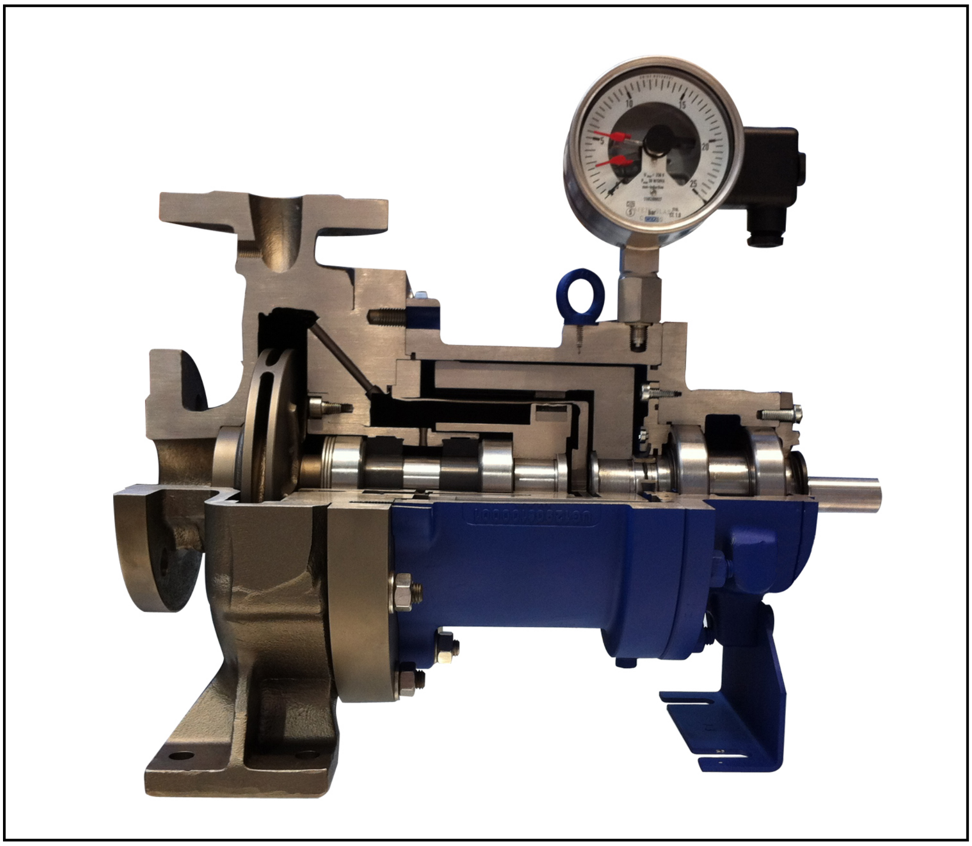
Monitoring Systems

Magnochem
Magnochem-Bloc

Supplementary Operating Manual



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Supplementary Operating Manual Monitoring Systems

Original operating manual

Subject to technical modification without prior notice.

Contents

1 General

This supplementary operating manual accompanies the operating/installation manual. All information contained in the operating/installation manual must be observed.

Table 1: Relevant operating manuals

Type series	Reference number of the operating/installation manual
Magnochem	2739.8
Magnochem-Bloc	2749.8

Manufacturer's product literature

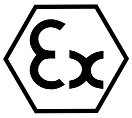
For accessories and/or integrated machinery components observe the relevant manufacturer's product literature.

2 Temperature Monitoring Sensors

Temperature monitoring of containment shroud

Eddy currents are induced in the metal containment shroud walls of mag-drive pumps. This causes the metal containment shroud to heat up. The heat loss generated is dissipated by a secondary circulation flow. The source of the cooling flow for the rotor space can be internal or external.

- With internal circulation, the cooling flow is bypassed from the main flow. The main flow passes through the pump's hydraulic system.
- With external circulation, the cooling flow is supplied to the rotor space from the outside via auxiliary connections.



Potentially explosive atmosphere
The cooling flow is sufficiently dimensioned for intended operation. The maximum permissible surface temperature that is dictated by the temperature class to EN13463-1 is not exceeded (temperature class and maximum permissible operating temperature as specified in the data sheet). An impermissible rise in temperature can occur at the containment shroud when the cooling flow is insufficient or fails completely.

An insufficient cooling flow or failure of the cooling flow can be caused by the following:

- Fluid properties
- Pressure too low
- Desynchronisation of magnetic coupling

The maximum surface temperature occurs at the containment shroud tube in the magnetic coupling area. KSB offers the following measuring instruments to detect an impermissible increase in temperature at the containment shroud:

- PT100 resistance thermometer
  For design and operational reasons, the PT100 resistance thermometer cannot detect the maximum surface temperature that occurs at the containment shroud. It can monitor the operating status of the pump. A distinction is made between the following operating statuses:
  - Intended operation: Temperature at containment shroud OK
  - Failure: Temperature at containment shroud too high
- Mineral-insulated thermocouple
  The mineral-insulated thermocouple can be used to monitor the temperature in this area.

2.1 Temperature monitoring at the containment shroud via the PT100 resistance thermometer

2.1.1 Function

Resistance thermometers are temperature sensors that measure the change in electrical resistance of metals with changing temperature. Resistance thermometers use a very thin layer of platinum film on a ceramic substrate. The nominal resistance of these measuring elements at 0 °C is 100 ohms.

Interpretation of readings

The nominal resistance of the PT100 resistance thermometer at 0 °C is 100 ohms.

Equation for calculating the resistance value at any temperature (T):
Temperature range: T = 0 - 850 °C

$$R\,(T) = 100 + 0.39083 \times T - 5.775 \times 10^{-5} \times T^2$$

Sample calculation:

T = 80 °C Measured temperature: T = 80 °C

$R(T) = 100+0.39083\times80 - 5.775\times10^{-5}\times80^2$
$R(T) = 130.8968\ \Omega$

The PT100 resistance thermometer has a resistance of approximately 130.9 ohms at a temperature of 80 °C.

T = 20 °C Measured temperature: T = 20 °C

$R(T) = 100+0.39083\times20 - 5.775\times10^{-5}\times20^2$
$R(T) = 107.7935\ \Omega$

The PT100 resistance thermometer has a resistance of approximately 107.8 ohms at a temperature of 20 °C.

2.1.2 Technical data of PT100 resistance thermometer

Table 2: Selection aid for resistance thermometer

Resistance thermometer (type)	Pump design		Technical measuring specifications		
	Leakage barrier		Cable lengths		Output signal 4 - 20 mA
	None	with	≤ 30 m	≥ 30 m	
TR 55	✗	-	✗	-	-
Ksb-4,13,xx,02	-	✗	✗	-	-
Ksb-4,13,xx,01	✗	✗	✗	✗	✗

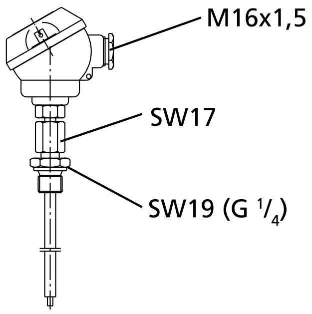


Fig. 1: PT100 resistance thermometer (TR 55)

PT100 (TR 55)

Table 3: Technical data (TR 55)

Characteristic	Value
Sensor type	PT100 resistance thermometer
Permissible measuring range (input signal)	-50 ... +450 °C
Output signal	80 to 268 ohm
Head transmitter	None
Type	TR 55
Sensor tolerance	Class B to IEC 60751
Sealing, sensor tip/support tube	Not pressure-proof
Sensor tip	Spring-loaded (spring travel approx. 3 to 4 mm)
Wiring	1×4-wire[1)]
Process connection	G1/4 B/clamping ring

1) For cable lengths up to 30 m

Characteristic	Value
Permissible ambient temperature	T3/ T4: -40 ... +100 °C T5: -40 ... +95 °C T6: -40 ... +80 °C
Nominal length, depending on overall length	75, 85 and 125 mm

Table 4: Technical data of connection head (TR55)

Characteristic	Value
Design, head	JS
Enclosure, head	IP54
Material	Aluminium
Cable connection	M16×1.5

Table 5: Characteristic values for explosion protection (TR 55)

Feature	Value
Explosion protection, intrinsic safety	Ex ib IIC T6
CE conformity marking	TÜV 10ATEX 555793 X
Maximum supply current	I_i = 550 mA
Maximum supply power	$P_{maxSensor}$ = 1.5 W
Maximum supply voltage	U_i = 30 V

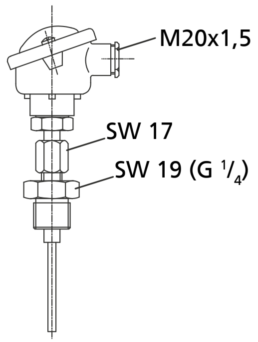


Fig. 2: PT100 resistance thermometer (Ksb-4,13,xx,02)

PT100 (Ksb-4,13,xx,02)

Table 6: Technical data (Ksb-4,13,xx,02)

Characteristic	Value
Sensor type	PT100 resistance thermometer
Permissible measuring range (input signal)	-40 ...+120 °C[2)]
Output signal	84 to 146 ohm
Head transmitter	None
Type	Ksb-4,13,xx,02
Sensor tolerance	Class B to IEC 60751
Sealing, sensor tip/support tube	Pressure-proof up to 20 bar at a max. temperature of 120 °C
Sensor tip	Spring-loaded (spring travel < 5 mm)
Wiring	1×4-wire
Process connection	G1/4B clamping ring
Material: spring-loaded support tube	1.4541
Permissible ambient temperature	T5: -40 … +80 °C T6: -40 … +55 °C
Nominal length, depending on size	120, 135 and 165 mm

2) This measuring range only applies when the PT100 resistance thermometer is used for designs with a leakage barrier. A larger measuring range (-40 to +200 °C) is possible for designs without a leakage barrier. Coordination with KSB required.

Table 7: Technical data of connection head (Ksb-4,13,xx,02)

Feature	Value
Design, head	BS
Enclosure, head	IP65
Material	Aluminium
Cable connection	M20×1.5

Table 8: Characteristic values for explosion protection (Ksb-4,13,xx,02)

Feature	Value
Explosion protection, intrinsic safety	2G Ex ia II C T5/T6
CE conformity marking	BVS 03 ATEX E 292
Maximum supply current	I_i max = 500 mA (for short circuit)
Maximum supply power	$P_{maxSensor}$ = 750 mW
Maximum supply voltage	U_i = 10 V DC

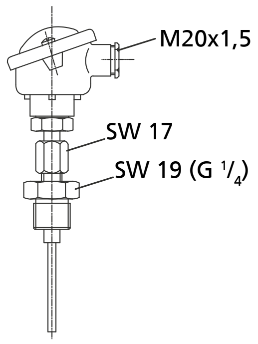


Fig. 3: PT100 resistance thermometer (Ksb-4,13,xx,01)

PT100 (Ksb-4,13,xx,01)

Table 9: Technical data (Ksb-4,13,xx,01)

Characteristic	Value
Sensor type	PT100 resistance thermometer
Output signal	4 - 20 mA
Head transmitter	T24 WIKA
Permissible measuring range	-40 ... +320 °C[2][3]
Type	Ksb-4,13,xx,01
Sensor tolerance	Class B to IEC 60751
Sealing, sensor tip/support tube	Pressure-proof up to 20 bar at a max. temperature of 120 °C
Sensor tip	Spring-loaded (spring travel < 5 mm)
Wiring	1×4-wire
Process connection	G 1/4B clamping ring
Material: spring-loaded support tube	1.4541
Cable connection	M20×1.5
Enclosure	IP65
Permissible ambient temperature	T4: -40 … +85 °C T5: -40 … +75 °C T6: -40 … +60 °C
Nominal length, depending on size	120, 135 and 165 mm

Table 10: Technical data of connection head (Ksb-4,13,xx,01)

Feature	Value
Design, head	BS
Enclosure, head	IP65

3) On designs with a leakage barrier the PT100 resistance thermometer may only be used for temperatures of -40 to 120 °C. If required, the measuring range may have to be adjusted.

Feature	Value
Material	Aluminium
Cable connection	M20×1.5

Table 11: Characteristic values for explosion protection (Ksb-4,13,xx,01)

Feature	Value
Explosion protection, intrinsic safety	2G E Ex ia II C T5/T6
CE conformity marking	BVS 03 ATEX E 292
Maximum supply current	I_i max = 120 mA (for short circuit)
Maximum supply power	$P_{maxSensor}$ = 800 mW
Maximum supply voltage	U_i = 30 V DC

Table 12: Technical data of head transmitter

Feature	Value
Type	T24.10
Design	Head-mounted version, explosion-proof
Output	Analog, 4 - 20 mA
Fault detection	Broken wire, short circuit
Explosion protection	2II 1G EEx ia/ II C T4/T5/T6
Explosion protection type test certificate	DMT 02 ATEX E 025 X
Auxiliary energy supply, U_B	DC 9 ... 30 V
Ambient/storage temperature	T4: -40 ... +85 °C T5: -40 ... +75 °C T6: -40 ... +60 °C
Current-loop circuit (+ and - connections)	U_i = 30 V, I_i = 120 mA, L_i = 110 µH Ci = 6.2 nF, Pi = 800 mW
Material	Plastic, PBT, glass-fibre reinforced
Enclosure (to IEC 60529/EN 60529)	Housing: IP 66/IP 67 Connection terminals: IP 00

2.1.3 Installing the PT100 resistance thermometer in the pump

⚠ WARNING

Leaks and/or corrosion damage on monitoring systems
No fault indications!
Leakage of fluid handled!

- ▷ Never install damaged or corroded monitoring systems in the pump.
- ▷ Check monitoring systems for damage and correct function prior to installation.

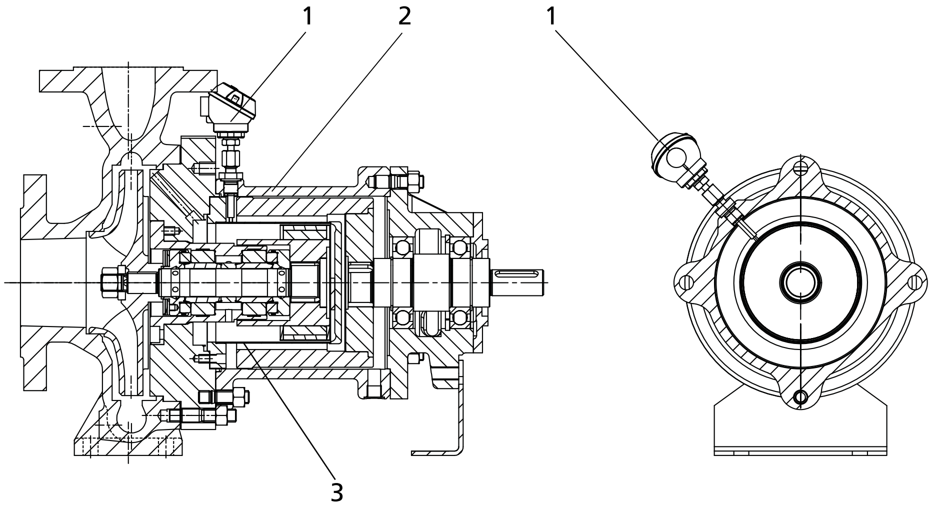


Fig. 4: Installation location of the PT100 resistance thermometer

1	PT100 resistance thermometer	2	Bearing bracket lantern
3	Containment shroud		

1. Remove the screw plug from the 4M.3 connection.
2. Screw the compression fitting up to the stop.
3. Insert the PT100 resistance thermometer into the fitting up to the stop or until the tip of the resistance thermometer contacts the containment shroud or its intermediate piece.
4. Turn the connection head of the PT100 resistance thermometer to the required position.
5. Pull the PT100 resistance thermometer back by approximately 1 to 2 mm.
6. Tighten the compression fitting to prevent the PT100 resistance thermometer from loosening and rotating.

2.1.4 Electrical connection of the PT100 resistance thermometer

⚠ DANGER

Incorrect electrical installation
Explosion hazard!

- ▷ For electrical installation, also observe the requirements of IEC 60079-11.
- ▷ Realise a suitable measuring chain.

⚠ DANGER

Work on the pump set by unqualified personnel
Danger of death from electric shock!

- ▷ Always have the electrical connections installed by a trained and qualified electrician.
- ▷ Observe regulations IEC 60364 and, for explosion-proof models, EN 60079.

Terminal assignment, four-wire system for TR 55

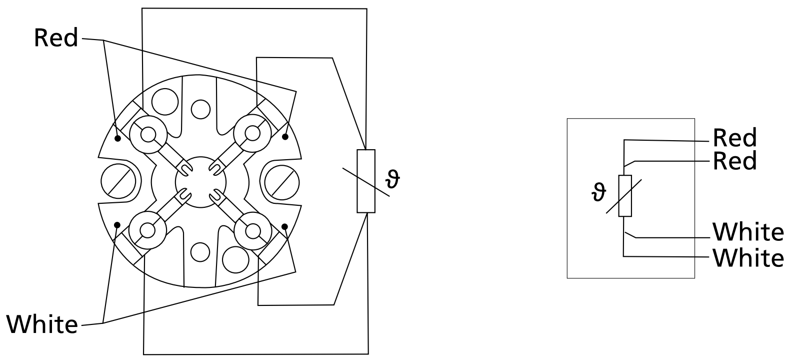


Fig. 5: Terminal assignment, four-wire system for TR 55

Terminal assignment, four-wire system for Ksb-4,13,xx,02

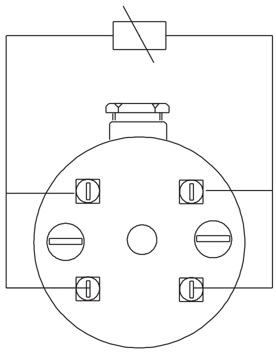


Fig. 6: Terminal assignment for PT100 four-wire system, pressure-proof (Ksb-4,13,xx, 02)

Terminal assignment, four-wire system for Ksb-4,13,xx,01 (T24)

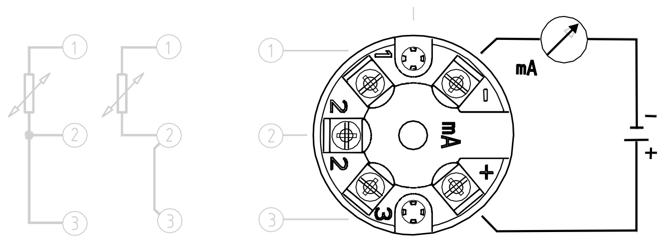


Fig. 7: Terminal assignment for PT100 including head transmitter (Ksb-4,13,xx,01 with T24)

1. Open the connection head.
2. Connect the PT100 resistance thermometer. (Observe terminal assignment. See illustrations.)

2.1.5 Design of measuring chain

The design of the measuring chain is influenced by the following factors:

- Potentially explosive or non-potentially explosive atmosphere
- Output signal (Ω or mA)

The measuring chain must be designed and configured in accordance with these factors. Observe the following illustration for selection.

Design of measuring chain

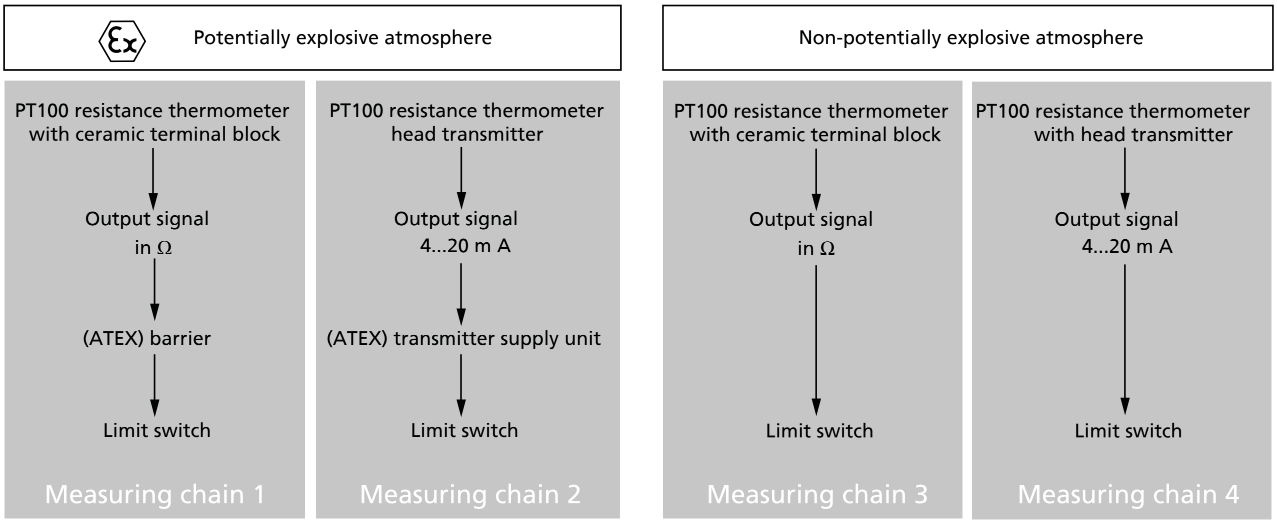


Fig. 8: Design of measuring chain

Description, measuring chain 1 (potentially explosive atmosphere)

Measuring chain 1 comprises the following elements:

Table 13: Description, measuring chain 1 (potentially explosive atmosphere)

Element	KSB device recommendation	For details, refer to...
PT100 resistance thermometer without head transmitter	TR 55 or Ksb-4,13,xx,2	(⇨ Section 2.1.2 Page 6)
(ATEX) barrier	Z 954	(⇨ Section 5.2 Page 44)
Limit switch	CF1M	(⇨ Section 5.1 Page 40)

Description, measuring chain 2 (potentially explosive atmosphere)

Measuring chain 2 comprises the following elements:

Table 14: Description, measuring chain 2

Element	KSB device recommendation	For details, refer to...
PT100 resistance thermometer with head transmitter	Ksb-4,13,xx,1	(⇨ Section 2.1.2 Page 6)
(ATEX) transmitter supply unit	KFD2-STC4-EX1	(⇨ Section 5.2 Page 44)
Limit switch	DGW 1.00 or DWG 4.00	(⇨ Section 5.1 Page 40)

Description, measuring chain 3

Non-potentially explosive atmosphere

Measuring chain 3 comprises the following elements:

Table 15: Description, measuring chain 3

Element	KSB device recommendation	For details, refer to...
PT100 resistance thermometer without head transmitter	TR55 or Ksb-4,13,xx,2	(⇨ Section 2.1.2 Page 6)
Limit switch	CF1M or DGW2.0	(⇨ Section 5.1 Page 40)

Description, measuring chain 4

Non-potentially explosive atmosphere

Measuring chain 4 comprises the following elements:

Table 16: Description, measuring chain 4

Element	KSB device recommendation	For details, refer to...
PT100 resistance thermometer with head transmitter	Ksb-4,13,xx,1	(⇨ Section 2.1.2 Page 6)
Limit switch	DGW 1.00 or DGW 4.00	(⇨ Section 5.1 Page 40)

2.1.6 Analysis of output signals

2.1.6.1 Determining the limit value

In a potentially explosive atmosphere, the maximum permissible surface temperature is dictated by the temperature class. The maximum permissible operating temperature of the pump is specified in the data sheet. Observe the following additional requirements when determining the limit value for the maximum surface temperature at the containment shroud:

Table 17: Temperature limits

Temperature class to EN13463-1	Maximum permissible surface temperature at containment shroud
T1	300 °C
T2	290 °C
T3	195 °C
T4	130 °C
T5	On request only
T6	On request only

For design and operational reasons, the PT100 resistance thermometer cannot detect the maximum surface temperature that occurs at the containment shroud in the magnetic coupling area. To avoid exceeding the maximum permissible surface temperatures at the containment shroud (see "Temperature limits" table), a safety margin to the temperature measured of at least 15 K must be observed. Only the operating status of the pump can be monitored using the PT100 resistance thermometer.

A distinction can be made between the following operating statuses:

- Intended operation
- Failure

Determining the initial value

The initial value and the temperature of the containment shroud or its intermediate piece during intended operation must first be determined.

NOTE

Observe possible process or rotational speed-related changes in the temperature.

⚠ DANGER

Excessive surface temperatures
Explosion hazard!

- ▷ The limit value for stopping the pump must never exceed the specified surface temperature of the respective temperature class.
- ▷ If the specified surface temperature of the respective temperature class is exceeded, immediately switch off the pump set and determine the cause.

1. Determine the temperature class of the system to EN 13463-1.
2. Note the maximum permissible surface temperature of the containment shroud by referring to the "Temperature limits" table.

3. Transition the pump to the steady state under the intended operating conditions (see data sheet on the duty point of the pump).
4. Note the value displayed on the limit switch (= initial value) in the steady state.
5. Check initial value.
   The initial value must be at least 15 K below the maximum permissible surface temperature at the containment shroud (see "Temperature limits" table).

Steady state Steady state is reached when the temperature rise does not exceed 2 K/h (to EN 13463-1: 2009-07).

If the difference is less, implement the following measures:

- Check operating conditions.
- Dismantle and clean pump (if required).
- Re-determine initial value.
  Consultation with KSB/KSB Service is required if the initial value is unchanged.

Determining limit values for operating statuses

Intended operation The initial value determined corresponds to the temperature at the containment shroud during intended operation.

Failure In a failure, an insufficient cooling flow or a failure of the cooling flow can cause the temperature to rise at the containment shroud. To be able to detect a failure via a rise in temperature, add a safety margin of 10 K to the initial value determined.

Initial value + 10 K = limit value

If, during a failure (non-intended operation), the limit value determined is exceeded, the pump is stopped. Depending on the factory setting of the limit switch, the pump will be started up again after the temperature at the containment shroud has dropped. The value that is specified as the hysteresis for the output determines the containment shroud temperature at which the pump is started up again.

A hysteresis of 1 K is factory set for the limit switch CFM1, for example. If the containment shroud temperature drops 1 K below the limit value here, the pump is started up again. If the pump must not be re-started after the limit value has been exceeded, other measures are required on site.

2.2 Temperature monitoring at the containment shroud via a mineral-insulated thermocouple

2.2.1 Functionality of the mineral-insulated thermocouple

The temperature of the containment shroud can be monitored by using an IEC 548-compliant mineral-insulated thermocouple fixed to the containment shroud. The mineral-insulated thermocouple measures in the containment shroud area where the highest surface temperatures occur: at the containment shroud tube in the magnetic coupling area. The mineral-insulated thermocouple installed functions as a passive component in the potentially explosive atmosphere and is designed as a "simple apparatus" to EN 60079-11.

2.2.2 Technical data of mineral-insulated thermocouple

Table 18: Technical data of mineral-insulated thermocouple with ceramic terminal block

Characteristic	Value
Type	K
Explosion protection	Intrinsic safety, "simple apparatus" to DIN EN 60079-11
Sensor type	K, NiCr-Ni
Sensor tolerance	IEC 584
Measuring point	Insulated
Diameter	0.34 mm
Process connection	G1/4, compression fitting
Sheath material	Austenite steel

Characteristic	Value
Sheath lengths, depending on size	130 and 230 mm
Connection cable material	PTFE
Connection cable diameter	3.5 mm
Connection cable length	1 m
Output signal	in µV

Table 19: Technical data of head transmitter

Feature	Value
Type	T12
Design	Head-mounted version, explosion-proof
Configuration	Pre-configured to type K, NiCr-Ni, IEC 584 ex works
Output	Analog, 4 - 20 mA
Fault detection	Broken wire, short circuit
Explosion protection	II 2 G Ex ib II B / II C T4/T5/T6
Explosion protection type test certificate	DMT 98 ATEX E 008X
Auxiliary energy supply, U_B	DC 9 ... 30 V
Ambient temperature	T4: -40 °C ... +85 °C T5: -40 °C ... +75 °C T6: -40 °C ... +60 °C
Current-loop circuit (+ and - connections)	Ui = 30 V, Ii = 100 mA, Li = 0,65 mH Ci = 25 nF, Pi = 705 mW
Max. power input	For U_B = 24 V max. 552 mW
Material	Plastic
Enclosure	Housing: IP00 IEC 60529/EN 60529 Electronics completely encapsulated
Connection cross-section of terminals	1.5 mm^2 max.

Table 20: Technical data of connection head

Feature	Value
Type of head	BSZ
Enclosure, head	IP65
Material	Aluminium
Process connection	G1/4, compression fitting
Cable connection	M20 × 1.5

2.2.3 Installing the containment shroud with fixed mineral-insulated thermocouple

⚠ WARNING

Leaks and/or corrosion damage on monitoring systems
No fault indications!
Leakage of fluid handled!

- ▷ Never install damaged or corroded monitoring systems in the pump.
- ▷ Check monitoring systems for damage and correct function prior to installation.

CAUTION

Kinking or breaking of the mineral-insulated thermocouple
Damage to the machinery!

- ▷ Never kink the mineral-insulated thermocouple.
- ▷ When removing/fitting the bearing bracket lantern, observe the connection cable of the mineral-insulated thermocouple.

NOTE

Potential influences on monitoring via induction or eddy currents are limited by design measures. Retrofitting or modifications must be carried out in the factory or by specialist personnel authorised by KSB.

The mineral-insulated thermocouple is integrated in the pump at the factory. It is affixed on containment shroud 82-15 and cannot be removed. The mineral-insulated thermocouple is fastened such that the measuring tip is located at the containment shroud tube in the area of the magnetic coupling. This is the area where the highest surface temperatures occur at the containment shroud.

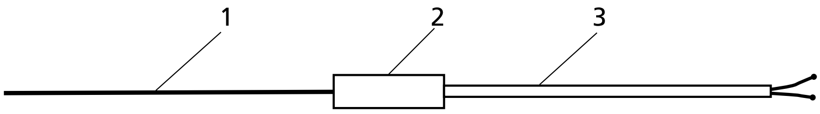


Fig. 9: Mineral-insulated thermocouple design

1	Mineral-insulated thermocouple	2	Adapter
3	Connection cable		

The connecting element (pot seal) between the mineral-insulated thermocouple and the connection cable is affixed on the containment shroud flange via a clip.

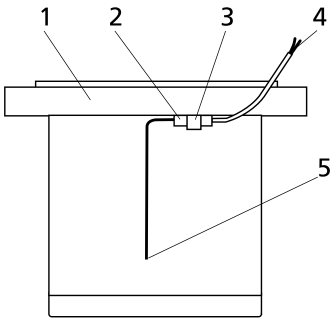
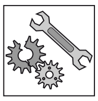


Fig. 10: Containment shroud with affixed mineral-insulated thermocouple

1	Containment shroud	2	Adapter
3	Clip	4	Cable
5	Measuring point		



CAUTION

Incorrect dismantling
Damage to the machinery!

▹ Never undo the attachment of the mineral-insulated thermocouple and the connecting element.

Since the mineral-insulated thermocouple is affixed on the 82-15 containment shroud, a few additional things must be taken into consideration when dismantling/ reassembling the pump:

Removing the bearing bracket lantern

- Before removing the bearing bracket lantern:
  - Disconnect the mineral-insulated thermocouple.
  - Undo the compression fitting at the 4M.3 connection.
  - Remove the compression fitting and connection head with support tube.
- While removing the bearing bracket lantern:
  - Also feed the connection cable of the mineral-insulated thermocouple through the 4M.3 connection.

Fitting the bearing bracket lantern on the containment shroud

- Prior to placing bearing bracket lantern 344 on casing cover 161:
  – Carefully guide the connection cable of the mineral-insulated thermocouple through connection 4M.3 at bearing bracket lantern 344 from the inside to the outside.
- While fitting bearing bracket lantern 344:
  – Pull the connection cable of the mineral-insulated thermocouple carefully through connection 4M.3.
- After bearing bracket lantern 344 has been fitted:
  – Insert the connection cable of the mineral-insulated thermocouple into the support tube of the connection head.

    Using the compression fitting, screw the connection head with the support tube into the 4M.3 connection on the bearing bracket lantern.

    Secure the compression fitting to prevent it from working loose and turning.

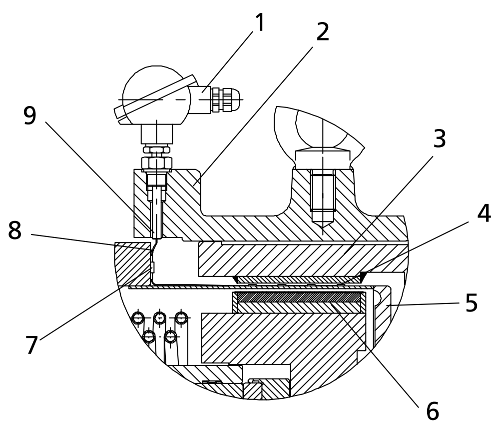


Fig. 11: Fitting the mineral-insulated thermocouple

1	Connection head	2	Bearing bracket lantern
3	Outer rotor	4	Tip of mineral-insulated thermocouple
5	Containment shroud	6	Inner rotor
7	Clip	8	Connection cable

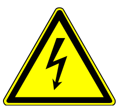
2.2.4 Electrical connection of mineral-insulated thermocouple

⚠ DANGER

Incorrect electrical installation
Explosion hazard!

▷ For electrical installation, also observe the requirements of IEC 60079-11.

▷ Realise a suitable measuring chain.



⚠ DANGER

Work on the pump set by unqualified personnel
Danger of death from electric shock!

▷ Always have the electrical connections installed by a trained and qualified electrician.

▷ Observe regulations IEC 60364 and, for explosion-proof models, EN 60079.

Mineral-insulated thermocouple with ceramic terminal block

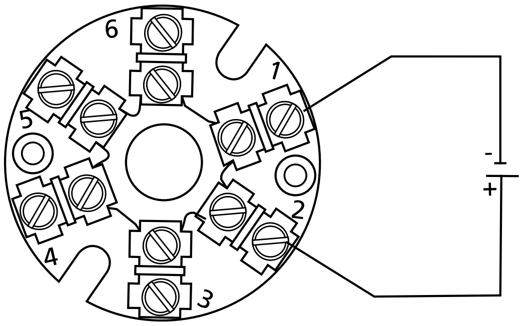


Fig. 12: Terminal assignment, mineral-insulated thermocouple with ceramic terminal block

-	White	+	Green

Mineral-insulated thermocouple with head transmitter


DANGER

Use of a head transmitter other than the one recommended by KSB
Explosion hazard!
Deviating/corrupted readings!

▷ Use the T12 head transmitter recommended by KSB.

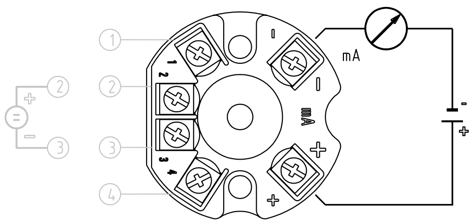
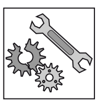


Fig. 13: Terminal assignment, mineral-insulated thermocouple with head transmitter



CAUTION

Contact of connection cable and outer rotor during operation
Rupture of mineral-insulated thermocouple!

▷ Carefully tighten the connection cable prior to establishing the electrical connection.

1. Lightly tighten the connection cable of the mineral-insulated thermocouple.
2. Fasten the connection cable in the connection head and establish electrical connection (observe terminal assignment illustrations).
3. Make sure that the mineral-insulated thermocouple is working properly.

2.2.5 Design of measuring chain

The measuring chain design is influenced by the following factors:

- Potentially explosive or non-potentially explosive atmosphere
- Output signal (mV or mA)

The measuring chain must be designed and configured in accordance with these factors. Observe the following illustration for selection.

Measuring chain design

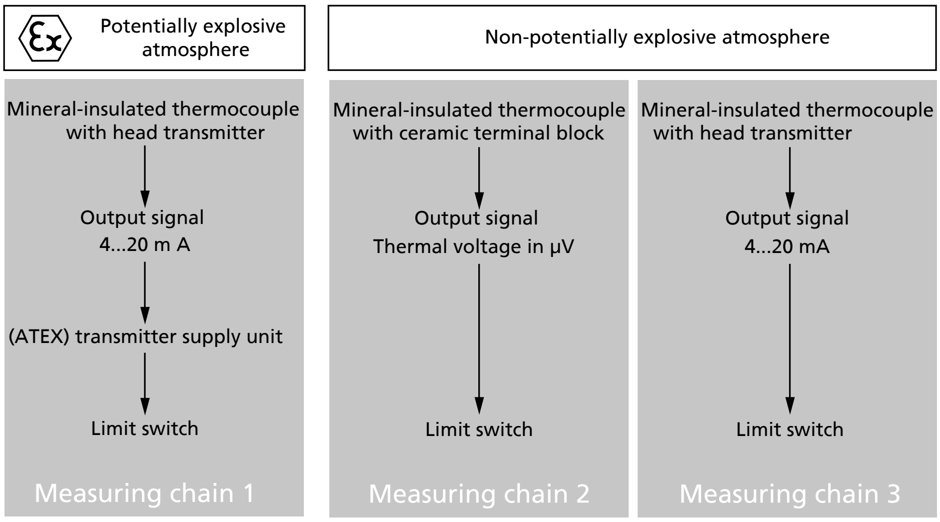


Fig. 14: Measuring chain design

Description, measuring chain 1 (potentially explosive atmosphere)

Measuring chain 1 comprises the following elements:

Table 21: Description, measuring chain 1 (potentially explosive atmosphere)

Element	KSB device recommendation	For details, refer to...
Mineral-insulated thermocouple with head transmitter	Integrated in pump	(⇨ Section 2.2.2 Page 14)
(ATEX) transmitter supply unit	KFD2-STC4-EX1	
Limit switch	DGW 1.00 or DGW 4.00	(⇨ Section 5.2 Page 44)

Description, measuring chain 2

Non-potentially explosive atmosphere

Measuring chain 2 comprises the following elements:

Table 22: Description, measuring chain 2

Element	KSB device recommendation	For details, refer to...
Mineral-insulated thermocouple with ceramic terminal block	Integrated in pump	(⇨ Section 2.2.2 Page 14)
Limit switch	CF1M or DGW 2.00	(⇨ Section 5.1 Page 40)

Description, measuring chain 3

Non-potentially explosive atmosphere

Measuring chain 3 comprises the following elements:

Table 23: Description, measuring chain 3

Element	KSB device recommendation	For details, refer to...
Mineral-insulated thermocouple with head transmitter	Output signal 4 - 20 mA	(⇨ Section 2.2.2 Page 14)
Limit switch	DGW 1.00 or DGW 4.00	(⇨ Section 5.1 Page 40)

2.2.6 Analysis of output signals

2.2.6.1 Determining the limit value

In a potentially explosive atmosphere, the maximum permissible surface temperature is dictated by the temperature class. The maximum permissible operating temperature of the pump is specified in the data sheet. Observe the following additional requirements when determining the limit value for the maximum surface temperature at the containment shroud:

Table 24: Temperature limits

Temperature class to EN13463-1	Maximum permissible surface temperature at containment shroud
T1	300 °C
T2	290 °C
T3	195 °C
T4	130 °C
T5	On request only
T6	On request only

The maximum surface temperature occurs at the containment shroud tube in the magnetic coupling area. The mineral-insulated thermocouple can be used to monitor the temperature in this area. To avoid exceeding the maximum permissible surface temperatures at the containment shroud (see "Temperature limits" table), a safety margin to the temperature measured at the containment shroud of at least 10 K must be observed. The operating status of the pump can be evaluated via the mineral-insulated thermocouple through monitoring the maximum surface temperature at the containment shroud.

A distinction can be made between the following operating statuses:

- Intended operation
- Failure

Determining the initial value

The initial value and the temperature of the containment shroud during intended operation must first be determined.

NOTE

Observe possible process or rotational speed-related changes in the temperature.

DANGER

Excessive surface temperatures
Explosion hazard!

- ▷ The limit value for stopping the pump must never exceed the specified surface temperature of the respective temperature class.
- ▷ If the specified surface temperature of the respective temperature class is exceeded, immediately switch off the pump set and determine the cause.

1. Determine the temperature class of the system to EN 13463-1.
2. Note the maximum permissible surface temperature of the containment shroud by referring to the "Temperature limits" table.
3. Transition the pump to the steady state under the intended operating conditions (see data sheet on the duty point of the pump).
4. Note the value displayed on the limit switch (= initial value) in the steady state.
5. Check initial value.
   The initial value must be at least 10 K below the maximum permissible surface temperature at the containment shroud (see "Temperature limits" table).

Steady state

Steady state is reached when the temperature rise does not exceed 2 K/h (to EN 13463-1: 2009-07).

If the difference is less, implement the following measures:

- Check operating conditions.
- Dismantle and clean pump (if required).
- Re-determine initial value.
  Consultation with KSB/KSB Service is required if the initial value is unchanged.

Determining limit values for operating statuses

Intended operation

The initial value determined corresponds to the temperature at the containment shroud during intended operation.

Failure

In a failure, an insufficient cooling flow or a failure of the cooling flow can cause the temperature to rise at the containment shroud. To be able to detect a failure via a rise in temperature, add a safety margin of 10 K to the initial value determined.

Initial value + 10 K = limit value

If, during a failure (non-intended operation), the limit value determined is exceeded, the pump is stopped. Depending on the factory setting of the limit switch, the pump will be started up again after the temperature at the containment shroud has dropped. The value that is specified as the hysteresis for the output determines the containment shroud temperature at which the pump is started up again.

A hysteresis of 1 K is factory set for the limit switch CFM1, for example. If the containment shroud temperature drops 1 K below the limit value here, the pump is started up again. If the pump must not be re-started after the limit value has been exceeded, other measures are required on site.

2.2.6.2 Setting the sensor type at the limit switch

The CF1M limit switch is factory-set for use with PT100. If the limit switch is used for the mineral-insulated thermocouple, the sensor type must be changed. (⇨ Section 5.1 Page 40)

3 Fill Level Monitoring Sensors

The pump shaft runs in product-lubricated plain bearings made from silicon carbide. If lubrication becomes insufficient or dry running occurs, the plain bearings can be damaged and the pump may fail.

In a potentially explosive atmosphere, additional precautions must be taken to ensure that no explosive atmosphere forms inside the pump. To avoid the formation of an explosive atmosphere inside the pump, the pump internals in contact with the fluid handled, including the rotor space and auxiliary systems, must always be filled with fluid handled.

KSB offers a level transmitter (Liquiphant) to monitor the fill level. The level transmitter protects against the following failures depending on the place of installation:

- Dry running
- Formation of a potentially explosive atmosphere inside the pump

3.1 Monitoring for dry running/formation of a potentially explosive atmosphere using a level transmitter

3.1.1 Functionality of the level transmitter (Liquiphant)

The fork of the level transmitter (Liquiphant) vibrates at its natural resonance. The vibration frequency of the fork changes depending on whether the fork is surrounded by fluid handled or by gas. The level transmitter (Liquiphant) detects a change in frequency and initiates switching of the isolating amplifier. The output contact of the isolating amplifier opens; a signal can be evaluated.

3.1.2 Technical data of level transmitter

Table 25: Technical data of level transmitter (Liquiphant)

Feature	Value
Sensor type	Level transmitter
Type	Liquiphant M
Type of construction	FTL 50 compact
Process connection	Thread G 3/4 A
Material	1.4435 Optional 2.4610
Fluid temperature range	-40 °C ... +150 °C
Electronic module	FEL 56
Signal transmission	On two-wire line to DIN EN 60947-5-6 (Namur)
Power supply	Intrinsically safe via isolating amplifier
Response time	Approx. 1 sec.
LED display in electronic module	Green: Ready for operation Red: Covered/uncovered
Ambient temperature	-50 ... +70 °C
Enclosure	Steel housing IP 66
Certificate of conformity	ATEX II 1/2 G Ex ia IIC 6

Inside the connection head of the level transmitter (Liquiphant) is the FEL56 electronic module. Two miniature switches (for max./min.) are integrated in this electronic module. The level transmitter (Liquiphant) is operational when the miniature switches on the electronic module are set.

Table 26: Setting of level transmitter (Liquiphant) – Level measurement

Switch	Position	
MAX/MIN	-	MIN
> 0,7 / > 0,5	> 0,7	-

3.1.3 Installing the level transmitter in the pipeline

The level transmitter can assume different monitoring tasks, depending on the place of installation. Whether the level transmitter is installed on the suction or discharge side is a function of the system or process. Observe the following table when selecting the place of installation.

Table 27: Recommended place of installation

Monitoring scope	Potentially explosive atmosphere			Non-potentially explosive atmosphere		
	Suction line		Discharge line	Suction line		Discharge line
	h_1 < installation height < ($h_2 + h_1$)	Installation height ≥ ($h_2 + h_1$)	Installation height ≥ ($h_2 + h_1$)	h_1 < installation height < ($h_2 + h_1$)	Installation height ≥ ($h_2 + h_1$)	Installation height ≥ ($h_2 + h_1$)
Fill level in						
Suction line	-	✗	✗	✗	✗	✗
Hydraulic system	-	✗	✗	-	✗	✗
Rotor space						
With internal circulation	-	✗	✗	-	✗	✗
With external liquid feed	-	-	-	-	-	-
Protection against dry running of plain bearing assembly	-	✗	-	✗	✗	-

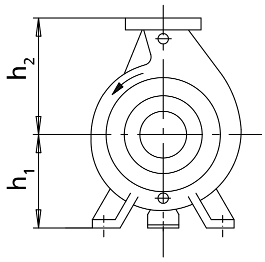


Fig. 15: Dimensions h1 and h2

⚠ DANGER

Unfilled, dry pump
Dry running
Formation of a potentially explosive atmosphere!

▷ No shut-off elements shall be located between the level transmitter and the pump.

⚠ DANGER

Fork of level transmitter contacts the flow of fluid handled
Malfunctions!

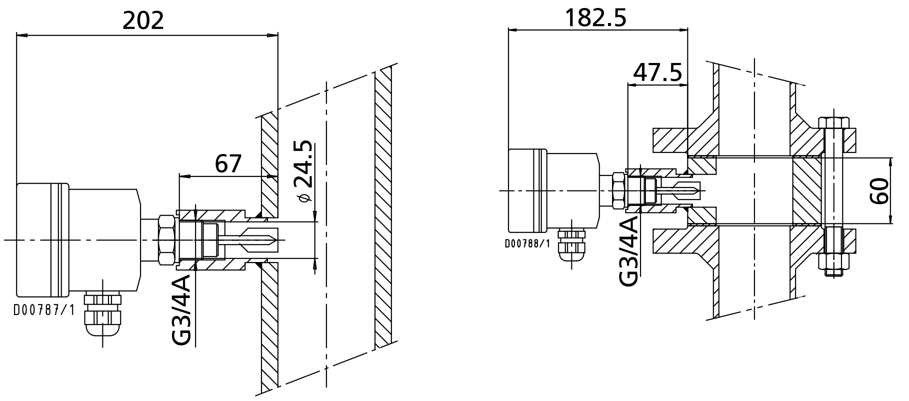
▷ Never allow the fork to protrude into the pipeline.

▷ Observe the manufacturer’s installation instructions.

The level transmitter can be installed in the pipeline as follows:

- Using a weld-in socket/tee

- Using an intermediate piece (optional accessory)



Installing the level transmitter with a weld-in socket in the pipeline

Installing the level transmitter with an intermediate piece in the pipeline

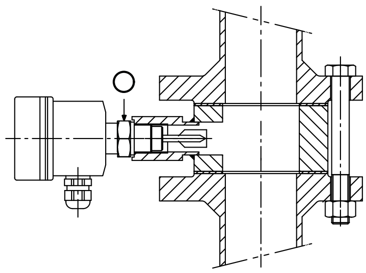


Fig. 16: Fitting level transmitter in pipeline

Install the level transmitter in the suction line:

Suction-side installation

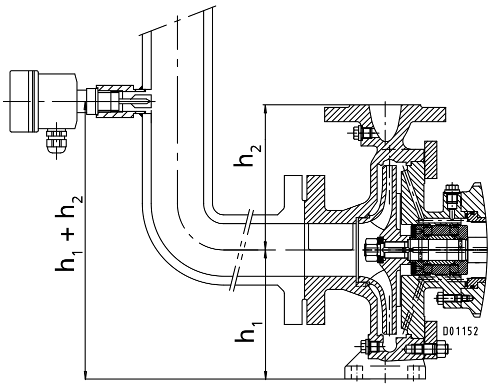


Fig. 17: Installing the level transmitter in the suction line

	NOTE
	The installation height must amount to at least h_1 (middle of suction nozzle). To ensure that the level transmitter can assume comprehensive monitoring tasks, KSB recommends that you position the transmitter at the height of the discharge nozzle or higher (>= $h_1 + h_2$).

1. Select the proper installation height (observe "Recommended place of installation" table).
2. Screw the level transmitter into the intermediate piece, for example.

	NOTE
	To ensure that a change in the fill level can be detected reliably and as early as possible, the fork of the level transmitter must be correctly positioned with the "O" marking on hexagon head WAF2 pointing upwards.

3. Align the level transmitter such that the "O" marking on hexagon head WAF32 is pointing upwards (see illustration titled "Install level transmitter in pipeline").

Installing the level transmitter in the discharge line:

Discharge-side installation

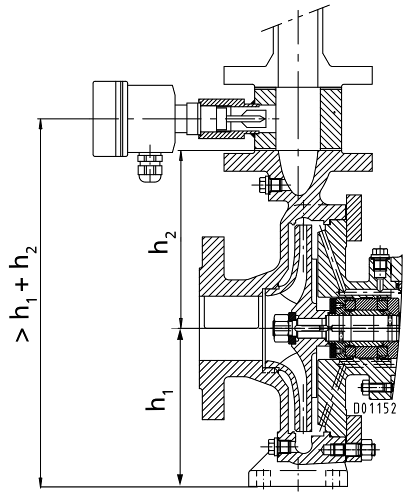


Fig. 18: Installing the level transmitter in the discharge line

The installation height must amount to at least h1 + h2 (height of discharge nozzle).

1. Select appropriate installation height (observe installation recommendations).
2. Screw the level transmitter into the intermediate piece, for example.

	NOTE
	To ensure that a change in the fill level can be detected reliably and as early as possible, the fork of the level transmitter must be correctly positioned with the "O" marking on hexagon head WAF2 pointing upwards.

3. Align the level transmitter such that the "O" marking on hexagon head WAF32 is pointing upwards (see illustration titled "Install level transmitter in pipeline").

3.1.4 Electrical connection of level transmitter (Liquiphant)

	⚠ DANGER
	Incorrect electrical installation Explosion hazard! ▹ For electrical installation, also observe the requirements of IEC 60079-11. ▹ Realise a suitable measuring chain.

	⚠ DANGER
	Work on the pump set by unqualified personnel Danger of death from electric shock! ▹ Always have the electrical connections installed by a trained and qualified electrician. ▹ Observe regulations IEC 60364 and, for explosion-proof models, EN 60079.

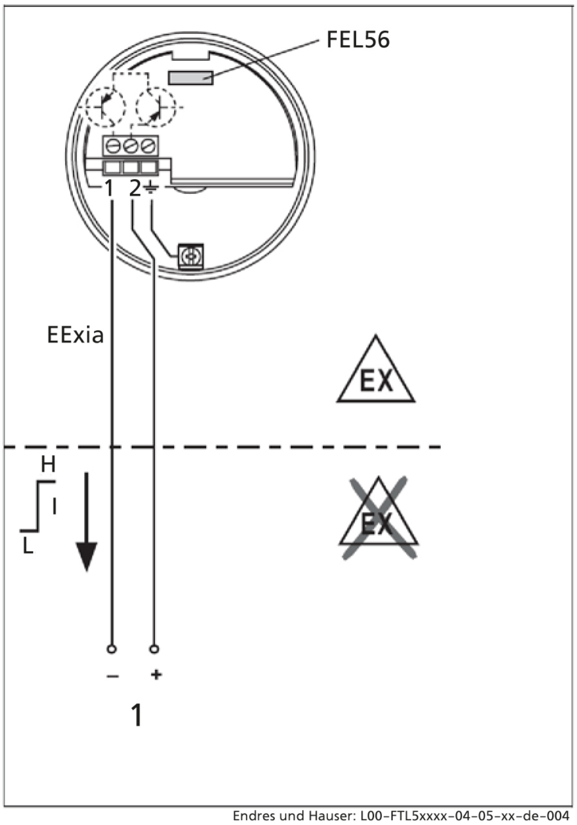


Fig. 19: Electrical connection of level transmitter

1	Isolating amplifier to IEC 60947-5-6 (NAMUR)

1. Electrically connect level transmitter (Liquiphant) (observe "Electrically connect level transmitter" illustration.)
2. Note/observe the setting for the switch and correct if necessary. (⇨ Section 4.1.2 Page 28) (⇨ Section 3.1.2 Page 22)

3.1.5 Design of measuring chain

Impacting the design of the measuring chain is whether the fill level monitoring facility will be used in a potentially explosive or non-potentially explosive atmosphere. The measuring chain must be coordinated for the application scenario.

Design of measuring chain

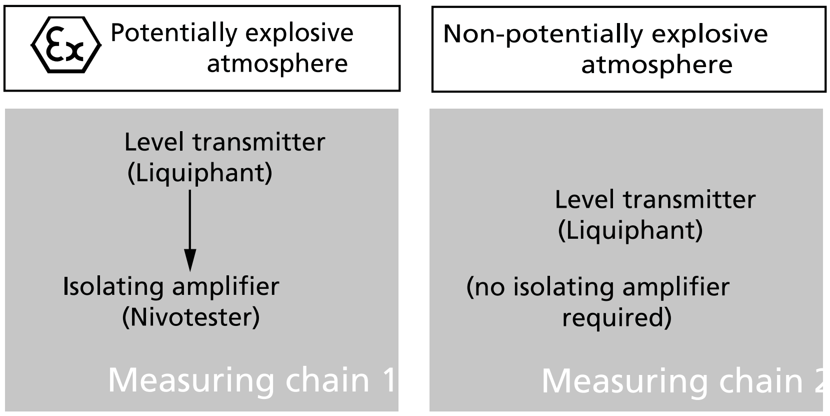
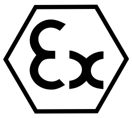


Fig. 20: Design of measuring chain



Description, measuring chain 1 (potentially explosive atmosphere)

Measuring chain 1 comprises the following elements:

Table 28: Description, measuring chain 1 (potentially explosive atmosphere)

Element	KSB device recommendation	For details, refer to...
Level transmitter	Liquiphant M FTL50	(⇨ Section 3 Page 22)
Isolating amplifier	Nivotester FTL235N	(⇨ Section 5.2 Page 44)

Description, measuring chain 2

Measuring chain 2 comprises the following elements:

Table 29: Description, measuring chain 2

Element	KSB device recommendation	For details, refer to...
Level transmitter	Liquiphant M FTL50	(⇨ Section 3 Page 22)

4 Leakage Monitor Sensors

The containment shroud is the component that provides a seal toward the outside atmosphere during intended operation. The space between the containment shroud and bearing bracket lantern is dry, meaning that there is no contact with the fluid handled.

In a failure, damage to the containment shroud or overloading of the containment shroud seal can produce a leak. The causes of this can be:

- Impermissibly high portion of abrasive solids
- Non-compliance with pressure/temperature limits

If a leak occurs and the model with leakage barrier is used, the fluid handled is collected between the containment shroud and the bearing bracket lantern.

To detect a leak that has occurred as a result of a failure, KSB offers the following monitoring options:

- Liquiphant level transmitter
- Pressure switch
- Contact pressure gauge
- Pressure transmitter

If the pressure level is low (i.e. low inlet pressure and low head), it is recommended that you use the level transmitter to monitor leakage conditions. The level transmitter detects whether liquid leakage has collected in the bearing bracket lantern. For higher pressure levels, a containment shroud leak can also be detected by using a pressure gauge to quantify the increase in pressure in the bearing bracket lantern.

4.1 Leakage monitoring via level transmitter (Liquiphant)

4.1.1 Functionality of the level transmitter (Liquiphant)

The fork of the level transmitter (Liquiphant) vibrates at its natural resonance. The vibration frequency of the fork changes depending on whether the fork is surrounded by fluid handled or by gas. The level transmitter (Liquiphant) detects a change in frequency and initiates switching of the isolating amplifier. The output contact of the isolating amplifier opens; a signal can be evaluated.

4.1.2 Technical data of level transmitter

Table 30: Technical data of level transmitter (Liquiphant)

Feature	Value
Sensor type	Level transmitter
Type	Liquiphant M
Type of construction	FTL 50 compact
Process connection	Thread G 3/4 A
Material	1.4435 Optional 2.4610
Fluid temperature range	-40 °C ... +150 °C
Electronic module	FEL 56
Signal transmission	On two-wire line to DIN EN 60947-5-6 (Namur)
Power supply	Intrinsically safe via isolating amplifier
Response time	Approx. 1 sec.
LED display in electronic module	Green: Ready for operation Red: Covered/uncovered
Ambient temperature	-50 ... +70 °C
Enclosure	Steel housing IP 66
Certificate of conformity	ATEX II 1/2 G Ex ia IIC 6

Inside the connection head of the level transmitter (Liquiphant) is the FEL56 electronic module. Two miniature switches (for max./min.) are integrated in this electronic module. The level transmitter (Liquiphant) is operational when the miniature switches on the electronic module are set.

Table 31: Setting of level transmitter (Liquiphant) - Leakage monitoring

Switch	Position	
MAX/MIN	MAX	-
> 0,7 / > 0,5	> 0,7	-

4.1.3 Installing the level transmitter (Liquiphant) in the pump

⚠ WARNING

Leaks and/or corrosion damage on monitoring systems
No fault indications!
Leakage of fluid handled!

▷ Never install damaged or corroded monitoring systems in the pump.
▷ Check monitoring systems for damage and correct function prior to installation.

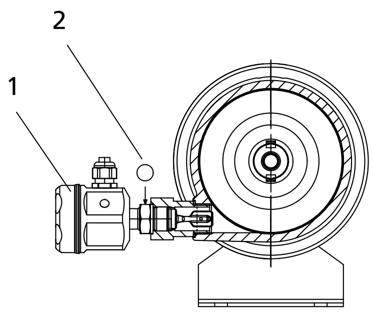


Fig. 21: Installing the level transmitter

1	Level transmitter (8M.2 connection)	2	Marking "O"

1. Remove screw plug from connection 8M.2.
2. Screw the level transmitter (Liquiphant) directly into the adapter.
3. Align the level transmitter such that the "O" marking on hexagon head WAF32 is pointing upwards.

4.1.4 Electrical connection of level transmitter (Liquiphant)

⚠ DANGER

Incorrect electrical installation
Explosion hazard!

▷ For electrical installation, also observe the requirements of IEC 60079-11.
▷ Realise a suitable measuring chain.

⚠ DANGER

Work on the pump set by unqualified personnel
Danger of death from electric shock!

▷ Always have the electrical connections installed by a trained and qualified electrician.
▷ Observe regulations IEC 60364 and, for explosion-proof models, EN 60079.

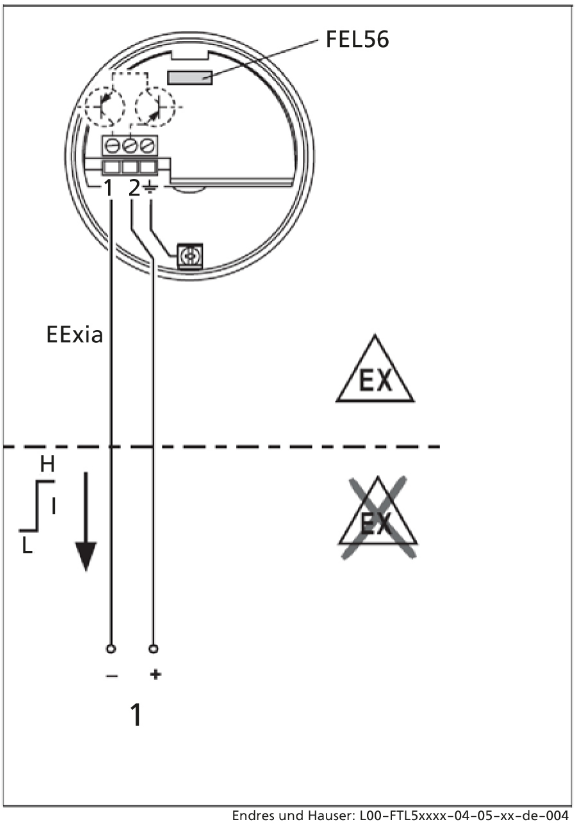


Fig. 22: Electrical connection of level transmitter

1	Isolating amplifier to IEC 60947-5-6 (NAMUR)

1. Electrically connect level transmitter (Liquiphant) (observe "Electrically connect level transmitter" illustration.)
2. Note/observe the setting for the switch and correct if necessary. (⇨ Section 4.1.2 Page 28) (⇨ Section 3.1.2 Page 22)

4.1.5 Design of measuring chain

Impacting the design of the measuring chain is whether the fill level monitoring facility will be used in a potentially explosive or non-potentially explosive atmosphere. The measuring chain must be coordinated for the application scenario.

Design of measuring chain

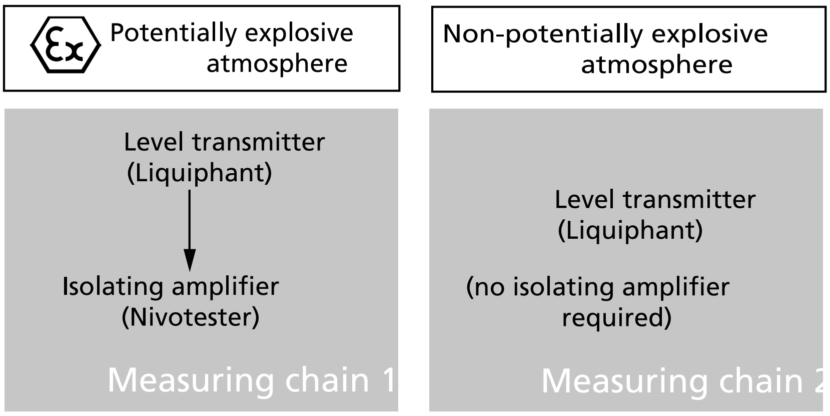


Fig. 23: Design of measuring chain

Description, measuring chain 1 (potentially explosive atmosphere)

Measuring chain 1 comprises the following elements:

Table 32: Description, measuring chain 1 (potentially explosive atmosphere)

Element	KSB device recommendation	For details, refer to...
Level transmitter	Liquiphant M FTL50	(⇨ Section 3 Page 22)
Isolating amplifier	Nivotester FTL235N	(⇨ Section 5.2 Page 44)

Description, measuring chain 2

Measuring chain 2 comprises the following elements:

Table 33: Description, measuring chain 2

Element	KSB device recommendation	For details, refer to...
Level transmitter	Liquiphant M FTL50	(⇨ Section 3 Page 22)

4.2 Leakage monitoring via pressure switch

4.2.1 Functionality of pressure switch

If a leak occurs, and the model with leakage barrier is used, the escaping fluid is collected in the bearing bracket lantern. The pressure in the bearing bracket lantern increases as a result of the sealing effect of the leakage barrier to the atmosphere. The pressure level is a function of the inlet pressure and the head. The pressure switch detects an increase in pressure in the bearing bracket lantern and opens the electrical contact when the limit value is exceeded.

NOTE

When a pressure switch is used, an increase in pressure cannot be directly detected/read at the pump.

4.2.2 Technical data of pressure switch

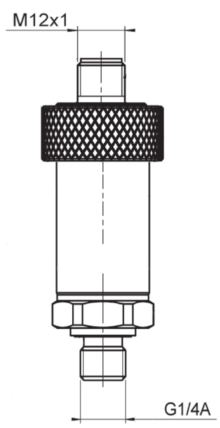


Fig. 24: Pressure switch

Table 34: Technical data

Characteristic	Value
Sensor type	Pressure switch
Type	EDS 4348
Sealing	Pressure-proof up to 25 bar

Characteristic	Value
Start-up pressure	3 bar (programmable with additional device)
Stop pressure	1.5 bar (programmable with additional device)
Switching output	1×PNP, NC contact
Switching mechanism	PNP NC contact opens at p > 3 bar
In-service load	≤ 34 mA
Process connection	G 1/4 A
Tightening torque	20 Nm
Material	1.4571
Permissible fluid temperature	-20 - +60 °C (higher temperatures with additional cooling distance)
Max. ambient temperature	T5, T4: +70 °C T6: +60 °C
Enclosure	IP 67

Table 35: Characteristic values for explosion protection

Characteristic	Value
Power supply	14 .. 28 V DC
Ambient temperature	T4, T5: -20 - +70 °C T6: -20 - +60 °C
Maximum input current	100 mA
Maximum input power	0.7 W
Maximum internal inductance	0 mH
Insulation strength against housing	125 V AC

4.2.3 Installing the pressure switch in the pump

⚠ WARNING

Leaks and/or corrosion damage on monitoring systems
No fault indications!
Leakage of fluid handled!

- Never install damaged or corroded monitoring systems in the pump.
- Check monitoring systems for damage and correct function prior to installation.

1. Remove screw plug from 8M.1 connection.
2. Screw pressure switch into bore with G1/4 thread.
3. Align connection head as required.

4.2.4 Electrical connection of pressure switch

⚠ DANGER

Incorrect electrical installation
Explosion hazard!

- For electrical installation, also observe the requirements of IEC 60079-11.
- Realise a suitable measuring chain.

⚠ DANGER

Work on the pump set by unqualified personnel
Danger of death from electric shock!

- Always have the electrical connections installed by a trained and qualified electrician.
- Observe regulations IEC 60364 and, for explosion-proof models, EN 60079.

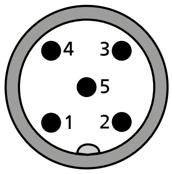


Fig. 25: Pressure switch terminal assignment

1	$+U_B$	2	0 V
3	0 V	4	Out 1
5	0 V		

1. Electrically connect pressure switch. Observe "Pressure switch terminal assignment" illustration.

4.2.5 Design of measuring chain

Impacting the design of the measuring chain is whether the fill level monitoring device will be used in a potentially explosive or non-potentially explosive atmosphere. The measuring chain must be matched to the application range.

Design of measuring chain

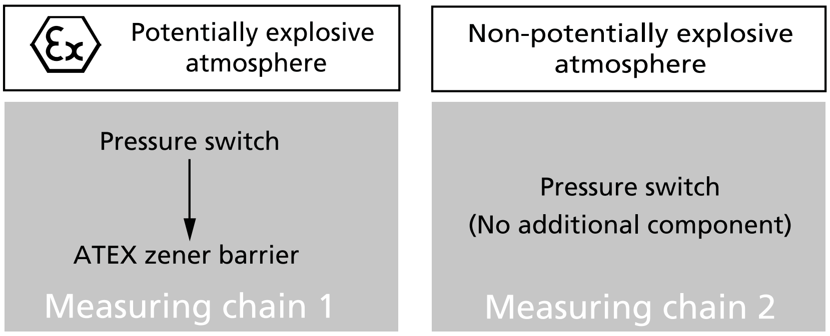


Fig. 26: Design of measuring chain

Description, measuring chain 1 (potentially explosive atmosphere)

Measuring chain 1 comprises the following elements:

Table 36: Description, measuring chain 1 (potentially explosive atmosphere)

Element	KSB device recommendation	For details, refer to...
Pressure switch	EDS 4348	(⇨ Section 4 Page 28)
(ATEX) zener barrier	Z 787	(⇨ Section 5.2 Page 44)

Description, measuring chain 2

Measuring chain 2 comprises the following elements:

Table 37: Description, measuring chain 2

Element	KSB device recommendation	For details, refer to...
Pressure switch	EDS 4348	(⇨ Section 4 Page 28)

4.3 Leakage monitoring via contact pressure gauge

4.3.1 Functionality of contact pressure gauge

If a leak occurs, and the model with leakage barrier is used, the escaping fluid is collected in the bearing bracket lantern. The pressure in the bearing bracket lantern increases as a result of the sealing effect of the leakage barrier to the atmosphere.

The pressure level is a function of the inlet pressure and the head. The contact pressure gauge detects an increase in pressure in the bearing bracket lantern and opens the electrical contact when the limit value is exceeded.

The increase in pressure in the bearing bracket lantern can be directly ready at the pump via the pressure gauge display.

4.3.2 Technical data of contact pressure gauge

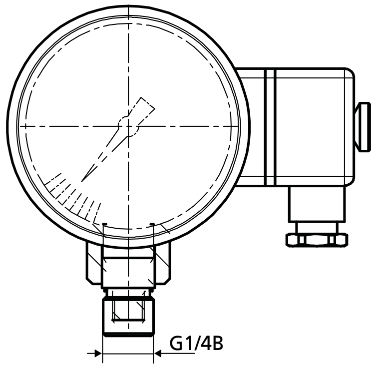


Fig. 27: Contact pressure gauge

Characteristic	Value
Sensor type	Pressure gauge with electrical switching contact
Type of pressure gauge	232.50
Inductive maximum-minimum transmitter	831 ATEX
Display range	0 to 25 bar
Nominal size	100 mm
Accuracy class	1.0
Process connection	G 1/4 B
Material	CrNi steel 316 L
Permissible fluid temperature	< 200 °C
Ambient temperature	-25 - +60 °C (depending on temperature class, limits see test certificate)
Enclosure	IP 65
Ambient temperature	-25 °C - +70 °C (see limits in test certificate, depending on temperature class)

4.3.3 Installing the contact pressure gauge in the pump

⚠ WARNING

Leaks and/or corrosion damage on monitoring systems
No fault indications!
Leakage of fluid handled!

- ▷ Never install damaged or corroded monitoring systems in the pump.
- ▷ Check monitoring systems for damage and correct function prior to installation.

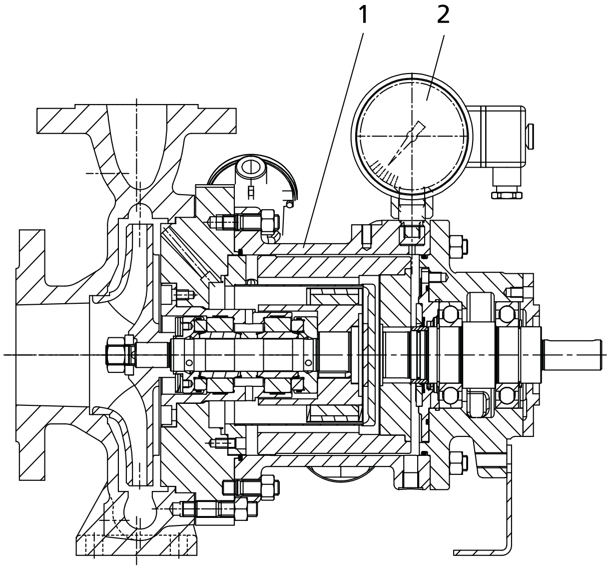


Fig. 28: Installing the contact pressure gauge

1	Bearing bracket lantern (8M.1 connection)	2	Contact pressure gauge

1. Remove screw plug from 8M.1 connection.
2. Screw contact pressure gauge into bore with G1/4 thread.
3. Align pressure gauge display as required.

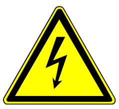
4.3.4 Electrical connection of contact pressure gauge

⚠ DANGER

Incorrect electrical installation
Explosion hazard!

▷ For electrical installation, also observe the requirements of IEC 60079-11.

▷ Realise a suitable measuring chain.



⚠ DANGER

Work on the pump set by unqualified personnel
Danger of death from electric shock!

▷ Always have the electrical connections installed by a trained and qualified electrician.

▷ Observe regulations IEC 60364 and, for explosion-proof models, EN 60079.

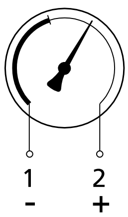


Fig. 29: Terminal assignment, contact pressure gauge

1. Electrically connect contact pressure gauge (Observe "Contact pressure gauge terminal assignment" illustration.)

4.3.5 Design of measuring chain

Impacting the design of the measuring chain is whether the fill level monitoring device will be used in a potentially explosive or non-potentially explosive atmosphere. The measuring chain must be matched to the application range.

Design of measuring chain

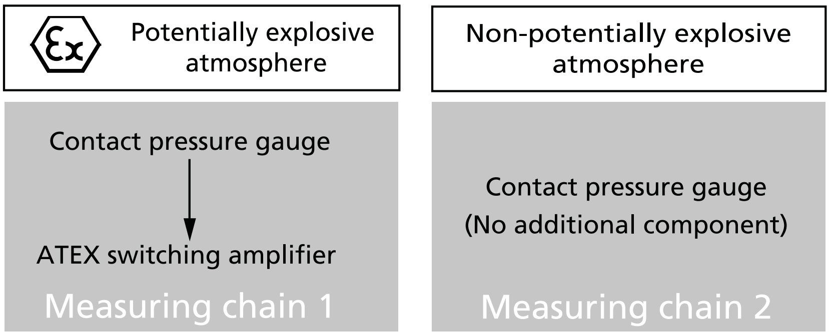


Fig. 30: Design of measuring chain

Description, measuring chain 1 (potentially explosive atmosphere)

Measuring chain 1 comprises the following elements:

Table 38: Description, measuring chain 1 (potentially explosive atmosphere)

Element	KSB device recommendation	For details, refer to...
Contact pressure gauge	PGS23.100 with inductive contact 831	(⇨ Section 4 Page 28)
(ATEX) switching amplifier	KFA6-SR2-EX1.W	(⇨ Section 5.2 Page 44)

Description, measuring chain 2

Measuring chain 2 comprises the following elements:

Table 39: Description, measuring chain 2

Element	KSB device recommendation	For details, refer to...
(ATEX) switching amplifier	KFA6-SR2-EX1.W	(⇨ Section 5.2 Page 44)

4.4 Leakage monitoring via pressure transmitter

4.4.1 Functionality of pressure transmitter

If a leak occurs, and the model with leakage barrier is used, the escaping fluid is collected in the bearing bracket lantern. The pressure in the bearing bracket lantern increases as a result of the sealing effect of the leakage barrier to the atmosphere. The pressure level is a function of the inlet pressure and the head. The pressure transmitter detects the pressure increase in the bearing bracket lantern. The output signal of the pressure transmitter is relayed to a limit switch that signals when the limit value is exceeded.

NOTE

When a pressure transmitter is used, an increase in pressure cannot be directly detected/read at the pump.

4.4.2 Technical data of pressure transmitter

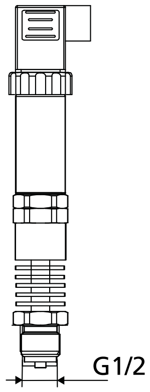


Fig. 31: Pressure transmitter

Table 40: Technical data of pressure transmitter

Characteristic	Value
Sensor type	Pressure transmitter
Type	IS-20-S
Measuring range	0 - 25 bar
Overload limit	50 bar
Wetted parts material	CrNi steel
Explosion protection	Ex ia I/II C T6
Housing	IP 65
Process connection	G1/2B
Fluid temperature	-40 - 200 °C
Output signal	4 to 20 mA, 2-wire
Power P_i	750 mW for category 1 D approval
Enclosure	IP 67
Permissible ambient temperature	-40 - +60 °C (T6) -40 - +80 °C (T5) -40 - +105 °C (T4)

Table 41: Characteristic values for explosion protection

Characteristic	Value
Voltage U_i	30 V DC
Amperage I_i	100 mA
Power P_i	1 W
Effective internal capacitance C_i	22 nF
Effective internal inductance L_i	0 µH

4.4.3 Installing the pressure transmitter in the pump

⚠ WARNING

Leaks and/or corrosion damage on monitoring systems
No fault indications!
Leakage of fluid handled!

- ▷ Never install damaged or corroded monitoring systems in the pump.
- ▷ Check monitoring systems for damage and correct function prior to installation.

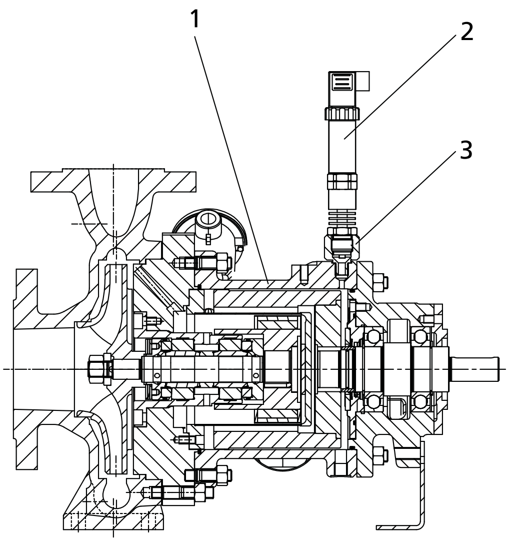


Fig. 32: Installing the pressure transmitter

1	Bearing bracket lantern (8M.1 connection)	2	Pressure transmitter
3	Adapter G1/4-G1/2		

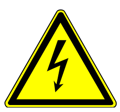
1. Remove screw plug from 8M.1 connection.
2. Screw adapter G1/4-G1/2 into bore.
3. Screw pressure transmitter into adapter G1/4-G1/2.
4. Align connection head as required.

4.4.4 Electrical connection of pressure transmitter

⚠ DANGER

Incorrect electrical installation
Explosion hazard!

- ▷ For electrical installation, also observe the requirements of IEC 60079-11.
- ▷ Realise a suitable measuring chain.



⚠ DANGER

Work on the pump set by unqualified personnel
Danger of death from electric shock!

- ▷ Always have the electrical connections installed by a trained and qualified electrician.
- ▷ Observe regulations IEC 60364 and, for explosion-proof models, EN 60079.

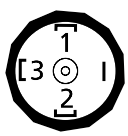


Fig. 33: Terminal assignment, angle outlet, pressure transmitter

1	U+	2	U-
3	Not used		

Table 42: Technical data of connection cable

Characteristic	Value
Core cross-section	Up to 1.5 mm²
Cable diameter	6 - 8 mm
Type of protection to IEC 60529	IP 65[4)]

1. Electrically connect pressure transmitter. Observe the terminal assignment (see "Terminal assignment, angle outlet, pressure transmitter" illustration).

4.4.5 Design of measuring chain

Impacting the design of the measuring chain is whether the fill level monitoring device will be used in a potentially explosive or non-potentially explosive atmosphere. The measuring chain must be matched to the application range.

Design of measuring chain

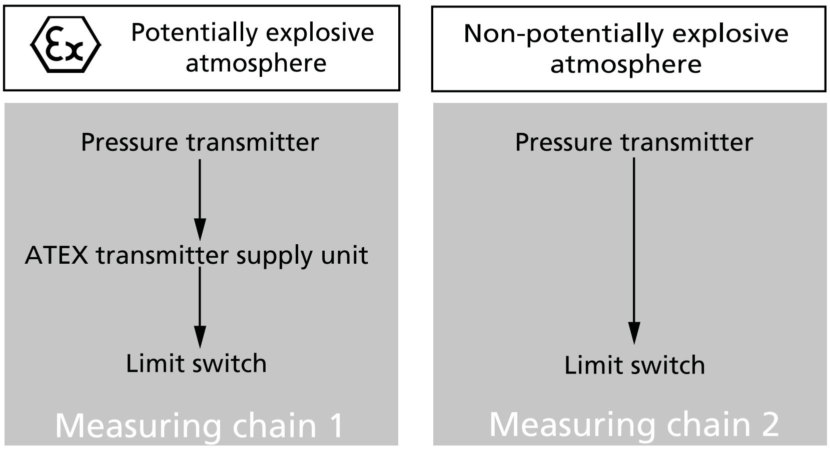
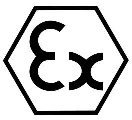


Fig. 34: Design of measuring chain



Description, measuring chain 1 (potentially explosive atmosphere)

Measuring chain 1 comprises the following elements:

Table 43: Description, measuring chain 1 (potentially explosive atmosphere)

Element	KSB device recommendation	For details, refer to...
Pressure transmitter	IS-20-S	(⇨ Section 4 Page 28)
(ATEX) transmitter supply unit	KFD2-STC4-EX1	(⇨ Section 5.2 Page 44)
Limit switch	DGW 1.00 or DWG 4.00	(⇨ Section 5.1 Page 40)

Description, measuring chain 2

Measuring chain 2 comprises the following elements:

Table 44: Description, measuring chain 2

Element	KSB device recommendation	For details, refer to...
Pressure transmitter	IS-20-S	(⇨ Section 4 Page 28)
Limit switch	DGW 1.00 or DWG 4.00	(⇨ Section 5.1 Page 40)

4) The type of protection specified applies only in the connected state with cable connectors that offer the appropriate level of protection

5 Sensor Accessories

5.1 Processing of output signals from analog sensors

If analog sensors are used to monitor the operating status of the pump, these sensors can be employed to measure temperature or pressure, for example.

A limit switch is also required to evaluate the measured output signals of the analog sensors. Using a limit switch makes it possible to distinguish between intended operation and a failure scenario (target/actual value comparison) and switch off the pump if the latter occurs.

Fig. 35: Signal processing, analog sensor – limit switch using temperature monitoring as an example: intended operation

T	Temperature	Ω	Electrical resistance in ohms
—⌒—	Closed contact		

Fig. 36: Signal processing, analog sensor – limit switch using temperature monitoring as an example: failure

T	Temperature	Ω	Electrical resistance in ohms
—⁄—	Open contact		

For example, during temperature monitoring, the analog sensor measures the temperature as part of processing routine and relays an output signal in ohms. The output signal of the analog sensor is the input signal for the limit switch. This must be taken into account when selecting the limit switch.

The following limit switches can be ordered from KSB:

Table 45: Limit switch

Output signal, analog sensor	Input signal, limit switch	KSB device recommendation	For product literature, see
ohm	ohm	CF1M	Manufacturer/type leaflet (⇨ Section 5.1.1 Page 41)
ohm	ohm	DGW 2.00	Manufacturer/type leaflet
mA	mA	DGW 1.00 or DG W4.00	Manufacturer/type leaflet

5.1.1 Additional information, limit switch CF1M

5.1.1.1 Technical data, limit switch CF1M

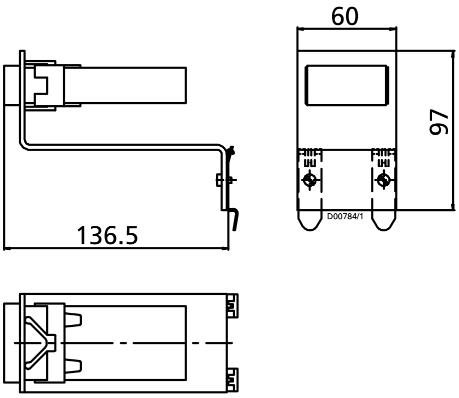


Fig. 37: Dimensions

Table 46: Technical data, limit switch CF1M

Characteristic	Value
Type	CF1M
Power supply	95 - 240 V AC, 50/60 Hz
Power consumption	Approx. 5 VA
Output	Relay contact, 250 V A, 3 A (ohmic)/1 A (ind.)
Ambient temperature	0 - 50 °C
Installation	In the control cabinet, can be snapped onto 35 mm standard rail to DIN EN 60715 by means of the mounting adapter supplied
Enclosure	IP 20

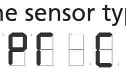
5.1.1.2 Installing the CF1M limit switch

The limit switch must be installed in the control cabinet in the non-potentially explosive atmosphere.

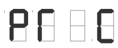
The limit switch is inserted into the rectangular cutout of the mounting angle supplied with the display pointing forwards and secured from the rear by means of the locking clip. The mounting angle can then be snapped onto the top hat rail.

5.1.1.3 Setting the sensor type

Setting the resistance thermometer sensor type

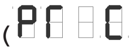
The CF1M limit switch is preprogrammed at the factory for use with the PT100 resistance thermometer. After the power supply is applied, the limit switch is in basic mode. The sensor type set briefly appears on the display of the limit switch (for PT100 with the  icon).

If the sensor type must be reset, proceed as follows:

1. Simultaneously press the UP, DOWN and MODE keys for approx. 3 seconds.
   ⇨ The following display appears for selecting a sensor:
2. Set the PT100 sensor type using the UP or DOWN arrow keys (icon: ).
3. Press the MODE key to confirm your entry.

⇨ The sensor type is set. The limit switch is back in basic mode.

Setting the mineral-insulated thermocouple sensor type

The CF1M limit switch is factory-set for use with PT100. The following steps are required to reprogram for the mineral-insulated thermocouple: After the power supply has been switched on, the device is in basic mode. Following a brief display of the sensor set (here, PT100 with icon ()), configure the device for mineral-insulated thermocouple sensor type K with the following icon: 

1. Simultaneously press the UP, DOWN and MODE keys for approx. 3 seconds.

   ⇨ The following display appears for selecting a sensor: 
2. Use the UP or DOWN arrow keys to select the mineral-insulated thermocouple type K with the following icon: 
3. Press the MODE key to confirm your entry.

⇨ The correct sensor type is set. The device has returned to basic mode. The actual value is now displayed when the mineral-insulated thermocouple is connected.

5.1.1.4 Setting the limit value for the cut-out temperature

After the selected sensor type has been displayed momentarily, the actual temperature value is displayed (red point LED below "PV" is lit).
Proceed as follows to change the cut-out temperature:

1. Press the MODE key.
2. Use the UP or DOWN arrow keys to enter the respective limit value.
3. Press the MODE key to confirm your entry.

⇨ The set value is accepted. The limit switch is back in basic mode. The actual value set is now displayed.

The limit switch is now ready to be used.

5.1.1.5 Setting parameters

All parameters other than the limit value are pre-set in the factory.

Proceed as follows to set/check the parameters:

1. Simultaneously press several keys for at least 3 seconds to gain access to the 3 parameter levels.
   - **Parameter level 1:** UP and MODE key
   - **Parameter level 2:** DOWN and MODE key
   - **Parameter level 3:** UP and DOWN and MODE key

   ⇨ The parameter and its value are displayed alternatingly in flashing mode.

Setting parameter 0.1 (⇨ Section 5.1.1.4 Page 42)

- Press the MODE key to view the next parameter.
- At the end of each parameter level, the display automatically returns to basic mode.
- As the parameter locking function is factory set to Lc2, no parameters can be changed, except for the set value, i.e. the parameters are read-only.

The correct function of the limit switch is only ensured if the parameters specified in the table below are set to the values indicated.

NOTE

If additional parameters are displayed during the check or the values displayed do not match the values given in the table (exception: limit value, parameter 0.1), the limit switch is not operational and must not be used. In such cases, please contact KSB.

Table 47: Parameter settings, limit switch

Parameter level (level No.)	Description	Value	Display, limit switch	
			Parameter	Value
0.1	Set value (here: limit value)	e.g. 50 °C (pump-specific)	S	50
1.1	Proportional band	0 (= on/off behaviour)	P	0
2.1	Display preselection (actual/set value)	PV (= actual value)		PV
2.2	Parameter locking function	Lc2 (only set value can be modified)	Loc	Lc2
2.3	Max. set value	200 °C	SH	200
2.4	Min. set value	0 °C	SL	0
2.5	Sensor correction	0.0 K	So	0.0
3.1	Sensor selection	PT 100 (IEC) without decimal point	SEn	Pt C
3.2	PV filter time	0.0	FiLt	0.0
3.3	Hysteresis output (⇨ Section 2.1.6.1 Page 13)	1.0 K	HYS	1.0
3.4	Function alarm output	Temperature alarm	EUnt	ALm
3.5	Function temperature alarm	No alarm	AL_F	----
3.6	Minimum increase rate	0 K/min.	rAtU	0
3.7	Maximum increase rate	0 K/min.	rAtd	0
3.8	Output action reverse/direct	Heating	cnt	HEAt

5.1.1.6 Trouble-shooting

Table 48: Trouble-shooting

Fault	Fault message	Cause	Display	Green LED	Pump running
Mains voltage: none or incorrect	-	Electrical connection	-	LED off	No
Mains voltage: correct	No	Relay output deactivated (activate via OUT/OFF button)	oFF 8888	LED off	No
	Yes	PT 100 defective	Flashing ----	LED off	No
	Yes	PT 100 incorrectly connected	Flashing ____	LED off	No
	Yes	Broken wire	Actual value does not change	LED off	No
	No	Actual value > limit value	Actual value	LED off	No
	No	Actual value < limit value	Actual value	LED on	Yes

5.2 Additional components in potentially explosive atmosphere

DANGER

Excessively high surface temperatures and production of sparks
Explosion hazard!

- Observe IEC 60079-11.
- Insert additional component in measuring chain.

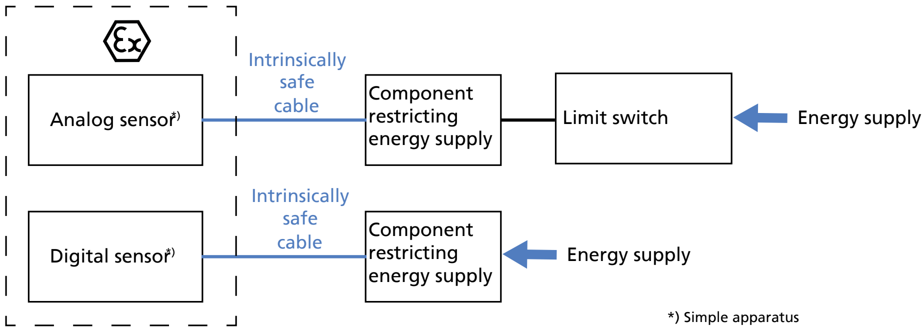


Fig. 38: Schematic representation of measuring chain

When a failure occurs (e.g. as a result of a short circuit), electrical energy is released, which can cause ignition in the presence of hot surfaces or sparks. The energy supplied to the intrinsically safe area must therefore be restricted such that ignition is not possible. To this end, an additional component is used that restricts, or limits, the transmission of electrical energy from a non-potentially explosive atmosphere to the potentially explosive atmosphere (intrinsically safe wiring).

Components are therefore used that must be coordinated with the monitoring sensor employed and its output signal. A matching zener barrier or signal isolator must be selected with respect to the sensor and output signal. The zener barrier or signal isolator must always be installed in a non-potentially explosive atmosphere (see "Schematic representation of measuring chain" illustration). Also observe the circuit diagrams (⇨ Section 6 Page 47) .

The following signal isolators can be ordered from KSB (observe assignment to sensor and output signal):

Table 49: Signal isolator

Sensor	Analog output signal		Digital output signal	KSB device recommendation		For product literature, see
	in mA	in ohms		Description	Type	
PT100	✗	-	-	Transmitter supply unit	KFD2-STC4-EX1	Manufacturer/type leaflet
Mineral-insulated thermocouple	✗	-	-	Transmitter supply unit	KFD2-STC4-EX1	Manufacturer/type leaflet
Level transmitter	-	-	✗	Isolating amplifier	FTL235N	Manufacturer/type leaflet
Contact pressure gauge	-	-	✗	Switching amplifier	KFA6-SR2-EX1.W	Manufacturer/type leaflet
Pressure switch	✗	-	-	Transmitter supply unit	KFD2-STC4-EX1	Manufacturer/type leaflet

The following zener barriers can be ordered from KSB (observe assignment to sensor and output signal):

Table 50: Zener barrier

Sensor	Analog output signal		Digital output signal	KSB device recommendation		For product literature, see
	in mA	in ohms		Description	Type	
PT100	-	✗	-	Barrier	Z954	Manufacturer/type leaflet
Pressure switch	-	-	✗	Zener barrier	Z787	Manufacturer/type leaflet

5.2.1 Technical data of signal isolator

Switching amplifier

Table 51: Technical data of switching amplifier

Characteristic	Value
Type of switching amplifier for ATEX	**KFA 6-SR-Ex1.W**
Power supply	AC 230 V
No-load voltage	DC 8 V
Short-circuit current	8 mA
Explosion protection	[EEx ia] IIC
Certificate of conformity	PTB 00 ATEX 2081
U_0	< 10.6 V DC
I_0	19.1 mA
P_0	51 mW
Permissible external capacitance	< 2.9 µF
Permissible external inductance	< 100 mH
Relay output	253 V AC, 2 A, 500 VA, cos phi > 0.7
Enclosure	IP 20
Fastening	35 mm standard rail

Transmitter supply unit

Table 52: Technical data of transmitter supply unit

Characteristic	Value
Type	**KFD2-STC4-EX1**
Power supply	24 V DC
Explosion protection	Ex ia IIc
Input signal	4 - 20 mA current input, Hart-compatible
Output signal	4 - 20 mA
Transmitter supply	≥ 16 V DC
Voltage U_0	25.4 V
Current I_0	86.8 mA
Power P_0	551 mW
Ambient temperature	-20 - +60 °C
Enclosure	IP 20
Fastening	35 mm standard rail

Isolating amplifier

Table 53: Technical data of isolating amplifier FTL235N

Characteristic	Value
Type	**FTL235N**
Supply voltage	85 V - 253 V AC, 50/60 Hz
Pump input power	70 mA at 230 V, maximum 1.75 W
Intrinsic safety	[Ex ia] II C
Input, driving signal	NAMUR standard
Output, relay	2, volt-free changeover contact, maximum 250 V AC, 2A
LED display in front panel	Green: Operational availability Yellow: Switching state Red: Failure
Fastening	35 mm top hat rail
Ambient temperature	-20 - +60 °C
Enclosure	IP 20
Certificate of conformity	DMT01ATEXE052

5.2.2 Technical data of zener barrier

Zener barrier Z954

Table 54: Technical data of zener barrier Z954

Characteristic	Value
Type	Zener barrier Z954
Explosion protection	[Ex ia] IIC
Approval number	BAS 01 ATEX 7005
Casing	Can be snap-mounted on 35 mm standard rail to DIN EN 60715
Max. core cross-section	2.5 mm^2
Voltage U_0	9 V
Current I_0	510 mA
Power P_0	1.15 W
Effective internal capacitance C_0	4,9 µF
Effective internal inductance L_0	12 mH
Nominal fuse current	50 mA
Enclosure	IP20
Permissible ambient temperature	-20 ... +60 °C

Zener barrier Z787

Table 55: Technical data of zener barrier Z787

Characteristic	Value
Type	Zener barrier Z787
Explosion protection	[Ex ia] IIC
Approval number	BAS 01 ATEX 7005
Maximum voltage in intrinsically safe circuit	28 V
Minimum value of built-in resistor	300 ohm
Maximum current in intrinsically safe circuit	93 mA
Maximum performance P_{max}	0,65 W
Maximum connectable external capacitance C_{max}	0,083 µF
Maximum connectable external inductance L_{max}	3,05 mH

5.2.3 Technical data of power supply unit

Table 56: Technical data of power supply unit

Characteristic	Value
Type	KFA6-STR-1.24.500
Rated voltage, supply	90 - 253 V AC, 48 - 63 Hz
Power loss, supply	2.5 W
Connection, output	Terminals 7+, 8-
Connection, supply	Terminals 14, 15
Current	500 mA
Voltage	24 V

6 Related Documents

6.1 Circuit diagram for PT100 resistance thermometer

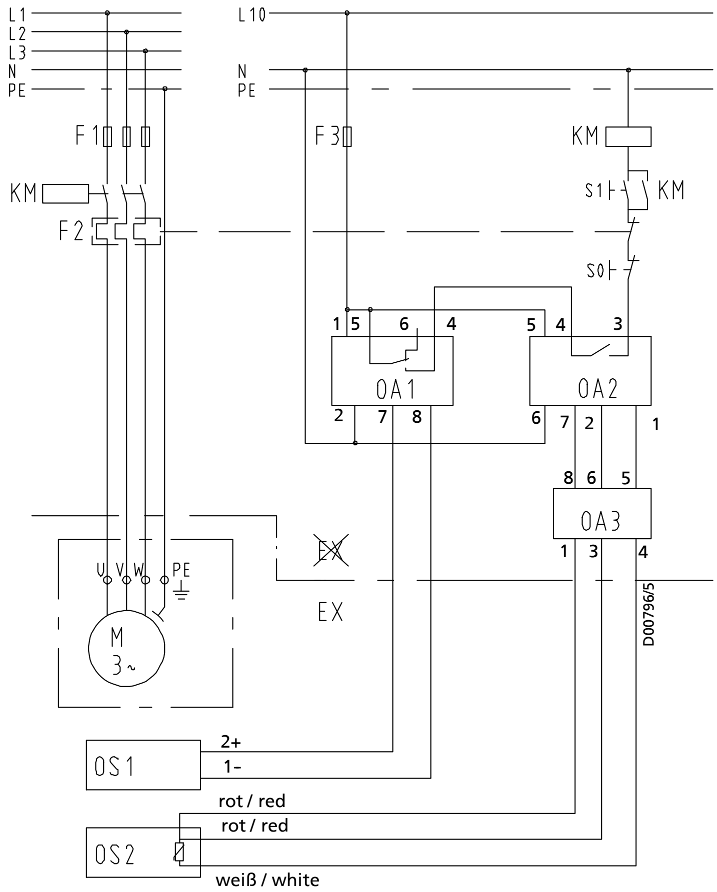


Fig. 39: Example of temperature monitoring at containment shroud with PT100 resistance thermometer

Type designation		Designation
0A1	FTL325N	Isolating amplifier
0A2	CF1M	Limit switch
0A3	Z954	Barrier
0S1	Liquifant M	Level transmitter
0S2	TR 55 three-wire system	PT 100 resistance thermometer

6.2 Circuit diagram for mineral-insulated thermocouple

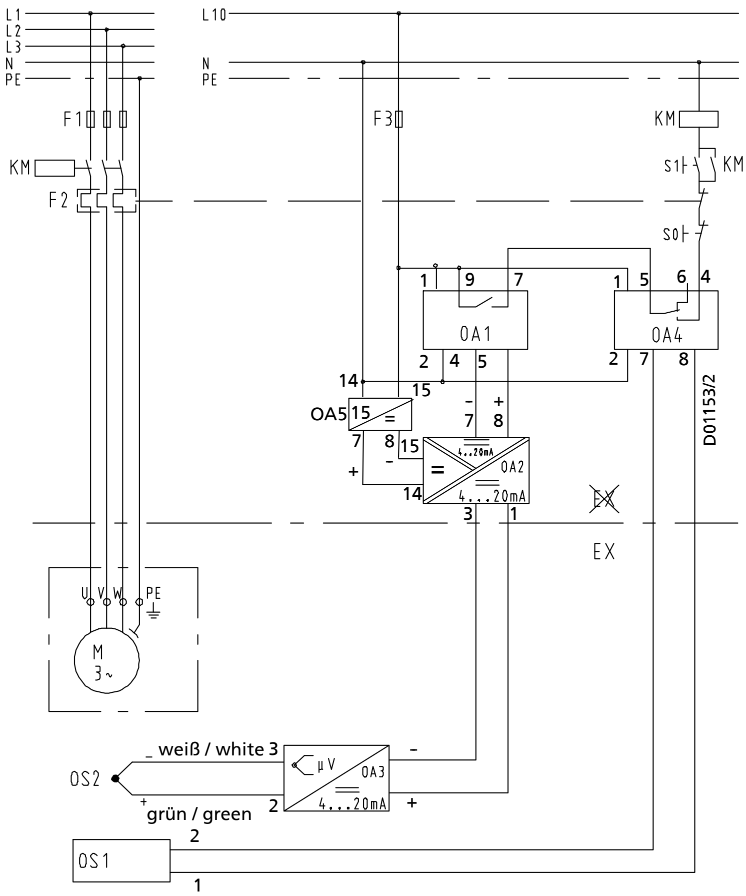


Fig. 40: Example of temperature monitoring at the containment shroud via a mineral-insulated thermocouple

Type designation		Designation
0A1	DWG4.0	Controller/display with current input
0A3	T12.10	Head transmitter
0A4	FTL325N	Isolating amplifier
0S1	Liquiphant M	Level transmitter
OS2	Type K	Mineral-insulated thermocouple (affixed to containment shroud)
0A2	KFD2-STC4-EX1	Transmitter supply unit
0A5	KFA6-STR-1.24.500	Power supply unit

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