



FILTER SYSTEMS

FCU 2210-5 FluidControl Unit

Operating and Maintenance Instructions

Valid from firmware versions 3.22 up

English (translation of original instructions)

Document no.: 3129487b



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All details are subject to technical modifications.

All content of this manual is subject to revision without notice.

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Preface

For you as the owner of a product manufactured by us, we have produced this manual, comprising the most important instructions for its **operation** and **maintenance**.

It will acquaint you with the product and assist you in obtaining maximum benefit in the applications for which it is designed.

Keep the manual in the vicinity of the device for immediate reference.

Note that the information on the unit's engineering contained in the documentation was that available at the time of publication. There may be deviations in technical details, figures, and dimensions as a result.

If you discover errors while reading the documentation or have additional suggestions or notes, contact us at:

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The editorial department looks forward to receiving your input.

Our motto: "Putting experience into practice"

Customer Service

Contact our technical sales department if you have any questions on our product. When contacting us, always include the model/type designation, serial no. and part-no. of the product:

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E-Mail: filtersystems@hydac.com

Modifications to the Product

We would like to point out that changes to the product (e.g. purchasing options, etc.) may result in the information in the operating instructions no longer being completely accurate or sufficient.

When making modifications or performing repair work to components affecting the safety of the product, the product may not be put back into operation until it has been examined and released by a HYDAC representative.

Please notify us immediately of any modifications made to the product whether by you or a third party.

Warranty

For the warranty provided by us, please refer to the General Terms of Sale and Delivery of HYDAC FILTER SYSTEMS GmbH.

Refer to these at www.hydac.com ⇒ General terms and conditions.

Using the Documentation



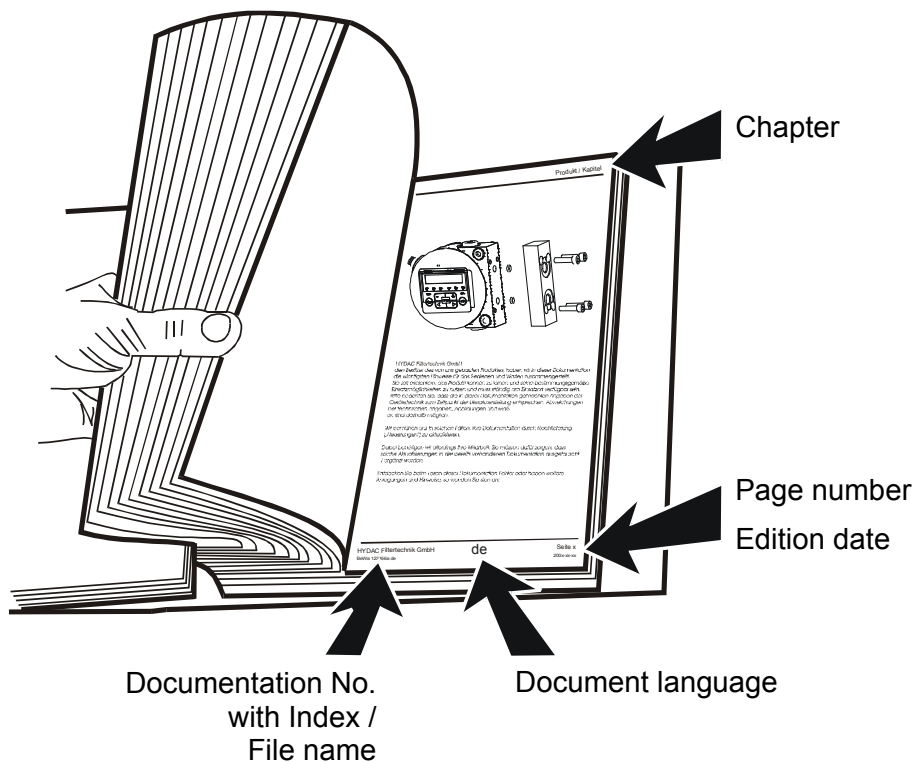
Please note that the method described above of locating specific information does not release you from your responsibility for carefully reading the entire manual prior to starting the unit up for the first time and carefully rereading the manual at regular intervals later on.

WHAT do I want to know?

I determine the topic I am looking for.

WHERE can I find the information I'm looking for?

The documentation has a table of contents at the beginning. There, I select the chapter I'm looking for and the corresponding page number.



The documentation number with its index enables you to order another copy of the operating and maintenance instructions. The index is incremented by one every time the manual is revised or changed.

Safety information and instructions

These operating instructions contain the key instructions for properly and safely operating the FCU.

Obligations and Liability

The basic prerequisite for the safe and proper handling and operation of the FCU is knowledge of the basic safety instructions and regulations.

These operating instructions in general, and the safety precautions in particular, are to be adhered by all those who work with the FCU.

In addition, the accident prevention rules and regulation applicable at the location of use are to be observed.

The FCU has been designed and constructed in accordance with the current state of the art and recognized safety regulations. Nevertheless, hazards may be posed to the life and limb of the individual using the product or to third parties. Risk of damage may be posed to the product or other equipment and property.

The FCU is only to be used as follows:

- Solely for its designated use
- Only when in safe, perfect condition.



Immediately remedy any malfunctions that might impair safety.

Always keep the operating and maintenance instructions near the measurement device.

In addition to the operating instructions, the general and local regulations on accident prevention and environmental protection are to be made available and observed.

Ensure that all information relating to safety and potential hazards of the FCU are kept in a legible condition. Replace them if necessary. Replace them if necessary.

Check the hoses and connectors for leaks on a daily basis.

	 WARNING
	<p>Hydraulic systems are pressurized</p> <p>Danger of bodily injury</p> <p>► Depressurize the system before performing any work on it.</p>

Explanation of Symbols and Warnings, etc.

The following designations and symbols are used in this manual to designate hazards, etc.:



DANGER denotes situations which can lead to death if safety precautions are not observed.



WARNING denotes situations which can lead to death if safety precautions are not observed.



DANGER denotes situations which can lead to severe injuries if safety precautions are not observed.



NOTICE denotes situations which can lead to property damage if safety precautions are not observed.

Proper/Designated Use

The Contamination Sensor (FCU) was developed for temporary or continuous monitoring of particulate contamination in hydraulic systems.

Analyzing the type, size and quantity of contamination enables quality standards to be verified and documented, and the requisite optimization measures to be implemented.

Any other use shall be deemed to be improper and not in keeping with the product's designated use; the manufacturer accepts no liability for any damage resulting from such use.

Proper or designated use of the product extends to the following:

- Maintaining adherence to all the instructions contained herein.
- Performing requisite inspection and maintenance work.

Improper Use

Any use other than described above is prohibited.

Improper use may result in hazard to life and limb.

Example of improper use:

- Improper connection of the FCU pressure and return flow hoses.
- Sealing of the FCU return line.

What to Do in Case of Emergency

In the event of an emergency, immediately disconnect the FCU from the power supply and from the hydraulic system.

Properly dispose of any escaping fluid in accordance with environmental guidelines.

Maintenance, Servicing and Troubleshooting

The specified adjustment, maintenance, and inspection work is to be conducted in a timely fashion.

Secure all operating media against accidental start up.

When performing any maintenance, servicing, inspection or repair work, disconnect the FCU from the power supply and ensure that it cannot be switched back on inadvertently.

Check that released threaded joints were refit tightly.

Always check the safety devices to see that they function properly after performing maintenance work.

Modifications to the FCU

Do not make any structural modifications (design modifications, extensions) to the FCU without the prior consent of the manufacturer.

Any conversion modifications require written permission from HYDAC FILTER SYSTEMS GMBH.

Immediately replace any parts which are not in perfect condition.

Use only original spare parts (OEM).

Training of personnel

The owner is obliged to only let persons work on the FCU, who:

- are familiar with the fundamental occupational safety and accident prevention regulations and have been properly instructed in the use of the FCU.
- they have read and understood these operating instructions.

Only properly trained and instructed personnel may work with the FCU.

The areas of responsibility of your staff must be established in a clear-cut manner.

Staff who are still being trained may only work on the FCU when supervised by a suitably experienced person.

Activity	Individuals	Instructed individuals	Personnel with technical training/ engineering background	Electricians	Supervisor with the appropriate authority
Packing Transportation		X	X		X
Commissioning			X	X	X
Operation		X	X	X	X
Troubleshooting/ locating the source of malfunction			X	X	X
Remedying of mechanical faults			X		X
Remedying of electrical faults				X	X
maintenance		X	X	X	X
Servicing					X
Decommissioning/storage		X	X	X	X

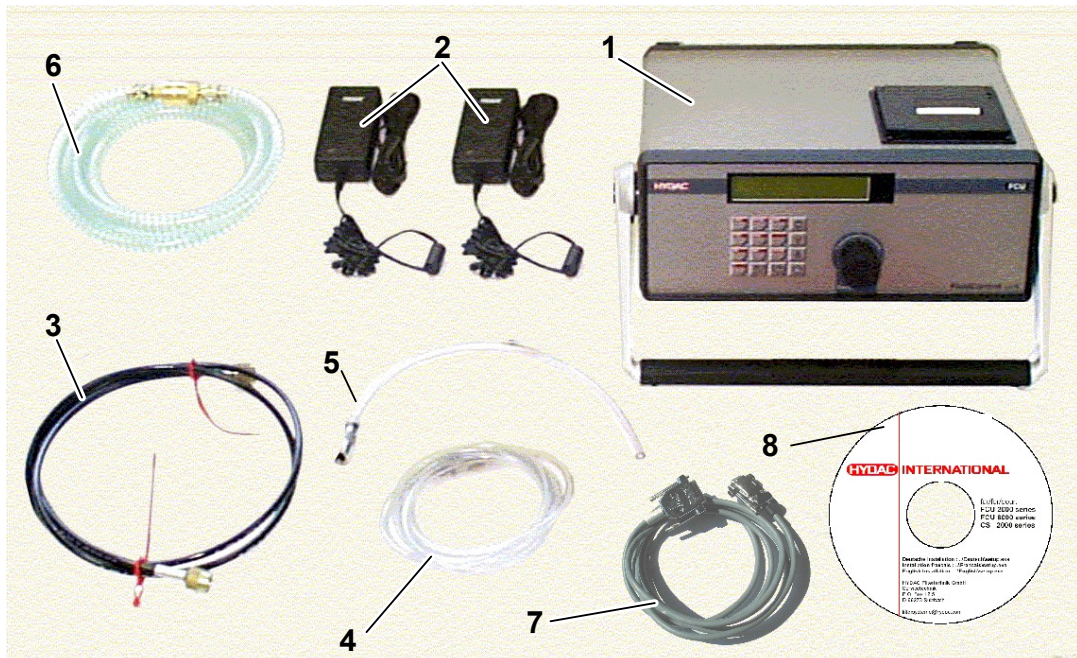
Checking the Scope of Delivery

The FluidControl Unit FCU comes packed and ready for operation.

Before commissioning the SFC, check the content of the package to make sure everything is present.

The following items are supplied:

Item	Pc.	Description
1	1	FluidControl Unit FCU 2xxx-4
2	2	Mains device and connection cable (configuration depends on the order)
3	1	hp-hose with mini measurement port DN4, L=2000 mm
4	1	Suction hose DN 6 with CPC quick-release coupling, L=1000 mm
5	1	Suction hose DN 6 with CPC quick-release coupling, L=250 mm
6	1	Return hose DN 7, L = 2000 m
7	1	Connection cable FCU <-> PC
8	1	CD-ROM with FluMoS light software
-	1	Operating and Maintenance Instructions
-	1	Calibration certificate



Description of the FCU

The FCU FluidControl Unit can determine the solid particle contamination of mineral oils on a continuous basis.

With the FCU, it is possible to record, save and display the Cleanliness Class completely automatically during continuous operation in accordance with NAS 1638 and/or SAE AS4059 or ISO 4406.

The measured values can be printed out online in the form of either tables or graphs by means of the built-in printer or sent via serial interface to a PC or a central display unit for visualization purposes there.

Filter units can for example be actuated via relay outputs.

For input and output functions, the FCU possesses a keyboard, an LCD (Liquid Crystal Display), a dot-matrix printer, control relay outputs and a serial data interface

The FCU possesses a measurement port 1604 as an input for connection with the hydraulic unit, as well as a DN 7 plug nipple as a return flow outlet.

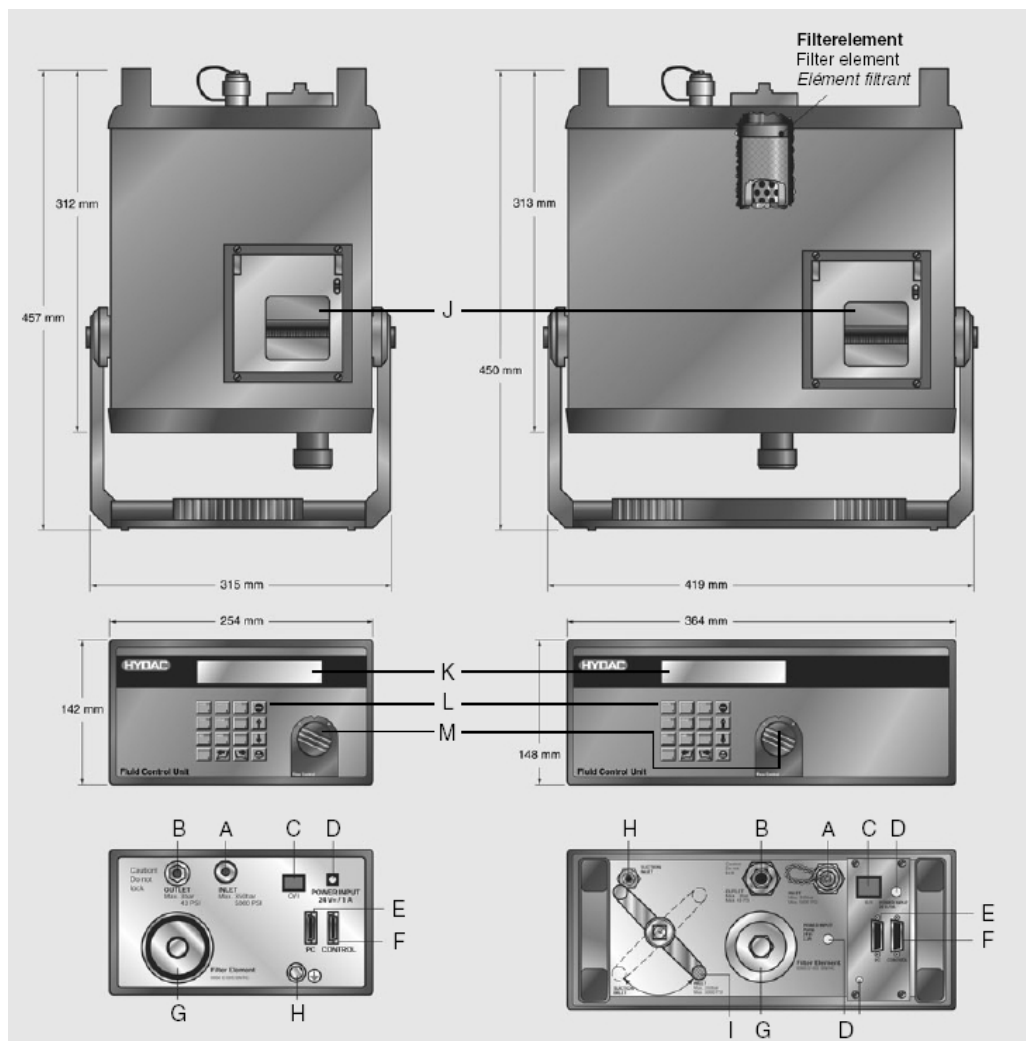
A flow rate control valve is available for setting the measurement flow rate. This is protected against larger particle contamination by an upstream filter.

Media from a depressurized reservoir can be inspected using the integrated pump with the enclosed suction hoses (DN8).

The FCU has a rechargeable battery for ~ 5 hours of operation independent of the mains network.

The FCU has a measured value memory for up to 3000 measured values, which are stored in the form of logs (maximum of 100).

Operating elements / Dimensions



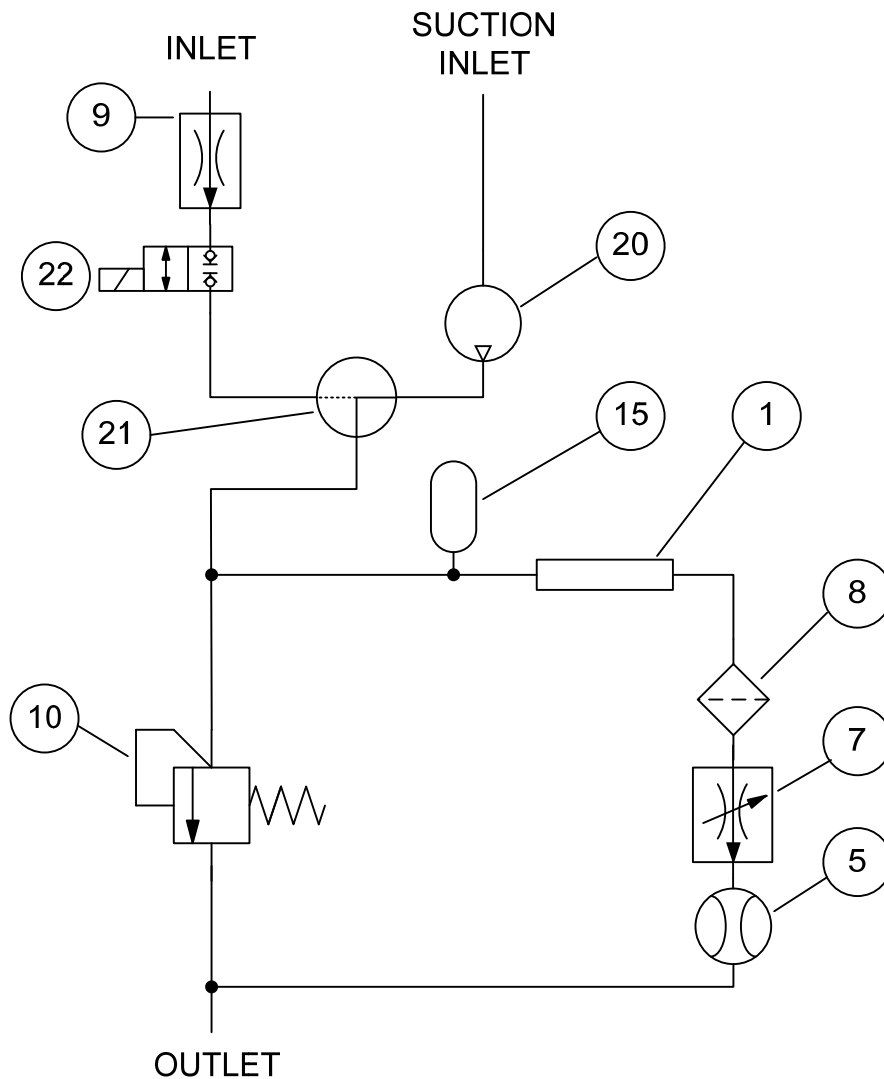
Item	Designation
a	High pressure port = INLET
b	Return port connection - OUTLET
C	Switch - On/Off
D	Electrical connection - 24 V DC
E	Serial interface
F	Control port
G	Sealing cover
H	Suction port SUCTION INLET (only 2xx0-4)
I	Change-over valve (only 2xx0-4)
J	Dot-matrix printer
K	Display
L	Keyboard
M	Flow rate regulator

Restrictions Pertaining**NOTICE****Impermissible operating conditions**

The FCU will be destroyed

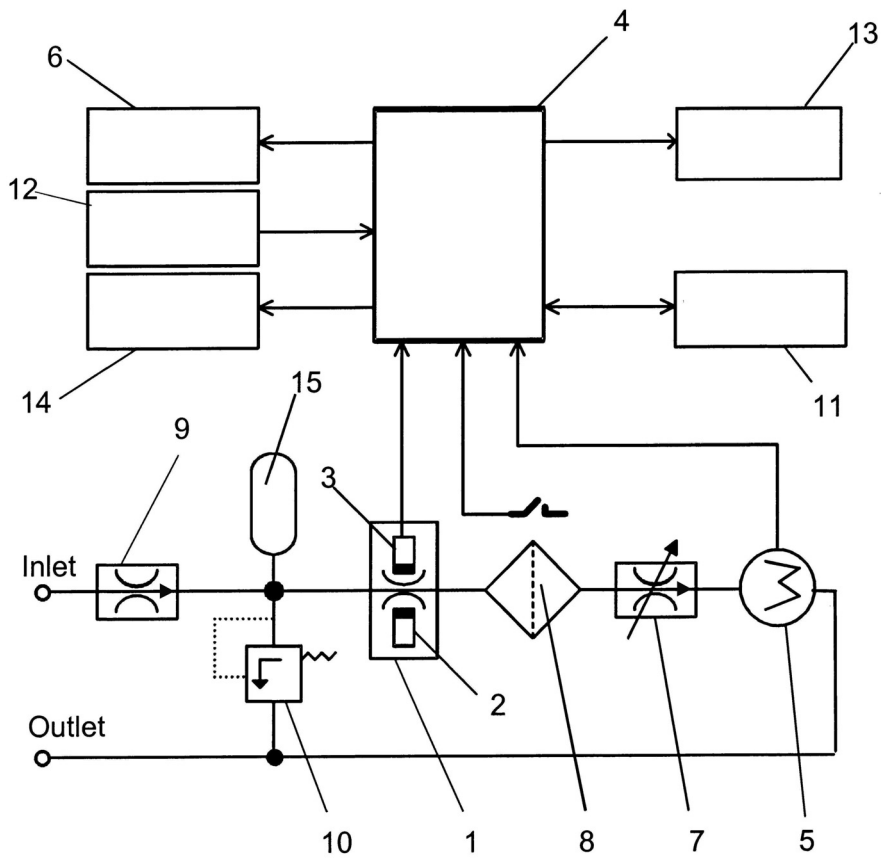
- ▶ The FCU may only be used with mineral oils or mineral oil-based raffinates.

Hydraulic diagram



Item	Designation
1	Optical sensor
5	Flow rate sensor
7	Flow rate control valve (adjustable)
8	Filter
9	Flow control valve
10	Pressure control valve
15	Pressure accumulator
20	Pump
21	Change-over valve
22	Shut-off valve

FCU Function Description



Item	Designation
1	Optical sensor
2	Infrared LED
3	Photodetector
4	Evaluation electronics
5	Flow rate sensor
6	Display
7	Flow rate control valve (adjustable)
8	Filter
9	Flow control valve
10	Pressure control valve
11	Serial interface
12	Keyboard
13	Relay
14	Printer
15	Pressure accumulator

A continuous flow of oil runs through an optical sensor (1) comprised of an infrared LED (2) and a photo receiver (3). The contamination particles present in the flow of oil cause pulse-like darkenings of the light beam, which are both classified as measurement signals in accordance with particle size and counted by an evaluation electronics system (4).

The measurement of the flow rate, which is necessary for specifying the contamination class, is carried out by a built-in flow rate sensor (5), the signals from which are also channeled to the electronic evaluation system (4).

Ultimately, the evaluation electronics (4) calculate on a continuous basis the particle counts and the SAE / NAS or ISO contamination classes for the reference volume of 100 ml, based on the measurement signals from the optical sensor and the flow rate sensor.

Here the measured values (up to 3000) are also stored on a continuous basis as they arise, together with date and time, in a manner that is safe from network outages. A battery-buffered real-time clock is available for this purpose.

A flow control valve (7) is available for adjusting the pressure fluctuation-independent flow of oil.

A hydraulic filter (8) with electrical contamination indicator is positioned upstream from this for the purpose of protecting against failure due to contamination.

The permanently adjusted valves (9) and (10) and the diaphragm memory (15) enable the connection to extraction points for the pressure range of 1 ... 350 bar at the "Inlet" access point.

The FCU can be operated via keyboard (12). Characteristic values for the measurement can be modified and various kinds of presentation can be selected in the LCD display (6).

If not set otherwise, the following information is continuously displayed during the measurement (see also in this connection the chapter "The Display of the FCU"):

- selected measurement mode
- Progress of the ongoing measurement
- Current value of the measurement results for 2 of the 4 particle size channels
- Tendency: increasing or decreasing ↓
- Current flow value
- only in the event of fault -> Error messages

Furthermore, the FCU also possesses 3 built-in relays with the following functions:

Relays 1 and 2 are limit value switches (change-over contacts) and also serve to control a filtration unit.

Relay 3 outputs the operational readiness signal (DEVICE READY) (closing device; closed when FCU is ready for operation)

The evaluation electronics in the FCU continuously monitors for this purpose the following:

- the particle sensor
- the filter clogging indicator
- the flow rate sensor
- the power supply voltage
- the internal evaluation electronics

The contact from Relay 3 is always closed during normal operation. Relay 3 opens the contact when a malfunction is recognized.

A corresponding fault message appears automatically in the display in the event of a malfunction, and the storing of data is interrupted. (see also in this connection the chapter Error Messages / Troubleshooting)

As soon as the error has been rectified, the evaluation electronics recognizes this fact, resets the fault message fully automatically and closes the Relay 3 contacts. Both the measuring operations and the storing of data are resumed.

This ensures that measurement operations can restart without requiring the intervention of operating personnel after malfunctions such as voltage loss, flow errors caused by drops in pressure, etc. have been eliminated in permanent online operation.

All of the measured and stored measured values can be read out via the serial interface (11), e.g. by means of a PC. (Software and cable are included with the unit as supplied.)

The built-in printer (14) documents the measurements in the form of tables or graphs.

Electrical connection of the FCU

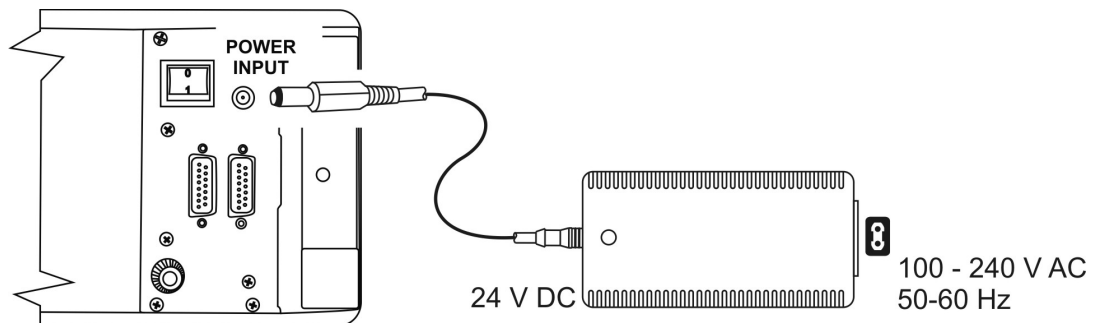
The FCU is equipped with a battery. This allows network-independent measurement (with online printout) from ~ 5 hours and measurements with internal pump: viscosity-dependent from ~ 2 hours.

The battery is automatically recharged when the power adapter is plugged in, regardless of whether the FCU is switched on or off at the switch or not.

Connecting the "POWER INPUT"

Insert the hollow plug on the supplied power adapter into the rear bush "POWER INPUT". Switch on the FCU on or off at the On/Off switch on the rear side.

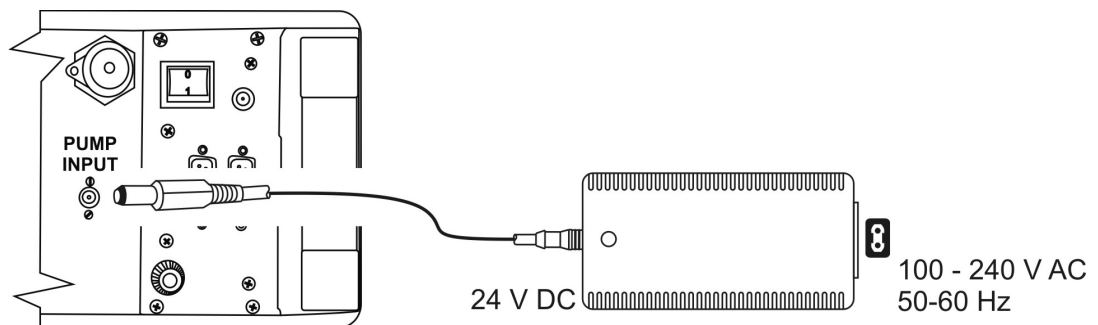
This connection is used for supplying the FCU electronics and battery charging circuit with power.



Connecting the "POWER INPUT PUMP"**NOTICE****Overloading the internal pumps**

The FCU will be destroyed

- ▶ Operate the FCU only using the original power adapter.
The integrated overload protection protects the FCU pump.



Insert the hollow plug on the supplied power adapter into the rear bushing "PUMP INPUT".

In the SETUP menu, check whether the item Pump supply is set to "external". You can find details on page 67.

If the parameter is set to "internal", the pump is only supplied with power via the battery if the power adapter is also connected.

Connecting the "PC" interface

You can communicate with a PC via this interface. This interface is designed in the standard version as RS232 and optionally as RS485.



Serial RS 232 Interface (Standard)

Pin	Signal function	
1	-	screen
2	TXD	Transmission line
4	RXD	Receiving line
8	GND	Ground

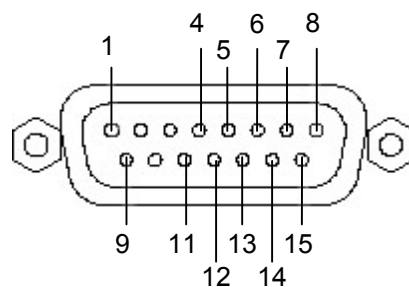
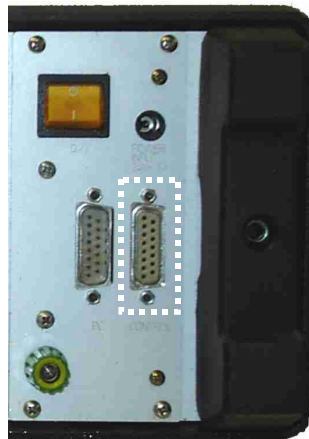
A corresponding cable for connecting the FCU to a PC is included in the scope of delivery.

Serial RS 485 Interface (OPTIONAL)

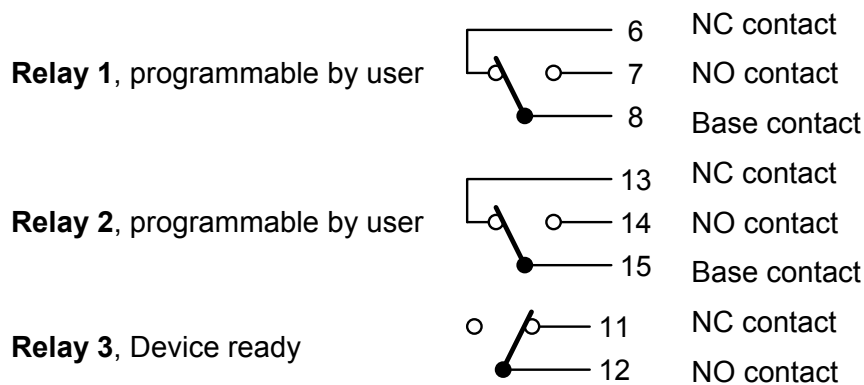
Pin	Signal function	
1	-	screen
2	T- (TA)	Transmission data
4	R- (RA)	Received data
8	GND	Ground
9	T+ (TB)	Transmission data
11	R+ (RB)	Received data
15	+5 V	Supply, bus termination

The pin assignment corresponds to DIN 66348 (DIN measurement bus)

"Control" – Connecting the control port



Contact assignment (switched position when the FCU is ready for operation)



2A is the maximum load for the relay contacts. Maximum switching voltage: 24 V DC / 50 V AC, maximum switching power: 30 W / 50 VA.

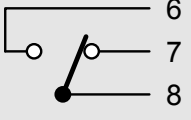
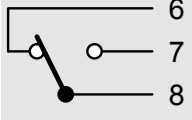
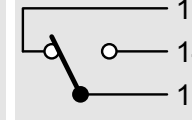
Pin 1 : 24 V operating voltage (in battery operation 12 V), maximum load capacity 200 mA

Pin 4 Ground (GND)

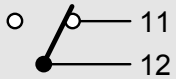
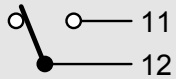
Pin 5 : Battery switch-off
When pin 5 is connected to pin 4, the FCU is not supplied by integrated batteries. This enables the FCU to be remote-controlled-switched on and off via an external power supply. The battery will however still be charged, if a power adapter is connected.

Relay Functions

The following tables show the switched position of the relays in the various operating modes in keeping with the operating condition or measurement result.

	Relay 1		Relay 2	
				
M1				
	Measurement currently in progress	Measurement stopped	After the first measured value is available: Flow error	Flow rate within set range
M2				
Exceed	Measured value \geq upper limit	After switch-on or start of a measurement. <u>Goes out again</u> when measured value \leq lower limit	Measured value \geq upper limit	After switch-on or start of a measurement. <u>Goes out again</u> when measured value \leq lower limit
Fall below	\leq lower limit	After switch-on or start of a measurement. <u>Goes out again</u> when measured value \geq upper limit	\leq lower limit	After switch-on or start of a measurement. <u>Goes out again</u> when measured value \geq upper limit
Within range	Lower limit \leq measured value \leq upper limit	After switching the unit on or starting a measurement <u>or</u> Measured value $<$ lower limit <u>or</u> Measured value $>$ upper limit	Lower limit \leq measured value \leq upper limit	After switching the unit on or starting a measurement <u>or</u> Measured value $<$ lower limit <u>or</u> Measured value $>$ upper limit
Outside range	Measured value \leq lower limit <u>or</u>	After switching the unit on or	Measured value \leq lower limit <u>or</u>	After switching the unit on or starting a



	Relay 1		Relay 2	
	measured value \geq upper limit	starting a measurement <u>or</u> lower limit < measured value < upper limit	measured value \geq upper limit	measurement <u>or</u> lower limit < measured value < upper limit
No function		Always off		Always off
M3				
	Measurement is currently in progress and one or more of the last 5 measured values > limit	5 consecutive measured values \leq limit <u>or</u> measurement stopped	After the first measured value is available: Flow error	Flow rate within set range
M4				
Start or result of check measurement after test cycle time \geq upper limit	Measurement is currently in progress and the measured values > limit	5 consecutive measured values \leq limit <u>or</u> measurement stopped	After the first measured value is available: Flow error	Flow rate within set range
When test cycle time elapsed, for the duration of a check measurement	Test cycle time has elapsed - check measurement is running.	Goes out again when measured value < upper limit. Test cycle time is restarted		
M5				
	Measurement currently in progress	Measurement stopped	After the first measured value is available: Flow error	Flow rate within set range
M6				
	Measurement currently in progress	Measurement stopped	After the first measured value is available: Flow error	Flow rate within set range

	Relay 3	
		
All operating modes		
	FCU ready for operation	FCU not ready for operation

Programmable limit values FCU 2210-5

	Min.	Max.
M2: Switching limits		
A channel SAE 4 $\mu\text{m}_{(c)}$	2	15
B channel SAE 6 $\mu\text{m}_{(c)}$	2	15
C channel SAE 14 $\mu\text{m}_{(c)}$	4	15
D channel SAE 21 $\mu\text{m}_{(c)}$	6	15
4 $\mu\text{m}_{(c)}$ channel ISO	12	25
6 $\mu\text{m}_{(c)}$ channel ISO	10	23
14 $\mu\text{m}_{(c)}$ channel ISO	9	21
Flow rate	0	150
M3: Filtration limit		
ISO	12 / 10 / 9	25 / 23 / 21
SAE	2 / 2 / 4	15 / 15 / 15
M4: Filtration limits		
ISO	12 / 10 / 9	25 / 23 / 21
SAE	2 / 2 / 4	15 / 15 / 15
M4: Test cycle time	0	1440
M5: Number of measurements	1	100
M6: Start delay	0	255
M6: Number of measurements	1	100

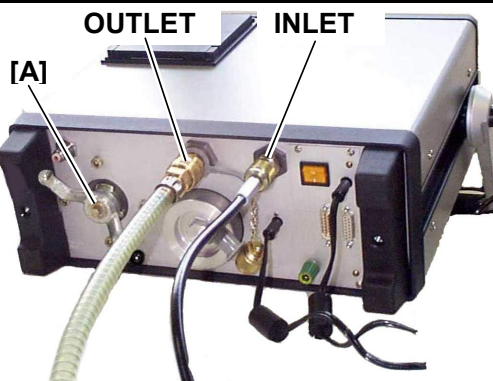
Hydraulic connection of the FCU

	 WARNING
	<p>Hydraulic systems are pressurized</p> <p>Danger of bodily injury</p> <p>▶ Depressurize the system before performing any work on it.</p>

Conducting Measurements via the High-Pressure Port (INLET)**NOTICE****If the OUTLET connection is closed or blocked**

The FCU will be damaged.

- ▶ Never seal the OUTLET connection.
- ▶ Put the free end of the OUTLET return hose into an unpressurized container.

**FCU 2210-5**

To connect the FCU, proceed as follows::

1. Plug the return-line hose into the OUTLET connector and route it into a suitable container, e.g. hydraulic tank.
2. Set the change-over valve [A] to the setting INLET.
3. Set the flow rate control valve to a value of 5.
4. Check the system pressure. Ensure that this does not exceed a pressure of 350 bar.
5. Connect the high pressure hose to the INLET connection.
6. Now connect the other end of the high pressure hose to the system.



Oil can start to flow through the FCU as soon as the system has been connected to the pressure fitting and a measurement has been started. Observe the autostart function.

Conducting measurements via the integrated pump (SUCTION INLET)**NOTICE****Change-over INLET / SUCTION INLET after a high pressure measurement**

The pump will be damaged.

- ▶ Wait at least 5 minutes after a high pressure measurement before changing over the suction port connection.
The pressure in the installed pulsation damper must first be reduced via the OUTLET connection.



To connect the FCU, proceed as follows::

1. Plug the return-line hose into the OUTLET connector and route it into a suitable container, e.g. hydraulic tank.
2. Set the change-over valve to the setting SUCTION.
3. Open the flow rate control valve completely.
4. Attach the suction hose to the SUCTION INLET connection.
5. Put the other end of the suction hose into the fluid to be measured.

Switching on the FCU

Switching on the FCU

When the FCU is switched on, various things are shown in the display, i.e. model no., firmware version, available memory, battery charge status, bus address and, possibly, error messages (cf. Error Messages / Troubleshooting chapter).

Example:

1. HYDAC FILTER SYSTEMS
FCU 2210 V3.22

2. Memory: 25.4% 61
Battery: 13.49 V 80%

3. Bus address: 1
Battery: 13.49 V 80%

4. Viscosity range:
1 ... 10 mm²/s

5. Measure -> OK/START
Abort -> STOP

The FCU is ready for operation.

Selecting the Viscosity Range

During startup, the viscosity range currently set is shown in the display. Before the first measurement, check the viscosity of the fluid to be measured and correct the settings if required. You can find details on change-over of the viscosity range on page 69.

The FCU provides two viscosity ranges for selection:

1 ... 10 mm²/s

5 ... 1000 mm²/s

Starting up the FCU

Conducting Measurements via the High-Pressure Port (INLET)

On the FCU2210-5, a magnetic valve at the INLET prevents oil from flowing through the FCU as soon as a pressure line is connected.

Pressing the START button releases the flow of oil through the device and starts the measurement.

If you press the "STOP" button, the measurement stops and the solenoid valve closes.

Set the flow rate to approx. 100 ml/min. using the flow control valve on the front.

If an error message appears in the display, turn the flow control valve in the required direction until the error message disappears and measurement operation starts automatically.

Conducting measurements via the integrated pump SUCTION INLET

NOTICE

Overloading the internal pumps

The FCU will be destroyed

- ▶ Operate the FCU only using the original power adapter.
The integrated overload protection protects the FCU pump.

Turn the flow control valve knob on the front side of the FCU all the way clockwise.

The installed FCU pump can be supplied with power "internally" via the integrated battery or "externally" via the power adapter.

Check the setting for "internal" or "external" in the Pump supply menu. For details on change-over, see page 67.

The factory setting of the FCU is "internal".

One battery charge is sufficient for conducting measurements using the pump for ~ 2 hours.



In order to make use of the full viscosity range, you must connect both power adapters. You can find the permitted viscosity ranges when operating with an internal pump on page 94.



The power consumption of the pump is dependent on the viscosity of the fluid to be conveyed. Starting with a viscosity of $> 150 \text{ mm}^2/\text{s}$ and upwards, the power consumption is so great that the overload protection feature of the power adapter connected may respond after a certain amount of time and the power supply will be shut off.

This prevents the pump motor from overheating. The ongoing measurement will be interrupted with a flow error. The power supply will then switch the power supply back on automatically after it has cooled

down.

Actuate the "START" key to start the measurement. The flow rate is automatically set to ~ 100 ml/min insofar as the viscosity of the medium permits this.

Operating the FCU

The various operating menus of the FCU are described below. The following conventions are used:

- **Fixed display texts** are highlighted in **light gray** (printed version) or **yellow** (PDF file).
- **Variable display texts** (user entries) are highlighted in **bold** (printed version) or **magenta** (PDF file)
- **Comments** are shown in *italics*.

Function of the Keys

Control buttons (gray)



Confirm entries / Start measurement



Cancel entries / Stop measurement



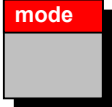
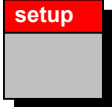

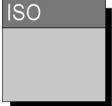
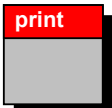


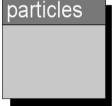











Scroll through menus (when the "□" menu symbol is displayed)











Scroll through Selection. Raise/lower numbers and letters (in Input mode)



Menu and Number Keys (red)

	Select measurement operation (with/without relay actuation)		Basic settings (Autostart, date, time, etc.)
	Editing measured value memory (name of the measuring point, measurement intervals, deleting, etc.)		Display ISO code (This key responds only when a measurement is being carried out)
	Print out (Online, measured value memory, etc.)		Display SAE or NAS Code (This key responds only when a measurement is being carried out)
	Set limits for controlling filtration units (via relays 1 and 2)		Display particle counts (This key responds only when a measurement is being carried out)
  	Direct input of multi-digit numerals		Display – Lighting 1x - goes out again after ~ 20 s. 2x – stays switched on (press 1x to switch off)
  			
  			
		(Only in input mode)	

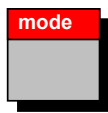












Key Combinations

	+		Insert space in measuring position designation. Press the keys simultaneously.
	+		Deleting space in measuring position designation Press the keys simultaneously.
	+		Switch to the PowerUp menu. Press the keys simultaneously. This is possible only if no measurement had been started beforehand.
	+		Activate / deactivate keypad lock. Press the keys simultaneously.


FCU menus

MODE - select operating mode

In the Menu mode, select the operating mode in which the measurement is to be carried out. When the FCU is switched on, the operating mode last used last is preset.

	MODE M1: Measure	
	MODE M2: Measure + Switch	
	MODE M3: Filter to	
	MODE M4: Filter from to	
	MODE M5: Measure + Autostop	
	MODE M6: Autostop pump	
	Confirm entries and start measurement.	

When autostart is activated, confirmation occurs automatically immediately after switching on the FCU.

	Accept the setting and exit the MODE menu.
---	--

MODE "M1: Measure"

Mode M1 "Measurement" is used for measuring oil cleanliness without using the control functions.

Typical applications: Short-time measurement of system cleanliness

MODE "M2: Measuring and switching"

Mode M2 "Measure + switch" can be used for measuring the cleanliness of the oil in the hydraulic system, at the same time offering the possibility of controlling limit relays for signaling purposes. This means that this menu enables the user to have external devices switched by two relays. An example of this would be an alarm indicator lamp on a control panel.

Possible reference values for triggering these switching sequences:

- The flow (volumetric flow rate)
- Cleanliness rating of the hydraulic fluid (indicated according to NAS or SAE or ISO)

Typical applications: Signal switching to a control panel at fully automated test benches.

MODE "M3: Filter to" (performance of automatic filtration)

Mode M3 "Filter to" enables the FCU to assume control of an external filtration unit (e.g. OF5C). In so doing, the external filtration unit is controlled in such a way that it is switched off by the FCU after it has fallen below the specified limit 5 times.

Typical applications: Flushing of hydraulic systems and documentation of the oil cleanliness rating achieved by way of an online printout.

MODE "M4: Filtering from to" (performance of automatic filtration)

Mode M4 "Filter from ... to" enables the FCU to assume control of an external filtration unit (e.g. OF5C). The external filtration unit will be controlled thereby in such a way that the oil cleanliness in the tank to be monitored will **always** be within the specified limits.

If the lower limit value is reached or if it is not met, then the FCU will switch off the unit to be actuated and the test cycle time begins. After the test cycle time has elapsed, the FCU carries out a testing measurement (100 ml) and checks whether the measured values lie within the limit values. If "yes", then the test cycle time begins again; if "no", then the unit is switched on in order to filter the fluid.

If the test cycle time setting is below LIMITS 0 [min], then this function is switched off.

Typical applications: Long-term monitoring and filtration of the oil cleanliness in hydraulic systems and documentation thereof via an online printout.

Mode "M5: Measure Autostop"

Mode M5 "Measure+autostop" enables the number (1 to 100) of single measurements to be programmed via the FCU's high-pressure port, after which measurement operation is concluded automatically. When online printing is activated, the result of the last measurement is additionally outputted in the form of particle counts (absolute value).

Typical applications: Routine analysis of the cleanliness of a hydraulic system using a defined number of measurements.

Mode "M6: Autostop pump"

Mode M6 "Autostop pump" enables the number (1 to 100) of single measurements to be programmed via the FCU's SUCTION INLET, after which measurement operation is concluded automatically.

The integrated pump starts up when the OK/START button is pressed.

The first measurement begins immediately after the set start delay. (The start delay is used to air-bleed and rinse the FCU)

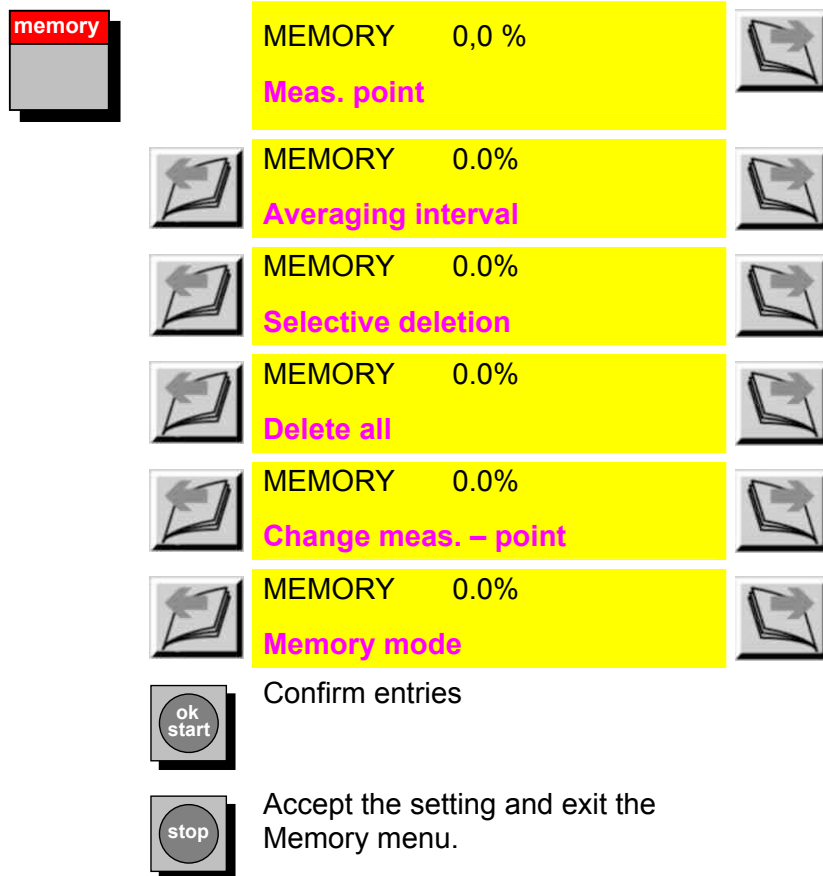
When online printing is activated, the result of the last measurement is additionally outputted in the form of particle counts (absolute value).

Typical applications: Gauging the oil cleanliness of a tank or an oil sample.

MEMORY Menu

In the MEMORY menu you can set the storage of logs.

The percentage shown in the display indicates how much of the memory has been used. 0.0% = Memory empty <-> 100 % Memory full.



Designating the measurement point

The measuring position designation is used for conveniently assigning a log to a measurement site at which a measurement is being or was performed. It is stored together with the measured results and appears on the log printouts.

The measurement site designation can be selected from among 20 customizable designations.



The FCU features a memory for entering 20 measurement point designations. This enables frequently occurring designations to be permanently configured and called up as needed.

The following characters can be selected:

1	2	3	4	5	6	7	8	9	0						
	.	:	!	"	\$	%	&	/	()	,	=	?	'	
a	b	c	d	e	F	g	h	i	j	k	l	m	n	o	p
q	r	s	t	u	v	w	x	y	z						
ä	é	è	ê	ö	ü	ß									
a	b	C	D	E	F	G	H	I	J	K	L	M	N	O	P

Q	R	S	T	U	V	W	X	Y	Z
---	---	---	---	---	---	---	---	---	---

Insert character:

Press the  +  keys simultaneously and a space will be inserted in front of the character just marked.

Delete character:

Press the  +  keys simultaneously and the character just marked will be deleted from the measuring point designation.

Setting the averaging interval

Entering an averaging interval enables the data quantity which accumulates during a measurement to be reduced.

An averaging interval of > 0 min causes only the mean value of all measurements completed within this interval to be saved and printed out.

The 0 min setting causes the averaging function to be deactivated. Each measured value is immediately saved and printed out.

The values 0 ... 1440 minutes are possible for the averaging interval.

The current, non-averaged measured value is always shown in the FCU display.

memory

MEMORY 0,0 %

Averaging interval

Averaging interval:

x [min]

or

Averaging interval:

x [min]

7 8 9

4 5 6

1 2 3

0

ok start Confirm entries.

stop Abort and exit without saving.

Selective deletion

This menu item enables individual or several logs to be deleted. Various criteria are available for selecting the logs to be deleted.

memory

MEMORY 0.0%
Selective deletion

ok start

↑

Log selection:
Log selection

↓

↑

Log selection:
Date

↓

↑

Log selection:
Meas. point

↓

↑

Log selection:
Date + Measuring point

↓

ok start

Press this key to confirm the operating mode selected and to initiate measurement.

stop

Abort and exit without saving.

Log selection:
Log selection

ok start

↔

Log number:
from: xxx to: yyy

↔

xxx / yyy — The default value is the last log number.

↑

Log number:
from: xxx to: yyy

↓

Change values

or

7	8	9
4	5	6
1	2	3
0		

Log number:
from: xxx to: yyy

ok start

Are you sure?
OK = YES STOP = NO


ok start


YES – The selected logs are deleted.


stop

No – Abort and exit


Log selection:
Date




 **Date of log:**
dd.mm.yyyy


 dd.mm.yyyy specified value is the date of the last log.

Date of log:
dd.mm.yyyy





Are you sure?
OK = YES STOP = NO


 **YES - The selected logs of dd.mm.yyyy are deleted.**

 **Abort and exit without saving.**


Log selection:
Meas. point




 **Measuring point:**
Designation X


 Designation X specified value is the measuring point of the last log.


Measuring point:
Designation X






Are you sure?
OK = YES STOP = NO



 **YES – The selected logs of designation X are deleted.**


 **Abort and exit without saving.**

Log selection:
Date + Measuring point 


 **Date of log:**
dd.mm.yyyy  dd.mm.yyyy specified value is the date of the last log.


Date of log:
dd.mm.yyyy 

 **Measuring point:**
Designation X  Designation X specified value is the measuring point of the last log.

Measuring point:
Designation X 



Are you sure?
OK = YES STOP = NO

 YES – The selected logs of the date dd.mm.yyyy and the measuring point are deleted.

 Abort and exit without saving.


Delete all


This menu item enables the entire log memory to be deleted

 **MEMORY 0.0%** 

Delete all













Are you sure?
OK = YES STOP = NO

 YES - All logs are deleted.

 Abort and exit.

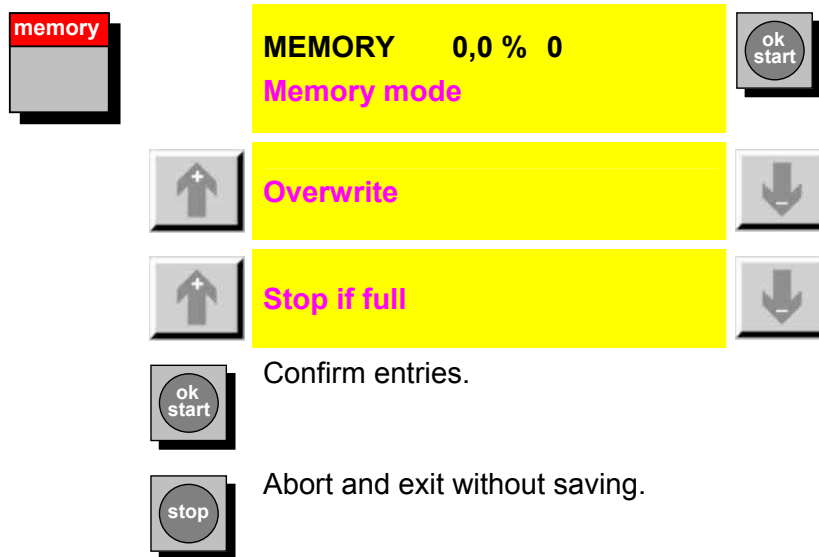
Change meas. – point

This menu item enables the designation of a measuring point to be changed.

	MEMORY 0,0 % 0 Change meas. point	
	Xxx dd.mm.yyyy hh:mm Designation X	
	Xxx dd.mm.yyyy hh:mm Designation X	
	Change measurement point: Designation X	
or 	Change measurement point: Designation X	
	Confirm entries.	
	Abort and exit without saving.	

Setting the memory mode

This menu item determines how the FCU behaves when its log memory is full.



Overwrite

Once 100 logs or 3000 measured values have been stored, the next log overwrites the oldest one in the memory.

If the memory is 100% full, the oldest log in the memory is deleted. This can continue to be repeated during an ongoing measurement until only one (i.e. the current) log is in memory. Then the oldest log line is deleted.

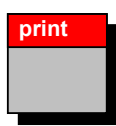













Stop if full

Once 100 logs or 3000 measured values have been stored, you can start no further measurements. Delete one or more logs in order to carry out further measurements.

A current measurement is stopped when the memory is 100% full.

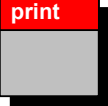






















PRINT menu

The PRINT menu enables printouts to be initiated of stored logs, ongoing measurements, the table of contents and the parameter list.


	PRINT Logs	
	PRINT PRINT Contents	
	PRINT PRINT All parameters	
	PRINT Paper feed	
	PRINT Online printout	
	PRINT Print out, cancel	
	Press this key to confirm the operating mode selected and to initiate measurement.	
	Abort and exit.	


Logs

Stored logs can be outputted via the built-in printer. Various criteria are available for selecting the logs to be printed.

	PRINT Logs	
	Log selection: Log selection	
	Log selection: Date	
	Log selection: Meas. point	
	Log selection: Date + Measuring point	
	Confirm entries	
	Abort and exit.	
	Log selection: Log selection	
	Log number: from: xxx to: yyy	
	Press this key to confirm the operating mode selected and to initiate measurement.	
	Printout format: List	
	Printout format: Graph	
	Press this key to confirm the operating mode selected and to initiate measurement.	
	Printout of: ISO	


 **Printout of:**
NAS (SAE) 



 The selected logs are printed.



 Abort and exit


Log selection: 
Date

 **Date of log:**
dd.mm.yyyy 

 Press this key to confirm the operating mode selected and to initiate measurement.


 **Printout format:**
List 


 **Printout format:**
Graph 

 Press this key to confirm the operating mode selected and to initiate measurement.



 **Printout of:**
ISO 


 **Printout of:**
NAS (SAE) 

 The selected logs are printed.

 Abort and exit


Log selection: 
Meas. point

 **Measuring point:**
Designation X 

 Press this key to confirm the operating mode selected and to initiate measurement.


 **Printout format:**
List 


 **Printout format:**
Graph 

 Press this key to confirm the operating mode selected and to initiate measurement.

 **Printout of:**
ISO 


 **Printout of:**
NAS (SAE) 

 The selected logs are printed.


 Abort and exit



Log selection:
Date + Measuring point 



 **Date of log:**
dd.mm.yyyy 


 Press this key to confirm the operating mode selected and to initiate measurement.



 **Measuring point:**
Designation X 



 Press this key to confirm the operating mode selected and to initiate measurement.


 **Printout format:**
List 


 **Printout format:**
Graph 

 Press this key to confirm the operating mode selected and to initiate measurement.

 **Printout of:** **ISO** 

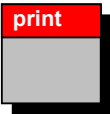
 **Printout of:** **NAS (SAE)** 


 The selected logs are printed.


 Abort and exit

PRINT Contents

A summary of the logs stored in memory is printed out. The following is output for each log: log number, measuring position designation, starting and stopping time, and number of log lines.

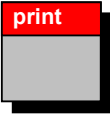
 **PRINT**
PRINT Contents


 Confirm entries and initiate printing.


 Abort and exit.

PRINT All parameters

All the current settings are outputted.

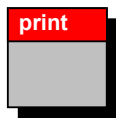


 **PRINT**
PRINT All parameters

 Confirm entries and initiate printing.

 Abort and exit.

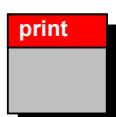
















Paper feed

The printer paper is transported ~ 1 cm.

	PRINT Paper feed
	Confirm entries and start paper feed.
	Abort and exit.

Online printout

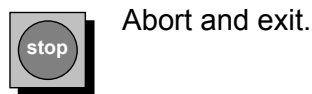
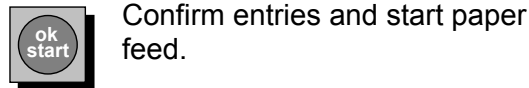
The measured values are outputted on line and on the printer.

	PRINT Online printout	
	Online printout: ON	
	Online printout: OFF	
	Press this key to confirm the operating mode selected and to initiate measurement.	
	Printout format: List	
	Printout format: Graph	
	Press this key to confirm the operating mode selected and to initiate measurement.	
	Printout of: ISO	
	Printout of: NAS (SAE)	
	Confirm entries	



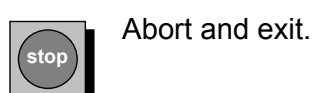
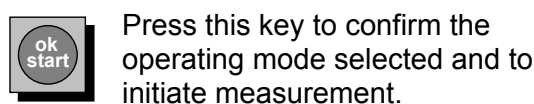
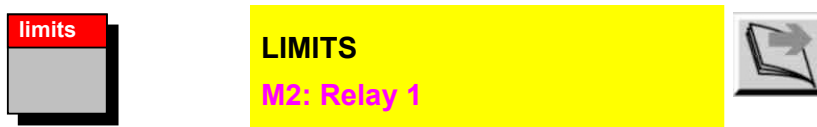
Print out, cancel

A current print operation is aborted.



LIMITS menu

The LIMITS menu enables settings (limits) to be entered for the various operating modes.



MODE M2



LIMITS
M2: Relay 1

LIMITS
M2: Relay 2

Press this key to confirm the operating mode selected and to initiate measurement.

M2:Rx Meas. channel:
xx m chan. unit

Values in accordance with limits table. See page 59

Press this key to confirm the operating mode selected and to initiate measurement.

M2:Rx Switch func.:
No function

M2:Rx Switch func.:
Within range

M2:Rx Switch func.:
Outside range

M2:Rx Switch func.:
Exceed

M2:Rx Switch func.:
Fall below

Press this key to confirm the operating mode selected and to initiate measurement.

M2:Rx Limit values:
↓xxx Unit

Jump from value to value.

M2:Rx Limit values:
↓xxx Unit

Select limit values by scrolling through them using the keys.

Press this key to confirm the operating mode selected and to initiate measurement.

 Abort and exit.

MODE M3



LIMITS

M3: Filter to



M3: Limit values:

↓(xx/yy/zz) Standard



Jump from value to value.



M3: Limit values:

↓(xx/yy/zz) Standard



Press this key to confirm the operating mode selected and to initiate measurement.



Abort and exit.

MODE M4



LIMITS

M4: Filter from to



M4: Limit values:

↓(xx/yy/zz) Standard



Jump from value to value.



M4: Limit values:

↓(xx/yy/zz) Standard



M4: Limit values:

↑(xx/yy/zz) Standard



Press this key to confirm the operating mode selected and to initiate measurement.



M4: Test cycle time:

xxx min



Standard value = 120 min



Press this key to confirm the operating mode selected and to initiate measurement.

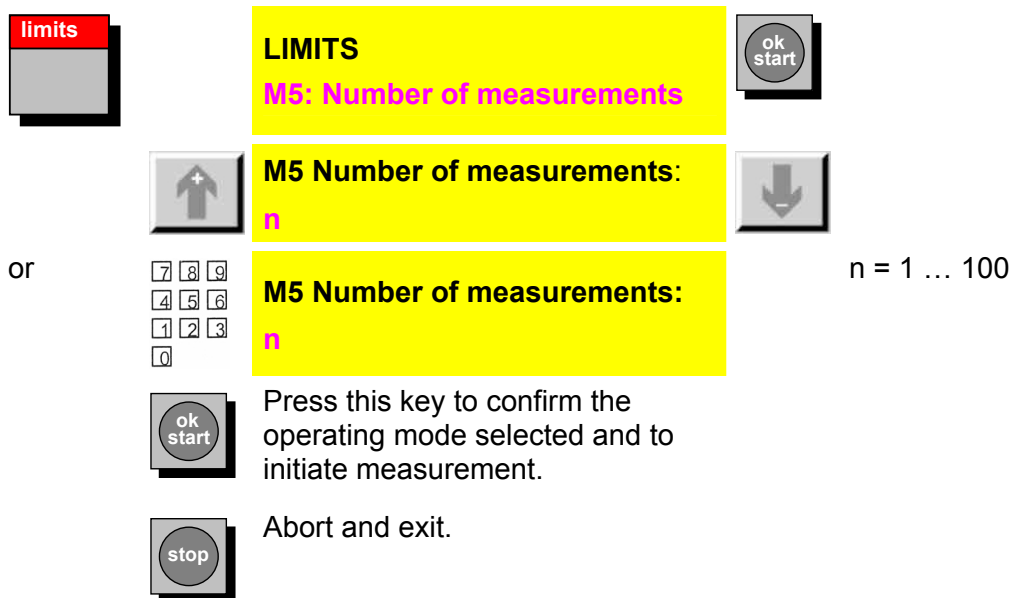


Abort and exit.










Limit values table

FCU 2210-5		
4	µm	SAE
6	µm	SAE
14	µm	SAE
21	µm	SAE
4	µm	ISO
6	µm	ISO
14	µm	ISO
Flow rate		

MODE M5

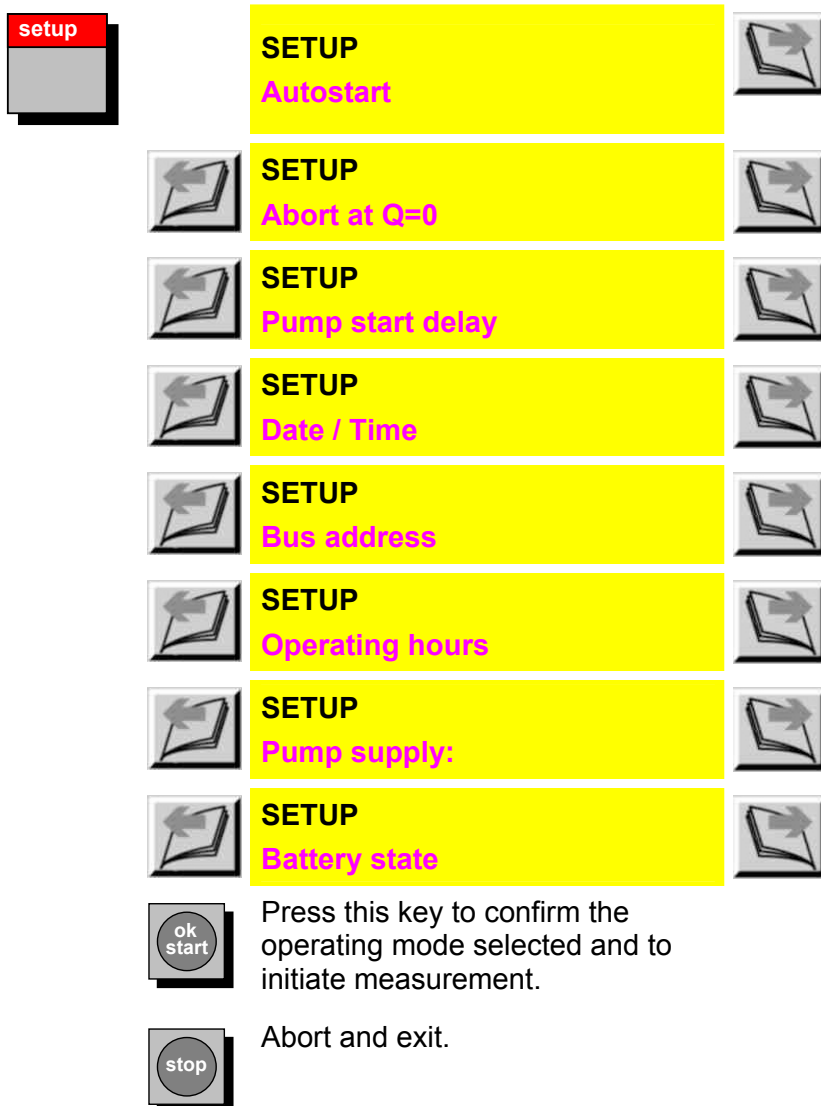


MODE M6

	<p>LIMITS</p> <p>M6: Start delay</p>													
<p>or</p>	 <p>M6 Start delay:</p> <p>t {sec}</p>	 <p>t = 5 ... 120</p>												
<p>or</p>	<table border="1" style="border-collapse: collapse; text-align: center; width: 40px;"> <tr><td>7</td><td>8</td><td>9</td></tr> <tr><td>4</td><td>5</td><td>6</td></tr> <tr><td>1</td><td>2</td><td>3</td></tr> <tr><td>0</td><td></td><td></td></tr> </table> <p>M6 Start delay:</p> <p>t</p>	7	8	9	4	5	6	1	2	3	0			<p>t = 5 ... 120</p>
7	8	9												
4	5	6												
1	2	3												
0														
	 <p>Press this key to confirm the operating mode selected and to initiate measurement.</p>													
<p>or</p>	 <p>M6 Number of measurements:</p> <p>n</p>	 <p>n = 1 ... 100</p>												
<p>or</p>	<table border="1" style="border-collapse: collapse; text-align: center; width: 40px;"> <tr><td>7</td><td>8</td><td>9</td></tr> <tr><td>4</td><td>5</td><td>6</td></tr> <tr><td>1</td><td>2</td><td>3</td></tr> <tr><td>0</td><td></td><td></td></tr> </table> <p>M6 Number of measurements:</p> <p>n</p>	7	8	9	4	5	6	1	2	3	0			<p>n = 1 ... 100</p>
7	8	9												
4	5	6												
1	2	3												
0														
	 <p>Press this key to confirm the operating mode selected and to initiate measurement.</p>													
	 <p>Abort and exit.</p>													
















SETUP menu

The SETUP menu enables settings to be entered which apply to several or all of the FCU's operating modes.



Autostart

This menu item enables a setting to be entered determining whether the FCU has to be started manually after having been switched on or whether it automatically performs a measurement in a preselected MODE.

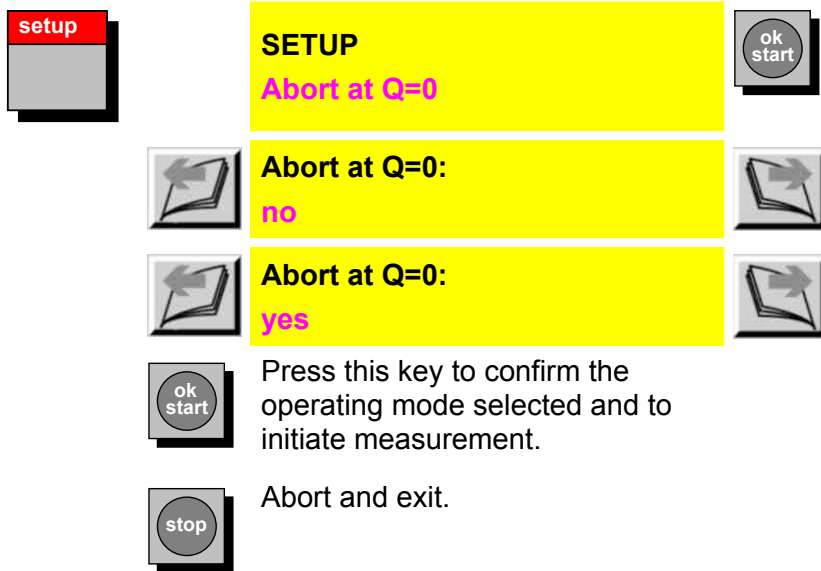
	SETUP Autostart	
	Autostart: no	
	Autostart: yes	
	Autostart function: M1: Measure	
	Autostart function: M2: Measuring and switching	
	Autostart function: M3: Filter to	
	Autostart function: M4: Filter from to	
	Press this key to confirm the operating mode selected and to initiate measurement.	
	Abort and exit.	

Abort at Q=0

This menu item enables a setting to be entered determining how the FCU acts when the current flowing through the sensor drops to a value of “0” while a measurement is in progress.

Measurement can either be interrupted or stopped altogether. An interrupted measurement automatically continues when a sufficient flow rate is present again.

This function works in all operating modes.



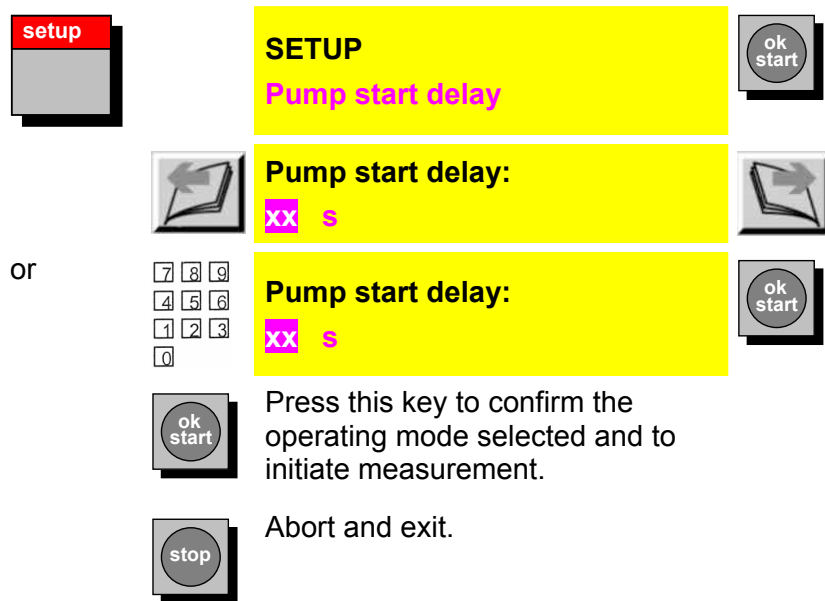
Setting the pump start delay

When conducting measurements with the aid of an external pump or an external filtration unit (e.g. OF5C), this function enables the user to operate the pump for a limited period of time within which a flow has to start at the FCU.

When the pump start delay has elapsed and the FCU does not detect any flow, measurement is stopped and the unit connected via a relay is switched off so as to prevent damage caused by dry running of the pump. This function is in effect in all operating modes except M2.

Measurement resumes as soon as enough flow is available. The stopping time ranges from 1 to 200 seconds (practical recommendation: 60 seconds).

The 0 sec. setting causes the averaging function to be deactivated. This means that the FCU waits as long as you wish for flow



Setting the date and time

The date and time are displayed and can be changed.

setup

SETUP
Date / Time

ok start

Date:
dd.mm.yyyy

Selection

Date:
dd.mm.yyyy

or

7 8 9
4 5 6
1 2 3
0

Date:
dd.mm.yyyy

ok start

Press this key to confirm the operating mode selected and to initiate measurement.

Time:
hh:mm:ss

ok start Correct the time.

stop Abort and exit.

Time:
hh:mm:ss

Selection

Time:
hh:mm:ss

or

7 8 9
4 5 6
1 2 3
0

Time:
hh:mm:ss

ok start Confirm entries.

stop Abort and exit.

Set bus address

The standard setting is 1; this setting should not be changed. If several units featuring DIN measurement bus interfaces (type code / - BUS) are connected to one bus, a bus address between 1 and 31 has to be allocated to each unit. An address may not be allocated twice.

or

7 8 9
4 5 6
1 2 3
0

ok start Press this key to confirm the operating mode selected and to initiate measurement.

stop Abort and exit.

Display operating hours

The operating hours of the unit are displayed.
The operating hours meter only records the measurement time.

ok start Press this key to confirm the operating mode selected and to initiate measurement.

stop Abort and exit.

Pump supply:

The FCU's integrated pump can be supplied either externally via one of the two power supply units supplied with the FCU or by the integrated batteries.



The external power supply unit provides for a higher voltage than the batteries, which means higher viscosities can be conveyed when it is used. For more information, see chapter "Technical Data".

The diagram shows the navigation path for the Pump supply menu. It starts with a 'setup' button leading to a 'SETUP' screen. From 'SETUP', the 'Pump supply:' option is highlighted. Pressing the up arrow leads to 'External', and pressing the down arrow leads to 'Internal'. Pressing the 'ok start' button confirms the selection and initiates measurement. Pressing the 'stop' button aborts and exits.

Check the battery status

The current battery charge is shown.



The diagram shows the navigation path for the Battery state menu. It starts with a 'setup' button leading to a 'SETUP' screen. From 'SETUP', the 'Battery state' option is highlighted. Pressing the 'ok start' button confirms the selection and initiates measurement. Pressing the 'stop' button aborts and exits.

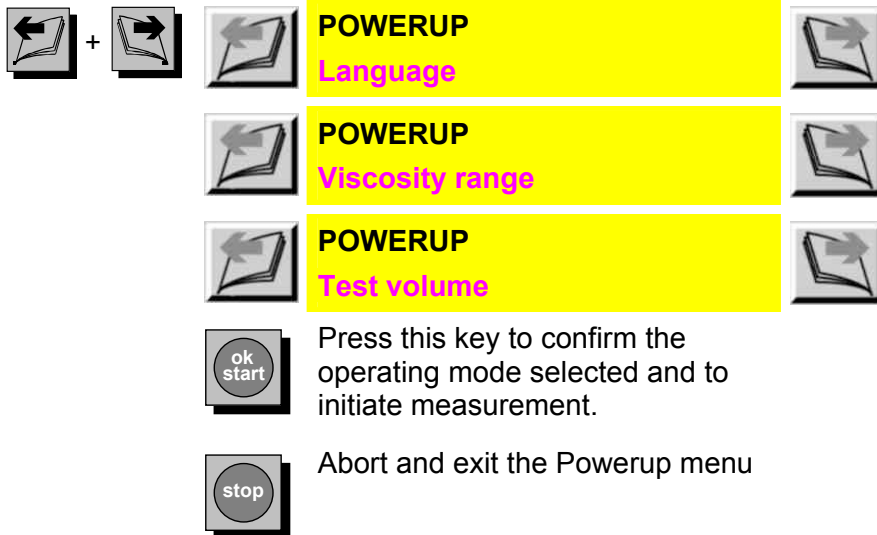
Battery voltage:
13.63 V 80%

POWERUP menu

The POWERUP menu is only available when the FCU is powered up and as long as no measurement has been started.


Settings are made here which are normally rarely changed.



The POWERUP menu is accessed by simultaneously pressing the  +  keys.







Selecting the language



This menu item enables the language for the texts shown in the display and on printouts to be selected.


Language  Applying the submenu selected.


 **Language:** **German** 
German

 **Language:** **German** 
English

 **Language:** **German** 
French

 **Language:** **German** 
Programmable


 Press this key to confirm the operating mode selected and to initiate measurement.



 Abort and exit the Powerup menu



Setting the viscosity range


The viscosity range of the fluid to be measured must be set here. Here we differentiate between low viscosity (1 ... 10 mm²/s) and high viscosity (5 ... 1000 mm²/s) mediums.


Check or correct the viscosity range before starting the measurement.

Viscosity range  Applying the submenu selected.

 **Viscosity range:** **1 ... 10 mm²/s** 






 **Viscosity range:** **5 ... 1000 mm²/s** 

 Press this key to confirm the operating mode selected and to initiate measurement.

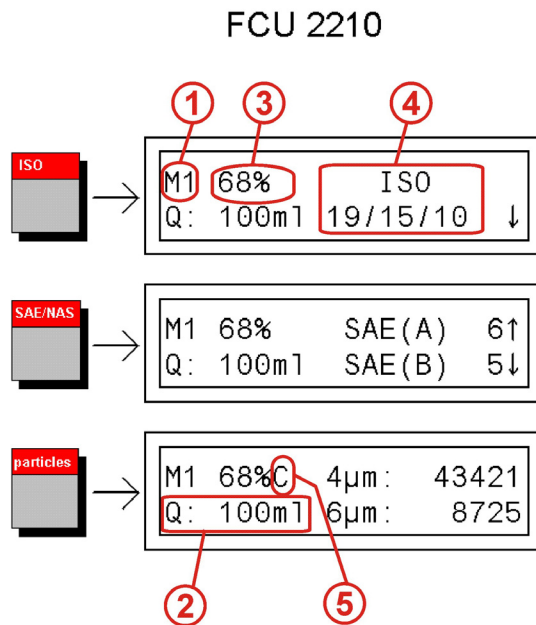
 Abort and exit.

Setting the measured volume




The volume that is analyzed for the determination of a measured value can be set here. Permitted values range from 10 ... 100.

Test volume		Applying the submenu selected.														
		Measurement volume: 100 ml		Depending on the key, the value is increased / decreased by 1 ml.												
Or	<table border="1" style="border-collapse: collapse; text-align: center;"> <tr><td>7</td><td>8</td><td>9</td></tr> <tr><td>4</td><td>5</td><td>6</td></tr> <tr><td>1</td><td>2</td><td>3</td></tr> <tr><td>0</td><td></td><td></td></tr> </table>	7	8	9	4	5	6	1	2	3	0			Measurement volume: XXX ml		Enter measurement volume via the keyboard.
7	8	9														
4	5	6														
1	2	3														
0																
		Press this key to confirm the operating mode selected and to initiate measurement.														
		Abort and exit.														

FCU Display





- ① The FCU is working in MODE M1 (measuring the cleanliness class).
- ② Display of the measured flow rate (100 ml/min is recommended).
- ③ Indicates elapsed measuring time in %. Begins at 0%; the cleanliness class is displayed again at 100%.
- ④ Specification of the currently determined contamination. You can switch back and forth between the display in ISO or SAE coding and

the display of particle counts with the keys   .

During the representation of the contamination class in SAE class, the figures / letters in brackets state the selected particle size range:


(A): >4 µm , (B): >6 µm, (C): >14 µm ,(D): >21 µm

The particle sizes displayed can be selected with the keys  and . The "tendency arrow" serves to display even very slight changes (: increasing contamination, ↓: decreasing contamination). It even indicates changes which would not otherwise be remarked upon by the specification of Contamination Class alone.

If the determined contamination lies above the specified display range (see page 94), >25 >23 or >12 / >15 are shown in all particle size ranges..

- ⑤ One can select between differential and cumulative displays of numbers of



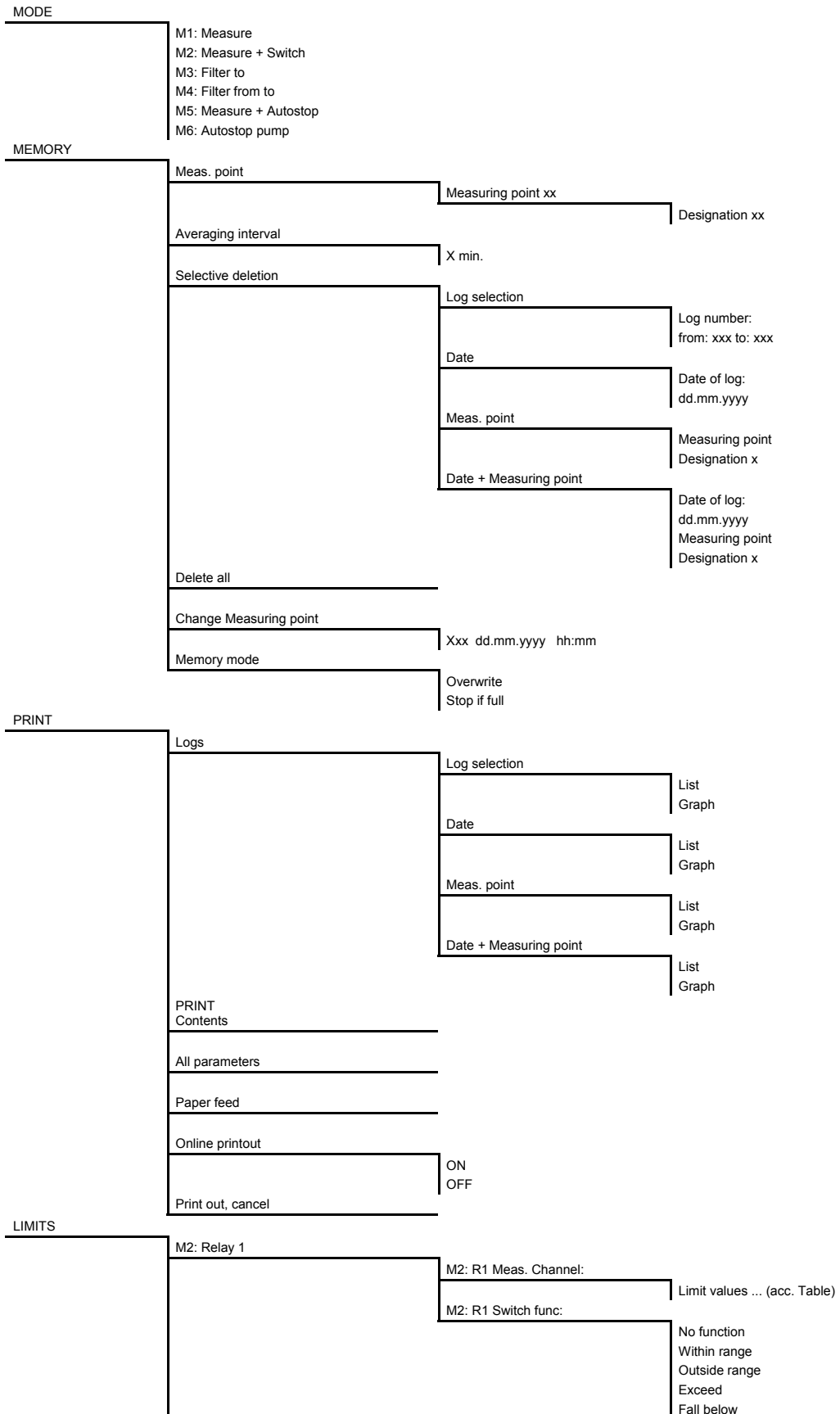
particles by using the keys . The selected presentation is indicated in the display by a "D" (differential) or "C" (cumulative) behind the display of the expired measurement time.

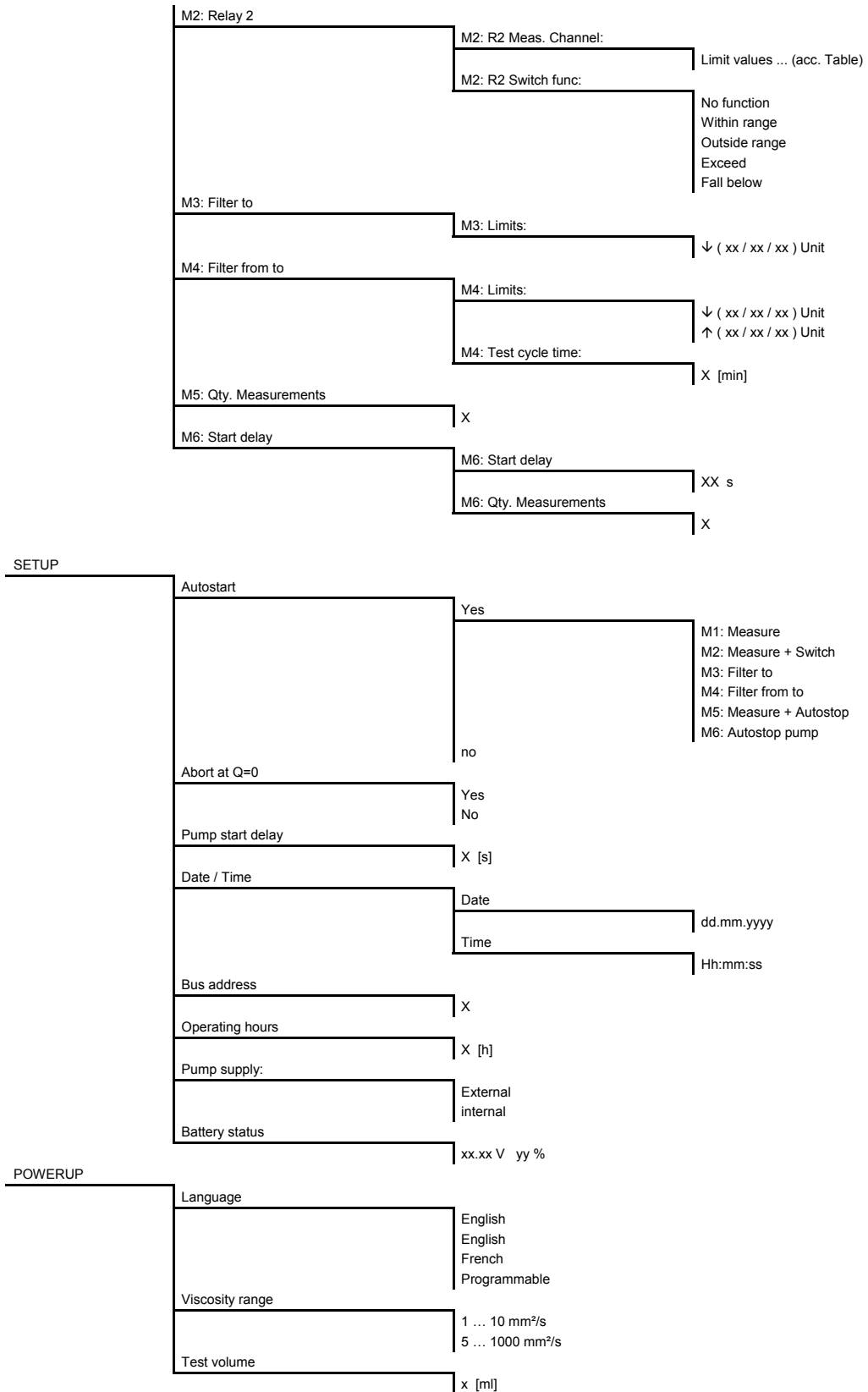
Differential representation means: particle count in the particle size ranges:
4...6 $\mu\text{m}_{(c)}$, 6...14 $\mu\text{m}_{(c)}$, 14...21 $\mu\text{m}_{(c)}$, >21 $\mu\text{m}_{(c)}$

Cumulative representation means: particle count in the particle size ranges:
>4 $\mu\text{m}_{(c)}$, >6 $\mu\text{m}_{(c)}$, >14 $\mu\text{m}_{(c)}$, >21 $\mu\text{m}_{(c)}$



If the determined particle count lies above the specified display range (see page 94), ">>>>>>" is shown in all particle size ranges as the particle count.

Brief Overview of the Menu Structure





Error Messages and Troubleshooting

Error message	Cause(s)	Remedy
Invalid parameter	You have entered a value which is outside the permitted value range (e.g. NAS 23).	Display the permitted value ranges using the keys  and  by scrolling above the maximum values. Then the minimum value is automatically displayed.
Check parameter Defective parameter: No. xx	The self-monitoring function of the FCU has detected a check sum error for one or more parameters. Cause: Strong electromagnetic interference has changed the parameters.	Rest all parameters using the keyboard or transfer the parameters with the FluMoS software.
Measurement ended Memory for measured values full	The setting for the "Memory mode" parameter is at "Stop if full". The maximum number of reports or measured values has been reached. No more values can be stored.	Delete the reports or set the "Memory mode" parameter to "Overwrite". For details see page 48.
Value not accepted	An error occurred while storing a value in EEPROM.	Repeat the entry or continue the measurement. If the fault recurs, contact HYDAC.

Error message	Cause(s)	Remedy
Number of defective logs:	<p>The self-monitoring function of the FCU has detected a check sum error for one or more stored logs. Possible causes</p> <ul style="list-style-type: none"> • Strong electromagnetic interference has changed the measured value memory. • The internal back-up battery is dead. • A measurement has been started and terminated — for example as a result of the FCU being switched off — without any measured values being stored. • A measurement previously conducted resulted only in a flow error. -> The protocol contains no values. 	<p>The defective logs are deleted automatically. After the next power up, this message is not displayed again if it was just a brief malfunction.</p> <p>If this message is displayed several times, this means that the internal back-up battery is probably dead. Send the FCU to HYDAC for repair.</p>
No logs stored!	You have tried to print logs, but the FCU memory is empty.	Carry out measurements.
Too few points	You have tried to print a graph, but the selected log has insufficient measurement values (min. 3) to produce a graph.	Print out the protocol in the form of a list.
Battery needs charging	The rechargeable batteries are dead.	Measurements are still possible. However, it is better to connect a power adapter, in particular for printing.
Use power supply	The rechargeable batteries are dead.	<p>The batteries require a charging time of ~ 11 hours.</p> <p>You can operate the FCU using a connected power supply.</p>

Error message	Cause(s)	Remedy
Flow rate error! Correct: 0 ml	<p>There is no oil flowing through the particle sensor (possibly only air).</p> <p>The flow rate sensor is faulty.</p> <p>Measurement volumes are set to 0 in the PowerUp Menu. (Starting with Firmware Version 3.20, the minimum measurement volume is min. 10 ml)</p>	<p>Turn the flow control valve control knob clockwise.</p> <p>Check the change-over valve setting.</p> <p>Check the hydraulic connections.</p> <p>Check the pressure. Fluid must flow through the return hose on the OUTLET from a pressure of >30bar/420psi. The pressure control valve must open (see circuit diagram)</p> <p>Change the measured volume to between 10 ... 100 ml)</p> <p>Send the FCU to HYDAC for repair.</p>
	<p>The batteries are exhausted as a result of measurements being carried out via the integrated pump without additional power supply unit.</p>	<p>Connect both power adapters (see page 23).</p>
Flow rate error! Correct: 15 ml	<p>The flow through the particle sensor is lower than the minimum value of 50 ml/min required to take measurements.</p>	<p>Turn the flow control valve clockwise until measurement operation starts.</p>
Flow rate error! Correct: 250 ml	<p>The flow through the particle sensor is higher than the maximum value of 150 ml/min permitted to take measurements.</p>	<p>Turn the flow control valve counterclockwise until measurement operation starts.</p>
Flow rate error!	<p>The internal filter is contaminated. Because of the inlet pressure of <2 bar, the "Filter contaminated" fault message is not issued.</p>	<p>Replace the FCU filter element.</p>
Filter contaminated	<p>The internal protection filter for the flow control valve of the FCU is exhausted.</p>	<p>Replace the FCU filter element.</p>
external inlet active (this message can only appear with the OF5C filter unit)	<p>The clogging indicator fitted in the OF5C has been activated, the OF5C filter is exhausted.</p>	<p>Replace the filter element at OF5C.</p>

Error message	Cause(s)	Remedy
Internal printer not ready	Paper roll empty	Insert a new roll of paper.
	Printer fault	Send the FCU to HYDAC for repair.
Error in selected language	The last language selected and stored in the FCU has been changed due to an internal fault.	Download the FCU languages to the FCU again using the PC software package FluMoS.
	The internal back-up battery is dead.	If the fault recurs, send the FCU to HYDAC for repair.
Reload languages	The internal memory for languages has been partially changed due to an internal fault.	Download the FCU languages to the FCU again using the PC software package FluMoS.
	The internal back-up battery is dead.	If the fault recurs, send the FCU to HYDAC for repair.
Calibration defect	The calibration values in the EEPROM have been altered due to electrical interference.	Send the FCU to HYDAC for repair.
Device ID defect	Internal device designations in the EEPROM have been altered due to electrical interference.	No measures required, as these values do not affect the FCU function. Send the FCU to HYDAC for repair.
Water/air in oil	Warning message when a sample exhibits a high water or air content.	Nothing needs to be done unless this message pops up when the fluid is clear. If this fault message also occurs when the fluid is clear, then send the FCU to HYDAC for repair if necessary.

Performing maintenance

Carry out the specified configuration, maintenance and inspection work every six months or, at the latest, when an error message or malfunction makes it necessary.

Secure all operating media against accidental start up.

Disconnect the FCU from the power supply when performing any maintenance, inspection or repair work.

Once maintenance work is complete, check that the FCU is still working properly.

Any screwed fittings which have been undone/removed are to be checked to see that they have been properly resecured.

Cleaning the FCU

Clean the control panel with a clean, moist cloth. Do not use any chemical cleaning agents, as these may damage the film attached to the surface of the FCU. Clean the outside of the FCU with a moist cloth.

Changing the FCU Filter Element

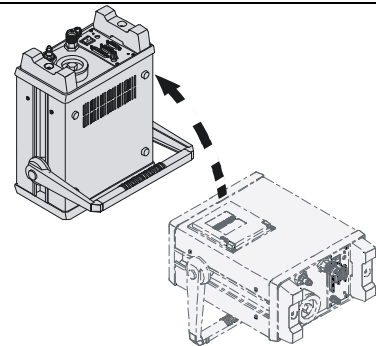
The FCU has an internal filter element with a differential pressure switch. The differential pressure switch switches at 2 bar. The message "Filter clogged" will appear on the display. Ensure that the flow rate control valve is not closed.

If the filter is contaminated, but the differential pressure of 2 bar cannot be achieved (e.g. with an inlet pressure <2 bar), then there will be no indication on the display. Only the message "Flow error" will appear in such cases.

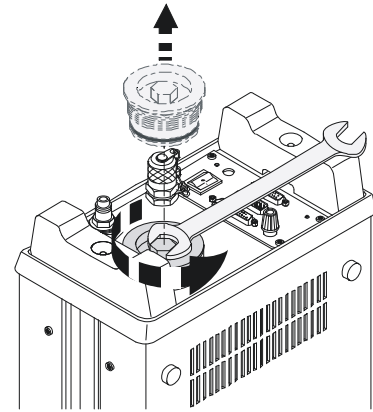
To change the filter, proceed as follows:

1. Put a suitable drip tray in place to catch the oil (~0.5 l).

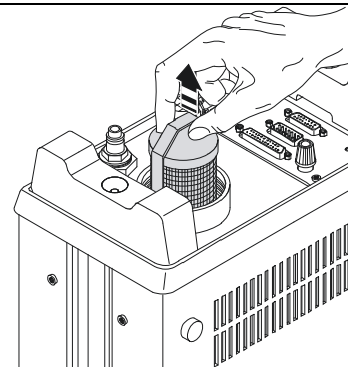
Turn the FCU so that the rear side faces upwards. Ensure that the flow rate control valve is not damaged.



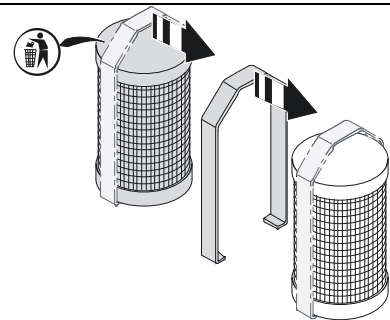
2. Unscrew the screw plug with a size 19 ring spanner by turning it counterclockwise.



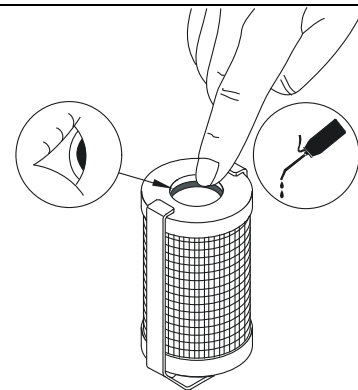
3. Pull the filter element out upwards by the strap.



4. Take the strap out of the old filter elements and push this over the new filter element.
Dispose of the old filter element correctly according to local regulations and guidelines.



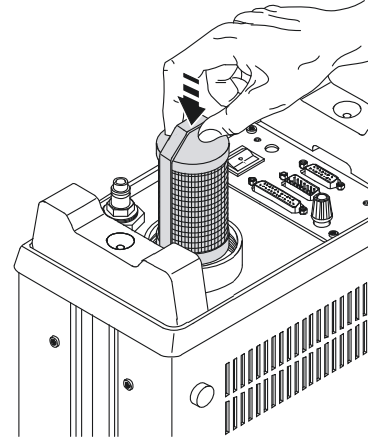
5. Moisten the O-ring on the new filter element slightly with fluid.



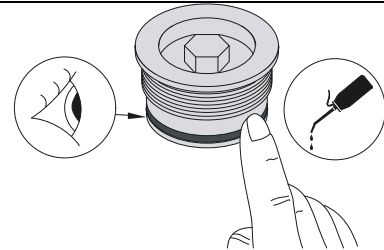
-
6. Place the new filter element with the strap into the FCU.

Press the filter element down into the filter mount.

Do not use excessive force or a hammer, etc.

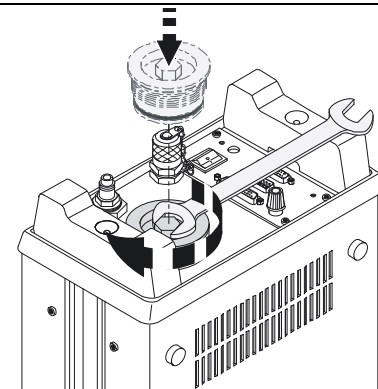


-
7. Check the screw plug O-ring for damage. Replace it if necessary.



-
8. Insert and manually screw in the screw plug clockwise.

Tighten the screw plug with a size 19 ring spanner.



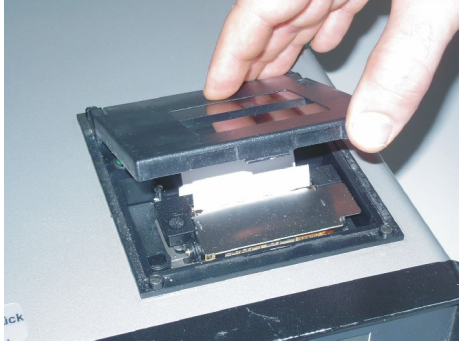

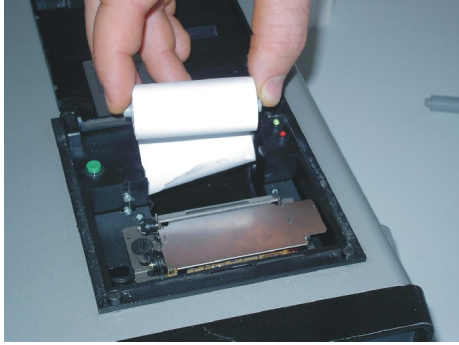
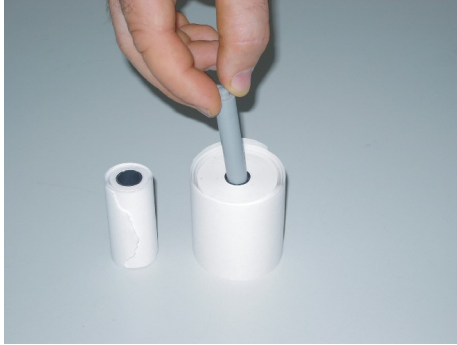
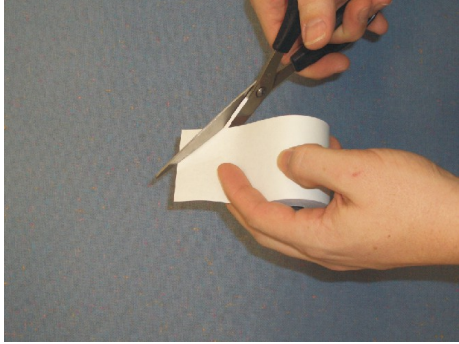
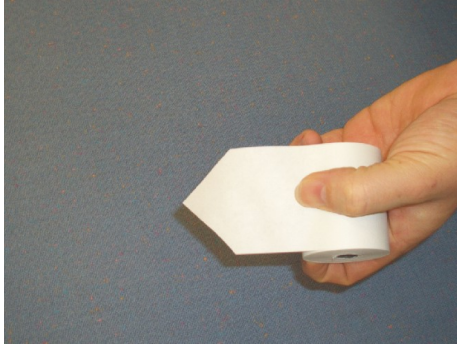

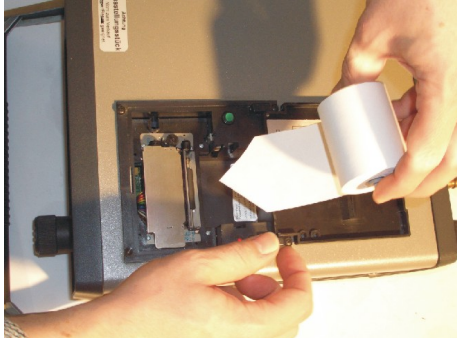
-
9. The filter element change is now complete.
-

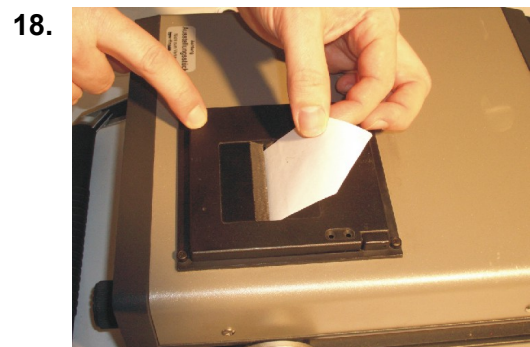
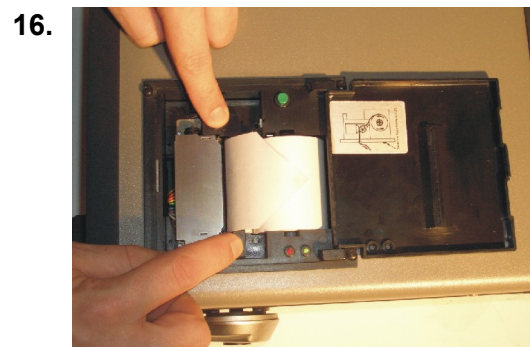
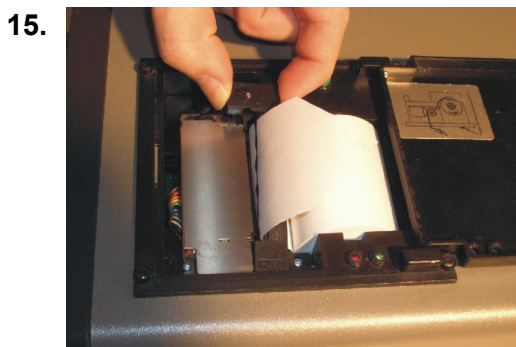
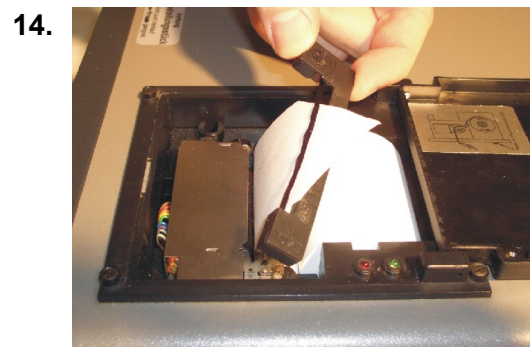
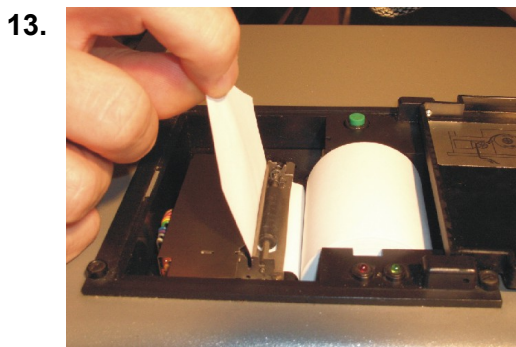
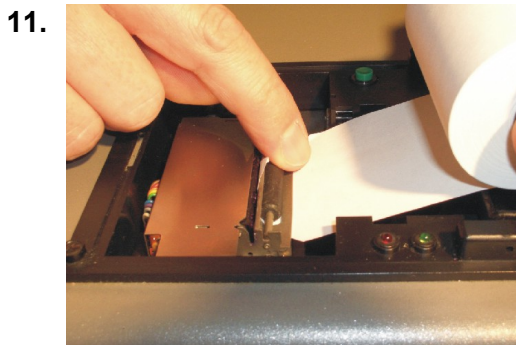
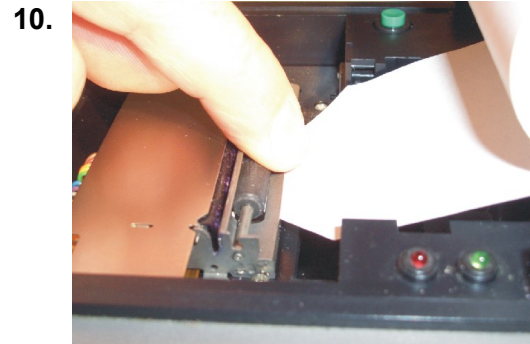
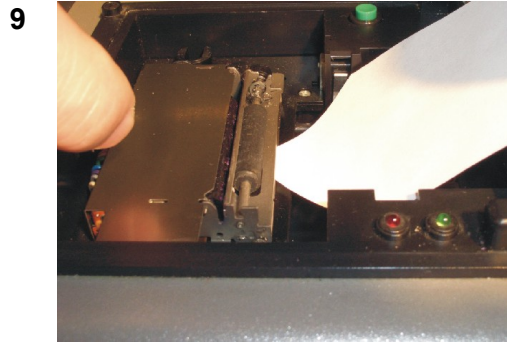
Back-flushing the FCU

If the sensor is blocked, use the flushing set available as an accessory. The part-no. can be found in the spare parts list.

A description of how to back-flush is included with the flushing set.

Internal dot-matrix impact printer – replace paper roll / ink ribbon

- 
- 
- 
- 
- 
- 
- 
- 



Disposing of the FCU

When decommissioning and/or disposing of the FCU, observe all local guidelines and regulations pertaining to occupational safety and environmental protection. This applies in particular to the oil in the unit, components covered with oil and electrical components.

After disassembling the unit and separating the various materials, reuse them or dispose of them properly in accordance with local regulations.

Storing the FCU

Rinse the FCU completely with n-heptane before putting it into storage.

Dispose of used cleaning agents and rinsing oils properly.

Storage conditions

Storage temperature:	-20 ... 85°C / -4 ... 185°F
Relative humidity:	max. 90%, noncondensing

Calibrating the FCU

We recommend that the FCU be recalibrated every 2 to 3 years. You will receive a calibration certificate at the time of each calibration.

Customer Service

Shipping address for calibration and repair:

Germany

HYDAC Service GmbH
Product Support, Werk 10
66128 Saarbrücken, Germany

Telephone: ++49 (0) 6897 509 883

Fax: ++49 (0) 6897 509 324

E-Mail: service@hydac.com

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P.O. Box 224
AUS-3025 Altona North

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Shanghai Minhang Economic &

Technological Development Zone

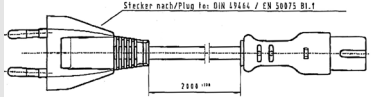
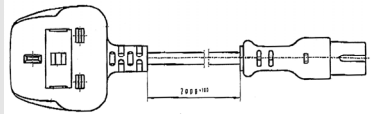
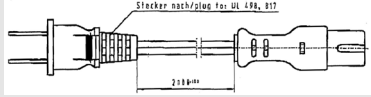
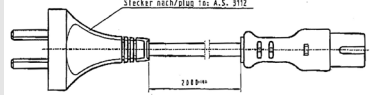
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Spare parts

Part no.	Article designation	
349154	Filter element replacement set, consisting of: 1x filter element, 1x O-ring, 1x support ring	
1260891	Filter element	
1251557	High-pressure measuring hose, DN 4, 5000 mm long	
349150	High-pressure measuring hose, DN 4, 2000 mm long	
349151	Return-line hose, DN 7, 2000 mm long	
1251558	Return-line hose, DN 7, 5000 mm long	
3036098	Suction hose with coupling, DN 6, 1000 mm long	
3068209	Suction hose with coupling, DN 6, 250 mm long	
349204	Connecting cable FCU – PC	
349155	Package of paper rolls, printer (5 rolls) Roll diameter: 50 mm Roll width: 58 mm	
349156	Ribbon cartridge for dot-matrix printer	
3090803	Power supply (without connecting cable) Primary: 90-264 V AC Secondary: 24 V DC, 2300 mA	
6008448	Connecting cable for power supply Euro plug, 2 m long	
6008447	Connecting cable for power supply Plug for UK, 2 m long	
6008446	Connecting cable for power supply Plug for USA, 2 m long	
6008449	Connecting cable for power supply Plug for AUS, 2 m long	

Accessories

Part no.	Designation	
3040814	Carrying case, including filter element replacement set for mineral oil, 2 rolls of paper, 1 ribbon cartridge for printer	
1204501	FCU back-flushing kit (mineral oil model)	
3355176	FluMoS light Software (download available free of charge at www.hydac.com)	
3371637	FluMoS Professional Software	
3053829	LabView Driver Package (Software)	
3143926	Windows Driver Package (Software)	
3028133	Reservoir Extraction Unit REU 1430-1-M (230V AC/50Hz/1Phase)	
3086166	FCU adapter kit for sample bottles with connection thread GL55 in accordance with DIN 168-1 (scope of delivery without sample bottle)	
3143465	Sample bottle 250 ml with connection thread GL 55 in accordance with DIN 168-1	
3487290	Suction strainer	

Explanation of the measuring technology terms used

Single measurement:	This refers to the analysis of the contamination of a specified sample quantity (<i>measurement volume</i>). The result of a single measurement is the <i>measured value</i> .
Measuring point	The name of the location at which the FCU is connected to the hydraulic system. This designation (max. 20 characters) can be entered in the FCU for documentation purposes. <i>Example: pump press W3</i>
Measurement volume:	Sample quantity which is analyzed for determining a <i>measured value</i> . (The measurement volume can be set by the user)
Measured value	The contamination codes determined by a single measurement, shown as a three-digit ISO code or NAS codes or SAE codes of the individual particle size channels.
Measurement:	After the "OK/START" - key is pressed, a <i>single measurement</i> begins, followed immediately upon completion by the next <i>single measurement</i> until the "STOP" - key is pressed (mode M1, M2, M4) or the target cleanliness (mode M3) is reached. This series of <i>single measurements</i> is referred to as a <i>measurement</i> for convenience reasons.
Log:	A measurement is described by a <i>log</i> . It is comprised of the <i>log header</i> and the <i>log lines</i> . The FCU saves up to 100 logs.
Log header:	The log header contains: A log number (a consecutive log number is automatically generated every time a measurement sequence is initiated). The designation of the <i>measurement point</i> (can be entered by the user), date + time of the beginning and end of the <i>measurement sequence</i> (generated automatically) <i>Averaging interval</i> Number of <i>log lines</i> <i>Measurement volume</i> Example: Memory log:6 Measuring point:25 from: 15.09.2003, 8:32 to: 15.09.2003, 10:42 Averaging interval: 10 min Number of log lines: 13 Measurement volume: 100 ml
Log line:	A <i>log line</i> consists of the time and results (4 particle channels and flow rate with NAS) (3 particle channels and flow rate with ISO and SAE) of a measurement. The FCU can store up to 3000 log lines.

Overview - ISO 4406 / SAE AS 4059 and NAS 1638 classes

ISO 4406:1999

In ISO 4406:1999, particle counts are determined cumulatively, i.e. $> 4 \mu\text{m}_{(c)}$, $>6 \mu\text{m}_{(c)}$ and $>14 \mu\text{m}_{(c)}$ (manually by filtering the fluid through an analysis membrane or automatically using particle counters) and allocated to measurement references.

The goal of allocating particle counts to references is to facilitate the assessment of fluid cleanliness ratings.

In 1999 the "old" ISO 4406:1987 was revised and the size ranges of the particle sizes undergoing analysis redefined. The counting method and calibration were also changed.

This is important for the user in his everyday work: even though the measurement references of the particles undergoing analysis have changed, the cleanliness code will change only in individual cases. When drafting the "new" ISO 4406:1999 it was ensured that not all the existing cleanliness provisions for systems had to be changed.

ISO 4406 table

Allocation of particle counts to cleanliness classes:

Class	Particle count / 100 ml		Class	Particle count / 100 ml	
	More than	Up to (and including)		More than	Up to (and including)
0	0	1	15	16,000	32,000
1	1	2	16	32,000	64,000
2	2	4	17	64,000	130,000
3	4	8	18	130,000	250,000
4	8	16	19	250,000	500,000
5	16	32	20	500,000	1,000,000
6	32	64	21	1,000,000	2,000,000
7	64	130	22	2,000,000	4,000,000
8	130	250	23	4,000,000	8,000,000
9	250	500	24	8,000,000	16,000,000
10	500	1,000	25	16,000,000	32,000,000
11	1,000	2,000	26	32,000,000	64,000,000
12	2,000	4,000	27	64,000,000	130,000,000
13	4,000	8,000	28	130,000,000	250,000,000
14	8,000	16,000			

Note: increasing the measurement reference by 1 causes the particle count to double.

Example: ISO class 18 / 15 / 11 means:

Cleanliness class	Particle count / 100 ml	Size ranges
18	130,000 – 250,000	> 4 µm (c)
15	16,000 – 32,000	> 6 µm (c)
11	1,000 – 2,000	> 14 µm (c)

Are in 100 ml of the analyzed sample.

Overview of the differences between ISO 4406:1987 and ISO 4406:1999

	"old" ISO 4406:1987	"new" ISO 4406:1999	
Size ranges	> 5 µm > 15 µm	> 4 µm (c) > 6 µm (c) > 14 µm (c)	
Dimension determined	Longest dimension of a particle	Diameter of the area-equivalent circle ISO 11171:1999	
Test dust	ACFTD dust	1-10 µm ultra fine fraction	ISO 12103-1A1
		SAE Fine, AC Fine	ISO 12103-1A2
		SAE 5-80 µm ISO MTD Calibration dust for particle counters	ISO 12103-1A3
		SAE Coarse Coarse fraction	ISO 12103-1A4
Comparable size ranges	Old ACFTD calibration	Comparable ACFTD calibration	New NIST calibration
	----- 5 µm 15 µm	< 1 µm 4.3 µm 15.5 µm	4 µm _(c) 6 µm _(c) 14 µm _(c)

SAE AS 4059

Like ISO 4406, SAE AS 4059 describes particle concentrations in liquids. The analysis methods can be applied in the same manner as ISO 4406:1999.

The SAE cleanliness classes are based on particle size, number and distribution. The particle size determined depends on the measurement process and calibration; consequently the particle sizes are labeled with letters (A-F).

The following table shows the cleanliness classes in relation to the particle concentration determined:

SAE AS 4059 table

		Maximum particle count / 100 ml					
Size ISO 4402		> 1 µm	> 5 µm	> 15 µm	> 25 µm	> 50 µm	> 100 µm
Size ISO 11171		> 4 µm _(c)	> 6 µm _(c)	> 14 µm _(c)	> 21 µm _(c)	> 38 µm _(c)	> 70 µm _(c)
Size code		a	b	C	D	E	F
Classes	000	195	76	14	3	1	0
	00	390	152	27	5	1	0
	0	780	304	54	10	2	0
	1	1,560	609	109	20	4	1
	2	3,120	1,220	217	39	7	1
	3	6,250	2,430	432	76	13	2
	4	12,500	4,860	864	152	26	4
	5	25,000	9,730	1,730	306	53	8
	6	50,000	19,500	3,460	612	106	16
	7	100,000	38,900	6,920	1,220	212	32
	8	200,000	77,900	13,900	2,450	424	64
	9	400,000	156,000	27,700	4,900	848	128
	10	800,000	311,000	55,400	9,800	1,700	256
11	1,600,000	623,000	111,000	19,600	3,390	512	
12	3,200,000	1,250,000	222,000	39,200	6,780	1,020	

Cleanliness codes according to SAE

Absolute particle count larger than a defined particle size

Example: cleanliness class to AS 4059:6

The maximum permissible particle count in the individual size ranges is bold-faced in the above table.

Cleanliness class to AS 4059:6B

Size B particles may not exceed the maximum number indicated for code 6

6 B = max. 19,500 particles > 5 µm in size

Specifying a cleanliness code for each particle size

Example: cleanliness class to AS 4059: 7 A / 7 B / 6 C / 5 D

Cleanliness class	Particle count / 100 ml
Size A (> 1 µm / > 4 µm _(c))	100,000
Size B (> 5 µm / > 6 µm _(c))	38,900
Size C (> 15 µm / > 14 µm _(c))	3460
Size D (> 25 µm / > 21 µm _(c))	306

Specifying the highest cleanliness code measured

Example: Cleanliness code according to AS 40596 A – F

The 6 A – F specification requires a particle count in size ranges A – F.

The respective particle concentration of cleanliness code 6 may not be exceeded in any of these ranges

NAS 1638

Like ISO 4406, NAS 1638 describes particle concentrations in liquids. The analysis methods can be applied in the same manner as ISO 4406:1999.

In contrast to ISO 4406, certain particle ranges are counted in NAS 1638 and attributed to measurement references.

The following table shows the cleanliness classes in relation to the particle concentration determined:

Cleanliness class	Maximum particle count / 100 ml					
	2...5 µm	5...15 µm	15...25 µm	25...50 µm	50...100 µm	> 100 µm
00	625	125	22	4	1	0
0	1,250	250	44	8	2	0
1	2,500	500	88	16	3	1
2	5,000	1,000	178	32	6	1
3	10,000	2,000	356	64	11	2
4	20,000	4,000	712	128	22	4
5	40,000	8,000	1,425	253	45	8
6	80,000	16,000	2,850	506	90	16
7	160,000	32,000	5,700	1,012	180	32
8	320,000	64,000	11,400	2,025	360	64
9	640,000	128,000	22,800	4,050	720	128
10	1,280,000	256,000	45,600	8,100	1,440	256
11	2,560,000	512,000	91,200	16,200	2,880	512
12	5,120,000	1,024,000	182,400	32,400	5,760	1,024
13	10,240,000	2,048,000	364,800	64,800	11,520	2,048
14	20,480,000	4,096,000	729,000	129,600	23,040	4,096

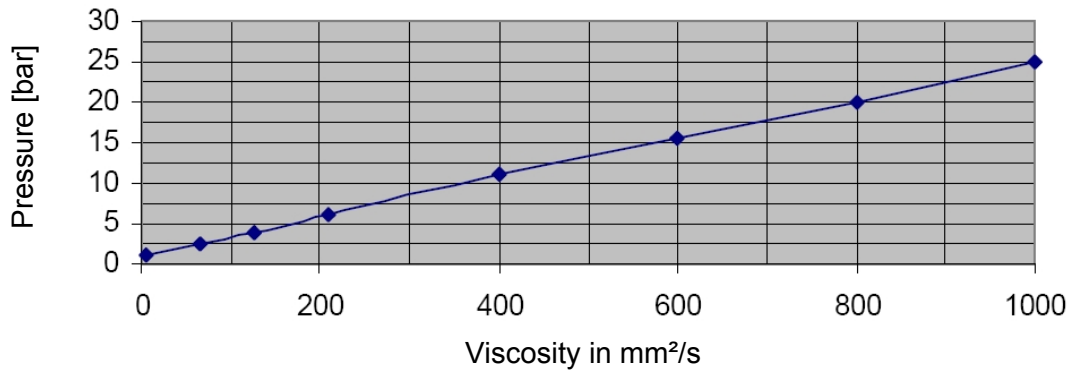
Increasing the class by 1 causes the particle count to double on average.

Technical data

Measured value display	Continuous view in LCD display
Self-diagnosis:	Continuous self-monitoring with error indication in LCD display
Particle size channels:	4 $\mu\text{m}_{(c)}$ / 6 $\mu\text{m}_{(c)}$ / 14 $\mu\text{m}_{(c)}$ / 21 $\mu\text{m}_{(c)}$
Measurement range (calibrated):	SAE 2 ... 12 ISO 12 / 10 / 09 ... 23 / 21 / 18
Indication range:	SAE 2 ... 15 ISO 12 / 10 / 07 ... 25 / 23 / 21
Accuracy:	$\pm 1/2$ class (ISO,NAS,SAE)
Calibration:	ISO 11943
Recalibration:	Recommended: every 2 to 3 years
Battery-buffered log memory:	Can accommodate up to 3000 measured values.
Inlet operating pressure:	Pressure connection (INLET): 1 ... 350 bar Suction connection (SUCTION): 0.5 bar

The minimum inlet pressure required to achieve a flow rate of 100 ml/min at the high-pressure inlet (INLET) for a given viscosity can be found by referring to the graph below.

Required pressure at the high pressure inlet of the FCU to achieve a flow of 100 ml/min. (flow regulator completely opened, new filter element)

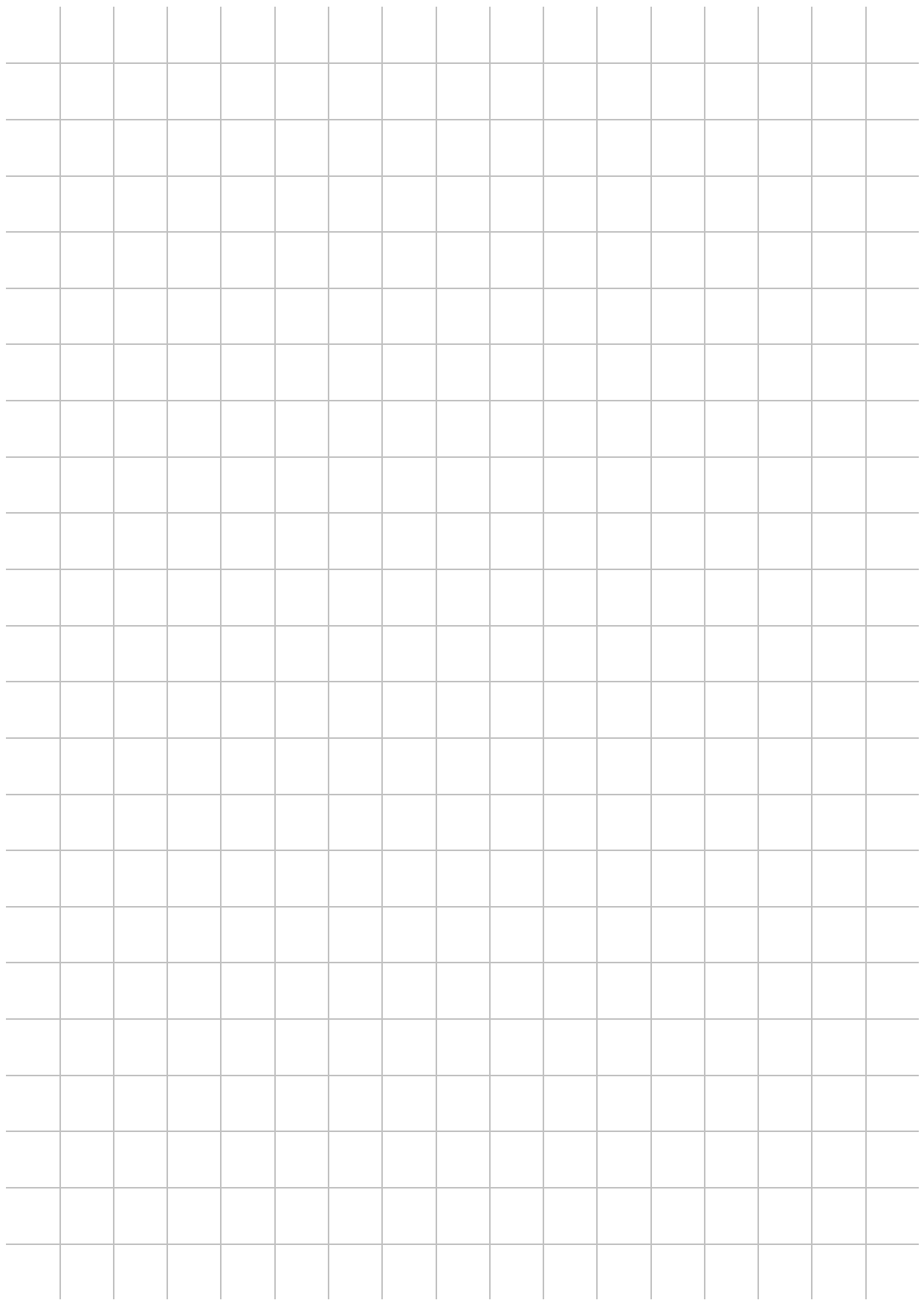


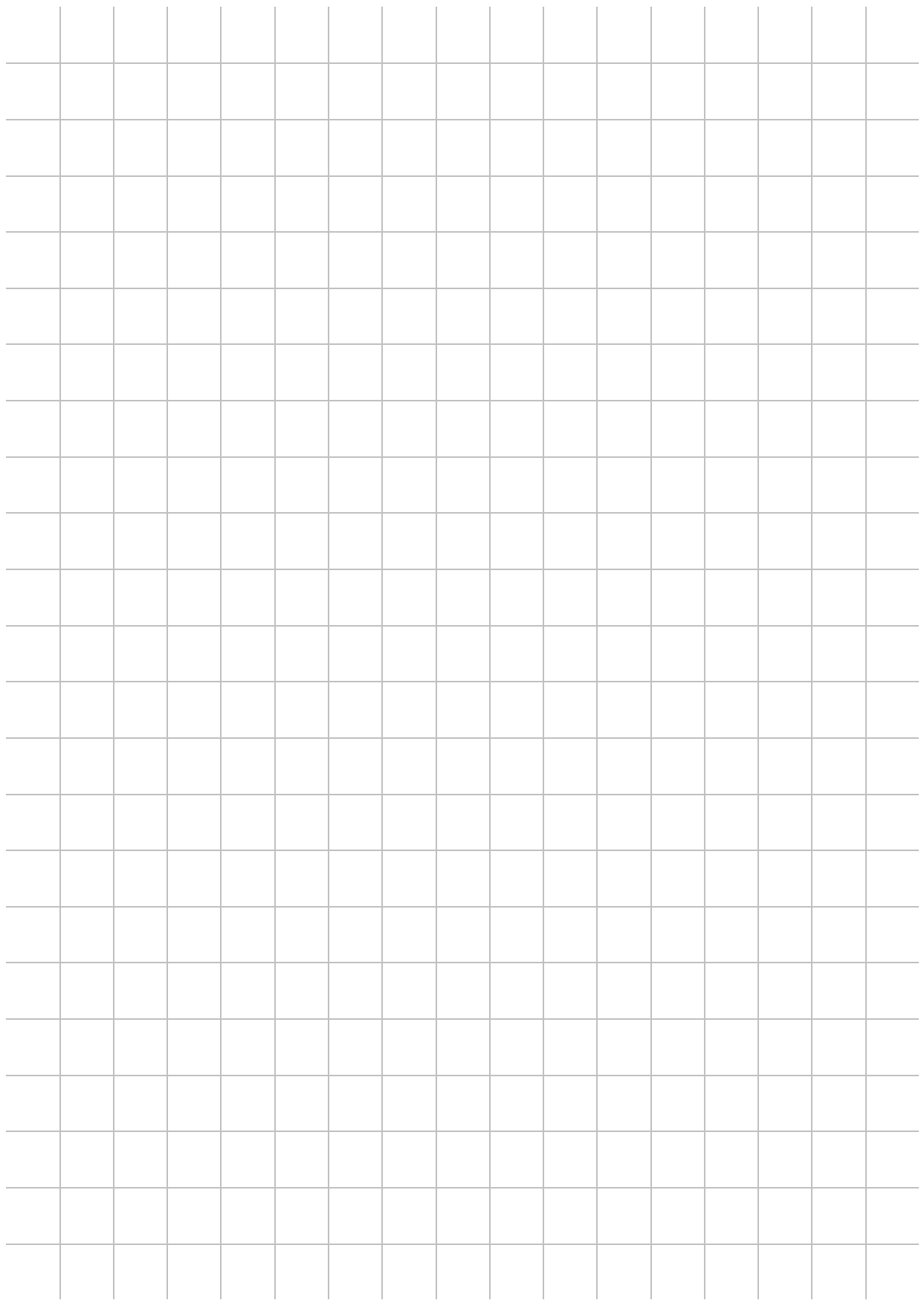
Connectors: Rear:	INLET: Mini measurement coupling DN4, SUCTION: CPC quick-release coupling Series LC DN6 OUTLET: DN 7 plug nipple
Return-line (OUTLET) flow rate:	max. 800 ml/min at INLET > 300 bar
Return-line (OUTLET) operating pressure:	max. 3 bar counterpressure
Measurement flow rate:	50 ... 150 ml/min

Permitted viscosity range: (high pressure inlet - INLET)	1 ... 1000 mm ² /s
Permitted viscosity range: (internal pump - SUCTION INLET)	max. 150 mm ² /s in continuous operation max. 350 mm ² /s short-term (max. 10 minutes)
Fluid temperature range:	0 ... 70°C
Supply voltage:	24 V DC, ± 25%
Power consumption:	100 W max.
Battery-powered operating duration:	Measurement without pump or pump supplied externally: ~ 5 hours Measurement with pump: depending on viscosity ~ 2 hours
Built-in printer:	Dot-matrix printer
Serial port:	RS 232 (for models /-BUS RS 485) with 15-pin Sub D plug
Ambient temperature:	0 ... 55°C
Storage temperature:	-20 ... 85°C
Relative humidity;	max. 90%, noncondensing
Protection class	IP40
Weight:	~ 15.8 kg

Factory default settings

	FCU 2210-5
POWERUP Menu	
Language	German
Viscosity range	5 ... 100 mm ² /s
Test volume	100 ml
MEMORY Menu	
Meas. point	HYDAC FCU 2210
Memory mode	Overwrite
Averaging interval	0 min
PRINT menu	
Online printout	on
Printout format	Graph
Printout of	ISO
Log duration	0.5 h / page (30 cm)
SETUP menu	
Autostart	No
Autostart function	M1: Measure
Abort at Q=0	No
Pump start delay	0 seconds
Bus address	1
Pump supply:	internal
LIMITS Menu	
M2:R1 Measurement channel	Flow rate
M2:R1 Switching function	No function
M2:R1 Limit values: below	90 ml
M2:R1 Limit values: above	110 ml
M2:R2 Measurement channel	Flow rate
M2:R2 Switching function	No function
M2:R2 Limit values: below	70 ml
M2:R2 Limit values: above	130 ml
M3: Limit values	17/14/11 ISO
M4 Limit values: below	17/14/11 ISO
M4 Limit values: above	23/19/16 ISO
M4: Test cycle time	120 min
M5: No. of measurements	5
M6: Start delay	10 s
M6: No. of measurements	5







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