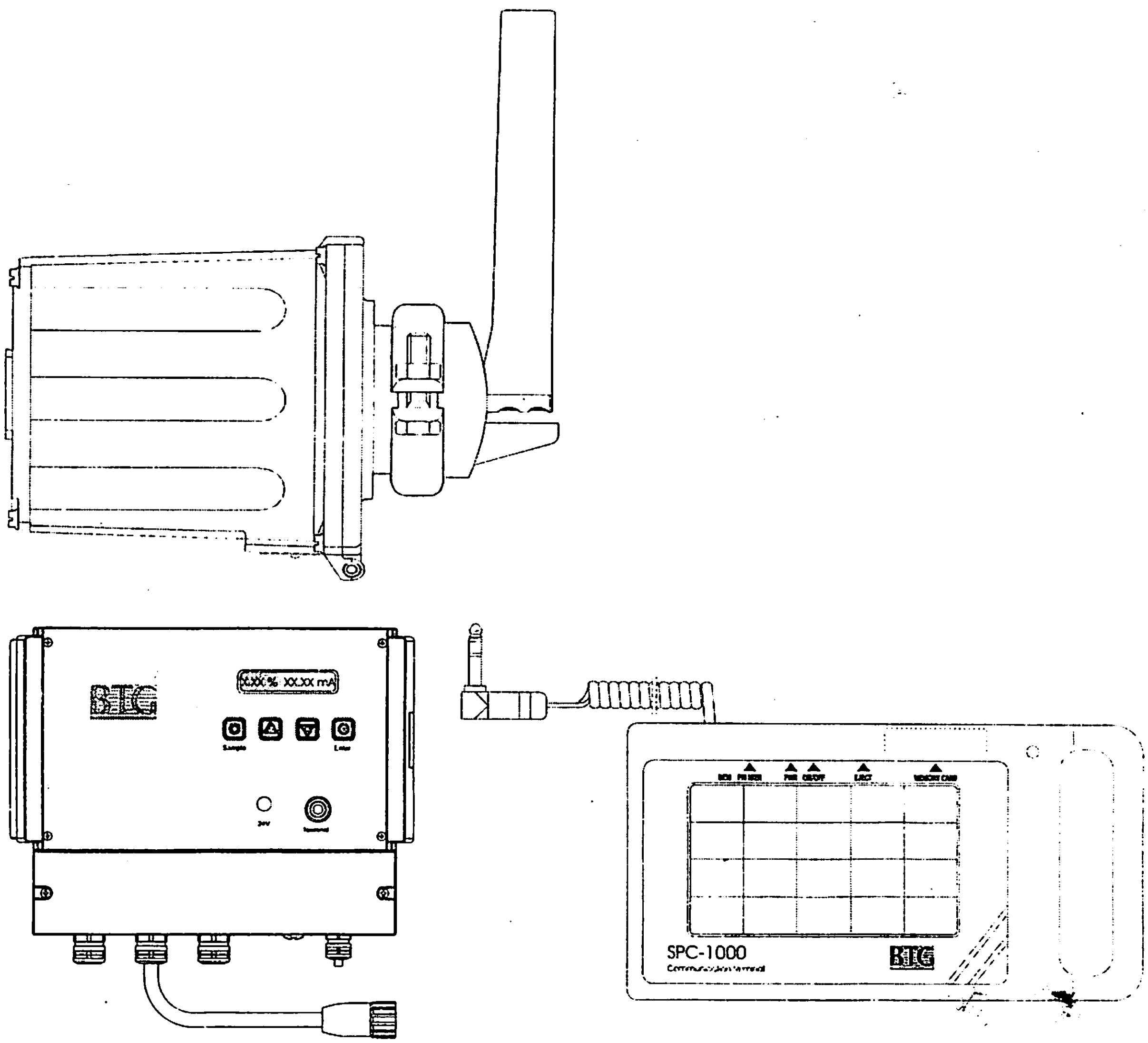
User Manual

MBT-2300 with JCT-1100

Smart Moving Blade Consistency Transmitter



M218.25/3en

2 Installation Instructions

2.1 Important information

The Consistency Transmitter is a precision tool and must be properly installed to ensure reliable service. So please, read the following instructions and user information before installing the transmitter.

This instruction manual contains installation instructions for the BTG moving blade consistency transmitter type MBT-2300.

2.1.1 Installation and Operating Conditions

The transmitter is designed and manufactured to provide accurate and reliable measurements through prolonged usage.

⇨ **Correct installation and regular maintenance according to the Service Manual will ensure maximum operating life of the transmitter.**

For Safety precautions please refer to SR218.25/2. Product type plate information see section 2.8

- Install the transmitter so that it is **protected** from direct mechanical damage.
- To protect the junction box from water or pulp spray install it under a roof overhang. If installed outdoors the roof will also protect the unit from direct sunlight and rain.
- Protect the transmitter from heavy vibration sources such as cavitating or unbalanced pumps.
- Install the transmitter at the **correct distance** from a pump, pipe elbow or valve.
- Wetted parts and sensing element, must be of the **correct material** for the specific application. Contact your BTG representative for information and advise.
- The main power voltage/frequency must be within acceptable limits and be protected against transient sources such as electrical storms or other electrical equipment.
- Make sure signal cables are located away from the power cables.
- Install the sampling valve – a BTG valve is recommended – close to the transmitter. This way the lab. sample will be representative of the sample measured by the consistency transmitter.

2.2 Before you start

2.2.1 Introduction

This manual contains instructions for planning and implementing the installation of the BTG MBT-2300 in-line moving blade type consistency transmitter.

The MBT-2300 is one of the basic models in a series of highly specialized transmitters optimized for their individual application ranges.

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

When you are satisfied that your MBT-2300 has been correctly installed and you are ready to power up the system for calibration, please turn to:

section 2.7: ***Quick start checklist.***

Double check items in the list before powering up. This list can help ensure trouble-free initialization of your system.

Following this introductory section (section 2.2) are the following:

2.3. Basic system description:

This section introduces the essential components of the system. It also includes important information about the dimensions of the components, including working space and installation clearance requirements.

2.4. Planning an installation:

This section is vital to the correct layout of the system components for the end-user, engineer and/or consultant. It contains advice on locating the transmitter in your process.

2.5. Installing the transmitter:

This section contains detailed instructions for installing the transmitter and weld-in stud.

2.6. Installing the junction box type JCT-1100

2.7. Quick start checklist

2.8. Type sign explanation

2.9. Miscellaneous

2.2.2 Visual inspection

This product was inspected and tested prior to shipment. However, even the best products can sustain shipping damage that will only be seen if the product is inspected. Before proceeding, check the transmitter, the hand-held terminal and the junction box for shipping damage. Look for loose screws, wires or electronic components.

2.3 Basic system description

2.3.1 The system

The system consists of a transmitter connected by a system cable to a junction box type JCT-1100. The junction box is normally supplied by BTG, but can also be supplied by the customer under certain conditions. To set up the transmitter a handheld terminal type SPC-1000 must first be connected (see fig 1).

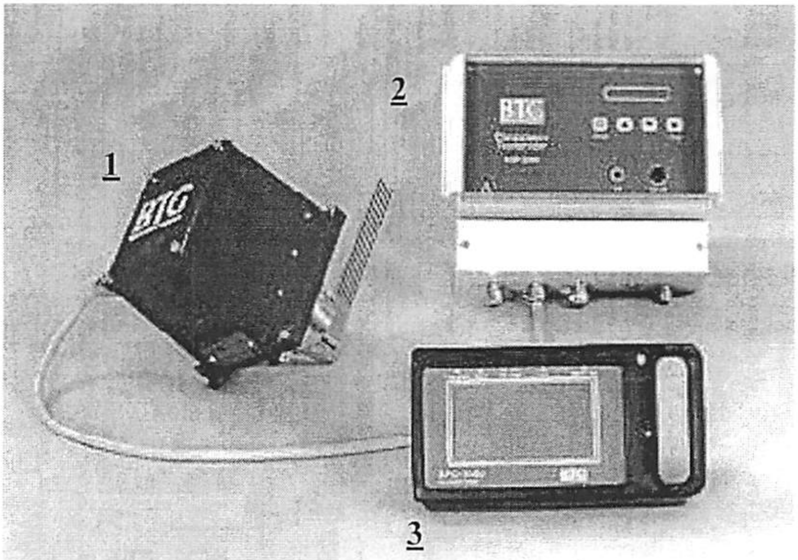


Fig 1 MBT-2300

1 Transmitter
2 Junction box type JCT-1100
3 Handheld terminal type SPC-1000

The transmitter contains measurement devices and electronic circuitry for signal conversion. It is mounted in a stud, welded to the pipe system.

The hand-held terminal allows the operator to set up and monitor the system, and includes a liquid crystal display (LCD) with a touchscreen keypad.

2.3.1.1 Conformity to CE directives and CSA approval

The entire system, consisting of the junction box (including the BTG original power supply), the transmitter and the hand-held terminal and the specified connecting cables (see the Installation instructions section of the JCT-1100 manual included in this manual) is designed to meet the following CE directives and their associated standards:

- Machine-Directive 93/44/EEG
- EMC-Directive 89/336/EEG
- Low voltage directive 73/23/EEG

The junction box JCT-1100 is CSA approved

2.3.2 Working space and installation clearance requirements

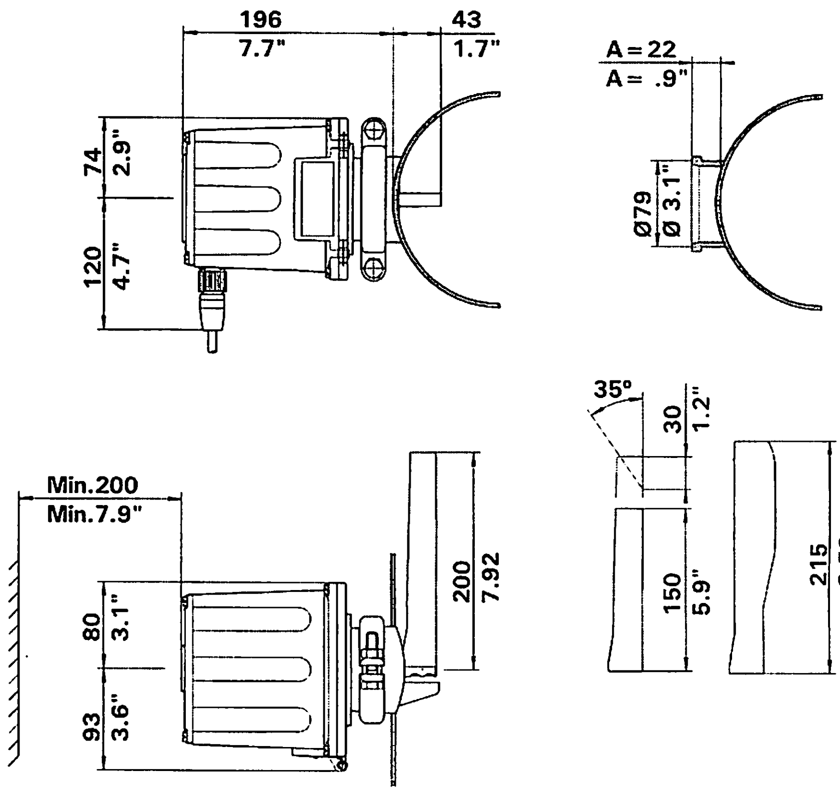
Always ensure that there is sufficient clearance for the full depth of the system before installing the junction box, transmitter and necessary components. **Make allowance for the need to open the junction box and connecting the hand-held terminal, removing the transmitter from its mounting assembly, as well as allowing sufficient working space to do this. It is the responsibility of the end-user to ensure adequate working space is available.**

⇨ **For unit conversions please refer to section 2.9.3 on page 38.**

2.3.2.1 Transmitter

The dimensions of the transmitter are given in fig 2.

Fig 2 Transmitter dimensions (mm/in)



The transmitter, including sensor, is approximately 240 mm (9.4 in) long. In addition to the installed length of the transmitter, which will be 196 mm (7.7 in), you will need a minimum of an additional 200 mm (8 in) for extracting the transmitter from the pulp line. Leave sufficient room around the transmitter to perform this task.

The transmitter weighs approximately 5,5 kg (12,1 lbs).

⚠ **Remember to provide access room for an operator, as well as the full depth of the transmitter and junction box.**

2.3.2.2 Junction box type JCT-1100

For information regarding the System description for JCT-1100, see the Product introduction section of the JCT-1100 manual included in this manual.

For information regarding the dimensions, installation clearances, etc. for JCT-1100, see the Installation instructions section of the JCT-1100 manual included in this manual.

2.3.2.3 Handheld terminal type BTG SPC-1000

The dimensions of the handheld terminal are given in fig 3.

Fig 3 Hand-held terminal type SPC-1000, dimensions (mm/in)

1 Telephone jack to junction box
2 Touchscreen
3 Rubber casing

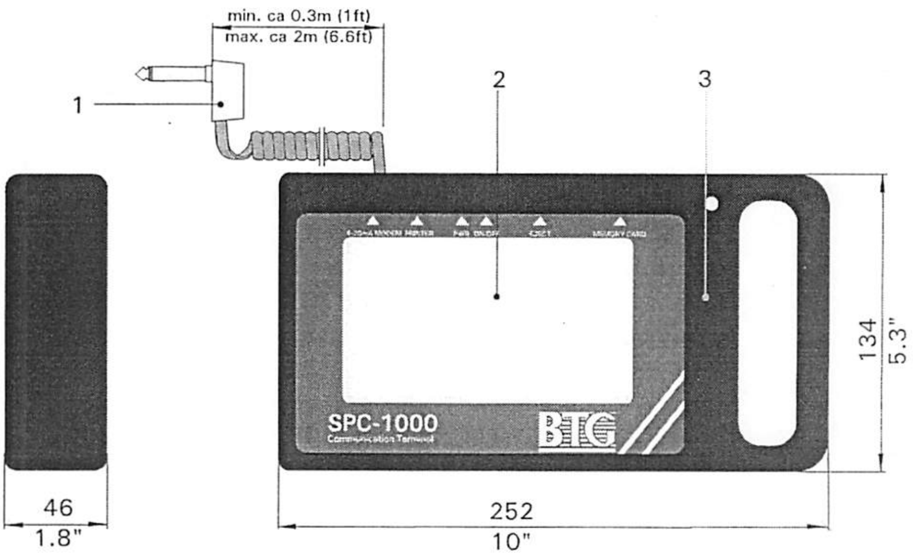
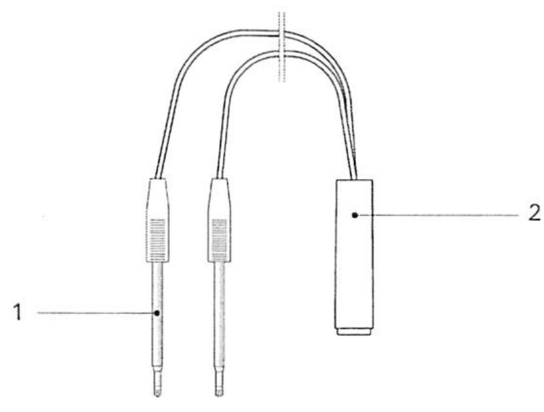


Fig 4 Adapter for terminal connection (included with SPC-1000 delivery)

1 Minigrippers
2 Connection for SPC-1000 telephone jack



2.3.2.4 Materials

All the materials used in the exposed surfaces of the MBT-2300 system are suitable for use in pulp and paper mill environments.

The system cable is sheathed in PVC. The transmitter housing is made of cast aluminium painted with alcyde paint.

Materials used in the submerged parts of the transmitter, i.e. the transmitter itself and weld-in stud are selected based on process conditions, and may be either stainless steel or Hastelloy.

2.4 Planning the installation

2.4.1 Advice and recommendations

**Calculate the dilution water control valve correctly and use a high quality precision actuator. Make sure that the dilution water pressure is stable and that the water is injected at high velocity into the pump suction.
Correct dilution is essential to ensure reliable transmitter operation!**

The MBT-2300 is a precision instrument designed to provide accurate and reliable measurements over a long period of time. To make sure of obtaining the best possible results, please note the following recommendations and advice when planning your installation.

Dilution

Dilution water should be pressure controlled or otherwise protected from major pressure variations.

To ensure good control, dilute no more than approx. 20% in each dilution stage, though a higher percentage may be acceptable early in the process.

If considerable dilution is required it should be carried out in two stages, 70% to 80% of the water being added in the bottom part of the pulp chest and the remainder in the form of a fine dilution upstream of the pump.

Thorough mixing at the bottom of the pulp chest upstream of the transmitter is vital, to avoid consistency variations.

The dilution water pipe should be inserted in such a way that it extends a minimum of 15 - 50 mm (0.6 - 2 in depending upon pipe size) into the main pipe on the suction side of the pump. See fig 5. The pipe must be inserted perpendicular to the suction stud. The pipe should be located at 1/3 of the distance between the pump and the chest, measured from the pump, to avoid back flow into the chest.

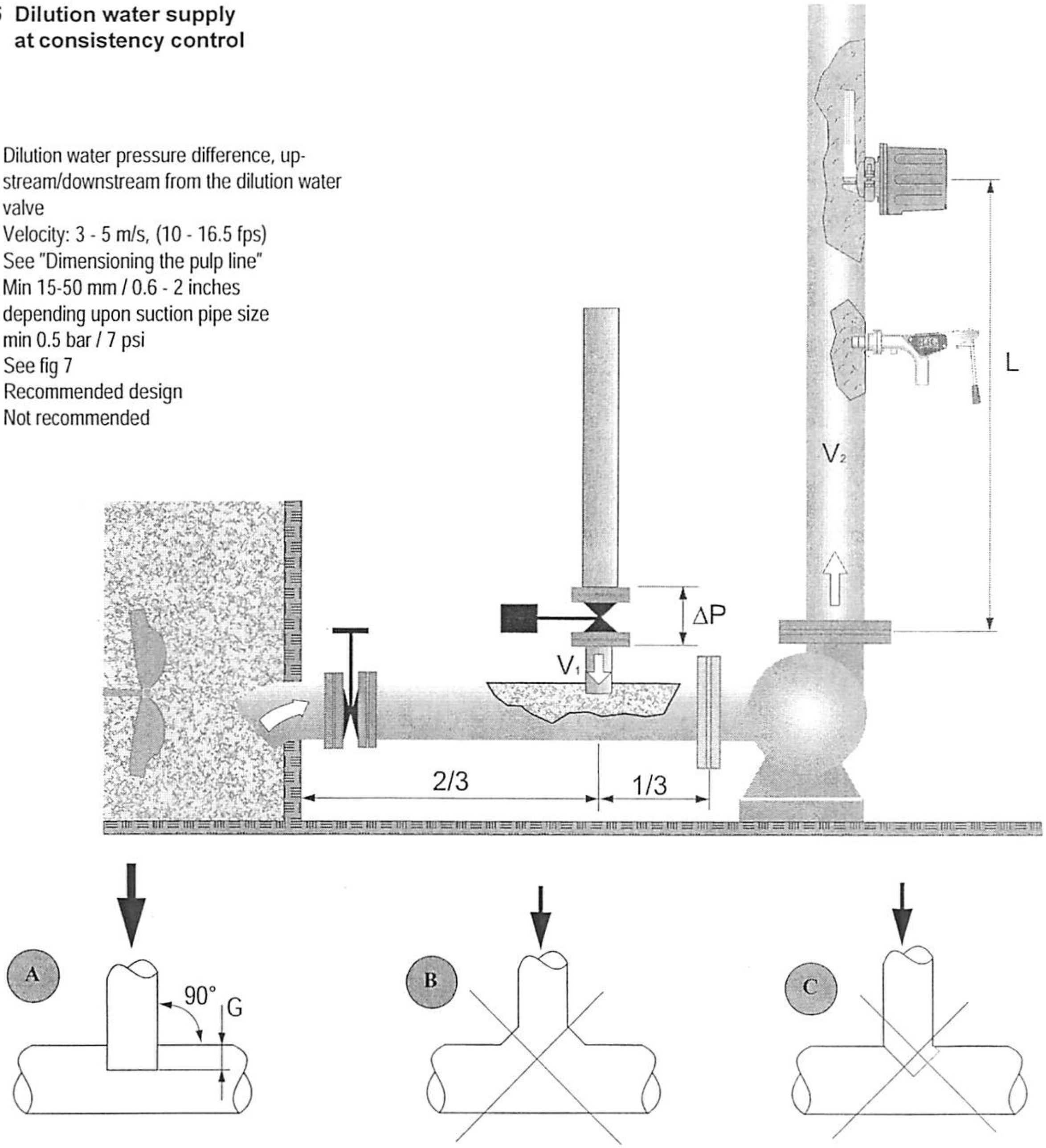
At the point of injection the dilution water pipe should be dimensioned to produce a rate of flow 3 - 4 times larger than the flow in the main pipe. Typically this means a dilution water flow 3 - 5 m/s (10 - 16.5 fps). The dilution water pipe should have the same or larger dimension as the valve bore to prevent the valve being plugged by pulp at water pressure loss.

Choose a dilution water valve with linear characteristics. The pressure drop over the valve should be at least 0.5 bar (7 psi) and should exceed 25% of the total pressure drop in the dilution water line. The valve and its actuator must operate with the least possible backlash and smallest possible dead zone. The valve must be tight when in its closed position. See fig 5.

⇨ **See section 2.9.1; How to calculate the dilution water valve.**

Fig 5 Dilution water supply at consistency control

Δ p = Dilution water pressure difference, upstream/downstream from the dilution water valve
V1 = Velocity: 3 - 5 m/s, (10 - 16.5 fps)
V2 = See "Dimensioning the pulp line"
G = Min 15-50 mm / 0.6 - 2 inches depending upon suction pipe size
Δ p = min 0.5 bar / 7 psi
L = See fig 7
A = Recommended design
B/C = Not recommended



Do not use saddles in dilution water piping see fig 5 (B).

Location of the dilution water valve:

The conventional method is to install the valve above the highest pulp level in the chest, to prevent pulp from entering the dilution pipe and valve during a shutdown. With modern large chests it is not always possible to meet this requirement.

Valve location **as close as possible to the suction pipe wall** is recommended.

Dimensioning the pulp line - See fig 5 - V_2

The transmitter is designed for installation in a pulp line dimensioned for a rate of flow of *0.1 - 5 m/s (0.33 - 16.4 fps).*

⇨ **See fig 19 for a nomogram how to estimate the flow velocity. Note the recommended flow velocity.**

Typically the main line is dimensioned for a normal rate of flow of 2 - 3 m/s (6.5 - 9.8 fps).

Sampling valve

The sampling valve should be installed as close to the transmitter as possible. This will help ensure that the laboratory sample is representative of the sample measured by the transmitter.

Installing a BTG sampling valve will ensure reliable results.

Main power supply

Main power supply voltage and frequency must be within acceptable limits, and must be protected against transients from sources such as electrical storms, or other equipment.

2.4.2 Choosing a site for the transmitter

Careful location of the transmitter is essential for optimum performance and ease of maintenance.

Fig 6 shows a typical installation. Your BTG sales engineer will be pleased to assist in selecting the location that will give the best results consistent with your specific control strategy.

Important recommendations:

There are a number of considerations to take into account:

1. The transmitter should be installed as close as possible to the point where the dilution water is injected, to ensure minimum time lag.
2. Recommended minimum distances: See fig 7.

⇨ **Never install the transmitter in a pipe section where turbulence is expected. Make sure the straight sections before and after the transmitter are sufficiently long. See fig 7.**

3. If the transmitter is installed too close to a pump, valve or pipe elbow, it may seem flow dependent, as it is measuring an unhomogenous flow. Two consecutive pipe elbows may also cause a spiral flow, that cannot be directed, even though the recommended straights are kept.
   Where it is not possible to arrange for sufficiently long straights, or if there might be a risk of a spiral flow, a flow aligner can be installed in the pipe upstream of the transmitter in accordance with fig 16.
4. For optimum results when the transmitter is positioned downstream of a pump or pipe elbow, it should be located at the theoretical outer turn of the pulp stream. See fig 8.
5. The transmitter should be installed **to the side** of sloping or horizontal pipes. Try to avoid installing it on top of the pipe, as air bubbles, if any, may disturb the measuring.
6. It is important to choose a location with sufficient space when inserting and removing the transmitter and when opening the cover. See section 2.3.2.1: *Transmitter.*
7. Do not mount the transmitter where it may be exposed to mechanical damage. A roof should be fitted over the transmitter to protect it from being sprayed by water or pulp.
8. Protect the transmitter from heavy vibration such as. cavitating or unbalanced pumps. One method is to install a rubber bellows in the line.

Fig 6 MBT-2300 system, typical control circuit for consistency control

1 Consistency transmitter MBT-2300
2 Junction box type JCT-1100 (option)
3 Hand held terminal SPC-1000
4 3-wire system for analog output/ power supply 24 V DC
5 Controller and recorder/ DCS
6 Dilution water valve
7 Pulp chest with sufficient mixing
8 Stock pump
9 BTG Sampling valve type MPS-1000

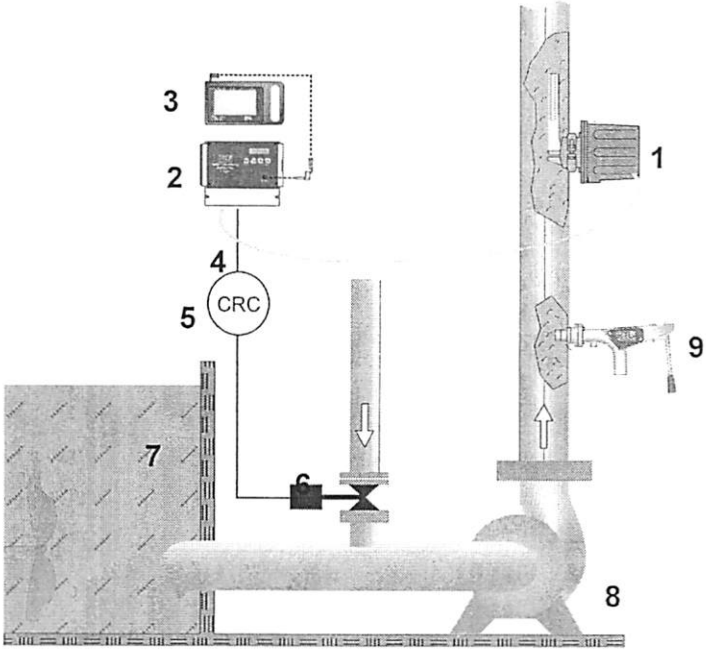
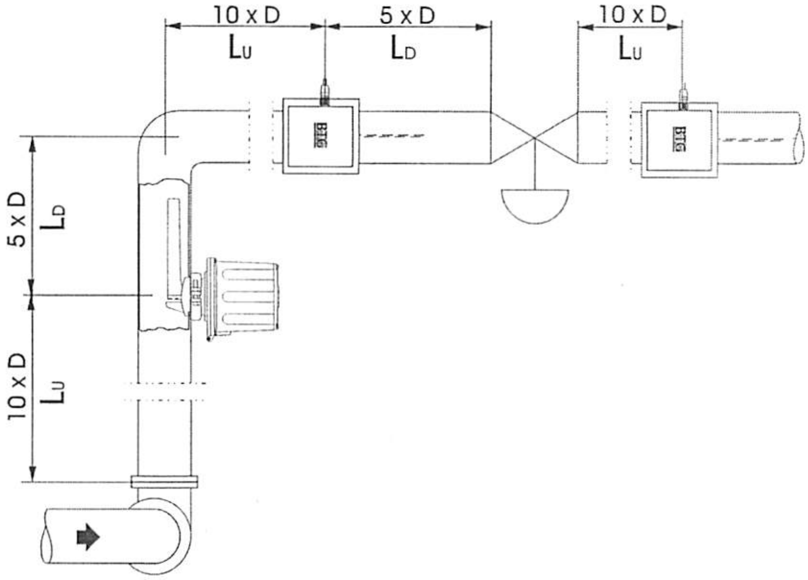


Fig 7 Recommended minimum calming length - distance between pump/ pipe elbow/ shut-off valve and consistency transmitter



The minimum distance the transmitter should be located downstream from a pump, bend or elbow is:

Upstream the transmitter L_U:

The diameter of the pipe multiplied by 10.

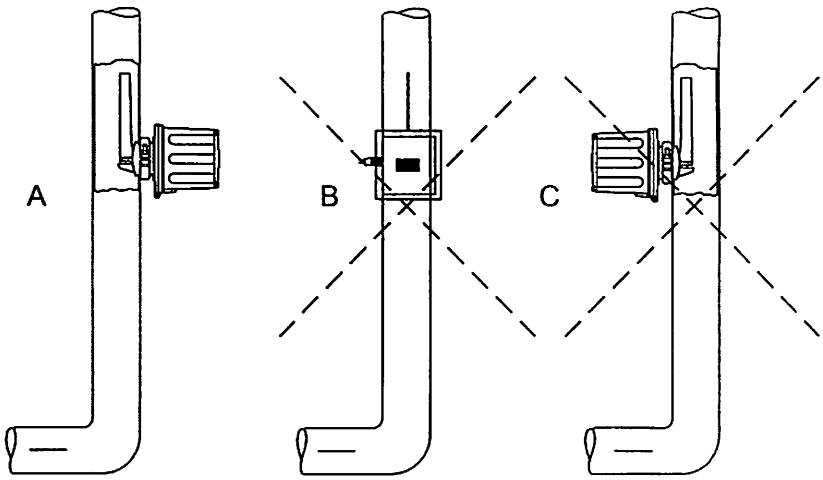
Downstream the transmitter L_D:

The diameter of the pipe multiplied by 5.

⇨ **Always choose the largest value of the above calculated distances.**

Fig 8 Installation of the transmitter in relation to a pipe elbow

⇨ **Alt. A is the most suitable - if possible, avoid using alt. B and C.**



2.4.3 Choosing a site for the JCT-1100 junction box

For information regarding choosing a site for the JCT-1100 junction box, see the Installation instruction section of the JCT-1100 manual included in this manual.

2.4.4 System cable dimensions

The standard system cable length is 10 m (33 ft). It is possible to use a system cable up to 100 m (330 ft) long. Contact your BTG sales engineer for more information regarding optional cable lengths. The cable is sheathed in PVC.

Cable type: 10 x 0.5 mm^2, shielded and twisted in pairs. Max OD 10 mm (0.4 in).

2.4.5 Selecting the sensing element

MBT-2300 can be equipped with a number of different sensing elements. The selection depends on consistency, pulp type (fiber length) and pipe dimension.

The table below presents the different size sensing elements. In doubtful cases however, always contact BTG for advice. Always select the largest possible sensing element to maximize the shear force, i.e. to maximize transmitter sensitivity and minimize the signal noise. Pipe dimension and transmitter stroke force may in some cases limitate the selection.

MBT/Sensing element		
Type	Min. pipe diam.	Consistency range
L	125 mm (5 in)	1,5 - 5 %
LM	100 mm (4 in)	1,5 - 5%
S	100 mm (4 in)	3 - 8 %
SM	80 mm (3 in)*	3 - 8 %
LC	125 mm (5 in)	1,5 - 5%

* **Note:** For pipe size 80 mm (3 in) there is a special, longer weld-in stud used.

Please contact BTG for selection of the correct sensing element.

The sensing element type **LC** is especially designed to measure on low consistency levels in low shear force pulp.

The back edges of sensing elements of type **LM** and **SM** are bevelled to fit smaller pipe dimensions.

If the sensing element produces too high a shear force and the transmitter gets overloaded, the sensing element can be shortened to an appropriate length. Place the sensing element in a screw vice and cut to an appropriate length. (The sensing element does not need to be disassembled from the transmitter if proceeding cautiously.)

2.5 Installing the transmitter

2.5.1 General

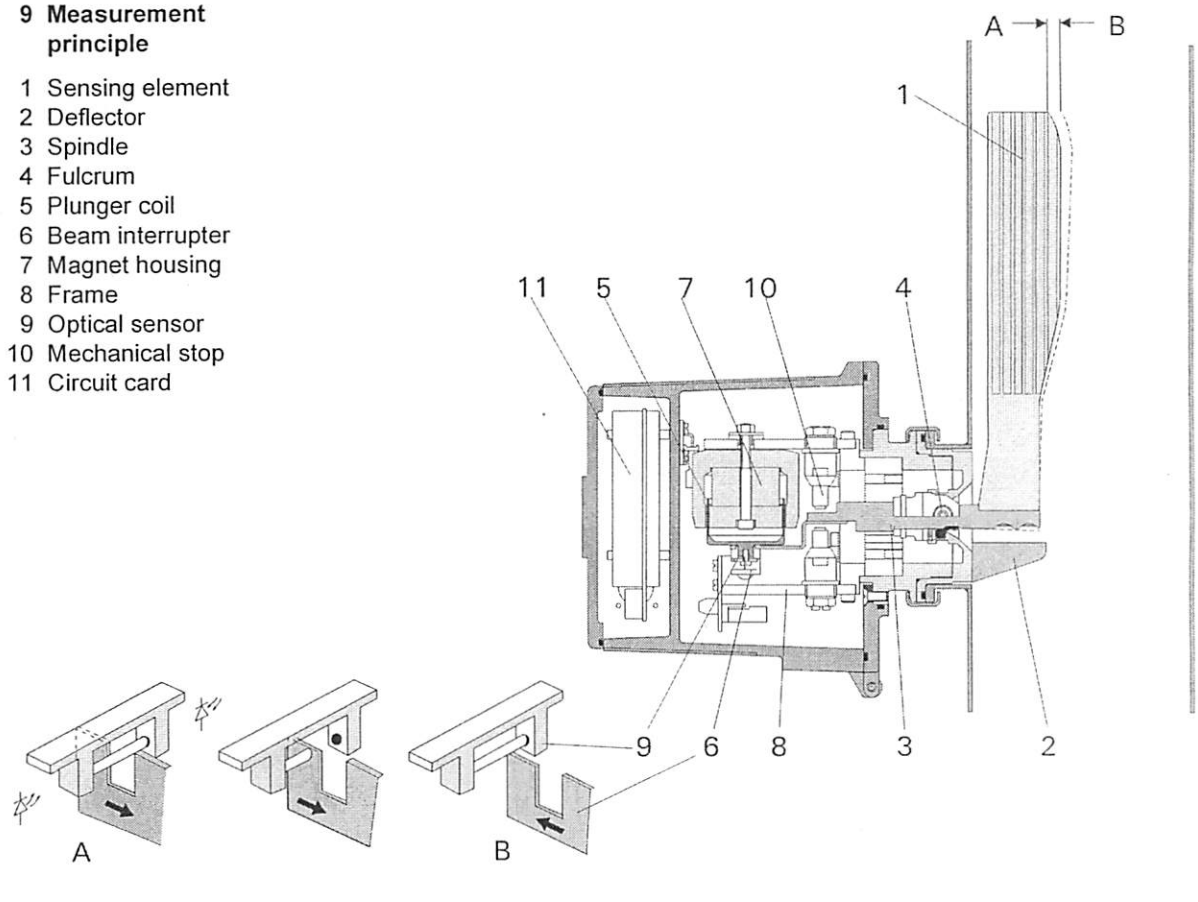
2.5.1.1 Mode of operation

Warning: To avoid personal injury, burns, agressive chemical injuries etc. it is of outmost importance that the pipe is depressurized and empty before opening it for installation or removal of the equipment.

The MBT-2300 sensing element, located in the pulp stream, is mounted on a spindle suspended between two ball bearings. The spindle pivots about a fulcrum by means of a plunger coil system. An optical sensor measures the spindle speed over a certain distance, thus giving a time value. This value depends on the pulp consistency. The time value is converted into 4-20 mA output signal including a superimposed digital signal according to the Hart® protocol. See fig 9

Fig 9 Measurement principle

1 Sensing element
2 Deflector
3 Spindle
4 Fulcrum
5 Plunger coil
6 Beam interrupter
7 Magnet housing
8 Frame
9 Optical sensor
10 Mechanical stop
11 Circuit card

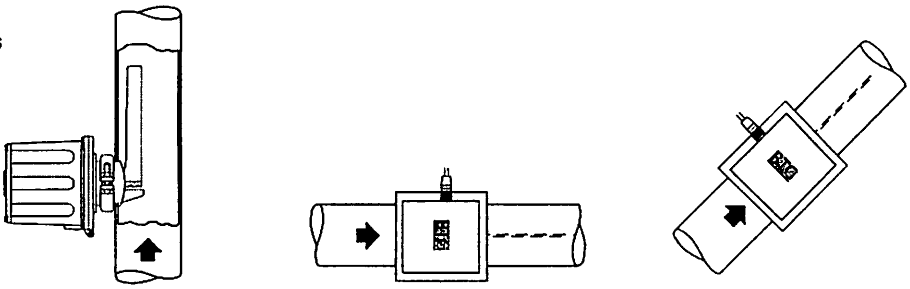


2.5.1.2 Positioning the transmitter

The transmitter is usually installed in a vertical pipe, and located downstream of a pump that mixes dilution water into the pulp. It should always be installed as close as possible to the point where the dilution water is injected, to ensure minimum time lag. See fig 10.

⇨ **To ensure minimum time lag, locate the transmitter close to the dilution point.**

Fig 10 Mounting alternatives for MBT-2300



2.5.2 Installing the weld-in stud

The weld-in stud and transmitter have pressure class DIN PN25 (360 psi at 68°F). Make sure that the topical pipe in combination with the weld-in stud will handle the topical pressure.

Make sure the pipe is empty before starting the work.

Determine proper location of the weld-in stud, before starting work. See section 2.4.2: *Choosing a site for the transmitter.*

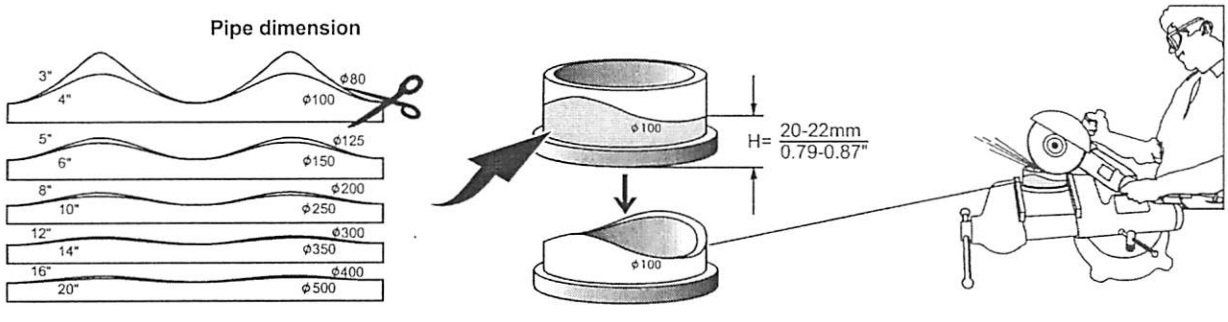
If a backflow deflector or flow aligner is required, we recommend you to prepare a complete pipe section with flow aligner and weld-in stud before welding into the pipe line.

1. Mark and drill a hole in the pipe, where the weld-in stud is to be placed. Fig 12 shows how the weld-in stud penetrates the pipe wall.
2. The stud shall be profiled to fit the current pipe dimension. No part of it should protrude into the pipe as this may disturb the measurement.

   On the stud there is a notch, which shall be in parallel with the pipe inside and corresponds to dimension H (22 mm (0,87 in) measured from the weld-in stud edge (fig 12). Dimension H is of vital importance when mounting the transmitter, thus avoiding functional problems.

   We recommend you use the self-adhesive profiling guide supplied with the transmitter. See fig 11. Select the profile for the current pipe dimension (marked on the guide). Cut out the profile and paste it on the weld-in stud directly under the flange. Profile the weld-in stud in accordance with the guide. Check the H-dimension again.

Fig 11 Self adhesive profiling guide for weld-in stud. Included in delivery

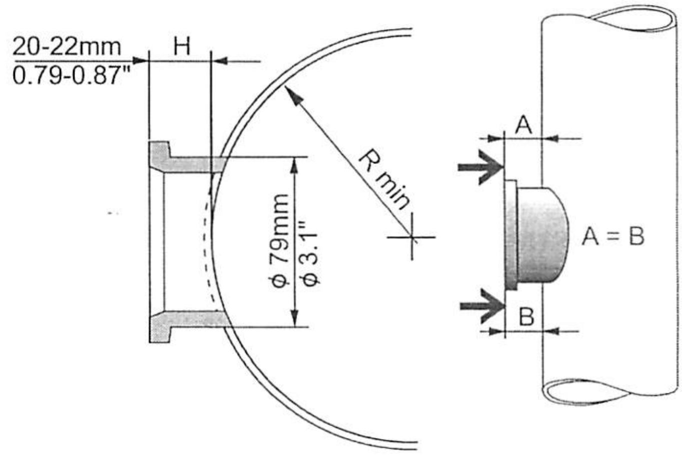


3. Fit the weld-in stud in correct position. Make sure that dimension H to the pipe inside is correct before welding the stud. Dimension H must be equal on both sides of the stud to make sure the stud edge is parallel to the pipe wall. A welding jig, described in section 2.5.2.1, facilitates the work. The jig can be ordered from BTG.
4. Weld the stud and make sure there is a full penetration weld.

Make sure the stud is profiled to the current pipe dimension, that the protruding length is correct (dimension H, fig 12) and that it's edge is parallel to the pipe wall.

⇨ **There are two versions of the weld-in stud. The standard version fits all sensing element sizes, except the SM-type (for 80 mm (3 in)) for which a longer stud is required.**

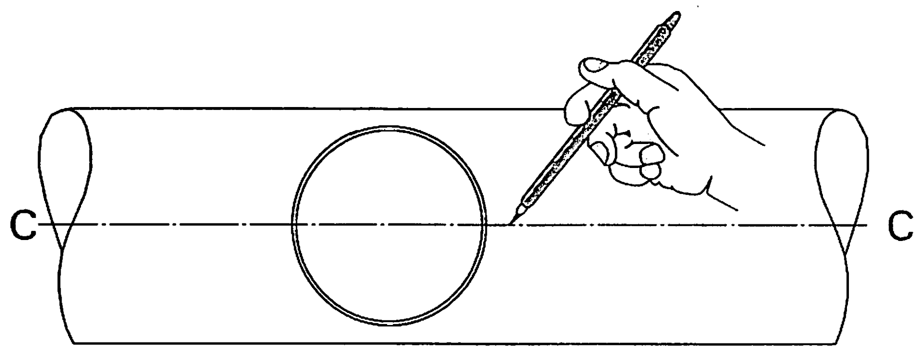
Fig 12 Mounting of weld-in stud.



2.5.2.1 Installation of a weld-in stud by means of a welding jig

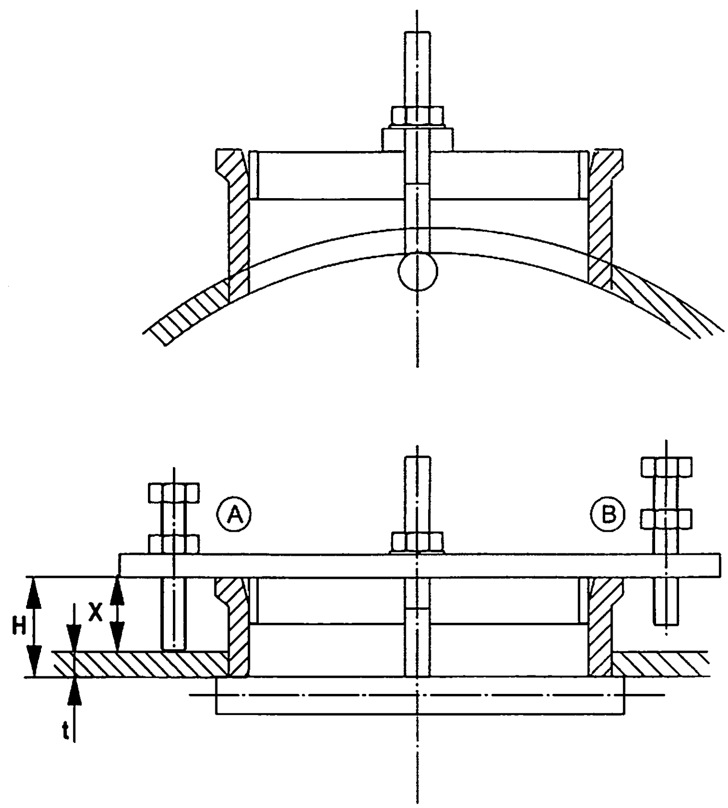
1. Profile the stud by means of the profiling guide (see section 2.5.2: *Installing the weld-in stud*).
2. For, adjust the setting screws so that dimension X + t = H = 22 mm is correct for the current pipe wall thickness (fig 14).
3. Mark the centre of the pipe as shown in fig 13. Make a hole in the pipe.

Fig 13 Marking the pipe centre



4. Place the weld-in stud on the jig as shown in fig 14.
5. Insert the jig into the hole in the pipe. Place the jig with the settings screws against the centre line as described in item 3. Tighten the centre screw in order to secure stud and jig in correct position.
6. Make sure that dimension X (H - t) is correct.
7. Secure the stud in it's correct position by means of a few small welding joints.
8. Remove the jig and complete the welding procedure.

Fig 14 Installation of weld-in stud by means of a welding jig

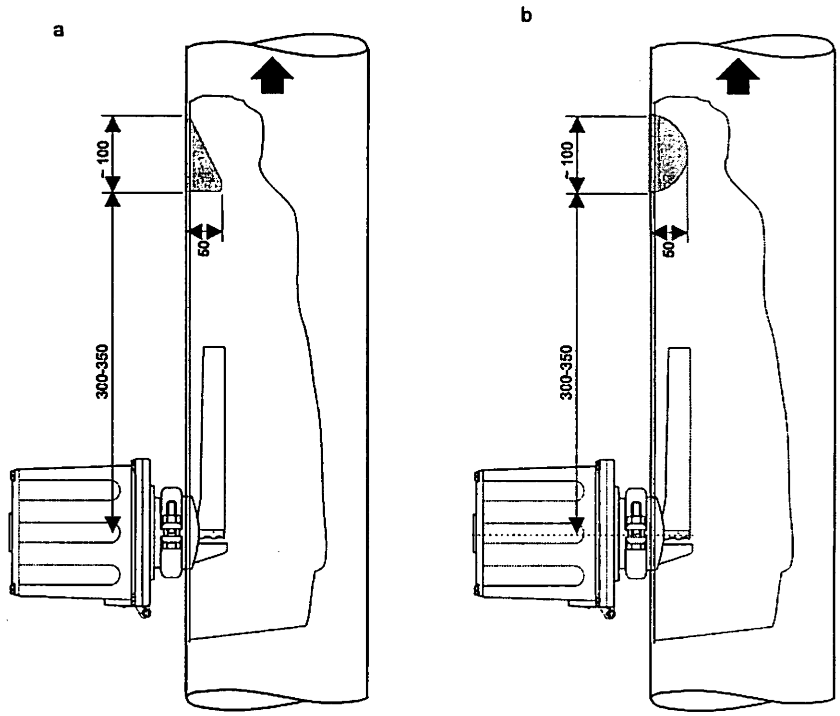


2.5.2.2 Installing a backflow deflector

Install a deflector if there might be a risk of backflow in the pipe.

In some installations there is a risk that pulp can drain out and is forced backwards at high consistency. This typically occurs during a shutdown, and may result in a damaged blade suspension. In order to eliminate this risk and to minimizing possibility of damages, we recommend you weld a deflector in a slot in the pipe downstream of the transmitter. Distance between deflector and transmitter shall be 300 - 350 mm (12 - 14 in) . See fig 15.

Fig 15 Installation of backflow deflector



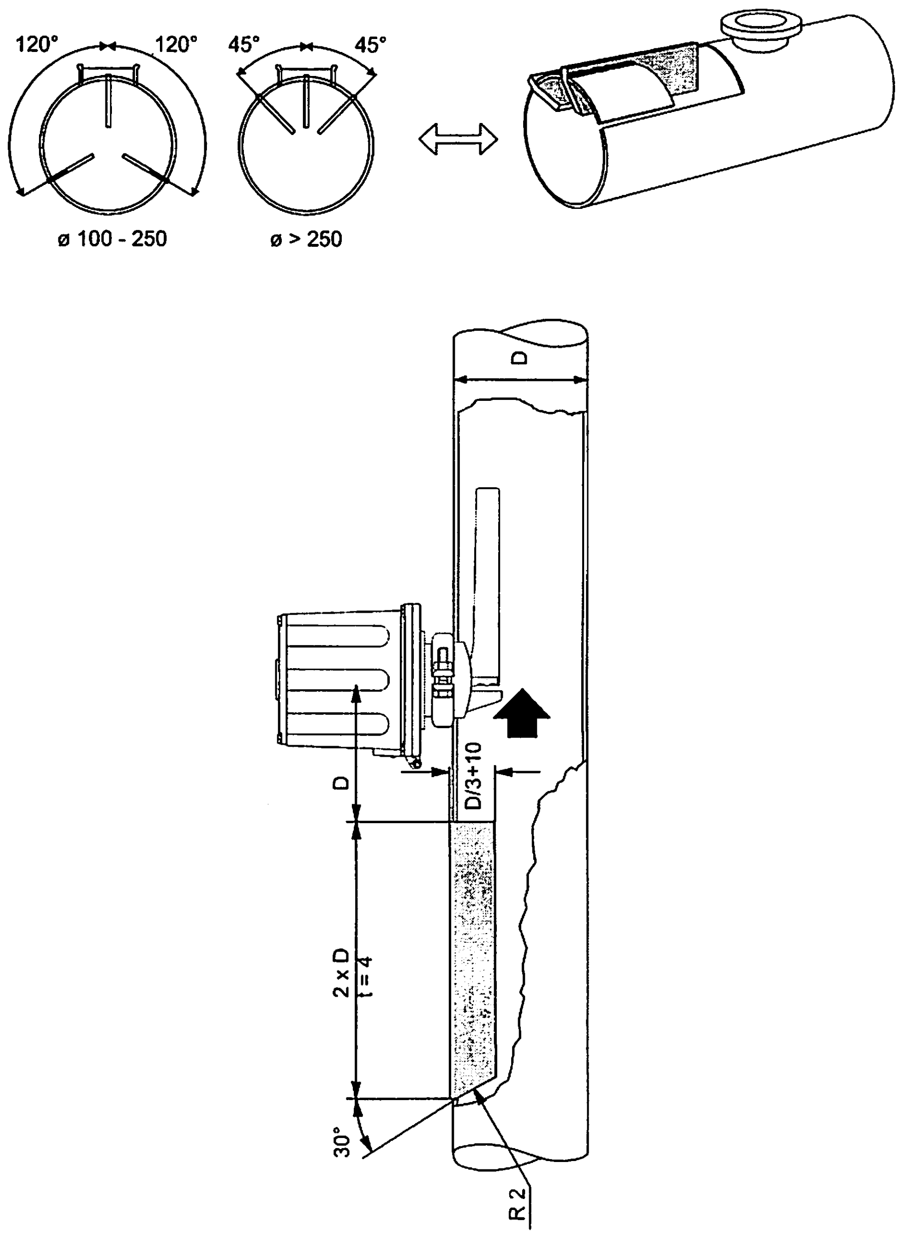
2.5.2.3 Installing a flow aligner

When recommended distance between transmitter and pump/pipe elbow/ control valve cannot be kept, see fig 7, install a flow aligner upstream of the transmitter in accordance with fig 16.

This flow aligner also has a positive effect on the installation where two successive pipe bends are, affecting the flow in an unfavorable way.

The installation is similar to that of the backflow deflector. See section 2.5.2.2: *Installing a backflow deflector.*

Fig 16 Flow aligners



2.5.3 Mounting of the transmitter in the weld-in stud

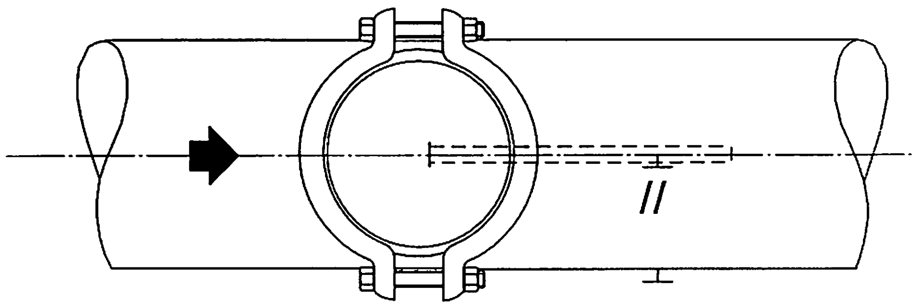
Place the O-ring (70.5 x 3 mm / 2.8 in x 0.75 in) in the groove in the transmitter flange. Lubricate the O-ring if it tends to fall out of the groove.

Carefully push in the sensing element in the flow direction through the stud and insert the transmitter.

Install the coupling halves to the weld in stud/transmitter flanges and fit the nuts. To prevent seizing it is recommended you grease the nuts, preferable with antiseize compounds

- Turn the transmitter so that its center line follows the pipe center line and the sensor points in the flow direction. Secure the nuts.

Fig 17 Mounting of coupling halves



⇨ **Place the sensing element in parallel with the pipe wall. Use the transmitter cover as a guide**

2.6 Installing the junction box type JCT-1100

For information regarding Installation instructions for the JCT-1100 junction box, see the Installation instruction section of the JCT-1100 manual included in this manual.

2.7 Quick start checklist

When you are confident your MBT-2300 has been correctly installed and you are ready to power up the system for calibration and/or testing, you should run through this brief check list before powering up. Using this list can help ensure trouble-free initialization of your system.

⇨ **To ensure that the transmitter is correctly installed and free from leakage it is recommended to pressure test the system with water. The pressure should be kept higher than the rating according to applicable regulations.**

1. Ensure that the system is turned OFF before attaching the system cable to the transmitter.

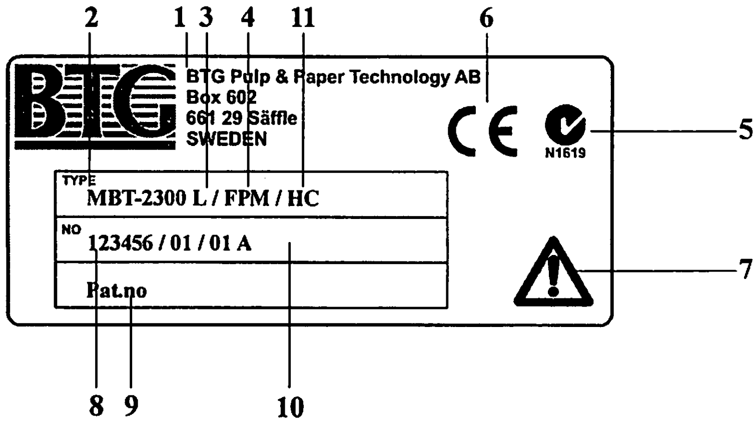
⇨ **Tighten the system cable contact securely!**

2. Check all wiring.
3. Switch on the main power supply.
4. Connect the hand-held terminal to the junction box. Switch it on and check that the display lights up.

Proceed to the MBT-2300 Operations instructions.

2.8 Type sign explanation

2.8.1 Transmitter type sign



2.8.1.1 Manufacturer

2.8.1.2 Transmitter model

MBT-2300

2.8.1.3 Sensing element

Sensing element type. L, LM, S, SM, LC. See section 2.4.5 on page 20

2.8.1.4 Rubber quality in wetted parts

FPM (Standard) = Fluorocarbon rubber for pH 1-12.

EPDM = Ethylene Propylene rubber for pH 8-14.

Q = Silicone rubber for low temperature (< 10° C/ 50° F) and low chemical aggressiveness.

2.8.1.5 CE-marking

The device is approved according to CE directives: 73/23/EEC, 89/336/EEC, (EN 50081-2, prEN 50082-2).

2.8.1.6 C-TNC marking

The device is approved according to C-TNC N1619 directives.

2.8.1.7 Warning sign

The device is designed for industrial use. Installation, handling and service must only be carried out by trained and authorized personnel and according to relevant standards. Read the manual for detailed information and pay special attention to the warning signs!

2.8.1.8 Manufacturing number

BTG internal manufacturing number.

2.8.1.9 Patent number

The transmitter is patented in relevant countries.

2.8.1.10 Revision number

Major technical revisions

2.8.1.11 Wetted parts made of

SS 2343, HC.

- SS 2343 = Standard material, stainless steel SS2343 (AISI 316 SS, DIN 1.4436) – not marked.
- HC = Nickel alloy Hastelloy C-276.

See data sheets D218.25.

⇨ **Always refer to the type sign when ordering spare parts.**

2.9 Miscellaneous

2.9.1 Dimensioning of the Dilution Water Valve for Consistency Control

Calculation of dilution water quantity – Q

Required data:

Production [t/h] = P

Uncontrolled consistency [%] = C1

Desired controlled consistency [%] = C2

2.9.1.1 Calculation formula for dilution water flow

$$\frac{P \times 100(C1 - C2)}{C1 \times C2} = Q \ \ m^3/h$$

Example:

Production = 8 t/h

Uncontrolled consistency = 3%

Desired controlled consistency = 2.5%

$$Q = \frac{8 \times 100(3 - 2{,}5)}{3 \times 2{,}5} = \frac{800 \times 0{,}5}{7{,}5} = 53{,}3 \ \ m^3/h$$

2.9.1.2 Dimensioning of the dilution water valve

Calculation formula for the capacity factor K_V.

$$K_v = Q\sqrt{\frac{\rho}{1000 \times \Delta_p}}$$

⇨ **NOTE! $C_v = K_v \times 1.155$**

K_v = Capacity factor (m^3/h)

Q = Quantity of liquid (m^3/h)

ρ = Density of liquid (kg/m^3)

Δ_p = Pressure drop across the control valve (bar)