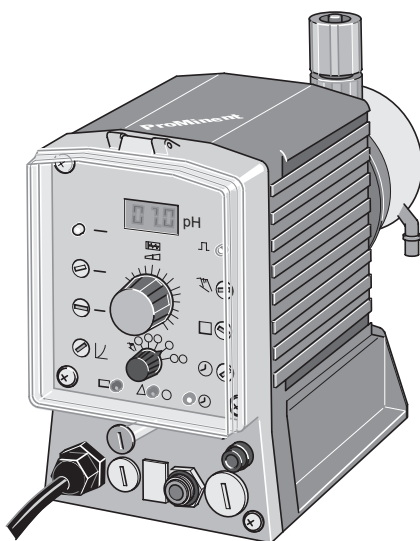


Instruction Manual

DULCOMETER®

Type D_4a, measured variable pH



D_4a

Please enter identcode here!

Please read the Operating Instructions through completely before commissioning this equipment. Do not discard!
Any part which has been subject to misuse is excluded from the warranty!

Publishing Details:

Operating Instructions
DULCOMETER®, Type D_4a, measured variable pH
© ProMinent Dosiertechnik GmbH, 1997

Address:

ProMinent Dosiertechnik GmbH
Im Schuhmachergewann 5-11
69123 Heidelberg · Germany

Phone: +49 (6221) 842-0

Fax: +49 (6221) 842-419

info@prominent.com

www.prominent.com

Subject to technical alterations.

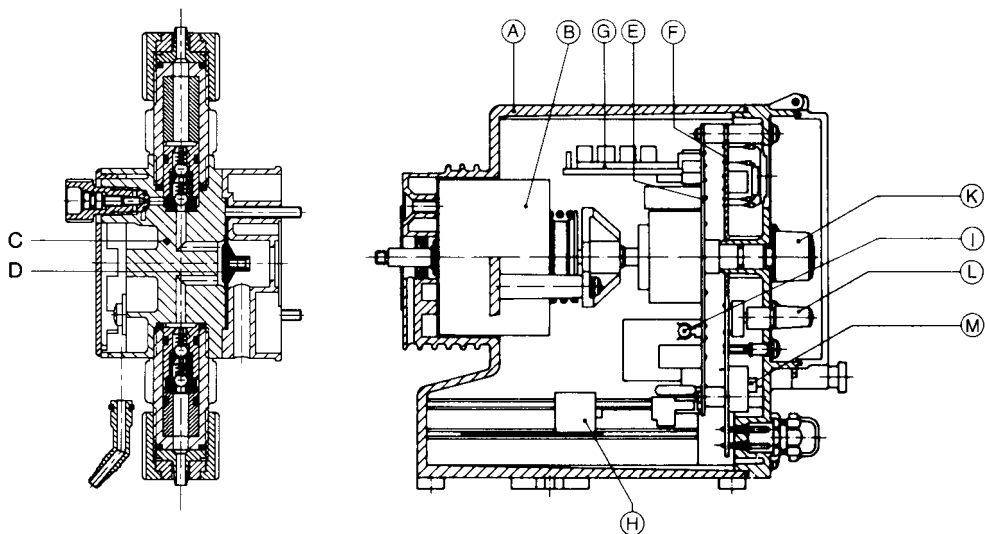


Fig. 1: Cross section of metering pump with built-in control system, type D_4a

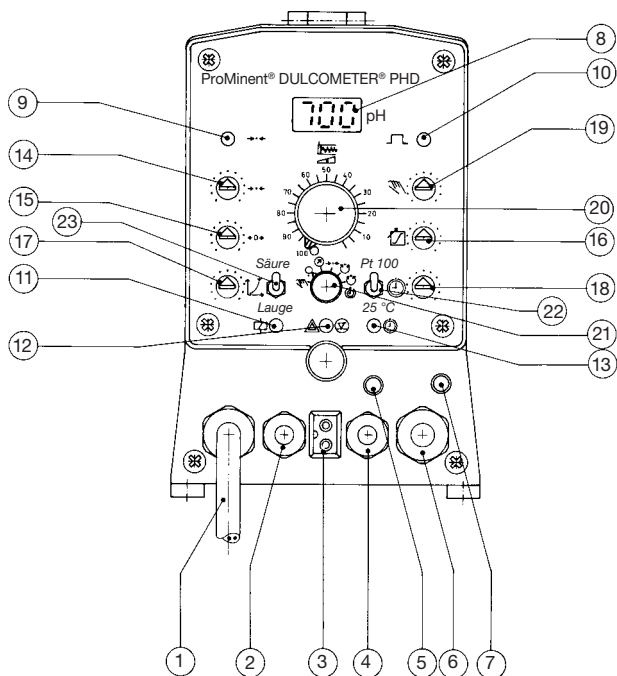


Fig. 2: Front view showing connectors, displays and controls

Explanation of Symbols

	Set value (display or adjustor)
	Stroke indication
	Manual operation
	Zero calibration, probe
	Slope calibration, probe
	Proportional bandwidth
	Control time (display or adjustor)
	Automatic operation
	Indication of measured value (metering pump off)
	State of relay indication
	Warning display
	Tank empty/Float switch
	Stroke distance adjustment
	Off, control voltage off

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Ordering System for DULCOMETER® Controller

D_4a										D Pump Type 4 Version a, measured variable pH									
PH										Measured variable ph measuring range 0 - 14 pH									
										Pump type 1601 16 bar; 0,84 l/h (0,54 l/h Version NS) 1201 12 bar; 1,45 l/h (0,84 l/h Version NS) 0803 8 bar; 2,86 l/h (1,98 l/h Version NS) 1002 10 bar; 1,91 l/h (1,50 l/h Version NS) 0308 3 bar; 7,00 l/h 0215 2 bar; 12,30 l/h									
										Liquid end material XX Without delivery unit NP Acrylic glass with FPM O-ring NS Acrylic glass self-bleeding/FPM (not to 0308, 0215) PP Polypropylen with EPDM O-ring TT PTFE + 25 % carbon with PTFE seal SS Stainless steel 1.4571 with PTFE seal									
										Electrical connection A 230 V; 50/60 Hz with Euro plug B 230 V; 50/60 Hz with Switzerland plug C 230 V; 50/60 Hz with Australia plug D 115 V; 50/60 Hz with USA plug									
										Connection of measured variable 2 SN6 PH 7 Plug connector DIN 19262 (without reference electrode connection) PH 8 SN6 with reference electrode connection PH 9 Plug connector DIN 19262 with reference electrode connection PH									
										Correction variable 0 None 1 Temperature (SN6) PH									
										Control direction 1 Raise measured value 2 Lower measured value 3 Control direction selectable (pH)									
										Signal current output 0 None 1 0/4...20 mA Δ pH 1...12									
										Relay 0 None A Relay output, level (pick-up action) B Relay output, clock generator pump stroke (pick-up action) C Relay output, pump stop (pick-up action) D Relay output, setpoint reached (pick-up action) E Control time monitoring (pick-up action) F Safety and power failure signalling relay (drop-out action)									
D_4a																			

General Instruction for Use

Please read through the following instructions carefully. Knowledge of these instructions will help you use the operating instructions manual more effectively.

Points are highlighted as follows

- Indicates step by step instructions
- Indicates enumerated points

User guidelines

IMPORTANT

Guidelines are intended to make your job easier.

and safety guidelines:



WARNING

Describes a possibly hazardous situation.

If the situation is not avoided you will be in grave danger and may lead to serious injury.



NOTICE

Could result in damage to property if safety guidelines are not observed.

**NOTICE**

- Check by means of the packing list or delivery note whether shipment is complete. Small parts often hide in the packing material.

**NOTICE**

- Read the whole instruction manual carefully before connecting the system to the power supply and putting it into service.

1 Introduction

The DULCOMETER® system type D_4a represents a packaged pH measuring, indicating and controlled chemical feed system integrated into a solenoid-operated metering pump.

2 General Description (Fig. 1)

For manufacturing and marketing purposes, the pump with built-in control system is separated into two modules which must be ordered separately:

1. Driving unit with built-in control system
2. Liquid end (pump head, diaphragm and intermediate disk)

The housing of the driving unit consists of a chemical-resistant plastic material (glass fibre reinforced Noryl) (A). The short-stroke solenoid (B) directly actuates a diaphragm (D), which displaces the media in the pump head (C). The entire actuating and control circuitry is located on the circuit boards (E) and (F). Two optional circuit boards (G) (standard output signal) and (H) (control time) are available on request and will be charged for extra.

The fuse (I) serves as a short circuit protection. The stroke distance (stroke volume) can be varied by means of knob (K); the selector switch (L) allows to choose the operating mode. The direction of control (feeding of acid or base) can be selected by means of slide switch (M) inside the housing.

3 Description of Connectors, Displays and Controls (Fig. 2)

3.1 Connectors

- ① Power cord
- ② Cable gland PG 7 exists only with relay option (A-F), otherwise a PG 7 blind plug will be there.
In case with option correction variable temperature a red SN 6 connector will be mounted there.
- ③ Connector for float switch: If the float switch is connected, the pump will stop and the red LED 12 be lit when the minimum level of the chemical feed tank is arrived at
- ④ Socket “SN 6 moisture-protected” for connection of a pH probe
- ⑤ Pin Socket “Reference Electrode”: only with option: connection of measured variable: SN 6 with reference electrode connection pH.
In case of using a separate probe, the reference electrode must be connected to the pin socket. The glass electrode will then be connected to pos. 4.
- ⑥ Cable gland PG 9 for standard signal output does only exist, if option: “signal current output 0/4...20 mA” was ordered.
If option “plug connector DIN 19262” was ordered, a connection socket for a DIN 19262 plug for connection of a pH combination probe will be there.
Connection pos. 4 is either not or provided with a cable gland PG 9 for standard signal output.
- ⑦ Pin socket, to be connected with the “sample reference potential” stainless steel rod in the sample solution). When used, the jumper KB 10 on the circuit board (see 3.4.1) must be removed.

3.2 Displays on the Front Plate

Item. Symbol Description

- ⑧  3-digit liquid crystal display (LCD), displaying the measured value a simulated value or the set value, depending on the position of selector switch 21.
- ⑨  Green LED; will be lit when the set value is reached and pump stops.
- ⑩  Yellow LED; flashes with each pump stroke.
- ⑪  Red LED; will be lit in connection with the relay functions ordered as options (A-F). The LED shows the pulled-in state of the relay.
- ⑫  Red LED; will be lit continuously when the liquid level in the chemical feed tank drops to a minimum, if a float switch is connected to 3. Flashes unless selector switch 21 is switched to the AUTOMATIC  or AUTOMATIC + CONTROL TIME  modes.
- ⑬  Green LED; burns as long as (with relay option E) control time is activated by means of selector switch 21, that is, selector switch is set to  and the set value is **not yet** achieved.

3.3 Controls

Item	Symbol	Description
⑭	↔	Potentiometer to adjust set value. If selector switch ⑳ is in position ↔ the set value is displayed on the LCD read-out ⑧.
⑮	↔	Potentiometer for zero calibration (only for pH probes having their zero voltage at pH 7).
⑯	↗	Potentiometer for slope calibration of the pH probe, e.g., at pH 4 or pH 10.
⑰	↗	Potentiometer to vary the proportional bandwidth, that is, the zone within which the stroking rate decreases from 100 to 15 % as the actual value approaches the set value.
⑱	⌚	Inoperative unless relay option E was ordered: Potentiometer to set control time that is the time within which the set value can be normally achieved. In case of faults, (e.g., faulty pH probe), the pump stops and the control relay pulls in when the pre-selected control time is exceeded. Simultaneously, the red LED 11 will be illuminated and the control relay will be available for fault annunciation. The pump will not be switched off when jumper KB 11 on the timer circuit board (Fig. 3b) is pulled out. The green LED 18 burns as long as the control time is activated and goes out when the control time has elapsed or the set point has been achieved.
⑲	↗	Potentiometer to simulate measured values. Selector switch 21 must be in position ↗. Irrespective of the actual measurement, any desired stroking rate can be selected manually by deliberately producing a corresponding error between the simulated measured value and the set value.
⑳	⏸	Stroke distance control, to select feed volume per stroke.
㉑	↗	6-position selector switch , to select the following modes (from left to right): MANUAL: Depending on the set value selected, and the measured value simulated by means of potentiometer ⑲ the stroking rate may be selected at pleasure. The LCD read-out indicates the simulated measured value. OFF The device is switched off on the control voltage side. MEASUREMENT: The measured value is read out. No feeding takes place. This position is used to calibrate the probe. ↔ SET VALUE DISPLAY: The LCD read-out indicates the set value as selected by means of potentiometer ⑭ ⌚ AUTOMATIC: The control system is in operation and additive feeding takes place relative to the error. The LCD read-out indicates the measured value ⌚ ⌚ AUTOMATIC + CONTROL TIME: Automatic operation plus activation of the control time (if relay option E was ordered). The set value must be arrived at within the time set by potentiometer ⑱, otherwise the pump will stop, LED ⑬ will go out, LED ⑪ will be lit and the appropriate relay pulled in.
㉒		Change-over switch "Pt 100"/"20 °C" (Option correction variable temperature only)
㉓		Control action change-over switch "Acid (Säure)/Caustic (Lauge)" (Options D 13 or D 14 only)

Description of Connectors, Displays and Controls

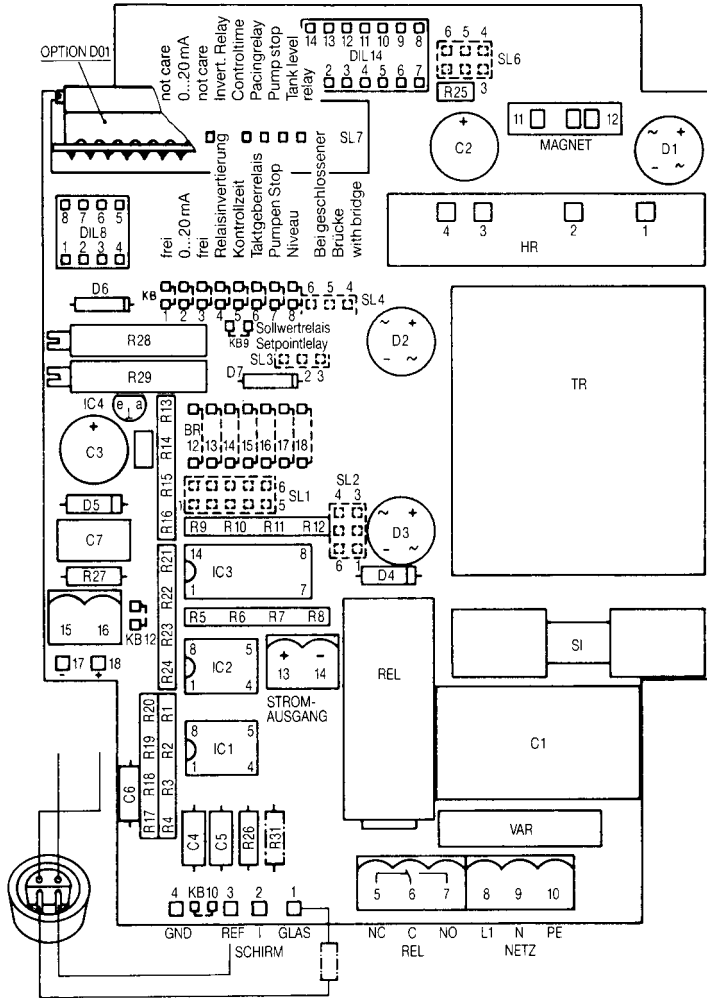


Fig. 3: Control circuit board (E)



NOTICE

The figures (1 to 8) indicated below the jumper strip KB 1 to KB 8 apply
Jumper KB 4 is factory-inserted; relay pulls in.

Fig. 3a: Control time circuit board

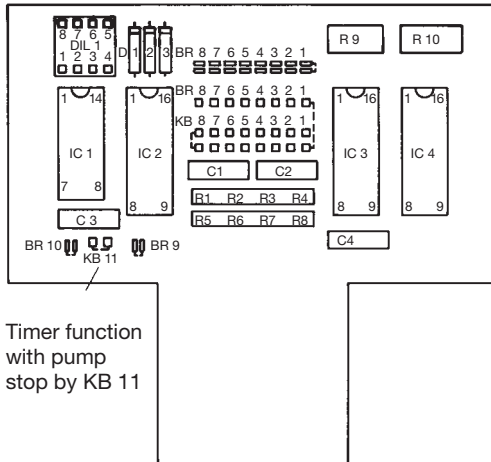


Fig. 3b: Standard output signal circuit board

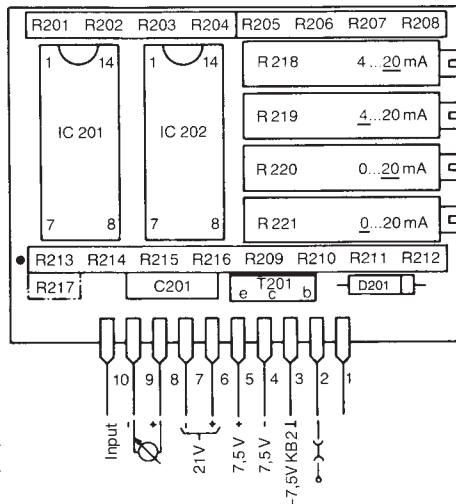


Fig. 4: View of control circuit

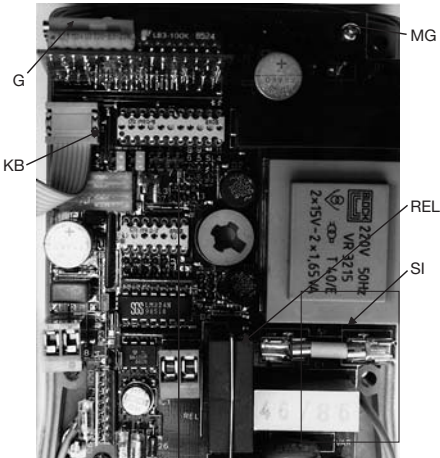


Fig. 4a: Direction-of-control swift

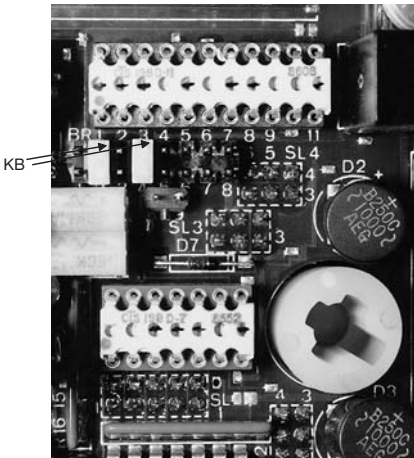
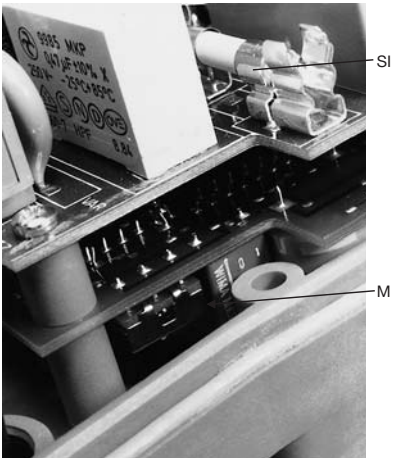


Fig. 4b: Jumper strip

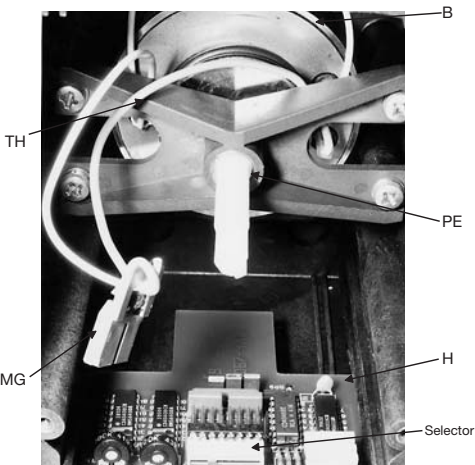


Fig. 5: Interior view of pump housing with control-time circuit board

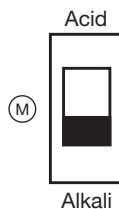
3.4 Internal Terminals and Control Facilities



WARNING

Pull mains plug before opening the pump!

To remove the electronic circuit, undo the 6 Philips head screws. Pull the orange colored front panel and the whole control circuitry out. This provides access to the direction-of control switch (M) (Fig. 1). To separate the circuitry from the pump, disconnect the blue solenoid connector in the upper section of the circuit board, and the protective earth connector (yellow-green cable) at the solenoid. If option D 07 "control time" is available in form of the optional circuit board (H) (Figs. 1, 3a) the 8-pole flat cable connector can be disconnected at the circuit board.



3.4.1 Control Circuit Board (Fig. 3 and 4)

Fig. 3 gives a view of the control circuit board (E) of Fig. 1. The connector (MG) of the solenoid is located at the top right. SL 7 at the top left is a connector strip to accommodate the optional circuit board "Standard output signal" (Fig. 3b) if option signal output was ordered. This optional circuit board must be plugged in in a way that the potentiometer screws face the edge of the circuit board. Below, there is an 8-pole socket DIL 8, accepting the flat cable connector of the optional circuit board (H) (Figs. 1, 3a and 5) when relay option E "Control time" is included. Next to the right lower corner of the DIL 8 socket, there are 8 plug-in jumpers KB 1 to KB 8 which have the following functions when open or closed:

KB 1: No connections, no jumper

KB 2: In case of option "Standard output signal", the signal range is 0...20 mA with the jumper in place, and 4...20 mA without jumper, both ranges corresponding to pH 2...12

KB 3: No connection, no jumper

KB 4: Inversion of relay function. With options having a relay output, the relay function can be changed from normally open to normally closed by removing the factory-made jumper connection

KB 5: With relay option E "Control time", this position is jumpered in order to actuate the relay

KB 6: With relay option B "Pacing relay", this position is jumpered. The output relay REL will be actuated synchronously with each pump stroke

KB 7: With relay option C "Pump stop", this position is jumpered. The output relay REL will pull in whenever the pump is stopped, e.g. when the chemical feed tank is empty or the set value is achieved.

KB 8: With relay option A "Tank level", this position is jumpered. When a float switch is connected and signals the minimum level, the pump will stop and the output relay REL will pull in

KB 9: With relay option D "Set value achieved", this position is jumpered. The output relay REL will pull in when the set value is achieved, that is, when the pump is stopped

On the bottom left of the control circuit board, there is the **important jumper KB 10**: It must be in place when the pH is measured without the "Sample reference potential" being connected to socket (7). If the sample reference potential (stainless steel bar in sample solution) is connected, as is recommended for an interference-free pH measurement, the jumper KB 10 must be removed.

Relay REL exists in various options.

Fuse (SI) protects the electronic circuit and the solenoid against short circuits.

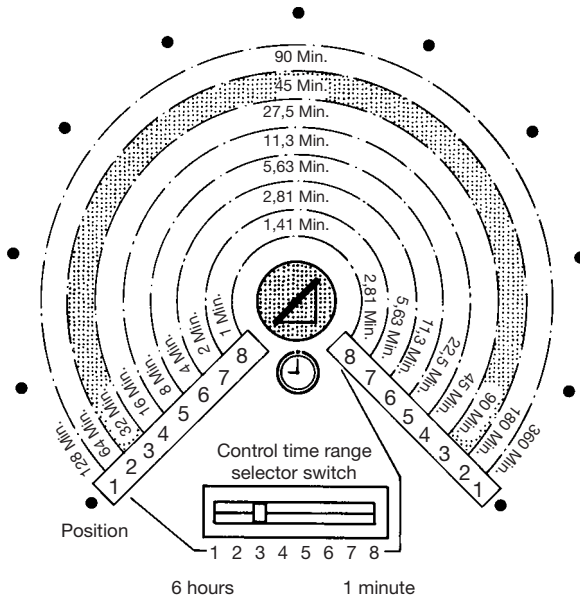
Description of Connectors, Displays and Controls

Fig. 4 shows distinctly some of the components described above: The optional circuit board “Standard output signal” (G), the solenoid connector (MG), the jumpers (KB), the output relay REL, the fuse holder (SI) and the direction-of-control switch (M).

3.4.2 Pump Housing and Solenoid (Fig. 5)

Fig. 5 gives a view of the interior of the black pump housing. The short-stroke solenoid (B) can be seen distinctly. On the bottom of the solenoid, there is the protective earth connector (SI). Below, one can see the optional circuit board (H) with relay option E (“Control time”) with the time selector switch which permits the selection of 8 control time ranges between 1 minute and 6 hours.

Fig. 6 shows the possible settings with relay option E “Control timer”. The slide switch allows 8 time ranges to be set. In the center, potentiometer (18) of the front panel is shown which allows a fine adjustment within the selected time range.



Standard setting: Selector switch: 3
Potentiometer at maximum right: 90 minutes
Open pump housing to obtain access to the selector switch

Fig. 6 **Option Control Time**
Control time range selector
switch Factory setting:
Range 3 (32 min. to 90 min.)

4 Description of the Metering Pump

The DULCOMETER® metering pump type D_4a is an electronically controlled short-stroke solenoid-driven diaphragm-type metering pump.

The pump discharge is discontinuous. Discrete pulses generated by an electronic circuit each energize the solenoid, causing the armature to produce a pump stroke of maximum length of 1.25 mm. The steelcored diaphragm displaces the media in the liquid end and the valve balls on the suction side are pressed tightly against their seats whilst those on the discharge side open and release the media into the discharge line. Since the duration of the pulse is limited, the solenoid will be de-energized when the stroke has been completed and a spring causes the armature to return to its original position. The discharge valve closes whilst the suction valves opens, allowing the media to be drawn into the liquid end.

The stroke volume can be infinitely varied from 100-10 % through knob (20). The adjustment should be made step by step with the pump operating since, while a stroke is being performed, the spindle is relieved for a short moment.

4.1 Installation of the Metering Pump (Fig. 7)

Mount the pump either directly on the top of the chemical feed tank or onto a wall bracket. The valves of the liquid end should always be aligned vertically. The use of a combined footvalve and float switch in the chemical feed tank is recommended. Plug the flat connector into the socket (3). The suction line should slope upward in the direction of flow. The footvalve should hang just clear of the tank bottom. Use an injection valve or an injection lance if the pump is to discharge into a pressurized system.

Further information is contained in the following Section.

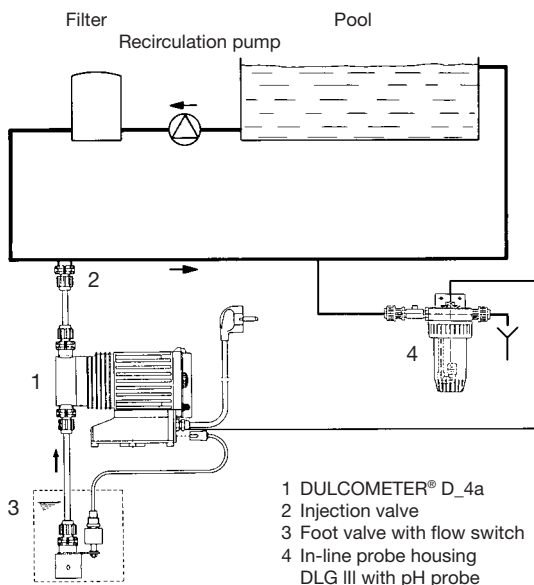
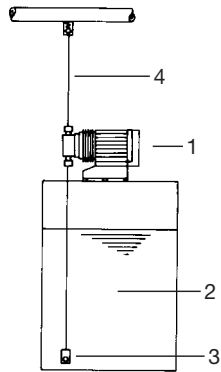


Fig. 7: Installation of metering pump

4.2 Typical Installation of the Metering Pump

1. Standard arrangement

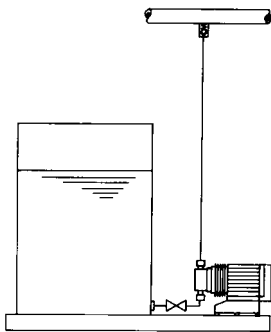
- 1 = Metering pump
- 2 = Chemical feed tank
- 3 = Foot valve with strainer and non-return valve
- 4 = Injection valve, spring-loaded
- 5 = Injection valve with enhanced spring action
- 6 = Back-pressure valve, adjustable
- 7 = Accumulator
- 8 = Solenoid-operated valve



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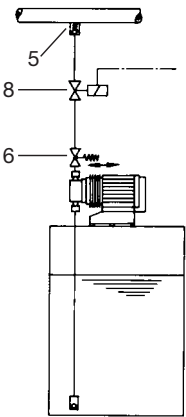
2. Positive suction head for media tending to emit vapor

3. Injection into vacuum systems



bracket

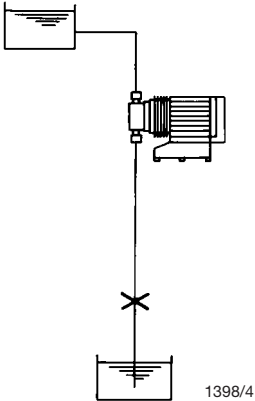
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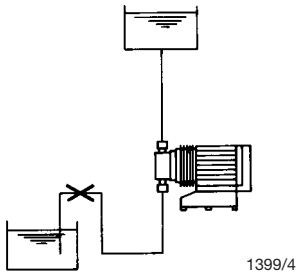
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HOW THE PUMP SHOULD NOT BE INSTALLED:

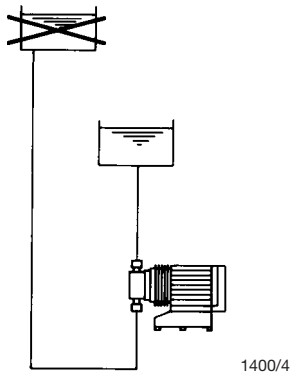
4. Faulty arrangement, suction lift too high



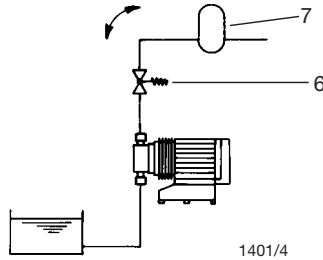
5. Faulty arrangement, suction line without air bleeding facilities



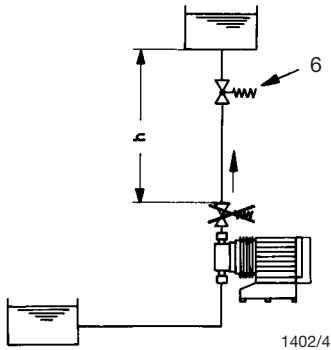
6. Faulty arrangement, positive suction head too high



7. Faulty arrangement, accumulator ineffective



8. Correct location of backpressure valve (or spring-loaded injection valve with reinforced spring)



Formula to calculate the maximum permissible vertical distance $h_{\max}$ of discharge line above backpressure valve:

$$h_{\max} = \frac{P_v \times 14,3}{Q \times g} \quad (\text{m})$$

Q = Mass density (kg/dm^3)

$h_{\max}$ = Height of line above backpressure valve (m)

P_v = Pressure setting of back pressure valve (bar)

g = Gravity constant $g = 10 \text{ m/s}^2$

4.3 Suction Lift of the Metering Pump

Depending on the pump type, the maximum suction lift is 2 - 5 mWC. (Table 1). The suction lift with an empty pump head depends on the stroke volume and is lower for low stroke volumes. The pump cannot prime against a head.

If the pump feeds into a pressurized system and has drawn air, the air will be just compressed within the pump head. In this case the discharge line must be disconnected and the air be allowed to escape until the suction line and the pump head are completely filled and free of bubbles.

The type **D_4a 1601-0308 NP and PP** pumps can be air-bled **without disconnection of the discharge line** when the air bleeding valve on the liquid end is loosened by a turn.

Table 1: Maximum suction lift of metering pumps

Type D_4a	1601	1201	0803	1002	0308	0215
Maximum suction lift mWC.	6	6	3	6	6	1.5

With media tending to emit vapors, a positive suction head is recommended. This is realized by placing the metering pump on a plinth or bracket at the foot of the chemical feed tank (see Section 4.2, Fig. 2).

Continuously fine bleeding of approx. 20 % of the dosing rate can be adjustet with the needle valve (Fig. 9, Pos. 8).

In order to prevent overfeeding or siphoning when the pump feeds into a vacuum system, e.g. the suction line of a recirculating pump, a backpressure valve should be installed on the liquid end in addition to the injection valve. A maximum of protection will be obtained by the use of a solenoid valve in the discharge line interconnected with the metering pump. This, however, is not necessary except for very high vacuum (Section 4.2, Fig. 3).

5 Commissioning

When the pump has been installed according to the suggestions made in Sections 4.1 to 4.3, place the selector switch on the front plate into the position  OFF and make the electrical connections.

5.1 Electrical Connections

With reference to Fig. 2, the electrical connections can be made in the following order:

- ① Connect the metering pump to the mains power supply via power plug
- ② Option “Relay Output” if available: No-voltage contacts with the following functions:

Green	=	Normally closed contact	(NC)
Brown	=	Common contact	(C)
White	=	Normally open contact	(NO)
- ③ Connection of the float switch via flat connector, if available
- ④ Connection of the pH combination probe, or the glass electrode if SN 6 with reference electrode connection pH is available
- ⑤ Connection of the reference electrode if (pin socket “Reference electrode”) is available
- ⑥ Connection of the recorder via signal cable if Option signal current output is available:

Brown: +	white: –
-----------------	-----------------
- ⑦ Connection of the “Sample reference potential”. This is a stainless steel pin immersed in the sample liquid. ProMinent® in-line or immersion probe housings already have this pin fitted.



NOTICE:

When use of the sample reference potential is made, remove jumper KB 10 on the control circuit board (E). Otherwise KB 10 must remain jumpered.

5.2 Installation of pH Probes

pH glass electrodes or combination probes should always be installed protected in a suitable manner, e.g. in an in-line or an immersion type probe housing. The operating conditions for the type of electrode used should be strictly observed. Enclosed, gel-filled pH combination probes (ProMinent®-Type PHE) should not be subject to any liquid pressure, that is, if an in-line probe housing is used, its discharge flow should be “opened”.

Irrespective of the working conditions, regular maintenance of the probes is imperative.

The location of the point of measurement and the sampling point of the sample liquid should be selected very carefully with due respect to the requirements of closed-loop control.

For installations in swimming pools detailed information on installation and operation can be obtained from your swimming pool supplier or ProMinent Dosierteknik GmbH.

5.3 Calibration of Probes

To tune the electrode to the built-in transmitter, place selector switch (21) on the front plate into the position  MEASUREMENT. With the switch in this position, no additive feeding takes place. The measured pH value will be displayed on the read-out (8).

Zero calibration is made by means of potentiometer (15) . Immerse the glass electrode or the combination probe together with the stainless steel pin (sample reference potential) into a buffer (calibrating) solution pH 7 while the jumper KB 10 (see Section 5.1) is open. If the stainless steel pin is not being used, jumper KB 10 must be closed. Turn potentiometer (15)  so as to obtain a stable reading of 7.0 pH on the display.

Rinse the probe with water and carry out the slope calibration by means of the potentiometer (16)  and a buffer solution having a pH different from 7, e.g. pH 4 or pH 10. Wait until the reading is stable.

Repeat both zero and slope calibrations to make sure that the values of the buffer solutions are correctly displayed.

Having completed calibration, install the probe in the probe housing ready for measurement and control.

IMPORTANT:

In the case of a probe failure an incorrect measured value can be read. This can lead to uncontrolled feeding. The customer must therefore ensure that as a result of this no consequential damage can occur. Possible safety measures are described below:

pH-measurement

Dirt deposits ageing, contamination of the reference electrode, dampness in the plug connections, cable rupture or mechanical damage (e.g. glass breakage) of pH probes can lead to any signals between pH 10 and 14.

As a safety measure the alarm values as well as the check time can be used.

The highest degree of safety is however only possible with a pH difference measurement (second probe). In general, regular probe maintenance (visual/functional checks, calibration) is necessary.

5.4 Setting the Set Value

To set the set value place selector switch (21) on the front plate into the position  SET VALUE DISPLAY. The LCD read-out will display the set value which can be set to any value between pH 0 and pH 14 by means of potentiometer (14) .



NOTICE:

During this procedure the metering pump will start to operate if the measured value differs from the set value.

5.5 Direction of Control Action

Unless ordered otherwise, the factory setting of the control direction is for **acid feeding** (when the measured value exceeds the set value). The control direction can be changed by means of the slide switch (M) inside the pump (see Figs. 1 and 4):

Switch position upward = **acid feeding**
 switch position downward = **alkali feeding**

If the pump has been ordered with Option D 13 (Part No. 81.81.18.2), an externally accessible control action change-over switch "Acid (Säure)/Caustic (Lauge)" is provided on the operator panel, see Fig. 2 (23).

5.6 Automatic Operation

To put the system into the automatic mode, place selector switch (21) on the front plate into the positions  AUTOMATIC or (if Option is available)  AUTOMATIC + CONTROL TIME. In both switch positions the red LED under the switch does not flash. In all other switch positions except (21) OFF the LED flashes to indicate that the system is not in the automatic mode.

In the AUTOMATIC + CONTROL TIME mode, the green LED  will be illuminated if a disturbance occurs, and the timer will be started. If the set value is not achieved within the pre-set control time, the green LED  will be extinguished, the metering pump will stop, the red LED  will be illuminated and the output relay will pull in and actuate an alarm. The alarm can be reset by a short actuation of the selector switch (21) to restart the control system and the timer. The time check will start from the beginning every time when a new disturbance occurs after the set value was achieved. That means that the control times are not summated.

The control time should be selected that in normal operation the set value will always be achieved within the control time. Only serious faults like electrode failure or lack of chemicals should cause the control time to be exceeded and alarm to be given.

For setting the control time refer to Figs. 5 and 6 and section 3.4.2.

5.7 Proportional Bandwidth

After the metering pump has been put into the automatic control mode, the controller has to be tuned to the process characteristics by means of potentiometer (17)  PROPORTIONAL BANDWIDTH. On the one hand the controller should suppress any disturbance as early as possible, on the other hand there should be no overshooting of the set value. Usually one begins with the maximum setting (turn potentiometer clockwise into its end position) when the controller emits the maximum pulse rate at a disturbance of as little as 1 pH. In this position the set value will be achieved within a minimum of time. However, if the set value is not only restored but overshoot, the proportional bandwidth must be reduced (turn potentiometer (17) anticlockwise) until overshooting does not occur any more.

It may also be necessary to **adapt the stroke distance** of the metering pump to the process. The stroke distance must be substantially reduced if, for instance, a few pump strokes already are capable not only of restoring the set value but of overshooting it.

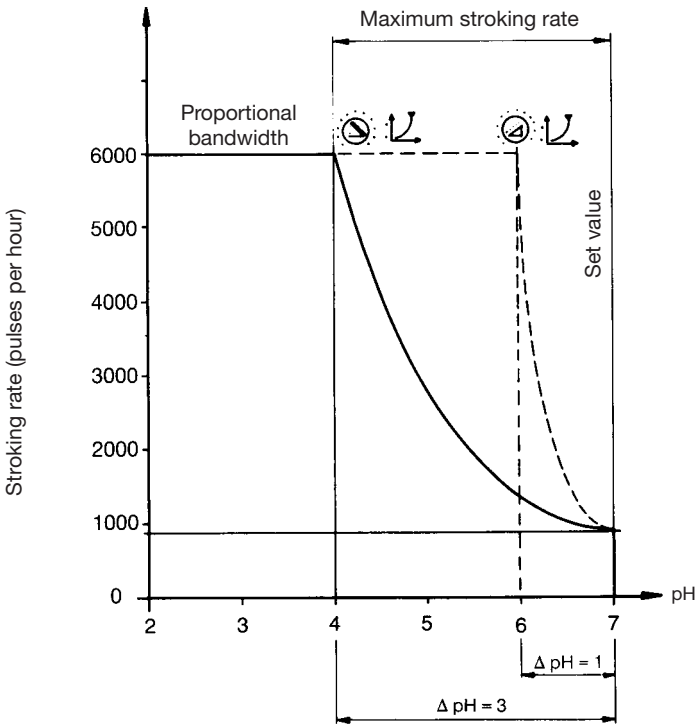


Fig. 8: Control characteristics of a type D_4a PH metering pump with built-in control system

Fig. 8 shows the characteristics of the stroking rate of a metering pump feeding alkali. The set value be pH 7. At the maximum proportional bandwidth setting the maximum stroking rate will be generated when the error is as low as $\Delta \text{pH} = 1$. At the minimum setting of the proportional bandwidth it takes an error of $\Delta \text{pH} = 3$ to produce the maximum stroking rate.

5.8 Manual Operation

The metering pump with built-in control system can be also controlled manually without reference to the measured pH value. This, for instance, may be useful in case of an electrode failure. In this mode the feeding rate can be controlled by variation of the stroking rate in addition to the variation of the stroke distance. The selector switch (21) is to be placed into the position  MANUAL. By turning the potentiometer (19) one can simulate any measured value and thus any error so that the stroking rate can be varied between 15 and a maximum of 100 spm.

6 Technical Data of Control Section

6.1 Controller Stage

Power supply:	230 V $\pm$ 10 %, 50/60 Hz or 115 V $\pm$ 10 %, 50/60 Hz
Read-out:	3-digit liquid crystal display, of measured value, set value or simulated measured value
Display range:	0.0...14.0 pH
Measurement and control range:	0.0...14.0 pH
Direction of control:	Internally switch-selectable; factory setting for feeding acid
LED displays:	Stroking rate; set value reached (no error); relay output (optional); low level; time check (optional)
Output signal:	Option: 0...20 mA (internally changeable to 4...20 mA) closed-loop current signal corresponding to pH 2...pH 12, maximum burden 750 Ohm
Input amplifier:	Differential amplifier with high common mode rejection; sample reference potential
Input impedance:	$>5 \cdot 10^{12}$ Ohm
Connector, pH probe:	Socket for SN6 plug, moisture-protected, to connect a combination probe; pin socket for sample reference potential Option: DIN B 19262 socket instead of SN6 socket Option: Pin socket for reference electrode
Zero shift, zero calibration:	± 1.5 pH
Slope calibration range:	47...85 mV/pH
Maximum pulse rate:	6000/h
Average power:	15 W
Peak power while pump is stroking:	200 W
Option „Relay output“:	Contact load: max. 250 V a.c./3 A 1100 VA min. 24 V d.c./25 mA
Permissible working temperature:	-10...+45 °C
Housing:	Shock-resistant Noryl, glass fiber reinforced
Dimensions of housing (w/o liquid end):	112 x 173 x 200 mm wide x high x deep
Type of enclosure:	IP 65, insulation class F

Technical Data of Control Section

6.2 Pump Stage

Technical data

D_4a	Delivery capacity at maximum pressure			Delivery capacity at medium pressure			Connections ä Ø x i Ø
	ml/stroke	ml/min.	l/h	ml/stroke	ml/min.	l/h	
1601	0.140	14.0	0.84	0.165	16.5	0.99	6 x 4
1601 NS	0.09	9.0	0.54	–	–	–	6 x 4
1201	0.242	24.2	1.45	0.265	26.5	1.59	6 x 4
1201 NS	0.14	14.0	0.84	–	–	–	6 x 4
0803	0.477	47.7	2.86	0.529	52.9	3.17	6 x 4
0803 NS	0.33	33.0	1.98	–	–	–	6 x 4
1002	0.318	31.8	1.91	0.363	36.3	2.18	8 x 5
1002 NS	0.25	25.0	1.50	–	–	–	8 x 5
0308	1.166	116.6	7.00	1.266	126.6	7.60	8 x 5
0215	2.050	205.0	12.30	2.200	220.0	13.20	12 x 9

(NS: self-bleeding liquid end)

Type of connections:

For PP, NP, NS and TT	6, 8 and 12 mm	Hose sleeve with clamping ring connection
For stainless steel SS	6, 8 and 12 mm	Swagelok system connection

Material in contact with medium for version:

	Liquid head end	Intake/delivery connection	Seals	Ball (6 - 12 mm connection)
PP	Polypropylene	Polypropylene	EDPM	Ceramic
NP	Acrylic glass	PVC	Viton®	Ceramic
NS	Acrylic glass	PVC	Viton®	Ceramic
TT	PTFE with carbon	PTFE with carbon	PTFE	Ceramic
SS	Stainless steel Mat. No. 1.4571	Stainless steel Mat. No. 1.4571	PTFE	Ceramic

DEVELOPAN® pump diaphragm with PTFE support.

Viton® is a registered trademark of DuPont Dow Elastomers.

Metering reproducibility: ±2 % when used in accordance with operating instructions

7 Accessories and Consumables

	Order Nr.
Buffer solution pH 7, 50 ml	50.62.53
Buffer solution pH 7, 1000 ml	50.62.58
Buffer solution pH 4, 50 ml	50.62.51
Buffer solution pH 4, 1000 ml	50.62.56
Buffer solution pH 5, 50 ml	50.62.52
Buffer solution pH 5, 1000 ml	50.62.57
Buffer solution pH 9, 50 ml	50.62.54
Buffer solution pH 9, 1000 ml	50.62.59
Buffer solution pH 10, 50 ml	50.62.55
Buffer solution pH 10, 1000 ml	50.62.60
pH combination probe type PHE, pH 1...12, T= 0...60 °C, max. 5 m water column	30.50.54
pH combination probe type PHEP, pH 1...12, T= 0...80 °C, max. 6 bar	15.00.41
pH combination probe, refillable, type PHEN, pH 1...12, T= 0...60 °C	30.50.90
pH combination probe type PHED, pH 1...12, T= 0...80 °C, max. 8 bar	74.10.36
pH combination probe type PHEX 112 SE, pH 1...12, T= 0 ...100 °C P max. = 16 bar (25 °C), 6 bar (100 °C)	30.50.96
PHEN 012 SL, refillable laboratory probe electrode, pH 0...12, T= 0...80 °C	30.50.78
Pt 100 SE resistance thermometer, 0...+100 °C	30.50.63

8 Spare Parts Kits

Consisting of: 1 pump diaphragm
 1 intake connector, complete for NP, PP, TT version
 1 delivery connector, complete for NP, PP, TT version
 2 valve balls
 4 valve balls for SS version
 1 set of seals

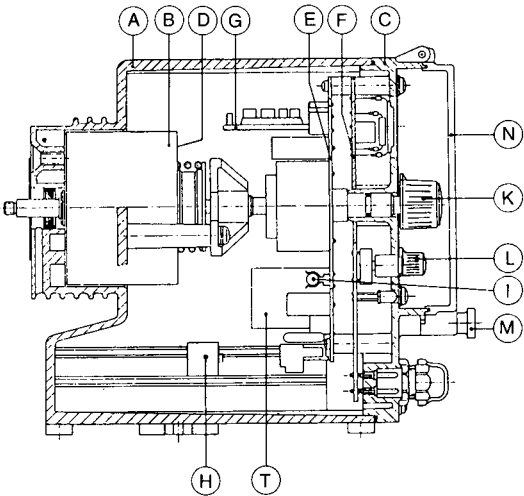
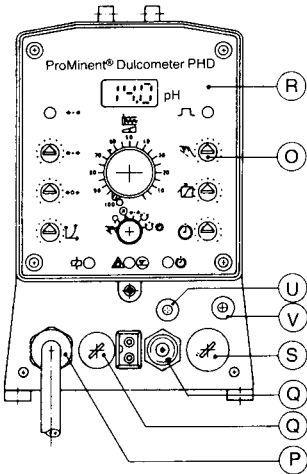
	Order No.
For pump type	
	NP 74.03.58
	NS 79.20.33
1601	PP 74.03.61
	TT 91.07.78
	SS 91.07.79
	NP 74.03.62
	NS 79.20.34
1201	PP 74.03.80
	TT 91.07.80
	SS 91.07.81

Spare Parts Kits

0803	NP	74.03.81
	NS	79.20.35
	PP	74.03.84
	TT	91.07.82
	SS	91.07.83
1002	NP	74.03.85
	NS	79.20.36
	PP	74.03.88
	TT	91.07.84
	SS	91.07.85
0308	NP	74.04.98
	PP	74.04.97
	TT	91.07.86
	SS	91.07.87
0215	NP	74.05.00
	PP	74.04.99
	TT	91.07.88
	SS	91.07.89

Table 3: Spare parts kits

8.1 Spare Parts List



D_4a PH		Order No.
A	PMD housing blue	80.07.41
B	Solenoid E 70 M6 230 V	81.78.08
	Solenoid E 70 M6 115 V	81.78.10
	Solenoid E 70 M3 230 V	81.78.01
	Solenoid E 70 M3 115 V	81.78.03
C	Front section, complete with electronic circuit D_4a 220/240 V	81.91.72
E	Main circuit board	81.90.12
F	Front circuit board	81.90.11
G	Output signal, optional	81.81.06
H	Timer control, optional	81.81.12
I	Fuse 6.3 x 32 mm 0.25 ATT 230 V	71.20.35
	6.3 x 32 mm 0.5 ATT 115 V	71.20.37
K	Control knob	70.35.57
	Arrow disk for control knob	70.35.59
	Cap for control knob	70.35.58
L	Knob of selector switch	70.35.65
M	Knurled screw	46.62.13
N	Perspex cover	81.91.73
O	Control knob	70.35.24
P	Cable gland PG 9	70.38.85
Q	Cable gland PG 7 or	70.38.96
	Plug PG 7 or	70.38.70
	SN 6 socket red	81.83.99
R	Front plate D_4a	60.61.92
S	SN 6 socket or	81.83.98
	Plug PG 7	70.38.71
T	Relay	71.13.40
	Fastener for relay holder	71.13.42
U	Pin socket, red	70.42.25
V	Pin socket, black	70.42.28
	Coding jumpers	71.39.95
	DIL-jumpers, 7-pole, D_4a, not coded	71.02.38
	DIL-jumpers, 9-pole, D_4a, not coded	71.02.39

9 Faults, Causes and Remedies

9.1 Mechanical Faults

1) Pump does not prime

- a) Bleed air from pump; for material version PP/NP loosen air bleeding valve (Fig.9) by giving it a turn, for other types release discharge line at the injection valve and wait until the pump head is filled with media.
- b) Pump valves are dry or stuck; moisten or dismantle and clean valves.
- c) Ruptured diaphragm; replace diaphragm referring to Section 10.2.
- d) Worn valve seats, valves do not close; replace valve seats or O-rings.
- e) Chemical feed tank is empty

2) Leaking liquid end

- a) O-rings are damaged or swollen; replace.
- b) Ruptured diaphragm; replace (Section 10.2.)

3) Pump does not discharge against a head

- a) Ruptured diaphragm; replace (Section 10.2).
- b) Valves do not close; clean, replace if necessary.

9.2 Changing of Diaphragm

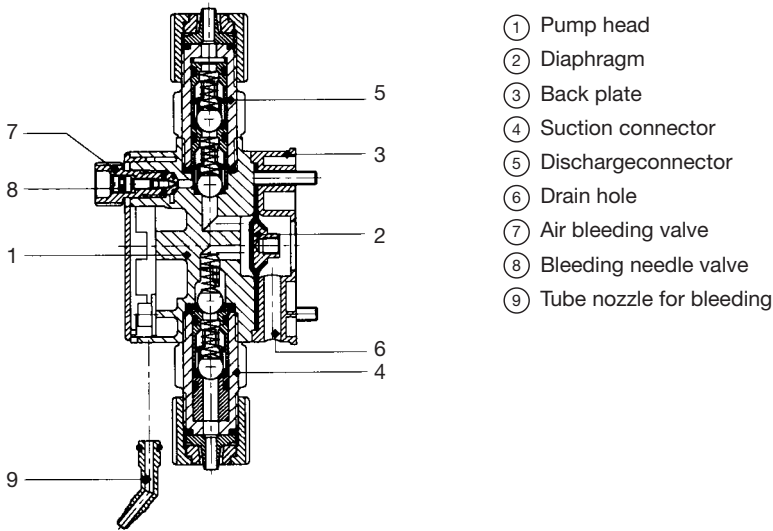


Fig. 9: Liquid end

A ruptured diaphragm can be recognized by media leaking out of the drain hole (6). To replace the diaphragm proceed as follows:

Unscrew the four Philips or hexagon socket head screws, remove pump head, set stroking distance to zero with the pump working and unscrew diaphragm by turning it anticlockwise. If necessary stick the fastening screws through pump head, diaphragm and intermediate disk and turn diaphragm off the armature rod. Place new diaphragm into the intermediate disk and replace pump head so that the suction connector is next to the drain hole in the head plate. Stick fastening screws through and turn the whole assembly clockwise until the diaphragm is securely fixed. Let the pump work, set the stroke distance to 100 % and turn the whole assembly clockwise until the suction connector points right down. Stop pump and tighten screws crosswise.

The arrow marks on the valves indicate the direction of flow.

To enable you to remedy smaller faults at any time we recommend you to have a spare parts kit ready to hand (Section 9).

9.3 Electrical Faults



NOTICE:

Ensure that the mains plug is pulled out before opening the pump!

- 1) Pumpe does not work, none of the LED's is alight
 - Check mains voltage, then fuse (SI in Fig. 3) inside the housing
- 2) Pump does not work, LED's indicate state of operation
 - Check thermal fuse (TH in Fig. 5) for passage
- 3) Pump does not work, LED's indicate state of operation,
 - Check d.c. impedance of solenoid bobbin.
The impedance of the solenoid bobbin should be:
220 V bobbin about 315 Ohm
240 V bobbin about 375 Ohm
115 V bobbin about 105 Ohm
- 4) Pump does not work, red LED (12) is alight, feed tank is full
 - Check float switch by pulling the float switch plug from its socket (3) and shorting the socket contacts;
Contacts open: Pump works, yellow LED (10) flashes with each pump stroke
Contacts jumpered: Pump is idle, yellow LED (10) does not flash, red LED (12) is alight.
If pump works in this manner, exchange float switch.
- 5) Read-out (8) displays a value higher than pH 14, liquid reference potential is connected to pin socket (7).
 - Remove jumper KB 10 on the control circuit board (Fig.3).
- 6) Red LED (12) flashes
 - Selector switch (21) is not in the AUTOMATIC or AUTOMATIC + TIMER CONTROL position

10 Connecting Pt 100 Resistance Thermometer

If the D_4a pump was ordered to include Option D 12, „Automatic temperature correction“ (Part No. 81.81.17.4), item 2 will consist of a SN 6 connector for connecting a Pt 100 resistance thermometer, instead of a plug or a PG cable gland for the relay output (Option). Then, the relay output will be run out of the pump housing at the liquid end side.

IMPORTANT:

There is an additional change-over switch (23) “Pt 100”/“20 °C” on the operator panel. If no Pt 100 is connected, place this switch into position “20 °C”. If a Pt 100 resistance thermometer is used, place this switch into position “20 °C”.

With the Pt 100 connected, the influence of temperature on the pH measurement will be automatically corrected within a temperature range from 0 °C - 100 °C.

As a rule, temperature correction of pH measurements is required only at pH values below 6 and above 8 when frequent temperature changes of the sample liquid occur.

11 Safety Information



NOTICE:

Measuring and control systems and their peripheral equipment may only be connected by trained personnel and qualified electricians.

Contact your customer service responsible!



Disposal of Old Parts

ATTENTION:

Plastic and electronic waste are classified as special waste and must be recycled!

Disposal Law

Waste (old parts) is to be disposed of in an orderly manner for the common good especially the protection of the environment. Therefore old parts have to be disposed of in accordance with the order on the (German) Waste Avoidance and Waste Management Act or recycled in accordance with the (German) Waste and Residual Materials Monitoring Act.

Taking back old parts

The municipal collection points for small quantities of the towns and municipalities accept plastic and electronic waste.

If you should not find any appropriate collection point **the ProMinent subsidiary or representative responsible for you will take back your old parts for a small fee!**

EC Declaration of Conformity

We,

ProMinent Dosiertechnik GmbH
Im Schuhmachergewann 5 - 11
D - 69123 Heidelberg

hereby declare that, on the basis of its functional concept and design and in the version brought into circulation by us, the product specified in the following complies with the relevant, fundamental safety and health stipulations laid down by EC regulations.

Any modification to the product not approved by us will invalidate this declaration.

Product description : ***Metering pump, series "D_4a..."***

Product type : ***D_4a PH.../RH.../CA.../CB...***

Serial number : ***see type identification plate on device***

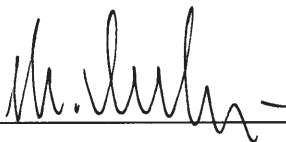
Relevant EC directives : ***EC - machine directive 98/37/EC***
EC - low voltage directive 73/23/EEC
EC - EMC - directive (89/336/EEC) subsequently 92/31 EEC

Harmonised standards used,
in particular : ***DIN EN 292-1, DIN EN 292-2, DIN EN 809***
DIN EN 60335-1, DIN EN 60335-2-41, DIN EN 50106
DIN EN 61010
DIN EN 50081-1/2, DIN EN 50082-1/2

National standards and other
technical specifications used,
in particular : ***DIN VDE 0700 T1***
DIN VDE 0700 T41
DIN VDE 0700 T500

Date/manufacturer's signature :

24. Nov 99



The undersigned :

Dr. Rainer V. Dulger, Executive Vice President R&D and Production