CCS 5
Contamination Control System
Particle counting + Water saturation + Temperature

Instruction manual
Version 1.3

Version valid from:	Apr.01.2024
software version from:	1.1.3

Index

1.   Safety information

1.1. Signal glossary

- Failure to observe the safety instructions in this manual implies various risks and endangerment of life and the physical condition of the operator. The notices are marked with the following **signal words:**

  ⚠ DANGER   **DANGER** implies a dangerous situation which **causes death** or **serious injuries** in case of nonobservance.

  ⚠ WARNING   **WARNING** implies a dangerous situation which can **cause death** or **serious injuries** in case of nonobservance.

  ⚠ CAUTION   **CAUTION** implies, together with the danger symbol, a dangerous situation which can **cause light, medium, or heavy injuries** in case of nonobservance.

- Failure to observe the safety instructions in this manual, which does not cause injuries but destruction of the system and its operability, are marked with the following signal word:

  NOTICE   *NOTICE* describes the correct way of handling the device.

The above signal words can be combined with the safety symbols or the warning symbols.

⚠   General danger

⚡   Danger caused by electricity

☠   Danger for the environment

1.2. Dangers of maloperation

The CCS 5 underwent a safety inspection. The integrated electric and hydraulic safety elements ensure safe operation if the device is used as it is intended.

⚠ WARNING

In cases of maloperation or abuse, as well as in cases of ignoring the application limits and safety regulations, the following threats can occur regarding the:

- Life or physical condition of the operator; ⚡

- The **CCS 5** device, as well as connected machines and systems; ⚠

- The accuracy of measurements made by the **CCS 5**; ⚠

- The environment. ☠

⚠ WARNING
Therefore, it is necessary that everybody having to do with the operation and the maintenance of the unit strictly follows this instruction manual!

1.2.1. Hazards by working at the hydraulic or lubrication system.

May occur the following hazards:
- uncontrolled discharge of the pressure fluids
- accidental machine movements
- thrown or bursting of parts
- skin toxicity
- noise emission

Uncontrolled discharge of the pressure fluids
Possible leaking of the hydraulic fluid:
In case of breakage of pipes, upon release of fasteners that are still pressurized, damages of the hydraulic hose lines or by exposure to excessively high forces.

The consequences can be:
- eye damage
- skin penetration
- fire hazard
- risk of slipping
- environmental hazards, such as penetration of the fluid into the soil / groundwater

Connection of the hoses from the CCS 5 to the hydraulic or lubrication system, see chapter 2.3.

Accidental machine movements
- Accidental operation of command or control devices. (buttons, levers, proximity switches, and so on)
- Error in control
- Failure of components due to for example: excessive system pressure, material fatigue…
- Contamination of the hydraulic fluid

Thrown or bursting of parts
May be a result of:
- excessive stress of components (e.g: high operating pressures or pressure peaks)
- material fatigue (e.g: demolished hydraulic hose assemblies)

Skin toxicity
- Through contact with hydraulic fluids. ⚠ **WARNING** **Follow the skin protection plan!**
- Vapors of pressure fluids can cause respiratory irritation, if inhaled.

Noise emission by
- pump units
- the work process noise generated by machines
   ⚠ **WARNING** **Use hearing protection at hazardous noise levels.**

NOTICE One or more hazards can occur simultaneously depending on maintenance work. Accordingly, several safeguards must be applied.

- **Note the five-finger rule of fluid technology during maintenance work!**
  1. Separate power supply
  2. Secure against re-supply
  3. Depressurized the system (also the pressure storage), lowering or supporting of the uphold loads, reduce residual energy
  4. Check the release pressure (pressure free)
  5. Prevent hazards by neighboring plants.

1.2.2. When all measurements are done:

1. Switch **OFF** the CCS 5 and disconnect the external power supply.
2. **Disconnect** the **pressure hose or suction hose** (depending on the hydraulic connection).
3. **(at last!) Disconnect the return hose** (transparent plastic hose) from the **[OUTLET PORT]** of the **CCS 5**.

1.3. Sources of danger

- An operation of the CCS 5 is only allowed at a shockproof socket.
- ⚠ **WARNING** Avoid the risk of direct and indirect contact with voltage- or current-carrying parts. Voltage disappearances, e.g.: avoid due to poor grounding.

1.4. Service staff

- Only authorized persons can work with the CCS 5.

The operator must:
- **hand over the maintenance instruction to the user.**
- **make sure, that the user reads and understands the instruction.**

1.5. Safety arrangements on site

- The CCS 5 must sit on a flat solid ground.
- For outdoor measurements (in the rain) use the CCS 5 only with tilted housing cover. This prevents the entry of water into the CCS 5.
  NOTICE Look at the hoses, while closing the housing cover!

1.6. Intended applications

- The CCS 5 is a mobile diagnostic system meant for continuous monitoring and condition analyses of hydraulic and lubricating systems, which enables the user to evaluate the up-to-date condition by measuring the particle contamination, water saturation and temperature.

- The particle size distribution is being shown in contamination classes according to ISO 4406:99, NAS 1638, and SAE AS 4059.

- Resulting out of measured saturation and temperature values, the theoretical water content in ppm (mg/kg) is being calculated and displayed for selected fluids.

- By knowing these important parameters, the user is able to evaluate the precise condition of the system. Having this information will help to initiate actions promptly and cost-saving measures before major failures can occur.

- The unit is suitable for pressure, as well as for suction operation, i.e., it can be connected to a pressure line by a minimess connection or absorb fluids which are to be analyzed by using an integrated suction pump.

1.6.1. Limitation of use

The device is exclusively adequate for on-line applications in hydraulic and lubricating systems within the following limitations:

- operation pressure (suction port): p = -0,2…0,2 bar *(-2,9…2,9 PSI)*
- operation pressure (pressure port): p = 1,5…350 bar *(21,75…5000 PSI)*
- viscosity range: ν = 10…400 mm²/s *(46,35…1854 SUS)*
- temperature range of the oil: 0…70 °C *(32…158°F)*
- ambient temperature range: 0…50 °C *(32…122°F)*
- Internal temperature range: 0…45°C (32…113 °F)

1.6.2. Visual inspection of the used fluid

- If extremely contaminated fluid is introduced to the CCS 5, the internal orifices of the laser sensor can be blocked and display an anomalous result, e.g.: 00/ 00/ 00. (see chapter 7.3.1 of the instruction manual)
  Classification of highly contaminated fluids:
  ➔ **More than 24.000 parts per ml (>NAS 10 or class 22 acc. to ISO 4406:99)**
  ➔ **Particles larger than 200 µm (which can be detected without laboratory microscope)**

- If the **laser sensor is blocked** (e.g. showing low classification code), please take the following steps:
  ➔ Attempt to **flush** the system with **clean** (NAS 4 or **ISO 16/13/9 or better**) **low viscosity fluid** (ISO VG 22) in the **continuous mode**.

  ➔ If this **does not help**, please **contact** the *local presentative* of **Eaton Technologies GmbH**, or **send** the CCS 5 to the *service center* of **Eaton Technologies GmbH Altlussheim.**

⚠ WARNING **The regular function of the CCS 5 and the warranty of safety are guaranteed only if it is used with provided and allowed accessories of Eaton Technologies GmbH.**

- Before measuring with the CCS 5, the oil has to be extracted from the system and visually examined for extremely large particles that may cause undue wear to the system.

- **⚠ CAUTION** ⚠ Before connecting the CCS 5 to the system, make sure that the oil discharged out of the CCS 5 gets caught in a tank. The oil must not get released to the environment!

⚠ DANGER ⚡ ⚠ **No unauthorized modifications or changes are allowed to the CCS 5! E.g.: open the unit by removing the front screws and remove the assembly.**

NOTICE **The terms and conditions stated in this instruction manual have to be followed strictly!**

2. Operation and installation

2.1. Setup

The CCS 5 consists of the equipment case (1), the external power supply (2), the USB – stick (3), high pressure measuring hose (minimess hose) (4), the suction hose and the return hose (5).
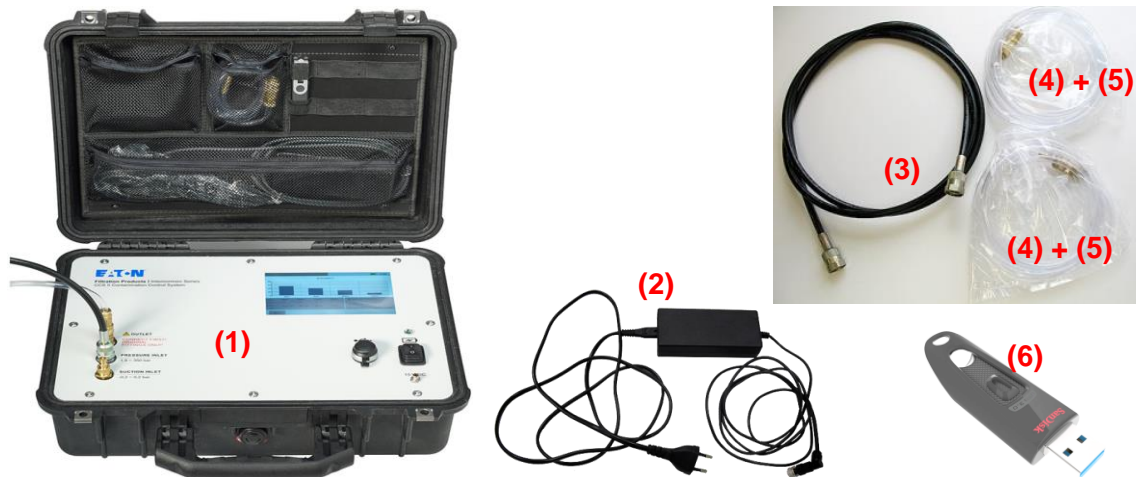
Optional accessories: thermal printer with adapter

2.2. General information

External factors have a huge and extensive influence on the lubricant during operation. External factors are for example forces, energies, and interactions with other materials. Pressure and shear stress also belong to the force effects. Energy influences are the supply and the removal of heat (high temperature amplitudes). A lubricant gets in contact with gases (air, nitrous gases or sulphur dioxid), liquids (water, external liquids like detergents, dissolver etc.) and solid matters (metals, ceramics, synthetic material parts and sealing materials). The contamination outcomes are very versatile for the hydraulic and lubricating system and cause a significantly higher abrasion, an increase of the failure risk of components as well as malfunctions.

The CCS 5 is for the continuous monitoring and condition analyses of hydraulic and lubricating systems. The CCS 5 can be handled in suction as well as in pressure operating mode.

The CCS 5 includes the following functions:

- Particle counting by a laser sensor for hydraulic and lubrication oils within the measuring range < 24000 particle/ 1 ml and the maximum particle size of < 200 μm.
- Exact evaluation of contamination classes according to ISO 4406:99, NAS 1638 and SAE AS 4059.
- Measuring of.
  - Water saturation   (0 … 100%)
  - Temperature   (0 … 70 °C)

    (see also the technical data at chapter 7.1)
- Calculation and output of the theoretical water content in ppm (mg/kg) based on fluid specific saturation curves.
- Display of all measurement values on a resistive touchscreen.
- Internal storage of measurements.
- Output of saved measurement files by USB-interface on the USB-stick.
- Thermal printer as accessories

  For the data management using an external computer and the LabVIEW Data Manager Software (export in MS EXCEL).

2.3. Connection to the hydraulic or lubricating system

- The CCS 5 can be handled in a **suction** as well as in a **pressure operating mode**.

NOTICE **Only ONE inlet hose is allowed to connect to the CCS 5 at the same time, either PRESSURE INLET OR SUCTION INLET.**

⚠ WARNING
⚠ DANGER **The return hose (OUTLET) should be always connected *FIRST*!**

Connection for suction mode   connection for pressure mode

- Connections from the top to the bottom:
  OUTLET port, **pressure INLET** port and **SUCTION INLET** port for the return line.

  NOTICE
  Use only the labeled hoses, that supplied by Eaton with the CCS 5.
  Check the hoses before using.

Also check the cleanliness of the ports at the CCS 5, the hydraulic system and the hoses.

The ports must be cleaned before using.

2.3.1. Connection into the pressure operating mode (max. *350* bar)

- Connect the return hose (transparent plastic hose) with the **[OUTLET PORT]** of the CCS 5 and transfer it to an oil collecting tank.

⚠ **CAUTION** ⚠

➤ The oil collecting tank must be dimensioned according to the time needed to perform the operation. Otherwise, an empty replacement tank should be provided and quickly changed when it is full.

➤ You may also circulate the measured oil back to the tank of the system.

➤ **NOTICE** **Never connect the recirculation to a pressurized line!**

- In the **pressure operating mode** the provided high pressure hose (minimess hose) is being connected with the CCS 5 - **[PRESSURE PORT]** and the hydraulic system.

2.3.2. Connection into the suction operating mode (min. -0.2 bar)

- Connect the return hose (transparent plastic hose) with the **[OUTLET PORT]** of the CCS 5 and transfer it to an oil collecting tank.

⚠ **CAUTION** ⚠

➤ The oil collecting tank must be dimensioned according to the time needed to perform the operation. Otherwise, you must provide an empty replacement tank that may be quickly changed when the first one is full.

➤ You may also circulate the measured oil back to the tank of the system.

NOTICE

**Never connect the OUTLET hose to a pressurized line!**

- In the **suction operating mode** the provided suction hose (transparent PVC-hose) is being connected with the **[SUCTION PORT]** of the CCS 5 using the quick lock coupling (two-sided locking).

- The hose has to be inserted into the tank.
  NOTICE **Pay attention to create a distance of minimum 15 cm from the tank bottom and the tank walls, so that no coarse particles, which are sedimented in the tank, get absorbed and choke the sensor system.**

2.4. Electrical connection

2.4.1. Mains operation

- The operating voltage of the CCS 5 amount to 15 V DC.
- To create the necessary operating voltage, connect the CCS 5 with the external power supply (100 V bis 240 V AC, 50/60 Hz). The power on the power supply is visible with a

blue power indicator. ⚠ **WARNING** ⚠
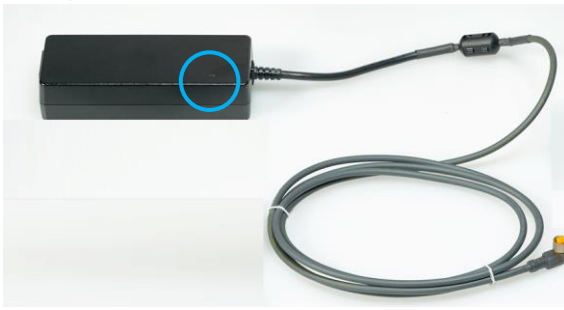
- connection with external power supply.
  $\Rightarrow$ the green LED turns ON when the power supply is connected, and the battery is being charged correctly.

- Switch ON: push the "power switcher" – to **I**.
- Switch OFF: push the "power switcher" – to **O**.

2.4.2.   Battery operation

- The rechargeable lithium-polymer battery with internal battery charger is integrated in the CCS 5.
- It allows for an approximate continuous operating time of 2-4 hours, depends on the viscosity of the testing fluid.
- **NOTICE** **The CCS 5 switches off automatically when the internal battery is completely discharged. Then it is only possible to start the CCS 5 with the external power supply unit.**
- In standby mode (measurement is not running) the recharge of an empty battery needs around 3 hours; During measurement the recharge takes around 6 hours.

Indicator of the battery status
The green LED on the front panel indicates the battery status of CCS 5.
It lights when battery is loading correctly.
   $\Rightarrow$ battery will be always loaded when the external power supply is connected
   $\Rightarrow$ it flashes when there is a failure with the battery, e.g. the temperature in case is too high or too low (0-45°C is allowed for charging of lithium polymer battery)

WARNING the charging process will be suspended automatically to protect battery.
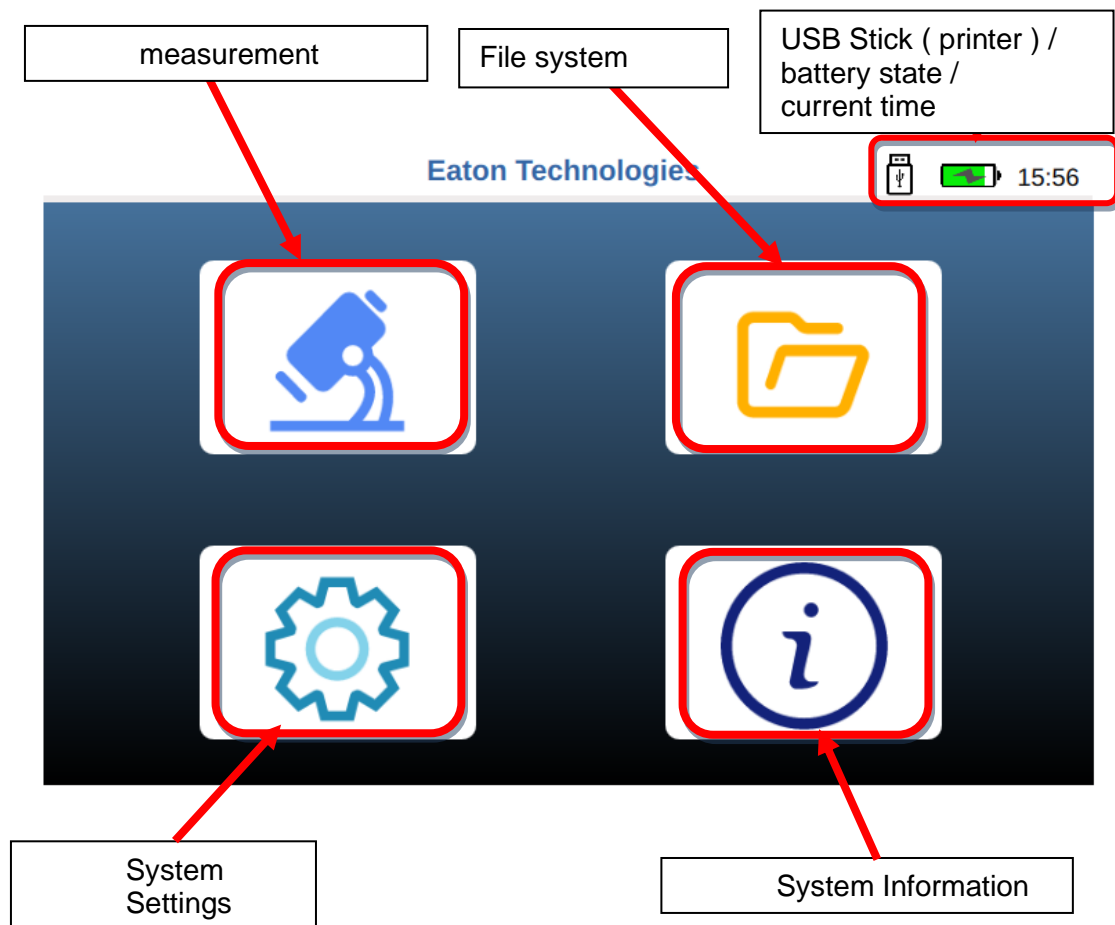
Car supply
With a special adapter it is possible to connect the CCS 5 with a **car plug**. (the accessory is available on request)

2.5. Operation with the CCS 5 software

- After connecting the necessary hoses, power and switching on the CCS 5, the unit is ready for operation. (green control diode lights)

- After switching on the CCS 5, and wait some seconds until the operating system is booted, then the main menu appears on the display

2.5.1. Main menu

- Start of the CCS 5 and wait until the operating system is booted, then the main menu is shown on display.
- The main menu enables the selection of the functions which the CCS 5 offers.

measurement

File system

USB Stick (printer) / battery state / current time

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System Settings

System Information

measurement
Accomplish of the measurements with various measuring programs (single, continuous, cyclic), and the fluid type in need. The CCS 5 must be connected acc. To the capital 2.3).

File system
For analysis, transferring and manage of the saved measurement results.

System settings
Settings of date, time, brightness of the display, as well as software update.

System information
Showing the software version, calibration date, system date/time, charging current of the battery.

2.5.2.   Icons

- **printer**, when a serial printer is connected. This printer can be ordered as a printer-set optionally.

- **USB stick:** when a USB-Stick is connected, saved files can be saved on it.

- **battery state**: it indicates the current battery capacity.

- **battery charge state**: battery in charge

- **battery error**: error in battery → *stop the CCS5, check the battery*

- **high internal temperature**: warning of high internal temperature, to protect battery and sensitive components.

- **error pressure switch**: internal pressure to high → *the OUTLET-hose should be checked.*

2.5.3.   Warning of calibration expiration

- **NOTICE** The validity of the calibration certificate is 12 months.

When the validity of the calibration is expired, a warning triangle will show on the window. Considering the transport and shipment, the warning icon will no be prompted until 400 days after calibration.

- **⚠ CAUTION** ⚠ ⚡ ⚠ Eaton recommends a calibration interval of 12 months. For the secondary calibration the CCS 5, the unit is to be sent to Eaton Technologies GmbH in Altlussheim.

2.5.4. measurement

- For the measuring in the appropriate operating mode (depending upon the hydraulic connection, see chapter 2.3).

- The following parameters are entered in the setup menu **"Setup"**:
  - Name of the measuring point
  - Selection of the measure-mode
  - Selection of the report standard (ISO 4406:99, NAS 1638, SAE AS 4059)
  - Selection of the flush time (0 ~ 300 seconds)
  - Selection of the test fluid
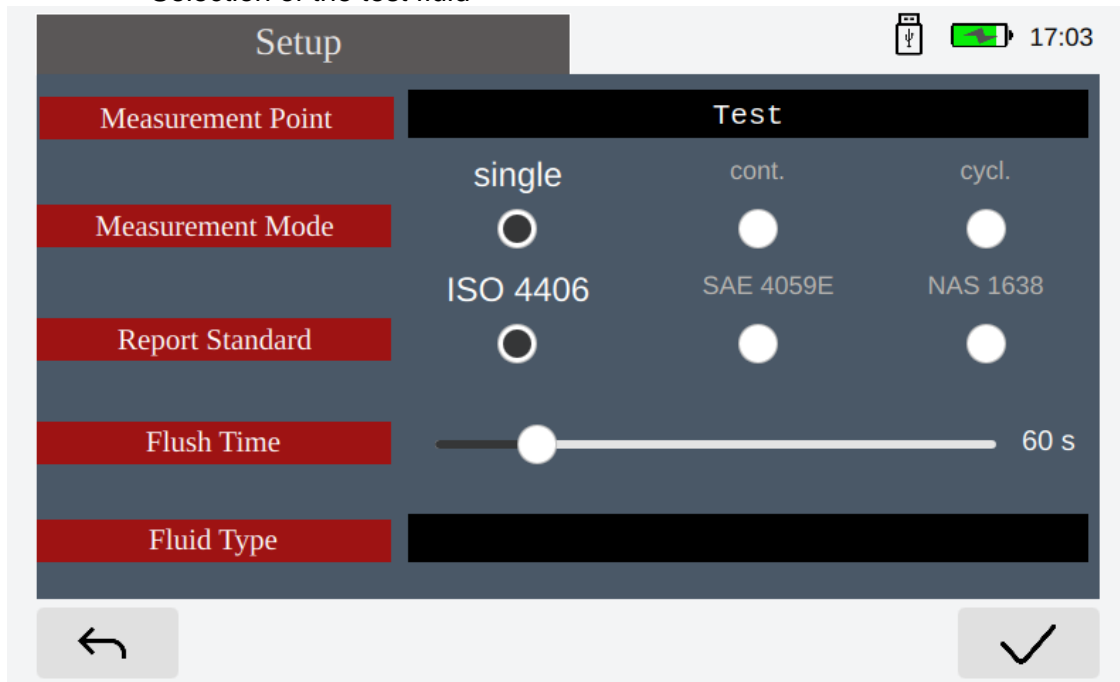
Measuring point: A virtual keyboard will show by touching the filed:

Then a proper name for the saving file can be given:
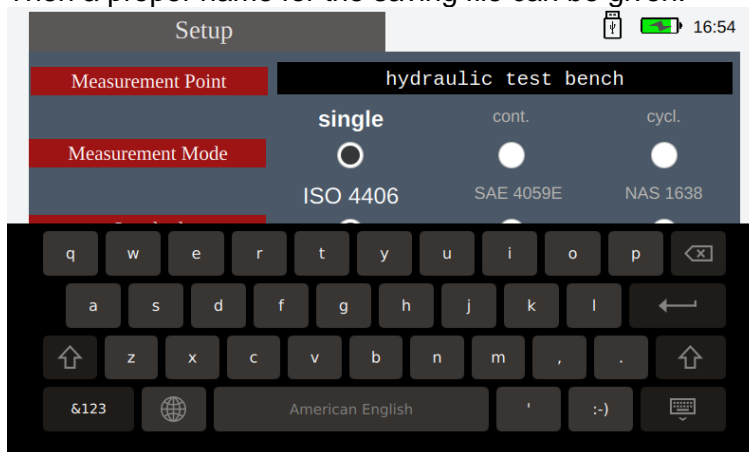
Enter the name of your measuring point by using the virtual keyboard, the maximum capacity is 50 characters.

Always use the same name for the same measuring point, so that the stored data can be systematized within the data file system. Every measurement automatically gets a new index (date and time) in the data file system. Measurements are displayed depending on the data sorting.

If no identification is entered, "**noname**" is automatically filled.

Measure-mode:
Select the measure-mode (single, continuous, cyclic) by choosing the check box.

	single	cont.	cycl.
Measurement Mode	●	○	○

Report standard:
It is possible to display the measurements according to ISO 4406:99 or NAS 1638 or SAE AS 4059. Select the classification format by choosing the check box.

	ISO 4406	SAE 4059E	NAS 1638
Report Standard	●	○	○
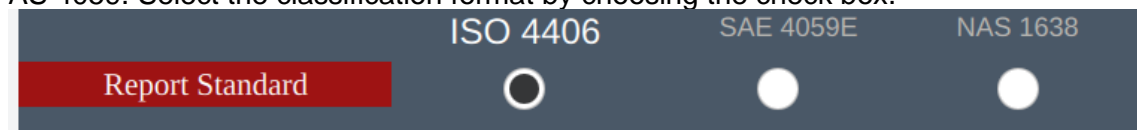
Flush time:
It is recommended to flush the system before every measurement, at least 30 seconds. The flush time can be set between 0 to 300 seconds, it needs about 0 to 500 ml.
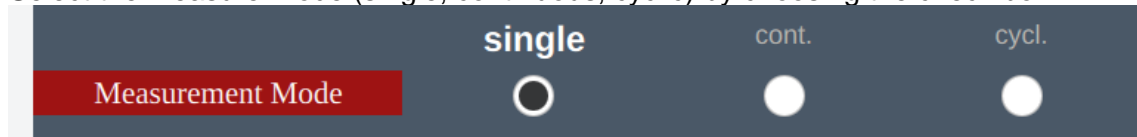
Flush Time	——●————————	60 s

Test fluid:
For the additional display of the existing theoretical ppm water content during the measurements, the type of oil should be selected.
If no test fluid is selected, then the measurements will only display the water saturation in % and not the corresponding ppm.

Fluid Type	

By touching the field above, a new window with all recorded fluids will show up to be selected:

Oil Type	Producer	Oil Name
H 150	Shell	Vitrea M
HLP 46	Panolin	Panolin 46
CLP 320	Castrol	Optigear Syn X 320
HLP 46	**Esso**	**Nuto H46**
HLP 46	Fuchs	Renolin B15
HEES 46	Condat Lubrifiants	Condat D 46
HEES 46	Castrol	Anvol SWX 46
10 W	Fuchs	Titan Suprema C 10W
Transformatorenoel	Mobil	Mobil ECT 35

✕		✓

Then confirm the selected fluid:

Oil Type	Producer	Oil Name
H 150	Shell	Vitrea M
HLP 46	Panolin	Panolin 46
CLP 320	Castrol	Optigear Syn X 320
HLP 46	**Esso**	**Nuto H46**
HLP 46	Fuchs	Renolin B15
HEES 46	Condat Lubrifiants	Condat D 46
HEES 46	Castrol	Anvol SWX 46
10 W	Fuchs	Titan Suprema C 10W
Transformatorenoel	Mobil	Mobil ECT 35

✕   ⦿✎   confirm with ✓

NOTICE to cancel the selected fluid, click the button ✕

⇒ then it will automatically lead to the previous menu.
⇒ The selected fluid is shown as below.

Fluid Type   HLP 46 / Nuto H46

Setup			🔌 🔋 17:23

Measurement Point   Test

Measurement Mode   single ⦿   cont. ○   cycl. ○

Report Standard   ISO 4406 ⦿   SAE 4059E ○   NAS 1638 ○

Flush Time   ●————————— 60 s

Fluid Type   HLP 46 / Nuto H46

↩   ⦿✎
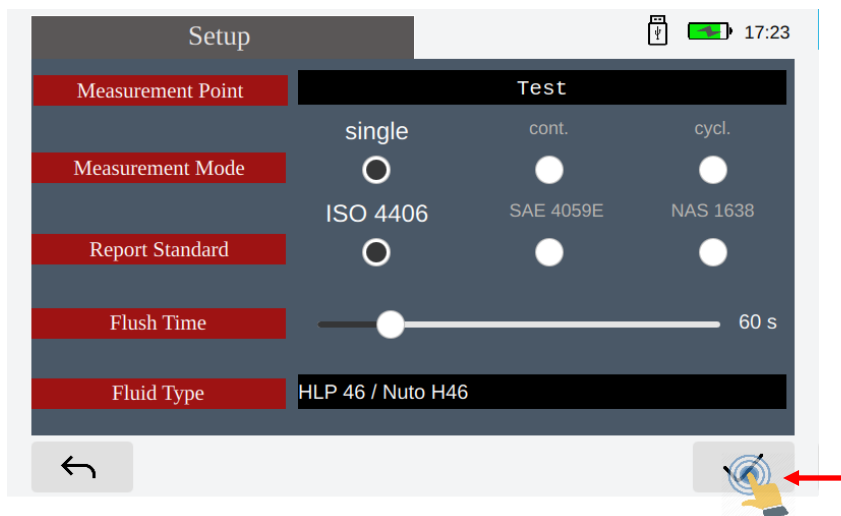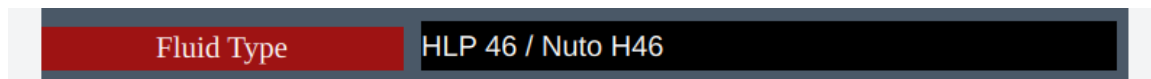
After entering all the necessary measurement parameters, confirm with ✓ and this will take you to the next menu.

2.5.4.1. Measure-type: single

- This mode is to accomplish a single measurement.
- The procedure as described in detail below is performed in any selected report standard (ISO 4406:99, NAS 1638, SAE AS 4059).
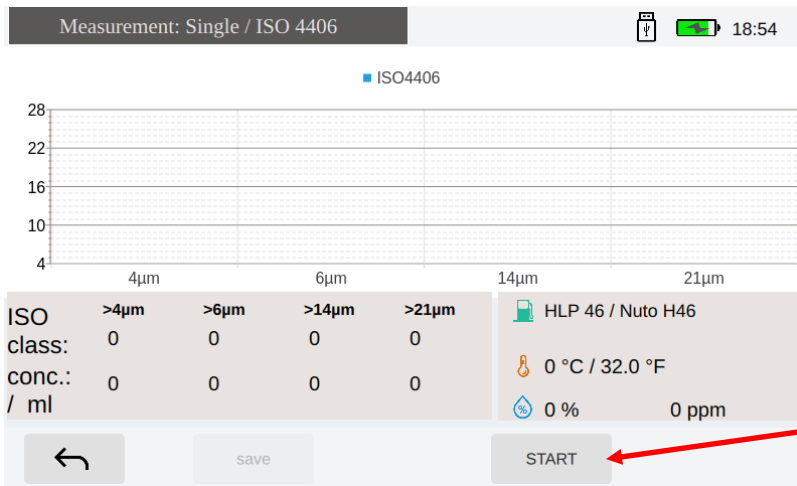
- Start the measurements with [**Start**].

Sensors will be initialized automatically for 10 seconds to have a self-check.
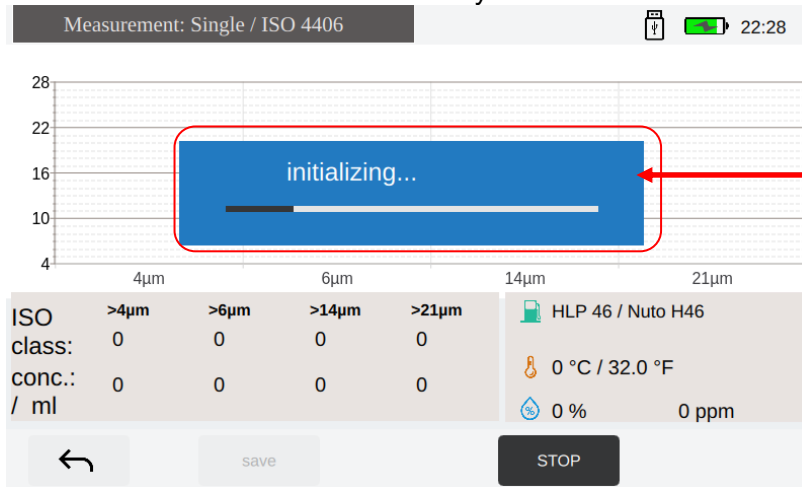
- A self-check runs automatically for 10 seconds

a flushing process runs prior measurement, it takes from 0 to 300 seconds, based on the settings in the setup menu.
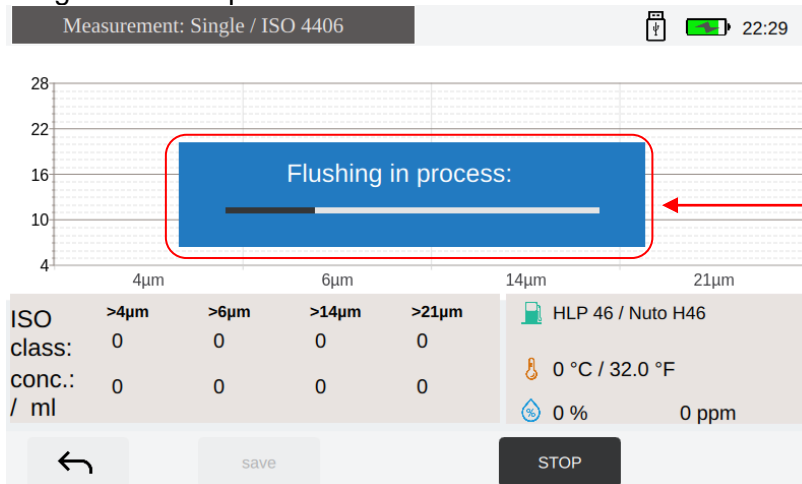
- Flushing process will run automatically based on the selected flushing time in the setup menu.

⚠ CAUTION ⚠ a pressure switch is integrated in the CCS 5, if the OUTLET hose is not connected to the CCS 5, the flushing and measurement will be stopped automatically and a warning message will show as below:
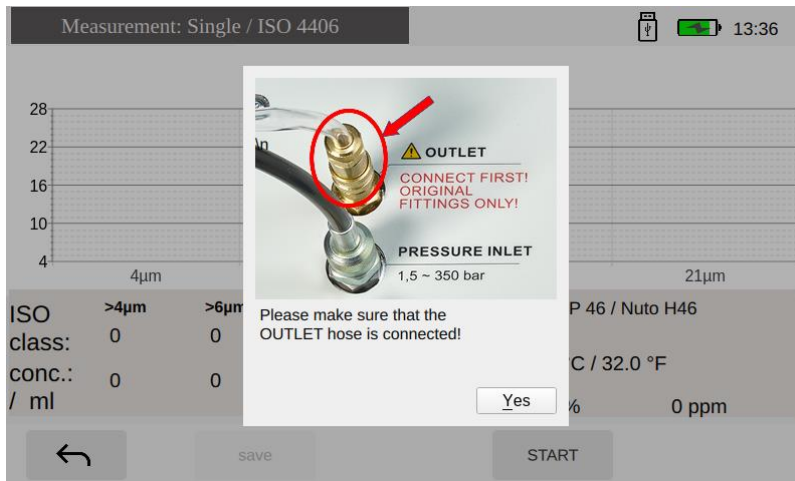
WARNING

Once the warning is shown on the window, it should be checked, if the OUTLET hose is connected to the CCS 5, as described in chapter 2.3.

- Once the OUTLET hose is connected, then confirm with the button [**Yes**]

once measurement is carried out, all results will show: operating mode, report standard type are shown in the headline
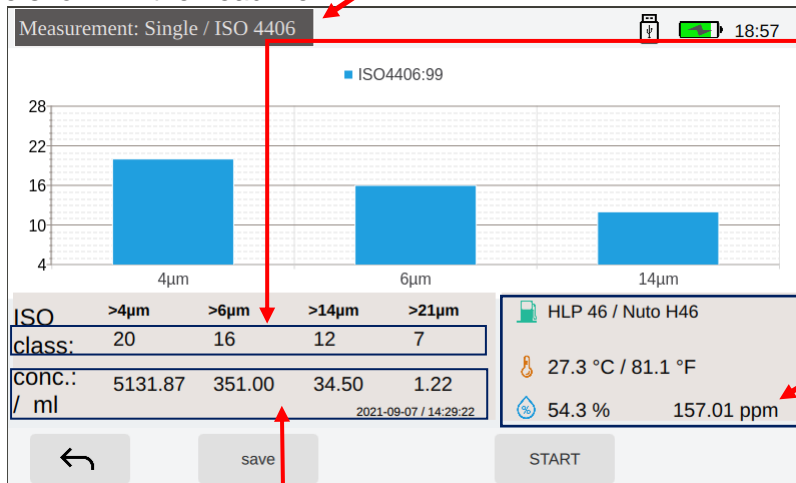
Particle concentration per 1 ml

- Contamination class.

- water saturation and temperature are shown with each measurement. When a fluid type is selected then the ppm water content is also displayed.
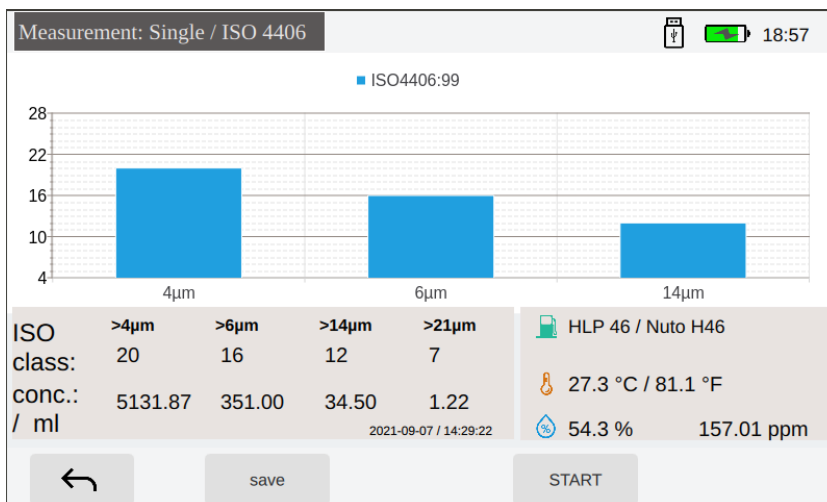
- Now all results are displayed and can be saved by clicking button "save".
  NOTICE The measurement results will not be automatically saved.
- New start with [**START**].
- With ↩ back to the previous menu "Setup".

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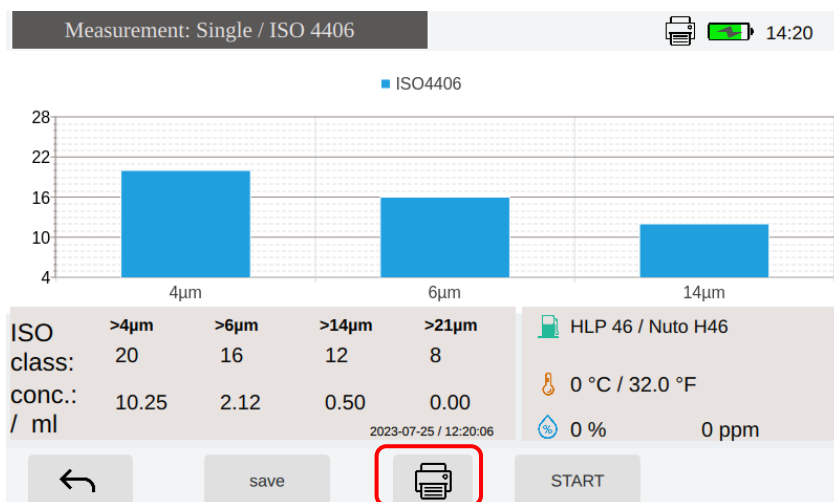
- The results can be also printed, when the thermal printer is connected to the USB port on the CCS5.
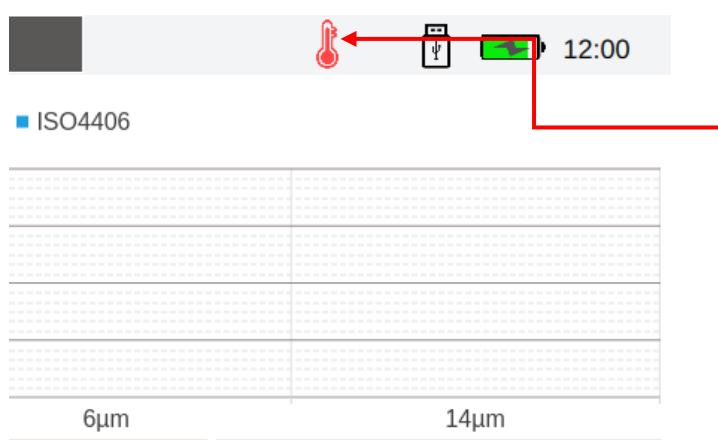
- An Icon will show on the windows once the internal temperature in system is out of range.

- It is recommended to stop the measurement and wait until the temperature goes down.

NOTICE

To assure a constant function of the device and the accuracy of the measurement results, it is recommended to perform a flushing of the CCS 5 with cleaned mineral oil (filtrated H22) for several minutes after finishing the measurements.

2.5.4.2.　Measure-type: continuous

- This mode is to accomplish the continuous measurements.

- After the second measurement a trend of the results will be shown on the display.

- The following details describe the operational sequence that takes place in each selected measurement mode (single / continuous / cyclic) and the kind of classification (ISO 4406:99, NAS 1638, SAE AS 4059). (Example: " Cont. / ISO 4406 ")

ISO4406: 4µm ISO4406: 6µm ISO4406: 14µm

ISO class:	>4µm	>6µm	>14µm	>21µm	HLP 22 / Tellus 22
	0	0	0	0	
conc.: / ml	0	0	0	0	0 °C / 32.0 °F
					0 % 0 ppm
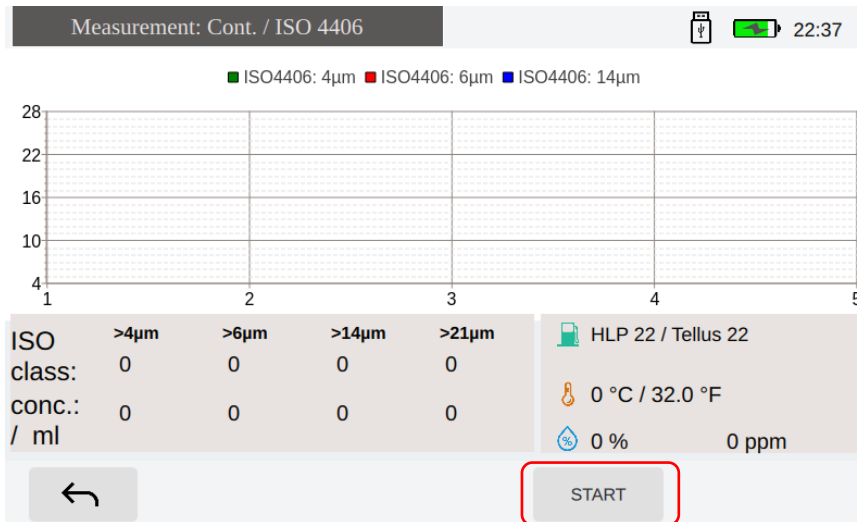
START

- start with button [**START**].

System and sensors will be initialized automatically for 10 seconds to have a self-check.

ISO4406: 4µm ISO4406: 6µm ISO4406: 14µm

initializing...

ISO class:	>4µm	>6µm	>14µm	>21µm	HLP 22 / Tellus 22
	0	0	0	0	
conc.: / ml	0	0	0	0	0 °C / 32.0 °F
					0 % 0 ppm

STOP

- A self-check will run automatically for 10 seconds

The flush process runs before the measurement, it takes from 0 seconds to 300 seconds, based on the selection in the setup menu.

ISO4406: 4µm ISO4406: 6µm ISO4406: 14µm

Flushing in process:

ISO class:	>4µm	>6µm	>14µm	>21µm	HLP 22 / Tellus 22
	0	0	0	0	
conc.: / ml	0	0	0	0	0 °C / 32.0 °F
					0 % 0 ppm

STOP

- Flushing process will run automatically based on the selected flush time in the setup menu.

⚠ **CAUTION** ⚠ a pressure switch is integrated in the CCS 5, if the OUTLET hose is not connected to the CCS 5, the flushing and measurement is to be stopped and a warning message will show as below:
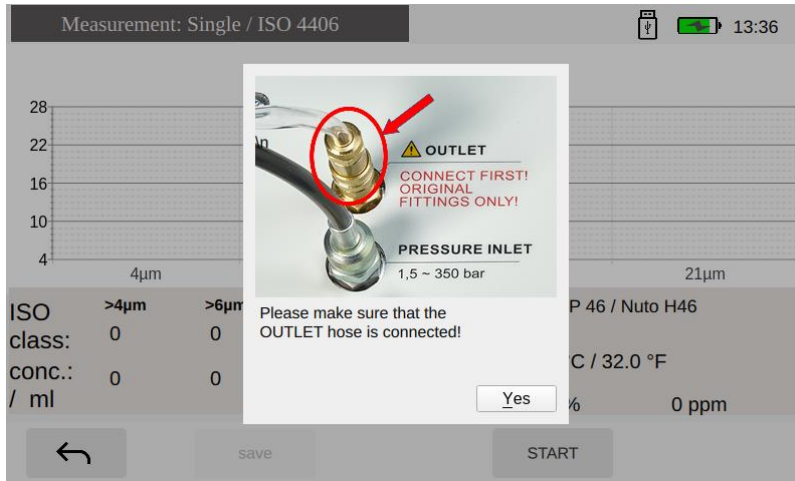
- Once the OUTLET hose is connected, then confirm with the button [**Yes**]

During measurement, results of the last measurement are shown below:

- Results of the last measurement: Both the water saturation and the temperature are shown with each measurement. When a fluid type is also selected, then the ppm water content is also displayed.

- Measurement can be stopped by clicking [**STOP**]

Once measurement is accomplished
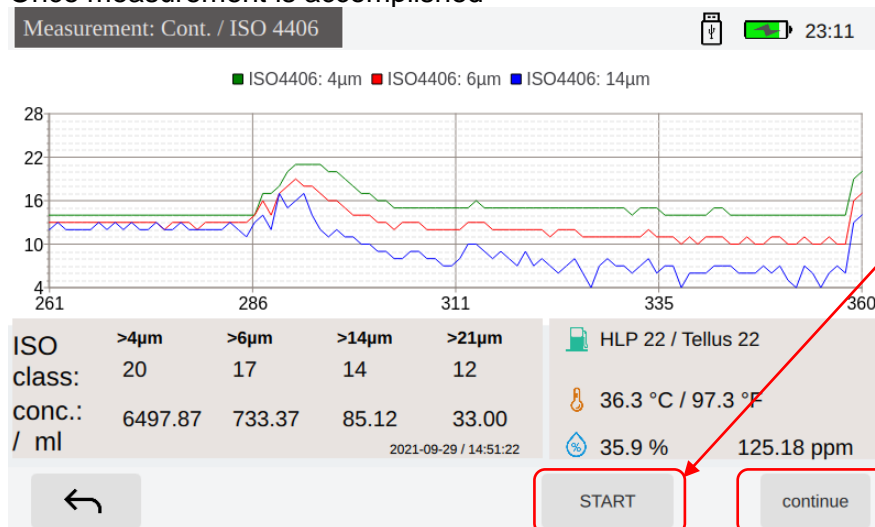
Measurement results of continious mode will be saved on the CCS5 automatically!

- A new measurement can be started by clicking [**START**]

- To forward measurement by clicking [**continue**]
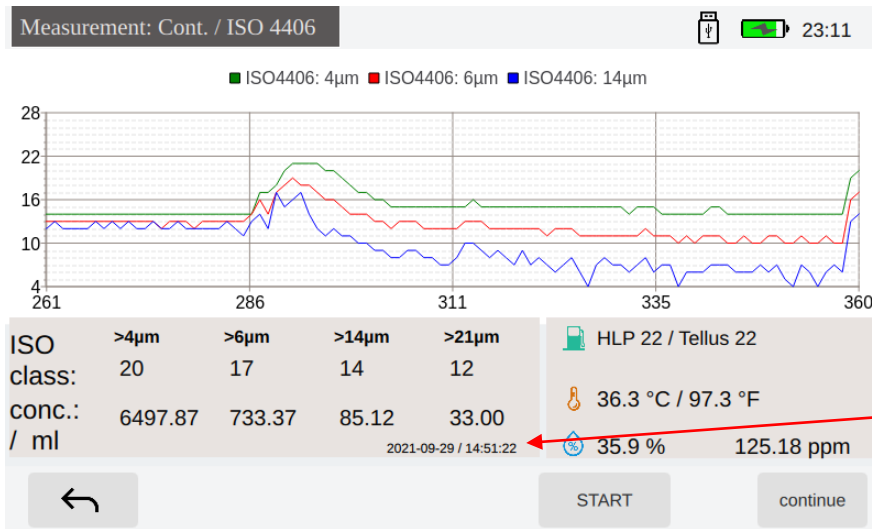
number of each measurement and the date, time of measurement are displayed.
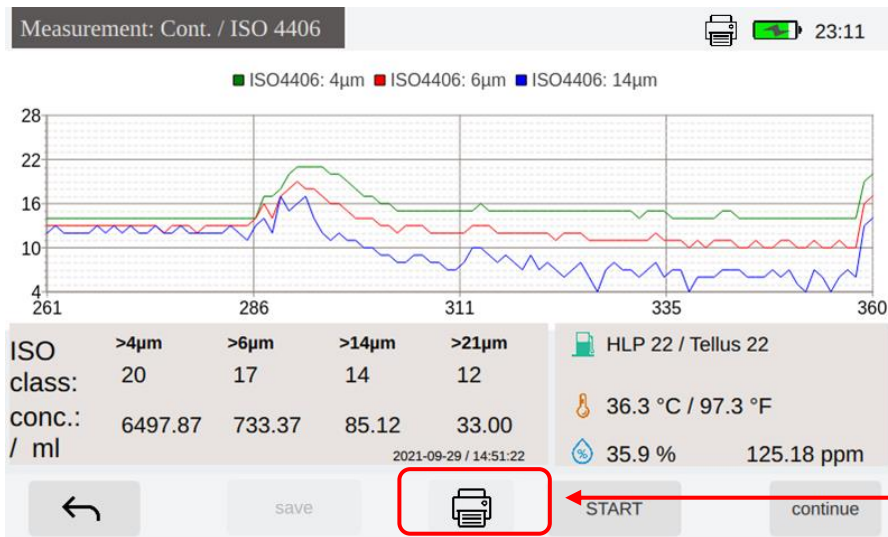
When the thermal printer is connected: results of the _**latest measurement point**_ can be printed by button

NOTICE the print function is active only when the measurement is stopped

NOTICE

To assure a constant function of the device and the accuracy of the measurement results, it is recommended to perform a flushing of the CCS 5 with cleaned mineral oil (filtrated H22) for several minutes after finishing the measurements.

2.5.4.3. Measure-type: cyclic

- This mode is to accomplish the cyclic measurements.

- The procedure as described in detail below is performed in any classification type (ISO 4406:99, NAS 1638, SAE AS 4059). (Example: "ISO 4406").
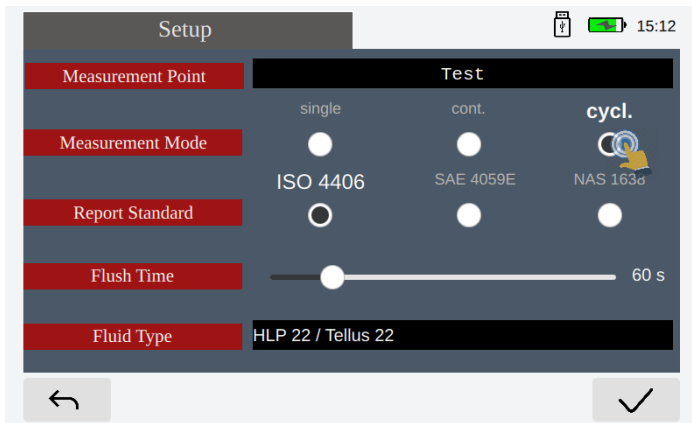
- Selection of the measurement mode of "**cycl**." For cyclic measurement.
- Then cycle period in hour and cycle numbers can be set:
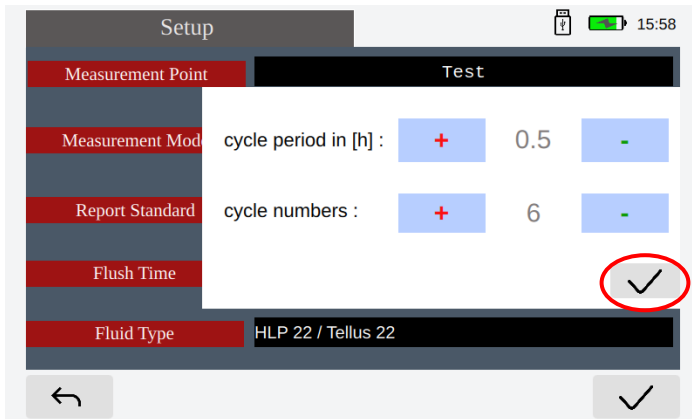
- Select the desired cycle period in hour with [**+** / **-**] buttons.

- Select the desired cycle numbers [2 ~ 100] with [**+** / **-**] buttons.

- Confirm the parameter selection with ✓.
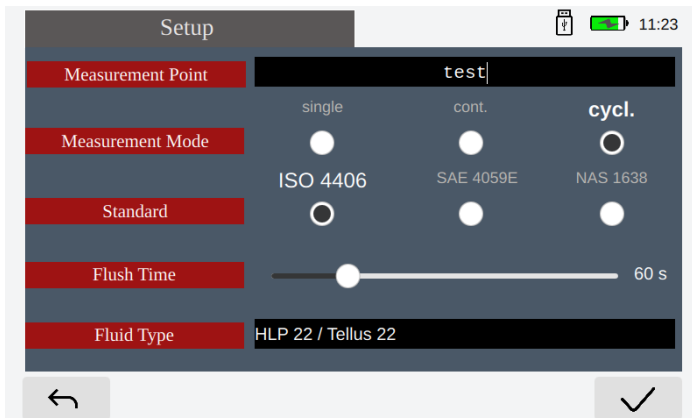
- Select classification type in "report standard".

- Select the "flush Time" in seconds.

- Select a fluid type if needed.

<u>Cycle period in [h]</u>
The time between one measurement and the next one can be selected between 0,5 hour to 24 hours in half hour steps.

<u>Cycle number</u>
The total number of measurements can be chosen two-steps wise from 2 to 100.

measurement results in cyclic will be saved automatically.

- Start the cyclic measurement with [**START**].

- A self-check will run automatically for 10 seconds
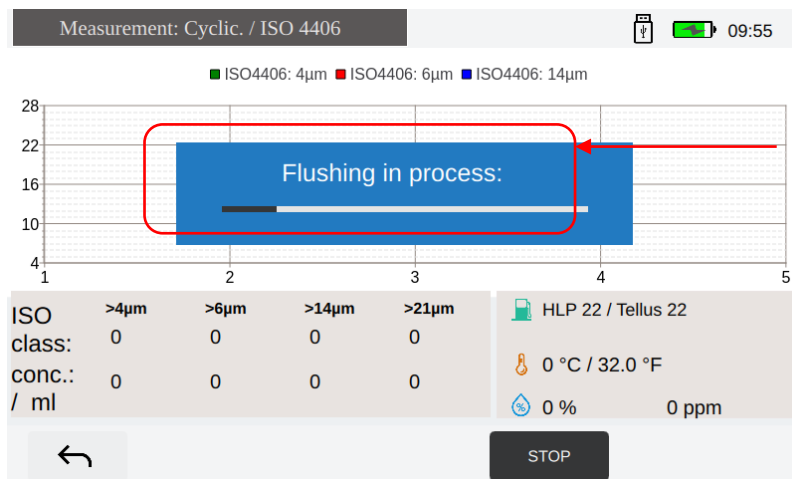
- Flushing process will run automatically based on the selected flush time in the setup menu.

⚠ CAUTION ⚠ a pressure switch is integrated in the CCS 5, if the OUTLET hose is not connected to the CCS 5, the flushing and measurement is to be stopped and a warning message will show as below:
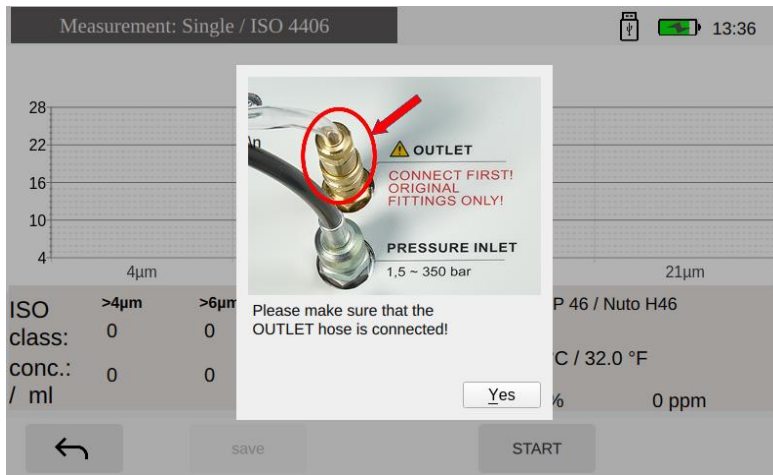
- Once the OUTLET hose is connected, then confirm with the button [**Yes**]

Once measurement is accomplished.

- The operating mode selected in the preceding menu, the classification type and the measuring mode are shown in the headline.

- Both the water saturation and the temperature are shown with each measurement. When a fluid type is also selected, then the ppm water content is also displayed.

NOTICE

To assure a constant function of the device and the accuracy of the measurement results, it is recommended to perform a flushing of the CCS 5 with cleaned mineral oil (filtrated H22) for several minutes after finishing the measurements.

2.5.5. File system
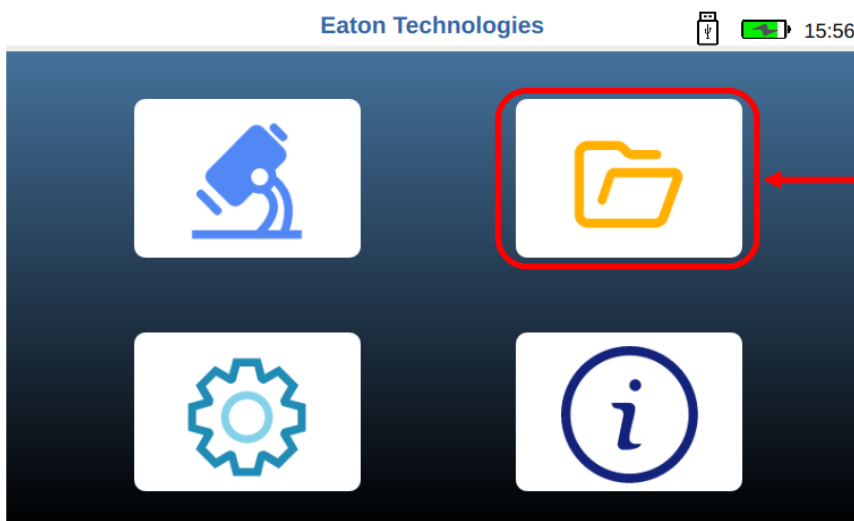
- Using this menu to manage the stored measurement data.

- The measurements in the permanent data storage persist until they are deleted manually, or the maximum quantity of the storage data is exceeded.
  - **Max. 100** measurements of each measure-type can be **saved** in the data storage. Thereafter, at each subsequent measurement, the data that is on the first place in the data storage is being deleted and overwritten by new data.

  - You may delete a single measurement.

  - You may also delete the complete data set.

- The stored measurements can be transferred, as a TXT – file using the USB – interface to USB – stick (**only FAT16 or FAT32 supported**) (see chapter 2.5.4.3)

- The results can be also printed by the thermal printer.

- The procedure as described in detail on the next page is always the same with all measuring modes (single, continuous, cyclic, bottle sampling).
  For illustration purposes the procedure is shown in one measuring mode only.

2.5.5.1. Display the saved results in graphic
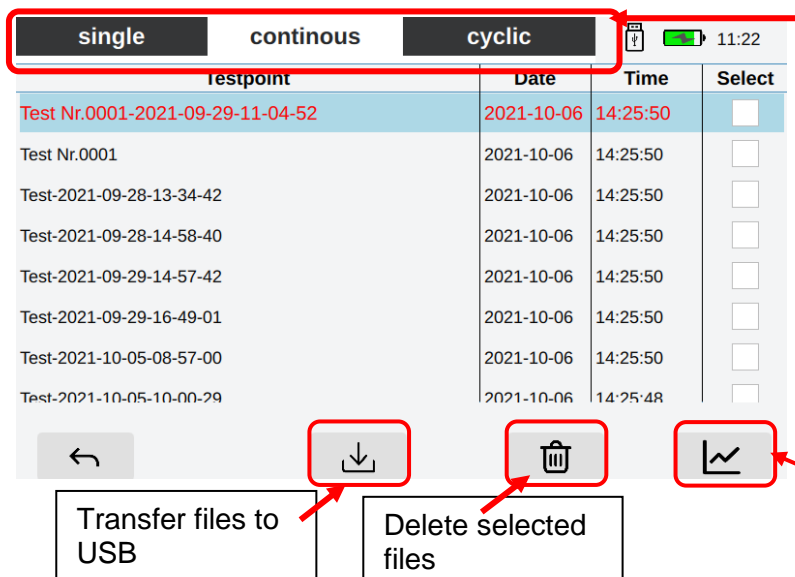
- Select the measuring type by clicking the tabs "**single**" or "**continuous**" or "**cyclic**"

  ⇨ The selected menu tab is highlighted "white".

- While a USB stick is inserted, the buttons "transfer to USB" will show

Transfer files to USB

Delete selected files

Delete selected files

An example to display a data set of a continuous measurement:
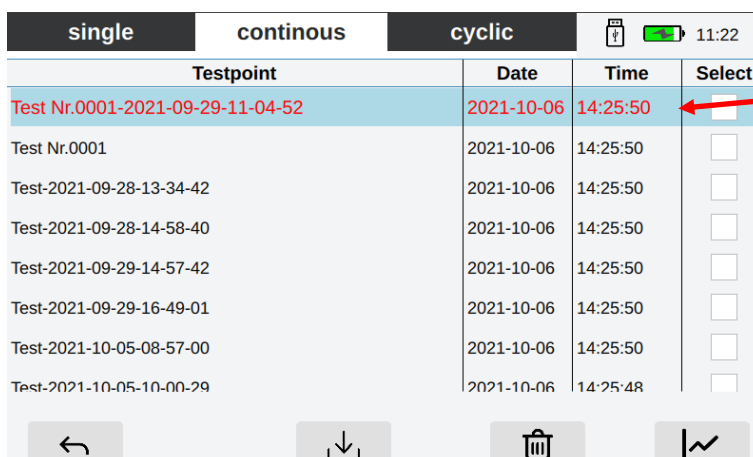
- Date and time, when the measurement file is saved, will show in the column "Date" and "Time".

single	continous	cyclic	🔋 ⚡ 11:51

Testpoint	Date	Time	Select
Test Nr.0001-2021-09-29-11-04-52	2021-10-06	14:25:50	☐
Test Nr.0001	2021-10-06	14:25:50	☐
Test-2021-09-28-13-34-42	2021-10-06	14:25:50	☐
Test-2021-09-28-14-58-40	2021-10-06	14:25:50	☐
Test-2021-09-29-14-57-42	2021-10-06	14:25:50	☐
Test-2021-09-29-16-49-01	2021-10-06	14:25:50	☐
Test-2021-10-05-08-57-00	2021-10-06	14:25:50	☐
Test-2021-10-05-10-00-29	2021-10-06	14:25:48	☐

↩ ⭳ 🗑 📊👆

- choose a saved measurement and open the data set: when the data set is blue highlighted.

- open the data set and show in graphical chart

History: Cont. / ISO 4406   🔋 ⚡ 16:56

■ ISO4406: 4µm ■ ISO4406: 6µm ■ ISO4406: 14µm

ISO class:	>4µm 20	>6µm 17	>14µm 14	>21µm 12	⛽ HLP 22 / Tellus 22
conc.: / ml	6497.87	733.37	85.12	33.00	🌡 36.3 °C / 97.3 °F
				2021-09-29 / 14:51:22	💧 35.9 % 125.18 ppm

↩   save to USB

- Display of the measuring data, the date/ time, the temperature, and the water saturation.

  The water content in ppm is additionally displayed when a fluid type is chosen.

  ⛽ HLP 22 / Tellus 22
  🌡 36.3 °C / 97.3 °F
  💧 35.9 %   125.18 ppm

History: Cont. / ISO 4406   🔋 ⚡ 16:59

■ ISO4406: 4µm ■ ISO4406: 6µm ■ ISO4406: 14µm

ISO class:	>4µm 15	>6µm 11	>14µm 8	[329] >21µm 4	⛽ HLP 22 / Tellus 22
conc.: / ml	170.87	14.12	1.62	0.12	🌡 39.4 °C / 102.9 °F
				2021-09-29 / 14:24:04	💧 33.1 % 123.1 ppm

↩   save to USB
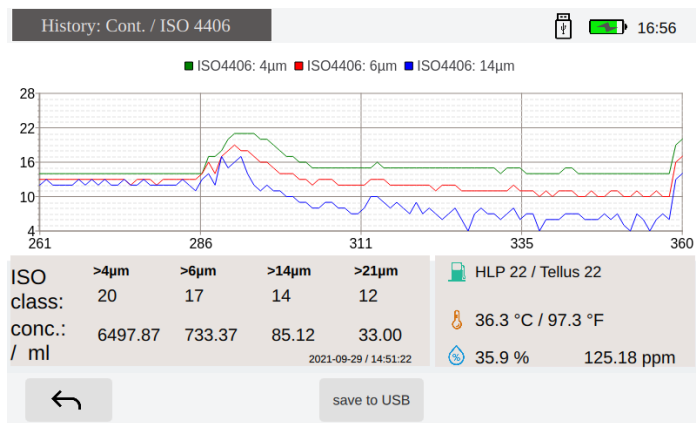
- clicking the chart, data of the selected measurement point will show.

- e.g. the measurement point "329" is chosen, the saved data is being shown below.

History: Cont. / ISO 4406   🔋 ⚡ 17:51

■ ISO4406: 4µm ■ ISO4406: 6µm ■ ISO4406: 14µm

ISO class:	>4µm 14	>6µm 12	>14µm 8	[69] >21µm 7	⛽ HLP 22 / Tellus 22
conc.: / ml	98.00	21.12	2.25	0.87	🌡 27.3 °C / 81.1 °F
				2021-09-29 / 11:39:59	💧 54 % 156.15 ppm

↩   save to USB

- swiping the charts to left or right, to choose a different measurement point.
  ⇨ it is recommended to use a *stylus* for resistive touch panel.

- By clicking the button "save to USB" the current file can be transferred to a USB stick, when a USB stick is connected
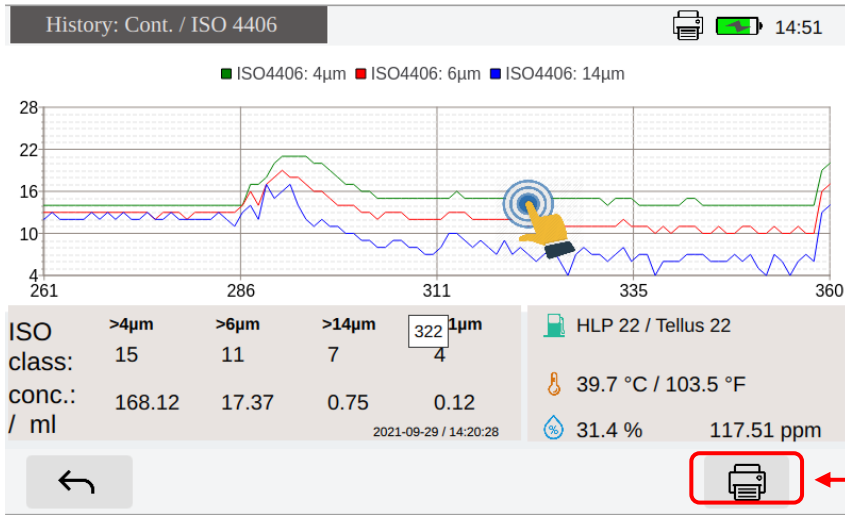
- **When the thermal printer is connected:** clicking the chart, data of the selected measurement point will show and can be printed.

- e.g. the measurement point "322" is chosen, then the results can be printed.

Measurement Point:
" Test Nr.0001-2021-09-29-11-04-52 "
date: 2021-09-29
time: 14:20:28
Fluid:
 HLP 22 / Tellus 22
Water saturation: 31.4 %

cal. water: 117.51 ppm
at temperature: 39.7°C
                103.5 °F
Contamination Class: ISO4406:99
15 / 11 / 7 / 4
particle amount in 1 ml:
 > 4um :   168.12
 > 6um :   17.37
 > 14um :   0.75
 > 21um :   0.12

- printing results by the thermal printer

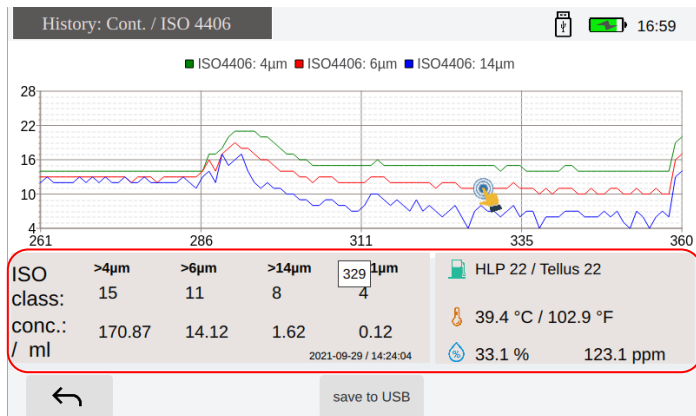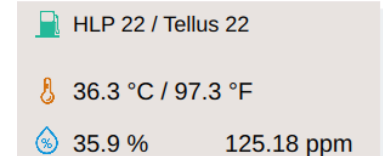An example to display a data set of a single measurement

- choose a saved measurement and open the data set: when the data set is blue highlighted.

- open the data set and show in graphical chart
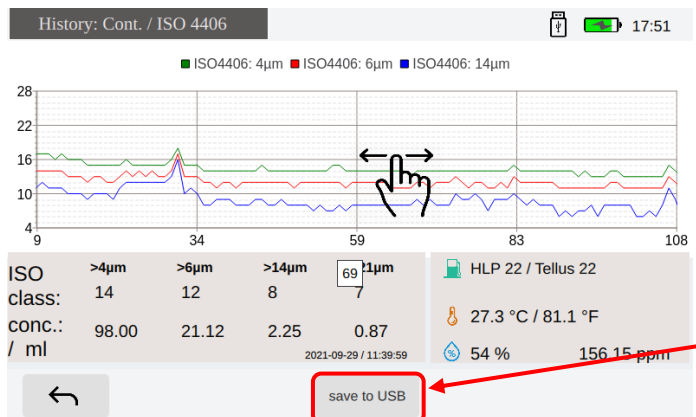
- Display of the measuring data, the date/ time, the temperature, and the

water saturation.

- The water content in ppm is additionally displayed when a fluid type is chosen.
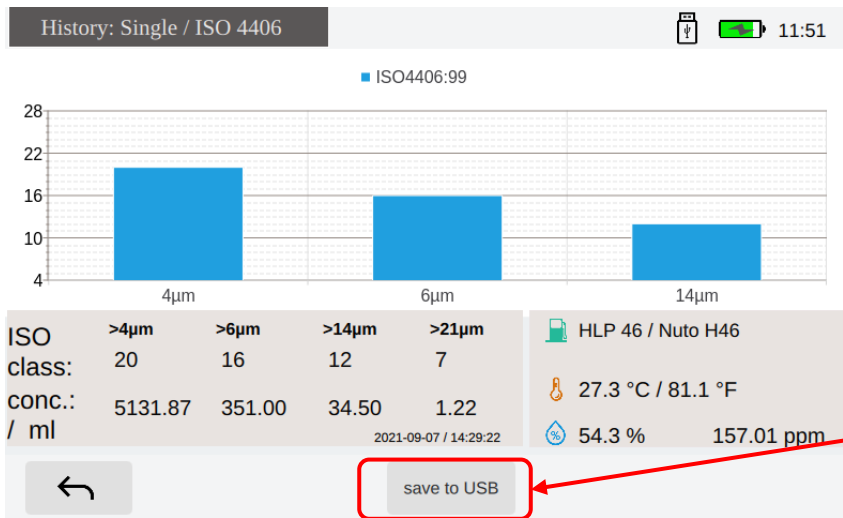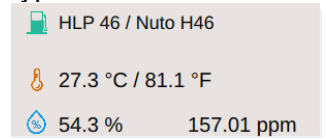

By click the button "save to USB" the current file can be transferred to a USB stick, when a USB stick is connected

When the thermal printer is connected:

clicking the button

,

results can be printed

2.5.5.2. Delete the saved files

The saved measurement files can be also deleted.

- in the menu "file system", select the saved files to be deleted.

- Then clicking the button 🗑 to delete the selected files

NOTICE **the selected files will be permanently deleted.**

2.5.5.3. Data transfer

saved measurement results from the CCS 5 can be transferred to a USB stick. The transferred files can be read as a text file on computer.

- Transfer of the stored measuring data to a **USB – stick (only FAT16 or FAT32 supported).**

- insert the USB – stick in the USB-connection port of the CCS 5.

- When the USB stick is recognized by the operating system, a USB logo will show on the screen.

- in the menu "file system", select the saved files to be deleted or transferred to USB stick.

Transfer selected files to USB

Delete selected files

Name ^	Änderungsdatum	Typ
cont	08.10.2021 14:15	Dateiordner
cyclic	08.10.2021 14:17	Dateiordner
single	10.11.2021 15:27	Dateiordner

- different directories acc. to the measure-types of the saved files that need to be transferred, will be generated on USB stick.

Cont: stored files of continuous measurement mode
Cyclic: stored files of cyclic measurement mode
Single: stored files of single measurement mode

2.5.6.   System settings
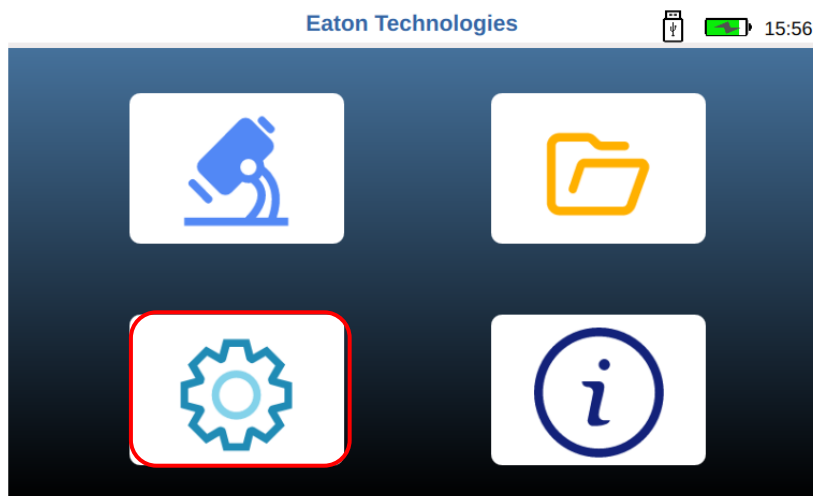
- All system settings can be done in this menu

2.5.6.1.   Date/ time

- the settings will be effective only when it is confirmed

- This function is meant for setting the real time clock integrated in the device.
- Day, month, hour, and minute are separately adaptable and are getting transferred to the real time clock.

2.5.6.2.   Brightness of the display

- The brightness has 4 levels and can be swiped to 25%, 50%, 75% or 100%.

- No need to confirm with the button

2.5.6.3.   Software update of the CCS 5

If a new version of software is available, it will be uploaded on the website: https://www.eaton.com/us/en-us/products/filtration-solutions/filtration-software-downloads.html

the software of new version should be downloaded and loaded to a USB stick. Make sure the software is on the root directory. Then insert the USB stick to USB port of CCS 5.
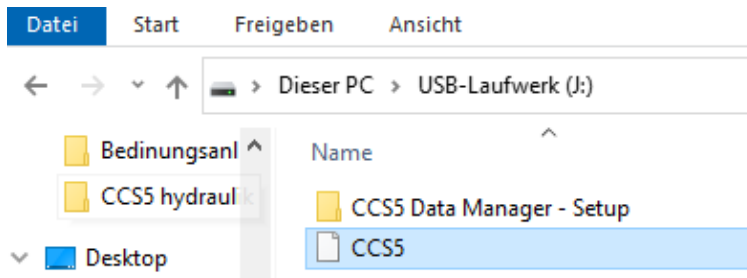
The USB icon will show if the USB stick is recognized.

The update will be executed by clicking the button "Software Update"

A warning message shows up and asks for confirmation.
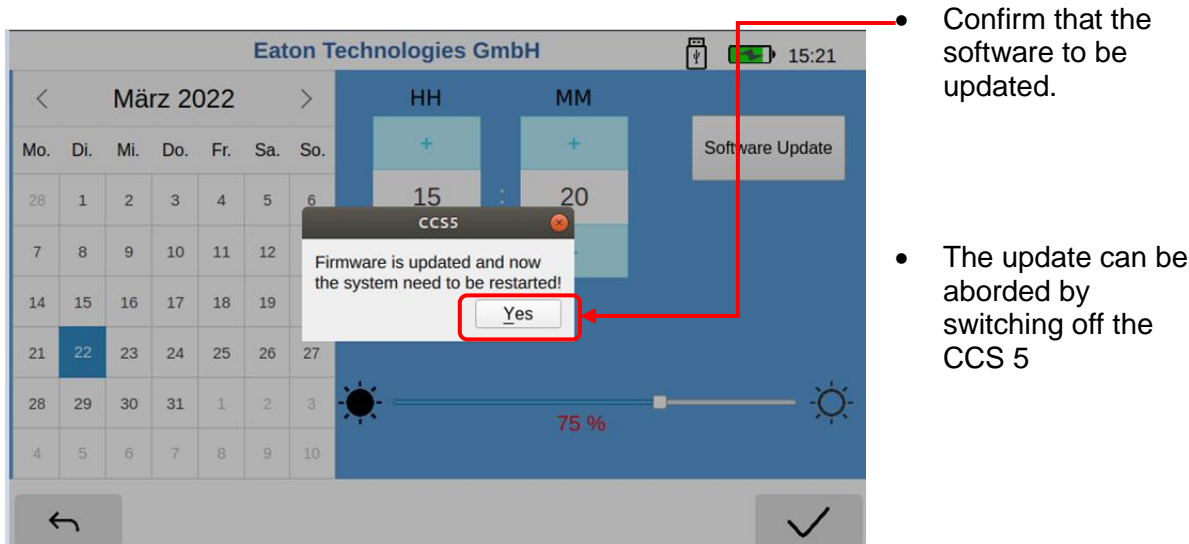
- Confirm that the software to be updated.

- The update can be aborded by switching off the CCS 5

the CCS5 restarts automatically, then the new software will be effective.

2.5.7. System information

All the system information is shown in this menu.
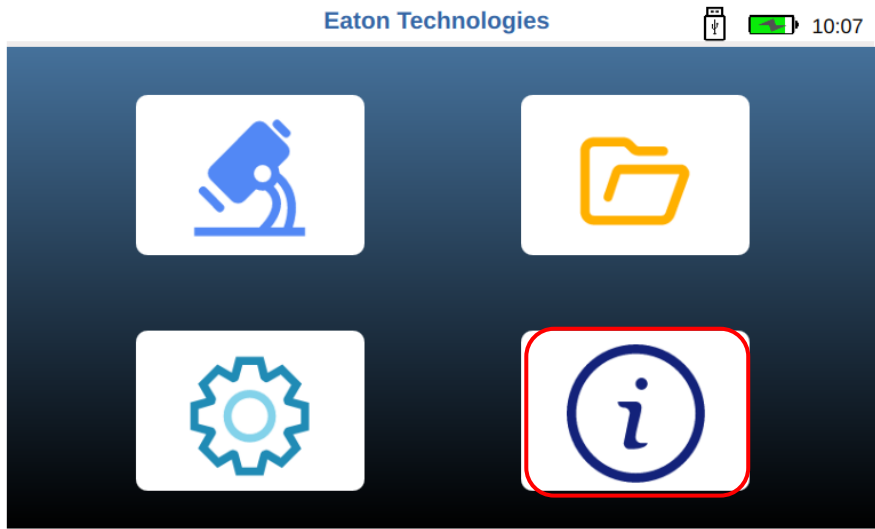
All system information around the CCS 5 can be checked.

Software version, current data/time, battery voltage, charging current, system temperature and the data when the last calibration was carried out.
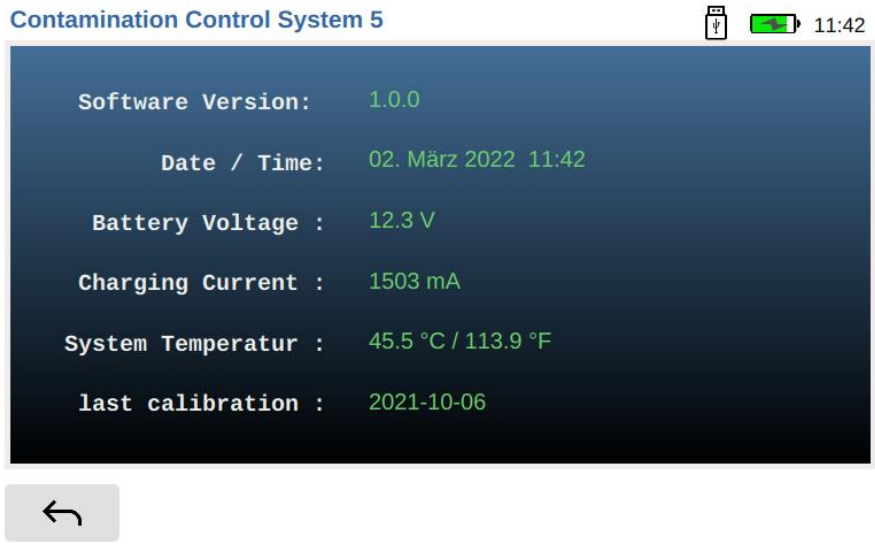
- **NOTICE** The validity of the calibration certificate is 12 months.

- **⚠ CAUTION** ⚠ ⚠ ⚠ Eaton recommends a calibration interval of one year. For the secondary calibration the CCS 5, the unit is to be sent to Eaton Technologies GmbH in Altlussheim.

2.5.8.   Update fluid list (optional)

If the testing fluid is not in the fluid list, which is integrated in the CCS5, Eaton Technologies GmbH provides service to analyze the fluid and update the fluid list. The new fluid list as a file named "WSPS_enc.bin" will be sent via Email to user, so that the fluid list can be updated by users.

NOTICE This function is available from the Software version 1.0.3.

The analyses of a new fluid can be ordered by article No.: **339855**

Step 1: copy the received file "**WSPS_enc.bin**" to the **root directory** of a USB stick and insert the USB stick into the USB port of CCS5.

NOTICE do **NOT** open or edit the file, otherwise the update will crash!

Step 2: open the menu "**measurement**"
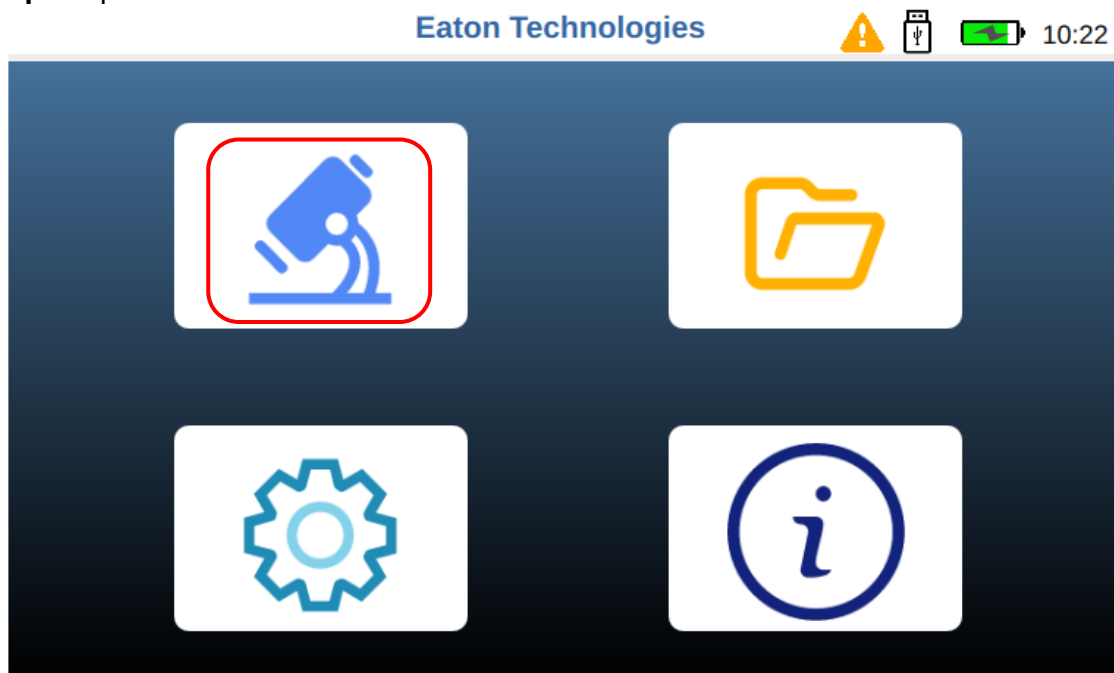
Step 3: touch the "**Fluid Type**" in the **SETUP** menu.
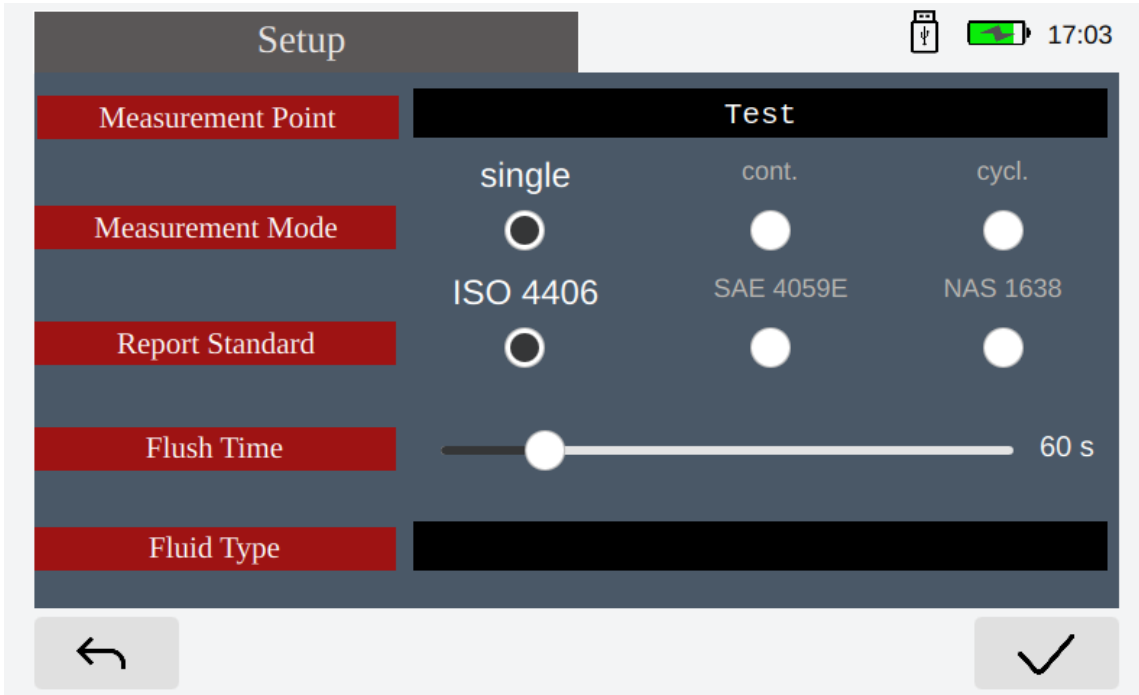
Then the Window "Fluid List" is opened. When a USB stick is detected on the CCS5, the button "update" will show as below.

Oil Type	Producer	Oil Name
CL 460	Mobil	Vacuoline 546
CLP 150	Shell South Africa	Omala 150. gear oil
CLP 220	Shell	Omala 220
CLP 320	Castrol	Optigear Syn X 320
CLP 320	ESSO	Mobilgear SHC XMP 320
CLP 320	Fuchs	Gearmaster ECO 320
CLP 320	OMV	HST 320
CLP 320	Shell Suedafrika	Omala 320. gear oil
CLP 460	CPC	HD460

Step 4: click the icon "UPDATE"

Now the system will check the update conditions. If the fluid list is not found

CLP 320		
CLP 320		
CLP 320	OMV	HST 320
CLP 320	Shell Suedafrika	Omala 320. gear oil
CLP 460	CPC	HD460

the file 'WSPS_enc.bin' can not be found on the USB Stick!

Yes
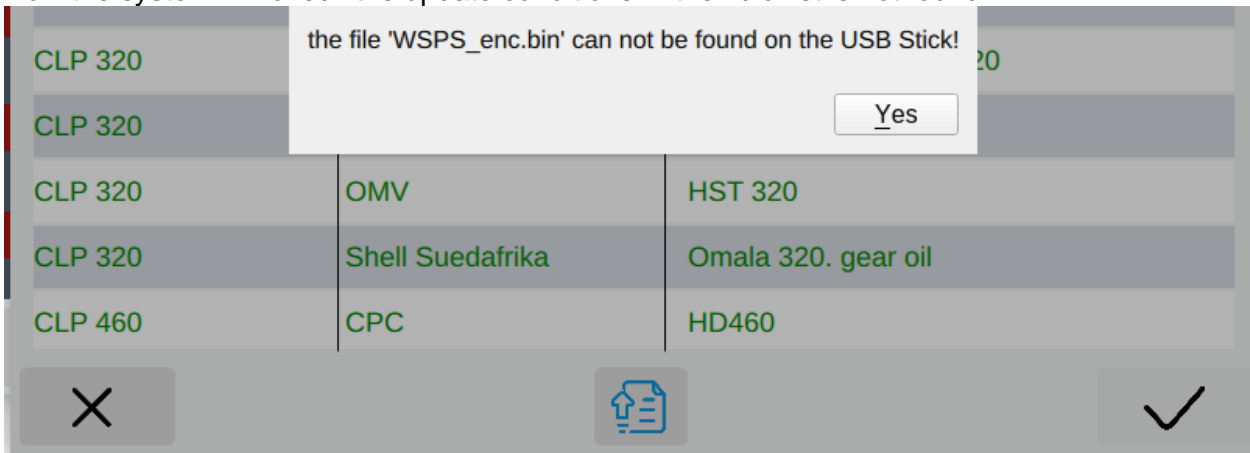
If the fluid data on the USB stick is identical or older than the data on the CCS5

NO need to updatd the saturation data

Close

CLP 320	ESS	XMP 320
CLP 320	Fuch	CO 320
CLP 320	OMV	HST 320
CLP 320	Shell Suedafrika	Omala 320. gear oil
CLP 460	CPC	HD460
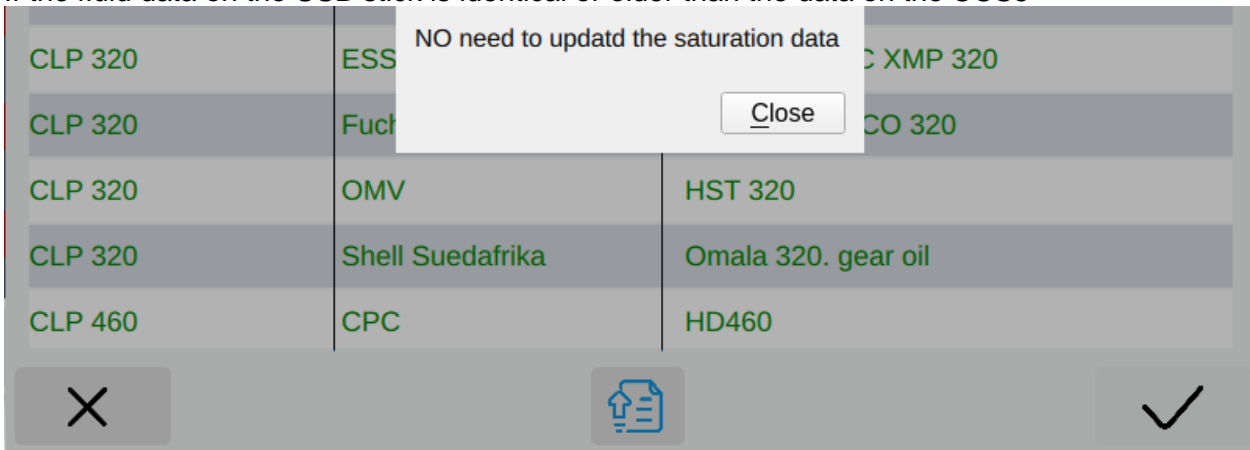
When all conditions are met, click "Yes" to confirm the update

Now the saturation data will be updated!
Current version: 1.1
New version: 1.2

Yes   No

CLP 320	Cas	320
CLP 320	ESS	XMP 320
CLP 320	Fuc	CO 320
CLP 320	OMV	HST 320
CLP 320	Shell Suedafrika	Omala 320. gear oil
CLP 460	CPC	HD460
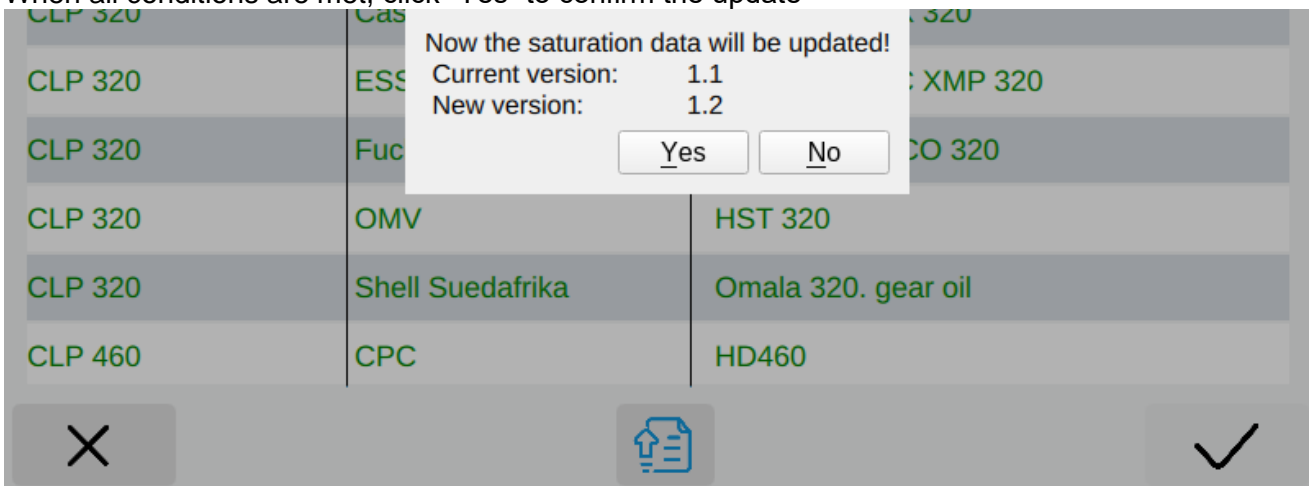
When the update succeeded: click „OK" to confirm

CLP 320	Cas			320
CLP 320	ESS	update successed, data will be reloaded!		XMP 320
CLP 320	Fuc		OK	O 320
CLP 320	OMV		HST 320	
CLP 320	Shell Suedafrika		Omala 320. gear oil	
CLP 460	CPC		HD460	
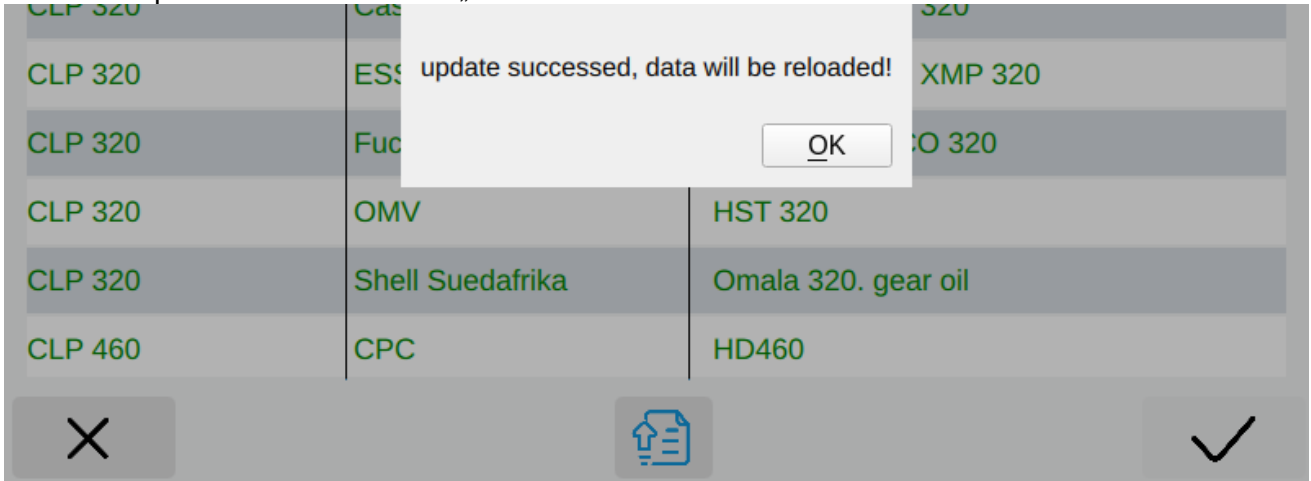
Now the CCS5 should be **restarted** manually, then the new fluid list will be effective.

3.   Connecting a (optional) thermal printer

An optional thermal printer set (Art._No.: **356151**), which consist of a thermal printer, an USB-Serial

adapter and 4x thermal paper rolls, can be used to print measurement results.

NOTICE The printing function is available from the *software version **1.1.3***.

3.1.   Connecting the printer and USB-Serial adapter

The cable of the printer should be connected to the adapter as below:
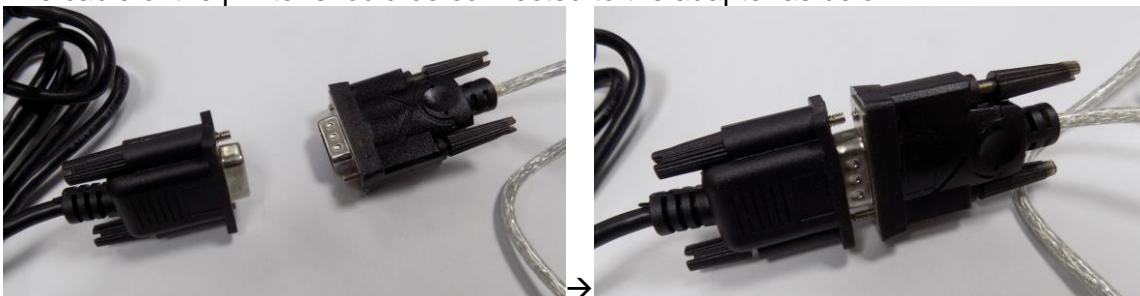
3.2. Connecting the USB-Serial adapter to CCS5

Now the printer is connected to the CCS5, it can be switched on.

If the printer works with the CCS5, this icon 🖶 will show on the screen.

4. Software "Data Manager"

a PC software for further data analysis is provided on the USB stick.

4.1. Installation of the Data Manager Software on an external PC

The CCS 5 DATA MANAGER software was especially developed for the CCS 5 and is provided on the included USB Stick.

The **installation** of the data manager software on an external computer is necessary. The data manager enables the data transfer to a MS Excel data sheet.

- Execute CCS 5 – data manager program installation (**setup.exe)** from the provided USB Stick. The **setup.exe** is located in the following folder: **setup\ Volume\ setup.exe**

- Execute the installation as instructed and wait until the installation has been completely finished.

Name	Änderungsdatum	Typ	Größe
bin	10.11.2021 15:56	Dateiordner	
license	10.11.2021 15:57	Dateiordner	
supportfiles	10.11.2021 15:57	Dateiordner	
nidist.id	05.10.2021 16:02	ID-Datei	1 KB
setup	30.08.2019 12:02	Anwendung	5.327 KB
setup	05.10.2021 16:02	Konfigurationseins...	17 KB

- In the Windows - START-menu, the folder "CCS 5" will be generated.

4.2. Data analysis with "Data Manager"

- Start the data manager program with:
  Datenmanager CCS5 → CCS5.

- the transferred data can be used for further data analysis within the "data manager" software, when the USB stick is insert to a Windows PC.

The data on a USB stick will be loaded automatically and displayed in the table in the "data manager".

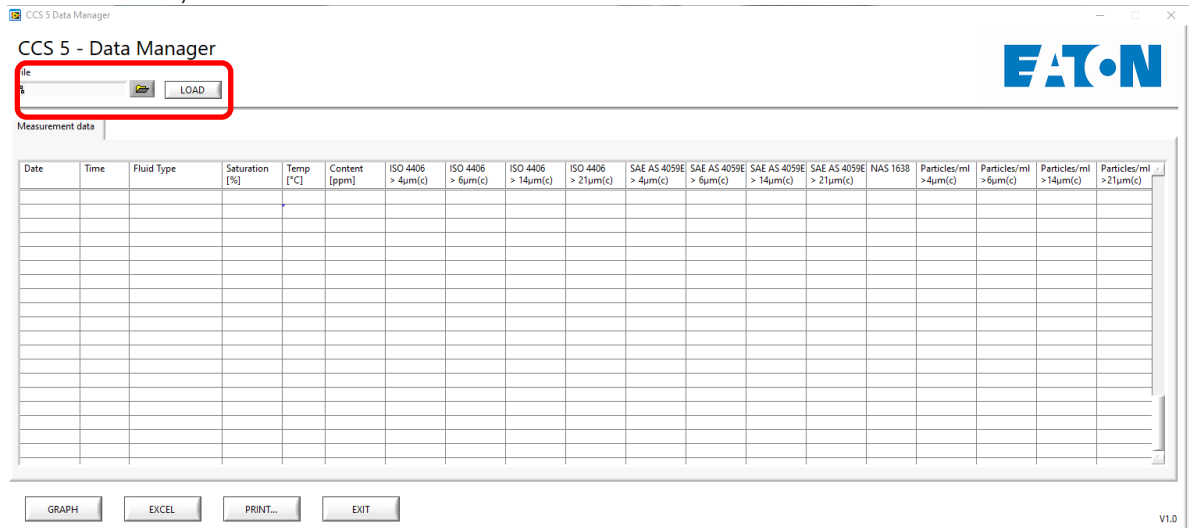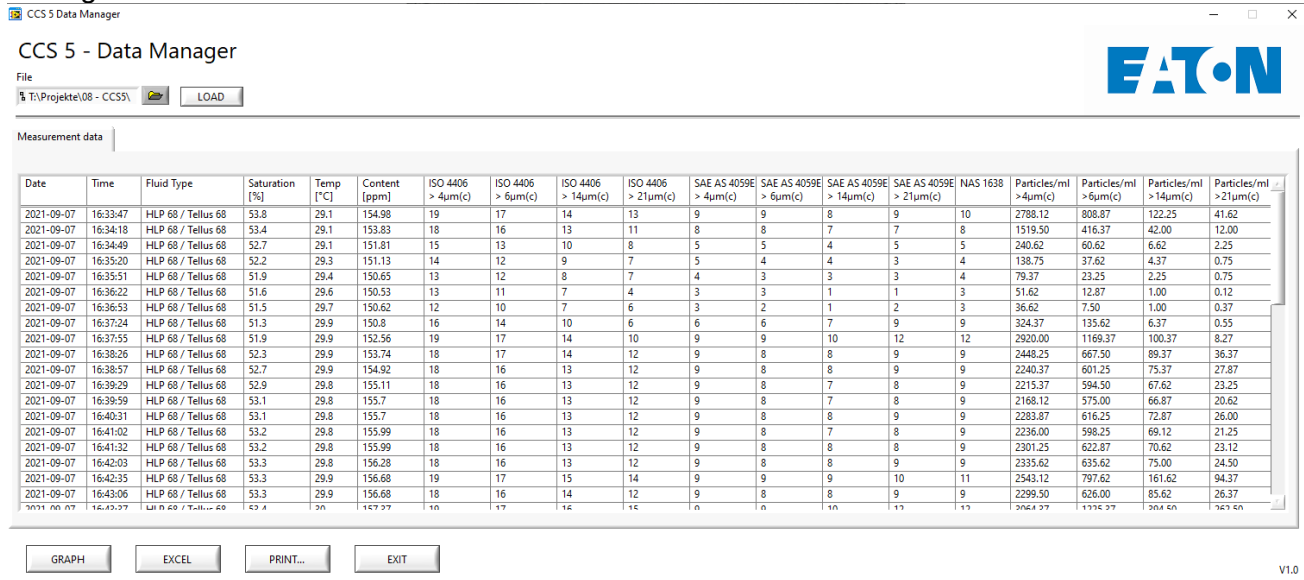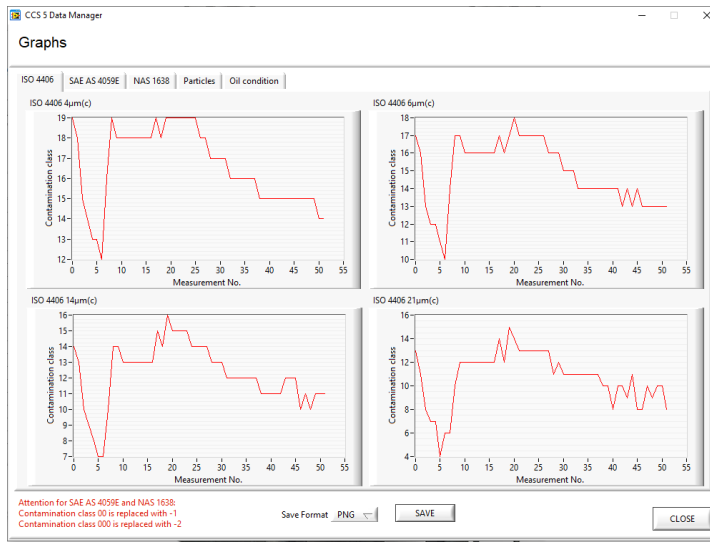| Date	Time	Fluid Type	Saturation [%]	Temp [°C]	Content [ppm]	ISO 4406 > 4µm(c)	ISO 4406 > 6µm(c)	ISO 4406 > 14µm(c)	ISO 4406 > 21µm(c)	SAE AS 4059E > 4µm(c)	SAE AS 4059E > 6µm(c)	SAE AS 4059E > 14µm(c)	SAE AS 4059E > 21µm(c)	NAS 1638	Particles/ml >4µm(c)	Particles/ml >6µm(c)	Particles/ml >14µm(c)	Particles/ml >21µm(c)
2021-09-07	16:33:47	HLP 68 / Tellus 68	53.8	29.1	154.98	19	17	14	13	9	9	8	9	10	2788.12	808.87	122.25	41.62
2021-09-07	16:34:18	HLP 68 / Tellus 68	53.4	29.1	153.83	18	16	13	11	8	8	7	7	8	1519.50	416.37	42.00	12.00
2021-09-07	16:34:49	HLP 68 / Tellus 68	52.7	29.1	151.81	15	13	10	8	5	5	4	5	5	240.62	60.62	6.62	2.25
2021-09-07	16:35:20	HLP 68 / Tellus 68	52.2	29.3	151.13	14	12	9	7	5	4	4	3	4	138.75	37.62	4.37	0.75
2021-09-07	16:35:51	HLP 68 / Tellus 68	51.9	29.4	150.65	13	12	8	7	4	3	3	3	4	79.37	23.25	2.25	0.75
2021-09-07	16:36:22	HLP 68 / Tellus 68	51.6	29.6	150.53	13	11	7	4	3	3	1	1	3	51.62	12.87	1.00	0.12
2021-09-07	16:36:53	HLP 68 / Tellus 68	51.5	29.7	150.62	12	10	7	6	3	2	1	2	3	36.62	7.50	1.00	0.37
2021-09-07	16:37:24	HLP 68 / Tellus 68	51.3	29.9	150.8	16	14	10	6	6	6	7	9	9	324.37	135.62	6.37	0.55
2021-09-07	16:37:55	HLP 68 / Tellus 68	51.9	29.9	152.56	19	17	14	10	9	9	10	12	12	2920.00	1169.37	100.37	8.27
2021-09-07	16:38:26	HLP 68 / Tellus 68	52.3	29.9	153.74	18	17	14	12	9	8	9	9	9	2448.25	667.50	89.37	36.37
2021-09-07	16:38:57	HLP 68 / Tellus 68	52.7	29.9	154.92	18	16	13	12	9	8	8	9	9	2240.37	601.25	75.37	27.87
2021-09-07	16:39:29	HLP 68 / Tellus 68	52.9	29.8	155.11	18	16	13	12	9	8	7	8	9	2215.37	594.50	67.62	23.25
2021-09-07	16:39:59	HLP 68 / Tellus 68	53.1	29.8	155.7	18	16	13	12	9	8	7	8	9	2168.12	575.00	66.87	20.62
2021-09-07	16:40:31	HLP 68 / Tellus 68	53.1	29.8	155.7	18	16	13	12	9	8	9	9	9	2283.87	616.25	72.87	26.00
2021-09-07	16:41:02	HLP 68 / Tellus 68	53.2	29.8	155.99	18	16	13	12	9	8	7	8	9	2236.00	598.25	69.12	21.25
2021-09-07	16:41:32	HLP 68 / Tellus 68	53.2	29.8	155.99	18	16	13	12	9	8	8	8	9	2301.25	622.87	70.62	23.12
2021-09-07	16:42:03	HLP 68 / Tellus 68	53.3	29.8	156.28	18	16	13	12	9	8	8	9	9	2335.62	635.62	75.00	24.50
2021-09-07	16:42:35	HLP 68 / Tellus 68	53.3	29.9	156.68	19	17	15	14	9	9	9	10	11	2543.12	797.62	161.62	94.37
2021-09-07	16:43:06	HLP 68 / Tellus 68	53.3	29.9	156.68	18	16	14	12	9	8	8	9	9	2299.50	626.00	85.62	26.37
2021-09-07	16:43:37	HLP 68 / Tellus 68	53.4	30	157.37	19	17	16	15	9	9	10	12	12	3064.37	1325.37	204.50	263.50

The transferred data can be:

I. **Presented graphically**

II. **Exported in a MS EXCEL - chart**

III. **Printed as a report**

I. For graphic presentation use the button „**GRAPH**".
- Depending on the presentation modes, which have been selected in the data manager menu, these are presented graphically.
  For example:
  Selection: ISO 4406

- Various contamination classes like **ISO4406:99**, **SAE AS4059** or **NAS1638** can be chosen.

- Back to the previous menu by using **„CLOSE"**.

Export in a Excel – data sheet by using the button „**EXCEL**"

- For further processing the data all standard functions in MS EXCEL are available.

II.   Print the report by using the button „**PRINT**"

- Selection of report type

- Selection of the printer.

CCS 5 Report   **EATON Technologies GmbH**

Date	Time	Fluid Type	ISO 4406 >4µm(c)	ISO 4406 >6µm(c)	ISO 4406 >14µm(c)	ISO 4406 >21µm(c)
2021-09-07	16:33:47	HLP 68 / Tellus 68	19	17	14	13
2021-09-07	16:34:18	HLP 68 / Tellus 68	18	16	13	11
2021-09-07	16:34:49	HLP 68 / Tellus 68	15	13	10	8
2021-09-07	16:35:20	HLP 68 / Tellus 68	14	12	9	7
2021-09-07	16:35:51	HLP 68 / Tellus 68	13	12	8	7
2021-09-07	16:36:22	HLP 68 / Tellus 68	13	11	7	4
2021-09-07	16:36:53	HLP 68 / Tellus 68	12	10	7	6
2021-09-07	16:37:24	HLP 68 / Tellus 68	16	14	10	6
2021-09-07	16:37:55	HLP 68 / Tellus 68	19	17	14	10
2021-09-07	16:38:26	HLP 68 / Tellus 68	18	17	14	12
2021-09-07	16:38:57	HLP 68 / Tellus 68	18	16	13	12

- Report-printing

For exiting the data manager software use Button „EIXIT".

CCS 5 - Data Manager

File
T:\Projekte\08 - CCS5\   LOAD

Measurement data

Date	Time	Fluid Type	Saturation [%]	Temp [°C]	Content [ppm]	ISO 4406 > 4µm(c)	ISO 4406 > 6µm(c)	ISO 4406 > 14µm(c)	ISO 4406 > 21µm(c)	SAE AS 4059E > 4µm(c)	SAE AS 4059E > 6µm(c)	SAE AS 405 > 14µm(c)
2021-09-07	16:33:47	HLP 68 / Tellus 68	53.8	29.1	154.98	19	17	14	13	9	9	8
2021-09-07	16:34:18	HLP 68 / Tellus 68	53.4	29.1	153.83	18	16	13	11	8	8	7
2021-09-07	16:34:49	HLP 68 / Tellus 68	52.7	29.1	151.81	15	13	10	8	5	5	4
2021-09-07	16:35:20	HLP 68 / Tellus 68	52.2	29.3	151.13	14	12	9	7	5	4	4
2021-09-07	16:35:51	HLP 68 / Tellus 68	51.9	29.4	150.65	13	12	8	7	4	3	3
2021-09-07	16:36:22	HLP 68 / Tellus 68	51.6	29.6	150.53	13	11	7	4	3	3	1
2021-09-07	16:36:53	HLP 68 / Tellus 68	51.5	29.7	150.62	12	10	7	6	3	2	1
2021-09-07	16:37:24	HLP 68 / Tellus 68	51.3	29.9	150.8	16	14	10	6	6	6	7
2021-09-07	16:37:55	HLP 68 / Tellus 68	51.9	29.9	152.56	19	17	14	10	9	9	10
2021-09-07	16:38:26	HLP 68 / Tellus 68	52.3	29.9	153.74	18	17	14	12	9	8	8
2021-09-07	16:38:57	HLP 68 / Tellus 68	52.7	29.9	154.92	18	16	13	12	9	8	8
2021-09-07	16:39:29	HLP 68 / Tellus 68	52.9	29.8	155.11	18	16	13	12	9	8	7
2021-09-07	16:39:59	HLP 68 / Tellus 68	53.1	29.8	155.7	18	16	13	12	9	8	7
2021-09-07	16:40:31	HLP 68 / Tellus 68	53.1	29.8	155.7	18	16	13	12	9	8	8
2021-09-07	16:41:02	HLP 68 / Tellus 68	53.2	29.8	155.99	18	16	13	12	9	8	7
2021-09-07	16:41:32	HLP 68 / Tellus 68	53.2	29.8	155.99	18	16	13	12	9	8	8
2021-09-07	16:42:03	HLP 68 / Tellus 68	53.3	29.8	156.28	18	16	13	12	9	8	8
2021-09-07	16:42:35	HLP 68 / Tellus 68	53.3	29.9	156.68	19	17	15	14	9	9	9
2021-09-07	16:43:06	HLP 68 / Tellus 68	53.3	29.9	156.68	18	16	14	12	9	8	8
2021-09-07	16:43:37	HLP 68 / Tellus 68	53.4	30	157.27	19	17	16	15	9	9	10

GRAPH   EXCEL   PRINT...   EXIT

5. Evaluation of measurement results

5.1. Water sensor

5.1.1. Display in % water saturation

- If no fluid type is selected, only the water saturation in % is being displayed.

ISO class:	>4µm	>6µm	>14µm	>21µm
	15	13	9	7
conc.: / ml	190.37	46.25	3.62	1.12

2021-09-28 / 14:56:08

28.9 °C / 84.0 °F
54.7 %   0 ppm

(0...70% Saturation)
The presence of free water is unlikely. A danger of dissolved water in oil does **not** exist!

(70...90% Saturation)
The presence of free water is **likely** in a low volume. The initiation of actions to reduce the water content can be recommended!

(90...100% Saturation)
There is water in free form and is therefore a potential danger for the hydraulic and lubricating system.
The initiation of actions to reduce the water content in the fluid is urgently necessary!

A **conversion** in **mg/kg** (ppm) – water content is only **possible** when a **fluid generated saturation characteristic line is specifically made for your type of fluid.**
Saturation characteristic lines for special oils can be provided on request.

5.1.2. Display of the fluid type and ppm water content

- If a fluid type is selected, the ppm water content **for this fluid is automatically** calculated from the deposited saturation function and is displayed.

ISO class:	>4µm	>6µm	>14µm	>21µm
	20	17	14	12
conc.: / ml	6497.87	733.37	85.12	33.00

2021-09-29 / 14:51:22

HLP 22 / Tellus 22
36.3 °C / 97.3 °F
35.9 %   125.18 ppm

The relation to the detected saturation values and the data, after Karl Fischer method accounted ppm (mg/kg), is calculated then evaluated by the detected and deposited 100% saturation curve (100% saturation = f(T)) and the simultaneously measured fluid temperature and is indicated at the display.

Attention: It is essential to select the correct kind of oil, or the display of the water content will not be equivalent with the effective value for this fluid.

Saturation characteristic curves for special oils can be created and implemented by Eaton Technologies GmbH. (Add-on program)

Example of a provided saturation characteristic curve:
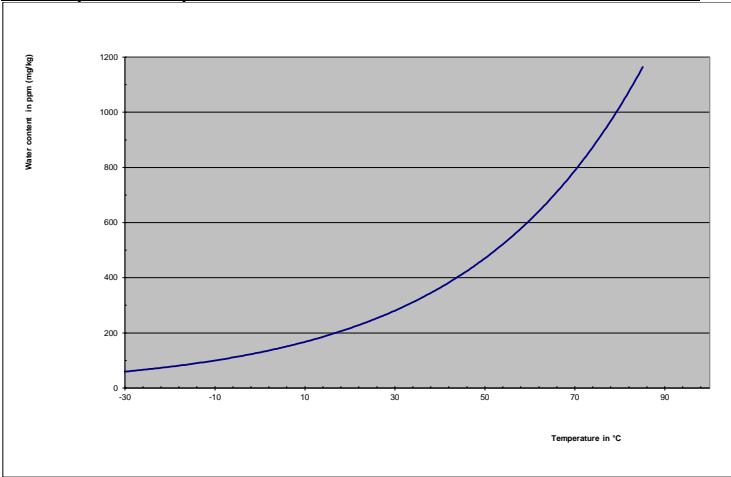
6.   Maintenance

A suction screen is fitted under the INLET (both for pressure and suction) measurement point union and protects the pump from coarse-particle contamination.

When the CCS 5 does not pump any fluid into the measurement channel, usually the measurement results stay at 4/4/4/4 or 0/0/0/0 of ISO4406, this indicates that the screen is full of dirty, it must be cleaned or replaced.

6.1. Pressure INLET

Detach all connections to the CCS 5. Open the INLET measurement point using a 19mm wrench.

Take the screen from the INLET out using a tweezer.

Clean the screen or replace it with a new one, then insert the new screen (ordering no. **355103**) into the INLET port.

Make sure that the screen is sitting correctly in the port.

Then Screw the connector of the pressure INLET tight to 20 NM using a 19mm wrench

6.2. Suction INLET

Detach all connections to the CCS 5. Open the INLET measurement point using a 17mm wrench.

Take the screen from the INLET out using a tweezer.

Clean the screen or replace it with a new one, then insert the new screen (ordering no. **355103**) into the INLET port.

Make sure that the screen is sitting correctly in the port.

Put a new copper ring (ordering no. 306330) on the port.

Then Screw the INLET connector tight to 10 NM using a 17mm wrench.

7. Calibration

- The laser sensor is calibrated according to ISO 11943:1999 with ISO MTD – fluid (base on ISO 11171:1999) and is delivered with a calibration certificate.
- The master laser sensor is calibrated according to the ISO 11171:1999.
- The water sensor is calibrated on delivery as well.

- **NOTICE** The validity of the calibration certificate is 12 months.

- **⚠ CAUTION** ⚠ ⚡ ⚠ Eaton recommends a calibration interval of one year. For the secondary calibration the CCS 5, the unit is to be sent to Eaton Technologies GmbH in Altlussheim.

- The calibration and maintenance package for the CCS 5 contains the following benefits:
  - maintenance of the device,
  - control of consumption items,
  - a function test of the sensors,
  - calibration with a calibration certificate,
  - 24 hour functioning test.

8. Appendix

8.1. Technical data

Measuring principle laser sensor:	particle counting to the light barrier principle
Measuring range laser sensor:	for particle sizes of: 4 µm, 6 µm, 14 µm and 21 µm
Particle counting according to:	ISO 4406:99, NAS 1638, SAE AS 4059
Particle sizes:	> 4 µm(c), > 6,0 µm(c), >14 µm(c), > 21 µm(c).
Representation of cc:	ISO 4 – 24, NAS 00 – 12, SAE AS 000 – 12
Measuring accuracy:	± 1 (contamination class)
Calibration master sensor:	ISO MTD in oil (ISO 11171)
Calibration laser sensor:	ISO MTD in oil (ISO 11943)
Max. particle concentration:	24000 particle / ml (sensor)
Sensor flowrate:	100 ml / min
Measuring principle water sensor:	determination of the water saturation based on the change of capacitance
Measuring range water sensor:	saturation: 0 – 100 % temperature: -30...+ 70 °C / *-22 …+ 158 °F*
Suction operating range:	-0,2…0,2 bar / *-2.9…2.9 PSI*
Pressure operating range:	1,5…350 bar / *22…5,000 PSI*
Viscosity range:	10…400 mm²/s / *45…1854 SUS*
Fluid temperature range:	0…70°C / *32…158 °F*
Ambient temperature range:	0…50°C / *32…122 °F*
Battery charging temperature:	0…45°C / *32…113 °F*
Fluid connections:	1 x mini measuring screwed joint M 16x2, 2 x plug-in coupling for hose DN 6
Fluid compatibility:	hydraulic and lubricating fluids based on mineral oil (also see on separate list of compatibility (7.7))

⚠ WARNING ⚠ ⚠ ⚠

Power supply:	15 V DC
External power supply unit:	100...240 V AC/ + 15 V DC/ 6 A, 50-60 Hz
Internal rechargeable battery:	12.6 V (Automatic with main connection)
Protection class:	IP 67 (with closed cover)
Measuring type:	on-line: single, continuous, cyclic tank samples with internal pump
Cycle interval:	up to 0,5...24 h, adjustable
Display - output:	contamination classes, number of particles, saturation, temperature, diagrams, graphics

| **Storage capacity:** | 3 x 100 measurements: |
	single: 100
	continuous: 100 set (each max.1000 measurements)
	cyclic: 100 set of each max. 100 measurements
Further serial equipment:	external power supply unit,
	high pressure hose,
	PVC – discharge hose,
	PVC – suction hose, data manager,
	USB Stick (with the software Data Manager)
Display:	7-inch resistive color touch display
Interfaces:	USB (data transfer to USB-stick)
Dimensions (mm):	l x b x h 425 x 284 x 155
Weight:	9.8 kg (without accessories)
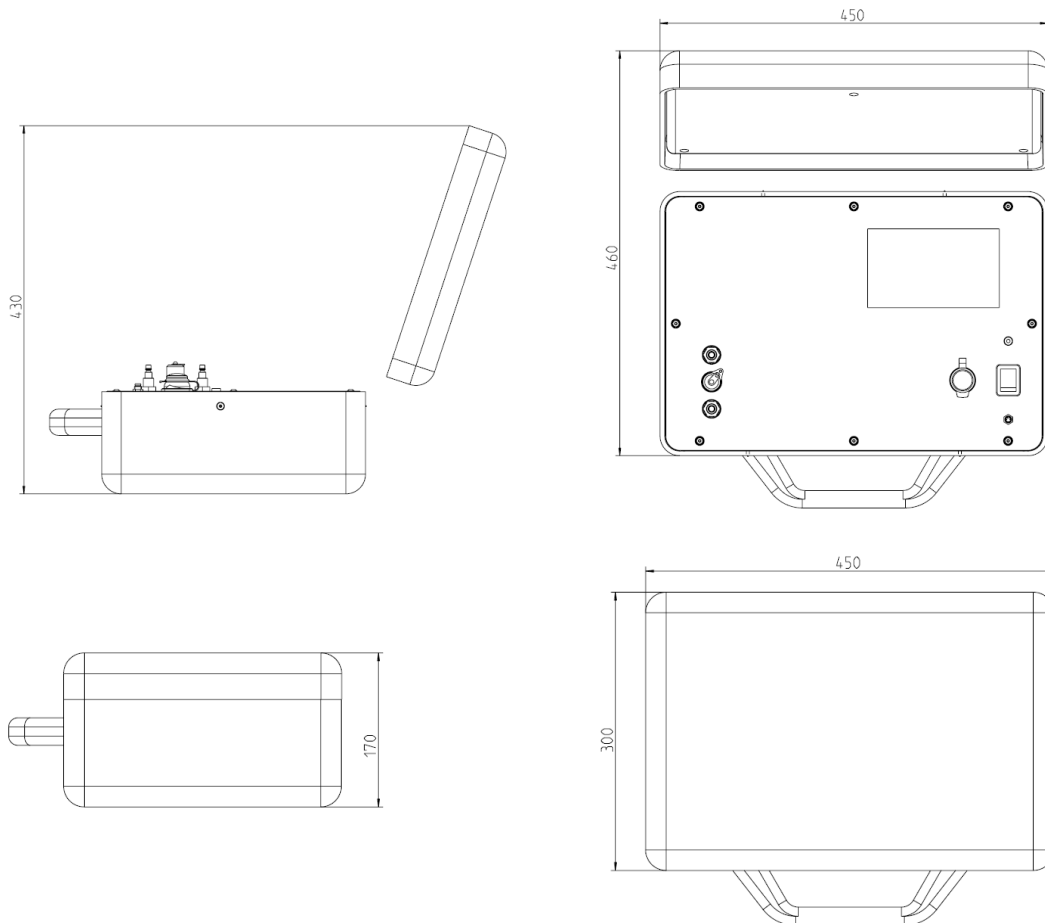
8.2. Hydraulic plan
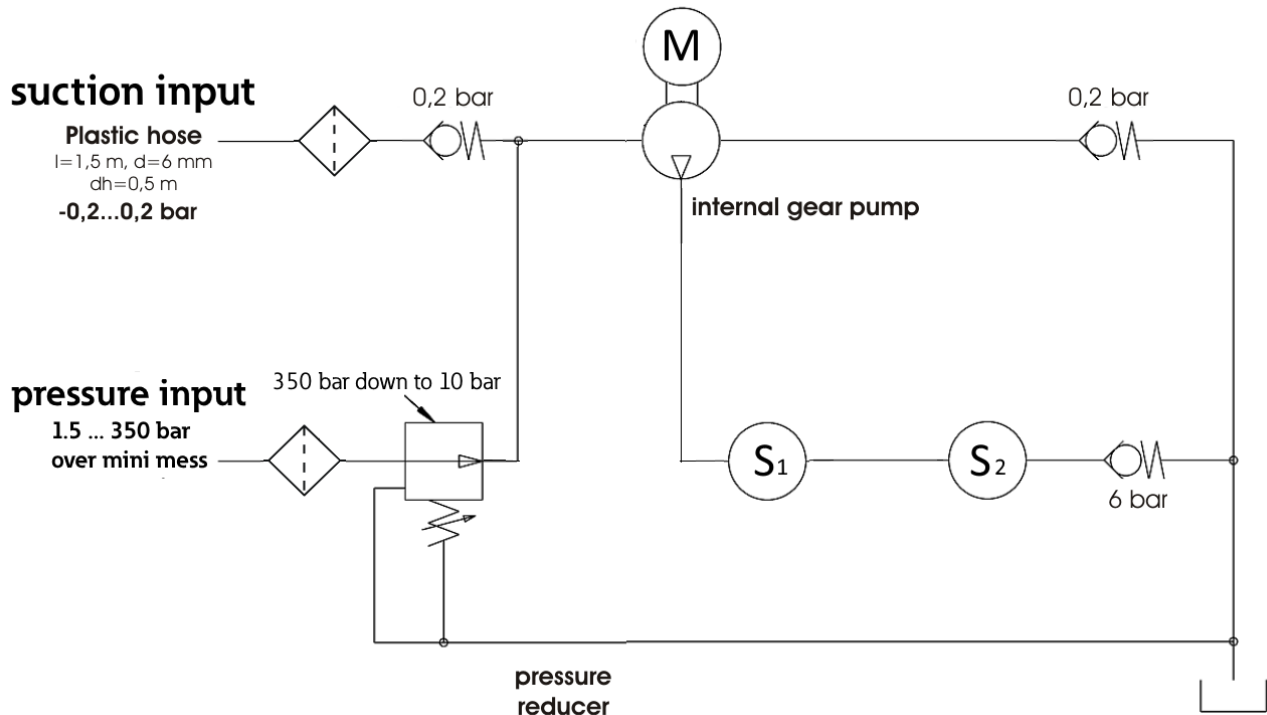
8.3. Measurement principle

8.3.1. Laser sensor – Particle Counter for CCS 5
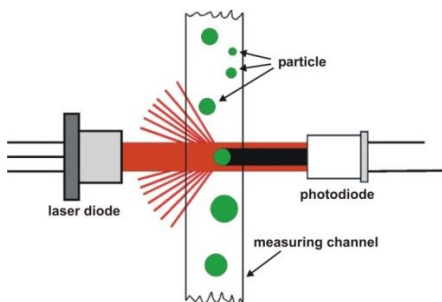
The laser sensor operates based on the light-blockade principle and generates an output signal depending on the particles' sizes. This is received, processes and classified by corresponding electronics.

The monochromatic light emitted by the laser diode is being received by a photo diode and then converted into an electric voltage. If a particle blocks this "light-blockade", the photodiode will detect a decrease in received light depending on the particle's size and the electric voltage of the photodiode will decrease as well.

Troubles or faulty measurements by:
- Dark fluids
    - The laser light cannot permeate the fluid column of the section measurements. ⇒ no decrease of the light ⇒ it is not possible to detect the particles.

- Contamination too high
    - Numbers of particles > 24000 P/ ml.
    - High chance of measuring from multiple less particles as one great particle.

- Conglomeration of fewer particles to one great particle through static electrical attractive forces or additives $\Rightarrow$ faulty measurement and the sensor is blocked!
    - It is not applicable during the off-line measurement by processing of the oil sample in the ultrasonic bath and sufficient homogenization (shaking) of the fluid before the measurement.

- Free water and air bubbles
    - Falsification of the measurement results.
    - Description of the water particle and air bubbles as great particles.
    - The measuring of HFA, HFB, HFC and aqueous cooling emulsion is not possible.

- Automatic flushing processes in all programs shall prevent false measurements. Therefore, the CCS 5 gets flushed completely with the new oil before the next measurement is done.
    (a) Single measurements:
        - Automatic flushing before the first measurement.
        - Automatic flushing before following measurements, when more than 10 minutes are gone since the last measurement or when changing the measuring point.

    (b) Continuous measurements:
        - Automatic flushing when starting the measurement.

    (c) Cyclic measurement:
        - Automatic flushing before each measurement.

- The measuring and display of the temperature, the water saturation and the water content of the fluid in all measuring programs should be prevent from alterations of the measurement results.

8.3.2. Water sensor

The **water sensor** is a **capacitive sensor**. As a dielectric between two electrodes a polymer film is used, which is able to absorb water molecules and by doing so it changes the capacity of the sensor element. This capacity is changed in a sensor output signal of **4… 20 mA**. As a measurement output the **saturation condition** (water saturation) of the fluid is displayed in **percent.**
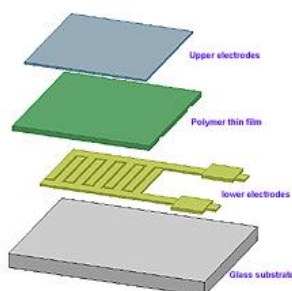
In addition, a temperature sensor is installed for precise temperature measurement of the fluid during the measurement.

As opposed to the absolute water content determination by the **Karl Fischer method**, in which the total mass fraction of free water and bound **water in mg / kg of oil** is stated, the **water sensor** evaluates the saturation condition of the fluid with water in percent.

The specification **100%** stands for a complete saturation of the fluid.

The saturation values are temperature dependent!

A relation to the detected saturation values and the data, after the Karl Fischer method accounted ppm (mg/kg), is calculated by the detected and deposited 100% saturation curve (100% saturation = f(T)) and the simultaneously measured fluid temperature and is indicated at the display.

8.4. Cleanliness classes according to ISO 4406:99

According to ISO 4406 (1999) the number of particles sized > 4 $\mu m_{(c)}$, > 6 $\mu m_{(c)}$ and > 14 $\mu m_{(c)}$ is being used to determine the cleanliness class. The determination of the cleanliness class doesn't depend on the particle size.

Example of presenting: **20 / 16 / 12**

	Partikel > 14 $\mu m_{(c)}$
	Partikel > 6 $\mu m_{(c)}$

Analysis volume: 1 ml   Partikel > 4 $\mu m_{(c)}$

Cleanliness class	Number of particles	Up to and including
26	320000	640000
25	160000	320000
24	80000	160000
23	40000	80000
22	20000	40000
21	10000	20000
20	5000	10000
19	2500	5000
18	1300	2500
17	640	1300
16	320	640
15	160	320
14	80	160
13	40	80
12	20	40
11	10	20
10	5	10
9	2,5	5
8	1,3	2,5
7	0,6	1,3
6	0,3	0,6

8.5. Cleanliness classes according to NAS 1638

Analysis volume: 100 ml

Particle number x 10³

Class	5 - 15 µm	15 - 25 µm	25 - 50 µm	50 - 100 µm	> 100 µm
00	0,125	0,022	0,004	0,001	0
0	0,250	0,044	0,008	0,002	0
1	0,5	0,089	0,016	0,003	0,001
2	1	0,178	0,032	0,006	0,001
3	2	0,356	0,063	0,011	0,002
4	4	0,712	0,126	0,022	0,004
5	8	1,425	0,253	0,045	0,008
6	16	2,85	0,506	0,090	0,016
7	32	5,7	1,012	0,18	0,032
8	64	11,40	2,025	0,36	0,064
9	128	22,8	4,05	0,72	0,128
10	256	45,6	8,1	1,44	0,256
11	512	91,2	16,2	2,88	0,512
12	1024	182,4	32,4	5,76	1,024

8.6. Cleanliness classes according to SAE AS 4059

Analysis volume: 100 ml

Size, ISO 11171 Calibration or Electron Microscope	Particle per 100 ml					
	> 4 µm (c)	> 6 µm (c)	> 14 µm (c)	> 21 µm (c)	> 38 µm (c)	> 70 µm (c)
Size Code	**A**	**B**	**C**	**D**	**E**	**F**
000	195	76	14	3	1	0
00	390	152	27	5	1	0
0	780	304	54	10	2	0
1	1560	609	109	20	4	1
2	3120	1220	217	39	7	1
3	6250	2430	432	76	13	2
4	12500	4860	864	152	26	4
5	25000	9730	1730	306	53	8
6	50000	19500	3460	612	106	16
7	100000	38900	6920	1220	212	32
8	200000	77900	13900	2450	424	64
9	400000	156000	27700	4900	848	128
10	800000	311000	55400	9800	1700	256
11	1600000	623000	111000	19600	3390	512
12	3200000	1250000	222000	39200	6780	1020

8.7. Fields of application – compatibility

NOTICE ⚠️ ⚠️

Applicable for:

- hydraulic oils H, HL, HLP, and HV
- gear oils C, CL, CLP
- gas oils, engine oils (not suitable for very dark engine oils)
- MIL-H-5606 E
- vegetable based oils (HTG, triglycerides)
- synthetic esters (HEES, HFD-U, HFD-R)

8.8. Trouble shooting

No repair of the CCS 5 can be done by operator.

Malfunctions, which could be eliminated by the operator, are limited to checking cables for breaks. ⚠️

NOTICE Any other cases require sending the CCS 5 to Eaton Technologies GmbH to recover the functions.

A brief description of the problem would expedite the trouble shooting and the repair process. To check your warranty and to answer questions by phone we need the serial number and the date of purchase of the instrument.

8.9. license and copyright of the CCS 5 Software

This product contains software components that are licensed by the copyright holders as Free Software or Open-Source Software. You can find an archive file with the source code packages and the corresponding license files of these software components from the included USB stick. You can make a request to our customer service within three years after the distribution of the product, when you need a new USB stick with the software copies. All files can be also found:
https://www.eaton.com/us/en-us/products/filtration-solutions/filtration-software-downloads.html

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8.10. Software updates

User can check all kinds of updates, like manuals, software, and source code:
https://www.eaton.com/us/en-us/products/filtration-solutions/filtration-software-downloads.html

8.11. Shipment, parts list

	article no.:
CCS 5 – Contamination Control System	**355043**
Accessories included:	
(1) Power supply unit, inclusive power cable	338658
(2) High pressure hose	313742
(3) PVC – hose DR. 8x1	316875
(4) Quick connector Rectus 21K KO08 MPX	335908
(5) USB – stick, 16GB, with software	355449
(6) Calibration certificate	annual maintenance/ calibration at Eaton Technologies GmbH

8.12. Optional accessories

• **Thermal Printer Set**	**356151**
o 1 x thermal printer	356152
o 1 x communication adapter	356153
o 4 x thermal paper	335920

8.13. spare parts

for changing the screen of the INLET:

• 1 x copper ring	306330
• 2 x o-ring 8x2 mm, FKM	316530
• 2 x screen	355103

8.14. Optional services

• Creation of a saturation curve:	339855

For more information, please e-mail us at filtrationinfo@eaton.com

Visit us online eaton.com/filtration for a complete list of Eaton´s filtration products.

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