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Equipment Description €

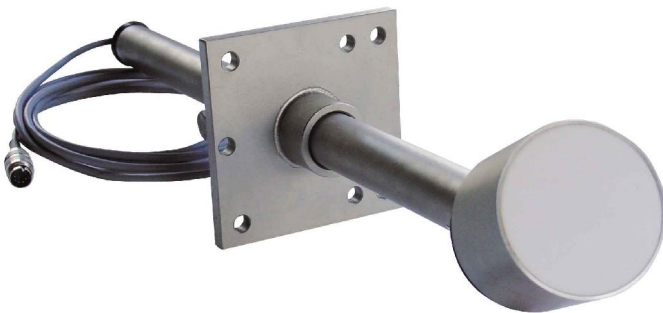
Moisture measuring probes Type FS(x)



Type FS V (Variable depth probe)



Type FS 1 („Diskprobe“)



Type FS A (Arm mounted probe)



Type FS M (Mixer probe)



Type FS H (High temperature probe)

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1. The moisture measuring probes

Werne & Thiel has specialized in the manufacture of robust probes for measuring the moisture content of materials with a very good price-performance ratio. These probes have already proved their values, and are being installed in various parts of the world with success. The casing and the mounting brackets are all made of stainless steel.

As shown in the pictures 1 to 6 of page 1 of this manual, different models are available to suit the application. The type description for the models shown, are: FSV, FS1, FSA, FSM and FSH.

Comparison of the different models:

Model	Area of application	Mounting
FSV	Adjustable probe for universal applications. Wide range of adjustment possible. Also suitable for thick wall situations. Can be mounted on a glider for measuring the moisture of materials on conveyer belts.	Adjustable mounting ring with three holes, onto a glider plate or with a angled tube fixture for wall mount.
FS1	Universal application. The distance between the front edge of the probe and the mounting flange is fixed. This distance is 11mm with the protective head overlay (against abrasion).	Fixed installation flange with three holes.
FSA	Arm mounted probe with standard arm lengths of 0.2m, 0.5m or 1m. Appropriate for installation inside of a silos or hopper.	Adjustable support arm for probe. Three different mounting brackets are available. 90°, 60° or 30°
FSM	Mixer-probe for installation in mixers. Conceived for use in rough environments. Additional protection against abrasion with a 8mm thick hardened or unhardened replaceable bushing. The sensor surface is protected with a 10mm strong ceramic disc.	Weldable mounting ring for floor or wall set-up with 3 bolts to adjust and secure the probe.
FSH	High temperature probe. For measuring the moisture content in applications requiring high temperature, withstanding capability up to a maximum of 190°C (374°F). Attention: Permissible temperature of the measuring head is max. 190 °C Permissible ambient temperature for the backstage electronics is max. 80°C (176°F) .	Adjustable mounting ring.

2. Applications

A few typical examples below bring out the all-round application possibilities of our probes:

- Moisture content of sands, gravel's etc. (Concrete production)
- Reprocessing of foundry sand for desired moisture content
- Moisture content of quartz sand e.g. for glass manufacture
- Quality optimization in food processing
- Corn production
- Fodder industry for animal food
- Ceramic powders and pastes
- Metal oxides
- Moisture content of building and construction materials
- Applications in chemical and pharmaceutical industries
- soil humidity
- Sludge from the sewage plants

and so on....

3. Measuring method and basic hints

General information about moisture measurement:

All current measuring systems (whether based on capacitive, microwave or conductivity measurements etc.) measure the water content of the mediums only indirectly, where a known physical effect is utilized for the purpose.

Some property of the medium changes (in accordance with the physical effect) due to a change in the moisture content, and these changes are then converted by the sensor into a proportionally varying signal [0-10V] or [0(4)-20mA]. As there is no absolute scale of indication, it becomes necessary to calibrate the measuring probe depending on the material in question. This calibration is required, whether the material is moving or not.

The Werne & Thiel moisture measuring probes are designed for on-line measurement of materials varying from rubbles to other not so rough objects. The measuring process determines the actual water content of a mixture. In order to achieve this, the difference between the dielectric constant of water ($\epsilon = 80$) and that of the material in question is estimated. Most materials have a dielectric constant are located in the range of $\epsilon = 3 \dots 10$. The water content of the material results in a widely varying range for the dielectric constant, and a measurement of the changes in the capacitive field permit us the attain a high resolution for the corresponding measured signal. This is then further processed by the electronic inside the probe, and the processed signal is available as the moisture measurement signal at the terminals of the probe.


This implies that for different materials the probe has to be calibrated separately, and a material specific calibration curve is required for evaluating the signal output at the probe terminals.

The calibration of the probe is of utmost importance during the installation procedure.

See also chapters 7 and 8

The amount of water in the material under the probe varies according to the density of the material under the probe (field penetration depth of 7-15cm).

Example: There are more water molecules within the measurement volume under the probe for high density sand (field penetration depth of app. 10cm.) than for loose sand rich in trapped air molecules. This implies a higher output signal in the former case.

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It is therefore evident that in addition to the importance of calibrating the probe, the location of the sensor is also of decisive influence in obtaining a reliable measurement. See Chapter 6, *Mounting instructions*.

These sensors can also measure the moisture content of materials when there is a small air gap between the material and the probe. This separation, however, must not vary. The limit of measurement is set by the minimum moisture content of the material.

The same criteria are also applicable when the measurement must be done through some intervening medium. Examples are: from the other side of a conveyer belt or through some additional protective layers such as those used for against abrasion etc.

It is **not possible** to do any moisture measurement through metalliferous conveyer belts or through containers.

Important: The larger the separation between the sensor surface and the measuring medium, the lesser is the sensitivity of the measurement. When there are different possibilities of mounting the probe, the one with the least separation between the sensor and the material is to be preferred.

Measurability of different materials

Basic considerations for good measurability of materials: The material should have a dielectric constant ϵ which is much smaller in comparison with that of water ($\epsilon = 80$), the ohmic resistivity (Ohm/cm) should not be too low, and the density of the material should remain fairly constant within the field of influence of the sensor during measurements.

Simple tests:

A material is essentially measurable when samples with different moisture content produce reproducible output signals under identical conditions of measurement with a probe. The mapping of the probe output signal to a definite value of moisture content (compilation of the calibration curve) must then be done in the laboratory. This calibration is rather flexible: e.g. an output signal of 1 Volt can be assigned to a moisture value of 1% and an output signal of 10V to a moisture content of 10%. Alternatively, 1Volt = 2% and 10V = 20% is also possible according to the chosen range of measurement.

This simplified assignment of moisture values to signals is only possible provided the calibration curve is linear. This is the case with minor deviations for sands obtained from the central European regions, namely such as those used in the production of concrete.

In other cases it is necessary to build the calibration curve using at least three different values of moisture.

The Werne & Thiel moisture measuring processor FMP2 can accept up to six such calibration points for building the calibration curve. Alternatively, such linearisation can be achieved with the help of a computer or a programmable logic controller.

Not measurable are those materials for which the dielectric constant approaches that of water, where the conductivity is high (producing a short circuit for the high frequency measuring fields) or those with large process dependent density variations (e.g. due to the presence of varying amounts of air within the material).

Also, a material **becomes unmeasurable** when the moisture content is so high that the sensor enters the so called region of saturation. With sands this situation is approached when the moisture content is so high that water starts running out of it. In such cases we stop describing it as moisture content of the material and instead talk about the solid content of water. We suggest using the Werne & Thiel OLAS (Optical Light Absorption Sensor) for measuring the solid / fluid content of such materials.

Another source of measuring error could be the changing salt content of the material. This happens because of the increased ionic conduction within the material, and can under circumstances lead to complete ionic short circuits.

For materials containing very little moisture (e.g. synthetic materials, where the moisture content may go down to ppm region) the amplification of the sensor signal has to be increased so much that external physical parameters might start influencing the output signal of the sensor. It is not advisable under such conditions to do any online measurements. We suggest using the laboratory equipment MB23/MB25 to carry out discrete point measurements.

4. Construction details

See chapter 15 page 22 for the mechanical dimensions

All Werne & Thiel moisture measuring sensors are built inside robust stainless steel casings. The required supporting fixtures are also made of stainless steel. The matured measuring electronic is very compact and constructed using the modern SMD technology.

The measuring electronic for the sensors are fully potted inside special casings, thus guaranteeing a high mechanical and electronic stability for use under extremely adverse conditions like the vibrating conveyor.

The probes comply with the IP68 protection standard. Probe type FS1 complies with standard IP50.

Each of the above mentioned sensors can also be fitted with 0 and % calibration adjustment controls. These are accessible through a water tight screwed cover at the rear of the top part of the casing.

The standard supply voltage is 9-32V DC. An alternative choice of +/- 15V is also possible.

A three meter long 5-pole shielded cable with permanently fitted metal sleeves at the terminal ends is supplied for connecting the probe (only FS1). All other probes come with a plug&screw connector and a separate 4mtr. long cable. The standard measuring surface of the sensor is made of ceramic.

The following types of protective covers for the sensor measuring surface can be supplied:

Sensor surface	Properties
Synthetic	For standard applications. Not suitable for abrasive materials. Good sliding characteristics.
Ceramic (Standard) (replaceable)	Extremely hard. Possesses a very high resistance against abrasion. Cracks may form due to hitting stones or metallic objects.
Special rubber (replaceable)	Wear resistant rubber with good protective properties against abrasions. No risk of cracks.
Teflon (replaceable)	Normally used in food processing technology and for sticky materials.

5. Temperature sensor for the material

Optionally, on request, a material temperature monitoring sensor PT100 (four conductor system) can be mounted on the casing. This is located centrally behind the measuring surface of the sensor. For probes containing the temperature sensor the connecting cable is of 8-pole shielded design.

For slow moving materials (e.g. in a Silo), where the temperature is normally below 30°C, an external temperature measuring feeler (e.g. Werne & Thiel type TS10) should be used for exact measurements. Measurements using the integrated temperature sensors is not advisable because the measured value might deviate slightly due to the internal heating of the probe from dissipations of the electronic circuitry.

When the temperature of the material is above 35°C (95°F), the integrated temperature sensor PT100 can be used safely.

6. Mounting instructions

Positioning of the sensor is of decisive importance for obtaining optimum measurement results!

FIG. E 1

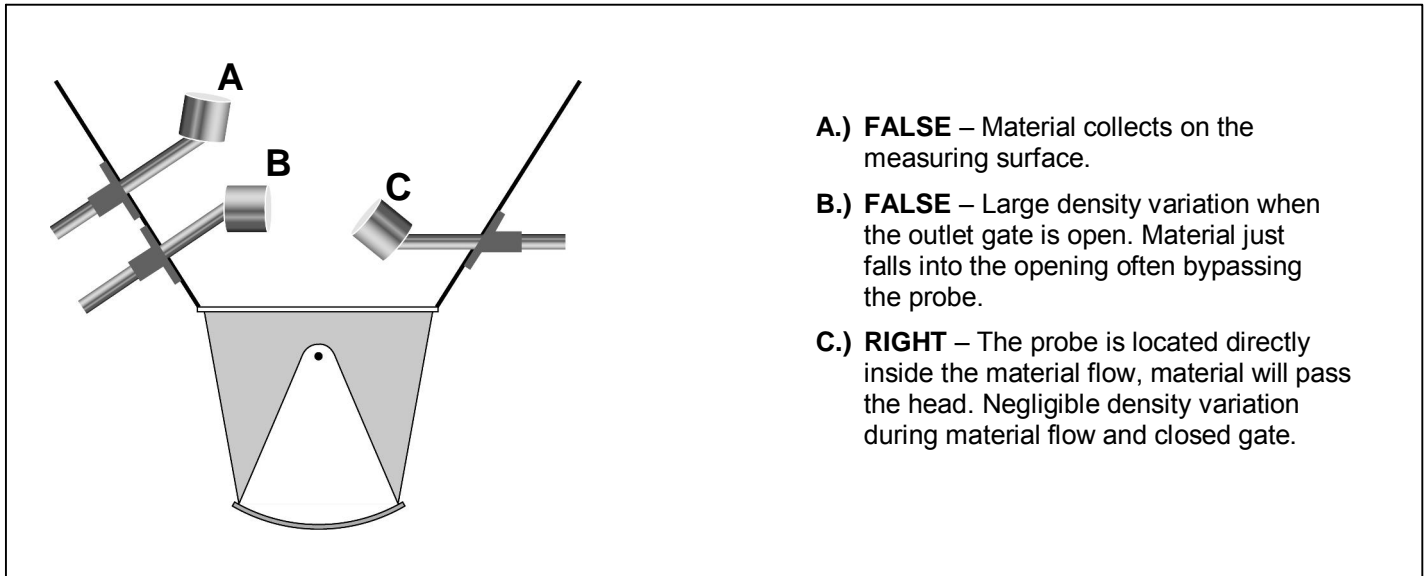


FIG. E 2

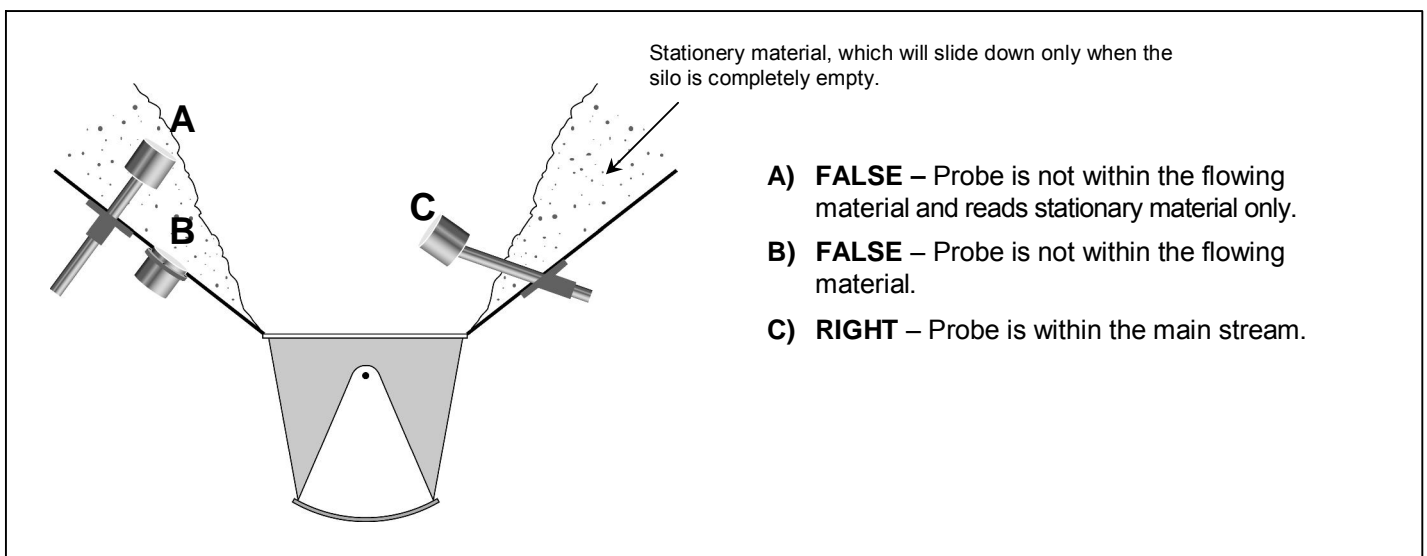


FIG. E 3

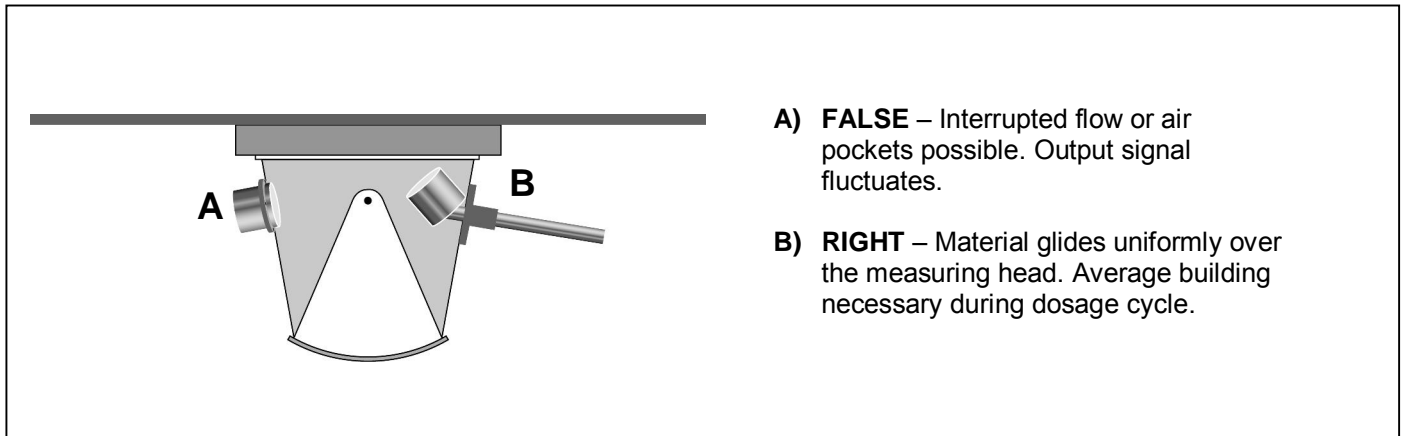
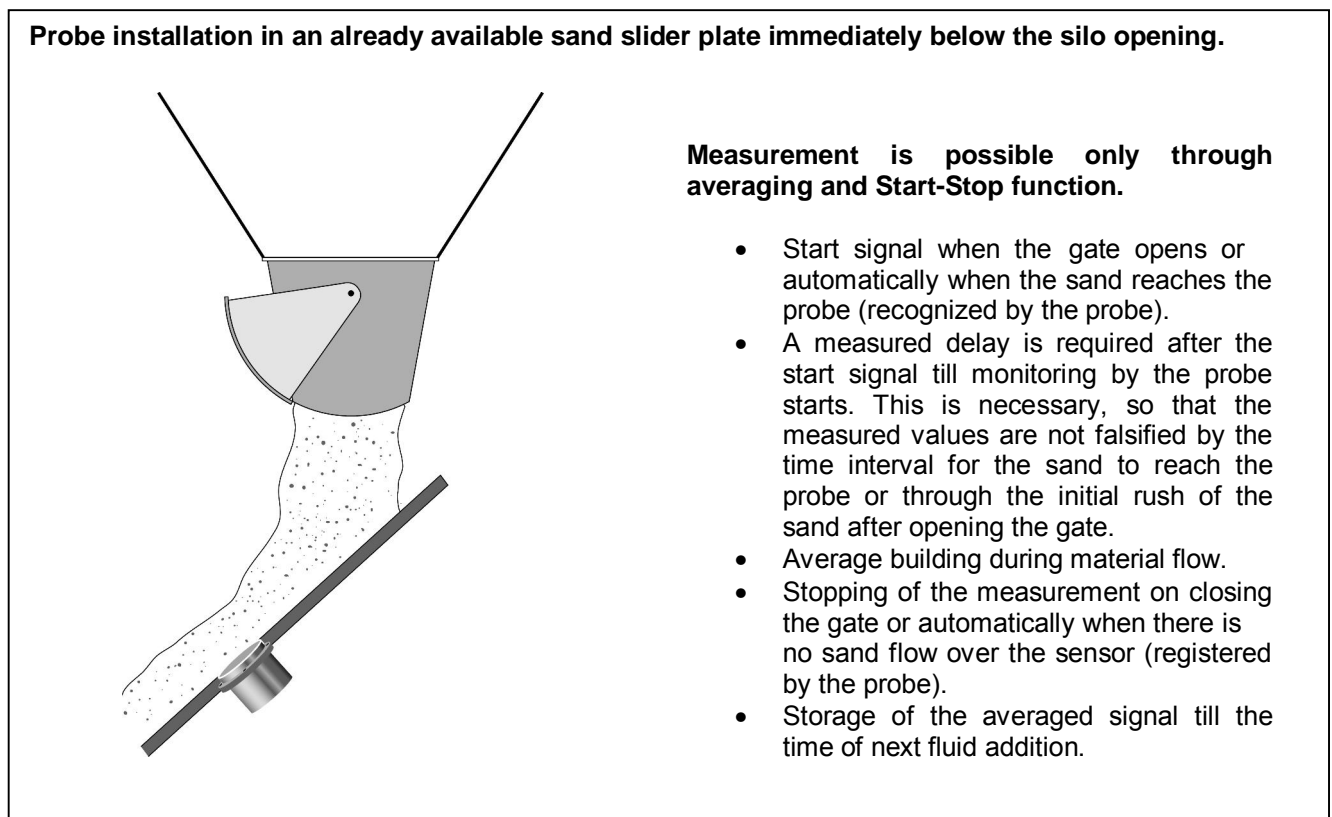
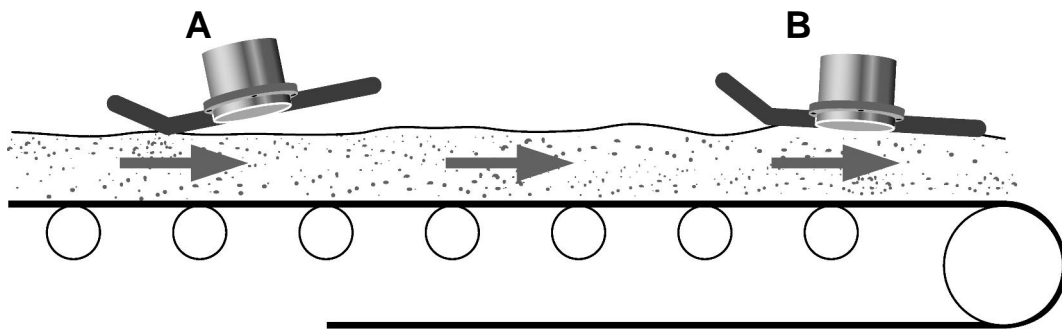


FIG. E 4



Measurements on a conveyer belt using gliders.

FIG. E 5



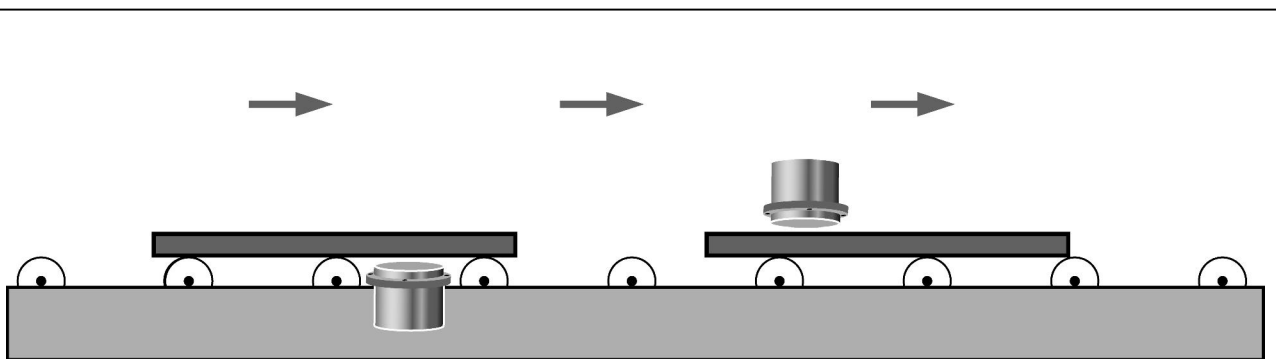
A: WRONG Air gap and varying surface contact falsify the measured signal.

B: CORRECT Uniform contact of the measuring surface with the material – negligible air gap.
 Ideal gliding angle of the glider should be between 5° – 15° (depending on the material)

IMPORTANT: Measurement is inaccurate when the surface height keeps varying for material thickness of 6 – 10 cm (depending on Material). In this case it is necessary to mechanically smoothen the surface e.g. with a leveling edge to obtain a uniform thickness of material. Surface height variations can be neglected provided the thickness of the material is more than 10cm.

Measurement of plates and slabs (gypsum, wood etc.) moving on roller conveyers.

FIG. E 6



Measurements through an air gap of 1-5mm possible.

Important: The air-gap **must** remain constant. A slight change in the gap height means a changed measuring signal.

Mounting Instructions (General)

Mounting Arm: (see Fig. E1 – E3)

- The sensor head is mounted at an angle of 45° to an arm. It is thus possible to adjust the angle of the sensor surface to the material flow direction in a continuously variable manner.
- The measuring surface of the sensor should make an angle of 35° to 50° to the direction of flow of the material. A marking at the rear end of the arm indicates the inclination of the measuring surface of the probe.
- The standard mounting plate is at an angle of 90° to the arm. Alternatively a 60°/30° mounting bracket is also available.
- The arm mounted probe is also available with the external adjustment potentiometers 0 and %. The measuring range of the probe can be adjusted to suit the different types of materials (normally the probe, as delivered, is calibrated for sand).
- The sensor head should be situated in the material approx. 600mm (2 feet) above the exit opening.
- To simplify the mechanical work for the mounting holes and the opening for the arm probe, paper templates are also supplied.

Installation in a sand silo

- The arm mounted probe can be installed in a silo already filled with sand as the sand does not flow out through the mounting hole (if the sand is not dry). It is, however, necessary to hollow out the sand as required before inserting the probe.
- **Tip:** Insert a tube with a smooth surface through the mounting hole and remove the excess sand.

Mounting instructions for installing the glider

See Fig. E 5

- The sensor surface of the probe FSV must be in line with the outer surface of the glider.
- The surface of the glider with the probe mounted, should make an angle of 5 -15° against the direction of flow of the material. (depends on the material)
- The adjusted angle should remain more or less constant even when the depth of the flowing material changes. The holding brackets for the glider should be correspondingly long or appropriately designed.

It is possible to coat the glider together with the probe with Teflon direct from the works. This is recommended only for sticky but non-abrasive materials.

Mounting instructions for the mixer probe FSM

- The probe must be positioned in such a way that always some material is present on or in front of the measuring surface of the sensor while the mixer is in motion.
- For pan type mixers it is recommended to mount the probe in the mixing floor. For horizontal, shaft mixers the probe should be mounted on the side wall.
- Possible peaks in the signal due to the mixer shovel passing by can be eliminated by limit settings and average building functions of the evaluating electronics.

Mounting instructions for the high temperature probe FSH

- The general procedure is similar to those for the types FSV, FS1.

ATTENTION:

- **Only the front part of the probe where the actual measuring surface is located can withstand a temperature of max.190°C (374°F). The rear part of the probe unit containing the electronic should not be exposed to temperatures above 80°C (176°F).**

ATTENTION

- **When carrying out welding work on the facility the probes must be fully disconnected electrically.**
- **While positioning the probes inside silos, attention must be paid to avoid heating the probe above 80°C by external heating units.**

7. Calibration of the probe

General

The calibration of the Werne & Thiel moisture measuring probes are effected by means of two potentiometer controls „0“ and „%“.

The controller labeled "0" is for adjusting the offset value.

The controller labeled "%" is for adjusting the amplification or slope of the calibration curve.

The probes can be delivered with built-in 0 and % adjustment potentiometers. For measurements with sands these adjustment potentiometers are not necessary because the probes are pre-calibrated for sand at the Werne & Thiel facility.

For use with other materials it is very much recommended to obtain probes with these adjustment potentiometers.

There are no standard calibration adjustments for all materials, and also no absolute moisture measurements are possible. The calibration of the moisture measuring sensors is specific to a material for a given range. One must make certain that the sensor signal voltage is within the permitted range of 0-10V (or. within the 0/4-20mA range).

To ensure this, it is necessary to have two samples of the material for calibration purpose: One with the minimum possible amount of moisture in the material and the other with the maximum possible amount of moisture in the material.

The signal voltage is to be measured directly at the output terminals of the probe (for current outputs, the current is to be measured in series at the output terminals).

For the Werne & Thiel moisture signal processor FMP the moisture curve 0 can be selected. The displayed value in percent (%) then corresponds to the probe output voltage of 0-10V.

In case the probe is not calibrated for the 0 and % values, a following processor (plc) electronic can no longer correct it, especially if the probe signal has already entered the saturation region.

Preparations for the calibration

The moisture measuring probes are calibrated with previously prepared samples of the moisture containing material. The moisture values should lie within the desired range of measurement. One sample should be in the lower part of the scale and the other in the upper part of the desired range.

For preparing the samples one should have at least 1-2 liters of the moisture containing material per sample ready. Metal containers must not be used. Likewise no metallic support or underlay is allowed. The material height should be at least 10cm (4"). This height should be the same in all sample containers.

Please note:

In case of very moist samples there is a tendency for the water to settle down in the bottom part of the container. Likewise, evaporation from the surface may change the moisture content of the upper part of the material sample.

For these reasons the samples should be well stirred and mixed prior to every calibration test.

When not being used, the containers should be kept well covered or sealed. These should also not be placed under direct sun light.

Principle of the calibration

A minimum of two moisture containing material samples are necessary. One should be in the lower part of the target range, and the other in the upper part.

The "0"-adjustment potentiometer is always for setting the calibration point for the relatively dry range (Offset).

The "%"-adjustment potentiometer is always for setting the calibration point for the relatively wet range (Amplification).

By alternately placing the probe in the dry and moist samples, the calibration curve is adjusted for the 0-10V range. The "0"-potentiometer shifts the calibration curve up or down, whereas the "%"-potentiometer is used for adjusting the slope of the calibration curve.

First the scale range = measurement range is fixed e.g. 0-10%.
The maximum possible signal range is 0-10V (0-20mA).

For the above example:

$10\% \triangleq 10V$ (or $10\% \triangleq 20mA$ for current outputs).

This gives us $1\% = 1V$.

When, for example, two samples with moisture contents from 1% and 7.5% are available:
The following measurement signals should be set to:

Sample 1: $1\% = 1V$ (1mA for 0-20mA or 5mA for 4-20mA probes)

Sample 2: $7.5\% = 1V \times 7.5 = 7.5V$ (15mA for 0/4-20mA probes)

For this purpose the probe is applied to the sample material and turned in with a slight pressure. The sensor surface should be cleaned when changing from wet sample to dry sample or vice versa.

IMPORTANT:

This applies only for materials where the probe signal varies linearly with the moisture content (e.g. sand). For non-linear signals multiple samples with well defined moisture values are required. With the help of integrated potentiometers within the probe (optional) merely the measurement window for the probe is fixed. A following electronic processing unit (e.g. Werne & Thiel moisture measurement processor FMP) or a programmable logic controller with a stored calibration curve is then used to determine the actual measured values and display these.

8. Calibration for the moist sand:

General

Switch on the probe approx. 30 min. before calibration (stable operating temperature).

The calibration of the probe is done in two steps:

- Static calibration
- Dynamic calibration

The reason for the two steps is because of the dependency of the results on density variation of the material, and also due to the influence on the high frequency field of the sensor from the installation. Attention must be paid to maintain a relatively constant density of the material on the measuring surface.

Static calibration

Under static calibration we understand measurements done outside of the sand silos, where the samples of the moist materials are placed in plastic buckets.

Sample extraction

Wet sample:

For calibrations with sand a sample of approx. 5-10 liter (2-3 gal) of the material is collected through the dosing opening. The container should be kept covered during the calibration adjustments in order to prevent the moisture content of the material from changing.

Dry sample:

The same amount of sand from the same source is collected, and then dried so that the moisture content goes down to a value of < 0.5%. This sample should also be stored in a cool place and kept covered. The dry sand must have cooled down before the calibration measurements.

Tip:

As the preparation of the dry sample takes more time, this procedure can be initiated at an earlier stage.

Determination of the moisture content of the samples

Before starting the static calibrations the moisture content of the sample is determined in the laboratory. The moisture content of the dried sand can be calculated according the well known formula:

$$\text{Moisture content} = ((\text{Moist weight} - \text{Dry weight}) / \text{Dry weight}) \times 100\%$$

Carrying out the static calibration

The sand in the plastic bucket is first loosened somewhat at the top and distributed evenly.

Static calibration with dry sand:

The probe is first placed on the top surface of the sample and then pushed in with a light twisting motion of the hand. A light pressure is applied on the probe with the hand during this procedure. The probe is then released from the hands without lifting out or moving it.

Adjustments for the dry sand sample:

The 0-potentiometer is then varied till the laboratory value is shown. Note the indicated moisture content on the measuring instrument during this procedure.

Static calibration for the wet sand:

The probe is placed on the sample, and as before is pushed into the sample.

Adjustments for the wet sand sample:

The %-potentiometer is then varied till the laboratory value is shown. Note the indicated moisture content on the measuring instrument during this procedure.

Further checks of the calibrated values

The calibration procedure should then be repeated with eventual minor adjustments of the 0 and % potentiometers. The indication of the moisture contents on the measuring instrument for dry and wet sands should now be correct.

Attention:

The measuring surface of the probe must be in full contact with the material. Care should be taken to avoid inadvertent motions (e.g. any axial movements), which might cause uneven contacts or air gaps at the measuring surface.

Important

- Always clean the sensor surface when moving from wet sand to dry sand.
- Sample material should be frequently stirred – moisture tends to settle down at the bottom, thus leaving the upper surface drier.

Dynamic calibration at the sand silo

General:

The dynamic calibration is necessary because it is not possible to vary the moisture content at will once inside the silo. The earlier static calibration enables one to obtain only an approximation to the calibration curve and fix the zero point. The dynamic calibration primarily corrects the slope of the calibration curve so that the correspondence of the actual moisture values and the indicated values are more or less in agreement.

Procedure for dynamic adjustments

The probe is now mounted in the silo and switched on. Moist sand is then allowed to flow across the probe, and the indicated moisture content is noted. At the same time a sample of the sand is collected, and as before, the moisture content is determined in the laboratory using the drying method. If there is a difference between the measured and the indicated value, then this should be corrected by using the % potentiometer.

Important: Error in measurement during laboratory tests (due to drying etc.).

As it is possible for the moisture values in the samples for the laboratory measurements to vary due to the inhomogeneity of the source sand, the calibration curve should only be minimally corrected for the slope. The required precision of the measurement is reached only after repeated dynamic calibrations, possibly with sands with different moisture contents.

Additional remarks

The zero point is usually set only once, and normally no further corrections are necessary.

During the operational phase, usually the slope of the curve varies due to density variations. That is why it is only necessary to correct the slope with the % potentiometer as necessitated by the varying conditions.

9. Type designation

FSX -X -X - X -X -X

Type	Option model	Remarks
U	Voltage output 0-10 V	
I	Current output 0-20 mA	
I4	Current output 4-20 mA	Standard
UT	Voltage output 0-10V, Material Temperature Sensor PT100 integrated	
IT	Current output 0-20mA, Material Temperature Sensor PT100 integrated	
I4T	Current output 4-20mA, Material Temperature Sensor PT100 integrated	
X	Synthetic material measuring surface	
K	Measuring surface with ceramic overlay against abrasion	Standard
TF	Measuring surface with Teflon overlay	
G	Measuring surface with rubber overlay	
X	Without built in calibration potentiometers	Standard
T	Integrated 0 and % calibration potentiometers	
TE	0- and % calibration potentiometers mounted in an external trimmer box (trimmers external)	
G50	Temperature up to 50°C	Standard
G80	Temperature up to 80°C	
G190	Sensor head temperature up to 190°C (Only for high temperature probe FSH)	only with Ceramic
15	Supply for ± 15V DC	
30	Supply for 9-32V DC	Standard
18H	Export equipment for non EU-countries Compatible with probe type 18V.	not for FSK, FSH, FSM
1	Disc probe basic type with fixed flange	
V	Adjustable probe 50mm adjustment range (without mounting clamping ring)	
A	Arm mounted probe for containers (Arm lengths 0.2m, 0.5m or 1m with bracket)	
M	Mixer probe (Extremely abrasion resistant) With integrated 0 and % Pots, 10 mm ceramic. (without brackets and without abrasion resistant tubing)	
H	High temperature probe Sensor head can withstand 190°C max.(without mounting ring)	only with Ceramic

Example: **FSV-30-G80-T-K-I**

Adjustable probe FSV for DC Supply 9-32V, temperature range up to 80°C, with integrated 0 and %-Adjustment potentiometers, Integrated ceramic abrasion protection on measuring head, with current output 0-20 mA.

10. Technical Data

Probe supply

Type FS (x) standard

+/-15 V probes:

Current input:

+/-15 V (Tolerance +/-0,5 V)

30 mA (at +15 V for voltage output of 0-10 V)

30 mA (at -15 V for voltage output of 0-10 V)

50 mA (at +15 V for current output 0-20 mA)

30 mA (at -15 V for current output 0-20 mA)

9-32 V Probes:

Current input:

9V-32V DC

165 mA for 10 V supply

125 mA for 15 V supply

70 mA for 24 V supply

58 mA for 30 V supply

(for current output 24mA)

Signal output

Option:

Output load resistance:

0-10 V

100 kohm

Standard:

Load resistance:

4-20 mA (0-20mA optional)

500 Ohm 0.1%, TK = 25 ppm

Maximum Signal Values

Voltage output:

Current output 0-20 mA:

Current output 4-20 mA:

-0,7 V to app. 12V (RL = 100 k Ohm)

-1.4 mA to app. 24 mA (Load = 500 Ohm)

+4 mA to app. 24mA (Load = 500 Ohm)

Protection against:

Overvoltage, reverse polarity and short-circuit of the output.

All inputs and outputs are protected against disturbances with suppression filters.

Material-Temperature sensor: PT100 optional

Alternatively semiconductor sensors with voltage outputs are possible

Measurement range and internal calibration of probe

0 and % adjusting trimmer to calibrate the probe (optional)

These allow you to adjust the measuring window of the probe to the desired range of moisture measurements for the material.

Accessible only through a water tight screw on the probe cover.

Abrasion Protection of Sensor:

Standard:

Ceramic:

Special rubber:

Teflon:

Ceramic.

3 mm thick, extremely good resistance to abrasion but brittle

3 mm thick impact resistant rubber, useful for gravel up to 10mm (3/8")

for sticky materials and for use in the food industry

Probe Type FSM supplied only with ceramic surface overlay, 10 mm thick

Probe Type FSH supplied only with ceramic surface overlay, 3 mm thick

Depth of insertion of the sensor edge

FS1:

FS1:

FSV, FSH:

FSA:

FSM:

9 mm (synthetic material protection overlay)

11 mm with Ceramic (standard), Rubber or Teflon overlay

continuously adjustable from 0 mm to app. 50 mm

length can be vary over a wide range (arm lengths 0.2m, 0.5m or 1m)

adjustable at the welded flange

Environmental conditions:

Operational: +0.5 °C (32.9°F) to +50°C (122°F) (Temperature range G50, Standard)
+0.5 °C (32.9°F) to +80°C (122°F) (Temperature range G80, optional)
Probe type FSH: +0.5°C (32.9°F) to +190 °C (374°F) at measuring surface,
permissible environmental temperature max 80 °C (176°F)

Storage: -25 °C (-13°F) to +65 °C (149°F)

Connection to the probe

Connecting cable 5 x 0.22 mm² shielded
all types of probes Cable is assembled with metallic terminal sleeves. Plug is optional.

Protection level for the probes:

FSV, FSA, FSM, FSH: IP 68
FS1: IP 50

Mounting possibilities

FS1: „Disk probe“ - with a fixed flange with three holes
FSV, FSH: Stainless steel clamping ring. Can be adjusted
FSA: Holding bracket for the arm mounted probe. Extension of the arm can be adjusted. Massive and stable construction. Stainless steel.
FSM: Massive welding ring made of stainless steel. An 8mm thick stainless steel cylinder is mounted around the probe to give protection against abrasion. It is supported by the welding ring and can also be of hardened steel.

Conformance: Conforms to CE standard EMV89/336EWG

11. Protection against damage by lightning

Sometimes, especially in open air installations, the probe can be damaged by lightning. In addition to reducing the risk by observing the guide lines laid down in the standard, VDE 185, Parts 1 and 2, it is necessary to equalize the potential between the probe and the processing electronic unit. This is achieved by grounding the cable shielding at both ends.

12. Connector pinouts

As a general rule:

Standard probes have a 5 pole probe plug.

Probes with built-in PT100 or external trimmer box have an 8 pole probe plug.

Probes with built-in PT100 and external trimmer box have a 12 pole probe plug.

12.1 M12 probe plug pinouts

All probes are fabricated with a M12 (M=metric) probe plug directly connected to the probe casing. (Exception: The FS1 probe (disk probe) is fabricated with an fixed probe cable.)

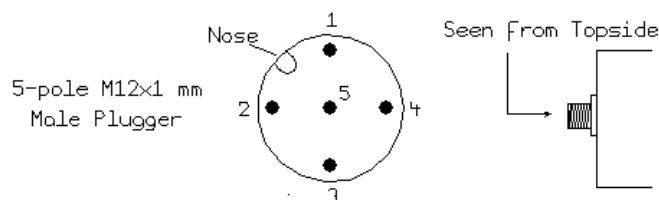
The probe cable (4m long) and the corresponding M12 coupling plug are supplied with the probe.

This plugable probe cable has permanently fitted metal sleeves at the terminal ends.

12.1.1 5-pole probe plug pinout



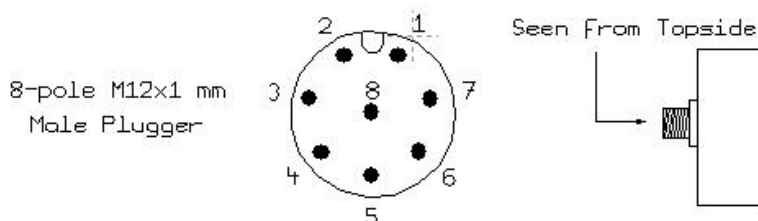
FSV-backside with male socket, protection cap and protection cap for the sensor adjustment.



Pin No.	Werne & Thiel Colours	Standard M12 Cable Colours	Wiring
1	white	brown	+9-30V DC (+15V)
2	brown	white	(-15V)
3	green	blue	Signal Output
4	yellow	black	Not Connected
5	grey	grey (yellow/green)	Ground

For Sensors with power supply 9-30V DC or Sensors For +/-15V DC power supply

12.1.2 8-pole probe plug pinout



Pin No.	Werne & Thiel Colours	Other Cable Type Colours	Wiring with ext. \emptyset and %-Trimmers	Wiring with PT100 - Sensor
1	white	grey	+9-30V DC (+15V)	+9-30V DC (+15V)
2	brown	white	(-15V)	(-15V)
3	green	black	Signal Output	Signal Output
4	yellow	blue	Not Connected	PT100 (2-2)
5	grey	brown	Ground	Ground
6	pink	violet	%-Trimmer Pin 1	PT100 (1-1)
7	blue	orange	\emptyset + %-Trimmer Pins 2	PT100 (2-1)
8	red	pink	\emptyset -Trimmer Pin 3	PT100 (1-2)

For Sensors with power supply 9-30V DC or Sensors For +/-15V DC power supply

12.2 External trimmer box

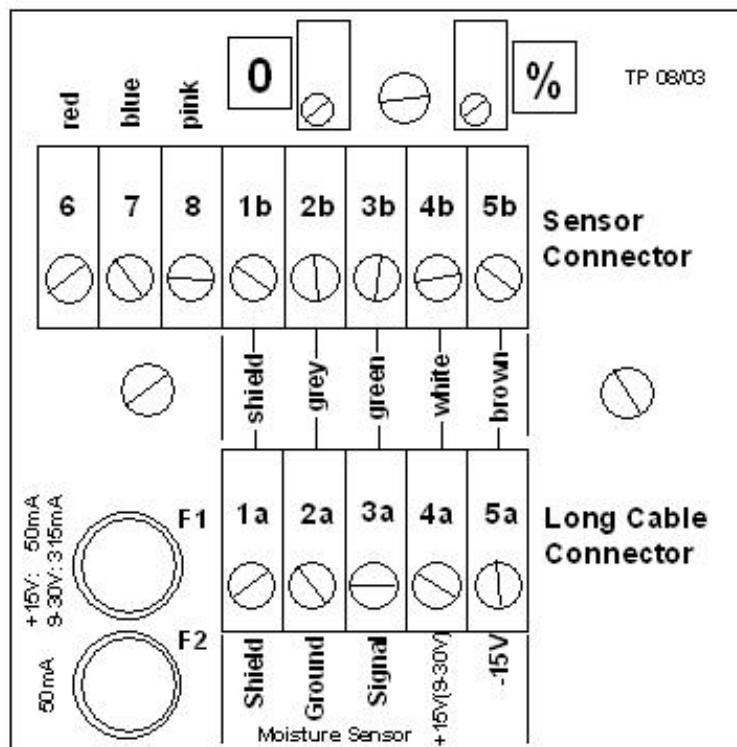
The optionally available external trimmer box allows the remote calibration of probes over a 4m long cable. This remote calibration is especially useful, if the probe isn't directly accesible like with the arm mounted probe (tpe FSA).

The FS1 and FSA probe (arm mounted probe) is fabricated without internal trimmers. If necessary the calibration can only be done with an external trimmer box.

The FSV, FSM and FSH probes, on the other hand, can have the optional calibration trimmers also built-in.

The trimmer box is shipped with the probe cable already assembled.

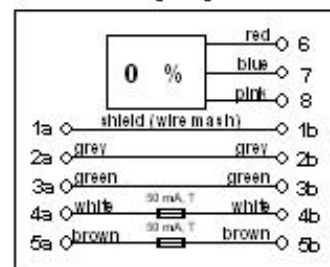
12.2.1 External trimmer box connector pinout for probes powered by +/-15V DC



Sensor connector:

Pin	Connection	colour
1b	Shield	black(wire mash)
2b	Ground	grey
3b	Sensor signal	green
4b	+15V	white
5b	-15V	brown
6	external adjustment	red
7	external adjustment	blue
8	external adjustment	pink

Wiring diagram

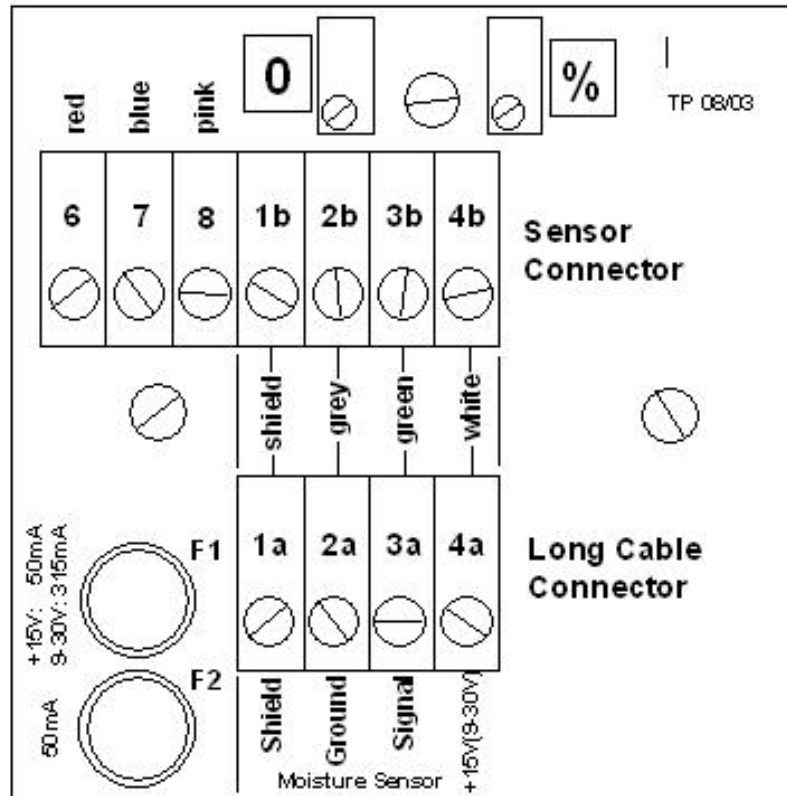


Long cable connection:

Pin	Connection	colour
1a	Shield	black(wire mash)
2a	Ground	grey
3a	Sensor signal	green
4a	+15V	white
5a	-15V	brown

All terminals are pluggable

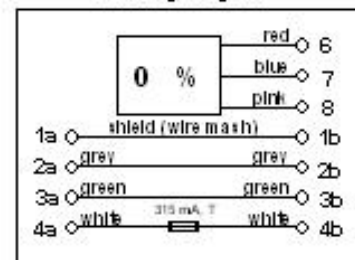
12.2.2 External trimmer box connector pinout for probes powered by 9-32V DC



Sensor connector:

Pin	Connection	colour
1b	Shield	black(wire mesh)
2b	Ground	grey
3b	Sensor signal	green
4b	9-30V DC	white
6	external adjustment	red
7	external adjustment	blue
8	external adjustment	pink

Wiring diagram



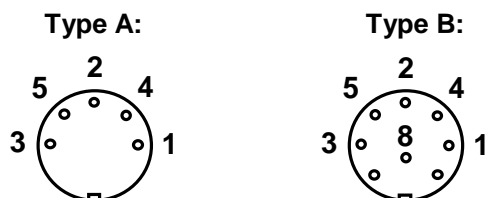
Long cable connection:

Pin	Connection	colour
1a	Shield	black(wire mesh)
2a	Ground	grey
3a	Sensor signal	green
4a	9-30V DC	white

All terminals are pluggable

12.3 Connector pinout for probes with plugs at the end of cables (not referring to the latest probes)

Connector plug viewed from front (pin side view)



Probes with +/-15 V supplies:	
Pin no. (Type A)	Strand color
1 Temperature	yellow
2 Supply -15V	brown
3 Supply +15V	white
4 Ground	gray
5 Signal output	green
Cable shield	--

Probes with +/-15 V supplies and with PT100:	
Pin no. (Type B)	Strand color
1 PT100 (1-1)	violet
2 Supply -15V	brown
3 Supply +15V	white
4 Ground	black
5 Signal output	green
6 PT100 (1-2)	red
7 PT100 (2-1)	blue
8 PT100 (2-2)	yellow
Cable shield	--

Probes with 9-32 V supplies:	
Pin no. (Type A)	Strand color
3 Supply 9-32 V	white
4 Ground	gray
5 Signal output	green
Cable shield	--

Probes with 9-32 V supplies and with PT100:	
Pin no. (Type B)	Strand color
1 PT100 (1-1)	violet
2 not used	
3 Supply 9-32V	white
4 Ground	black
5 Signal output	green
6 PT100 (1-2)	red
7 PT100 (2-1)	blue
8 PT100 (2-2)	yellow
Cable shield	--

13. Cabling

During the installation it is necessary to observe proper spatial separation between the lines which act as the sources of disturbance and those which are sensitive to pick-ups. All cables carrying measurement and electrical signals must be shielded and properly earthed according to the regulations. Please see also article 11 above regarding protection against lightnings. Minimum distance to power carrying cables should be approximately 0.5m, and the signal cables should not be laid parallel to power lines or any other line which might influence the measurements.

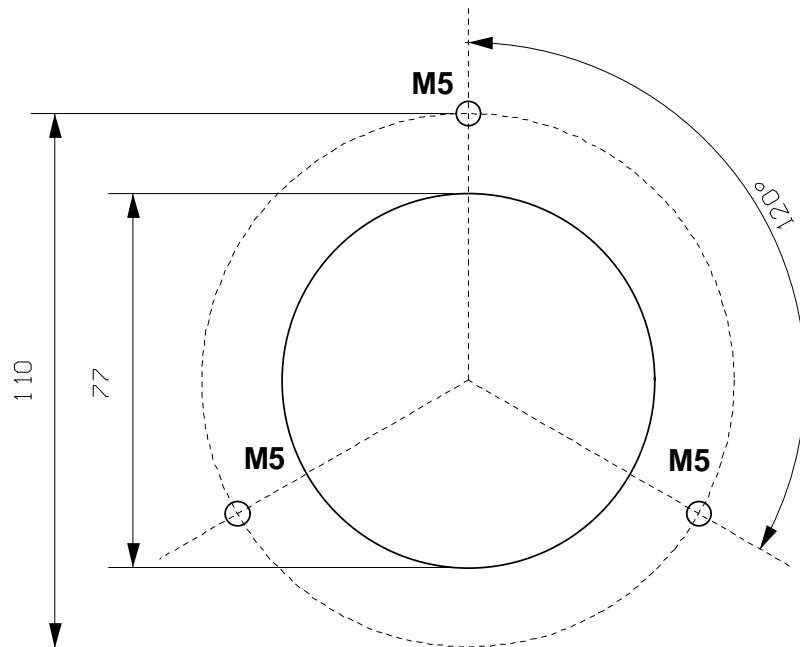
It is decidedly advantageous to lay the cables inside any available metallic channels or pipes of the already installed equipment instead of going for an open construction.

It is also possible to get disturbances coupled in via unwanted potential carrying fixtures. These can be overcome by observing potential decoupling measures like galvanic separation etc. Supply networks without any ground wires should be properly earthed according to the VDE regulations.

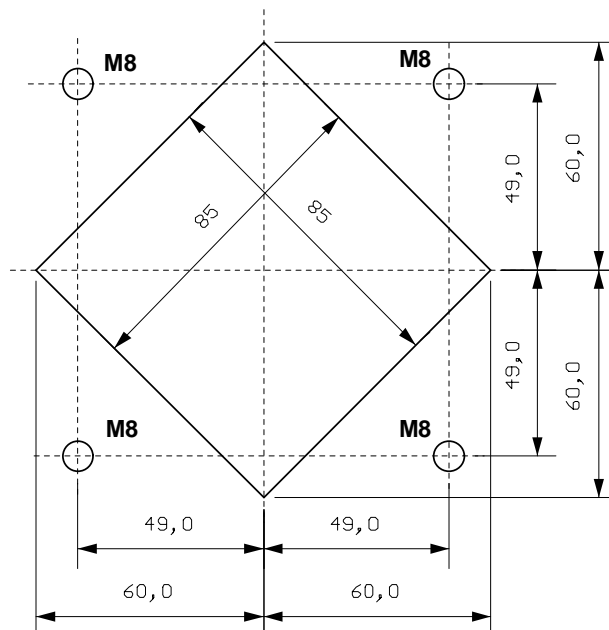
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14. Mounting dimensions

Adjustable probe FSV and high temperature probe FSH:

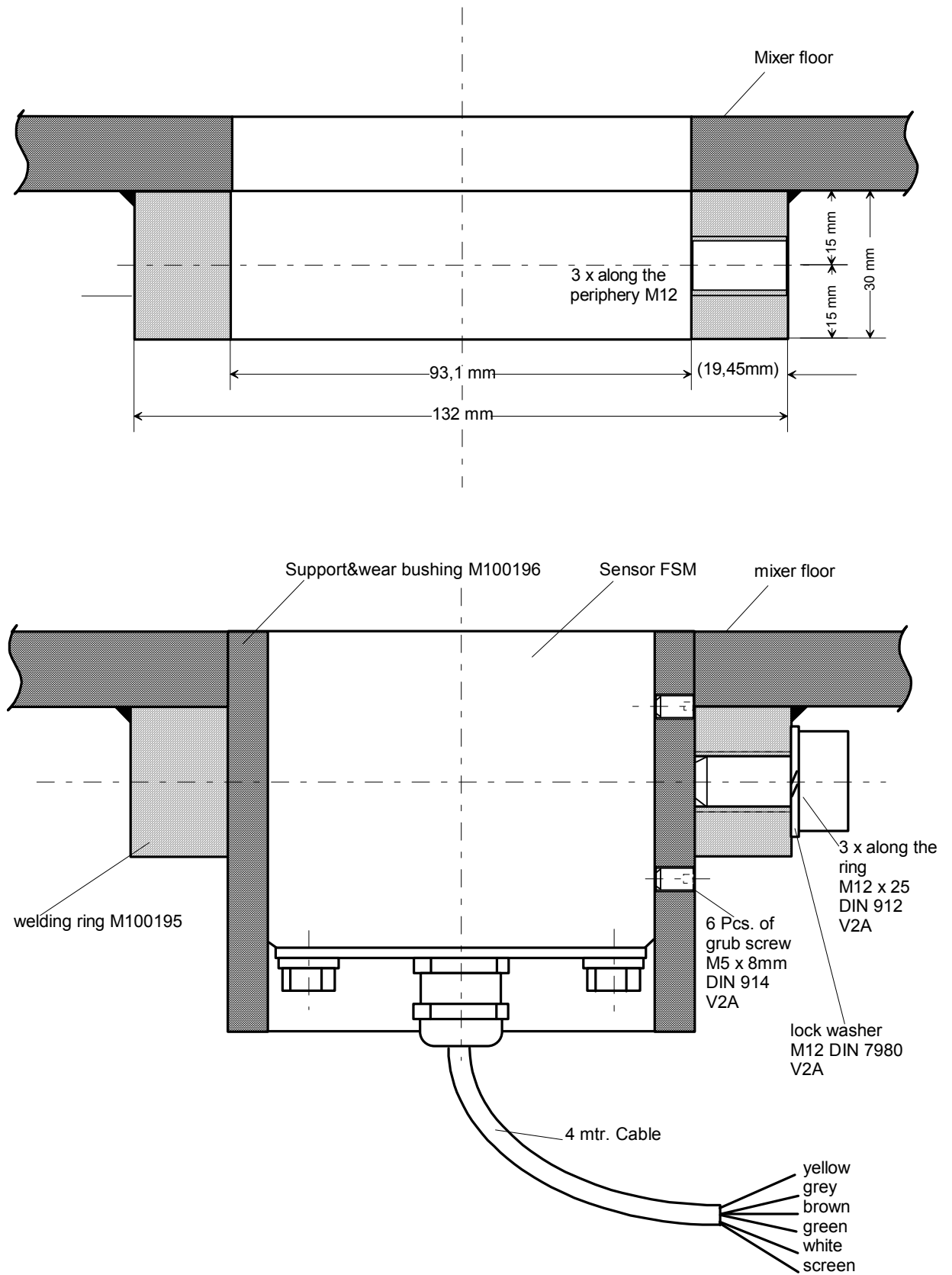


Arm mounted probe FSA:



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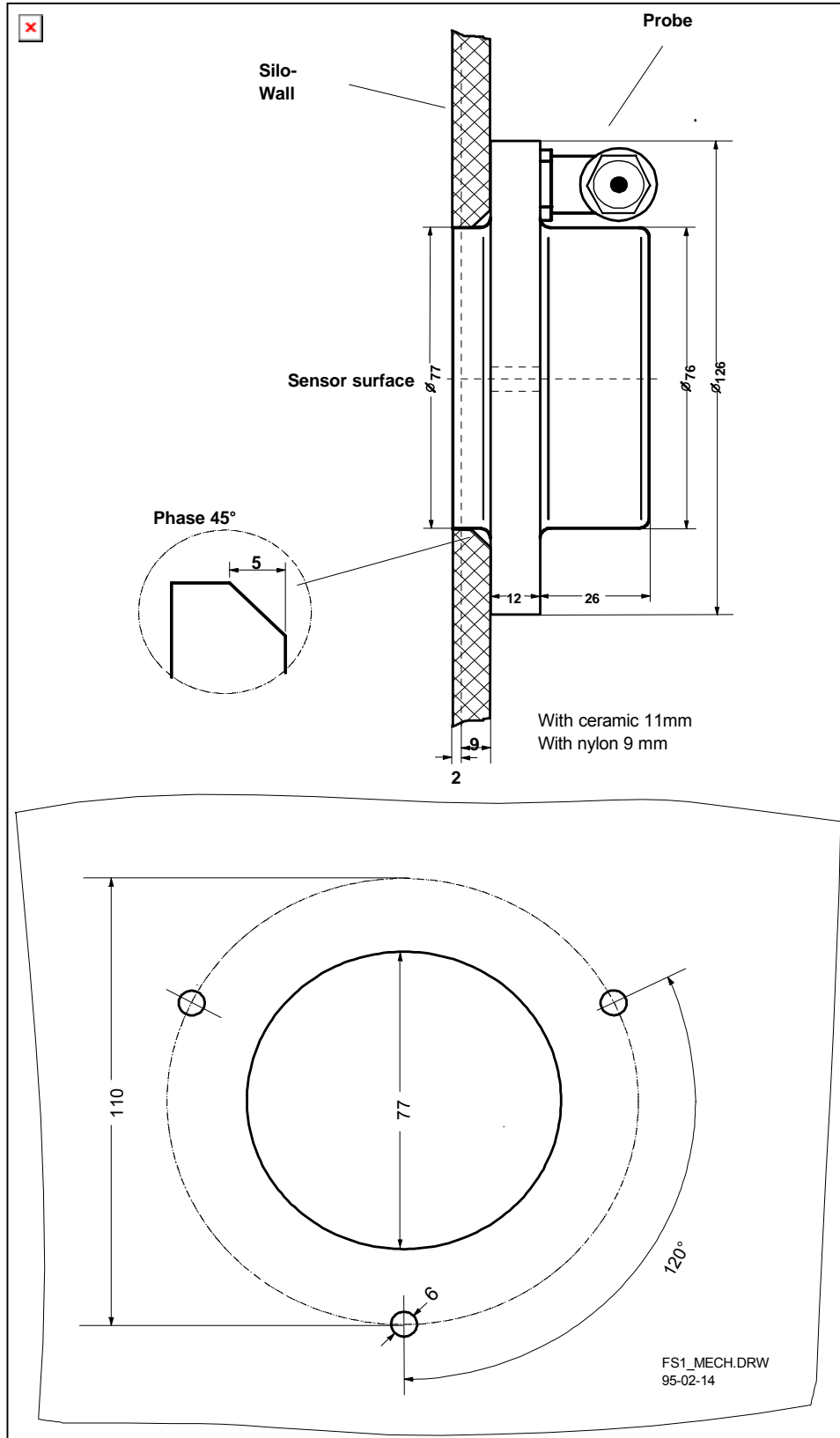
Mixer probe FSM:



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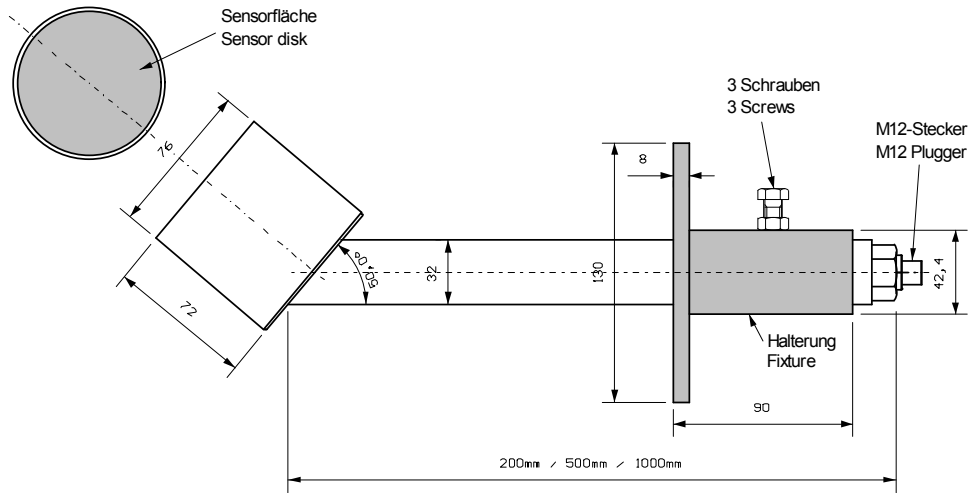
15. Mechanical dimensions

Probe FS1:

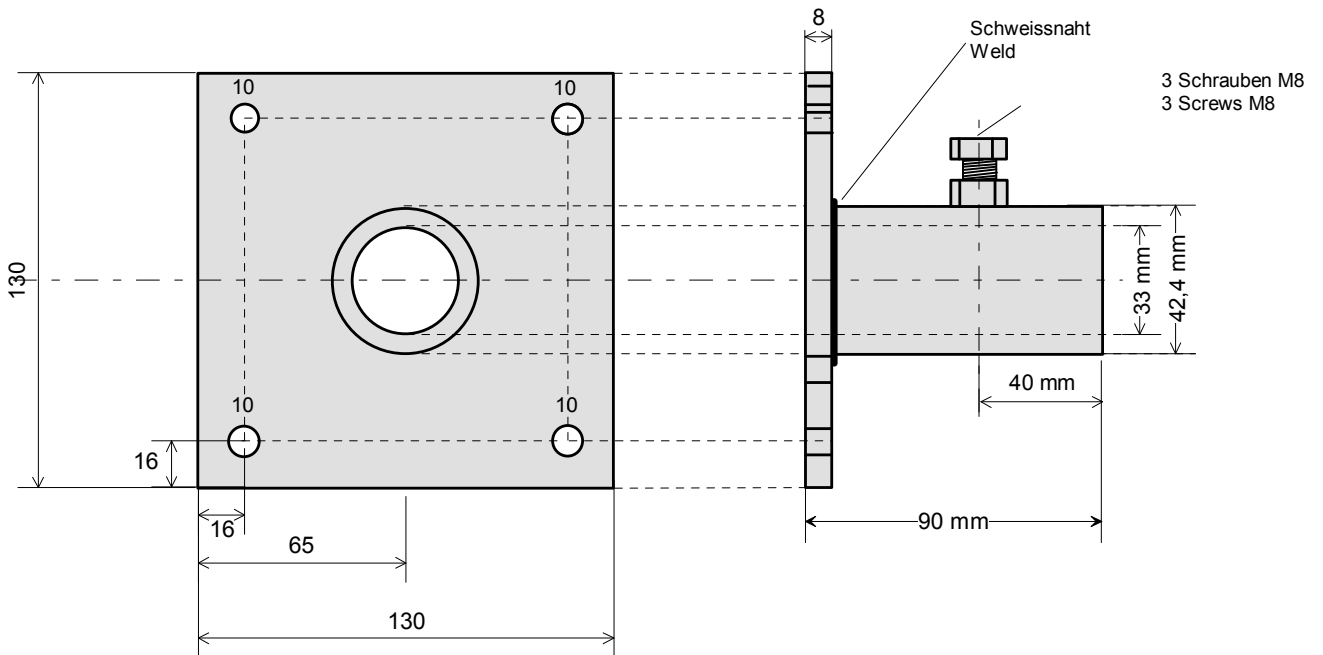


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Arm mounted probe FSA:

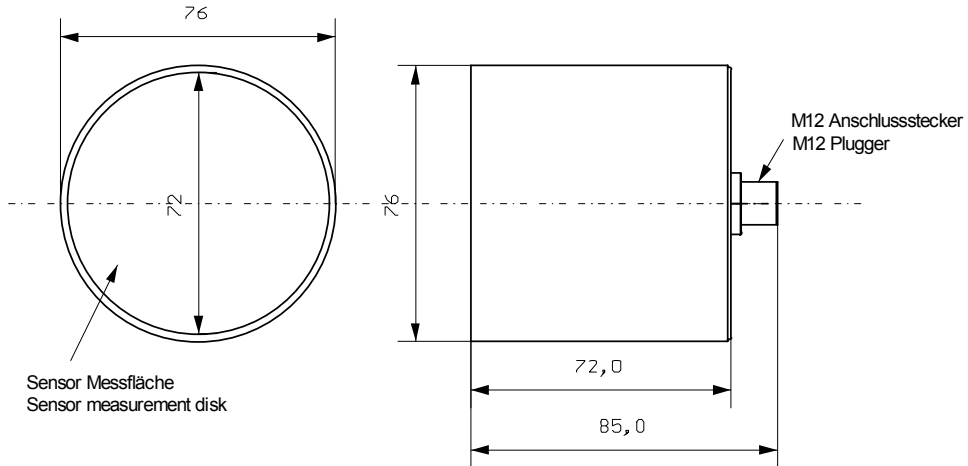


Fittings for the probe FSA:

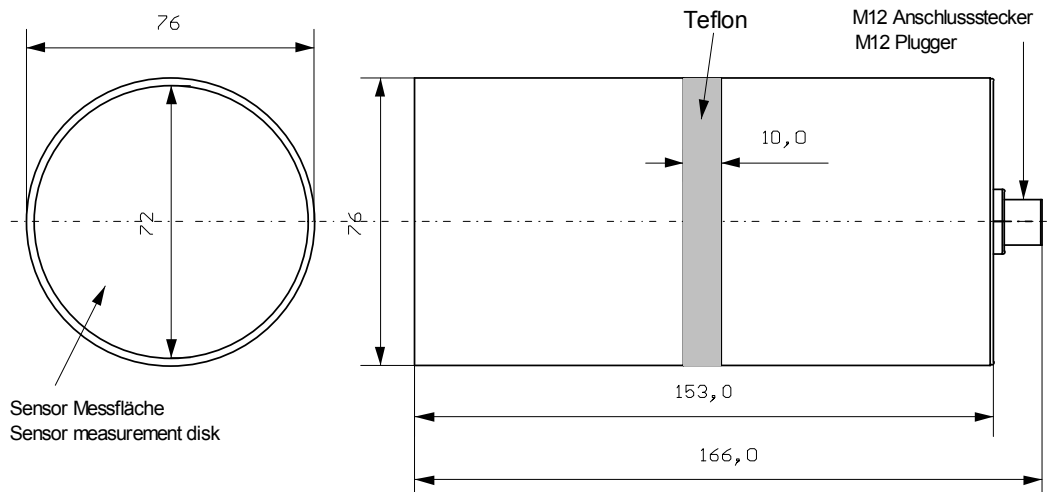


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Adjustable ring probe FSV:



High temperature sensor FSH-G190-T-K (max. head temperature 190°C)



16. Accessories

See also the possible model variations under article 9 – type designations.

- Clamping ring for probes FSV, FSH
- Welding ring for mixer probe FSM
- Strengthening tube for mixer probe FSM
- Calibrating disk for output signal 0 V (0% Sand)
- Calibrating disk for output signal 4 V (8% Sand)
- Calibrating disk for material specific adjustments
- Extension cable (with coupling/plug). Length to be specified by customer
- Plug / Coupling single (IP68)
- Stainless steel gliders for probes. Used for measurements on conveyer belts.

17. Notes