F I E L D S Y S T E M S

SmartLC

Installation, operating & service manual

W4760064 V1.0 CN, 2001-11-06

metso automation

Table of Contents

Caution / Warning

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

Before installing the process coupling, make sure that the process pipeline is empty and unpressurized!

Flushing water temperature must not differ more than max. ± 20°C (36°F) from the process temperature!

Always check that the incoming voltage & frequency are correct before making any electric connections. Incorrect connections will damage the equipment! The applicable electrical safety regulations must be closely followed in all installation work!

1. Introduction

1.1. SmartLC Consistency Transmitter

The SmartLC consists of three parts: the transmitter, an operator unit, and a backflushing unit.

The optical transmitter is installed to a sample line branched from the production line. It utilizes light polarization to measure continuously the consistency of the pulp flow within the following consistency ranges:

- SmartLC: 0 – 1.5 %
- SmartLCU: 0 – 0.2 %

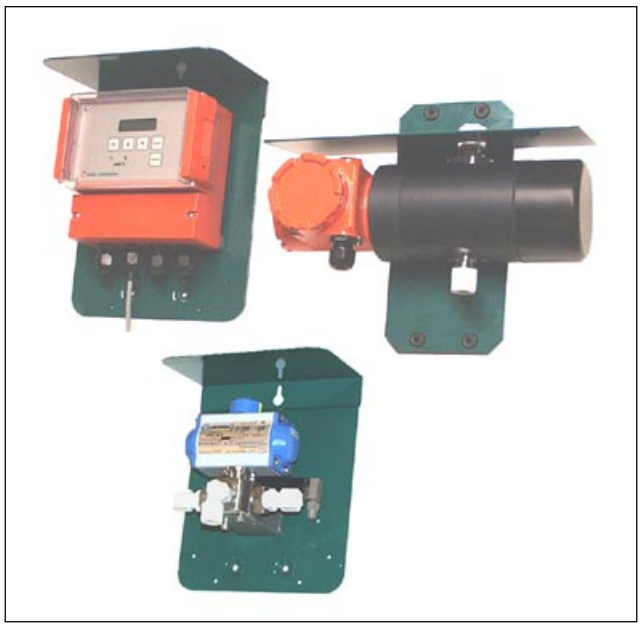


Fig. 1.1. SmartLC.

1.2. Operating Principle

The light source is a NIR-LED (880 nm) which transmits light into a polarizing, cubic beam splitter prism. The prism polarizes the light in such a way that the component transverse to the measurement cell travels straight through it, while the opposite component is redirected by 90° and captured by a detector monitoring light intensity.

An identical prism on the opposite side of the measurement cell is positioned so that the light component with unchanged polarization is redirected to a reference detector (R-channel), and the component with rotated polarization travels straight through it and is captured by the measurement detector (M-channel).

When the glass cell is empty or full of water, the reference channel signal is at the maximum and the measurement channel signal is close to its minimum value.

When the stock travelling through the measurement cell is thicker, the light reaching the M-channel increases and at the same time light to the R-channel is reduced. This phenomenon is due to the fact that wood fibers depolarize the transmitted light very efficiently, and the light with changed polarization is captured by the M-channel.

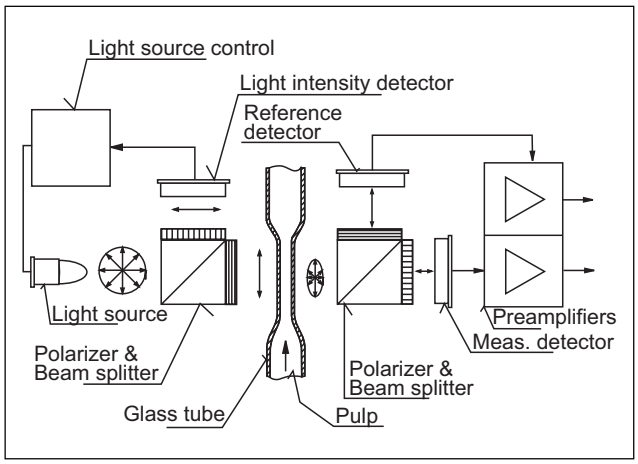


Fig. 1.2. Operating principle of SmartLC.

2. Installation

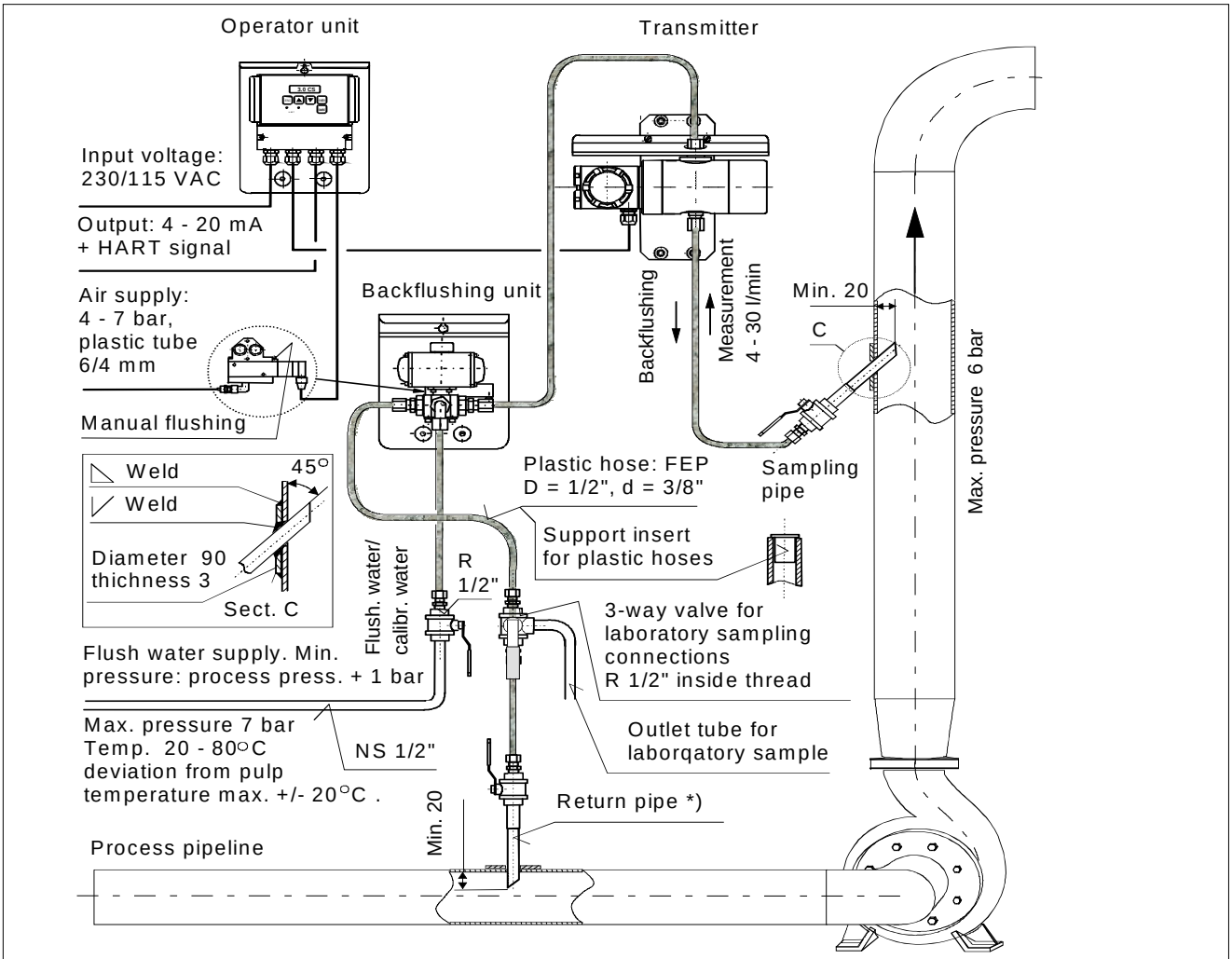
2.1. Choosing the Installation Point

2.1.1. Transmitter & Operator Unit

Install the SmartLC transmitter to a sample line branched from the production line. Sample flow rate in the sample line must be at least 4 liters/minute (~ 1 US gal/min) and maximum 30 liters/min (7.9 US gal/min).
Install the transmitter in a horizontal position, with the sample flowing from bottom to top (exception: white water installations). This ensures that the measurement cell is always full of flowing sample.
Install the operator unit close to the transmitter, either on the wall or in a mounting rack.
The operator unit connects to the transmitter with a cable, length 10 m (33 ft).

2.1.2. Sampling

The best sampling point is towards the end of a straight pipe section where the flow has stabilized.
Do not install the sampling tube close to a pump or other device causing pressure pulses, as these will disturb the sample flow.



*) Sample can be returned to the process pipeline or some other suitable process point.

Content of delivery: (numbers in parentheses refer to the spare parts list)
Transmitter, backflushing unit, operator unit, plastic hose FEP 1/2" length 5 m, sample tube with valve and connectors, hose coupling (22), support (2), connector nut (3).
Operator unit comes with a connected transmitter cable, length 10 m (33 ft). A cable to the operator unit, length 10 m (33 ft), is connected to the solenoid valve of the backflushing unit.

Fig. 2.1. Installation principle of SmartLC.

2.2. Installation Examples

2.2.1. Sample line

The sample line must be as straight and short as possible, to avoid clogging. The sample line must be provided with shut-off valves, so that the transmitter can be disconnected from process also when the process is operating.

During normal operation the shut-off valves must be completely open. However, the maximu flow rate is 30 liters/minute (7.9 US gal/minute). Install a three-way valve to the sample line, immediately after the transmitter, to provide laboratory samples.

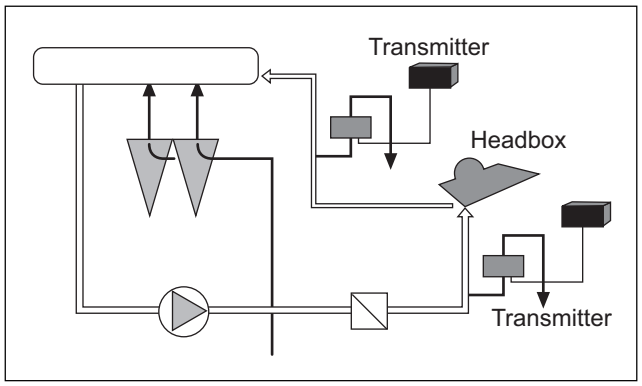


Fig. 2.2. Installation to headbox.

2.2.2. Sample outlet

The best alternative for the sample flow is to arrange a free sample discharge, for example into a tank above the liquid level. The sample can be returned to the process only if the process pressure at the outlet point is considerably lower than at the sampling point. Due to differences between individual mills, the following examples only give rough guidelines for installation.

2.2.3. Headbox

Sampling from the circulation flow, however not close to a chemical feed point. Sample outlet to the wire pit.

2.2.4. Save-all filter

Sampling from the line after the mixing of white water and sweetener stock, well after the mixing chest and as close to the filter as possible. Sample outlet to the mixing chest.

Sampling for the SmartLCU from the filter's clear filtrate line; follow the general mounting instructions. Sample outlet to the cloudy filtrate line.

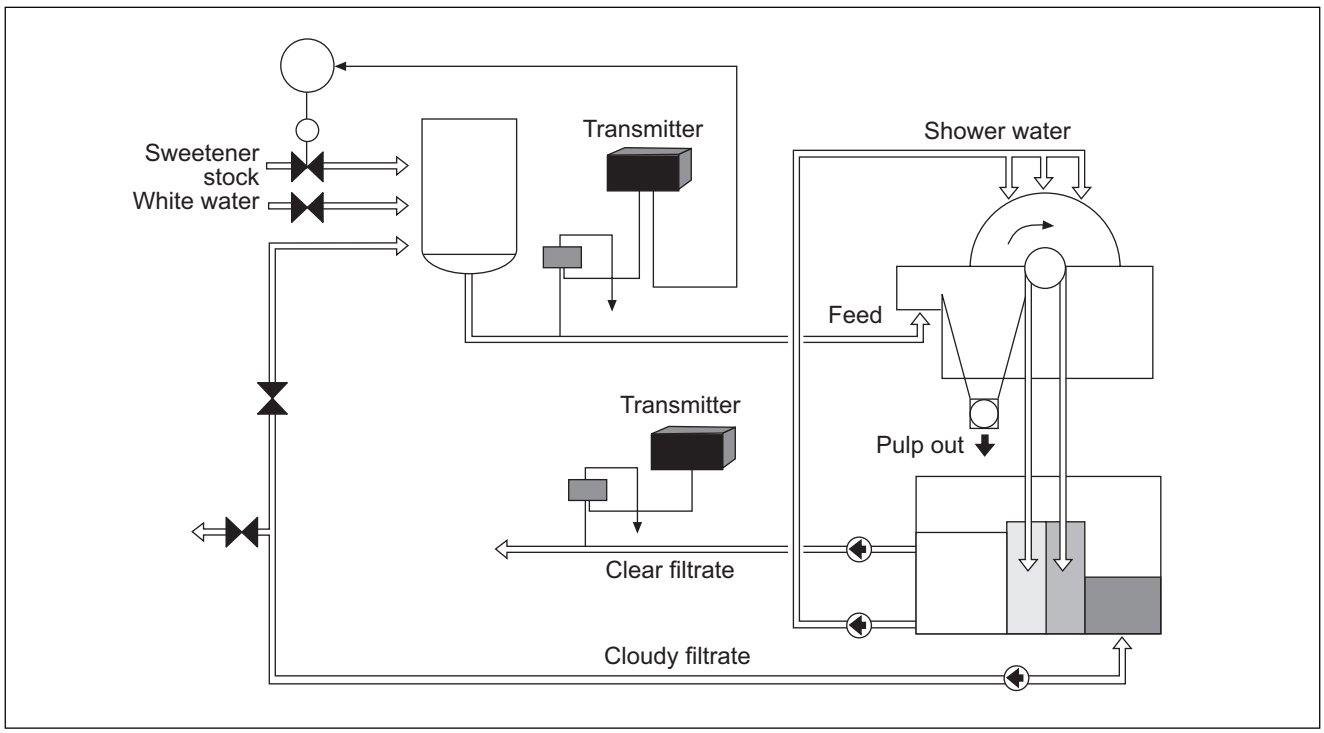


Fig. 2.3. Installation to save-all filter.

2.2.5. Groundwood mill

Sampling from the accept of primary screen. The sample outlet point must be selected according to machinery configuration.

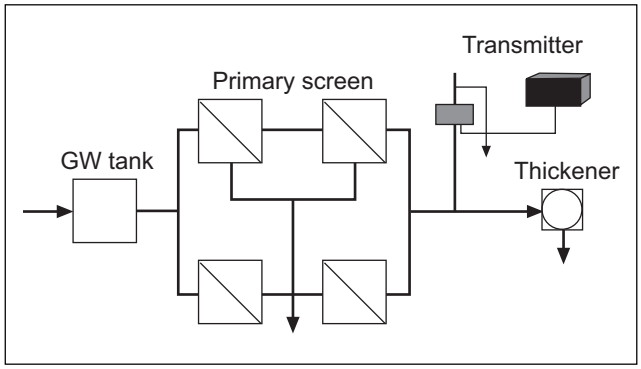


Fig. 2.4. Typical GW plant installation.

2.2.6. White water

Push the sampling tube through the bottom of the wire channel. Choose the mounting depth so that the sample represents the average consistency in the channel – not too close to the bottom or surface.

In white water installations the incoming sample line must be connected to the transmitter from above. The sample flow must be sufficient. If necessary, the sample line must be extended to a lower floor to increase the pressure difference (and thus flow rate).

In white water applications, the Deaeration module is recommended (order code H2430745).

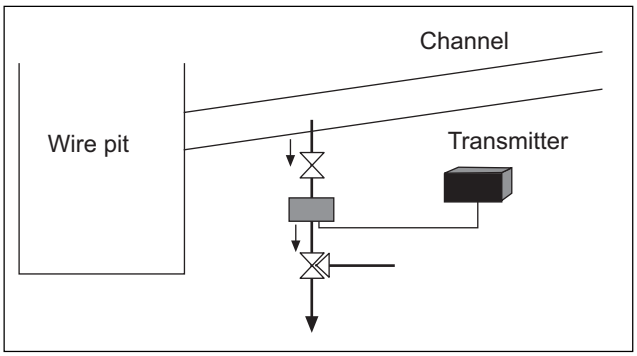


Fig. 2.5. Typical white water installation.

2.3. Installing the operator unit

The operator unit is attached to its mounting plate and need not be detached for installation (Fig. 2.6). Choose an easily accessible and safe place for the operator unit, and mount it in position by its mounting plate with three screws.

2.4. Installing the Transmitter

Mount the transmitter to the wall with a mounting rack. Connect the transmitter to the operator unit with the cable included in delivery (see Electric connections). The best sample line material is flexible tube, diam-eter 1/2" (e.g. FEP). The 90° bends of acid-proof piping (AISI 316) are easily clogged.
Choose the installation point so that there is enough room for service operations; the required space is indicated
in Fig. 2.7. Make all sample line connections and joints very carefully to prevent leaking.

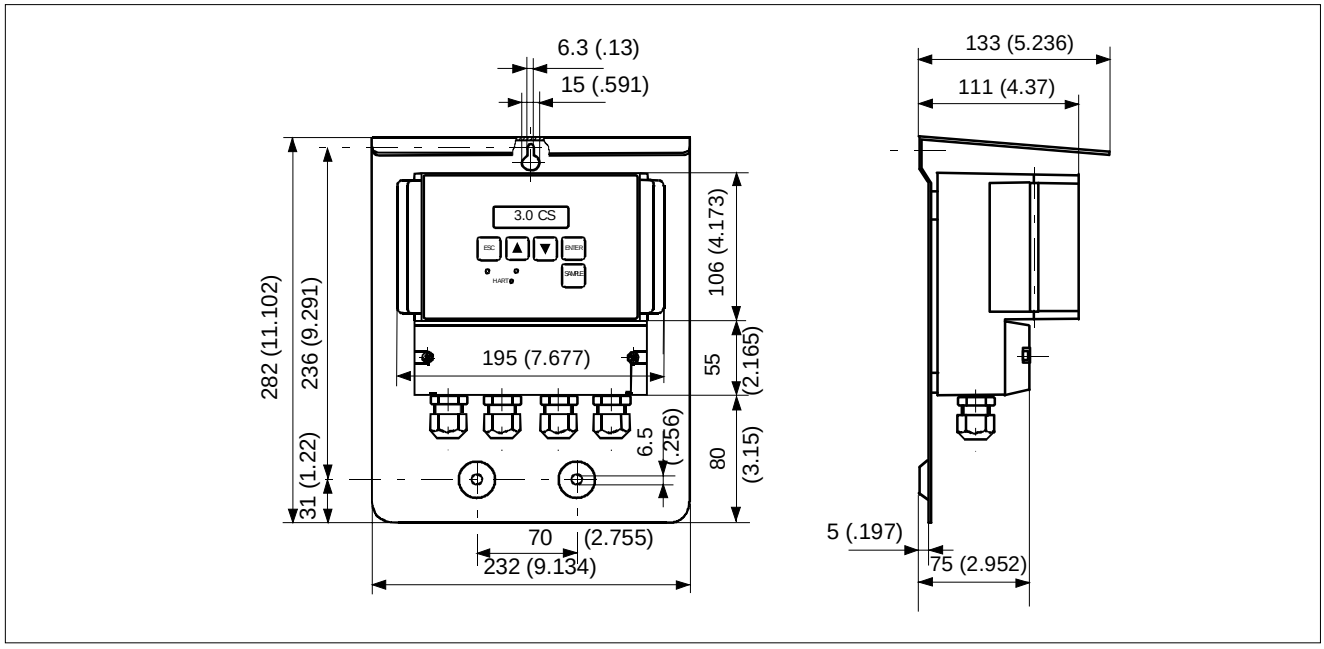


Fig. 2.6. Operator unit

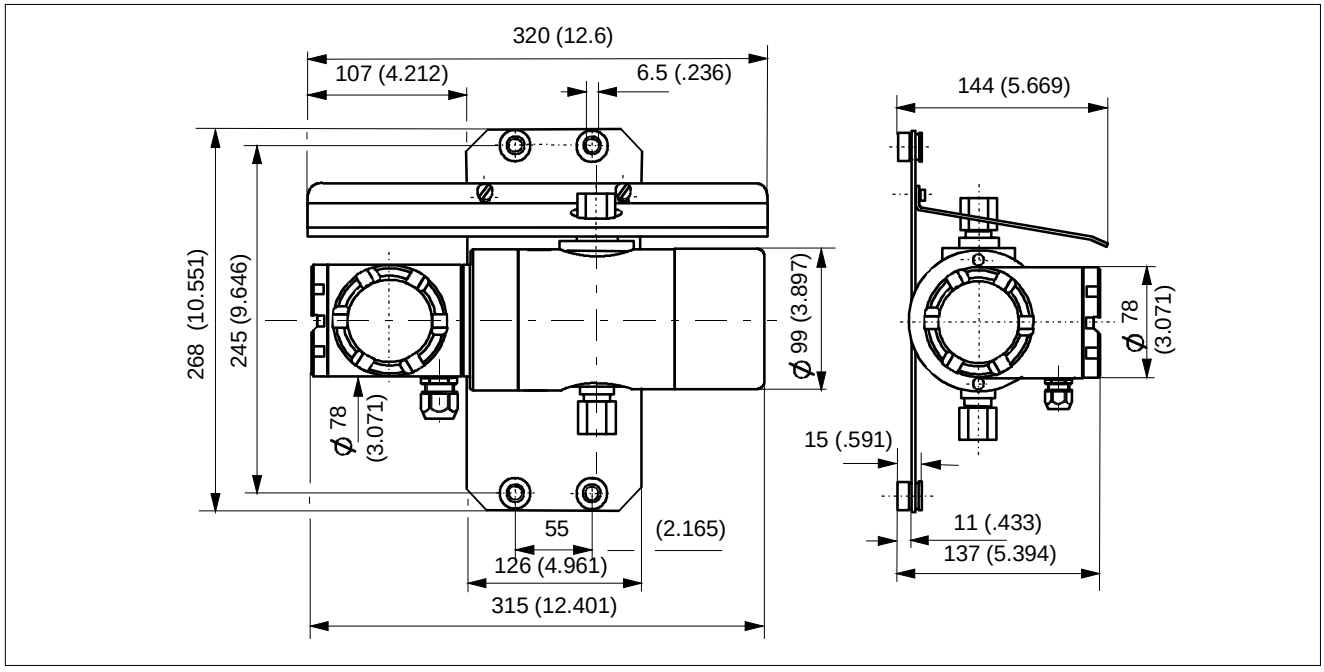


Fig. 2.7 Transmitter.

2.5. Installing the Backflushing Unit

The backflushing unit cleans the transmitter's sample line with clean water, flushing it against the direction of sample flow.

The backflushing unit is needed to ensure unhindered sample flow in the SmartLC sample line in installation points where accumulating fillers or fibers might otherwise disturb the sample flow, even block it altogether.

2.5.1. Parts of backflushing unit

The unit consists of an acid-proof three-way valve, a pneumatic actuator, and a solenoid valve.

The operator unit sends the control signal (24 VDC) to the solenoid valve which controls the operation of the pneumatic actuator by using pressurized air. The pneumatic actuator turns the three-way valve so that water flows into the sample line, cleans the transmitter's measurement cell, and forces the sample from the sample line back to the process.

The measurement result obtained prior to backflushing will remain on (in the current output, on operator unit and on HART® communicator) during the backflushing operation and for 15 seconds after it. This delay ensures that the sample line and measurement cell are again full of flowing sample before the measurement continues.

Flushing water pressure must be higher than process pressure. Temperature difference between the flushing water and process must not be greater than ±20°C (36°F).

2.5.2. Contents of delivery

The backflushing unit is delivered as one package, including:

- a FEP-hose, length 5 m (16.4 ft)
- Backflushing valve
  - solenoid valve
  - pneumatic actuator
  - 3-way valve

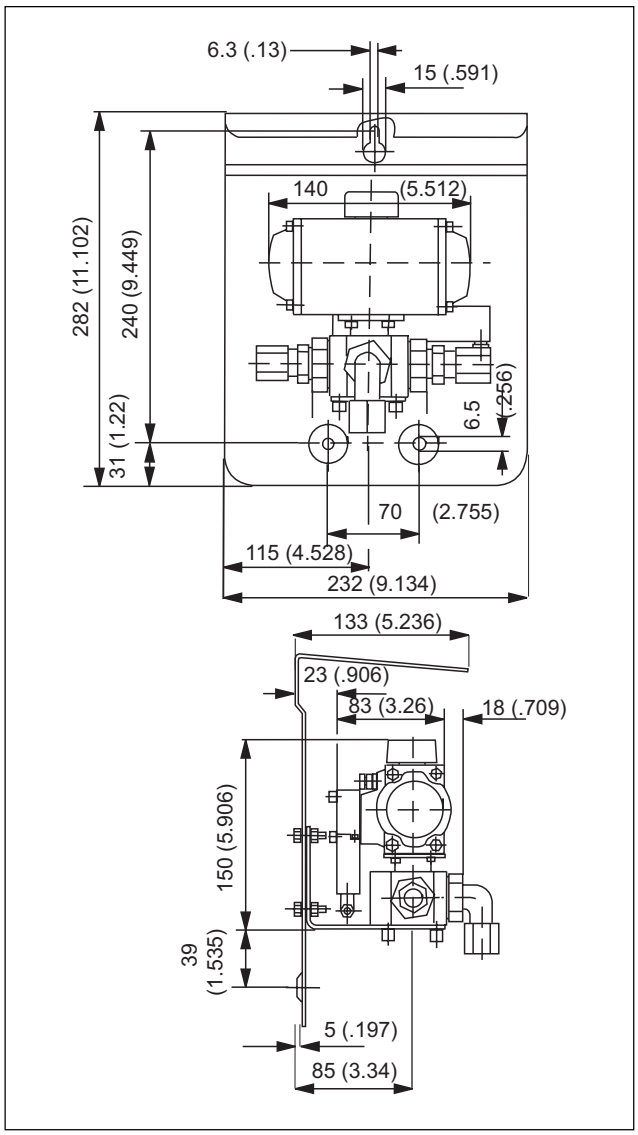


Fig. 2.8. Dimensions of the backflushing unit.

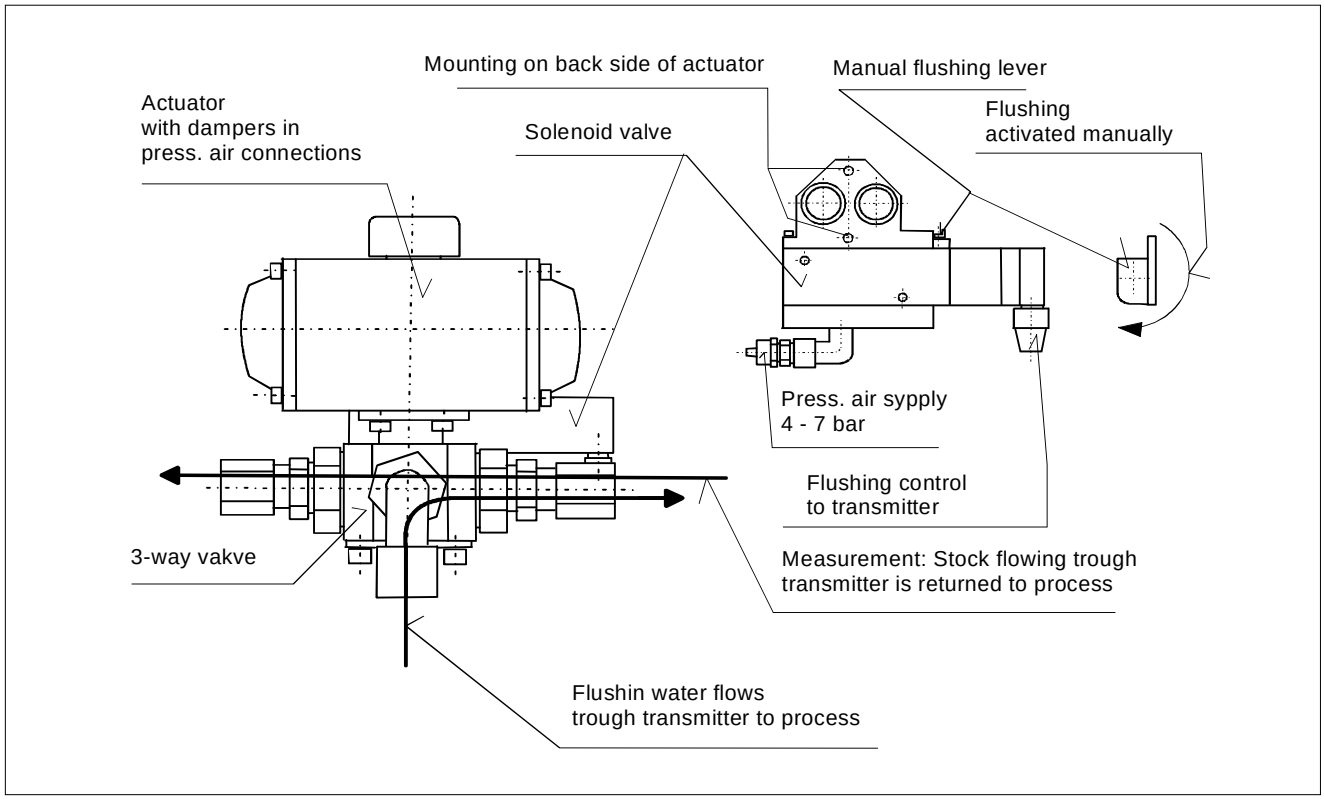


Fig. 2.9. Backflushing unit

2.5.3. Connection instruction

The electric connections are shown in Fig. 3.2, chapter 3. Connect the backflushing valve and the sample line. Install the backflushing valve to the sample line, to the outlet side of SmartLC transmitter. Choose the place so that there are no easily clogged sections (e.g. tight bends)
in the sample line between the valve and the outlet to process.

- Connect the pressurized air and flushing water tubes to the backflushing valve. A filter and oil sprayer are recommended for the pressurized air feed to increase the actuator lifetime.
- Connect the solenoid valve control cable.

Connect the outlet tube of SmartLC transmitter to the valve end closer to the solenoid valve.

2.5.4. Connecting the solenoid valve

Insert the solenoid valve cable through the bushing, and connect it to terminals 15 & 16 (watch markings on the cable), cable shield to protective ground.

2.5.5. Testing

- Switch power on to the SmartLC operator unit.
- See that the actuator's axis turns 90º clockwise when backflushing begins.
- After the set backflushing time is up, the actuator axis must turn back to the original position.
- Backflushing can also be force-started manually from the solenoid valve.

2.6. Installing the Sampling Tube

The optional SmartLC sampling tube is recommended for sampling. When installed correctly, this device ensures
representative sampling from the production flow. Install the sampling tube perpendicular to the pipe wall, so that its tip protrudes about 3–5 cm (1–2") into the pipeline.
The best sampling point is towards the end of a straight pipe section where the flow has stabilized. Do not install the sampling tube close to a pump or other device causing pressure pulses, as these will disturb the sample flow.

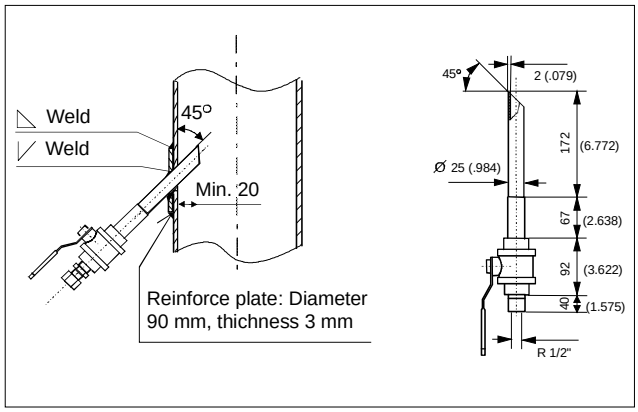


Fig. 2.10 Sample tube

3. Electric Connections

The connections of the SmartLC transmitter are illus-trated
in Fig. 3.1. The device requires a 230/115 VAC power supply. In the current loop the SmartLC functions as an active transmitter, i.e. no power supply is connect-ed
to the loop. If the transmitter is not connected to a system or other similar load (e.g. plotter), short terminals 10 and 11 using a wire or max. 600 W resistor.
Make all connections to the current and digital input terminals located in the connection box of the operating unit.
Fig. 3.2 shows the connection of a test meter and the 275 HART® communicator.
With the HART® communicator, the minimum load resistance is 250 W.

3.1. Making the Connections

- Open the connection box and transmitter covers.
- Insert the connection cable (1) through the transmit-ter's inlet bushing, and connect it as shown in Fig. 3.2.
- Insert the AC-supply cable (3) through bushing (3), the system cable (2) through bushing (2). If the remote recipe selection (option) is used, the signals are transmitted by cable 2. Leave an extra loop of cable outside the bushings as reserve and to conduct drain water out.
- Insert the backflushing unit cable (4) through bush-ing (4).
- Tighten the bushing nuts, and make sure that the inlets are properly sealed.
- Make the connections as shown in Fig. 3.2, and connect the groundings according to the control system instructions.
- Install the connection box covers.

NOTE: In the connection box, terminals 10 and 11 must be connected together with a 0...600 Ohm resistor, otherwise the device will not operate!

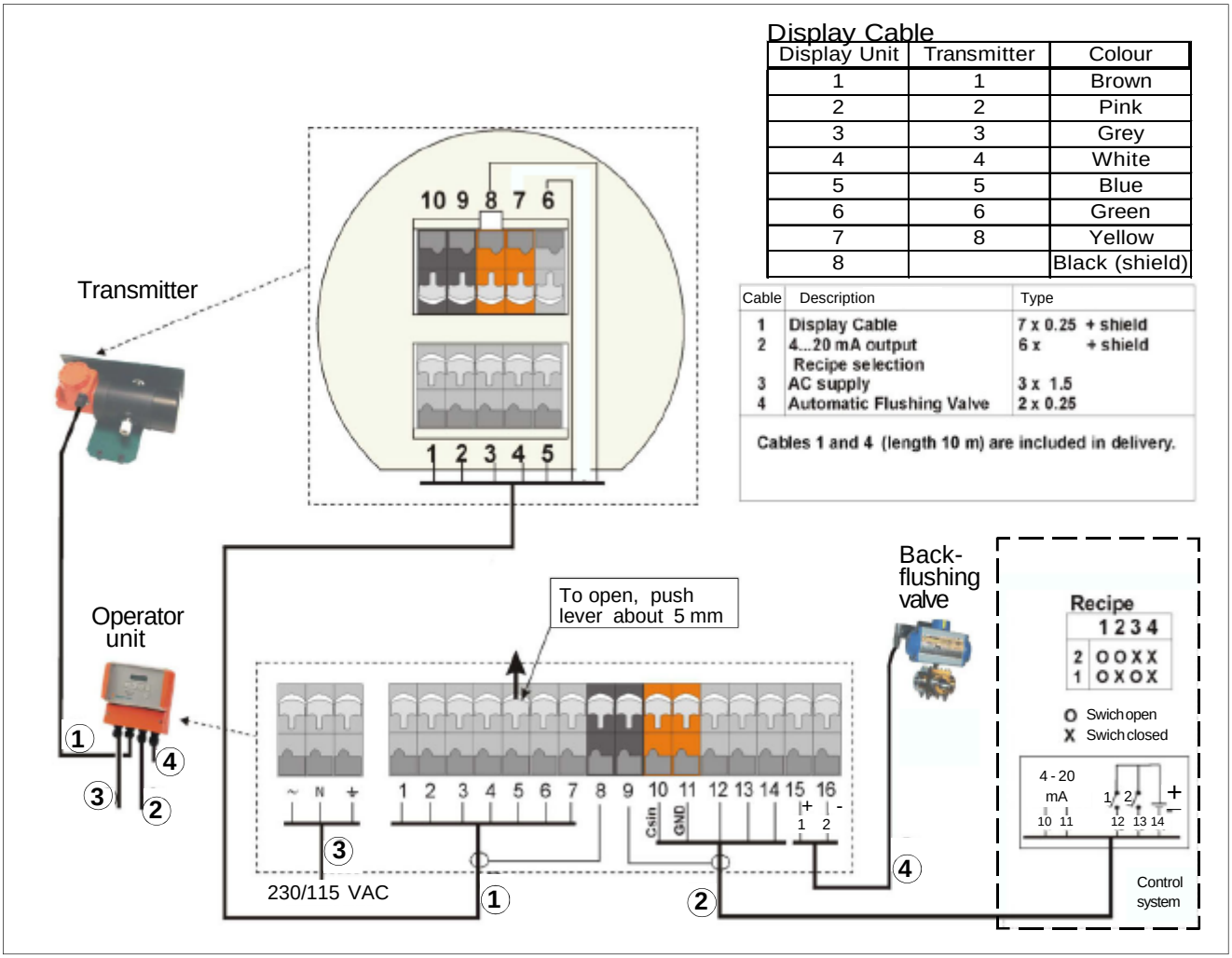


Fig. 3.1 Wiring diagram

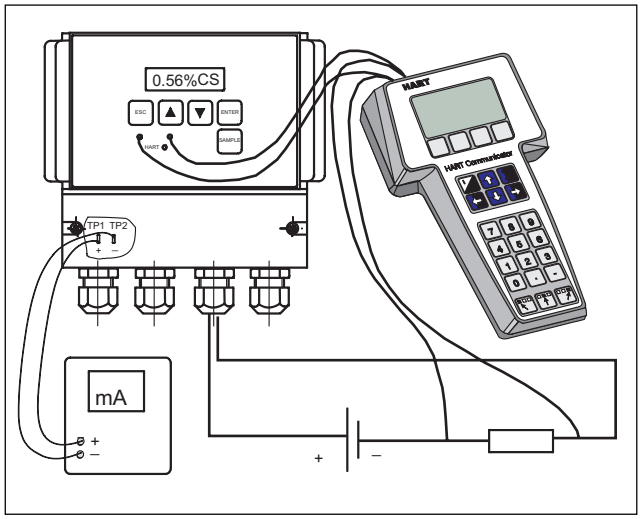


Fig. 3.2. Test and HART® connections of SmartLC.

3.2. Remote Recipe Selection (option)

The recipe used by the SmartLC can be remote-selected by using the digital inputs DI1–DI2 (terminals 12–13) in the operator unit. If this option is used, set 0 (zero) as the recipe number in the MEASURE menu.

Fig. 3.2 shows the digital input settings for all four recipes. X = DC-power (24 V ± 20%) is connected between DICOM (terminal 14) and the digital input. If none of the digital inputs are connected, recipe 1 will be in use.

4. Start-up

4.1. Initial Measures

When the transmitter and operator unit have been installed, check:

- all connections – sample line, electric connections;
- position of the mains power selector (230/115V) – the selected voltage must correspond to the voltage rating shown on the connection box;
- all connections and joints in the sample line.

SmartLC is calibrated while the process is operating. If possible, make changes to the process so that pulp consistency varies in the measuring point. If this is not possible, connect a water inlet line to the sample line immediately after the branching point, so that the sample in the line can be diluted.

Calibration involves two phases:

- Determining the consistency line.
- Configuring for the desired consistency range.

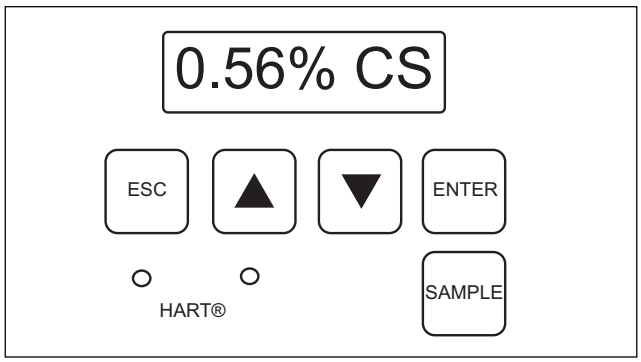


Fig. 4.1. Keys of the operator menu.

4.2. Operating the Transmitter

The SmartLC is operated using either the operator unit (Fig. 4.1) or the HART® communicator. After installation, the transmitter itself requires no operation.

If the necessary process data was given to the supplier when the transmitter was ordered, it has been preconfigured, and after installation it can be immediately tuned by using process samples. If not, it must first be configured (CONFIGUR).

The main menu contains four main functions; for more information on the submenus see Fig. 4.2:

- MEASURE: Measurement
- CONFIGUR: Configuration
- CALIBR: Calibration (i.e. tuning).
- DIAGNOST: Diagnostics

Select the desired operation and press ENTER. Press ESC to return to the previous menu.

See the following chapters of this manual for more information on the individual functions of the menu.

When power is switched on, the % CS display will appear automatically. At any time you can access the MEASURE menu by pressing ESC (if necessary press several times until the correct menu appears). Use the arrow keys to move around in the menus.

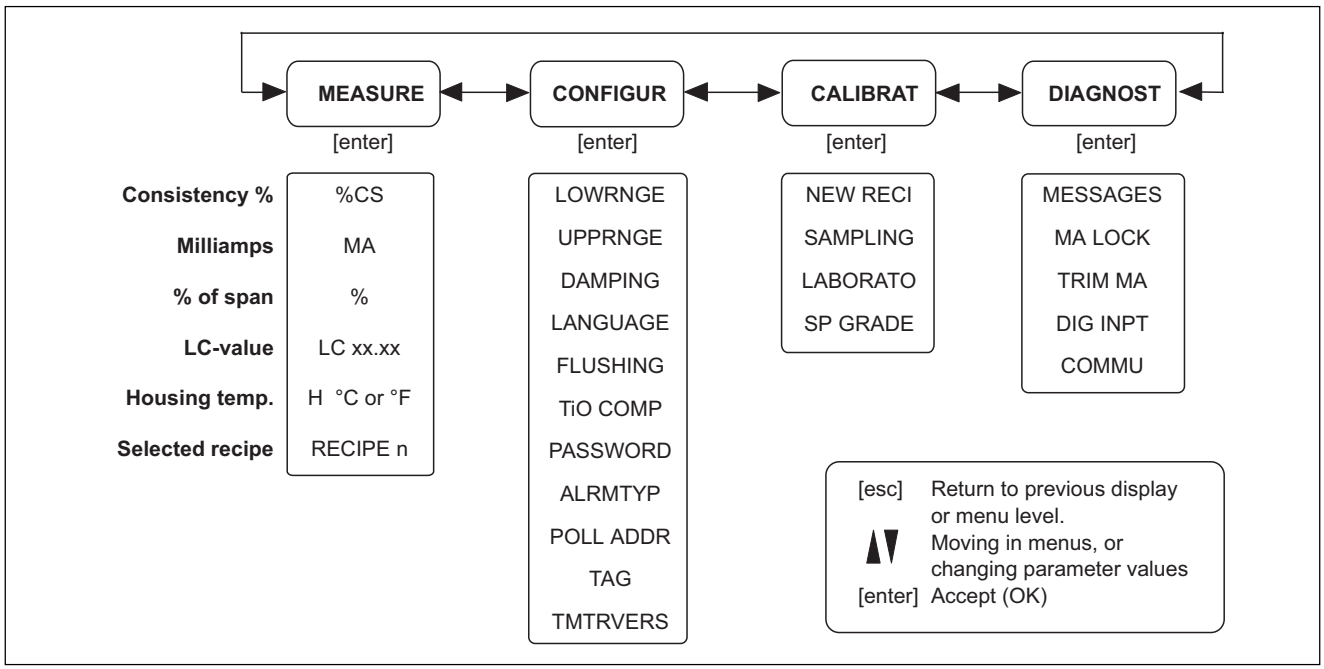


Fig. 4.2. Functions and menus of the transmitter.

5. Measurement

5.1. Measurement

When operating power is switched on to the transmitter, it will show the %Cs display and the output signal will be immediately on. The transmitter only begins to measure the actual process consistency after it has been configured and tuned (calibrated).

Usually the transmitter is calibrated for total consistency by making the required sensitivity and/or zero offset correction to the calibration curve.

The device can be set to show the measured consistency value (4 alternatives) or the electronics temperature. Use the arrow keys to choose the desired display format:

X.XX%CS: pulp consistency (%).
XX.XXMA: output signal (mA).
XX.XX%: display as per cent (%) of the total span.
LC XX.XX: value corresponding to LC-100 transmitter's reading.
H XX.X: electronics temperature, C = °C or F = °F.

RECIPE X: recipe selection.

NOTE: When calibrating, make sure that the recipe being calibrated is active (= currently selected for measurement). If the remote recipe selection through digital input is used (see connections), make sure to set zero as the recipe number with the operator unit keys. A blinking text RECIPE X, and NOT CALIB appearing after a recipe number is selected, indicate that calibration has not been done for the recipe in question.

6. Configuration

6.1. Configuration

Usually configuration is only needed once: when the transmitter is started up for the very first time. The settings needed to control the transmitter's operation are given in configuration.

The configured data remains in device memory also when the power is switched off.

LowRnge:
Low limit for measurement, % Cs. Default is 0.0 % Cs.

UppRnge:
High limit for measurement, in % Cs. Defaults: 1.5 % Cs for SmartLC and 0.2 % Cs for SmartLCU.

Damping:
Damping the fluctuation of the output signal, 1 to 60 seconds. Use at least the minimum value required to damp disturbing fluctuations. Defaults: 10 seconds for SmartLC and 20 seconds for SmartLCU.

Language:
Display language, default: English, or the language of the country in question. Available alternatives are Finnish, English, Swedish, French, and German.

Flushing:
Backflushing can be set to occur at intervals of 1 to 600 minutes (TI), and its duration (TON) can be up to 300 seconds; set at 10-second steps.

If the duration is zero, backflushing will not occur.

Backflushing can also be force-controlled: setting 'Manual ON' starts the backflushing immediately, and it will continue until set 'Manual OFF'. After this the backflushing operation will resume the set sequence. Default: 10-second backflushing every 20 minutes.

TiO COMP:
If the measured stock contains titanium dioxide (TiO_2) set the compensation ON.

Otherwise leave it OFF.

Password:
Available range is 000...999. Setting 000 = no password. If password protection has been activated but you have forgotten the password, use number 555 to cancel the protection.

If any other password than 000 is set, the prompt PASS = 0 will always appear when the configured data is changed. To continue editing, give the correct password with the number keys and then press ENTER. Default: no password.

Alrmtyp:
Alarm type. The current output can be set to indicate transmitter failure by sending either 3.7mA or 22.5mA signal. Default: 3.7 mA.

Poll addr:
Transmitter's HART® address, 0...15. Default is 0 (normal installation with one transmitter).

Values 1–15 set the transmitter to multidrop mode (a system with two or more HART® transmitters connected to the same bus), and its current output will be fixed to 4mA.

Tag:
Tag code (position) of the measurement point. Up to 8 characters, either letters or numbers. The currently selected character is indicated by an apostrophe at the upper left corner.

Use the arrow keys to select characters, press ENTER to accept and then select the next character. You can move forward from this field when all characters have been given.

TmTr Vers:
Version codes for the transmitter's software and electronics; these cannot be changed.

7. Calibration

7.1. About Calibration

After the transmitter has been installed, it must be calibrated for each pulp grade it will be measuring. Before calibration, make sure that the transmitter has been configured (see chapter 6 for instructions). Precalibrated recipes for four (4) different pulps or blends can be stored in the transmitter's memory.

The calibration menu contains four submenus:

1. NEW RECI: new recipe
2. SAMPLING: take a sample
3. LABORATO: Laboratory results
4. SP GRADE: Special grade correction for recipe no. 1

Fine-tuning is done either as single-point calibration to define the zero offset P2, or as two-point calibration which also involves the curve gain correction P1 (Fig. 7.1).

For the original curve these values are P1 = 1 and P2 = 0. In sample-based calibration the SmartLC will correct the P1 & P2 as indicated by the laboratory results and calibration samples. Up to 4 recipes for different pulp grades can be stored in the transmitter's memory. The desired recipe can be activated either directly at the transmitter, by remote selection through the digital inputs, or by using the HART® communicator.

The calibrated data remains in device memory also when the power is switched off.

7.2. Calibration Options

NOTE: If SP GRADE calibration has been in use and you wish to calibrate recipe 1 (single-point or two-point calibration), first erase the SP GRADE table!

During sampling, the SmartLC will calculate the average consistency and standard deviation for the samples. The device is able to calculate and store data on two samples. The sample(s) can be handled as follows:

- Single-point calibration
- Two-point calibration

Fig. 7.1 shows the calibration curves.

1. Basic curve
2. Basic curve with single-point calibration
3. Basic curve with two-point calibration

To give a better idea of how calibration works, its effect has been exaggerated in the figure.

7.2.1. Single-point calibration

The selected basic calibration curve is moved in the direction of consistency; this eliminates the difference between measured consistency and laboratory at the calibration point (zero offset). The slope of the curve (P1) does not change, but the value of P2 changes by the obtained zero offset.

Even if single-point calibration is used, you can still take two consistency samples and then choose the one taken when the process was more stable. The samples should preferably be taken when the process is at the "setpoint consistency".

In most cases the single-point calibration gives a sufficiently good result.

Calculation formula:

- **P2 =** LAB – sample average
- **P1 =** no change

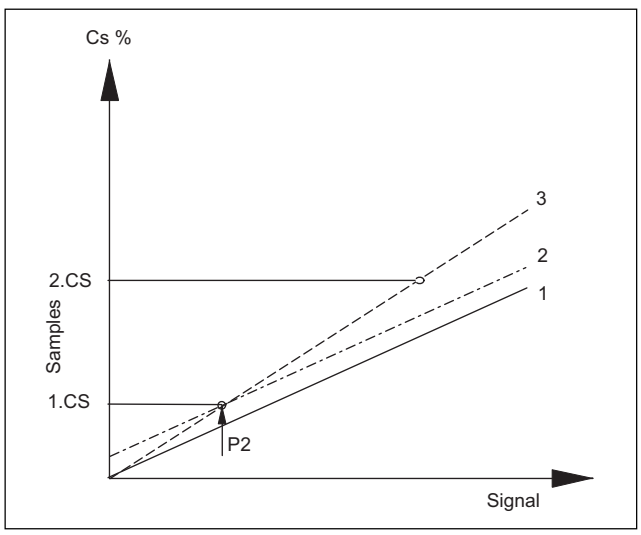


Fig. 7.1. Calibration line.

7.2.2. Two-point calibration

The selected basic calibration curve is moved in the direction of consistency (zero offset), and additionally its slope is changed. The curve is adjusted to pass through two consistency points. The SmartLC will calculate new values for P1 and P2.

Note that 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 any significant effect on the slope of the curve.

SmartLC will give an alert if calibration is attempted at less than 25 % consistency difference: the text "USE BOTH" will blink when the calibration is accepted if 0.8 < Cs2/Cs1 < 1.25.

Two-point calibration is recommended when accurate measurement over a wide measuring range is needed.

Calculation formula:

- **P1 =** $\dfrac{(2Cs\ LAB - 1Cs\ LAB)}{(2Cs\ SAMPLE - 1Cs\ SAMPLE)}$

- **P2 =** (1Cs LAB – P1 x 1Cs SAMPLE)

If the value of P2 is increased by 0.1, the consistency reading will increase by 0.1 % Cs – in other words, the desired zero offset can be made directly on P2 without any other calibration measures. Thus the consistency measured by the transmitter is: P1 x % Cs (basic calibration curve) + P2.

7.3. NEW RECIpe menu

NOTE: Make sure that the pulp grade being calibrated is also active (i.e. selected for measurement). The active recipe number must be the same in the MEASURE and CALIBRATion menus.

It is recommended that the CONFIGURation and CALIBRATion/NEW RECIpe values of calibrated transmitters (including the P1 & P2 calculated after the LABORATOry menu has been executed) should be saved. The values can be read only after saving.

The displays of the NEW RECIpe menu are:

- **RECIPE n**
  Select recipe for calibration, alternatives: 1...4.
- **P1**
  Gain, i.e. slope of the calibration curve. In normal calibration use the default value (P1 = 1).
- **P2**
  Offset (zero point correction). In normal calibration use the default value (P2 = 0).
- **SAVE OK? or PASS=**
  Activate a new recipe for use. Accept the SAVE? prompt by pressing ENTER, and the program returns to the NEW RECIpe menu.
  If password protection is in use the display will read PASS=.
  Use the arrow keys to give the password and press ENTER to continue.

7.4. SAMPLING menu

- **1 START**
  Press ENTER to start sample taking.
- **END SAMpling**
  The display will blink until ENTER is pressed again; this tells the SmartLC that sample taking has been completed. The average consistency reading for the sampling period is saved in memory.
- **1. CS X.XX%**
  Average consistency for the sampling period. Use the arrow keys to proceed to the next field. When the Sample key is used, the sample is taken under 1. Cs.
- **1. Sd X.XX%**
  Standard deviation. A blinking display indicates that the standard deviation for the sampling period was more than 5% of the sample average. If this occurs, it is advisable to wait for the process to stabilize and then take a new sample. Use the arrow keys to proceed to the next field. Taking a second sample is not compulsory when using single-point calibration; press ESC to return to the main menu.
- **2 START**
  Start taking a second sample (same as 1 START). The results 2.CSX.XX%, 2.SdX.XX% will appear as described above. If necessary, repeat the procedure for one or both samples. Finally press ESC to return to the main menu.

NOTE: If you wish to exit a menu without making any changes, press ESC several times until the desired menu appears.

7.5. LABORATOry menu

When the samples have been taken and the laboratory results are ready, go to CALIBRAT –> LABORATOry.

- **RECIPE n**
  Select the recipe you wish to calibrate.
- **1 CS X.XX%**
  The average of SmartLC's consistency reading during the sampling. Use the arrow keys to change this reading so that it corresponds to the total consistency indicated by the laboratory results, and press ENTER.
- **2 CS X.XX%**
  The average of SmartLC's consistency reading during the sampling. Use the arrow keys to change this reading so that it corresponds to the total consistency indicated by the laboratory results, and press ENTER.
- **CHNG CAL**
  Press ENTER to save the laboratory values, and proceed to select the calibration method (single-point or two-point calibration).
- **USE FRST**
  Press ENTER to accept single-point calibration with the first sample, or proceed to the next alternative with the arrow keys.
- **USE SCND**
  Press ENTER to accept single-point calibration with the second sample, or proceed to the next alternative with the arrow keys.
- **USE BOTH**
  Press ENTER to accept two-point calibration using both samples, or return to the previous alternatives with the arrow keys. If the difference between the two samples is less than 25%, the display blinks to warn of possible errors. However, the calibration can still be accepted.
- **SAVE OK?**
  Press ENTER to accept the new calibration for the selected recipe. If password protection is in use, this step will also require the password. The message NO SAMP indicates that no sample(s) have been taken. The message REPEAT CAlibration asks you to repeat sampling, because the requested change in the calibration curve would otherwise be out of range, P1<0.1 or >10, or P2 > 10 or <–10.
  The message W CAL OUT warns of suspiciously large changes in the basic calibration curve, but the calibration can still be accepted. P1<0.5 or >1.5, or P2 > 1.0 or <–1.0.

7.6. SPecial GRADE menu

In some special cases the predefined pulp grade curves may give unsatisfactory results even after two-point calibration. In such cases the curve for recipe 1 can be corrected by applying an offset table with up to 16 points under the SPecial GRADE menu.

Enter in this table the known consistency offsets (laboratory – SmartLC reading) of the calibrated curve at the desired consistency levels.

When measuring outside the range defined by the table, the transmitter will use the offsets of the table's nearest extreme point.

For consistencies between those defined in the table, the transmitter will apply linear interpolation based on the closest table values.

7.7. Using the Sample key

The SAMPLE key can be used for single-point calibration. The laboratory result can then be entered as instructed in section 7.5 above.

- Take a pulp sample.
- Wait at least 3 seconds.
- Press SAMPLE to return to the normal consistency display.

The average consistency measured at the time of sampling is now saved in memory for single-point calibration.

If two-point calibration is required, sampling for the second calibration point must be done in the CALIBRAT/SAMPLING menu.

8. Sample Taking

8.1. Sample Taking

It is important to obtain representative samples, i.e. the sample must represent the average pulp measured. To ensure this, the sample must be taken from a good point in the pipeline, from the correct depth inside the pipe and over a sufficiently long period. In addition, the sample must be transferred to the receptacle and to laboratory in unchanged condition, regardless of who performs the actual sample taking.

Even if the entire sequence from process pipe to laboratory is carried out in the best possible manner, the error margin of the result is rarely better than ± 5% of the reading. At 1.0% consistency level this means ± 0.05% Cs.

8.1.1. Representative process point

When choosing the installation point for the sampler (e.g. NOVE), follow closely the applicable installation instructions. In particular, avoid installing the sampler on the inside curve of a bend.

8.1.2. Representative depth inside the pipe

The sampler must protrude through the pipe wall and well towards the center of the pipe; next to the pipe wall there is always a layer of water which varies according to the pulp flow rate, and this layer will inevitably affect the results if the sampler is too short.

8.1.3. Representative time period

Pulp consistency in the process may sometimes vary considerably from one moment to the next. It is therefore important to obtain a representative average sample to the receptacle. A large sample volume, or several consecutive smaller portions, will help in this task.

8.1.4. Representative sample to receptacle

Critical moments in sample taking include the opening and closing of the sampler, the flow rate, and possible splashing.

The sampler should always be rinsed after each use to avoid clogging. It is recommended that you first allow the sample to flow for a few moments, and then "scoop" a suitable portion from the flow – for example by passing the flexible sample tube several times over the sample receptacle.

The sample flow should be as strong as possible, but not so strong that the sample splashes out from the receptacle. Too weak sample flow may dilute the sample.

8.2. Laboratory Procedures

8.2.1. Representative sample to laboratory

Sedimentation will occur as soon as the sample is allowed to stand for a moment.

Always stir the sample thoroughly before separating smaller portions from a larger sample volume. Such smaller portions should be scooped with a ladle, never poured from the larger vessel.

The best result will be obtained by taking several samples directly from the process pipe to separate vessels, and by processing all samples separately and completely. This will ensure that stirring and taking partial samples do not distort the results.

If the samples are kept separate from the very beginning, they will provide more information than one large sample; for example, you can estimate how representative they are by comparing their standard deviations.

8.2.2. Sample processing

In the laboratory it is important to pay attention to the accuracy of the weighing scale, and the proper timing of actions both before and after drying. Following the TAPPI T240 om-93 Standard ensures +10% repeatability in the determination of consistency.

In practice this error can be about halved; and even then the error may be significant when evaluating the accuracy of the measurement or the need for transmitter recalibration.

8.2.3. Result analysis and transmitter recalibration

If the SmartLC accepts the samples and the standard deviation between separate analyses was small enough, the results can be applied to determine if the transmitter should be recalibrated. Experience has shown that there is no need to recalibrate the transmitter based on a single batch of samples, if the difference between the average of the samples and transmitter reading is less than +5 % of the reading.

The recommended method for recalibration is halving the difference: the transmitter's output will then approach the laboratory result by half the difference, and random sample/laboratory errors will not have a too large effect.

9. Diagnostics

9.1. Error Messages

Select MESSAGES in the DIAGNOST menu. Use the arrow keys to scroll through the messages. To delete messages press ENTER, and the transmitter will display the ERASE? prompt. Press ENTER again to delete the selected message. Proceed in the same way to read and delete the other messages.

When the text NO MESS (no messages) appears, press ESC to return to the main diagnostics menu.

9.1.1. Serious faults/errors

The following faults are so serious that the transmitter's normal operation stops and the configured error current (3.7 mA or 22.5 mA) gives an alarm.

Error message:	Description:
• **CPU.EE ER**	Memory error on CPU board
• **T.PRO ER**	Housing temperature channel faulty
• **OPT 1 ER**	Measurement channel over range

9.1.2. Minor errors/faults

The following faults will not set the alarm current.

Error message:	Description:
• **AD ERROR**	AD-converter error, conversion restarted.
• **HART ERR**	HART® communication error

9.1.3. Warnings & error messages during operation

- **W. NO CAL:** The current recipe has not been calibration, the transmitter uses the basic curve instead. A blinking recipe text in the measurement display indicates the same thing.
- **NO SAMPLE:** no sample has been taken.
- USE SCND blinking: the difference between the sample consistencies is less than the recommended 25%.
- **CAL HI:** warns of suspiciously large changes in the basic calibration curve; the calibration can still be accepted.
- **REPEA CA:** asks you to repeat sampling, because the requested change in the calibration curve would otherwise be out of range, P1<0.1 or >10, or P2 > 10 or <–10.
- **WRONG PW:** wrong password..
- **LOW CS:** the consistency (%) defined in configuration is too low. However, the selection can still be accepted.
- **HIGH CS:** the consistency (%) defined in configuration is too high. However, the selection can still be accepted.

9.2. Testing Current Output Operation

As the SmartLC generates the mA output digitally, the transmitter is provided with the TRIM MA function.

9.2.1. TRIM MA

In order to trim the mA output, connect an accurate Ammeter to the transmitter's output. The transmitter will give out two current values (4 mA and 20 mA). Measure the actual currents precisely and correct the readings to the transmitter if necessary. The transmitter will calculate the required correction factors based on these test currents.

- Select TRIM MA in the DIAGNOST menu. The transmitter will now give out a constant 4 mA current.
- Use the arrow keys to correct the displayed reading to match the measured current and press ENTER to accept.
- Repeat the same procedure at 20 mA. The SmartLC will then trim the current output applying the obtained correction factors.

9.2.2. MA LOCK

This function locks and force-controls the output signal (loop test). When this command is given, the transmitter's output signal locks to its momentary value and the mA reading will appear on the display.

The reading can be edited with the arrow keys. This function can be used to check the cabling and the current-measuring circuits. Press ESC to exit the lock mode.

NOTE: Before using this function, make sure that the output is disconnected from automatic control!

10. HART® communication

HART® communication is a digital method for data transfer between a field instrument and a HART® master device (terminal or control system). The communication is carried out by applying FSK-modulation compatible with the Bell202 modem standard: a high-frequency communication signal is incorporated in a DC-level measurement signal. The average level of the FSK-signal is zero, and thus it does not distort the 4–20 mA measurement signal.

The SmartLC is provided with HART® communication. The transmitter is able to communicate with all master devices that use the standard HART®-protocol. The most commonly used is the 275HART® communicator, which is provided with a SmartLC device description.

Fig. 10.1. 275 HART® communicator.

10.1. 275HART® Communicator

When the 275HART® communicator with SmartLC device description is connected to the transmitter (Fig. 3.1), it will display the main menu:

SmartLC:tag
Online
1 Measurement
2 Configuration
3 Calibration
4 Diagnostics

Move in the menu with the UP and DOWN arrow keys. The next submenu can always be accessed with the RIGHT arrow key. The LEFT arrow key allows you to move backwards in the menu.

The Communicator incorporates a numeric keyboard that can also be used to enter letters. Function keys are located below the display, and their functions are shown at the bottom of each screen. Fig. 10.2 shows the menus of the 275HART® communicator for the SmartLC.

10.2. Menus

10.2.1. Measurement

This menu shows the measured consistency and temperature values, the output current given by the transmitter, and the number of the currently active recipe.

The values are continuously updated on the display.

10.2.2. Configuration

This menu can be used to view and edit the device configuration. This menu contains the following submenu:

1 Range values
2 Detailed config
3 Device info
4 Clear configuration changed flag

Range values allows the user to set the measuring range limits corresponding to 4 mA **(LowRnge)** and 20 mA **(UppRnge).** The minimum allowed difference between these values is the minimum span **(Min span).** This menu also shows the lower scale limit **(LSL)** and upper scale limit **(USL)** of the measurement.

Submenu **Detailed config** allows you to set the damping time constant **(Damping)** and the **Alarm current** (3.7mA or 22.5mA) that the transmitter sends when a failure occurs.

The transmitter can also be set to **Burst Mode**; in this mode it will independently send the variable selected under **Burst Option**.

Device info shows the basic information for the transmitter:

1 Poll addr
Transmitter's HART® address (default 0), can be set within the range 0...15.
2 Manufacturer
Manufacturer ID; cannot be changed.
3 Model
Transmitter model (SmartLC); cannot be changed.
4 Sensor s/n
Transmitter's serial number; cannot be changed.
5 Tag
User-defined measuring point code; 8 characters.
6 Message
User-defined text; 32 characters.
7 Universal rev
HART® version supported by the transmitter; cannot be changed.
8 Fld dev rev
Internal version number; cannot be changed.
9 Software rev
Software version number; cannot be changed.

- **Hardware rev**
  Circuit board version number; cannot be changed.
- **Descriptor**
  User-defined text; 16 characters.
- **Date**
  User-defined date.
- **Device code**
  Transmitter's option code; can be changed by user.
- **Final asmbly num**
  Year/week in transmitter's serial number; cannot be changed.

Clear configuration changed flag resets the bit indicating configuration changes in the HART® status byte.

When any values have been changed, they must be sent to the transmitter. The heading SEND has appeared at the bottom of the display; press function key F2 below this heading, and the data will be sent to the transmitter. After sending the SEND heading will disappear. The changed values need not be sent one by one; first make all changes to the displayed values and then press SEND to send them all at the same time.

10.2.3. Calibration

Recipes for the transmitter are defined and calibrated in the **Calibration** menu. This menu contains the following submenu:

1 New recipe
2 Sampling
3 Lab results
4 Special grade
5 Tempr calibrations

New recipe allows you to create a new recipe for the transmitter. Give the recipe number (1...4) and define the pulp grade. The recipe also includes calibration coefficients – at this point use the default values P1=1 (gain) and P2=0 (zero offset). Press SEND (F2) to send the recipes to the transmitter.

Sampling allows you to take consistency samples for calibration. Two separate samples can be taken **(sample 1** and **sample 2**). Press RIGHT arrow to choose the desired sample. Press OK (F4) to end sample calculation; the display will show the average consistency and standard deviation for the sample. Sampling can be repeated as many times as needed; the transmitter will always remember the latest Sample 1 & 2.

Go to **Lab results** to enter the laboratory values corresponding to the samples taken, and to calibrate the transmitter by using these values. Use the ENTER key (F4) to give and accept the recipe number, calibration method, and consistency value(s). See section 7.3 of this manual for more information on the calibration.

Special grade allows you to enter a consistency deviation table for the special pulp grade in recipe 1. See section 7.6 for more detailed information.

The temperature measurement is calibrated under **Tempr calibrations** .

10.2.4. Diagnostics

This menu contains the following submenu:

- **Device Status**
- **Zero device status**
- **Master reset**
- **Loop test**

Device status shows the possible error messages given by the transmitter. The text ON means that the indicated error is currently active. See section 9.1 of this manual for more information on the error messages.

The displayed error messages are cleared under **Zero device status**.

Master reset allows you to reset (restart) the transmitter. This function has the same effect as cycling the supply power off and on.

Loop test allows you to force the transmitter's current output to the desired value in order to test the current loop. Press ENTER (F4) to set the desired value to the current output. Press ABORT (F3) to exit the menu – when this key is pressed, the current output will return to the value corresponding to the measured consistency.

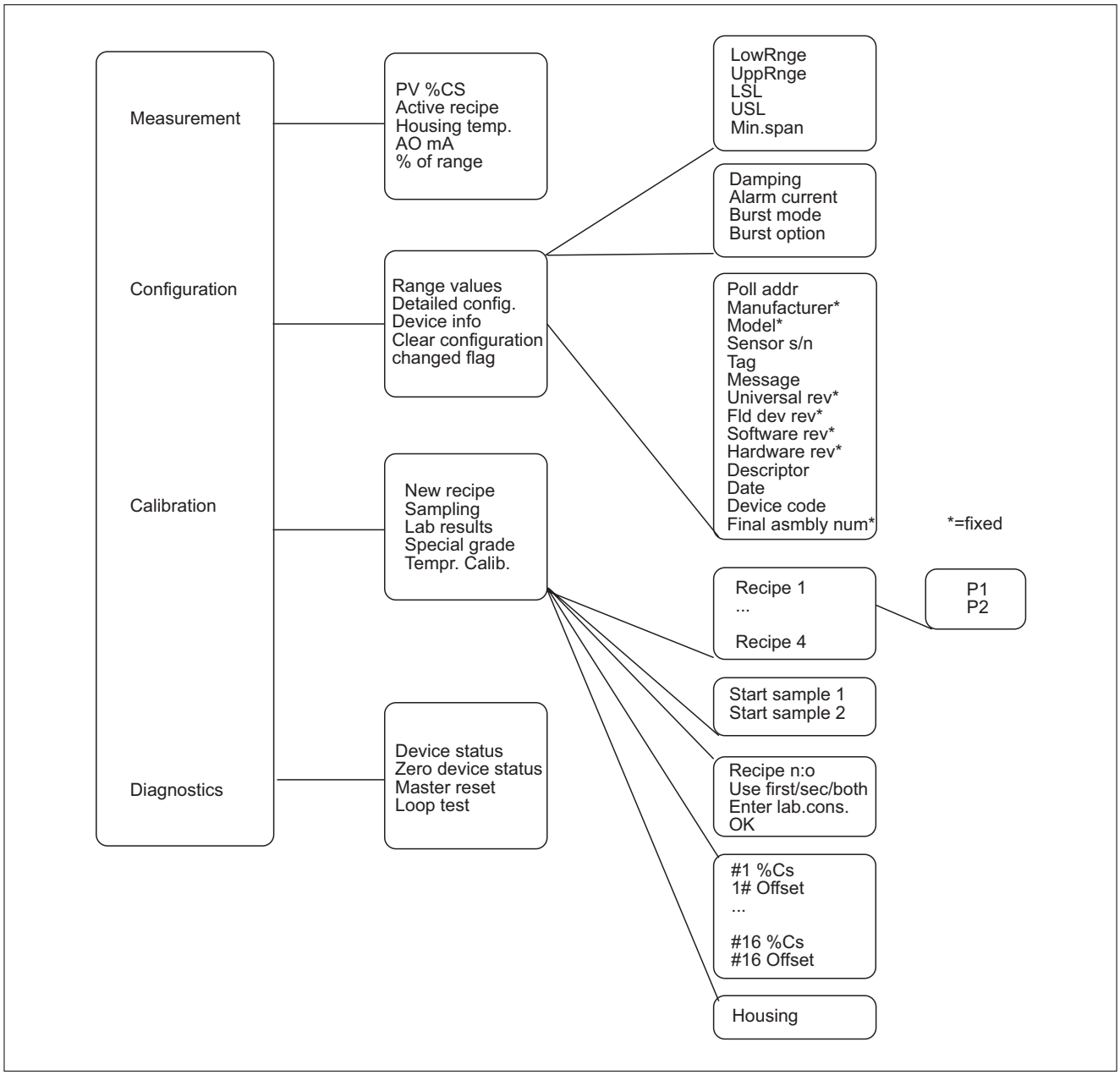


Fig. 10.2. Menus of the 275 HART® communicator.

11. Service

11.1. General Instructions

The SmartLC consists of modules connected to each other with cables and connectors. This construction provides for quick and simple service, as faulty units can easily be replaced by new ones, even in mill conditions.

If an electric fault occurs, its reading usually drifts to either extreme (minimum or maximum). However, the consistency may also be actually outside the measurement range – therefore, if the measurement result jumps to either extreme, always check first whether the consistency at the measuring point is still within the calibrated range. When some fault occurs, remember to run a general checkup: check the light source, fuse, connections, and outgoing current loop.

NOTE: Always switch power off before any service or maintenance actions!

11.2. Checking the Process Variables

- Make sure that sample flows freely in the sample line and through the transmitter.
- Make sure that the consistency is still within the calibrated range.
  If these points are OK, proceed to troubleshoot the electric operation of the device.

11.3. Checking the Measurement Cell Cleanliness

- Fill the measurement cell with clean water, temperature over 20°C (>68°F).
- Check the LC-value: for SmartLC it must be max. 0.01, for SmartLCU max. 0.05.

NOTE: Never try to clean the measurement cell with a screwdriver or other hard tool!

11.4. Fuse

The main fuse of the device is located in the SmartLC operator unit, next to the connections.

When the connection box is opened, the fuse can be seen. Fuse capacity is 250 mA (T).

11.5. Replacing the Measurement Cell

See the drawing in Appendix 3 of this manual.Make sure to proceed exactly as instructed below!

- Close the shut-off valves of the sample line, and let the pressure be released from the sampling valves.
- Switch operating power off.
- Disconnect the sample line tubes from the transmitter.
- Disconnect the transmitter's cable from its connector on the transmitter.
- Remove the shield plate above the transmitter.
- Detach the connector nut, part 3.
- Detach the countersunk screws (3 pcs) of the O-ring (part 4) below the transmitter, remove the O-ring.
- Detach the measurement cell mounting screws (3 pcs) located on top of the transmitter. To release the measurement cell, hold it around the capillary and push gently – do NOT hold by the capillary itself!
- Insert a new measurement cell.
- Push the O-ring (part 4) from below into position.
- Tighten the measurement cell.
- Connect the tubes.

SmartLC Technical specifications

Applicability:
? Screened pulps

Consistency range:
? 0 to 1.5 %Cs SmartLC
? 0 to 0.2 %Cs SmartLCU

Span:
? min. 0.2 %Cs SmartLC
? min. 0.03 %Cs SmartLCU

Sample flow rate:
? min. 4 liters/minute (1.1 US gal/min)
? max. 30 liters/minute (7.9 US gal/min)

Damping:
? 1 to 60 seconds

Output signal:
? 4 – 20 mA + HART®

Power supply:
? 115/230 VAC ±10 %, 49 – 61 Hz

Load capacity:
? 0 – 600 ?
? HART® requires min. 250 ? load resistance.

Process pressure:
? max. 7 bar (101.5 psi)

Operating conditions:
? Ambient temperature -20 to 60°C (-4 to 140°F)
? 0 to 95% R.H. (no condensation)
? Process 20 to 80°C (68 to 176°F)
? Storage -20 to 80°C (-4 to 176°C)
? Vibration max. 2 g / 100 – 500 Hz

Performance:
? Repeatability
0.01 %Cs SmartLC
0.0015 %Cs SmartLCU
? Effect of process temperature:
max. 0.1 % Cs / 10°C SmartLC
max. 0.015 % Cs / 10°C SmartLCU

Materials:
? Transmitter's electronics housing: Aluminium alloy
? Parts directly exposed to humidity: AISI 316L
? Measurement cell: borosilicate glass
? Operator unit: Polycarbonate
? Plastic tube FEP ½" length 5m (16.4 ft)

Enclosure class:
? operator unit IP 65
? transmitter IP 66 (Nema 4X)

Mounting:
? To a sample line branched from the main process flow using ½" plastic or rubber hose

Electric connections:
? Terminals in operator unit
? Housing equipped with sealed inlet bushings

EMC test standards:
? Emitted interference: EN50081-1: 1992
? Reference standard: EN55022: 1998 / Class B
? Interference immunity: EN61000-6-2: 1999
? Reference standards: EN61000-4-2,-3,-4, -5, -6, -8, -11

Backflushing unit

Pressurized air supply:
? 4 to 7 bar (58 to 101.5 psi)

Flushing water supply:
? max. 7 bar (101.5 psi) at least 1 bar (14.5 psi) higher than process pressure, temperature difference between flushing water and process max. 20°C (36°F).
? Exception: in white water applications the temperature of flushing water must be higher than process temperature.

Sample line:
? ½"

Flushing water supply line:
? ½"

Weight:
? transmitter 4.6 kg (10.1 lb)
? operator unit 1.5 kg (3.3 lb)
? backflushing unit 3.2 kg (7 lb)

Recycling of used up units:
Almost all parts of units are suitable for recycling.
Parts materials are specified in documents dispatched with the product.
Also a separate recycling instructions guide is available from the manufacturer.
Alternatively the manufacturer takes care of the used up units on a special fee.

SmartLC Contents of delivery

- Transmitter
- Operator unit
- Backflushing unit
- Cable between operator unit and transmitter, length 10 m (33 ft)
- Cable between operator unit and backflushing unit, length 10 m (33 ft)
- Plastic hose FEP, length 5 m (16.4 ft)
- Sampling tube

Options:

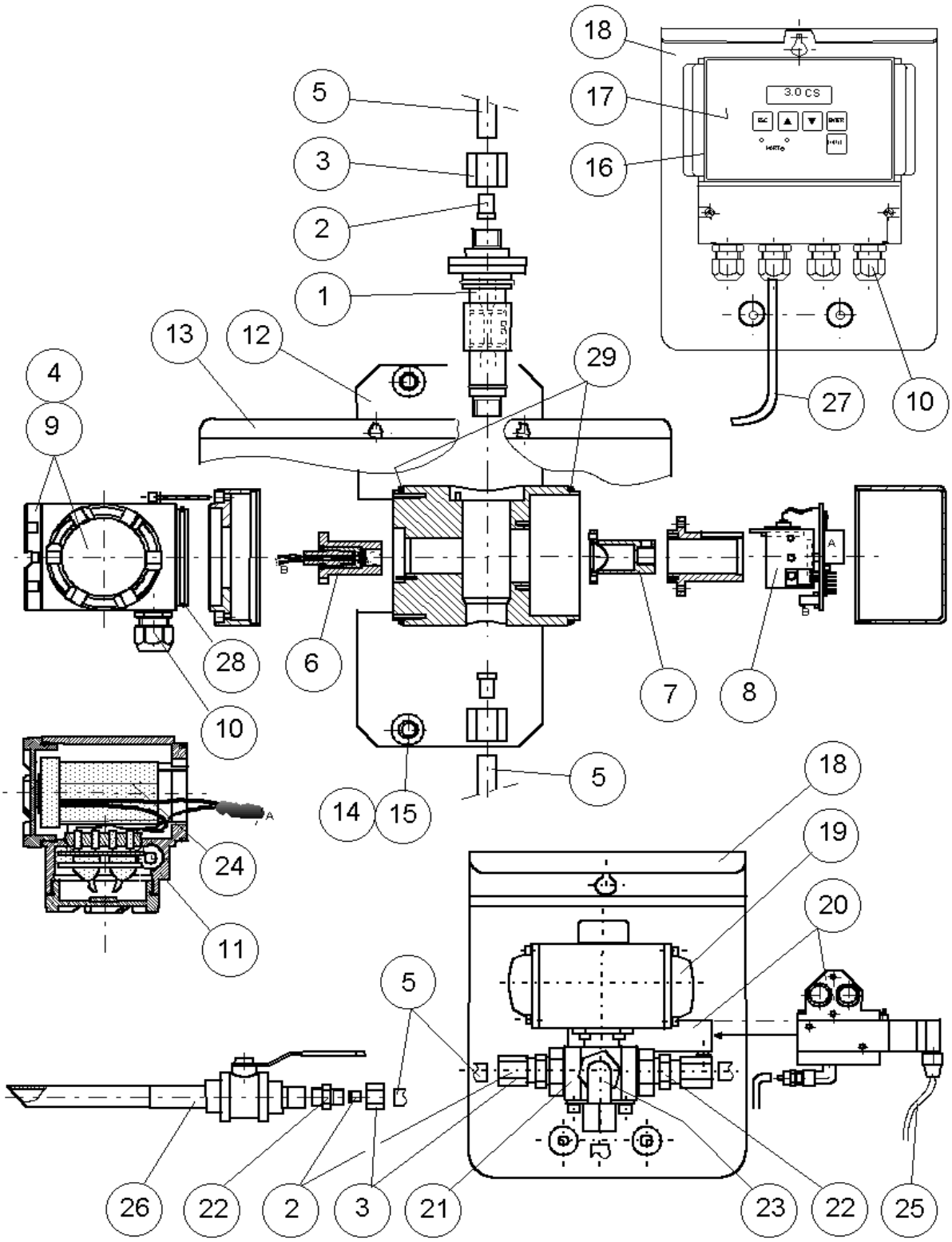
- Deaeration module

metso automation

SmartLC Spare parts

Part no.	Code	Item	Qty
1	A4370292 A	Measurement cell 0–1.5 %Cs	1
1	A4370293 A	Measurement cell U 0–0.2 %Cs	1
2	H4000276	Support nipple	6
3	238592	Connector nut	6
4			
5	175596	FEP – Tube, 3/8" / ½" in normal delivery length 5 m (16.4 ft)	1
6			
7	A4370291 B	Optics unit 2	1
8			
9			
10	72900011	Seal bushing	1
11	A4740028 V1.	Electronics housing	1
12			
13			
14	H4760053 V1.	Support sleeve	4
15	82920035	Rubber inlet	4
16	A4760006 V1.	Operator unit	1
17	A4730136 V1.	Display & keypad panel	1
18			
19	82920034	Actuator	1
20	82920033	Solenoid valve	1
21	262360	3-way valve	1
22	82162502	Straight pipe connector	3
23	82200139	Pipe connector 90°	1
24			
25	A4760027 V1.	Backflushing unit cable	1
26	H3430690 V1.	Sampling tube ½"	1
27	A3740026 V1.	Operator unit cable, normal length 10 m (33 ft)	1
28	80006535	O-ring 65.09 x 3.53 NBR 70 SHA	1
29	80008200	O-ring 82.22 x 2.62 Viton	2

SmartLC Spare parts



 Manufacturer reserves the right to changes without prior notice.

F I E L D S Y S T E M S

Metso Automation Oy
Field Systems
Lentokentänkatu 11, P.O. Box 237
FIN-33101 TAMPERE, Finland
Tel. +358 20 48 3170, Fax +358 20 48 3171
www.metsoautomation.com

Documentation: Mikromestarit Ay. Translation: Marjo Nygård.