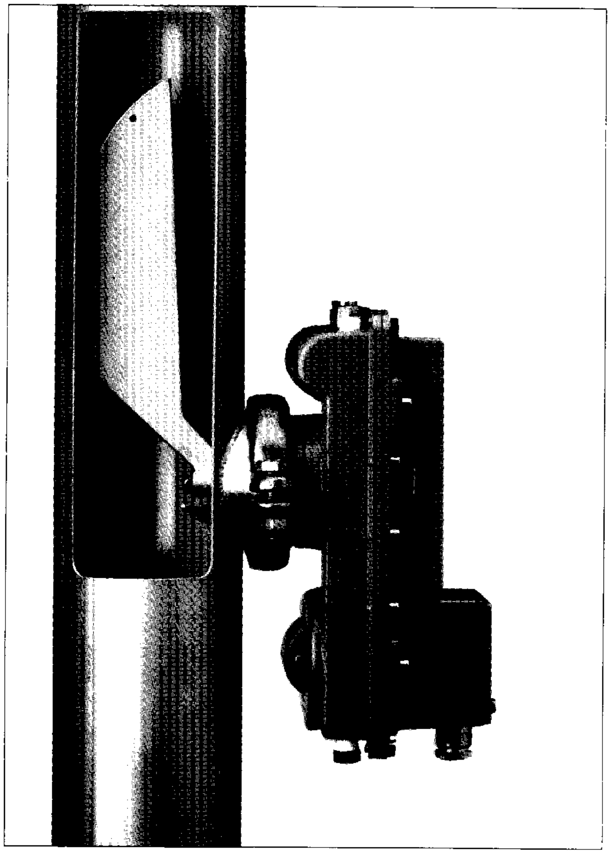
Operating and Installation Instructions
Parts List



WARNING!

Make sure that the process pipe is empty and unpressurized before disconnecting or connecting the transmitter. Observe the process's safety regulations.

Contents:

1 APPLICATION
1.1 Applications of the different sensor types
1.2 Applicability with different material options

2 INSTALLATION
2.1 Choosing the mounting location
2.2 Mounting the process coupling on process pipe and installing the transmitter
2.3 Electrical connections

3 CALIBRATION
3.1 Factory calibration
3.2 Precalibration
3.3 Checks before putting into operation
3.4 Setting-up procedure
3.5 Making your own *"Measurement force as a function of consistency"* curves
3.6 PULP-EL + EL-TUNE C
3.7 Calibration after servicing the transmitter

4 CONSTRUCTION AND PRINCIPLE OF OPERATION
4.1 Mechanical part
4.2 Electronics circuits

5 MAINTENANCE
5.1 Mechanical parts
5.2 Checking the condition of the electronics

6 TECHNICAL SPECIFICATIONS

7 PARTS LIST

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1 APPLICATION

The PULP-EL consistency transmitter is used for pulp consistency measurements in pulp and paper industry. PULP-EL is installed directly on the stock pipe (Fig. 1).

The transmitter is supplied with the sensor type, process coupling and sensor protector blade to suit the application.

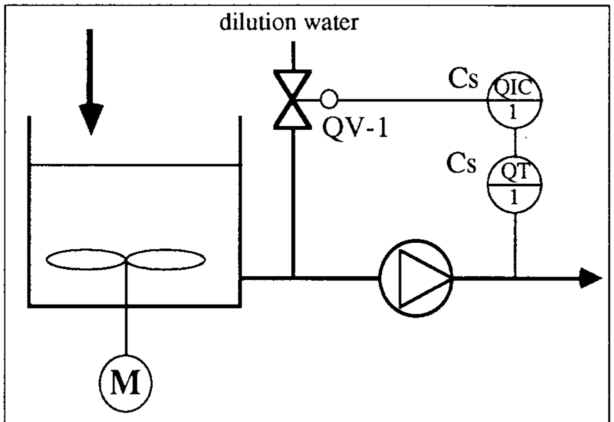


Figure 1 Typical consistency control application for PULP-EL

1.1 Applications of the different sensor types

The transmitter is supplied with different optional sensor types (Figure 1.1a).

The flow velocity and consistency ranges best suited for the different sensor options and pulp types are shown in Fig. 1.1b.

When making a tag-specific selection you specify a "window" whose width represents the flow velocity range used in the process, e.g. 1.2 to 3 m/s, while the height represents the consistency range, e.g. 2.5 to 2.8 % Cs. The obtained "window" should fit inside the white area of the diagram. Velocity effects or other disturbances may occur outside this area (especially for the UL sensor such effect may be considerable).

The PULPSEL PC program supplied by Valmet Automation can also be applied in the selection of sensor type. PULPSEL also calculates the minimum lengths of required straight pipe sections and the values of the calibration weights.

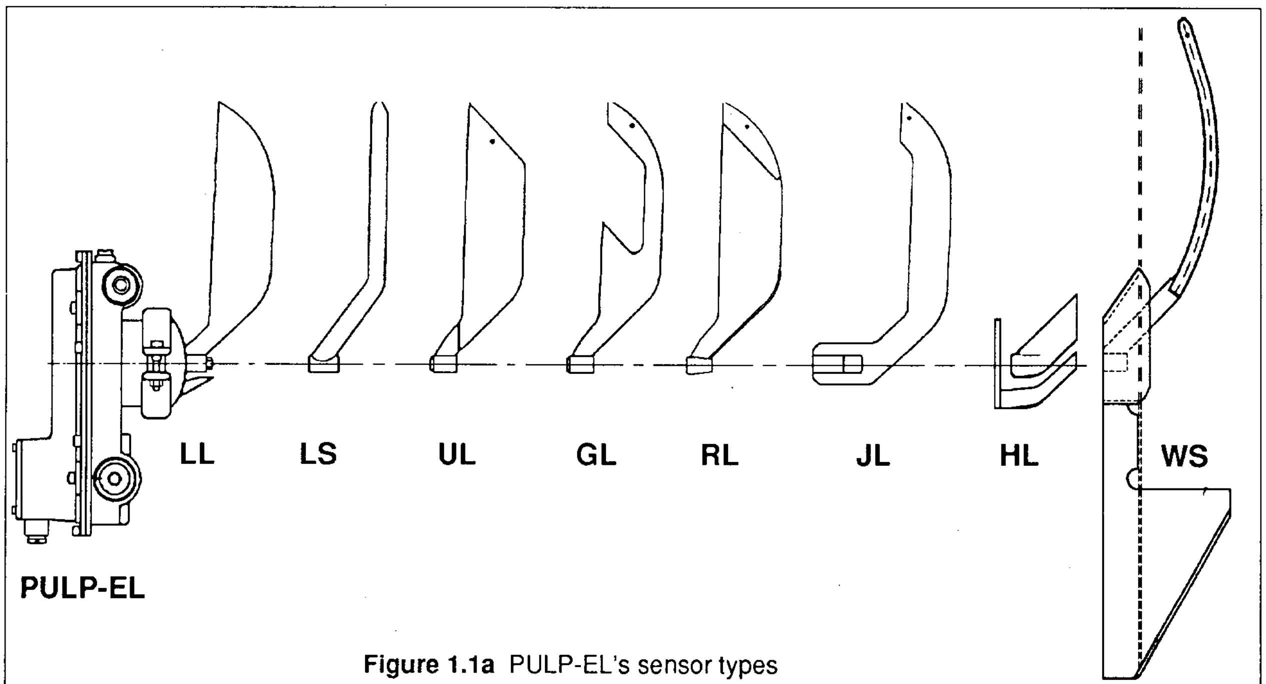
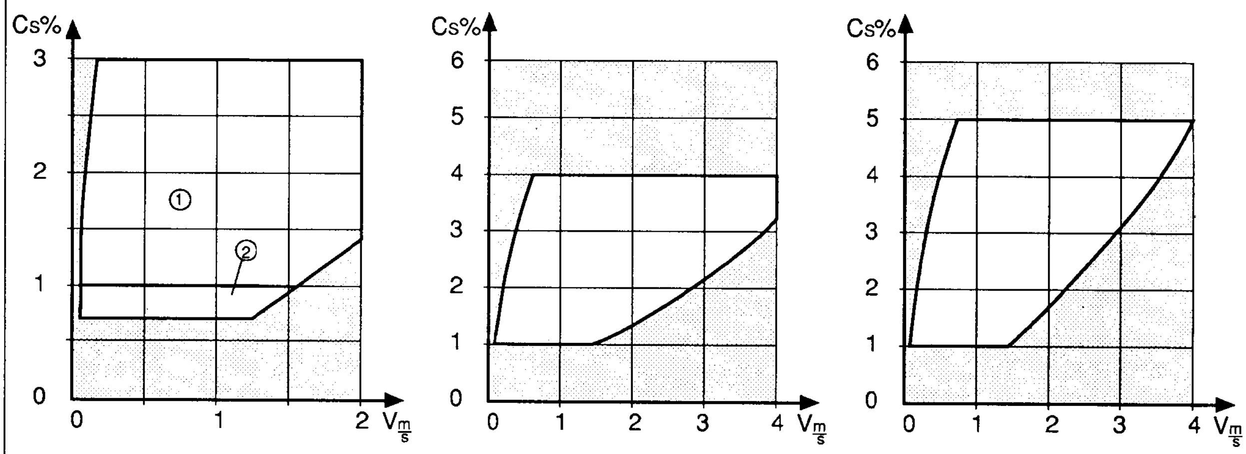


Figure 1.1a PULP-EL's sensor types

The pulp types corresponding to the codes are specified after the figures.



PULP-EL UL

(1) + (2): For pulps A, B, F, G and L

(1) : For pulps C, D and J

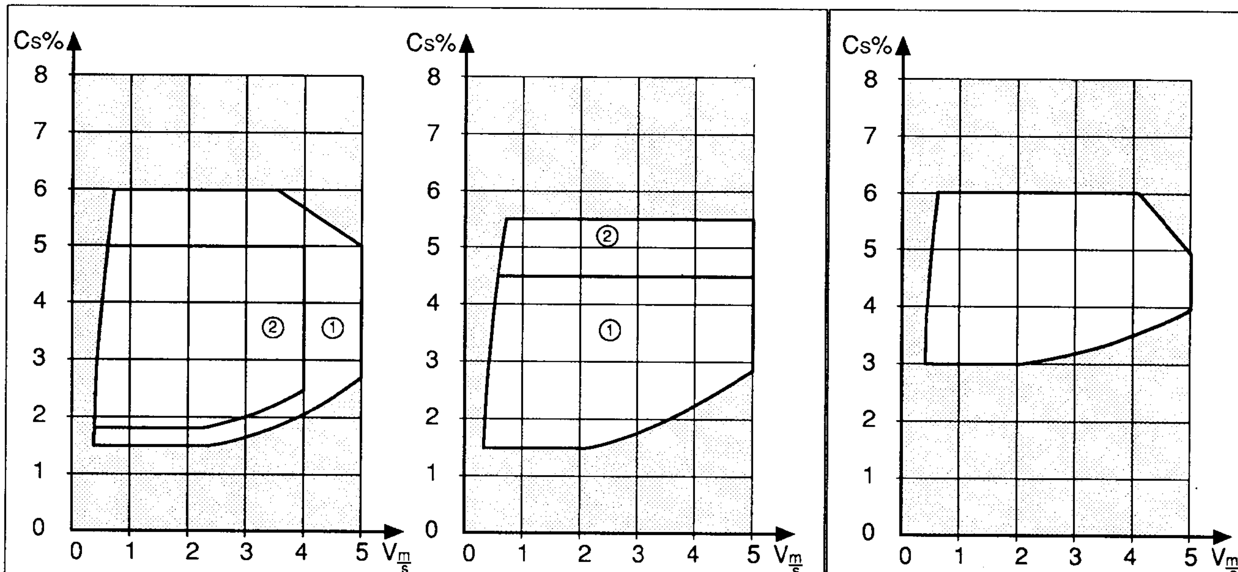
PULP-EL UL

For pulp E

PULP-EL UL

For pulp K

PULP-EL **UL**



PULP-EL LL

(1) + (2): For pulps A and B

(2) : For pulps C and D

PULP-EL LL

(1) : For pulp G

(1) + (2): For pulp L

PULP-EL **LL**

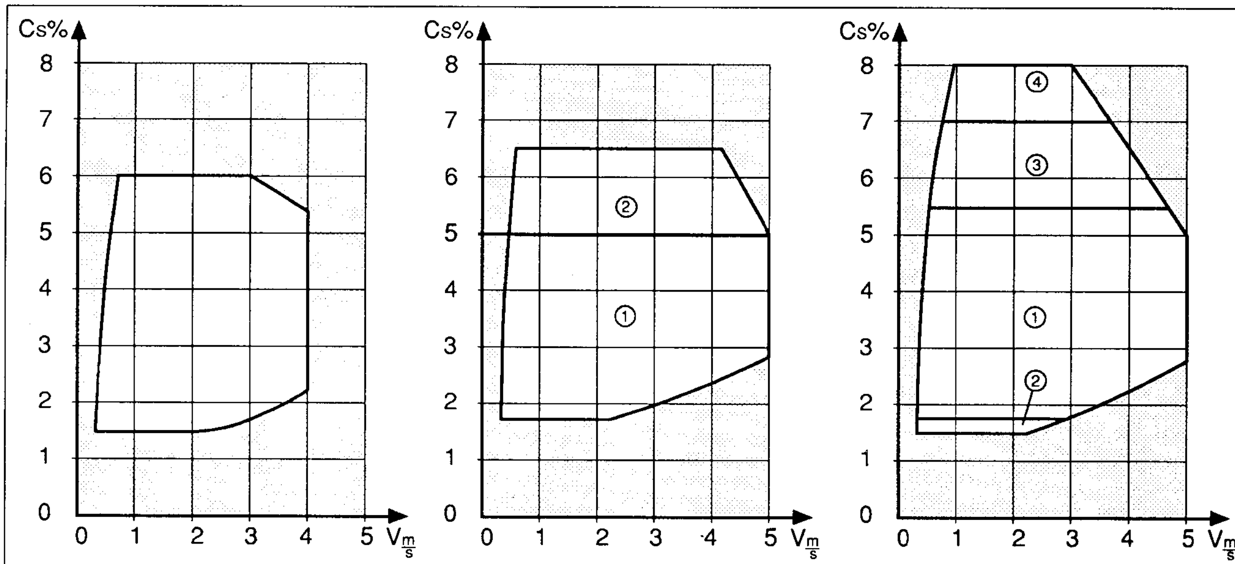
PULP-EL LS

For pulps F and G

PULP-EL **LS**

Figure 1.1b Velocities of flow/consistency ranges/pulp types for different PULP-EL sensor types (cont. on next page)

The pulp types corresponding to the codes are specified after the figures.



PULP-EL RL

For pulps A and B

PULP-EL RL

(1) + (2): For pulps C and D

(1) : For pulps E and F

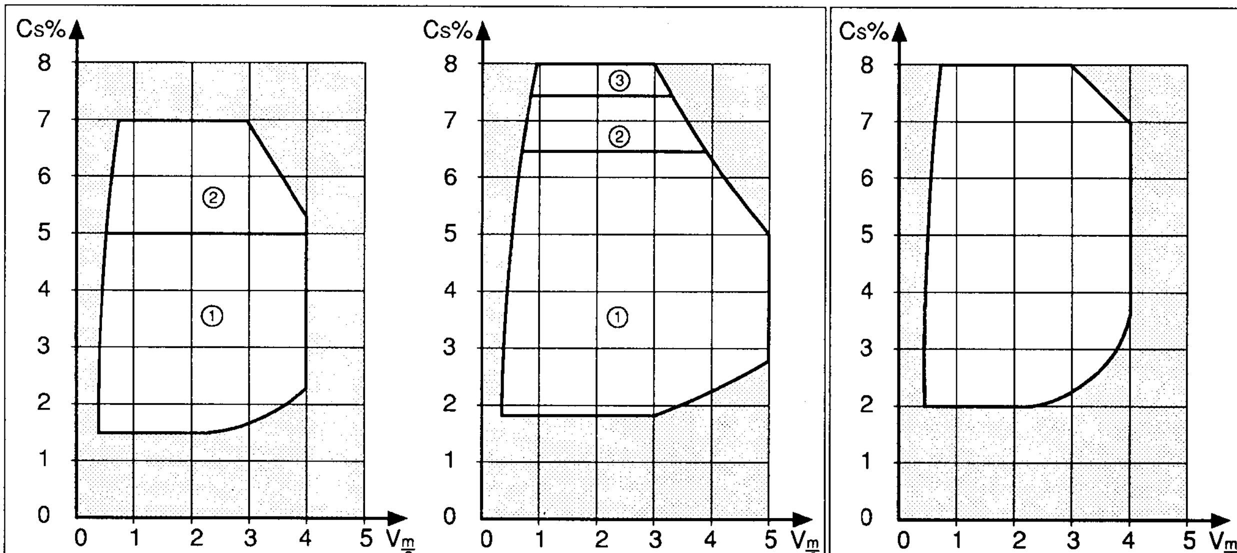
PULP-EL RL

(1)+(2)+(3): For pulp J

(1)+(3)+(4): For pulp K

(1)+(2) : For pulp L

PULP-EL **RL**



PULP-EL GL

(1) + (2): For pulps A and B

(1) : For pulp G

PULP-EL GL

(1)+(2) : For pulps C, D, E

(1) : For pulp F

(1)+(2)+(3): For pulps J and K

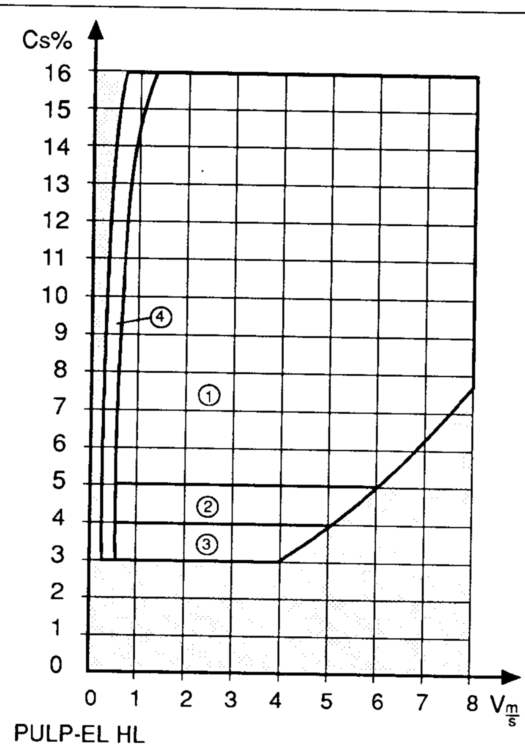
PULP-EL WS

For pulps H and I

PULP-EL **GL**

PULP-EL **WS**

Figure 1.1b Velocities of flow/consistency ranges/pulp types for different PULP-EL sensor types (cont. from previous page)



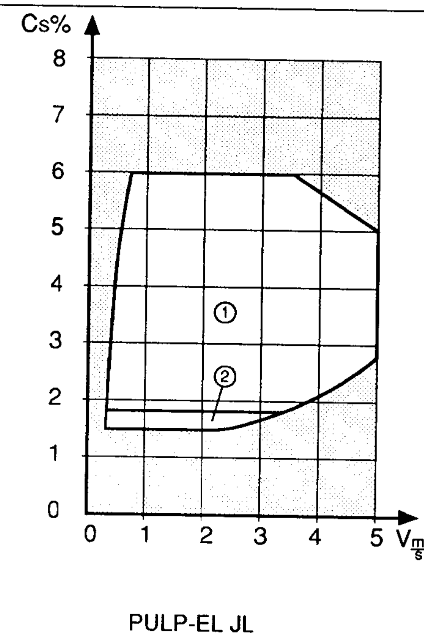
① : For pulps C, D, E and K

①+② : For pulps L, J and F

①+②+③ : For pulps A, B and G

④ Also suitable for this zone when flow velocity variations are max. 1:2

PULP-EL **HL**



①+② : For pulps A and B

① : For pulps B and C

PULP-EL **JL**

Figure 1.1b Velocities of flow/consistency ranges/pulp types for different PULP-EL sensor types (cont. from previous page)

Pulp type codes used in Fig. 1.1b

Code	Pulp type
A	Long-fibered unbleached pulp
B	Long-fibered bleached pulp
C	Short-fibered unbleached pulp
D	Short-fibered bleached pulp
E	Groundwood
F	RMP, TMP, when CSF < 200 ml (SR > 52)
G	RMP, TMP, when CSF > 200 ml (SR < 52)
H	Recycled fiber pulp, OCC, unscreened
I	Recycled fiber pulp, unscreened
J	Recycled fiber pulp, OCC, screened
K	Recycled fiber pulp, screened
L	CTMP

1.2 Applicability with different material options

Metal parts in contact with process medium:
a. AISI316L
b. Titanium
c. Hastelloy C276
AISI316 is suitable for most applications. Titanium is recommended for bleaching stages that use chlorine or chlorine compounds. Peroxide bleaching stages and applications where free chlorine gas may occur are an exception: Hastelloy C276 must be used for them.

Packings in contact with process medium:
- Numbers 6 and 35 in Parts List (Chapter 7): PTFE
- Number 5 in Parts List: special rubber

The effect of flow velocity on measurement accuracy on the recommended measuring ranges will be insignificant if the transmitter is installed as specified in the Installation Instructions.

2 INSTALLATION

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

2.1 Choosing the mounting location

Points of importance in installation:

- The pipe diameter must be at least 100 mm, and velocity of flow must be as shown in Section 1.1. When necessary, the pipe diameter can be changed at the measuring point so as to achieve the desired velocity of flow.
- Pulp flow in the pipe must be of the “plug” type.
- The pipe should have sufficiently long straight sections both upstream and downstream from the transmitter (Fig. 2.1a).
- The transmitter must be mounted at an angle of 90 degrees to the pump shaft, and on that side of the stock pipe where the pulp is discharged from the pump (Fig. 2.1b through 2.1d). After a pipe bend, the transmitter should be mounted on the side of the outer curve of the bend (Figures 2.1e through 2.1g). If this is not possible, the transmitter may be mounted on the opposite side of the pipe.

NOTE! The direction of a pipe curve downstream from the transmitter has no effect.

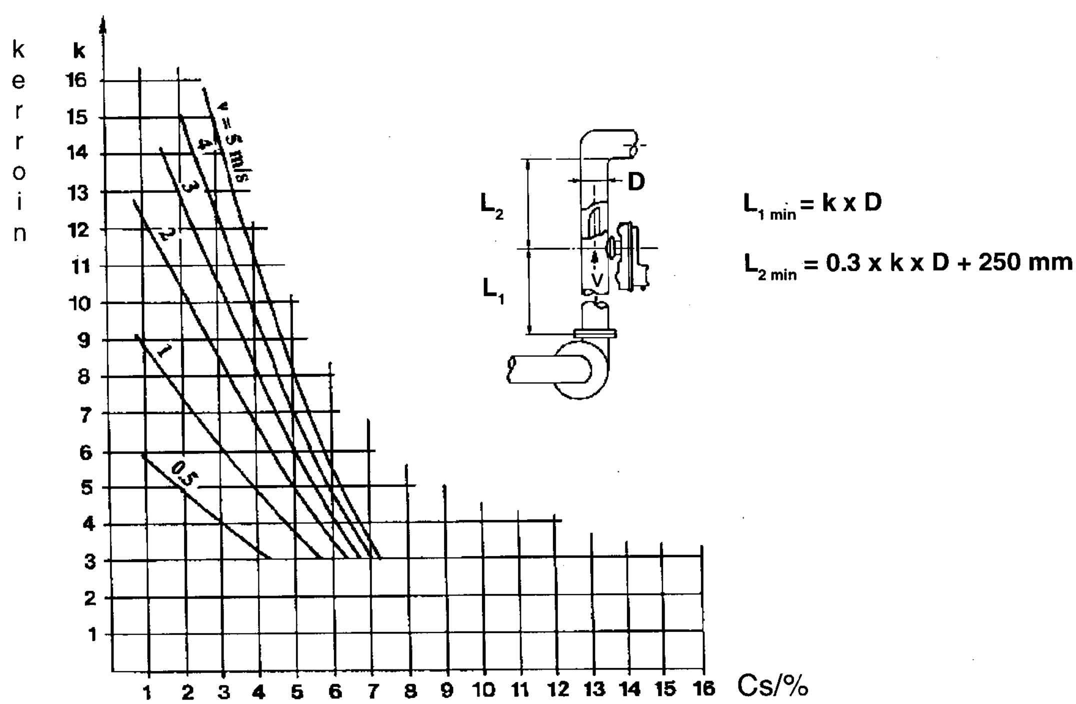


Figure 2.1a Minimum lengths of straight pipe section upstream (L1) and downstream (L2) from PULP-EL as a function of pulp consistency and velocity of flow

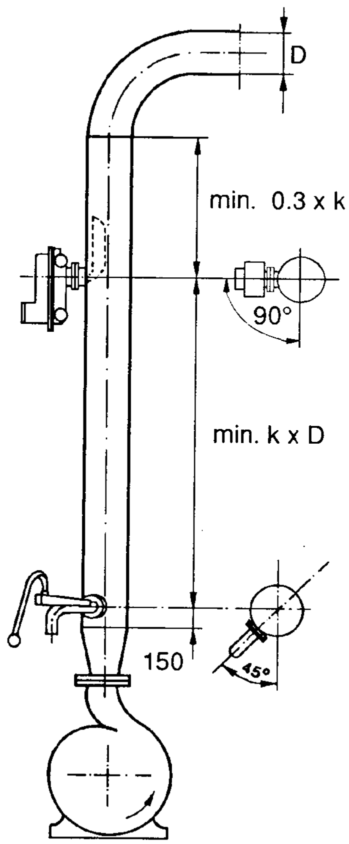


Figure 2.1b Installation of PULP-EL transmitter and NOVE sampler on vertical pipe after pump

Figure 2.1c Installation of PULP-EL transmitter, NOVE sampler and flow tranquilizer element (mounting pipe) on vertical pipe after pump

Figure 2.1d Installation of PULP-EL transmitter and NOVE M sampler on vertical pipe after pump (Note: different pump type than in Figures 2.1b and c)

- The figures also show correct mounting locations for Valmet's NOVE sampler.

- Figure 2.1c also shows a flow tranquilizer element (mounting pipe element).

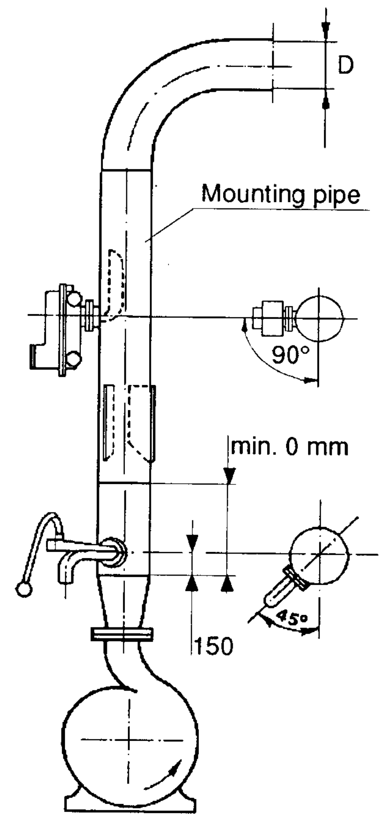


Figure 2.1c

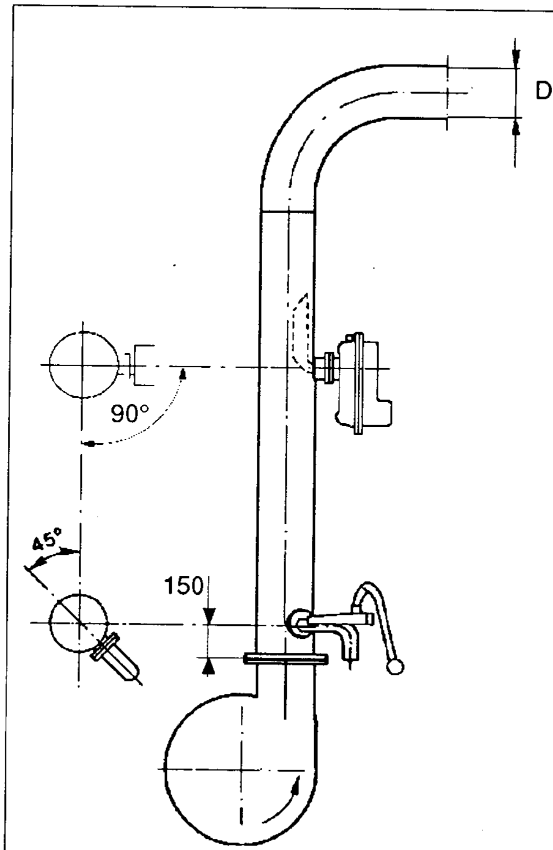


Figure 2.1d

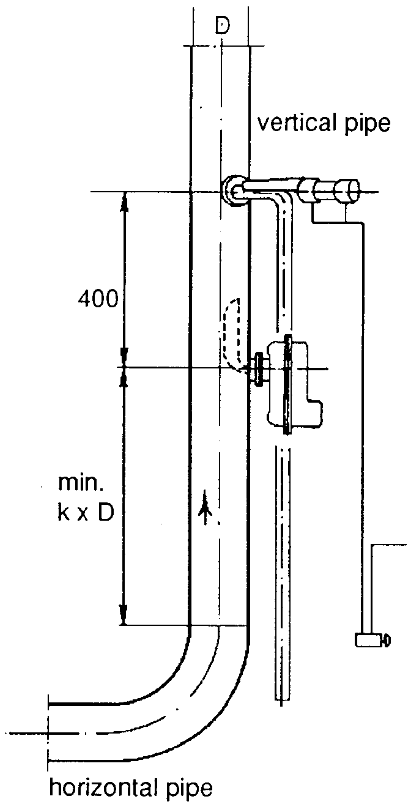


Figure 2.1e Installation of PULP-EL transmitter and NOVE sampler on vertical pipe after pipe bend

- If the distance between PULP-EL and pipe bend is more than 1.5 x k x D when installed on horizontal pipe after vertical pipe, the transmitter should mounted on the side of the pipe to avoid the effects of possible air in the process pipe (Fig. 2.1h).

- If the recommended lengths of straight pipe cannot be provided, we recommend the use of a mounting pipe element (Fig. 2.1i) which is installed as a part of the process line as shown in Figures 2.1c and 2.1k. The mounting element is equipped with process coupling for PULP-EL, flow tranquilizer element, and sensor protector blades both upstream and downstream from the sensor.

Note! We do not recommend the flow tranquilizer element for installations where you measure waste-paper stock coming directly from pulper.

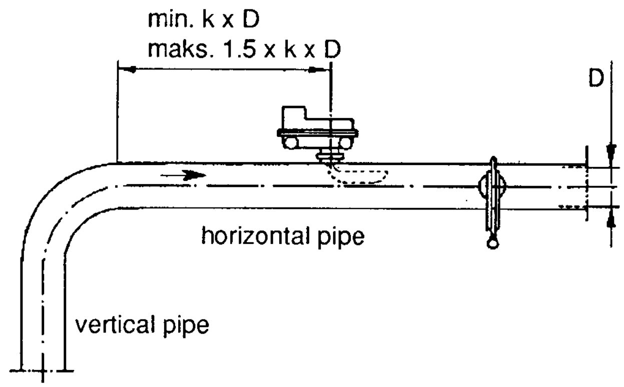


Figure 2.1f Installation of PULP-EL transmitter and NOVE sampler on horizontal pipe after upward or downward bend, at max. 1.5 x k x D distance from the bend

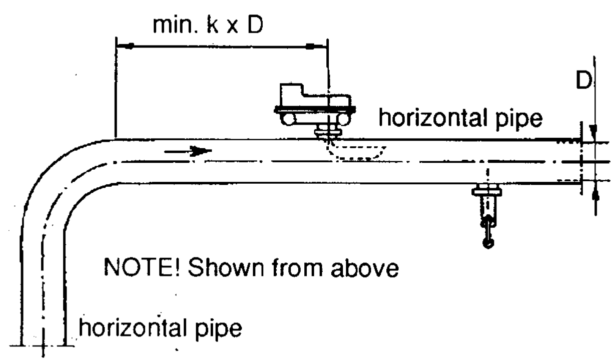


Figure 2.1g Installation of PULP-EL transmitter and NOVE P/M sampler on a pipe in the horizontal plane

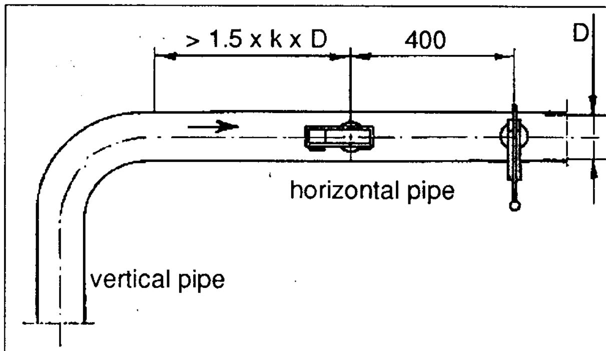
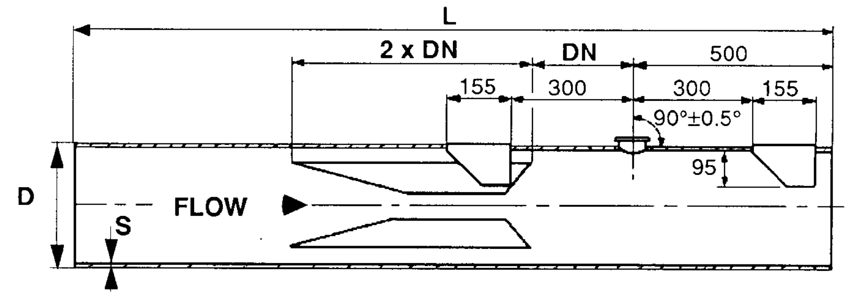


Figure 2.1h Installation of PULP-EL transmitter and NOVE sampler on horizontal pipe after upward or downward bend, at more than 1.5 x k x D distance from the bend

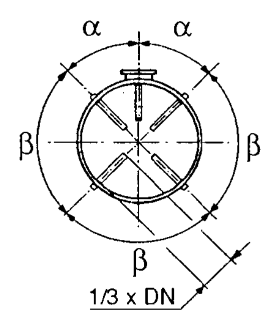
• For applications where the mounting pipe element is not used we recommend the sensor protector blade shown in Figure 2.1j. The blade will protect the sensor against impacts from lumps of pulp or other hard objects.
If there is a possibility of back flow, a protector blade should also be installed downstream from the transmitter (see Fig. 2.2b).
Note! There is one exception: A protector blade must not be installed for PULP-EL UL.

• If the process pipe has multiple bends before the measuring point (Fig. 2.1k), the result will be a whirling pulp flow that will not be tranquilized even in a long straight section of pipe. For such applications we recommend the mounting element illustrated in figure 2.1i.
Note! Valmet does not answer for the strength and product safety of other manufacturers' mounting elements in accordance with figure 2.1i.

Mounting pipe element
(AISI316L)



DN ISO	D x S **)	L mm	*)	α/°	β/°	Weight kg
100	114.3 x 2	1000	2	90	180	9
125	139.7 x 2	1125	2	90	180	12
150	168.3 x 2	1250	4	45	90	15
200	219.1 x 3	1500	4	45	90	32
250	273.0 x 3	1750	4	45	90	46
300	323.9 x 3	2000	6	30	60	68
350	355.6 x 3	2250	6	30	60	82
400	406.4 x 4	2500	6	30	60	124
500	508.0 x 4	3000	8	22.5	45	180
600	609.6 x 4	3500	8	22.5	45	250



*) number of flow tranquilizer plates
**) other dimensions according to the order

Figure 2.1i Mounting pipe element

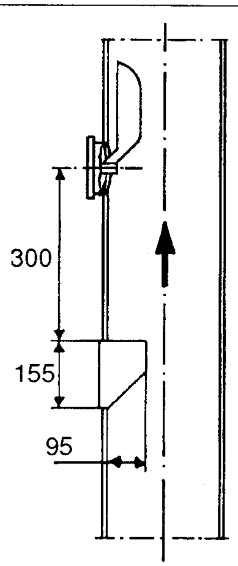


Figure 2.1j Installation of sensor protector blade on process pipe

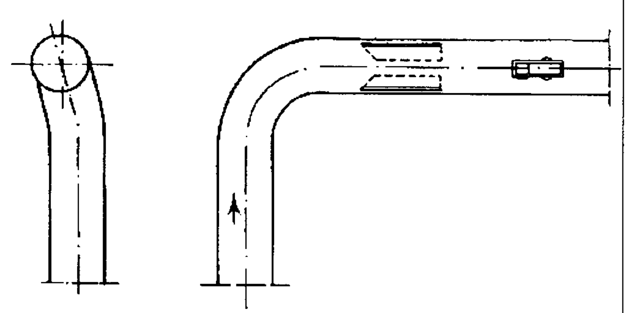
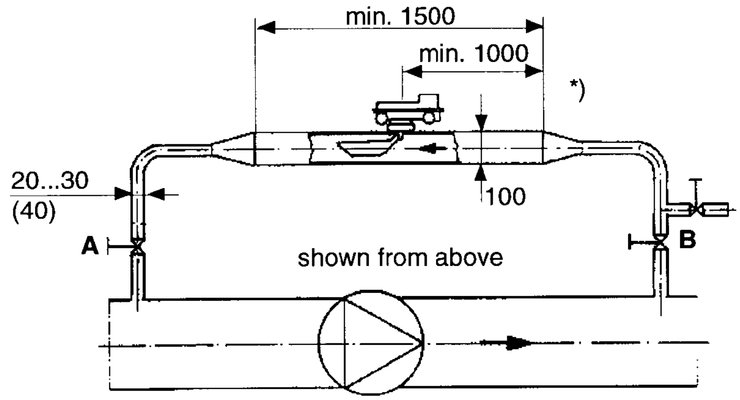


Figure 2.1k Mounting pipe element after two pipe bends following each other closely (NOTE: whirling flow)

PULP-EL **UL**



*) The bypass line may also be vertical.

Figure 2.1l Installation of PULP-EL UL (transmitter for low consistencies) on a bypass line

- Low pulp consistencies are measured with sensor option UL. To achieve as accurate measurement as possible at very low consistencies, we recommend a bypass installation where the velocity of flow can be limited to 0.1...1 m/s. This installation is illustrated in Figure 2.1l. The bypass line is connected to the main process pipe with 20 mm pipes if consistency is max. 2 % Cs, and with 30 mm pipes if consistency is max. 3 % Cs. 40 mm pipe is used for consistencies above 3 % Cs.

Note! Due to the risk of clogging, this installation is not suitable for unscreened pulp.

- PULP-EL HL, the transmitter for high consistencies, is primarily installed on the small-diameter pipe section following the stock pump (Fig. 2.1m). This pipe section usually includes several measuring devices, such as flowmeters and valves. However, PULP-EL HL can be mounted at any unoccupied position, also on the outer curve of a pipe bend. The sensor protector blade supplied with the transmitter must always be installed in high consistency applications. A blow coupling (Fig. 2.2e) must be used instead of standard process coupling in digester blow line installations.

PULP-EL **HL**

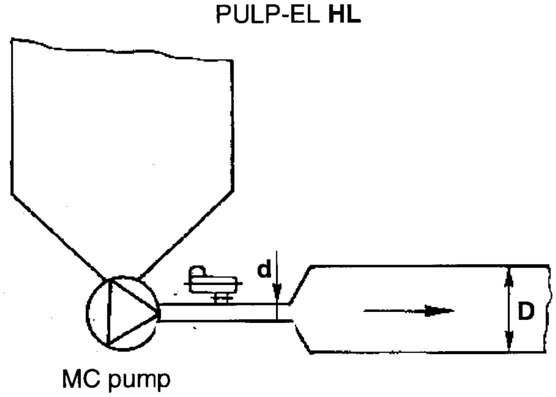


Figure 2.1m Installation of PULP-EL HL (4 to 16 % consistency range) after MC pump

2.2 Mounting the process coupling on process pipe and installing the transmitter

Procedure:

- Machine the process coupling so that it fits the pipe surface and is at right angles to the pipe. To do this, use the profile tapes supplied in the kit (Fig. 2.2a).

When desired, the coupling is factory-machined to suit the pipe surface.
NOTE! This must be specified separately in the order.

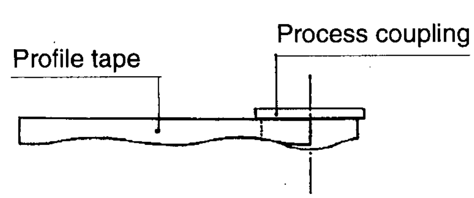


Figure 2.2a Profile tape to shape the coupling before welding

Installation of process couplings and sensor protector blades

PULP-EL LL/LS/GL/RL/HL
Using the welding guide (Fig. 2.2g), the process coupling is welded exactly at right angles to the pipe as shown in Fig. 2.2b. The coupling is first attached to the welding guide, whose use is recommended.

Procedure:
- Attach the process coupling to the welding guide (Fig. 2.2g).
- Equalize the height adjustment at both ends of the welding guide to ensure that the guide is supported steadily on its end pieces and will not rock on the process coupling.
- Attach the welding guide to the process pipe with mounting clamps.
- Weld the coupling at four points on the process pipe.
- Remove the guide and carry out final welding of the coupling.

Protector blade distances L3 and L4 for types LL/LS/GL/RL: L3 = L4 = 300 mm; and for type HL: L3 = L4 = 150 mm.
The protector blade downstream from the sensor is only installed in applications where there is a possibility of a back flow that may damage the sensor. The protector blades must be centered exactly in line with the process coupling. The blades have 5 mm holes to facilitate installation; for instance, you may push a piece of wire through the holes. When installation and welding is completed, you can remove the part of the blades remaining outside the pipe.
In exceptional cases, when process pressure is more than 10 bar and there is exceptionally strong vibration, it is advisable to reinforce the mounting of the process coupling with a reinforcing ring (Fig. 2.2c).

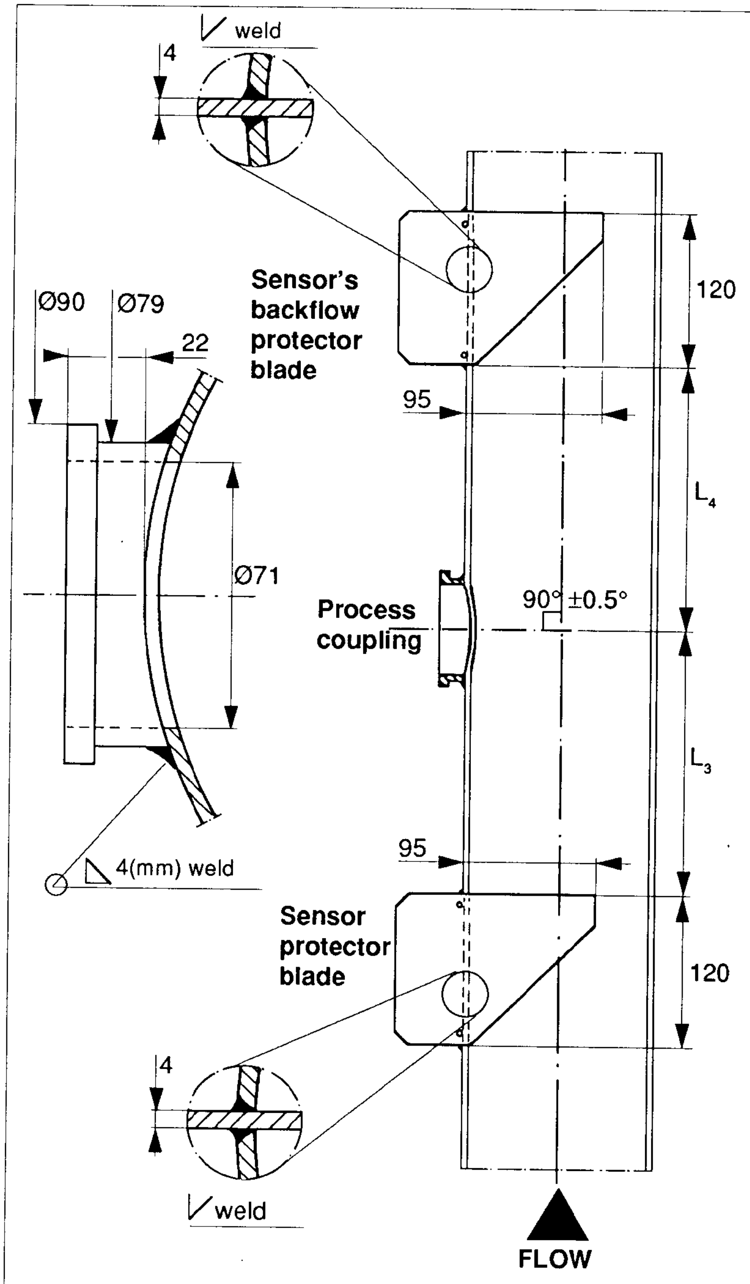


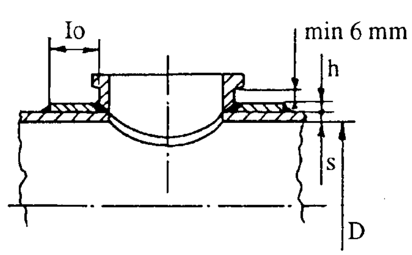
Figure 2.2b Installation for PULP-EL LL/LS/GL/RL/HL

PULP-EL UL
With the exception of the protector blade, install the process coupling a described above. Also refer to Figures 2.2c and 2.1l. Protector blade or flow tranquilizer element must not be used in UL installations.

PULP-EL WS
Install the process coupling with protector blade as shown in Fig. 2.2d. The easiest way to install the assembly is as follows:
Cut a 9 mm wide and 182 mm long bevelled aperture on the pipe for the protector blade. Place the process coupling on the pipe and draw the outline of the required mounting hole on the pipe. Then cut out the hole. Remove all burrs from the coupling's hole and round the edges of the hole as shown in Fig. 2.2d. Weld the coupling. Install the backflow protector blade in line with the coupling's center line as shown in the figure.

PULP-EL HL in digester blow line installations
Install the blow line coupling with protector blade as shown in Fig. 2.2e. Use single bevel weld to mount the coupling at right angles to the pipe. Install the protector blade exactly in line with the coupling's center line.
Make sure that the coupling's bottom edge is at level with the pipe's inner wall. When welding, take into account the regulations concerning pressurized vessel installations.

PULP-EL JL
Install the process coupling on fiberglass-reinforced plastic pipe as shown in Fig. 2.2f. First make a bevelled hole on the pipe. Then laminate the process coupling carefully on the pipe in accordance with lamination instructions. The coupling must be at right angles to the pipe's center line.



D = inside diameter of pipe
s = wall thickness of pipe
lo = width of reinforcing ring
h = thickness of reinforcing ring

Dmax. mm	s mm	p max. bar	t max. °C	h mm	Io mm
250	4	25	100	5	32
400	6	25	100	5	50
500	7	25	100	6	60

NOTE! If the pipe's wall thickness is greater than that given in the table, the thickness of the reinforcing ring can be correspondingly smaller.

Figure 2.2c Reinforcing the process coupling

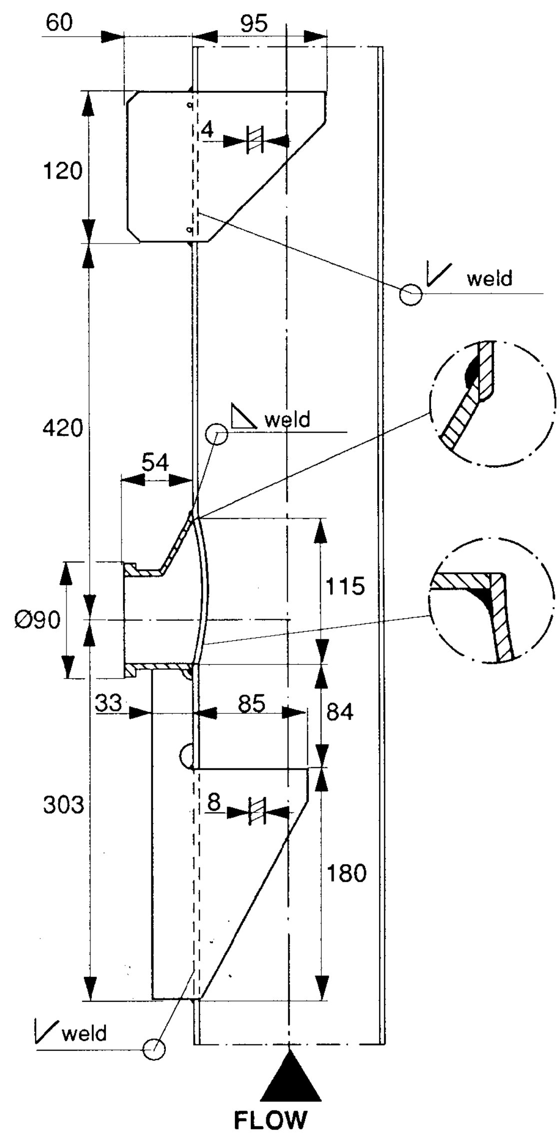


Figure 2.2d Installation for PULP-EL WS

Installing the transmitter

- Place PTFE sealing ring in the groove on the transmitter's coupling flange (Fig. 2.2h). Attach the transmitter to the coupling with mounting clamp. Before tightening the screws, make sure that the transmitter is exactly parallel to the process pipe, with the sensor blade parallel to the direction of flow.

Note! When required, the process coupling can be shut with shut-off flange.

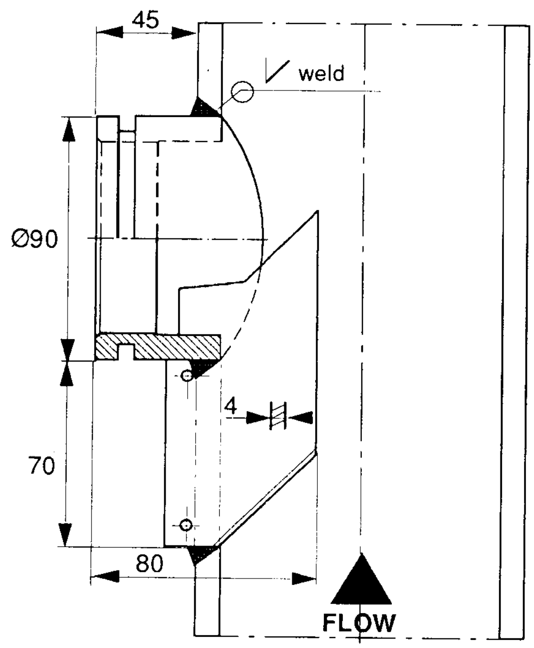


Figure 2.2e
Installation of PULP-EL HL in digester blow line

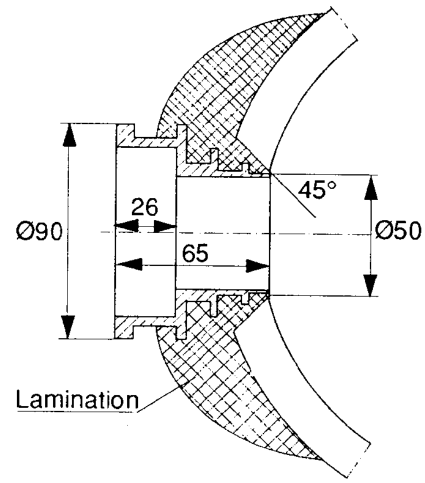


Figure 2.2f Installation for PULP-EL JL

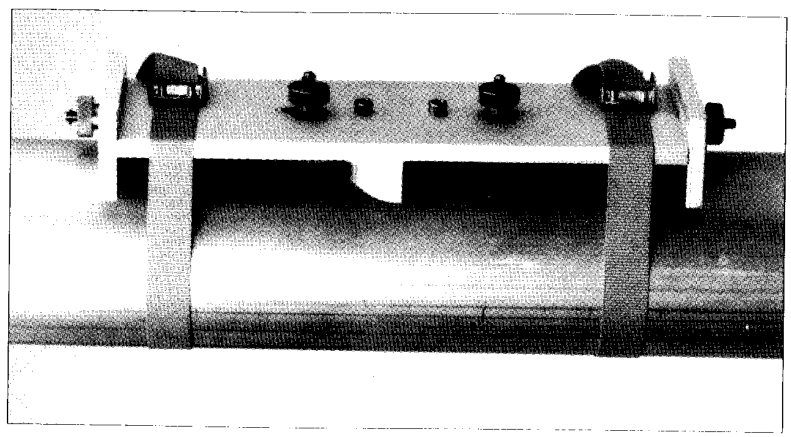


Figure 2.2g Process coupling welding guide

1. Process coupling
2. Sealing ring
3. Mounting clamp
4. Shut-off flange

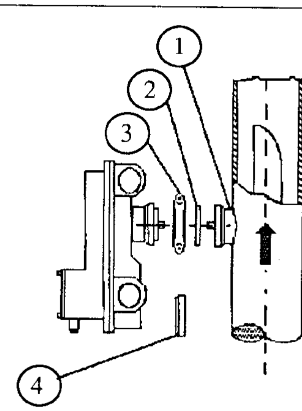


Figure 2.2h Mounting parts for PULP-EL

2.3 Electrical connections

Procedure:

- Loosen the screws (31, Fig. 4-1) on the connection box cover (33), and open the cover.

- Bring the cable to the terminal block (16) through the Pg13.5 inlet gland (32) and make sure that the rubber packing on the gland is of suitable size and provides a good seal.

- Connect the wiring as shown in Figure 2.3a.

- Tighten the connection box cover with screws.

- Tighten the nut on the Pg13.5 gland.

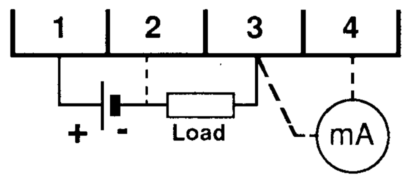


Figure 2.3a Wiring

Note! In place of the Pg13.5 gland, we can supply a 1/2-14 NPS adapter on which you can attach a connecting sleeve equipped with matching thread.

3. CALIBRATION

3.1 Factory calibration

Before delivery, the transmitter is factory-tested for correct operation and provided with basic calibration. Refer to Technical Specifications.
If desired, the transmitter will also be calibrated for the specified range. For this purpose the transmitter's mounting position has to be specified in the order in addition to the calibration details.

3.2 Precalibration

3.2.1 Preliminary procedure

- Make sure that your PULP-EL transmitter has a sensor that suits the pulp type and consistency level.

- Mount the transmitter on Valmet's PULP-EL calibration and servicing stand. The stand must rest on a horizontal and level base. See Figures 3.2a and 3.2b.

- Take out the PULP-EL calibration weights; see Fig. 3.2a.

- Connect the PULP-EL for calibration as shown in Fig. 3.2c.

- You may also use the EL-TUNE C calibration and linearization unit, which is equipped with a POWER unit. Make the connections as instructed in the PULP-EL + EL-TUNE C operating instructions.

EL-TUNE C has a percentage display for the 0% = 4 mA (0 mA, 3-W) to 100% = 20 mA range.

- Make sure that the DAMP trimmer is set for minimum damping. The trimmer turns through 240 degrees, and the minimum setting is fully counterclockwise. The DAMP trimmer is located under M6 plug screw. See fig. 3.2.

3.2.2 Performing the calibration: PULP-EL LL/LS/GL/HL/WS/RL/JL

PULP-EL's calibration before final installation is done with calibration weights. In the calibration you use the PULP-EL calibration form. On this form you specify the required basic data and the shear forces corresponding to the lower and upper range-values, which you get from the PULP-EL shear force curves for the different sensor and pulp types. As instructed on the form, you calculate the required calibration weights, also taking into account the mounting position effect. Finally you make the possibly required Zero correction on the basis of consistency samples taken at the setting-up stage.

The calibration procedure is next described by means of an example. (Instructions for PULP-EL UL are given in a separate Section.)

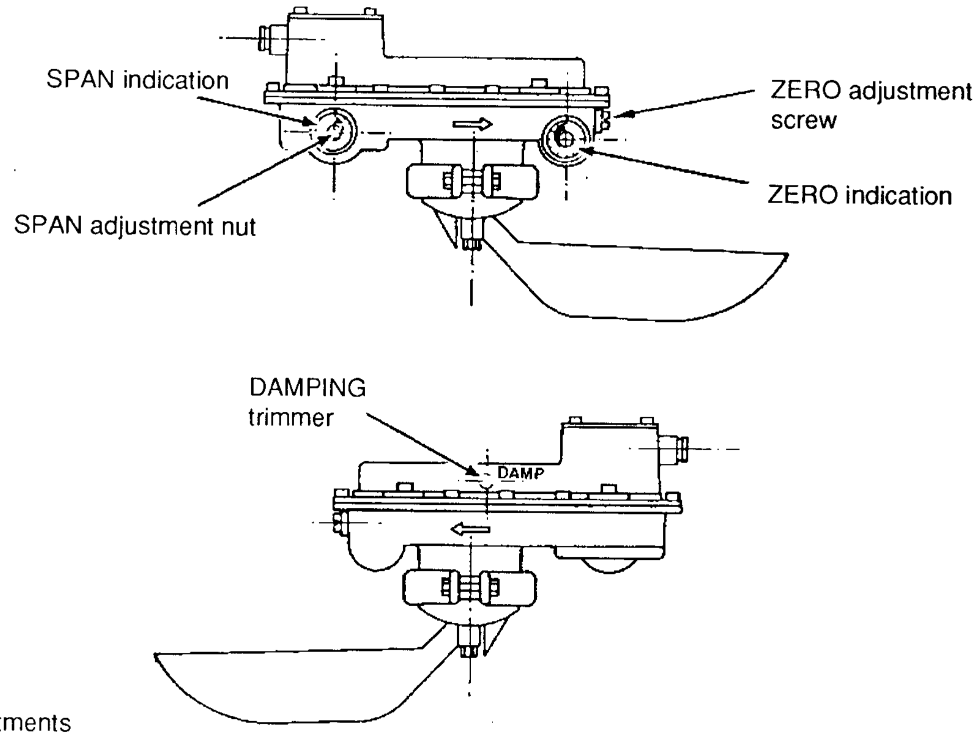


Figure 3.2
PULP-EL's adjustments

A. Span calibration

1. Specify the basic data on the calibration form (items 1-5). Refer to the example on the calibration form (Fig. 3.2d).

2. Take out the set of shear force curves for PULP-EL RL (Fig. 3.2e). Read the shear force corresponding to lower range-value 3% Cs (2 N) and the shear force corresponding to upper range-value 5% Cs (6.5 N). Enter these shear force values on the calibration form (items 6 and 7, Fig. 3.2d).

3. Calculate the simulation weight ms corresponding to Span (item 8 on the form).

4. Calculate the simulation weight mz corresponding to Zero (item 9 on the form).

5. Adjust the Zero setting without any weight. Use the tool provided on the calibration stand to adjust the ZERO screw for 4 mA (2-W) or 0 mA (3-W) output. Turn the ZERO screw clockwise to decrease the output, or counterclockwise to increase the output.

6. Place the Span simulation weight(s) ms with weight holder on the sensor (also take into account the weight of the weight holder). Use an M10 ring spanner to adjust the SPAN nut for 20 mA output.

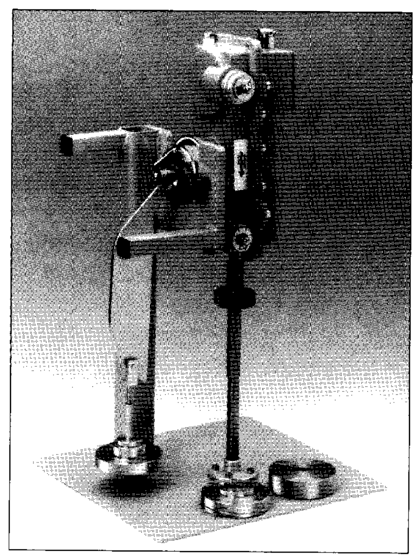


Figure 3.2a Calibration stand and weights

7. Remove the ms simulation weight(s) and readjust the ZERO screw for 4 mA (2-W) or 0 mA (3-W) output.

8. Again place the Span simulation weight(s) ms on the sensor, and adjust the SPAN nut for 20 mA output.

9. Since the adjustments affect each other, repeat steps 7 and 8 until you reach the desired accuracy.

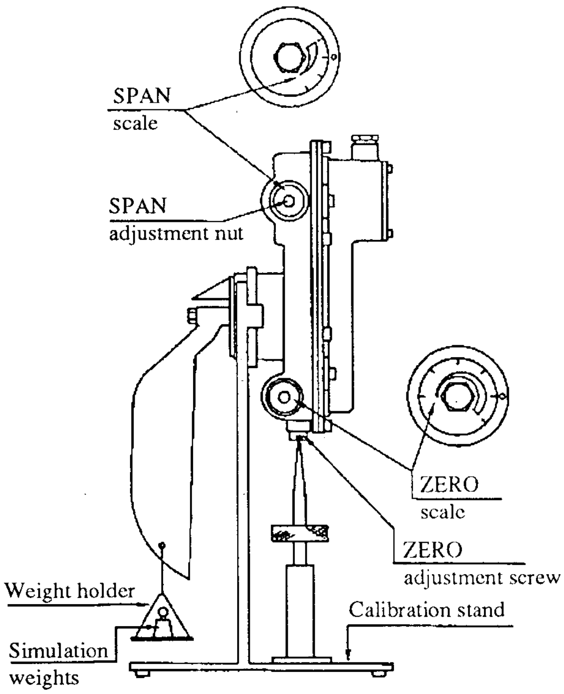


Figure 3.2b PULP-EL on calibration stand

B. Zero adjustment *(range elevation)*

1. Zero setting is done at the upper range limit. Place the Zero simulation weight(s) mz on the sensor. Adjust the ZERO screw for 20 mA output.

2. Check PULP-EL's output at the setting-up stage with the consistency close to the setpoint value. Take consistency samples, preferably five of them, and calculate the average value of the laboratory analyses of the samples. Enter PULP-EL's output at the sampling moments on the calibration form.
Compare PULP-EL's indication to the consistency analysis result and, if necessary, adjust the ZERO screw for Zero correction. Turn the ZERO screw clockwise to decrease the output, and counterclockwise to increase the output.

3.2.3 Performing the calibration: PULP-EL UL

PULP-EL UL measures low consistencies, typically less than 2 %. Its lower range-value is always set at 0 % consistency.
The minimum span for which PULP-EL can be calibrated is 1 N. If the desired span requires a narrower calibration, you have to use the EL-TUNE C calibration unit with the PULP-EL.

In other respects PULP-EL UL's Span calibration is carried out as described above.

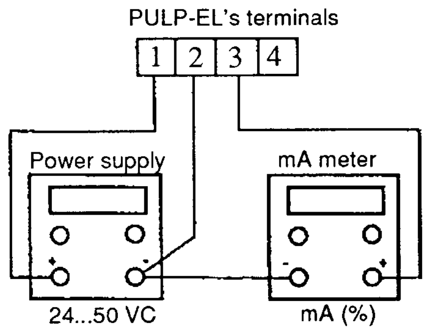


Figure 3.2c Calibration wiring

PULP-EL UL's Zero calibration is done after installation (when setting it up for operation) with the ZERO screw. The process pipe must then be full of water or fiber suspension. With the flow stopped in the pipe, adjust the ZERO screw for 4 mA (2-W) or 0 mA (3-W) output.

3.3 Checks before putting into operation

1. Make sure that the process connections do not leak.
2. Make sure that the direction of flow relative to the sensor blade is as shown in Figure 2.2h.
3. Make sure that the velocity of flow is within the specified limits (see Section 1.1).
4. Make sure that the consistency level is within the specified limits (see Section 1.1).
5. Make sure that you have selected the correct sensor (see Section 1.1).

3.4 Setting-up procedure (Figure 3.2)

3.4.1 Zero adjustment (range elevation)

Refer to Section 3.2.2 B2: Zero adjustment (range elevation).

3.4.2 Damping adjustment (2-W)

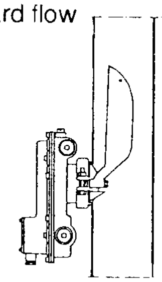
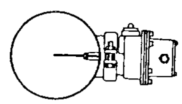
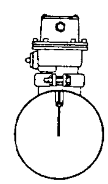
If the transmitter's output has too much noise, you can adjust the damping trimmer to reduce the signal noise. The time constant is selectable between 2 and 20 seconds. The damping trimmer is located under an M6 plug screw on the electronics housing (indicated by the DAMP plate next to the plug screw). Turn the trimmer clockwise to increase the time constant. The maximum rotation is 240 degrees. When replacing the plug screw, apply suitable locking medium (e.g. Loctite 542) on the thread to ensure tightness and good sealing.

Appendix 1 to doc. BCs150VA
1995-01-15

PULP-EL consistency transmitter

Calibration form for sensor types LL, LS, GL, HL, WS, RL and JL

1. Pulp type ***Recycled fiber pulp, screened, J.***
2. Calibrated range *3* - *5* %Cs   Set point *4,5* %Cs
3. Sensor type *RL*
4. Tag/description *Calibration example*
5. Mounting position *Vertical pipe*
   Upward flow

Mounting position/Zero correction kz			
Sensor type	a) Vertical pipe, upward flow 	b) Horizontal pipe, PULP-EL on side of pipe 	c) Horizontal pipe, PULP-EL on top of pipe 
	kz	**kz**	**kz**
LL	-0.90 N	-0.50 N	-2.00 N
LS	+1.00 N	+0.40 N	+0.40 N
GL	+0.70 N	+0.20 N	+0.30 N
HL	+5.20 N	+2.40 N	+6.20 N
(UL	-3.0 N	-1.5 N	-5.2 N)
WS	-1.9 N	-1.1 N	-2.8 N
RL	-1.3 N	-0.8 N	-2.9 N
JL	0.00 N	0.00 N	+1.00 N

6. Shear force at lower range-value: F1 = *2* N
7. Shear force at upper range-value: F2 = *6.5* N
8. SPAN simulation weight
   - rounded to 25 g accuracy

   ms = 100 x (F2 - F1)
   ms = 100 x (*6.5* - *2*) = *450* g
9. ZERO simulation weight
   - rounded to 25 g accuracy

   mz = 100 x (F2 + kz)
   mz = 100 x (*6.5 - 1.3*) = *525* g
10. Consistency samples when consistency ≈ setpoint consistency
    1. *4.3* 2. *4.5* 3. *4.4* 4. *4.2* 5. *4.6*

    Average: *4.3* %Cs
11. Transmitters output: $\left[\frac{(4.1 - 3)}{2} \cdot 100\,\% = \right]$ *55* % or *4.1* %Cs
12. PULP-EL's Zero correction: $\left[+\frac{0.2}{2} \cdot 100\,\% = \right]$ *+10* % / *+0.2* %Cs

Date: *1994-09-26*   **Name:** *Matti Hietaranta*

Figure 3.2d Sample calibration form for PULP-EL (blank form for copying is shown on next page)

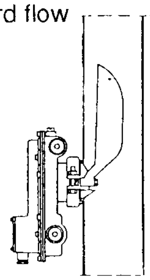
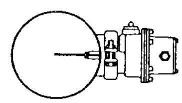
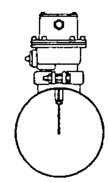
Appendix 1 to doc. BCs150VA
1995-01-15

PULP-EL consistency transmitter

Calibration form for sensor types LL, LS, GL, HL, WS, RL and JL

1. Pulp type ______________________________
2. Calibrated range ____________ - ____________ %Cs   Set point ______ % Cs
3. Sensor type ______________________
4. Tag/description ______________________________
5. Mounting position ______________________________

____

Mounting position/Zero correction kz			
Sensor type	a) Vertical pipe, upward flow 	b) Horizontal pipe, PULP-EL on side of pipe 	c) Horizontal pipe, PULP-EL on top of pipe 
	kz	kz	kz
LL	-0.90 N	-0.50 N	-2.00 N
LS	+1.00 N	+0.40 N	+0.40 N
GL	+0.70 N	+0.20 N	+0.30 N
HL	+5.20 N	+2.40 N	+6.20 N
(UL	-3.0 N	-1.5 N	-5.2 N)
WS	-1.9 N	-1.1 N	-2.8 N
RL	-1.3 N	-0.8 N	-2.9 N
JL	0.00 N	0.00 N	+1.00 N

6. Shear force at lower range-value: F1 = __________ N
7. Shear force at upper range-value: F2 = __________ N

8. SPAN simulation weight — ms = 100 x (F2 - F1)
   - rounded to 25 g accuracy — ms = 100 x (-   ) = __________ g
9. ZERO simulation weight — mz = 100 x (F2 + kz)
   - rounded to 25 g accuracy — mz = 100 x (+/-   ) = __________ g

10. Consistency samples when consistency ≈ setpoint consistency
    1. ________ 2. ________ 3. ________ 4. ________ 5. ________
    Average: ________ %Cs

11. Transmitters output: ______ % or ________ %Cs

12. PULP-EL's Zero correction: +/- ______ % / +/- ______ %Cs

Date: ______________________   **Name:** ______________

3.5 Making your own "Measurement force as a function of consistency" curves

1. See that the PULP-EL has been calibrated for a relatively wide range.

2. With PULP-EL connected to measurement, vary the consistency at the measuring point through the entire measurement range or operating range. Enter the laboratory-analyzed consistency value and the corresponding transmitter output for each point in a table. Define a sufficient number of points for drawing the curve.

3. Disconnect the transmitter from the process pipe without altering the adjustments in any way.

4. Mount the transmitter on the calibration stand as shown in Figure 3.2a.

5. Simulate the consistencies obtained above with weights. In other words, find the weights that correspond to the transmitter's output at each consistency value (1 N = 100 g).

6. These weights now represent the measurement forces at the defined consistency points.
Draw a curve in accordance with Fig. 3.2e for the examined pulp.

7. You can then use the curve to precalibrate the transmitter as described in Section 3.2. This method ensures a highly accurate precalibration for a specific user (mill)/pulp type at a particular measuring point.

Note! If the mounting position changes, this must be taken into account in the calibration. (Refer to Calibration Form, Fig. 3.2d).

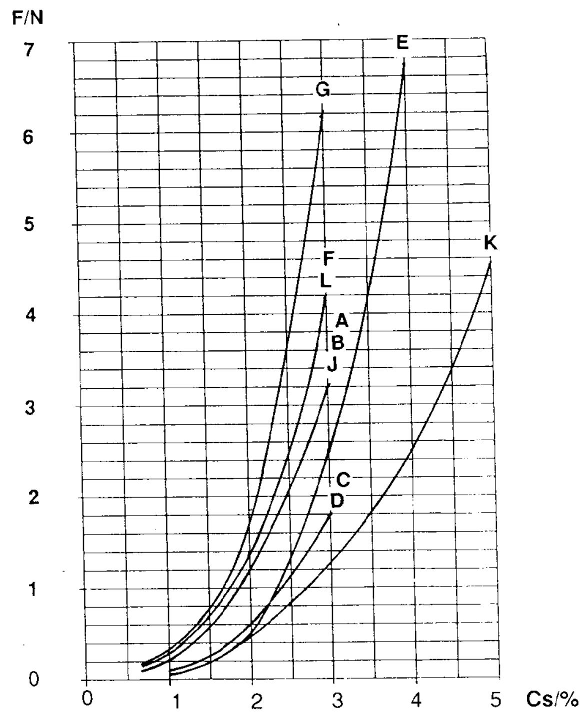
3.6 PULP-EL + EL-TUNE C

If you want especially accurate as well as linearized range calibration and/or precalibration for different pulps on the same transmitter, you have to use the VALMET EL-TUNE C calibration unit with PULP-EL. (Refer to EL-TUNE C's Operating and Installation Instructions, document CCs100 A).
EL-TUNE C permits accurate calibration without disconnecting the transmitter from the process.
A "consistency/transmitter output" characteristic curve drawn on the basis of consistency samples from the process is used as the basis of calibration. You have to make sure that the PULP-EL's calibration range is sufficiently wide to cover all desired measurement ranges.

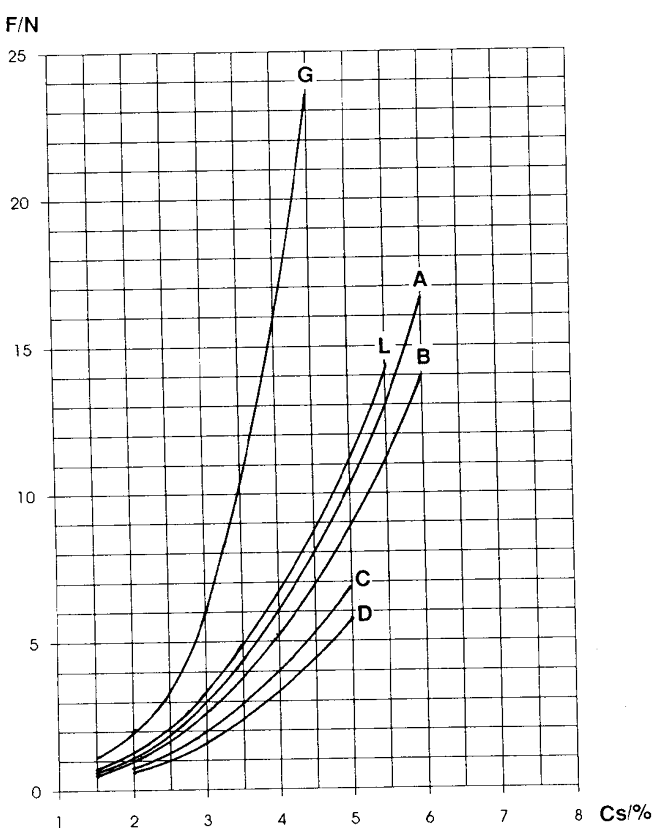
Notes:

Pulp type codes for calibration curves (Fig. 3.2e)

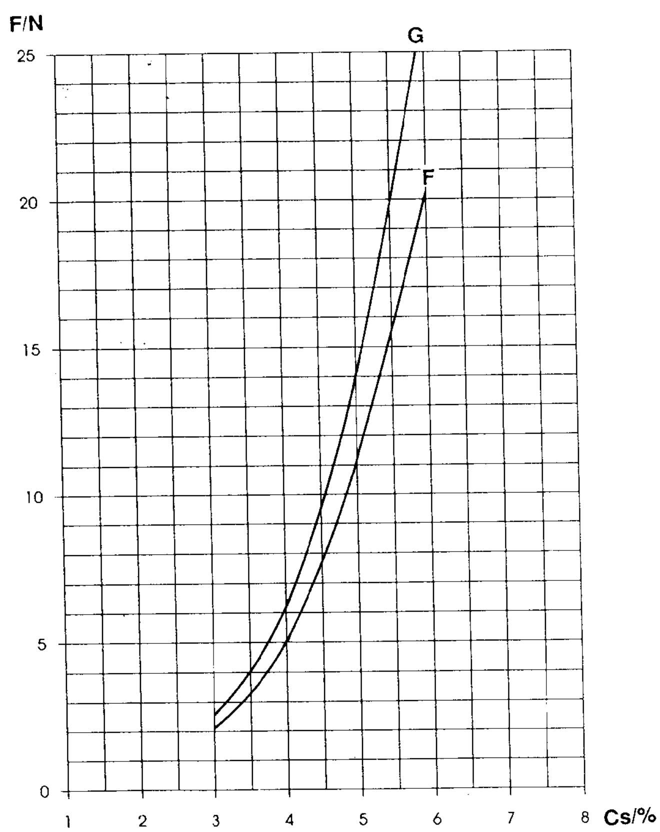
Code	Pulp type
A	Long-fibered unbleached pulp
B	Long-fibered bleached pulp
C	Short-fibered unbleached pulp
D	Short-fibered bleached pulp
E	Groundwood
F	RMP, TMP, when CSF < 200 ml (SR > 52)
G	RMP, TMP, when CSF > 200 ml (SR < 52)
H	Recycled fiber pulp, OCC, unscreened
I	Recycled fiber pulp, unscreened
J	Recycled fiber pulp, OCC, screened
K	Recycled fiber pulp, screened
L	CTMP



PULP-EL UL



PULP-EL LL



PULP-EL LS

Figure 3.2e Calibration curves for different sensor types

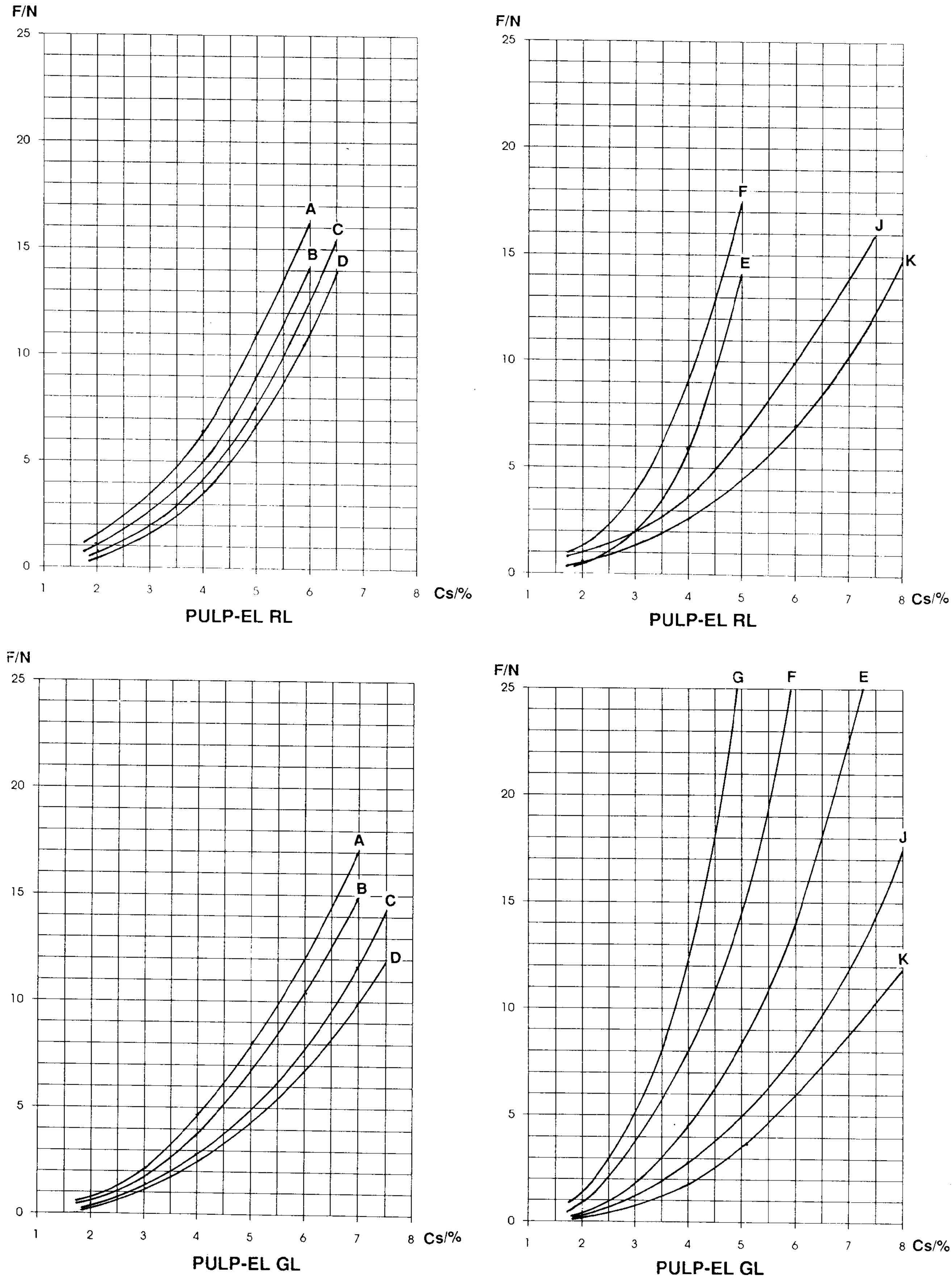


Figure 3.2e Calibration curves for different sensor types

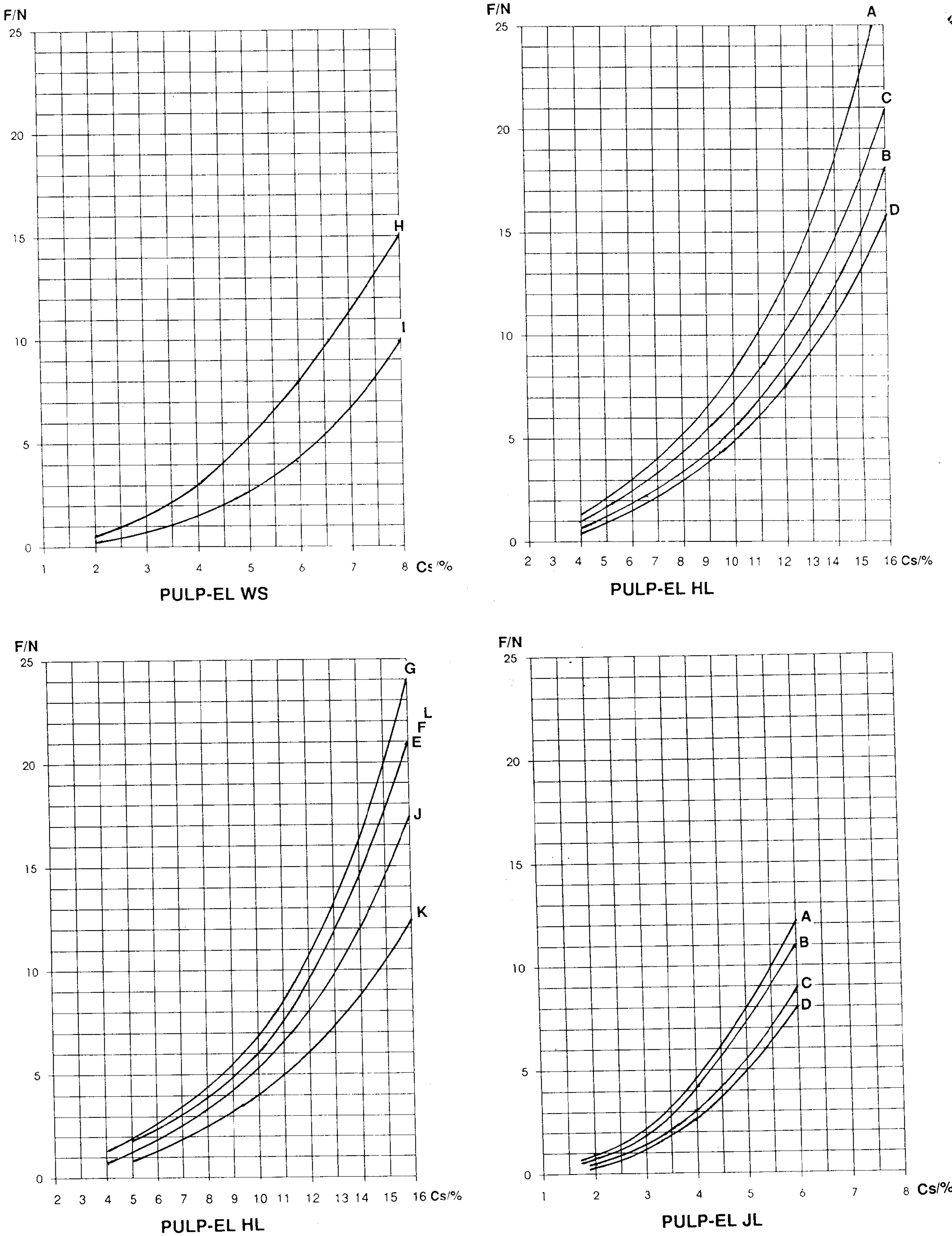


Figure 3.2e Calibration curves for different sensor types

3.7 Calibration after servicing the transmitter

The construction of the transmitter is shown in Figure 4.1a. Oil must be emptied from the transmitter before servicing.

3.7.1 Setting up the differential capacitor

Before setting the capacitor:

- The transmitter must be mounted on the calibration stand (Fig. 3.2a).
- The cover (23, Fig. 4.1a) on which the component board is attached must be turned up and supported on a special angle piece so that the wires to the differential capacitor are not stretched or disconnected.

Procedure:

1. Tighten the retaining screw (36) of the outer capacitor plates carefully.
2. Apply Loctite 542 on the adjusting nuts (35) of the capacitor's centre plate.
3. Align the centre plate parallel with the outer plates.
4. Unscrew the motion limit screws (21) and apply Loctite 542 on them.
5. Connect the wiring from differential capacitor to component board (Fig. 5-5).
6. Connect power supply and current measurement to the component board.
7. Set SPAN *(20)* at maximum.
8. Turn mechanical ZERO setting (26) to minimum.
9. Set electrical ZERO and SPAN settings on the component board at centre position.
10. Place a weight (approx. 50 g) on the sensor blade or rod.
11. Disconnect the damping jumper (Fig. 5-1).
12. Set the transmitter's output at 3.5 mA by adjusting the position of the capacitor's centre plate (by turning the three adjusting nuts (35) an equal amount).
13. Set SPAN (20) at minimum.
14. Apply Loctite 542 to the limit screws on the rocker plate. Move the sensor blade up and down, and turn the limit screws to a position where the output range is 3.5 to 20 mA (2-W) or 0 to 20 mA (3-W).
15. Reconnect the damping jumper.

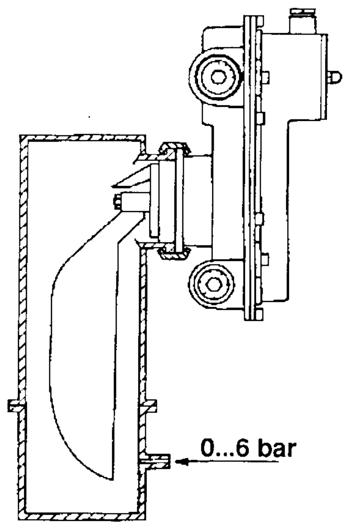


Figure 3.7-2a Static pressure adjustment

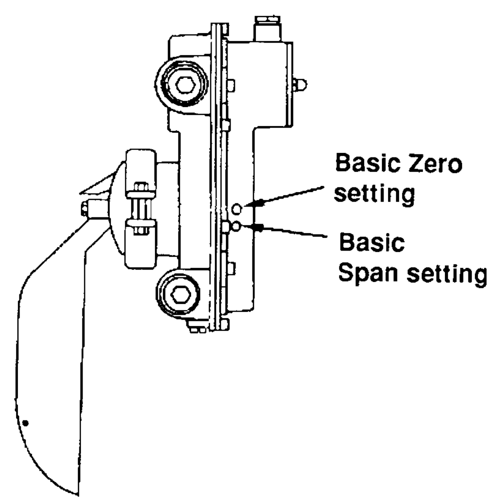


Figure 3.7-2b
Trimmer locations on circuit board

3.7.2 Static pressure adjustment

Before adjustment:
- Turn the cover (23) in the same way as in 3.7.1.

Procedure:

1. Attach the transmitter, including its process coupling sealing ring, to a pressure cylinder with mounting clamp (Fig. 3.7-2a).
2. Depending on the type of the pressure cylinder, you may have to disconnect the sensor blade from the transmitter to do the calibration.
3. Make the same electrical connections as in 3.7.1.
4. Set SPAN at approximately centre position.
5. Adjust ZERO for approx. 50% output (12 mA).
6. Apply pressure to the cylinder.
7. Vary the pressure between e.g. 0 and 6 bar.
8. If the output reading deviates more than 0.12 % per bar, loosen the locking screw (37, Fig. 4.1a) on the taper pin and turn the taper pin (2) in a direction where the swing of the output indication is smaller when pressure changes.
9. Tighten the taper pin at a position where the swing is smallest, and apply Loctite 542 on the locking screw.
10. Disconnect the transmitter from the pressure cylinder.
11. Loosen the retaining screws (40; 4 screws) on the inlet cone assembly (39) so that the cone assembly settles at a new centre position.
12. Apply locking medium (e.g. Loctite 270) to the screws and tighten the screws by turns so as to tighten the cone assembly uniformly and at right angles against the counterface.
Reconnect the transmitter to the pressure cylinder and repeat the procedure from step 8.

NOTE! Maximum rotation of the taper pin is 45 degrees (at which the slot for the screwdriver is at right angles to the housing).

3.7.3 Assembly before final calibration (Fig. 4.1a)

1. Replace the sealing (41) on the cover assembly and tighten the cover (23) with ten M6 screws. When attaching the cover, be careful not to break the wires from the 3 inlet pins on the cover.
2. Fill the housing with AK200 silicone oil through the filling hole at the ZERO screw's end of the housing. Leave the transmitter in the filling position, with the plug open, for approx. 30 minutes to vent air from the housing as completely as possible. Then put in more oil to fill the housing completely.
3. Apply PTFE sealing tape on the plug screw.
4. Press the expansion diaphragm under the component board fully down with a suitable tool (e.g. a ruler), and screw in the plug. **5.** Mount the sensor blade exactly parallel to the transmitter body. Use e.g. Loctite 270 to lock the blade's retaining screw in position.
6. Finally attach the electronics housing and its wiring.

3.7.4 Final calibration after servicing

Procedure:

1. Mount the transmitter on the calibration stand (Fig. 3.4a).

2. Connect power supply and current measurement to the transmitter.

3. Move the sensor blade upwards. The output should be less than 4 mA (min. 3.5 mA) for 2-W system or 0 mA for 3-W system.
If not, adjust the ZERO trimmer on the component board (Fig. 3.7-2b) as required.

The component board includes two trimmers:
- electrical basic ZERO adjustment trimmer
- electrical basic SPAN adjustment trimmer

NOTE! These trimmers are only used for basic calibration after servicing the transmitter.

4. Set SPAN at maximum.
5. Place 800 g weight on the weight holder. The output should be 18.5 to 20 mA. If not, adjust the electrical SPAN trimmer (Fig. 3.7-2b) for this range.

4. CONSTRUCTION AND PRINCIPLE OF OPERATION

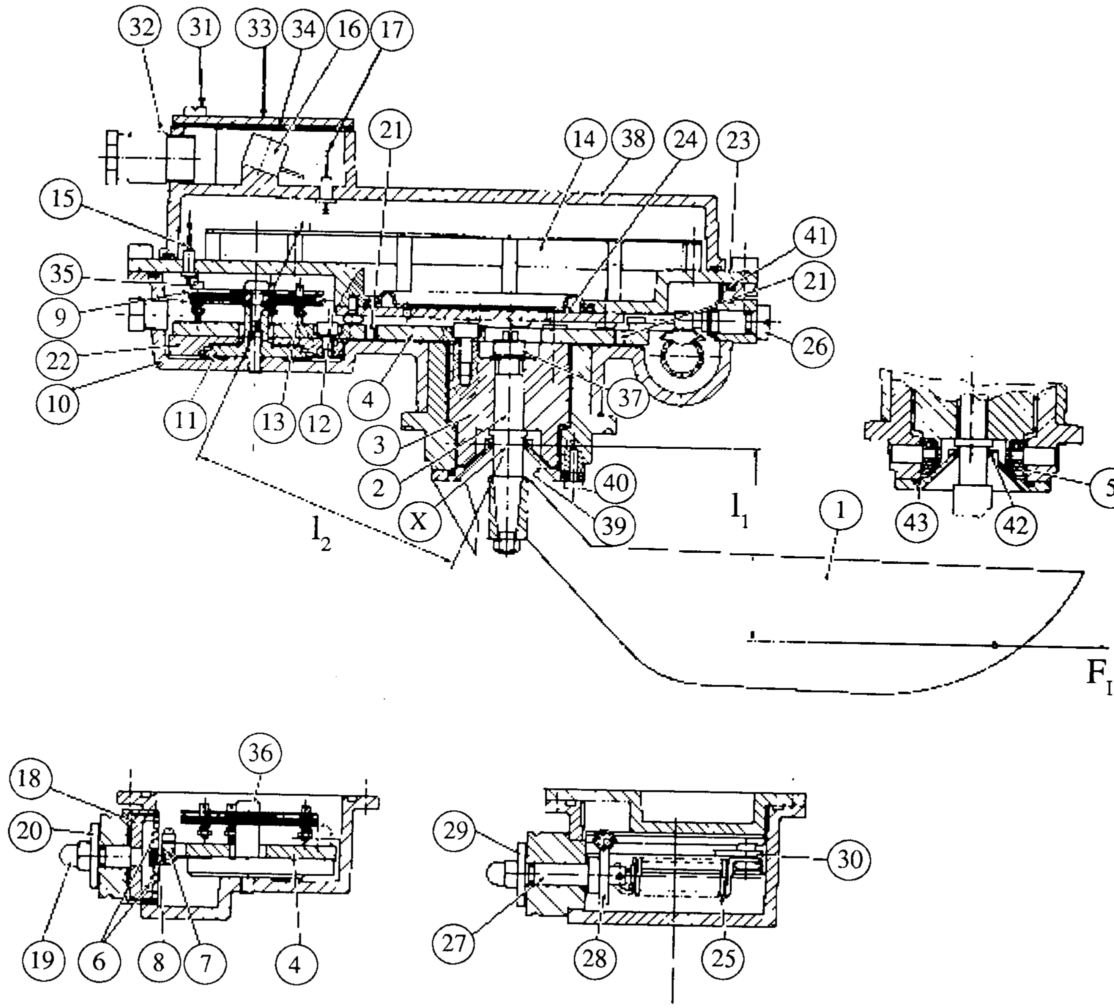


Figure 4.1a PULP-EL's mechanical construction and principle of operation

4.1 Mechanical part (Figure 4.1a)

PULP-EL's operation is based on motion balance.

The PULP-EL's sensing element in the process pipe is a shaped blade (1) or rod. A shear force that depends on pulp consistency acts on the sensor when pulp flows in the pipe.
Variations in the velocity of flow on the recommended velocity ranges do not have a significant effect on the shear force.
The sensor blade or rod comprises an integral assembly with the taper pin (2), centre boss (3) and rocker plate (4). This assembly is pivoted on a ball bearing (5) at point X.
The shear force is transmitted from the rocker plate to measuring springs (6) through pin holder (7) and centre pin (8).

Shear force produces a sensor torque:

$F_l \times l_1$, which is countered by measuring torque:

$F_m \times l_2$

The following equation applies to the balance of these two torques:

$$F_1 \times l_1 = F_m \times l_2$$

The measuring force **Fm** is applied to the measuring springs.

The centre of the measuring spring assembly is displaced by the distance Δl:

$$\Delta l = F_m/C = (l_1 \times F_1)/(C \times l_2)$$

C = the spring constant of the measuring spring.

The displacement is measured electrically. The displacement sensor is a differential capacitor consisting of 3 capacitor plates. The outer plates (9) are permanently attached to the housing (10) through a damping pillar (11). The centre plate (12) is attached to the rocker plate (4) with three stud bolts (13).

Electrical connection from the capacitor plates to the component board (14) is carried out through inlet pins (15).

The electronics circuits are located on the component board (14). Electrical connection from the component board to the terminal block (16) is carried out through inlet pins (17).
Full span always corresponds to the same displacement (S) of the spring centre.
The shear force **Fls** corresponding to displacement S indicates the actual span.

The span can be changed by adjusting the SPAN nut (19) located outside the housing. The nut allows you to change the effective spring constant C of the measuring spring assembly. The approximate span value can be read from the scale on the SPAN disk (29). The motion of the rocker plate is limited by stop screws (21).
To eliminate the effects of pipework vibration and process noise, the housing is filled with damping oil (silicone oil).
Counterbalance weight (22) serves as damping cylinder, and damping pillar (11) acts as damping piston. Due to thermal expansion of the oil, the cover assembly (23) is equipped with an expansion diaphragm (24).
Zero adjustment, i.e. range elevation, is performed with the ZERO adjustment screw.
Adjusting the ZERO screw affects a helical spring (25). The end of the ZERO screw (26) is equipped with a worm that connects with the ZERO adjustment shaft's (27) gear (28).

Approximate Zero value can be read from the scale on the ZERO disk (29). One end of the zero adjustment spring is attached to the zero adjustment shaft, and the other end to the rocker plate through retaining plate (30).

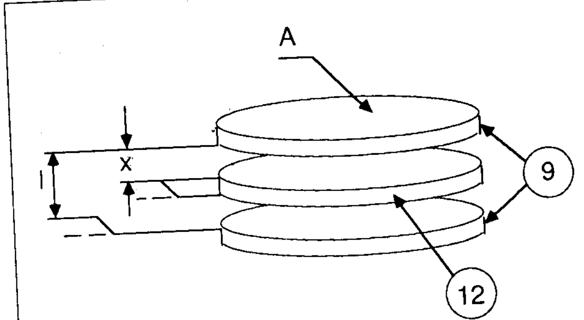


Figure 4.1b
The arrangement of the differential capacitor

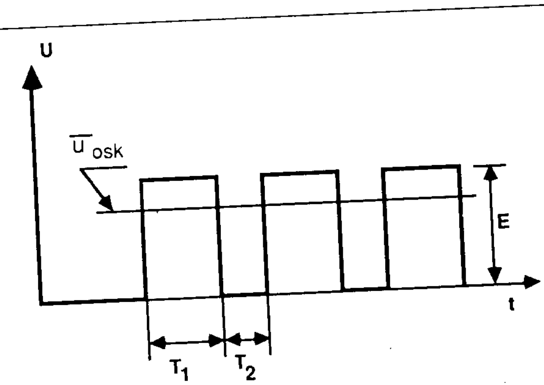


Figure 4.1c Time average of pulse voltage

4.2 Electronics circuits

General principle of operation:
The operation of PULP-EL is based on motion balance. The force acting on the transmitter's sensor blade displaces the centre plate of a differential capacitor (No. 12, Fig. 4.1a and 4.1b).
The capacitor's partial capacitances (C1 and C2) vary in accordance with the position of the centre plate relative to the outer plates (9).

C_1 = fi (A/l-x) **C_2 = fi (A/x)**
fi = constant
l = distance of outer plates
x = distance of centre plate
A = Surface area of capacitor plates

The capacitances drive an oscillator circuit so that the time average of its output voltage follows the centre plate's displacement linearly. The oscillator operates as a free-running multivibrator whose partial cycle times depend on the differential capacitor's partial capacitances C_1 and C_2.
With the resistances of resistors R1 and R1 in the circuit, the partial capacitances produce time constants that are proportional to the durations of the corresponding output voltage states of the multivibrator.

$T_1 = kR1C_1$ **$T_2 = kR2C_2$**
k = constant
R1 = R2 = resistance R in time constant circuit
$C_1 = C_2$ = partial capacitances

$\bar{u}_{osk} = E\{T_1/(T_1 + T_2)\}$

E = pulse voltage
T_1= pulse duration
T_2 = pulse interval

The time average ($\bar{u}_{osc}$) of the multivibrator's pulse voltage E depends on the ratio of the durations of the voltage states (Fig. 4.1c).
The voltage time average indicates the displacement of the capacitor's centre plate.

The voltage time average is generated through a filter circuit (RC circuit). The circuit's time constant RC is much greater than pulse cycle times T1 and T2.

$I_{out} = G\bar{u}_{osk}$
G = constant (U/I converter)

$\bar{u}_{osk}$ = oscillator voltage's time average

The filter circuit's output voltage $\bar{u}_{osk}$ drives the output stage to give an output current proportional to the force acting on the sensor blade as the transmitter's output current I_{out}.

4.2.1 Electronics circuit for 2-wire system (2-W)
(Figure 4.2-1a)

PULP-EL 2-W's circuit board has an oscillator, filter and output stage.
The oscillator is a free-running multivibrator whose frequency is approx. 12 kHz. R1 and R2 are resistors in the oscillator's time constant circuit. When the differential capacitor's partial capacitancies C_1 and C_2 change, constant fi of the time constant circuits will change correspondingly. As a result the oscillator's pulse ratio (T_1 and T_2) will also change (refer to 4.2).
The oscillator's supply voltage is 6.4 V ±5 % (can be measured through test points 2 and 9). This voltage is stabilized through amplifier A2 and Zener diode V11 (1N4566A). The Zener diode is provided with a constant operating current with a DC generator (V28 and V29).
The pulse voltage's time average is generated from the oscillator's pulse ratio voltage (E) through a low-pass filter circuit (R14, R15, C6 and C7). This filter circuit filters out the pulse frequency. The magnitude of the resultant voltage depends on the ratio of the differential capacitor's partial capacitancies. In other words, the voltage follows the variations in pulp consistency. The voltage's time average drives comparison amplifier A1, and ZERO adjustment is connected to one input of this amplifier.
Feedback voltage is applied to amplifier A1 by passing the signal current through a resistor network (R18, R26 and R32). SPAN adjustment is carried out by adjusting the feedback voltage. In balanced conditions the feedback voltage is proportional to the time average of the oscillator's output voltage. The output signal is only driven through the time average of the oscillator's pulse voltage.
The pair of transistors (V32 and V33) in the output stage are driven by the output voltage of amplifier A1, providing an output signal that corresponds to the measured signal.

A damping circuit is provided in connection with amplifier A1 to slow down rapid signal variations. The time constant can be selected with a trimmer (R37): fi_{min} = 2 s, and fi_{max} = 20 s. Damping can be removed by disconnecting the Damping jumper (X1).

4.2.2 Electronics circuit for 3-wire system (3-W)
(Figure 4.2-1b)

PULP-EL 3-W's oscillator and filter circuits are identical to those in PULP-EL 2-W, but the oscillator's supply voltage is 9.0 V ±5%. This voltage is stabilized to Zener diode V11 (1N936A).
The output stage is powered from a current applied through DC generator to terminal 2 (negative supply) on the terminal block. The time average of the oscillator's pulse ratio voltage drives comparison

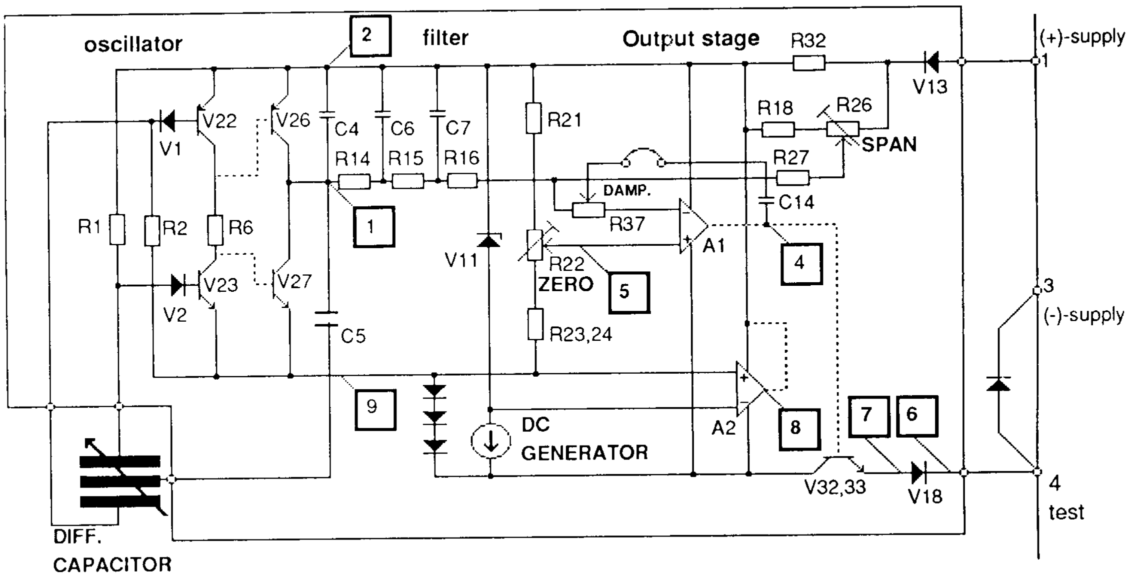


Figure 4.2-1a Functional diagram (2-W)

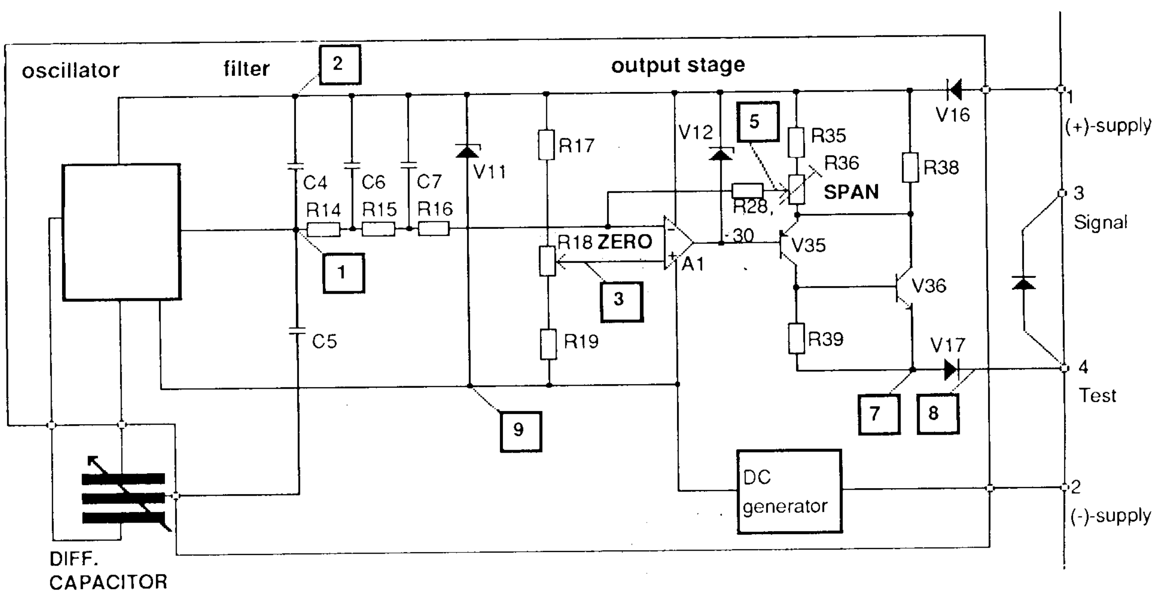


Figure 4.2-1b Functional diagram (3-W)

amplifier A1. The amplifier's output drives the current of transistor pairs V35 and V36 in the output stage. This signal current (I_{out}) is proportional to the time average of the oscillator's pulse ratio; in other words, it depends on the measured signal.

Feedback voltage is applied to amplifier A1 by passing the signal current through a resistor network (R35, R36 and R38). In balanced conditions the feedback voltage is proportional to the time average of the oscillator's output voltage.

SPAN adjustment is carried out by adjusting the feedback voltage. ZERO adjustment is performed with the voltage of the amplifier's (+)-input. Electrical limitation of the output signal is provided by limiting the output voltage of amplifier A1 with Zener diode V12 (4.7 V)

WARNING!
Before disconnecting the transmitter from the process, make sure that the process pipe is unpressurized and the disconnection will be safe.

5. MAINTENANCE

5.1 Mechanical parts

5.1.1 Replacing the sensor blade or rod

1. The retaining nut of the sensor blade is secured with Loctite. However, it can be loosened without heating.
2. First unscrew the nut about 2 turns, then lift the sensor blade from the mounting cone with two strong screwdrivers. Then unscrew the nut fully.
3. When re-installing the sensor blade, be sure to align it exactly parallel to the housing (use, for instance, a ruler).
4. Secure the sensor blades's retaining nut with Loctite 270. Do not let any Loctite into the inlet cone assembly.

5.1.2 Replacing the O-ring on inlet pin

1. First remove the oil through the hole at the end of the housing. Place the new O-ring (42) in the groove on the inlet cone assembly. Also replace the PTFE packing on the inlet cone assembly.
2. Re-assemble the parts.
3. Make sure that the packings are not leaking (i.e., no air escapes through the oil-filling hole when pressure is on).
4. Finally fill the housing with silicone oil (AK200) as full as possible as instructed in Section 3.7.3.

5.2 Checking the condition of the electronics

The transmitter's electronics are faulty, if:
- The output signal does not respond to displacements of the differential capacitor's centre plate.
- The output signal does not change when you adjust the SPAN and ZERO trimmers.

5.2.1 Check measurements

(Fig. 5-1, 5-2, 5.2-1, 5-3 and 5-4)

Procedure:
- Apply 24 V supply to the transmitter; use 500 ohm load resistor.
- Connect digital voltmeter's (DVM) positive lead to test point 'i', and negative lead to test point 'j'.
- Refer to Tables 5-1 and 5-2 for the voltage values at the different test points.
- The waveform of the voltage at test point 1 can also be examined with an oscilloscope (electrically isolated), with GUARD at test point 2.

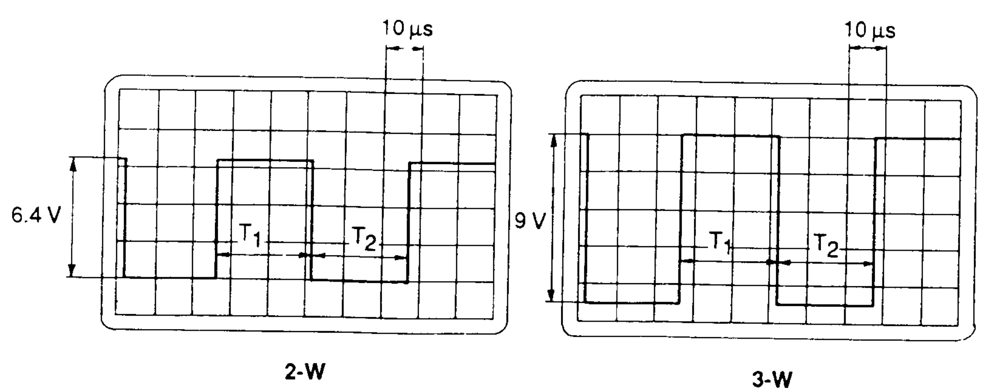


Figure 5.2-1 Pulse waveform measured across test points 1 and 2:

Pulse durations:
- at 50 % measured signal T1 and T2 are approximately equal; maximum permissible difference is 5 %
- at 0 % and 100 % signals the difference between T1 and T2 can be up to 40 % of the smallest partial cycle time

TABLE 5-1
Voltage table for 2-W system (Figures 5-1 and 5-3)

TEST POINTS j (-)	TEST POINTS i (+)	Voltage	NOTE
1	2	2.80...3.60 V ±5 %	Depends on measured signal
3	2	3.20 V ±10 %	Depends on ZERO setting
4	2	2.40...0.70 V ±10 %	Depends on measured signal
5	2	3.20 V ±10 %	Depends on ZERO setting
6*	7	4.00...20.00mA ±0.3 %	Depends on measured signal
8	2	1.80...0.70 C ±5 %	Depends on measured signal
9	2	6.4 V ±5 %	Oscillator's stabilized supply voltage (V 11)

TABLE 5-2
Voltage table for 3-W system (Figures 5-2 and 5-4)

TEST POINTS i (+)	TEST POINTS j (-)	Voltage	NOTE
1	9	3.90...5.10 V ±5 %	Depends on measured signal
2	9	9.0 V ±5 %	Oscillator's stabilized supply voltage (V 11)
3	9	3.80 V ±5 %	ZERO settings affects approx. 5 %
4	9	8.0...3.0 V ±10 %	Depends on measured signal
5	9	8.7...7.5 ±10 %	Depends on measured signal
6	9	-8.5....-35.0 V ±10 %	Depends on supply voltage (24 to 50 V)
7*	8	0.00...20.00 mA ±0.3 %	Depends on measurd signal

* Current measurement (mA); mA meter's Rin = 20 ohm

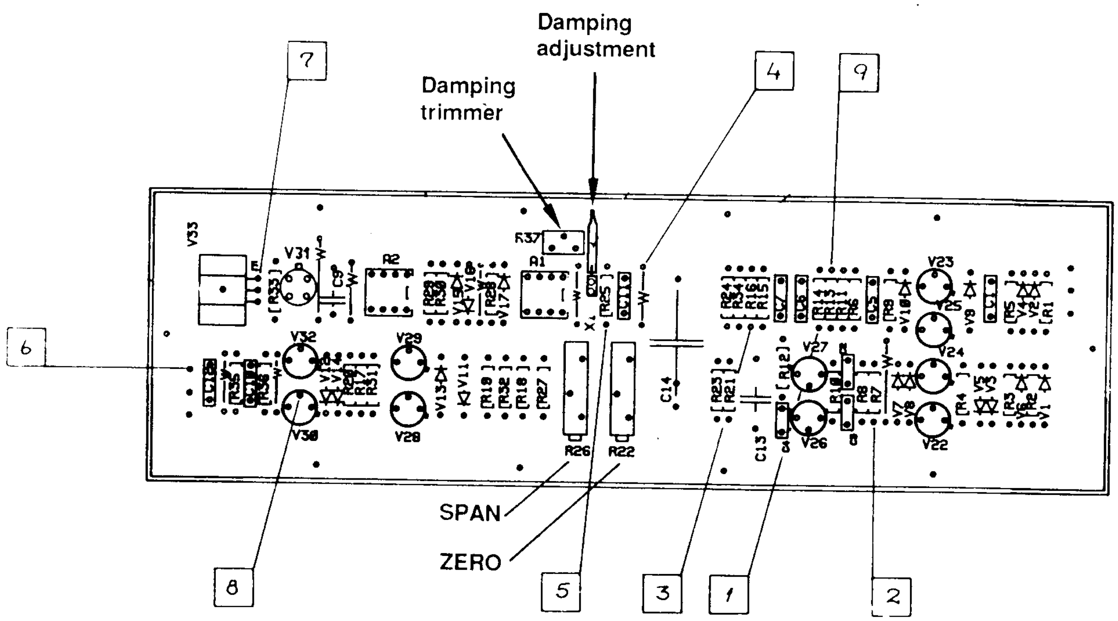


Figure 5-1 Component layout and test points (2-W)

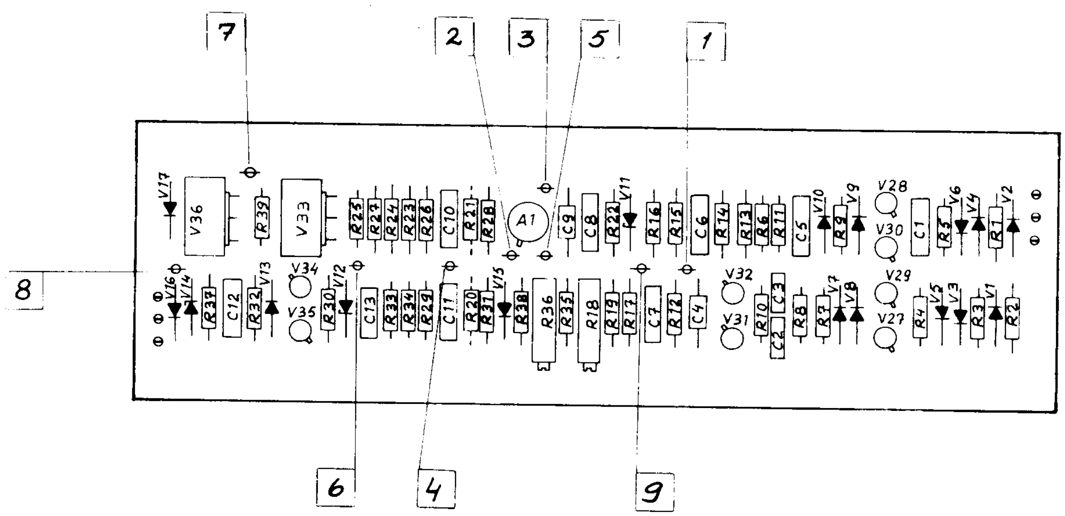


Figure 5-2 Component layout and test points (3-W)

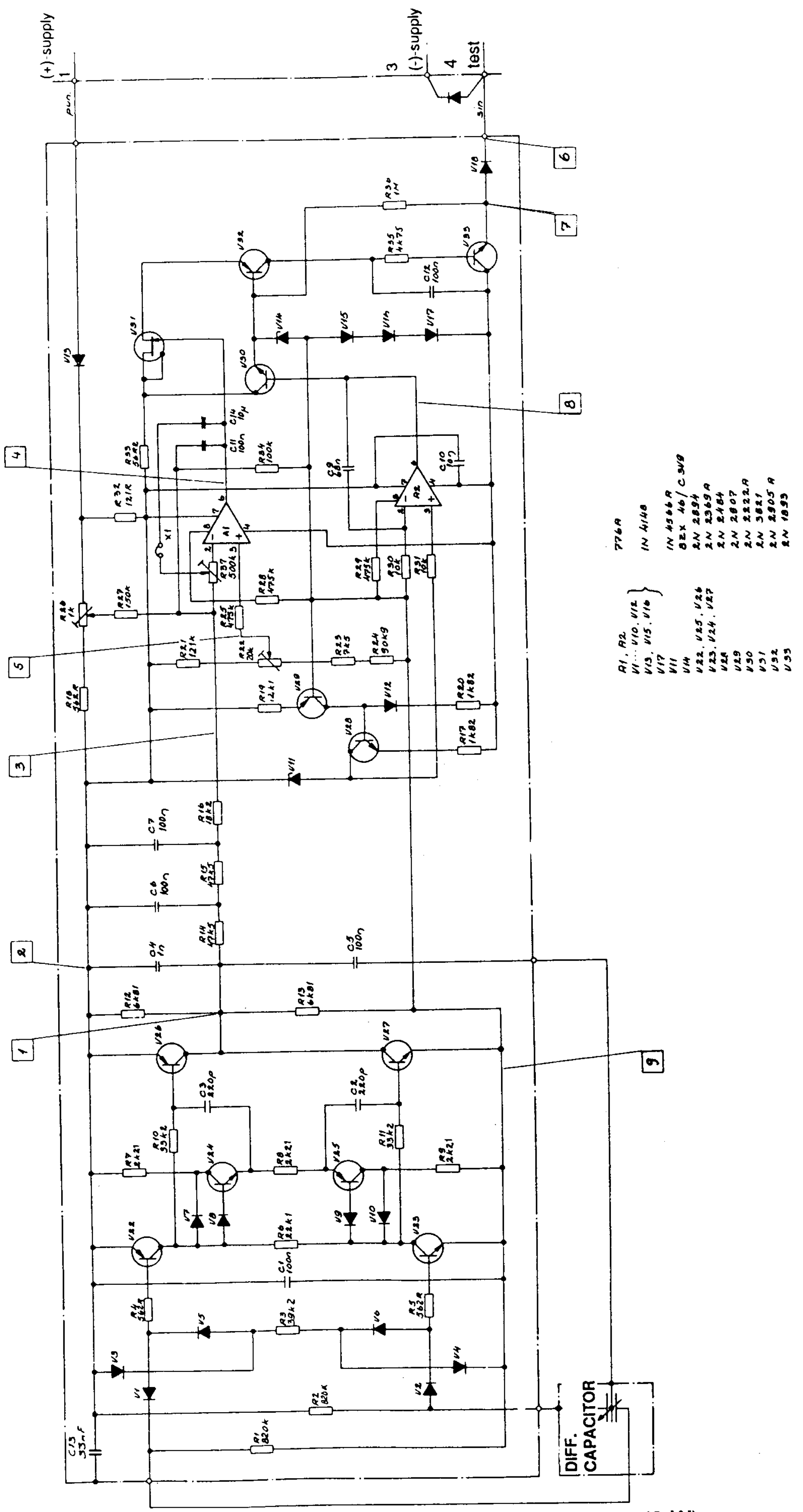
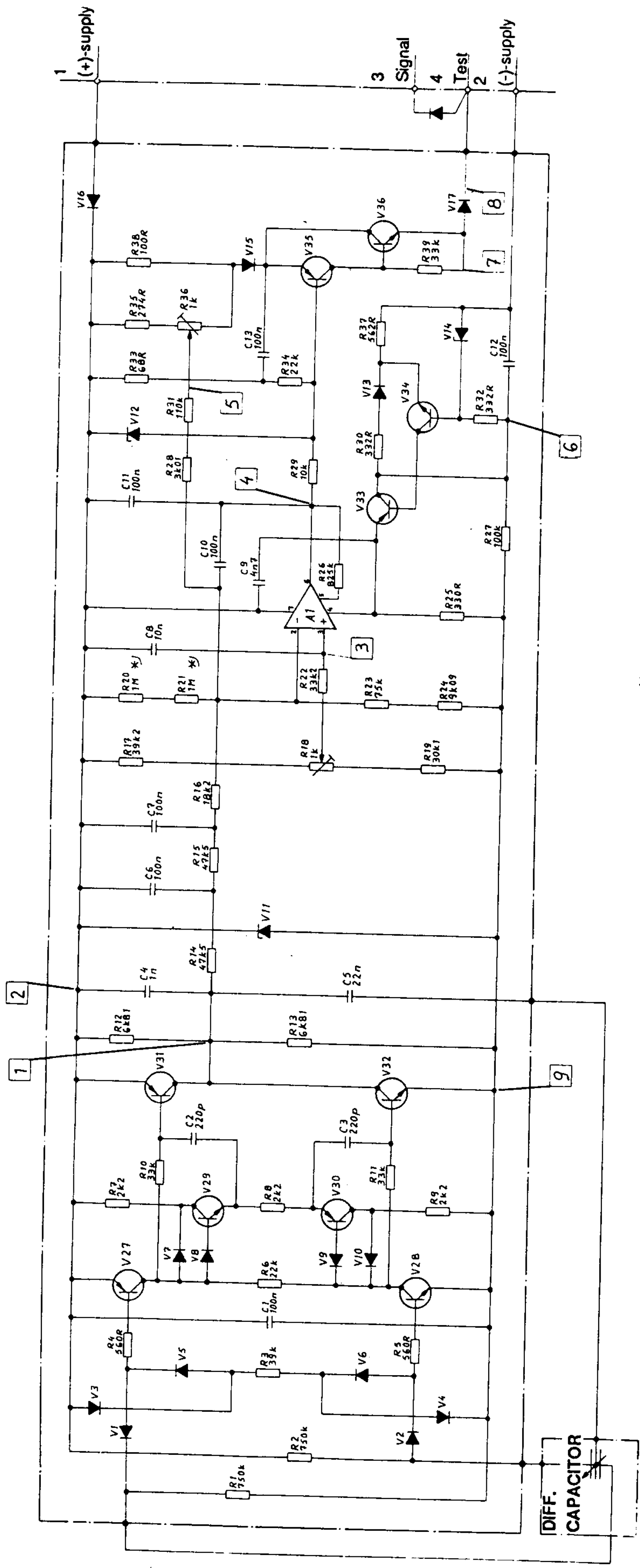


Figure 5-3 Circuit diagram (2-W)



* Connect resistors
R20 and R21
for 4-20 mA range

Figure 5-4 Circuit diagram (3-W)

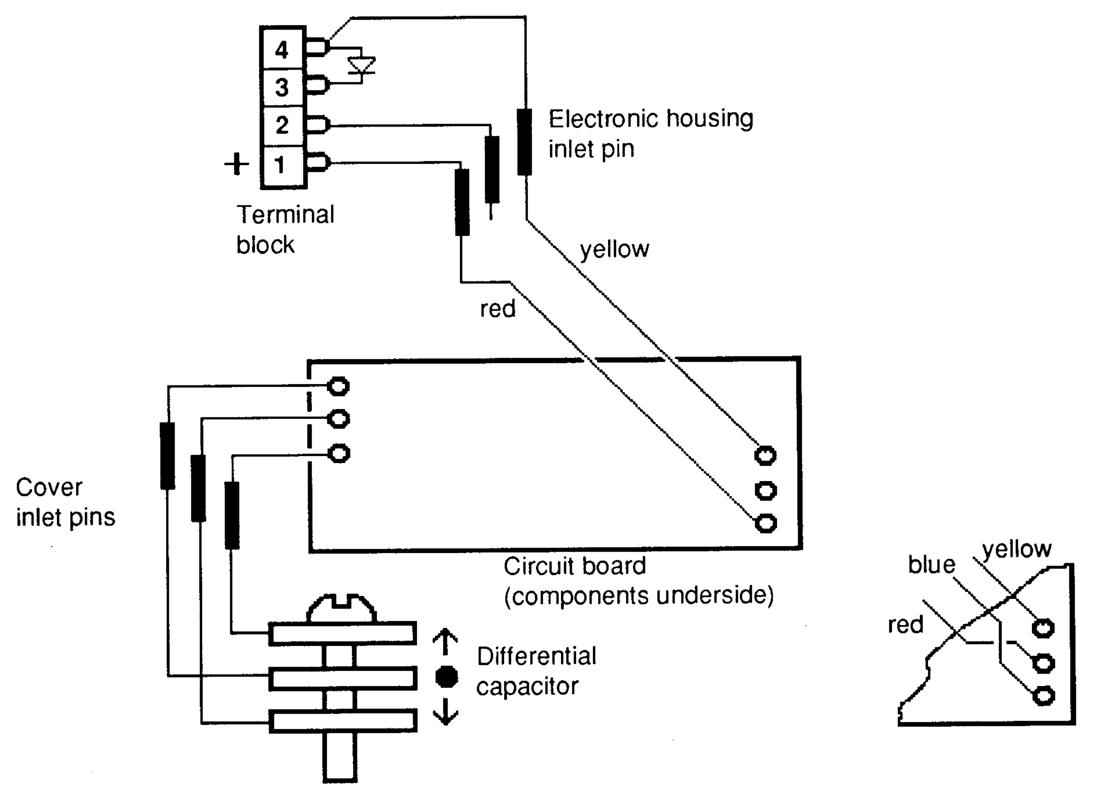


Figure 5-5 Wiring from component board to differential capacitor and terminal block

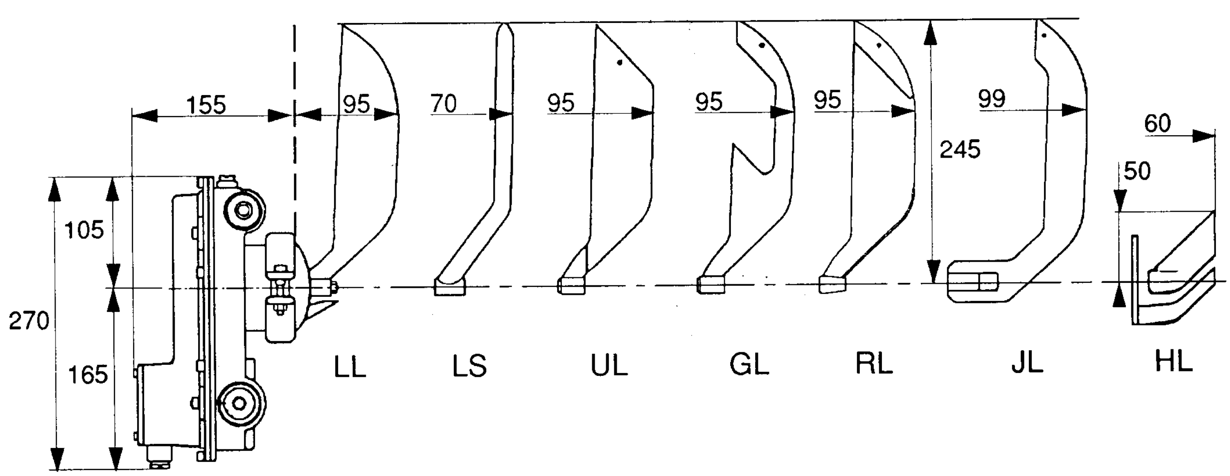


Figure 6-1 Dimensions

6. TECHNICAL SPECIFICATIONS

Types and materials:
- Refer to the Selection Table.

Applicability
Refer to Table: Applicable ranges of PULP-EL sensor types.

Span
Corresponds to change in measurement force acting on sensor from lower range-value to upper range-value:

Sensor type	min./N	maks./N
LL/LS/GL/RL/JL	1.5	8
(LL/LS/GL/RL/JL)D	3	16
UL	1	6
WS	1	6
WS D	2	12

Range elevation:
- PULP-EL WS: max 12 N
- Other PULP-EL types: max. 15 N

Damping time constant: 2 to 20 s.

Standard calibration
Span/Damping time constant
- PULP-EL LL/LS/GL/RL/JL/WS: 5 N/2 s
- PULP-EL HL: 8 N/10 s
- PULP-EL UL: 1.5 N/2 s

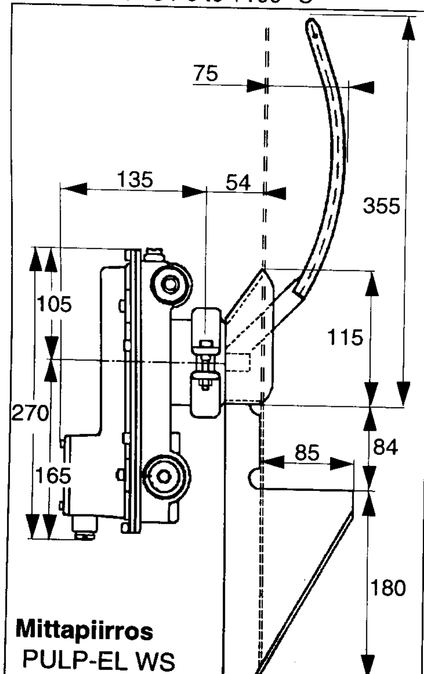
Output signal: 4-20 mA (2-W)

Supply voltage: 24-50 V DC

Permissible load
- 24 V supply: 550 ohm
- 48 V supply: 1750 ohm

Process pressure: max. 25 bar.
When process pressure exceeds 10 bar, reinforcement of process coupling's mounting hole must be specified separately. Refer to the Operating and Installation Instructions.

Temperature limits
Ambient temperature/Corresponding process temperature
-30 to +70 °C / 0 to +80°C
-30 to +50 °C / 0 to +100 °C



Mittapiirros
PULP-EL WS

Permissible velocity of flow (m/s)

	min / max
- PULP-EL UL	0.1 / 2-3
- PULP-EL HL	0.4 / 8
- PULP-EL WS	0.4 / 4
- Other PULP-EL types	0.4 / 5

Refer to Section 1.1 and PULPSEL PC program for detailed specification of permissible velocities on the basis of consistency and pulp type.

Performance
- repeatability: 0.02 % Cs
- dead zone: 0.005 % Cs
- static pressure effect: 0.02 % Cs per 1 bar

The consistency percentage values are given for 3 % Cs reference pulp (HL: 9 % Cs).

Process connections
Coupling to be welded on process pipe, sealing ring and mounting clamps are supplied with transmitter. Process pipe's nominal size should be specified in the order. If not, we will deliver a coupling designed for DN200 pipe.

Electrical connections
- terminal block: see the fig. Wiring
- Pg13.5 inlet gland (1/2-14NPS adapter as option).

Enclosure class: IP65, NEMA4.

Weight
- PULP-EL WS: 7.5 kg
- Other PULP-EL types: 4.8 kg

Materials
Options for metal parts in contact with process medium:
- AISI 316 L, Hastelloy C-276 or titanium.

Other metal parts: Aluminium alloy.

Selection Table

PULP-EL □□□□□

Sensor type
- **UL** For low consistencies
- **LL** Blade-type sensor
- **LS** Rod-type sensor
- **GL** Special blade-type sensor 1)
- **RL** Special blade-type sensor 1)
- **HL** For high consistencies 1)
- **JL** For plastic pipe installations 2)
- **WS** For unscreened recycled fibers 1)

Materials

	Wetted parts	*Sensor finish*
2S	AISI316	Unburnished
2P	AISI316	Burnished
2F	AISI316	PFA-coated
6S	Titanium	Unburnished
6P	Titanium	Burnished
3S	Hastelloy C276	Unburnished
3P	Hastelloy C276	Burnished

Material for process coupling
- **2** AISI316L
- **3** Hastelloy C276
- **6** Titanium

Span
- **-** Normal
- **D** Doubled

Process pipe's diameter (mm)

1) Burnished sensor only.
2) Supplied with special metal coupling.

Packings:
O-ring on the inlet of sensor mounting pin, in contact with process medium: special rubber
Other packings: PTFE, FKM (Viton).

Applicable ranges of different sensor types / % Cs

Sensor type	UL	LL	LS	GL	RL	WS	HL	JL
Long-fibered unbleached chem. pulp	0.7-3	1.5-6		(1.7-7)	(1.5-6)		4-16	1.5-6
Long-fibered bleached chem. pulp	0.7-3	1.5-6		(1.7-7)	(1.5-6)		4-16	1.5-6
Short-fibered unbleached chem. pulp	1-3	(1.8-5)		1.8-7.5	1.7-6.5		5-16	1.8-6
Short-fibered bleached chem. pulp	1-3	(1.8-5)		1.8-7.5	1.7-6.5		5-16	1.8-6
Groundwood (SGW, PGW)	1-4			1.8-7.5	1.7-5		5-16	
RMP, TMP (CSF<200ml)(SR>52) 3)	0.7-3		3-6	1.5-6.5	1.5-5		5-16	
RMP, TMP (CSF>200ml)(SR<52) 3)	0.7-3	1.5-4.5	3-6	(1.5-5)			4-16	
CTMP	0.7-3	1.5-5.5			(1.5-5)		4-16	
Unscreened recycled fiber						2-8		
Unscreened OCC recycled fiber						2-8		
Screened recycled fiber	1-5			1.8-8	1.7-8		5-16	
Screened OCC recycled fiber	1-3			1.5-8	1.5-7		4-16	

3) Raw material: Long-fibered.
Notice when choosing the sensor type: Applications whose consistency values are given in parentheses are not optimal solutions in terms of sensor type for the specified pulp, but for other pulp types they are.

7. PARTS LIST (Figure 7-1)

The list gives the parts for the following PULP-EL types:
- PULP-EL UL/LL/JL/GL/LS/HL/RL/WS

Parts marked with asterisk (*) are spare parts. When ordering spares, please quote this document's number **BCs150VA**
1995-01-15, the equipment's model, type, material option, sensor finish, serial number, and the quantity, name and number of the required part.

Order example:
BCs150VA 1995-01-15, M1, PULP-EL LL 2-W, AISI316, 1132, 1 blade-type sensor Part No. 15.

No.	Part	Qty
1	Plug	2
*2	Damping oil (AK 200)	-
3	Hex nut (SFS2067 M8)	1
*4	Taper pin	1
*5	O-ring (12 x 3)	1
*6	Sealing, PTFE	1
7	Slot-headed screw (SFS2176 M4 x 10)	4
*8	O-ring	3
9	Sleeve	1
10	Plug nut (DIN 1587 M6)	2
11	Zero setting spring	1
*12	Gear	1
13	Spring cotter	1
14	Housing, assembly	1
*15	Blade-type sensor (PULP-EL LL)	1
*16	Rod-type sensor (PULP-EL LS)	1
17	Hex nut (SFS 2067 M6)	1
*18	Expansion diaphragm	1
19	Cover, assembly	1
*20	Cover sealing	1
21	Allen screw (SFS2219 M6 x 10)	8
*22	Circuit board (2-W)	1
	or	
*23	Circuit board (3-W)	1
*25	Sealing	1
26	Electronics housing	1
27	Allen screw (SFS2219 M6 x 16)	4
*28	Sealing plate	1
29	Inlet gland (Pg13.5)	1
30	Connection box cover	1
31	Claw washer	2
32	Special washer	2
33	Spring washer (DIN127 B5)	2
34	Slot-headed screw (DIN84 M5 x 8)	2
*35	Sealing, PTFE	1
36	Coupling	1
37	Hex nut (DIN 934 M10)	2
38	Hex screw (DIN931 M10 x 40)	2
*39	Mounting clamp (NS 70) assy.	1
*40	High-consistency sensor (PULP-EL HL)	1
*41	Protector blade for high-consistency sensor	1
42	Centre boss	1
43	Ball-bearing journal	2
44	Ball bearing	2
45	Inlet cone UL/LL/LS	1
46	Inlet cone JL/GL/RL/WS	1
47	Inlet cone HL	1
48	Coupling plug	1
49	Low-consistency sensor (PULP-EL UL)	1
50	Special blade-type sensor (PULP-EL GL)	1
51	Sensor for thick-walled fiberglass pipe (PULP-EL JL)	1
52	Special hex nut UL/LL/GL/LS/RL/WS	
*54	Coupling WS	1
*55	Rod-type sensor (PULP-EL WS)	1
*56	Special blade-type sensor (PULP-EL RL)	1
*57	Coupling HL for blow-line installation	1
*58	Coupling JL for plastic pipe	1
*59	Sensor protector blade	

The sealing set includes parts:
5, 6, 8, 18, 29, 25, 28 and 35

Additional equipment
Mounting pipe element (see Fig. 2.1i).

Other equipment
PULPSEL, PC calibration program (update)
PULP-EL process coupling welding guide
PULP-EL servicing and calibration stand
PULP-EL calibration weights

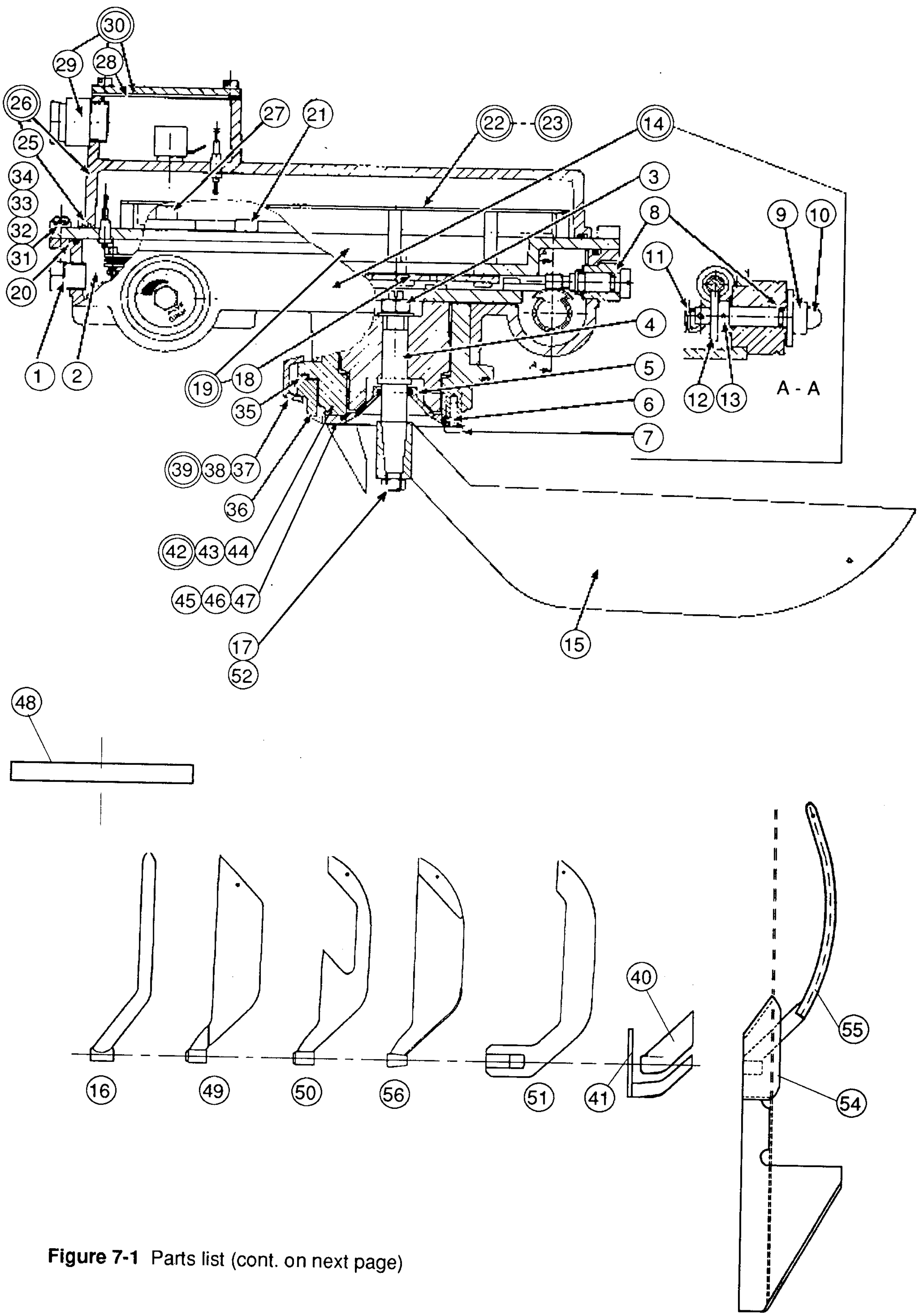


Figure 7-1 Parts list (cont. on next page)

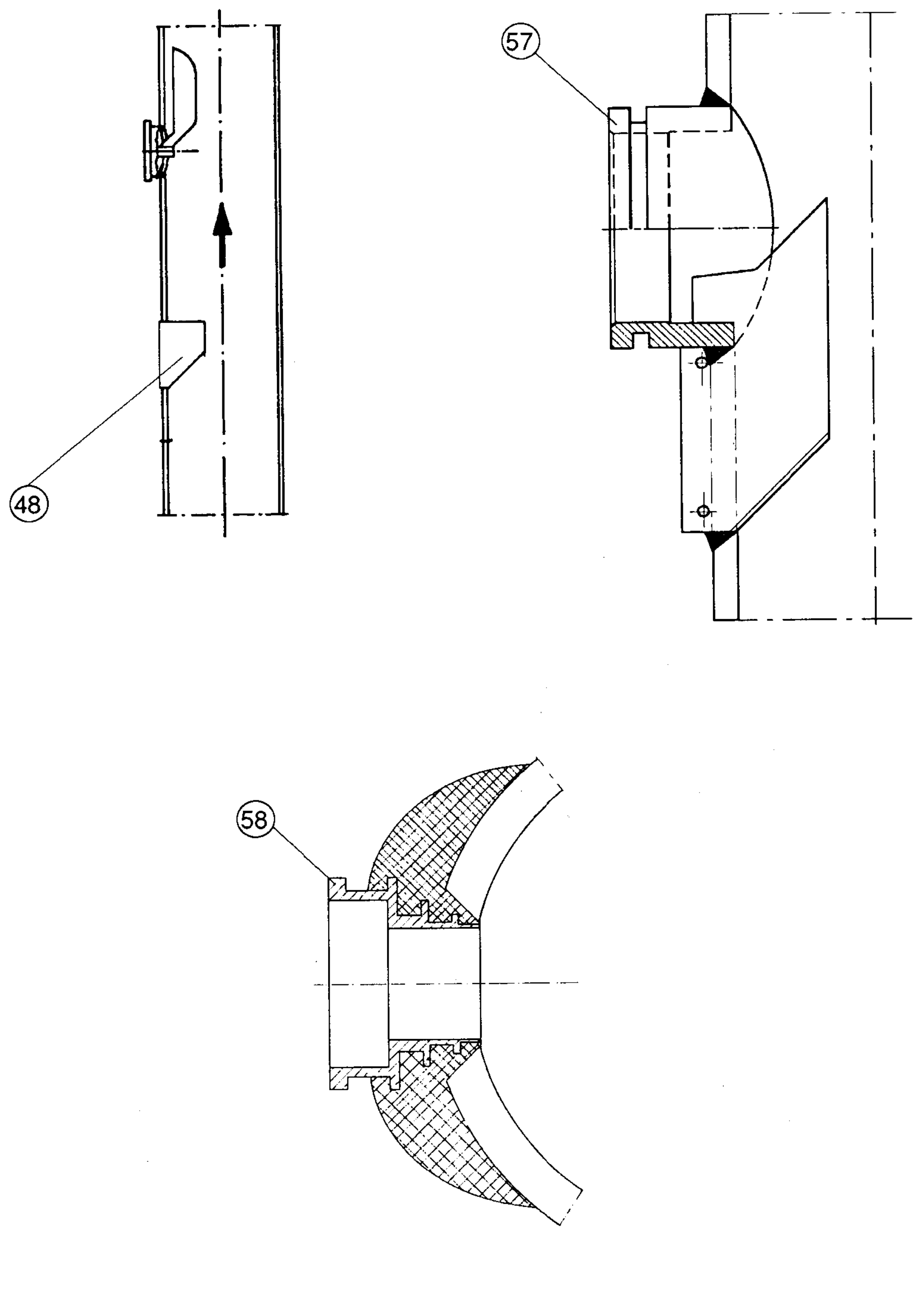


Figure 7-1 Parts list (cont. from previous page)