Metso Rotating Consistency Measurement

Installation & Owner's Manual K09157 V1.0 EN

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Warnings & Safety information

Always ensure that the incoming voltage and frequency are correct before making any electric connections. Wrong connection may damage the equipment! The applicable safety regulations must be closely followed in all installation work. All electric connections may only be made by appropriately trained and authorized persons!

Before any welding works in the vicinity of the devices, make sure that operating voltage is not connected!

The samplers contain moving parts. Be careful when testing the sampler! Do not push your fingers between any moving parts!

Removing the device covers exposes moving parts - danger of crushing or cutting injury!

Before installing any mounting parts, make sure that the process pipe is empty and depressurized!

During installation, maintenance and service operations, remember that the sample line may contain hot sample or water - be careful!

Recycling and disposal

When sorted by material, nearly all parts of the device can be recycled. A materials list is delivered with the device. Upon request, the manufacturer will provide more detailed instructions for recycling and disposal. The device may also be returned to the manufacturer for recycling and disposal against a separate fee.

1. Introduction

1.1. Metso Rotating Consistency Transmitter

Metso Rotating Consistency Transmitter is a rotating shear force consistency transmitter. The sensor part consists of a shaft pair driven by an electric motor. The shafts are concentrically aligned and flexibly connected together so that the inner (measuring) shaft is allowed to have a phase shift with respect to the outer (drive) shaft.

A mixing propeller, mounted on the drive shaft, draws a continuous sample from the main process line past the sensing element that is mounted on the measuring shaft. Shear force from the pulp suspension strives to retard the rotation of the measuring shaft and the sensing element, while the drive shaft is not subjected to the shear force. Thus there will be a phase shift between the measuring shaft and the drive shaft.

Both shafts have separate cogwheels so that the phase shift can be measured by means of an optical measurement system. The measured signal is converted in the transmitter electronics into a digital signal and compensated for internal and external temperature variations, rotation variations and various compensations. The signal is then converted into a 4 - 20 mA output signal with a superimposed digital HART®.

Fig. 1. Metso Rotating Consistency Transmitter, MD model sensor and TCU.

1.2. Acceptance inspection

After unpacking the delivery, make sure that it corresponds to the order. Also check all devices for possible transport damage.

Contents of delivery, MD model:
- transmitter, MD model, sensing element and material according to order
- TCU operating unit, MD model with selected communication
- sensor cable
- motor controller cable
- mounting set
- device manual and calibration quick guide
- possible options: process coupling set, mounting chamber

Contents of delivery, BD model:
- transmitter, BD model, sensing element and material according to order
- TCU operating unit, BD model with selected communication
- sensor cable
- mounting set
- device manual and calibration quick guide
- possible options: process coupling set, mounting chamber

Fig. 2. Metso Rotating Consistency Transmitter, BD model sensor and TCU.

1.3. Conformity to CE directives and CSA approval

The entire system, consisting of a TCU with power supply, a transmitter, and the connecting cables (see chapter 4. TCU installation and cabling), has been designed to meet the CE directives and their associated standards as stated in the CE Declaration of Conformity document delivered with the device.

In order to meet the EMC directives, the following precautions must be taken:

1. All wiring must be shielded. Power supply electronics: shielded, coverage ≥ 80 %. Interface cable: coverage 100 % aluminum.
2. All units must be tested as a complete system to conform with the relevant CE directives and their standards.

When the units are used in other combinations, Metso cannot guarantee their CE directive conformity. In combination with customer-installed external devices, the units may conform to EMC and safety requirements when properly installed and using an adequate CE marked equipment.

NOTE: System operator is responsible for the CE directive conformity. Conformity must be checked by inspection.

- Be careful when handling the equipment around vessels containing pressurized/hot materials.
- Take necessary safety precautions when mounting the equipment by using appropriate lift gear, platforms and tools.
- The motor and TCU are powered by hazardous voltages.

The TCU box is CSA approved. The transmitter motor can be ordered as CSA approved.

1.4. Materials

All the materials used in the exposed surfaces of the system are selected and manufactured for use in pulp and paper industry environments. The system cable is sheathed in PVC. The transmitter housing is made of cast aluminum painted with epoxy-poly urethane paint.

Materials used in the wetted parts of the transmitter, i.e. the transmitter itself, its mounting chamber (if used) and process coupling, must be selected according to the process conditions. Alternatives: stainless steel AISI316L or 254 SMO®.

1.5. Transmitter Central Unit (TCU)

TCU is the user interface, power supply and calculation unit of the transmitter. Operations can be performed by using the keypad and four-line display. The TCU is attached to a protective cover which protects it from falling dirt, water, pulp etc.

The TCU has the following connectors:

- sensor cable, sensor electronics supply voltage and RS485 serial port connectors;
- 4 - 20 mA current output (passive) to DCS;
- digital communication using HART communication protocol;
- RS232 connection to a PC (for maintenance purposes);
- mains supply voltage;
- binary inputs for remote motor control and/or recipe selection.

NOTE: Make sure to use the correct TCU version with the device.

1.6. Basic transmitter dimensions

Weights etc. details are found in Technical specifications.

An additional room of at least 250 mm (10") must be left behind the transmitter to be able to extract the unit from the pulp line. Make sure to leave sufficient room around the transmitter to perform this task.

NOTE: Always ensure that the system can be inserted to its full depth in the selected location before you install the transmitter, TCU and necessary components.

Transmitter, MD (Motor Drive) model

Fig. 3 shows transmitter dimensions with the TH sensing element, permanent magnet motor and small flange. Pressure rating of the small flange is PN25.

Transmitter with TM sensing element, MD model

Fig. 4 shows transmitter dimensions with the TM sensing element, permanent magnet motor and large flange. The flange is available with two different pressure ratings, PN10 and PN25.

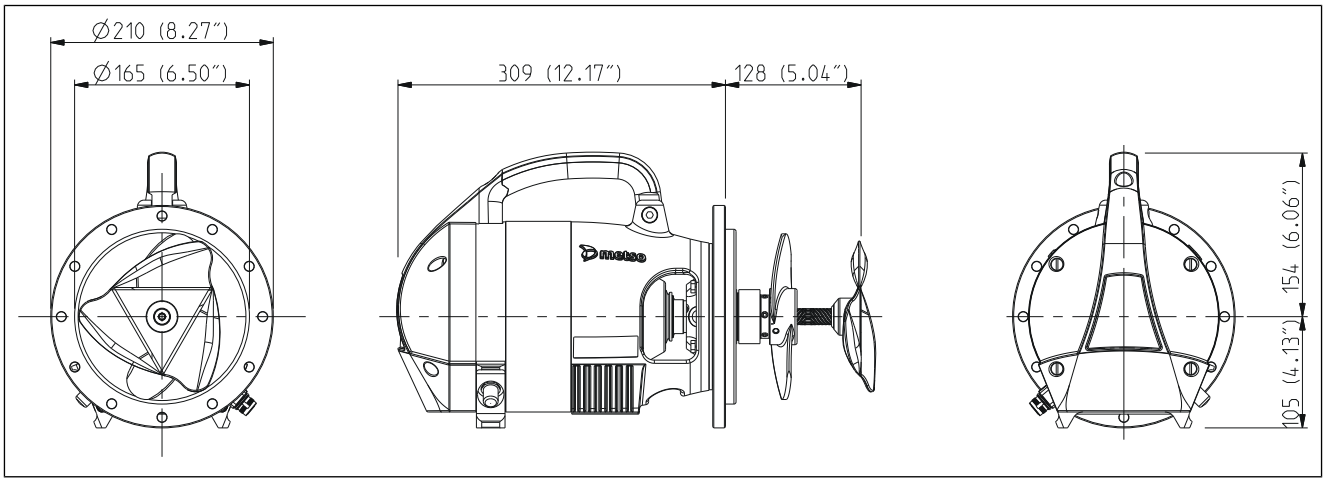


Fig. 3. The dimensions of the transmitter with TH sensing element and small flange, MD model.

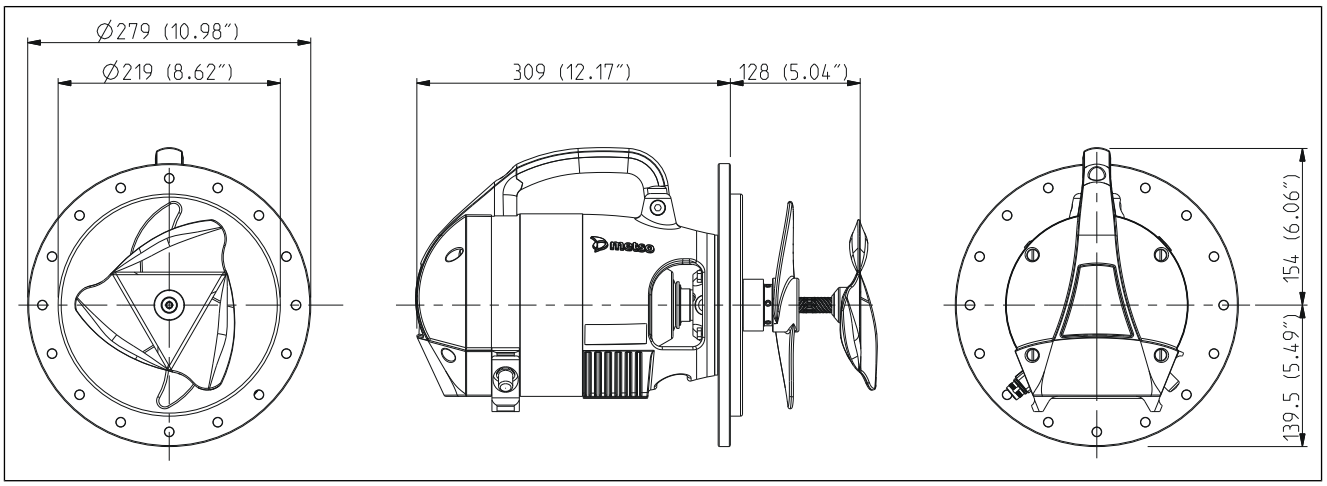


Fig. 4. The dimensions of the transmitter with TM sensing element and large flange, MD model.

Transmitter with TH sensing element, BD (Belt Drive) model

Fig. 5 shows transmitter dimensions with the TH sensing element, 3-phase asynchronous motor and small flange. Pressure rating of the small flange is PN25.

Transmitter with TM sensing element, BD model

Fig. 6 shows transmitter dimensions with TM sensing element, 3-phase asyncronous motor and large flange. The flange is available with two different pressure ratings, PN10 and PN25.

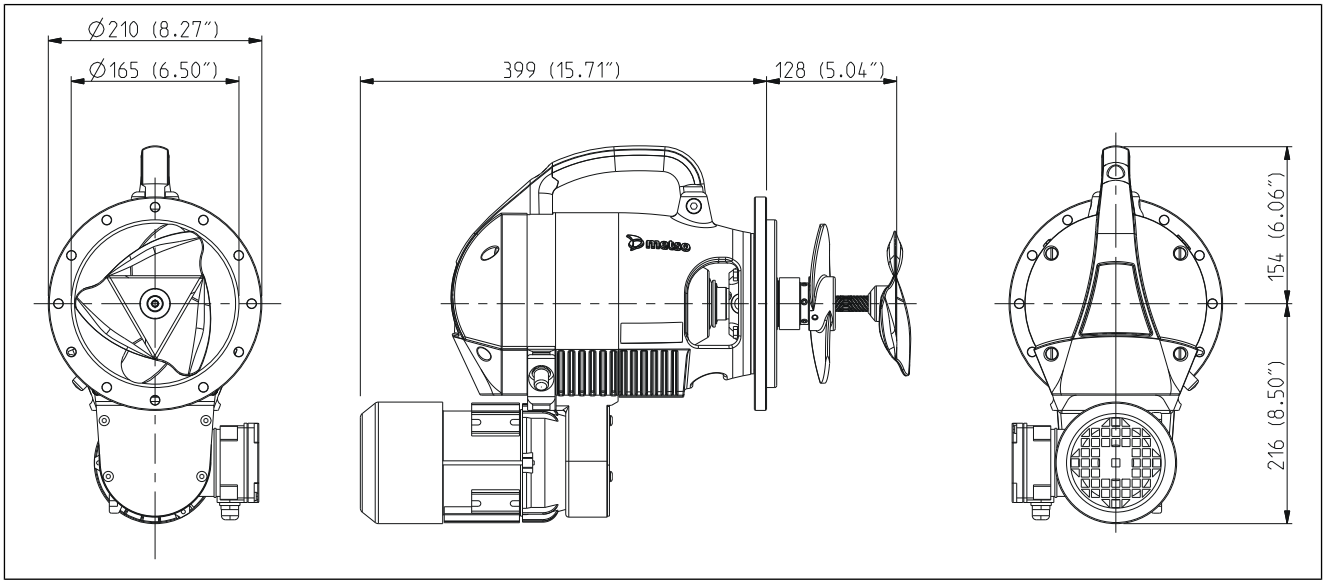


Fig. 5. The dimensions of the transmitter with TH sensing element and small flange, BD model.

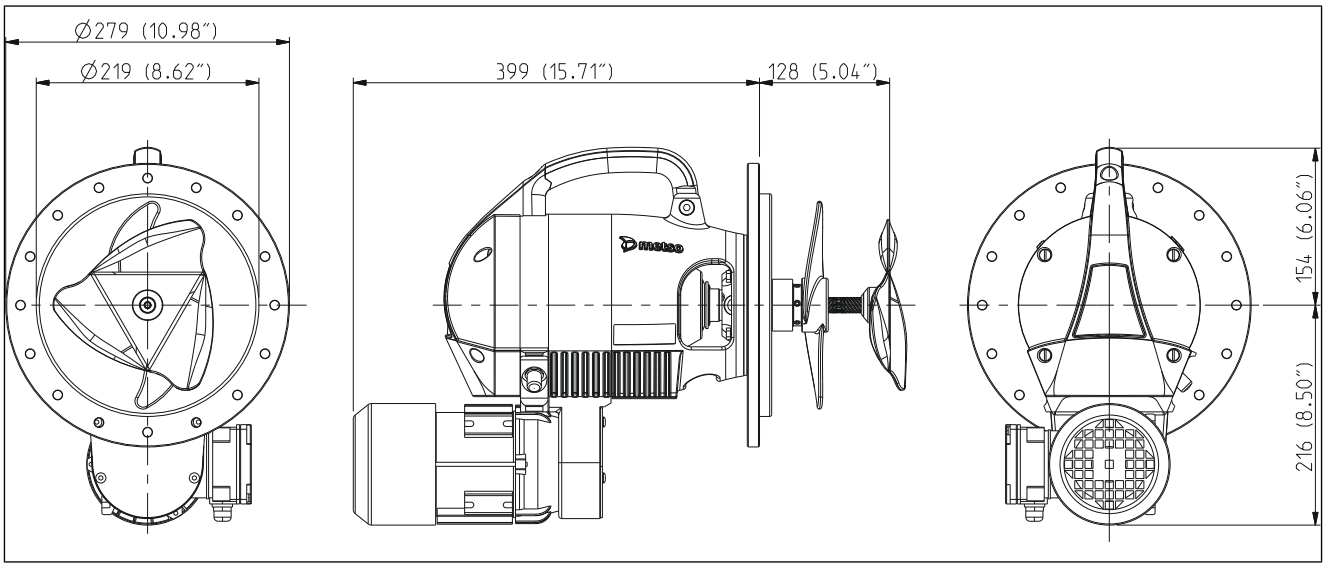


Fig. 6. The dimensions of the transmitter with TM sensing element and large flange, BD model.

2. Safety recommendations

These safety recommendations are based on a risk analysis carried out in accordance with the requirements of the machinery and low voltage directives in order to comply with European standards for CE marking. Read carefully all safety recommendations and instructions before installing any parts of the delivery.

2.1. About the device

An operating consistency transmitter poses a risk due to moving machine parts or hazardous voltages only when its covers have been removed for installation or service operations.

Be sure to follow precisely the instructions and recommendations when installing, connecting, or servicing the transmitter. These safety recommendations apply to a transmitter installed with an AC-powered TCU.

The mounting parts, e.g. mounting chamber and process coupling, have been manufactured by Metso in accordance with the EU Pressure Equipment Directive, PED.

NOTE: Always use only parts manufactured or approved by Metso Automation. Follow valid instructions and standards during installation.

2.2. Selecting transmitter model

The pressure rating of the transmitter and its mounting parts must be suited to the maximum pipe pressure and temperature at the installation site. Select the material of the transmitter and its mountings parts so as to minimize the risk of corrosion. See Technical specification for more detailed information.

2.3. Installing and connecting the transmitter

Welding or bolting and the subsequent inspection must take place in accordance with the valid standards and regulations.

For safety reasons, only use approved lifting equipment during installation. Fasten all parts well during installation. Dimension and weights, see Technical specification.

NOTE: Before installing any mounting parts, make sure that the pipe is empty and depressurized! Read the installation instructions in chapter 3 of this manual.

- Use approved lifting equipment during installation. Ensure that the transmitter is fastened properly. For transmitter dimensions and weight see Technical specification.
- If the transmitter is located high up, construct proper scaffolding.
- When the transmitter has been installed, make a pressure test using water in the pipeline. The test pressure must be adapted to the standards and regulations in each country.

The electric motor uses a hazardous voltage. Only a qualified electrician may connect the motor. Follow the instructions closely! Make sure to connect the motor earth correctly; double-check after connecting.

NOTE: High voltage motor! The connection must be made only by authorized personnel.

2.4. Installing the TCU

The TCU uses a hazardous voltage. Only a qualified electrician may connect the TCU. Make sure to connect the earth correctly, double-check after connecting.

NOTE: High voltage inside the TCU!

2.5. Starting up and servicing the transmitter

Before starting or servicing the transmitter, study carefully the instructions in chapters 1 and 3. Do not remove any covers before ensuring that the transmitter motor is switched off. When the safety covers on the motor drive belt wheel or on the measuring parts are removed, there is a risk of injury by crushing or cutting.

NOTE: Take all professional precautions before servicing.

NOTE: Moving the covers may cause the injury of crushing or cutting.

NOTE: Hot or corrosive liquids may flow out from the process pipe under pressure – risk of serious chemical burn injuries!

Before removing the transmitter from the process line, make sure that the line is empty and depressurized.

Be careful when opening the TCU cover. The unit contains live parts that may cause electric shocks. If the connections have been made correctly, the live parts are protected against normal contact.

Transmitters in corrosive applications should be removed regularly from the process line and their seals and other critical parts inspected carefully. If corrosion damage is observed on the transmitter or its mounting parts, ensure that correct material has been selected for the application.

NOTE: Leakage may cause personal injury or equipment damage due to corrosion or burning!

3. Transmitter installation

3.1. Before you begin

NOTE: Correct installation and regular maintenance according to the Installation, operating & service manual will ensure maximum use transmitter capacity.
NOTE: Never lift or rotate the unit from the sensing element.

The device is a precision instrument, designed and manufactured to provide accurate and reliable measurements throughout its lifetime. It must be installed correctly to ensure reliable operation. Please read the following instructions carefully prior to starting the installation work. This instruction manual contains installation instructions for the entire product line of Metso in-line rotating consistency transmitters.

NOTE: If you are in doubt about whether the model you plan to install is in all respects the same as the model in this manual, or if you have any questions about the installation, please contact your Metso sales engineer.

3.2. Important considerations

- Install the transmitter so that it is protected from direct mechanical damage. If the installation site is likely to be frequently sprayed by water or pulp, protect the device with a suitable enclosure.
- The TCU must always be kept attached to its shield (included in every delivery) to protect it from water or pulp splashes. If the TCU is installed outdoors, the shield will also protect it from direct sunlight and rain.
- Protect the transmitter from heavy vibration sources, e.g. cavitation or unbalanced pumps.
- Choose the installation site so as to ensure the required distance from pumps, pipe elbows, valves and other changes in the pipe profile.
- Pay attention to the type and material of the mounting chamber, weld-in process coupling, sensing element, propeller, etc. – these must be selected according to the requirements of each application to ensure PED conformity. Contact your Metso representative for further information.
- Always use only good quality sealing water as the flushing water for the mechanical seal. Make sure that the flushing/sealing water pressure is maintained at all times. See Fig. 13.
- The main power voltage & frequency must be within acceptable limits and be protected against transient disturbance sources, such as other equipment or electrical storms.
- Make sure that signal cables are located far away from the power cables.
- If the transmitter must be installed high up or in a place where it will be difficult to reach, a platform should be constructed to provide easy access during service and inspection. A platform is also a good solution for positioning the sampling valve.
- Install a Nove sampling valve close to the transmitter. This will ensure that the reference samples will be representative of the sample measured by the consistency transmitter.
- Reserve enough space for the transmitter casing; see chapter 1.6. Also pay attention to the limits given in Technical specifications.

3.3. Process pipe requirements at PN 10, PED

Pipe opening without additional reinforcement

The required process pipe wall thicknesses are shown in Table 1. The opening shall not be located on or close to a process pipe welding. No additional reinforcement is required.

Table 1. The required process pipe wall thicknesses without additional reinforcement. Values are calculated in 10 bar and 120 °C. Corrosion allowance 0.5 mm.

Material	1.4404 (AISI 316L)		1.4547 (254 SMO)	
Size	Req. wall[1]	Req. wall w/opening [2]	Req. wall[1]	Req. wall w/opening [2]
DN200	1.5	**1.5**	1.3	**1.3**
DN250	1.8	**1.8**	1.4	**1.4**
DN300	2.0	**2.0**	1.6	**1.6**
DN350	2.2	**2.2**	1.7	**1.7**
DN400	2.5	**2.5**	1.9	**1.9**
DN450	2.8	**2.8**	2.0	**2.0**
DN500	3.1	**3.1**	2.2	**2.2**
DN600	3.6	**3.6**	2.6	**2.6**
DN700	4.1	**4.1**	3.0	**3.0**
DN800	4.6	**4.6**	3.4	**3.4**

¹)Minimum required process pipe wall thickness without opening. ²)Minimum required process pipe wall thickness with process coupling opening Ø 188.

3.4. Process pipe requirements at PN 16, PED

Pipe opening without additional reinforcement

The required process pipe wall thicknesses are shown in Table 2. The opening shall not be located on or close to a process pipe welding.

Pipe opening with reinforcement pad

The required process pipe opening reinforcements are shown in Tables 3 and 4. EN 13445-3 prohibits the use of reinforcing pad when $D_{opening} > 0.5xD_{pipe\_iniside}$.

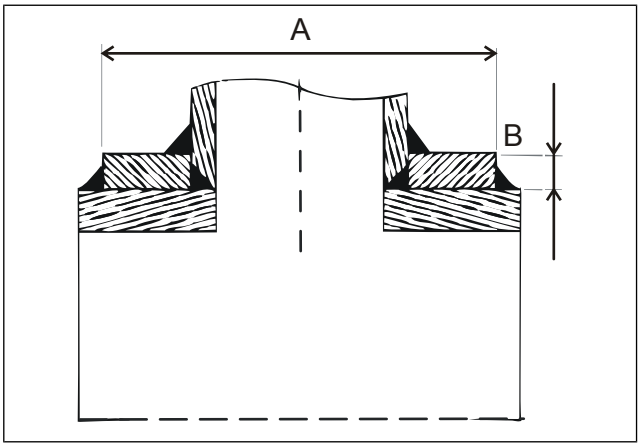


Fig. 1. Reinforcing pad for process pipe sizes DN400…DN800 (see Tables 3, 6).

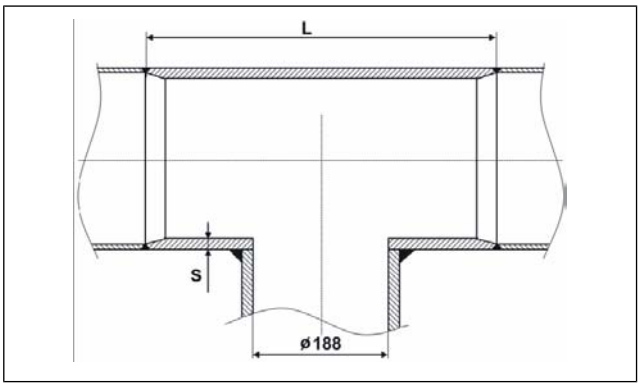


Fig. 2. Pipe replacement section for process pipe sizes DN200…DN800 (see Tables 4, 7).

Table 2. Required process pipe wall thickness without additional reinforcement. Values are calculated in 16 bar and 120 °C. Corrosion allowance 0.5 mm.

Material	1.4404		1.4547	
Size	Req. wall[1]	Req. wall w/opening [2]	Req. wall[1]	Req. wall w/opening [2]
DN200	2.0	**2.0**	1.6	**1.6**
DN250	2.4	**2.8**	1.8	**2.0**
DN300	2.7	**3.2**	2.1	**2.3**
DN350	3.0	**4.0**	2.2	**2.6**
DN400	3.4	**5.0**	2.5	**2.9**
DN450	3.7	**5.6**	2.7	**3.2**
DN500	4.1	**6.3**	3.0	**3.6**
DN600	4.9	**8.0**	3.5	**5.0**
DN700	5.6	**8.8**	4.0	**5.6**
DN800	6.3	**10.0**	4.6	**7.1**

[1])Minimum required process pipe wall thickness without opening. [2])Minimum required process pipe wall thickness with process coupling opening Ø 188.

Table 3. Required reinforcing pad dimensions (Fig. 1) when the required minimum wall thickness with opening (Table 2) is not fulfilled. Values are calculated in 16 bar and 120 °C. Corrosion allowance 0.5 mm.

Material	Size	DN200	DN250	DN300	DN350	DN400	DN450	DN500	DN600	DN700	DN800
1.4404	A [mm]	(1	(1	(1	(1	Ø 240	Ø 240	Ø 250	Ø 260	Ø 280	Ø 290
	B [mm]	(1	(1	(1	(1	3.0	3.0	3.0	4.0	4.0	4.0
1.4547	A [mm]	(1	(1	(1	(1	Ø 230	Ø 230	Ø 240	Ø 240	Ø 240	Ø 250
	B [mm]	(1	(1	(1	(1	3.0	3.0	3.0	3.0	3.0	4.0

[1]) EN 13445-3 denies the use of reinforcing pad when Dopening > 0.5xDpipe_iniside.

Table 4. Required pipe replacement section dimensions (Fig. 2) when the required minimum wall thickness with opening (Table 2) is not fulfilled. Values are calculated in 16 bar and 120 °C. Corrosion allowance 0.5 mm.

Material	Size	DN200	DN250	DN300	DN350	DN400	DN450	DN500	DN600	DN700	DN800
1.4404	L [mm]	245	260	265	275	280	290	300	320	340	360
	S [mm]	2.0	2.8	3.2	4.0	5.0	5.6	6.3	8.0	8.8	10.0
1.4547	L [mm]	240	250	255	260	270	280	285	300	320	330
	S [mm]	1.6	2.0	2.3	2.6	2.9	3.2	3.6	5.0	5.6	7.1

3.5. Process pipe requirements at PN25, PED

Pipe opening without additional reinforcement

The required process pipe wall thicknesses are shown in Table 5. The opening shall not be located on or close to a process pipe welding.

Pipe opening with reinforcement pad

The required process pipe opening reinforcements are shown in Tables 6 and 7. EN 13445-3 prohibits the use of reinforcing pad when $D_{opening} > 0.5xD_{pipe\_iniside}$.

Table 5. Required process pipe wall thickness without additional reinforcement. Values are calculated in 25 bar and 120 °C. Corrosion allowance 0.5 mm.

Material	**1.4404**		**1.4547**	
Size	**Req. wall**[1]	**Req. wall w/opening** [2]	**Req. wall**[1]	**Req. wall w/opening** [2]
DN200	3.0	**4.5**	2.2	**2.6**
DN250	3.7	**6.3**	2.6	**3.6**
DN300	4.2	**7.1**	3.0	**4.0**
DN350	4.6	**8.0**	3.3	**5.0**
DN400	5.1	**8.8**	3.7	**5.6**
DN450	5.7	**10.0**	4.1	**6.3**
DN500	6.3	**11.0**	4.5	**7.1**
DN600	7.3	**12.5**	5.4	**8.0**
DN700	8.4	**14.0**	6.1	**10.0**
DN800	9.5	**16.0**	6.9	**11.0**

¹)Minimum required process pipe wall thickness without opening. ²)Minimum required process pipe wall thickness with process coupling opening Ø 188.

Table 6. Required reinforcing pad dimensions (Fig. 1) when the required minimum wall thickness with opening (Table 5) is not fulfilled. Values are calculated in 25 bar and 120 °C. Corrosion allowance 0.5 mm.

Material	Size	DN200	DN250	DN300	DN350	DN400	DN450	DN500	DN600	DN700	DN800
1.4404	A [mm]	(1	(1	(1	(1	Ø 300	Ø 310	Ø 320	Ø 340	Ø 360	Ø 380
	B [mm]	(1	(1	(1	(1	4.0	4.0	5.0	5.0	6.0	8.0
1.4547	A [mm]	(1	(1	(1	(1	Ø 290	Ø 200	Ø 310	Ø 320	Ø 340	Ø 360
	B [mm]	(1	(1	(1	(1	3.0	3.0	4.0	4.0	4.0	5.0

¹) EN 13445-3 denies the use of reinforcing pad when Dopening > 0.5xDpipe_iniside.

Table 7. Required pipe replacement section dimensions (Fig. 2) when the required minimum wall thickness with opening (Table 6) is not fulfilled. Values are calculated in 25 bar and 120 °C. Corrosion allowance 0.5 mm.

Material	Size	DN200	DN250	DN300	DN350	DN400	DN450	DN500	DN600	DN700	DN800
1.4404	L [mm]	260	270	280	290	300	320	340	350	360	380
	S [mm]	4.5	6.3	7.1	8.0	8.8	10.0	11.0	12.5	14.2	16.0
1.4547	L [mm]	250	260	270	280	290	300	310	320	330	360
	S [mm]	2.6	3.6	4.0	5.0	5.6	6.3	7.1	8.0	10.0	11.0

3.6. Process pipe requirements at PN10, ASME

Pipe opening without additional reinforcement

The required process pipe wall thicknesses are shown in Table 8. The opening shall not be located on or close to a process pipe welding.

Pipe opening with reinforcement pad

Required reinforcing pad dimensions (see Fig. 3) when the required minimum wall thickness with opening (see Fig.) is not fulfilled. Values are calculated in 10 bar and 120 °C. Corrosion allowance 0.5 mm.

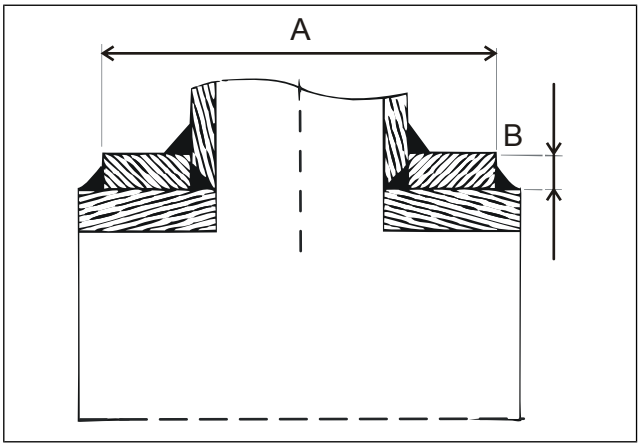


Fig. 3. Reinforcing pad for process pipe sizes DN400…DN800 (see Table 9).

Table 8. Required process pipe wall thickness without additional reinforcement. Values are calculated in 10 bar and 120 °C. Corrosion allowance 0.5 mm.

Material	SA-240 gr. 316L		SA-240 S31254 (SMO)	
Size	Req. wall[1]	Req. wall w/opening [2]	Req. wall[1]	Req. wall w/opening [2]
DN200	2.0	**3.6**	1.5	**2.6**
DN250	2.4	**4.6**	1.9	**3.2**
DN300	2.7	**4.5**	1.9	**3.2**
DN350	3.3	**5.6**	2.2	**4.0**
DN400	3.5	**6.3**	2.4	**4.0**
DN450	3.9	**6.3**	2.6	**4.5**
DN500	4.5	**8.0**	3.1	**5.0**
DN600	5.2	**8.8**	3.4	**5.6**
DN700	5.9	**10.0**	3.9	**6.3**
DN800	4.6	**4.6**	3.4	**3.4**

¹)Minimum required process pipe wall thickness without opening. ²)Minimum required process pipe wall thickness with process coupling opening Ø 188.

Table 9. Required reinforcing pad dimensions (Fig. 3) when the required minimum wall thickness with opening (Table 8) is not fulfilled. Values are calculated in 10 bar and 120 °C. Corrosion allowance 0.5 mm.

Material	Size	DN200	DN250	DN300	DN350	DN400	DN450	DN500	DN600	DN700	DN800
316L	A [mm]	Ø 260	Ø 265	Ø 270	Ø 270	Ø 270	Ø 280	Ø 290	Ø 300	Ø 310	Ø 320
	B [mm]	4.0	4.0	5.0	5.0	5.0	5.0	6.0	6.0	6.0	6.0
SMO	A [mm]	Ø 245	Ø 250	Ø 255	Ø 260	Ø 260	Ø 270	Ø 275	Ø 280	Ø 290	Ø 300
	B [mm]	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0

3.7. Process pipe requirements at PN16, ASME

Pipe opening without additional reinforcement

The required process pipe wall thicknesses are shown in Table 2. The opening shall not be located on or close to a process pipe welding.

Pipe opening with reinforcement pad

The required process pipe opening reinforcements are shown in Table 11. EN 13445-3 prohibits the use of reinforcing pad when $D_{opening} > 0.5xD_{pipe\_iniside}$.

Table 10. Required process pipe wall thickness without additional reinforcement. Values are calculated in 16 bar and 120 °C. Corrosion allowance 0.5 mm.

Material	SA-240 gr. 316L		SA-240 S31254 (SMO)	
Size	Req. wall[1]	Req. wall w/opening[2]	Req. wall[1]	Req. wall w/opening[2]
DN200	2.6	**5.0**	1.8	**3.6**
DN250	3.1	**6.3**	2.1	**4.0**
DN300	3.5	**7.1**	2.4	**4.5**
DN350	3.9	**8.0**	2.6	**5.0**
DN400	4.3	**8.8**	2.9	**5.6**
DN450	4.7	**8.8**	3.1	**6.0**
DN500	5.1	**10.0**	3.4	**6.0**
DN600	6.1	**12.0**	4.0	**8.0**
DN700	7.0	**14.2**	4.6	**8.8**
DN800	7.9	**16.0**	5.1	**10.0**

[1])Minimum required process pipe wall thickness without opening. [2])Minimum required process pipe wall thickness with process coupling opening Ø 188.

Table 11. Required reinforcing pad dimensions (Fig. 3) when the required minimum wall thickness with opening (Table 10) is not fulfilled. Values are calculated in 16 bar and 120 °C. Corrosion allowance 0.5 mm.

Material	Size	DN200	DN250	DN300	DN350	DN400	DN450	DN500	DN600	DN700	DN800
316L	A [mm]	Ø 260	Ø 250	Ø 300	Ø 350	Ø 400	Ø 450	Ø 500	Ø 600	Ø 700	Ø 800
	B [mm]	5.0	5.0	5.0	5.0	5.0	6.0	6.0	6.0	6.0	6.0
SMO	A [mm]	Ø 280	Ø 300	Ø 320	Ø 320	Ø 320	Ø 320	Ø 340	Ø 340	Ø 360	Ø 350
	B [mm]	4.0	4.0	4.0	4.0	4.0	4.0	4.0	5.0	5.0	6.0

3.8. Process pipe requirements at PN25, ASME

Pipe opening without additional reinforcement

The required process pipe wall thicknesses are shown in Table 13. The opening shall not be located on or close to a process pipe welding.

Pipe opening with reinforcement pad

The required process pipe opening reinforcements are shown in Table 12. EN 13445-3 prohibits the use of reinforcing pad when $D_{opening} > 0.5xD_{pipe\_iniside}$.

Table 12. Required process pipe wall thickness without additional reinforcement. Values are calculated in 25 bar and 120 °C. Corrosion allowance 0.5 mm.

Material	**1.4404**		**1.4547**	
Size	**Req. wall**[1]	**Req. wall w/opening** [2]	**Req. wall**[1]	**Req. wall w/opening** [2]
DN200	3.0	**4.5**	2.2	**2.6**
DN250	3.7	**6.3**	2.6	**3.6**
DN300	4.2	**7.1**	3.0	**4.0**
DN350	4.6	**8.0**	3.3	**5.0**
DN400	5.1	**8.8**	3.7	**5.6**
DN450	5.7	**10.0**	4.1	**6.3**
DN500	6.3	**11.0**	4.5	**7.1**
DN600	7.3	**12.5**	5.4	**8.0**
DN700	8.4	**14.0**	6.1	**10.0**
DN800	9.5	**16.0**	6.9	**11.0**

[1])Minimum required process pipe wall thickness without opening. [2])Minimum required process pipe wall thickness with process coupling opening Ø 188.

Table 13. Required reinforcing pad dimensions (Fig. 3) when the required minimum wall thickness with opening (Table 12) is not fulfilled. Values are calculated in 25 bar and 120 °C. Corrosion allowance 0.5 mm.

Material	Size	DN200	DN250	DN300	DN350	DN400	DN450	DN500	DN600	DN700	DN800
1.4404	A [mm]	(1	(1	(1	(1	Ø 300	Ø 310	Ø 320	Ø 340	Ø 360	Ø 380
	B [mm]	(1	(1	(1	(1	4.0	4.0	5.0	5.0	6.0	8.0
1.4547	A [mm]	(1	(1	(1	(1	Ø 290	Ø 200	Ø 310	Ø 320	Ø 340	Ø 360
	B [mm]	(1	(1	(1	(1	3.0	3.0	4.0	4.0	4.0	5.0

3.9. Selecting the installation position

Choosing the right place for the transmitter is essential for its optimum performance and ease of maintenance. The transmitter can be installed in a vertical, horizontal or inclined pipe. When installing in a horizontal or inclined pipe, make sure to choose a place where the transmitter will not measure large air bubbles trapped in the pulp.

Your Metso sales engineer will be pleased to assist in selecting the location that will give the best results consistent with your specific control strategy.

Pay attention to the following considerations:

1. To ensure minimum time lag, install the transmitter as close as possible to the dilution water injection point.
2. Recommended minimum distances, see Fig. 5 and 6.
3. Avoid proximity to pipe bends or elbows, as these will cause turbulence and dewatering. When the transmitter is positioned downstream from a pump or a pipe elbow, the optimum place is at the theoretical outer turn of the pulp stream. If the optimum position cannot be chosen, for example due to space limitations, consult a Metso sales engineer.
4. If the transmitter will be installed so high up that it will be difficult to reach, build a platform for easier access during service and inspection.
5. Choose a location with sufficient room around the transmitter for insertion and removal and for opening the covers. Also make sure that the transmitter can be inserted and removed without problems. See chapter 1.6 and the Technical specification for the dimensions of the different transmitter models.
6. Install the transmitter so that it is protected from direct mechanical damage. If the place is such that it is likely to be frequently sprayed by water or pulp, protect it with a suitable enclosure.
7. Protect the transmitter from heavy vibration such as cavitation or unbalanced pumps. One possible method is to install rubber bellows to the line.

3.10. Transmitter position on process pipe

The process coupling can be used at pipe diameter 200 mm or larger. For smaller pipes use a measuring chamber. Install the transmitter at the outer turn (Fig. 4, position A), after a pipe bend or pump outlet. Side position, B, could also be ok, but avoid position C.

Calming distance

To ensure a good measurement conditions a certain calming distance is required. The calculation for different consistency levels and pipe positions:

- At Cs < 8 % and vertical pipe run:
  V1 = 3 * pipe diameter or min. 1 m, V2 = V1 * 0,5.
- At Cs < 8 % and horizontal pipe run:
  H1 = 4,5 * pipe diameter, H2 = H1 * 0,5.
- At Cs > 8 % and vertical pipe run:
  V1 = 1,5 * pipe diameter or min. 0,5 m, V2 = V1.
- At Cs > 8 % and horizontal pipe run:
  H1 = 2,25 * pipe diameter or min. 0,75 m,
  V2 = 1,5 * pipe diameter or min. 0,5 m.

In case of installation in an inclined pipe position use the calming distance given for horizontal pipes. All lengths are calculated in the table in Fig. 5.

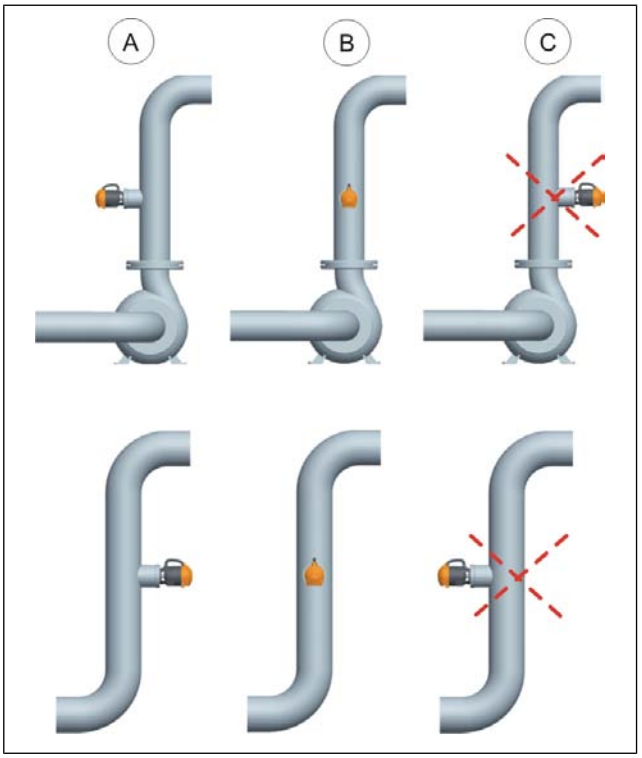
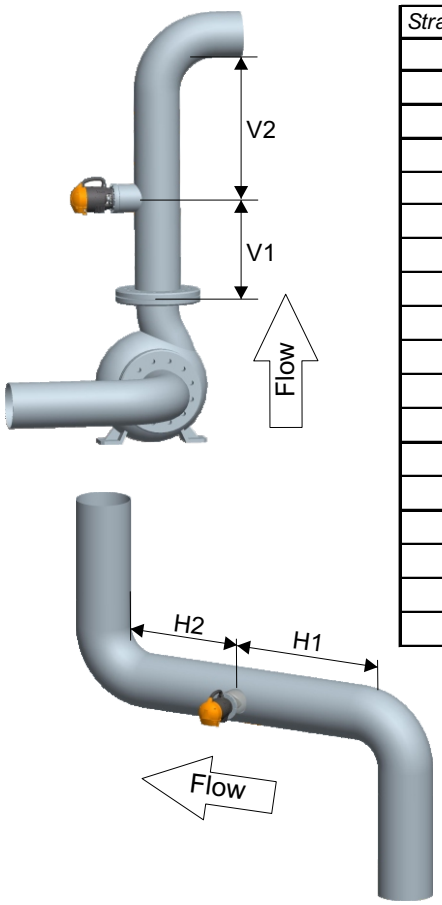


Fig. 4. Transmitter positions.



Straight pipe sections	*Cs < 8 % vertical installation*		*Cs < 8 % horisontal installation*	
Pipe diameter D	V1 min.	V2 min.	H1 min.	H2 min.
DN 200	1000	500	1500	500
DN 250	1000	500	1500	500
DN 300	1000	500	1500	500
DN 400	1200	600	1800	900
DN 500	1500	750	2250	1125
DN 600	1800	900	2700	1350
DN 700	2100	1050	3150	1575
DN 800	2400	1200	3600	1800
	Cs > 8 % vertical installation		*Cs > 8 % horisontal installation*	
DN 200	500	500	750	500
DN 250	500	500	750	500
DN 300	500	500	750	500
DN 400	600	600	900	600
DN 500	750	750	1125	750
DN 600	900	900	1350	900
DN 700	1050	1050	1575	1050
DN 800	1200	1200	1800	1200

Fig. 5. Calming distances.

3.11. Process coupling or mounting chamber

The transmitter is usually installed in a vertical pipe, downstream from a pump mixing dilution water into the pulp. To minimize the time lag after dilution, the transmitter should always be installed as close as possible to the water injection point.

If the pipe diameter is < 200 mm (8"), the transmitter should be connected to the pulp line with a mounting chamber. See Fig. 6. If the pipe diameter is 200 mm (10"), the transmitter should be connected to the pulp line with a process coupling. See Technical specifications.

3.12. Installation with mounting chamber

Standard mounting chambers are designed for a welded connection. Flanged mounting chambers are available on request. Typical installations are shown in Fig. 6. Check the free space requirements; see chapter 1.6, Fig. 3 to 6.

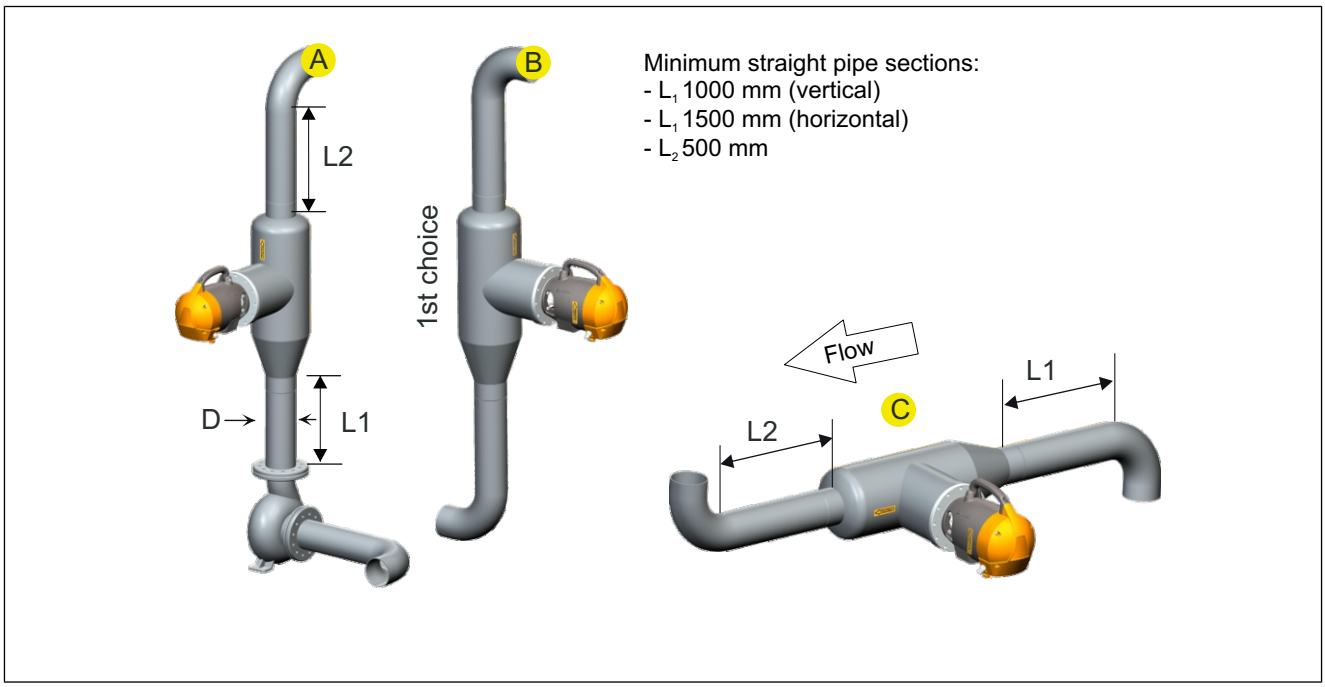


Fig. 6. Mounting chamber location.

3.13. Installation with process coupling

Depending on the consistency level and pulp type the process coupling should have a certain dimension (H in Fig. 7). A good rule of thumb is to use 150 mm with consistencies < 5 %, and 90 mm when consistency is > 5 %.

If you have any questions about the installation, please contact your Metso sales engineer.

The process coupling should be profiled and installed so that one pin bolt is located at the top of the coupling, Fig. 8. This makes it easier to mount the transmitter: when the pin bolt is mounted, the transmitter can be first secured on that pin bolt. This also reduces the risk of damaging the mechanical seal by hitting the seal at the process coupling flange.

The delivery includes a profiling guide for the process coupling. Make sure the coupling is profiled so that one hole is on the top, see Fig. 8.

Cut a 190 mm hole to the process pipe (Fig. 9). Three deflector plates are mounted before the coupling is welded to the pipe (Fig. 9).

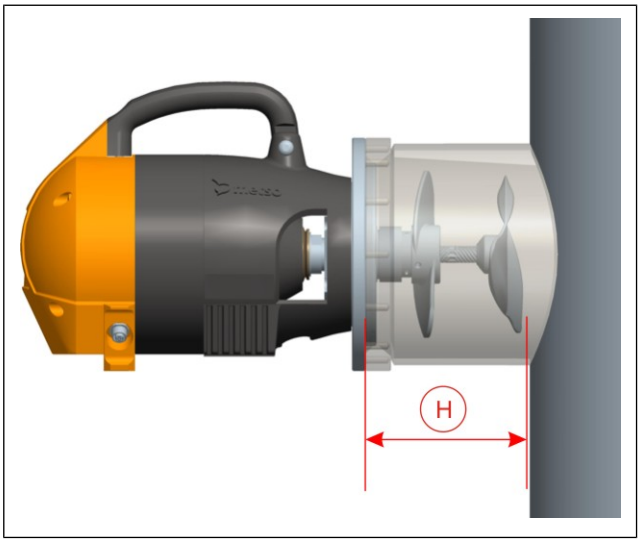


Fig. 7. H. coupling dimension.

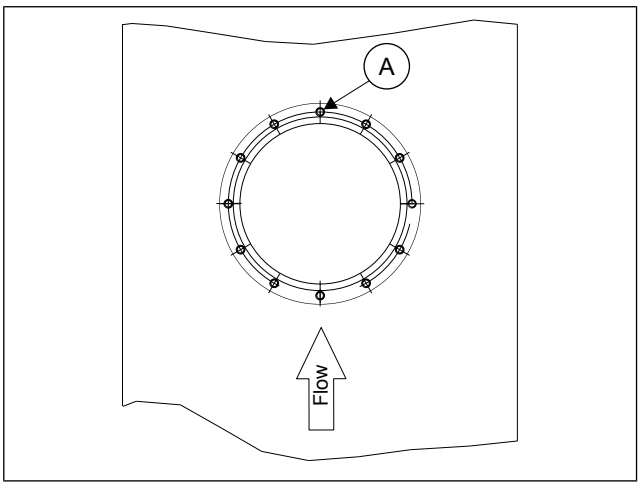


Fig. 8. A. mount the pin bolt here, secure with Loctite.

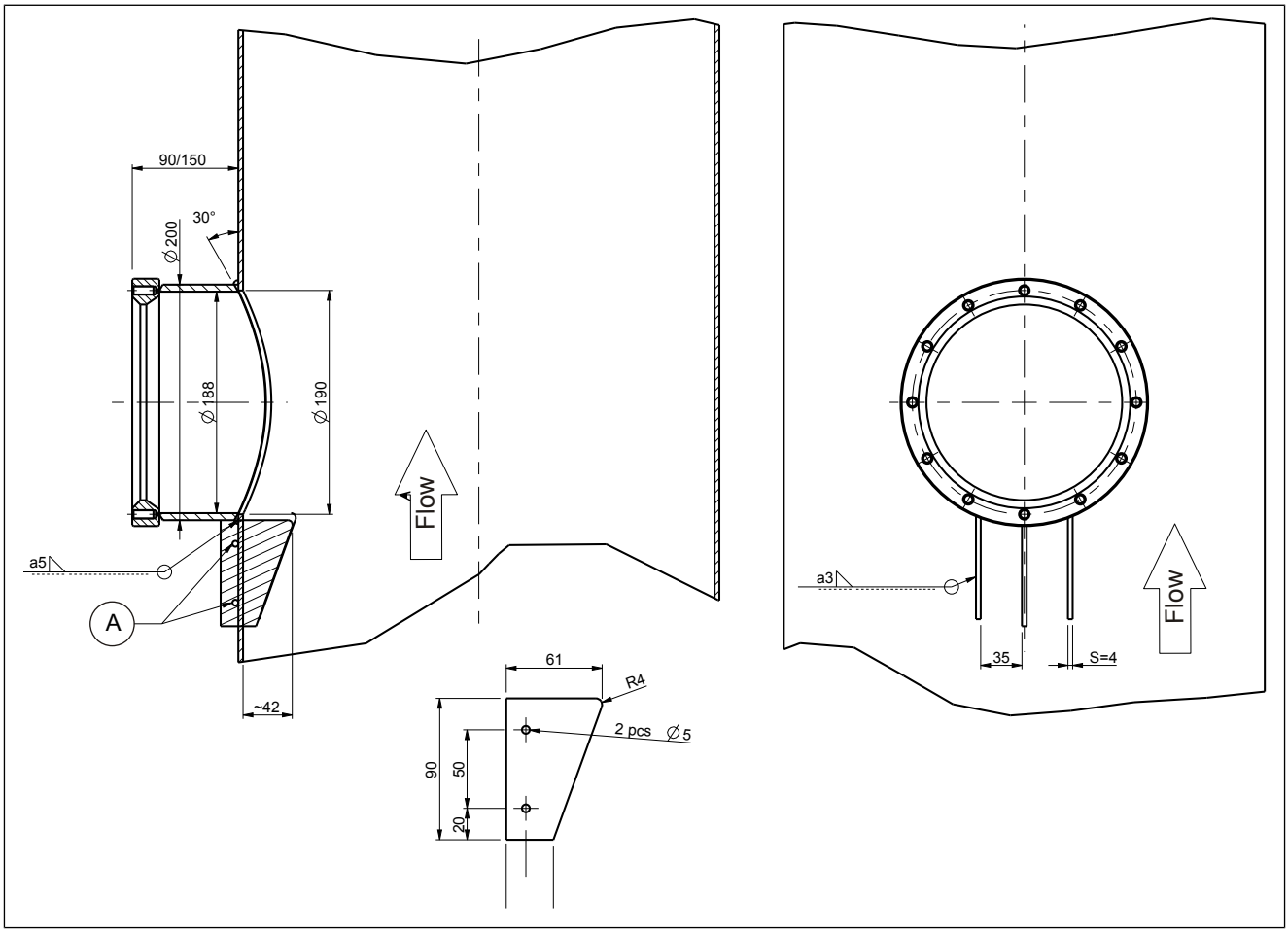


Fig. 9. Installing deflector plates: A. alignment holes.

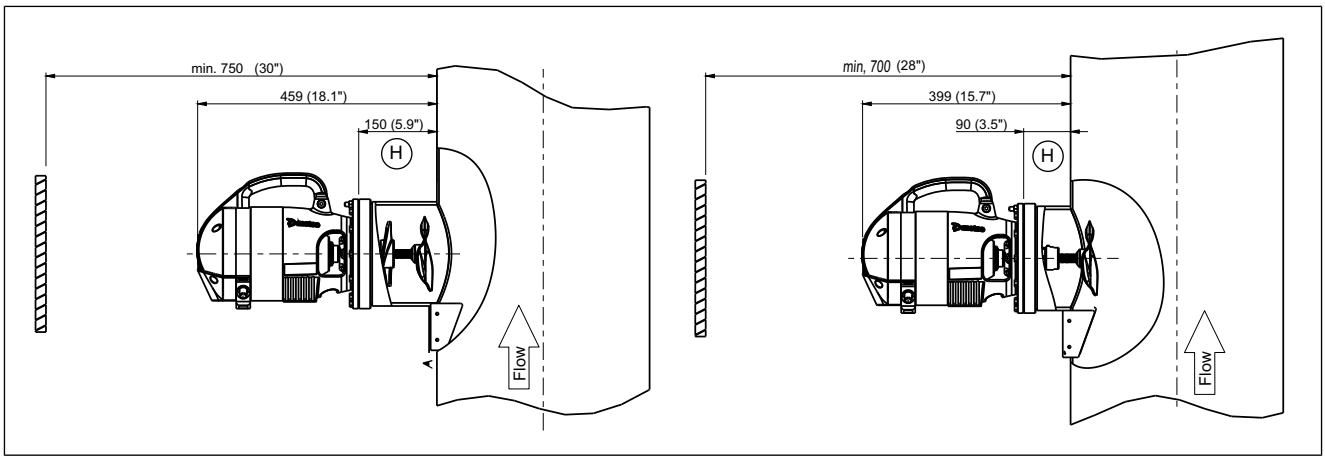


Fig. 10. Profile dimensions of process coupling, H. coupling dimension.

3.14. Installation of protection bar

The protection bar is used instead of deflector plates when the transmitter measures unscreened pulp and extra protection is needed. Install as follows:

1. Profile the coupling as required, use the cutting pattern K08953 for guidance. Bevel the coupling for welding as shown in Fig. 11.
2. Align the protection bar in the middle of the curved part. Align the end of the bar with the process flange (see drawing). If necessary, grind the end bevel of the arm bigger. Weld all around the part to ensure that there are no leaks.
3. Make a diam. 190 mm hole to the process pipe. Also cut a V-shaped notch for the protection bar to the side facing the flow.
4. Weld the coupling and protection bar to the process pipe as shown in Fig. 11. Sand or etch the weld seam.

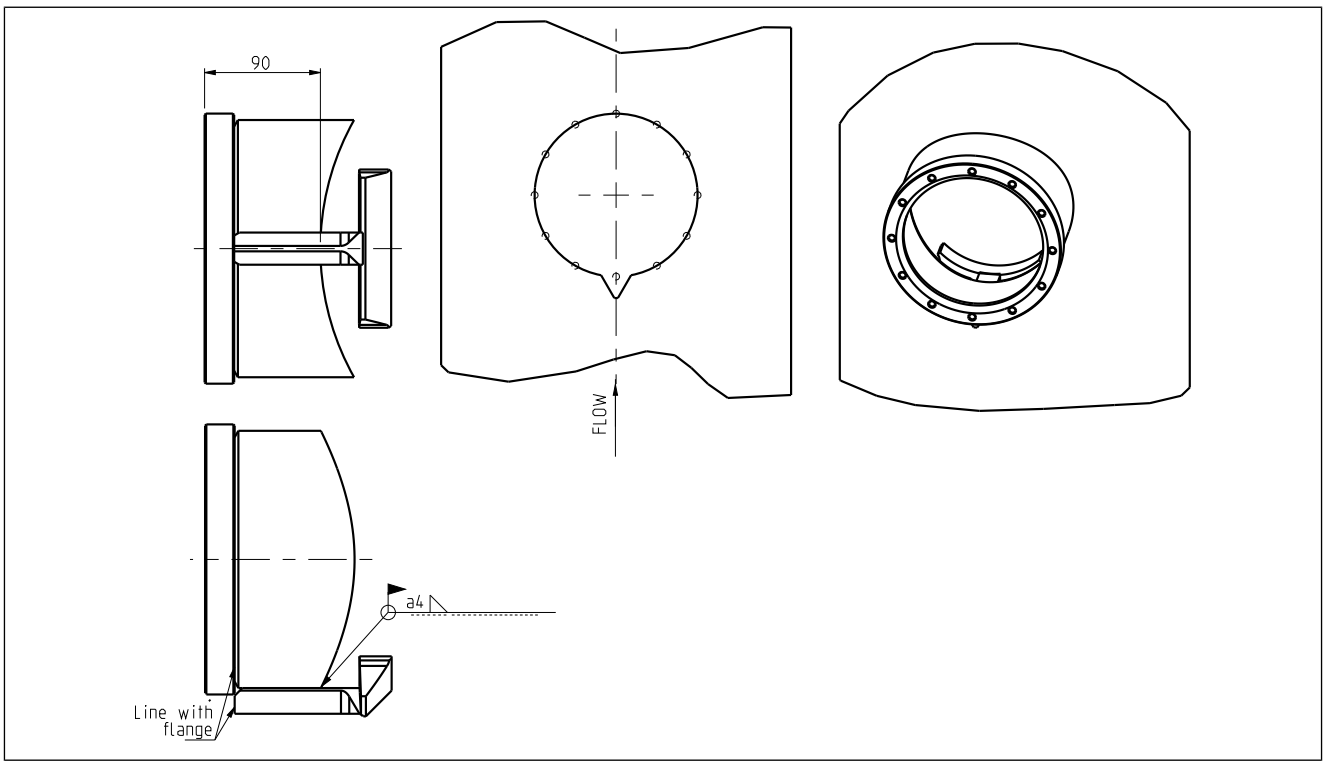


Fig. 11. Installation of protection bar.

3.15. Installing the transmitter

NOTE: Never lift the transmitter by the sensing element. Handle the device with care – it is a high precision instrument!

1. Make sure that the O-ring around the transmitter flange is in its position.
2. Hang the transmitter on the upper pin bolt, and secure with a washer and nut.
3. Fasten the transmitter with the other bolts and tighten them properly, max. tightening torque 19 Nm.

Always install the BD model transmitter so that the 3-phase motor points downwards (Fig. 12) for the best possible protection.

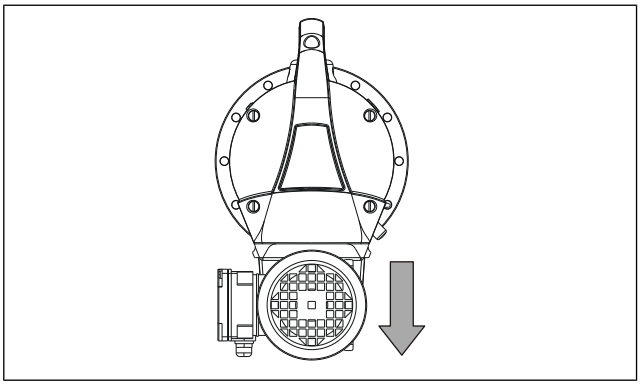


Fig. 12. Motor pointing downwards.

Water connection

1. Install the seal water fittings (included in delivery) to the R1/4 threads on the mechanical seal of the transmitter. Use Teflon tape or suitable sealing glue to seal the connections.
2. The incoming and outgoing water connections can be installed to the transmitter whichever way is the most convenient. However, make sure that water flows in the direction indicated by the arrow on the inlet pipe.
3. Install a shut-off valve to the incoming water line.
4. See Fig. 13. Connect the incoming water to the right hand side. An arrow on the inlet pipe indicates the flow direction. Install the shut-off valve to the incoming water line.

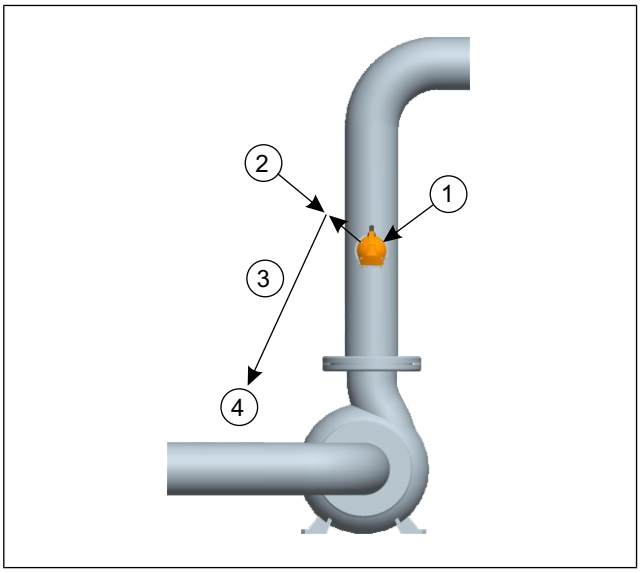


Fig. 13. Water connection: 1. flushing water 0.9 - 9 bar, 2. water overflow assembly, 3. 3/8" plastic tube outlet, 4. 0.5 - 1 l/m to channel.

NOTE: Make sure the pressure restrictor is mounted to the inlet pipe! High pressure water can destroy the mechanical seal or flushing water seal.

5. Install the water overflow assembly to the outgoing water connection. It should be pointing upwards so that the water level is secured at all times. The overflow assembly also ensures that no pressure builds up inside the seal if the drain hose gets blocked.
6. Connect a hose to the outlet and lead it straight down to the floor channel.
7. Water flow should be 0.5 – 1 l/min.

3.16. Connection of electric 3-phase motor (only for BD-model)

NOTE: High voltage motor! Only authorized personnel is permitted to make the connections.

NOTE: Make sure that the connected motor voltage is correct. If not, switch over to the correct voltage.

This section only applies to BD-model transmitters with 3-phase motor. The motor is a standard 3-phase motor.

1. Make sure that the connected motor voltage is correct. If not, adjust the rails in the junction box for the correct voltage, according to the data on the motor type designation plate.
2. The use of overload protection is highly recommended! Set the overload protection to the same value as the rated current for the motor (indicated on the rating plate). If the overload protection trips frequently, it may be raised by max. 20%. However, the external motor temperature must never exceed 80°C (176°F). The temperature can be measured between the two cooling flanges outside the motor.
3. Install the start/stop switches, safety switch, and overload protection close to the motor so that they are within easy reach. This will facilitate calibration and maintenance, when the motor must be started and stopped several times.
4. The motor must be interlocked with the pump motor, so that the transmitter stops when the pump stops.

Check the following:

1. Connection box for incoming 3-phase power (Fig. 15, point A).
2. Check the motor plate (point B) for a correct voltage and connection type (Y or Δ, Fig. 14).

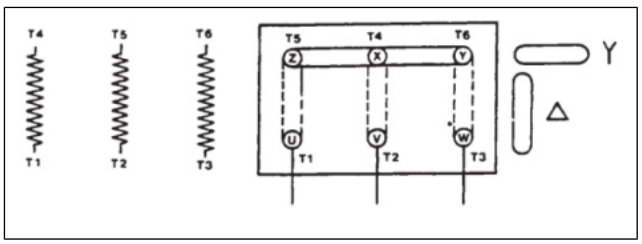


Fig. 14. Connection of motor.

Start the motor and check the rotation direction.

1. A sticker on the motor indicates the direction (point C).
2. If no sticker can be found, the motor should rotate clockwise when seen from behind the transmitter (point D).

NOTE: Always make sure that the water supply to the mechanical seal is on. If the motor is run without water, the dry seal will be damaged within a few moments!

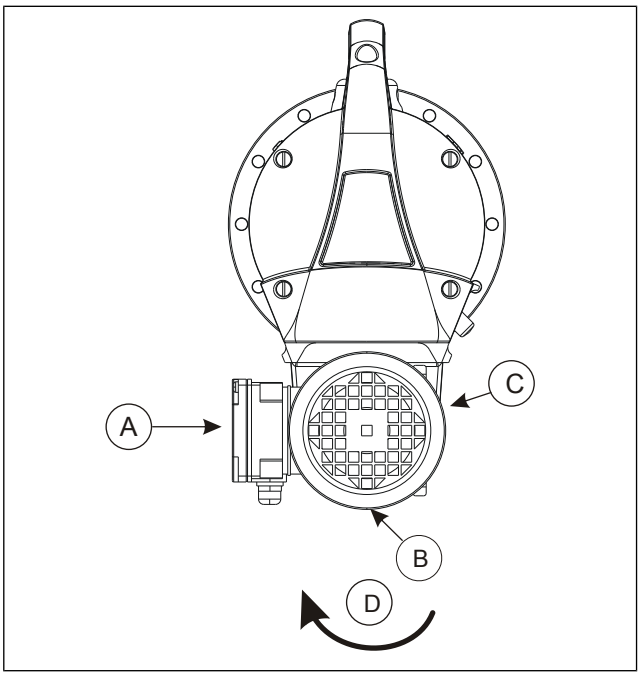


Fig. 15. A. connection box, B. motor plate, C. sticker, D. rotation direction.

4. TCU installation and cabling

4.1. TCU and protective cover

The TCU (Transmitter Central Unit) is delivered attached to the protective cover. Attach the cover to the wall with three mounting screws in an easily accessible place. When selecting a place for the TCU, remember that the length of the sensor cable is 10 m. Fig. 1 and 2 show the mounting dimensions of the cover.

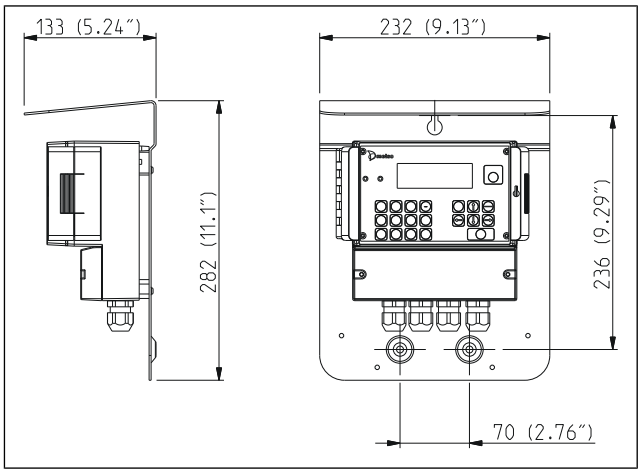


Fig. 1. Mounting dimensions of TCU, BD model of the transmitter (K09173).

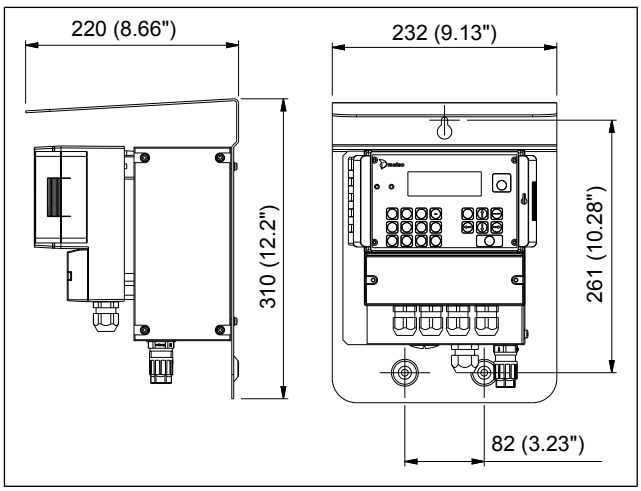


Fig. 2. Mounting dimensions of TCU, MD model (K09176).

4.2. Connections on transmitter

The **MD** model transmitter has two connectors: one for the TCU cable, and one for the motor voltage supply. With this model, voltage for the motor is supplied from the motor controller (in TCU).

The **BD** model transmitter only contains one connector for the TCU cable. 3-phase voltage is connected directly to the motor.

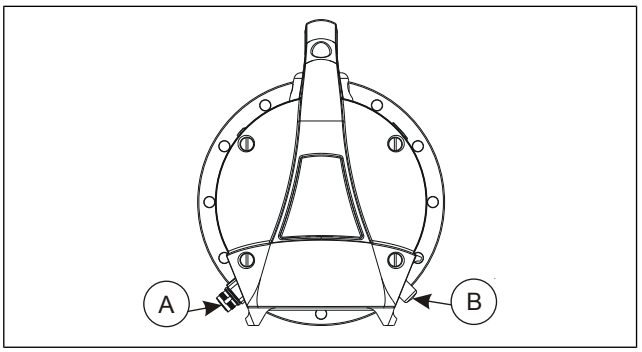


Fig. 3. Metso rotating consistency transmitter, rear view: A. motor cable connector, B. TCU cable connector

4.3. Electric connection of TCU, MD model (with motor controller)

NOTE: Make sure that the power supply cables are de-energized before connecting them. Check all connections before connecting power to the cables.

Mounting the power connector

1. Remove about 40 mm from the end of the cable sheath; Fig. 4, step A. Wrap the ground conductor once around the cores before sliding on the union nut, so that the ground conductor is the last to become disconnected when extreme tension is applied.
2. Slide the nut onto the conductor (step B).
3. Snap the cores into the marked core entries (1,2,3. . .; steps B & C).
   At 230 VAC 1-phase power:
   1 = line
   2 = N
   4 = GND
   At 110 VAC 2-phase power:
   1 = line 1
   2 = line 2
   4 = GND
4. Cut off the projecting core ends so that there is no overhang (step D).

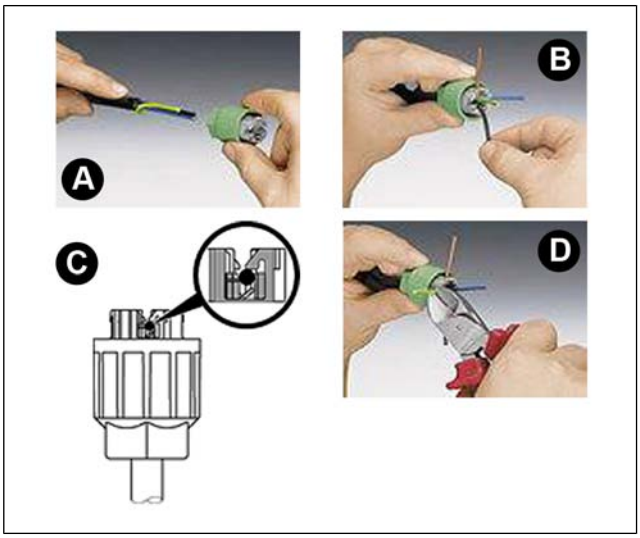


Fig. 4. Mounting power cable connector.

Connecting cables to TCU

1. Connect the power cable (fig. 5).
   Push the conductor (E1) onto the connector (E2). Slide the nut onto the conductor (step F) and fasten it on the connector, tighten properly (3 Nm, step G).
2. Connect the sensor cable (Fig. 6).
3. Insert the output signal cable into the TCU connector casing through the inlet and connect it to the terminal block as shown in the drawing. For voltage and resistance see Fig. 7.
   - Do not connect the protective shield of the current signal cable.
4. Insert a cable for binary inputs, see description in the chapter 4.5.

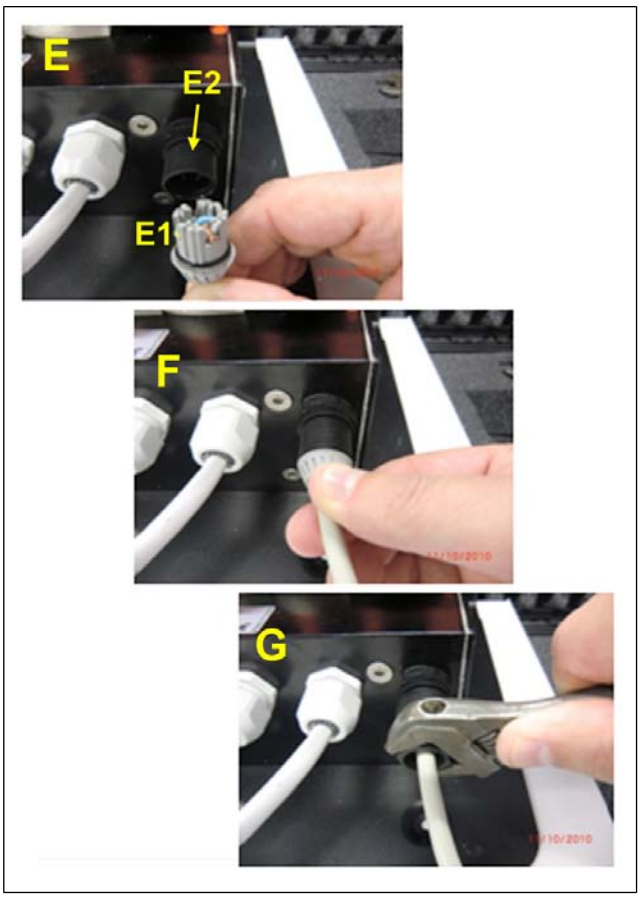


Fig. 5. Connecting the power cable.

The transmitter contains a passive current supply that requires an external current source. Fig. 7 shows the load capacity of the current output as a function of supply voltage. Resistance here is the sum of load resistor, cable resistance, and power source resistance in the current loop. HART communication requires a minimum loop resistance of 250 Ohms.

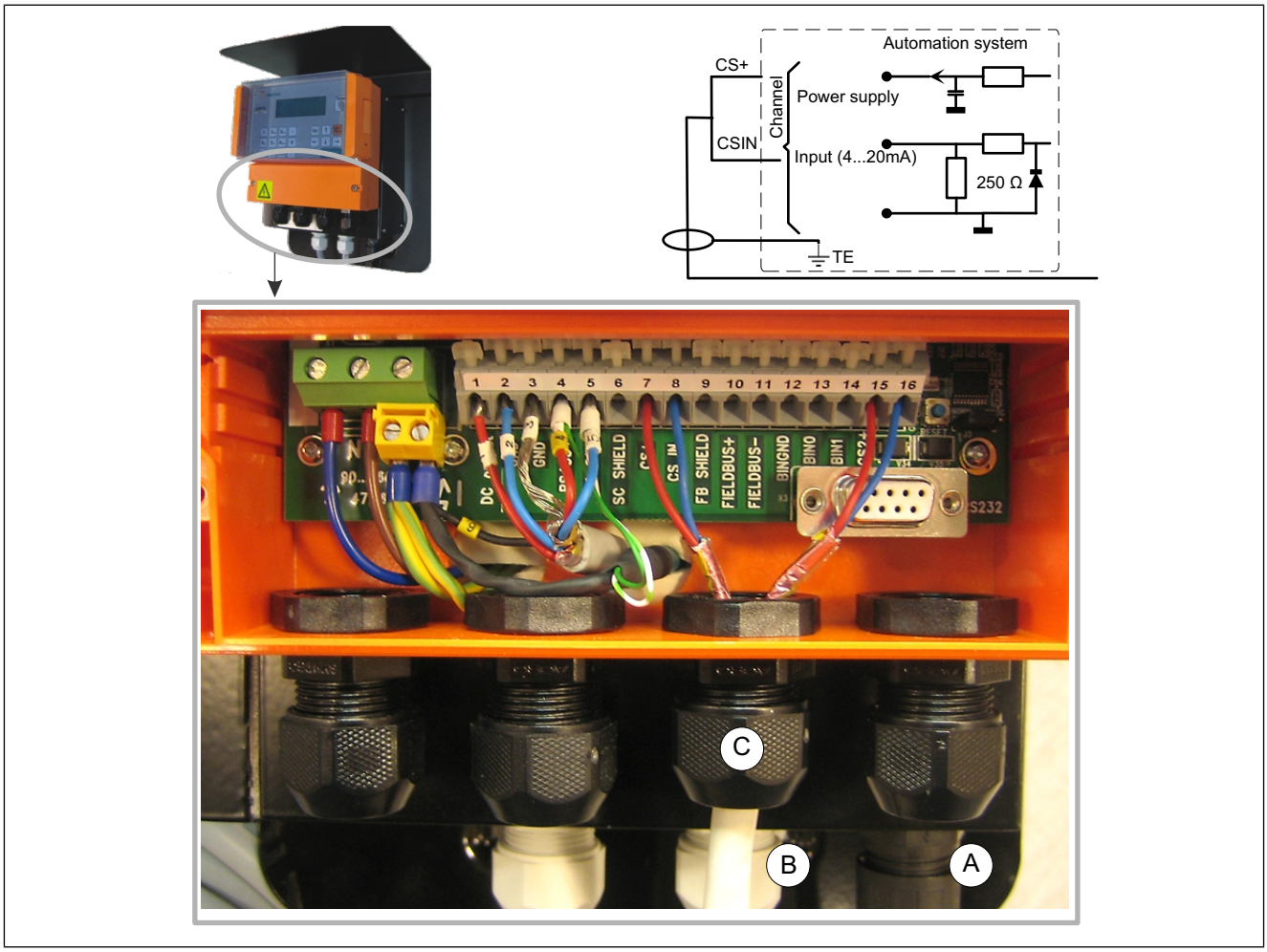


Fig. 6. Connections of TCU, MD model: A. power, B. transmitter, C. analog signal 4 - 20 mA.

4.4. Electric connection of TCU, BD model (no motor controller)

NOTE: Make sure that the power supply cables are de-energized before connecting them. Check all connections before connecting power to the cables.

1. Insert the power supply cable 90-260 VAC: Fig. 8, point A.
2. In a normal delivery the sensor cable (Fig. 3, point B) is already connected to the TCU.
3. Insert the output signal cable into the TCU connector casing through the inlet (Fig. 8, point C) and connect it to the terminal block as shown in the drawing. For voltage and resistance see Fig. 7.
   - Do not connect the protective shield of the current signal cable.
4. Insert a cable for binary inputs, see description in the chapter 4.5.

The transmitter contains a passive current supply that requires an external current source. Fig. 7 shows the load capacity of the current output as a function of supply voltage. Resistance here is the sum of load resistor, cable resistance, and power source resistance in the current loop. HART communication requires a minimum loop resistance of 250 Ohms.

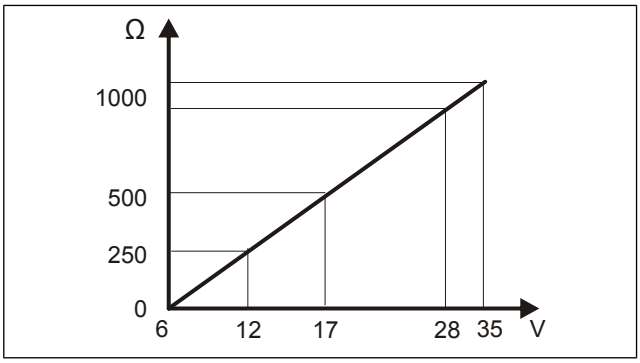


Fig. 7. Current output load capacity of the TCU.

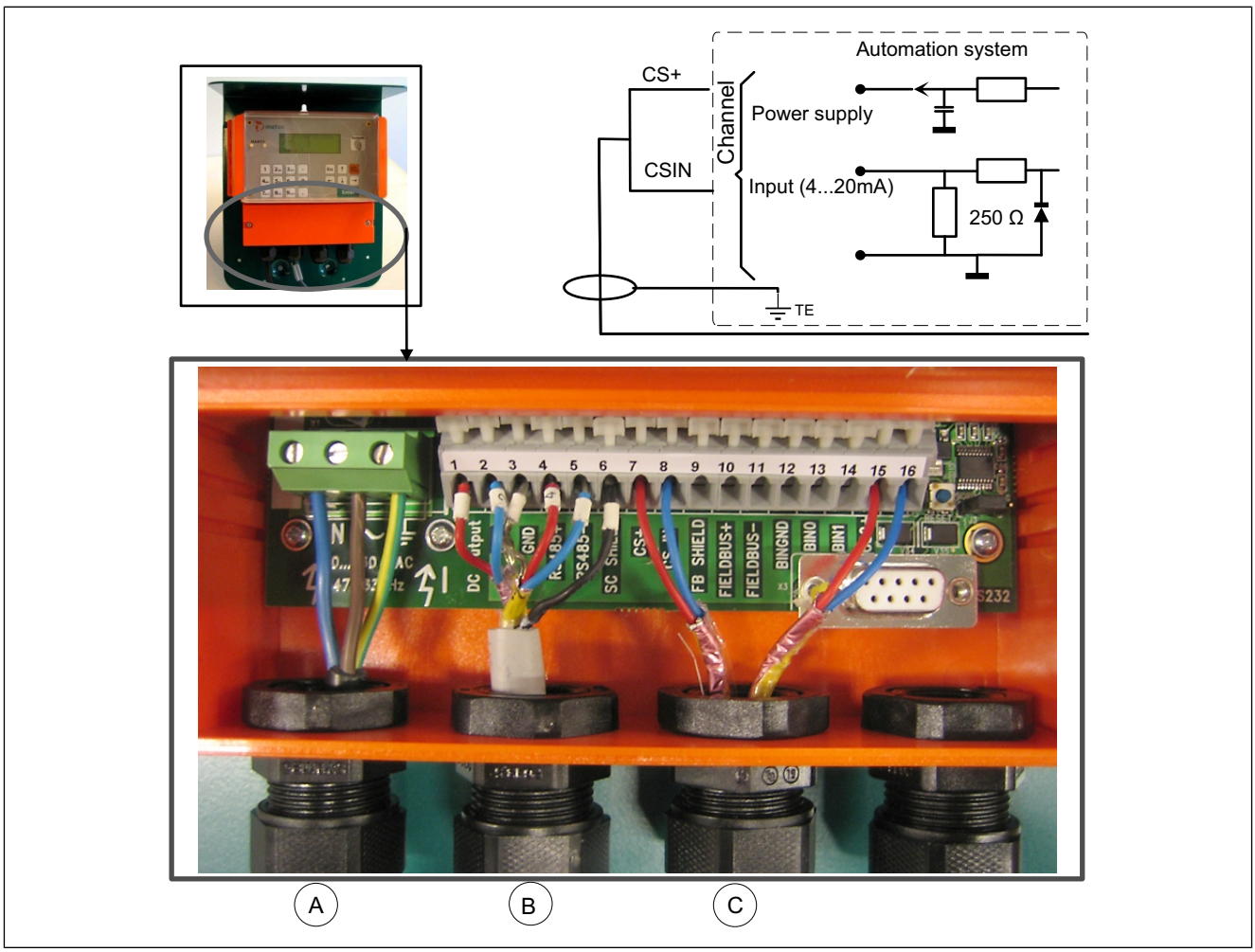


Fig. 8. Connections of TCU, BD model. A. power, B. transmitter, C. analog signal 4-20 mA.

4.5. Binary inputs

The TCU contains two galvanically isolated binary inputs, BIN 0 (connection 13) and BIN 1 (connection 14), both inputs share a common ground (connector 12). The switching device must be able to supply 12–28 VDC / 10 mA to the binary input. The connection principle of binary inputs is shown in Fig. 9. The inputs can be used for recipe selection, sampler status and/or motor status. The selection is made during configuration; see chapter 7.

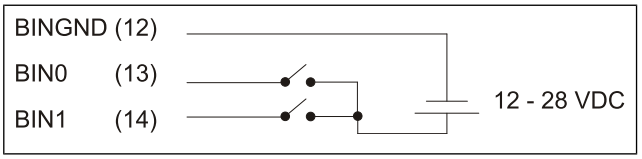


Fig. 9. Connection principle of binary inputs.

Operation chart

Table 1. BIN1 configured for recipe selection.

BIN0	BIN1	
open	open	recipe 1 selected
closed	open	recipe 2 selected
open	closed	recipe 3 selected
closed	closed	recipe 4 selected

Table 2. BIN1 configured for sampler status.

BIN0	BIN1		
open	open	recipe 1 selected	sampler not active
closed	open	recipe 2 selected	sampler not active
open	closed	recipe 1 selected	sampler active
closed	closed	recipe 2 selected	sampler active

Table 3. BIN1 configured for motor running status.

BIN0	BIN1		
open	open	recipe 1 selected	motor not running
closed	open	recipe 2 selected	motor not running
open	closed	recipe 1 selected	motor running
closed	closed	recipe 2 selected	motor running

Notes

5. Setting up

5.1. Important!

NOTE: Do not rotate or twist the sensing element in any way. Never lift the transmitter by the sensing element!

The transmitter is a sensitive piece of precision equipment – handle it with care! When installing or removing the transmitter, only lift it by the handle. Be careful not to damage the unit by overloading the measuring system.

Before starting the motor, make sure that the mechanical seal gets a steady supply of flushing water. Before starting the transmitter, familiarize yourself with its operation.

- Make sure to check the rotating direction of the motor before admitting pulp to the line.
- Check that the actual torque value in air agrees with the corresponding values stated in the attached test protocol.
- Make sure that a suitable Nove sampling valve for pulp is located close to the transmitter; this is very important for transmitter calibration and checking.
- When calibrating the transmitter, make sure to take representative samples from the line. The sampling and also laboratory routines should always follow exactly the same procedure.

5.2. Quick start checklist

A pressure test with water is recommended to ensure that the mounting chamber / process coupling and transmitter have been correctly installed and do not leak anywhere.

Before switching on the motor, check the following:

1. Make sure that the mechanical seal gets a steady supply of flushing water, and also that the water drains out properly.
2. Make sure that the system is turned OFF before attaching the system cable to the transmitter. Tighten the system cable!
3. Check all wirings.
4. Switch on the main power supply and see that the TCU display lights up.
5. **BD model:** Switch on the electric motor briefly and check its rotating direction, see chapter 3.15, Fig. 15.
   MD model: To start the motor, see chapters 6 Operation / 7 Configurations.

5.3. Basic configuration and calibration

1. Select the language and temperature unit (Celsius/Fahrenheit); see chapter 7 Configurations / 4=User settings.
2. Set the device date and time; see chapter 7 Configurations / 6=Set clock.
3. Scale the current output; see chapter 7 Configurations / 2=Output signal1.
4. Calibrate the consistency; see chapter 8 Calibration.

Notes

6. Operation

6.1. General

The transmitter can be operated either by using the local user interface TCU or remotely by digital communication over the 4 – 20 mA output loop (HART communication protocol).

Total support, including sophisticated calibration methods and thorough diagnostics, is available from Metso FieldCare™. Please refer to the DTM user manual. Basic functionality is available for other field communicators or control systems capable of HART communication.

The local operation unit of the device is the Transmitter Central Unit (TCU); see Fig. 1.

Fig. 1. Transmitter Central Unit, TCU.

6.2. TCU user interface

The display and keypad controls (see Fig. 2):

1. **Number keys**: enter numerical data, letters and select menu options.
2. **LCD display**: 20 columns, 4 rows.
3. **Sample**: start and stop sampling at calibration.
4. **Esc**: exit the edit mode without saving data; move backwards in the menu structure; toggle between result display and main menu.
5. **Edit/Save**: go to edit mode, save data after editing.
6. **Arrows**: move the cursor, move in menus.
7. **Enter**: move between result displays; in edit mode, jump to the next value to edit.

Display symbols:

≡ symbol, value is editable
: symbol, value is read only
= symbol, value is measured or a selection to enter next submenu

An example of editing instruction:

- Press "Edit/Save" to start editing, a cursor starts to blink.
- Use number keys to feed in the value.
- Press "Enter" to move to the next value.
- Press arrow keys to scroll between fixed values (Alarm curr.).
- Press "Edit/Save" to save and exit from the edit mode.
- Press "Esc" to leave the page.

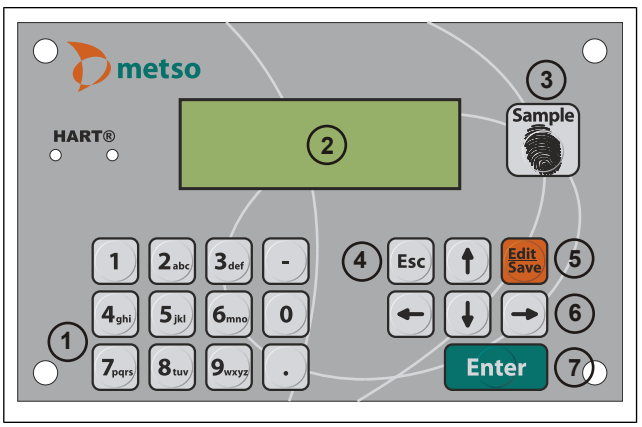


Fig. 2. Front panel.

6.3. Operation with the TCU

Fig. 3 shows a map of the TCU functions and their locations in TCU display system. The "Main result display" is the default after power-up. When you press "Enter" the extra result display will appear. Press again "Enter" to return to the main result display.

Press "Esc" in either of the result displays to access the sample: Start and stop sampling at calibration operations menu (from TCU main menu).

To access a menu function or submenu, press the number key indicated before the name of the function/submenu. Press "Esc" to return to the previous level.

All TCU functions can be accessed from the operations menu. You can always return to the "Main result display" by pressing "Esc" several times.

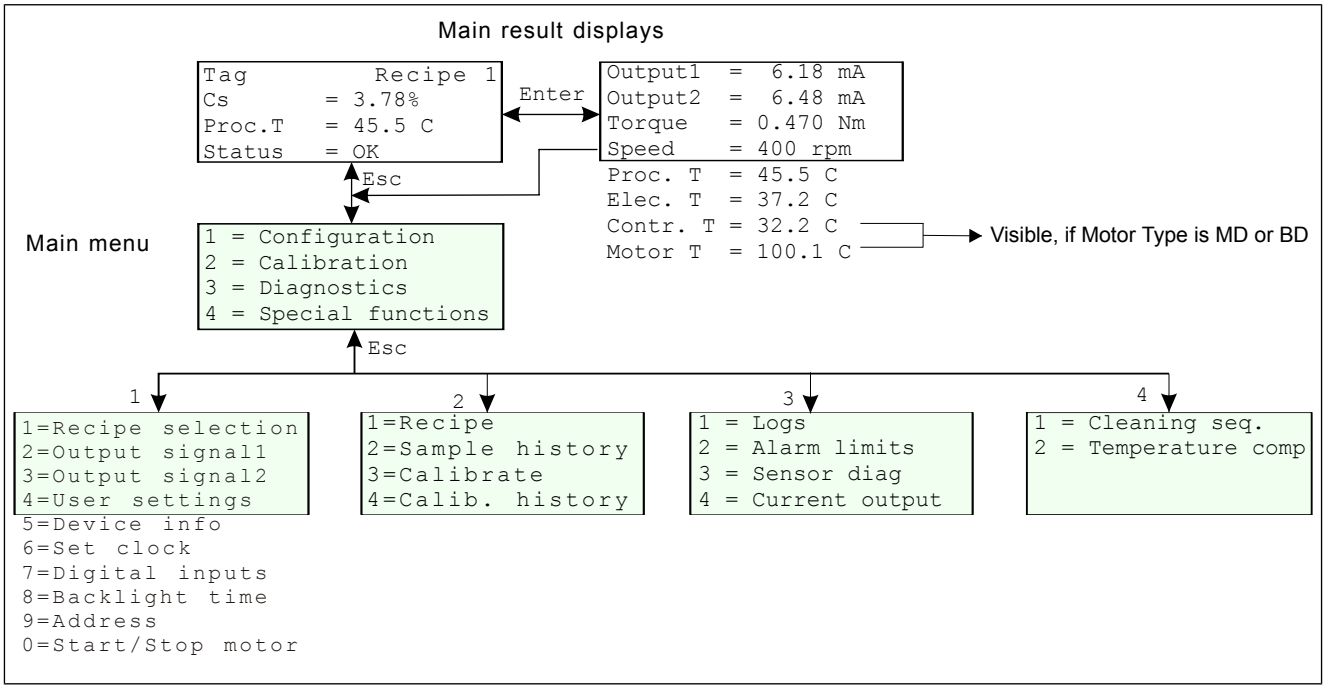


Fig. 3. TCU menu system, main menus.

6.4. Result displays

Main result display

Tag: Transmitter's "tag" or position code in the system. This can be changed in "Configuration" -> "User settings".

Recipe1: Currently selected recipe. This can be changed in "Configuration" -> "Recipe mode". Letter "R" after the number indicates that remote recipe selection is in use. In this case the active recipe is selected by two digital input signals on the TCU unit.

Cs: Consistency in percentage points (% Cs).

Proc.T: Process temperature (pulp temperature), in degrees Celsius (C = °C) or Fahrenheit (F = °F). This can be changed in "Configuration" -> "User settings".

STATUS: Device status information (OK / alarm / error message).

```
Tag          Recipe   1
Cs           =  3.78% Cs
Proc.T       = 45.5   C
Status       = OK
```

Extra result display

Output (1 and 2): The state of the transmitter's analog output in milliamps (mA). Not shown, if Profibus PA transmitter is used.

Torque: Shear force detected by the device, in Newton meters (Nm).

Speed: The rotation frequency of the electric motor, rpm (rotations per minute).

Proc.T: Process temperature (pulp temperature), in degrees Celsius (C = °C) or Fahrenheit (F = °F). This can be changed in "Configuration" -> "User settings".

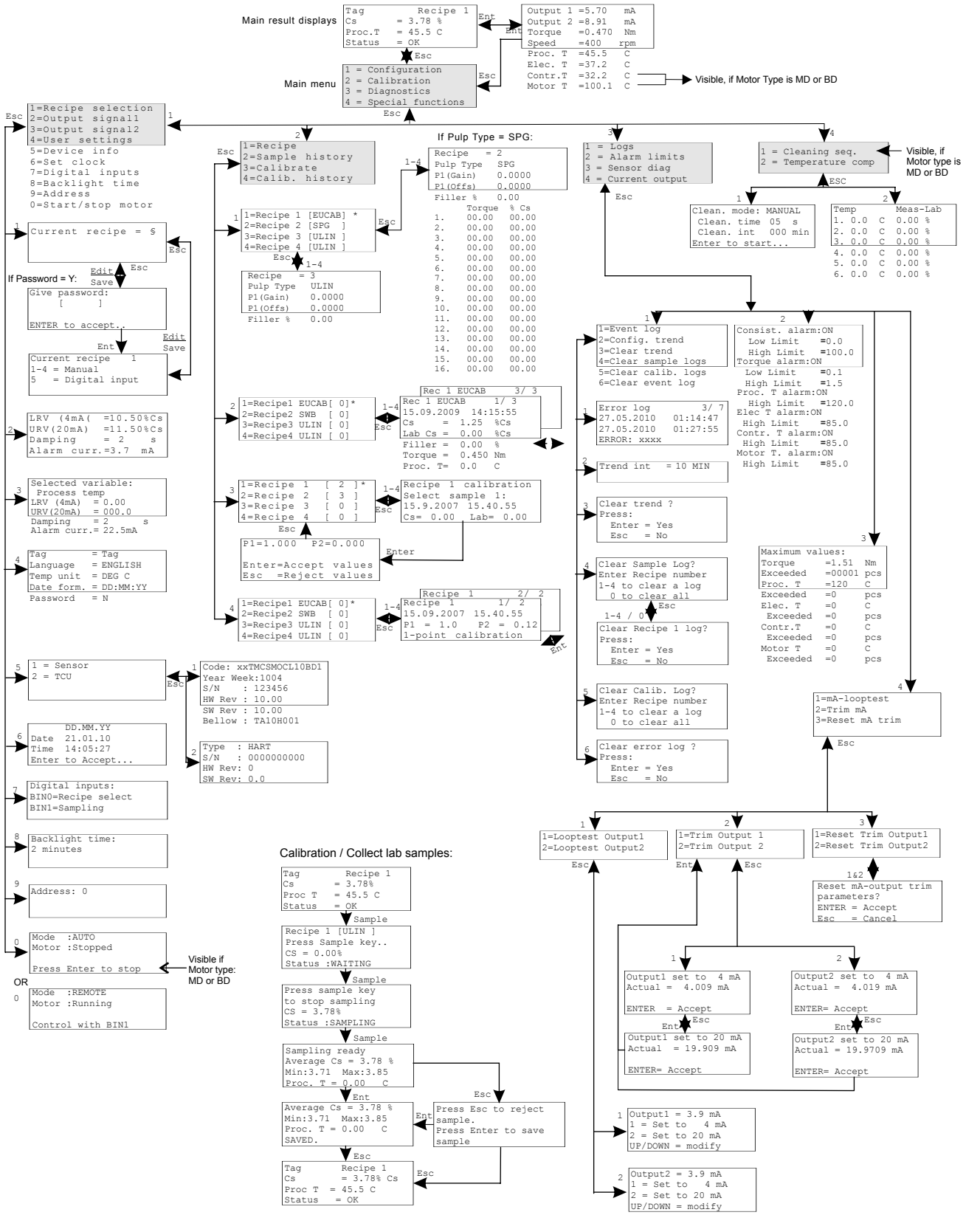
Elec.T: Electronics temperature.

Contr.T: Motor controller temperature. Shown only when MD model is used.

Motor T: Motor temperature. Shown only when MD model is used.

```
Output1      = 6.18 mA
Output2      = 6.48 mA
Torque       = 0.470 Nm
Speed        = 400 rpm
Proc. T      = 45.5 C
Elec. T      = 37.2 C
Contr. T     = 32.2 C
Motor T      = 100.1 C
```

6.5. Operation map



7. Configurations

7.1. To start

Select "Esc" in "Main result display" to get to "Main menu".

```
1 = Configuration
2 = Calibration
3 = Diagnostics
4 = Special functions
```

Then select "1=Configuration" from "Main menu".

```
1=Recipe selection
2=Output signal1
3=Output signal2
4=User settings
5=Device info
6=Set clock
7=Digital inputs
7=Backlight time
9=Address
0=Start/stop motor
```

7.2. Recipe selection

Select the active recipe to be changed here by pressing "Edit/Save".

```
Current recipe ≡ 1
```

Recipe mode

- **1 - 4:** Manual, fixed recipe selection.
- **5:** Digital input, remote control via binary inputs. When remote selection is activated, it overrides fixed recipe selections by the operator, and the active recipe is selected instead by the TCU's digital inputs.
  Remotely selected recipe is indicated in the measurement display with letter "R" after the recipe number.

```
Current recipe ≡ 1
1-4   = Manual
      = Digital input
```

7.3. Output signal1

LRV = Lower range value: The consistency percentage that produces the 4 mA analog output signal. Default, 3.0 % Cs.

URV = Upper range value: The consistency percentage that produces the 20 mA analog output signal. If the span is too wide (> 1.5 Nm), the transmitter will not accept the upper limit, and you will have to either lower the upper limit and/or raise the lower limit. The span may also be too narrow (< 0.8 % Cs), in which case you have to raise the upper limit and/or decrease the lower limit. Default, 1.5 % Cs.

Damping: Damping the fluctuation of the output signal, 1 - 60 sec. Define at least the min. value required to damp harmful fluctuations.

Alarm current: Analog output current to indicate transmitter failure. Possible values are 3.7 mA, 22.5 mA, HOLD (analog output is frozen when alarm goes on) and NONE (no alarm signal at all). Default, 3.7 mA.

```
LRV  (4mA)≡10.50 %Cs
URV (20mA)≡11.50 %Cs
Damping    ≡2     s
Alarm curr.≡3.7   mA
```

7.4. Output signal2

Selected variable: Process, electronics or motor temp, torque, vibration or consistency. Default, "Process temp".

Other settings same as in Output signal1.

```
Selected variable:
  Process Temp
LRV (4mA)   ≡0.00
URV(20mA)   ≡0.000
Damping     ≡2     s
Alarm curr.≡ 3.7mA
```

7.5. User settings

Tag: Transmitter's tag is a text describing the installation position of the device. Max. 8 characters, letters/numbers.

Language: Display language, English.

Temp unit: Temperature unit, degrees in Celcius = °C / Fahrenheit = °F. Default, C.

Date form: Date format, DD.MM.YY or MM.DD.YY.

Password: The access to some operations is restricted by a password. This field shows if the password is in use "Y" = Yes or not "N" = No. When in use, all pages with editable values will ask for password (3121). Default, not in use.

```
Tag         ≡Tag
Language    ≡ENGLISH
Temp unit   ≡ DEG C
Date form.  ≡DD.MM.YY
Password    ≡N
```

7.6. Device info

```
1 = Sensor
2 = TCU
```

Sensor

- **Code:** Built from selection parts by TCU software.
- **Year Week:** In format YYWW.
- **S/N:** Serial number of transmitter electronics.
- **HW Rev:** Version number of transmitter electronics.
- **SW Rev:** Software version of transmitter.
- **Bellows:** E.g. TA 10 H 000 = manufacturer, year, material, serial number.

```
Code: xxTMCSMOCL10BD1
Year Week:1004
S/N      : 123456
HW Rev   : 10.00
SW Rev   : 10.00
Bellows :TA10H001
```

TCU

- **Type:** HART/PA/FF protocol.
- **S/N:** Serial number of TCU electronics.
- **HW Rev:** Version number of TCU electronics.
- **SW Rev:** Software version of TCU.

```
Type   : HART
S/N    : 0000000000
HW Rev: 0
SW Rev: 0.0
```

7.7. Set clock

Date ja time: Enter the date with the number keys. To start press "EDIT/SAVE". The first character in the field begins to blink. Note that the date/month order is set in "User Settings" => "Date".

Example: to enter the date 14.06.2009 (June 14, 2009) the key sequence is as follows:

1 4 ENTER 0 6 ENTER 0 9 ENTER

Enter: Confirm changes.

```
          DD.MM.YY
Date      30.09.07
Time      14:05:55
```

7.8. Digital inputs

BIN0: For recipe selection (in remote recipe selection mode).

BIN1: Selectable. Receipe select / Motor.

- If "BIN1" is used for recipe selection, all four recipes can be activated through input signals.
- If motor is selected and "BIN1" is active, the motor is running. When "BIN1" becomes inactive the motor will stop.
- If "BIN1" is used for sampling information, sample timing can be automated (no need to press the SAMPLE key). Only two recipes (recipe 1 and recipe 2) can be activated through input signals.

```
Digital inputs
BIN0=Recipe select
BIN1=Sampling
```

7.9. Backlight time

The display light goes on when any key is pressed, and it will remain on for the selected time after the last key is pressed: 1, 2, 3, 4 or 5 minutes.

```
Backlight time:
2 minutes
```

7.10. Address

HART(R) address of the device. Acceptable values are from 0 to 15. Default value is 0 (zero), i.e. normal installation with a single transmitter, analog output signal (4 - 20 mA) is active.

Values 1 - 15 define a fixed 4 mA current output and all communication with the device is performed over the digital HART protocol.

WARNING: Do not set values 1 - 15 if the 4 - 20 mA analog output signal is needed!

Profibus PA address, 0 - 126.

```
Address:  0
```

7.11. Motor start/stop

Mode: Shows the motor mode, manual/auto/remote.

- In "AUTO" mode the motor starts/stops at power on/off.
- In "MANUAL" mode press "Enter" to start/stop motor. Note that if power fails, the operator must again start the motor by pressing "Enter".
- When "REMOTE" mode is in use, the motor is controlled by BIN1. If BIN1 is already on when the mode is set to "REMOTE", the motor must first be started by pressing "Enter".

```
Mode  :AUTO
Motor :Stopped

Press ENTER to start
```

```
Mode  :REMOTE
Motor :Running

Control with BIN1
```

Notes

8. Calibration

8.1. Calibration principle

Fig. 1 shows the calibration principle. As the graph shows, the relationship between consistency and the torque detected by the sensor is not linear and it differs for different pulp types, sensing elements etc.

The calibration curves, determined experimentally in Metso's laboratory, represent consistency (% Cs) as a function of the torque (Nm) acting on the sensor. The transmitter produces accurate consistency readings by compensating the detected torque with the information from a calibration curve.

The transmitter is delivered with factory calibration and is thus able to measure consistency as soon as the power is switched on. The factory calibration is performed for the device during the final factory testing using pure water.

Metso Automation recommends calibrating the device again when setting it up, in order to optimize the device settings for the conditions in which it will be used. Perform calibration by taking a consistency sample and entering its laboratory value into the transmitter, as instructed futher. When this has been done, the status line on the display will change from Default Calibration to OK.

The transmitter should be calibrated for each pulp type used. You can save calibrations for 4 pulps or pulp mixes in the TCU memory. In the transmitter's post-installation calibration, consistency samples are used to tune the selected calibration curve for the pulp to be measured. Tuning is done either as single-point calibration to define the zero offset P2, or as two-point calibration where you also define the curve's slope correction P1 (see Fig. 2). For more detailed descriptions of these two calibration methods, see sections futher in this chapter.

In the original curve, P1 = 1 and P2 = 0. In sample-based calibration the device will itself calculate the corrections for P1 and P2 in accordance with laboratory results and samples. Calibration results, P1 and P2 parameters, are stored in recipes. A recipe is a set of information that the device needs in order to convert the measured torque value to consistency. When the consistency transmitter knows the pulp recipe, it can accurately convert torque to % Cs.

You can save 1 - 4 recipes for different pulp types in the TCU memory. The desired calibration can be activated either directly from the transmitter or with remote selection through binary inputs or HART®. Calibrations and other operations are carried out through menus, no mechanical settings or changes are needed. Calibration data is preserved in memory even if power is switched off.

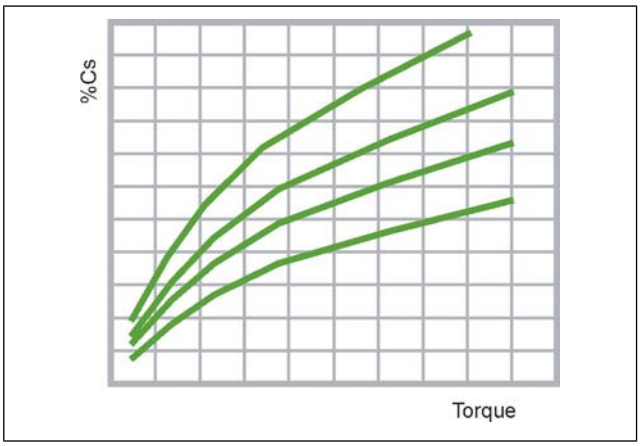


Fig. 1. Calibration principle.

8.2. Requirements for good calibration result

IMPORTANT: To get as good calibration result and following measurement performance as possible there are some vital points that must be followed:

1. The transmitter must be installed and started up according to supplier's instructions.
2. Give the transmitter time to warm up to an ambient temperature. This is a transmitter with mechanical parts that needs some running time.
3. The process should run as stable as possible, with a normal flow, temperature and consistency level. This gives the best conditions for an accurate calibration.
4. A sampler specifically designed for taking pulp samples must be installed close to the transmitter.
5. To eliminate human error, use a predefined standard how to take samples, how to handle the sample and how to determine the lab consistency.

Please contact your Metso representative if you need help or further advice.

8.3. Calibration methods

Single-point calibration

In this calibration the selected curve, which converts the torque into a consistency signal, is moved in the required direction according to consistency. The goal is to achieve zero offset at the calibration point, thus eliminating the difference between the measured consistency and sample consistency. The slope of the curve (slope factor P1) does not change, but the value of P2 changes in accordance with the zero offset.

In single-point calibration you can also take two samples and use the one taken when the process was steadier. The samples should preferably be taken at the so-called setpoint consistency.

In most cases single-point calibration is sufficient for consistency control applications.

The calculation formula:
P2 = LAB – sample average
P1 = unchanged

Two-point calibration

In this calibration the selected curve, which converts the torque into a consistency signal, is moved in the required direction according to consistency. The goal is to achieve a zero offset at the calibration point and to change the slope of the curve as necessary, so that the curve passes through two consistency points. The transmitter calculates new values for P1 and P2.

IMPORTANT: In two-point calibration the difference between the consistency points must be at least 25 %, calculated from the lower point. This ensures that possible errors in sampling and consistency analysis will not have a noticeable effect on the slope of the curve. The transmitter will alert the operator when an attempt is made to calibrate using points whose consistency difference is less than 25 %.

Two-point calibration is recommended in cases when accurate measurement is needed over a wide measuring range, when calibrating a pulp mix or pulp type that does not have a predefined calibration curve in the menu, or when the pulp has a large, unknown filler content. Considerable differences may also occur between different recycled fiber pulps in relation to the basic slope of the calibration curve.

The calculation formula:
$P1 = (CsLAB_2 - CsLAB_1) / (CsSAMPLE_2 - CsSAMPLE_1)$
$P2 = CsLAB_1 - (P1 \times CsSAMPLE_1)$

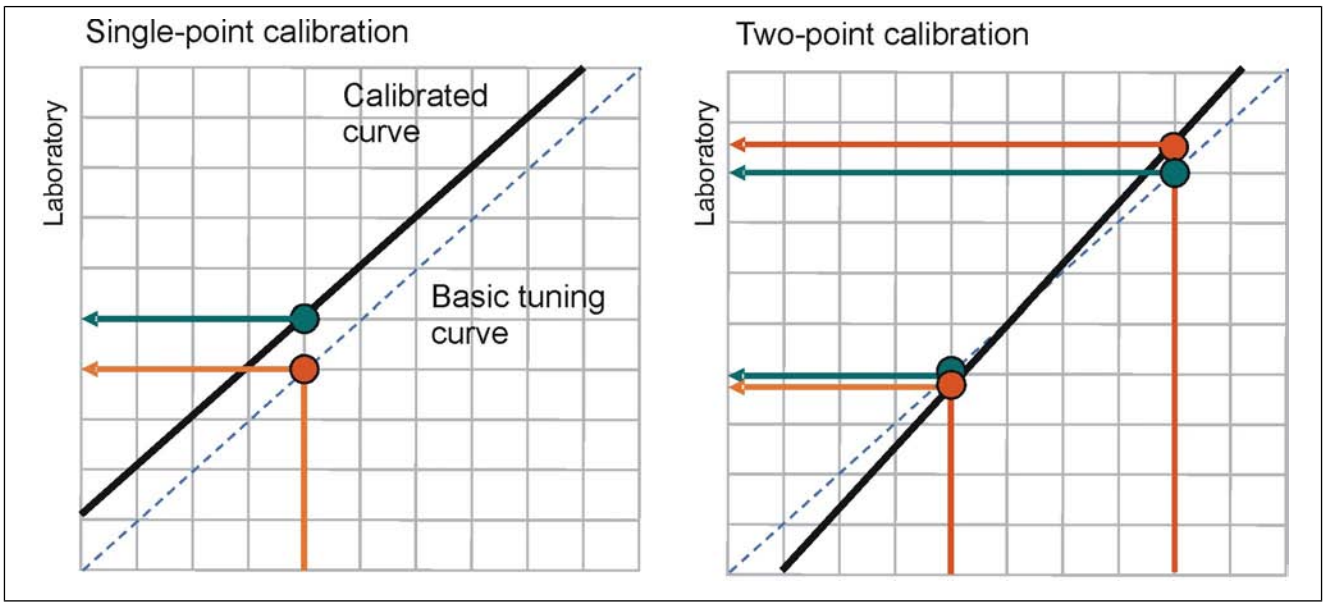


Fig. 2. Single-point and two-point calibration.

8.4. Creating a recipe

In the Main result display press "Esc".

```
Tag          Recipe   1
Cs           =  3.78% Cs
Proc.T       = 45.5   C
Status       = OK
```

Select "2" (Calibration).

```
1 = Configuration
2 = Calibration
3 = Diagnostics
4 = Special functions
```

Select "1" (Recipe).

```
1=Recipe
2=Sample history
3=Calibrate
4=Calib. history
```

Select 1 - 4 for the wanted recipe. In this example we use recipe 1.

```
1=Recipe1 [EUCAB] *
2=Recipe2 [SWB]
3=Recipe3 [ULIN]
4=Recipe4 [ULIN]
```

Press "Edit/Save" to start editing.

Pulp type: Select the correct one with arrows keys. The next section shows all the possible types, select the type that is closest to your process. "Pulp type" is the only setting needed for a normal calibration.

Filler % (ash %) of the pulp, i.e. the percentage of fillers from total solids. Can be used to fine tune the filler content if the total consistency changes. Lab consistency will include the filler content, so the main Compensation is already done.

P1: Curve slope correction, default value = 1.
P1 = 0.1 ... 10.

P2: Curve offset correction, default value = 0. P2 can be used to make an offset change on the consistency value from the transmitter. P2 = -10 ... 10

- New P2 = old P2 + offset (to increase the transmitter value).
- New P2 = old P2 – offset (to decrease the transmitter value) e.g. offset = 0,1 will increase the consistency reading 0,1 %.

When the settings are done press "Edit/save" to save them, press "Esc" to go to the main menu.

```
Recipe      = 1
Pulp Type   ≡  ULIN
P1 (Gain)   ≡  0.0000
P2 (Offset)≡   0.0000
Filler %    ≡  0.00
```

Pulp type

There are several predefined calibration curves available for the most common pulp types. These curves have been determined experimentally in Metso Automation's laboratory. The available pulp types are:

- **HWU:** Unbleached hardwood chemical pulp, e.g. birch pulp or eucalyptus, bagasse and other agro fibers.
- **HWB:** Bleached hardwood chemical pulp, e.g. birch pulp or eucalyptus, bagasse and other agro fibers.
- **SWU:** Unbleached softwood chemical pulp, e.g. pine and other softwood pulps.
- **SWB:** Bleached softwood chemical pulp, e.g. pine and other softwood pulps.
- **GW:** Groundwood, including pressure groundwood.
- **TMPL:** Thermomechanical pulp, low freeness.
- **TMPH:** Thermomechanical pulp, high freeness.
- **RMPL:** Refiner Mechanical Pulp, low freeness.
- **RMPH:** Refiner Mechanical Pulp, high freeness.
- **CTMP:** Chemi-thermomechanical pulp.
- **RCFS:** Recycled fiber, screened.
- **ROCCS:** Recycled fiber, OCC, screened.
- **EUCAU:** Unbleached eucalyptus.
- **EUCAB:** Bleached eucalyptus.

There are three more calculation modes for special purposes:

- **ULIN:** Unlinearized 0–1.5 Nm torque range, the corresponding output display is 0 – 100 %.
- **POLY:** Third order polynome conversion from torque to consistency.
- **SPG:** Special Grade. Torque-to-consistency relationship is determined by a curve defined by max. 16 points. Between two consecutive points the values are interpolated linearly.

8.5. Collecting lab samples

In the "Main result display" press "Sample".

```
Tag          Recipe   1
Cs           =  3.78% Cs
Proc.T       = 45.5   C
Status       = OK
```

```
Recipe1 [ULIN]
Press Sample key..
Cs = 0.00%
Status:WAITING
```

Press again "Sample" to start storing the transmitter value. Collect the sample from the process at the same time, for a laboratory evaluation.

```
Press Sample key
to stop sampling
CS = 3.78%
Status:SAMPLING
```

Press "Sample" when sample collecting is done. The display shows the "Average Cs" value and the Min. & Max. Cs values during sampling.

```
Sampling ready
Average Cs=3.78%
Min:3.71 Max:3.85
Proc.T=47.5 C
```

Press "Enter" to store the value in the transmitter memory or press "Esc" to discard the sample.

```
Average Cs=3.78%
Min:3.71  Max:3.85
Proc. T = 0.00
SAVED.
```

After pressing "Enter" press "Esc" to exit from sampling mode.

8.6. Entering the lab value

Press "2" (Sample history) to enter the consistency value determined at lab.

```
1=Recipe
2=Sample history
3=Calibrate
4=Calib. history
```

Select the correct recipe. The number indicates how many samples have been stored in the recipe. The active recipe is indicated by an asterisk (*) at the end of the line. The number [4] indicates the number of stored samples.

```
1=Recipe1 EUCAB[ 4]*
2=Recipe2 SWB  [ 1]
3=Recipe3 ULIN [ 1]
4=Recipe4 ULIN [ 1]
```

Use arrows up/down to scroll between the sample information. If more than one sample has been stored, press "Enter" or use the left/right arrows to scroll between samples. This display shows sample number 4 of 4 stored samples. Press "Edit/Save" to enter the lab consistency ("Lab Cs") value. Save the value by pressing "Edit/Save". Press "Esc" to leave "Sample history".

```
Rec 1 EUCAB  1/4
15.9.2009 14:15:55
Cs          =1.25  %Cs
Lab Cs      ≡0.00  %Cs
Filler      ≡0.00  %
Torque      =0.450 Nm
Proc.T      =0.0   C
```

8.7. Calibrating

Press "3" (Calibrate) in the Calibration menu.

```
1=Recipe
2=Sample history
3=Calibrate
4=Calib. history
```

- [1/2]] indicates that both single-point and two-point calibrations are possible.
- [1] indicates that only a single-point calibration is possible.

Select the recipe to be calibrated.

```
1=Recipe 1  [ 1/2 ]
2=Recipe 2  [ 1/2 ]
3=Recipe 3  [ 1 ]
4=Recipe 4  [ - ]
```

A single-point calibration requires at least one stored transmitter value and corresponding lab value. A two-point calibration requires at least two stored transmitter values and corresponding lab values. Scroll between the samples with up/down arrows, if more than one sample is stored.

Press "Enter" when the correct sample is in the display. Now the first sample is fixed for the calibration.

```
Recipe 1 calibration
Select sample 1:
15.6.2010 14:24:55
Cs =3.77  Lab=3.71
```

For a two-point calibration select a second sample (use up/down arrows). To proceed with single-point calibration press "Enter".

```
Recipe 1 calibration
Select sample 2:
Single-point calib.
No sample 1
```

If the values of parameters P1 and/or P2 look too low/high, or if the difference between the two samples is less than 25 % of the consistency level, the display will show a message of the possible error, but you can still choose to accept the calibration. If the values are extremely low or high, the calibration parameters will not be accepted.

Press "Enter" to accept the values. The transmitter is now calibrated and operates with the new calibration settings.

8.8. Calibration history

Press "4" for the calibration history in the Calibration menu.

```
1=Recipe
2=Sample history
3=Calibrate
4=Calib. history
```

The following display will appear:

```
1=Recipe1 EUCAB[ 4]*
2=Recipe2 SWB  [ 1]
3=Recipe3 ULIN [ 1]
4=Recipe4 ULIN [ 1]
```

When a recipe is selected, information on the latest calibration will be shown:

```
Recipe 1      1 / 4
15.9.2009   14:15:55
P1 = 1.0    P2 = 0.12
1-point calibration
```

Notes

9. Diagnostics

9.1. TCU diagnostics

Press "3" in Main menu to access the diagnostics functions.

```
1=Logs
2=Alarm limits
3=Sensor diag
4=Current output
```

9.2. Logs

Press "1" for the "Logs" menu.

```
1=Event log
2=Config. trend
3=Clear trend
4=Clear sample logs
5=Clear calib. logs
6=Clear event log
```

Event log

Event log contains the 96 most recent events. You can view events by pressing "Enter" or up/down keys.

Error log: The event index and the number of events stored in the event log.

The starting and ending times of the events are shown in the next two lines. If the event is still on or if the ending time was not detected, the ending timestamp is shown as '--.--.---- --:--:--'.

The message "Shutdown" in the place of the event state end time indicates that the event state was on when power was shut down. If the event state is still on when the power is switched on next time, the event is reported as a new event.

Error: A text describing the event.

```
Error log              3/7
27.05.2010    01:14:47
27.05.2010    01:27:55
Error: xxxx
```

Config trend

The display shows the trend interval (1 min, 2 min, 5 min, 10 min, 30 min), which is used as a time stamp in the trend table and for calibration samples.

```
Trend Int  ≡10 MIN
```

Clear trend

In this display you can clear the trend interval by pressing "Enter", "Esc" cancels the function.

```
Clear trend ?
Press:
  Enter  = Yes
  Esc    = No
```

Clear sample/calib logs

In these displays you can clear one sample/calibration log at a time by pressing "1" - "4" keys or clear all sample logs by pressing "0".

```
Clear Sample Log?
Enter Recipe number
1-4 to clear a log
  0 to clear all
```

```
Clear Recipe 1 log?
Press:
  Enter  = Yes
  Esc    = No
```

Accept clearing with "Enter" or cancel it with "Esc".

Clear event log

In this display you can clear the error log by pressing "Enter", "Esc" cancels the function.

```
Clear error log?
Press:
  Enter  = Yes
  Esc    = No
```

9.3. Alarm limits

In "Alarm limits" you can set some diagnostics ON/OFF and also set alarm limits for these diagnostics items.

```
Consist. alarm :ON
  Low Limit  ≡ 0.0
  High Limit ≡ 100.0
Torque alarm   :ON
  Low Limit  ≡ 0.1
  High Limit ≡ 1.5
Proc. T alarm  :ON
  High Limit ≡ 120.0
Elec Temp alarm:ON
 High Limit  ≡ 85.0
Contr. T alarm :ON
 High Limit  ≡ 85.0
Motor T. alarm :ON
 High Limit  ≡ 85.0
```

9.4. Sensor diagnostics

"Sensor diag." contains some raw measurement information from the sensor primarily needed for detecting faults and it can not be edited.

Torque: Measured shear force in Newton metres, Nm.

Proc. T: Measured process temperature raw value from A/D-converter, C°.

Elec. T: Measured electronics temperature raw value from A/D-converter, C°.

Contr. T: Measured motor controller temperature raw value from A/D-converter, C°.

Motor T: Measured temperature raw value from A/D-converter, C°.

Exceeded: How many times the maximum limits have been exceeded.

```
Maximum values:
 Torque    =1.51  Nm
 Exceeded  =00001 pcs
 Proc. T   =120   C
 Exceeded  =0     pcs
 Proc. T   =0     C
 Exceeded  =0     pcs
 Elec. T   =0     C
 Exceeded  =0     pcs
Contr.T    =0     C
 Exceeded  =0     pcs
Motor T    =0     C
 Exceeded  =0     pcs
```

9.5. Current output

Press "4" in the "Diagnostics" menu for the "Current output" menu.

```
1=mA-looptest
2=Trim mA
3=Reset mA trim
```

mA-looptest

1, 2: Select "Looptest Output1/Output2".

```
1=Looptest Output1
2=Looptest Output2
```

Looptest locks the output signal to 4 mA, 20 mA, hold (present) value, or some other user-defined value. It can be used to check the cabling and current measuring circuits.

- **Output1/2:** When this display is activated, the analog output is frozen to its present value, shown here.
- **1:** Set the analog output1/2 to 4 mA.
- **2:** Set the analog output1/2 to 20 mA.
- **Up/Down:** Increase/decrease the analog output value with the Up/Down keys.

```
Output1     = 3.9 mA
1 = Set to    4 mA
2 = Set to   20 mA
Up/Down =  modify
```

Trim mA

1, 2: Select Trim Output1/Output2.

```
1=Trim Output1
2=Trim Output2
```

This function requires that you connect an ammeter to the transmitter's analog output. The transmitter will first send a 4 mA signal to the analog output. Measure the actual current value and enter it to the device by changing the "Actual" value.

- **Output1/2:** The analog output is frozen to its present value, shown here.
- **Actual:** Enter the measured value in the Edit mode.
- **Enter:** Accept the value.

```
Output1 set to 4 mA
Actual =  4.009 mA

ENTER = Accept
```

Then the transmitter sends a 20 mA signal to the analog output. Measure the actual current value and change it in the same way as for the 4 mA signal.

```
Output2 set to 20 mA
Actual =  20.909 mA

ENTER = Accept
```

Reset trim output

1, 2: Select Reset trim output1/output2.

```
1=Reset trim Output1
2=Reset trim Output2
```

```
Reset mA-output2 trim
parameters?
ENTER = Accept
Esc   = Cancel
```

9.6. Special functions display

To access the "Special functions", press "4" in the TCU's main menu.

```
1 = Cleaning seq.
2 = Temperature comp
```

Cleaning seq

NOTE: Only available for MD model. When cleaning sequence is active the motor reverse the rotation direction during the set cleaning time.

- **Cleaning mode:** Manual/Auto, default Manual.
- **Cleaning time:** Duration of cleaning, 0 - 60 s.
- **Cleaning interval:** Time between cleanings, 0 - 999 s.

```
Clean. mode: MANUAL
 Clean. time.≡05   s
 Clean. int .≡000  min
Enter to start ...
```

Temperature compensation

You can define a temperature compensation correction curve for the transmitter if temperature dependency is observed in the measurement results.

Press "Edit" key. Define the correction curve by entering 2 - 6 pairs of temperature/consistency ("Temp"/"Lab") points. Based on the curve drawn from these points, the transmitter subtracts the curve consistency from the measurement results.

```
    Temp      Meas-Lab
1.  0.0  C   0.00 %
2.  0.0  C   0.00 %
3.  0.0  C   0.00 %
4.  0.0  C   0.00 %
5.  0.0  C   0.00 %
6.  0.0  C   0.00 %
```

9.7. Error messages / warnings

Errors can be categorized into groups:
- TCU errors,
- transmitter errors,
- measurement errors, and
- errors in communication between TCU and transmitter.

In error situations the following status messages are used:
- WARNING: No effect to output signal. Some service action is required to correct the problem.
- FAILSAFE: Serious error. Output signal set to State "fail Safe". State can be set in menu "Configuration" - "Output signal".
- INFO: Informative message. No effect on output signal.

Error messages can be viewed on the TCU, "Diagnostics/Event Log" display.

WARNING messages:

PROC. T OUT OF LIMITS: Process Temperature High Limit.
- Process temperature is at the maximum measurement limit. -› Set measurement in limits (Main menu / 3=Diagnostics / 2=Alarm limits).
- The PT sensor is disconnected. -› Connect the sensor.
- Wrong sensor type settings. -› Change settings (Main menu / 1=Configuration / 5=Device info).

PROC. T OUT OF LIMITS: Process Temperature Low Limit.
- Process Temperature is at the minimum measurement limit. This may be due to a short-circuit in PT-100 sensor wires.
  -› Set measurement in limits (Main menu / 3=Diagnostics / 2=Alarm limits).
  -› Fix the PT sensor.
- Wrong sensor type settings. -› Change settings (Main menu / 1=Configuration / 5=Device info).

MOTOR T OUT OF LIMITS: Motor Temperature High Limit.
- Motor temperature is at the maximum measurement limit. -› Set measurement in limits (Main menu / 3=Diagnostics / 2=Alarm limits).
- The MT sensor is disconnected. -› Fix the connection.
- Wrong sensor type settings. -› Change settings (Main menu / 1=Configuration / 5=Device info).

MOTOR T OUT OF LIMITS: Motor Temperature Low Limit.
- Motor temperature is at the minimum measurement limit. This may be due to a short-circuit in KTY84-1 sensor wires.
  -› Set measurement in limits (Main menu / 3=Diagnostics / 2=Alarm limits).
  -› Fix MT sensor.
- Wrong sensor type settings. -› Change settings (Main menu / 1=Configuration / 5=Device info).

ELEC T OUT OF LIMITS: Electronics Temperature is over the measurement limit. -› Check maximum value (Main menu / 3=Diagnostics / 3=Sensor diag).

SENSOR RESTART: Sensor boot-up process is active. -› Wait until restarted.

TORQUE OUT OF LIMITS: Torque overshoot.
- Measured torque is over the user defined value.
  -› Too high consistency.
  -› Check sensing element type.
  -› Check measurement limits (Main menu / 3=Diagnostics / 3=Sensor diag).

TORQUE OUT OF LIMITS: Torque undershoot.
- Measured torque is under the user defined value, below 0 Nm.
  -› Check sensing element type.
  -› Check measurement limits (Main menu / 3=Diagnostics / 3=Sensor diag).

PULSE MEASUREMENT WARNING: Synch pulses are drifting. -› Check threshold level, LED current, RecDetect bit.

PULSE MEASUREMENT WARNING: Synch pulses are not found correctly. -› Check threshold level, LED current, RecDetect bit.

PULSE MEASUREMENT WARNING: Too long/short pulse(s) found within a measurement cycle (Pulse screening Hi/Lo). -› Electronics interferense.

CLOCK WARNING: TCU clock error.
– Real time clock can't read. -› Set the clock (Main menu / 1=Configuration / 6=Set clock).

DRIVE COMM TIMEOUT: Communication error between TCU and motor controller.

DEFAULT CALIBRATION: Default Calibration in use.
– Device not calibrated in the mill, P1 = 1, P2 = 0. -› Calibrate.

CLOCK NOT SET: TCU clock time not checked, still in the factory time zone. -› Set the clock (Main menu / 1=Configuration / 6=Set clock).

ANALOG OUTPUT1 SATURATED: Current output1 saturated.

ANALOG OUTPUT1 FIXED: Fixed current value set to current output.

UNKNOWN SENS.ELEMENT: Sensing element not set.

CS OUT OF LIMITS: Consistency out of limits. -› Set measurement in limits (Main menu / 3=Diagnostics / 2=Alarm limits).

MOTOR NOT RUNNING

CTRL TEMP OUT OF LIMITS: Motor controller temperature out of range.

ANALOG OUTPUT2 SATURATED: Current output2 saturated.

ANALOG OUTPUT2 FIXED: Fixed current value set to current output.

FAILSAFE messages:

PULSES OUT OF SYNC: Pulses from optical-interrupter are not synchronous. -› Electronics interferense.

NO PULSES: Pulses are not detected at optical-interrupter.
-› Motor not running, belt broken.
-› Check threshold level, LED current, RecDetect bit.

SENSOR BOARD ERROR: System voltage 5 V, not correct. -› Check cable connection to board.

SENSOR BOARD ERROR: System voltage 3,3 V, not correct. -› Check cable connection to board.

SENSOR BOARD ERROR: OptoLED Vfwd (forward voltage drop), not correct. -› Check LED current.

NO SENSOR ERROR: TCU Sensor Serial communication Error between TCU and sensor.

TCU EEPROM ERROR: TCU EEPROM can't write or read.

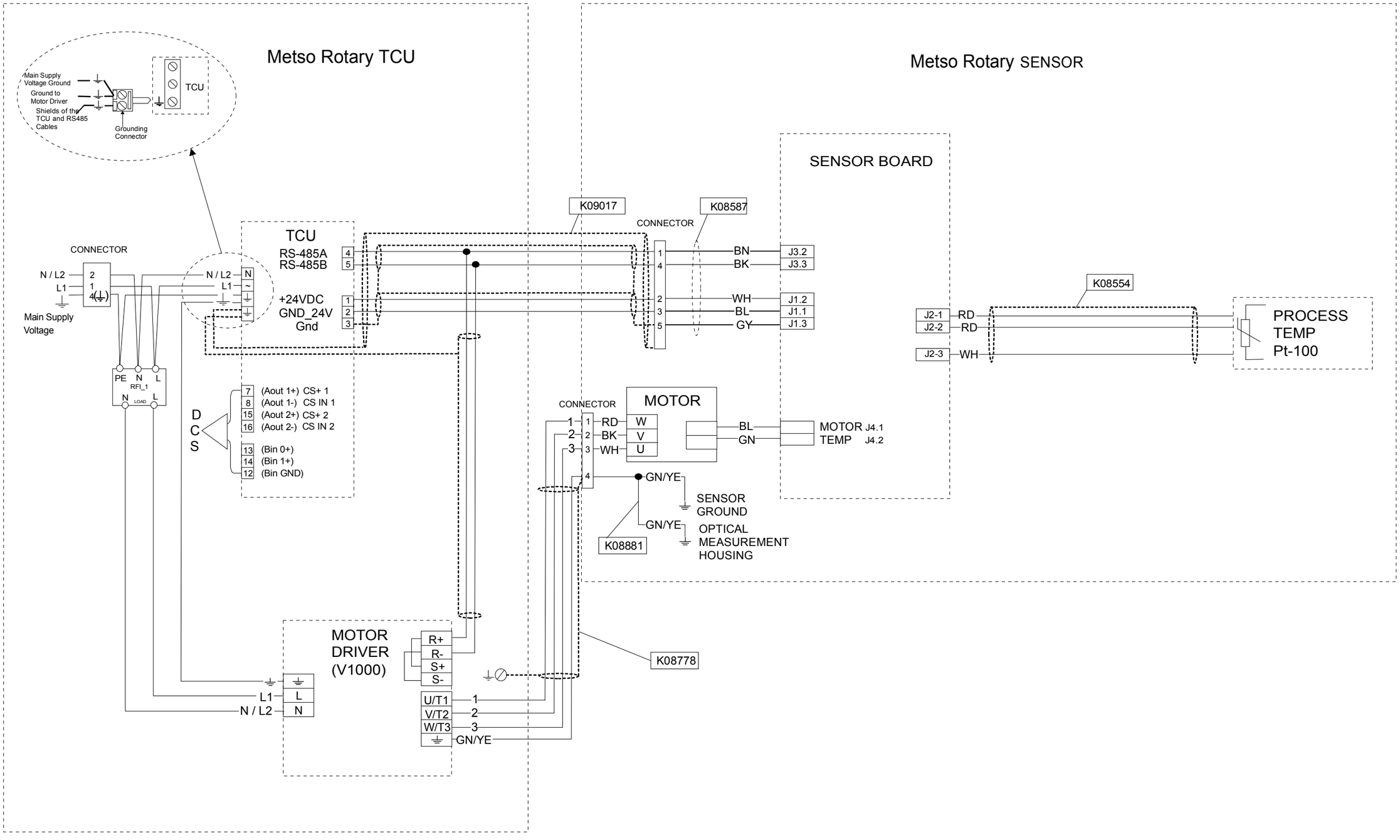
INFO messages:

CALIBRATION BRAKE ON: Calibration brake interface current level.

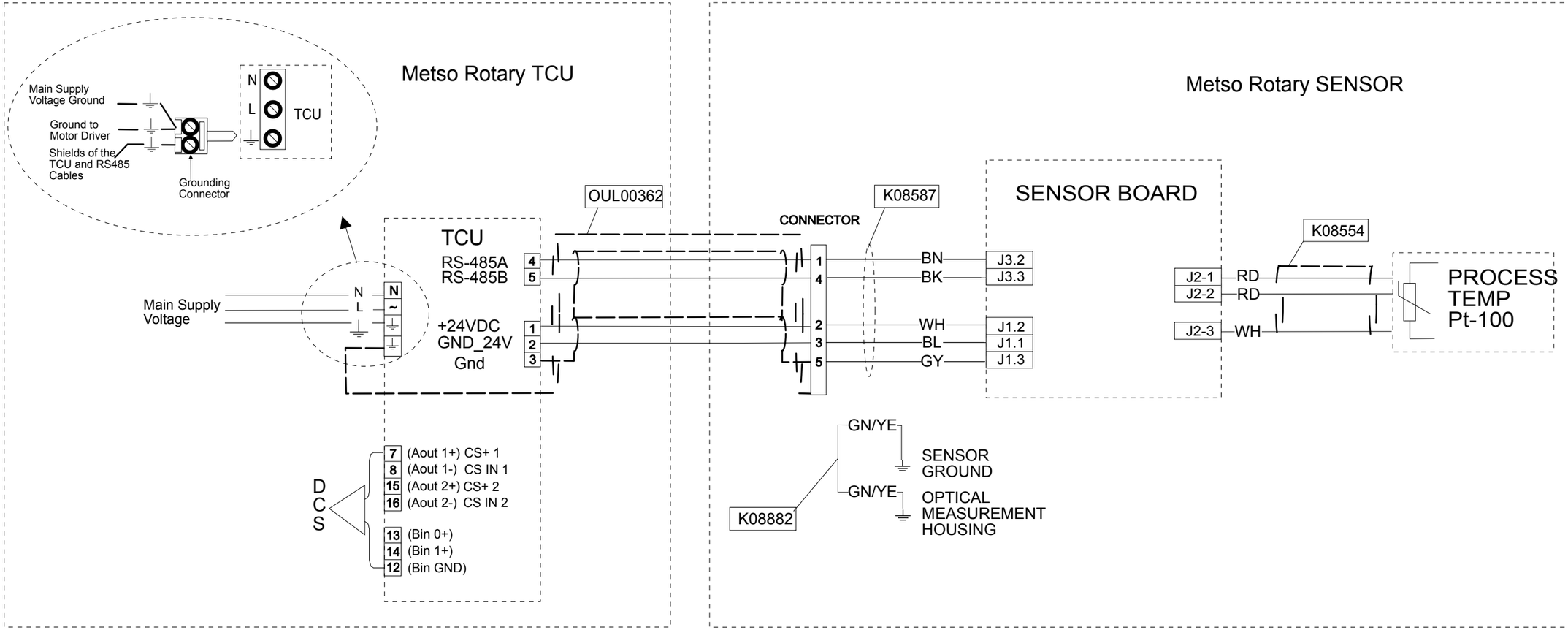
CLEANING SEQUENCE ACTIVE: Measurement value freezed during cleaning sequency.

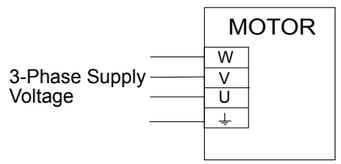
Notes

10. Electric connections, MD model

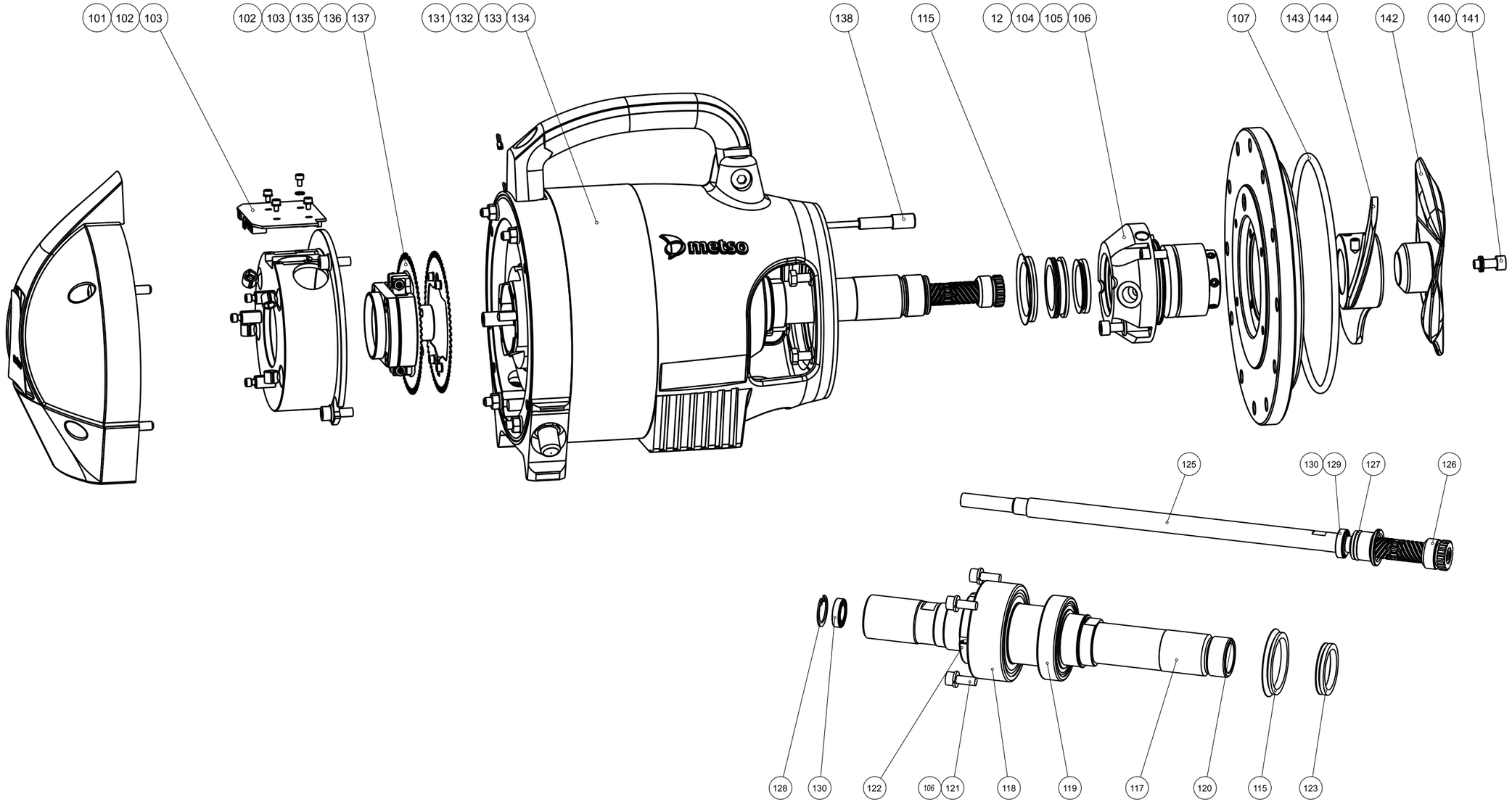


11. Electric connections, BD model

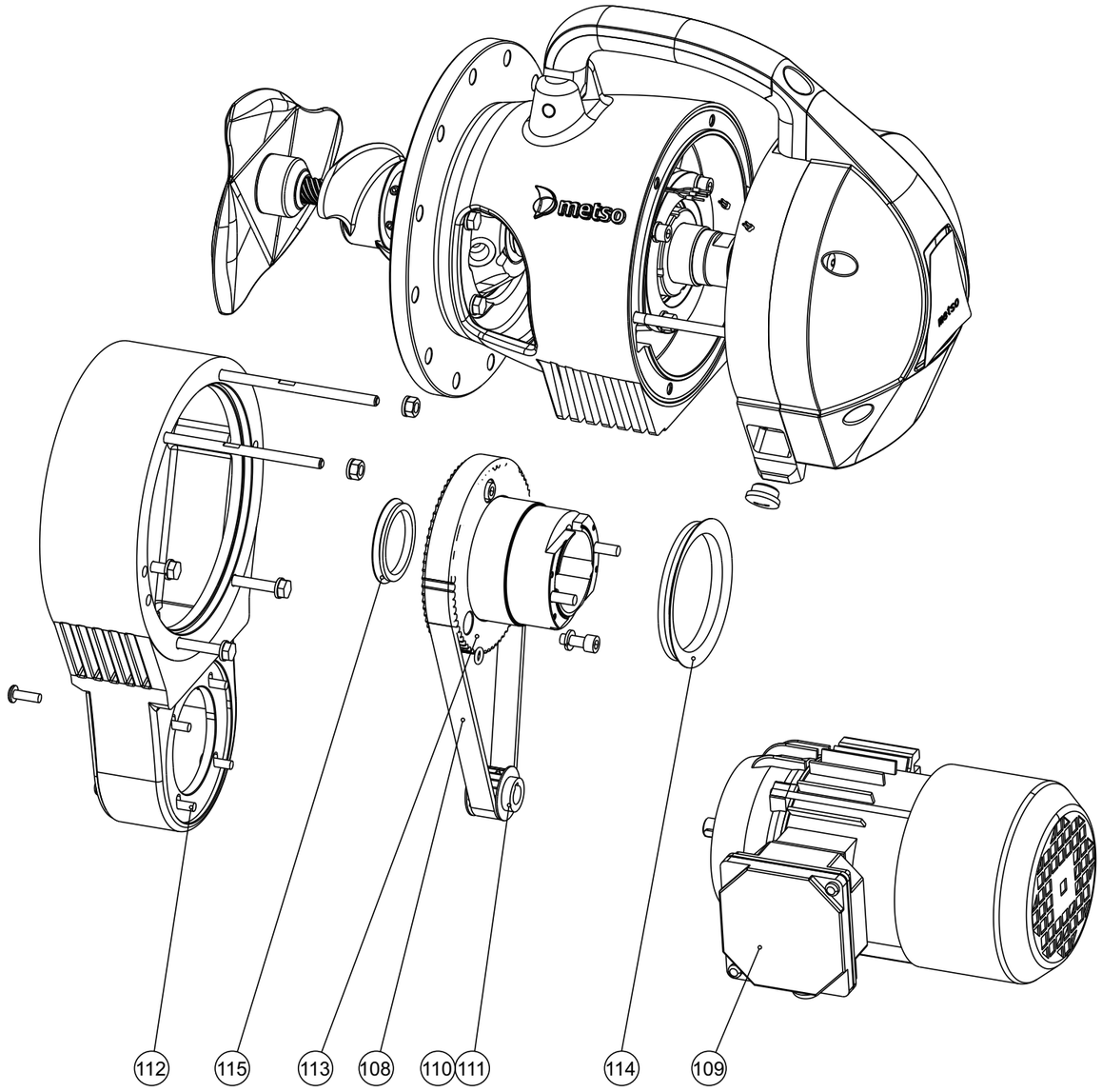




12. Spare parts drawing, MD model



13. Spare parts drawing, BD model



Metso Rotating Consistency Transmitter - Spare parts

* **Recommended spare parts with one unit installed**
** **Recommended spare parts when several units are installed at the mill**
*** **Recommended spare parts when several units installed and all service is done locally**

*	**	***		K09400	Circuit board set, Sensor electronics	set contains:	Qty
			101	K08337	Circuit board assembly		1
			102	217604	Socket head screw	M3X5 DIN912	4
			103	135517	Lock washer	M3 DIN127	4

*	**	***		K09402	Mechanical seal set, SS	set contains:	Qty
			104	K08327	Mechanical seal JCSW	AISI316L	1
			105	218446	Socket head screw	M6X12 DIN912	4
			106	135533	Spring washer	M6.1 DIN127B	4
				K09403	Mechanical seal set, SMO	set contains:	Qty
			104	K09142	Mechanical seal JCSW	254 SMO	
			105	218446	Socket head screw	M6X12 DIN912	4
			106	135533	Spring washer	M6.1 DIN127B	4

					Process flange seals		Qty
*	**	***	107	K08615	O-ring, 160x5	EPDM, for S25 flange	1
*	**	***	107	T00363	O-ring, 215.27x5.33	EPDM, for L10/L25 flange	1

*	**	***	108		Drive belt, BD model only		Qty
			108	K08349	Drive belt	5M-550-15 HTD	1

					Sensing element fastening parts		Qty
*	**	***	140	197699	Socket Head Screw	M6x16 DIN912 A4	1
*	**	***	140	K09127	Socket Head Screw	M6x16 DIN912 254SMO	1
*	**	***	141	K08977	Lock Washer	NL6 254SMO Nord-Lock	1

	**	***	109		BD Motor		Qty
			109	K08347	BD1, 220-240/380-420 50Hz 440-480 60Hz		1
			109	K08982	BD2, 380-420/660-690 50Hz 440-480 60Hz		1
			109	K09426	BD3, 500-550 50Hz 550-575 60Hz		1
			109	K09427	BD4, 200-220 60Hz		1

	**	***		K09404	BD motor accessory set	set contains:	Qty
			110	K08244	Belt roller	HTD 18-5M-15	1
			111	01103369	Slot set screw	M4X4 DIN916	1
			112	K08550	Socket head screw	M5X16 ISO7380	4

	**	***		K09405	BD drive set	set contains:	Qty
			108	K08349	Drive belt	5M-550-15 HTD	1
			110	K08244	Belt roller	HTD 18-5M-15	1
			111	01103369	Slot set screw	M4X4 DIN916	1
			113	K08242	Belt roller	HTD 72-5M-15	1
			114	K08703	V-ring	VA-70 AF15 NBR	1
			115	K07098	V-ring	VA-38 AF15 NBR	1

			116		Operating units		Qty
	**	***	116	K09173	Operating unit, TCU	for BDx models	1
	**	***	116	K09176	Operating unit, TCU	for MD models	1
	**	***		OUL00284	Keyboard TCU		1
	**	***		K09475	Operating unit, TCU PA	for BDx models	1
	**	***		K09476	Operating unit, TCU PA	for MD models	1

Metso Rotating Consistency Transmitter - Spare parts

* **Recommended spare parts with one unit installed**
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*** **Recommended spare parts when several units installed and all service is done locally**

		***		**K09406**	**Drive shaft set, SS**	**set contains:**	**Qty**
			106	135533	Spring washer	M6.1 DIN127B	4
			115	K07098	V-ring	VA-38 AF15 NBR	1
			117	K07754	Drive shaft SS	AISI316L	1
			118	K08334	Ball bearing	3207 A-2Z/MT33	1
			119	K08333	Ball bearing	6007-2RS1	1
			120	K06110	Cylindrical pin, SS	2X10 DIN7 SS	1
			121	197699	Socket head screw	M6X16 DIN912 SS	4
			122	K08336	Lock nut	KMK7 M35X1.5	1
			123	K09139	V-ring	VA-30 (mechanical seal)	1
			124	K09409	Measuring shaft bearings set		1
		***		**K09407**	**Drive shaft set, SMO**	**set contains:**	**Qty**
			106	135533	Spring washer	M6.1 DIN127B	4
			115	K07098	V-ring	VA-38 AF15 NBR	1
			117	K09029	Drive shaft SMO	254 SMO	1
			118	K08334	Ball bearing	3207 A-2Z/MT33	1
			119	K08333	Ball bearing	6007-2RS1	1
			120	K09126	Cylindrical pin, SMO	2X10 DIN7 SMO	1
			121	197699	Socket head screw	M6X16 DIN912 SS	4
			122	K08336	Lock nut	KMK7 M35X1.5	4
			123	K09139	V-ring	VA-30	1
			124	K09409	Measuring shaft bearings set		1
			Notes:	Measuring shaft package could be needed if components are worn or damaged. Mechanical seal package could also be needed if the seal is worn and/or damaged.			

		***		**K09408**	**Measuring shaft set**	**set contains:**	**Qty**
			125	K07771	Measuring shaft	AISI316L	1
			126	K08657	Pipe assembly	Bellow HC	1
			127	K08614	O-ring	18X2 FFKM	1
			Note:	Always include Measuring shaft bearing package if the shaft is being replaced			

		***		**K09409**	**Measuring shaft bearings set**	**set contains:**	**Qty**
			128	T00435	Locking ring	22X1 DIN472	1
			129	256743	Locking ring	12x1 DIN471	1
			130	T00368	Ball bearing	61801-2Z	2

		***	**132**		**MD motor**		**Qty**
				K08878	Motor assembly, MD model	MD-model	1

		***		**K09411**	**Optical disc set**	**set contains:**	**Qty**
			102	217604	Socket head screw	M3X5 DIN912	8
			103	135517	Lock washer	M3 DIN127	8
			135	K07008	Cog wheel		2
			136	53321405	Screw	M4x10 DIN916 A4	4
			137	135707	Hexagon nut	M4 DIN934	4

	Process temperature measurement		**Qty**
138	K08554	Thermoelement assembly	1

Metso Rotating Consistency Transmitter - Spare parts

* **Recommended spare parts with one unit installed**
** **Recommended spare parts when several units are installed at the mill**
*** **Recommended spare parts when several units installed and all service is done locally**

		***	**21**	**K08589**	**Mounting set S25**	**set contains:**	**Qty**
			22	K0274	Hexagon screw	M8X25 DIN933	11
			23	135608	Washer	8,4 DIN125	12
			24	T00433	Pin bolt	M8X40 DIN939	1
			25	56022800	Hexagon nut	M8 DIN934	1
		***	**21**	**K09116**	**Mounting set L10**	**set contains:**	**Qty**
			22	K0274	Hexagon screw	M8X25 DIN933	15
			23	135608	Washer	8,4 DIN125	16
			24	T00433	Pin bolt	M8X40 DIN939	1
			25	56022800	Hexagon nut	M8 DIN934	1
		***	**21**	**K09117**	**Mounting set L25**	**set contains:**	**Qty**
			22	T00590	Hexagon screw	M10X35 DIN933	15
			23	162958	Washer	10.5 DIN125	16
			24	T00591	Pin bolt	M10X45 DIN939	1
			25	56022810	Hexagon nut	M10 DIN934 A4	1

		***	**12**	**K09006**	**Seal water piping set**	**set contains:**	**Qty**
			13	T00415	Pressure restrictor	Rubber	1
			14	T00414	Pipe, water flushing		2
			15	T00417	Y-fitting	G1/4	1
			16	T00418	Cap nut	G1/4	1
			17	85548188	Flow direction arrow		1
			18	04053000	Hose coupling	1/4X13	1

		***		**Closing flange sets**	
			K09174	Closing flange set, S25 SS	AISI 316
			K09175	Closing flange set, S25 SMO	254 SMO
			K08603	Closing flange set, L10 SS	AISI 316
			K08604	Closing flange set, L25 SS	AISI 316

		***		**Process coupling sets**	
			K09423	Process coupling set SS, S25	AISI 316 / PN25
			K09425	Process coupling set SMO, S25	254 SMO / PN25

		***		**Mounting chambers**	
			K09214	Mounting chamber DIN 150 SS W PN10 90mm	AISI 316
			K09213	Mounting chamber DIN 150 SS W PN10 150mm	AISI 316
			K09212	Mounting chamber DIN 100 SS W PN10 90mm	AISI 316
			K09144	Mounting chamber DIN 100 SS W PN10 150mm	AISI 316

Metso Rotating Consistency Transmitter - Spare parts

* **Recommended spare parts with one unit installed**
** **Recommended spare parts when several units are installed at the mill**
*** **Recommended spare parts when several units installed and all service is done locally**

		***		**Complete sensor assemblies**	
			K09108	Sensor assembly TMP SS L10 MD	AISI 316
			K09211	Sensor assembly TMH SS L10 MD	AISI 316
			K08613	Sensor assembly TMP SS L10 BD1	AISI 316
			K08983	Sensor assembly TMP SS L10 BD2	AISI 316
			K09007	Sensor assembly TMP SS L25 BD2	AISI 316
			K08562	Sensor assembly THP SS S25 MD	AISI 316
			K09202	Sensor assembly THH SS S25 MD	AISI 316
			K09111	Sensor assembly THH SS L10 MD	AISI 316
			K08593	Sensor assembly THP SS S25 BD1	AISI 316
			K09180	Sensor assembly THP SS S25 BD2	AISI 316
			K09114	Sensor assembly PMH SS S25 MD	AISI 316
			K09112	Sensor assembly PMH SS L10 MD	AISI 316
			K09200	Sensor assembly PMH SS L25 MD	AISI 316
			K09209	Sensor assembly PMH SMO S25 MD	254 SMO
			K09205	Sensor assembly PMH SS S25 BD1	AISI 316
			K09197	Sensor assembly PMH SS L25 BD1	AISI 316
			K09203	Sensor assembly PMH SS S25 BD2	AISI 316
			K09196	Sensor assembly PMH SS L25 BD2	AISI 316
			K09115	Sensor assembly PHH SS S25 MD	AISI 316
			K09113	Sensor assembly PHH SS L10 MD	AISI 316
			K09201	Sensor assembly PHH SS L25 MD	AISI 316
			K09210	Sensor assembly PHH SMO S25 MD	254 SMO
			K09206	Sensor assembly PHH SS S25 BD1	AISI 316
			K09199	Sensor assembly PHH SS L25 BD1	AISI 316
			K09207	Sensor assembly PHH SS S25 BD2	AISI 316
			K09198	Sensor assembly PHH SS L25 BD2	AISI 316

		***	**142**	**Sensing elements**	
			142	K06101	Sensing element TM SS	AISI 316
			142	K08339	Sensing element TH SS	AISI 316
			142	K08517	Sensing element PM SS	AISI 316
			142	K07673	Sensing element PH SS	AISI 316
			142	K09368	Sensing element TMC SS	AISI 316
			142	K09324	Sensing element THC SS	AISI 316
			142	K09370	Sensing element PMC SS	AISI 316
			142	K09372	Sensing element PHC SS	AISI 316
			142	K09123	Sensing element PM SMO	254 SMO
			142	K09124	Sensing element PH SMO	254 SMO
			142	K09371	Sensing element PMC SMO	254 SMO
			142	K09373	Sensing element PHC SMO	254 SMO

		***	**143**	**Propellers**	
			143	K08501	Propeller large SS	AISI 316
			143	K08493	Propeller small SS	AISI 316
			143	K08518	Hub SS	AISI 316
			143	K09122	Hub SMO	254 SMO

		***	**144**	**Propeller locking screws**	
			144	K09032	Socket head screw M6x10 DIN914	AISI 316
			144	K09125	Socket head screw M6x10 DIN914	254 SMO

Metso Rotating Consistency Transmitter — Technical specification

Sensor part

- Rotating shear force based transmitter for pulp consistency measurement in pulp and paper industry.
- Sensing element selection based on pulp type and measured consistency range.
- Selection of process coupling / mounting chamber (option) based on process pipe diameter and pressure rating **– see table 1**

Table 1. Sensors and consistency ranges by pulp type.

Pulp type	Sensor type			
	TM	TH	PM	PH
SW chem.pulp	1.5 – 6	1.5 – 7	6 – 9	7 – 15
HW chem.pulp	1.6 – 7	1.6 – 8	6.5 – 10	8 – 16
GW	1.7 – 7	1.7 – 8	7 – 10	8.5 – 16
TMP	1.7 – 7	1.7 – 8	7 – 10	8.5 – 16
RCF	1.8 – 8	1.8 – 9	7.5 – 11	9 – 18

Measurement
Measuring range..... 1.5–18 % Cs
Span minimum ..... 1.0 % Cs
Repeatability ..... ± 0.01 % Cs
Sensitivity..... 0.004 % Cs
Damping ..... adjustable, 1–60 sec.

Materials
Enclosure..... Aluminum / Polycarbonate
Wetted parts..... AISI 316L (standard) / 254 SMO®
O-ring material..... EPDM / FFKM (SMO)

Process conditions
Temperature..... 0 to +120°C (+32 to +248°F)
Flow velocity..... 0.3–5 m/sec
pH 1.5–13
Pressure rating..... PN10/150 lbs, PN25/363 lbs
Vibration..... max. 2G (20 m/s^2), 10–2000 Hz

Sealing water
Temperature..... max. 60°C (140°F)
Pressure ..... 0.5–9 bar (7.3–130.5 psi)
Flow rate..... 0.6–1 L / minute
Quality ..... no impurities, mech. cleaned particle size < 200µm
* For operation without water flushing please consult Metso

Motor – MD models
Power supply..... from motor controller (in TCU)
Power rating ..... 0.35 kW
Enclosure class ..... IP65 (NEMA 4X) when installed

Motor – BD models (see table 2)
Power supply..... 200–690 VAC (three-phase), 45–65 Hz
Power rating ..... 0.25 kW
Enclosure class ..... IP55 (option: IP56)

Table 2. Motor voltages & connections.

Frequency		50 Hz		60 Hz	
Connection		Delta	Star	Delta	Star
Motor type	BD1	220–240	380–420	–	440–480
	BD2	380–420	660–690	440–480	–
	BD3*	–	500–550	–	550–575
	BD4**	–	–	200–220	–
	MD	220-240VAC			

BD3* – Non-standard, CSA safety certificate available on request.
BD4** – Non-standard, also available for other voltage or frequency ratings on request.

Environment
Ambient temperature
- BD model..... -20 to +70°C (-4 to +158°F)
- MD model ..... -20 to +50°C (-4 to 122°F)

Temp. during storage..... -50 to +80°C (-50 to +176°F)

EMC test standards
Radiated interference..... IEC 61000-6-2
Interference immunity..... IEC 61000-6-4

Weight
MD model (motor drive)
- sensor + S25 flange..... 21 kg (46.3 lbs)
- sensor + L10 flange ..... 24 kg (52.9 lbs)
- sensor + L25 flange ..... 27.5 kg (60.6 lbs)

BD model (belt drive)
- sensor + S25 flange..... 23 kg (50.7 lbs)
- sensor + L10 flange ..... 26 kg (57.3 lbs)
- sensor + L25 flange ..... 29.5 kg (65 lbs)

Metso Rotating Consistency Transmitter — Technical specification

Metso Rotating Consistency Transmitter: order codes	Communication	Sensing element	Propeller / Hub	Wetted parts	Flange type	Motor type	Special option
MA: ma+HART® **PA:** Profibus PA							
TM: 1.5–8 %Cs **TH:** 1.5–9 %Cs **PM:** 6–11 %Cs **PH:** 7–18 %Cs **C:** (special coated sensing element)							
P: Propeller **H:** Hub							
SS: AISI 316L **SMO:** 254 SMO® **C** (special coated wetted parts)							
L10: large flange, PN10 **L25:** large flange, PN25 **S25**: small flange, PN25							
BD1: 220–480 VAC, 3-phase **BD2:** 380-690 VAC, 3-phase **BD3:** 550–575 VAC, 3-phase **BD4:** 200–220 VAC, 3-phase **MD:** 220-240 VAC, 1-phase motor controller							
A							

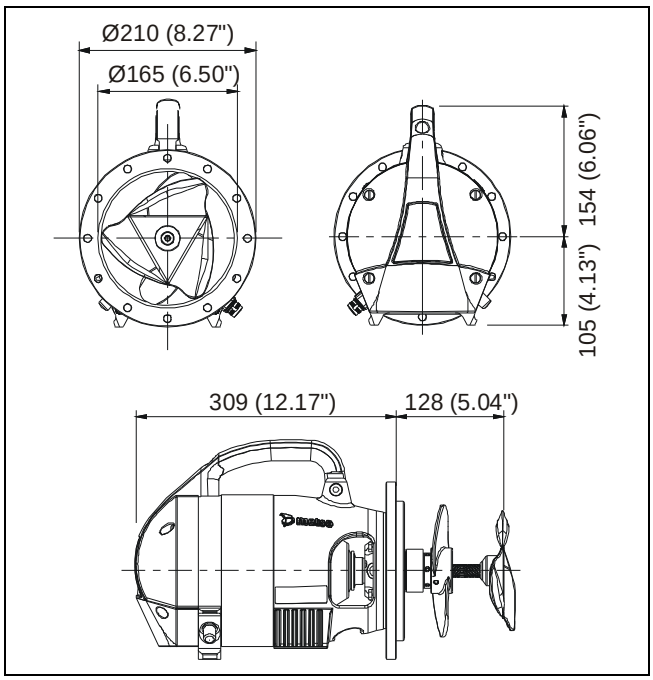
Special option (for future use)

Examples of order codes:

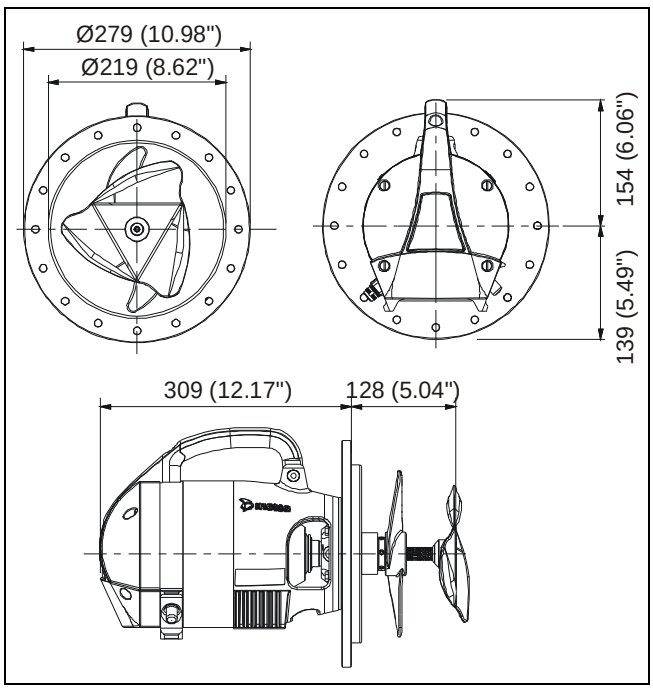
Metso Rotating Consistency Transmitter
MA THC P SS S25 MD

Metso Rotating Consistency Transmitter
MA PH H SMO L25 BD2

Dimensions, MD-model, small flange (S25)



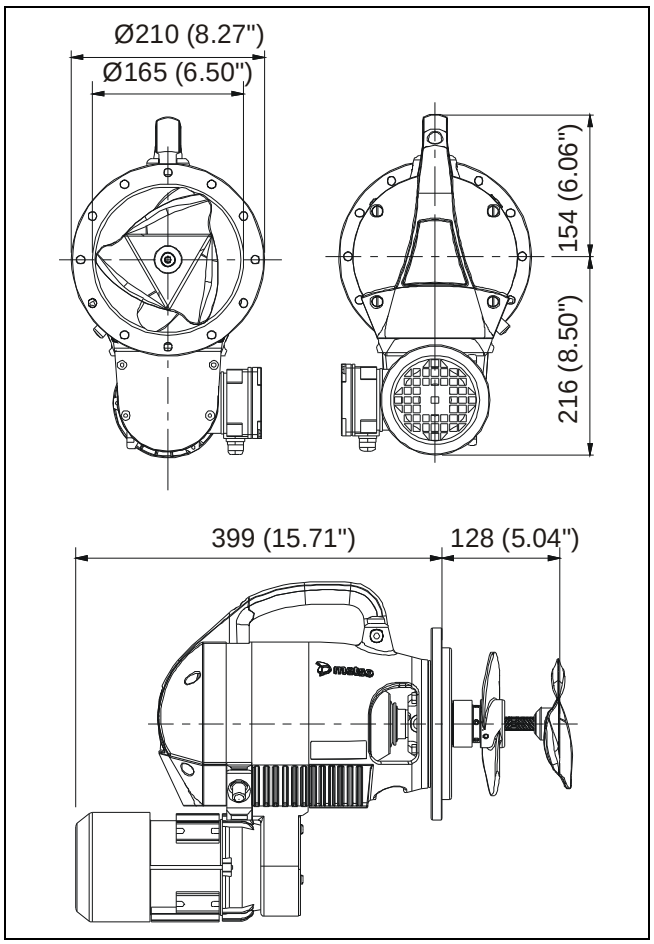
Dimensions, MD-model, large flange (L10 / L25)



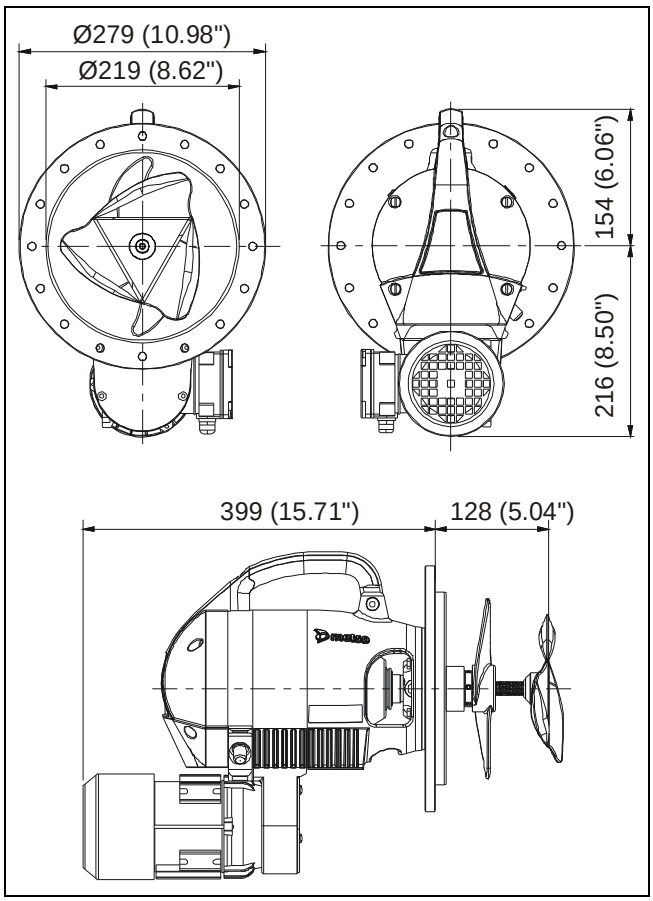
Metso Rotating Consistency Transmitter

Technical specification

Dimensions, BD-model, small flange (S25)



Dimensions, BD-model, large flange (L10 / L25)



Metso Rotating Consistency Transmitter — Technical specification

Operating unit TCU

Connections
Cable to sensor ..... length 10 m (33 ft)
- option..... length 20 m (66 ft)

Motor controller cable ..... length 10 m (33 ft)
- option..... length 20 m (66 ft)

Operating power
- TCU..... 90–260 VAC / 25 W
- TCU + motor controller .. 200–240 VAC / 375 W

Connections to mill system
- Analog outputs ..... 2 current outputs, 4–20 mA; second output configurable
- HART®..... 12–35 VDC
- Binary inputs ..... 2 inputs, galvanically isolated 12–28 VDC / 10 mA

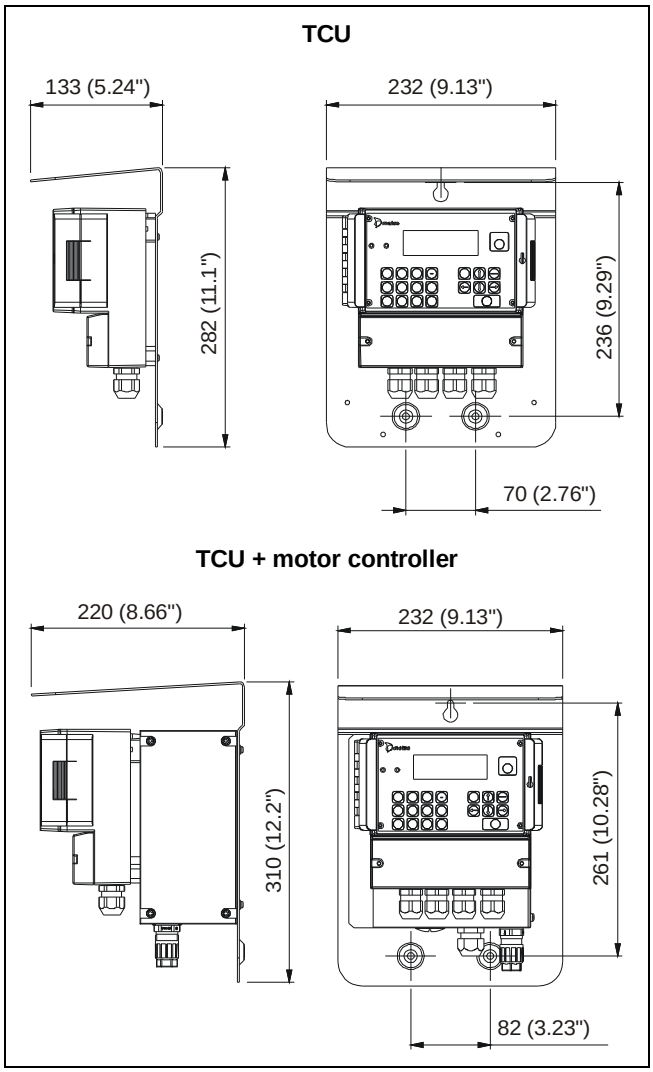
PROFIBUS PA Slave (option)
IEC 61158-2
- Profibus power supply ... taken from the bus
- Bus voltage ..... 9–32 VDC, reverse polarity protection
- Max. basic current ..... 14.2 mA

Connections to PC (configuration & diagnostics)
- DTM for FieldCare™..... HART®
- PC-connection (service). RS-232

Environment
Ambient temperature ..... max.50°C (max.122°F)
Enclosure class ..... IP65 (NEMA 4)
Vibration
- TCU..... max. 1 G (10 m/s^2), 10–2000 Hz
- TCU + motor controller .. max. 0.5 G (5 m/s^2), 10–2000 Hz

Weights
TCU..... 2 kg (4.4 lbs)
TCU + motor controller..... 6.7 kg (14.8 lbs)

Dimensions



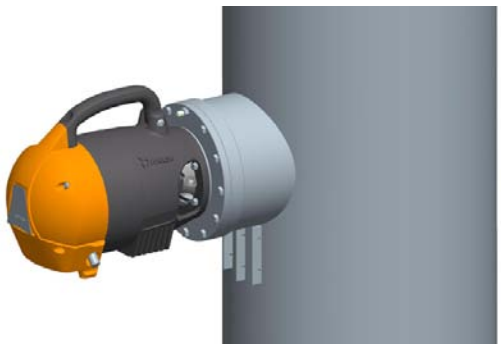
Metso Rotating Consistency Transmitter — Technical specification

Options

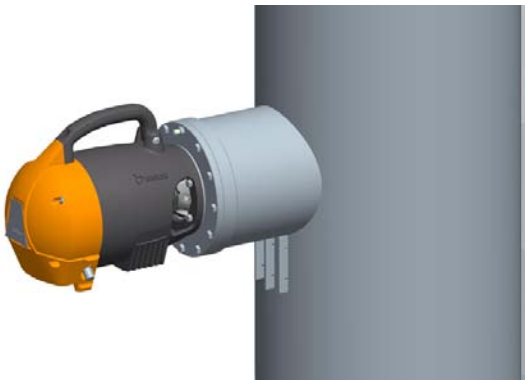
PN25 process coupling; used when process pipe diameter is 200 mm (8") or larger.

- Deflectors included, profiling and deflector mounting by customer.

Process coupling, profiled to 90 mm, used when consistency is > 5%

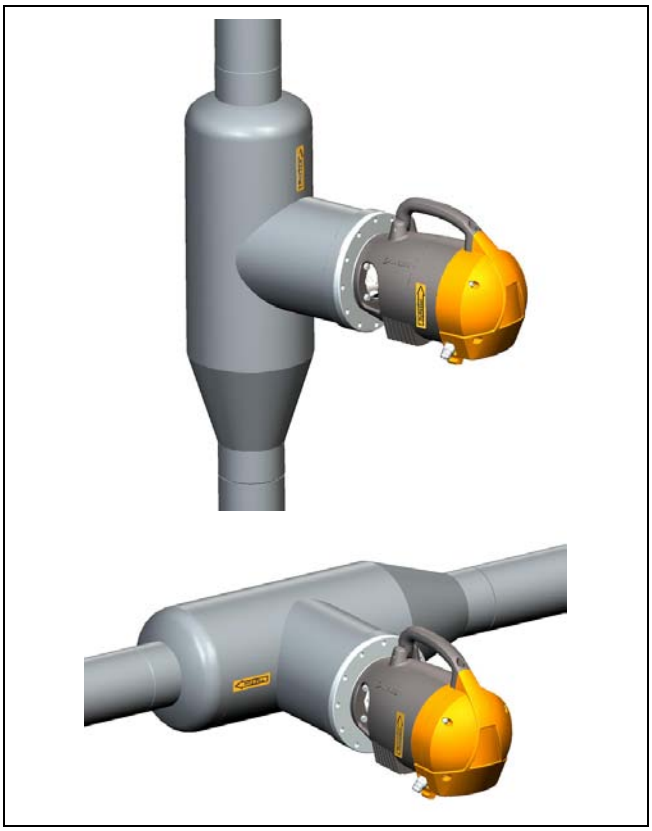


Process coupling, profiled to 150 mm, used when consistency is < 5 %



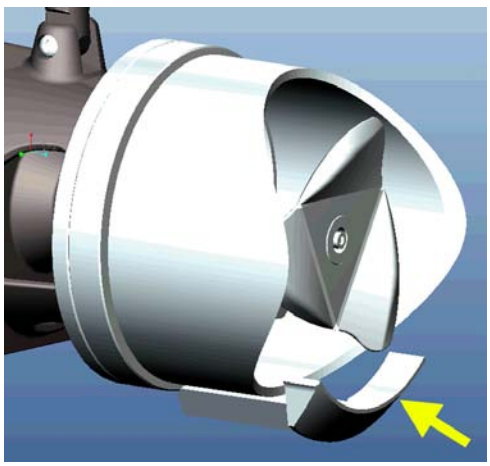
PN10 mounting chamber; used when process pipe diameter is 150 mm (6") or smaller

- Chamber 90 mm or 150 mm
- Deflectors to be used with the 90 mm chamber (chamber and deflectors mounted by Metso.



Protection bar

- Used instead of deflector plates when measuring unscreened pulp and extra protection is needed



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