FCU 8000 series
FluidControl Unit

Operating and Maintenance Instructions
Valid from firmware versions 3.22 up

English (translation of original instructions)

Document no.: 3109776d
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We have made every endeavor to ensure the accuracy of the contents of this document. However, errors cannot be ruled out. Consequently, we accept no liability for such errors as may exist nor for any damage or loss whatsoever which may arise as a result of such errors. The content of the manual is checked regularly. Any corrections required will be incorporated in future editions. We welcome any suggestions for improvements.

All details are subject to technical modifications.
Technical specifications are subject to change without notice.

HYDAC FILTER SYSTEMS GMBH
Postfach 12 51
66273 Sulzbach / Saar
Germany

Documentation Representative

Mr. Günter Harge
c/o HYDAC International GMBH, Industriegebiet, 66280 Sulzbach / Saar
Telephone: ++49 (0)6897 509 1511
Fax: ++49 (0)6897 509 1394
E-Mail: guenter.harge@hydac.com
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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.

Sometimes the information contained in the documentation cannot always keep up with changes made to the product as we attach considerable importance to keeping our products cutting-edge. Consequently, there might be deviations in technical details, illustrations and dimensions.

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

HYDAC FILTER SYSTEMS GMBH
Technische Dokumentation
Postfach 12 51
66273 Sulzbach / Saar
Germany

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, please always include the model/type designation and article no. of the product:

Fax: +49 (0) 6897 / 509 - 846
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.

They are available at: www.hydac.com -> Legal information.
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.

Use the FCU:

- 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

Hydraulic systems are under pressure

Danger of bodily injury

Depressurize the system before performing any work on it.
Explanation of symbols and warnings

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.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Individuals</th>
<th>Instructed individuals</th>
<th>Personnel with technical engineering background</th>
<th>Electricians</th>
<th>Supervisor with the appropriate authority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Packing</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Transportation</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Commissioning</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Operation</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Troubleshooting/locating the source of malfunction</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Remediing of mechanical faults</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Remediing of electrical faults</td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Maintenance</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Servicing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Decommissioning/storage</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>
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:

<table>
<thead>
<tr>
<th>Pc.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>FluidControl Unit FCU 8xxx</td>
</tr>
<tr>
<td>2</td>
<td>Mains device and connection cable (configuration depends on the order)</td>
</tr>
<tr>
<td>1</td>
<td>hp-hose with mini measurement port DN2, L=2000 mm</td>
</tr>
<tr>
<td>1</td>
<td>Return hose DN 7, L = 2000 m</td>
</tr>
<tr>
<td>1</td>
<td>Connection cable FCU &lt;-&gt; PC</td>
</tr>
<tr>
<td>1</td>
<td>CD-ROM with FluMoS light software</td>
</tr>
<tr>
<td>1</td>
<td>Operating and Maintenance Instructions</td>
</tr>
<tr>
<td>1</td>
<td>Calibration certificate</td>
</tr>
</tbody>
</table>
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 particle numbers for six particle sizes and 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 mini measurement port (System 1620) as an input for connection with the hydraulic unit, as well as a DN 7 plug nipple a a return flow.

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

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

<table>
<thead>
<tr>
<th>Item</th>
<th>Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>High pressure port = INLET</td>
</tr>
<tr>
<td>B</td>
<td>Return port connection - OUTLET</td>
</tr>
<tr>
<td>C</td>
<td>Switch - On/Off</td>
</tr>
<tr>
<td>D</td>
<td>Electrical connection - 24 V DC</td>
</tr>
<tr>
<td>E</td>
<td>Serial interface</td>
</tr>
<tr>
<td>F</td>
<td>Control port</td>
</tr>
<tr>
<td>G</td>
<td>Sealing cover</td>
</tr>
<tr>
<td>J</td>
<td>Dot-matrix printer</td>
</tr>
<tr>
<td>K</td>
<td>Display</td>
</tr>
<tr>
<td>L</td>
<td>Keyboard</td>
</tr>
<tr>
<td>M</td>
<td>Flow rate regulator</td>
</tr>
<tr>
<td>N</td>
<td>Filter element</td>
</tr>
</tbody>
</table>
Restrictions on use – FCU 8110 / 8210

NOTICE

Impermissible operating conditions

The FCU will be destroyed

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

Restrictions on use – FCU 8111 / 8211

NOTICE

Impermissible operating conditions

The FCU will be destroyed

► Only operate the FCU in conjunction with HFD-R operating fluids (phosphoric acid esters e.g. Skydrol, Fyrquel, Hyjet).
Hydraulic diagram

<table>
<thead>
<tr>
<th>Item</th>
<th>Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Optical sensor</td>
</tr>
<tr>
<td>5</td>
<td>Flow rate sensor</td>
</tr>
<tr>
<td>7</td>
<td>Flow rate control valve (adjustable)</td>
</tr>
<tr>
<td>8</td>
<td>Filter</td>
</tr>
<tr>
<td>9</td>
<td>Flow control valve</td>
</tr>
<tr>
<td>10</td>
<td>Pressure relief valve</td>
</tr>
<tr>
<td>15</td>
<td>Pressure accumulator</td>
</tr>
</tbody>
</table>
FCU Function Description

<table>
<thead>
<tr>
<th>Item</th>
<th>Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Optical sensor</td>
</tr>
<tr>
<td>2</td>
<td>Laser light source</td>
</tr>
<tr>
<td>3</td>
<td>Photodetector</td>
</tr>
<tr>
<td>4</td>
<td>Evaluation electronics</td>
</tr>
<tr>
<td>5</td>
<td>Flow rate sensor</td>
</tr>
<tr>
<td>6</td>
<td>Display</td>
</tr>
<tr>
<td>7</td>
<td>Flow rate control valve (adjustable)</td>
</tr>
<tr>
<td>8</td>
<td>Filter</td>
</tr>
<tr>
<td>9</td>
<td>Flow control valve</td>
</tr>
<tr>
<td>10</td>
<td>Pressure relief valve</td>
</tr>
<tr>
<td>11</td>
<td>Serial interface</td>
</tr>
<tr>
<td>12</td>
<td>Keyboard</td>
</tr>
<tr>
<td>13</td>
<td>Relay</td>
</tr>
<tr>
<td>14</td>
<td>Printer</td>
</tr>
<tr>
<td>15</td>
<td>Pressure accumulator</td>
</tr>
</tbody>
</table>
A continuous flow of oil runs through an optical sensor (1) comprised of a laser light source (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 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 print-out) for ~ 5 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 "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)

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>- screen</td>
</tr>
<tr>
<td>2</td>
<td>TXD Transmission line</td>
</tr>
<tr>
<td>4</td>
<td>RXD Receiving line</td>
</tr>
<tr>
<td>8</td>
<td>GND Ground</td>
</tr>
</tbody>
</table>

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

Serial RS 485 Interface (OPTIONAL)

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>- screen</td>
</tr>
<tr>
<td>2</td>
<td>T- (TA) Transmission data</td>
</tr>
<tr>
<td>4</td>
<td>R- (RA) Received data</td>
</tr>
<tr>
<td>8</td>
<td>GND Ground</td>
</tr>
<tr>
<td>9</td>
<td>T+ (TB) Transmission data</td>
</tr>
<tr>
<td>11</td>
<td>R+ (RB) Received data</td>
</tr>
<tr>
<td>15</td>
<td>+5V Supply, bus termination</td>
</tr>
</tbody>
</table>

The pin assignment corresponds to DIN 66348 (DIN measurement bus)
"Control" – Connecting the control port

![Diagram of control port]

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

<table>
<thead>
<tr>
<th>Relay 1, programmable by user</th>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6</td>
<td>NC contact</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>NO contact</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>Base contact</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Relay 2, programmable by user</th>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>13</td>
<td>NC contact</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>NO contact</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>Base contact</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Relay 3, Device ready</th>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>11</td>
<td>NC contact</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>NO contact</td>
</tr>
</tbody>
</table>

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 remotely-controlled-switched on and off via an external power supply. The battery will however still be charged, if a power adapter is connected.

- Pin 2/3/9/10/11/12: BSU operation
  The FCU controls the BSU via these pins. See BSU instructions.
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.

<table>
<thead>
<tr>
<th>M1</th>
<th>Measurement currently in progress</th>
<th>Measurement stopped</th>
<th>After the first measured value is available: Flow error</th>
<th>Flow rate within set range</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>M2</th>
<th>Exceed measured value ≥ upper limit</th>
<th>After switch-on or start of a measurement. Goes out \textit{again} when measured value ≤ lower limit</th>
<th>Measured value ≥ upper limit</th>
<th>After switch-on or start of a measurement. Goes out \textit{again} when measured value ≤ lower limit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fall below</th>
<th>≤ lower limit</th>
<th>After switch-on or start of a measurement. Goes out \textit{again} when measured value ≥ upper limit</th>
<th>≤ lower limit</th>
<th>After switch-on or start of a measurement. Goes out \textit{again} when measured value ≥ upper limit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relay 1</td>
<td>Relay 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------</td>
<td>--------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><img src="image1" alt="Relay 1" /></td>
<td><img src="image2" alt="Relay 2" /></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Within range</th>
<th>Relay 1</th>
<th>Relay 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower limit ≤ measured value ≤ upper limit</td>
<td>After switching the unit on or starting a measurement or Measured value &lt; lower limit or Measured value &gt; upper limit</td>
<td>Lower limit ≤ measured value ≤ upper limit</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Outside range</th>
<th>Relay 1</th>
<th>Relay 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured value ≤ lower limit or Measured value ≥ upper limit</td>
<td>After switching the unit on or starting a measurement or Measured value &lt; lower limit or Measured value &gt; upper limit</td>
<td>Measured value ≤ lower limit or Measured value ≥ upper limit</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No function</th>
<th>Relay 1</th>
<th>Relay 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Always off</td>
<td>Always off</td>
<td>Always off</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>M3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement is currently in progress and one or more of the last 5 measured values &gt; limit</td>
</tr>
</tbody>
</table>
### Relay 1 and Relay 2

<table>
<thead>
<tr>
<th>Relay 1</th>
<th>Relay 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Relay 1 Diagram" /></td>
<td><img src="image2" alt="Relay 2 Diagram" /></td>
</tr>
</tbody>
</table>

### M4
- **Start or result of check measurement after test cycle time ≥ upper limit**
- **Measurement is currently in progress and the measured values > limit**
- **5 consecutive measured values ≤ limit or 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
- **Controlling the BSU**
- **Controlling the BSU**
- **Controlling the BSU**
- **Controlling the BSU**

### M6
- **Controlling the BSU**
- **Controlling the BSU**
- **Controlling the BSU**
- **Controlling the BSU**

In mode M2 "Measure+Switch", the relays keep their last setting after the "Stop" button has been pressed.

Pressing the "Stop" button again returns the relays to their basic setting.

### Relay 3

<table>
<thead>
<tr>
<th>Relay 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image3" alt="Relay 3 Diagram" /></td>
</tr>
</tbody>
</table>

### All operating modes

| FCU ready for operation | FCU not ready for operation |
## Adjustable limit values

<table>
<thead>
<tr>
<th>M2: Switching limits</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>FCU81xx</td>
<td></td>
<td>FCU 82xx</td>
</tr>
<tr>
<td>2 µm channel NAS</td>
<td>4 µm(_{\text{c}}) channel SAE</td>
<td>0 15</td>
</tr>
<tr>
<td>5 µm channel NAS</td>
<td>6 µm(_{\text{c}}) channel SAE</td>
<td>0 15</td>
</tr>
<tr>
<td>15 µm channel NAS</td>
<td>14 µm(_{\text{c}}) channel SAE</td>
<td>0 15</td>
</tr>
<tr>
<td>25 µm channel NAS</td>
<td>21 µm(_{\text{c}}) channel SAE</td>
<td>0 15</td>
</tr>
<tr>
<td>50 µm channel NAS</td>
<td>38 µm(_{\text{c}}) channel SAE</td>
<td>0 15</td>
</tr>
<tr>
<td>100 µm channel NAS</td>
<td>70 µm(_{\text{c}}) channel SAE</td>
<td>0 15</td>
</tr>
<tr>
<td>2 µm channel ISO</td>
<td>4 µm(_{\text{c}}) channel ISO</td>
<td>10 25</td>
</tr>
<tr>
<td>5 µm channel ISO</td>
<td>6 µm(_{\text{c}}) channel ISO</td>
<td>7 23</td>
</tr>
<tr>
<td>15 µm channel ISO</td>
<td>14 µm(_{\text{c}}) channel ISO</td>
<td>5 21</td>
</tr>
<tr>
<td>Flow rate</td>
<td>Flow rate</td>
<td>0 150</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>M3: Filtration limit</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO</td>
<td>ISO</td>
<td>10 / 7 / 5</td>
</tr>
<tr>
<td>NAS</td>
<td>SAE</td>
<td>0 / 0 / 0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>M4: Filtration limits</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO</td>
<td>ISO</td>
<td>10 / 7 / 5</td>
</tr>
<tr>
<td>NAS</td>
<td>SAE</td>
<td>0 / 0 / 0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>M4: Test cycle time</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1440</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>M5: Flushing volume</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>500</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>M6: Start delay</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>M6: Measurements / sample</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>M6: Measurement volume</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>250</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>M6: Dilution of sample</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>250</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>M6: Thinner</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>250</td>
<td></td>
</tr>
</tbody>
</table>
FCU in online operation

**WARNING**

Hydraulic systems are under pressure
Danger of bodily injury

► Depressurize the system before performing any work on it.

**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.

---

![Image of FCU showing OUT and IN connections]
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 flow rate control valve to a value of 3.
3. Check the system pressure. Ensure that this does not exceed a pressure of 350 bar.
4. Connect the high pressure hose to the INLET connection.
5. Now connect the other end of the high pressure hose to the system.

Oil starts to flow through the FCU as soon as the system has been connected to the pressure fitting.
FCU in BSU operation (only for FCU 8110 / 8210)

The BottleSampling Unit BSU permits the counting of oil sample bottles. The procedure of a measurement or a flushing process is controlled completely by the FCU 8xx0.

Figure 1: Front view, BSU 8000 with FCU 8110 / 8210
Connect the FCU to the BottleSampling Unit BSU:
1. Remove the filter insert.
2. Insert the Bottle Sampling Adapter into the FCU.
3. Connect the hydraulic ports (so they cannot be mixed up) to the BSU and seal the port of the FCU marked "OUTLET" with the quick-release plug.
4. Plug the control plug of the BSU into the appropriate socket of the FCU.
5. Insert the jack plug for the voltage supply socket into the FCU.

You can find more details on Bottle Sampling operation in the BSU instructions.

Figure 2: Ports of the FCU being measured with the BSU
Diagram of the Bottle Sampling Unit

- **P**: Compressed air inlet (max. 6 bar / 90 psi)
- **V1**: Valve for pressurizing / depressurizing the pressure chamber
- **V2**: Shut-off valve
- **V3**: Drain valve
- **A**: Collection vessel
- **B**: Sample jar
- **C**: Test container
- **D**: Pressure chamber
- **R**: Control valve (on front of BSU)
- **M**: Pressure gauge (on front of BSU)
- **S**: Flow rate sensor
- **St**: Suction tube
- **X**: Silencer
Perform basic settings for bottle sampling operation

The following settings must be made in the **POWERUP** menu under point "M6: Bottle Sampler" (see also page 80)

**BottleSampler draining**

When the flushing procedure is completed in mode M5, or the measurements in mode M6, the drain valve will open for the configured time so that the oil can completely drain from the test container (see 44). (Recommended: 30 seconds)

**Compressor**

At this point you must pre-set the time required for a constant pressure to be achieved in the pressure chamber, after switching on the compressed air supply via a compressor. (We recommend 30 seconds using the CompressedAir Unit CAU 8110)

**Compressed air**

At this point you must pre-set the time required for a constant pressure to be achieved in the pressure chamber, after switching on the compressed air supply from the ring main. (Recommended: 5 seconds)

The following settings must be made in the **SETUP** menu (see also page 72)

**BS compressed air supply**

At this point the type of compressed air supply to the BSU must be specified.

Options: "Compressor" or "Compressed air"

The relevant pressure build-up time, which is specified in the POWERUP menu, is used as a basis for the modes of operation of bottle sampling.

**Additional test**

At this point you have the option whether to make an additional individual test in mode M6, once the pre-set number of individual tests have been completed.

Options: "Yes" or "No"
Flushing Bottle Sampling Unit

**WARNING**

Flushing media with explosion protection

Risk of explosion

- Do not flush the BSU with liquids requiring explosion protection.

Use the mode M5 to flush the system of FCU and BSU.

You should do this before each measurement of a sample to prevent remnants of a previous sample in the system from falsifying the measurement results.

The flushing volume is pre-set in the LIMITS menu (can be set from 50 to 500 ml).

With the buttons [mode] and [mode], select mode M5 and then press the button [start]. Then, the pressure in the pressure chamber is first built up.

Then the shutoff valve is opened and the flushing medium conveyed through the BSU and FCU. The flow rate is adjusted using the control knob on the front of the BSU.

In bottle sampling mode, the flow-rate control on the FCU has no effect.

Notes in the display of the FCU refer to the control knob on the front of the BSU.

Once the preset flushing volume has flowed through the BSU and FCU flowed, the pressure chamber is depressurized and the test container is drained. Make sure that the test container is completely drained.
Measurement with Bottle Sampling Unit

Use mode M6 to analyze the contamination of an oil sample from a sample jar by means of the Bottle Sampling Unit BSU (optional accessory).

Make the following settings in the LIMITS menu:

- **Pre-run volume**
  Amount of oil conveyed before the first measurement (adjustable 10 - 100 ml)
  Recommended setting 20 ml

- **Measured volume**
  Quantity of oil which is to be measured in total (via several individual measurements)

- **Measurements / sample**
  This is the number of single measurements into which the test volume is to be divided.
  With a test volume of 100 ml and 4 measurements per sample, for example, 4 measurements of 25 ml each will be carried out. The resultant quantity of particles from each individual measurement is projected for 100 ml each.

- **Dilution**
  If the sample has to be diluted due to excessive contamination or high viscosity, the dilution ratio can be input here. The measurement results will automatically be projected to produce values from an undiluted sample.
  The first value to be set specifies the test volume (configurable from 1 to 250).
  The second value is the volume of the thinner (e.g. clean oil) (configurable from 0 to 250). See also page 70.
  If you measure undiluted samples, the second value must equal 0.
  Example: 250 ml oil mixed with 50 ml thinner => setting 250:50 (5:1)

With the buttons and , select mode M6 and then press the button . Then, the pressure in the pressure chamber is first built up. Then the shutoff valve V2 is opened and the sample conveyed through the BSU and FCU. Directly after the flushing process, the first measurement starts.

The following message will appear in the display during measurement:

![Display Message](image)

Where:
- **M6** : Measuring mode
- **xx** : Number of the current measurement
- **yy** : Progress of the ongoing measurement in %
- **zz** : Current flow rate
- **qq** : Progress of the ongoing measurement (previously measured volume)
Once each individual measurement has been completed, the relevant result is printed out when online printing is activated (see page 53).

The resultant quantity of particles is projected for 100 ml.

If "Yes" was selected in the Setup-Menu under additional measurement, you will be asked whether an additional single measurement (measurement volumes as for completed individual measurements) should be carried out, once the last individual measurement has ended.

Display:

```
M6 +1Measurement -> OK
finish ->STOP
```

After the last measurement has been made or after the button `STOP` has been pressed, the pressure chamber is depressurized and the test container drained. On the transparent drain hose, check that the test container drains empty and no medium gets trapped. With high-viscosity media, this process can take some time. If necessary, correct the time for the BS draining in the POWERUP menu upward.

The single measurements which are to be used to produce an average overall result, can be selected afterwards.

Display:

```
M6: Averaging
Measurements: 123456789
```

The number of the single measurements can selected using the `+` and `-` buttons and the relevant individual measurement can be activated (number is displayed) or deactivated (underscore is displayed) using the `+` and `-` keys for averaging.

For example: From 5 single measurements, measurements 2, 3 and 4 should be used to calculate an average value.

Display:

```
Averaging
Measurements: _234_
```
The average result is printed out, even if online printing is switched off. If all the single measurements are deactivated, no average result will be printed out. The selection is completed with the OK/START button.

Until the set draining time has elapsed, the following message appears in the LC display:

Display:

```
mode
M6: Finished/draining in progress please wait
```

When the draining time has passed, the measuring procedure in mode M6 is complete:

Display:

```
mode
Measurement OK/START:
Cancel ->STOP
```
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 8110    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 82.

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)

Press the "START" key and set the flow rate to approx. 50 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.

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)

**mode**
Select measurement operation (with/without relay actuation)

**setup**
Basic settings (Autostart, date, time, etc.)

**memory**
Editing measured value memory (name of the measuring point, measurement intervals, deleting, etc.)

**ISO**
Display ISO code (This key responds only when a measurement is being carried out)

**print**
Print out (Online, measured value memory, etc.)

**SAE/NAS**
Display SAE or NAS Code (This key responds only when a measurement is being carried out)

**limits**
Set limits for controlling filtration units (via relays 1 and 2)

**particles**
Display particle counts (This key responds only when a measurement is being carried out)

**Display – Lighting**
1x - goes out again after ~ 20 s.
2x – stays switched on (press 1x to switch off)

Direct input of multi-digit numerals (Only in input mode)

Key Combinations

- **ok start** + 
  Insert space in measuring position designation.
  Press the keys simultaneously.

- **ok start** + 
  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.

- **M1: Measure**
- **M2: Measure + Switch**
- **M3: Filter to**
- **M4: Filter from to**
- **M5: Flushing BS**
- **M6: Bottle Sampler**

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: Flushing BS"

With the mode M5 "Flushing BS", the FCU and BottleSampling Unit BSU (optional accessories) can be flushed.

MODE "M6: Bottle Sampler"

In mode M6 "Bottle Sampler", the contamination of an oil sample from a sample jar can be measured by means of the BottleSampling Unit BSU (optional accessory).
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.

Accept the setting and exit the MEMORY menu.
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.

Select the respective measurement point via the keys.

The first letter blinks.

Navigate to the position desired using the keys.

Select the characters from the table via the keys.

Numbers can be entered directly via the keypad.

Confirm the designation for the measurement point.

Abort and exit without saving.

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
```
Insert character: 
Press the ok + start keys simultaneously and a space will be inserted in front of the character just marked.

Delete character: 
Press the ok + start 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.

Confirm entries.

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 0,0 %**

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

Abort and exit without saving.

Are you sure?

OK = YES STOP = NO

YES – The selected logs are deleted.

No – Abort and exit
Log selection: Date

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

Are you sure?

OK = YES  STOP = NO

YES – The selected logs of designation X are deleted.

Abort and exit without saving.

Log selection: Date + Meas. point
Date of log:  
**dd.mm.yyyy**

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

Measuring point  
**Designation X**

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 %**

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.

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.

**Memory mode**

**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.

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

Abort and exit.
Logs

The stored logs from the FCU online operation can be output 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
### FCU 8000 series FCU menus

- **Printout of:** Particles
  - (only for print-out format "List")

- **Printout of:** NAS (SAE)
  - (SAE: for 82xx only)

**The selected logs are printed.**

- **Abort and exit**

---

<table>
<thead>
<tr>
<th>FCU 81xx</th>
<th>FCU 82xx</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO</td>
<td>ISO</td>
</tr>
<tr>
<td>Particles</td>
<td>Particles</td>
</tr>
<tr>
<td>Channel NAS 1 … 3</td>
<td>Channel SAE A … C</td>
</tr>
<tr>
<td>Channel NAS 4 … 6</td>
<td>Channel SAE A … C</td>
</tr>
</tbody>
</table>

**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**

  - **Graph**

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

- **Printout of:** ISO
  - (only for print-out format "List")

- **Printout of:** Particles
  - (SAE: for 82xx only)

- **Printout of:** NAS (SAE)
The selected logs are printed.

Abort and exit

<table>
<thead>
<tr>
<th>FCU 81xx</th>
<th>FCU 82xx</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO</td>
<td>ISO</td>
</tr>
<tr>
<td>Particles</td>
<td>Particles</td>
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<td>Channel SAE A … C</td>
</tr>
<tr>
<td>Channel NAS 4 … 6</td>
<td>Channel SAE A … C</td>
</tr>
</tbody>
</table>

Log selection:

**Meas. point**

Measuring point

*Designation X*

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

Printout format:

List

Graph

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

Printout of:

ISO  

Particles  

NAS (SAE)  

(Printout format "List")  

(only for 82xx only)

The selected logs are printed.

Abort and exit
<table>
<thead>
<tr>
<th>FCU 81xx</th>
<th>FCU 82xx</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO</td>
<td>ISO</td>
</tr>
<tr>
<td>Particles</td>
<td>Particles</td>
</tr>
<tr>
<td>Channel NAS 1 … 3</td>
<td>Channel SAE A … C</td>
</tr>
<tr>
<td>Channel NAS 4 … 6</td>
<td>Channel SAE A … C</td>
</tr>
</tbody>
</table>

**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:

Particles

(only for print-out format "List")

Printout of:

NAS (SAE)

(SAE: for 82xx only)

The selected logs are printed.

Abort and exit
<table>
<thead>
<tr>
<th>FCU 81xx</th>
<th>FCU 82xx</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO</td>
<td>ISO</td>
</tr>
<tr>
<td>Particles</td>
<td>Particles</td>
</tr>
<tr>
<td>Channel NAS 1 … 3</td>
<td>Channel SAE A … C</td>
</tr>
<tr>
<td>Channel NAS 4 … 6</td>
<td>Channel SAE A … C</td>
</tr>
</tbody>
</table>
BS-Logs

The stored logs from the Bottle Sampling operation can be output via the built-in printer. Various criteria are available for selecting the logs to be printed.

- **PRINT**
  - BS 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: 
Particles

Printout of: 
NAS (SAE)

The selected logs are printed.

Abort and exit

<table>
<thead>
<tr>
<th>FCU 81xx</th>
<th>FCU 82xx</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO</td>
<td>ISO</td>
</tr>
<tr>
<td>Particles</td>
<td>Particles</td>
</tr>
<tr>
<td>Channel NAS 1 … 3</td>
<td>Channel SAE A … C</td>
</tr>
<tr>
<td>Channel NAS 4 … 6</td>
<td>Channel SAE A … C</td>
</tr>
</tbody>
</table>

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:
Particles

(only for print-out format "List")

Printout of:
NAS (SAE)

(SAE: for 82xx only)
The selected logs are printed.

Abort and exit

<table>
<thead>
<tr>
<th>FCU 81xx</th>
<th>FCU 82xx</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO</td>
<td>ISO</td>
</tr>
<tr>
<td>Particles</td>
<td>Particles</td>
</tr>
<tr>
<td>Channel NAS 1 … 3</td>
<td>Channel SAE A … C</td>
</tr>
<tr>
<td>Channel NAS 4 … 6</td>
<td>Channel SAE A … C</td>
</tr>
</tbody>
</table>

**Log selection:**

- **Meas. point**

- **Measuring point**
  - Designation X

- **Printout format:**
  - List

- **Printout format:**
  - Graph

- **Printout of:**
  - ISO

- **Printout of:**
  - Particles

- **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:
Particles
(Printout format "List")
(Printout format "Graph")
SAE: for 82xx only)

Printout of:
NAS (SAE)
The selected logs are printed.

Abort and exit
FCU 8000 series

FCU menus

<table>
<thead>
<tr>
<th>FCU 81xx</th>
<th>FCU 82xx</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO</td>
<td>ISO</td>
</tr>
<tr>
<td>Particles</td>
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</tr>
<tr>
<td>Channel NAS 4 ... 6</td>
<td>Channel SAE A ... C</td>
</tr>
</tbody>
</table>

**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.
- **stop**
  - Abort and exit.

**PRINT All parameters**

All the current settings are outputted.

- **PRINT**
  - **PRINT All parameters**
    - Confirm entries and initiate printing.
- **stop**
  - 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: Particles
- Printout of: NAS (SAE)
- (only for print-out format "List")
- (SAE: for 82xx only)
Confirm entries

Abort and exit.

**Print out, cancel**

A current print operation is aborted.

Confirms entries and start paper feed.

Abort and exit.

**LIMITS menu**

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

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

Abort and exit.
MODE M2

**LIMITS**

**M2: Relay 1**

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

**M2:R1 Measurement channel:**

*xx m chan. unit*

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

**M2: R1 Switch func:**

*No function*

**M2: R1 Switch func:**

*Within range*

**M2: R1 Switch func:**

*Outside range*

**M2: R1 Switch func:**

*Exceed*

**M2: R1 Switch func:**

*Fall below*

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

**M2:R1 Limit values:**

*↓xxx  ↑yyy Unit*

Jump from value to value.

**M2:R1 Limit values:**

*↓xxx  ↑yyy Unit*

Select limit values by scrolling through them using the keys.

Abort and exit.
LIMITS
M2: Relay 2
Press this key to confirm the operating mode selected and to initiate measurement.

M2:R2 Measurement channel:
xx m chan. unit
Press this key to confirm the operating mode selected and to initiate measurement.

M2: R2 Switch func:
No function
M2: R2 Switch func:
Within range
M2: R2 Switch func:
Outside range
M2: R2 Switch func:
Exceed
M2: R2 Switch func:
Fall below
Press this key to confirm the operating mode selected and to initiate measurement.

M2:R2 Limit values:
[ ] xxx      yyy
Unit
Jump from value to value.

M2:R2 Limit values:
[ ] xxx      yyy
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.
## Measurement channel table

<table>
<thead>
<tr>
<th>Channel</th>
<th>FCU 81xx</th>
<th>Channel</th>
<th>FCU 82xx</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 µm</td>
<td>NAS</td>
<td>A</td>
<td>SAE</td>
</tr>
<tr>
<td>5 µm</td>
<td>NAS</td>
<td>B</td>
<td>SAE</td>
</tr>
<tr>
<td>15 µm</td>
<td>NAS</td>
<td>C</td>
<td>SAE</td>
</tr>
<tr>
<td>25 µm</td>
<td>NAS</td>
<td>D</td>
<td>SAE</td>
</tr>
<tr>
<td>50 µm</td>
<td>NAS</td>
<td>E</td>
<td>SAE</td>
</tr>
<tr>
<td>100 µm</td>
<td>NAS</td>
<td>F</td>
<td>SAE</td>
</tr>
<tr>
<td>2 µm</td>
<td>ISO</td>
<td>4 µm</td>
<td>ISO</td>
</tr>
<tr>
<td>5 µm</td>
<td>ISO</td>
<td>6 µm</td>
<td>ISO</td>
</tr>
<tr>
<td>15 µm</td>
<td>ISO</td>
<td>14 µm</td>
<td>ISO</td>
</tr>
</tbody>
</table>

**MODE M3**

**LIMITS**

*M3: Filter to*

*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:

\[ (xx / yy / zz) \quad \text{Standard} \]

M4: Limit values:

\[ (xx / yy / zz) \quad \text{Standard} \]

M4: Limit values:

\[ (xx / yy / zz) \quad \text{Standard} \]

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

M4: Test cycle time:

\[ xxx \quad \text{[min]} \]

Standard value = 120 [min]

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

Abort and exit.
MODE M5

LIMITS

M5: Flushing volume

M5 Flushing volume:

Xxx ml

or

M5 Flushing volume:

Xxx ml

n = 1 ... 100

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

Abort and exit.

MODE M6

LIMITS

M6: Bottle Sampler

M6 Pre-run volume

xxx ml

or

M6 Pre-run volume:

xxx ml

n = 10 ... 100

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

M6 Measurement volume:

xxx ml

or

M6 Measurement volume:

xxx ml

n = 1 ... 100

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

M6 Measurements/sample:

n

n = 1 ... 100
**M6 Measurements/sample:**

\[ n = 1 \ldots 100 \]

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

**M6 Dilution:**

\[ x : y \]

\[ n = 0 \ldots 250 \]

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

Abort and exit.
SETUP menu

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

- **SETUP Autostart**
- **SETUP Abort at Q=0**
- **SETUP Pump start delay**
- **SETUP Date / Time**
- **SETUP Bus address**
- **SETUP Operating hours**
- **SETUP BS pressure supply**
- **SETUP Additional test**
- **SETUP Battery state**

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

Abort and exit.
**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
  - M2: Measuring and switching
  - M3: Filter to
  - 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.

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

Abort and exit.
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

![Setup menu](image)

**SETUP**

**Pump start delay**

**Pump start delay:**

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

Abort and exit.
Setting the date and time

The date and time are displayed and can be changed.

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

Correct the time.

Abort and exit.

Confirm entries.

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.

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

Abort and exit.

Display operating hours

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

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

Abort and exit.
BS pressure supply

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

Abort and exit.

Additional test

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

Abort and exit.
Check the battery status

The current battery charge is shown.

**SETUP**

**Battery state**

**Battery voltage:**

13.63 V 80 %

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

Abort and exit.
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.

- **POWERUP M6 Bottle Sampler**
- **POWERUP Language**
- **POWERUP Viscosity range**
- **POWERUP Test volume**

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

Abort and exit the Powerup menu
M6: Bottle Sampler

Bottle Sampler

BS draining t s

Bottle Sampler

Compressor t s

Applying the submenu selected.

Abort and exit the PowerUp menu.
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

Applying the submenu selected.

Language: German

Applying the submenu selected.

Language: English

Applying the submenu selected.

Language: French

Applying the submenu selected.

Language: Programmable

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

stop

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

Applying the submenu selected.

Viscosity range:

5 … 1000 mm²/s

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

stop

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

Enter measurement volume via the keyboard.

Measurement volume:

XXX ml

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

Abort and exit.
The FCU is working in Mode M1 (measuring the cleanliness class).

Display of the measured flow rate (50 ml/min is recommended).

Indicates elapsed measuring time in %. Begins at 0%; the cleanliness class is displayed again at 100%.

Specification of the currently determined contamination.

You can switch back and forth between the display in ISO or NAS (FCU 81xx) or SAE (FCU 82xx) coding and the display of particle counts with the keys SAE/NAS Partikel.

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

FCU 81xx:

FCU 82xx:

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 particle count lies above the specified display range (see page 109), >25 or >15 is shown in all particle size ranges as the particle count.

One can select between differential and cumulative displays of numbers of particles by using the keys 📈 and 📊. 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:

- **FCU 81xx:**
  - 2…5µm, 5…15µm, 15…25µm, 25…50µm, 50…100µm and >100µm
- **FCU 82xx:**
  - 4…6µm (c), 6…14µm (c), 14…21µm (c), 21…38µm (c), 38…70µm (c) and >70µm (c)

Cumulative representation means particle count in the particle size ranges:

- **FCU 81xx:**
  - >2µm, >5µm, >15µm, >25µm, >50µm and >100µm
- **FCU 82xx:**
  - >4µm (c), >6µm (c), >14µm (c), >21µm (c), >38µm (c) and >70µm (c)

If the determined particle count lies above the specified display range (see page 109), "fffffff" is shown in all particle size ranges as the particle count.
## Brief Overview of the Menu Structure

### MODE
- M1: Measure
- M2: Measure + Switch
- M3: Filter to
- M4: Filter from to
- M5: Flushing BS
- M6: Bottle Sampler

### MEMORY
- Meas. point
- Measuring point xx
- Designation xx
- Averaging interval
- X min.
- Selective deletion
- Log selection
- Log number: from xxx to xxx
- Date
- Date of log: dd.mm.yyyy
- Meas. point
- Date + Measuring point
- Measuring point x
- Designation x
- Date of log: dd.mm.yyyy
- Meas. point
- Designation x

### PRINT
- Logs
  - Log selection
  - List
  - Graph
  - Date
  - List
  - Graph
  - Meas. point
  - List
  - Graph
  - Date + Measuring point
  - List
  - Graph
- BS logs
  - Log selection
  - List
  - Graph
  - Date
  - List
  - Graph
  - Meas. point
  - List
  - Graph
  - Date + Measuring point
  - List
  - Graph

### PRINT
- Contents
- All parameters
- Paper feed
- Online printout
## FCU 8000 series

### Brief Overview of the Menu Structure

#### LIMITS

<table>
<thead>
<tr>
<th>Relay 1</th>
<th>Relay 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>M2:</strong></td>
<td><strong>M2:</strong></td>
</tr>
<tr>
<td><strong>R1 Meas. Channel:</strong></td>
<td><strong>R1 Meas. Channel:</strong></td>
</tr>
<tr>
<td>See table, page 68.</td>
<td>See table, page 68.</td>
</tr>
<tr>
<td><strong>Switch func:</strong></td>
<td><strong>Switch func:</strong></td>
</tr>
<tr>
<td>No function</td>
<td>No function</td>
</tr>
<tr>
<td>Within range</td>
<td>Within range</td>
</tr>
<tr>
<td>Outside range</td>
<td>Outside range</td>
</tr>
<tr>
<td>Exceed</td>
<td>Exceed</td>
</tr>
<tr>
<td>Fall below</td>
<td>Fall below</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Relay 2</th>
<th>Relay 1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>M3:</strong></td>
<td><strong>M3:</strong></td>
</tr>
<tr>
<td><strong>Filter to</strong></td>
<td><strong>Filter to</strong></td>
</tr>
<tr>
<td><strong>Limits:</strong></td>
<td><strong>Limits:</strong></td>
</tr>
<tr>
<td>( \text{Unit} )</td>
<td>( \text{Unit} )</td>
</tr>
<tr>
<td>( \text{Unit} )</td>
<td>( \text{Unit} )</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Relay 1</th>
<th>Relay 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>M4:</strong></td>
<td><strong>M4:</strong></td>
</tr>
<tr>
<td><strong>Filter from to</strong></td>
<td><strong>Filter from to</strong></td>
</tr>
<tr>
<td><strong>Limit values:</strong></td>
<td><strong>Limit values:</strong></td>
</tr>
<tr>
<td>( \text{Unit} )</td>
<td>( \text{Unit} )</td>
</tr>
<tr>
<td>( \text{Unit} )</td>
<td>( \text{Unit} )</td>
</tr>
<tr>
<td><strong>Test cycle time:</strong></td>
<td><strong>Test cycle time:</strong></td>
</tr>
<tr>
<td>( X \ [\text{min}] )</td>
<td>( X \ [\text{min}] )</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Flushing BS</th>
<th>Bottle Sampler</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>M5:</strong></td>
<td><strong>M6:</strong></td>
</tr>
<tr>
<td><strong>Flushing volume [ml]</strong></td>
<td><strong>Pre-run volume</strong></td>
</tr>
<tr>
<td></td>
<td>( XX )</td>
</tr>
<tr>
<td></td>
<td><strong>Test volume</strong></td>
</tr>
<tr>
<td></td>
<td>( X )</td>
</tr>
<tr>
<td></td>
<td><strong>Measurements / sample</strong></td>
</tr>
<tr>
<td></td>
<td>( X )</td>
</tr>
<tr>
<td></td>
<td><strong>Dilution</strong></td>
</tr>
<tr>
<td></td>
<td>( X )</td>
</tr>
</tbody>
</table>

#### SETUP

<table>
<thead>
<tr>
<th>Autostart</th>
<th>Measure</th>
<th>Measure + Switch</th>
<th>Filter to</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Abort at Q=0</strong></th>
<th><strong>Pump start delay</strong></th>
<th><strong>Date / Time</strong></th>
<th><strong>Bus address</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>( X \ [s] )</td>
<td><strong>Date</strong></td>
<td>( X )</td>
</tr>
<tr>
<td>No</td>
<td></td>
<td><strong>dd.mm.yyyy</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Time</strong></td>
<td></td>
<td><strong>HH:mm:ss</strong></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Operating hours</strong></th>
<th><strong>BS pressure supply</strong></th>
<th><strong>Additional test</strong></th>
<th><strong>Battery status</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>( X \ [h] )</td>
<td>Compressor</td>
<td>Yes</td>
<td>( xx.xx \ V )</td>
</tr>
<tr>
<td></td>
<td>Compressed air</td>
<td>No</td>
<td>( yy \ % )</td>
</tr>
</tbody>
</table>
# POWERUP

## Language

- English
- English
- French
- Programmable

## Viscosity range

- 1…10 mm²/s
- 5…1000 mm²/s

## Test volume

- x [ml]
## Error Messages and Troubleshooting

<table>
<thead>
<tr>
<th>Error message</th>
<th>Cause(s)</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Invalid parameter</td>
<td>You have entered a value which is outside the permitted value range (e.g. NAS 23).</td>
<td>Display the permitted value ranges using the keys ↑ and ↓ by scrolling above the maximum values. Then the minimum value is automatically displayed.</td>
</tr>
<tr>
<td>Check parameter</td>
<td>The self-monitoring function of the FCU has detected a check sum error for one or more parameters.</td>
<td>Rest all parameters using the keyboard or transfer the parameters with the FluMoS software.</td>
</tr>
<tr>
<td>Defective parameter:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. xx</td>
<td>Cause: Strong electromagnetic interference has changed the parameters.</td>
<td></td>
</tr>
<tr>
<td>Measurement ended</td>
<td>The setting for the &quot;Memory mode&quot; parameter is at &quot;Stop if full&quot;.</td>
<td>Delete the reports or set the &quot;Memory mode&quot; parameter to &quot;Overwrite&quot;. For details see page 52.</td>
</tr>
<tr>
<td>Memory for measured values full</td>
<td>The maximum number of reports or measured values has been reached. No more values can be stored.</td>
<td></td>
</tr>
<tr>
<td>Value not accepted</td>
<td>An error occurred while storing a value in EEPROM.</td>
<td>Repeat the entry or continue the measurement. If the fault recurs, contact HYDAC.</td>
</tr>
<tr>
<td>Error message</td>
<td>Cause(s)</td>
<td>Remedy</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>--------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Number of defective logs:</td>
<td>The self-monitoring function of the FCU has detected a check sum error for one or more stored logs. Possible causes</td>
<td>The defective logs are deleted automatically. After the next power up, this message is not displayed again if it was just a brief malfunction. 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.</td>
</tr>
<tr>
<td></td>
<td>- Strong electromagnetic interference has changed the measured value memory.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- The internal back-up battery is dead.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- A measurement has been started and terminated – for example as a result of the FCU being switched off – without any measured values being stored.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- A measurement previously conducted resulted only in a flow error.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>-&gt; The protocol contains no values.</td>
<td></td>
</tr>
<tr>
<td>No logs stored!</td>
<td>You have tried to print logs, but the FCU memory is empty.</td>
<td>Carry out measurements.</td>
</tr>
<tr>
<td>Too few points</td>
<td>You have tried to print a graph, but the selected log has insufficient measurement values (min. 3) to produce a graph.</td>
<td>Print out the protocol in the form of a list.</td>
</tr>
<tr>
<td>Battery needs charging</td>
<td>The rechargeable batteries are dead.</td>
<td>Measurements are still possible. However, it is better to connect a power adapter, in particular for printing.</td>
</tr>
<tr>
<td>Use power supply</td>
<td>The rechargeable batteries are dead.</td>
<td>The batteries require a charging time of ~ 11 hours.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>You can operate the FCU using a connected power supply.</td>
</tr>
<tr>
<td>Error message</td>
<td>Cause(s)</td>
<td>Remedy</td>
</tr>
<tr>
<td>--------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Flow rate error!</td>
<td>There is no oil flowing through the particle sensor (possibly only air). The flow rate sensor is faulty. Measurement volumes are set to 0 in the PowerUp Menu. (Starting with Firmware Version 3.20, the minimum measurement volume is min. 10 ml)</td>
<td>Turn the flow control valve control knob clockwise. Check the change-over valve setting. Check the hydraulic connections. Check the pressure. Fluid must flow through the return hose on the OUTLET from a pressure of &gt;30bar/420psi. The pressure control valve must open (see circuit diagram) Change the measured volume to between 10 ... 100 ml) Send the FCU to HYDAC for repair.</td>
</tr>
<tr>
<td>Flow rate error!</td>
<td>The flow through the particle sensor is lower than the minimum value of 20 ml/min required to take measurements.</td>
<td>Turn the flow control valve clockwise until measurement operation starts.</td>
</tr>
<tr>
<td>Flow rate error!</td>
<td>The flow through the particle sensor is higher than the maximum value of 80 ml/min permitted to take measurements.</td>
<td>Turn the flow control valve counterclockwise until measurement operation starts.</td>
</tr>
<tr>
<td>Flow rate error!</td>
<td>The internal filter is contaminated. Because of the inlet pressure of &lt;2 bar, the &quot;Filter contaminated&quot; fault message is not issued.</td>
<td>Replace the FCU filter element.</td>
</tr>
<tr>
<td>Filter contaminated</td>
<td>The internal protection filter for the flow control valve of the FCU is exhausted.</td>
<td>Replace the FCU filter element.</td>
</tr>
<tr>
<td>Internal printer not</td>
<td>Paper roll empty</td>
<td>Insert a new roll of paper.</td>
</tr>
<tr>
<td>ready</td>
<td>Printer fault</td>
<td>Send the FCU to HYDAC for repair.</td>
</tr>
<tr>
<td>Error message</td>
<td>Cause(s)</td>
<td>Remedy</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>--------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Error in selected language</td>
<td>The last language selected and stored in the FCU has been changed due to an internal fault. The internal back-up battery is dead.</td>
<td>Download the FCU languages to the FCU again using the PC software package FluMoS. If the fault recurs, send the FCU to HYDAC for repair.</td>
</tr>
<tr>
<td>Reload languages</td>
<td>The internal memory for languages has been partially changed due to an internal fault. The internal back-up battery is dead.</td>
<td>Download the FCU languages to the FCU again using the PC software package FluMoS. If the fault recurs, send the FCU to HYDAC for repair.</td>
</tr>
<tr>
<td>Calibration defect</td>
<td>The calibration values in the EEPROM have been altered due to electrical interference.</td>
<td>Send the FCU to HYDAC for repair.</td>
</tr>
<tr>
<td>Device ID defect</td>
<td>Internal device designations in the EEPROM have been altered due to electrical interference.</td>
<td>No measures required, as these values do not affect the FCU function. Send the FCU to HYDAC for repair.</td>
</tr>
<tr>
<td>BSU connected</td>
<td>You are trying to start a MODE M1 ... M4 for online operation although a BSU is connected.</td>
<td>Select a mode for BottleSampling operation.</td>
</tr>
<tr>
<td>No BSU</td>
<td>You are trying to start a MODE M5 or M6 although no BSU is connected or detected.</td>
<td>Check if the plug of the BSU is plugged into the FCU -&gt; insert the plug into the CONTROL port of the FCU. Check if the BSU is switched on -&gt; switch the BSU on. If the error is still present, the BSU is defective. Contact HYDAC.</td>
</tr>
<tr>
<td>No BS reports selected</td>
<td>You are trying to print a report that was not generated with the BottleSampling Unit.</td>
<td>Select a suitable report in the menu &quot;Print / Reports&quot; to print out.</td>
</tr>
<tr>
<td>Error message</td>
<td>Cause(s)</td>
<td>Remedy</td>
</tr>
<tr>
<td>---------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| Laser sensor error | The monitoring of the transmitting current in the laser sensor has tripped. Either the measurement cell is blocked or there is air in the measurement cell. In Bottle Sampling operation, this message can occur between the analysis of the sample bottles more often, because depending on can run dry on the viscosity of investigated sample and the time interval of the laser sensor. | **Online operation:** Make sure that fluid flows through the sensor (check pressure port connection and position of the flow control valve). Once the FCU has been switched off and on again, the error should no longer appear. If no flow rate can be set via the sensor, perform a backflush to eliminate the blockage. If fluid flows through the sensor and the error recurs, send the FCU in for repair.  
**BottleSample operation:** Acknowledge the error message with the OK button and start a new measurement. If the message repeats during the following measurements, backflush the FCU to eliminate the error (possibly a blockage). If fluid flows through the sensor and the error recurs, send the FCU in for repair. |
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.

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.

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 19 mm 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**

1. 
2. 
3. 
4. 
5. 
6. 
7. 
8.
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 electronical 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

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

Dispose of used cleaning agents and flushing oils properly.

Storage conditions

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

Calibrating the FCU

We recommend that the FCU be recalibrated every year. 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
Telephone: +49 (0) 6897 509 883
Fax: +49 (0) 6897 509 324
E-Mail: service@hydac.com

USA

HYDAC Technology Corporation, HYCON Division
2260 City Line Road
USA-Bethlehem, PA 18017
P.O. Box 22050
USA-Lehigh Valley, PA 18002-2050
Telephone: +1 (0) 610 266 0100
Fax: +1 - 610 - 2 31-04 45
E-Mail: sales@hydacusa.com
Internet: www.hydacusa.com

Australia

HYDAC Pty. Ltd.
109 Dohertys Road
P.O. Box 224
AUS-3025 Altona North
Telephone: +61 - 3 - 92 72 89 00
Fax: +61 - 3 - 93 69 89 12
E-Mail: info@hydac.com.au
Brazil

HYDAC TECNOLOGIA LTDA
Estrada Fukutaro Yida, 225
CEP 09852-060
Cooperativa
BR-São Bernardo do Campo – SÃO PAULO
Telephone: +55 - 11 - 4393.6600
Fax: +55 - 11 - 4393.6617
E-Mail: hydac@hydac.com.br
Homepage www.hydac.com.br

China

HYDAC TECHNOLOGY (SHANGHAI) LIMITED
28 Zhongpin Lu
Shanghai Minhang Economic &
Technological Development Zone
SHANGHAI 200245; P.R. CHINA
Telephone: (0086) 21/64 63 35 10
Fax: (0086) 21/64 30 02 57
E-Mail: hydacsh@hydac.com.cn
## Spare parts

### FCU 8xx0 (version for mineral oil)

<table>
<thead>
<tr>
<th>Part no.</th>
<th>Article designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>349154</td>
<td>Filter element replacement set, consisting of: 1x filter element, 1x O-ring, 1x support ring</td>
</tr>
<tr>
<td>1260891</td>
<td>Filter element</td>
</tr>
<tr>
<td>6003720</td>
<td>High-pressure measuring hose, DN 2, 5000 mm long</td>
</tr>
<tr>
<td>682859</td>
<td>High-pressure measuring hose, DN 2, 2000 mm long</td>
</tr>
<tr>
<td>349151</td>
<td>Return-line hose, DN 7, 2000 mm long</td>
</tr>
<tr>
<td>1251558</td>
<td>Return-line hose, DN 7, 5000 mm long</td>
</tr>
</tbody>
</table>

### FCU 8xx1 (version for HFD fluids)

(Example: Skydrol, Fyrquel, Hyjet)

<table>
<thead>
<tr>
<th>Part no.</th>
<th>Article designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>349432</td>
<td>Filter element replacement set, consisting of: 1x filter element, 1x O-ring, 1x support ring (HFD-R fluids)</td>
</tr>
<tr>
<td>1262608</td>
<td>Filter element (HFD-R fluid)</td>
</tr>
<tr>
<td>682859</td>
<td>High-pressure measuring hose DN 2, 2000 mm long (HFD-R fluid)</td>
</tr>
<tr>
<td>349434</td>
<td>Return hose DN 7, 2000 mm long (HFD-R fluid)</td>
</tr>
</tbody>
</table>
### FCU 8xxx

<table>
<thead>
<tr>
<th>Part no.</th>
<th>Article designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>349204</td>
<td>Connecting cable FCU – PC</td>
</tr>
</tbody>
</table>
| 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, 2000 mm long |
| 6008447 | Connecting cable for power supply  
Plug for UK, 2000 mm long |
| 6008446 | Connecting cable for power supply  
Plug for USA, 2000 mm long |
| 6008449 | Connecting cable for power supply  
Plug for AUS, 2000 mm long |

### Accessories

<table>
<thead>
<tr>
<th>Part no.</th>
<th>Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>3040342</td>
<td>BottleSampling Unit BSU 8000-1-K (120 V / 60 Hz)</td>
</tr>
<tr>
<td>349785</td>
<td>BottleSampling Unit BSU 8000-1-M (230 V / 50 Hz)</td>
</tr>
<tr>
<td>3051675</td>
<td>BottleSampling Unit BSU 8000-1-O (240 V / 50 Hz)</td>
</tr>
</tbody>
</table>
| 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) |
| 1204502  | FCU back-flushing kit (HFD fluid 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) |
Explanation of the measuring technology terms used

Single measurement: This refers to the analysis of the contamination of a specified sample quantity (measurement volume). The result of a single measurement is the measured value.

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.

Example: pump press W3

Measurement volume: Sample quantity which is analyzed for determining a measured value. (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 single measurement begins, followed immediately upon completion by the next single measurement until the "STOP" - key is pressed (mode M1, M2, M4) or the target cleanliness (mode M3) is reached.

This series of single measurements is referred to as a measurement for convenience reasons.

Log: A measurement is described by a log. It is comprised of the log header and the log lines. 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 measurement point (can be entered by the user), date + time of the beginning and end of the measurement sequence (generated automatically)

Averaging interval

Number of log lines: Measurement volume

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 log line 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 µm(c), >6 µm(c) and >14 µm(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:

<table>
<thead>
<tr>
<th>Class</th>
<th>More than</th>
<th>Up to (and including)</th>
<th>Class</th>
<th>More than</th>
<th>Up to (and including)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>1</td>
<td>15</td>
<td>16.000</td>
<td>32.000</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>2</td>
<td>16</td>
<td>32.000</td>
<td>64.000</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>4</td>
<td>17</td>
<td>64.000</td>
<td>130.000</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>8</td>
<td>18</td>
<td>130.000</td>
<td>250.000</td>
</tr>
<tr>
<td>4</td>
<td>8</td>
<td>16</td>
<td>19</td>
<td>250.000</td>
<td>500.000</td>
</tr>
<tr>
<td>5</td>
<td>16</td>
<td>32</td>
<td>20</td>
<td>500.000</td>
<td>1.000.000</td>
</tr>
<tr>
<td>6</td>
<td>32</td>
<td>64</td>
<td>21</td>
<td>1.000.000</td>
<td>2.000.000</td>
</tr>
<tr>
<td>7</td>
<td>64</td>
<td>130</td>
<td>22</td>
<td>2.000.000</td>
<td>4.000.000</td>
</tr>
<tr>
<td>8</td>
<td>130</td>
<td>250</td>
<td>23</td>
<td>4.000.000</td>
<td>8.000.000</td>
</tr>
<tr>
<td>9</td>
<td>250</td>
<td>500</td>
<td>24</td>
<td>8.000.000</td>
<td>16.000.000</td>
</tr>
<tr>
<td>10</td>
<td>500</td>
<td>1.000</td>
<td>25</td>
<td>16.000.000</td>
<td>32.000.000</td>
</tr>
<tr>
<td>11</td>
<td>1.000</td>
<td>2.000</td>
<td>26</td>
<td>32.000.000</td>
<td>64.000.000</td>
</tr>
<tr>
<td>12</td>
<td>2.000</td>
<td>4.000</td>
<td>27</td>
<td>64.000.000</td>
<td>130.000.000</td>
</tr>
<tr>
<td>13</td>
<td>4.000</td>
<td>8.000</td>
<td>28</td>
<td>130.000.000</td>
<td>250.000.000</td>
</tr>
</tbody>
</table>
Note: increasing the measurement reference by 1 causes the particle count to double.

Example: ISO class 18 / 15 / 11 means:

<table>
<thead>
<tr>
<th>Cleanliness class</th>
<th>Particle count / 100 ml</th>
<th>Size ranges</th>
</tr>
</thead>
<tbody>
<tr>
<td>18</td>
<td>130,000 – 250,000</td>
<td>&gt; 4 µm (c)</td>
</tr>
<tr>
<td>15</td>
<td>16,000 – 32,000</td>
<td>&gt; 6 µm (c)</td>
</tr>
<tr>
<td>11</td>
<td>1,000 – 2,000</td>
<td>&gt; 14 µm (c)</td>
</tr>
</tbody>
</table>

Are in 100 ml of the analyzed sample.

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

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 5 µm</td>
<td>&gt; 15 µm</td>
<td>&gt; 4 µm (c)</td>
</tr>
<tr>
<td>&gt; 15 µm</td>
<td></td>
<td>&gt; 6 µm (c)</td>
</tr>
<tr>
<td>&gt; 14 µm (c)</td>
<td></td>
<td>&gt; 14 µm (c)</td>
</tr>
</tbody>
</table>

Dimension determined:

<table>
<thead>
<tr>
<th>Longest dimension of a particle</th>
<th>Diameter of the area-equivalent circle ISO 11171:1999</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACFTD dust</td>
<td>ISO 12103-1A1</td>
</tr>
<tr>
<td>SAE Fine, AC Fine</td>
<td>ISO 12103-1A2</td>
</tr>
<tr>
<td>SAE 5-80 µm ISO MTD Calibration dust for particle counters</td>
<td>ISO 12103-1A3</td>
</tr>
<tr>
<td>SAE Coarse Coarse fraction</td>
<td>ISO 12103-1A4</td>
</tr>
</tbody>
</table>

Comparable size ranges:

<table>
<thead>
<tr>
<th>Old ACFTD calibration</th>
<th>Comparable ACFTD calibration</th>
<th>New NIST calibration</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 µm</td>
<td>&lt; 1 µm</td>
<td>4 µm (c)</td>
</tr>
<tr>
<td>15 µm</td>
<td>4,3 µm</td>
<td>6 µm (c)</td>
</tr>
<tr>
<td></td>
<td>15,5 µm</td>
<td>14 µm (c)</td>
</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th>Classes</th>
<th>Size ISO 4402</th>
<th>Size ISO 11171</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&gt; 1 µm</td>
<td>&gt; 5 µm</td>
</tr>
<tr>
<td></td>
<td>&gt; 4 µm(c)</td>
<td>&gt; 6 µm(c)</td>
</tr>
<tr>
<td></td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>000</td>
<td>195</td>
<td>76</td>
</tr>
<tr>
<td>00</td>
<td>390</td>
<td>152</td>
</tr>
<tr>
<td>0</td>
<td>780</td>
<td>304</td>
</tr>
<tr>
<td>1</td>
<td>1.560</td>
<td>609</td>
</tr>
<tr>
<td>2</td>
<td>3.120</td>
<td>1.220</td>
</tr>
<tr>
<td>3</td>
<td>6.250</td>
<td>2.430</td>
</tr>
<tr>
<td>4</td>
<td>12.500</td>
<td>4.860</td>
</tr>
<tr>
<td>5</td>
<td>25.000</td>
<td>9.730</td>
</tr>
<tr>
<td>6</td>
<td>50.000</td>
<td>19.500</td>
</tr>
<tr>
<td>7</td>
<td>100.000</td>
<td>38.900</td>
</tr>
<tr>
<td>8</td>
<td>200.000</td>
<td>77.900</td>
</tr>
<tr>
<td>9</td>
<td>400.000</td>
<td>156.000</td>
</tr>
<tr>
<td>10</td>
<td>800.000</td>
<td>311.000</td>
</tr>
<tr>
<td>11</td>
<td>1.600.000</td>
<td>623.000</td>
</tr>
<tr>
<td>12</td>
<td>3.200.000</td>
<td>1.250.000</td>
</tr>
</tbody>
</table>

### 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

<table>
<thead>
<tr>
<th>Cleanliness class</th>
<th>Particle count / 100 ml</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size A ( &gt; 1 µm / &gt; 4 µm(c))</td>
<td>100.000</td>
</tr>
<tr>
<td>Size B ( &gt; 5 µm / &gt; 6 µm(c))</td>
<td>38.900</td>
</tr>
<tr>
<td>Size C ( &gt; 15 µm / &gt; 14 µm(c))</td>
<td>3460</td>
</tr>
<tr>
<td>Size D ( &gt; 25 µm / &gt; 21 µm(c))</td>
<td>306</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Cleanliness class</th>
<th>Maximum particle count / 100 ml</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2…5 µm</td>
</tr>
<tr>
<td>00</td>
<td>625</td>
</tr>
<tr>
<td>0</td>
<td>1.250</td>
</tr>
<tr>
<td>1</td>
<td>2.500</td>
</tr>
<tr>
<td>2</td>
<td>5.000</td>
</tr>
<tr>
<td>3</td>
<td>10.000</td>
</tr>
<tr>
<td>4</td>
<td>20.000</td>
</tr>
<tr>
<td>5</td>
<td>40.000</td>
</tr>
<tr>
<td>6</td>
<td>80.000</td>
</tr>
<tr>
<td>7</td>
<td>160.000</td>
</tr>
<tr>
<td>8</td>
<td>320.000</td>
</tr>
<tr>
<td>9</td>
<td>640.000</td>
</tr>
<tr>
<td>10</td>
<td>1.280.000</td>
</tr>
<tr>
<td>11</td>
<td>2.560.000</td>
</tr>
<tr>
<td>12</td>
<td>5.120.000</td>
</tr>
<tr>
<td>13</td>
<td>10.240.000</td>
</tr>
<tr>
<td>14</td>
<td>20.480.000</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Measured value display</th>
<th>Continuous view in LCD display</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-diagnosis</td>
<td>Continuous self-monitoring with error indication in LCD display</td>
</tr>
</tbody>
</table>
| Calibration            | FCU 81xx : ISO 4402 / NAS 1638  
FCU 82xx : ISO 11943 |
| Particle size channels:| **FCU 81xx**:  
2µm / 5µm / 15µm / 25µm / 50µm / 100µm  
**FCU 82xx**:  
4µm\(_{(c)}\) / 6µm\(_{(c)}\) / 14µm\(_{(c)}\) / 21 µm\(_{(c)}\) / 38µm\(_{(c)}\) / 70µm\(_{(c)}\) |
| Measurement range (calibrated): | **FCU 81xx**:  
NAS 0 … 12  
ISO 0 / 0 / 0 … 23 / 21 / 18  
**FCU 82xx**:  
SAE 0 … 12  
ISO 0 / 0 / 0 … 25 / 23 / 21 |
| Indication range:      | **FCU 81xx**:  
NAS 0 … 15  
ISO 0 / 0 / 0 … 25 / 23 / 21  
**FCU 82xx**:  
SAE 0 … 15  
ISO 0 / 0 / 0 … 25 / 23 / 21 |
| Recalibration          | Recommended: annually |
| Battery-buffered log memory | Up to 3000 measured values |
| Connectors, rear:      | INLET: Test point type 1620, DN2  
OUTLET: Plug nipple, DN7 |
<p>| INLET Operating Pressure | 1 … 350 bar |
| OUTLET Flow            | ~ 800 ml/min at 350 bar |
| Operating Pressure     | max. 3 bar counterpressure |
| Measurement flow rate  | 20 … 80 ml/min |
| Permissible viscosity range | 5 … 800 mm(^2)/s |
| Fluid temperature range | 0 … +70° C / 32 … 158° F |</p>
<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Voltage</td>
<td>24 V DC, ± 25%</td>
</tr>
<tr>
<td>Power consumption</td>
<td>25 Watt max.</td>
</tr>
<tr>
<td>Battery-powered operating duration</td>
<td>~ 6 hours (online pressure off)</td>
</tr>
<tr>
<td>Built-in printer</td>
<td>Dot-matrix printer</td>
</tr>
<tr>
<td>Serial interface</td>
<td>RS 232 (for models /-BUS: RS 485) with 15-pin Sub D plug</td>
</tr>
<tr>
<td>Ambient temperature range</td>
<td>0 … +55° C / 32 … 131° F</td>
</tr>
<tr>
<td>Storage temperature range</td>
<td>-20 … +80° C / -4° … +185° F</td>
</tr>
<tr>
<td>Relative humidity</td>
<td>max. 90%, non-condensing</td>
</tr>
<tr>
<td>Protection class</td>
<td>II (double insulated)</td>
</tr>
<tr>
<td>IP Class</td>
<td>IP40</td>
</tr>
<tr>
<td>Weight</td>
<td>~ 14 kg</td>
</tr>
</tbody>
</table>
## Factory default settings

<table>
<thead>
<tr>
<th>POWERUP Menu</th>
<th>FCU 81xx</th>
<th>FCU 82xx</th>
</tr>
</thead>
<tbody>
<tr>
<td>M6: BS draining</td>
<td>30 s</td>
<td>30 s</td>
</tr>
<tr>
<td>M6: Compressor</td>
<td>30 s</td>
<td>30 s</td>
</tr>
<tr>
<td>M6: Compressed air</td>
<td>5 s</td>
<td>5 s</td>
</tr>
<tr>
<td>Language</td>
<td>German</td>
<td>German</td>
</tr>
<tr>
<td>Viscosity range</td>
<td>5 … 1000 mm²/s</td>
<td>5 … 1000 mm²/s</td>
</tr>
<tr>
<td>Test volume</td>
<td>100 ml</td>
<td>100 ml</td>
</tr>
</tbody>
</table>

| MEMORY Menu | | |
|-------------|-------------|
| Meas. point | HYDAC FCU 8110 | HYDAC FCU 8210 |
| Averaging interval | 0 min | 0 min |
| Memory mode | Overwrite | Overwrite |

| PRINT menu | | |
|-------------|-------------|
| Online printout | ON | ON |
| Printout format | List | List |
| Printout of | Particles | Particles |
| Log duration | 1 h / page (30 cm) | 1 h / page (30 cm) |

| SETUP menu | | |
|-------------|-------------|
| Autostart | No | No |
| Autostart function | M1: Measure | M1: Measure |
| Abort at Q=0 | No | No |
| Pump start delay | 0 seconds | 0 seconds |
| Bus address | 1 | 1 |
| BS pressure supply | Compressor | Compressor |
| Additional test | No | No |

| LIMITS Menu | | |
|-------------|-------------|
| M2: R1 Measurement channel | Flow rate | Flow rate |
| M2: R1 Switching function | No function | No function |
| M2: R1 Limit values, below | 30 ml | 30 ml |
| M2: R1 Limit values, above | 70 ml | 70 ml |
| M2: R2 Measurement channel | Flow rate | Flow rate |
| M2: R2 Switching function | No function | No function |
| M2: R2 Limit values: below | 30 ml | 30 ml |
| M2: R2 Limit values, above | 70 ml | 70 ml |
| M3: Limit values | 5/5/5 NAS | 17/14/11 ISO |
| M4 Limit values, below | 5/5/5 NAS | 17/14/11 ISO |
| M4 Limit values, above | 10/10/10 NAS | 23/19/16 ISO |
| M4: Test cycle time | 120 min | 120 min |
| M5: Flushing volume | 50 ml | 50 ml |
| M6: Pre-run volume | 10 ml | 10 ml |
| M6: Measurement volume | 100 ml | 100 ml |
| M6: Measurements / sample | 4 | 4 |
| M6: Dilution | 1:0 | 1:0 |