
HYDAC INTERNATIONAL
FluidControl Unit
FCU 2010/FCU 2110
HYDAC
FluidControl Unit
E 7.602.2/10.02

1. OIL CONDITION MONITORING AND OIL SERVICING

1.1. THE CONCEPT

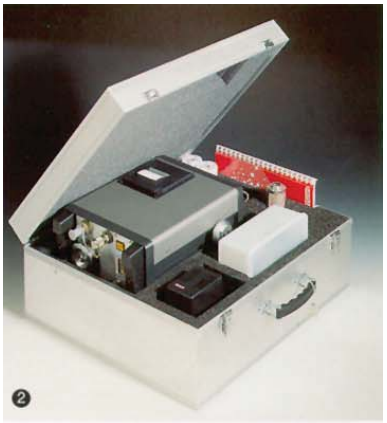
For hydraulic systems and lubrication systems to operate reliably it is imperative that the operating fluid is in perfect condition. Today, it is a well-known fact that 70 - 80 % of the breakdowns of hydraulic systems are caused by too much contamination in the operating fluid. In practice, there is one recurring main factor which affects the fluid:

- contamination due to **solid particles**.

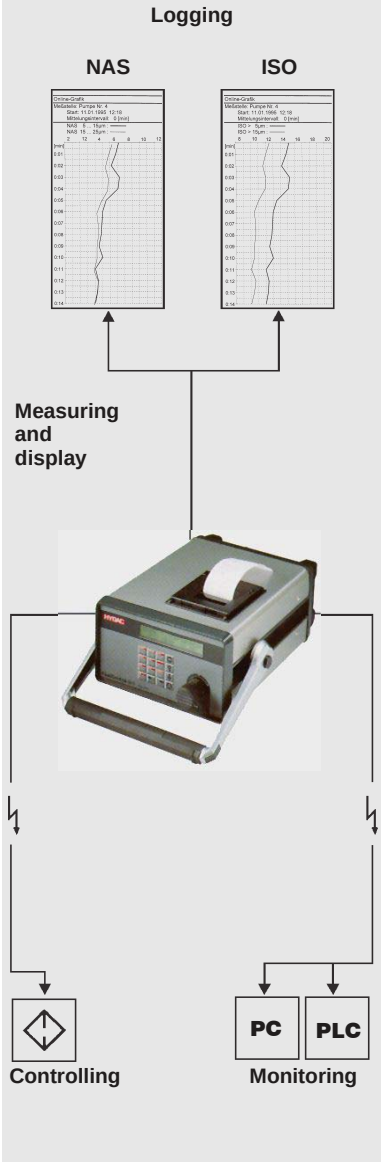
These are responsible for component wear and tear but can also lead to the breakdown of a system.

If this contamination condition is systematically monitored, a considerable increase in the reliability, service life and economy of a system can be achieved by carrying out specific oil servicing measures.

It follows that the key to preventative maintenance and comprehensive quality assurance procedures is to record the actual solid particle contamination on-line in the system.



FluidControl Unit FCU 2010
Measuring, logging, controlling, monitoring.



❶ FCU 2010

❷ FCU case incl. accessories

❸ PC software package FCUDESK

❹ KE 1310

❺ OF5C20 (OF5 with FCU 2010)

❻ FCU 2010 in a mobile application

❼ FCU 2010 on a power unit

❽ FCU 2010 during a flushing operation

❾ FCU 2010 in a test room

1.2. THE APPLICATIONS

Application	Task	Fluid Control System
1. Power units or hydraulic systems, in pressure lines up to 350 bar	– sporadic checks during operation	FCU 2010 FCU 2110
	– during flushing operations after delivery or during commissioning	
	– logging the oil cleanliness before delivery or during commissioning	
2. Hydraulic systems, tank extraction	– as a permanent installation for continuous or sporadic checks	FCU 2010 FCU 2110 KE 1310
Off-line circuit	– as a permanent installation for continuous checks	FCU 2030 FCU 2130
Tank	– for cleaning the oil via off-line units	OF5 with FCU 2010 OF5 with FCU 2110
3. Lubricating oil systems	– as a permanent installation for continuous checks	FCU 2030 FCU 2130
Pressure circuit	– sporadic checks during operation	FCU 2010 FCU 2110
4. Test rig or test room	– sporadic checks of the test rig oil	FCU 2010 FCU 2110
	– permanent checks	FCU 2030 FCU 2130
	– for cleaning via off-line unit	OF5 with FCU 2010 OF5 with FCU 2110
5. Function tests, final inspection, test runs of machines, systems	– machine tools	FCU 2010 FCU 2110
	– mobile vehicles	
	– injection moulding machines	
	– transmissions, etc.	

1.3. THE TOOL:
FCU 2010

The FluidControl Unit FCU 2010 was designed as a portable, robust and easy-to-operate unit specially for this purpose.

The FCU 2010 records the **solid particle contamination** according to the optical **light blockage principle** which is also commonly followed in laboratory measuring technology.

In contrast to laboratory units, however, with the FCU 2010 it is possible to carry out **continuous on-line measurements** directly on the pressure lines.

This means that there are 3 major advantages over the conventional practice of particle counting using sample bottles:

- no measuring errors due to incorrect sampling as the particles are measured directly from the oil flow
- no waiting times for an expensive external laboratory analysis.
- variations in contamination can be detected over time

With the HYDAC FluidControl Unit FCU 2010, on the other hand, the solid particle contamination is recorded simply, quickly, accurately and, above all, repeatably.

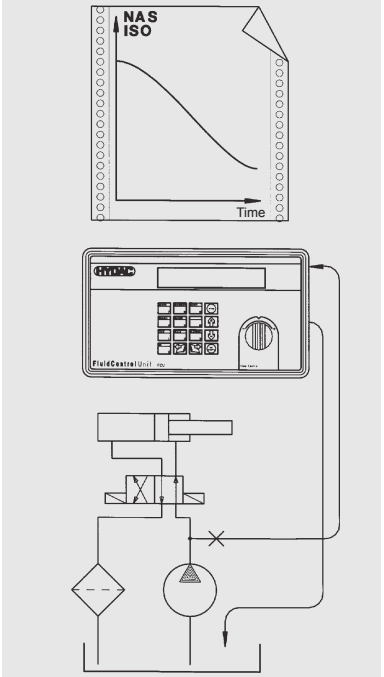
The FCU 2010 can be connected directly to available test points (up to 350 bar) on the system to be tested.

Depending on the particular application, the unit can be combined with a pump. This gives the advantage that, according to requirement, the level of contamination can be checked, stored and logged at almost any point in the pressurised range as well as in the non-pressurised range.

Now also available:

- FCU 2110
with 3 digit ISO code display
(> 2/ > 5/ > 15 µm)
- FCU 2030, FCU 2130
19" panel mounted model
for permanent installation.
- all models are also available in a version that is suitable for use with phosphate ester.

Simple hydraulic connection; continuous measurement and logging



1.4. THE CONTROL FUNCTIONS

As its name already suggests, the FluidControl Unit FCU 2010 offers, in addition, many control functions which extend well beyond a "mere" measuring unit.

As the FCU 2010 was strictly developed for use in automated applications, in addition to the measuring possibilities previously described, it comprises the following control elements:

- **two relay outputs** which can be programmed as **limit switches, if required**. This enables, for example, units to be controlled automatically on test rigs.
- two **special modes of operation** for direct, simple control of **filtration units** dependent on the measurement result.
- a **serial interface**.

With the optional PC software package FCUDESK the FCU 2010 can be operated completely remotely and, moreover, measured values can be stored or further processed using MS-EXCEL®.

For incorporation into automatic test rigs, etc. this interface can also optionally be configured as a **field bus in accordance with DIN MESSBUS standard**.

This means that, for example, it is possible for up to 31 measuring units to communicate simultaneously with one central computer.

The HYDAC FCU 2010 has the following features:

- on-line measuring procedure in accordance with international standards (ISO 4406, NAS 1638).
- continuous measurement, automatic, even without operating staff.
- optional output of the cleanliness classes to ISO 4406 and NAS 1638.
- The contamination measurement is practically independent of the colour of the fluid or the basic turbidity due to the use of patented semi-conductor infra-red diode technology together with electronic compensation.
- robust and portable unit for industrial field applications, even in the case of heavily contaminated fluids.
- large data memory to store the measured values (up to 3000).
- logging by means of a variety of print-outs, tabular and graphical.

Operation also with:

- rechargeable batteries
- 24 V DC
- mains supply

- evaluation and archiving of measurements is also possible by means of the optional PC software "FCUDESK for Windows" or standard spreadsheet programs, e.g. MS-EXCEL®.
- control of filtration units depending on the measurement result.
- clear, easy-to-read display
- extremely easy to operate
- safe, fast connection to hydraulic or lubricating oil units via the standard Minimess connections
- monitoring and logging of measures within the framework of a quality assurance system to DIN/ISO 9000 ff.

2. THE FLUIDCONTROL UNIT FCU 2010

2.1. DESCRIPTION

The FluidControl Unit FCU 2010 comprises in one single unit:

- hydraulic conditioning
- complete set of sensors
- evaluation electronics.

The hydraulic conditioning adapts the hydraulic conditions prevailing at the measuring point to the values required by the FCU 2010. This means that a very wide application range is possible, namely pressures of 1 - 350 bar and viscosities of 5 - 1000 cSt.

The sensors record the contamination particles in the oil.

Finally, the evaluation electronics prepare the measured values with the aid of a microcomputer and display the measurement results via the display and operating panel.

At the heart of the FCU 2010 is a fibre-optic sensor which operates according to the light blockage principle. This sensor technology is adapted to the particle size spectrum in the hydraulics. The same principle is followed in the commonly used particle counters for laboratories.

This sensor was designed specially for rough industrial applications and is resistant to interference, clogging and vibrations.

The prepared data is displayed as an individual result in the easy-to-read display panel of the FCU 2010 in accordance with international standards ISO 4406 or NAS 1638.

At the same time, the average value of the last 10 measurements is shown (FCU 2010 only).

Up to 3000 individual measurements are saved in a data memory and can be called up, when required, in the form of a graph or a table.

This can be carried out by means of:

- the built-in printer
- an external EPSON/IBM or HP-compatible printer
- the RS 232 interface with the optional PC software package FCUDESK. The data can also be subsequently further processed in MS-EXCEL®.

In addition to the customary data recording and storage, the FCU 2010 also offers the possibility of carrying out direct control functions. For this, various modes are available, e.g. filtration until a pre-selected cleanliness class is achieved or: constant checking of the cleanliness level and filtration when required.

The particular units such as, for example, filtration units, are controlled via relay contacts.

The returning fluid can be fed back into the system via several connection possibilities or collected in suitable containers.

2.2. PERFORMANCE FEATURES

- on-line measuring procedures
- connection of the measuring system via standard test points with threaded coupling
- fast, automatic data acquisition and output (40 s - 120 s)
- display of the cleanliness classes to international standards ISO 4406 or NAS 1638
- display of the current measured value
- display of the average value of the last 10 measurements (FCU 2010 only)
- trend display
- large operating pressure and viscosity range
- particle sensor largely resistant to clogging
- robust metal housing
- CE conformity
- a variety of logging methods:
  - memory print-out
  - on-line continuous log
  - tabular format
  - graphical format
- measured value memory for up to 3000 measurements (backed up by battery)
- error and warning display (intrinsic control)
- control of peripheral units via relay contacts
- RS 232 interface for data transfer to a PC
- different modes of operation can be selected
- automatic continuous measuring of the cleanliness class
- continuous measuring until a pre-selected cleanliness class is reached (e.g. during flushing)
- continuous measuring with control of peripheral units (filtration units) in a pre-selected range of the cleanliness class (e.g. in off-line filtration with fluctuating system contamination).

2.3. TECHNICAL SPECIFICATIONS FLUIDCONTROL UNIT FCU 2010/FCU 2110

2.3.1 **Measured value display**
Continuous display via LCD, 2 lines each having 20 characters:

a)

FCU 2010	FCU 2110
NAS (5-15 µm) Class 2…12	NAS (2-5 µm) Class 2…12
NAS (15-25 µm) Class 4…12	NAS (5-15 µm) Class 2…12
NAS (25-50 µm) Class 6…12	NAS (15-25 µm) Class 4…12
NAS (> 50 µm) Class 6…12	NAS (> 25 µm) Class 6…12
ISO Class 10/9…24/21	ISO Class 12/10/9..25/23/21

b) Average value display of the last 10 measurements (FCU 2010 only)

c) Trend display given by arrow pointing upwards or downwards

d) Display of mode of operation

e) Display of sensor flow rate

f) Display of the expired measuring time in %

2.3.2 **Measuring time**
Dependent on sensor flow rate, a new measured value is displayed every 40 to 120 seconds.

2.3.3 **Test point**
High pressure measuring hose DN4 with threaded coupling M16x2 (system Minimess 1620)

2.3.4 **Permissible sensor flow rate**
50 ml/min to 150 ml/min

2.3.5 **Max. total flow rate**
800 ml/min at 350 bar

2.3.6 **Permiss. viscosity range**
5 ... 1000 mm²/s (4500 sus)

2.3.7 **Permiss. pressure range**
1 - 350 bar (15 - 5000 psi)

2.3.8 **Permiss. fluid temperature range**
0 ... +70 °C (30 ... 160 °F)

2.3.9 **Inputs and outputs**
2 relay outputs
maximum load 2 A

1 parallel interface for EPSON/IBM or HP-compatible printer

1 serial interface RS232

2.3.10 **Data memory**
for up to 3000 measurements, back-up provided by separate lithium batteries

2.3.11 **Weight**
approx. 12.4 kg

2.3.12 **Model code**

FCU 2 1 1 0 - 1 - M

Unit
FCU = FluidControl Unit

Resolution
2 = 4 particle size channels

Type
0 = ISO code (>5/>15/>25/>50 µm)
1 = ISO code (>2/>5/>15/>25µm)
2 = ISO code (>4/>6/>14/>21µm)

Housing
1 = portable
3 = 19" panel mounted

Media
0 = for mineral oil
1 = for phosphate esters

Options
1 = standard, without options

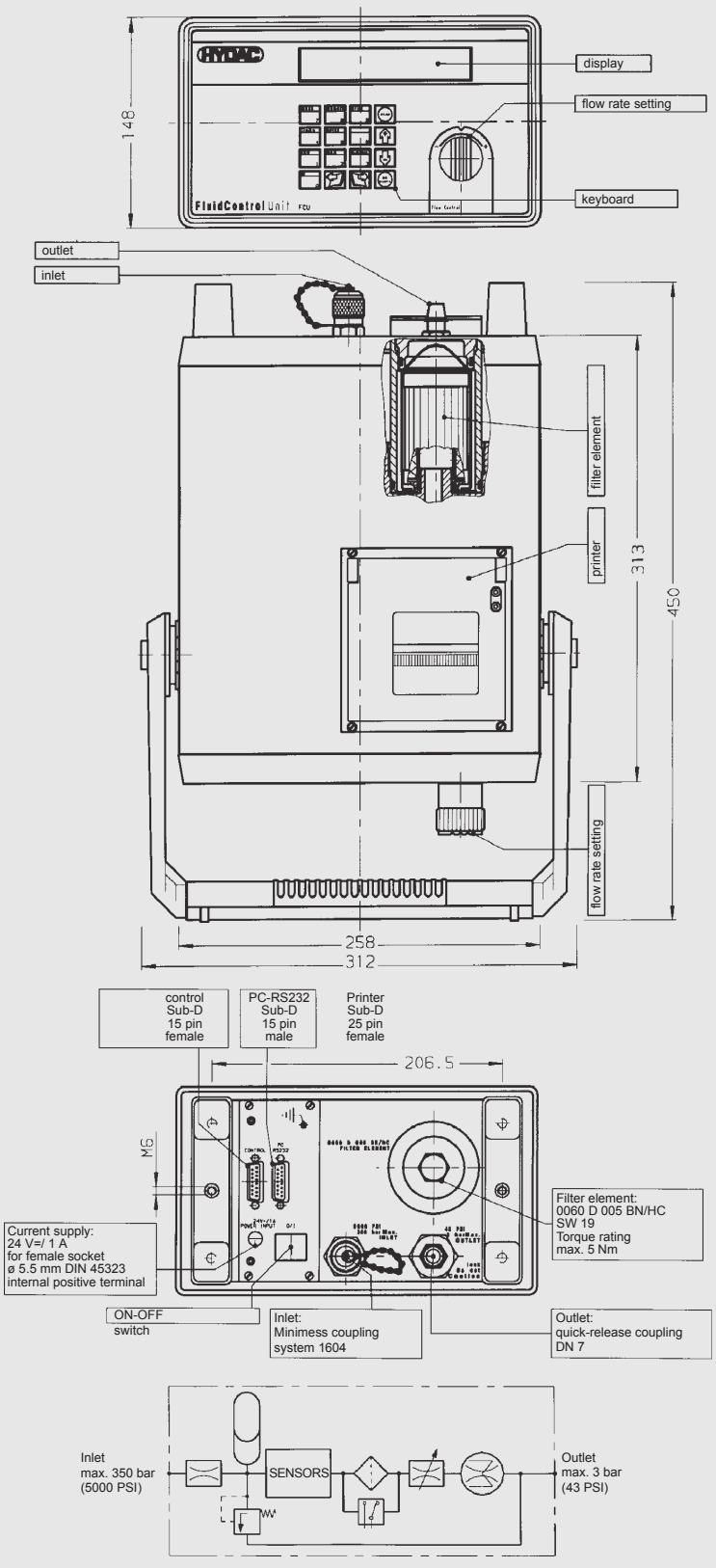
Supply voltage
K = 120 V AC/ 60 Hz USA/CDN
M = 230 V AC/ 50 Hz Europe
N = 240 V AC/ 50 Hz UK
O = 240 V AC/ 50 Hz Australia
P = 100 V AC/ 50 Hz Japan

Accessories on request:
Aluminium case

Order designation:
Travel case for FCU 2010/2110

Stock number:
349 153

2.3.13 **Dimensions FCU 2010**



2.4. TECHNICAL SPECIFICATIONS CONDITIONING UNIT KE 1310

The conditioning unit KE1310 is a special self-priming gear pump for connecting the FCU 2010 to non-pressurised reservoirs.

2.4.1 **Suction connection**
Male probe DN 7 for supplied suction hose

2.4.2 **Test point to FCU 2010**
Measuring coupling M16x2 (system Minimess 1620) for connecting the FCU 2010's measuring hose

2.4.3 **Viscosity range**
20 - 800 mm²/s (3800 sus)

2.4.4 **Max. operating pressure**
13.5 bar (190 psi)

2.4.5 **Flow rate**
0.5 l/min at 5 bar, 100 mm²/s

2.4.6 **Permiss. fluid temperature range**
0 ... +70 °C (30 ... 160 °F)

2.4.7 **Weight**
4.5 kg

2.4.8 **Model code**

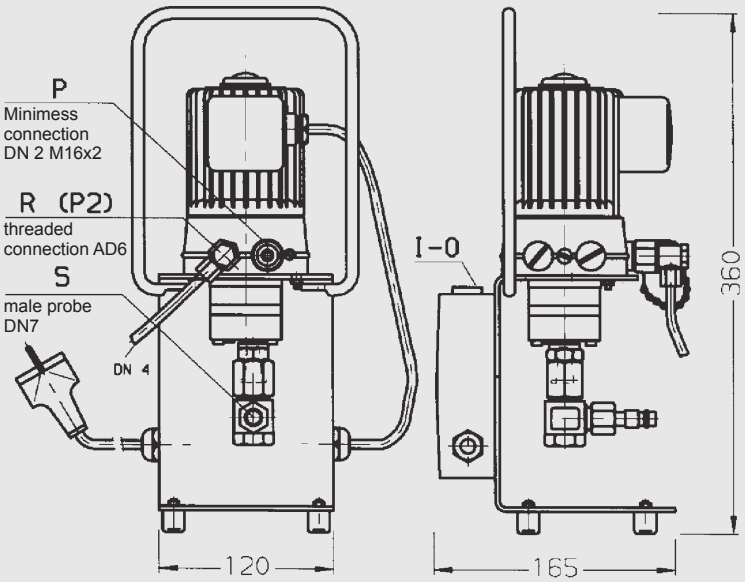
KE 1310 - M

Unit
Conditioning unit

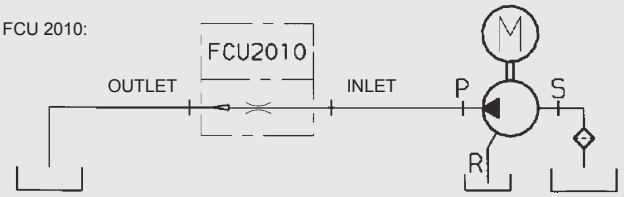
Type
1310 – portable

Supply voltage
K – 110 V, 50 Hz / 60 Hz, 1-phase
M – 230 V, 50 Hz (standard), 1-phase
N – 230 V / 400 V, 50 Hz, 3-phase

2.4.9 **Dimensions KE 1310**



Connection to FCU 2010:



2.5. PRINT-OUT OF THE MEASUREMENT RESULTS WITH THE FCU 2010

The large memory capacity of the FCU 2010 enables it to store up to 3000 measurements.

For the print-out of measurement ranges it is important to have easy access to the memory. Therefore, with the FCU 2010 the memory can be searched under different criteria:

- date of the measurement
- name of the measurement point (can be selected alphanumerically)
- number of the measurement (consecutive numbering).

This means that individual measurements can be called up and printed out very easily.

Both the measured values stored by the FCU 2010 and the values displayed on-line can be printed out in several ways:

There is a choice of:

- a continuous on-line log print-out, both in tabular as well as in graphical format. This is highly suitable for monitoring flushing processes.
- print-out of an individual measured value directly after the measurement on request.
- print-out of a complete log after the completion of a measurement range on request.
- print-out of a graph after the completion of a measurement range on request.

The measured values are printed out in accordance with the classification to NAS code 1638 and ISO standard 4406.

With long-term measurements, the measurement range may need to be condensed when the values are printed out.

This is possible by inputting an "averaging interval" from 1 min up to 24 h. In this case, once this time has expired, only the average values of all values measured during this interval are stored and printed.

This is important when the FCU 2010 is incorporated as part of a quality assurance system, e.g. in a test room.

The FCU 2010 also offers the possibility of printing out the measured values as a curve over a time axis.

The classification of this curve can be selected, i.e. to NAS or ISO standard.

Memory log: 18 — Page: 1

Measurement point	from	to
TKD 1996	08.06.1996 9:48	08.06.1996 11:02
No. of log lines: 75	Duration of log: 1:14	Averaging interval: 1 min

Time [h:m]	NAS [µm] 5-15	15-25	25-50	>50	ISO >5µm/>15µm	Q [ml]
0:00	13	14	14	11	22/ 19	100
0:01	13	13	13	10	22/ 19	100
0:02	11	10	11	08	19/ 16	100
0:03	10	09	10	07	18/ 15	100
0:04	09	09	09	06	17/ 15	100
0:05	09	08	08	<06	17/ 14	100
0:06	08	08	08	<06	16/ 14	100
0:07	08	08	08	<06	16/ 13	100
0:08	08	07	08	<06	16/ 13	100
0:09	08	07	07	<06	16/ 13	100
0:10	07	07	07	<06	16/ 13	100
0:11	07	07	07	<06	16/ 13	100
0:12	07	07	07	<06	16/ 13	100
0:13	08	07	08	<06	16/ 13	100
0:14	07	07	07	<06	16/ 13	100
0:15	07	07	08	<06	15/ 13	100
0:16	07	07	07	<06	15/ 13	100
0:17	07	07	07	<06	15/ 13	100
0:18	07	07	07	<06	15/ 13	100
0:19	07	07	07	<06	15/ 13	100
0:20	07	07	07	<06	15/ 13	100
0:21	07	07	07	<06	15/ 13	100
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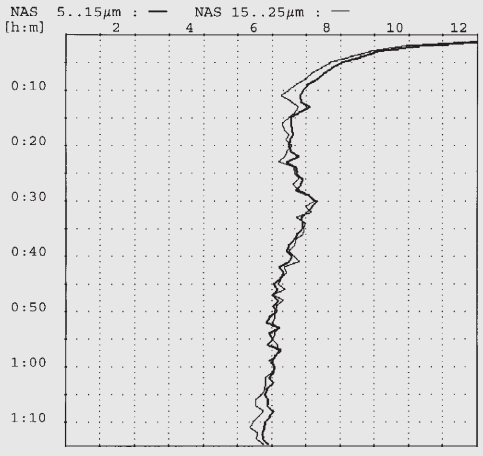
0:26	07	07	08	<06	16/ 13	99
0:27	07	07	08	<06	16/ 13	99
0:28	07	07	08	<06	16/ 13	99
0:29	08	08	08	<06	16/ 13	99
0:30	08	08	08	06	16/ 14	99
0:31	08	07	08	<06	16/ 13	99
0:32	08	08	08	<06	16/ 13	99
0:33	07	07	08	<06	16/ 13	99
0:34	07	07	08	<06	16/ 13	99
0:35	07	07	08	<06	16/ 13	100
0:36	07	07	08	<06	16/ 13	100
0:37	07	07	08	<06	15/ 13	99
0:38	07	07	08	<06	15/ 13	99
0:39	07	07	07	<06	15/ 13	99
0:40	07	07	08	<06	15/ 13	99
0:41	07	07	08	<06	15/ 13	99
0:42	07	07	08	<06	15/ 13	99
0:43	07	07	07	<06	15/ 13	99
0:44	07	07	07	<06	15/ 13	99
0:45	07	07	07	<06	15/ 13	99
0:46	07	07	07	<06	15/ 13	99

Memory graph: 18

Measurement point	from	to
TKD 1996	08.06.1996 9:48	08.06.1996 11:02
No. of log lines: 75	Duration of log: 1:14	Averaging interval: 1 min



2.6. ACCESSORIES - PC SOFTWARE FCUDESK FOR WINDOWS®

2.6.1 **Description**

The PC software package FCUDESK, available as an accessory, enables:

- the transfer of measured data from the memory of the FCU 2010 to a PC
- the on-line display and storage of FCU 2010 measurements on the PC
- the complete remote control of the FCU 2010 from the PC. This means that the settings for the FCU 2010 can first be entered on the PC so that measurements can also be started from the PC.

The software package consists of the program disks containing the FCUDESK program and a transfer cable for connection to the serial port of the PC.

FCUDESK uses the Windows user interface and is therefore very simple to operate.

All commands are incorporated into menus and the settings are entered via dialogue boxes. The program can be used both with a mouse and with a keyboard.

With the FCUDESK program it is possible to transfer measured values from the FCU 2010 to a personal computer and store them on a floppy disk or the hard disk. With the FCUDESK program the stored data can be viewed at any time as a table or as a graph or exported and further processed directly using MS-EXCEL®.

The program offers extensive possibilities for displaying the measured data on the PC screen, as is customary under Windows.

In this way, different measurement ranges can even be displayed simultaneously as a mixture of graphs and tables, optionally to NAS or ISO classification.

As well as displaying the measured values it is also possible to amend the settings of the FCU 2010 on the PC, save them on the PC and download them to the FCU 2010.

This simplifies the organisation and management of the measured data considerably.

2.6.2 **Applications**

Coupling the FCU 2010 with the PC and an added database application allows, within the framework of ISO 9000, the

- permanent monitoring of the oil quality in serial production test rigs or system test rigs
- permanent system monitoring over months and years to optimise the intervals between oil and filter changes
- optimum storage of control measurements within the framework of commissioning, servicing and maintenance of hydraulic and lubrication systems.

2.6.3 **System requirements**

The minimum requirements for FCUDESK are as follows:

- A computer with a 286, 386, 486 or Pentium processor which has installed on it Microsoft Windows version 3.x, Windows '95 or NT 4.0.
- 4 MB of RAM memory.
- An EGA, VGA, Super VGA or Hercules® graphics card, compatible with Microsoft Windows version 3.x Windows '95 or NT 4.0
- A hard disk with at least 7 MB free disk space.
- A 1.44 MB, 3½" floppy disk drive.
- A free serial interface with 9-pin plug to IBM-AT standard (COM1 or COM2).
- A Microsoft Windows-compatible mouse.

2.6.4 **FCU DESK 20XX**

- FCUDESK 20XX for FCU 2010, FCU 2011, FCU 2030, FCU 2031
- FCUDESK 21XX for FCU 2110, FCU 2111, FCU 2130, FCU 2131

3. FILTROMAT OF 5 WITH FCU 2010

3.1. APPLICATION

The HYDAC filtration unit, type OF 5, is used as a mobile unit for servicing and maintenance, but also for off-line filtration on hydraulic or lubricating oil units. Combining it with a FluidControl Unit, type FCU 2010, greatly increases the level of efficiency of the filtration unit.

The FCU 2010 constantly measures the level of contamination of the oil which, at the same time, is pumped by the filtration unit. A display shows the cleanliness class corresponding to the standards ISO 4406 or NAS 1638.

This provides many application possibilities:

- when filling a system with hydraulic fluids the oil is filtered, the current contamination class is displayed
- after filling, the tank contents can be filtered off-line, whereby the cleanliness class is constantly displayed
- the duration of cleaning using off-line filtration can be adapted exactly to the requirements, due to the combination of the filtration unit with the FCU 2010
- off-line filtration as thorough as necessary and as short as possible.

  However, the FluidControl Unit does not only measure the current oil cleanliness, it is also programmable and can therefore undertake control functions for the Filtromat OF 5. For example, it is possible to input the command to filter until a pre-selected cleanliness class is reached. Automatic filtration cycles can also be programmed.
- Switching off the filtration when a pre-selected cleanliness class is reached, switching on again in the case of increasing contamination at a pre-determined level, etc.

3.2. CONSTRUCTION AND DESIGN OF THE FILTRATION UNIT

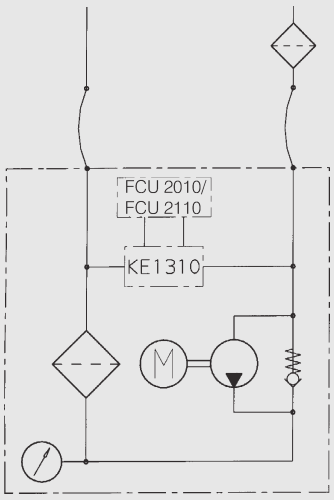
HYDAC filtration units are compact units consisting of a motor-pump unit together with a size 1300 filter housing.

Furthermore, the unit is equipped with two transparent hoses and everything is ready-assembled on a mobile trolley.
(For further details, please see the brochure on the Filtromat OF 5.

The FCU 2010 is installed in a separate housing which is also mounted on the mobile trolley. The oil flow to be measured is fed to the FCU 2010 by means of a pump KE 1310 mounted on the mobile trolley.

The pump sucks a partial flow out of the suction tract of the filtration unit and feeds this directly to the FCU 2010. The partial flow is then fed into the drain line of the filtration unit.

3.3. FUNCTION DIAGRAM



3.4. TECHNICAL SPECIFICATIONS

3.4.1 **Operating fluid**
Mineral oil to DIN 51524 and DIN 51525,
other media on request.

3.4.2 **Operating pressure**
Max. 4.5 bar

3.4.3 **Suction pressure**
Max. 0.6 bar across the unit inlet

3.4.4 **Temperature range**
Ambient temperature max. 40 °C
Medium temperature max. 70 °C

3.4.5 **Viscosity range**
Min. 15 mm²/s
Max. 300 mm²/s

3.4.6 **Supply voltage**
400 V / 3~ / 50 Hz

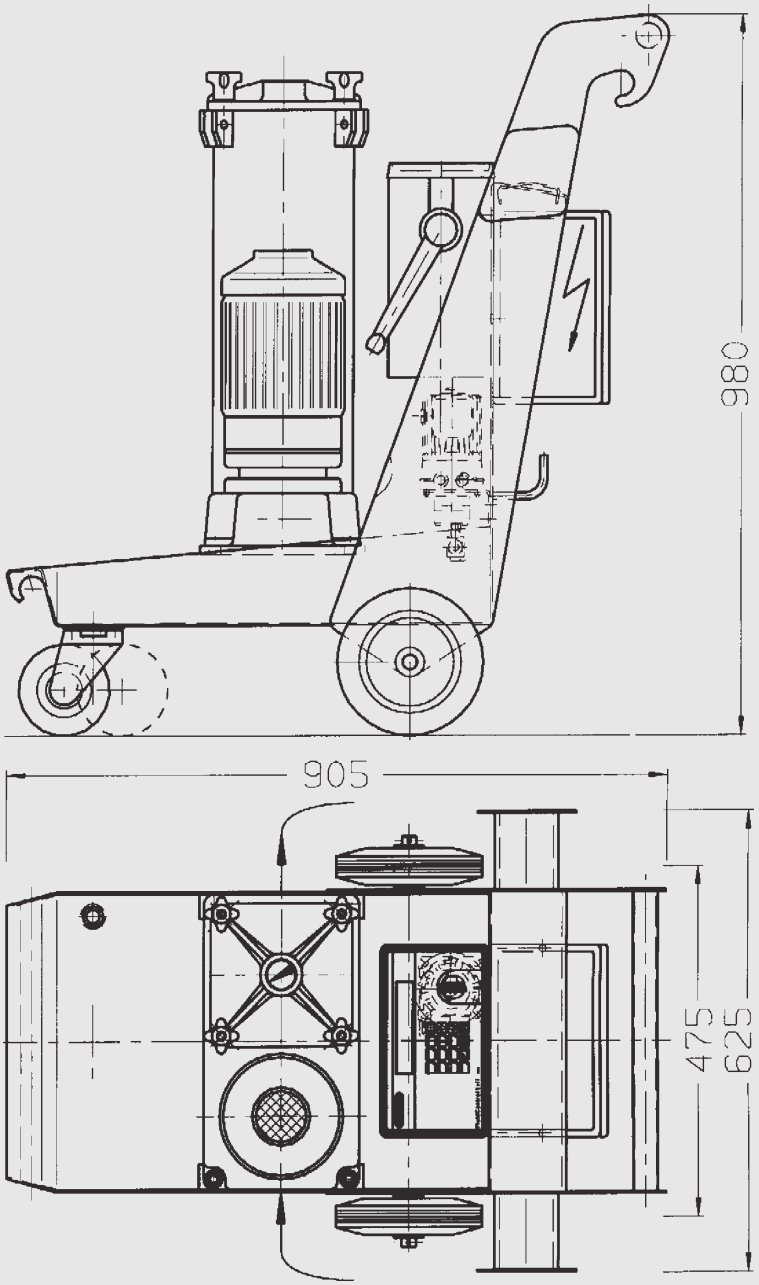
3.4.7 **Electric motor**

Motor output:	1.5 kW at 50 Hz
Construction:	B14 large flange
Rpm:	1450 1/min at 50 Hz
Safety type:	IP54
Insulation:	stator winding insulation material class B
Type of operation:	S1 continuous operation

3.4.8 **Flow rate**
40 l/min
at 1450 1/min (motor rpm)

3.4.9 **Paint**
Ruby red RAL 3003

3.5. DIMENSIONS FILTROMAT OF5



3.6. MODEL CODE

OF5C 20 P 6 N 2 B 03 C

Cont-amination monitoring system
OF5 C = mobile filtration unit with contamination monitor

Type code
20 = with FluidControl Unit FCU 2010
21 = with FluidControl Unit FCU 2110

Seals
P = NBR (Perbunan)

Motor-pump unit
6 = max. flow rate 40 l/min

Electric motor voltage
N = 400 V / 3 ~ / 50 Hz

Filter size
2 = element size 1300

Filter material
B = Betamicron® (BN/HC)

Filtration rating
03 = 3 µm absolute
05 = 5 µm absolute
10 = 10 µm absolute
20 = 20 µm absolute

Clogging indicator
C = electrical clogging indicator

4. NOTE

The information in this brochure relates to the operating conditions and applications described.
For applications or operating conditions not described, please contact the relevant technical department.
Subject to technical modifications.