JUMO MAERA

Level probes

Types 401015, 402090, 404391, 404392

B 401015.4

Installation Instructions

JUMO

2013-06-18/00588054

1 Safety information

1.1 Warning signs

DANGER!

This symbol indicates that **injury to persons caused by electrical shock** may occur, if the respective protective measures are not carried out.

CAUTION!

This symbol in combination with the signal word indicates that **damage to assets or data loss** will occur if suitable precautions are not taken.

1.2 Note signs

NOTE!

This symbol refers to **important information** about the product or its handling or additional use.

2 General safety instructions

2.1 Intended use of the product

NOTE!

Intended use of the product:

Level measurement probes are used for hydrostatic filling level measurements of **ventilated** tanks or to measure the level in open waters.

The **correct level probe** must be selected in terms of the measuring range, version and specific on-site measuring conditions before mounting, installation and startup! Details provided by the manufacturer, with the exception of those derived from test series, constitute advice. The operator is responsible for the decision!

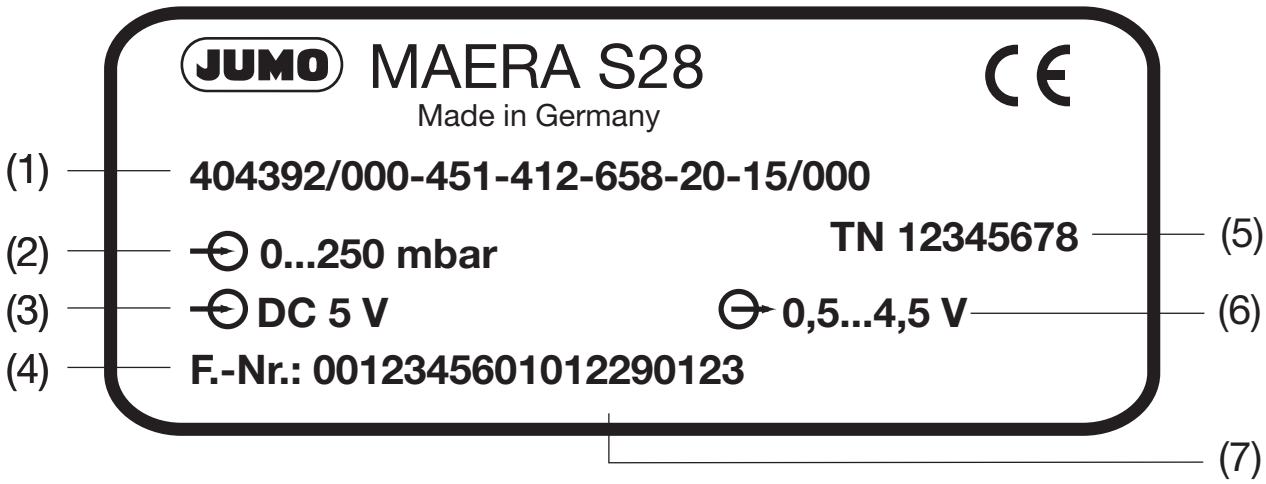
The manufacturer shall not be liable for damage resulting from improper or unintended use.

To prevent damage to the level probe and protect your process, only **qualified specialists** are permitted to perform mounting, installation and startup. They must be familiar with the relevant national regulations as well as standards and directives related to the application to prevent injuries to persons and physical damage. The qualified specialists must have read the operating manual, made note of the nameplate and understood both so they will be able to follow the instructions. Changes and repairs may only be made if the operating manual allows it.

Please note that the manufacturer will not be liable for damage resulting from improper or unintended use.

3 Instrument identification

3.1 Nameplate



(1) Type code
(2) Measuring range
(3) Voltage supply
(4) Manufacturing number
(5) Part no.
(6) Output signal
(7) Date of manufacture
2912 = 2012/29
(year/week)

3.2 Order details

The order details consists of features. They are described in the technical data for the device:

- starting at Section 10.1 "JUMO MAERA S25, type 401015", page 20
- starting at Section 10.2 "JUMO MAERA S26, type 402090", page 28
- starting at Section 10.3 "JUMO MAERA F27, type 404391", page 37
- starting at Section 10.4 "JUMO MAERA S28, type 404392", page 46

3.3 Scope of delivery

The scope of delivery consists of:

- Level probe
- Operating manual
- Optional certificates
- Optional accessories
  (starting at Section 11 "Accessories", page 57)

3.4 Goods receiving

- Check whether the packaging is damaged.
- Check whether the scope of delivery is complete and matches your order.
- Check whether the level probe shows any signs of transport damage that may have occurred.

Please note that the membrane on the process connection of the level probe must not be damaged. If it is, measurement errors may occur or process liquid may even escape. Therefore it must not be touched with pointed or hard objects.

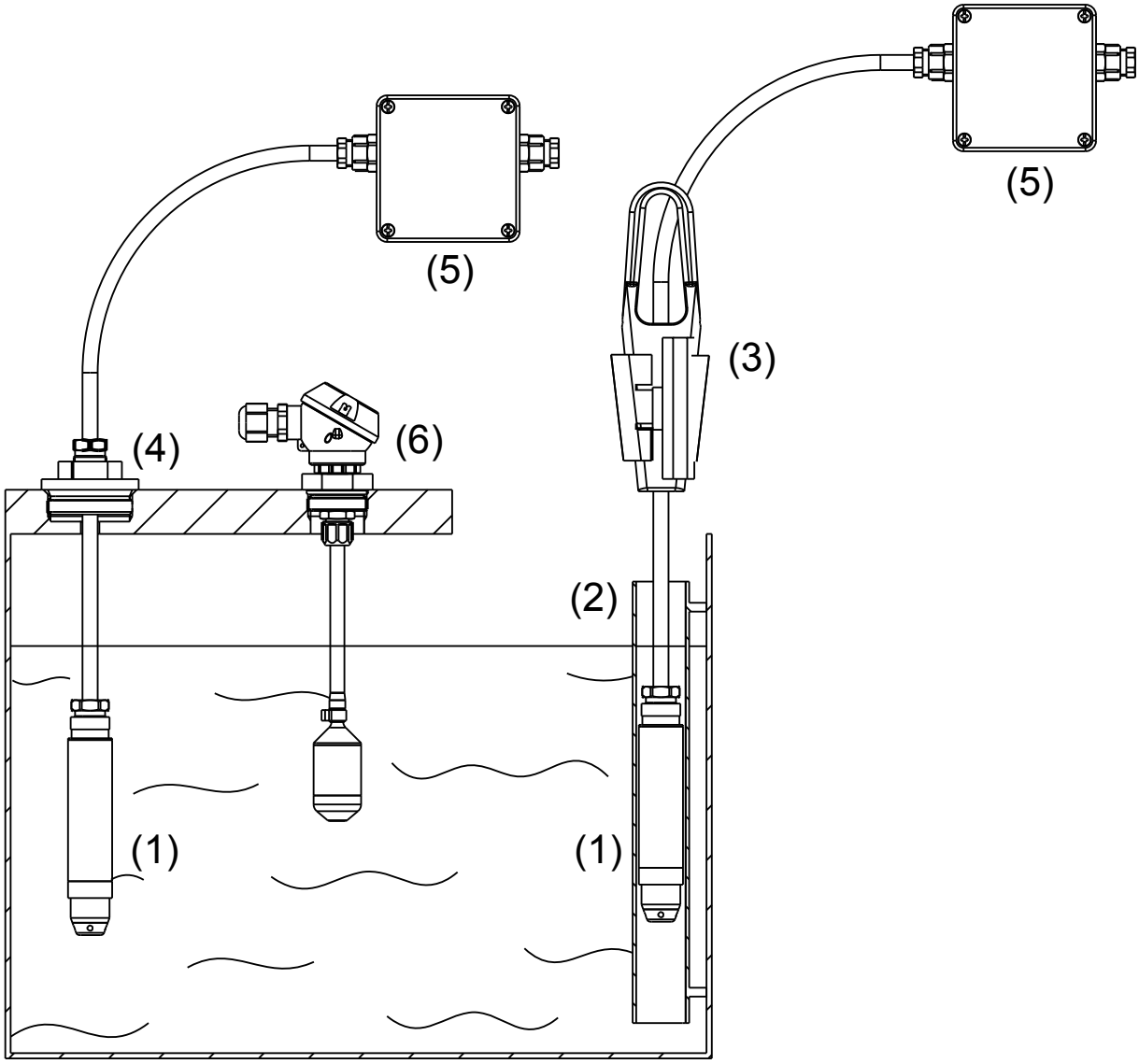
4 Storage

The device must be stored in dry, clean conditions and must be protected against external mechanical damage!

The admissible temperatures for storage are listed in the technical data for the device:

- JUMO MAERA S25,
  Section 10.1.5 "Ambient conditions", page 21,
- JUMO MAERA S26,
  Section 10.2.5 "Ambient conditions", page 29,
- JUMO MAERA F27,
  Section 10.3.5 "Ambient conditions", page 39,
- JUMO MAERA S28,
  Section 10.4.5 "Ambient conditions", page 47.

5 Mounting



(1) Level probe, suspended vertically in the measuring material
(2) Guide tube for level probe
(3) Cable holder
(accessory, part no. 00061389)
(4) Sealing screw
(accessory, part no. 00333329)
(5) Terminal box with pressure compensation element
(accessory, part no. 00061206)
(6) Terminal head form J with a pressure compensation element
(accessory, part no. 00602743/00602744)

CAUTION!

Always mount the device in an unpressurized and currentless state.

NOTE!

The **membrane** on the process connection of the level probe must not be damaged. If it is, measurement errors may occur or process liquid may even escape. Therefore it must not be touched with pointed or hard objects.

NOTE!

Cable module

The **special cable** of the level probe should be fastened so that the pressure compensation element is not crushed in the cable module. The end of the cable must be in a dry space or in a suitable terminal box so that no moisture can penetrate. The cable should also not be routed through places subject to moist conditions.

If there are fluctuations in the measuring material, a guide tube should be used to prevent measurement errors in flows due to lateral motion and the level probe striking against the container wall.

We recommend using a terminal box with a pressure compensation element (see Section 11.3 "Terminal box with pressure compensation element", page 59).
The terminal case should be mounted as close as possible to the surface of the medium whilst still outside the medium.

JUMO MAERA S25 (type 401015)

In this design a stranded core PVC cable is optionally encased in an application-oriented PE or PA protective tube. To prevent moisture from getting into the protective tube (in this case the pressure compensation tube) a hose endpiece (see Section 11.5 "Hose endpiece", page 60) is included with delivery in the mounting material.

Protective tube	
Material	PE, PA
Color	Natural
External diameter	8 mm
Bending radius	Approx. 120 mm It is vital to note that if the protective tube is kinked or pinched, this will prevent ambient pressure compensation.
Admissible medium temperatures	-5 to +80 °C (depending on the measuring material and level probe)
Yield stress PE protective tube PA protective tube	 10 M Pa 22 M Pa

JUMO MAERA S26 (type 402090),
JUMO MAERA F27 (type 404391),
JUMO MAERA S28 (type 404392)

Cable	
Version	6-core, shielded cable with integrated pressure compensation tube; AWG 24 with ferrules
Material Sheathing Pressure compensation tube	 PE, PUR, FEP PA
Color PE, FEP cable PUR cable	 Black Pebble gray
External diameter	Approx. 8.4 mm
Conductor cross section	0.25 mm^2
Bending radius Movable Fixed	 160 mm 120 mm Note that if the cable is kinked, this will prevent ambient pressure compensation.
Tensile force	Up to 400 N
Weight PE, PUR cable FEP cable	 Approx. 115 g/m Approx. 90 g/m
Admissible medium temperatures	-40 to +70 °C (depending on the measuring material)
UV resistance	PE and PUR cable acc. to VDE 0207, test procedure EN 60811 part 2-1 section 8 FEP cable acc. to DIN ISO 4892-2

6 Installation and startup

CAUTION!

Install the device in a currentless state.

NOTE!

The level probe must be grounded. To prevent **electrolysis**, the screen of the level probe must be set to the same potential as the other devices in the measuring material such as the pump, agitator, etc.

JUMO MAERA S25 (type 401015)

Connection		**Terminal assignment**
		
		Cable[a]
4 to 20 mA, 2-wires (output 405)		
Voltage supply DC 10 to 30 V, nominal voltage supply DC 24 V	U_B+[b] 0 V/S-	White Brown
DC 0.5 to 4.5 V ratiometric (output 412)		
Voltage supply DC 5 V, nominal voltage supply DC 5 V	U_B[b] 0 V/S- S+	White Brown Green
DC 0 to 10 V 3-wires (output 415)		
Voltage supply DC 11.5 to 30 V, nominal voltage supply DC 24 V	U_B[b] 0 V/S- S+	White Brown Green

Connection		Terminal assignment
DC 1 to 5 V 3-wires (output 418) **DC 1 to 6 V 3-wires (output 420)**		
Voltage supply DC 10 to 30 V, nominal voltage supply DC 24 V	U_B[b] 0 V/S- S+	White Brown Green

[a] For cable specifications see page 12 and following.

[b] Peak voltages must not exceed or fall below the values specified for the voltage supply!

Reverse voltage protection	Yes (2-wires)
Max. current consumption	25 mA
Circuit	SELV

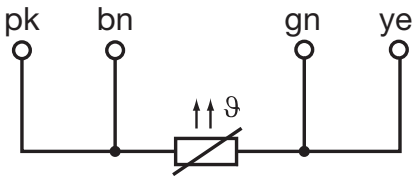
JUMO MAERA S26 (type 402090),
JUMO MAERA F27 (type 404391),
JUMO MAERA S28 (type 404392)

Connection		Terminal assignment
		
		Cable[a]
4 to 20 mA, 3-wires (output 402)		
Voltage supply DC 11.5 to 30 V, nominal voltage supply DC 24 V	U_B[b] 0 V/S- S+	White Gray Yellow
4 to 20 mA, 2-wires (output 405)		
Voltage supply DC 10 to 30 V, type 404391: DC 12 to 30 V, nominal voltage supply DC 24 V	$U_{B/S}$+[b] 0 V/S-	White Gray

Connection		Terminal assignment
4 to 20 mA, 3-wires (output 406)		
Voltage supply DC 11.5 to 30 V, nominal voltage supply DC 24 V	U_B 0 V/S- S+	White Gray Yellow
DC 0.5 to 4.5 V ratiometric (output 412)		
Voltage supply DC 5 V, nominal voltage supply DC 5 V	U_B 0 V/S- S+	White Gray Yellow
0 to 10 V DC 3-wires (output 415)		
Voltage supply DC 11.5 to 30 V, nominal voltage supply DC 24 V	U_B 0 V/S- S+	White Gray Yellow
DC 1 to 5 V 3-wires (output 418) **DC 1 to 6 V 3-wires (output 420)**		
Voltage supply DC 10 to 30 V, nominal voltage supply DC 24 V	U_B 0 V/S- S+	White Gray Yellow
Screen		
Attention: Ground the device! Ground all connected devices (such as pumps and valves) to the same potential!		Black

[a] For cable specifications see page 12 and following.

[b] Peak voltages must not exceed or fall below the values specified for the voltage supply!

Integrated temperature sensor (with basic type extension 007)	
	Pink (pk) Brown (bn) Green (gn) Yellow (ye)
Max. current consumption	
JUMO MAERA S26, type 402090	25 mA
JUMO MAERA F27, type 404391 with DC 24 V with DC 5 V	 25 mA 2 mA
JUMO MAERA S28, type 404392	30 mA

NOTE!

Level probes in open air applications without integrated overvoltage protection must be protected against electrical discharge. Use of external overvoltage protection is also recommended upstream and downstream from the display or evaluation unit.

7 Operation

CAUTION!

Comply with the technical data in the installation instructions in general.

Special care is required when the level probe is in operation to ensure that the actual temperature does not exceed or fall below the admissible medium temperature and that the level probe does not freeze in the measuring material. In addition, the admissible overpressure must not be exceeded.

DANGER!

Potentially explosive atmosphere:

The devices described in these installation instructions are **not** designed for use in a potentially explosive atmosphere.

Note

Continuously fluctuating measuring material temperatures may result in a zero point offset. Extreme fluctuations may even cause the device to fail.

8 Cleaning

NOTE!

The cleaning agents that are used must not corrode the material of the probe body and seals.

Mechanical damage to the membrane and cable must be prevented.

9 Maintenance and returns

NOTE!

JUMO level probes are maintenance-free.

If irregularities are noted, please send the level probe to the manufacturer with a filled in decontamination declaration and information about the application and the measuring material. The decontamination declaration can be found at our home page under

http://www.jumo.de/de_DE/support/produktservice/reparaturdienst.html .

Please remove the level probe only in an unpressurized and currentless state.

Since further damage may occur during dismounting, make certain no mechanical damage occurs to the probe body and membrane or the cable.

Terminal box with pressure compensation element (accessory, part no. 00061206):
Always keep the filter free of contamination!

10 Technical data

10.1 JUMO MAERA S25, type 401015

10.1.1 General information

Reference conditions	DIN 16086 and EN 60770
Principle of measurement	Piezoresistive sensor with stainless steel separating membrane
Pressure transfer medium	Synthetic oil
Admissible load changes	> 10 million, 0 to 100 % measuring range
Mounting position	Vertical/suspended on the cable

10.1.2 Measuring range

Relative pressure	Measuring ranges start at 0 bar.				
Measuring range	0.25	0.4	0.6	1	bar
Overload capacity	0.75	1.2	1.8	3	bar
Burst pressure	1	1.6	2.4	4	bar

10.1.3 Output

Analog output	
Current	
Output 405	4 to 20 mA, 2-wires
Voltage	
Output 412	DC 0.5 to 4.5 V, 3-wires, ratiometrically 10 to 90 % of the voltage supply
Output 415	DC 0 to 10 V, 3-wires
Output 418	DC 1 to 5 V, 3-wires
Output 420	DC 1 to 6V, 3-wires
Step response	
T_{90}	≤ 10 ms

Burden Current 4 to 20 mA, 2-wires Voltage DC 0.5 to 4.5 V, 3-wires DC 0 to 10 V, 3-wires DC 1 to 5 V, 3-wires DC 1 to 6 V, 3-wires	 $R_L \leq [(U_B - 10\ V) \div 0.02\ A]\ (\Omega)$ $R_L \geq 20\ k\Omega$ $R_L \geq 10\ k\Omega$ $R_L \geq 10\ k\Omega$ $R_L \geq 10\ k\Omega$

10.1.4 Mechanical properties

Note the resistance of the materials!

Process connection Material Process connection 567 Process connection 707	 Stainless steel 316 L Stainless steel 316 Ti
Measuring membrane Material	 Stainless steel 316 L
Case Material	 Stainless steel 304
Protective cap Material	 Rigid PVC
Weight	90 g (without cable)
Diameter	27 mm

10.1.5 Ambient conditions

Admissible temperatures Measuring material	 0 to 50 °C The device must **not** be allowed to freeze in the measuring material! Depending on the measuring material it may be necessary to impose a restriction.
Storage	-20 to +80 °C, dry

Electromagnetic compatibility	
Interference emission[a]	Class B
Interference immunity[b]	Industrial requirements
Protection type[c]	IP68, immersible to 20 m

[a] According to EN 61326-1
[b] According to EN 61326-2-3
[c] According to EN 60529

10.1.6 Accuracy

Relative pressure					
Measuring range	0.25	0.4	0.6	1	bar
Linearity[a]	**0.3**	**0.3**	**0.3**	**0.3**	**% of FS**
Accuracy at 20 °C[b]	0.5	0.5	0.5	0.5	% of FS
Overall accuracy at 0 to 50 °C[c]	1	1	1	1	% of FS
Long-term stability[d]	0.3 % of FS per year				

[a] Linearity based on limit point setting
[b] Includes: linearity, hysteresis, repeatability, deviation from measuring range start (offset) and measuring range end
[c] Includes: linearity, hysteresis, repeatability, deviation from measuring range start (offset) and measuring range end, thermal effect on measuring range start (offset) and measuring span
[d] Reference conditions according to EN 61298-1

10.1.7 Auxiliary power

Voltage supply U_B[a]	
4 to 20 mA, 2-wires (output 405)	DC 10 to 30 V, nominal voltage supply DC 24 V
DC 0.5 to 4.5 V, 3-wires (output 412)	DC 5 V
DC 0 to 10 V, 3-wires (output 415)	DC 11.5 to 30 V, nominal voltage supply DC 24 V
DC 1 to 5 V, 3-wires (output 418)	DC 10 to 30 V, nominal voltage supply DC 24 V

DC 1 to 6 V, 3-wires (output 420)	DC 10 to 30 V, nominal voltage supply DC 24 V
Reverse polarity protection	Yes (2-wire)
Max. power consumption	≤ 25 mA
Circuit	SELV

[a] Peak voltages must not exceed or fall below the values specified for the voltage supply!

10.1.8 Electrical connection

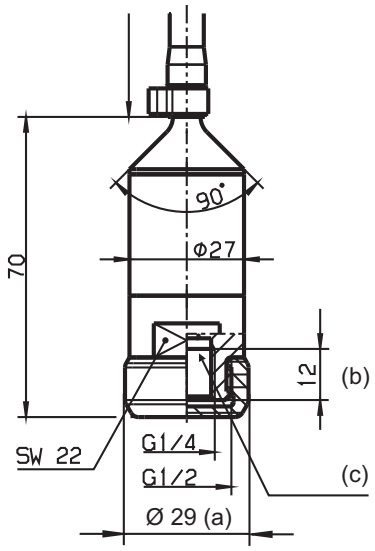
Stranded core PVC cable, incased in a PE or PA protective tube (in contact with the medium).

Because of ambient pressure compensation, the mounting of the level probe must not pinch the protective tube encasing the cable. A hose endpiece is included among the items supplied. It is also essential to ensure that moisture cannot get into the protective tube.

Protective tube	
Material	PE, PA
Colour	Natural
External diameter	8 mm
Bending radius	approx. 120 mm It is vital to take into account that if the protective tube is kinked or pinched, this will prevent ambient pressure compensation.
Permissible medium temperatures	-5 to +80 °C (subject to the medium and the level probe)
Yield stress PE protective tube PA protective tube	 10 M Pa 22 M Pa

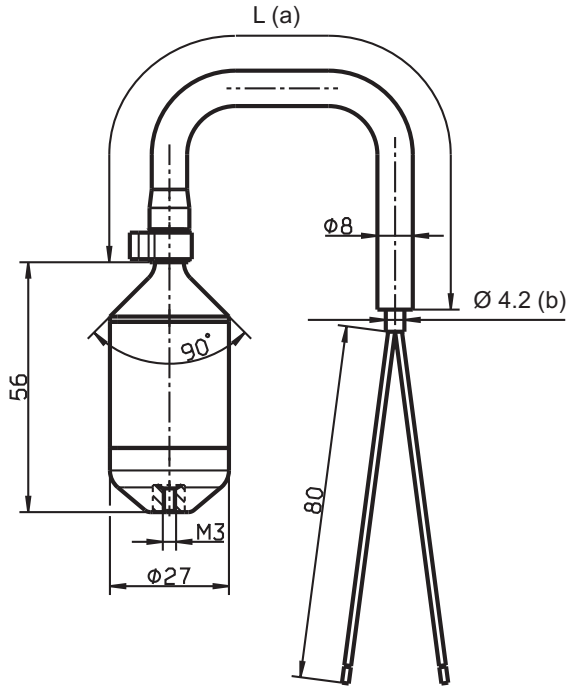
10.1.9 Dimensions process connection

Process connection 567



(a) The protective cap has three holes (Ø 3) and protects the housing against contact corrosion, and the sensitive separating diaphragm
(b) Max. depth of engagement
(c) Sensitive diaphragm

Process connection 707

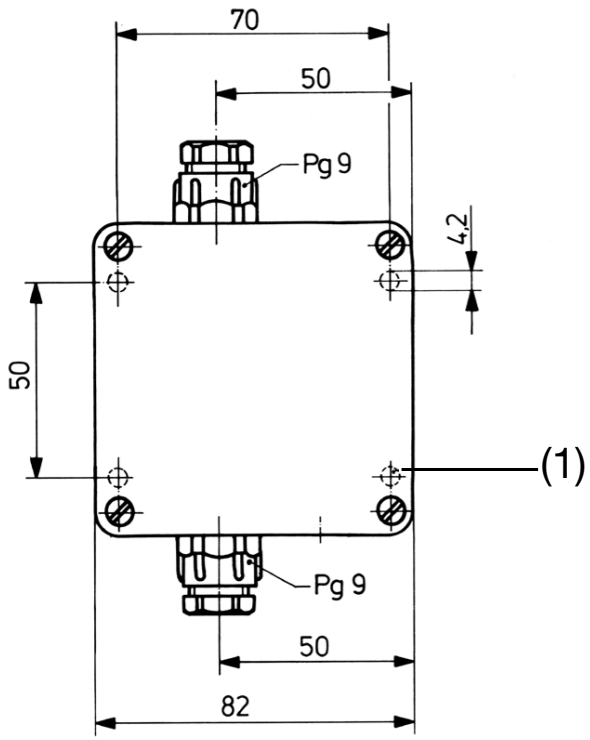


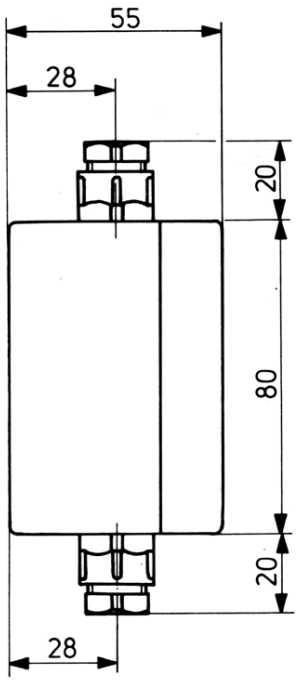
(a) Cable length as required by customer
(b) Ø 4.6 for three-wire output

10.1.10 Dimensions accessories

Terminal box with pressure compensation element

Part no. 00061206

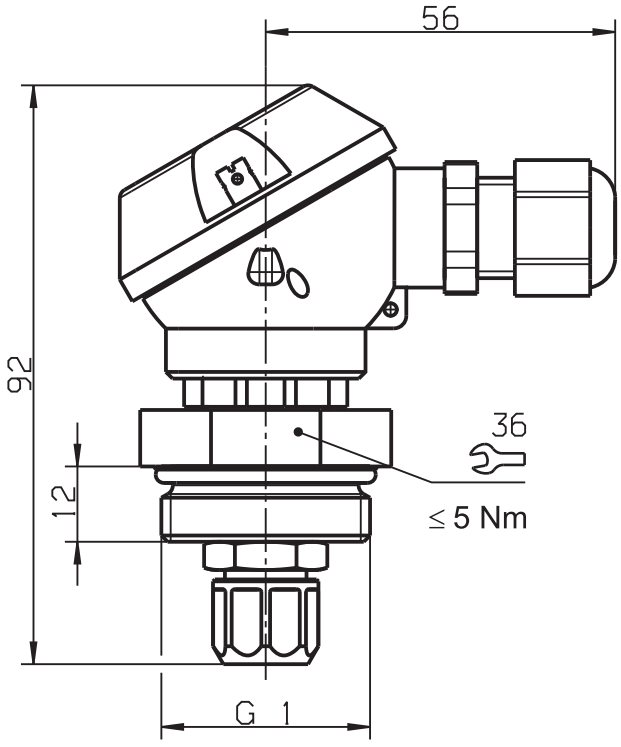




(1) Mounting hole

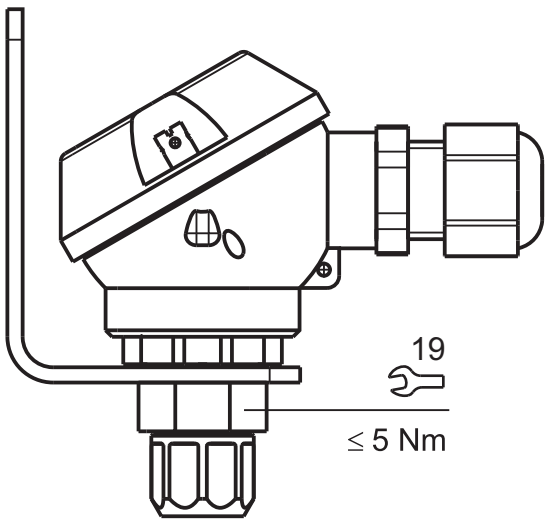
Tank cover mounting

Part no. 00602743



Wall mounting

Part no. 00602744



10.1.11 Order details

	(1)	**Basic type**
401015/000		JUMO MAERA S25 - Level probe
401015/999		JUMO MAERA S25 - Level probe, special version
	(2)	**Input**
451		0 to 250 mbar relative pressure
452		0 to 400 mbar relative pressure
453		0 to 600 mbar relative pressure
454		0 to 1 bar relative pressure
	(3)	**Output**
405		4 to 20 mA, 2-wires
412		0.5 to 4.5 V, 3-wires
415		0 to 10 V, 3-wires
418		1 to 5 V, 3-wires
420		1 to 6 V, 3-wires
	(4)	**Process connection**
567		G 1/4 internal
659		Connection open underneath
707		M3 (× 0.5) internal
	(5)	**Material of process connection**
20		CrNi (stainless steel)
	(6)	**Electrical connection type**
11		Attached cable
	(7)	**Protective tube**
1		PE protective tube
2		PA protective tube
	(8)	**Length of connecting cable**
005		5 m
010		10 m
025		25 m

	(9)	Extra codes
	000	None
	691	Higher humidity and vibration protect

Example: 401015/000-452-405-707-20-11-1-005/000

10.1.12 Accessories

Article	Part no.
Terminal head form J with pressure compensation Tank cover mounting Wall mounting	 00602743 00602744
Terminal box with pressure compensation element (can only be used with the hose endpiece, Section 11.5 "Hose endpiece", page 60)	00061206

10.2 JUMO MAERA S26, type 402090

10.2.1 General information

Reference conditions	DIN 16086 and EN 60770
Principle of measurement	Piezoresistive sensor with stainless steel separating membrane
Pressure transfer medium	Synthetic oil
Admissible load changes	> 10 million, 0 to 100 % measuring range
Mounting position	Vertical/suspended on the cable

10.2.2 Measuring range

Relative pressure	Measuring ranges start at 0 bar.						
Measuring range	0.25	0.4	0.6	1	1.6	2.5	bar
Overload capacity	0.75	1.2	1.8	3	4.8	7.5	bar
Burst pressure	1	1.6	2.4	4	6.4	10	bar

10.2.3 Output

Analog output[a]	
Current	
Output 402	0 to 20 mA, 3-wires
Output 405	4 to 20 mA, 2-wires
Output 406	4 to 20 mA, 3-wires
Voltage	
Output 412	DC 0.5 to 4.5 V, 3-wires, ratiometrically 10 to 90 % of the voltage supply
Output 415	DC 0 to 10 V, 3-wires
Output 418	DC 1 to 5 V, 3-wires
Output 420	DC 1 to 6V, 3-wires
Step response	
T_{90}	≤ 10 ms
Burden	
Current	
0 to 20 mA, 3-wires	$R_L \leq [(U_B - 12\ V) \div 0.02\ A]\ (\Omega)$
4 to 20 mA, 2-wires	$R_L \leq [(U_B - 10\ V) \div 0.02\ A]\ (\Omega)$

4 to 20 mA, 3-wires	$R_L \leq [(U_B - 12\ V) \div 0.02\ A]\ (\Omega)$
Voltage	
DC 0.5 to 4.5 V, 3-wires	$R_L \geq 50\ k\Omega$
DC 0 to 10 V, 3-wires	$R_L \geq 10\ k\Omega$
DC 1 to 5 V, 3-wires	$R_L \geq 10\ k\Omega$
DC 1 to 6 V, 3-wires	$R_L \geq 10\ k\Omega$

[a] Additional outputs available on request.

10.2.4 Mechanical properties

Note the resistance of the materials!

Process connection Material	 Stainless steel 316 Ti
Measuring membrane Material	 Stainless steel 316L
Case Material	 Stainless steel 316 Ti
Sealing cone Material	 FPM
Weight	200 g (without cable)
Diameter	25 mm

10.2.5 Ambient conditions

Admissible temperatures	
Measuring material/ environment	0 to 50 °C The device must **not** be allowed to freeze in the measuring material! Depending on the measuring material it may be necessary to impose a restriction.
Storage	-20 to +80 °C, dry
Electromagnetic compatibility	
Interference emission[a]	Class B
Interference immunity[b]	Industrial requirements

Protection type[c]	IP68, immersible to 60 m

[a] According to EN 61326-1
[b] According to EN 61326-2-3
[c] According to EN 60529

10.2.6 Accuracy

Relative pressure							
Measuring range	0.25	0.4	0.6	1	1.6	2.5	bar
Linearity[a]	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**% of FS**
Accuracy at 20 °C[b]	0.5	0.5	0.5	0.5	0.5	0.5	% of FS
Overall accuracy at 0 to 50 °C[c]	1.6	1.6	1.3	1.1	1.1	1.1	% of FS
Long-term stability[d]	0.2 % of FS per year						

[a] Linearity based on limit point setting
[b] Includes: linearity, hysteresis, repeatability, deviation from measuring range start (offset) and measuring range end
[c] Includes: linearity, hysteresis, repeatability, deviation from measuring range start (offset) and measuring range end, thermal effect on measuring range start (offset) and measuring span
[d] According to EN 61298-1

10.2.7 Auxiliary power

Voltage supply U_B[a]	
0 to 20 mA, 3-wires (output 402)	DC 11,5 to 30 V, nominal voltage supply DC 24 V
4 to 20 mA, 2-wires (output 405)	DC 10 to 30 V, nominal voltage supply DC 24 V
4 to 20 mA, 3-wires (output 406)	DC 11,5 to 30 V, nominal voltage supply DC 24 V
DC 0,5 to 4,5 V, 3-wires (output 412)	DC 5 V
DC 0 to 10 V, 3-wires (output 415)	DC 11,5 v 30 V, nominal voltage supply DC 24 V
DC 1 to 5 V, 3-wires (output 418)	DC 10 to 30 V, nominal voltage supply DC 24 V

DC 1 to 6 V, 3-wires (output 420)	DC 10 to 30 V, nominal voltage supply DC 24 V
Max. power consumption	≤ 25 mA
Circuit	SELV

[a] Residual ripple: Peak voltages must not exceed or fall below the values specified for the voltage supply!

10.2.8 Electrical connection

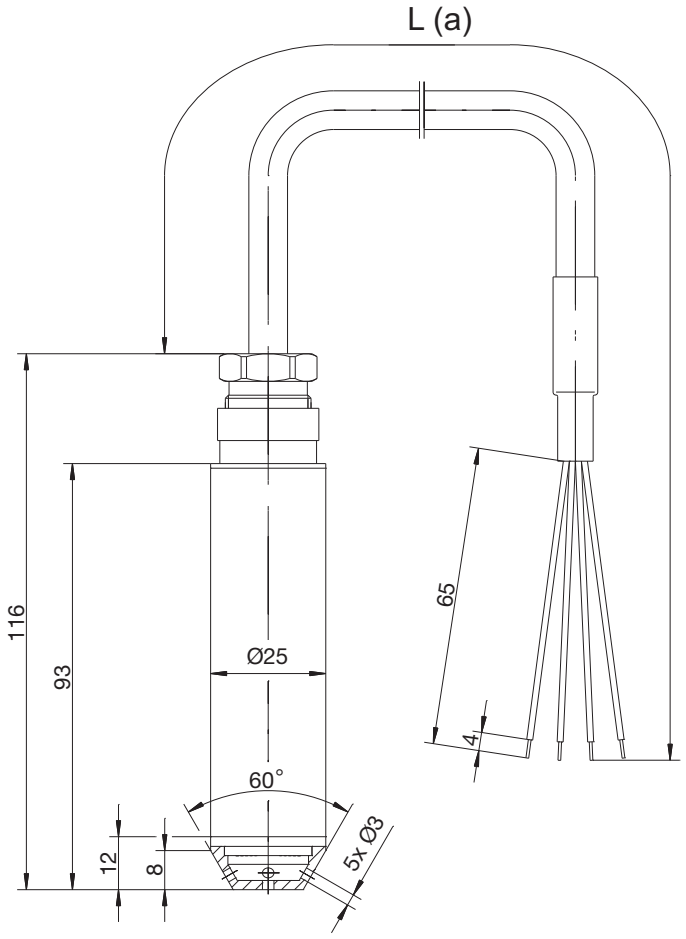
6-core, shielded cable with integrated pressure compensation tube; AWG 24 with ferrules

Material	
Outer sheath	PE, PUR, FEP
Pressure compensation tube	PA
Color	
PE and FEP cables	Black
PUR cable	Pebble-gray
External diameter	Approx. 8,4 mm
Conductor cross-section	0,25 mm^2
Bending radius	
moveable	160 mm
fixed	120 mm
	Please note that a bend in the cable prevents ambient pressure compensation.
Tension force	Up to 400 N
Weight	
PE and PUR cables	Approx. 115 g/m
FEP cable	Approx. 90 g/m
Permissible medium temperatures	-40 ... +70 °C (subject to the medium)

UV resistance	PE and PUR cables according to VDE 0207, test method EN 60811 part 2-1, section 8 FEP cable according to DIN ISO 4892-2

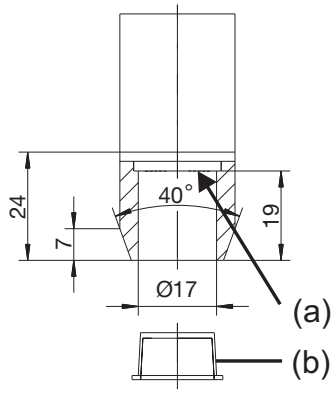
10.2.9 Dimensions Process connections

Process connection 658



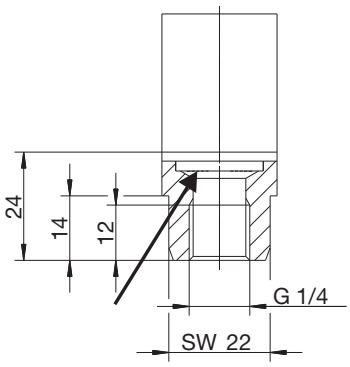
(a) Cable length to customer specification

Process connection 659



(a) Sensitive membrane
(b) Protective cap

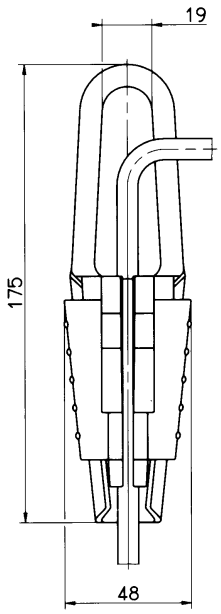
Process connection 567



10.2.10 Dimensions of accessories

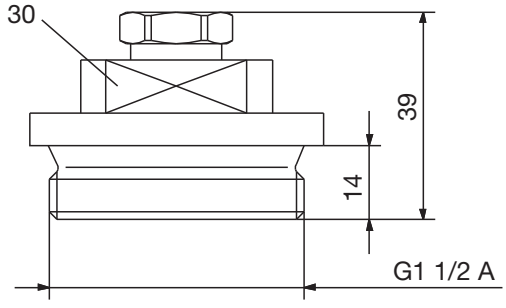
Cable clamp assembly

Part no. 00061389

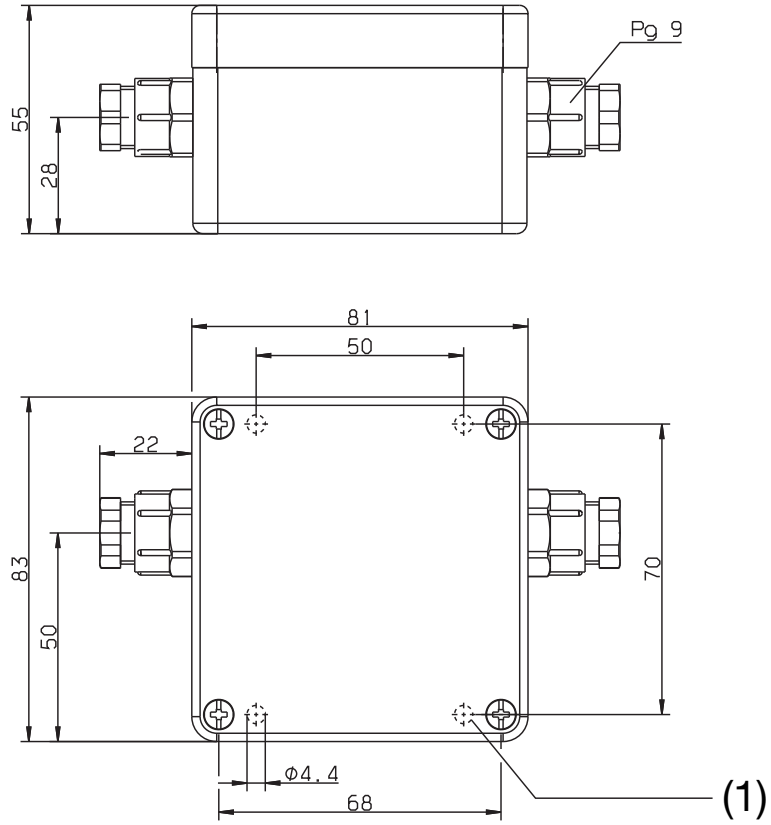


Terminal box with pressure compensation

Part no. 00333329



Screw plug (cover mounting)
Part no. 00061206



(1) Mounting hole

10.2.11 Order details

	(1)	Basic type
402090/000		JUMO MAERA S26 - Level probe
402090/023		JUMO MAERA S26 - Level probe with improved accuracy[a]
402090/999		JUMO MAERA S26 - Level probe, special version
	(2)	**Input**
	451	0 to 250 mbar relative pressure
	452	0 to 400 mbar relative pressure
	453	0 to 600 mbar relative pressure
	454	0 to 1 bar relative pressure
	455	0 to 1.6 bar relative pressure
	456	0 to 2.5 bar relative pressure
	999	Special measuring range for relative pressure

	(3)	**Output**
402		0 to 20 mA, 3-wires
405		4 to 20 mA, 2-wires
406		4 to 20 mA 3-wires
412		0.5 to 4.5 V 3-wires
415		0 to 10 V 3-wires
418		1 to 5 V 3-wires
420		1 to 6 V 3-wires
	(4)	**Process connection**
567		G 1/4 internal
658		Connection closed underneath
659		Connection open underneath
	(5)	**Material of process connection**
20		CrNi (stainless steel)
	(6)	**Electrical connection type**
14		PUR cable, gray, screened, e.g. suitable for use in water (seawater, well water, brine), as well as in coolant and lubricant (UV-resistant)
15		PE-LD cable, black, screened, e.g. suitable for use in water (seawater, well water, brine, UV-resistant)
25		FEP cable, black, screened, e.g. suitable fo ruse in water (seawater, saltwater, well water, and mine water), as well as in different oils, fuels and solvents (UV-resistant)
	(7)	**Length of connecting cable**
005		5 m
010		10 m
...		...
100		100 m

	(8)	Extra codes
	000	None
	593	Fitting with cutting rings (preparation for protection tube)
	631	Higher humidity and vibration protect

[a] Devices with reduced characteristic deviation can be supplied only with output 405 and only for spans from 600 mbar up to 6 bar.

Example: 402090/000-454-405-659-20-15-010/000

10.2.12 Accessories

Article	Part no.
Terminal box with pressure compensation element	00061206
Cable clamp assembly[a]	00061389
Sealing plug	00333329
Pressure equalization filter for cable	00382632

[a] The hot-dip galvanized housing is made of sheet steel. The clamping jaws and guide chambers are made of fiberglass-reinforced PA molding compound.

10.3 JUMO MAERA F27, type 404391

10.3.1 General information

Reference conditions	DIN 16086 and DIN EN 60770
Sensor system	Capacitive ceramic sensor
Mounting position	Vertical/suspended on the cable

10.3.2 Measuring range

Relative pressure	Measuring ranges start at 0 bar. Case: Stainless steel (standard)								
Measuring range	0.05	0.1	0.16	0.25	0.4	0.6	1	1.6	bar
Overload capacity	-0.3/4	-0.3/4	5	6	6	10	10	10	bar
Burst pressure	150								bar
Relative pressure	Measuring ranges start at 0 bar. Case: PTFE (basic type extension 022)								
Measuring range	0.05	0.1	0.16	0.25	0.4	0.6	1	1.6	bar
Overload capacity	-0.3/2	-0.3/2	2	2	2	2	2	2	bar
Burst pressure	150								bar

10.3.3 Output

Analog output Current Voltage	 4 to 20 mA, 2-wires DC 0.5 to 4.5 V, 3-wires, ratiometrically 10 to 90 % of the voltage supply
Step response T_{90}	 ≤ 10 ms
Burden Current 4 to 20 mA, 2-wires Voltage DC 0.5 to 4.5 V, 3-wires	 $R_L \leq [(U_B - 12\ V) \div 0.02\ A]\ (\Omega)$ $R_L \geq 10\ k\Omega$

10.3.4 Mechanical properties

Note the resistance of the materials!

Process connection Material	 Stainless steel 316 Ti
Sensor Material	 Ceramic Al_2O_3 (99.9 %)
Case Material Standard For basic type extension 022 Seal[a] Protective cap (658)	 Stainless steel 316 Ti Stainless steel 316 Ti PTFE FPM, standard EPDM, on request PVDF
Weight	200 g (without cable)
Diameter	25 mm
Stainless steel version	Max. 41 mm
PTFE version	Max. 50 mm

[a] Additional seals are available on request.

10.3.5 Ambient conditions

Admissible temperatures	
Measuring material/ environment	-20 to +60 °C The device must **not** be allowed to freeze in the measuring material! Depending on the measuring material it may be necessary to impose a restriction.
For basic type extension 022	0 to 40 °C The device must **not** be allowed to freeze in the measuring material! Depending on the measuring material it may be necessary to impose a restriction.
Storage	-20 to +100 °C, dry
Electromagnetic compatibility	
Interference emission[a]	Class B
Interference immunity[b]	Industrial requirements
Protection type	
Standard	IP68, immersible up to 16 m
For basic type extension 022[c]	IP68, immersible up to 16 m

[a] According to EN 61326-2-3
[b] According to EN 61326-1
[c] According to EN 60529

10.3.6 Accuracy

Relative pressure	The measurement ranges start at 0 bar								
Measuring range	0.05	0.1	0.16	0.25	0.4	0.6	1	1.6	bar
Linearity[a]	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**	**% of FS**
Accuracy at 20 °C[b]	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	% of FS
Accuracy for 0 to +40 °C[c]	0.9	0.9	0.9	0.9	0.9	0.9	0.4	0.4	% of FS
Accuracy for -20 to +60 °C[c]	1.3	1.3	1.3	1.3	1.3	1.3	0.6	0.6	% of FS
Long-term stability[d]	0.2 % of FS per year								

[a] Linearity based on limit point setting

[b] Includes: linearity, hysteresis, repeatability, deviation from measuring range start (offset) and measuring range end

[c] Includes: linearity, hysteresis, repeatability, deviation from measuring range start (offset) and measuring range end, thermal effect on measuring range start (offset) and measuring span

[d] According to EN 61298-1

10.3.7 Auxiliary power

Voltage supply U_B[a]	
4 to 20 mA, 2-wires (output 405)	DC 12 to 30 V, nominal voltage supply DC 24 V
DC 0,5 to 4,5 V, 3-wires (output 412)	DC 5 V
Max. power consumption	at DC 24 V ≤ 25 mA at DC 5 V ≤ 2 mA
Circuit	SELV

[a] Residual ripple: Peak voltages must not exceed or fall below the values specified for the voltage supply!

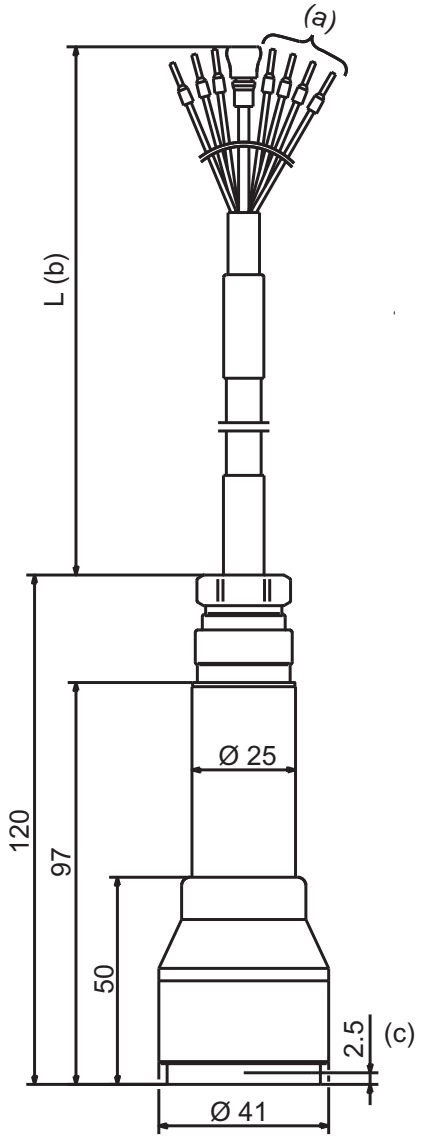
10.3.8 Electrical connection

6-core, shielded cable with integrated pressure compensation tube; AWG 24 with ferrules

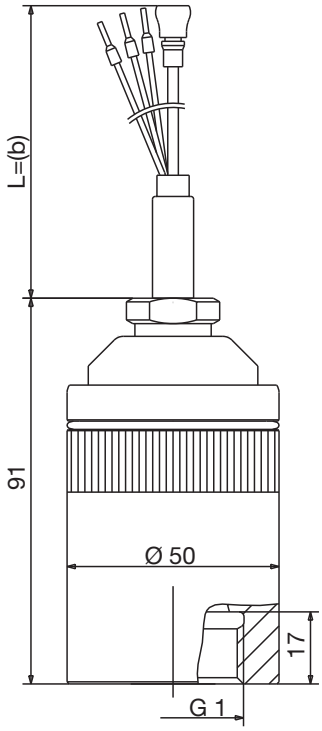
Material	
Outer sheath	PE, PUR, FEP
Pressure compensation tube	PA
Color	
PE and FEP cables	Black
PUR cable	Pepple-gray
External diameter	Approx. 8,4 mm
Conductor cross-section	0,25 mm^2
Bending radius	
Moveable	160 mm
Fixed	120 mm
	Please note that a bend in the cable prevents ambient pressure compensation.
Tensile force	Up to 400 N
Weight	
PE and PUR cables	Approx. 115 g/m
FEP cables	Approx. 90 g/m
Permissible medium temperatures	-40 to +70 °C (subject to the medium)
UV resistance	PE and PUR cables according to VDE 0207, test method EN 60811 part 2-1, section 8
	FEP cable according to DIN ISO 4892-2

10.3.9 Dimensions

Type 404391/000-... or type 404391/007-...



Type 404391/022-...



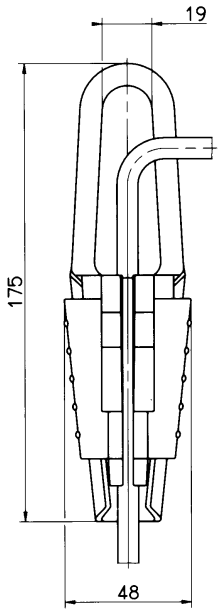
(a) For basic type extension 007 only (integrated Pt100 temperature sensor)

(b) Cable length to customer specification

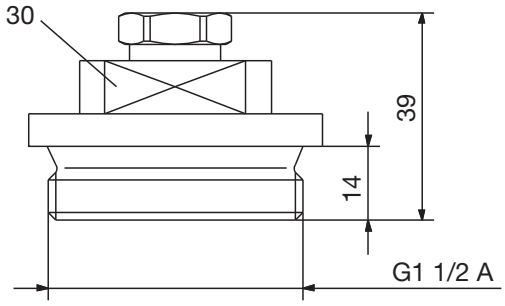
(c) Dimension to sensor surface

10.3.10 Dimensions accessories

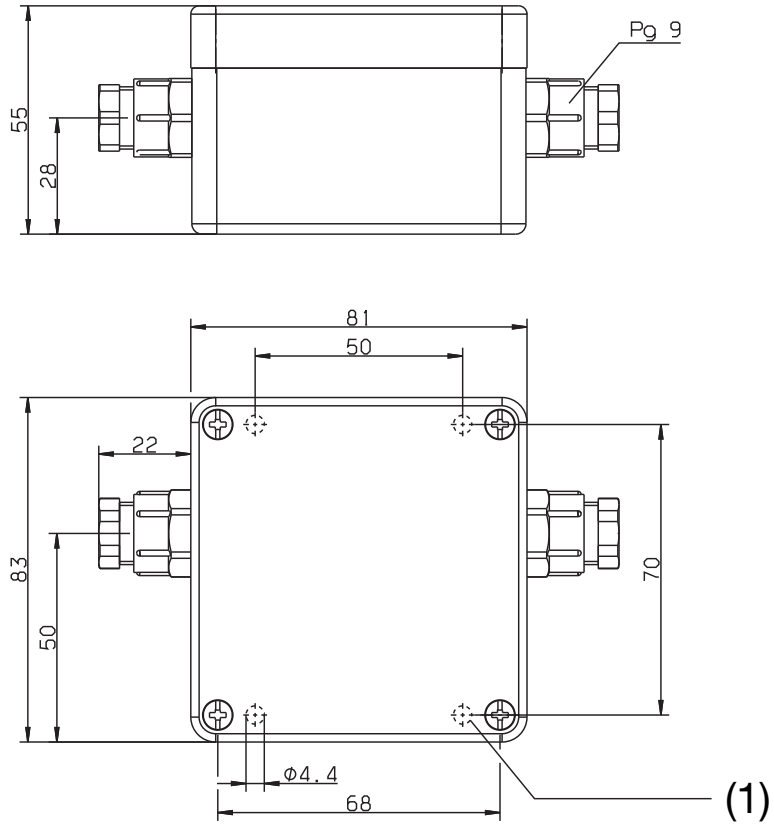
Cable clamp assembly
Part no. 00061389



Screw plug (cover mounting)
Part no. 00333329



Terminal box with pressure compensation element
Part no. 00061206



(1) Mounting hole

10.3.11 Order details

	(1)	**Basic type**
404391/000		JUMO MAERA F27 - Level probe
404391/007		JUMO MAERA F27 - Level probe with integrated Pt100 temperature sensor[a]
404391/022		JUMO MAERA F27 - Level probe with PTFE plastic case[b]
404391/999		JUMO MAERA F27 - Level probe, special version
	(2)	**Input**
412		0 to 50 mbar relative pressure
414		0 to 100 mbar relative pressure
415		0 to 160 mbar relative pressure
451		0 to 250 mbar relative pressure
452		0 to 400 mbar relative pressure
453		0 to 600 mbar relative pressure
454		0 to 1 bar relative pressure
455		0 to 1.6 bar relative pressure
999		Special measuring range
	(3)	**Output**
405		4 to 20 mA, 2-wires
412		0.5 to 4.5 V, 3-wires
	(4)	**Process connection**
568		G 1 internal[c]
658		Connection closed underneath
659		Connection open underneath
	(5)	**Electrical connection type**
14		PUR cable, gray, screened, e.g. suitable for use in water (seawater, well water, brine), as well as in coolant and lubricant (UV-resistant)
15		PE-LD cable, black, screened, e.g. suitable for use in water (seawater, well water, brine, UV-resistant)

25		FEP cable, black, screened, e.g. suitable fo ruse in water (seawater, saltwater, well water, and mine water), as well as in different oils, fuels and solvents (UV-resistant)
	(6)	**Length of connecting cable**
005		5 m
010		10 m
...		...
100		100 m
999		Special length
	(7)	**Extra codes**
000		None
593		Fitting with cutting rings (preparation for protection tube)[d]

[a] With output 405 only, not with basic type extension 022.
[b] With process connection 568 only.
[c] With basic type extension 022 only.
[d] With basic type extensions 000, 007 and 999.

Example: 404391/000-452-405-659-15-010/000

10.3.12 Accessories

Article	**Part no.**
Terminal box with pressure compensation element	00061206
Cable holder[a]	00061389
Sealing screw	00333329
Pressure equalization filter for cable	00382632

[a] The hot-dip galvanized housing is made of sheet steel. The clamping jaws and guide chambers are made of fiberglass-reinforced PA molding compound.

10.4 JUMO MAERA S28, type 404392

10.4.1 General information

Reference conditions	DIN 16086 and DIN EN 60770
Principle of measurement	Piezoresistive sensor with stainless steel separating membrane
Pressure transfer medium	Synthetic oil
Admissible load changes	>10 million, 0 to 100 % measurement range
Mounting position	Vertical/suspended on the cable

10.4.2 Measuring range

Relative pressure	Measuring ranges start at 0 bar.									
Measuring range	0.25	0.4	0.6	0.1	1.6	2.5	4	6	10	bar
Overload capacity	0.75	1.2	1.8	3	4.8	7.5	12	18	30	bar
Burst pressure	1	1.6	2.4	4	6.4	10	16	24	40	bar

10.4.3 Output

Analog output[a] Current Output 405	4 to 20 mA, 2-wires
Step response T_{90}	≤ 10 ms
Burden Current 4 to 20 mA, 2-wires	$R_L \leq [(U_B - 10\ V) \div 0.02\ A]\ (\Omega)$

[a] Additional outputs are available on request.

10.4.4 Mechanical properties

Note the resistance of the materials to the medium!

Process connection Material	 Stainless steel 316 Ti
Measuring membrane Material	 Stainless steel 316 L
Case Material	 Stainless steel 316 Ti
Seals Material	 FPM
Weight	400 g (without cable)
Diameter	25 mm

10.4.5 Ambient conditions

Admissible temperatures Measuring material/ environment Storage	 0 to 50 °C The device must **not** be allowed to freeze in the measuring material! Depending on the measuring material it may be necessary to impose a restriction. -20 to +80 °C, dry
Electromagnetic compatibility Interference emission[a] Interference immunity[b]	 Class B Industrial requirements
Overvoltage protection[c]	Integrated overvoltage protection Nominal leakage current: 1 kA
Protection type[d]	IP68, immersible to 100 m

[a] According to EN 61326-2-3
[b] According to EN 61326-1
[c] According to EN 61000-4-5
[d] According to EN 60529

10.4.6 Accuracy

Relative pressure										
Measuring range	0.25	0.4	0.6	1	1.6	2.5	4	6	10	bar
Linearity[a]	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.2**	**0.2**	**0.2**	**% of FS**
Accuracy at 20 °C[b]	0.5	0.5	0.5	0.5	0.5	0.5	0.3	0.3	0.3	% of FS
Accuracy for 0 to +50 °C[c]	1.6	1.6	1.3	1.1	1.1	1.1	0.8	0.8	0.8	% of FS
Long-term stability[d]	≤ 0.2 % of FS per year									

[a] Linearity based on limit point setting

[b] Includes: linearity, hysteresis, repeatability, deviation from measuring range start (offset) and measuring range end

[c] Includes: linearity, hysteresis, repeatability, deviation from measuring range start (offset) and measuring range end, thermal effect on measuring range start (offset) and measuring span

[d] According to EN 61298-1

10.4.7 Auxiliary power

Voltage supply U_B[a]	DC 10 to 30 V, nominal voltage supply DC 24 V
Max. power consumption	≤ 30 mA
Circuit	SELV

[a] Residual ripple: Peak voltages must not exceed or fall below the values specified for the voltage supply!

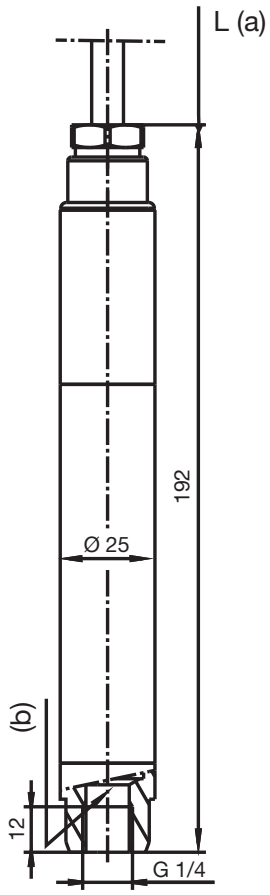
10.4.8 Electrical connection

6-core, shielded cable with integrated pressure compensation tube; AWG 24 with ferrules

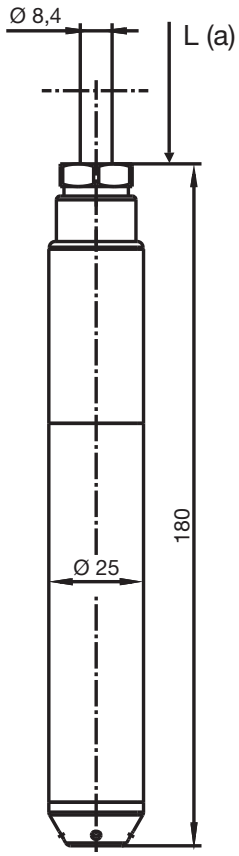
Material Outer sheath Pressure compensation tube	 PE, PUR, FEP PA
Color PE and FEP cables PUR cable	 Black Pepple-gray
External diameter	ca. 8.4 mm
Conductor cross-section	0.25 mm^2
Bending radius Moveable Fixed	 160 mm 120 mm Please note that a bend in the cable prevents ambient pressure compensation.
Tension force	Up to 400 N
Weight PE and PUR cables FEP cable	 Approx. 115 g/m Approx. 90 g/m
Permissible medium temperatures	-40 to +70 °C (subject to the medium)
UV resistance	PE and PUR cables according to VDE 0207, test method EN 60811 part 2-1, section 8 FEP cable according to DIN ISO 4892-2

10.4.9 Dimensions process connections

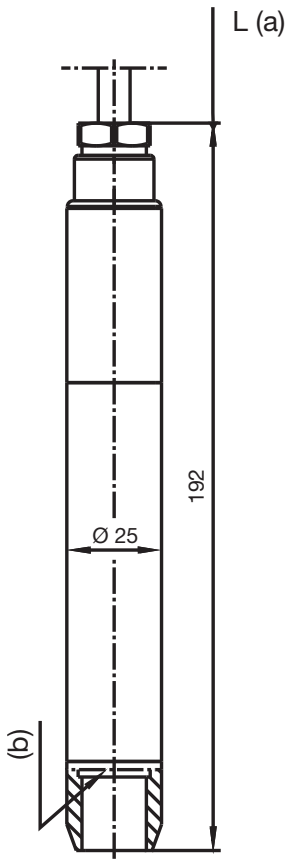
Process connection 567



Process connection 568



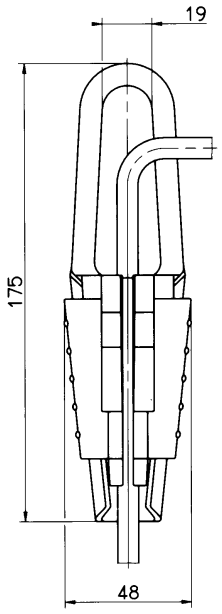
Process connection 569



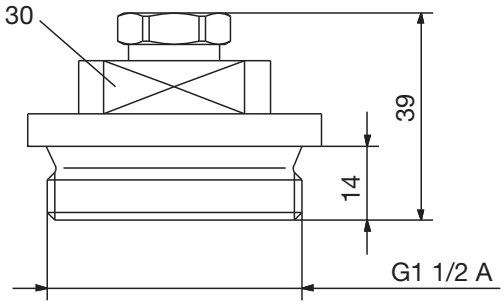
(a) Cable length to customer specification
(b) Sensitive membrane

10.4.10 Dimensions accessories

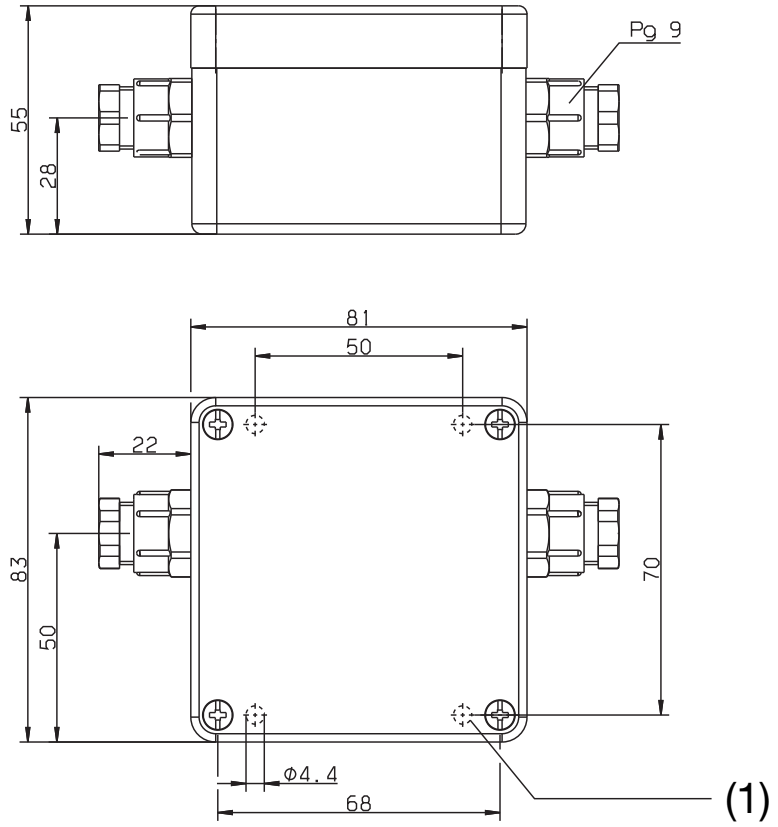
Cable clamp assembly
Part no. 00061389



Screw plug (cover mounting)
Part no. 00333329



Terminal box with pressure compensation element
Part no. 00061206



(1) Mounting hole

10.4.11 Order details

	(1)	**Basic type**
404392/000		JUMO MAERA S28 - Level probe
404392/025		JUMO MAERA S28 - Level probe, deep well version[a]
404392/999		JUMO MAERA S28 - Level probe, special version
	(2)	**Input**
451		0 to 250 mbar relative pressure
452		0 to 400 mbar relative pressure
453		0 to 600 mbar relative pressure
454		0 to 1 bar relative pressure
455		0 to 1.6 bar relative pressure
456		0 to 2.5 bar relative pressure
457		0 to 4 bar sealed gauge
458		0 to 6 bar sealed gauge
459		0 to 10 bar sealed gauge
999		Special measuring range relative pressure
	(3)	**Output**
405		4 to 20 mA, 2-wire
	(4)	**Process connection**
567		G 1/4 internal
658		Connection closed at bottom
659		Connection open at bottom
	(5)	**Material of process connection**
20		CrNi (stainless steel)
	(6)	**Electrical connection type**
14		PUR cable, gray, screened, e.g. suitable for use in water (seawater, well water, pit water), as well as in coolant and lubricant (UV-resistant)
15		PE-LD cable, black, screened, e.g. suitable fo ruse in water (seawater, well water, pit water, UV-resistant)

25		FEP cable, black, screened, e.g. suitable for use in water (seawater, saltwater, well water, and mine water), as well as in different oils, fuels, and solvents (UV-resistant)
26		Submersile motor line, EPR cable, blue, e.g. suitable for use in water (drinking water)
	(7)	**Length of connecting cable**
005		5 m
010		10 m
...		...
100		100 m
	(8)	**Extra code**
000		None
007		Integrated Pt100 temperature sensor
593		Fitting with cutting rings (preparation for protection tube)
631		Higher humidity and vibration protect

[a] The deep-well version was designed for use in measuring ranges between 0 to 4 bar to 0 to 10 bar with a free-hanging cable length of up to 100 m. Area of application: the version is only available with a closed process connection and an EPR-cable without pressure compensation. Another benefit is the improved moisture and vibration protection. The user must always bear in mind that a stainless-steel version is not suitable for use in media containing chlorine (such as seawater).

Example: 404392/000-454-405-659-20-15-020/007, 631

10.4.12 Accessories

Article	Part no.
Terminal box with pressure compensation element	00061206
Cable holder[a]	00061389
Sealing screw	00333329
Pressure equalization filter for cable	00382632

[a] The hot-dip galvanized housing is made of sheet steel. The clamping jaws and guide chambers are made of fiberglass-reinforced PA molding compound.

10.4.13 Deep well version

The deep well version is an enclosed atmosphere and is a sealed design (so-called sealed gauge).

The reference chamber is tightly sealed in a very high vacuum.
The cell is adjusted to 1 bar. As a result, the sensor measures almost 0 bar overpressure when measuring the atmospheric pressure. The maximum measurement error is thus approx. ±20 mbar depending on the variations in barometric pressure. The aim of this is to prevent aggressive gases and condensate resulting from the pumping effect, which is caused by differences in temperature, leading to corrosion damage.

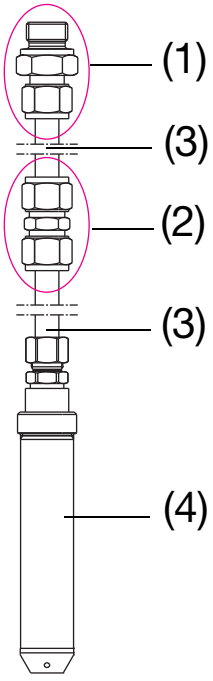
10.5 Cutting ring screw connection (extra code 593)

For applications in which the outer cable sheathing is not resistant, usage can be facilitating with a protection tube suitable for the application (diameter 12 mm) and corresponding screw connections. There is a cutting ring screw connection for this purpose on the electrical output next to the cable. It can be used by the customer to fasten the protection tube.

10.5.1 Mounting in the example: stainless steel

Use of the level probe (4) can be implemented as follows:

- With an electrical connection
- With a protection tube (3) (usually consisting of several tube sections)
- With straight screw connections (2) for the liquid-tight connection between the individual tube sections (3)
- With a straight screw-in connection (1) for fastening on the tank cover (not shown here).



1. Lubricate the thread and cone of the coupling connecting piece and the thread of the union nut for the straight screw connection (two-sided tube fitting). Select a lubricating paste that is suitable for the application.

2. Push the first tube section over the cable in the direction of the electrical connection of the measuring instrument.
3. To ensure proper tube cutting, guide the tube to the stop of the pre-mounted screw connection and tighten the union nut finger-tight. Use the union nut to press the cutting ring together and cut into the tube, which creates the seal.
4. A vertical mark on the tube and straight screw connection can be used to visualize the tightening path that has already been followed.
5. For the straight screw connection made of stainless steel, tighten the union nut about 1/4 revolution beyond the point where a noticeable increase in force is required.
6. To check whether the assembly is correct, loosen the union nut again. The front cutting ring surface is covered by tube material. If not, the screw connection must be retightened.

NOTE!

The extra code can be selected in combination with level probes JUMO MAERA S26 (type 402090), JUMO MAERA F27 (type 404391) and JUMO MAERA S28 (type 404392). Only level probe JUMO MAERA S26 (type 402090) can be used to implement a complete stainless steel system without the measuring material coming in contact with cable and seals.

10.6 Higher humidity and vibration protect (extra codes 631, 691)

Encapsulated electronics protect the device from climatic effects, which can cause measurement errors due to the condensation buildup and may also cause the level probe to fail. Higher humidity and vibration protect should be selected especially in applications with hot measuring materials and cold ambient conditions, vice versa or greatly fluctuating temperatures. This also applies in all cases for outside mounting.

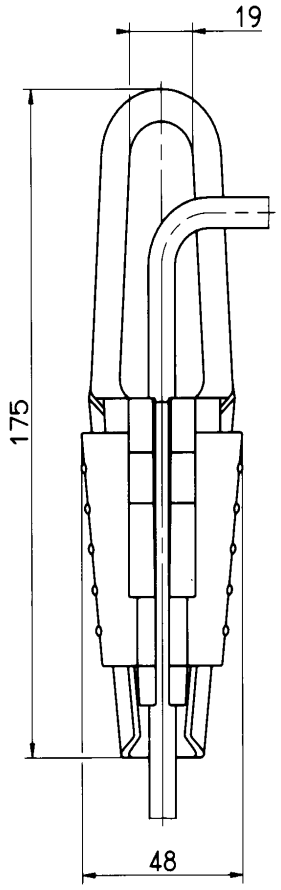
11 Accessories

11.1 Cable clamp assembly

The cable clamp assembly (part no. 00061389) holds the probe in the liquid at a defined depth. Using the cable holder ensures that the cable will not be inadmissibly deformed. The cable holder is compatible with all JUMO level probes.

The clamping range is 5.5 to 10.5 mm. The maximum tensile force is 2.5 kN. The case is made of hot-dip galvanized steel sheet. The clamping jaws and guide brackets are made of fiberglass-reinforced polyamide. A stainless steel version can be implemented on request.

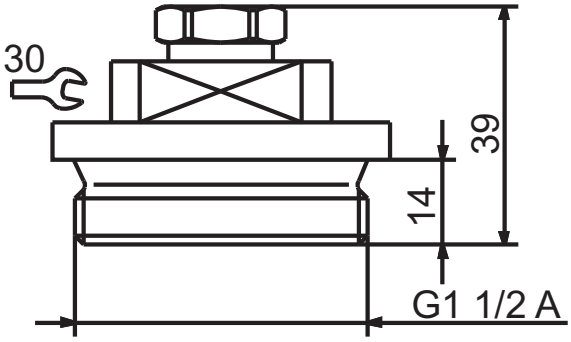
Please note that a hose endpiece must be used with the JUMO MAERA S25 level probe type 401015, see Section 11.5 "Hose endpiece", page 60.



11.2 Screw plug

For closed containers or wells with a well head, the cable should be guided through and fastened by a screw plug (part no. 00333329).

Please note that a hose endpiece must be used with the JUMO MAERA S25 level probe type 401015, see Section 11.5 "Hose endpiece", page 60.

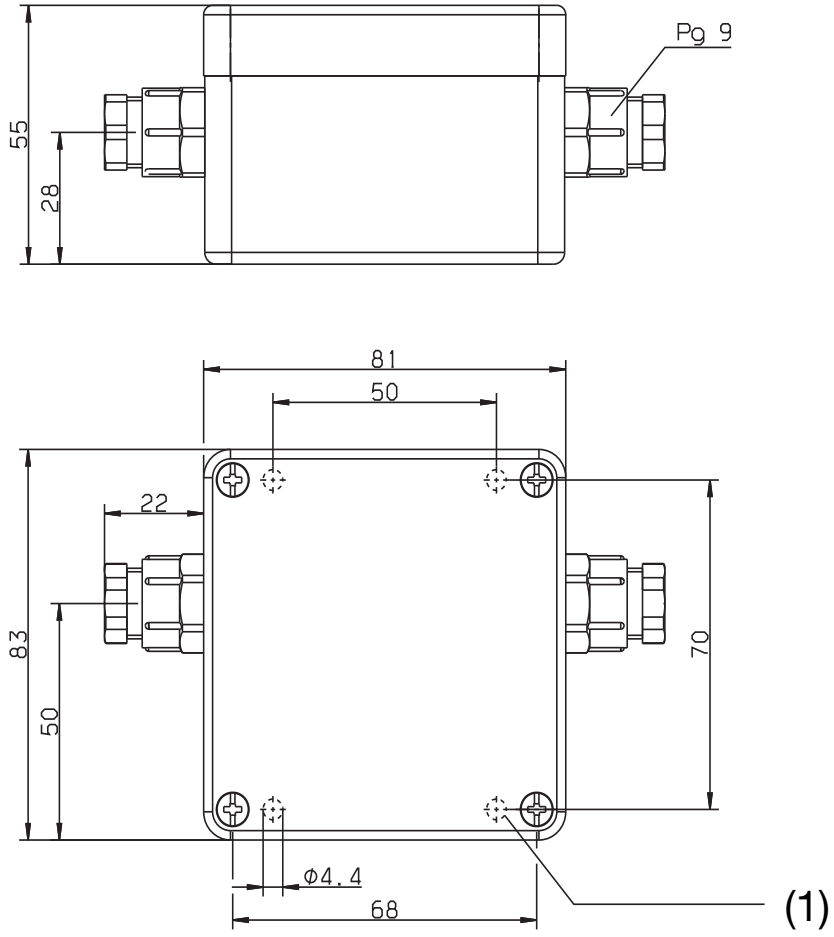


11.3 Terminal box with pressure compensation element

The terminal box (part no. 00061206) ensures secure installation of the probe cable. The end of the pressure compensation tube is always protected from deposits and condensation (IP65). The remaining distribution can be performed with a cable, without a pressure compensation tube.

The terminal case should be mounted as close as possible to the surface of the process liquid whilst still outside the medium to ensure the system is implemented cost-effectively and in the best possible way.

Please note that a hose endpiece must be used with the JUMO MAERA S25 level probe type 401015, see Section 11.5 "Hose endpiece", page 60.



(1) Mounting hole

11.4 Pressure equalization filter for cable

The pressure equalization filter (part no. 00382632) is a breathable filter that ensures aeration and ventilation without moisture penetrating. It can be used with product series JUMO MAERA S26 (type 402090), JUMO MAERA F27 (type 404391) and JUMO MAERA S28 (type 404392).

11.5 Hose endpiece

The hose endpiece is used exclusively with the JUMO MAERA S25 variant of the level probe (type 401015).
In this device a standard line is encased in an application-oriented protective tube. The hose endpiece prevents the hose which serves to compensate pressure from being pinched off or kinked when it is guided through a wall. The hose endpiece may be guided through wall openings in stonework or brickwork, clamping screw connections or cutting ring screw connections in a tank, cable glands in a control cabinet or JUMO cable holder, etc. (see Section 11.1 "Cable clamp assembly", page 57).

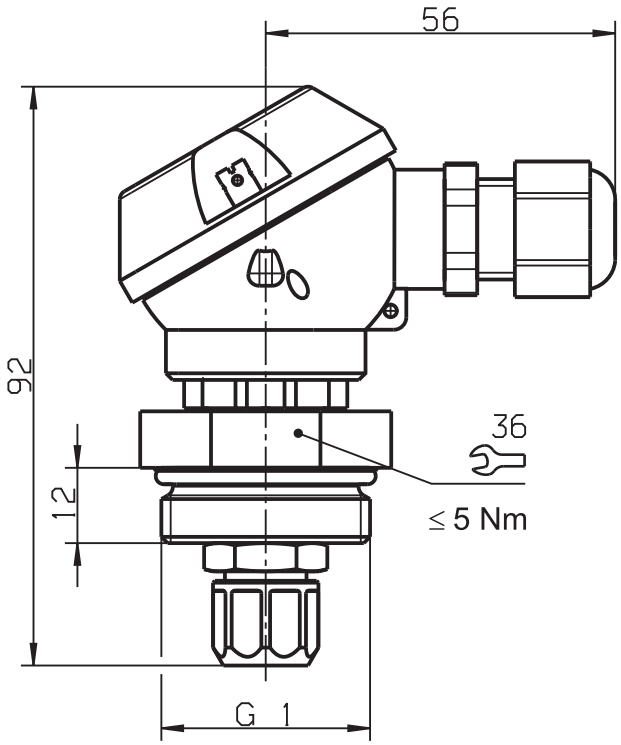
It should also be used for the JUMO terminal box with pressure compensation (see Section 11.3 "Terminal box with pressure compensation element", page 59).

If you have questions about this accessory we will be pleased to assist you.

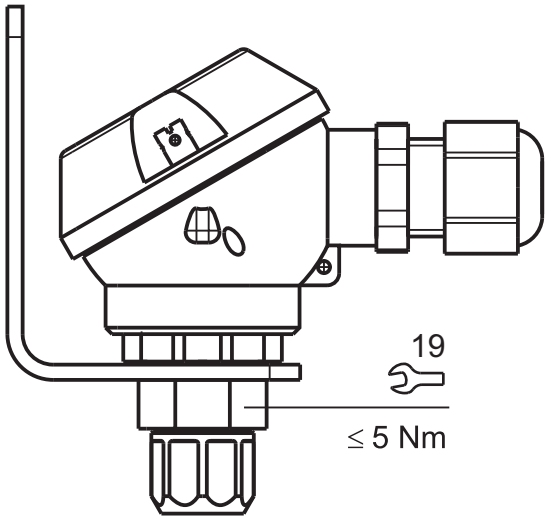
11.6 Terminal head form J with pressure compensation

The terminal head form J is only suitable for use in the level measurement probe variant JUMO MAERA S25 (type 401015). It is used to mount the level measurement probe cost-effectively and in the best possible way. It corresponds to protection type IP67. By using it locally, which can be achieved using the tank mounting (part no. 00602743) or wall mounting (part no. 00602744) versions, a rapid pressure compensation can be achieved and the length of the special cable can be minimized. The costs are thereby reduced as an electric standard cable can be used as the outgoing cable from the terminal head form J. Furthermore, the direction, for example to the control cabinet, can be individually specified. For the electrical connection and further information, please see the accompanying installation instructions (B 401015.4.1).

Tank cover mounting



Wall mounting



12 Faults/errors

DANGER!

Measuring material may be harmful to people, the environment and equipment!

CAUTION!

Touching the membrane with pointed or hard objects will damage it irreparably!

Type of fault	Possible cause	Action
No measure-ment or output signal	Voltage supply too low	Check the voltage supply, see Section 10 "Technical data", starting on page 20
	Lead break, false connection	Check connecting cables, see Section 10 "Technical data", starting on page 20
	Mechanical, thermal or chemical damage to pressure transmitter	Send the device in to the supplier with a description of the error and a decontamination declaration
Output signal is constant even when the pressure changes	Measuring system destroyed by overpressure	
	Because of overvoltage, current limiting has distorted the output signal	Check the voltage supply, see Section 10 "Technical data", starting on page 20
Output signal is too high	The selected measuring range is too small	Send the device in to the supplier with a description of the error and a decontamination declaration
	Electronics faulty	
	Voltage supply is too high	

Type of fault	Possible cause	Action
Output signal is too low	For current output signal: burden is too large For voltage output signal: burden is too small	Change burden, see Section 10 "Technical data", starting on page 20
	Voltage supply is too low	Change the voltage supply, see Section 10 "Technical data", starting on page 20
	Membrane damaged by mechanical effects, aggressive measuring material, corrosion, etc.	Send the device in to the supplier with a description of the error and a decontamination declaration
Deviating zero point signal	Temperature of measuring material or ambient temperature is too high or too low	Send the device in to the supplier with a description of the error and a decontamination declaration
	Membrane dirty	**Carefully** clean the membrane, e.g. with a small brush or sponge using a non-aggressive cleaning agent, see Section 8 "Cleaning", starting on page 18. The membrane must not be damaged!
	Membrane damaged by mechanical effects, aggressive measuring material, corrosion, etc.	Send the device in to the supplier with a description of the error and a decontamination declaration
	Moisture has penetrated	
Output signal characteristic is not linear	Device adjustment has been changed by inadmissible operating conditions (such as overpressure)	

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