STAUFF ®

FILTRATION TECHNOLOGY

Stauff Laser Particle Counter

LasPaC I

Operating Instructions

Contents

1   Declaration of EU Conformity

In compliance with EU directive 89/392/EEC on "Machines", Appendix IIA

The type of machine

Make: Stauff
Type name: LasPaC I

has been developed, designed and manufactured in accordance with EU directive 89/392/EEC.

The following harmonized standards have been applied:

Simple Pressure Vessels 93/68/EEC (22.07.1993)
Electromagnetic Compatibility 93/68/EEC (22.07.1993)
Machines 93/44/EEC (14.06.1993)
Low-Voltage Directive 93/68/EEC (22.07.1993)

The following national standards, guidelines, and specifications have been applied:

6. GSGV (BGBl.I p. 1171
Law on electromagnetic compatibility (BGBl.I p. 1864)
2. GSGV (BGBl.I p. 1564)
9. GSGV (BGBl.I p. 704)
1. GSGV (BGB.I p. 629)

Werdohl — Aug. 30, 2001

2   How To Use this Manual

- Special attention is to be paid to gray and framed fields indicating **Attention:** or **Warning:** , since they contain safety-relevant information.

- Gray fields in *italics* indicate that a key of the touch screen has to be pressed.

- Menu guidance of the LasPaC I is in English, using terms that are — as we believe — generally known in computer technology or electronics. In addition, we have included a translation list in the Glossary / Translations section.

3   Unpacking the Unit

If you should detect any damage on the packaging, please report it immediately to the shipping agent, to Walter Stauffenberg GmbH & Co. KG, to the Stauff branch operation, or dealer near you. When taking the device out of the packaging, please check it for potential damage.

3.1   Scope of Delivery

Please check whether your LasPaC I unit includes the following items:

Item	Order Number
Calibration certificates: These are tables specifically for your unit. Please store these certificates in a safe place and check the serial number!	
Reportmanager and downloading software	
Transport case	1030012289
Plastic hose with 6L connection	1030012286
Test hose SMS-20-1500-C	1210007145
Test hose SMS-20/K06L-1500-C	1210007146
Operating pen	1030012290
5 rolls of thermal printing paper	1030012288
Two sampling bottles	1030012293
Power cable	
USB interface cable	

3.1.1   Protecting the Device

Do not place any heavy objects on the device and protect it against
- Intense solar radiation,
- High humidity,
- Strong vibration,
- Extreme temperatures
- Explosive or chemically aggressive atmospheric environments.

4   Sample Fluids

4.1   Compatibility with Sample Fluids

The casing is coated with robust polyester.
The materials that will be in contact with the sample fluids are
- Steel type 1.0161 and 1.4571
- Aluminum
- Boron silicate glass
- Polyamide
- Viton (FPM)

These materials are compatible with nearly all petrochemical products.

The **standard version of the LasPaC I is not compatible with phosphate ester (e.g. skydrol) or ketone (e.g. acetone).**

Special versions suitable for other sample fluids, for instance ester, ketone, skydrol or aqueous solutions are available upon request.

Attention! If in doubt, please contact STAUFF.

4.2 Temperature of the Sample Fluid

The temperature of the sample fluid must not exceed 90 °C (194°F). Higher temperatures will lead to faulty measuring results or may destruct the device.

5 Safety Instructions

For your own safety, please observe the warnings below:

5.1 Dangerous Substances

Warning! If toxic, flammable or highly ignitable substances are to be used, be sure to comply with the applicable safety precautions!

5.2 What Pressure is Present in the Sample Supply Line?

Warning! Identify the pressure of the sample fluid flowing to the LasPaC I. Be sure to use the correct inlet (see illustration under quick start)! The maximum permissible pressure must not be exceeded! There is a risk of injury due to bursting hoses and connections, or the device could be destroyed.

Attention: Internal leakage oil will automatically cause that oil is being transported from PORT I (high pressure entry) to PORT II (low pressure entry). If the low pressure inlet is closed, a too high pressure will be built up. The device will then be destroyed inside. In order to avoid this, it is essential to connect PORT II first, and then PORT no. I. It must be avoided to have a pressure exceeding 6 bar (87 psi) at PORT II.

Be sure to use the low-pressure inlet (PORT II) for up to 5 bar (73 psi). For a short period of time and at a certain loss of measuring accuracy, you can use the low-pressure inlet (PORT II) for sample fluids of up to 6 bar (87 psi).

Supply the sample fluids at a minimum of 5 bar (73 psi) and a maximum of 420 bar (6092 psi) via the high-pressure inlet (PORT I).

Admissible operating overpressure of the black testing hoses:

up to 0°C (32°F)	463 bar (6715 psi)
up to 30°C (86°F)	418 bar (6063 psi)
up to 50°C (122°F)	380 bar (5511 psi)
up to 80°C (176°F)	327 bar (4743 psi)

In the case of the transparent plastic hose with 6L connection, an operating overpressure of up to 10 bar (145 psi) is admissible.

5.3 When a Problem Arises

Warning! Do not repair or modify the device yourself! If you should encounter any difficulties please contact STAUFF. The case must not be opened. Even if the power plug has been pulled out of the outlet, the device is still in energized condition!

A short-circuit could be caused, for instance, by finger rings, wrenches, or other objects that are dropped into the casing.

6 Quick Start

Attention: Before installation (startup, switching-on), please be sure to read not only this brief information, but also the entire detailed operating instructions! Noncompliance with the operating instructions can result in hazards to people and property. Please understand that we cannot accept any claims resulting from noncompliance with instructions.
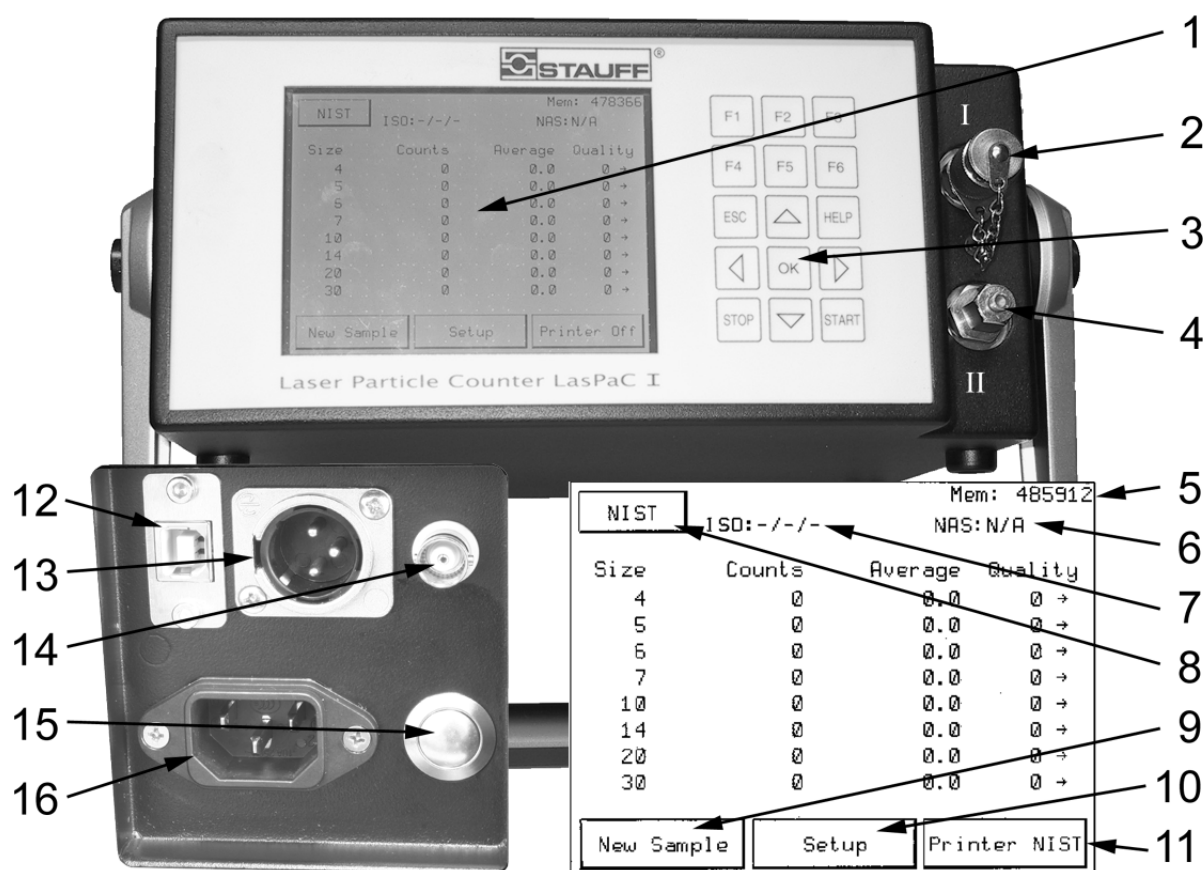
6.1 Illustration

Figure 1: Connections and operating elements

1	Touch screen	9	Start new measurement
2	Port I: high-pressure inlet / low-pressure outlet	10	System settings
3	Key pad	11	Set the printer
4	Port II: high-pressure outlet / low-pressure inlet	12	USB interface
		13	10 ... 36 VDC socket
5	Free memory space	14	BNC jack for sensor signal
6	ISO class (depending on calibration selected)	15	ON/OFF switch
7	AS 4059 class at NIST; NAS class at AC	16	110 ... 240 VAC power connection
8	Calibration selected		

6.2 Operation

The LasPaC is operated by pressing the buttons on the touch screen or by pressing the respective keys on the keypad. Please use the enclosed pen for the touch screen.

6.3 Place of Sampling

In order to obtain representative particle counts, we recommend that the sample is taken during normal operating conditions. Sampling from the pressure line is preferred over sampling from the tank.

This is the only measurement where test conditions can be reproduced for follow-up measurements. After any measurement, make sure that there is no contaminated or resinifying oil left inside the LasPaC.

6.4 11 Steps to Obtain the Measuring Result

a   Before starting-up, charge the storage cell.

b   Look for suitable measuring point.

c   Identify the pressure at this measuring point.

d   Turn on device by pressing button 15 or select "New Sample" if the device is in ON condition.

e   Select the measuring profile depending on the pressure.
    i   Pressure < 5bar low-pressure measurement = *Low Pressure Std. [F1]*
    ii Pressure > 5 bar (73 psi) and < 420 bar (6091 psi) = high-pressure measurement; select with *High Pressure Std. [F2]*.

f   Enter data.

g   Press "Start".

h   Connect the LasPaC to the measuring point in accordance with the information displayed.

> **Attention:** Internal leakage oil will automatically cause that oil is being transported from PORT I (high pressure entry) to PORT II (low pressure entry). If the low pressure inlet is closed, a too high pressure will be built up. The device will then be destroyed inside. In order to avoid this, it is essential to connect PORT II first, and then PORT no. I. It must be avoided to have a pressure exceeding 6 bar (87 psi) at PORT II.
>
> **Attention:** Be sure to connect the hoses to the LasPaC first and then to the measuring point!

  LP outlet -> port I: low-pressure measurement fluid outlet
  LP inlet   -> port II: low-pressure measurement fluid inlet
  HP outlet -> port II: high-pressure measurement fluid outlet
  HP inlet   -> port I: high-pressure measurement fluid inlet

i   Press "Start".

j   First the oil in the LasPaC is being changed. Then, 3 individual measurements are performed, each using 10 ml of fluid. After the measurements are completed, the average value as well as the cleanliness classes are displayed.
You can cancel the measuring operation by pressing "Stop".

k   Activate "New Sample" if you wish to perform more measurements.

6.5 Displaying and Printing

While the measurement is going on, you can use the touch screen to select *NIST* (calibration in compliance with ISO 11171) or *AC* (calibration in compliance with ISO 4402).
Setting the printer should be carried out before any measurement, otherwise the printout will be incomplete.

6.6 Maintenance and Cleaning

After each test, the oil should be removed and the LasPaC should be cleaned with clean oil and then filled with clean oil. The Profile *FLUSH* uses the low-pressure mode.
- Turn on the device or press *New Sample* if the unit is already in ON condition.
- Press *Custom [F3]*
- Press *profiles: _____*
- Press *FLUSH*
- Press *"Start"* twice

6.7 Charging the Storage Cell

The LasPaC I is equipped with an intelligent charging system. To charge the storage cell, perform the following steps:

1. The device must have been OFF for at least 5 seconds and must not be connected to the general power supply (pull out the power plug).
2. Connect the device to the power supply via the power cable.
3. The charging process starts automatically.
4. Charging time for a full charge is approximately 3 hours. Charging time for a partial charge is proportionately shorter.
5. The microprocessor-controlled charging system stops the charging process automatically as soon as the full capacity of the storage cell is reached.

Please note: The fan included in the LasPaC I is running as long as the unit is connected to the power supply, both power system operation and charging operation.

7 Sampling

There are several ways to perform "good" sampling. In any case, however, the following prerequisites need to be adhered to in order to obtain an informative result:

1. The oil in the hydraulic system should be at operating temperature. For this purpose and in order to establish a quasi-stable condition, the system should be running for a while (approx. 30 min) before starting.

2. If several measurements are carried out in succession (either directly one after the other or at larger time intervals), the measurements should always be carried out in the same place. This way, optimal reproducibility of the sampling conditions can be ensured.

3. The oil at the sampling point should be free of air and water bubbles. Since both air and water bubbles are interpreted by the Laser particle counter as solid matter particles, they would cause the particle counter to give a false reading. This is not only the case with our particle counters, but is true for any laser or incandescent-light particle counters.

4. There should always be sufficient oil available at the sampling point.

5. An assessment of the mathematical and functional parameters underlying the measuring procedure by the operator can be very helpful. For instance, if the individual measurements vary too much this may be because the hydraulic system is unstable or because the LasPaC I has not been flushed sufficiently (i.e. there might still be particles from previous measurements present in the LasPaC I). In that case, the measurement should be repeated.

6. The flushing period should allow for the medium already contained in the LasPaC I (from a previous measurement or flushing procedure). A reliable result can be obtained much quicker with a clean and well flushed LasPaC I. A LasPaC I still containing a heavily contaminated medium from a preceding measurement is likely to take longer until a stable condition is reached. The flushing period should allow for the fact that the system's sampling valve is flushed for about 15 seconds before clean oil enters the measuring tube. The factory-set measuring cycles include a flushing time that is normally required. Parameters need to be adjusted only in very special cases. It is also possible to do without adjusting the parameters specifically, if the vast majority of measurements are performed under "normal" conditions. If an isolated "abnormal" measurment is to be performed, an adequate result can be obtained simply by performing a second measurement, i.e. the first measurement is not taken into consideration and serves as an additional flushing procedure.

7.1 Measuring Points

The optimal sampling points are described in the order of their relevance.

a) Sampling from the return-flow line

In this case, the sampling point is located downstream of all the hydraulic components and upstream of the return-flow filter. The LasPaC I can be connected to a STAUFF measuring coupling, for instance, or to another so-called miniature measuring connection.

Whenever possible, the measuring point should be located downstream of a 90° elbow or a ball cock (measuring point 2), since there is a turbulent flow in this area in most cases. A valve, or a branch that branches off from the main flow at an angle of 90° (measuring point 1) is not a recommended measuring area, since it is not certain that the larger particles will be carried along and follow the change of direction. The dynamic motive forces especially cause larger particles to remain within the main flow stream and therefore do not arrive at the sampling valve, i.e. the result is inaccurate.
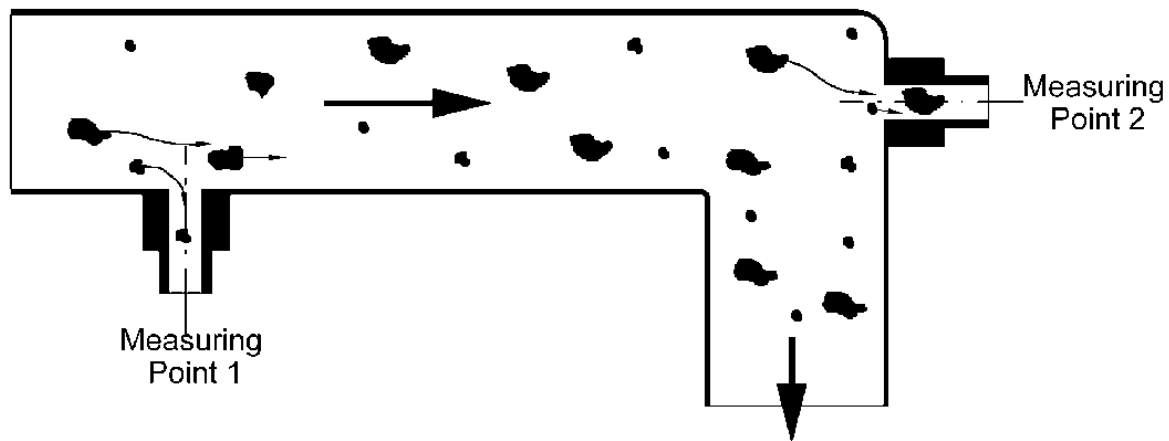
Figure 2: Measuring point

b) Sampling from the tank

The oil sample should be taken, whenever possible, from the center area of the tank – horizontally as well as vertically. Special attention should be paid to the fact that there are no air bubbles in the oil (for example if oil gushes back into the tank due to excessive flow). If this procedure is absolutely necessary, the system is to be turned off for the time of sampling. For this reason, in systems with several tanks it is advisable to sample from the pump tank where turbulent mixing is prevented.

c) Sampling from the pressure line

With regard to the type of connection (valve and location), the same requirements apply as described under "Sampling from the return-flow line".

It is important that pressure fluctuations caused by the pump, for instance, are not too large.

8   Flow Rate and Hydrodynamic Conditions

Via the hoses supplied with the unit, the LasPaC I can suck in oils of any viscosity up to 160 cStoke. In the case of deviations – e.g. if a hose other than the one supplied for the low-pressure inlet is used – a hydrodynamic assessment is necessary to determine whether the sample fluid is transported through the device without forming bubbles.

Please note:

- Even if no bubbles can be seen in the discharge hose, you cannot be absolutely sure that the flow of the medium is bubble-free.
- If the high-pressure inlet is used, hydrodynamic conditions normally do not cause any problems.

9   General Information on the LASPAC I

9.1   Control Panel

The LasPaC I is equipped with a keypad and a graphic LC display with a touch screen.

9.2   Connections

On the right side of the front panel, the connections for the **Stauff measuring couplings** are located**:**

- Low-pressure outlet = high-pressure inlet → PORT I
- Low-pressure inlet = high-pressure outlet → PORT II

On the left side of the device, the **electrical connections** as well as the power switch are located. The LASPAC I is equipped with:

- A BNC jack for service purposes
- A 9-pin sub-D connection for an RS232 computer interface
- A special connection for an external power connection (10VDC to 36VDC)
- A coupling socket for non-heating appliances for 100VAC up to 240VAC, 50Hz up to 60Hz.

9.3   Installation

Whenever possible, select a dry and clean place where the device can stand well. Place the device on one of the sides that are fitted with supports.

9.4   Startup

9.4.1   Power Supply

Connect the power cable to the coupling socket for non-heating appliances on the left side of the device and to the power system.

9.4.2   Hydraulic Connections

Use the transparent hose for the oil return flow in the case of high-pressure operation or as a suction hose in the case of low-pressure operation.
Before connecting, you must find out whether

- The high-pressure or the low-pressure inlet has to be used, and whether
- The maximum admissible pressure for the respective inlet is being adhered to.

Warning! Please observe the safety instructions regarding the pressure that is present in the sample supply line!

10 Operation

10.1 Switching-on

The ON/OFF button is located on the left side of the device.

10.2 Main Window

```
┌─────────────────────────────────────────┐
│ ┌───────┐  ISO:-/-/-      Mem:  415898   │
│ │ NIST  │  AS4059:-                      │
│ └───────┘                                │
│   Size      Counts    Average  Quality   │
│     4         0         0.0       0  →    │
│     6         0         0.0       0  →    │
│    10         0         0.0       0  →    │
│    14         0         0.0       0  →    │
│    21         0         0.0       0  →    │
│    25         0         0.0       0  →    │
│    38         0         0.0       0  →    │
│    70         0         0.0       0  →    │
│ ┌───────────┬──────────┬──────────────┐  │
│ │New Sample │  Setup   │ Printer NIST │  │
│ └───────────┴──────────┴──────────────┘  │
└─────────────────────────────────────────┘
```

Figure 3: Main window

To select items, press the respective buttons on the touch screen.

10.2.1 *Nist* / **AC**

This button activates the display of the number of particles measured and the indication of the ISO classes in accordance with the various international calibration regulations NIST = ISO 11171 and AC = ISO 4402. The area AC is not calibrated.

10.2.2 *New Sample*

Use this button to get to a selection box from which you can choose a default profile or the profile used before by using CUSTOM. From there you get to the start of a new measurement where you can make additional entries and settings.

10.2.3 *Setup*

The "System Settings" window opens up and offers the following options: *SYSTEM SETUP*, *PROFILE SETUP,* and *CALIBRATION SETUP*. Pressing keys F1 through F3 will take you to the respective menu options as well. The *Setup* button is not active while the measurement is taking place.

10.2.4 Printer Settings

The "Print Settings" window opens up and offers the options *PRINTER AC*, *PRINTER NIST,* and *NONE*.

- *Printer Off*: With this setting, the printer is in switched off condition.

- *Printer NIST*: With this setting, the printout is based on the ISO11171 calibration. The particle counts, ISO classes and the AS 4059 classes are printed.

- *Printer AC*: With this setting, the printout is based on the ISO4402 calibration. The printout contains the particle counts, the ISO classes, and the NAS class. The area AC is not calibrated.

10.3 Selecting Menu Options

... by pressing the respective button or the respective function key *F1* through *F6* on the keypad provided that a function key is indicated.

10.3.1 Calling-up the Setting Menu

Press the *Setup* button on the display panel.

Display Panel   Keypad
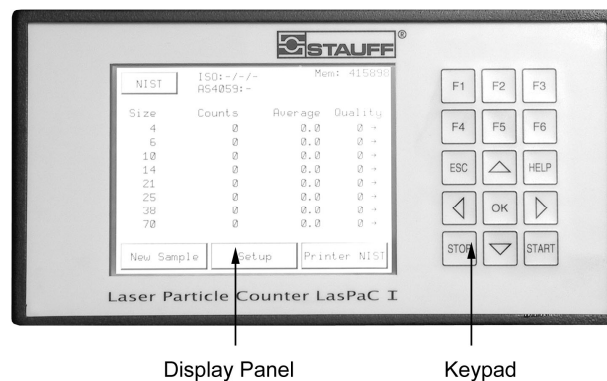
Figure 4: Operating elements

Note: The "Setup" function cannot be called up while a measurement is going on.

10.4 Entering Values

10.4.1 Entering Numerical Values

.. on the numerical keypad that automatically opens when numerical values need to be entered.
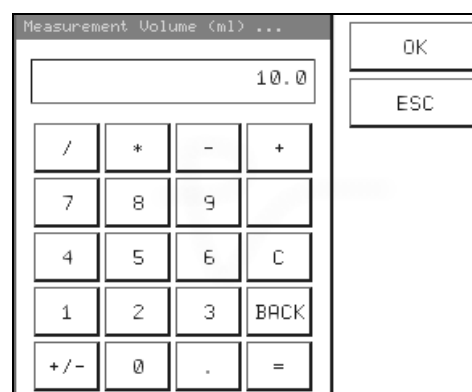
Figure 5:Numerical keypad

10.4.2 Entering Text

... via the text display. It opens up automatically when letters need to be entered.

<p align="right">Figure 6: Text keypad</p>

Note: If you encounter any problems when entering values, recalibrate the touch screen to adjust it to your personal "touch". By default, the touch screen set to the pen which is delivered along with the unit. It can also be operated with a ball-point pen or by using your fingertip.

Warning: Do not use any pointed objects that could damage the touch screen.

10.4.3 Correcting Values

.. using the *Back* key or *"C"* in the calculator.

10.4.4 Confirming entries

.. by pressing the *OK* key.

10.4.5 Exiting Window without Saving Recent Entries

.. by pressing the *ESC* key.

11 Performing a Measurement

11.1 Selecting Profiles

11.1.1 Selecting a Default Profile

Press the *New Sample* button in the main window to open up a selection box. Select *Low Pressure Std.*, *High Pressure Std.* or the profile used last by selecting *Custom*.

11.1.2 Selecting Any Profile

Press the *Profiles: ...* button in the main window after having selected a default profile. A selection box will open up. Select the desired measuring procedure (profile) for the next sample. The list can also be scrolled up and down using the arrow keys.

Confirm the desired profile by pressing the respective names.

Figure 7: Selecting a profile

11.2 Notes Window

Here you can enter comments and information with regard to the sample by using the alphanumerical keyboard.

Figure 8: Notes

11.3 *START*

Press the *START* key. The "Hydraulic Connection" window will appear. In order to start a measurement, press the *START* key. Use *ESC* to get back to the "Info" window without starting a measurement. The arrows in the next windows indicate input and output of the sample for the measuring profile selected.

LP stands for Low Pressure, HP stands for High Pressure. It is absolutely necessary that you check whether the correct hose connections have been made. The figure behind "Remaining Space" indicates how many measurements can still be saved.

```
        Hydraulic Connection

                    LP Outlet  ⟵━━━━━

    Remaining Space: 20 Profiles

                    LP Input   ━━━━━⟶


       ┌──────────┐   ┌──────────┐
       │  Start   │   │   ESC    │
       └──────────┘   └──────────┘
```
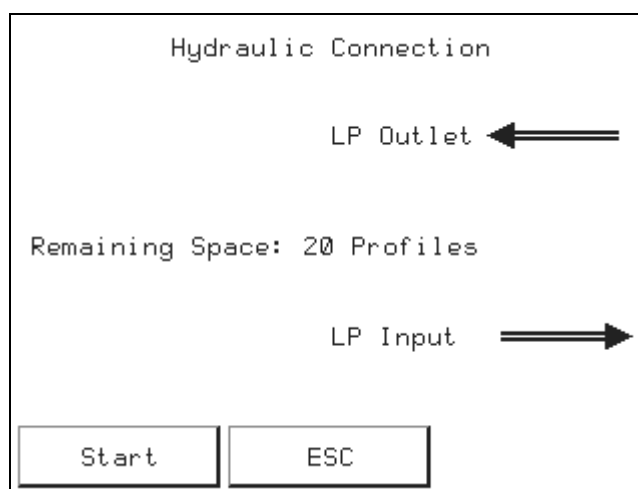
Figure 9: Hydraulic connections

12 Flushing

If the previous liquid measured was severely contaminated or if the next liquid is not compatible with the previous one, you need to flush the LasPaC I. Be sure to remove any resinifying liquids from the LasPaC I.

12.1 Running the Flushing Procedure

Perform a measuring procedure with the flushing fluid and the *Flush* measuring cycle. There will be no measurement during this cycle. If the printer is in ON condition, 0 particles will be indicated for each particle size. The data are not saved.

Attention! Be sure to use the appropriate flushing fluid that is compatible with the device.

12.2 Flushing Fluids

We recommend using clean hydraulic oil or petroleum benzene for cleaning purposes. The flushing fluids must be miscible with the sample fluid measured last.

If your flushing fluid is not miscible with the sample fluid of a previous measuring procedure, flush the unit by successively using suitable liquids that are miscible in the appropriate order. In-between procedures, run air through the system to remove most of the fluid used last.

12.3 Checking Cleanliness

Perform a measuring procedure using a filtered fluid.

13 System Setup

Press the *Setup* button and then *System Setup* in the "System Settings" window. The following menu will appear:

```
System Settings ...

    Recalibrate Touch Screen [F1]

    Change display contrast [F2]

    Reset display to default [F3]

    Reset to User Level [F4]

    Admin Setup ... [F5]

                            OK
```
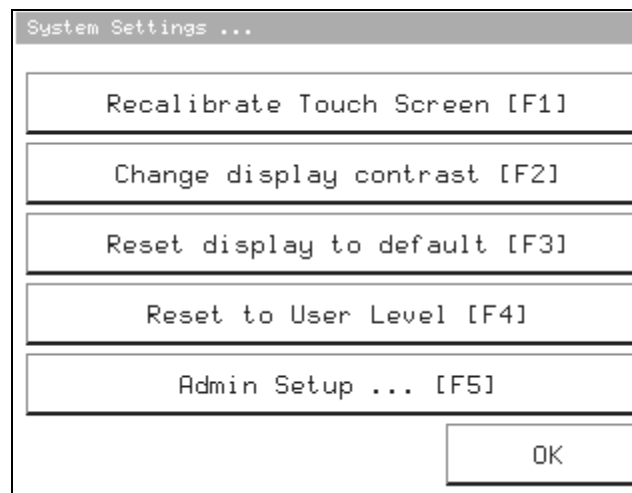
Figure 10: System settings

13.1 Calibrating the Touch Screen

After selecting *Recalibrate Touch Screen*, press on each one of the five squares that will appear one after the other in order to calibrate the touch screen to your convenience.

The touch screen will react differently to different operating elements and fingers. We recommend using the enclosed pen. The default setting of the touch screen is based on the pen.

```
□  <-Press on first button



        Touchscreen Calibration
```
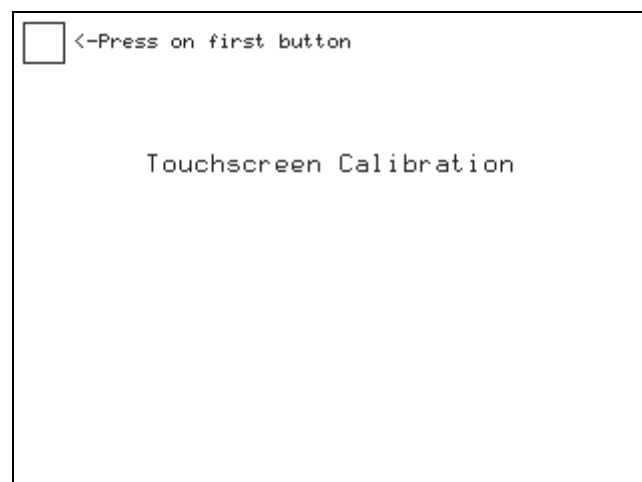
Figure 11: Calibrating the touch screen

13.2 Adjusting the Display Contrast

The contrast of the display can be adjusted under *Change Display Contrast*. Increase the contrast of the display by pressing the Δ key. Decrease it by pressing the ∇ key. If the display is too bright, reduce the contrast. If the display is too dark, intensify the contrast. By

pressing the *F6* key, you can reactivate the factory setting. In the lower left of the window, the contrast setting is indicated in percent. Confirm the adjustment with *OK*.

```
Display Contrast settings ...        ESC

Key              Function

Arrow up         Increase Contrast
Arrow down       Decrease Contrast
F6               Reset Contrast to Default


   Percent: None

                              ┌──────────────┐
                              │     OK       │
                              └──────────────┘
```
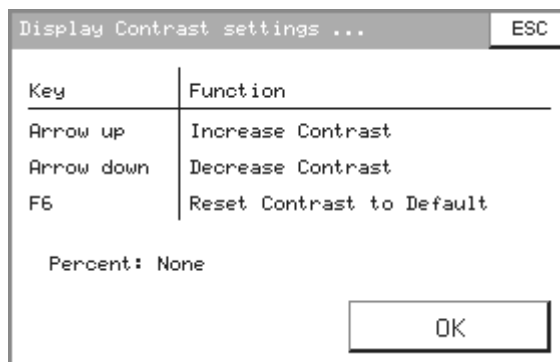
Figure 12: Setting the display contrast

13.3 Display in Basic Setting

Use *Reset Display to Default* to reactivate the factory setting of the display contrast.

13.4 Enabling the Administrator Level

The system is set to administrator mode when you enter the password after you have pressed *Set Administrator Level*. The default password is "STAUFF". However, you can change the password in the "Extended System Settings" window which you can reach via *Admin Setup ...* (only after having entered a valid password). Upon entry and confirmation of the password, *Set Administrator Level* will change over to *Reset to User Level* and the *Admin Setup ...* option will appear.
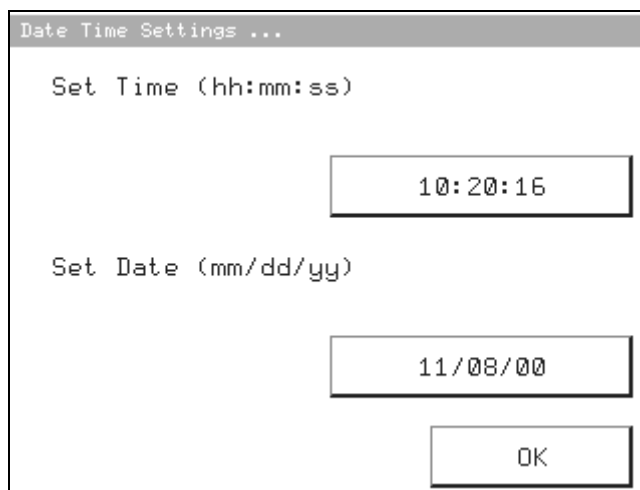
13.5 Administrator Level

After pressing *Admin Setup ...* the "Extended System Settings" will appear.
The following functions are accessible to the administrator only, upon entry of the valid password.

13.5.1 *System Time*

Enter date using the mm/dd/yy (month/day/year) format and time using the hh:mm:ss (hour:minute:second) format.
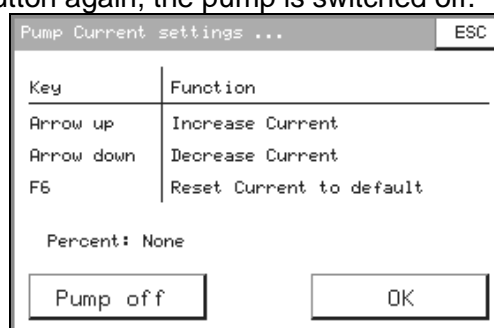
Figure 13: System time

13.5.2 *Pump Current*

Use the Arrow up and Arrow down functions (arrows Δ and ∇ on the keypad) to increase or reduce the pump output (pump current). If the pump stops, increase the output. Use *F6* to reset the output to factory setting. These adjustments can be made while the pump is running. For this purpose, press *Pump off* in the main window. The setting will switch to *10 ml/min* and then, after pressing it again, to *25 ml/min*. You can adjust the discharge rate by using arrows Δ and ∇. The window in the lower left shows you the current setting in percent. By pressing the *25 l/min* button again, the pump is switched off.

Figure 14: Pump output

13.5.3 *Serial Port*

This field is inhibited. Configuration of the interface and the commands are described in the section on Serial Communication.

13.5.4 *Admin. Password*

This is where you can change the password for the administrator. The default password 'STAUFF' will remain to be valid as well.

13.6 Back to the User Level

Use *Reset to User Level* in order to return to the user level.

14 Profile Setup

Press the *Setup* button and then *Profile Setup* in the "System Settings" window. You will get the menu shown below. Here you can create a new measuring cycle or change or delete an existing one.
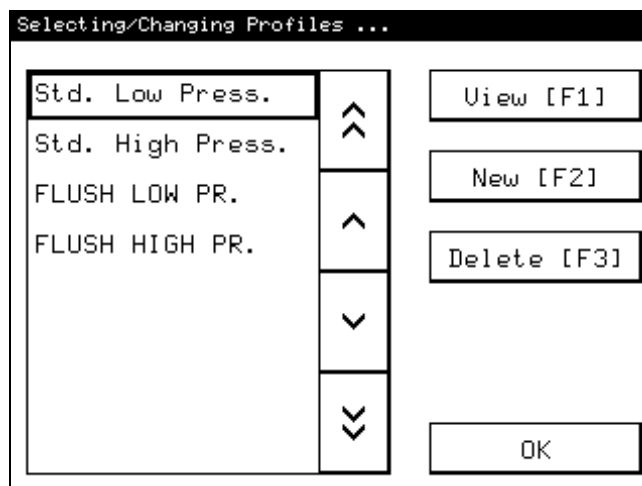
Figure 15: Profile settings

14.1 *Edit* / *View*

Select the measuring profile where you wish to change or view any settings and/or the name of the profile.
Edit is active if a valid password has been entered, otherwise the *View* function will appear. The displays following *View* can be exited only with *ESC*. *View* merely enables you to check the profile settings.

14.2 *New*

Create a new measuring profile. A name indicating date and time of creation is assigned automatically. Decide whether you want to copy an existing profile or use the default settings. You can change the name if you like. *New* can only be selected if a valid password has been entered.

14.3 *Delete*

Select a profile name and press *Delete* in order to delete the profile.
Note: Default profiles Std. Low Press. and Std. High Press. cannot be deleted.

14.4 Profile Properties

This menu will appear after *Edit*, *View,* and *New*. Here you can change the name and the settings of a measuring profile.
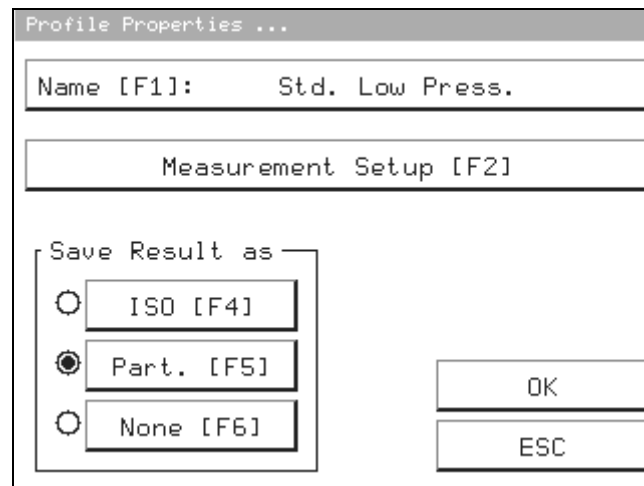
Figure 16: Profile properties

14.4.1 Profile Name

Click on *Name.* The text display will appear. Assign a name to the measuring profile. The system does not check whether the name already exists. It is therefore possible that two profiles with the same name contain different settings. They will be listed with the same name.

14.4.2 *Measurement Setup*

The "Profile Flow Chart" opens up. This is where you can define the settings for the measurement.

14.4.3 Radio Buttons in "Save Result As"

Decide whether the results of the particles measured are to be saved in the RAM. For *ISO* and *Part.*, the number of the particles measured per channel are saved. It is possible to store approx. 700 measuring cycles. Select *None* if the measurements are not to be saved. The figure in the upper right corner of the main window, behind Mem:, shows how much memory space is still available.

14.4.4 Profile Flow Chart

You can change the measurement settings in the "Profile Flow Chart" window by pressing the respective keys.
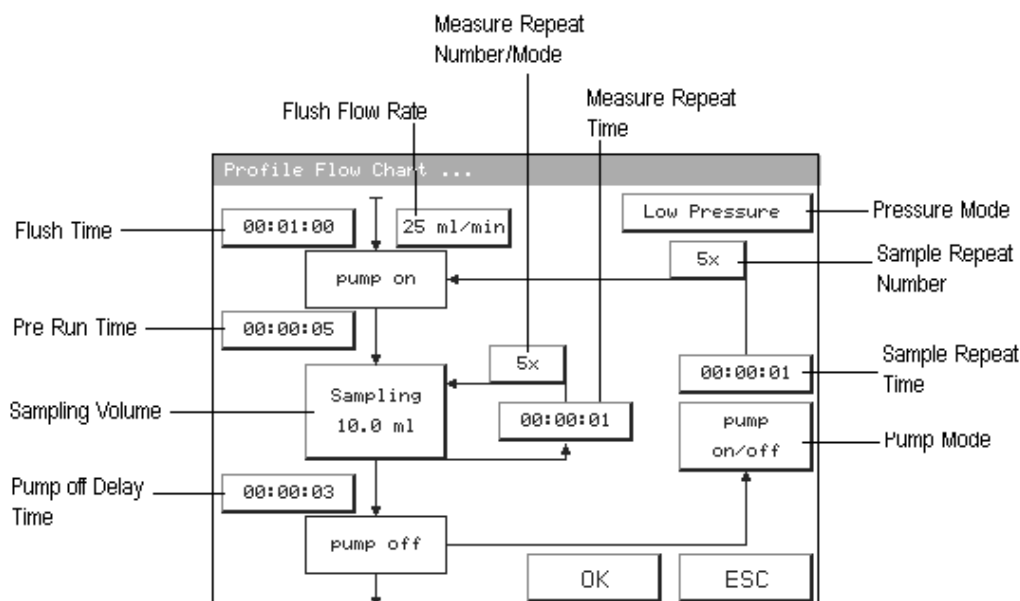
Figure 17: Profile flow chart

14.4.4.1 Flush Time and Flow Rate

During this time, the pump is running at the speed set under "Flush Flow Rate". If the "Flush Time" has been set to 0 seconds, there will be no flushing. If the "Flush Flow Rate" has been set to 0 ml/min, the system will wait and, after the flushing time has expired, the pump will be set to the "Measure Flow Rate" (25 ml/min).

14.4.4.2 Pre Run Time

During this time, the pump is running at the speed necessary for measuring (Measure Flow Rate). If the "Pre Run Time" is set to 0 seconds, there will be no stabilization of the flow rate before measuring.

14.4.4.3 Sampling Volume

Here you can adjust the sampling volume in steps of 0.1 ml.

14.4.4.4 Measure Repeat Time

The "Measure Repeat Time" is the waiting time between the individual measurements of a group of measurements.

14.4.4.5 Measure Repeat Number / Mode

This function opens a windows with the options *Manual*, *Repeats ..*, *Tolerance ...*, and *DQ ISO 11171 ...*.

Manual

Upon choosing *Manual*, a button labeled *Sample OK* will appear on the touch screen after the measurement has been started. The LasPaC I keeps performing the measurement until this button is pressed.

Repeats..

Under *Repeats...*, you specify how many repetitions you want to have performed in one group of measurements. "*Repeats ...* = 2" means 3 individual measurements of one sample (first measurement and 2 repetitions).

Tolerance Range
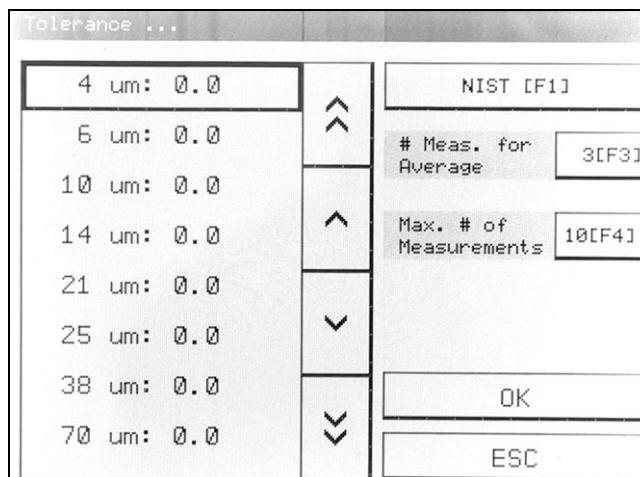
Figure 18: Tolerance ranges

- **Allocation of particle size -> value**
  The user can specify a value as an upper threshold for the calculation using the following formula for each particle size for the last # individual measurements. If the values are not below this limit, the condition is not considered fulfilled. The measurements are repeated until the value is adhered to for all the particle sizes or until the specified number of measurements ("Max. # of Measurements") is completed. With the entry of 0.0, you can specify that no condition needs to be met for this particular particle size.

  $$Value = \frac{100 \cdot (X_{max} - X_{min})}{\overline{X}}$$

  $\overline{X}$ Average of the previous # individual measurements
  X_{max} Maximum of the previous # individual measurements
  X_{min} Minimum of the previous # individual measurements

For example:

For 5 µm, the previous 3 measurements resulted in the following particle counts: 35282, 35389, and 36522.

$$\overline{X} = \frac{35282 + 35389 + 36522}{3} = 35731$$

X_{max} $= 36522$
X_{min} $= 35283$

$$Value = \frac{100 \cdot (36522 - 35283)}{35731} = 3.47 < 10.0$$

The condition for this particle size is fulfilled.

- **AC / NIST**
  Select the type of calibration for which the stabilization criteria shall apply.

- **# Measurements for Average**
  Number of the individual measurements that need to be within the entered tolerance band.

- **Max. # of Measurements**
  When the stabilization criterion has not been fulfilled, the measurement stops after a set number of measurements.

DQ ISO 11171

Enables the user to use the stabilization criterion for 5 individual measurements in compliance with ISO11171, section 6 (the D_Q criterion is used). The measurements are repeated until the stabilization criterion is fulfilled or until the maximum number of measurements is reached.
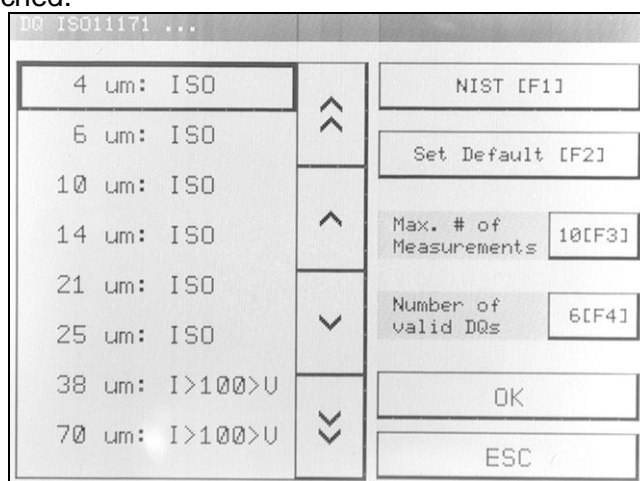
Figure 19: ISO tolerance range

The formula for the stabilization criterion is:

$$D_Q = \frac{100 \cdot (X_{max} - X_{min})}{\overline{X}}$$

$\overline{X}$ Average of the previous 5 individual measurements

X_{max} Maximum of the previous 5 individual measurements

X_{min} Minimum of the previous 5 individual measurements

The admissible values for DQ are:

$\overline{X}$		Maximum value for D_Q
Greater than	Smaller than	
10000		11.0
5000	10000	11,3
2000	5000	11,9
1000	2000	13,4
500	1000	15,6
200	500	19.3
100	200	27.5

The ISO stabilization criterion is considered as being fulfilled if D_Q does not exceed a certain value, which depends on the average particle count, for a given particle size. The stabilization criterion is considered as not being fulfilled if D_Q is greater than the value listed in the table or if the average particle count $\overline{X}$ is smaller than 100.

For 5 µm, the last 5 measurements resulted in the following particle counts: 35710, 35282, 35345, 35389, and 36522.

$$\overline{X} = \frac{35710 + 35282 + 35345 + 35389 + 36522}{5} = 35650$$

$$X_{max} \quad = 36522$$
$$X_{min} \quad = 35283$$

$$D_Q = \frac{100 \cdot (36522 - 35283)}{35650} = 3.47 < 11.0$$

The condition for this particle size is fulfilled.

- **Allocation of particle size and D_Q criterion**
  You have the following options when setting the D_Q criteria:
  ISO   The last 5 measurements of a channel must fulfill the D_Q criterion. A channel can only fulfill the stabilization criterion if at least 100 particles per measurement have been counted in this channel. This can be achieved, e.g. in the case of clean oils, by increasing the sample volume.
  I>100>V The criterion only needs to be fulfilled if the average of the counted particles is >= 100. If less particles have been counted, the criterion for this channel is considered as being fulfilled.
  IGNORE The stabilization criterion for this channel is not considered as being fulfilled.

- **AC / NIST**
  Select the type of calibration for which the stabilization criteria shall apply.

- **Set Default**
  This function sets the D_Q criterion to 'ISO' and the 'Number of valid D_Qs' to 6.

- **Max. # of Measurements**
  If the stabilization criterion has not been fulfilled, the measurement stops after the set number of measurements.

- **Number of Valid D_Q**
  Minimum number of channels that have to fulfill the criterion. The number of channels with setting ISO or I>100>V must be greater than or equal to the 'Number of valid DQs'.

> **Attention:** If that many channels have been assigned IGNORE that the number of the channels that have to be fulfilled cannot be reached, the measurement will continue until 'Max. # of Measurements' is reached. This can also happen if too many channels count less than 100 particles and the criterion has been set to ISO.

14.4.4.6 Pump off Delay Time

Residual run time of the pump following a measurement, in the case of *Pump on/off*, before the pump is switched off. If the "Pump mode" has been set to *Pump Continuous*, this time only applies after the last measurement has been completed.

14.4.4.7 Pump Mode

Use the "Pump Mode" function to select *Pump on/off* (the pump is turned off between the individual groups of measurements) and *Pump Continuous* (the pump is running between the individual groups of measurements).

14.4.4.8 Sample Repeat Time

Refers to the waiting time between successive groups of measurements.

14.4.4.9 Sample Repeat Number
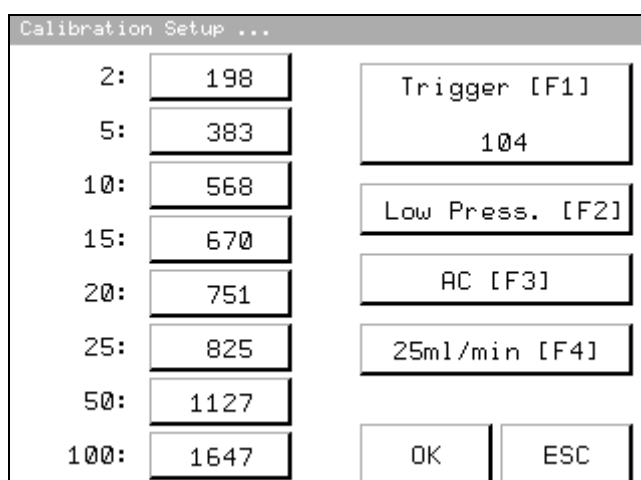
The number of repetitions of the groups of measurements. (0 means that the sample is measured once).

14.4.4.10   Pressure Mode

By pressing the "Pressure Mode" key, you change over from *Low Pressure* to *High Pressure Mode* and vice versa. The current set mode is displayed.

15 Calibration Setup

Here you can view the calibration data for the different calibration regulations.

Figure 20: Calibration

15.1 *Low / High Pressure*

Use this button to select the calibration range for high-pressure applications or for low-pressure applications. The currently displayed mode can be edited.

15.2 Calibration: *AC / NIST*

Use this button to determine the calibration regulation applicable to the calibration.

15.3 Flow Rate for Measurements

The flow rate for measurements has been specified as 25 ml/min.

15.4 *Trigger*

The sensor signal must fall below the trigger value so that the registered particle can be taken into consideration.

15.4.1 Allocation of Particle Size / Threshold Value

The threshold value for the respective particle size, flow rate, pressure mode, and type of calibration. The channels have been allocated the following values:

Channel	1	2	3	4	5	6	7	8
ISO 11171 in µm(c)	4	6	10	14	21	25	38	70
ISO 4402 in µm (not calibrated)	2	5	10	15	20	25	50	100

16 Charging the Storage Cell

The LasPaC I is equipped with an intelligent charging system. To charge the storage cell, perform the following steps:

1. The device must have been OFF for at least 5 seconds and must not be connected to the general power supply (pull out the power plug).
2. Now connect the device to the power supply via the power cable.
3. The charging process starts automatically.
4. Charging time for a full charge is approximately 3 hours. Charging time for a partial charge is proportionately shorter.
5. The microprocessor-controlled charging system stops the charging process automatically as soon as the full capacity of the storage cell is reached.

Please note: The fan included in the LasPaC I is always running as long as the unit is connected to the power supply, both power system operation and charging operation.

17 Software

The software and drivers for the USB connection are on the enclosed CD.
Minimum system requirements: Windows 98$^®$ and Excel 2000$^®$
To load the USB drivers, the CD must be inserted when first connecting the LasPaC to the PC. Let the computer automatically search for the driver on the CD.

17.1 Installation

You can start the installation with "LasPaCI_Comport.exe" in the folder
„X:\Software - Software\LasPaC1\Stauff" on the cd. This installation needs to write a file into your Windows folder. After this is done you need to copy the folder STAUFF from the CD on your harddisk. Administrator rights are required for the installation.

17.2 Open Reportmanager

a   Connect the LasPaC I to your PC with the USB interface cable that came with it.
b   Switch on the LasPaC I.
c   Press *ESC* on the touchscreen or on the LasPaC I keypad. The display now shows the main screen. The Excel$^®$ macros can only run correctly when the LasPaC I displays the main screen.
d   Before starting the evaluation make sure that no other Excel files are open.
e   Open LasPaC_Report_LasPaC_2_x.xls on your computer. Depending on your PC's security settings, you may have to confirm activation of Excel$^®$ macros. If you refuse, the evaluation cannot start.
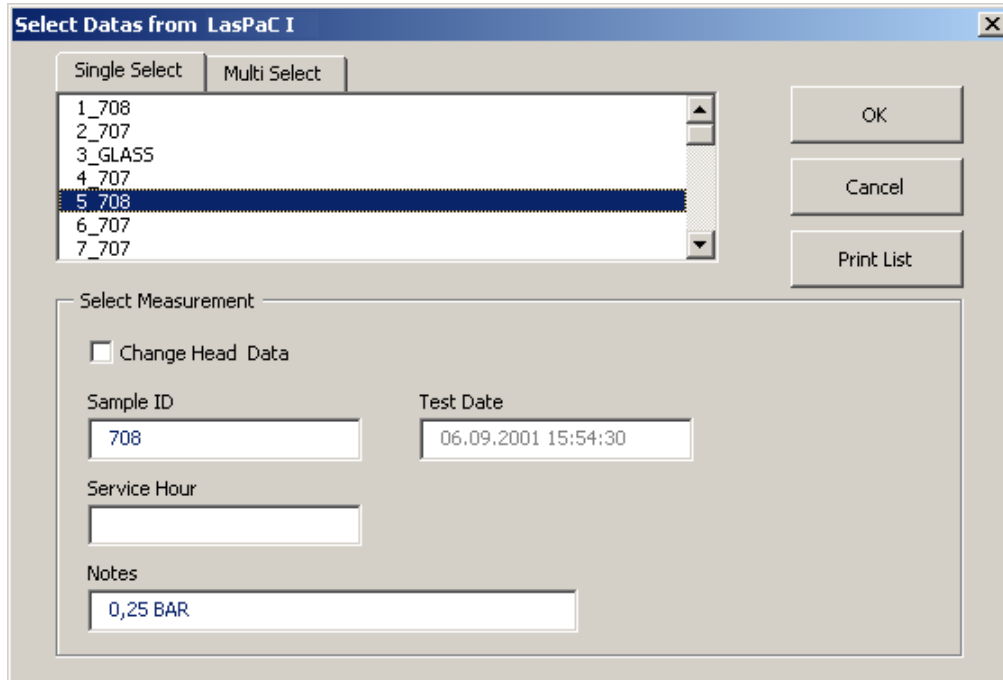
17.2.1 Reportmanager in brief

Figure 21: Mainscreen Reportmanager

Read Data from LasPaC	Reads the data from the LasPaC and transfers selected records to the current report.
Delete Data on LasPaC	Deletes the LasPaC's memory.
Write Data as Text File	Writes the data on the LasPaC to the hard drive as a text file.
Read Data from Text File	Reads the data from the LasPaC from a text file and transfers selected records to the current report.
Com Port: x	Sets the Com port connected to the LasPaC.
New Report	Deletes all report data and begins a new report.
Report Path	Sets the standard path for storing report data.
Report Name	Sets the report name.
Open Report	Opens an existing report.
Save Report	Saves the current report.
Show Report	Displays the current report.
No. of Reports	The number of records in the current report.
Max ISO 4406 Code	The maximum permissible ISO classes in the installation. Entered in the trend.

17.2.1.1 Select loaded data
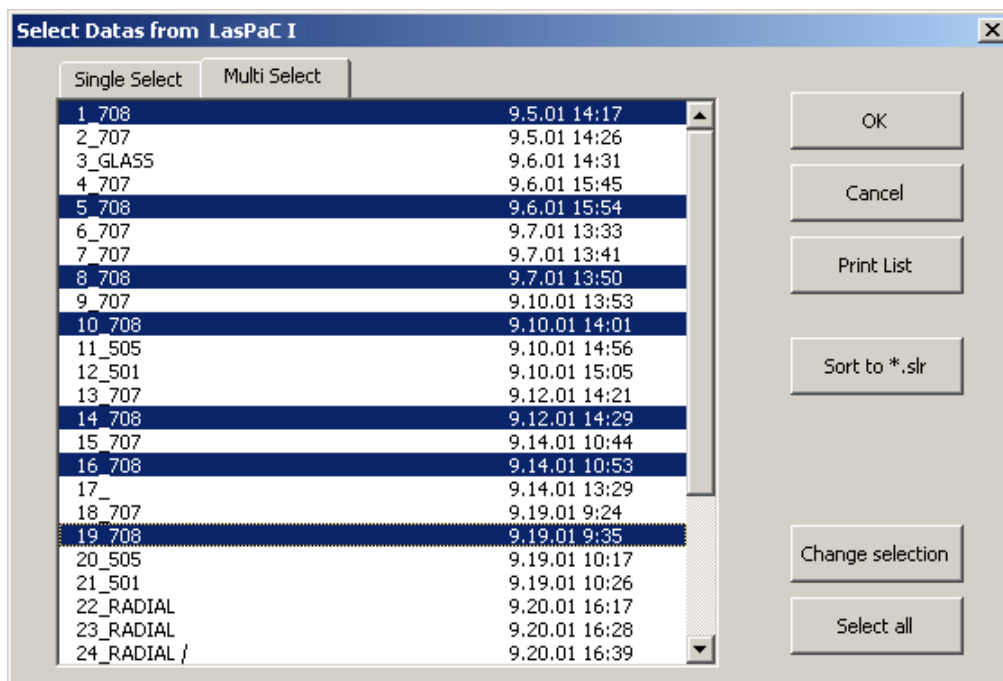
Figure 22: Single Select

Once a record has been selected, its header data can be viewed and changed by activating the "Change Head Data" field.

The selected record is transferred to the current report.

Figure 23: Multi Select

The "Multi Select" tab allows you to append several records to the current report.
For easier identification all measurement data are numbered sequentially followed by an underscore.
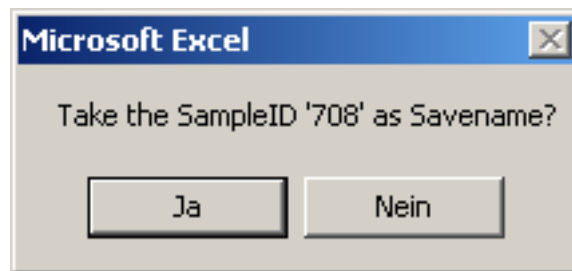
Figure 24: ID as Safename

When the first record of a report is read you are asked if you want to save the report under the ID in the box (here 708).

The following dialog appears if the sample ID of the record being transferred is not the same as the first record in the report:
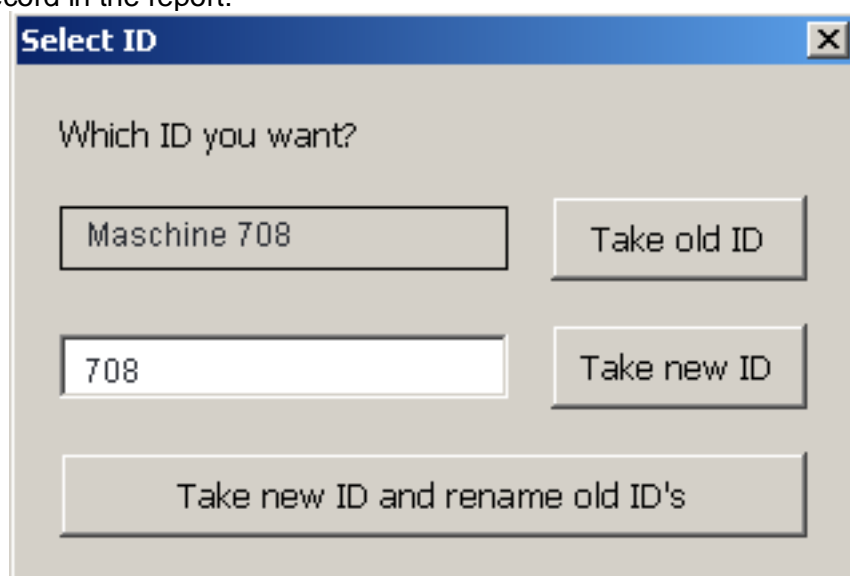
Figure 25: Select ID

Take old ID	Takes the sample ID of the first record for the record being transferred.
Take new ID	The sample ID of the record being transferred is taken for this record. The text can be changed.
Take new ID and rename old IDs	Takes the sample ID as the text shown in the white field for the record being transferred and renames all existing sample IDs in the report with it.

17.2.1.2 Report Navigator for displayed report
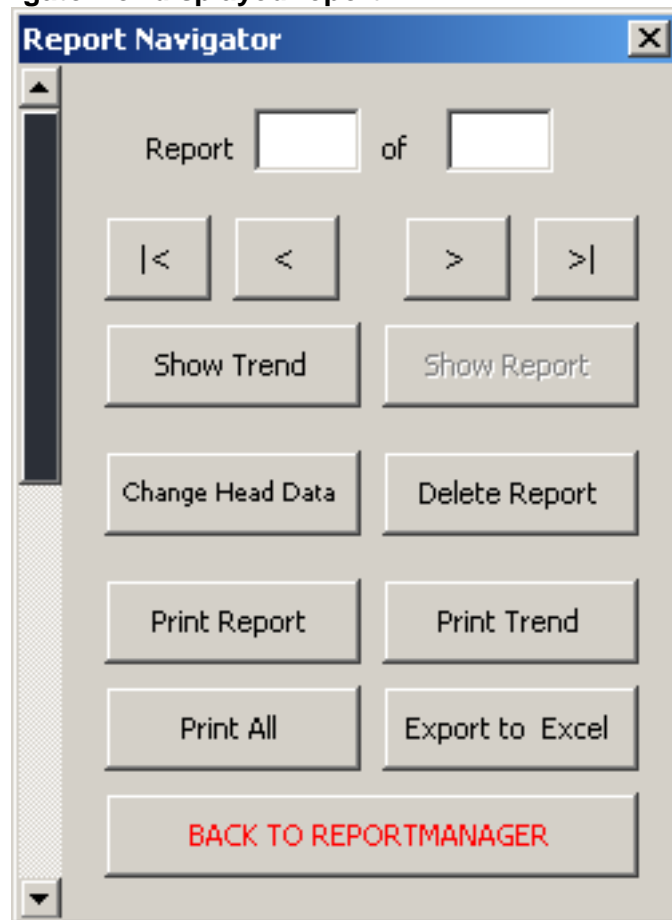
Figure 26: Navigator

|<	Displays the first record.
<	Displays the previous record.
>	Displays the next record.
>|	Displays the last record.
Show Trend	Shows the trend.
Show Report	Displays the current record.
Change Head Data	Opens the dialog to change the header data of the displayed record.
Delete Report	Deletes the current record.
Print Report	Prints the displayed record on the standard printer.
Print Trend	Prints the trend on the standard printer.
Print All	Print the trend and all records on the standard printer.
Export to Excel	Saves the records and the trend as an Excel file.
Back to Reportmanager	Returns to Reportmanager.
Scrollbars	Scrolls down/up the displayed record/trend.

Buttons with grey text are inactive.

®STAUFF

17.3 Analysis Example

17.3.1 Single Value Analysis

STAUFF®

LasPaC I Report

according to ISO 11171

Sample ID / No.	: TESTSTAND 1 No. 20
Service Hour	: 254
Oil Temperature	: 30°C
Notes	: CHECK
Test Date	: **26. Apr 2001 11:56**
Report Date	: 27. Apr 2001
Profile Name	: Std. High Press.

Meas. Volume	: 10 ml
Analysis Volume	: 1 ml

ISO4402	: 14 / 12 / 8	(Calibr. ISO 11 171: 1999)
AS4059	: 5 A-F	(Calibr. ISO 11 171: 1999)
	5A/4B/2C/4D/4E/5F	

Analysis Cumulative

Particle Size	Particle / ml
> 4.0 µm (c)	155,3
> 6.0 µm (c)	25,6
> 10.0 µm (c)	4,9
> 14.0 µm (c)	2,1
> 21.0 µm (c)	1,1
> 25.0 µm (c)	0,5
> 38.0 µm (c)	0,2
> 70.0 µm (c)	0,1
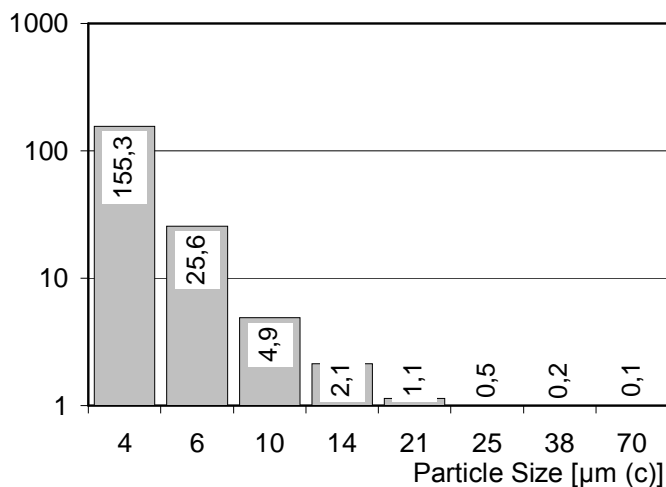
Analysis differential

Particle Size	Particle / ml
4.0 ... 6.0 µm (c)	129,8
6.0 ... 10.0 µm (c)	20,7
10.0 ... 14.0 µm (c)	2,8
14.0 ... 21.0 µm (c)	1,0
21.0 ... 25.0 µm (c)	0,6
25.0 ... 38.0 µm (c)	0,4
38.0 ... 70.0 µm (c)	0,1
> 70.0 µm (c)	0,1
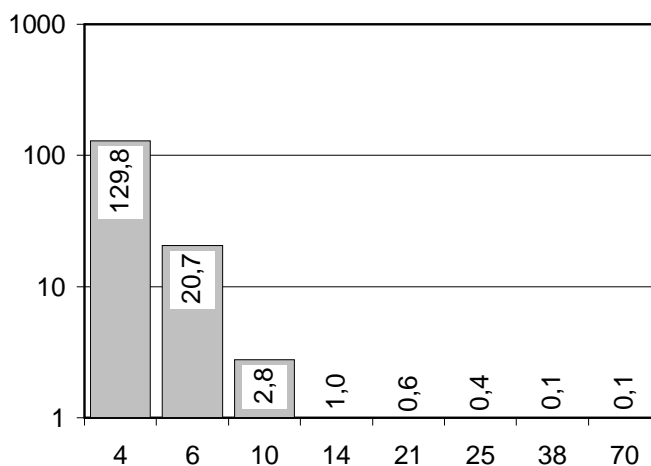
17.3.2 Trend Analysis

STAUFF®   **LasPaC I Report**
according to ISO 11171   27.04.2002

Sample ID: : **TESTSTAND 1**
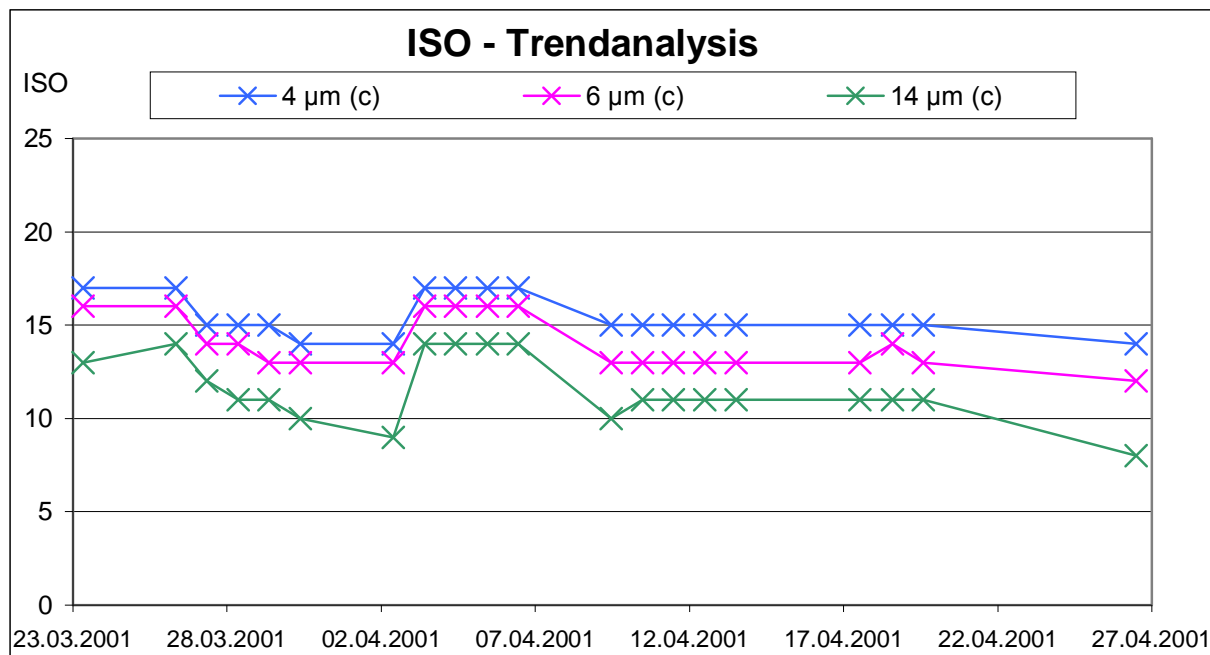
Measurements:
ISO-Classes

Date:	4 µm (c)	6 µm (c)	14 µm (c)	Notes
23.03.2001	17	16	13	CHECK
26.03.2001	17	16	14	CHECK
27.03.2001	15	14	12	CHECK
28.03.2001	15	14	11	CHECK
29.03.2001	15	13	11	CHECK
30.03.2001	14	13	10	CHECK
02.04.2001	14	13	9	CHECK
03.04.2001	17	16	14	CHECK
04.04.2001	17	16	14	CHECK
05.04.2001	17	16	14	CHECK
06.04.2001	17	16	14	CHECK
09.04.2001	15	13	10	CHECK
10.04.2001	15	13	11	CHECK
11.04.2001	15	13	11	CHECK
12.04.2001	15	13	11	CHECK
13.04.2001	15	13	11	CHECK
17.04.2001	15	13	11	CHECK
18.04.2001	15	14	11	CHECK
19.04.2001	15	13	11	CHECK
26.04.2001	14	12	8	CHECK

18 Serial Communication

The measuring results can be imported into the PC or any notebook, using the serial interface. The control functions are provided by the download software. Any further processing and storing of the data is done with the help of special macros in Microsoft Excel®.

18.1 Interface Setting

The LasPaC I is equipped with a RS232 (serial interface) the offers a transmission rate of 57600 bps at 8 data bits, "no parity", "one stop bit", and "no handshake". For communicating with the PC, a suitable serial interface cable (1 to1) is used. Commands are entered, in the form of upper-case or lower-case letters, as ASCII strings. The LasPaC I responds with a respective text and/or exclamation mark. In the case of an unknown command or a time-out, the response is a question marks or an individual letter.

The following commands can be used for downloading the stored measurements:

18.2 Interface Commands

DL M<Enter>

The LasPaC I sends an ASCII string with the comments on the measurement, the used measuring profile name, date and time of the measurement, as well as the particles measured for each individual measurement, separated by tabs.

DL P<Enter>

The LasPaC I sends all existing measuring profiles and their settings in the form of an ASCII string.

ME<Enter>

"Memory Erase" deletes all of the stored measurements.

19 Breaks in the Measuring Operation

If you do not plan on performing any measurements for some time, clean the system and rinse out all of the residue.

Fill the system with a liquid that is miscible with the sample fluid. For oils, for instance, the liquid could be non-resinifying hydraulic oil or petroleum benzene.

Note: Liquids are miscible if mixing does not result in any stria.

19.1 Shipping the Device

Warning! Remove all flammable liquids from your device by flushing before you ship it anywhere.

The device must be free of any contamination, for instance, caused by radioactivity, bacteria, or toxic substances if you send it to us for servicing!

Seal the test connections by screwing on the associated covers.

Attention! Discharge the batteries of the storage cells to prevent any self-discharging. Wait with recharging it until you intend to perform the next measurement.

20 Changing the Printing Paper

Figure 27: Inserting the printing paper
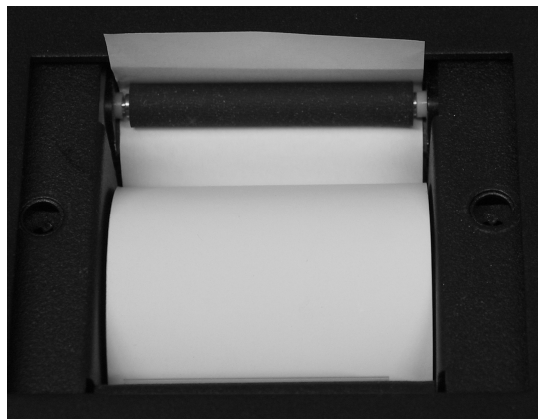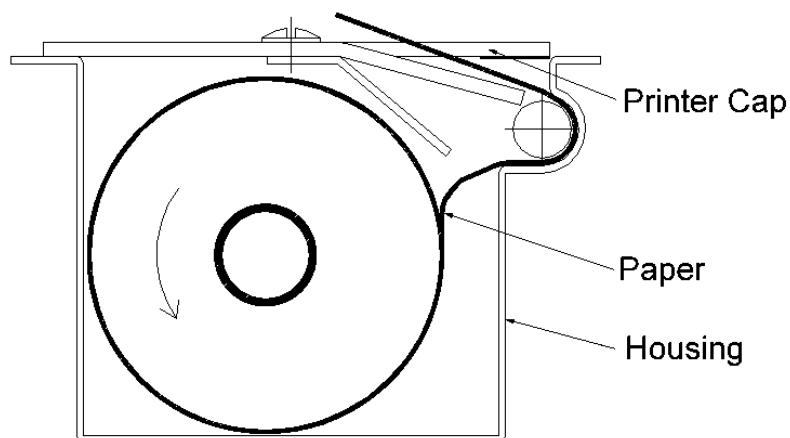

Figure 28: Properly inserted printing paper

Figure 29: Sectional view of printer with paper

Loosen both of the screws on top of the printer and remove the cover. Position and hold the leading end of the new paper roll underneath the rubber cylinder in such a way that the paper is pulled in automatically. The paper must not be folded. After that, attach the cover again using both of the screws. The paper does not need to be cut. You can separate it from the roll by pulling it towards you and somewhat to the side.

21 Appendix

21.1 Technical Data

Microprocessor-controlled 8-channel particle counter for monitoring the contamination in hydraulic fluids based on mineral oil.

The particle counter is equipped with a laser sensor. The orifice of the sensor has a cross-section of 500 x 500 µm. The maximum concentration is 24,000 particles/ml at a flow rate of 25 ml/min (ISO 4406, Code 23).

21.1.1 Calibration

The sensor has been calibrated in accordance with the following standards:

Calibration ISO 11171 (1999):

4 ... 70 µm(c) (applies to ISO 4406: 1999 and AS 4059)

Calibration ISO 4402 (1991): only equip, not calibrated!

1 ... 100 µm (applies to ISO 4406: 1987 and NAS 1638)

Channel	1	2	3	4	5	6	7	8
ISO 11171 in µm(c)	4	6	10	14	21	25	38	70
ISO 4402 in µm	2	5	10	15	20	25	50	100

21.1.2 Compatible Fluids

Resistant to mineral oils (other fluids upon request, e.g. skydrol)

21.1.3 Pressure and Viscosity Ranges

High pressure 5 bar (73 psi)... 420 bar (6092 psi)
            viscosity up to 300 mm²/sec
Low pressure 0 ... 6 bar (87 psi)
            viscosity up to 160 mm²/sec

Attention: Internal leakage oil will automatically cause that oil is being transported from PORT I (high pressure entry) to PORT II (low pressure entry). If the low pressure inlet is closed, a too high pressure will be built up. The device will then be destroyed inside. In order to avoid this, it is essential to connect PORT II first, and then PORT no. I. It must be avoided to have a pressure exceeding 6 bar (87 psi) at PORT II.

Admissible operating overpressure of the testing hoses:

up to 0°C (32°F)	463 bar (6715 psi)
up to 30°C (86°F)	418 bar (6063 psi)
up to 50°C (122°F)	380 bar (5511 psi)
up to 80°C (176°F)	327 bar (4743 psi)

Admissible operating overpressure for the clear hose: 10 bar (145 psi)

21.1.4 Voltage Supply

Line-operated: voltage range within 110 VAC ... 240 VAC
or 10 VDC ... 36 VDC
Storage-cell-operated: High-pressure operation approx. 11 measurements
Low-pressure operation approx. 9 measurements
(approx. 2.5 hrs)
Power supply and charging unit integrated in the device

21.1.5 Operating Conditions

Fluid temperature: 0 ... 90°C (194°F)
Ambient temperature: 0 ... 40°C (104°F)
Relative humidity:
Operation: 20% ... 85%, non-condensing
Storage: ... 95%

21.1.6 Data Output

Cumulative particle counts and purity classes in accordance with ISO 4406 and AS 4059, via screen, integrated printer and/or data memory

21.1.7 Integrated Data Memory

700 individual measurements

21.1.8 Download Software

For downloading and storing the data in ASCII format, as well as for analysis and further processing in MV Excel®

21.1.9 Dimensions (W x H x D) in mm

Particle counter	360 x 420 x 145	14.2" x 16.5" x 5.7"
Case	410 x 700 x 200	16.1" x 27.6" x 7.9"

21.1.10 Weights

Particle counter: 8.5 kg (18.7 lb)
Particle counter with case and accessories: 18 kg (39.6 lb)

21.2 Hydraulics Plan
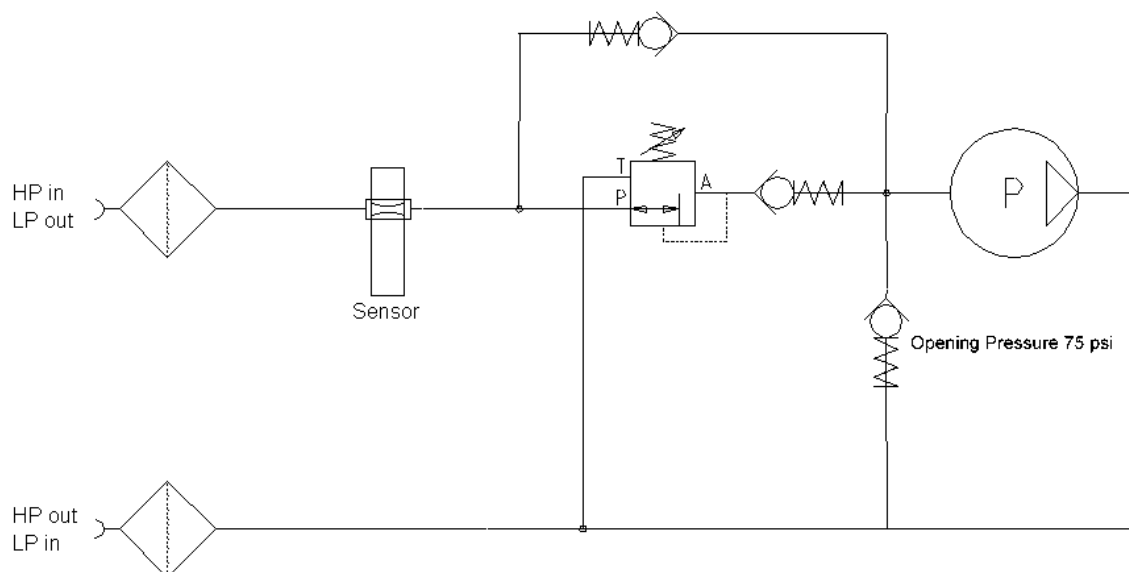
Figure 30: Hydraulics plan

21.3 Glossary

(Individual) measurement	number of measured particles for the sampling volume selected in the "Profile Flow Chart"
AC	Corresponds to ISO 4402/1977 and ISO 4406/1987
Admin	Administrator
Admin setup	Administrator Setup
Button	Knopf / Taste
C	Clear
Calibration	data apply only to a specific device
ISO 11171	Standard on the calibration of particle counters as of 1999
ISO 4402	Standard on the calibration of particle counters as of 1991
Mem.	Memory
Measuring profile	containing all parameters set of a particular measurement
NAS	Corresponds to ISO 4402/1977 and NAS 1638
Nist	Corresponds to ISO 11171/1999 and ISO 4406/1999
profiles	settings for measurement

22 List of Illustrations

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