. is	149	80
			Secondary value	150	80
			Third value is	151	80
			Third value	152	80
			4th value is	153	80
			4th value	154	80
		HART input	HART input value	155	80
			HART input stat.	179	80
			HART input unit	156	80
			HART input form.	157	80
	Application	Electr. delta P (LHC*-51)		158	81
		Fixed ext. value (LHC*-51)		174	81
	Diagnosis	Diagnostic code		071	81
		Last diag. code		072	81
...	**...**	Reset logbook		159	81

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Level 1	Level 2	Level 3	Level 4	Direct access	Page
... Expert	**... Diagnosis**	Min. meas. press.		073	81
		Max. meas. press.		074	81
		Reset peakhold		161	81
		Operating hours		162	81
		Config. counter		100	81
		Diagnostic list	Diagnostic 1	075	82
			Diagnostic 2	076	82
			Diagnostic 3	077	82
			Diagnostic 4	078	82
			Diagnostic 5	079	82
			Diagnostic 6	080	82
			Diagnostic 7	081	82
			Diagnostic 8	082	82
			Diagnostic 9	083	82
			Diagnostic 10	084	82
		Event logbook	Last diag. 1	085	82
			Last diag. 2	086	82
			Last diag. 3	087	82
			Last diag. 4	088	82
			Last diag. 5	089	82
			Last diag. 6	090	82
			Last diag. 7	091	82
			Last diag. 8	092	82
			Last diag. 9	093	82
			Last diag. 10	094	82
		Simulation	Simulation mode	112	83
			Sim. pressure	113	83
			Sim. level	115	83
			Sim. tank cont.	116	83
			Sim. current	117	83
			Sim. error no.	118	83

10.2 Description of parameters

This section describes the parameters in the order they are arranged in the "Expert" operating menu.

Expert

Parameter name	Description
Direct access (119) Entry	Enter the direct access code to go directly to a parameter. **Options:** A number between 0 and 999 (only valid entries are recognized) **Factory setting:** 0 **NOTICE** For direct access, it is not necessary to enter leading zeros.

10.2.1 System

Expert → System

Parameter name	Description
Code definition (023) Entry	Use this function to enter a release code with which the device can be unlocked. **Options:** A number between 0 and 9999 **Factory setting:** 0
Lock switch (120) Display	Displays the status of DIP switch 1 on the electronic insert. You can lock or unlock parameters relevant to the measured value with DIP switch 1. If operation is locked by means of the "Operator code" (021) parameter, you can only unlock operation again by means of this parameter. **Display:** • On (locking switched on) • Off (locking switched off) **Factory setting:** Off (locking switched off)
Operator code (021) Entry	Use this function to enter a code to lock or unlock operation. **Options:** • To lock operation: enter a number between 1 and 9999 provided the release code = 0; then a number ≠ release code. • To unlock operation: enter the number 0. **NOTICE** The release code is "0" in the order configuration. Another release code can be defined in the "Code definition" parameter. If the user has forgotten the release code, it can be made visible again by entering the number sequence "5864". **Factory setting:** 0

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Expert → System → Instrument info

Parameter name	Description
Cust. tag number (254) Entry	Enter device tag e. g. TAG number (max. 8 alphanumeric characters). **Factory setting:** no entry or as per order specifications
Device tag (022) Entry	Enter device tag e. g. TAG number (max. 32 alphanumeric characters). **Factory setting:** no entry or as per order specifications
Serial number (096) Display	Displays the serial number of the device (11 alphanumeric characters).
Firmware version (095) Display	Displays the firmware version.
Ext. order code (097) Display	Enter the extended order code. **Factory setting:** As per order specifications
Order identifier (098) Entry	Enter the order identifier. **Factory setting:** As per order specifications
ENP version (099) Display	Displays the ENP version (ENP = electronic nameplate)
Electr. serial no. (121) Display	Displays the serial number of the main electronics (11 alphanumeric characters).
Sensor serial no. (122) Display	Displays the serial number of the sensor (11 alphanumeric characters).

Expert → System → Display

Parameter name	Description
Language (000) Selection	Select the menu language for the local display. **Options:** • English • Optionally one further language (as selected when ordering the device) • One further language (language of the producing factory) **Factory setting:** English
Display mode (001) Selection	Specify the contents for the first line of the local display in the measuring mode. **Options:** • Primary value (PV) • External value • All alternating **Factory setting:** Primary value (PV)
Add. disp. value (002) Selection	Specify the contents for the second line of the local display in the measuring mode. **Options:** • No value • Pressure • Main value (%) • Current • Temperature The options depend on the measuring mode chosen. **Factory setting:** No value
Format 1st value (004) Selection	Specify the number of places after the decimal point for the value displayed in the main line. **Options:** • Auto • x • x.x • x.xx • x.xxx • x.xxxx • x.xxxxx **Factory setting:** Auto

Expert → System → Management

Parameter name	Description
Enter reset code (124) Entry	Reset parameters completely or partially to the factory values or order configuration, see → 36, "Resetting to factory settings (reset)". **Factory setting:** 0

10.2.2 Measurement

Expert → Measurement

Parameter name	Description
Measuring mode (005) Selection	Select the measuring mode. The operating menu is structured differently depending on the measuring mode selected. **NOTICE** If the measuring mode is changed, no conversion takes place. If necessary, the device has to be recalibrated after the measuring mode has been changed. **Options:** • Pressure • Level **Factory setting** Pressure or as per order specifications

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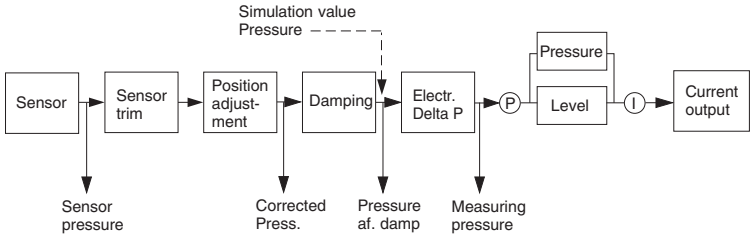
Expert → Measurement → Basic setup

Parameter name	Description
Pos. zero adjust (007) Selection	Position adjustment – the pressure difference between zero (set point) and the measured pressure need not be known. **Example:** • Measured value = 2.2 mbar (0.033 psi) • You correct the measured value via the "Pos. zero adjust" parameter with the "Confirm" option. This means that you are assigning the value 0.0 to the pressure present. • Measured value (after pos. zero adjust) = 0.0 mbar • The current value is also corrected. **Factory setting:** Abort
Calib. offset (192)/(008) (absolute pressure sensor) Selection	Position adjustment – the pressure difference between the set point and the measured pressure must be known. **Example:** • Measured value = 982.2 mbar (14.73 psi) • You correct the measured value with the value entered (e. g. 2.2 mbar (0.033 psi)) via the "Calib. offset" parameter. This means that you are assigning the value 980.0 (14.7 psi) to the pressure present. • Measured value (after pos. zero adjust) = 980.0 mbar (14.7 psi) • The current value is also corrected. **Factory setting:** 0.0
Damping switch (164) Display	Displays the switch position of DIP switch 4 which is used to switch the damping of the output signal on and off. **Display:** • Off The output signal is not damped. • On The output signal is damped. The attenuation constant is specified in the "Damping value" parameter (017) (184) **Factory setting** On
Damping value (017) Entry	Enter the damping time (time constant τ). The damping affects the speed at which the measured value reacts to changes in pressure. **Input range:** 0.0 s to 999.0 s **Factory setting:** 2.0 or as per order specifications
Press. eng. unit (125) Selection	Select the pressure unit. If a new pressure unit is selected, all pressure-specific parameters are converted and displayed with the new unit. **Options:** • mbar, bar • mmH2O, mH2O, inH2O • ftH2O • Pa, kPa, MPa • psi • mmHg, inHg • kgf/cm^2 **Factory setting:** mbar or bar depending on the sensor nominal measuring range, or as per order specifications
Temp. eng. unit (126) (only for LHC*-51) Selection	Select the unit for the temperature measured values. **NOTICE** The setting affects the unit for the "Sensor temp." parameter. **Options:** • °C • °F • K **Factory setting:** °C
Sensor temp. (110) (only for LHC*-51) Display	Displays the temperature currently measured in the sensor. This can deviate from the process temperature.

Expert → Measurement → Pressure

Parameter name	Description
Switch P1/P2 (163) Display	Indicates whether the "SW/P2High" DIP switch (DIP switch 5) is switched on. **NOTICE** The "SW/P2High" DIP switch determines which pressure input corresponds to the high-pressure side. **Display:** • SW setting "SW/P2 High" is switche off: The "High pressure side" (006) parameter determines which pressure input corresponds to the high-pressure side. • P2 High "SW/P2 High" is switched on: Pressure input P2 corresponds to the high-pressure side, independent of the setting in the "High pressure side" (006) parameter. **Factory setting:** SW setting
High pressure side (006) (183) Selection	Determines, which pressure input corresponds to the high-pressure side. **NOTICE** This setting is only valid if the "SW/P2High" DIP switch is in the OFF position (see the "Pressure side switch" (163) parameter). Otherwise P2 corresponds to the high-pressure side in any case. **Selection:** • P1 High Pressure input P1 is the high-pressure side. • P2 High Pressure input P2 is the high-pressure side. **Factory setting** P1 High
Set LRV (013) Display	Set the lower-range value – without reference pressure. Enter the pressure value for the lower current value (4 mA). **Factory setting:** 0.0 or as per order specifications
Set URV (014) **Display**	Set the upper-range value – without reference pressure. Enter the pressure value for the upper current value (20 mA). **Factory setting:** Upper range limit sensor or as per order specifications.
Meas. pressure (020) Display	Displays the measured pressure after sensor recalibration, position adjustment and damping. 
Sensor pressure (109) Display	Displays the measured pressure before the sensor trim and position adjustment.
Corrected press. (172) Display	Displays the measured pressure after sensor trim and position adjustment.
Pressure af. damp (111) Display	Displays the measured pressure after sensor trim, position adjustment and damping.

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Expert → Measurement → Level

Parameter name	Description
Level selection (024) Selection	Select the method for calculating the level **Options:** • In pressure If this option is selected, specify two pressure/level value pairs. The level value is displayed directly in the unit that you select via the "Output unit" parameter. • In height If this option is selected, specify two height/level value pairs. From the measured pressure, the device first calculates the height using the density. This information is then used to calculate the level in the "Output unit" selected using the two value pairs specified. **Factory setting:** In pressure
Output unit (025) Selection	Select the unit for the measured value display for the level before linearization. **NOTICE** The unit selected is only used to describe the measured value. This means that the measured value is not converted when a new output unit is selected. **Example:** • Current measured value: 0.3 ft • New output unit: m • New measured value: 0.3 m **Options** • % • mm, cm, dm, m • ft, inch • m^3, in^3 • l, hl • ft^3 • gal, lgal • kg, t • lb **Factory setting:** %
Height unit (026) Selection	Select the height unit. The measured pressure is converted to the selected height unit using the "Adjust density" parameter. **Prerequisite** "Level selection" = "In height" **Options** • mm • m • inch • ft **Factory setting:** m
Calibration mode (027) Selection	Select the calibration mode. **Options:** • Wet Wet calibration takes place by filling and emptying the container. With two different levels, the level, volume, mass or percentage value entered is assigned to the pressure measured at this point in time ("Empty calibration" and "Full calibration" parameters). • Dry Dry calibration is a theoretical calibration. For this calibration, you specify two pressure/level value pairs via the following parameters: "Empty calib.", "Empty pressure", "Full calib.", "Full pressure". **Factory setting:** Wet

Parameter name	Description
Empty calib. (028) **Empty calib. (011)** Entry	Enter the output value for the lower calibration point (container empty). The unit defined in "Output unit" must be used. **NOTICE** • In the case of wet calibration, the level (container empty) must actually be available. The associated pressure is then automatically recorded by the device. • In the case of dry calibration, the level (container empty) does not have to be available. The associated pressure has to be entered in the "Empty pressure (029)" parameter for the "In pressure" level selection. The associated height has to be entered in the "Empty height (030)" parameter for the "In height" level selection. **Factory setting:** 0.0
Empty pressure (029) Entry/display	Enter the pressure value for the lower calibration point (container empty). → See also "Empty calib. (028)". **Prerequisite** • "Level selection" = in pressure • "Calibration mode" = Wet → display • "Calibration mode" = Dry → entry **Factory setting:** 0.0
Empty height (030) Entry/display	Enter the height value for the lower calibration point (container empty). Select the unit via the "Height unit (026)" parameter. **Prerequisite:** • "Level selection" = in height • "Calibration mode" = Wet → display • "Calibration mode" = Dry → entry **Factory setting:** 0.0
Full calib. (031) **Full calib. (012)** Entry	Enter the output value for the upper calibration point (container full). The unit defined in "Output unit" must be used. **NOTICE** • In the case of wet calibration, the level (container full) must actually be available. The associated pressure is then automatically recorded by the device. • In the case of dry calibration, the level (container full) does not have to be available. The associated pressure has to be entered in the "Full pressure (030)" parameter for the "In pressure" level mode. The associated height has to be entered in the "Empty height" parameter for the "In height" level selection. **Factory setting:** 100.0
Full pressure (032) Entry/display	Enter the pressure value for the upper calibration point (container full). → See also "Full calib.". **Prerequisite** • "Level selection" = in pressure • "Calibration mode" = Wet → display • "Calibration mode" = Dry → entry **Factory setting:** Upper-range limit (URL) of the sensor
Full height (033) Entry/display	Enter the height value for the upper calibration point (container full). You select the unit via the "Height unit" parameter. **Prerequisite:** • "Level selection" = in height • "Calibration mode" = Wet → display • "Calibration mode" = Dry → entry **Factory setting:** Upper-range limit (URL) is converted to a height unit
Density unit (127) Display	Displays the density unit. The measured pressure is converted to a height using the "Height unit", "Density unit" and "Adjust density" parameters. **Factory setting:** g/cm^3
Adjust density (034) Entry	Enter the density of the medium. The measured pressure is converted to a height using the "Height unit" and "Adjust density" parameters. **Factory setting:** 1.0

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Parameter name	Description
Process density (035) **Entry**	Enter a new density value for density correction. The calibration was carried out with water as the medium, for example. Now the container is to be used for another medium with another density. The calibration is corrected appropriately by entering the new density value in the "Process density" parameter. **NOTICE** If you change to dry calibration after a wet calibration using the "Calibration mode" parameter, the density for the "Adjust density" and "Process density" parameters must be entered correctly before changing the calibration mode. If the pressure falls with increasing levels, such as in the case of residual volume measurement, a negative value must be entered for this parameter. **Factory setting:** 1.0
Level before lin. (019) **Display**	Displays the level value prior to linearization.

Expert → Measurement → Linearization

Parameter name	Description
Lin. mode (037) Selection	Select the linearization mode. **Options:** • Linear • The level is output without being converted beforehand. "Level before lin. (019)" is output. • Erase table • The existing linearization table is deleted. • Manual entry (sets the table to the edit mode, an alarm is output): The value pairs of the table ("X-value (193/040)" and "Y-value (041)") are entered manually. • Semiautomatic entry (sets the table to the edit mode, an alarm is output): The container is emptied or filled in stages in this entry mode. The device automatically records the level value ("X-value (193/040)"). The associated volume, mass or %-value is entered manually ("Y-value (041)"). • Activate table The table entered is activated and checked with this option. The device shows the level after linearization. **Factory setting:** Linear
Unit after lin. (038) Selection	Select the volume unit (unit of the Y-value). **Options:** • % • cm, dm, m, mm • hl • in^3, ft^3, m^3 • l • in, ft • kg, t • lb • gal • lgal **Factory setting:** %
Line numb. (039) Entry	Enter the number of the current point in the table. The subsequent entries for "X-value" and "Y-value" refer to this point. **Input range:** 1 to 32
X-value (193/040) Display/Entry	Enter the level value for the specific point in the table and confirm. **NOTICE** • If "Lin. mode" = "Manual", the level value has to be entered. • If "Lin. mode" = "Semiautomatic", the level value is displayed and has to be confirmed by entering the associated Y-value.
Y-value (041) Entry	Enter the output value for the specific point in the table. The unit is determined by "Unit after lin. (038)". **NOTICE** The linearization table must be monotonic (increasing or decreasing).

Parameter name	Description
Edit table (042) Selection	Select the function for entering the table. **Options:** • Next point: enter the next point. • Current point: stay on the current point to correct a mistake for example. • Previous point: skip back to the previous point to correct a mistake for example. • Insert point: insert an additional point (see example below). • Delete point: delete the current point (see example below). **Example:** Add a point - in this case between the 4th and 5th point for example • Select point 5 via the "Line-numb." parameter. • Select the "Insert point" option via the "Edit table" parameter. • Point 5 is displayed for the "Line-numb" parameter. Enter new values for the "X-value" and "Y-value" parameters. **Example:** Delete a point - in this case the 5th point for example • Select point 5 via the "Line-numb." parameter. • Select the "Delete point" option via the "Edit table" parameter. • The 5th point is deleted. All of the subsequent points are moved up one number i. e. following deletion, the 6th point becomes Point 5. **Factory setting:** Current point
Tank description (173) Entry	Enter the tank description (max. 32 alphanumeric characters)
Tank content (043) Display	Displays the level value after linearization.

Expert → Measurement → Sensor limits

Parameter name	Description
LRL sensor (101) Display	Displays the lower-range limit of the sensor.
URL sensor (102) Display	Displays the upper-range limit of the sensor.

Expert → Measurement → Sensor trim

Parameter name	Description
Lo trim measured (129) Display	Displays the reference pressure present to be accepted for the lower calibration point.
Hi trim measured (130) Display	Displays the reference pressure present to be accepted for the upper calibration point.
Lo trim sensor (131) Display	Sensor recalibration by entering a target pressure while simultaneously and automatically accepting a reference pressure present for the lower calibration point.
Hi trim sensor (132) Display	Sensor recalibration by entering a target pressure while simultaneously and automatically accepting a reference pressure present for the upper calibration point.

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10.2.3 Output

Expert → Output → Current output

Parameter name	Description
Output current (054) Display	Displays the current value of the current.
Alarm behav. P (050) Selection	Configure the current output for when the sensor limits are undershot or overshot. **Options:** • Warning The device continues measuring. An error message is displayed. • Alarm The output signal assumes a value that can be specified by the "Output fail mode" function. • NAMUR - Lower sensor limit undershot: Current output = 3.6 mA - Upper sensor limit overshot: Current output assumes value of 21 mA to 23 mA, depending on the setting of the "High alarm curr. (052)" parameter. **Factory setting:** Warning
Alarm cur. switch (165)	Displays the switch status of DIP switch 3 "SW/alarm min." **Display** • AF The alarm current has the value defined in the "Output fail mode (190)". • Alarm min. The alarm current is 3.6 mA regardless of the software setting.
Output fail mode (190) Selection	Select the output fail mode. In the event of an alarm, the current assumes the current value specified with this parameter. **Options:** • Max. (110%): can be set from 21 mA to 23 mA • Max: can be set from 21 mA to 23 mA → see also "High alarm curr. (052)" • Hold: last measured value is held • Min. (–10%): 3.6 mA **Factory setting:** Max. alarm 110% (22 mA)
High alarm curr. (052) Entry	Enter the current value for the high alarm current. → See also "Output fail mode (190)". **Input range:** 21 mA to 23 mA **Factory setting:** 22 mA
Set min. current (053) Entry	Enter the lower current limiting value. Some switching units do not accept current values lower than 4.0 mA. **Options:** • 3.8 mA • 4.0 mA **Factory setting:** 3.8 mA
Get LRV (015) Entry	Set the lower-range value – reference pressure is present at the device. The pressure for the lower current value (4 mA) is present at the device. With the "Confirm" option, you assign the lower current value to the pressure value present. **Options:** • Abort • Confirm **Factory setting:** Abort
Set LRV **(056, 013, 166, 168)** Entry	Set the pressure value for the lower current value (4 mA). **Factory setting:** • 0.0 % in the level measuring mode; 0.0 or in accordance with ordering specifications in the pressure measuring mode • 0.0 m^3/h in the flow measureing mode

Parameter name	Description
Get URV (016) Entry	Set the upper-range value – reference pressure is present at the device. The pressure for the upper current value (20 mA) is present at the device. With the "Confirm" option, you assign the upper current value to the pressure value present. **Options:** • Abort • Confirm **Factory setting:** Abort
Set URV (057, 014, 167, 169) Entry	Set the pressure value for the upper current value (20 mA). **Factory setting:** 100.0 % in the level measuring mode; URL sensor or in accordance with ordering information in the pressure measuring mode
Startcurrent (134) Entry	Use this function to enter the start current. This setting is also effective in the HART multidrop mode. **Options:** • 12 mA • Max Alarm (22 mA, non-adjustable) **Factory setting:** 12 mA
Curr. trim 4mA (135) Entry	Enter the current value for the lower point (4 mA) of the current linear regression line. You can adapt the current output to the transmission conditions with this parameter and "Curr. trim 20mA (136)". Perform the current trim for the lower point as follows: 1. Select the "Current" option in the "Simulation mode" parameter. 2. Set the 4mA value in the "Sim. current" parameter. 3. Enter the current value measured with the switching unit in the "Curr. trim 4mA" parameter. **Input range:** Measured current ±0.2 mA **Factory setting:** 4 mA
Curr. trim 20mA (136) Entry	Enter the current value for the upper point (20 mA) of the current linear regression line. You can adapt the current output to the transmission conditions with this parameter and "Curr. trim 4mA (135)". Perform the current trim for the lower point as follows: 1. Select the "Current" option in the "Simulation mode" parameter. 2. Enter the "20 mA" value in the "Sim. current" parameter. 3. Enter the current value measured with the switching unit in the "Curr. trim 20mA" parameter. **Input range:** Measured current ±0.2 mA **Factory setting:** 20 mA
Offset trim 4mA (137) Display	Displays the difference between 4 mA and the value entered for the "Curr. trim 4mA (135)" parameter. **Factory setting:** 0
Offset trim 20mA (138) Display	Displays the difference between 20 mA and the value entered for the "Curr. trim 20mA (136)" parameter. **Factory setting:** 0

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10.2.4 Communication

Expert → Communikation → HART config

Parameter name	Description
Burst mode (142) Selection	Switch the burst mode on and off. **Options:** • On • Off **Factory setting:** On
Burst option (143) Entry	Use this parameter to specify what HART command is sent to the master. **Options:** • 1 (HART command 1) • 2 (HART command 2) • 3 (HART command 3) • 9 (HART command 9) • 33 (HART command 33) **Factory setting:** 1 (HART command 1)
Current mode (144) Selection	Configure the current mode for HART communication. **Options:** • Signaling Measured value transmitted by the current value • Fixed Fixed current 4.0 mA (multidrop mode) (measured value only transmitted via HART digital communication) **Factory setting** Signaling
Bus address (145) Entry	Enter the address for exchanging data via the HART protocol. (HART 5.0 master: Range 0 to 15, where address = 0 calls up the "Signaling" setting; HART 6.0 master: range 0 to 63) **Factory setting:** 0
Preamble number (146) Entry	Enter the number of preambles in the HART protocol. (Synchronization of the modem modules along a transmission path, each modem module could "swallow" one byte; at least 2 bytes must be preambles.) **Input range:** 2 to 20 **Factory setting:** 5

Expert → Communication → HART info

Parameter name	Description
Device type code (105) Display	Displays the numeric ID of the device. • for LHCR-51, LHCR-51: 35 • for LHC-M51, PPC-M51: 25
Device revision (108) Display	Displays the device revision, e. g.: 1
Manufacturer ID (103) Display	Displays the manufacturer number in decimal numerical format. Here: 17
HART revision (180) Display	Displays the HART revision. Here: 6
Descriptor (139) Entry	Enter the tag description (max. 16 alphanumeric characters).
HART message (140) Entry	Enter a message (max. 32 alphanumeric characters). This message is sent via the HART protocol at the request of the master.
HART date (141) Entry	Enter the date of the last change in configuration. **Factory setting:** DD/MM/YY (date of the final test)

Expert → Communication → HART output

Parameter name	Description
Primary value is (147) Display	Indicates which measured variable is transmitted as the primary process value via the HART protocol. The variable displayed depends on the "Measuring mode (005)" selected: • "Pressure" measuring mode: "Meas. pressure" • "Level" measuring mode, "Linear" lin. mode: "Level before lin." • "Level" measuring mode, "Activate table" lin. mode: "Tank content"
Primary value (148) Display	Displays the primary process value.
Secondary val. is (149) Display	Secondary value. Displays the assignment. The following process values can be displayed depending on the measuring mode selected: • "Meas. pressure" • "Sensor pressure" • "Corrected press." • "Pressure af. damp" • "Sensor temp." • "Level before lin." • "Tank content"
Secondary value (150) Display	Displays the secondary process value.
Third value is (151) Display	Third process value. Displays the assignment. The variable displayed depends on the measuring mode selected, see also "Secondary val. is (149)".
Third value (152) Display	Displays the third process value.
4th value is (153) Display	4th process value. Displays the assignment. The variable displayed depends on the measuring mode selected, see also "Secondary val. is (149)".
4th value (154) Display	Displays the 4th process value.

Expert → Communication → HART input

Parameter name	Description
HART input value (155) Display	Displays the HART input value.
HART input stat. (179) Display	Displays the HART input status Bad/Uncertain/Good
HART input unit (156) Selection	Select the HART input value. **Options:** • Unknown • mbar, bar • mmH2O, ftH2O, inH2O • Pa, hPa, kPa, MPa • psi • mmHg, inHg • Torr • g/cm^2, kg/cm^2 • lb/ft^2 • atm • °C, °F, K, R **Factory setting:** Unknown
HART input form. (157) Selection	Specify the format for displaying the HART input value. **Options:** • x.x (default) • x.xx • x.xxx • x.xxxx • x.xxxxx **Factory setting:** x.x

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10.2.5 Application

Expert → Application

Parameter name	Description
Electr. delta P (158) Entry	For switching the electr. delta P application on or off with an external or constant value. **Options:** • Off • External value • Constant **Factory setting:** Off
Fixed ext. value (174) Entry	Use this function to enter the constant value. The value refers to "HART input unit". **Factory setting:** 0.0

10.2.6 Diagnosis

Expert → Diagnosis

Parameter name	Description
Diagnostic code (071) Display	Displays the diagnostic message with the highest priority currently present.
Last diag. code (072) Display	Displays the last diagnostic message that occurred and was rectified. **NOTICE** • Digital communication: the last message is displayed. • The messages listed in the "Last diag. code" parameter can be deleted via the "Reset logbook" parameter.
Reset logbook (159) Selection	With this parameter, you reset all the messages of the "Last diag. code" parameter and the "Last diag. 1" to "Last diag. 10" event log. **Options:** • Abort • Confirm **Factory setting:** Abort
Min. meas. press. (073) Display	Displays the lowest pressure value measured (peakhold indicator). You can reset this indicator by means of the "Reset peakhold" parameter.
Max. meas. press. (074) Display	Displays the highest pressure value measured (peakhold indicator). You can reset this indicator by means of the "Reset peakhold" parameter.
Reset peakhold (161) Selection	You can reset the "Min. meas. press." and "Max. meas. press." indicators with this parameter. **Options:** • Abort • Confirm **Factory setting:** Abort
Operating hours (162) Display	Displays the hours of operation. This parameter cannot be reset.
Config. counter (100) Display	Displays the configuration counter. This counter is increased by one every time a parameter or group is changed. The counter counts up to 65535 and then starts again at zero.

Expert → Diagnosis → Diagnostic list

Parameter name	Description
Diagnostic 1 (075) **Diagnostic 2 (076)** **Diagnostic 3 (077)** **Diagnostic 4 (078)** **Diagnostic 5 (079)** **Diagnostic 6 (080)** **Diagnostic 7 (081)** **Diagnostic 8 (082)** **Diagnostic 9 (083)** **Diagnostic 10 (084)**	These parameters contain up to ten diagnosis messages that are currently pending, arranged in order of priority.

Expert → Diagnosis → Event logbook

Parameter name	Description
Last diag. 1 (085) **Last diag. 2 (086)** **Last diag. 3 (087)** **Last diag. 4 (088)** **Last diag. 5 (089)** **Last diag. 6 (090)** **Last diag. 7 (091)** **Last diag. 8 (092)** **Last diag. 9 (093)** **Last diag. 10 (094)**	These parameters contain the last 10 diagnosis messages to occur and be rectified. They can be reset with the "Reset logbook" parameter. Errors which have occurred multiple times are displayed once only.

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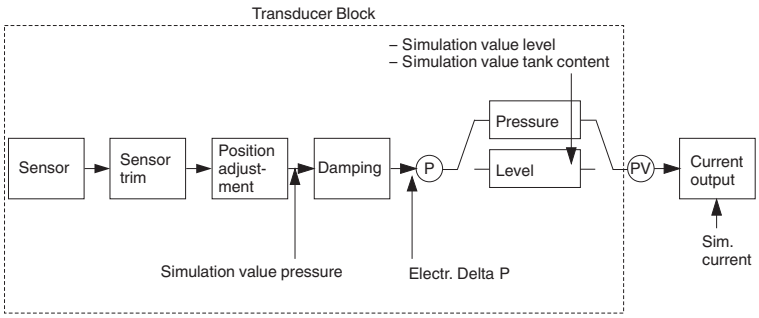
Expert → Diagnosis → Simulation

Parameter name	Description
Simulation mode (112) Selection	Switch on simulation and select the simulation mode. Any simulation running is switched off if the measuring mode or level type "Lin. mode (037)" is changed. **Options:** • None • Pressure, → see also this table, "Sim. pressure" parameter • Level, → see this table, "Sim. level" parameter • Tank content, → see this table, "Sim. tank cont." parameter • Current, → see this table, "Sim. current" parameter • Alarm/warning, → see this table, "Sim. error no." parameter  **Factory setting:** None
Sim. pressure (113) Entry	Enter the simulation value. → See also "Simulation mode". **Prerequisite:** "Simulation mode" = Pressure **Switch on value:** Current pressure measured value
Sim. level (115) Entry	Enter the simulation value. → See also "Simulation mode". **Prerequisite:** "Measuring mode" = Level and "Simulation mode" = Level
Sim. tank cont. (116) Entry	Enter the simulation value. → See also "Simulation mode". **Prerequisites:** "Measuring mode" = Level, "Activate table" lin. mode and "Simulation mode" = Tank content.
Sim. current (117) Entry	Enter the simulation value. → See also "Simulation mode". **Prerequisite:** "Simulation mode"= Current value **Factory setting:** Current value of the current
Sim. error no. (118) Entry	Enter the diagnostic message number. → See also "Simulation mode". **Prerequisite:** "Simulation mode"= Alarm/warning **Switch on value:** 484 (simulation active)

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