HYDROTECHNIK

ENG

HySense® CX 197
Service-Measuring-Kit

Operating Instructions

Version 1.5 ENG
02/2020

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1. SAFETY

1.1 General safety and warning information

- Heed the valid regulations for accident protection and environmental protection.
- Heed the safety regulations and provisions of the country in which the product is used/applied.
- Use HYDROTECHNIK GmbH products only if they are in technically perfect condition.
- Heed all instructions on the product.
- People who install, operate, uninstall or maintain HYDROTECHNIK GmbH products may not be under the influence of alcohol or other drugs or medications that influence the ability to react.
- Use only accessory and spare parts approved by the manufacturer in order to exclude danger to people due to unsuitable spare parts.
- Adhere to the technical data and environmental conditions specified in the product documentation.
- If in safety-relevant applications unsuitable products are installed or used, unintended operating conditions can arise in the application; these can cause personal injury or property damage. Therefore, only use a product in safety-relevant applications if these are explicitly specified and permitted in the product documentation.
- You may only start the product up if it has been determined that the end product (for example, a machine or system) in which the HYDROTECHNIK GmbH products are installed complies with the country-specific provisions, safety regulations, and standards of the application.

⚠ Caution

Dangerous electrical voltage

- Never cut, damage or modify the power pack cables or place things on it.
- Never touch the power pack with wet or moist hands.
- Only connect the power pack to power supplies for which it is suited,
- Unplug the power cable from the outlet during a thunderstorm.
- Unplug the power cable if you detect smoke or there is an odor, or if the power cable is damaged.
- Ensure sufficient grounding of your system. Inadequate grounding may cause incorrect measurements.

⚠ Caution

Laser

The particle counter contains a laser, which with proper use is classified as a Class 1 laser according to DIN EN 60825-1:2001-11. The accessible laser beam is not dangerous under reasonably foreseeable conditions.

- For Class 1 laser equipment, in the upper performance range, blinding, compromising of color vision, and disruptions cannot be excluded.
- Do not remove any covers or panels.

1.2 Notes on handling the service measuring kit

- Close the pressure and tank lines in the correct sequence.
- Heed the maximum permissible pressure range.
- If the service measuring kit is operated with a hot medium, then there is a danger of burns when touching the block.

- When ventilating, note that skin contact with hot oil can cause burns. Adjust the oil pressure so that only a little oil escapes.
- The service measuring kit should be fastened securely in a suitable location so that falling or damage to the sensors is avoided.
- Handle the service measuring kit and measurement technology properly.
- If hydraulic fluid escapes or is spilled, avoid contamination of the environment and the ground water. Use oil binders to bind escaped oil.
- During installation, pay attention to cleanliness in order to prevent foreign bodies such as metal chips or fibers from cleaning cloths from getting into the hydraulic lines and causing wear and malfunctions in the product.
- Before start-up, check whether all hydraulic and mechanical connections are connected and tight, and ensure that all gaskets and seals of the plug connections are inserted correctly and undamaged.
- Do not use hemp as a sealant.

1.3 Information about the handling of sensors and cables

- Protect the sensors from exceeding the allowed power range, mechanical overload and incorrect pin assignment.
- Never expose the service measuring kit to excessive heat or humidity and observe the technical data.
- Never submerge the sensors in water or other liquids. Never let liquids penetrate the instrument.
- Never open the instruments.
- Avoid strong magnetic fields. Keep the sensors away from electric motors or other instruments that generate electromagnetic fields. Strong magnetic fields can cause malfunctions and influence measurement values.
- Prevent the formation of condensation. If condensation has formed, let the instrument acclimate before you switch it on. Otherwise it can be damaged.

2. BASICS

2.1 Scope

This manual is valid for the service measuring kit HySense® CX 197 (called the service measuring kit or CX 197 below). It is intended for the operator of this CX 197, that means the person who works with the instrument. This is not a technical manual. Please contact our customer service if you have questions that go beyond the contents of this manual.

2.2 Copyright

The technical state at the time of delivery of the instrument and the manual is decisive if no other information is given. We reserve the right to make technical changes without special announcement. Earlier manuals are no longer valid. The general conditions of sale and delivery of HYDROTECHNIK GmbH are valid.

2.3 Limitation of liability

We guarantee the faultless functioning of our product in accordance with our advertising, the product information we publish, and this manual. Additional product properties are not assured. We assume no liability for efficiency and fault-free function if the product is used for a different purpose than the one described in the Intended use section.

Compensation for damages is generally excluded except in case intention or gross negligence on the part of HYDROTECHNIK GmbH is proven.

If this product is used in environments for which it is not suited or that do not correspond to the technical standard, HYDROTECHNIK GmbH is not responsible for the consequences. HYDROTECHNIK GmbH assumes no liability for damage to installations and systems around the product that is caused by a fault of the product or an error in this manual. HYDROTECHNIK GmbH is not responsible for the violation of patents and/or other rights of third persons outside the Federal Republic of Germany.

HYDROTECHNIK GmbH is not liable for damage that results from improper operation and non-compliance with the instructions in this manual.

HYDROTECHNIK GmbH is not liable for lost profits and for consequential damages that arise from non-compliance with safety and warning information. HYDROTECHNIK GmbH accepts no liability for damage that results from the use of accessories and/or wearing parts that are not provided and/or approved by HYDROTECHNIK GmbH.

In case of faults and/or technical trouble, please contact HYDROTECHNIK GmbH's customer service. HYDROTECHNIK GmbH assures you that it will take suitable measures immediately. HYDROTECHNIK GmbH’s warranty provisions apply; we will send you these on request.

2.4 Intended use

The service measuring kit handles the control and monitoring of the oil condition and the interval for oil changes in stationary and mobile hydraulic systems. The service measuring kit is to be used with hydraulic oils and Group 2 fluids according to classification of the pressure equipment directive 2014/68/EU (non-hazardous fluids).

2.5 Warranty

In accordance with our general terms and conditions, HYDROTECHNIK GmbH guarantees the perfect condition of the CX 197 for a period of twelve months. Wearing parts and rechargeable batteries are excluded from this warranty. The warranty is voided if repair work or interventions are executed by people who are not authorized for this by HYDROTECHNIK GmbH.

Within the warranty period, we will repair damage or defects that are caused by a manufacturing fault insofar as they are reported to us immediately after their discovery, but no later than twelve months after delivery. The warranty service is done at our option through free repair of defective parts or replacement with sound parts. Please send the instruments for which you are making warranty claims postage-paid and with a copy of the invoice or the delivery slip to HYDROTECHNIK GmbH customer service. You can find the address at the end of this manual.

2.6 Customer obligations

The operator of the service measuring kit must ensure that only people who

- are familiar with the regulations concerning occupational safety and accident prevention,
- have been instructed in the operation of this measurement instrument,
- have read and understood this manual,

are permitted to use and operate this instrument.

2.7 Authorized personnel

People are considered to be authorized if they have a professional education, technical experience, and knowledge of the relevant standards and regulations and if they are able to assess their duties and recognize possible dangers early on.

Operator of the CX 197

People are considered to be authorized if they have been instructed in the operation of the instrument and have read and understood this manual completely.

Personnel for installation and maintenance

People are considered to be authorized if they have been trained in all aspects of the instrument and have read and understood this manual completely.

3. DESCRIPTION OF THE SERVICE MEASURING KIT

3.1 General

The service measuring kit consists of a measurement block that is equipped with a Patrick particle monitor, HySense® CV 100 viscosity sensor, and HySense® CM 100 humidity sensor. These instruments can also be read out separately. Furthermore, the instrument is also equipped with a power pack, CAN data cable, and three connection lines.

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In connection with the HYDROTECHNIK MultiSystem 5060Plus, MultiSystem5070 or MultiSystem4070 measurement instrument, the CX 197 handles the diagnosis and monitoring of changes to the hydraulic and lubrication media. Measurements can be made periodically on systems or machines and stored in a measurement value database for the appropriate metering point. Through analysis of the data, it is possible to make an evaluation in which the oil change, deviation from target values, and exceeding of limit values are determined.

Furthermore, it is possible to check whether the correct viscosity class is used, the particle contamination is becoming critical or if a high humidity content is threatening the formation of free water. This way, looming damage can be detected at an early stage or avoided completely. This offers the opportunity to avoid severe machine faults and consequential damages by taking suitable measures and to extend maintenance and oil change intervals. With the monitoring of the lubrication medium, oil changes and fill-ups can be detected and thus system maintenance can be performed and the use of the prescribed lubricant quality documented.

The CX 197 records the following physical oil variables:

- Temperature
- Viscosity
- Relative humidity
- Particle contamination
- Relative permittivity
- Conductivity

Since the viscosity and relative permittivity depend heavily on the temperature, these variables are converted to a fixed reference temperature of 40°C. For the analysis of a system, the metering point is created in the measurement instrument and an oil type is assigned from the oil database.

3.2 Dimensions of the service measuring kit

For the dimensions of the CX 197, see the following technical drawing:

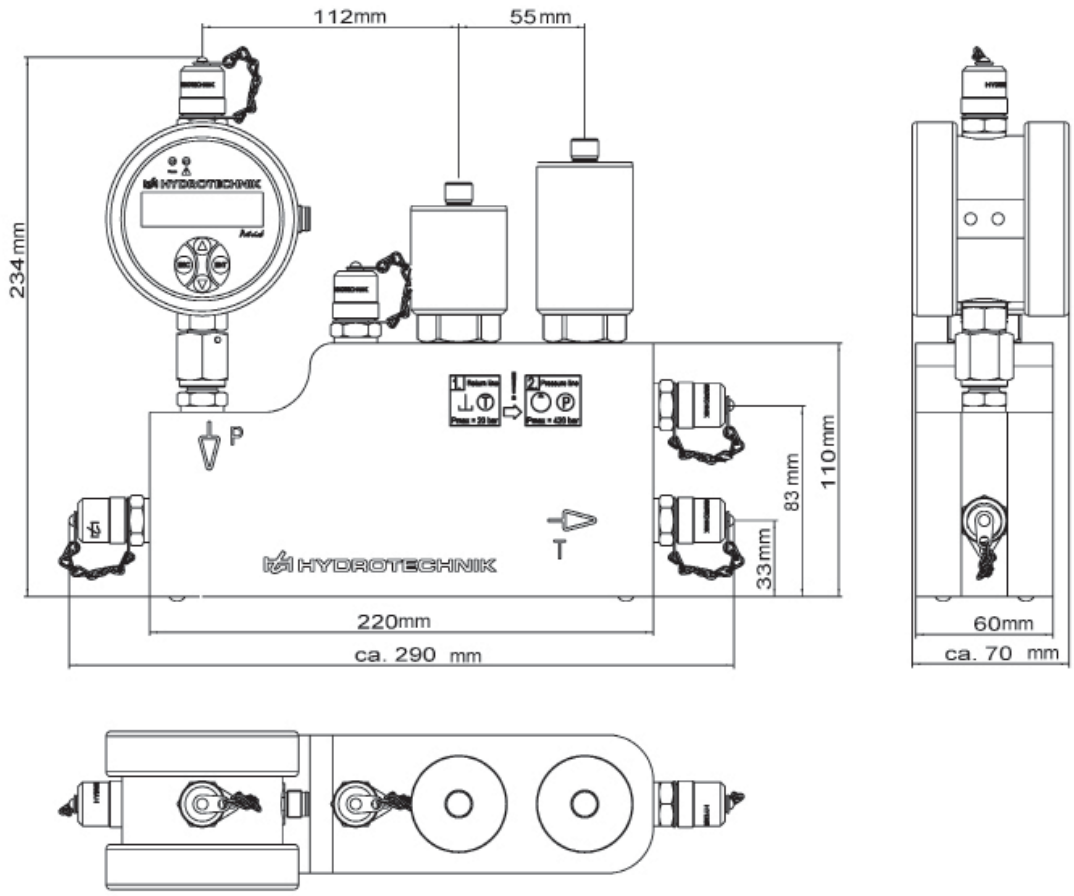

Figure 1: Technical drawing CX 197

Table 1 CX 197 components

Component	Number	Function	Part number
Measuring block	1	Holder for the sensors	3402-CX10-D100-200
MINIMESS® test point	5	Connection to oil circuit, ventilation of the system	2103-01-18.00N
Direct connection	1	Holds the particle monitor	2103-07-41.62N
Bursting disk	2	Protection of the sensors against damage	880C-00-00.02
Current regulation valve	1	Handles the reduction of the incoming system pressure to <10 bar	8803-08-00.01
Sieve	1	Filtering of coarse contamination in the oil	8806-01-06.01

3.3 Scope of delivery of the service measuring kit

In this section, the scope of delivery of the products is depicted and labeled:

Figure 2: CX 197 scope of delivery

A: CAN connection cable

B: CX 197

C: Country plug adapter lines

D: Power pack with connection to measurement instrument and CAN cable

E: Minimess® connection

The service measuring kit includes all necessary parts for connecting the CX 197 to a hydraulic system that is equipped with Minimess® 1620 test points. For this, two simple Minimess® connection lines **E** for the tank line and ventilation are included in the scope of delivery (see Figure 1). The third connection line has a check valve on one side and serves as connection for the pressure line. Here, the simple end is connected to the CX 197 and the end with the check valve to the system's pressure line. The CAN connection cable **A** connects the sensors and enables a connection to a measurement instrument (optionally Multisystem 5060Plus, Multisystem 5070 or Multisystem 4070). With the power pack **D**, there is an independent power supply to the sensors via the CAN cable.

4. START-UP OF THE SERVICE MEASURING KIT

Figure 3 depicts the connected CX 197. The next section describes the start-up in more detail.

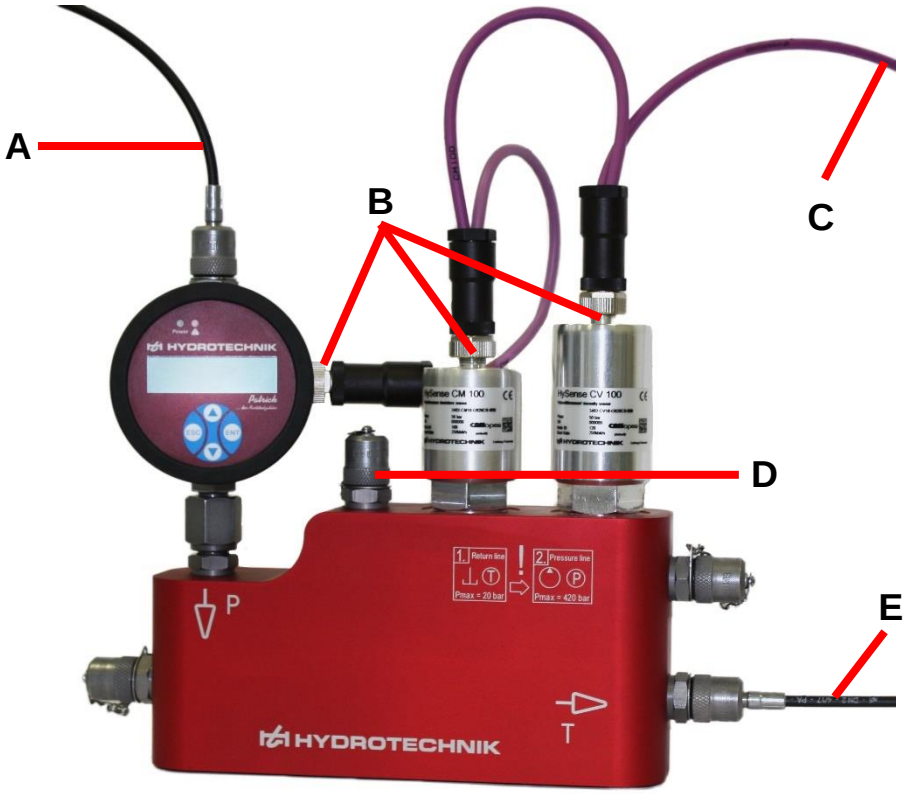

Figure 3: Connections to the CX 197

A: Supply line (pressure connection)

B: Connection to sensors

C: Connection to measurement instrument or CAN sensors

D: Connection for ventilation

E: Drain (tank connection)

4.1 Connection to a hydraulic system

Heed the correct sequence when connecting to a hydraulic system:

- First connect the tank line to the CX 197 with a simple hose line (point **E**, Figure 3)
- Connect the other end of this hose line to the tank line of your hydraulic system

- For the pressure connection, use the hose line with the check valve on one side. First connect the simple side (without check valve) to the CX 197 on the input side (point **A**, Figure 3)
- Then finally, you can connect this hose line with the check valve to the pressure connection of the hydraulic system

⚠ Warning

Incorrect sequence during connection

- Sensors can be damaged
- Oil can escape

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The CX 197 does not have its own pump, which is why it is installed in the pressure line. The symbols P and T with an arrow are engraved on the front side of the CX 197. The arrows on the CX 197 indicate the flow direction of the medium. The P symbol stands for pressure and the T for the tank side (Figure 3 or Figure 4). The warning on the front of the CX 197 (Figure 4) symbolizes the correct connection sequence with the maximum pressures that may not be exceeded.

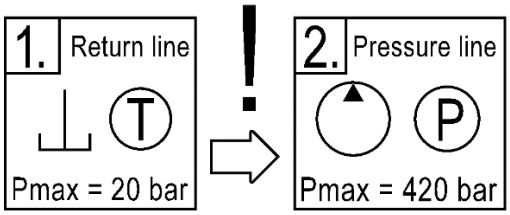

Figure 4: Printing on the CX197 (pictograms)

4.1.1 Installation in the pressure line

An installation of the CX 197 is recommended in a pressure line to the Figure 5 left. Here, it can be connected directly to a Minimess® test point with the included lines. The return can be connected directly to a tank line on the system (heed connection sequence, see Chapter 4.1).

Alternatively, test points can be selected for which there is a sufficient pressure difference for a suitable flow (Figure 5 right).

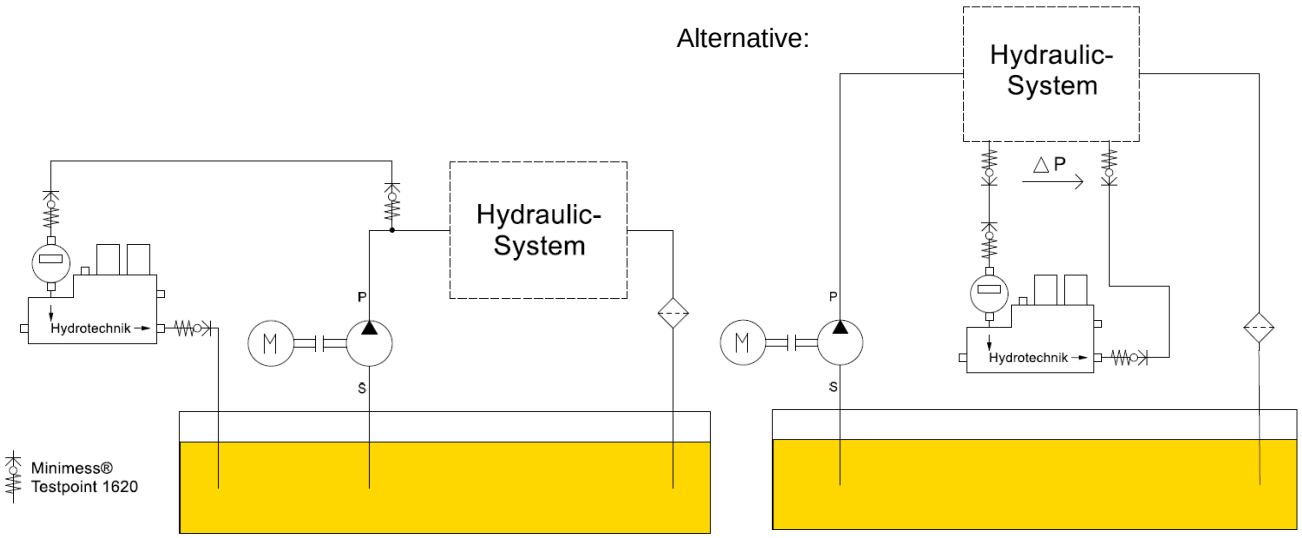

Figure 5: Installation situation of the CX 197; left: recommended installation; right: alternative installation

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4.1.2 Installation in the return line

If it is possible to establish pressure in the return line that generates a necessary flow (e.g. with a pre-tensioned check valve), then the CX 197 can also be installed there.

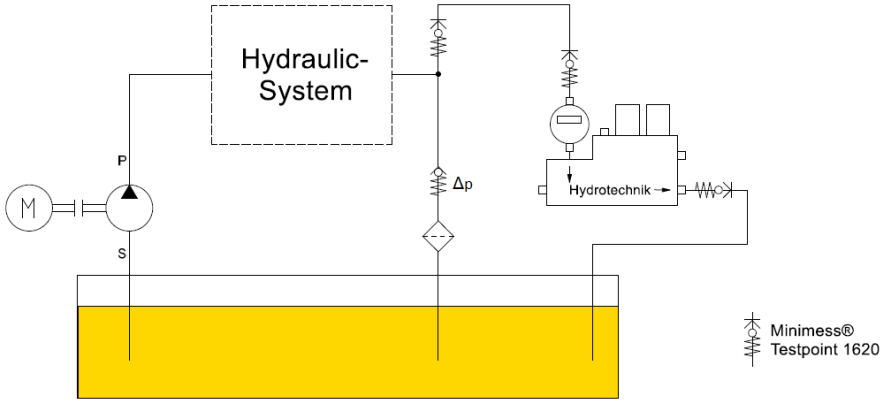

Figure 6: Installation situation of the CX 197 in the return line

Due to a prior measurement, the CX 197 can be filled with an oil that is incompatible with other oils. In order to avoid the danger of contamination, empty the CX 197 or flush it out sufficiently. Flush with at least 200 ml and separate the oil at the return.

⚠ Caution

Danger of contamination with other oil

Since the CX 197 could still be filled with incompatible oil from the last measurement, empty or flush the CX 197 with at least 200 ml of oil.

4.1.3 Setting the flow

Since the Patrick particle monitor requires a constant flow between 50 and 400 ml/min, attention should be paid to the appropriate flow. It can be checked directly after current is connected to the Patrick. For this, use the arrow key to go into the menu and select:
SENSORPARAM. / SET FLOW.
The bar diagram reflects the flow between 50 and 400 ml/min.

In case of heavily soiled oil:
If larger particles (> 125µm) go through the CX 197, they can stop up the sieve installed in front of the current regulation valve. Normally the sieve protects the downstream current regulation valve that has a small nozzle.

If it happens that there is no sufficient flow despite the pressure applied, the CX 197 can be opened and the current regulation valve unscrewed. This way, it is possible to clean the soiled parts.

4.2 Ventilating the service measuring kit

Before the first measurements can be made, the CX 197 must be ventilated. Proceed as follows:

- Connect the CX 197 as described in Chapter 4.1. The flow should be at least 50 ml/min.
- Now connect the MINIMESS® test point between particle monitor and moisture sensor to the third MINIMESS® hose line.
- During ventilation, move the CX 197 a little in order to convey all the air out of the CX 197.

⚠ Warning

Risk of burns

When ventilating, note that skin contact with hot oil can cause burns. Adjust the oil pressure so that only a little oil escapes.

4.3 Connecting the sensors

Figure 7 shows the CAN data line together with the power pack and the data line. Proceed as follows:

- Connect the sensors with the included CAN cable (point **A**, Figure 7)
- Connect the plug of the CAN cable (point **B**, Figure 7) to the CAN system or measurement instrument (MS5060Plus, MS5070 or MS4070)
- If the sensors are supplied autonomously with current, the plug on the CAN data line (point **B**, Figure 7) is connected to the socket of the power pack (point **C**, Figure 7). Then the plug on the power pack (point **D**, Figure 7) is used as the data line of the CAN bus.

Figure 7: CAN data line with network connection

⚠ Note

Power supply

The measurement instrument's rechargeable battery is only sufficient for a limited time. For longer supply of the sensors, either connect the power pack of the measurement instrument or operate the sensors with the included power pack. For this, connect the power pack to the three-way CAN cable.

The communication of the sensors takes place via the data line of the CAN connection cable. For this, connect the connection line of the CAN connection cable or the data cable of the connected power pack to a CAN bus or a measurement instrument (Multisystem 5060Plus, Multisystem 5070 or Multisystem 5070).

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The bus system for the communication of the sensors with the measurement instrument is done via CANOpen. For this, the sensors must be set to this bus system. If this is not the case, this configuration is described precisely in the operation manual for the individual sensors (HySense® CM 100 or HySense® CV 100).

In principle, it is also possible to use the individual sensors directly on the connected CX 197 via serial interface (RS232), CANOpen or with analogue current output. The sensors offer other possibilities for this (such as continuous measurement with learning phase and the detection of oil parameters). For additional information and instructions, see the operation manual for the sensors in question.

5. USE WITH A MULTISYSTEM MEASUREMENT INSTRUMENT

The service measuring kit can be operated directly with a hand measurement instrument MultiSystem 5060Plus, MultiSystem 5070 or MultiSystem 4070. If your measurement instrument has earlier firmware, it's easy to update the instrument via the HYDROTECHNIK software “hydrocenter” (can be downloaded from the homepage HYDROTECHNIK.com).

Connect the data cable to the 8-pin CAN connection on the measurement instrument as described in Chapter 4.3. Note that the power output on the measurement instrument is activated if the sensors should be supplied with power by the measurement instrument. The CAN interface on the measurement instrument must also be activated (see operation manual for the MultiSystem instrument).

Figure 8: Service measuring kit connected to the MultiSystem 5070

Chapter 5.1 below will describe use with a MultiSystem 5070 or MultiSystem 4070 measurement instrument. Menu guidance is the same in both measurement instruments.

The description for the MultiSystem 5060Plus is in Chapter 5.2.

5.1 Use with the MultiSystem 5070/4070

Essentially, display of the options of the F1 to F5 keys can be done as text or symbols. For this, the measurement instrument is set under:

- Set (5) / Instrument (3) / General Settings (2)
- then right arrow key
- under “Softkeys”

(see Figure 9). In the following figures, the display will be in "text.”

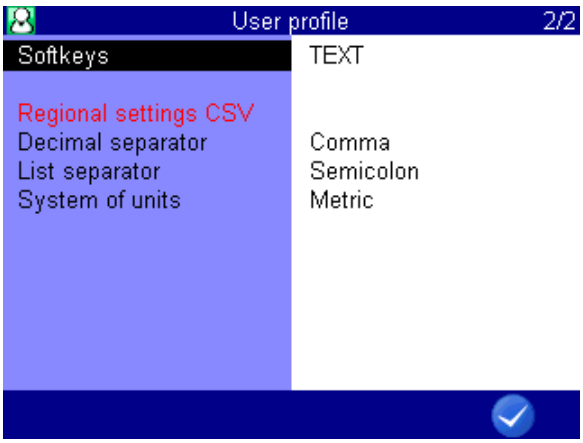

Figure 9: Display options, text or symbol

On this menu, you can also set the separator for the CSV file.

Furthermore, you can also select the unit system that should be used to display the units. These include the metric system and the US measurement system.

5.1.1 Opening the “HySense CX 197” function

Use the menu key to reach the main menu (home). By selecting the folder “Extras / Special applications / Oil condition” (see Figure 10) you can reach the user menu for the service measuring kit.

Alternatively with the MultiSystem 5070/4070, you can also press the corresponding number with the number keys 1-9 to select the window. To reach the menu, these would be the keys: 6-2-1-2.

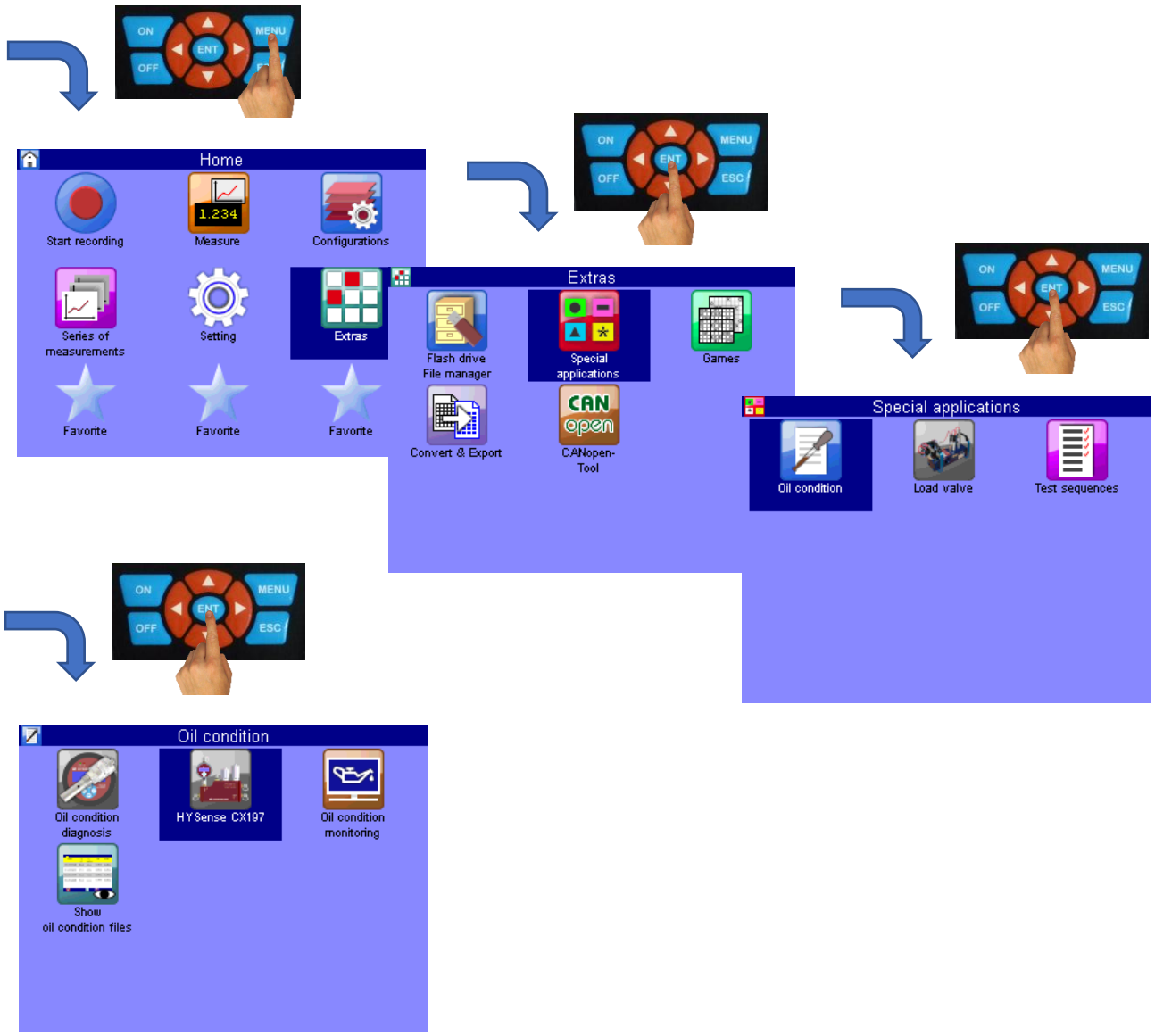

Figure 10: Main menu of the user function “HySense CX 197” for the MultiSystem 5070/4070

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5.1.2 Operating the “HySense CX 197” function

If you start the “HySense CX 197” function, there is an automatic search for connected oil condition sensors. Here, the measurement instrument searches automatically with the baud rate 125 kBit/s and 250 kBit/s. Setting the baud rate on the MultiSystem 5070 is thus no longer necessary.

If the measurement instrument finds sensors, the sensors found are displayed. By confirming with the F5 (OK) key, the instrument is in ONLINE mode. If no sensors are found, the OFFLINE mode is activated.

ONLINE/OFFLINE mode
ONLINE mode means that the sensors (at least partially) were detected and the evaluation of currently measured measurement values is correct. You are in a position to save measurements or perform an interval measurement. The measurement values and evaluation are updated every three seconds.

In OFFLINE mode, you can examine measurements made at a metering point. For this, there is also a condition evaluation, however now with the saved measurements. In the process, the settings are displayed that are set at the time of measurement.

5.1.3 Selection of the metering point

This menu is depicted in Figure. With the ENT key, you can select a metering point with which additional measurements can be performed or these can be examined.

A new metering point can also be created. There are two possibilities for this:

1. You can select an existing metering point with the cursor and select F3: COPY. Here, all of the settings are taken over from the selected metering point and a mew metering point is created in the next free space (Figure 11 left). With F2: EDIT, you can change the parameters of a metering point.

2. An empty entry is selected. Here, you will see the following on the F3 key: NEW. You can create a new metering point here. The start values are the default values (Figure 11 right).

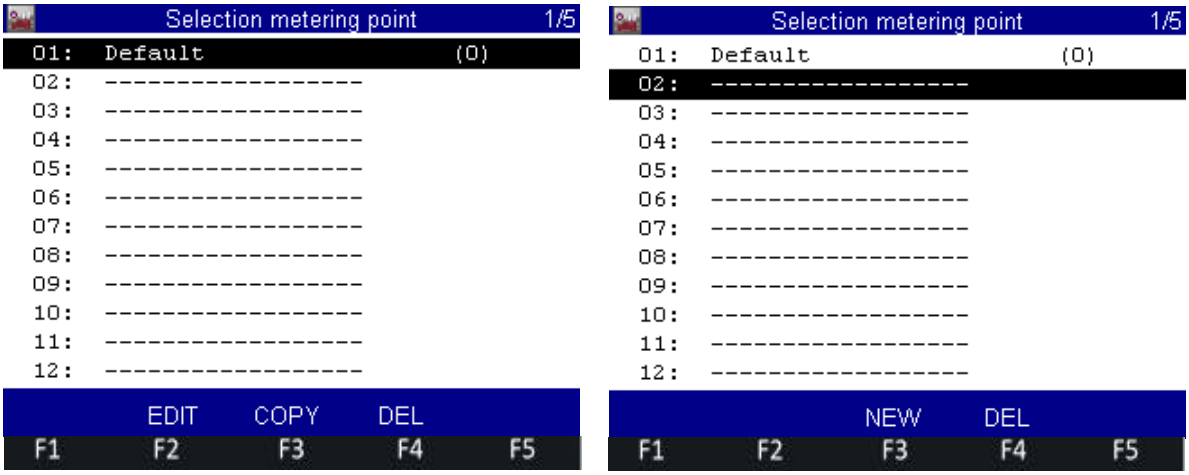

Figure 11: Takeover of the parameters of an existing metering point; right: Creation of a new metering point.

The first entry is the metering point “Default.” It can be selected, but not changed or deleted. The saving of measurements is also not possible here. It serves only to display measurement values according to the default parameters.

If you create or edit a metering point, the menu depicted on the left in Figure 12 appears. Here, you can use the ENT key to reach the field to be edited. In the two upper entries, the name and the oil are defined. The remaining entries determine the limits set for the metering point. Pressing the right arrow key allows you to reach the settings for the warning limits. Here, you can also define limits that cause a warning with yellow and red indicators.

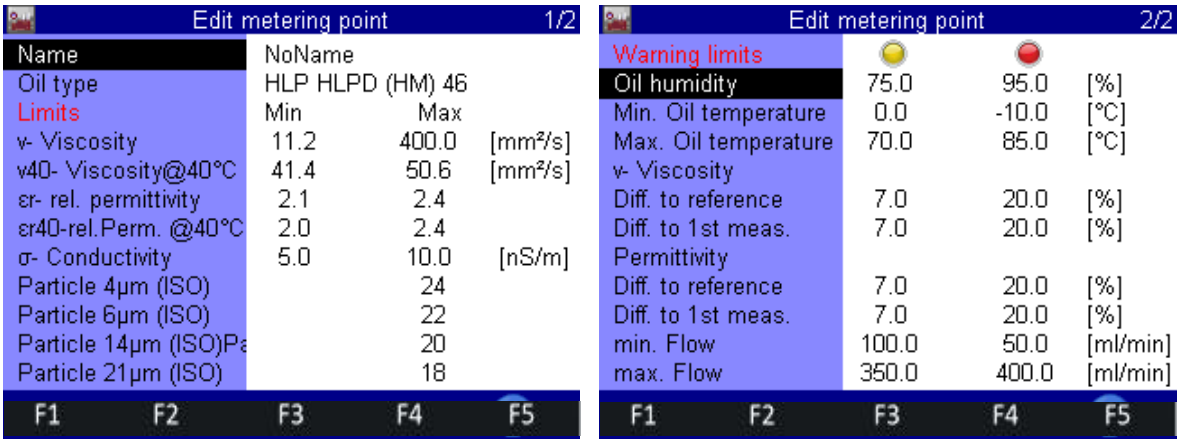

Figure 12: Editing the parameters for a metering point

Oil database:
If you press the ENT key in the “oil type” field, you reach the oil database (Figure 13). Here, you can select a pre-defined oil type or define an entry from the specific parameters of the oil.

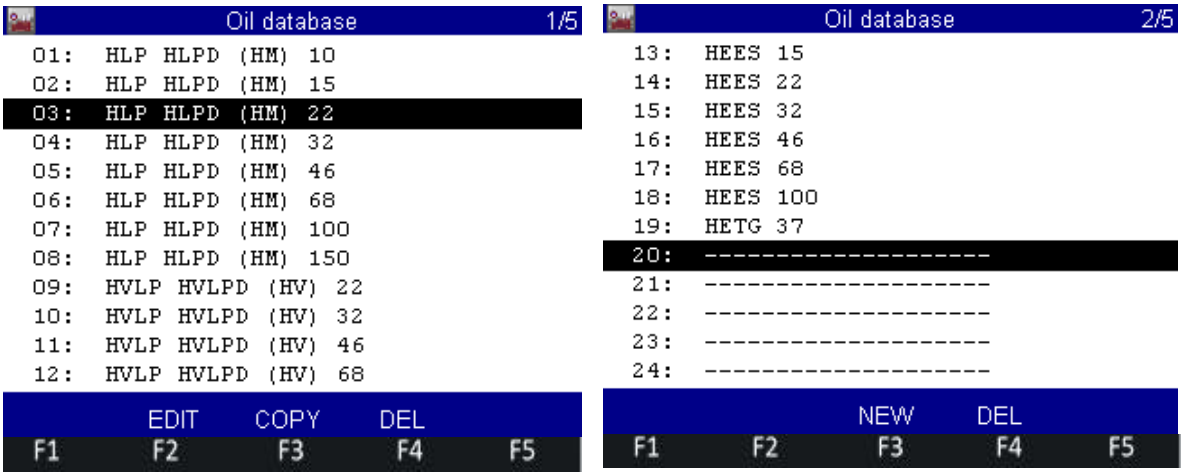

Figure 13: Oil database

Analogous to the metering points, you can change copied entries and create new entries here (Figure 13 left: F3 COPY). New entries are created in an empty field as depicted on the right in Figure 13. The figure displayed on the left in Figure 14 appears.

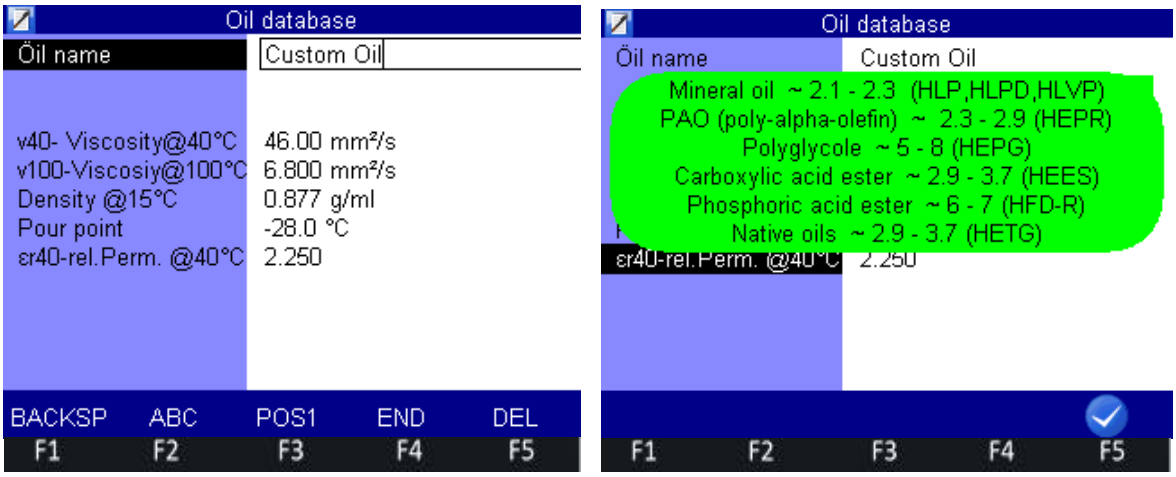

Figure 14: Creating an oil in the oil database

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An oil is defined with the following characteristic values:

- Viscosity at 40°C (v_{40})
- Viscosity at 100°C (v_{100})
- Density at 15°C
- Pour point
- Permittivity at 40°C (ε_{40})

⚠ Note

Parameters for "own oil"

The first four variables are common details in the oils' data sheets.
For selection of the permittivity, a green help window is displayed as soon as you put the cursor on the field, as depicted on the right in Figure 14. In it, the unit-free value of the permittivity of a particular oil type is suggested. There is a precise description in the next section.

Permittivity (also called dielectric constant):
The permittivity is an important parameter that describes the dielectric behavior of the oil (that is, the **polarity**). If the value increases, this indicates a worsening or a change in the oil property.

Since the permittivity depends on many properties such as the type and quantity of additives, moisture content, etc., no precise specification for an oil type can be made. However, particular oil types can be divided into approximate ranges, as seen in Table 4.

Table 4: Order of magnitude of the permittivity for oil types:

Oil type	Descriptions	Permittivity ε_r
Mineral oil	HL, HLP, HLPD, HVLP, HVLPD	2.0– 2.4
Polyalphaolephine (PAO)	HEPR	2.3– 2.9
Synthetic ester/ Native oils	HEES / HETG	2.9– 3.7
Polyglycols	HEPG	> 5
Phosphate esters	e.g. HFD-R	6– 7

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⚠ Note

Determining permittivity for "own oil"

If you would like to specify the start value of the permittivity, a measurement can be performed and then the measurement value of the permittivity entered in the oil database.

5.1.4 Evaluation of the measurements - Condition menu

If a metering point is selected, the condition menu opens (Figure 15). The header line displays the measurement system and the connection state (ONLINE/OFFLINE).

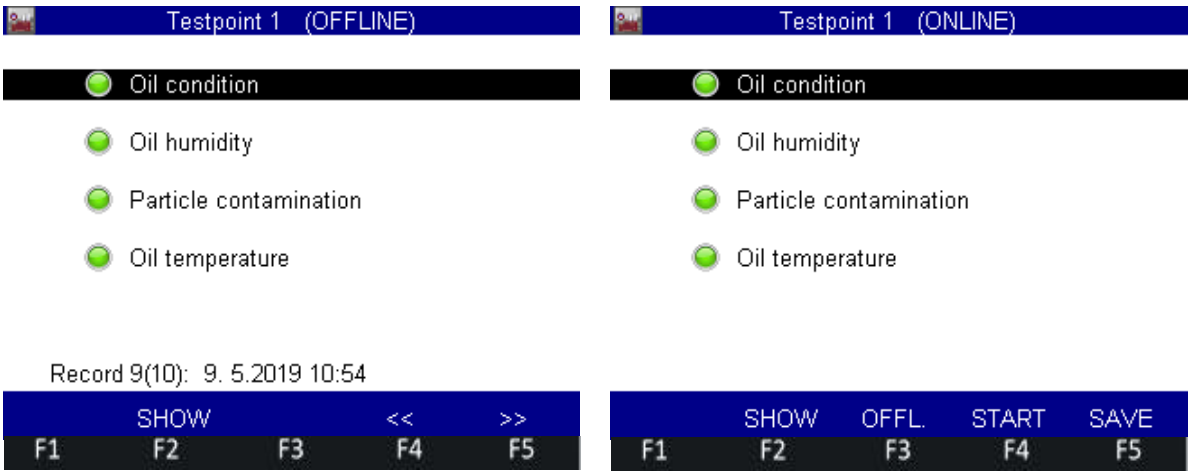

Figure 15: Oil condition menu, left: in OFFLINE mode, right: in ONLINE mode

The condition window lists the four main points of the evaluation with a traffic-light display. The left **Fehler! Verweisquelle konnte nicht gefunden werden.** i s in OFFLINE mode. The measurement that is used for condition evaluation is

displayed at the left bottom. With the F4 and F5 keys, you can select the measurement series.

Figure 15 depicts the ONLINE mode on the right. Here, the measurement values are read from the sensors automatically and evaluated in color.

With the F3 color: OFFL. If you reach OFFLINE mode where you can examine older measurements.

The F4 key: START starts an interval measurement in which you can record a particular number of measurements automatically by specifying an interval time.

The F5 key: SAVE saves a measurement.

By pressing the ENT key, you reach the selection of the four main points of the submenu, where you can get more information about the condition. These points will be displayed in more detail below:

Oil condition:

If you open the first point “Oil condition,” the window depicted in Figure 16 (top left) appears. There are three windows in total for the menu element that you reach by pressing the right/left arrow keys.

The first window displays the evaluation of the viscosity; the second, the permittivity; and the third, the conductivity. In the evaluation of the viscosity and the permittivity, there is a calculation on the reference temperature of 40°C. This value is also used in the deviation for the default value (data sheet value) and the first measurement.

The limit values and warning limits (in the square boxes) are also listed and can be changed directly and adjusted with the F2 key: EDIT. If the value of the limits is reached, the condition indicator of the traffic light changes. This condition can also be detected on the main menu.

Use F4 and F5 to save the values here. In the process, all set values are saved (measurement values, limits, and traffic light indicator).

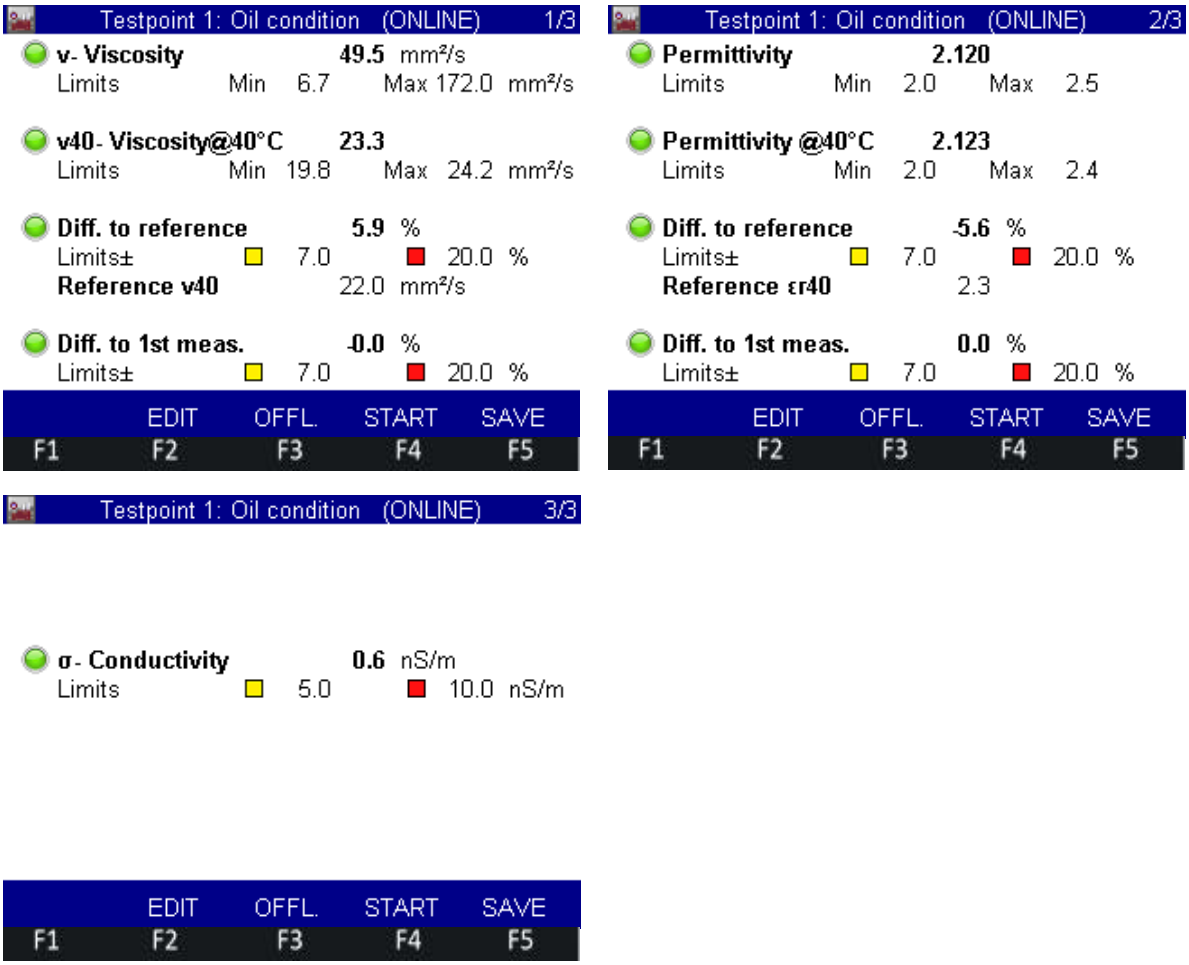

Figure 16: Oil condition on the "Oil condition menu"

Oil humidity:

If you select the "Oil humidity" element from the condition menu, a window opens (Figure 17), on which the measurement value of the relative humidity is depicted, Here too, you can adjust the warning limit with the F2: EDIT key.

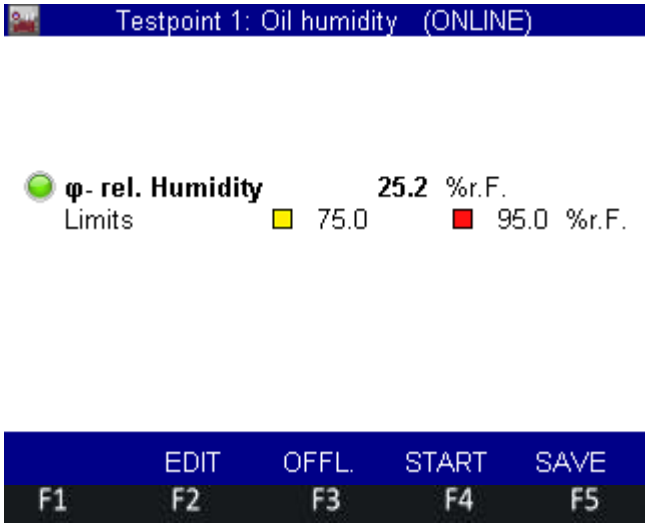

Figure 17: Oil humidity on the "Oil condition" menu

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Particle contamination:

In the particle analysis, on the one hand the particle classes are displayed with the limits to be edited; and on the other, the current flow. The flow has to be provided with warning limits to warn if the flow is at its limits.

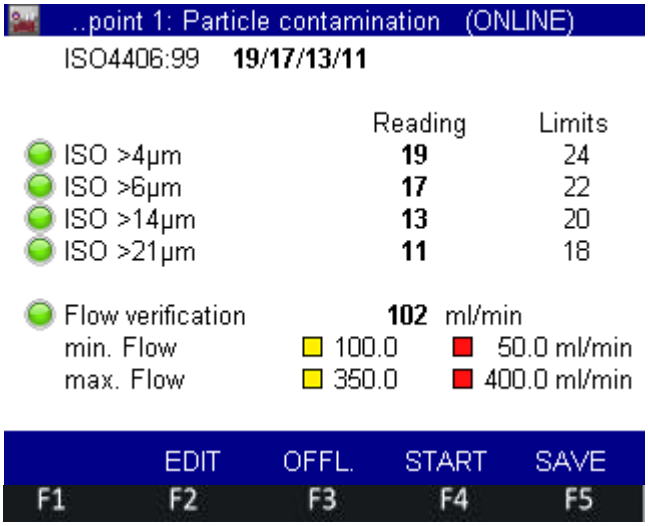

Figure 18: Particle contamination on the "Oil condition" menu

Oil temperature:

If you press Enter under oil temperature, then it is indicated with a traffic light control whether the set warning a limit values for the oil temperature are underrun or exceeded.

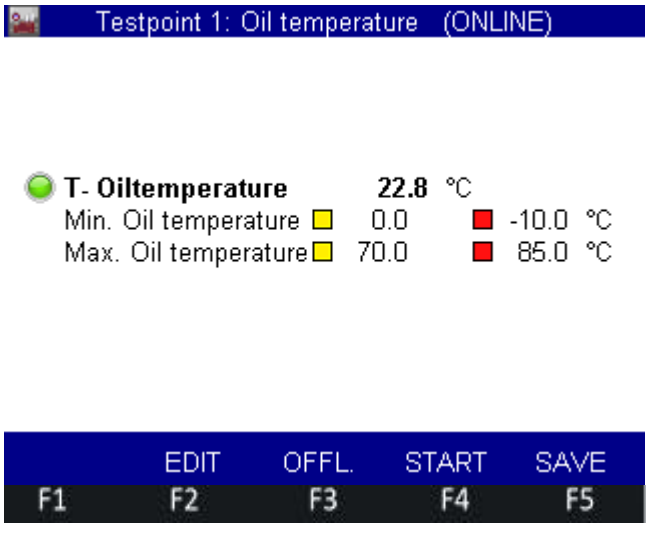

Figure 19: Oil temperature on the "Oil condition" menu

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5.1.5 Display of the measurement values

If you are on the condition menu (Figure 15), you can use the F2 key (“DISPLAY”) to reach the measurement value table that is depicted in Figure 20.

It consists of 4 pages, which can be reached the pressing the right/left arrow keys. The first three pages include the measurement values; the fourth page the oil set. For the evaluation of the measurement series and the limits set, see the condition evaluation of the respective measurement series.

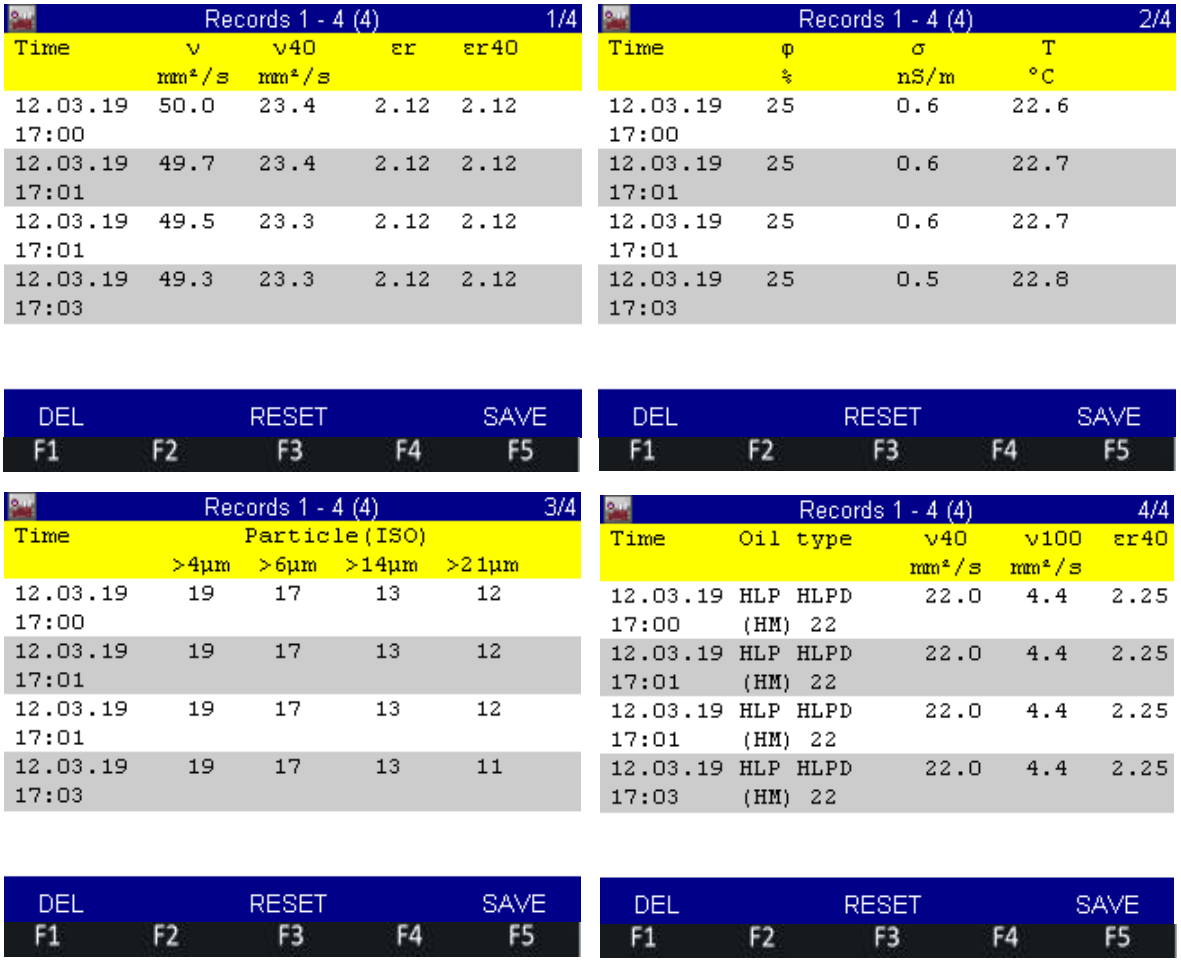

Figure 20: Measurement value table

Use the F1 key “DELETE” to delete individual measurements; use the F3 key “Reset” to delete all measurements for the metering point.

If you are in online mode, if you press the F5 key, the “SAVE” function appears that you can use to record a new measurement value.

5.1.6 Exporting the measurement data

The MultiSystem 5070/4070 automatically creates CSV files with all measurement data (measurement values, limits, warning limits, calculations, and conditions). To export this file to a computer, there are two possibilities:

1. **Connecting a USB cable to the measurement instrument:**

   To do this, enable the internal memory of the measurement instrument as follows:

   - From the main menu, select the following path:
     "Settings/Device/Connections/USB (Device)"

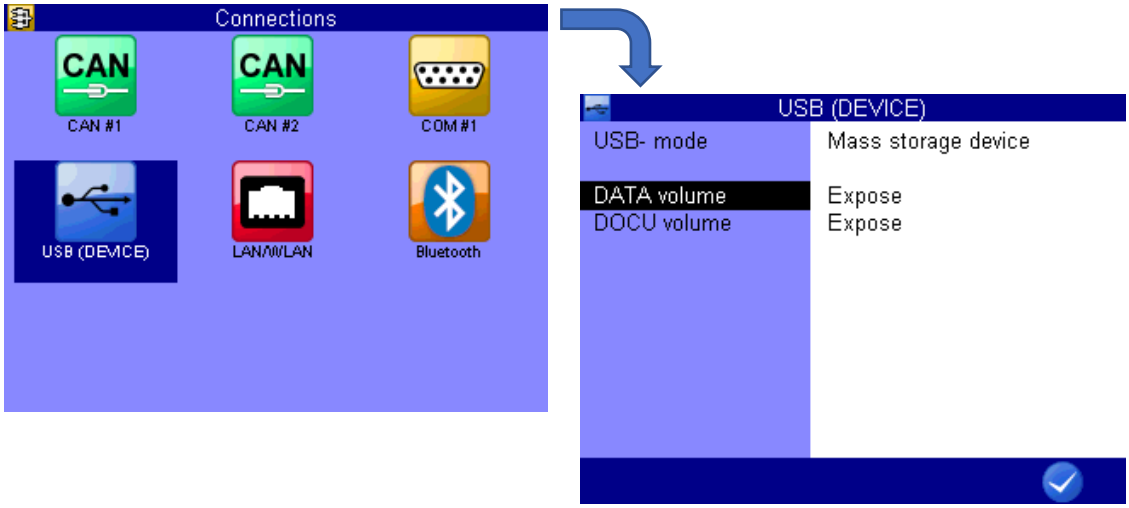

Figure 21: Enabling internal memory for the data export

   - The menu window depicted on the right in Figure 21 appears. Change the DATA volume element to "Enable."

   - If you now connect the USB to the computer again, a folder with the drive "DATA-VOL" appears automatically. Under it, there is a folder "CSV," which contains the measurement files in CSV format.

2. **Exporting with a USB stick:**

   - Connect a USB stick to the measurement instrument and go to the instrument's main menu. Open the following path:
     "Extras / USB Stick File Manager"

   - In "Save" mode, select the "CSV files" entry on the FileType tab (see Figure 22, left).

   - Then, on the "Selected" tab, you can mark several measurement files that should be exported to the USB stick. The selected files are displayed with an asterisk * in front of their names.

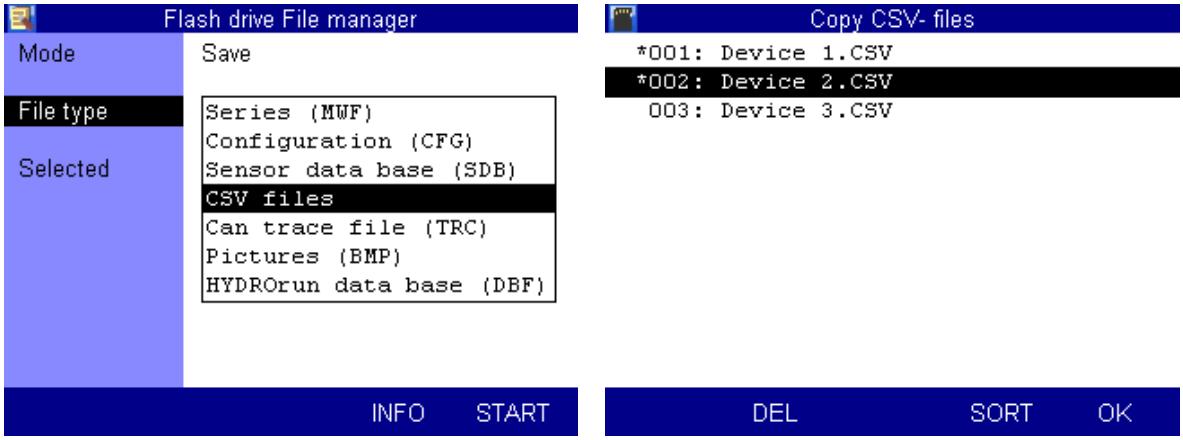

Figure 22: left: Selection of the file type: right: Selection of the measurement files

ENG

- After confirming the selection with F5 (OK), the export procedure can be started with F5 (START).

5.1.7 Evaluating measurements

The CSV measurement files can be copied into a template file that is available for download on the HYDROTECHNIK GmbH homepage at: HYDROTECHNIK.com. The tool is called: *"Analysis tool_HySense® CX 197."* The file can be opened with Excel and the entire measurement file transferred to the tool with copy and paste.

The tool offers the opportunity to display any measurement in a report with a graphic evaluation of the entire measurement process. The limits entered in the process are considered and the condition is also evaluated.

There are precise instructions on the overview page in the tool.

5.2 Use with the MultiSystem 5060Plus

5.2.1 Opening the "*Measuring section CX 197*" function

With the menu key, you can use the menu guidance to reach the main menu, where you will find the "Measuring section CX 197" function under "Special applications." Select the menu with the Enter key (ENT).

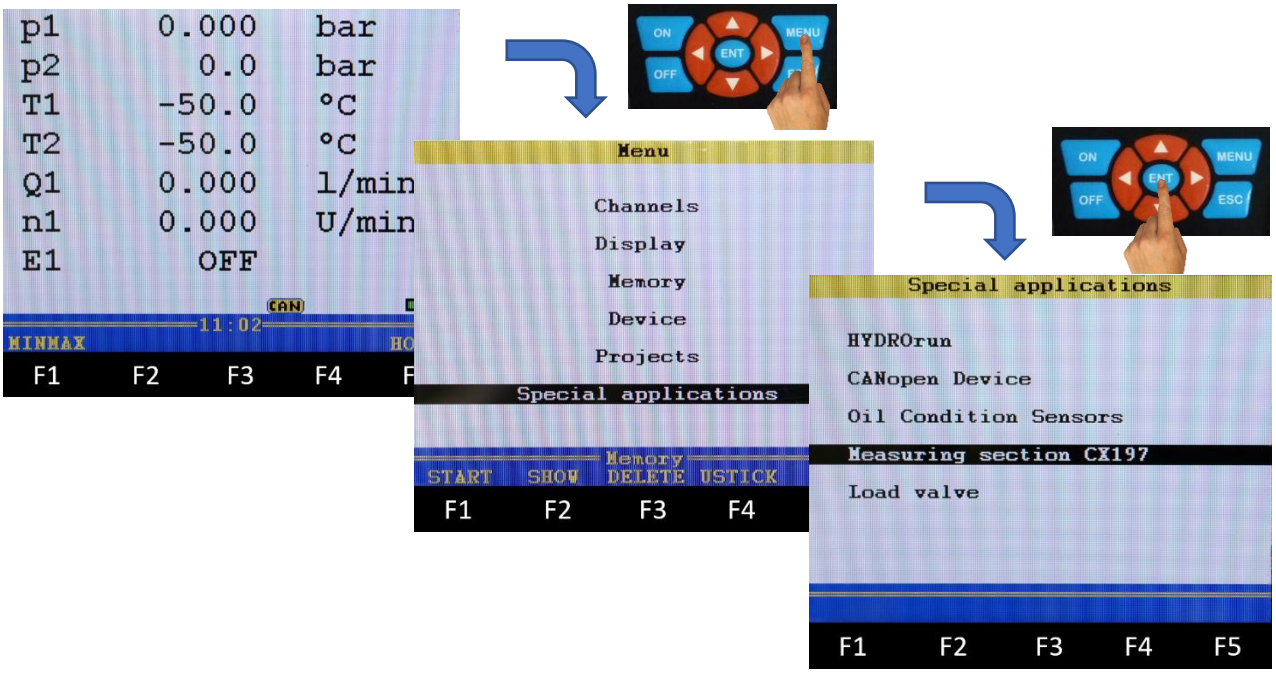

Figure 23:Menu guidance to the main menu of the service measuring kit for the MultiSystem 5060Plus

5.2.2 Operating the "*Measuring section CX 197*" function

The interface of the "Measuring section CX 197" menu is depicted in Figure 24. On the window, the three sensors of the measurement set are listed with a symbolized LED display, which functions as traffic light display (indicator display).

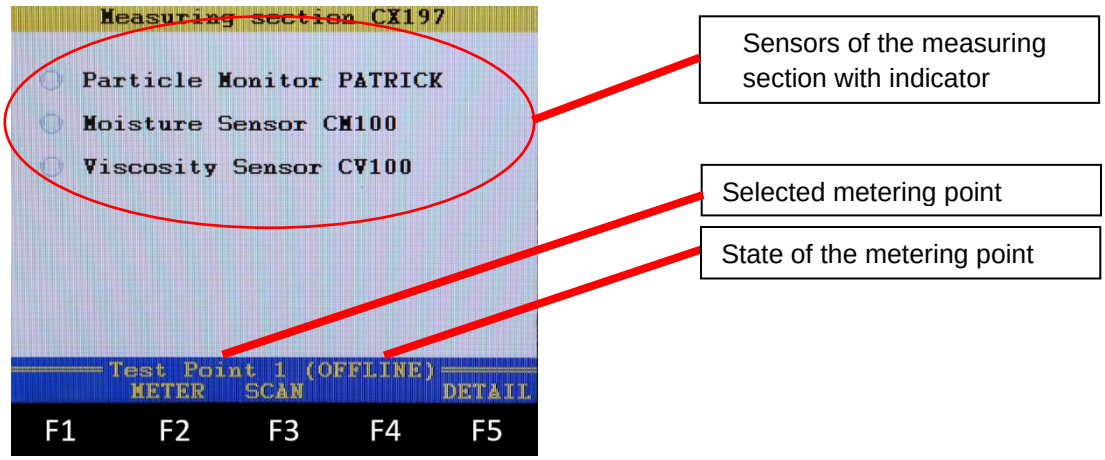

Figure 24: "Measuring section CX 197" menu

In the blue field on the lower part of the display, you can see the selected metering point with a note about whether the sensors are connected to the measurement instrument and detected (online mode) or whether the measurement is in offline mode. Here, the last saved measurement of the metering point is used for evaluation.

The indicator display depicts the state at the sensor on the last measurement. Possible states are listed in the table below.

Table 5: Possible state indicators on the "Measuring section CX 197" main menu

Color coding	Symbol	Sensor state
White	○	No measurement values
Green	●	State OK
Yellow	●	Warning: Abnormalities in measured values
Red	●	Warning: Limit value exceeded

The state of the sensor at the time of the last measurement is displayed on the main menu. Here, for example, it can happen that the display indicates red for the humidity sensor even though the rel. humidity exhibits no abnormalities. Since the permittivity is also measured with this sensor, its state is also incorporated into the display. For detailed information about the trigger, you can check the state menu under F5 "DETAIL" (see Chapter 5.2.7). The evaluation and analysis of the measurement are done on this menu.

⚠ Note

Updating the state display

The indicator display and evaluation under the "DETAIL" menu always refer to the last saved measurement. If you would like to update the display on the connected metering point, you have to save a measurement under F2 "Measure."

5.1.3.1: Online connection via CAN bus

With the F3 key ("SCAN") in Figure 24: "Measuring section CX 197" menu, the channels on the CAN bus system are searched for connected sensors. If the sensors are detected, then the state of the metering point changes to "ONLINE."

5.2.3 Measurement menu “Measuring section CX 197”

With the F2 key “Measure” on the main menu (Figure 24), you can reach the measurement menu that is depicted in Figure 25.

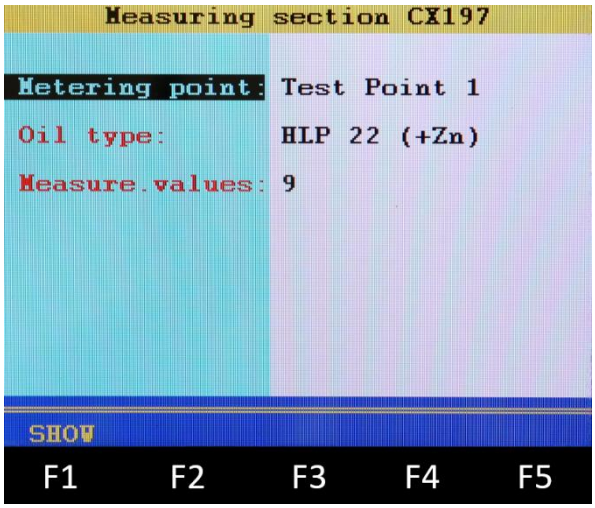

Figure 25: Measuring menu of the "Measuring section CX 197” function

Only the metering point can be selected with the cursor on this menu. The “Oil type” and “Measure. values” lines are information fields that display the selected oil type and the number of measurement values. If you are in offline mode, then only the function F1 “SHOW” is listed under the blue quick-access field. This is how you can reach the display of the measurement values via the measurement value table. If the sensors are connected and detected (online mode), then a measurement is performed and saved under F5 “SAVE.” After that, the number of measurement values in the display increases by 1.

5.2.4 Selection of the metering point

If you press the “ENT” key on the measurement menu in Figure 25, you will reach the selection of the metering point (Figure 26 left). It lists metering points that are selected with “ENT.” Measurements can now be made for the selected metering point or in offline mode on the main and condition menu, measurement values examined. The number of measurements is in brackets next to the name of the metering point.

By pressing the F2 key (“EDIT”), you can edit the metering point (Figure 26 right). The name can be created/changed here, the oil selected from a database, and the limits entered. The limit values are specified with default values and can be changed at any time.

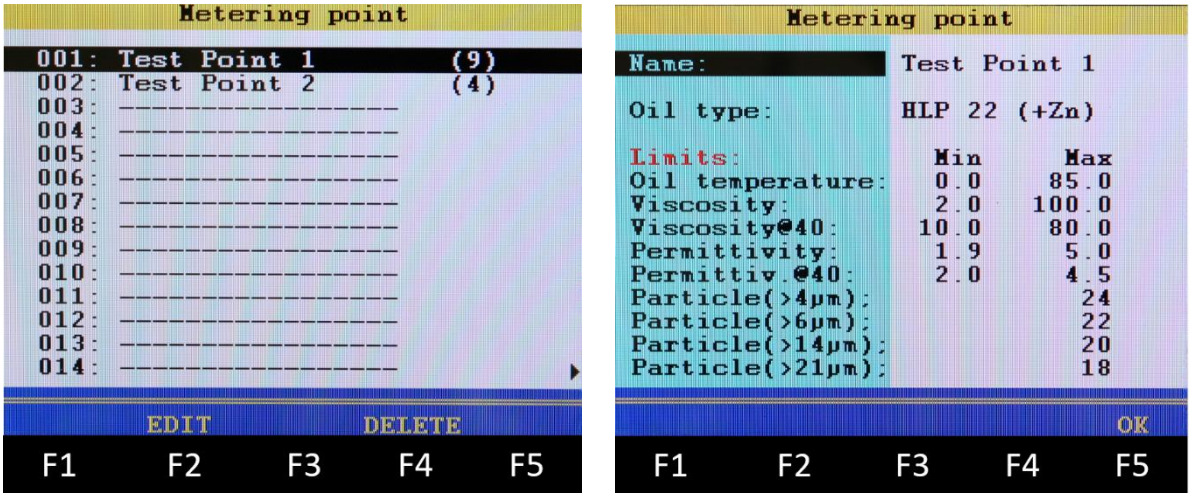

Figure 26: left: Metering point selection: right: EDIT menu of the metering point

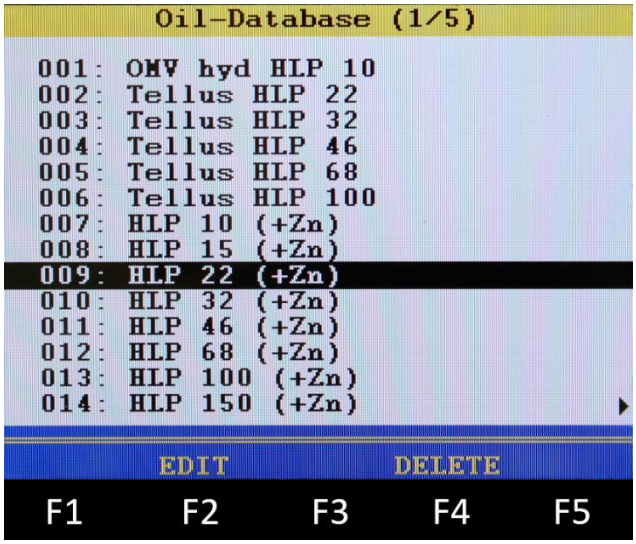

Figure 27: Oil database

If you select the oil type with the Enter key from the metering point selection on the Edit menu (Figure 26 right), you reach the oil database that is depicted in Figure 27.

Here, you can select a pre-defined oil (001-037) or create an oil with its parameter starting with memory number 038. The oils 001-006 are common oils of a brand. The oils starting with numbers 007 to 037 describe oil types with their properties. Here, for example, the oil type with the number 009 describes an HLP type (mineral oil) that contains zinc with the viscosity 22 mm^2/s at 40°C.

If, starting with memory number 038, you use the F2 key (“EDIT”) to create your own oil, you reach the menu depicted in Figure 28. Here, you define the oil parameters:

- Viscosity at 40°C (v_{40})
- Viscosity at 100°C (v_{100})
- Density at 15°C
- Pour point
- Permittivity at 40°C (ε_{40})

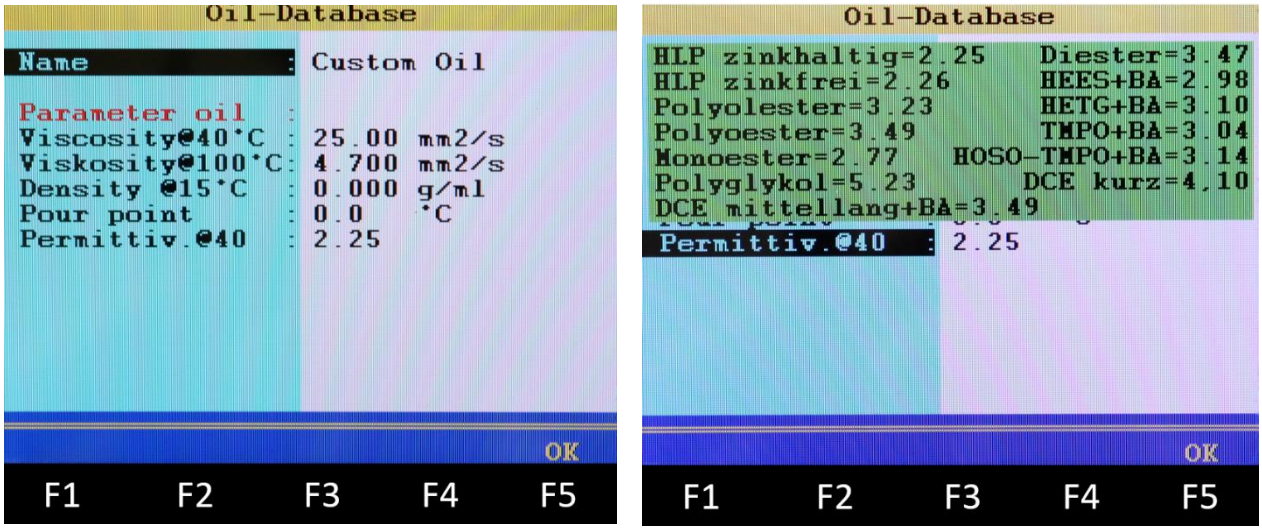

Figure 28: Creating an oil with oil parameters: right: Help window for selection of the permittivity at 40°C

ENG

⚠ Note

Parameters for "own oil"

The first four variables are common details in the oils' data sheets.
For selection of the permittivity, a green help window is displayed as soon as you put the cursor on the field, as depicted on the right in Figure 28. In it, the unit-free value of the permittivity of a particular oil type is suggested. There is a precise description in the next section.

Permittivity (dielectric constant):
The permittivity is an important parameter that describes the dielectric behavior of the oil (that is, the **polarity**). If the value increases, this indicates a worsening or a change in the oil property.

Since the permittivity depends on many properties such as the type and quantity of additives, moisture content, etc., no precise specification for an oil type can be made. However, particular oil types can be divided into approximate ranges, as seen in Table 6.

Table 6: Order of magnitude of the permittivity for oil types:

Oil type	Descriptions	Permittivity ε_r
Mineral oil	HL, HLP, HLPD, HVLP, HVLPD	2.0– 2.4
Polyalphaolephine (PAO)	HEPR	2.3– 2.9
Synthetic esters. Native oils	HEES / HETG	2.9– 3.7
Polyglycols	HEPG	> 5
Phosphate esters	e.g. HFD-R	6– 7

ENG

⚠ Note

Determining permittivity for “own oil”

If you would like to specify the start value of the permittivity, a measurement can be performed and then the measurement value of the permittivity entered in the oil database.

5.2.5 Display of the measurement values

If you are on the measurement menu (Figure 25), you can use the F1 key (“DISPLAY”) to reach the measurement value table. Under this, the saved measurement data for each metering point is saved. The display is done in table form. The table consists of 8 windows that are displayed in brackets in the yellow field in the header. You can switch among them by pressing the right or left keys on the keyboard. The sets reflect the number of measurements.

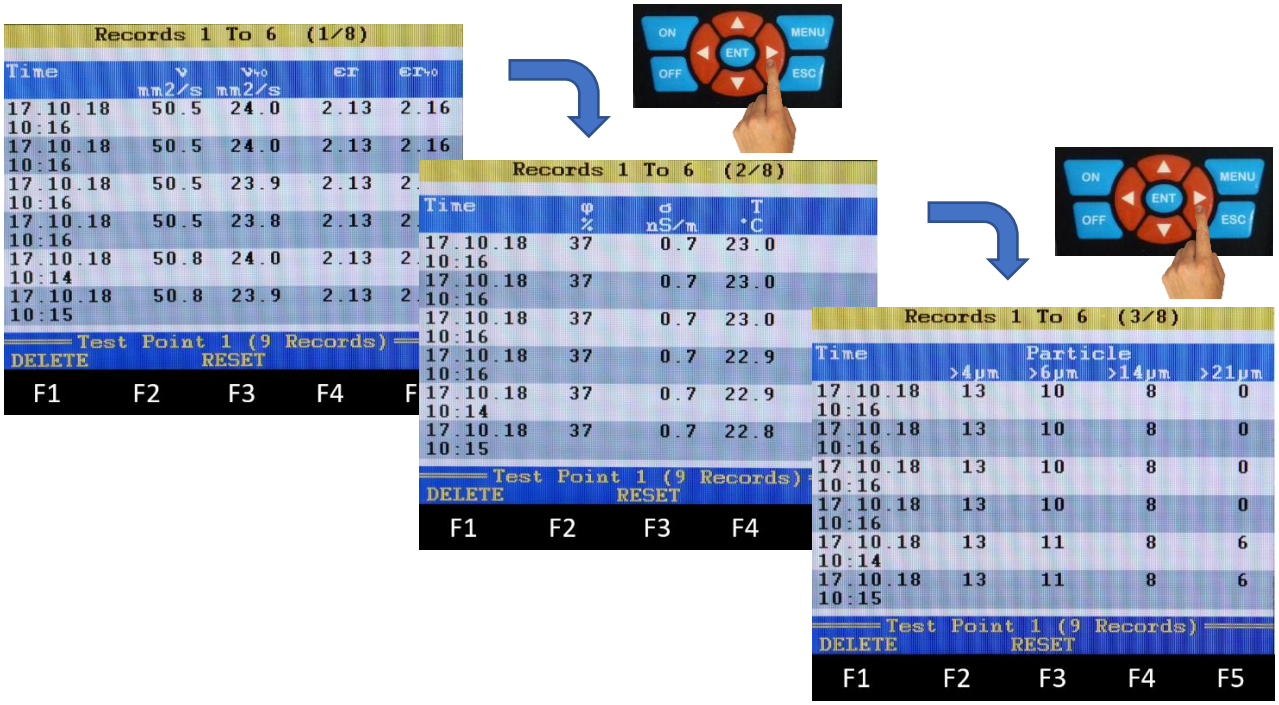

Figure 29: Measurement value table

In the first three windows, the direct measurement values for a particular time stamp are saved. The fourth window displays the oil with its oil parameters that was selected for the measurement. Windows 5-8 reflect the limits set at the time of the measurement.
Use the F1 key “DELETE” to delete individual measurements; use the F3 key “Reset” to delete all measurements for the metering point by resetting the table. If you are in online mode, if you press the F5 key, the “SAVE” function appears that you can use to record a new measurement value.

5.2.6 Exporting the measurement data

With the measurement instrument, it is possible to export the saved measurement values in the measurement value table. Here, the measurement values are saved in a text file on a USB stick. This way, the data can be transferred to a PC and there can be a graphic display of the measurement data.

To start the data export, go to the measurement instrument's main menu and press the F4 key (“USTICK”) under Save in the blue field. The mode is set to “Save” and the data type “CX 197 Series (TXT)” is selected. Then, by selecting the metering point under “Selection,” you can specify that its measurement value table will be saved on the USB stick under the same name selected.

5.2.7 Evaluation of the measurements - Condition menu

If you are on the Condition menu (Figure 24), you can use the F5 key (“DETAIL”) to reach the oil condition menu that is depicted in Figure 30**Fehler! Verweisquelle konnte nicht gefunden werden.**. On this menu, there is a condition evaluation, which with an indicator display (traffic light display) indicates warnings or calculates deviations of the oil condition.

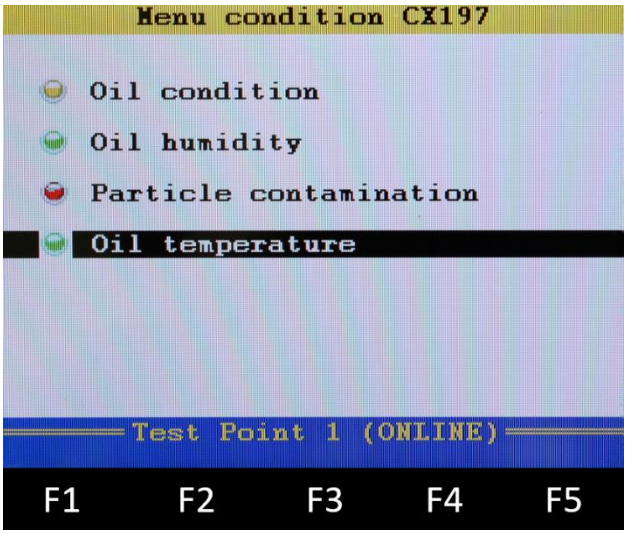

Figure 30: Oil condition menu

On the oil condition menu, the four points (oil condition, oil humidity, particle contamination, and oil temperature) can be selected with the Enter key.

Oil condition:

If you open the first point “Oil condition,” the window depicted in Figure 31 appears. There, the difference to the setpoint is specified in the first block. Here, the difference from the data sheet value is displayed as a percentage; or is displayed for the self-defined oil characteristic value. The traffic light display reacts by turning yellow as soon as one of the two deviations (v40 or ε40) is greater than 7% and less than 20%. If the deviation becomes greater than 20%, the traffic light turns red. If the deviation is less than 7%, the traffic light is green.

The same colors are used in the next block, “Changing of the measuring.” Here, the percentage deviation of the last measurement value from the first measurement value is calculated. This way, you can see how much the oil has changed in the course of operation.

The lower displays “Limits v, v40” and “Limits ε, ε 40” are red if the set limits have been exceeded.

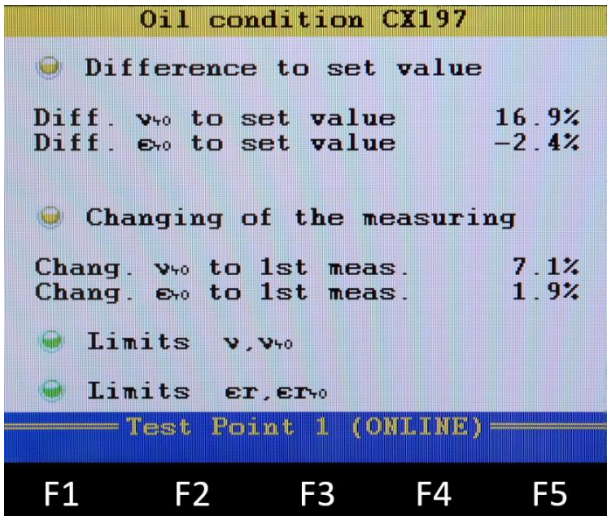

Figure 31: Oil condition on the "Oil condition" menu

Oil humidity:

If you select the "Oil humidity" element from the Condition menu, a window opens (Figure 32), on which it is signaled with three indicators whether the relative oil humidity is greater than 50%, 75% or greater than 95%.

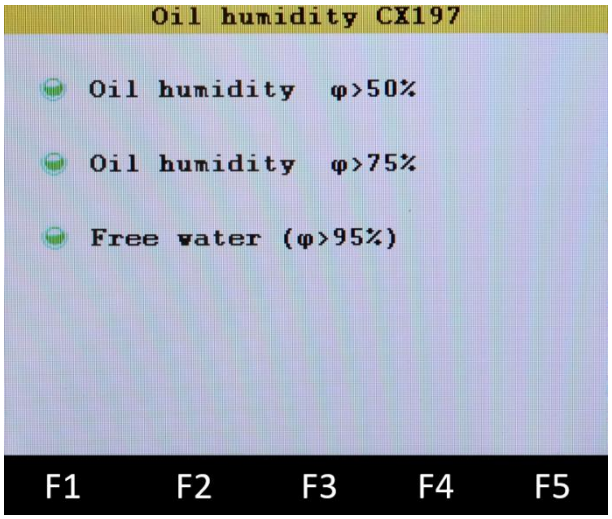

Figure 32: Oil humidity on the "Oil condition" menu

Particle contamination:

The three indicators depicted in Figure 33 are used for particle analysis:

- Particle contamination: This indicator turns red if a measurement value exceeds the limit value set under Limits.
- Meas. values existing: Here you can see whether measurement values have been sent by the particle monitor or whether there is a communication problem.

- Flow verification: If the flow is set too high or low, this indicator turns red.

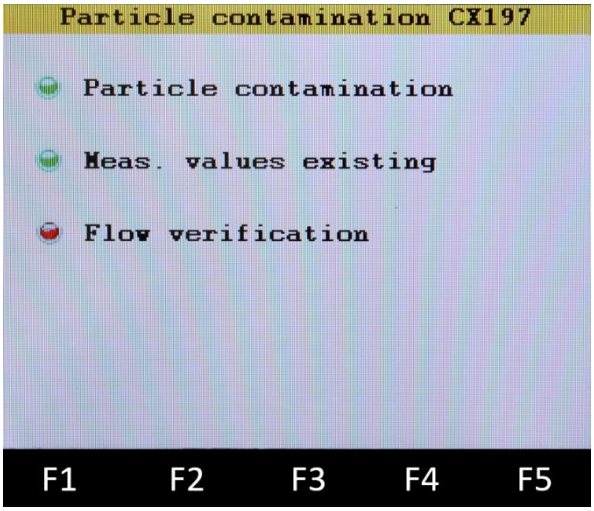

Figure 33: Particle contamination on the "Oil condition" menu

Oil temperature:

If you select oil temperature, then it is indicated with a traffic light control whether the set limit values for the oil temperature have been underrun or exceeded.

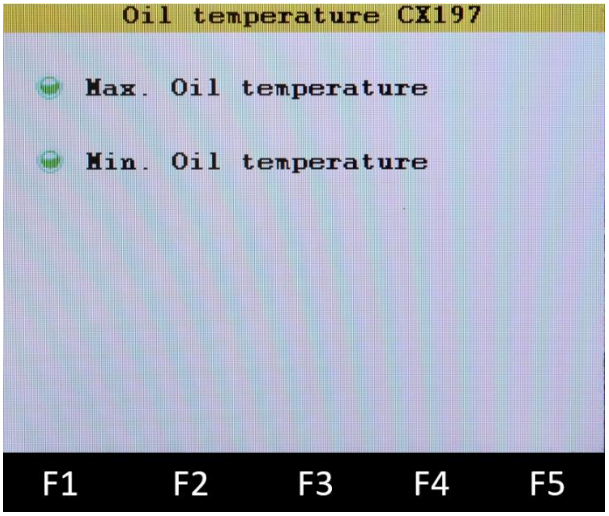

Figure 34: Oil temperature on the "Oil condition" menu

6. Interpretation of the measurement results

Thanks to the particle monitor, you can get information about the degree of contamination of the oil with foreign particles. The humidity sensor specifies the dissolved humidity content directly. These variables provide direct insights into the wear of the oil due to particles and/or humidity. If the limit values for these variables are exceeded, you should take action.

The oil condition is a variable formed from many parameters. Limit values for specific oil parameters depend on the respective use e.g. the components and materials used. The type and speed of oil parameter change, in turn, depends on the application, the specific system load, and the pressure or lubricant used. Therefore, it is not possible to define universally valid limit values for individual parameters.

6.1 Specific oil parameter change

If you examine the temporal change of the parameters, there are two distinguishing criteria:

- Quick change: the parameters change suddenly as compared to the last measurement. Here is should be assumed that there has been a recent event. For example, there might have been an oil change or top-up.

- Slow change: the parameters change slowly across several measurements. Here, it should be assumed that there is a gradual condition change, such as happens with oil aging.

⚠ Note

Possibilities are revealed that point to particular causes. Due to the complexity of various oil parameters, it cannot be guaranteed that statements hold true.

6.1.1 Viscosity

Slow increase

If the viscosity increases slowly and constantly, this indicates an oil aging due to oxidation. There is a polymerization happening. That is, the carbon water substance chains of the base oil are forming insoluble polymers due to reaction with oxygen.

Caution: In addition to polymers, acids also arise during this reaction! These can cause corrosion.
Indications of oxidation (in addition to increase in viscosity):

- Brown color of the oil
- The same applies for the increase of permittivity

- Polymer chains can be deposited in the system (e.g. In the tank or filter)

In order to determine oxidation for certain, a laboratory analysis with determination of the oxidation count (or the TBN Total Base Number) is necessary.

Slow decrease

If the viscosity decreases constantly, this can be an indication of the “cracking” of the base oil. With cracking, the long-chain carbon water chains are broken up, which reduces the viscosity. The cause of this can be extreme temperatures over a short time, so-called hot spots (as during blending) or electrostatic discharges.

Indications (in addition to decrease of viscosity):

- Gray color of the oil
- Evaporation loss

Quick increase/decrease

If there is a jump in the viscosity, it should be assumed that there has been an oil change or an oil top-up with an oil with a different viscosity. An oil change can be detected if the measurement value is set in the amount of an ISO VG class (viscosity at 15, 22, 32, 46... mm^2/s @ 40°C).

A jump can also occur due to a top-up with an oil with another viscosity.

6.1.2 Permittivity (dielectric constant)

The permittivity is an important parameter that describes the dielectric behavior of the oil (that is, the **polarity**). It depends on many properties, such as the type and quantity of additives, humidity content, oil type, etc. Particular oil types can be divided into ranges, as you can see from the following table.

Oil type	Descriptions	Permittivity ε_r
Mineral oil	HL, HLP, HLPD, HVLP, HVLPD	2.0– 2.4
Polyalphaolephine (PAO)	HEPR	2.3– 2.9
Synthetic esters. Native oils	HEES / HETG	2.9– 3.7
Polyglycols	HEPG	> 5
Phosphate esters	e.g. HFD-R	6– 7

Slow increase

This indicates (as for viscosity) an oil aging that can have various causes:

- Oxidation (see point 6.1.1 viscosity)
- Reduction of additives:
  Due to the usually polar reduction or decomposition products, the permittivity increases
- Humidity increase:
  Since water has a very high permittivity (dipolar property), the permittivity increases with increasing water content. Here, the measurement value “relative humidity” provides insight.

ENG

Quick increase/decrease

If there is a jump in the permittivity, it has to be assumed that there has been a recent event. In addition to sudden wear (e.g. due to contamination, water, etc.), there may also have been an oil top-up or oil change.

A frequent error is due to the confusion of mineral and “biological” fluids. Here you can see the differences in permittivity clearly. The variable range of poly(alcyl)glycols (>5) deviates significantly from other oils.

6.1.3 Conductivity

Oils are not conductive and have a very small conductivity value of few nS/m. Since the measurement variable is so heavily dependent on temperature that it can change by a multiple across the temperature, there is no temperature-compensated conversion.

Instead, the conductivity is regarded sooner as an indication in order to determine larger changes in the oil property. A change of the conductivity generally also causes a change in the permittivity.

⚠ Note

When comparing the measurement value for conductivity, heed the same temperature.

The following causes can cause a change in the conductivity:

- Acids and bases (ion conductivity)
- Heavy contamination with conductive particles
- Water ingress

7. Service and accessories

7.1 Cleaning and maintenance

The outside of the CX 197 can be cleaned with a soft, dampened cloth. If the CX 197 was used previously with a contaminated or another incompatible oil type, the oil in the CX 197 and the lines has to be removed. It is recommended that you flush the instrument out

ENG

⚠ Caution

Damage to the instrument is possible!

Switch the instrument off and disconnect from the power supply BEFORE starting to clean. This prevents the risk of a short-circuit, and thereby possible damage to the device.

⚠ Caution

Damage to the instrument is possible!

Do not use any aggressive cleaning materials, solvents or similar chemicals when cleaning the CX 197 or the sensors. The consequence could be damage to the sensor element and thus it could affect the measurement results.

7.2 Calibration

The service measuring kit requires no maintenance. However, it is still necessary to have it recalibrated regularly. If it is in frequent use, we recommend recalibrating it every 12 months. Have the service measuring kit calibrated by the manufacturer with the Patrick sensors, HySense® CV 100, and HySense® CM 100. HYDROTECHNIK maintains a high-performance calibration laboratory.

Note

Measurement deviation in the viscosity measurement!

Since additives that influence SAW technology are primarily used to improve viscosity, measurement deviations can occur with highly additive oils. In this case, the service measuring set must be calibrated to the oil used.

Please contact our service at:

Tel.: +49 6431 4004-555
E-mail: service@hydrotechnik.com

ENG

7.3 Accessories and spare parts

Part	Part number	Remarks
HySense® CX 197	3402-CX10-D100-000	Service measuring kit with case, cables, connection lines, and power pack

Part number	Description	Remarks
3402-CV10-G926C0-000	HySense® CV 100	Viscosity sensor
3402-CM10-G926C0-000	HySense® CM 100	Humidity sensor
3160-00-76.00	Patrick	Particle monitor
3160-00-82.00	MultiSystem 5070	Measurement instrument
3160-00-83.00	MultiSystem 4070	Measurement instrument
S110-AC-AC-0100N	Minimess® measurement hose DN2-63 MPa, 1m	Connection to service measuring kit (tank line or for ventilation)
S110-AC-AR-0100N	Minimess® measurement hose with check valve DN2-63 MPa, 1m	Connection to service measuring kit (pressure line)
8812-00-00.39	Power pack M12 x 1; 8-pin with data line for measurement instrument and country plug adapter	Power supply for CAN cable 8824-TB-00.00 with data line
8824-TB-00.00	CAN 3-way data cable	CAN connection cable measurement instrument/sensors
880C-00-00.02	Bursting disk 50 bar	For protection of the sensors

For use of the individual sensors:

Part number	Description	Remarks
8824-T7-00.00	Interface cable M12 x 1; plug; 8-pin/D-SUB connection; 9-pin	For configuration and reading out of the internal memory
8808-50-01.03	Y-distributor M12 8-pin; connector, plug, connector	Required with the “8824-T7-00.00” interface cable
8812-00-00.36	Power pack M12 x 1; 8-pin with country plug adapter	Power supply for individual sensor or Y-adaptor

ENG

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