Anton Paar

Measure,
what is measurable,
and make measurable
that which is not.

Galileo Galilei (1564–1642)

Instruction Manual

DSA 5000 M

Firmware Version: V2.20

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Contents

1 About the Instruction Manual

This instruction manual informs you about the installation and the safe handling and use of the product. Pay special attention to the safety instructions and warnings in the manual and on the product.

The instruction manual is a part of the product. Keep this instruction manual for the complete working life of the product and make sure it is easily accessible to all people involved with the product. If you receive any additions or revisions to this instruction manual from Anton Paar GmbH, these must be treated as part of the instruction manual.

Conventions for safety messages

The following conventions for safety messages are used in this instruction manual:

DANGER
Danger indicates a hazardous situation which, if not avoided, will result in death or serious injury.

WARNING
Warning indicates a hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION
Caution indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE
Notice indicates a situation which, if not avoided, could result in damage to property.

TIP *Tip gives extra information about the situation at hand.*

Typographical conventions

The following typographical conventions are used in this instruction manual:

Convention	Description
<key>	The names of keys and buttons are written inside angle brackets.
"Menu Level 1 > Menu Level 2"	Menu paths are written in bold, inside straight quotation marks. The menu levels are connected using a closing angle bracket.

2 Safety Instructions

Liability

- Read the instruction manual at hand before using DSA 5000 M.
- Make sure that this instruction manual is easily accessible to all personnel involved with the instrument.
- Follow all hints and instructions contained in this instruction manual to ensure the correct use and safe functioning of DSA 5000 M.
- The instruction manual at hand does not claim to address all safety issues associated with the use of the instrument and samples. It is your responsibility to establish health and safety practices and determine the applicability of regulatory limitations.
- Anton Paar GmbH only warrants the proper functioning of DSA 5000 M if no adjustments have been made to the mechanics, electronics, and firmware.
- Only use DSA 5000 M for the purpose described in this instruction manual. Anton Paar GmbH is not liable for damages caused by incorrect use of DSA 5000 M.
- The results delivered by DSA 5000 M not only depend on the correct functioning of the instrument, but also on various other factors. We therefore recommend you have the results checked (e.g. plausibility tested) by skilled personnel before consequential actions are taken based on the results.

Installation and use

- DSA 5000 M is **not** an explosion-proof instrument and therefore must not be operated in areas with risk of explosion.
- The installation procedure shall only be carried out by authorized personnel who are familiar with the installation instructions.

- Do not use any accessories or wearing parts other than those supplied or approved by Anton Paar GmbH.
- Make sure all operators are trained to use the instrument safely and correctly before starting any applicable operations.
- In case of damage or malfunction, do not continue operating DSA 5000 M. Do not operate the instrument under conditions which could result in damage to goods and/or injuries and loss of life.
- If liquid was spilled over the instrument, disconnect the instrument from the mains. Clean and dry the housing of the instrument. If you have a suspicion that liquid got into the instrument, have the instrument cleaned and checked for electrical safety by a service technician.
- Ensure that spilled liquids can not get into plug connections or venting slots of electrical equipment.

Moving the instrument

- Make sure that all hoses and the measuring cell are empty before you move or lift DSA 5000 M.
- To move or lift DSA 5000 M, place one hand at the back and grip the ledge at the top. Place the other hand at the front, under the display. There is a hollow for your fingers.
- When carrying the system, keep it close to your body.

Handling of chemicals

- Observe all safety regulations regarding the handling of the samples, cleaning, rinsing and waste liquids (e.g. use of safety glasses, gloves, respiratory protection, exhaustion, etc.).
- Check the chemical resistance of all materials (see Appendix A.3) which come into contact with the sample or cleaning liquid before starting the measurement.
- Make sure that different liquids (samples and cleaning liquids) or gases that come into contact with each other are chemically compatible. They should not react exothermally or produce any solid particles that might stick to the inner wall of the measuring cell.
- Prior to starting a measurement or cleaning procedure, make sure that all parts that come into contact with fluids, especially the measuring cell, the injection adapters, hoses and waste container, are properly connected and in good condition.
- Prior to starting a measurement or cleaning procedure, check the injection adapters for leak tightness (see Chapter 7.2).

Special precautions for flammable chemicals

- Observe and adhere to your national safety regulations for handling the measured samples (e.g. use of safety goggles, gloves, respiratory protection etc.).
- Keep any sources of ignition, like sparks and open flames, at a safe distance from DSA 5000 M.
- Place DSA 5000 M on a laboratory bench with a non-flammable surface, preferably made of bricks, ceramics or stoneware.
- Only store the minimum required amount of sample, cleaning agents and other flammable materials near DSA 5000 M.
- Do not spill sample/cleaning agents or leave their containers uncovered. Immediately remove spilled sample/cleaning agents.
- Make sure that the setup location is sufficiently ventilated. The environment of DSA 5000 M must be kept free of flammable gases and vapors.
- Connect DSA 5000 M to the mains via a safety switch located at a safe distance from the instrument. In an emergency, turn off the power using this switch instead of the power switch on DSA 5000 M.
- Supply a fire extinguisher.
- Ensure the sufficient supervision of DSA 5000 M during operation.

Service and repairs

- Service and repair procedures may only be carried out by authorized personnel or by Anton Paar GmbH.
- Prior to sending DSA 5000 M to your representative or Anton Paar GmbH for repair or service, make sure that all liquids and solvents are completely drained out of the instrument.

Disposal

- Concerning the disposal of DSA 5000 M, observe the legal requirements in your country.

Safety instructions for operation

CAUTION

Harmful liquids leaking from the instrument may cause injuries if the following hint is not adhered to.

- Only operate DSA 5000 M in the pressure range from 0 to 3 bar (0 to 44 psi) relative pressure.
- When using a syringe, do not apply a force higher than 35 N. If you feel a noticeable resistance, a measuring cell or hose may be blocked.

NOTICE

Only operate DSA 5000 M in the temperature range from 0 to 70 °C (32 to 158 °F).

3 The Measuring Principle

DSA 5000 M simultaneously determines two physically independent properties within one sample. The two-in-one instrument is equipped with a density cell and a sound velocity cell thus combining the proven Anton Paar oscillating U-tube method with a highly accurate measurement of sound velocity. Both cells are temperature-controlled by a built-in Peltier thermostat. Density and sound velocity, and their derived values are used as input for various concentration calculation models that are integrated in DSA 5000 M.

Definition of density and specific gravity

The density ρ of a sample is defined as mass divided by volume:

$$\rho = \frac{m}{V}$$

The specific gravity SG is calculated by dividing the density of a sample by the density of pure water at 20 °C:

$$SG = \frac{\rho_{Sample}}{\rho_{Water}}$$

Density and Specific Gravity values are highly temperature-dependent.

The oscillating U-tube method

The sample is introduced into a U-shaped borosilicate glass tube that is being excited to vibrate at its characteristic frequency electronically. The characteristic frequency changes depending on the density of the sample. Through a precise determination of the characteristic frequency and a mathematical conversion, the density of the sample can be measured.

The density is calculated from the quotient of the period of oscillations of the U-tube and the reference oscillator:

$$\text{density} = KA \times Q^2 \times f_1 - KB \times f_2$$

KA, KB ...	Apparatus constants
Q	Quotient of the period of oscillation of the U-tube divided by the period of oscillation of the reference oscillator
f_1, f_2	Correction terms for temperature, viscosity and nonlinearity

The sound velocity analysis

The sample is introduced into the sound velocity measuring cell that is bordered by an ultrasonic transmitter on the one side, by a receiver on the other side. The transmitter sends sound waves of a known period through the sample. The velocity of sound can be calculated by determining of the period of received sound waves and by considering the distance between the transmitter and receiver.

$$v = \frac{\text{original length} \times (1 + 1.6\text{E-}5 \times \Delta\text{temp})}{\frac{P_S}{\text{divisor}} - TAU \times f_3}$$

original length ...	Original path length of the sound waves (factory default = 5000 µm)
Δtemp	Temperature deviation to 20°C
P_S	Oscillation period of the received sound waves
divisor	512
TAU	Apparatus constant for sound velocity
f_3	Correction term for temperature

Due to the high temperature dependency of the density and velocity of sound values, the measuring cells have to be thermostated precisely.

Concentration measurement based on density and sound velocity values

In binary mixtures, the density of the mixture is a function of its composition. Thus, by using density/concentration tables, the density value of a binary mixture can be used to calculate its composition. This is also possible with so-called quasi binary mixtures. These are mixtures containing two major components and some additional components which are present in very small concentrations compared to the two main components. Many decarbonated soft drinks, for example, can be considered to be quasi binary solutions of sugar in water because the concentration of flavors and acids are very small compared to sugar and water. Thus, the sugar concentration can be measured by determination of density only.

By using both input parameters - density and sound velocity - for concentration determination of binary mixtures, the margin of error is even reduced. By combining the density and velocity of sound measurements additionally the concentrations of certain ternary solutions as well as pure sulfuric acid and oleum in the range of 0 to 100 % H_2SO_4 and 0 to 65 % SO_3 can be measured.

4 DSA 5000 M - An Overview

The DSA 5000 M lab instrument is a density and sound velocity meter developed to combine highest precision with easy operation and robust design.

The sample to be measured is usually filled manually by syringe. Certain semiautomatic/automatic sample filling systems are available on request.

Features and Benefits

Accuracy

Your DSA 5000 M instrument is equipped with the world's most advanced digital density and sound velocity measurement technology:

- The period of oscillation of the U-tube is measured by optical pickups.
- Two integrated Pt 100 platinum thermometers together with Peltier elements provide an extremely precise thermostatting of the sample.
- ThermoBalance™: An additional reference oscillator provides long-term stability and enables precise measurements over the whole temperature range of the instrument with only one adjustment at 20 °C.
- Viscosity-related errors are automatically corrected over the full viscosity range by measuring the damping effect of the viscous sample followed by a mathematical correction of the density value.
- In DSA 5000 M, special adjustments with standards of high viscosity and high density lead to an enhanced precision for samples with high viscosity and high density.
- Based on an additional measuring cell made of stainless steel and high resolution electronics, the velocity of sound of the filled in sample can be determined accurately.

Error detection

A major source of measuring errors when using a density and sound velocity meter are gas bubbles in the filling of the measuring cells. This issue was addressed by Anton Paar with two new features:

- FillingCheck™: The instrument automatically detects inhomogeneities and gas bubbles in the whole density measuring cell by an advanced analysis of its oscillation pattern and generates a warning message in real time for any single measurement.
- U-View™: You can visually inspect the density measuring cell using a real-time camera with zoom function.

User interface

The touch screen user interface supports easy and intuitive operation in routine applications as well as in sophisticated scientific research work:

- For the most common applications, 5 measuring methods are predefined. Just select the method fitting your application or create your own methods.
- The measured density and/or sound velocity values are automatically converted into concentration values for a large number of factory-programmed substances. You can also program special substances as required.
- Under harsh industrial conditions, operate DSA 5000 M with the set of robust softkeys instead of the touch screen.
- You can operate DSA 5000 M via external keyboard, computer mouse or bar code reader.
- You can connect an external terminal or touch screen (VGA interface).

Data management and safety

DSA 5000 M offers up-to-date data management and safety features to make your work easier and help you comply with your quality management regulations:

- Print out reports.
- Export your data in the format of your choice (MS Excel, text or PDF).
- Choose between the interfaces: 4 x USB, Ethernet, RS-232, 2 x S-BUS and CAN BUS.
- Use the powerful audit trail function with tamper-proof data export (checksum).
- Rely on full compliance with GLP/GMP and 21 CFR part 11.

Compact and robust design

The tradition of the legendary previous DSA generations is continued in the M series:

- Compact design

- Sealed housing
- Robust housing materials: coated aluminum (top and sides), aluminum (base and back) and Polystyrene/Butadiene (front).

5 Checking the Supplied Parts

DSA 5000 M was tested and packed carefully before shipment. However, damage may occur during transport.

1. Keep the packaging material (box, foam piece, transport protection) for possible returns and further questions from the transport and insurance company.
2. Check the delivery for completion by comparing the supplied parts to those noted in Table 5.1.
3. If a part is missing, contact your Anton Paar representative.
4. If a part is damaged, contact the transport company and your Anton Paar representative.

Table 5.1: Standard parts

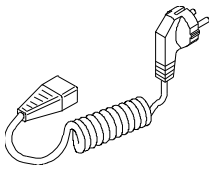
Symbol	Pcs.	Article Description	Mat. No.
	1	DSA 5000 M	45497
	1	Power cord Europe USA UK Thailand	 65146 52656 61865 79730
	1	Instruction manual English German	 89560 89559
	1	Density standard "ultra-pure water" 5x10 mL with certificate	96044

Table 5.1: Standard parts

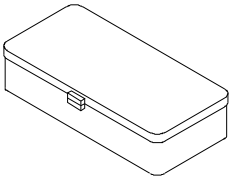
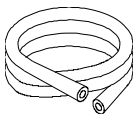
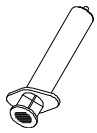
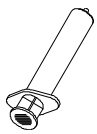
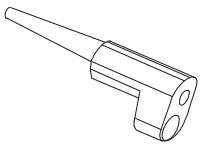
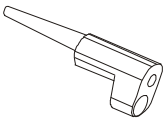
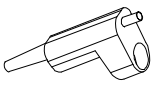
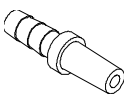
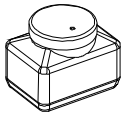
Symbol	Pcs.	Article Description	Mat. No.
	1	Accessory kit DSA 5000 M containing:	3176
	0.5 m	Hose 3 x 5 mm silicone (transparent)	50814
	4 m	Hose 3 x 5 mm Viton (black)	54629
	5	Syringe 5 mL Luer	63130
	1	Hamilton glass syringe	70339
	1	Injection adapter Luer	12225
	1	Injection adapter DSA	12211
	1	Injection adapter fitting DSA	12213
	2	Male Luer plug PTFE	63865
	2	Adapter Luer cone	63863
	1	Waste vessel	6210

Table 5.1: Standard parts

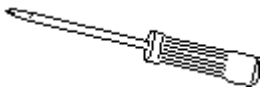
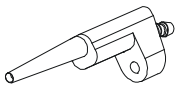
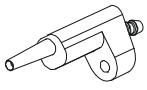
Symbol	Pcs.	Article Description	Mat. No.
	1	Screwdriver	75030

Table 5.2: Optional parts

Article Description	Mat. No.
Data handling	
Keyboard German USB	80809
Keyboard USA USB	80807
Printer RS-232C incl. cable 9600N81	44737
Printer Epson TM-U220D for DMA M	93362
RS-232 connection cable 9 pin 3 m	70429
Gender changer DB9M/DB9M	302592
Automatization	
Sample filling unit Xsample 22	81340
Protection	
Protecting cover for keyboard	13350
Protection foils for touch screen (3 pcs.)	81402
Protective cover front (3 pcs.)	88856
Protection cap for USB interfaces	81168
Special application accessories	
Cooling kit DMA M	80810
Drying cartridge (with beaded ruby gel)	65085
Filling adapters	
 Injection adapter with olive	23660
 Injection adapter with olive DSA	23661
Syringes	
Syringes 5 mL Luer (100 pcs.)	6772
Syringe 5 mL Luer (5 pcs)	63130
Syringe glass 10 mL Luer	70339
Hoses	
Hose 3 x 5 mm silicone (transparent)	50814
Hose 2 x 4 silicone	51273
Hose 2 x 4 Viton	54628
Hose 3 x 5 mm Viton (black)	54629

6 Functional Components

6.1 View of the Front and Right Side

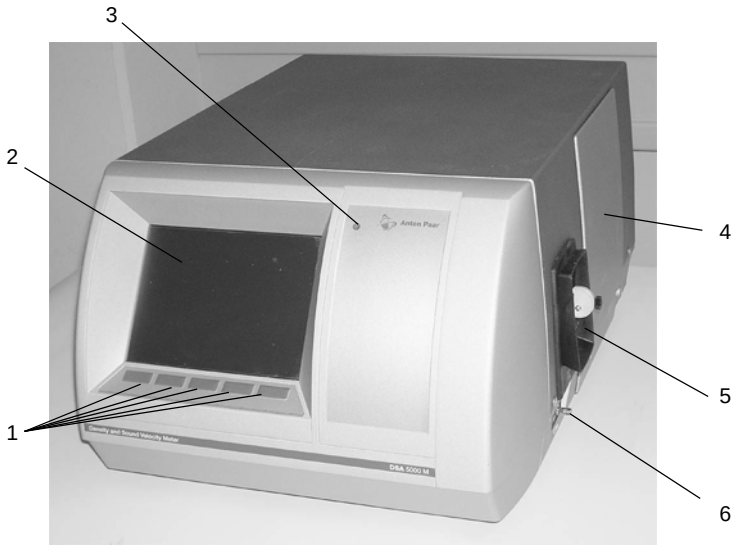


Fig. 6 - 1 View of the front and right side of DSA 5000 M

1 ... Softkeys
2 ... Color TFT touch screen
3 ... Power on LED
4 ... Xsample slot cover plate
5 ... Filling device with sample inlet and outlet
6 ... Air pump outlet

6.2 View of the Left Side

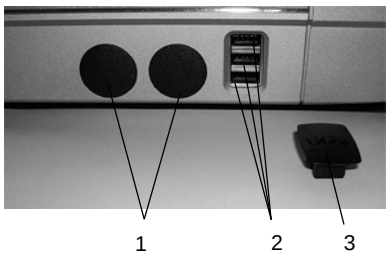


Fig. 6 - 2 View of the left side

1 ... Blind covers for inlet and outlet of the optional cooling kit
2 ... USB interfaces
3 ... Protection cover for the USB interfaces

6.3 Rear View

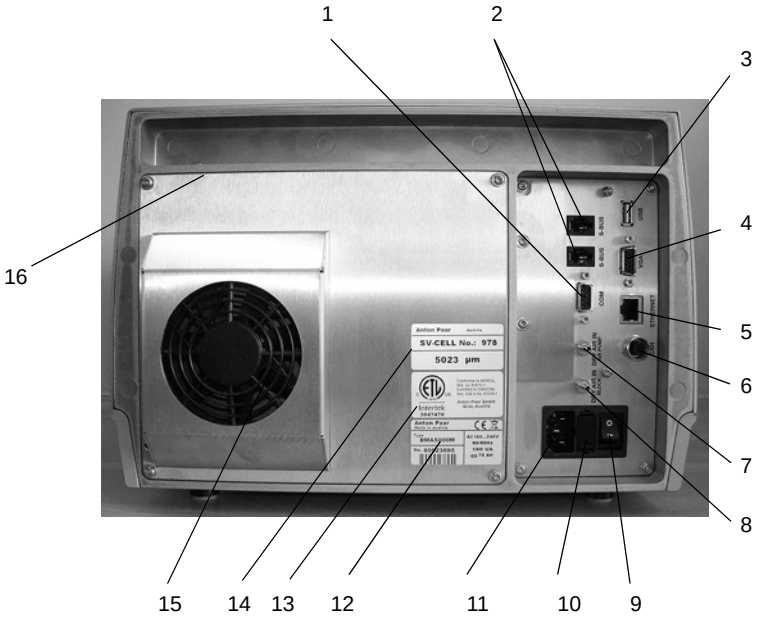


Fig. 6 - 3 Rear view

1 ... RS-232 interface (COM)
2 ... S-BUS interfaces
3 ... USB interface
4 ... VGA interface
5 ... Ethernet interface
6 ... CAN interface
7 ... "DRY AIR IN AIR PUMP" connector
8 ... "DRY AIR IN BLOCK" connector
9 ... Power switch
10 ... Fuse holder
11 ... Power inlet
12 ... Type plate with serial number
13 ... UL test mark
14 ... Sound distance
15 ... Fan
16 ... Carrying ledge

6.4 Operating Elements of the Main Screen

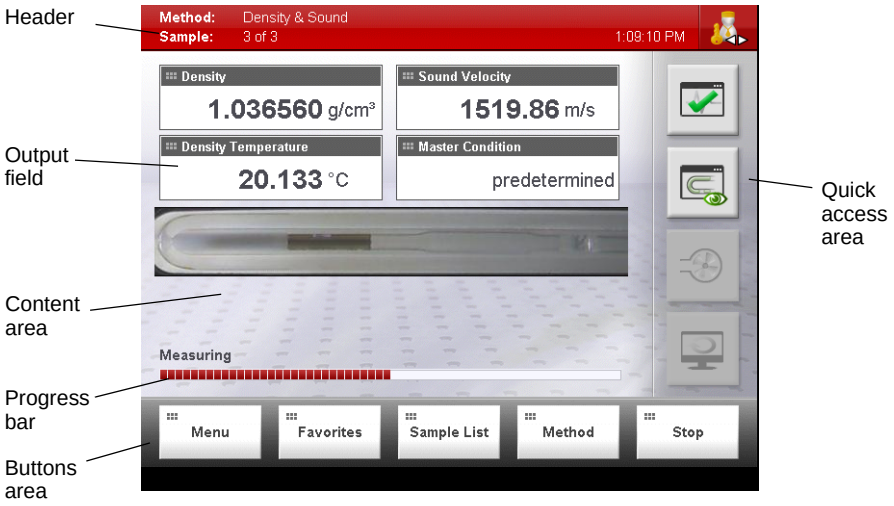


Fig. 6 - 4 Main screen example

Header

In the left part of the header, you find the name of the currently active method and the sample number.

On the right side of the header you find a clock and the user indicator. The user indicator indicates the kind of user that is currently logged on (see Chapter 10.4).

Content area

In the content area, the measuring values are displayed in small, medium or large output fields. The layout of the content area is defined in the settings of the current method and can be adapted according to your needs.

The progress bar at the bottom of the content area indicates whether the instrument is currently measuring or whether a measurement was finished.

Buttons area

The buttons in this area have the following functions:

<Menu>	To open the main menu.
<Favorites>	To open the favorites list.
<Quick Settings>	To open the quick settings list. Only available in the "No Sample List" mode instead of the <Sample List> button.
<Sample List>	To open the current sample list.
<Method>	To open the method list and select a method.
<Start>	To start a measurement.
<Stop>	To stop and abort a measurement.

Quick access buttons

	To open the diagnosis list. The general instrument status as well as all measuring errors that have occurred during the measurements of the currently active sample list are described in this list. The button changes its appearance depending on the current error status: With green check: The general instrument status and the error status of all measured samples of the current sample list are OK. With yellow warning sign: • The instrument (or system) has a minor problem (e.g. an air or water check is overdue, there is a printer problem etc.). • One or more samples of the current sample list had a filling error. With red lightning sign: • The instrument (or system) has a major problem that needs to be fixed before you continue with measurements (e.g. sample changer is blocked). • One or more samples of the current sample list could not be measured (e.g. measuring cell is partly empty so that it can not oscillate). To reset the diagnosis button to the green check, confirm all error messages by tapping on the <X> button on the right side of the message. The diagnosis button will also be reset to the green check symbol if you delete the currently active sample list (see Chapter 13.3).
	U-View™: To open the live camera view of the measuring cell.
 	To start/stop the air pump. The air pump is off. The air pump is on.
 	To unfreeze the screen after a finished measurement. The screen is frozen. The screen is unfrozen.

Monitor mode

If you have not started a measurement yet, or if you have terminated a measurement by tapping <Stop>, the instrument is in the monitor mode and shows a continuous reading of the current measuring values.

Measuring mode

If you have started a measurement, the continuous measuring values are shown until the measurement is finished. The final values are frozen until the next measurement is started. To unfreeze the screen, tap the  button.

6.5 Operating Elements of the Menu Screen

To access the menu, tap <Menu> on the main screen.

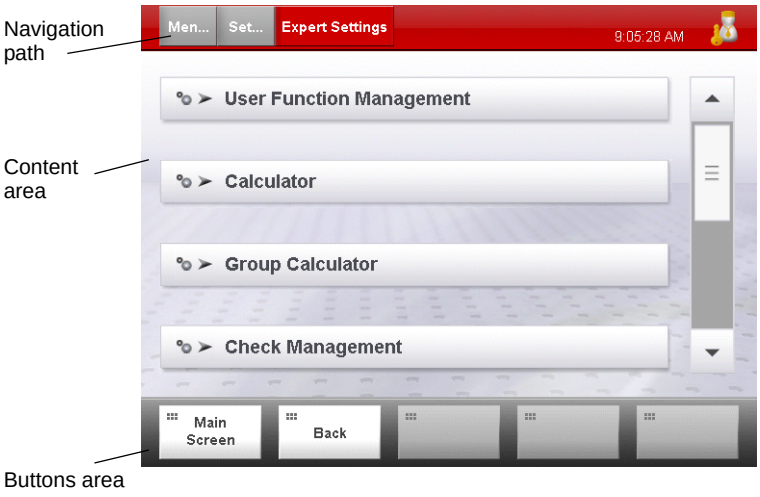


Fig. 6 - 5 Menu screen example

Header

On the left side of the header, you find the navigation path to your current position in the menu. You can go back to any menu position in your current path by directly tapping on the respective box of the navigation path.

Content area

In the content area, you find the menu options of the current menu level and the menu dialogs.

Buttons area

The buttons at the bottom of the screen have different functions depending on the current menu or dialog.

7 Installing the Instrument

To install the instrument, put it on a bench, mount injection adapters and hoses and connect the instrument to the mains. Define general instrument settings and perform an air/water check to check the validity of the factory adjustment.

For the installation of Xsample filling equipment, see the respective instruction manual.

Installation procedure

1. Place the instrument on a bench.
2. Mount the injection adapters.
3. Connect the hoses.
4. Connect the instrument to the mains and switch it on.
5. Define the general settings.
6. Perform an air/water check.

7.1 The Right Place

The installation conditions for DSA 5000 M shall correspond to conditions in a typical laboratory.

WARNING
Using hazardous or flammable chemicals as samples or cleaning liquids could destroy the instrument and cause serious injuries when not taking special precautions into account.

- See the section "Special precautions for flammable chemicals" in Chapter 2 for information about a suitable installation place.

To guarantee temperature stability, do not place DSA 5000 M:

- near a heater
- near an air conditioner
- at a vibrating surface or close to vibrating equipment
- in direct sunlight.

NOTICE

- Ensure that the power plug and the power switch are always easily accessible so that the instrument can easily be disconnected from the mains at any time.
- A strong built-in cooling fan dissipates heat through the bottom and the rear of DSA 5000 M. Ensure that the airflow is not blocked and assure a minimum distance of 10 cm (3.9 inches) to walls behind and besides the instrument.
- High humidity or a measuring temperature that is significantly below the ambient temperature may lead to condensation within the measuring cells. Install a drying cartridge (see Appendix C.1) to avoid condensation.

7.2 Mounting the Injection Adapters

DSA 5000 M uses two adapters and a connection tube for directing the sample flow. The injection adapter DSA leads to the sound velocity measuring cell and serves as sample inlet adapter. The pre-assembled connection tube leads the sample from the sound velocity measuring cell to the density measuring cell. The injection adapter Luer leads the sample from the density measuring cell to the waste (see Fig. 7 - 2).

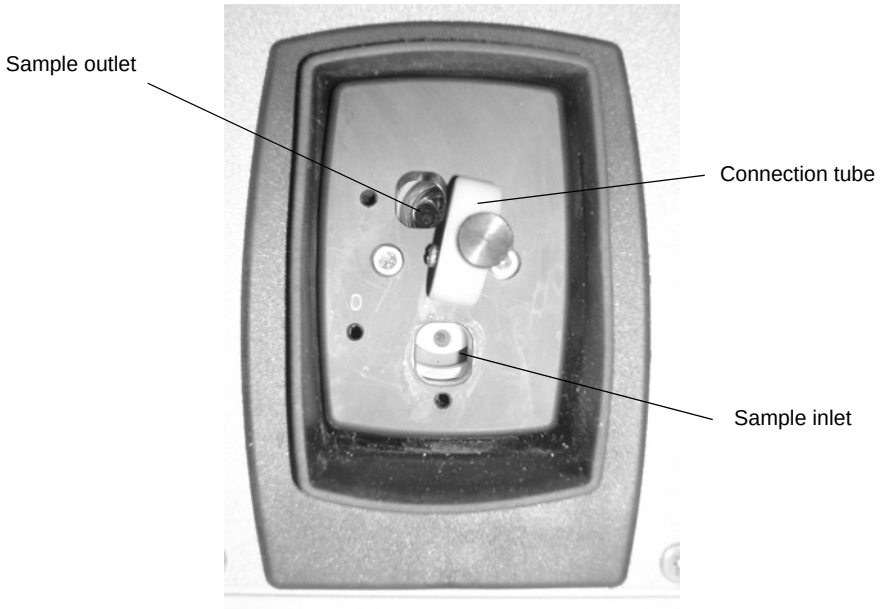


Fig. 7 - 1 Filling device at DSA 5000 M

1. Take the injection adapter DSA and the injection adapter Luer from the accessory box.

2. Pull out the black transport plastic plugs from the tip of the injection adapters.

TIP *Keep the black transport plastic plugs for later. They can be used as an injection adapter tool to widen the tips of the adapters in case of leaks.*

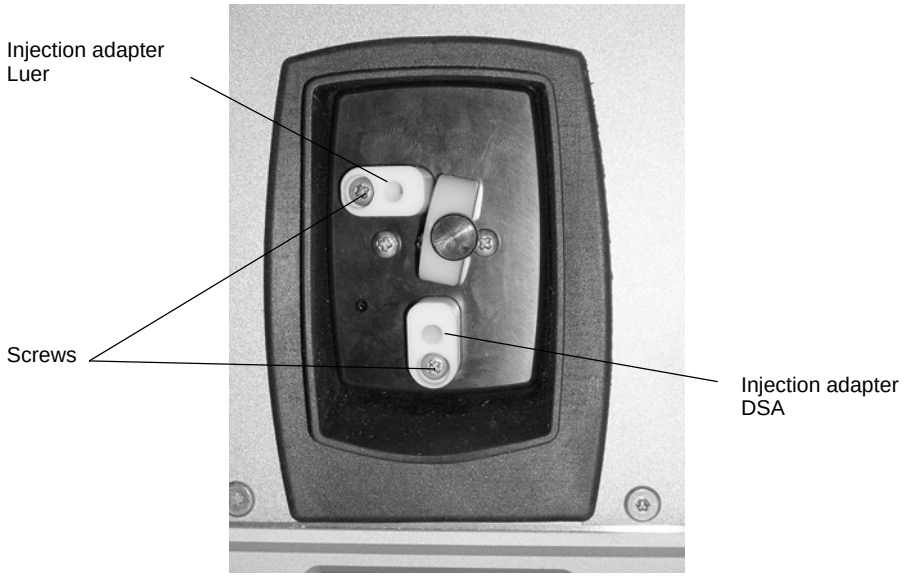


Fig. 7 - 2 Mounted injection adapters

3. Carefully insert the injection adapter DSA into the sample inlet opening of the filling device until the tip of the adapter reaches the opening of the measuring cell (see Fig. 7 - 1).

4. With moderate force, push the adapter towards the measuring cell.

CAUTION

If the screw for fastening the adapter is screwed in too tightly, the density measuring cell may be damaged. Harmful liquids leaking from the instrument may cause injuries.

- Tighten the screw until some resistance against further turning can be felt and then stop to tighten the screw.
  The gap left between the holding plate and the adapter where the thread of the screw becomes visible is approx. 3 to 8 mm (approx. 0.12 to 0.31 inches).

5. Insert the screw into the bore hole of the adapter and tighten the screw.

6. Insert the injection adapter Luer into the sample outlet opening and fasten it with the screw in the same way (see Fig. 7 - 2).

7.3 Checking for Leak Tightness

1. Close one adapter tightly with a male Luer plug.

2. Fill air under moderate pressure through the other adapter using a 5 mL plastic syringe from the accessory box and wait for a few seconds.

3. Release the plunger of the syringe.

   - If the connections are leak tight, the plunger of the syringe will be slowly pushed back by the pressure in the measuring cell.
   - If the connections are leaking, no pressure was built up in the measuring cell and the plunger will not move. In this case, repeat the mounting of the adapters.

7.4 Mounting the Hoses

NOTICE
Only use the supplied hose and waste vessel if their materials are resistant to the samples and cleaning liquids that you are going to inject. If not, use other parts made of appropriate material.

To connect the waste vessel

1. Cut a piece of approx. 250 mm (10 in) length from the Viton hose contained in the accessory kit.

2. Attach an adapter Luer cone (from the accessory kit) to one end of the Viton hose and insert it into the sample outlet adapter of the DSA 5000 M.

3. Insert the other end of the Viton hose into the hole of the closed waste vessel cap.

Fig. 7 - 3 Placing the waste vessel

To connect the silicone hose at the air pump outlet

1. Cut a piece of approx. 250 mm (10 in) length from the 3 x 5 mm silicone hose from the accessory kit.
2. Attach the silicone hose to the air pump outlet.
3. Attach an adapter Luer cone (from the accessory kit) to the other end of the silicone hose.

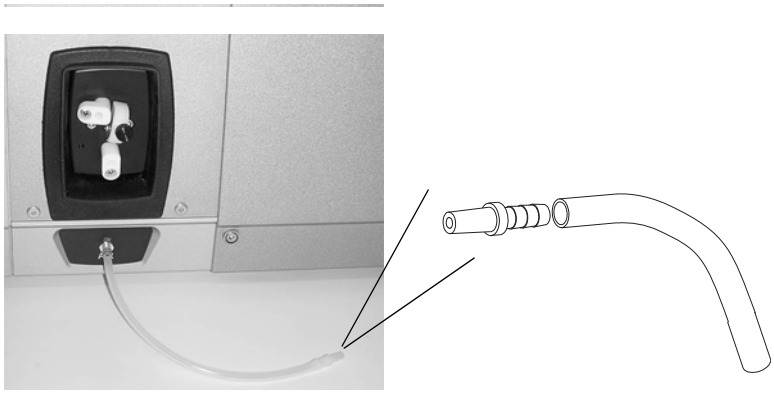


Fig. 7 - 4 Connecting the silicone hose to the air pump outlet

7.5 Switching the Instrument On/Off

1. Check the operating voltage.

WARNING
Serious injuries are possible through high voltage at parts of the instrument if the following hints are not adhered to.

- Make sure that the non-fused earth conductor of the power cord (or power inlet) is connected to earth.

NOTICE
Before switching on DSA 5000 M, make sure that the correct line voltage is available (AC 100 to 240 V, 50 to 60 Hz). If large voltage fluctuations are to be expected, the use of a constant voltage source (UPS) is recommended.

2. Connect the power inlet of DSA 5000 M to the mains using the power cord.
3. Turn on DSA 5000 M using the power switch at the rear of the instrument.

   The green light on the front indicates that the power is on.

   After turning on the power, DSA 5000 M needs approx. 15 minutes for temperature equilibration and internal temperature adjustments. During this time "temp. equilibration" is displayed.
4. To switch the instrument off, use the power switch.

NOTICE
Do not turn off DSA 5000 M during the night. This allows the measuring cells to achieve long term temperature stability.

7.6 Instrument Settings and First Checks

After installing the hardware, set date and time (see Chapter 10.1.1). To check the validity of the factory adjustment, perform an air check and a water check.

The instrument has a factory adjustment over the whole temperature and viscosity range. However, during transport, the density adjustment can be influenced.

NOTICE
DSA 5000 M is factory adjusted and the water check shall be performed as a control measurement to check if the adjustment is still valid after transport.

1. Wait at least 15 minutes after a reboot for the temperature to stabilize.
2. To perform an air check, tap <Menu> and select **"Checks/Adjustments > Checks > Air Check"** (see Chapter 11.2.2).
3. To perform a water check, tap <Menu> and select **"Checks/Adjustments > Checks > Water Check"** (see Chapter 11.2.2).
4. Follow the instructions on the screen.
5. If the check result is OK, the instrument is ready for routine measurements.
6. If the check result is not OK, clean the measuring cells thoroughly and repeat the water check.
7. If the check result is still not OK, perform an air/water adjustment (see Chapter 11.3.1).

8 Operating the Instrument

8.1 Input Alternatives

You can:

- Tap the elements on the touch screen.
- Use a computer mouse and click on the elements on the touch screen.
- Use an external keyboard to enter characters.
- Use a bar code reader.
- Use the softkeys below the touch screen.

8.2 Using the External Keyboard

To use buttons

When an external keyboard is connected, you can use the function keys <F1> to <F5> in combination with the <Ctrl> key to operate the five buttons within the buttons area. <F1> corresponds to the leftmost button, <F5> corresponds to the rightmost button.

To operate a button, press <Ctrl> and the corresponding <F> function key at the same time.

To navigate within lists

- To move the cursor one line up or down within the list, press the <↑> or <↓> key on your external keyboard.
- To move the cursor one page up or down, press the <PgUp> or <PgDn> key on your external keyboard.

To exit dialog windows and wizards with/without saving

- To get one menu level higher and save changes, press the <↵> key on your external keyboard.
- To get one menu level higher without saving changes, press the <Esc> key on your external keyboard.
- To navigate to the next wizard step, press <↵> on your external keyboard.

8.3 Using the Touch Screen

In the following parts of this manual, the operation of the instrument is described only for the input option touch screen.

NOTICE

To ensure long lifetime of the touch screen element of your instrument:

- Only use clean and dry fingers to operate the touch screen.
- Never use any sharp objects.
- Operate the touch screen with gentle fingertip pressure only.

To use buttons

Use the buttons by directly tapping on them.

The buttons at the bottom of the screen can also be activated with the softkeys below them.

To highlight items

To highlight a row in a table or list (e.g. data memory, sample list, favorites list), directly tap on the row. The highlighted row will change its color from white to dark gray.

Fig. 8 - 1 Example: Favorites list with favorite No. 2 highlighted

To use drop-down boxes

1. Tap on the drop-down box and then highlight an item in the drop-down list.
2. Tap <OK> to select the entry and close the list.

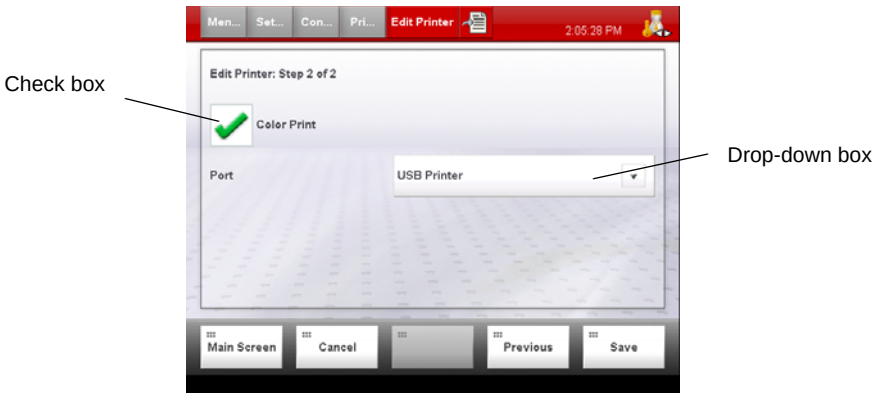


Fig. 8 - 2 Example: Drop-down box and check box in the "Edit Printer" wizard (menu "Setup > Control Panel > Printer Management")

To use check boxes

Tap on the check box to activate or deactivate the desired function (see Fig. 8 - 2).

To use radio buttons

Choose one of the radio buttons to activate one of the available functions.

Fig. 8 - 3 Example: Radio buttons in the "Camera" dialog (menu "Setup > Measurement System Settings > Camera")

To enter characters into an input box or list field

1. There are two ways to open the on-screen keyboard:

   - Tap on the input box or list field twice to open the on-screen keyboard.
   - Tap the "A" symbol within the input box or list field (see Fig. 8 - 4).

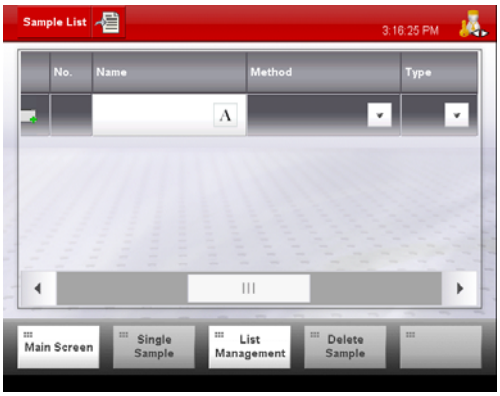


Fig. 8 - 4 Input field of the sample list

2. Enter characters/numbers/special characters by tapping the buttons on the screen and then tap <OK>.

Fig. 8 - 5 On-screen keyboard

The function of the special buttons are:

←	Deletes the character on the left side of the cursor position.
◄ / ►	Moves the cursor position to the left/to the right.
⇧	Changes to upper case in alphabetic character mode and to special characters in number mode.
123	Changes to the number mode.
abc	Changes to alphabetic character mode.
Alt Gr	Changes to further special characters.
^	For notation of exponential numbers, e.g. to enter 0.025 as 2.5 ^-2 (only number mode).

To exit dialog windows with/without saving

TIP When a measurement is currently in progress, you can not save any changes to instrument settings. The <OK> button is deactivated and tapping <Main Screen> quits the dialog without saving the changes.

You have three options to exit a dialog window:

- To get directly to the main screen, tap <Main Screen> and decide whether you want to save or discard changes in the following pop-up window.
- To get one menu level higher and save changes tap <OK>.
- To get one menu level higher without saving changes tap <Cancel>.

To exit wizards with/without saving

A wizard is a combination of two or more dialog windows. You have three options to exit a wizard:

- To get one level up and save the settings, complete all steps of the wizard and then tap <OK>. To navigate in the wizard steps, use the buttons <Next> and <Previous>.
- To get one menu level up without saving changes, tap <Cancel>.
- To get directly to the main screen without saving, tap <Main Screen> and, in the following dialog, select the option <Yes>.

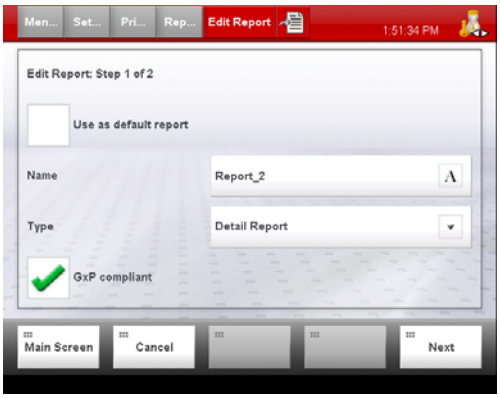


Fig. 8 - 6 "Edit Report" wizard

8.4 Calibrating the Touch Screen

If you have difficulties in hitting the touch screen user elements (buttons, drop-down boxes, etc.), you can calibrate the touch screen. The touch screen sensors will then be adapted to the way you tap on the screen.

1. Tap <Menu> and select **"Setup > Control Panel > Calibrate Touch Screen"**.
2. Follow the instructions on the screen. Use your finger, not a stylus.
3. Tap anywhere on the screen to accept the new calibration.

8.5 Setting the Screen Saver

You can set the time after which the screen saver is automatically activated.

To set the time

1. Tap <Menu> and select **"Setup > Control Panel > Screen Saver"** to open the settings for the screen saver.
2. Use the check box to activate/deactivate the option:
   - Automatically switch off display after ... minutes.
3. Enter a value between 1 and 300 minutes.
4. Tap <OK> to save the changes.

To deactivate the screen saver

There are two ways to deactivate the screen saver:

- Tap the screen or use any other input device (external touch screen, mouse, keyboard).
- Start a measurement via any interface (Ethernet or RS-232).

8.6 Activating/Deactivating the Feedback Beeps

If both feedback beep functions are activated, the instrument beeps upon every successful touch screen or softkey action, mouse click and bar code reader input as well as after the completion of a measurement.

1. Tap <Menu> and select **"Setup > Control Panel > Feedback Beeps"**.
2. Activate/deactivate the feedback beep option for beeping when a screen item or key is touched.
3. Activate/deactivate the feedback beep option for beeping when a measurement was completed.
4. Tap <OK>.

8.7 Logging On/Off

When delivered, the instrument is freely accessible without password.

If user accounts are installed and passwords set, you may have to pass a logon procedure after switching on the instrument.

To log on

1. Tap on the user indicator on the right side of the header of the main screen to open the "Logon" dialog.
2. Select your "User name", enter your "Password" and tap <OK>.

NOTICE
If the instrument is used in the increased security mode, your user account will be deactivated after three failed logon attempts.

To log off

1. Tap on the user indicator on the right side of the header of the main screen to open the "Logon" dialog.
2. Tap <Log off>.

   The user indicator changes its appearance to: 

   The instrument finishes the current measurement or measurement series but does not accept any input until someone successfully logs on.

To retrieve a forgotten password

1. Tap <Forgot Password> in the "Logon" dialog.
2. Follow the instructions on the screen.

Related topics

Creating, Editing and Deleting User Accounts: Chapter 10.4.2

8.8 Using Favorites

The favorites function enables you to quickly access your favorite menu dialogs directly from the main screen.

You can also use the favorites function to activate your favorite menu dialogs without touching the touch screen by using the softkeys below the touch screen.

The favorites list is the same for all users.

To add a dialog window to the favorites list

1. Open the dialog window via the menu tree.
2. Tap the "Add to Favorites" icon  in the header.

To use the favorites list

1. In the main screen, tap <Favorites> to open the favorites list.
2. Highlight a favorite either by tapping on its name or by using <▲> and <▼> and tap <OK>.

To change the sequence of the favorites list

1. Tap <Menu> and select **"Setup > Favorites Management"**.
2. Highlight the list item and use the up/down arrows in the right column to change the position of the list item in the favorites list.
3. Proceed so with all other list items whose position you want to change and tap <OK>.

To rename a favorites list item

1. Tap <Menu> and select **"Setup > Favorites Management"**.
2. Highlight the list item and tap <Rename>.
3. Enter the new favorite name and tap <OK>.

To delete a favorites list item

1. Tap <Menu> and select **"Setup > Favorites Management"**.
2. Highlight the list item and tap <Delete>.

9 Installing Optional Input/Output Devices

In this chapter, you find information about the installation of optional input/output devices. For detailed information on the devices, see the respective manual.

If you are using accessories that are not supplied by Anton Paar, we do not guarantee the functionality and safety.

9.1 External Keyboard, Bar Code Reader, Mouse

To connect the external keyboard, bar code reader and mouse

- Connect the external keyboard and bar code reader (not supplied by Anton Paar) to one of the USB interfaces that are located on the left and rear of the instrument.
- Connect the mouse (not supplied by Anton Paar) to a USB interface.

To use a bar code reader

A bar code reader can be used to fill in input boxes, e.g. sample names or user-defined data fields. In the "Sample List" mode, you can also assign methods to samples by reading the respective bar code (see Appendix H for bar code examples).

Tested bar code readers are Symbol DS6707 or Datalogic Firescan D131.

To deactivate the on-screen keyboard in the sample list

If you activate this function, the on-screen keyboard will not appear when editing the sample list. You can conveniently enter your inputs with an external keyboard or bar code reader.

You can directly enter your settings into the cells and use the tab key of the external keyboard to jump between cells of the sample list.

If you set your bar code reader to conclude the bar codes with a tab character, the cursor will jump into the next cell after reading a bar code.

1. Select the menu **"Setup > Control Panel > Keyboard and Bar Code Settings"** to open the settings for the external keyboard.
2. Use the check box to activate/deactivate the option "Use a bar code scanner to edit the sample list".
3. Tap <OK> to save the changes.

9.2 USB Flash Drive

- Insert a USB flash drive or another USB mass storage device into one of the four USB interfaces that are located on the left and rear of the instrument.

TIP *Some older USB flash drives are formatted in the super floppy way. These are not compatible with your DSA 5000 M instrument. The memory sticks formatted in the standard hard disk way are compatible.*

9.3 Printer

You can use an RS-232 printer via RS-232 interface or an office printer (PCL compatible) via USB interface or via local network. After connecting the printer to the instrument, register the printer in the menu **"Setup > Control Panel > Printer Management"**.

For a list of tested printers, refer to "www.anton-paar.com/generation_m-tested-printers".

9.3.1 Connecting a Printer

To connect an RS-232 printer

1. Connect the printer (Mat. No. 44737 or 93362) to the RS-232 interface (COM) of the instrument using the cable that is supplied together with the printer.
2. If you use an RS-232 printer which is not supplied by Anton Paar, set the communication settings on the printer properly (see Appendix A.2).

To connect an office printer (not supplied by Anton Paar) via USB interface

- Connect the printer to a USB interface of the instrument.

To connect an office printer (not supplied by Anton Paar) via local network

You can connect your instrument and a PCL compatible printer (or an Epson Stylus D120) via Ethernet to your local network.

1. Connect the instrument via Ethernet interface to your local network.
2. Tap <Menu> and select **"Setup > Control Panel > Network"**.
3. If your network server has DHCP functionality, activate "Obtain an IP address automatically (DHCP)", then tap <Next> and <OK>.
4. If your network server has no DHCP functionality, deactivate "Obtain an IP address automatically (DHCP)" and enter the correct "IP Address", "Subnet Mask", "Default Gateway", and tap <Next>.

5. Enter the primary and secondary DNS and tap <OK>.

6. Connect the printer to your local network. For details, see the printer instruction manual.

9.3.2 Registering, Editing, Deleting a Printer

You can register up to 5 printers.

To register a new printer or edit a printer

1. Tap <Menu> and select **"Setup > Control Panel > Printer Management"** to open the printer list.

2. Tap <New> to register a new printer or highlight a list item and tap <Edit> to edit a printer.

   The "Edit Printer" wizard opens.

3. For RS-232 printers, perform the following settings:

   - Activate/deactivate the check box "Use as default printer".
   - Enter a "Name" for the printer.
   - Select the adequate printer "Type".

4. Tap <OK>.

5. For USB and network printers, perform the following settings:

   - Activate/deactivate the check box "Use as default printer".
   - Enter a "Name" for the printer.
   - Select the adequate printer "Type".
   - Select the paper "Format".

6. Tap <Next>.

   - Select the "Port".
   - Activate/deactivate the check box "Color Print".
   - For network printers only: Enter the IP address and IP port.

7. Tap <OK>.

To delete a printer

1. Tap <Menu> and select **"Setup > Control Panel > Printer Management"** to open the printer list.

2. Highlight a printer list item and tap <Delete>.

TIP *The standard printer can not be deleted.*

Related topics

Creating, Editing and Deleting Printer Report Layouts: Chapter 10.2.1

Defining the Result Output: Chapter 12.2.3
Printing and Exporting Results and Other Data: Chapter 15.6

9.4 External Terminal or Data Projector

The external terminal or data projector (not supplied by Anton Paar) has to be capable of delivering a 640 x 480 px resolution in true color (VGA) at minimum 60 Hz.

- Connect the external terminal or data projector to the VGA interface at the rear of the instrument.

9.5 External Touch Screen

The external touch screen (not supplied by Anton Paar) has to be capable of delivering a 640 x 480 px resolution in true color (VGA) at minimum 60 Hz.

Only touch screens from Elo Touch Systems and compatibles are supported. We recommend the model Elo 1715L 17" LCD Desktop Touchmonitor (1000 Series, firmware V1.9 and higher). Only order the external touch screen with IntelliTouch Surface Wave Touch Technology.

- Connect the external touch screen to the VGA interface at the rear and to one of the four USB interfaces that are located on the left and rear of the instrument.

TIP *Connect the USB plug via a hub to DSA 5000 M. Otherwise, the touch screen functionality might fail.*

- If necessary, run an auto adjustment routine on the external touch screen. For details, see the touch screen instruction manual.

Calibrating the external touch screen

If you have difficulties in hitting the touch screen user elements (buttons, drop-down boxes, etc.), perform a touch screen calibration.

To calibrate the touch screen

1. Tap <Menu> and select **"Setup > Control Panel > Calibrate External Touch Screen"**.

2. Follow the instructions on the screen. Use your finger, not a stylus.

10 Defining General Settings

10.1 Instrument Settings

These settings are not method-dependent and thus will not change after a change of the current method.

10.1.1 Date and Time

1. Tap <Menu> and select **"Setup > Control Panel > Date and Time"**.
2. Enter the current date and time and tap <OK>.

10.1.2 Regional Settings

1. Tap <Menu> and select **"Setup > Control Panel > Regional Settings"**.
2. Enter the "Language", "Data Format" (for numbers, date and time format, etc.), and the "Keyboard Layout".

   The instrument displays "Are you sure you want change the regional settings? The instrument will reboot to complete this action".
3. Tap <Yes> to install the new settings.

   The instrument reboots.

If the instrument is operated in a language or font you do not understand, proceed as follows:

1. Tap the leftmost button in the main screen (<Menu>).
2. Select the menu item with the  symbol (menu **"Setup"**).
3. Select the second menu item (menu **"Setup > Control Panel"**) and again the second menu item (menu **"Setup > Control Panel > Regional Settings"**).
4. Use the drop-down boxes to set the desired language, data format and keyboard layout.
5. Confirm each change with the rightmost button (<OK>) in the buttons area.
6. In the following dialog, tap the right button (<Yes>).

   The instrument reboots.

10.1.3 Input Units

In this menu, you can define the unit for every temperature value which you enter during operation.

1. Tap <Menu> and select **"Setup > Control Panel > Input Units"**.
2. Select the input unit for temperatures and tap <OK>.

10.1.4 Air Pump Settings

You can set the timeout after which the air pump is stopped and the condition on which the air pump is stopped.

1. Tap <Menu> and select **"Setup > Measuring System Settings > Air Pump"**.
2. Use the check box to activate/deactivate the option:
   - Air pump stops automatically when density value is stable.
   - Air pump stops automatically after ... s.

   In case both options are activated and the air density value gets not stable within the period of time that is defined with the second option, the air pump stops nevertheless after this period of time.
3. Tap <OK> to save the changes.

10.1.5 Saving a Camera Picture

You can define when the instrument automatically saves a picture of the measuring cell.

1. Tap <Menu> and select **"Setup > Measuring System Settings > Camera"**.
2. Use the radio buttons to select one of the options:

   Automatically save a picture ...
   - of each measurement.
   - only if a measuring error is detected
   - never
3. Tap <OK> to save the changes.

10.1.6 Network

If you connect the instrument to your local network, you can use a network printer for printouts and request the instrument system information and instruction manual via any PC in the network.

1. Tap <Menu> and select **"Setup > Control Panel > Network"**.

2. If your network server has DHCP functionality, activate "Obtain an IP address automatically (DHCP)", then tap <Next> and <OK>.

3. If your network server has no DHCP functionality, deactivate "Obtain an IP address automatically (DHCP)" and enter the correct "IP Address", "Subnet Mask", "Default Gateway", and tap <Next>.

4. Enter the primary and secondary DNS and tap <OK>.

10.1.7 Instrument Name and Location

If you have more than one DSA 5000 M and want to easily differentiate between them in printouts, data exports or within your local network (LIMS), you can define instrument names and locations.

1. Tap <Menu> and select **"Setup > Control Panel > Instrument Name and Location"**.

2. Enter the "Instrument Name" and "Instrument Location" and tap <OK>.

10.2 Defining the Printout Settings

You can define the layout of the printer report and if you want an automatic printout. To set the output data for each method, see Chapter 12.2.3.

10.2.1 Creating, Editing and Deleting Printer Report Layouts

You can set up to 10 different report layouts for e.g. different methods, different sample types or for internal or external use. The layouts can be created, edited or deleted.

To create or edit a report

1. Tap <Menu> and select **"Setup > Printout Settings > Report Management"** to open the report list.

2. Tap <New> to create a new report or highlight a list item and tap <Edit>.

   The two-step "Edit Report" wizard opens.

3. Perform the following settings:

   - Activate/deactivate the check box "Use as default report".
   - Enter a report "Name".
   - Select the report "Type" "List" or "Detail".

   List reports contain several measurement results in a table.

   Detail reports contain one detailed measurement result per page.

   - Activate/deactivate the "GxP compliant" function.

4. Tap <Next> and perform the following settings:

   - Define the paper format (portrait or landscape).
   - Activate/deactivate the check box "Print Camera Image".

5. Tap <Save>.

To delete a report

1. Tap <Menu> and select **"Setup > Printout Settings > Report Management"** to open the report list.

2. Highlight a list item.

3. Tap <Delete>.

10.2.2 Defining Header and Background of the Printer Report

You can import logos via USB flash drive and use them as header or background logo in the printer report. You can also define an address which will be printed in the header of the printer report.

To be recognized by the instrument and fit into the document layout, the logo graphic files have to:

- have the extension .jpg or .bmp.
- be located in the root directory of the USB flash drive.
- have a maximum size of 400 x 200 px (header logo).

To import logos

1. Tap <Menu> and select **"Setup > Printout Settings > Import Logos"**.

2. Use the drop-down list "Drive" to select the connected USB flash drive.

3. Use the drop-down list "File Name" to select the correct file.

4. Use the drop-down list "Place" to define the position of the file in the internal logo list.

5. Tap <Import> to load the file from your USB flash drive into the instrument.

To select logos

You can select a logo for the report header and a second logo for the report background.

1. Tap <Menu> and select **"Setup > Printout Settings > Select Logos"**.

2. Use the two drop-down boxes to select a logo for the header and a second logo for the background.

3. Tap <OK> to save the changes.

To enter name and address for the header

1. Tap <Menu> and select **"Setup > Printout Settings > Name and Address"**.

2. Enter the name and address and tap <OK>.

10.2.3 Activating/Deactivating an Automatic Printout

1. Tap <Menu> and select **"Setup > Printout Settings > Automatic Printout"**.

2. Use the drop-down box "Frequency" to define if you want to have an automatic printout after each sample or if you do not want to have an automatic printout.

3. Use the drop-down box "Printer" to define on which printer you want to have the print reports.

4. Use the drop-down box "Report" to select the report layout.

   The "list report" layout type can not be selected for the automatic printout.

5. Tap <OK> to save the changes.

Related topics

Registering, Editing, Deleting a Printer: Chapter 9.3.2
Defining the Result Output: Chapter 12.2.3
Printing and Exporting Results and Other Data: Chapter 15.6

10.3 Setting Sample List Options

In the **"Sample List"** menu, you can:

- Select the sample list mode.

- Define automatic sample name additions before and after the sample name. These additions will be added to each sample name after the measurement of the sample was finished. You can compose the additions out of a fixed part and an additional data field (date and time, user name, sample number, etc.).

- Activate up to three user-defined data fields and give names for the fields. In these fields, you can assign special types of information of your choice to your samples. Typical examples are a filling line number, a tank number or a batch identification. For each data field that you define, an extra column will be added to the sample list.

- Define mandatory data fields. The measurement can only be started after filling in the mandatory data fields. If mandatory data fields are not completed in the sample list, these fields will be prompted again for completion after the start of the measurement.

To set sample list mode and automatic sample name

1. Tap <Menu> and select **"Setup > Measuring System Settings > Sample List > Sample List/Sample Settings"**.
2. Select the "Sample List Mode".

- If no sample changer or a sample changer without magazine is connected, you can select "No Sample List" or "Sample List".

  The "No Sample List" mode is set by default. On the main screen, the button <Quick Settings> is displayed.

  If the "Sample List" mode is selected, the button <Sample List> is displayed instead of the <Quick Settings> button on the main screen.

- If a sample changer with magazine is connected, you can select "Simple" mode or "User-defined" mode. For details, see the corresponding Xsample instruction manual.

3. Define the "Automatic Sample Name" ("Sample Name Prefix" and "Sample Name Postfix").
4. Tap <OK> to save the changes.

To set user-defined data fields

1. Tap <Menu> and select **"Setup > Measuring System Settings > Sample List > User-defined Data Fields"**.
2. Activate/deactivate the three "User-defined Data Fields", enter their names and tap <OK> to save the changes.

To set sample list warnings

The sample list warnings are only generated if you prepare a sample list prior to any measurement.

1. Tap <Menu> and select **"Setup > Measuring System Settings > Sample List > Sample List Warnings"**.
2. Use the two check boxes to activate/deactivate the "Sample List Warnings":

   - Warn if sample list contains a sample without a name.
   - Warn if sample list contains methods with different measurement temperatures.

3. Tap <OK> to save the changes.

To set mandatory data fields

You can set the sample name and user-defined data fields as mandatory.

1. Tap <Menu> and select **"Setup > Measuring System Settings > Sample List > Mandatory Data Fields"**.
2. Use the check box(es) to define whether it is mandatory to enter a sample name or content for user-defined data fields for each measurement.
3. Tap <OK> to save the changes.

Related topics

Using the "Sample List" Mode: Chapter 13.3

10.4 Installing User Accounts and Passwords

When delivered, the instrument is freely accessible without password. Three user accounts are factory preset. The default passwords are set to "user name", written in lower case letters, e.g. "administrator" is set as the password for the "administrator" user. For the "administrator" user, the auto logon function is activated.

10.4.1 User Groups, Auto Logon, Naming Rules and Password Rules

User groups

There are three user groups which have different levels of user rights:

	**Operator** This user group may perform measurements, select a method, edit the sample list and perform checks.
	**Manager** This user group has the rights of the operator user group and may additionally perform adjustments.
	**Administrator** This user group has the right to access the whole menu.

Naming rules

User names must have at least one character. Allowed are characters from the ASCII table which are letters, numbers and most special characters.

If you operate the instrument in the increased security mode, user names must have at least six characters.

NOTICE
If the increased security is activated, user accounts that do not comply with the naming rules or password rules will be deactivated.

User names are not case sensitive.

Password rules

With low security levels, giving a password is not mandatory. If you do not set a password, users can log on by selecting their user name from the user list only.

The password must have at least one character. Allowed are characters from the ASCII table which are letters, numbers and most special characters. The password is case sensitive, for example "Anton Paar" or "anton paar" does make a difference in the logon.

With high security levels (21 CFR Part 11 and "Increased Security"), giving a password is mandatory. Passwords must have at least six characters. When setting new passwords, the last five passwords must not be used.

Auto logon function

You can assign the auto logon function to one user in the menu **"Setup > User Management"**.

If this user is logged on and the instrument is switched off and on again, there is no logon procedure. All instrument functions according to user rights of the auto logon user are freely accessible.

Example: The user "smith" belongs to the user group "operator" and the auto logon function is activated for him. If he switches off the instrument, anyone can switch the instrument on and start measuring without a need to log on. Only operator level functions are available.

NOTICE
If the increased security is activated, auto logon will automatically be disabled (if enabled before).

10.4.2 Creating, Editing and Deleting User Accounts

You need administrator rights to create, edit or delete user accounts. Up to 50 user accounts can be created.

TIP

- *A user with a deactivated account can not log on until he/she is activated again.*
- *A user who has no administrator rights can only change his own password.*

To create or edit a user account

1. Tap <Menu> and select **"Setup > User Management"**.

2. Tap <New> to create a new user account or highlight a user name on the user list and tap <Edit> to edit a user account.

   The "Edit User" dialog opens.

3. Perform the following settings:

   - Activate/deactivate the user account with the check box.
   - Enter a "User Name".
   - Select the "User Group".
   - Activate/deactivate the "Auto log on" using the second check box.
   - Select the "Role for the Electronic Signature".

4. If you want to set or change the password, tap <Set Password>, enter the password in the following dialog and tap <OK>.

5. Tap <OK>.

To delete a user account

You can not delete your own account (i.e. the currently active account) or an account of a user group that has a higher level of user rights than your own account.

1. Tap <Menu> and select **"Setup > User Management".**

2. Highlight a user name on the user list and tap <Delete>.

To set or change a password

If the instrument is operated in increased security mode, you may not use the last five passwords a second time.

1. Tap <Menu> and select **"Setup > User Management"**.

2. Tap <New> to create a new user account or highlight a user name on the user list and tap <Edit> to edit a user account.

3. To set or change the password, tap <Set Password>, enter the password in the following dialog and tap <OK>.

4. Tap <OK>.

Related topics

Logging On/Off: Chapter 8.7
Electronic Signature: Chapter 16.2.1

11 Checking, Adjusting and Calibrating the Instrument

11.1 Definitions

Checking

Checking the correct state of operation of an instrument by measuring a sample of exactly known measurement properties and comparing the result with the expected values.

Adjusting

Enabling correct measurements in the future by injecting a sample of exactly known measurement properties (standard) and adjusting the instrument constants in a way that the known correct results are found by the instrument.

Usually at least two standards are needed with measurement properties that encompass the expected measurement results of your samples for a successful adjustment.

Calibrating

Calibrations are checking procedures which are carried out using certified standards. By comparing the measured result with the standard reference value, you can validate the quality of your measurements.

11.2 Checks

11.2.1 Editing the Check Settings

You can edit the name, method (custom check only), time interval and the tolerance of density and sound velocity checks.

Tolerances

The factory presets for the check tolerance of density for both air and water checks are 0.00005 g/cm^3. The factory present for the check tolerance of sound velocity for the water check is 0.30 m/s.

To edit the settings of the Air Check and Water Check

1. Tap <Menu> and select **"Setup > Expert Settings > Check Management"** to open the check administration list.
2. Highlight the Air Check or Water Check and tap <Edit> to open the two-step "Check Edit" wizard.

3. Perform the following settings:

   - Enter a name for the check.
   - Use the check box "Must be started every" to define if the check is obligatory and enter a time interval in days.

4. Tap <Next>.

   - Define the maximum allowed lower and upper deviation.

5. Tap <OK>.

To create a custom check

1. Tap <Menu> and select **"Setup > Expert Settings > Check Management"** to open the check administration list.

2. Tap <New> to open the two-step "Check Edit" wizard.

3. Perform the following settings:

   - Enter a name for the check.
   - Select the method to define detailed method settings for the check, e.g. temperature.
   - Use the check box "Must be started every" to define if the check is obligatory and enter a time interval in days.

4. Tap <Next>.

   - Select the quantity.
   - Define the check tolerance entering the lower and upper value.

5. Tap <OK>.

To edit a custom check

1. Tap <Menu> and select **"Setup > Expert Settings > Check Management"** to open the check administration list.

2. Highlight a custom check and tap <Edit> to open the two-step "Check Edit" wizard.

3. Change the settings as required.

11.2.2 Performing Checks

With checks, carried out in regular intervals, you can ensure a high and stable accuracy of your density and sound velocity measurements.

During a check, you fill a medium of known density (air, water or any customer-specific standard liquid) into the measuring cells and compare the measured values with reference values.

DSA 5000 M performs the water checks and air checks automatically at the measuring temperature of the method that is currently active. Also the predetermination/equilibrium type of measurement is used according to the selected method. The density and sound velocity of water and the density of air at the measuring temperature are calculated and the actually measured values are compared with the calculated values. With water checks and custom checks, these calculated values are calculated for the set temperature. With air checks, the calculated value is calculated for the set temperature and the measured air pressure.

Custom checks have to be defined for a certain method and are always performed at the temperature of the selected method with the corresponding predetermination/equilibrium type of measurement.

Air checks and water checks are available for any method.

When to do water checks and custom checks

Use the water check and custom check to verify that the instrument is measuring with satisfactory accuracy. We recommend performing a water check or custom check every day before starting the measurements. Perform additional water checks or custom checks on demand depending on your judgment, e.g. when you get unexpected results.

When to do air checks

NOTICE
The air check does not give you any information about the accuracy of sound measurement as the sound velocity of air is not within the instrument's specifications.

Use the air check to evaluate the efficiency of your cleaning and drying procedure. We recommend performing an air check every day after the measurements have been finished and the measuring cell was cleaned and dried.

Perform additional air checks on demand depending on your judgment, e.g. after the measurement of critical samples that might stick to the measuring cell (e.g. samples containing adhesives, sticky particles, proteins).

To perform a check

1. Tap <Menu> and select **"Checks/Adjustments > Checks"** to open the checks list.
2. Highlight a list item and tap <Start>.
3. Follow the instructions on the screen.

   For a water check use freshly degassed ultra-pure (bi-distilled or deionized) water.

For an air check clean and dry the measuring cell properly.

Use the camera image to check whether the measuring cell is clean or water was filled bubble free.

When the check is finished, the following information is displayed:

- Check type
- Date and time
- Current method
- User name
- Check result ("passed" or "not passed")
- Module density
  - Density of water, air or a user-defined standard at the check temperature (reference value)
  - Tolerance of the check (upper and lower value)
  - Measured density value
  - Nominal atmospheric pressure (air check only)
- Module sound velocity (water check only)
  - Sound velocity of water at the check temperature (reference value)
  - Tolerance of the check
  - Measured sound velocity value

4. Tap <Print or Export> if you want to print or export the check results.

5. Tap <OK> or <Main Screen> to exit the check.

If the water check failed, we recommend taking corrective actions until the check is valid again:

- Take a look at the camera image attached to the result to check if the water was filled bubble free (see Chapter 11.2.3).

- Check the quality of the water.

- Clean the measuring cells thoroughly.

- If the above mentioned actions do not help, perform an air/water adjustment.

11.2.3 Viewing, Printing or Exporting Current Check Data

The total number of entries in the check history is limited to 100.

1. Tap <Menu> and select **"Data Memory > Check/SOP Data"**.

2. Highlight a list item and tap <Detail>.

3. To perform a printout on paper or to a PDF file or to export the data as an MS Excel or Text file tap <Print or Export> and follow the instructions on the screen.

Related topics

Density Tables: Appendix I
Degassing Samples: Appendix B.1
Filling Samples: Chapter 13.4

Cleaning and Drying the Measuring Cell: Chapter 14.1
Performing an Air/Water Adjustment: Chapter 11.3.1

11.3 Adjustments

11.3.1 Performing an Air/Water Adjustment

An air/water adjustment has to be performed if the water check had a "not passed" result and using freshly degassed ultra-pure water and cleaning the measuring cell did not help.

The adjustment media are dry air and freshly degassed ultra-pure (bi-distilled or deionized) water.

The ThermoBalance™ technology allows for precise measurements over the whole temperature range with only one adjustment at 20 °C. To achieve the maximum possible precision of measurements at different temperatures, you can additionally perform a temperature range adjustment (see Chapter 11.3.2).

The air/water adjustment takes 5 to 10 minutes if the instrument is already clean and dry and equilibrated to 20 °C.

The adjustment procedure can be aborted by tapping <Cancel>.

To perform an air/water adjustment

1. Tap <Menu> and select **"Checks/Adjustments > Air/Water Adjustment"**.
2. Choose whether you want to adjust the density module, the sound module or both.
3. Rinse the measuring cell.

TIP *If you use undenatured ethanol as the last rinsing liquid, only 3-4 minutes drying time are required.*

4. Tap <Air Pump on> to dry the measuring cell.
5. Tap <OK>.

   The atmospheric pressure is displayed. The air pressure is measured automatically by a built-in sensor.
6. Tap <OK>.

   The air adjustment routine is carried out.
7. Fill ultra-pure water into the measuring cell and tap <OK>.
8. Check that the water is filled without air bubbles.

TIP *If the water was filled without air bubbles, you can ignore a possible error message "Master Condition: filling warning" during the adjustment routine. The coefficients for the FillingCheck™ function are also adjusted during the adjustment procedure.*

The water adjustment routine is carried out.

When the adjustment is finished, the following information is displayed:

- Density air/water adjustment:
  - Old Value: Calculated density of water of the previous adjustment.
  - New Value: Calculated density of water with the new adjustment constants.
  - Deviation: Relative and absolute deviation between new and old value.
- Sound water adjustment:
  - Old Value: Calculated sound velocity of water of the previous adjustment.
  - New Value: Calculated sound velocity of water with the new adjustment constants.
  - Deviation: Relative and absolute deviation between new and old value.

9. Check the recommendation on the screen and select one of the options <Reject>, <Print> or <Apply>.

Related topics

Cleaning and Drying the Measuring Cell: Chapter 14.1
Degassing Samples: Appendix B.1
Filling Samples: Chapter 13.4

11.3.2 Performing a Temperature Range Adjustment

You can adjust your instrument over the whole temperature range to reach the maximum accuracy for measurements at different temperatures than 20 °C.

During the temperature range adjustment, an air adjustment is performed at 40 °C and 60 °C, then a water adjustment at 60 °C and 40 °C.

The whole adjustment takes about 30 minutes.

The adjustment procedure can be aborted by tapping <Cancel>.

1. Tap <Menu> and select **"Checks/Adjustments > Other Adjustments > Density + Sound Module > Temperature Range Adjustment"**.

2. Follow the instructions on the screen.

3. Check that the water is filled without air bubbles.

TIP *If the water was filled without air bubbles, you can ignore a possible error message "Master Condition: filling warning" during the adjustment routine. The coefficients for the FillingCheck™ function are also adjusted during the adjustment procedure.*

Related topics

Measuring at Low/High Temperatures: Appendix C.2

11.3.3 Performing a High Density/High Viscosity Adjustment

With DSA 5000 M, you can perform an adjustment at high density and/or at high viscosity to reach an exceptionally high accuracy for the measurement of high density values and/or samples with a high viscosity.

For the high density adjustment you need a standard that has a high density (higher than 1.40000 g/cm³), but low viscosity (similar to water).

For the high viscosity adjustment, you need two standards:

- One standard with a viscosity of approx. 100 mPa·s (±5 mPa·s) and with exactly known density (±0.00002 g/cm³).
- One standard with a viscosity of approx. 200 mPa·s (±5 mPa·s) and with exactly known density (±0.00002 g/cm³).

The adjustment procedure can be aborted by tapping <Cancel>.

1. Tap <Menu> and select **"Checks/Adjustments > Other Adjustments > Density + Sound Module > High Density/Viscosity Adjustment"**.

2. Follow the instructions on the screen.

   First an air and water adjustment is performed.

   When the adjustment is finished, the following information is displayed:

   - Old Value: Calculated density of water of the previous adjustment.
   - New Value: Calculated density of water with the new adjustment constants.
   - Deviation: Relative and absolute deviation between new and old value.

3. Check the recommendation on the screen and select <Special> if "Apply" is recommended.

4. For filling the high-density standard and the two viscosity standards, follow the instructions on the screen.

   After the adjustment with the high-density standard, select <Visc. Standard 1> and after the adjustment with the first viscosity standard select <Visc. Standard 2>.

   Check that the standards are filled without air bubbles.

TIP *If the standard was filled without air bubbles, you can ignore a possible error message "Master Condition: filling warning" during the adjustment routine. The coefficients for the FillingCheck™ function are also adjusted during the adjustment procedure.*

11.3.4 Performing an Atmospheric Pressure Adjustment

You can adjust the built-in atmospheric pressure sensor.

1. Tap <Menu> and select **"Checks/Adjustments > Other Adjustments > Density + Sound Module > Atmospheric Pressure Sensor Adjustment"**.

2. Use a calibrated external pressure sensor to get an exact pressure value.

   Do not use the atmospheric pressure that you can get from a local weather station, because this usually is not the absolute atmospheric pressure, but a calculated atmospheric pressure at sea level.

3. Tap <OK> to start the adjustment.

4. Enter the atmospheric pressure (in hPa) and tap <OK>.

5. Wait for the adjustment to be finished and then tap <OK>.

   The final value may deviate from the one you entered by up to ±7 hPa. This will not influence the measuring accuracy.

11.3.5 Performing Special Adjustments (only for Density)

11.3.5.1 Special Adjustments

Special adjustments are user-specific adjustments for special density units, concentrations and temperatures. After a successful adjustment procedure, the special adjustment can be used as a standard measuring quantity that is displayed and printed. It can also be used:

- as an input parameter for a user function
- as the input quantity for the Canadian excise alcohol table

Five different special adjustments can be stored. For each special adjustment name, unit and temperature can be specified.

During a special adjustment, density coefficients are calculated from the oscillation period of two liquids of known density according to:

$$\rho = A \times PQ^2 - B$$

ρ .....density
A, B ... density coefficients
PQ .... period of oscillation

Prerequisites for standards

The densities of the two liquids that are used for special adjustment have to differ by at least $\Delta\rho$ = 0.01 g/cm³.

The PQ-values of the adjustment media have to differ by at least 0.0001.

Special adjustments can be performed at any set temperature within the specified temperature range (0 to 70 °C or 32 to 158 °F).

Hints for measurements using special adjustments

If the instrument is operated using a special adjustment, the set measuring temperature must be the same as the temperature at which the special adjustment was performed. Otherwise no results will be obtained.

No viscosity correction is available if the instrument is operated using a special adjustment.

No adjustment history is available for special adjustments.

To perform a special adjustment

1. Tap <Menu> and select **"Checks/Adjustments > Other Adjustments > Density + Sound Module > Special Adjustments"**.
2. Use the drop-down box "Adjustments" to select one of the 5 available "Special Adjustment" entries and tap <OK>.
3. Enter "Name" and "Unit" for the special adjustment.
4. Define the "Temperature" and tap <OK> to continue.

   The special adjustment routine starts.
5. Rinse the measuring cell.
6. Tap <Air Pump on> to dry the measuring cell.
7. Fill the first standard into the measuring cell and tap <OK>.

   Check that the standard is filled without air bubbles.
8. Enter the reference value for the first standard and tap <OK>.
9. Enter the reference value for the second standard and tap <OK>.
10. Rinse the measuring cell.
11. Tap <Air Pump on> to dry the measuring cell.
12. Fill the second standard into the measuring cell and tap <OK>.

    Check that the standard is filled without air bubbles.
13. Check the recommendation on the screen and select one of the options <Print>, <Reject> or <Apply>.

    After successful adjustment, the determined special adjustment coefficients are stored. A new output quantity is generated in the group Special Adjustments which is calculated using these coefficients.

TIP *The new output quantity will only calculate valid results in methods using the same set temperature as the previously performed special adjustment.*

11.3.5.2 Special Adjustment for the Canadian Excise Alcohol Table

To use the output quantity "Canadian Excise Alcohol Table" (see Appendix F), it is necessary to perform a special adjustment with apparent density values of air and water and link that adjustment to the Canadian Excise Alcohol Table.

1. Perform a special adjustment with air and water using apparent density for the reference values.
2. Link the special adjustment to the Canadian Excise Alcohol Table (see Chapter 12.2.6).
3. Select the table for output fields, result outputs and the data browser.

11.3.6 Viewing, Printing or Exporting Adjustment Data

You can view, print and export the detailed data for the last 50 adjustments both for density and temperature.

1. Tap <Menu> and select **"Data Memory > Adjustment Data > Density + Sound Module"** and select **"Density Adjustment"**, **"Sound Adjustment"**, **"Special Adjustment"** or **"Temperature Adjustment"** to open the respective adjustment list.
2. Highlight a list item and tap <Details> to see the detailed adjustment data.
3. To perform a printout on paper or to a PDF file or to export the data as an MS Excel or Text file tap <Print or Export> and follow the instructions on the screen.

11.3.7 Viewing, Printing or Exporting Adjustment History: KB Graph

You can view, print and export the KB values for the last 50 adjustments in form of a graph.

1. Tap <Menu> and select **"Data Memory > Adjustment Data > Density + Sound Module > Density Adjustment KB Graph"**.
2. To perform a printout on paper or to a PDF file, tap <Print or Export> and follow the instructions on the screen.

   Graphs can not be printed by RS-232 printers with paper roll.

11.3.8 Resetting the Adjustment Data to Factory Adjustment

You can re-activate the factory adjustment for the density measurement.

1. Tap <Menu> and select **"Checks/Adjustments > Other Adjustments > Density + Sound Module > Reset to Factory Adjustment"**.
2. Activate the check box "Density + Sound Module" and tap <OK>.

11.4 Calibrating

The goal of a calibration is to validate the accuracy of the density and sound velocity measurement. The accuracy of the sound velocity measurement can not be validated as there are no certified liquid standards for sound velocity available.

To calibrate the instrument, measure a certified standard liquid and compare the result to the reference value indicated in the calibration certificate of the standard.

The physical properties (density, velocity of sound, viscosity) of the liquid density standards should be similar to those of the samples.

The frequency of calibrations with certified liquid density standards depends on your requirements and judgment. Recommendation: 1 to 2 calibrations per year.

NOTICE

A bad quality standard will influence your adjustment result in a negative way, leading to inaccuracy of the instrument.

- Always check the date of expiry of the calibration liquids.
- Store the calibration liquids in a cool and dark place.
- Use the calibration liquids immediately and only once after the container has been opened.

To perform a calibration

1. Perform a water check.
2. If necessary, carry out an air/water adjustment at 20 °C.
3. Thoroughly clean and dry the measuring cells.
4. Select a measuring method that is set to "20 °C" and "measurement finished by equilibrium slow".
5. Open the bottle with the liquid density standard.

TIP *If your bottle with density standard has a septum, we recommend you pierce it carefully with any clean, sharp tool and fill a Luer tip syringe with standard liquid by pushing the tip into the hole of the septum, holding the bottle upside down and slowly pulling the plunger.*

6. Immediately after opening the bottle, inject the standard into the measuring cell of your DSA 5000 M.

7. Perform a measurement.

TIP *If you have enough standard liquid, we recommend making a series of three measurements and take the arithmetic average of the results.*

8. After the measurement is finished, print the result.

9. Document the calibration procedure in a calibration protocol which contains the operator's name, date, place, description of the calibration procedure, results and the calibration certificate of the liquid density standard.

Related topics

Performing Checks: Chapter 11.2.2
Performing an Air/Water Adjustment: Chapter 11.3.1
Cleaning and Drying the Measuring Cell: Chapter 14.1
Defining and Using Methods: Chapter 12
Performing Measurements: Chapter 13.5

12 Defining and Using Methods

12.1 Measuring Methods

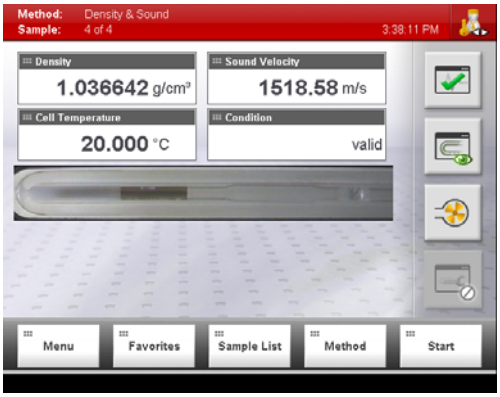
Each method contains the following kind of information:

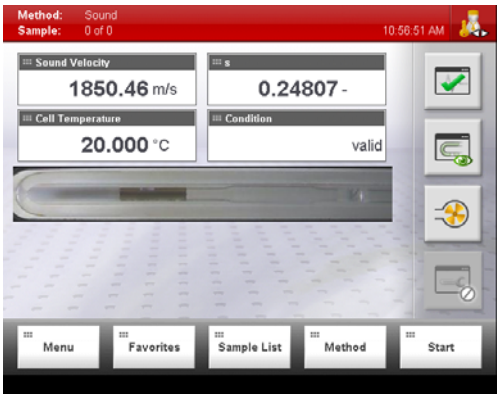
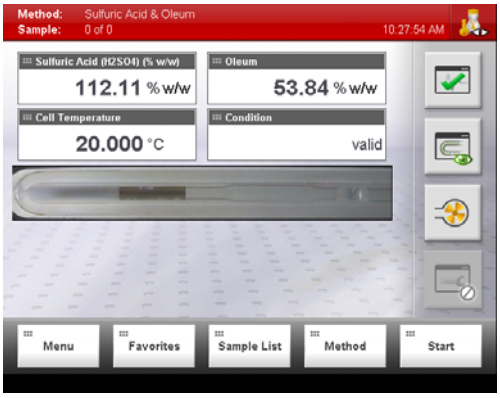
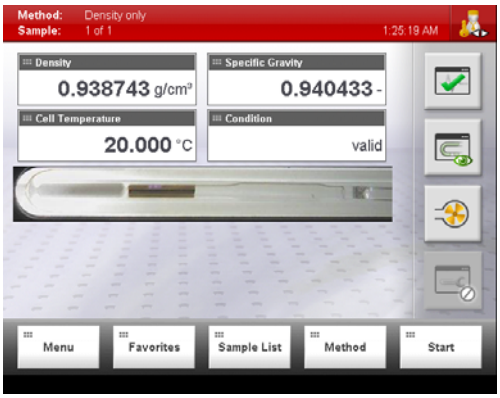
- Instrument settings
- Xsample and measuring module settings (if any module is installed)
- Layout of measuring data on the main screen
- Measuring units
- Parameter list for printout and data export

You can use the factory preset methods as they are or change them to suit your needs (see Chapter 12.2). You can also create new methods (see Chapter 12.3).

Factory preset methods

DSA 5000 M is delivered with a set of 5 predefined methods covering the most common applications. The measuring temperature for these 10 methods is set to 20 °C.

	**Density & Sound** • Density, Sound Velocity, Density Temperature, Master Condition, U-View™ • General purpose method
	**Density (not visc.-corr.) & Sound** • Density (not visc.-corr.), Sound Velocity, Density Temperature, Master Condition, U-View™ • General purpose method, for comparison with old instruments without viscosity correction

	**Sound** • Sound Velocity, s, Density Temperature, Master Condition, U-View™ • General purpose method
	**Sulfuric Acid & Oleum** • Sulfuric Acid (H_2SO_4) (% w/w), Oleum, Density Temperature, Master Condition, U-View™ • For measurement of concentrated sulfuric acid (H_2SO_4) and oleum in the range from 0 to 100 % H_2SO_4 and 0 to 65 % SO_3
	**Density only** • Density, Specific Gravity, Density Temperature, Master Condition, U-View™ • General purpose method

12.2 Changing Methods

You need administrator rights to create, edit or delete methods. Up to 50 methods can be created.

12.2.1 Defining Measuring Settings

For each method, you can set the following measuring parameters for measurements:

- Measurement finished by predetermination or temperature equilibrium (measuring cell temperature = set temperature).

  If you select **Predetermination**, the instrument finishes the measurement before temperature equilibrium was reached and calculates the density at the set temperature in advance. This saves time but makes the result less accurate.

  If you select **Equilibrium**, the measurement finishes after temperature equilibrium was established.

  With DSA 5000 M you have the choice between predetermination, equilibrium fast, equilibrium medium and equilibrium slow. The slower the equilibrium, the more accurate the results are.

- Measuring temperature.

- Timeout: If a measurement is not finished after the specified timeout, it will be aborted. The timeout count starts when temperature equilibrium is reached.

To define the density measuring settings

1. Tap <Menu> and select **"Methods > Method Settings > "Method Name" > Density Module"**.

2. Select the predetermination/equilibrium type of measurement.

3. Enter the "Measuring Temperature".

4. Define the "Timeout".

5. Use the drop-down box "FillingCheck™" to select one of the options:

   - always active
   - active during a measurement
   - not active

6. Tap <OK>.

To define the sound velocity measuring settings

1. Tap <Menu> and select **"Methods > Method Settings > "Method Name" > Sound Module"**.

2. Select the period criterion.

3. Select the time criterion and tap <OK>.

12.2.2 Defining the Displayed Output Fields

For each method, you can select the number and content of output fields on the display.

TIP *We recommend having always the output field "Master Condition" in addition to the measurement values on the screen.*

To define the number of output fields

When switching to another display layout, the contents of the output fields of the previous display layout are transferred to the new layout.

1. Tap <Menu> and select **"Methods > Method Settings > "Method Name" > Display Layout"**.

2. Highlight a list item and tap <OK>.

To define the content of output fields

You can directly change the content of output fields in the main screen. The changes are automatically saved in the current method.

1. Tap on the output field.

2. Select the "Group", "Quantity", "Unit" and number of "Digits" and tap <OK>.

TIP *Before you use the output quantity "Canadian Excise Alcohol Table" of the group "Ethanol Tables" (see Appendix F), it is necessary to perform a special adjustment with apparent density values of air and water (see Chapter 11.3.5.2) and to link that adjustment to the Canadian excise alcohol table (see Chapter 12.2.6).*

12.2.3 Defining the Result Output

You can define the list of output quantities for printouts and data exports. You can change the settings any time and repeat the printout of saved results, if required.

If no output quantities are selected, the data browser settings are used instead (see Chapter 15.2).

1. Tap <Menu> and select **"Methods > Method Settings > "Method Name" > Result Output"**.

2. Tap on the list item that you want to change or on the empty field at the bottom of the list if you want to add an item.

The row is highlighted.

3. Tap on the highlighted list item to get to the "Change Quantity" dialog.
4. Use the drop-down boxes to define the "Group", "Quantity", "Unit" and the number of "Digits".
5. Tap <OK>.

To change the sequence of the result output items

1. Tap <Menu> and select **"Methods > Method Settings > "Method Name" > Result Output"**.
2. Highlight a list item and use the up/down arrows in the right column to change the position of the list item.
3. Proceed so with all other list items whose position you want to change and tap <OK>.

12.2.4 Defining Limits

Limits can be set for any parameter separately, e.g. density, sulfuric acid etc.

If any of the selected quantities is out of the limited range, you will be warned with the yellow warning sign in the quick access area and a message in the "Diagnosis" window.

NOTICE
Limits are only applied in the measuring mode but not in the monitor mode.

To define limits

1. Tap <Menu> and select **"Methods > Method Settings > "Method Name" > Limits"**.
2. Select the quantity to be monitored in the column "Quantity".
3. Define the "Lower" and "Upper" limit for the selected quantity.
4. Tap <OK>.

12.2.5 Defining Multiple Measurements

Using multiple measurements enables you to perform several measurements automatically. A single entry in the sample list starts a series of up to 10 measurements of a sample and calculates the average value of these measurements.

Multiple measurements create an additional entry in the data memory as not only the single measurements but also the average values are calculated and stored.

NOTICE
If multiple measurements are activated for a certain method, it is no longer possible to define a temperature scan for the specific method in the sample list.

To define multiple measurements

1. Tap <Menu> and select **"Methods > Method Settings > "Method Name" > Multiple Measurement Settings"**.
2. Select the number of multiple measurement cycles.
3. Tap <OK>.

12.2.6 Defining Formula Parameters

You can enter formula parameters to define which special adjustment shall be used for the Canadian Excise Alcohol Table.

The input quantity for the Canadian excise alcohol table can be defined as:

- Special Adjustment 1, ..., 5 (see Chapter 11.3.5.2)

To define formula parameters

1. Tap <Menu> and select **"Methods > Method Settings > "Method Name" > Formula Parameters"**.
2. Select the special adjustment for the Canadian Excise Alcohol Table.
3. Tap <OK>.

12.2.7 Defining Quick Setting Parameters

Quick settings function

The quick settings function allows you to easily access different parameters concerning your measurement without changing the current method.

The quick settings comprise several measuring settings or functions and are available in all sample list modes. See Appendix G for an overview on the parameters that can be defined as quick settings.

Depending on the sample list mode, different quick setting parameters are set by default:

- If the "No Sample List" mode is used: Sample name, measurement type ("Type") and "Density Temperature"
- If the "Sample List" mode is used: Measurement type and "Density Temperature"

Additional parameters can be added to your quick settings for every method. Activated user-defined data fields (see Chapter 10.3) and user functions of the "Constant" type (see Chapter 16.3) will be automatically added to your quick settings.

If you have connected one or more Anton Paar measuring modules to your master instrument, the range of parameters that can be added to your quick settings will be extended. See the instruction manual of your measuring module for information on the available parameters.

To set a quick setting parameter

1. Tap <Menu> and select **"Methods > Method Settings > "Method name" > Quick Settings Management"**.
2. Tap the insert field in the free line.
3. Use the "Quantity" drop-down box to select the desired parameter and tap <OK>.
4. Tap <OK> to save the settings.

To change the sequence of the quick setting parameters

1. Tap <Menu> and select **"Methods > Method Settings > "Method name" > Quick Settings Management"**.
2. Highlight a parameter and use the up or down arrow in the "Order" column to change the position of the parameter in the list.
3. Tap <OK> to save your settings.

To delete a quick setting parameter

TIP *The parameters "Sample name" and "Type" can not be deleted.*

1. Tap <Menu> and select **"Methods > Method Settings > "Method name" > Quick Settings Management"**.
2. Highlight the parameter you want to delete and tap <Delete>.

12.3 Creating, Deleting, Hiding and Arranging Methods

You can copy, rename, hide and delete methods. The maximum number of methods is 50.

To create a new method, make a copy of the existing method which has the most similar method settings to the one you want to create. Then rename the new method and change its method settings to your needs.

NOTICE
Creating, deleting, hiding and arranging methods affects the position numbers in the method list. If you use bar codes for assigning methods, check the position numbers of your methods after these actions.

To copy a method

1. Tap <Menu> and select **"Methods > Method Management"** to open the method list.
2. Highlight a method name and tap <Copy>.

   A new method is created with the same method name as the original one and an additional number in brackets.

   The new method is saved in the last position of the method list.

To rename a method

1. Tap <Menu> and select **"Methods > Method Management"** to open the method list.
2. Highlight a method name and tap <Rename>.
3. Enter the new method name.
4. Tap <OK>.

To delete a method

1. Tap <Menu> and select **"Methods > Method Management"** to open the method list.
2. Highlight a method name and tap <Delete>.

TIP *You can not delete the currently used method. Change the method (see Chapter 12.4) and then delete the desired method.*

To set methods visible or invisible

If a method is set invisible, you can not select this method any longer in the method list and the method settings.

1. Tap <Menu> and select **"Methods > Method Visibility"**.
2. Highlight a method.
3. Enable the check box to set the method visible or disable the check box to set the method invisible.
4. Tap <OK>.

To change the sequence of the method list

1. Tap <Menu> and select **"Methods > Method Visibility"**.
2. Highlight a method and use the up and down arrows in the "Order" column to change the position of the method in the list.
3. Proceed so with all other methods whose position you want to change and tap <OK>.

12.4 Selecting the Method

You can select the method using the <Method> button at the main screen or using the respective column in the sample list.

To select a method with the <Method> button

1. Tap <Method> to open the methods list.
2. Highlight a method either by tapping on its name or by using <▲> and <▼> and tap <OK>.

Related topics

Making a Backup of the Instrument Settings: Chapter 17.1

13 Measuring

In this chapter, the filling of samples and the measuring procedure including the detection of bubbles are described.

13.1 General Sample Settings

Sample name

If you have defined automatic sample name parts (see Chapter 10.3), they will be added to each sample name after measurement has been finished.

The complete sample name, including automatic sample name parts, may consist of up to 50 characters.

Measurement types

S (Standard)	To perform a standard measurement
C (Check)	To perform one of the predefined checks. It is only possible to select a check which has been defined for the selected method before.
MM (Multiple Measurements)	To perform several 2 to 10 measurements of a single sample automatically.
TS (Temperature Scan)	To perform a temperature scan.

- If you select "C (Check)", tap the column "Unit/Settings" and select one of the defined checks (Air Check and Water Check are predefined).
- If you select "MM (Multiple Measurements)", tap the column "Unit/Settings" and enter a value between 2 and 10.
- If you select "TS (Temperature Scan)", tap the column "Unit/Settings" and enter the "Start", "Step" and "End" temperature of the temperature scan.

  Make sure to set the temperature step interval so that the instrument can reach the end temperature by a whole number of steps (divide the interval between start and end temperature by whole numbers only to find appropriate step settings).

  The minimum step size in temperature scans depends on the defined type of equilibrium (Measurement finished by) of the density module:

Measurement finished by	Minimum step size
Predetermined	1 °C
Equilibrium fast Equilibrium medium Equilibrium slow	0.02 °C 0.01 °C 0.005 °C

13.2 Using the "No Sample List" Mode

If no sample changer or a sampler changer without magazine is connected, the simple mode is set by default (see Chapter 10.3). You only need to tap <Start> to start a measurement.

You can use the quick settings function to do the following:

- Enter a sample name and select a measurement type.
- Override available method settings for the following measurement(s) (see Chapter 12.2.7).

To change the sample settings

The last defined settings are maintained for all following measurements until changes are made anew.

1. Tap <Quick Settings>.
2. Enter a sample name using the corresponding input field if needed.
3. Define your parameters if needed.
4. Tap <OK>.

13.3 Using the "Sample List" Mode

The sample list is a tool that helps you managing samples that you want to measure.

- No results are stored in the sample list but using the <Single Sample> button in the sample list links you to the data memory and you can view the results of already measured samples in the sample list.
- You can define temperature scans in the sample list.
- Checks can also be started from the menu "Checks/Adjustments".
- Standard measurements can also be started from the main screen.

Number of entries

The sample list can contain up to 200 entries. The 201st entry overwrites the oldest entry. Entries older than 24 hours are automatically removed.

The sample list will be automatically cleared if you switch off the instrument.

NOTICE
In the "Sample List" mode and "Simple" mode, each measurement is entered into the data memory and the sample list. The maximum data storage volume of 1000 data is calculated from the already measured samples (data memory) plus the samples in the sample list. Therefore, regularly clear the sample list and the data memory.

To create or edit a sample list

TIP *If you have activated user-defined data fields (see Chapter 10.3), the data fields are shown in columns.*

1. Tap <Sample List> to open the sample list window.
2. To enter a sample name, tap on a cell in the column "Name".
3. Tap on a cell in the column "Method" and select a method from the drop-down list.
4. Tap on the ... icon in the column "Quick Settings" and select measurement type and measurement settings as desired.
5. To exit the sample list and save the changes, tap <Main Screen>.

To edit or delete a sample in the sample list

TIP *You can not edit or delete samples in the sample list that have already been measured.*

- To edit a sample, highlight the row and change the settings as desired.
- To delete a sample from the list, highlight the sample and tap <Delete Sample>.
- To exit the sample list and save the changes, tap <Main Screen>.

To save a sample list

1. Tap <Sample List> and then <List Management>.
2. Select **"Save Sample List"** and then <OK>.
3. Choose one of the 10 available entries in the drop-down list "Sample list templates".
4. Tap <Rename> and enter a name for your sample list.
5. Tap <OK>.

To load a sample list

1. Tap <Sample List> and then <List Management>.
2. Select **"Load Sample List"** and then <OK>.
3. Choose one of the ten sample lists in the drop-down list "Sample list templates".
4. Tap <OK>.

To clear the current sample list

1. Tap <Sample List> and then <List Management>.
2. Select **"Clear Sample List"**.

   After the sample list was cleared, the symbol on the diagnosis quick access button may change: If the symbol was the yellow alarm signal or the red lightning, they will change to the green check.

Related topics

Setting Sample List Options: Chapter 10.3

13.4 Filling Samples

To achieve highly accurate measuring results, fill the samples into the measuring cell homogeneously and without bubbles.

CAUTION
Filling samples and cleaning liquids which the wetted parts are not resistant to will corrode the wetted parts. Sample leaking from corroded parts may cause serious injuries.
Before filling any sample or cleaning liquid into your DSA 5000 M:

- make sure that all safety instructions concerning the use of chemicals and the use of flammable chemicals are met (see Chapter 2 and Chapter 13.7). Borosilicate glass is not resistant to samples containing hydrofluoric acid, even in traces.
- make sure all wetted parts are resistant to it (see Appendix A.3).
- make sure that you have suitable cleaning fluids at hand for cleaning the measuring cells (see Chapter).
- if a sample changer is connected check the resistance of the wetted parts. For information about the materials, see the corresponding instruction manual of the sample changer.

NOTICE
Samples with a moderate tendency to corrode borosilicate glass such as strong alkali solutions (e.g. caustic soda) can be measured with the DSA 5000 M.

- However, take care to remove such samples immediately after measurement and rinse the measuring cells properly.
- Check the validity of the adjustment more frequently than generally recommended.
- Perform a new adjustment, if necessary.
- The measuring temperature for strong alkali solutions should not be higher than 20 °C. Higher temperatures dramatically increase the speed of corrosion.

Important for high accuracy measurements

If you use a syringe to fill the instrument, we recommend using a 2 mL syringe only to fully utilize the instrument's accuracy. Inject the entire sample volume. The syringe can stay connected to the filling adapter during the measurement.

Make sure to apply exactly the same filling procedure for checks, adjustments and measurements.

Sample amount

If the measuring cell is clean and dry, you need approx. 3 mL of sample.

If you are measuring without cleaning and drying between the samples, you need a higher amount of sample because you have to flush residues of the previous sample out of the measuring cell to avoid cross-contamination.

Bubble detection using the camera (U-View™)

1. Tap the  button in the quick access area to open the live camera view of the measuring cell.
2. Tap <Zoom In> to get a magnified view.
3. Attach a USB flash drive and tap <Save Picture> to save the current picture.
4. Tap <X> to exit the measuring cell view.

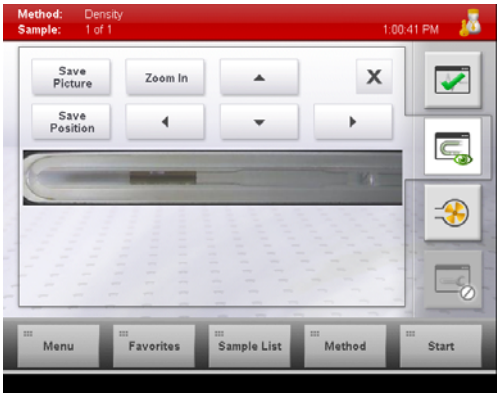


Fig. 13 - 1 Camera window

To fill with a glass syringe (Luer tip) - for sulfuric acid and oleum measurement

Fig. 13 - 2 Filling with a glass syringe

NOTICE

- To avoid sample flowing from the waste container backwards to the instrument the waste container must be below the level of the filling adapter of the instrument.
- Acid drops will destroy the surface of the instrument. Never put any sulfuric acid containers on top of the instrument.
- It can not be avoided that acid drops emerge from the measuring cells when filling with a syringe. Place an acid-proof catch basin underneath the filling equipment.
- Inserting the glass tip of the syringe directly into the inlet adapter as done with the plastic syringe in Fig. 13 - 3 may result in the fracture of the tip. Do not insert the syringe directly into a Teflon adapter.

1. Connect a short piece of Viton hose to the inlet adapter.

2. Connect the glass syringe to the other end of the Viton hose.

To fill with a plastic syringe (Luer tip)

NOTICE
Do not use syringes that contain lubricants. The lubricants can dissolve into your sample and lead to a systematic measuring error.

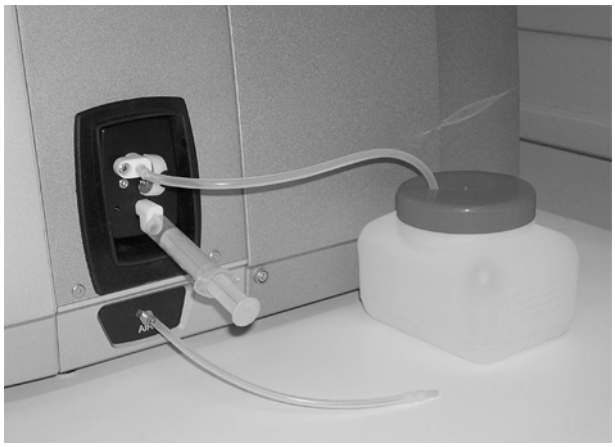


Fig. 13 - 3 Filling with a plastic syringe

1. Connect the syringe to the sample inlet adapter, which is the lower one.
2. Push the plunger of the syringe slowly and continuously until a drop emerges from the sample outlet adapter.

   A sample amount of approx. 3 mL is necessary.
3. Leave the syringe in the filling position during the measurement.

To fill with a peristaltic pump

NOTICE
- The liquid levels in the sample container and waste container must be below the filling level of the instrument. Never put the peristaltic pump or waste container on top of the instrument.
- Check the hoses of the peristaltic pump daily.
- Check the life time of the hoses specified by the supplier and change the hose frequently.

1. Mount an adapter Luer cone to a silicone hose (3 x 5 mm).
2. Connect the adapter Luer cone plus silicone hose to the sample inlet adapter and lead the silicone hose into the sample container.
3. Mount a second adapter Luer cone to a second piece (approx. 700 mm long) of the 3 x 5 mm silicone hose.

4. Connect the adapter Luer cone plus silicone hose to the sample outlet adapter and lead the silicone hose via the peristaltic pump to a waste vessel.

5. Set the flow rate to 10 to 25 mL per minute.

6. Start the pump.

7. Turn off the pump after filling a sufficient amount of sample.

To fill automatically with an Xsample

For details, see the respective Xsample instruction manual.

Related topics

Safety instructions: Chapter 2
Special filling techniques: Appendix B.2

13.5 Performing Measurements

To speed up measurements

- Automatic sample naming: See Chapter 10.3.
- Prethermostatting: Prethermostat your samples to the measuring temperature before injection to reduce the time necessary for the temperature equilibration.
- Predetermination option: Using this option reduces the measuring time substantially (see Chapter 12.2.1).

To perform a measurement

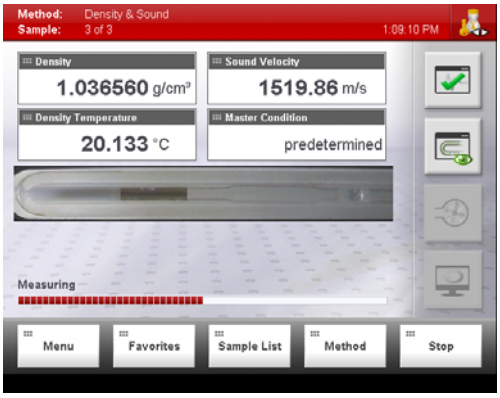
1. Before starting a measurement, check if:
   - the hoses are connected correctly
   - the hose connections are tight
   - the waste hose leads into the waste container
   - the waste container’s volume is large enough for the number of samples
   - the correct sample names are entered
   - the method settings are set correctly
   - suitable cleaning liquids are available.

2. Fill the measuring cell with sample.

3. Enter a sample name if required.

4. Tap <Start> and wait until the measurement is finished.

   The progress bar shows the progress of the measurement with a growing red bar and the message "Measuring".



During measurements the last 1, 2 or 3 digits might be gray colored. This means that the set temperature has not been reached yet. In that case, only the black colored digits are valid. The number of valid (black colored) digits increases during measurement progress until all digits are black (when using equilibrium mode).

When the measurement is finished, the progress bar turns green, the message "Finished" is displayed and an acoustic signal is given. The "Master Condition" output field shows the message "valid".

The result values are frozen. The display can be unfrozen by tapping the  button.

The result values are saved in the data memory and can be viewed, printed, exported or deleted.

5. Measure the next sample or clean and dry the instrument.

Related topics

Safety Instructions: Chapter 2
Mounting the Hoses: Chapter 7.4
Measuring Methods: Chapter 12.1
Using the "Sample List" Mode: Chapter 13.3
Filling Samples: Chapter 13.4
Cleaning and Drying the Measuring Cell: Chapter 14.1
Handling the Measurement Data: Chapter 15
Measuring at High Humidity/Low Temperature Conditions: Appendix C.1
Measuring at Low/High Temperatures: Appendix C.2
Degassing Samples: Appendix B.1

13.6 Filling and Measurement Errors

13.6.1 Status Messages

Density/Sound condition

The output fields "Master Condition", "Density Condition" and "Sound Condition" give information about the current status of measurement and may show the following messages:

temp. equilibration	Appears during temperature equilibration. In this stage no predetermined result can be determined by the instrument.
predetermined	Appears before the exact measuring temperature has been reached and the instrument can determine a predetermined result.
valid	Appears when the measuring temperature has been reached and the measurement has been taken.

Sample status icons

In the first column of the sample list, you find an icon for each sample that has already been measured. The icon indicates the status of the sample:

	The sample was successfully measured.
	Reduced precision due to e.g. a filling error.
	No result due to a malfunction.

13.6.2 Error Messages

Automatic bubble detection (FillingCheck™)

If a bubble has been detected anywhere in the U-tube in real time, the "Master Condition" output field shows "Filling Warning" or "Error: No Oscillation" for the current sample and the diagnosis quick access button changes: Instead of the green check mark, the yellow alarm sign is displayed.

Note: For complete transparency and traceability of your sample filling and measurement process, check the filling visually by means of the built-in camera (U-View™) in addition to the fully automatic FillingCheck™.

TIP *FillingCheck™ provides excellent support to the operator for samples of low and medium viscosity ranges. High viscous samples above 3000 mPa·s, which firmly enclose contained air bubbles, might not be analyzed correctly and generate a filling warning even if filled without bubbles.*

Diagnosis window

The appearance of the <Diagnosis> quick access button indicates the current error status (see the section "Quick access buttons" in Chapter 6.4). Tapping the button opens the diagnosis window where the general status of DSA 5000 M and the measuring errors that occurred within the current sample list are displayed.

13.7 Measuring Ternary Solutions

13.7.1 General Description

Ternary solutions are fluid three-component systems consisting of

- a component A with the concentration A,
- a component B with the concentration B and
- a solvent, typically water.

For certain ternary solutions both concentrations can be determined by measuring the density and velocity of sound.

13.7.2 Calculations

Each concentration is calculated from polynomials up to the third order, each of which is based on the relative density and velocity of sound deviation to water at the measuring temperature.

For the concentration calculation of ternary solutions, two 2D polynomials are required, one for determination of concentration A and one for determination of concentration B. The concentrations are calculated based on the 2D polynomial formula stated in Chapter 16.3. You have to insert the "d" value (density number, d) for "x" and the "s" value (sound number, s) for "y".

The density number (d) is equal to the relative density deviation of the sample from water at the measuring temperature: If degassed bi-distilled water is measured, the density number (d) must be 0 ±0.00010.

The sound number (s) is equal to the relative sound velocity deviation of the sample from water at measuring temperature: If degassed bi-distilled water is measured, the sound number (s) must be 0 ±0.00010.

For calculating the polynomial coefficients, it is necessary to measure the (d) and (s) values of a large number of samples of known concentrations within the entire concentration range of interest. All measurements have to be performed at the same measuring temperature.

Based on these (d) and (s) values and the corresponding reference concentrations A and B, the coefficients have to be calculated by means of a two-dimensional regression using e.g. the least square fit method.

Contact your local Anton Paar representation if further information or support is required.

13.7.3 Setting up a Method for Measuring Ternary Solutions

As this evaluation method is strongly application dependent and has to be verified for every individual ternary solution, you have to enter an individual measuring method for each ternary solution type.

1. Define a user function for concentration A on your DSA 5000 M (see Chapter 16.3).

   Proceed as follows:

   - Select "2D Polynomial" as the function type.
   - Enter or choose a physical quantity.
   - Select "d" (density number) and "s" (sound number) as the input quantities.
   - Enter the polynomial coefficients.

2. Repeat this procedure for concentration B.

3. Create a new method (see Chapter 12.3) and select your two user functions as result output quantities.

13.8 Measuring Sulfuric Acid and Oleum

13.8.1 General Description

DSA 5000 M is designed to measure the concentration of pure sulfuric acid and oleum (fuming sulfuric acid) in the range of 0 to 100 % H_2SO_4 and 0 to 65 % SO_3.

The concentrations are automatically derived from density or sound velocity measured by the instrument.

The samples are filled into the measuring cells using a glass syringe or a peristaltic pump and Viton hoses which are resistant to concentrated sulfuric acid and oleum.

13.8.2 Additional Safety Instructions

Beside the safety instructions from Chapter 2, the additional safety instructions below have to be followed when measuring sulfuric acid and/or oleum:

WARNING

Oleum (fuming sulfuric acid) and sulfuric acid are highly caustic substances which may cause irritations and serious injuries to skin, eyes and mucous membranes.

- Follow all the precautions for the handling and measurement of samples and cleaning materials written below. The list does not cover all regulations and safety procedures. Safety standards are available from government agencies and various chemical associations.
- Working with oleum and sulfuric acid requires special training of employees. Make sure that all employees handling these hazardous substances are periodically instructed in all handling, safety and emergency procedures.
- Ensure that all operators are fully trained in the correct use of the instrument and its safe operation.
- Always wear protective clothing and eye protection (protective goggles or face shield) when handling oleum or sulfuric acid.
- Make sure there is fire extinguishing equipment, first aid kits, overhead drench showers and eye baths within reach.

WARNING

Mixing oleum or concentrated sulfuric acid with water or organic solvent will cause a very strong exothermic reaction with the danger of serious injuries. An exothermic reaction within the measuring cells may destroy them.

- Never mix oleum or concentrated sulfuric acid with water nor dilute acid in the measuring cells.
- Always dilute oleum by adding it drop by drop to 98 % H_2SO_4 while stirring and cooling.
- Dilute concentrated H_2SO_4 by adding it drop by drop to water while stirring and cooling.
- Before filling any kind of sulfuric acid or oleum into the instrument, make sure that the measuring cells have been cleaned and dried or that they already contain concentrated sulfuric acid or oleum.
- Do not fill concentrated sulfuric acid or oleum into the measuring cells if there is still water, organic solvent or dilute acid in the cells.

WARNING

Oleum and concentrated sulfuric acid react with oxidizable organic materials and solvents, reducing agents, chlorates, permanganates, ammonia, oxides and hydroxides of alkali and alkaline earth metals. The chemical reaction may lead to serious injuries or may destroy objects containing those substances.

- Never bring oleum or concentrated sulfuric acid into contact with those materials and substances.
- Always use separate waste containers for sulfuric acid waste and ethanol (or other solvent) waste.
- Label the waste containers properly, so that no mix-ups are possible.
- Make sure that the material of the sulfuric acid waste container is resistant to sulfuric acid and oleum.
- Clean all spillages immediately.
- Do not leave sample containers uncovered.
- Do not leave the instrument unattended while in use.
- Operate the instrument in a fume hood or a sufficiently ventilated area free from flammable gases and vapors.

13.8.3 Setting the Correct Temperature

After having selected the correct measuring method "Sulfuric Acid & Oleum" (see Chapter 12.4), the measuring temperature has to be set to either 20 °C or 40 °C (see Chapter 12.2.1). The temperature is set to 20 °C by default.

If all samples have concentrations of 27 % free SO_3 and below, then 20 °C should be selected as the measuring temperature. All samples are liquid at this temperature.

If samples with concentrations of more than 27 % free SO_3 have to be measured regularly, then 40 °C has to be selected as the measuring temperature. This switches the instrument's firmware to full range evaluation from 0 % H_2SO_4 to 65 % SO_3.

Note that measurements at 20 °C take considerably less time than measurements at 40 °C.

13.8.4 Filling Sulfuric Acid and Oleum Samples

You can fill sulfuric acid and oleum either via a glass syringe or semiautomatic by using an external peristaltic pump. For details, see Chapter 13.4. Consider the additional hints when filling sulfuric acid/oleum.

NOTICE

Mixing concentrated sulfuric acid or oleum with water, organic solvent or dilute acid causes an exothermic reaction. An exothermic reaction within the measuring cells may destroy them.

- Before filling any kind of sulfuric acid or oleum into the instrument, make sure that the measuring cells have been cleaned and dried or that they already contain concentrated sulfuric acid or oleum.
- Do not fill concentrated sulfuric acid or oleum into the measuring cells if there is still water, organic solvent or dilute acid in the cells.

Oleum samples with 28 % to 58 % of free SO_3 may freeze within the sample containing parts such as hoses, sample containers, etc. at temperatures below 35 °C.

- Keep the sample containing parts at a temperature above 35 °C to avoid the sample freezing.

In case of not properly fixed or not resistant hoses, sample could leak onto the bench and cause corrosion.

- Place the peristaltic pump in an acid-proof catch basin for safety reasons.
- Never use hoses which are not resistant to sulfuric acid and oleum.

TIP *If you measure a series of samples of very similar concentrations, you can displace the previous sample by the new sample. The minimum amount necessary to fully replace the old sample is*

- *approx. 10 mL of new sample when filling by syringe*
- *approx. 25 mL of new sample when filling by peristaltic pump.*

13.8.5 Calculations

For basic information to the measuring principle see Chapter 3.

The calculation of the concentration of sulfuric acid % w/w is done using a function of the density number (d) or the sound velocity number (s), depending on the concentration range.

The density number (d) is equal to the relative density deviation of the sample from water at the measuring temperature: If degassed bi-distilled water is measured, the density number (d) must be 0 ±0.00010.

The sound number (s) is equal to the relative sound velocity deviation of the sample from water at measuring temperature: If degassed bi-distilled water is measured, the sound number (s) must be 0 ±0.00010.

The following table shows for the measuring temperatures 20 °C and 40 °C in which concentration ranges the density or sound number is used for the calculation.

Temperature	Density number	Sound number
20 °C	0 - 87 % H_2SO_4 0 - 27 % free SO_3	87 - 100 % H_2SO_4
40 °C	0 - 90 % H_2SO_4 0 - 47 % free SO_3	90 - 100 % H_2SO_4 47 - 65 % free SO_3

Fig. 13 - 4 shows the density and sound velocity graphs of sulfuric acid and oleum for the whole concentration range at a measuring temperature of 40 °C.

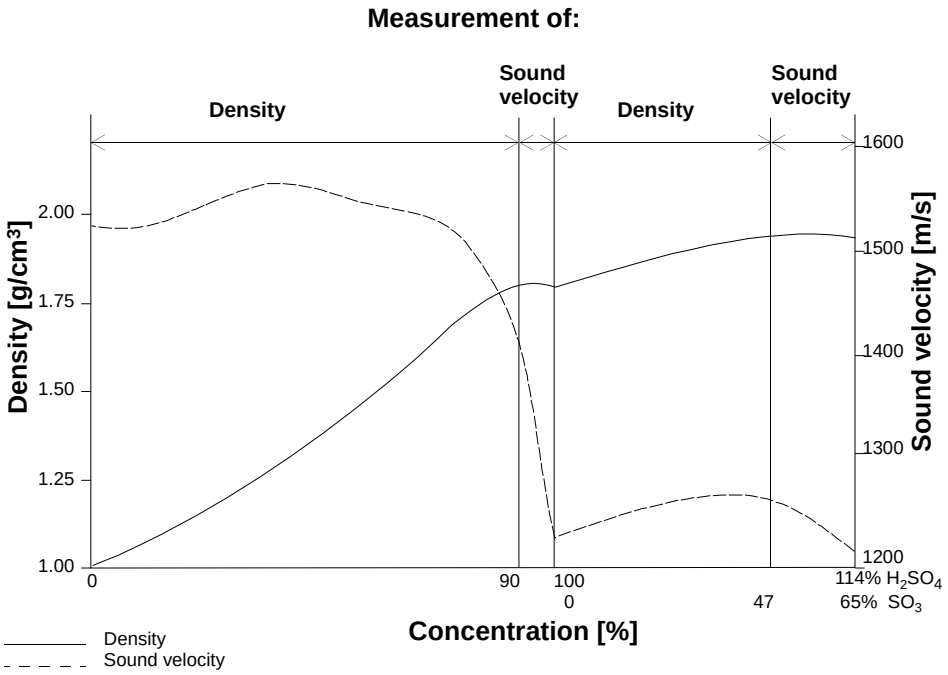


Fig. 13 - 4 Density and sound velocity of sulfuric acid and oleum at 40 °C

The concentration of free SO_3 % w/w is calculated from the concentration of sulfuric acid according to:

$$\%\ \text{free}\ SO_3 = \frac{MW_{SO_3} \times (\%\ H_2SO_4 - 100)}{MW_{H_2O}} = 4.444 \times (\%\ H_2SO_4 - 100)$$

MW ... Molecular weight

13.8.6 Correction Possibilities for Calculated Analysis Results

If mean deviations between the analysis results of DSA 5000 M and a reference method occur, the corrections can be stored as a special function. The corrections will automatically be applied to the results.

1. Create a new user function (for details see Chapter 16.3).
2. Specify if you want to apply your correction via entering a formula, a polynomial or a table.
3. Define either "Sulfuric Acid (H_2SO_4)" or "Oleum" as the input quantity.
4. Specify:
   - a correction formula in case of "user formula"
   - correction coefficients in case of "polynomials"
   - table values in case of "user tables".
5. Tap <OK>.

14 Cleaning and Storing the Instrument

To assure a constant and high accuracy of your measurements, employ a regular and effective cleaning routine and store the instrument under the recommended conditions.

WARNING

Before filling any sample or cleaning liquid into your DSA 5000 M, make sure that:

- all safety instructions concerning the use of chemicals and the use of flammable chemicals are met (see Chapter 2).
- all wetted parts are resistant (see Appendix A.3).

WARNING

Cleaning the measuring cells after measurement of sulfuric acid and oleum samples requires special precautions. If these are not adhered to, serious injuries and damage of goods are possible.

- For details, see Chapter 14.2

NOTICE

Do not use any mechanical action for cleaning the measuring cell.

Cleaning frequency

Clean and dry the measuring cell at least after each working day or working shift.

Cleaning more frequently can be necessary when

- you perform adjustments
- you measure a sample that is not miscible with the previous sample (e.g., water after a petrochemical sample)
- you want to measure using a minimum sample amount
- you measure a sample that could chemically react with the previous sample

14.1 Cleaning and Drying the Measuring Cell

Cleaning liquids

For cleaning and drying after standard measurements with harmless samples, employ two cleaning liquids:

- Cleaning liquid 1 dissolves and removes sample residues in the measuring cell. It has to be a good solvent for all sample components.

- Cleaning liquid 2 removes cleaning liquid 1 and is easily evaporated by a stream of dry air in order to accelerate drying of the cell. Cleaning liquid 2 has to be a good solvent for cleaning liquid 1.

Recommended for aqueous samples and beverages: water (cleaning liquid 1) and non-denatured ethanol (cleaning liquid 2).

Recommended for petrochemical samples: petroleum naphtha (cleaning liquid 1) and acetone (cleaning liquid 2).

If you are not sure if a cleaning liquid is suitable for your sample, perform a preliminary test in a test tube to see if any phase separation, precipitate or opalescence can be observed.

To perform a cleaning and drying procedure without Xsample filling equipment

1. Rinse the measuring cell with cleaning liquid 1 (minimum 5 mL).

   If your sample is viscous or contains particles, use more cleaning liquid.

2. Empty the measuring cell.

3. Rinse the measuring cell with cleaning liquid 2 (minimum 5 mL).

4. Empty the measuring cell.

5. Insert the air pump hose with the adapter Luer cone into the sample inlet injection adapter.

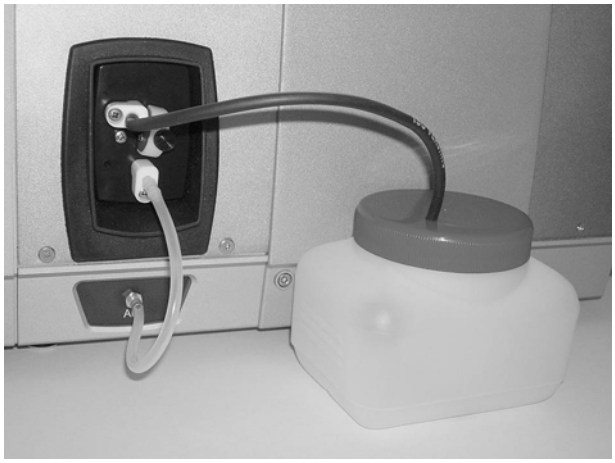


Fig. 14 - 1 Drying the measuring cells

6. Tap the  button in the quick access area to start the air pump.

7. Wait until the measuring cell is dry (stable density reading).

The time needed depends on the vapor pressure of your cleaning liquid 2 and the temperature of the measuring cell (Ethanol at 20 °C: approx. 5 min., Acetone at 20 °C: approx. 3 min.).

If the ambient humidity is larger than 90 % relative humidity, use a drying cartridge (see Appendix C.1) to reduce the drying time.

8. Tap the  button in the quick access area to stop the air pump or wait for the pump time out.

9. Disconnect the air pump hose from the sample inlet adapter.

To perform a cleaning and drying procedure with Xsample filling equipment

For details, see the respective Xsample instruction manual.

Related topics

Safety Instructions: Chapter 2
Performing Checks: Chapter 11.2.2
Air Pump Settings: Chapter 10.1.4
Measuring at High Humidity/Low Temperature Conditions: Appendix C.1

14.2 Cleaning and Drying the Measuring Cells after Sulfuric Acid/Oleum Measurements

WARNING

The mixture of oleum or concentrated sulfuric acid with water or solvents will cause very strong exothermic reaction which may destroy the measuring cells and/or cause serious injuries.

- Never flush out oleum or concentrated sulfuric acid with water.
- Make sure samples of very different concentrations do not come into contact with each other. Therefore use only 98 % H_2SO_4 to remove oleum, remove 98 % H_2SO_4 only with 70 % H_2SO_4, and remove 70 % H_2SO_4 with 40 % H_2SO_4. Then water may be used to rinse the cells.
- Always use separate waste containers for sulfuric acid waste and ethanol (or other solvent) waste. Label the waste containers properly to avoid mix-ups.
- Always place the waste containers in such a way that the liquid level is below the level of the filling adapter of the instrument.
- Never flush sulfuric acid waste and ethanol (or other solvent) waste down the sink.
- Always dispose of the waste according to regional laws and regulations.
- Place the waste containers behind a safety shield and in a catch basin.

NOTICE

Residues of sample on the filling adapters will cause corrosion or inaccuracy of results. While cleaning, leave the filling adapters on the instrument, so that they are cleaned together with the cell.

When the air pump sucks air with high humidity into the measuring cells or the ambient temperature is much lower than the measuring temperature, condensation could build up within the measuring cells, bearing the danger of an exothermic reaction when sulfuric acid or oleum is filled. An exothermic reaction may destroy the measuring cells.

- Use a drying cartridge (desiccator) to help completely dry the cells (see Appendix C.1). The cartridge has to be attached to the "DRY AIR IN AIR PUMP" connector at the rear of the instrument with a short piece of Viton hose.

To clean and dry the cells using a syringe

WARNING

Syringes made from polypropylene/polyethylene are not resistant to oleum and concentrated sulfuric acid and will corrode. Sample may leak from the corroded parts and cause serious injuries.

- Do not use polypropylene/polyethylene syringes for oleum and H_2SO_4 with concentrations higher than 95 %.
- Only use glass syringes with Teflon-sealed plungers for the concentration range of 95 % to 100 % H_2SO_4 and for oleum.

1. Fill the syringe with sulfuric acid of the proper concentration (see warning above).
2. Connect the syringe to the Viton filling hose and slowly inject the liquid into the cells. Leave the syringe plugged to the filling hose.
3. Remove the liquid from the measuring cells by slowly pulling back the plunger of the syringe.
4. Unplug the syringe and drain its contents into the sulfuric acid waste container.
5. Repeat steps 1 to 4 with sulfuric acid of decreasing concentrations until it is safe to rinse with water (concentration of H_2SO_4 40 % or below).
6. Applying the same method, rinse with at least 30 mL of water.
7. Exchange the sulfuric acid waste bottle with an ethanol waste bottle.
8. Rinse with at least 20 mL of 96 % ethanol.
9. Attach the air hose with the Luer adapter cone to the filling hose.

10. Tap the  button in the quick access area to start the air pump.
11. Wipe the sample outlet hose dry of traces of ethanol and put it into a sulfuric acid waste bottle if sulfuric acid is to be filled into the measuring cells.
12. Tap the  button in the quick access area to stop the air pump or wait for the pump time out.
13. Disconnect the air hose from the filling hose.
14. Fill in the new sample for measuring (see Chapter 13.5).

To clean and dry the cells using a peristaltic pump

1. Fill the cells with sulfuric acid of the proper concentration (see the warnings above).
2. Repeat step 1 with sulfuric acid of decreasing concentrations until it is safe to rinse with water (concentration of H_2SO_4 40 % or below).
3. Rinse with a minimum of 30 mL of distilled water.
4. Exchange the sulfuric acid waste bottle with the ethanol waste bottle.
5. Rinse with at least 30 mL of 96 % ethanol.
6. Loosen the cartridge of the peristaltic pump.
7. Attach the air hose with the Luer adapter cone to the filling hose.
8. Tap the  button in the quick access area to start the air pump.
9. Wipe the sample outlet hose dry of traces of ethanol and put it into a sulfuric acid waste bottle if sulfuric acid is to be filled into the measuring cells.
10. Tap the  button in the quick access area to stop the air pump or wait for the pump time out.
11. Lock the pump lever of the peristaltic pump.
12. Disconnect the sample intake hose from the air hose.
13. Fill in the new sample for measuring (see Chapter 13.5).

14.3 Cleaning the Instrument Housing and Touch Screen

To clean the instrument housing or the touch screen, use a soft tissue that can be wetted with ethanol or warm water, if necessary with some mild cleaning agent added (pH < 10).

WARNING

Ethanol is a flammable liquid.

- Be sure that all safety instructions regarding the use of flammable liquids (see Chapter 2) are strictly followed.

NOTICE

Using substances for cleaning which are not suitable causes corrosion of the instrument housing. Never use:

- highly nonpolar solvents (e.g. toluene, hexane, solvent naphtha)
- strong acids or bases (e.g. nitric acid, sulfuric acid, hydrochloric acid, caustic soda)
- strong mechanical action (steel brush).

Related topics

Measuring in Harsh Environments: Appendix C.3

14.4 Storing the Instrument

Clean and dry the measuring cell (see Chapter 14.1) before storing the instrument for more than one day. Otherwise, algae may grow on the glass surface that are difficult to remove.

For storage for less than one day, the measuring cell can be filled with deionized water or the last cleaning liquid that has been injected. In case of syringe injection, leave the syringe mounted to the injection adapter to prevent spillage of the liquid.

15 Handling the Measurement Data

15.1 Defining the Data Memory Settings

Your instrument can store 1000 result data files with or without camera pictures. After 900 measurements, the instrument issues a reminder for clearing the memory. If the memory is full, no measurements are possible and in that case no more measuring results will be saved, so make sure to free memory space in time.

To avoid reminders and the necessity of deleting data manually, you can set the data memory to behave as a circular buffer if you use the instrument in low security mode.

- Tap <Menu> and select **"Setup > Expert Settings > Data Memory Settings"** and activate the check box "Automatically delete old measurement data".

  The oldest 100 measurement results will then be automatically deleted as soon as the number of 900 measuring results has been exceeded in the data memory.

15.2 Defining Data Columns for the Data Browser

You can define the kind of data which shall be displayed in the data browser. You can change these settings any time and add further sample parameters to the result data files.

To set data for data browser display

1. Tap <Menu> and select **"Setup > Data Browser Settings"**.
2. Tap on the list item that you want to change or on the empty field at the bottom of the list if you want to add an item.

   The row is highlighted.
3. Tap on the highlighted list item to get to the "Change Quantity" dialog.
4. Use the drop-down boxes to define the "Group", "Quantity", "Unit" and the number of "Digits".
5. Tap <OK>.

To change the order of the data

1. Tap <Menu> and select **"Setup > Data Browser Settings"**.
2. Highlight a list item and use the up/down arrows in the right column to change the position of the list item in the favorites list.

This results in changing the sequence of the columns in the data browser.

3. Proceed so with all other list items whose position you want to change and tap <OK>.

15.3 Viewing Results

Your instrument supports two forms of result visualization:

- In the multiple sample view you can see a number of results listed in a table.
- In the single sample view you can see a more detailed view of one result at a time.

In the multiple sample view, the output quantities according to the data browser settings are displayed. In the single sample view, the output quantities according to the result output settings are displayed.

If no output quantities have been selected in the result output settings or if the measuring method of a sample has been deleted, the data browser settings are also used for the single sample view, printouts and data exports.

Multiple sample view

1. Tap <Menu> and select **"Data Memory > Measured Data"** to open the multiple sample view.
2. Use the two scrollbars to scroll vertically and horizontally.

Single sample view

1. In the multiple sample view, highlight the sample that you want to see in more detail.
2. Tap <Single Sample> to open the single sample view.
3. Use the <▲> or <▼> button to see the previous or next result.

15.4 Filtering Results

With the filter tool, you can reduce the number of measuring results in the multiple and in the single sample view.

Filter settings can be defined separately:

- for printing, exporting and viewing of measured data
- for deleting measured data

Subsequent actions as printing, exporting, deleting, only apply to the data corresponding with the filter criteria.

Filter criteria

- Date
- Date range
- Sample Name
- Method (only available if previously used)
- User-defined data fields
- Print/Export Status
- Sample Error State
- User (only those who performed measurements are available)
- Magazine pos.
- Measuring value
- Master Condition (Quantity)
- Camera image available
- Electronic Signature

Comparators

- older than
- newer than
- equals
- not equal
- larger than
- smaller than
- containing
- not containing
- printed/exported
- not printed/exported

Different filter criteria are linked to each other using an AND relation.

To define a filter

1. In the multiple sample view, tap <Filter> to open the "Filter" dialog.

2. Define one or more filter criteria in the first column "Filter criterion":

3. Select an available "Comparator" and assign a "Value" to the filter criteria.

4. Tap <OK> to get back to the multiple sample view.

   The multiple sample view and the single sample view now only show those results that meet your filter criteria.

Examples:

- If you only want to see the samples that were measured with the method "Density & Sound", choose the following settings:

  - Filter criterion: "Method"
  - Comparator: "equals"
  - Value: "Density & Sound"

- If you only want to see the samples that have not been exported yet, choose the following settings:

  - Filter criterion: "Print/Export Status"
  - Comparator: "not printed/exported"

- If you only want to see the samples that have been measured during the last week, choose the following settings:

  - Filter criterion: "Date range"
  - Comparator: "equals"
  - Value: "Last Week"

To delete a filter

1. In the multiple sample view, tap <Filter> to open the "Filter" dialog.

2. Highlight the filter that you want to delete and tap <Delete>.

15.5 Viewing Statistics

Statistical numbers are always calculated according to the filter settings of the measured data in the data browser.

Statistical details will only be calculated for those quantities which are activated for the result output of the respective measuring method (see Chapter 12.2.3).

Results from checks and/or temperature scans are not included in any statistical analysis.

1. Tap <Menu> and select **"Data Memory > Statistic"** to open the statistics overview.

   A table of methods and their respective number of result output quantities is displayed.

2. Highlight a row.

3. Tap on <Statistic Details>.

4. For each output quantity the following statistics are displayed:

No. of Values	Number of measurements
Minimum	Lowest value
Maximum	Highest value
Average	Arithmetic mean value
StdDev	Standard deviation

15.6 Printing and Exporting Results and Other Data

Your instrument supports three kinds of printouts:

- Simple continuous printouts using an RS-232 printer with paper roll
- Report printouts using an office printer (USB or local network)
- Report printouts to PDF files (USB flash drive)

Your instrument supports the export of result data files in the data formats MS Excel (.xls) and MS Text Editor (.txt).

You can printout and export measured data, check data, adjustment data, statistics, audit trails, etc.

To make a printout

1. Tap <Print or Export> and select **"Print Report (Paper/PDF File)"**.
2. Tap <OK> to open the "Print Report" dialog.
3. Use the drop-down boxes "Target", "Report" and "Drive" and the input box "File Name" to define the printout settings and tap <OK>.

   Exported PDF files are password-protected.

To export data

1. Insert the USB flash drive into a USB interface.
2. Tap <Print or Export> and select **"Export Data (Excel File/Text File)"**.
3. Tap <OK> to open the "File Export" dialog.
4. Use the drop-down box "File Format" to select "Excel" or "Text", define the "Drive" and enter the "File Name", then tap <OK>.

   The measuring results are exported according to your current filter settings (see Chapter 15.3). For each method those data are exported which are defined in the **"Result Output"** menu.

Related topics

Filtering Results: Chapter 15.4
Activating/Deactivating an Automatic Printout: Chapter 10.2.3
Creating, Editing and Deleting Printer Report Layouts: Chapter 10.2.1
Defining Header and Background of the Printer Report: Chapter 10.2.2
Registering, Editing, Deleting a Printer: Chapter 9.3.2
Defining the Result Output: Chapter 12.2.3

15.7 Deleting Results

We recommend deleting your result data regularly after a successful data export or printout.

To delete a single result

1. Tap <Menu> and select **"Data Memory > Delete Measured Data"**.
2. Highlight a row in the multiple sample view.
3. Tap <Single Sample> and tap <Delete Entry>.

To delete several results

1. Tap <Menu> and select **"Data Memory > Delete Measured Data"** to open the multiple sample view (delete).
2. Tap <Filter> to change the number of results to be deleted (see Chapter 15.4).
3. Tap <Delete All> to delete the filtered data.

Related topics

Filtering Results: Chapter 15.4

16 Using Special Functions

16.1 System Security

You can enable different system security settings to ensure data security and to protect your measuring system from unauthorized access.

16.1.1 Security Level

Depending on your needs you can set different security levels: low or 21 CFR Part 11 compliant. The security level "Low" is set by default.

If any changes are applied to one of the standard security level settings (see Table 16.1), the security level is switched to user-defined security level.

Table 16.1: Comparison of security level settings

Security Level	**Low**	**21 CFR Part 11**
Audit Trail	Off	On
Audit Trail Backup Reminder	-	Default: 7 days
Electronic Signature	Off	On
E-Sign requires password	-	On if activated
Auto Logoff	Off	On
Auto Logoff Time	-	Default: 60 min
Password Expires	Off	On
Password Expiry Time	-	Default: 60 days
Increased Security	Off	On

To view the security settings

1. Tap <Menu> and select **"Setup > System Security > Security Level"**.
2. To check your current settings, tap <Details>.

To set the security level

NOTICE
Your current sample list will be reset by changing the security level.

NOTICE
By activating "21 CFR Part 11", increased security is activated automatically (see Chapter 16.1.3).

1. Tap <Menu> and select **"Setup > System Security > Security Level"**.

2. Use the drop-down box to select a security level.

   The user-defined security level is only visible and can be selected if the user has changed any default security settings.

3. If you want to compare your current settings and the settings that will be affected by changing the security level, tap <Details>.

   The settings affected by changing the security level will be highlighted with red letters.

4. Tap <OK> to set the security level.

16.1.2 Auto Logoff and Password Expiry

To set an auto logoff time

You can set the instrument to automatically log off the current user after a defined time of inactivity.

1. Tap <Menu> and select **"Setup > System Security > Logon Settings"**.
2. Use the check box to activate or deactivate the auto logoff function.
3. Set the auto logoff time to a time between 1 and 60 min.

To set password expiry

You can define how long passwords are valid. The setting applies to all passwords. If a password expires, the corresponding user account is deactivated.

For activating a user account and setting a password, see Chapter 10.4.2.

1. Tap <Menu> and select **"Setup > System Security > Logon Settings"**.
2. Use the check box to activate the password expiry function.
3. Set the password expiry time to a time between 1 and 60 days.

16.1.3 Increased Security

In addition to different security levels (see Chapter 16.1.1), you can tighten your security settings by activating increased security settings.

NOTICE
If the increased security is activated, all user accounts that do not comply with the naming rules or password rules will be deactivated. The auto logon function will be deactivated if set.

Table 16.2: Increased security settings

On	Off
No endless data storage allowed	Endless data storage allowed
Only user-defined sample list mode allowed	All sample list types allowed
Lock user account after three failed logon attempts	User account is not locked after failed logon attempts
Auto Logon is not allowed	Auto Logon allowed
User name must have at least 6 characters	User name can be shorter than 6 characters
User name must be entered instead of selected from list	User name can be selected from list
Password must have at least 6 characters	Passwords can have any length
Last 5 passwords must not be used	Same passwords can be used

To activate or deactivate increased security

1. Tap <Menu> and select **"Setup > System Security > Increased Security"**.
2. If you want to view your current settings, tap <Details>.
3. Use the "Increased Security" check box to activate or deactivate increased security.
4. If you want to view the settings that will be affected by activating increased security, tap <Details>.
5. Tap <OK> to save the setting.

16.2 Audit Trail

Using the audit trail function, you get all operating steps that directly or indirectly lead to changes in measuring results documented in a log file. Additionally all changes which are relevant for data integrity, manipulation or access control are documented in a log file as well.

The following operations including the respective warnings which appear in the diagnosis window are documented in the audit trail:

- Successful or rejected adjustments and passed or failed checks
- Resetting of adjustments to factory adjustment
- Exceeding of adjustment intervals and check intervals
- Changes of methods via settings in the density module
- Changes in customer functions
- Changes of user accounts (creating, editing, activating, deactivating, deleting, changing a password)
- Saving and restoring of parameter settings and configurations

- Deletion of measured data (number auf deleted measuring data and corresponding unique sample ID)
- Changes in the instrument firmware, module firmware and operating
- system
- Changes in the setup of the measuring system (mounting or dismounting modules)
- Activation or deactivation of the audit trail function and exporting/deletion of audit trail entries
- Changes to the instrument date and time

If you are working under QM regulations like GLP/GMP or 21 CFR part 11, we recommend you set your security level to 21 CFR part 11 or a user-defined security level where audit trail is active. Export the audit trail data in regular intervals and store the data in a safe place.

To activate/deactivate audit trail

There are two ways to activate the audit trail function:

- You can set the security level to "21 CFR Part 11" (see Chapter 16.1.1) and audit trail will be activated automatically.
- You can activate the audit trail function within your user-defined security mode.

1. Tap <Menu> and select **"Setup > System Security > Audit Trail"** to open the "Audit Trail Settings" dialog.

2. Activate/deactivate the audit trail using the check box "Audit Trail active".

3. Activate/deactivate the "Backup Reminder", define the time span and tap <OK>.

To view, print or export the audit trail

The audit trail list can store up to 999 entries. Make sure to regularly export and delete the audit trail data.

1. Tap <Menu> and select **"Data Memory > Audit Trail"** to open the audit trail list.

2. Highlight a list item and tap <Single Entry> to see more detailed information.

3. To perform a printout on paper or to a PDF file or to export the data as an MS Excel or text file, tap <Print or Export> and follow the instructions on the screen.

To delete the audit trail entries

1. Tap <Menu> and select **"Data Memory > Delete Audit Trail"**.

2. Tap <OK>.

   All audit trail entries that have already been exported are deleted.

For data safety reasons, it is not possible to delete audit trail entries that have not been exported before.

Verifying the integrity of audit trail exports

Audit trail data exports are protected by a MD5 checksum file that is exported together with the data file to guarantee full traceability.

After successful export of the data file and the corresponding md5 file, a new audit trail entry including the MD5 checksum (hash) is generated. This checksum can be compared with the checksum of the exported file at any time to confirm that the exported file was not manipulated.

To generate an MD5 checksum

Any MD5 checksum program can be used.

Example: Using the program "md5summer.exe" that can freely be downloaded from www.md5summer.org/download.html.

1. On your PC, start "md5summer.exe".
2. When asked "please select the root folder", select the directory where the log files (the .md5 file and .xls or .txt file) are saved and click <Verify sums>.
3. In the following dialog, select the .md5 file that you want to check and click <Open>.

   The check status and result are displayed.

   If the checksum (hash) is the same as in the corresponding DSA 5000 M audit trail entry, the export file has not been manipulated.
4. Quit the program by clicking on <Close>.

16.2.1 Electronic Signature

Electronic signatures can be classified as ordinary manual signatures to help within the authenticity of electronic data in regulated process environments.

Roles for the electronic signature

Depending on importance or impact, different signing roles can be assigned to a user. According to common regulations, you can choose between three different roles: submitter, reviewer or approver.

Once the electronic signature function has been activated, a sample can be signed as positive or negative by the submitter, followed by the reviewer and finally by the approver. If a user of a higher level signs first, the signing states of the lower levels are set according to the evaluation of this higher level user.

Example: If a sample is signed as positive by the approver prior to a submitter or reviewer, the signing states of submitter and reviewer are also set as positive consequently.

Signing states

With the electronic signature activated, three boxes appear in the first column of the data table in the multiple sample view next to the sample error state icon. The boxes illustrate the signing states of submitter (bottom box), reviewer (middle box) and approver (top box):

- grey box: not signed yet
- green box: signed as positive
- red box: signed as negative

To set the electronic signature

1. Tap <Menu> and select **"Menu > Setup > System Security > Electronic Signature"**.
2. Use the "Electronic Signature" check box to activate or deactivate the electronic signature.
3. If a password is required during the signing process, use the second check box to activate a password inquiry (for setting a password, see Chapter 10.4.2).
4. Tap <OK>.

To assign the role for the electronic signature

1. Tap <Menu> and select **"Setup > User Management"**.
2. Highlight the user to whom an electronic signature role shall be assigned.
3. Tap <Edit>.
4. Use the "Role for Electronic Signature" drop-down box to specify the role for electronic signature.
5. Tap <OK>.

To execute the electronic signature for a sample

Only the user who carried out the measurement is allowed to sign the corresponding sample as the submitter.

NOTICE
Once you have executed electronic signature, you can no longer change the signing state of the respective sample.

1. Tap <Menu> and select **"Data Memory > Measured Data"**.
2. Highlight the sample that shall be signed.
3. Change to the single sample view by tapping <Single Sample>.
4. Tap the corresponding signing role button.
5. If needed, add a comment using the input field.
6. Enter your password if inquired.
7. Assess the sample by tapping <Sign negative> or <Sign positive>.
8. If you want to print or export your results including signing state and respective comments, tap <Print or Export>.

16.3 User Functions - Constants, Formulas, Polynomials and Tables

With user functions, you can automatically calculate quantities of your interest from the output values of your instrument. For the calculated quantities, you have the same options for display, printout and export as for standard measurement results.

Examples:

- Calculate the concentration of binary mixtures from the density of the mixture.
- Convert your results into a unit which is not supported in the standard instrument configuration.

There are six types of user functions: constants, formulas, linear functions, polynomials with one input value (1 D), polynomials with two input values (2 D) and user tables.

You can program up to 20 user functions.

Cascading user functions

You can freely use the output value of one user function as the input variable for another user function independently of the types of user functions involved. The instrument firmware automatically checks for circularity of the formula system.

Displaying user functions in output fields

To select an output quantity from the group "User Functions" for the display, see Chapter 12.2.2.

Output fields displaying custom functions feature the user symbol  in the upper left corner of the output field. A maximum of 20 characters of the user function’s name can be displayed.

To program or edit a constant

The "Constant" user function is used to integrate a user-defined value to the result output.

The constant can describe every quantity needed and does not need to be directly measured with your measuring system. The constant can be also be integrated in other user functions or changed if needed.

The constant has to be activated in the method settings of the desired methods. Then a value for the constant can be set in the method settings of the respective methods or in the sample settings via the quick settings function.

1. Tap <Menu> and select **"Setup > Expert Settings > User Function Management"** to open the user functions list.

2. Tap <New> to program a new constant or highlight a list item and tap <Edit> to edit a constant.

   The four-step "User Function" wizard opens.

3. Perform the following settings:

   - Enter a name for the constant (up to 50 characters long).
   - Use the drop-down box "Function Type" to select "Constant".
   - Use the drop-down box "Physical Quantity" to select the type of quantity you want to use.
   - Use the drop-down box "Unit" to select the output unit.

4. Tap <Next>.

   - Activate/deactivate the check box "Protect function against changes by other users".
   - Enter a comment to describe this user function.

   This comment will not be printed, exported or displayed anywhere but is only an internal description of your user function.

5. Tap <Next>.

   A message is displayed to inform you in which menu you can set the value for the constant and in which menu you can activate the user function.

6. Tap <OK> to save the "Constant" user function.

7. To activate the constant in the desired methods, tap <Menu> and select **"Methods > Method Settings > "Method name" > Activate Modules / Constants"**.

8. Highlight your constant user function, enable the check box and tap <OK>.

   The constant is automatically added to the quick settings parameters.

9. To enter a value for the constant, use the quick settings function in the sample list or the menu **"Formula Parameters"** in the method settings.

To program or edit a formula

1. Tap <Menu> and select **"Setup > Expert Settings > User Function Management"** to open the user functions list.

2. Tap <New> to program a new formula or highlight a list item and tap <Edit> to edit a formula.

   The four-step "User Function" wizard opens.

3. Perform the following settings:

   - Enter a name for the formula (up to 50 characters long).
   - Use the drop-down box "Function Type" to select "Formula".
   - Use the drop-down box "Physical Quantity" to select the type of quantity you want to calculate.
   - Use the drop-down box "Unit" to select the output unit.

4. Tap <Next>.

   - Activate/deactivate the check box "Protect function against changes by other users".
   - Enter a comment to describe this user function.

   This comment will not be printed, exported or displayed anywhere but is only an internal description of your user function.

5. Tap <Next>.

   - Enter a "Name" for the first variable and define the input quantity.
   - Do the same for further input quantities if required.

6. Tap <Next>.

7. Enter your formula and tap <OK>.

TIP *Only the operators () + - / * ^ and constants are allowed.*

To program or edit a linear function

1. Tap <Menu> and select **"Setup > Expert Settings > User Function Management"** to open the user functions list.

2. Tap <New> to program a new linear function or highlight an existing linear function and tap <Edit> to open the four-step "User Function" wizard.

3. Perform the following settings:

   - Enter a name for the linear function (up to 50 characters long).
   - Use the drop-down box "Function Type" to select "Linear Function".
   - Use the drop-down box "Physical Quantity" to select the type of quantity you want to calculate.
   - Use the drop-down box "Unit" to select the output unit.

4. Tap <Next>.

- Activate/deactivate the check box "Protect function against changes by other users".
- Enter a comment to describe this user function.

  This comment will not be printed, exported or displayed anywhere but is only an internal description of your user function.

5. Tap <Next>.

6. Define the input quantity and tap <Next>.

7. Enter "Offset" and "Factor" for your linear function and tap <OK>.

To program or edit a polynomial (one- or two-dimensional)

The general formula for a one-dimensional polynomial is:

$f(x) = coeff0 + coeff1 * x + coeff2 * x^2 + coeff3 * x^3 + coeff4 * x^4$

x ..... selected input quantity
f(x) ... calculated output quantity

The general formula for a two-dimensional polynomial is:

$f(x) = Coeff00 + Coeff01 * y + Coeff02 * y^2 + Coeff03 * y^3 + Coeff10 * x + Coeff11 * x * y + Coeff12 * x * y^2 + Coeff20 * x^2 + Coeff21 * x^2 * y + Coeff30 * x^3$

x ..... selected first input quantity
y ..... selected second input quantity
f(x,y) ... calculated output quantity

1. Tap <Menu> and select **"Setup > Expert Settings > User Function Management"** to open the user functions list.

2. Tap <New> to program a new polynomial or highlight an existing polynomial and tap <Edit> to open the four-step "User Function" wizard.

3. Perform the following settings:

   - Enter a name for the polynomial (up to 50 characters long).
   - Use the drop-down box "Function Type" to select the polynomial type.
   - Use the drop-down box "Physical Quantity" to select the type of quantity you want to calculate.
   - Use the drop-down box "Unit" to select the output unit.

4. Tap <Next>.

   - Activate/deactivate the check box "Protect function against changes by other users".
   - Enter a comment to describe this user function.

   This comment will not be printed, exported or displayed anywhere but is only an internal description of your user function.

5. Tap <Next>.

6. Define the input quantity/quantities and tap <Next>.

7. Enter the polynomial coefficients.

   If you do not enter a value for a coefficient, the coefficient will be set to the value zero.

8. Tap <OK>.

To program or edit a user table

If you have a literature table or own experimental data about the density of a binary mixture at different concentrations, you can program this data into a user table.

TIP
- *The larger the number of data pairs and the higher the accuracy of the data pairs, the higher the accuracy of the results that you can obtain with your user table.*
- *Your DSA 5000 M will interpolate, but not extrapolate. This means, that the data pairs that you enter into the instrument should cover the whole range of values that you want to measure.*

1. Tap <Menu> and select **"Setup > Expert Settings > User Function Management"** to open the user functions list.

2. Tap <New> to program a new user table or highlight an existing user table and tap <Edit> to open the four-step "User Function" wizard.

3. Perform the following settings:

   - Enter a name for the user table (up to 50 characters long).
   - Use the drop-down box "Function Type" to select "Table".
   - Use the drop-down box "Physical Quantity" to select the type of quantity you want to calculate.
   - Use the drop-down box "Unit" to select the output unit.

4. Tap <Next>.

   - Activate/deactivate the check box "Protect function against changes by other users".
   - Enter a comment to describe this user function.

   This comment will not be printed, exported or displayed anywhere but is only an internal description of your user function.

5. Tap <Next>.

6. Define the input quantity and tap <Next>.

7. Enter the values of the table and tap <OK>.

To verify a user function

You can directly check the output of your user function when you have finished the programming.

Tap <Save and Try> at the last step of the "User Function" wizard (step 4 of 4) to save the user function and to automatically switch to the calculator (see Chapter 16.4).

To copy a write-protected user function

If you want to change a user function that has been created by another user and has been write-protected, you can copy the user function and save the changes in the copy.

1. Tap <Menu> and select **"Setup > Expert Settings > User Function Management"** to open the user functions list.

2. Highlight the write-protected user function and tap <Edit>.

3. Choose one of the displayed options:

   - Tap <Yes> to make a copy of this user function and save your changes under a different name.
   - Tap <No> to open this function in read-only mode.

To delete a user function

1. Tap <Menu> and select **"Setup > Expert Settings > User Function Management"** to open the user functions list.

2. Highlight a list item and tap <Delete>.

16.4 Calculator

With the calculator, you can simulate any factory predefined function or any of your own user functions. You can enter an input value and check which output value the function will generate. You can also generate a graph within a defined range for the selected function.

Examples:

- You have programmed a user function and want to verify if it works properly.
- You want to check the output of the factory predefined function "Ethanol OIML-ITS-90 % v/v" for some density values of your interest.

To perform a calculation

1. Tap <Menu> and select **"Setup > Expert Settings > Calculator"** to open the calculator.

2. Use the drop-down boxes to select the "Function" and the output "Unit" and tap <OK>.
3. Select **"Manual Value Input (Calculator)"** and tap <OK>.
4. Enter the "Value" for the input parameter(s) and tap <Next>.
5. Read out the result of the function.
6. To calculate further results with other values, tap <Previous> and repeat steps 4 and 5.
7. To exit the calculator, tap <OK>.

To generate a graph

1. Tap <Menu> and select **"Setup > Expert Settings > Calculator"** to open the calculator.
2. Use the drop-down boxes to select the "Function" and the output "Unit" and tap <OK>.
3. Select **"Data Diagram"** and tap <OK>.
4. Set the check box "Select" for the variable quantity (in case more than two quantities are available).
5. Enter a "Value" for the constant input parameter which has not been activated in column "Select" and tap <Next>.
6. Define the range for the x axis (variable input quantity) by entering the "First Value" and the "Last Value" for the variable quantity.

   The graph is displayed and can be printed out or exported by tapping <Print or Export>.

   Graphs can not be printed by RS-232 printers with paper roll.
7. To calculate further results with other values, tap <Previous> and repeat steps 4 to 7.
8. To exit the calculator, tap <OK>.

16.5 Group Calculator

With the group calculator, you can simulate all calculations belonging to a certain group in one step. Enter the corresponding input values to get all output values belonging to the group.

To perform a calculation

1. Tap <Menu> and select **"Setup > Expert Settings > Group Calculator"**.

2. Use the drop-down box "Group", select the type and tap <Next>.

3. Enter the "Values" for the Input Quantities and tap <Next>.

4. Read out the calculated results.

5. To calculate further results with other values, tap <Previous> and repeat steps 3 and 4.

6. To exit the calculator, tap <OK>.

17 Service Utilities

In this chapter, you can find information about making a backup/restore of your instrument settings, performing a firmware upgrade, getting details about the system and viewing the live raw data.

17.1 Making a Backup of the Instrument Settings

You can use this utility for:

- Saving the current instrument status including all method settings and your favorites list for safety reasons for the case that someone changes the settings accidentally.
- Saving the current settings before you perform a firmware upgrade.
- Copying the instrument settings to one more other DSA 5000 M instruments.

A backup file contains the following instrument settings and instrument information:

- Global settings in the control panel (regional settings, keyboard settings, network settings)
- Method settings (display layout and content, result output settings, limit settings, module settings, check definitions)
- User functions
- Users
- System settings (instrument settings, global module settings, sample list settings, audit trail settings, printout settings)
- Adjustments (special adjustments, adjustment data)

To make a backup of instrument settings

1. Tap <Menu> and select **"Service > Backup Instrument Settings"** to open the "Backup" dialog.

2. Select the data storage location (USB flash drive) and enter a "file name" or accept the automatic file name.

3. Tap <Next>.

4. Select the content of your backup file in the column "Value" and tap <OK>.
5. Tap <Yes> to create your backup file.

   The backup file is stored into the root directory of your USB flash drive.

17.2 Restoring Instrument Settings

For version 1.70 and higher, you can restore any backup file made with version 1.60 or higher.

NOTICE
When restoring the instrument settings, make sure that the backup file corresponds with the instrument type.

1. Tap <Menu> and select **"Service > Restore Instrument Settings"** to open the "Restore" dialog.
2. Tap <Details> to scan the content of the selected backup file.
3. Select the location of your backup (USB flash drive) and the "file name" using the two drop-down boxes.

   The backup file must be stored in the root directory of your USB flash drive.
4. Tap <Next>.
5. Select the settings to be restored to your instrument in the column "Value" and tap <OK>.
6. Tap <Yes> to restore the settings.
7. Follow the instructions on the screen.

17.3 Updating the Firmware

Generally, it is only necessary to update the user interface firmware. This sets up the instrument with the new features of the latest firmware version containing the module firmware.

NOTICE
To update the firmware, you need administrator rights with activated auto logon function (see Chapter 10.4.1).

TIP *Before starting the update of the user interface firmware, export or print relevant measurement data (see Chapter 15.6) and create a backup of the instrument settings (see Chapter 17.1).*

TIP *For the new instruction manual, select the respective product page on www.anton-paar.com and send a download request (under the entry **Manuals** in the **Downloads** tab).*

To update the user interface firmware

1. Load the latest firmware into the root directory of your USB flash drive.
2. Insert the USB flash drive into a USB interface of your instrument.
3. Tap <Menu> and select **"Service > Update > User Interface Firmware"**.
4. Select the location (USB flash drive) and the "file name" of the new firmware.
5. Tap <Update>.
6. Follow the instructions on the screen.
7. Restore the instrument settings (see Chapter 17.2).

To update the module firmware

TIP *A diagnosis message is shown if a too old firmware is installed on one of your modules. If the auto logon for a user with administrator rights is activated, the firmware update of the module can be started. Otherwise, the administrator must log on and then start the firmware update (menu **"Service > Update > Module Firmware"**).*

1. Load the latest module firmware into the root directory of your USB flash drive.
2. Insert the USB flash drive into a USB interface of your instrument.
3. Tap <Menu> and select **"Service > Update > Module Firmware"**.
4. Select the location (USB flash drive) and file name of the new firmware or select "Internal" and tap <Update>.

   If you select "Internal", the instrument automatically checks the system. In case any modules run an older firmware version, the instrument will update it to the version supported by the user interface firmware. No USB flash drive is required in that case.
5. Follow the instructions on the screen.

To install a language pack

To receive a language pack, contact your Anton Paar representative.

1. Load the desired language pack into the root directory of your USB flash drive.
2. Insert the USB flash drive into a USB interface of your instrument.

3. Tap <Menu> and select **"Service > Update > Install Language Pack"**.
4. Select the location (USB flash drive) and file name of the language pack and tap <Update>.
5. Follow the instructions on the screen.

17.4 Viewing the System Information

In this menu, you find information about the configuration of the hardware and firmware including, if connected, Xsample filling equipment and external measuring modules. The instrument type, serial number and firmware versions are shown in a table.

In this menu, you can also save an instrument log file to a USB flash drive. This file contains the last operating steps and may help during trouble shooting.

To view hardware and firmware configuration

1. Tap <Menu> and select **"Service > System Information"** to open the configuration overview table.
2. Use the vertical scrollbar to scroll through the table.

To save the instrument log file

1. Tap <Menu> and select **"Service > System Information"** to open the configuration overview table.
2. Insert a USB flash drive into a USB interface and tap <Save Logfile>.
3. Accept the automatically generated file name or enter a new one and tap <OK>.

   The instrument log file is now saved to the root directory of the USB flash drive.

To change the log file configuration

In special cases your Anton Paar representative will ask you to change the configuration of your log file in order to get more specific information about your instrument.

1. Tap <Menu> and select **"Service > Update > Logging Configuration"**.
2. Insert a USB flash drive with the special configuration file delivered by your Anton Paar representative into a USB interface.
3. Tap <OK>.
4. Save the instrument log file.

17.5 Viewing and Printing Live Raw Data

If the monitor-mode is active, you get a live view of sensor signals including raw data in this menu. You can export or print the live raw data.

After a measurement is finished, the live raw data of the main measuring unit (e.g. "DMA Density") are frozen as well as the quantities on the main screen. To unfreeze the values, tap the  button.

To view live raw data

- Tap <Menu> and select **"Service > Live Raw Data"**.

DMA Density

Quantities not mentioned in this table are described in Appendix F (e.g. Density, Density Temperature, Density (not visc.-corr.) etc.).

dD Harmonic Value	Damping of the first harmonic.
Delta RHO Value	Difference between density calculated from 1st harmonic and density calculated from fundamental oscillation.
Density 1st Harmonic	Density calculated from the 1st harmonic of the U-tube.
Density Progress	Indicator (0-100) for the progress of the measurement.
e	Viscosity correction factor.
Fill Status	Status information about correct filling of the U-tube.Values different from zero indicate an incorrect filling.
RHO NC Harmonic Value	Not viscosity-corrected density calculated form the 1st harmonic.
RHO17 Value	Viscosity-corrected density, valid if viscosity less than 700 mPa·s.
RHOg5 Value	Viscosity corrected density, valid if viscosity greater than 500 mPa·s.
Status Value	Status information indicating the temperature status of the cell.

Calculations

You can view a list of the calculations of the currently available output quantities.

DCB - Air Pump

Air Pump State	Status of the air pump (0 or 1).

DMA Density - Air Pressure

Air Pressure	Currently measured air pressure.
Air Pressure Condition	Current status of the measurement.
Air Pressure State	Status of the air pressure measurement.
Air Pressure Substate	Detailed information about the status of the air pressure measurement.

DCB - Environment

Heatsink temperature	Temperature of the heat sink.
Room temperature	Temperature measured within the instrument.
NTC temperature	Temperature measured within the instrument.
CAN Connector Current	Current measured at the CAN interface.

DCB - CAN Connector

CAN Connector Current	Current measured at the CAN interface.

To print live raw data

1. Tap <Menu>, select **"Service > Live Raw Data"** and choose one of the groups of live raw data quantities.
2. To perform a printout on paper or to a PDF file, tap <Print or Export> and follow the instructions on the screen.

18 Communication with External PC and LIMS

18.1 Connecting the Instrument to an External PC via Ethernet

You can transfer the system information and a PDF file of the instruction manual from your instrument to any PC of your local network via Ethernet.

1. Connect the instrument to your local network via the Ethernet interface.
2. Tap <Menu> and select **"Setup > Control Panel > Network"**.
3. Activate the option "Obtain an IP address automatically (DHCP)" or enter the network parameters manually.

   For details about the Network settings, see Chapter 10.1.6.
4. Open an internet browser on a PC that is connected to your local network.
5. Enter the IP address of your instrument in the address field of the browser and press the <↵> key.

   Now the system information of your instrument is displayed together with a download link for the PDF file of the instruction manual.

18.2 Connecting the Instrument to an External PC via RS-232

If you want to connect the DSA 5000 M to a PC (AP-SoftPrint) you have to use a certain cable and a gender changer. Please find below the Mat. No.:

1 pc. Mat. No. 70429	RS-232 connection cable
1 pc. Mat. No. 302592	Gender changer

Connecting the RS-232 cable

1. Connect the gender changer to the RS-232 connector at the rear of the DSA 5000 M.
2. Connect to the other end of the gender changer the RS-232 cable.
3. Connect the other end of the RS-232 cable to your PC.

   If you have no RS-232 connector at your PC, it is also possible to use a USB connector by using a USB/RS-232 converter.

You can operate the instrument using commands for the serial interface RS-232.

NOTICE
If you have defined an RS-232 printer, make sure that you do not print anything (manually or automatically) while using the RS-232 interface for data transfer to a PC. Otherwise, there will be a conflict with the RS-232 printer and both the printout and data transfer will fail.

Required RS-232 settings

- Baud rate: 9600
- Data bits: 8
- Stop bits: 1
- Parity: none
- Handshaking: none

Output format

- Language: always English
- Decimal separator: . (dot)
- Column separator: ; (semicolon)
- Line end: CR

RS-232 interface commands

Commands can be written with or without blanks between the words, for example both "getdata" and "get data" are valid commands.

The encoding is according to the 8-bit ANSI code page 850. This means that strings with special characters can only be converted with a loss of information. A "?" (question mark) will be used for characters which can not be encoded.

The following interface commands are available to operate the instrument:

start or **start method_number** or **start method_number magazine_position**	Creates a new sample in the sample list and starts a measurement with the active method. Creates a new sample in the sample list and starts a measurement with the given method number. If an Xsample sample filling module is active and the sample list is in the user-defined mode, the magazine position is evaluated and set for the sample.
abort	Aborts the measurement.
getdatahead	Gets meta data of the last measured sample. The meta data contains the names of the output quantities of the last measured sample. The output quantities depend on the method and are set in the **"Result Output"** settings.
getdataunit	Gets unit data of the output quantities of the last measured sample. For each output quantity the unit is returned.

getdata	Returns the result values of the last measurement only once.
finished	Returns the status of the measurement.
getrawdata	Returns the current raw data values for "Density (not visc.-corr.)", "Density Temperature", "Set Temperature" and the "Unique Sample ID". The unique sample ID is "NaN" if no sample was measured yet.
getmethodname	Returns the name and number of the method.
getid	Returns the serial number, instrument type, firmware version and protocol version.
set temperature xx.xxx	Sets the set temperature of the current method to the given value (xx.xxx in [°C]). This command is only allowed, if no measurement is in progress.
help	Returns a list of the available RS-232 interface commands.

RS-232 commands and responses

Command	Response	Description
start or **start method_number** or **start method_number magazine_position**	measurement started	The command was accepted and the measurement was started.
	measurement already started	The measurement was already started.
	invalid method	The received start command did not contain a method number or the number could not be parsed.
	simple mode not supported	An Xsample sample filling equipment is active but the sample list is in the simple mode which is not supported. Change to the user-defined sample list mode.
	missing magazine position	An Xsample sample filling module is active and the sample list is in the user-defined mode but no magazine position parameter was received.

Command	Response	Description
start or **start method_number** or **start method_number magazine_position**	wrong magazine position	An Xsample sample filling module is active and the magazine position parameter is not valid (e.g. smaller than 1 or larger than the magazine size).
	sample storage full	The data memory and sample list are full. Clear the data memory and sample list or activate the automatic clearing option (see Chapter 15.1).
	heating	The Heating Attachment is heating, so no measurement can be started.
abort	measurement aborted	The measurement was aborted.
	measurement not started	No measurement was started.
	already aborting	The measurement is already being aborted.
getdatahead	Density;Specific Gravity;Density Temperature;Master Condition	Example response with the default settings.
	no data available	No measurement has yet been finished and so no data is available.
getdataunit	g/cm³;-;°C;-	Example response with the default settings.
	no data available	No measurement has yet been finished and so no data is available.
getdata	0.000892;0.000894;20.001;valid	Example response with the default settings.
	no new data available	No new measurement has yet been finished and so no new data is available.
finished	Measurement not started	No measurement has yet been started.
	Measurement not finished	The measurement is in progress now.
	Measurement finished	The measurement was finished.
getrawdata	1.102689;19.999;20.000:8	Example response.
getmethodname	method name: Density, 0	Example response.

Command	Response	Description
getid	serial number: 80000000 DSA 5000 M V1.70.6534.40 protocol version: 2.00	Example response.
set temperature xx.xxx	accepted	The command was accepted and the density temperature was set to the given value.
	wrong parameter value	The given value was not accepted (e.g. value is out of specifications).
help	commands: • abort • start (method number) (magazine position) • finished • getdatahead • getdataunit • getdata • getrawdata • getmethodname • getid • set temperature xx.xxx • help	List of all available commands.

18.3 Connecting the Instrument to a LIMS

The instrument can be connected to your Laboratory Information Management System (LIMS) using the Anton Paar software LIMS Bridge. LIMS Bridge can be used to send remote measurement commands from the LIMS to the instrument and to forward result files from the instrument to the LIMS.

For more details, see the LIMS Bridge instruction manual.

Appendix A: Technical Data

A.1 Measuring Performance

Table A.1: Technical data of measuring performance

Measuring range density	0 to 3 g/cm^3
Measuring range sound velocity	1000 to 2000 m/s
Measuring range temperature[a]	0 to 70 °C (32 to 158 °F)
Pressure range	0 to 3 bar (0 to 44 psi)
Repeatability density (s. d.)	0.000001 g/cm^3
Repeatability sound velocity (s. d.)	0.1 m/s
Repeatability temperature (s. d.)	0.001 °C (0.002 °F)
Measuring time per sample[b]	1 to 4 minutes
Sample volume	approx. 3 mL
Ambient air pressure sensor	yes
Full range viscosity correction	yes
Reference oscillator	yes
Automatic bubble detection	yes
Visual check of the density measuring cell	Camera

a. Cooling down further than 20 °C (68 F) below ambient temperature only with external cooling using the cooling kit
b. Including full temperature equilibrium

Table A.2: Typical accuracy of concentration measurements (only valid for uncontaminated samples)

0 - 100 % H_2SO_4	±0.02 % H_2SO_4
0 - 28 % free SO_3	±0.04 % H_2SO_4
28 - 65 % free SO_3	±0.1 % free SO_3
for other applications	application-dependent, typically 0.01 to 0.1 %

A.2 General Technical Data

Dimensions (L x W x H):	482 x 340 x 231 mm (19.0 x 13.4 x 9.1 inches)
Weight:	22.5 kg (49.6 lbs)
Voltage:	AC 100 to 240 V, 50/60 Hz
Power:	190 VA
Power inlet:	according to IEC/EN 60320-1/C14, protection class I
Fuses:	Glass tube fuses 5 x 20 mm; IEC60127-2; AC 250 V; 5 A TH
Housing material:	
Top & side cover	Aluminum, coated
Back	Aluminum
Front	Styrene/Butadiene
Environmental conditions (EN 61010):	Indoor use only
Ambient temperature:	15 to 35 °C (59 to 95 °F)
Air humidity:	10 to 90 % relative humidity, non-condensing
Pollution degree:	2
Overvoltage category:	II
Altitude:	max. 3000 m (9800 ft)
Touch screen:	6.4 inch TFT, 640 x 480 px
Memory:	• 512 MB SD-card (upgrade capability up to 8 GB) for internal information (logfiles and instrument settings) • from DCB version 1.000.009: SD-card is no longer used • 1000 measuring values with/without camera pictures
Interfaces:	4 x USB (2.0 full speed), 2 x S-Bus, 1 x Ethernet (100 Mbit), 1 x CAN Bus, 1 x RS-232, 1 x VGA
RS-232 printer settings:	Interface: RS-232 C; Baud rate: 9600; Parity: None; Stop bit: 1; Data bits: 8

WARNING

Serious injuries are possible through high voltage if the following hints are not adhered to.

- Only connect devices to the interfaces that comply with PELV (protective extra-low voltage) according to EN 61140 or with SELV (safety extra-low voltage) according to EN 60950.

NOTICE

Connect only Anton Paar equipment or equipment with a maximum power consumption of 40 W to the CAN interface. Otherwise, the instrument will not work.

A.3 Wetted Parts

The following materials are in contact with samples and cleaning liquids:

DSA 5000 M:

Material	Part
Borosilicate glass	Density measuring cell
PTFE	Filling adapter
Stainless Steel DIN 1.4539/UNS N08904	Sound velocity cell

Standard accessories:

Material	Part
Polyethylene	Waste vessel
Polypropylene/Polyethylene	Syringe 5 mL Luer
PTFE	Injection adapter Luer
PTFE	Male Luer plug PTFE
PTFE	Adapter Luer cone
Silicone	Hose 3 x 5 mm silicone
Viton	Hose 3 x 5 mm Viton

Appendix B: Measuring Special Samples

B.1 Degassing Samples

There are different methods for the degassing of liquid samples. The preferable method for your application depends on the kind of sample and the amount of gas that is dissolved in the sample. Always take care that you treat all samples in the same way in order to get reproducible measuring results.

Be aware of the fact that you may change the composition of many samples slightly during the pretreatment due to evaporation of volatile components.

To boil the sample

WARNING
Samples containing toxic volatile compounds can cause irritation and serious injuries to your eyes, skin and mucous membranes as well as well as toxication.

- If your sample contains volatile compounds that are toxic, always handle it in an appropriate environment like a fume hood, especially when you boil your sample.

WARNING
When boiling flammable liquids, there is the risk of fire. Serious injuries are possible.

- Do not boil any flammable liquid.

1. Boil the liquid for several minutes to remove dissolved air.
2. Fill a clean glass flask full with the boiled liquid and cover it.
3. Wait until the liquid has cooled down to the approx. measuring temperature.

To stir the sample

- Stir your sample vigorously for 2 to 15 minutes (depending on the stirring equipment) until no bubbling occurs any more.
- You can also pour the sample through a paper filter after stirring to get an even more efficient degassing effect.

To use an ultrasonic bath

- Put your sample for approximately 5 to 10 minutes into an ultrasonic bath until the bubble formation stops.

B.2 Special Filling Techniques

Bubbling samples

If the sample to be measured tends to form gas bubbles, degas it before the measurement (see Appendix B.1).

If this is not possible, introduce the sample at a temperature higher than the measuring temperature.

You can also put the density meter at a slight angle by means of proper spacers below the right side of DSA 5000 M to allow the bubbles to escape due to buoyancy.

Suspensions and emulsions

Suspensions or emulsions may tend to separate in the measuring cells, giving incorrect results. Leave such samples in the measuring cell as briefly as possible. Pre-thermostat them before filling.

It may help to put spacers below the left legs of DSA 5000 M, thus putting it at an angle to counterbalance the separation force generated by the oscillation of the measuring cell.

Highly viscous samples

Highly viscous samples can be heated up to lower the viscosity. Always heat the sample to a temperature that is approx. 15 °C higher than the measuring temperature, which can be 70 °C maximum.

Pastes

Paste-like materials like toothpaste or tomato ketchup can be filled by syringe. Inject these kinds of samples into the measuring cell by pushing the plunger very slowly and continuously.

If the samples have a very high viscosity, you can fill them into the syringe by pulling the plunger completely out of the syringe, filling it from the back using a spoon and then mounting the plunger again.

Gases

It is possible to measure gases with DSA 5000 M. For details, contact your local Anton Paar representative and ask for the respective application report and the necessary accessories.

Appendix C: Measuring under Special Conditions

C.1 Measuring at High Humidity/Low Temperature Conditions

If the ambient air contains humidity and the measuring temperature is lower than the ambient temperature, condensation may occur in the measuring cell and measuring cell block.

Condensation in the measuring cell causes adjustment and measurement errors in DSA 5000 M instruments and also in any RXA series instruments connected to them. Condensation in the measuring cell block damages the electronics and may lead to a failure of the U-View™ function. The higher the difference between the set measuring temperature and ambient temperature and the higher the air humidity, the easier condensation occurs.

To prevent condensation in the measuring cell

To prevent condensation in the measuring cell, use a drying cartridge (Mat. No. 65085) and connect it to the "DRY AIR IN AIR PUMP" connector at the rear of DSA 5000 M.

NOTICE

- Never connect hoses containing liquids or moist gases to the "DRY AIR IN AIR PUMP" connector as this may lead to condensations in the measuring cell and subsequently to measurement and adjustment errors.
- Operate the "DRY AIR IN AIR PUMP" connector only at ambient pressure.

Fig. C - 1 Drying cartridge connected

For a measuring temperature of 20 °C, a drying cartridge must be used under the following conditions:

Ambient temperature	Relative air humidity (r. h.)
20 °C	> 70 %
25 °C	> 50 %
30 °C	> 38 %

To prevent condensation in the measuring cell block

To prevent condensation in the measuring cell block, connect a dry air supply to the "DRY AIR IN BLOCK" connector at the rear of DSA 5000 M using a 3 x 5 mm hose made of suitable material (e.g. silicone) (see Fig. C - 1).

NOTICE
Never connect hoses containing liquids or moist gases to the "DRY AIR IN BLOCK" connector as this may lead to damage to the electronics.

The dry air supply must be used additionally to the drying cartridge if the measuring temperature is more than 5 °C lower than the ambient temperature. The following specifications of the applied air are required:

- 0.2 to 0.3 bar (2.9 to 4.4 psi)
- Class 5 from ISO 8573-1
- Max. particle size: 40 µm
- Max. pressure dew point: 10 °C below measuring temperature
- Max. oil content: 25 mg/m^3

To regenerate moist ruby gel

The drying cartridge contains beaded ruby gel, a non-toxic drying agent. When active, the color of the drying agent is red. Ruby gel which has absorbed liquid turns orange.

Moist ruby gel can be regenerated: Pour the ruby gel into a glass bowl and blow hot, dry air (max. 130 °C, 266 °F) through it for approx. 5 hours or place it in a laboratory oven for a few hours (or overnight) until it is red again.

NOTICE
Do not use higher drying temperatures than 130 °C (266 °F). Otherwise the indicator function of the ruby gel is spoiled.

C.2 Measuring at Low/High Temperatures

To measure at low temperatures

To perform measurements at temperatures lower than 20 °C (36 °F) below ambient temperature, install the cooling kit (Mat. No. 80810) and connect DSA 5000 M to an external thermostat. If your tap water is cool enough also connecting to a tap water supply will help. Operate the cooling kit with a moderate flow of water (1 to 3 liters per minute).

Temperature range of the cooling unit	5 to 30 °C (41 to 86 °F)
Maximum pressure	1 bar (14.5 psi). For more details, see the cooling kit brief instructions.
Connector	Self-locking coupling 8 mm, Type Rectus 21KBTS08MVN, Mat. No. 75090

Example: Your ambient temperature is 25 °C (77 °F) and you want to perform measurements at 0 °C (32 °F). Install the cooling kit and connect DSA 5000 M to an external thermostat or tap water line that is delivering water at a constant temperature between 5 to 15 °C (41 to 59 °F) and change the measuring temperature to 0 °C (32 °F) in the "Density Module" dialog.

To measure at high temperatures

NOTICE
At measuring temperatures of 50 °C (122 °F) and higher, the applied pressure must be limited to 3 bar (44 psi). Otherwise, the injection adapters may leak.

To prevent bubble formation

If you are measuring samples at temperatures significantly higher than ambient temperature, the tendency to form gas bubbles in the measuring cell will dramatically increase. To ensure precise results, you can:

- Degas your samples thoroughly directly before measuring (see Appendix B.1).
- Heat your samples up to a temperature significantly higher than the measuring temperature with stirring, directly before measuring.

To measure highly viscous samples at high temperatures

See Appendix B.2.

C.3 Measuring in Harsh Environments

- Use the softkeys below the touch screen for operating the buttons in the lower area of the screen.
- Use a stylus or any convenient plastic stick with a soft and round ending to operate the touch screen.
- Use a PC mouse.

Protection foil

Your DSA 5000 M is delivered with a transparent plastic protection foil covering the touch screen. Three spare protection foils can be ordered (Mat. No. 81402).

If the touch screen has become dirty, you can exchange the used protection foil against a new one.

To exchange the protection foil

1. Remove the used protection foil from the display using your finger nails.
2. Hold the new foil in one hand and use the thumb finger nail of the other hand to peel off the back liner from a small area.
3. Position the back liner free end of the foil on one edge of the display, hold the opposite end and bend the foil backwards.
4. Peel off the back liner with one hand, simultaneously rolling the foil slowly onto the display with the other hand.
5. Carefully flatten out the foil with a clean cotton cloth, pushing bubbles towards the edges.
6. In case of bubbles between foil and display, gently push them towards the edges or lift up the foil partly or completely and reapply the foil more slowly.

Appendix D: Adjusting the Camera Settings

D.1 Adjusting the Camera Position

If the camera does not show the complete measuring cell, you can adjust the position of the camera.

1. Log on as "administrator".
2. Tap the  button in the quick access area.

   The camera window opens.

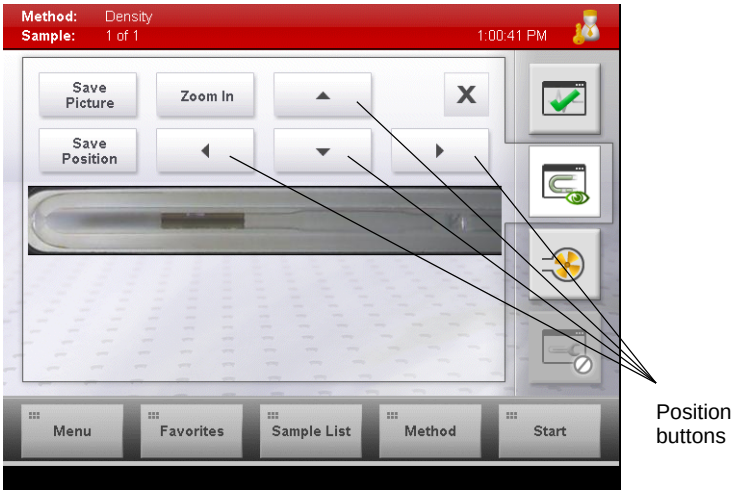


Fig. D - 1 Adjusting the camera position

3. Use the position buttons to accommodate the position of the camera.
4. To save the correct camera position, tap <Save Position>.
5. Close the camera window by tapping <X>.

D.2 Setting the Camera Illumination

If the illumination of the camera picture is not suitable for your special environment, you can change the corresponding default setting.

1. Log on as "administrator".
2. Tap <Menu> and select **"Setup > Control Panel > Advanced Camera Settings"**.
3. Increase the value "Auto Exposure Luminance" to increase the brightness of the camera picture.

Appendix E: Trouble Shooting

Table E.1: Adjustment

Problem	Cause and Correction	See
Readjustment is necessary very often.	Bad water quality for checks/adjustments: Use freshly degassed ultra-pure water.	Chapter 11.3.1
	The measuring cell is not clean: Clean and dry the measuring cell perfectly before an air check/ adjustment.	Chapter 14
	The measuring cell is corroded by hydrofluoric acid, strongly alkaline solutions or mechanical abrasion: Do not leave glass-corroding liquids in the measuring cell.	Chapter 14
	Direct sunlight on DSA 5000 M: Install DSA 5000 M at a place without direct sunlight.	Chapter 7.1
The adjustment is not finished after 10 minutes.	The measuring cell is not sufficiently dry for the air adjustment: Clean and dry the measuring cell perfectly before an air check/adjustment.	Chapter 14
	There are gas bubbles in the measuring cell during water adjustment: Repeat the filling procedure and use freshly degassed ultra-pure water.	Chapter 11.3.1

Table E.2: Measurement

Problem	Cause and Correction	See
I can not start any measurement 15 minutes or more after booting the instrument.	Verify whether one or more modules are using older firmware versions than expected from the instrument’s firmware. This information is either displayed at the start screen or in the diagnosis list of the quick access area. Tap <Menu> and select **"Service > Update > Module Firmware"** to update the respective modules using the internal firmware update package.	Chapter 17.3
Master Condition: "Filling Warning"	Gas bubbles in the measuring cell: Degas your sample. Fill the sample at higher temperature than the measuring temperature.	Appendix B.1
Master Condition: "Error: No Oscillation"	The measuring cell is only partly filled: Fill the sample again.	
Master Condition: "Timeout Error"	The sample is instable (e.g. emulsion): Prethermostat your sample.	Appendix B.2
	The timeout is set too short: Change the timeout setting.	Chapter 12.2.1

Table E.2: Measurement

Problem	Cause and Correction	See
The calibration failed. The results deviate from reference values.	Bad cleaning and drying: Improve your cleaning and drying procedure.	Chapter
	The calibration liquid was stored too long: Use a fresh calibration liquid.	
	Adjustment problems: Improve your adjustment routine.	Chapter 11.3.1
The measuring times during a temperature scan are varying.	The measuring times during temperature scans can vary due to internal temperature measurements and calibration after changing the temperature by a defined value.	

Table E.3: Touch screen

Problem	Cause and Correction	See
I do not hit the screen elements.	Bad touch screen calibration: Perform a new touch screen calibration.	Chapter 8.4

Table E.4: Data memory

Problem	Cause and Correction	See
I can not see certain results in the data memory.	The filter function is activated and the results do not match the filter criteria: Change the filter settings.	Chapter 15.3
I have deleted all results but there are still results visible in the data memory.	The filter settings in the **"Delete Measured Data"** menu are different from the settings in the **"Data Browser Settings"** menu: Perform corresponding settings in both menus.	Chapter 15.7 and Chapter 17

Table E.5: Data export

Problem	Cause and Correction	See
The export to the USB flash drive does not work.	The USB flash drive has the old super floppy formatting and is therefore not accepted by the instrument: Reformat to hard disk type or try a newer USB mass storage device.	
Wrong output data are exported.	The settings in the **"Result Output"** menu are wrong: Change the settings.	Chapter 12.2.3

Table E.6: Password protection

Problem	Cause and Correction	See
The instrument boots up without logon procedure and no password is requested.	A user with activated auto logon function was logged on the instrument before it was switched off: Tap on the user indicator icon and log on with another user account.	Chapter 10.4.2

Table E.7: Printout problems

Problem	**Cause and Correction**	**See**
No printout on office printer.	Office printer problems: Check if the printer has enough paper, toner etc. See the respective printer instruction manual.	
	The office printer type is not supported by your instrument.	Chapter 9.3
	Wrong interface used: Use the interface which was defined in the **"Printer Management"** menu or change the interface settings.	Chapter 9.3
	Wrong or no definition of the printer in the **"Printer Management"** menu: Change the definition.	Chapter 9.3
No printout on POS printer.	Printer problems: Check the printer. See the respective printer instruction manual.	
	Wrong or no definition of the printer in the **"Printer Management"** menu: Change the definition.	Chapter 9.3
	Chinese printer: Declare the printer as "RS-232 (Chinese)" in the **"Printer Management"** menu.	Chapter 9.3
The POS printer printout makes no sense.	Wrong communication settings on the POS printer: Change the DIP switch settings (see the printer instructions).	Appendix A.2
Wrong output values are printed.	The settings in the **"Result Output"** menu are wrong: Change the settings.	Chapter 12.2.3

Appendix F: List of Output Quantities

The following quantities can be selected as output for the output fields.

Group: System	
DataField 1	Custom-specific data field (optional sample ID).
DataField 2	Custom-specific data field (optional sample ID).
DataField 3	Custom-specific data field (optional sample ID).
Date	Current date.
Last Check Date	Date of the latest check.
Last Check Name	Name of the last check.
Last Check Result	Result of the latest check.
Last Check User	Name of the user who performed the latest check.
Master Condition	Sum of all available conditions from measuring modules within the system.
Measurement Type	Type of measurement defined in the sample list: S (Standard) C (Check) TS (Temperature scan) MM (Multiple measurement)
Method	Name of the selected or used method.
Sample Error State	Error messages concerning the sample: "No error", "Was canceled", etc.
Sample List Number	Number of the current sample list entry.
Sample Name	Name of the current sample.
Serial Number	Serial number of the instrument.
Sub Measurement Number	Measurement numbers within one single temperature scan performing several measurements at different temperatures
Time	Current time.
Unique Sample ID	Internal unique sample ID that can not be reset.
User	Name of the user in a certain context.

Group: Density	
Apparent Density Brass	Apparent density referring to scales which are adjusted with brass weights.
Apparent Density Steel	Apparent density referring to scales which are adjusted with steel weights.

Apparent Specific Gravity	Apparent density divided by the apparent density of water at the specified temperature. Apparent density is the weight in air (not mass!) divided by the volume.
Density	Value of viscosity-corrected true density.
Density (not visc.-corr.)	Density value without viscosity correction. The density is correct for samples with a viscosity at around 1 mPa·s (water). Noticeable high readings for samples of higher viscosity.
Density Temperature	Temperature in the measuring cell measured by the Pt 100 measuring sensor.
Density Condition	Current status of the measurement.
Density Control Temp.	Temperature in the cell block measured by the Pt 100 control sensor.
Density Set Temp.	Set measuring temperature.
Specific Gravity	Density of the sample at measuring temperature divided by the density of water at a measuring temperature.
Specific Gravity (not visc.-corr.)	Specific gravity without viscosity correction.
Specific Gravity t/04	Density of the sample at measuring temperature divided by the density of water at 4 °C.

Group: Density (Expert)	
d	Density number, calculated by subtracting the density of water from the measured density and dividing by the density of water at measuring temperature.
d (not visc.-corr.)	Density number without viscosity correction.
Damping	Damping represents the energy loss during oscillation caused by sample viscosity, and is used for viscosity correction of the density.
Last Air/Water Adjustment Date	Date of the latest air/water adjustment.
Last Air/Water Adjustment User	Name of the user who performed the latest air/water adjustment.
Periodic Time	Period of oscillation of the U-tube in the harmonic oscillation of 0th order.
Periodic Time 1st Harmonic	Period of oscillation of the U-tube in the harmonic oscillation of 1st order.

Periodic Time Ref. Oscillator	Actual period of oscillation of the reference oscillator.
PQ U-tube	Quotient of the period of oscillation of the U-tube divided by the period of oscillation of the reference oscillator.
PQ U-tube 1st Harmonic	Quotient of the period of oscillation of 1st order of the U-tube divided by the period of oscillation of the reference oscillator.

Group: Sound	
Current Period of Sound	Currently measured period of sound velocity.
s	Sound number (s), calculated by subtracting the velocity of sound of water from the measured sound velocity and dividing by the sound velocity of water at measuring temperature.
Sound Condition	Current status of the measurement.
Sound Velocity	Measured sound velocity value in m/s.

Group: User Functions User functions can be formulas, polynomials (1D or 2D) or tables (see Chapter 16.3).

Group: Ethanol Tables Ethanol concentrations in percentage by volume (% v/v) or percentage by weight (% w/w) according to ethanol concentration tables issued by different	
Canadian Excise Alcohol Table	Special ethanol table converting the output of a special adjustment into an ethanol value.
Ethanol AOAC 60 °F (% v/v)	Percentage by volume at 15.56 °C (60 °F), AOAC (American Organization of Analytical Chemists) tables, based on true density at 20 °C. The measuring temperature must be 20 °C (68 °F).
Ethanol AOAC 60 °F (% v/v) (not visc.-corr.)	Ethanol AOAC 60 °F (% v/v) without viscosity correction.
Ethanol HM C&E (% v/v) Ethanol HM C&E (% w/w)	HM C&E table at 20 °C.
Ethanol IUPAC (% v/v) Ethanol IUPAC (% w/w)	Tables of the International Union of Pure and Applied Chemistry, based on true density at 20 °C. The measuring temperature has to be 20 °C (68 °F).
Ethanol Kaempf (% v/v) Ethanol Kaempf (% w/w)	Percentage by volume/weight according to W. KAEMPF, based on true density at 20 °C.

Ethanol OIML (% v/v) Ethanol OIML (% w/w)	According to the tables of the International Organisation of Legal Metrology (OIML), temperature according to ITS 68, based on true density at 20 °C.
Ethanol OIML-ITS-90 (% v/v) Ethanol OIML-ITS-90 (% w/w)	According to the tables of the International Organisation of Legal Metrology (OIML), temperature according to ITS 90, based on true density at 20 °C.
Ethanol Proof 60 °F Ethanol Proof 60 °F (not visc.-corr.)	Proof degrees at 15.56 °C (60 °F), based on true density at 20 °C. Ethanol Proof 60 °F without viscosity correction.

Group: Extract/Sugar Tables Concentration of extract/sugar (saccharose) of beverages in different concentration units.	
Baumé	Based on specific gravity at set temperature (t). For liquids heavier than water °Be = (145 x SGt/t - 145) / SGt/t. For liquids lighter than water °Be = (140 - 130 x SGt/t) / SGt/t.
Concentration Sugar (°Balling)	Extract in percentage by weight, Balling table, based on true density at 20 °C.
Concentration Sugar (°Brix)	Saccharose in percentage by weight, NBS Table 113, based on true density at 20 °C.
Concentration Sugar (°Plato)	Extract in percentage by weight, Plato table, based on true density at 20 °C.
Mass Concentration Sugar	Saccharose in g/l, kg/m^3, vol.

Group: Acid/Base Tables Concentration of different aqueous acids and bases in percentage by weight (% w/w) and mole per liter (mol/l) according to different tables.	
Hydrochloric Acid (HCl) (% w/w) (mol/l) (N)	Table of CRC Handbook of Chemistry and Physics, based on true density at 20 °C, range 0 to 40 % (0 to 21.5 mol/l). Accuracy approx. 0.02 % (0.01 mol/l).
Nitric Acid (HNO_3) (% w/w) (mol/l) (N)	Landolt-Boernstein, based on true density at 20 °C, range 0 to 100 % (0 to 23.9 mol/l). Accuracy approx. 0.07 % (0.02 mol/l).

Oleum	SO_3 in percentage by weight according to the CRC Handbook of Chemistry and Physics, based on true density at 20 °C Range 0 to 87 % H_2SO_4 Range 0 to 27 % free SO_3 40 °C Range 0 to 90 % H_2SO_4 Range 0 to 47 % free SO_3 based on velocity of sound at 20 °C Range 87 to 100 % H_2SO_4 40 °C Range 90 to 100 % H_2SO_4 Range 47 to 65 % free SO_3
Phosphoric Acid (H3PO4) (% w/w) (mol/l) (N)	Landolt-Boernstein, based on true density at 20 °C, range 0 to 100 % (0 to 19.03 mol/l). Accuracy approx. 0.06 % (0.01mol/l).
Sodium Hydroxide (NaOH)[a] (% w/w) (mol/l) (N)	Landolt-Boernstein, based on true density at 20 °C, range 0 to 50 % (0 to 9.56 mol/l). Accuracy approx. 0.04 % (0.01 mol/l).
Sulfuric Acid (H_2SO_4) (% w/w) (mol/l) (N)	See the explanation for Oleum.

a. Caution: corrodes measuring cell.

Group: Special Adjustments Up to 5 special adjustments can be stored in DSA 5000 M (see Chapter 11.3.5).

Appendix G: List of Quick Settings Parameters

Parameter Type	Parameter Select	Description
Sample Name		Only in the "No Sample List" mode
Type	S (Standard)	To perform a standard measurement
	C (Check)	To perform one of the predefined checks. It is only possible to select a check which has been defined for the selected method before.
	MM (Multiple Measurement)	To perform 2 to 10 measurements of a single sample automatically.
	TS (Temperature Scan)	To perform a temperature scan.
Density Temperature		To set the temperature of the density measuring cell. Enter a value between 0 and 70 °C.
Density Measurement finished by	Predetermination	default
	Equilibrium fast	
	Equilibrium medium	
	Equilibrium slow	
	None (use method default)	
Density Timeout		To set the timeout for the density measurement (between 30 and 3600 s; default 600 s).
Density FillingCheck™	Always active	default
	Not active	
	Active during measurement	
	None (use method default)	

Parameter Type	Parameter Select	Description
Density Canadian Excise Alcohol Table	Special Adjustment 1, …, 5	default
	None (use method default)	
Sound Period Criterion		To set a period criterion for the sound velocity measurement. Possible range: 1E -6 to 500E -6 Factory default: 90E-6
Sound Time Criterion		To set a time criterion for the sound velocity measurement. Possible range: 4 to 32 sec Factory default: 30 sec
User-defined data fields		If set as mandatory in the sample list settings.
User functions of the "Constant" type		If activated in the method settings.

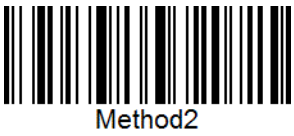
Appendix H: Bar Codes for Assigning Methods

To generate a bar code for a method, you can use any bar code generator, e.g. http://barcode.tec-it.com.

- Use the format "MethodX" with "X" standing for the position number of the method in the method list.
- To view the position number, tap <Method> on the main screen.

NOTICE
Please check the position number of your method after any changes in the method order, after deleting or hiding methods and after creating new methods.

The bar codes pictured below are type Code 128 (encodes all 128 ASCII characters).



Appendix I: Density Tables

Density of Air

At the temperature t in [°C] and the pressure p in [mbar] or [hPa] the density ρ of air in [g/cm³] is calculated using the following formula for an air humidity of 50 %:

$$\rho=(((0.34844*p-0.5*(0.252*t-2.0582))/(273.15+t)/1000))$$

The numbers are valid for a CO_2 content in air of 0.03 % by volume; the numbers change by ±1/19000 for every change in CO_2 volume content of ±0.0001.

Density of Air (-10 °C to +90 °C)[1]

Composition of dry air in [v/v]: 78.110 % N_2; 20.938 % O_2; 0.916 % Ar; 0.033 % CO_2; 0.002 % Ne

The table lists values of air with 50 % air humidity.

Meas. temp. in °C	Density in g/cm³ at the pressure in mbar (=hPa)							
	900	920	940	960	980	1000	1013.25	1050
-10	0.001200	0.001227	0.001253	0.001280	0.001306	0.001333	0.001350	0.001399
-5	0.001176	0.001202	0.001228	0.001254	0.001280	0.001306	0.001323	0.001371
0	0.001152	0.001177	0.001203	0.001228	0.001254	0.001279	0.001296	0.001343
5	0.001129	0.001154	0.001179	0.001204	0.001229	0.001254	0.001271	0.001317
10	0.001107	0.001131	0.001156	0.001181	0.001205	0.001230	0.001246	0.001291
15	0.001085	0.001110	0.001134	0.001158	0.001182	0.001206	0.001222	0.001267
20	0.001065	0.001088	0.001112	0.001136	0.001160	0.001184	0.001199	0.001243
25	0.001045	0.001068	0.001091	0.001115	0.001138	0.001162	0.001177	0.001220
30	0.001025	0.001048	0.001071	0.001094	0.001117	0.001140	0.001156	0.001198
35	0.001007	0.001029	0.001052	0.001075	0.001097	0.001120	0.001135	0.001176
40	0.000989	0.001011	0.001033	0.001055	0.001078	0.001100	0.001115	0.001156
45	0.000971	0.000993	0.001015	0.001037	0.001059	0.001081	0.001095	0.001135
50	0.000954	0.000976	0.000997	0.001019	0.001040	0.001062	0.001076	0.001116
55	0.000938	0.000959	0.000980	0.001001	0.001023	0.001044	0.001058	0.001097
60	0.000922	0.000943	0.000964	0.000984	0.001005	0.001026	0.001040	0.001079
65	0.000906	0.000927	0.000947	0.000968	0.000989	0.001009	0.001023	0.001061
70	0.000891	0.000911	0.000932	0.000952	0.000972	0.000993	0.001006	0.001043
75	0.000877	0.000897	0.000917	0.000937	0.000957	0.000977	0.000990	0.001027
80	0.000862	0.000882	0.000902	0.000922	0.000941	0.000961	0.000974	0.001010
85	0.000849	0.000868	0.000887	0.000907	0.000926	0.000946	0.000959	0.000995
90	0.000835	0.000854	0.000874	0.000893	0.000912	0.000931	0.000944	0.000979

1. Literature: F. Spieweck, H. Bettin: Review: Solid and liquid density determination tm 7/8 1992 p291

Density of Water (0 °C to 100 °C)[2]

T °C	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
0	.999840	.999846	.999853	.999859	.999865	.999871	.999877	.999883	.999888	.999893
1	.999899	.999903	.999908	.999913	.999917	.999921	.999925	.999929	.999933	.999937
2	.999940	.999943	.999946	.999949	.999952	.999954	.999956	.999959	.999961	.999962
3	.999964	.999966	.999967	.999968	.999969	.999970	.999971	.999971	.999972	.999972
4	.999972	.999972	.999972	.999971	.999971	.999970	.999969	.999968	.999967	.999965
5	.999964	.999962	.999960	.999958	.999956	.999954	.999951	.999949	.999946	.999943
6	.999940	.999937	.999934	.999930	.999926	.999923	.999919	.999915	.999910	.999906
7	.999901	.999897	.999892	.999887	.999882	.999877	.999871	.999866	.999860	.999854
8	.999848	.999842	.999836	.999829	.999823	.999816	.999809	.999802	.999795	.999788
9	.999781	.999773	.999766	.999758	.999750	.999742	.999734	.999725	.999717	.999708
10	.999699	.999691	.999682	.999672	.999663	.999654	.999644	.999635	.999625	.999615
11	.999605	.999595	.999584	.999574	.999563	.999553	.999542	.999531	.999520	.999508
12	.999497	.999486	.999474	.999462	.999450	.999438	.999426	.999414	.999402	.999389
13	.999377	.999364	.999351	.999338	.999325	.999312	.999298	.999285	.999271	.999258
14	.999244	.999230	.999216	.999202	.999187	.999173	.999158	.999144	.999129	.999114
15	.999099	.999084	.999069	.999053	.999038	.999022	.999006	.998991	.998975	.998959
16	.998942	.998926	.998910	.998893	.998876	.998860	.998843	.998826	.998809	.998792
17	.998774	.998757	.998739	.998722	.998704	.998686	.998668	.998650	.998632	.998613
18	.998595	.998576	.998558	.998539	.998520	.998501	.998482	.998463	.998443	.998424
19	.998404	.998385	.998365	.998345	.998325	.998305	.998285	.998265	.998244	.998224
20	.998203	.998182	.998162	.998141	.998120	.998099	.998077	.998056	.998035	.998013
21	.997991	.997970	.997948	.997926	.997904	.997882	.997859	.997837	.997815	.997792
22	.997769	.997747	.997724	.997701	.997678	.997654	.997631	.997608	.997584	.997561
23	.997537	.997513	.997490	.997466	.997442	.997417	.997393	.997369	.997344	.997320
24	.997295	.997270	.997246	.997221	.997196	.997170	.997145	.997120	.997094	.997069
25	.997043	.997018	.996992	.996966	.996940	.996914	.996888	.996861	.996835	.996809
26	.996782	.996755	.996729	.996702	.996675	.996648	.996621	.996594	.996566	.996539
27	.996511	.996484	.996456	.996428	.996400	.996373	.996344	.996316	.996288	.996260
28	.996232	.996203	.996174	.996146	.996117	.996088	.996059	.996030	.996001	.995972
29	.995943	.995913	.995884	.995854	.995825	.995795	.995765	.995735	.995705	.995675
30	.995645	.995615	.995584	.995554	.995523	.995493	.995462	.995431	.995401	.995370
31	.995339	.995307	.995276	.995245	.995214	.995182	.995151	.995119	.995087	.995056
32	.995024	.994992	.994960	.994928	.994895	.994863	.994831	.994798	.994766	.994733
33	.994700	.994667	.994635	.994602	.994569	.994535	.994502	.994469	.994436	.994402
34	.994369	.994335	.994301	.994268	.994234	.994200	.994166	.994132	.994097	.994063
35	.994029	.993994	.993960	.993925	.993891	.993856	.993821	.993786	.993751	.993716

2. Literature: Spieweck, F. & Bettin, H.: Review: Solid and liquid density determination. Technisches Messen 59 (1992), pp. 285-292.

T °C	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
36	.993681	.993646	.993610	.993575	.993540	.993504	.993468	.993433	.993397	.993361
37	.993325	.993289	.993253	.993217	.993181	.993144	.993108	.993072	.993035	.992998
38	.992962	.992925	.992888	.992851	.992814	.992777	.992740	.992703	.992665	.992628
39	.992591	.992553	.992515	.992478	.992440	.992402	.992364	.992326	.992288	.992250
40	.992212	.992174	.992135	.992097	.992058	.992020	.991981	.991942	.991904	.991865
41	.991826	.991787	.991748	.991708	.991669	.991630	.991590	.991551	.991511	.991472
42	.991432	.991392	.991353	.991313	.991273	.991233	.991193	.991152	.991112	.991072
43	.991031	.990991	.990950	.990910	.990869	.990828	.990787	.990747	.990706	.990665
44	.990623	.990582	.990541	.990500	.990458	.990417	.990375	.990334	.990292	.990250
45	.990208	.990167	.990125	.990083	.990040	.989998	.989956	.989914	.989871	.989829
46	.989786	.989744	.989701	.989658	.989616	.989573	.989530	.989487	.989444	.989401
47	.989358	.989314	.989271	.989228	.989184	.989141	.989097	.989053	.989010	.988966
48	.988922	.988878	.988834	.988790	.988746	.988702	.988657	.988613	.988569	.988524
49	.988480	.988435	.988390	.988346	.988301	.988256	.988211	.988166	.988121	.988076
50	.988030	.987985	.987940	.987894	.987849	.987804	.987758	.987712	.987667	.987621
51	.987575	.987529	.987483	.987437	.987391	.987345	.987298	.987252	.987206	.987159
52	.987113	.987066	.987020	.986973	.986926	.986879	.986833	.986786	.986739	.986692
53	.986644	.986597	.986550	.986503	.986455	.986408	.986360	.986313	.986265	.986217
54	.986170	.986122	.986074	.986026	.985978	.985930	.985882	.985833	.985785	.985737
55	.985688	.985640	.985591	.985543	.985494	.985446	.985397	.985348	.985299	.985250
56	.985201	.985152	.985103	.985054	.985004	.984955	.984906	.984856	.984807	.984757
57	.984708	.984658	.984608	.984558	.984509	.984459	.984409	.984359	.984308	.984258
58	.984208	.984158	.984107	.984057	.984007	.983956	.983905	.983855	.983804	.983753
59	.983702	.983652	.983601	.983550	.983499	.983448	.983396	.983345	.983294	.983242
60	.983191	.983140	.983088	.983036	.982985	.982933	.982881	.982829	.982778	.982726
61	.982674	.982621	.982569	.982517	.982465	.982413	.982360	.982308	.982255	.982203
62	.982150	.982098	.982045	.981992	.981939	.981886	.981834	.981780	.981727	.981674
63	.981621	.981568	.981515	.981461	.981408	.981354	.981301	.981247	.981194	.981140
64	.981086	.981032	.980979	.980925	.980871	.980817	.980763	.980708	.980654	.980600
65	.980546	.980491	.980437	.980382	.980328	.980273	.980219	.980164	.980109	.980054
66	.980000	.979945	.979890	.979835	.979780	.979724	.979669	.979614	.979559	.979503
67	.979448	.979392	.979337	.979281	.979226	.979170	.979114	.979058	.979002	.978946
68	.978890	.978834	.978778	.978722	.978666	.978610	.978553	.978497	.978441	.978384
69	.978328	.978271	.978214	.978158	.978101	.978044	.977987	.977930	.977874	.977816
70	.977759	.977702	.977645	.977588	.977531	.977473	.977416	.977358	.977301	.977243
71	.977186	.977128	.977070	.977012	.976955	.976897	.976839	.976781	.976723	.976665
72	.976607	.976548	.976490	.976432	.976374	.976315	.976257	.976198	.976140	.976081
73	.976022	.975963	.975905	.975846	.975787	.975728	.975669	.975610	.975551	.975492
74	.975432	.975373	.975314	.975255	.975195	.975136	.975076	.975017	.974957	.974897
75	974838	.974778	.974718	.974658	.974598	.974538	.974478	.974418	.974358	.974298
76	.974237	.974177	.974117	.974056	.973996	.973935	.973875	.973814	.973753	.973693

T °C	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
77	.973632	.973571	.973510	.973449	.973388	.973327	.973266	.973205	.973144	.973083
78	.973021	.972960	.972899	.972837	.972776	.972714	.972653	.972591	.972529	.972468
79	.972406	.972344	.972282	.972220	.972158	.972096	.972034	.971972	.971910	.971847
80	.971785	.971723	.971660	.971598	.971535	.971473	.971410	.971348	.971285	.971222
81	.971159	.971096	.971034	.970971	.970908	.970844	.970781	.970718	.970655	.970592
82	.970528	.970465	.970402	.970338	.970275	.970211	.970148	.970084	.970020	.969956
83	.969893	.969829	.969765	.969701	.969637	.969573	.969509	.969445	.969380	.969316
84	.969252	.969188	.969123	.969059	.968994	.968930	.968865	.968800	.968736	.968671
85	.968606	.968541	.968477	.968412	.968347	.968282	.968216	.968151	.968086	.968021
86	.967956	.967890	.967825	.967760	.967694	.967629	.967563	.967497	.967432	.967366
87	.967300	.967234	.967169	.967103	.967037	.966971	.966905	.966838	.966772	.966706
88	.966640	.966574	.966507	.966441	.966374	.966308	.966241	.966175	.966108	.966042
89	.965975	.965908	.965841	.965774	.965707	.965640	.965573	.965506	.965439	.965372
90	.965305	.965238	.965170	.965103	.965036	.964968	.964901	.964833	.964765	.964698
91	.964630	.964562	.964495	.964427	.964359	.964291	.964223	.964155	.964087	.964019
92	.963951	.963882	.963814	.963746	.963677	.963609	.963541	.963472	.963404	.963335
93	.963266	.963198	.963129	.963060	.962991	.962922	.962854	.962785	.962716	.962646
94	.962577	.962508	.962439	.962370	.962300	.962231	.962162	.962092	.962023	.961953
95	.961884	.961814	.961744	.961675	.961605	.961535	.961465	.961395	.961325	.961255
96	.961185	.961115	.961045	.960975	.960905	.960834	.960764	.960694	.960623	.960553
97	.960482	.960412	.960341	.960271	.960200	.960129	.960058	.959988	.959917	.959846
98	.959775	.959704	.959633	.959562	.959490	.959419	.959348	.959277	.959205	.959134
99	.959062	.958991	.958920	.958848	.958776	.958705	.958633	.958561	.958489	.958418
100	.958346	.958273	.958201	.958129	.958057	.957985	.957913	.957840	.957768	.957696

Appendix J: Sound Velocity of Water

Sound Velocity of Water (0 °C to 100 °C)[3]

Temperature	Sound Velocity	Temperature	Sound Velocity
0	1402.74	25	1497.00
1	1407.71	26	1499.64
2	1412.57	27	1502.20
3	1417.32	28	1504.68
4	1421.96	29	1507.10
5	1426.50	30	1509.44
6	1430.92	31	1511.71
7	1435.24	32	1513.92
8	1439.46	33	1516.05
9	1443.58	34	1518.12
10	1447.59	35	1520.12
11	1451.51	36	1522.06
12	1455.34	37	1523.93
13	1459.07	38	1525.74
14	1462.70	39	1527.49
15	1466.25	40	1529.18
16	1469.70	41	1530.80
17	1473.07	42	1532.37
18	1476.35	43	1533.88
19	1479.55	44	1535.33
20	1482.66	45	1536.72
21	1485.69	46	1538.06
22	1488.63	47	1539.34
23	1491.50	48	1540.57
24	1494.29	49	1541.74

3. Literature: Landolt-Börnstein: Neue Serie, Band 5, Molekularakustik Temperaturskala von 1990. PTB-Mitt. 100 (1990), pg.195-196

Temperature	Sound Velocity	Temperature	Sound Velocity
50	1542.87	76	1555.40
51	1543.93	77	1555.31
52	1544.95	78	1555.02
53	1545.92	79	1555.02
54	1546.83	80	1554.81
55	1547.70	81	1554.57
56	1548.52	82	1554.30
57	1549.28	83	1553.98
58	1550.00	84	1553.25
59	1550.68	85	1553.25
60	1551.30	86	1552.82
61	1551.88	87	1552.37
62	1552.42	88	1551.88
63	1552.91	89	1551.35
64	1553.35	90	1550.79
65	1553.76	91	1550.20
66	1554.11	92	1549.58
67	1554.43	93	1548.92
68	1554.70	94	1548.23
69	1554.93	95	1547.50
70	1555.12	96	1546.75
71	1555.27	97	1545.96
72	1555.37	98	1545.14
73	1555.44	99	1544.29
74	1555.47	100	1543.41
75	1555.46		

Appendix K: Firmware Versions

Firmware version	Date of release	Document number	Comments
V1.60	19.08.2009	D17IB02A D17IB02B D17IB02C	First released version. Changed accuracy of concentration measurement.
V1.70	15.01.2009	D17IB02D	• Group calculator • GUI performance improved • Audit trail: password rules • Temperature scan for all instruments • Mandatory data fields • Installing of language pack • Three new RS-232 commands according to DMA classic instruments • More detailed information in system information • Live raw data can be printed • Screen saver is disabled by interface commands
V2.00	10.09.2010	D17IB001EN-A	• GUI performance improved • Data browser filter: only users and methods used are available • More detailed information about firmware module state during startup (new initialization screen instead of online screen) • Safe mode operation after firmware errors • Sample list: ring buffer for 200 sample list entries. Sample list entries older than 24 hours are automatically removed • Data memory can be set as ring buffer if Audit Trail is deactivated • <Monitor> button to unfreeze the screen moved to the quick access area • Allowed minimum step size in temperature scans depends now on the equilibrium setting of the density module • Keyboard and bar code settings: the sample list can be edited with a bar code reader (tab key as terminator) • <Redo> option after adjustments available • New air pump setting: Automatic stop when the density value is stable • Audit Trail stores more detailed and structured information on changes to the system • New RS-232 commands: "set temperature" and "help" • Printing a single sample on a list report is not supported any more
V2.10	22.12.2010	D17IB001EN-B	New multiple measurements menu.

V2.20	12.09.2011	D17IB001EN-C	• New system security settings implemented: different security levels, electronic signature, auto logoff and password expiry • "Audit Trail" menu now in the "System Security" menu • Quick settings implemented for convenient change of measurement settings • "No Sample List" mode available • Methods can be hidden and ordered • New "Constant" user function added • Printing support for adjustments added • Camera images during adjustment/check procedure added • PDF print reports and Excel exports optimized

Appendix L: Declaration of Conformity

CE Declaration of Conformity

Anton Paar

Anton Paar GmbH hereby declares that the product listed below in the version offered for sale meets all the basic requirements of the applicable sections of the relevant EU directives in design and type.

This declaration will be deemed invalid should any unauthorized modifications be made to the product. Follow the information given in the instruction manual when setting up and operating the instrument.

Product designation:	DSA 5000 M DENSITY AND SOUND VELOCITY METER SOFT DRINK ANALYZER M DENSITY AND SOUND VELOCITY METER SOFT DRINK ANALYZER M PEPSI DENSITY AND SOUND VELOCITY METER
Model:	**DSA 5000 M**
Manufacturer:	**Anton Paar GmbH**

The product meets the requirements of the following directives:

- **Electromagnetic Compatibility 2004/108/EC**

  Applied standards:

EN 61326-1:2006	Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements

  The product is classified as a class B equipment and is intended for the use in industrial area.

- **Low Voltage Directive 2006/95/EC**

  Applied standards:

EN 61010-1:2001	Safety requirements for electrical equipment for measurement, control and laboratory use Part 1: General requirements
IEC 61010-2-010:2003	Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 2-010: Particular requirements for laboratory equipment for the heating of materials

Dipl. HTL Ing. Gerhard Raffer
Division Manager

Dipl. Ing. Günter Hofer
Department Manager

Appendix M:Menu Tree

The menu tree also shows which parts of the menu are accessible for users with administrator, manager or operator rights using the following colors:

Administrator
Administrator, Manager
Administrator, Manager, Operator

Checks/ Adjustments	Checks		
	Air/Water Adjustment		
	Other Adjustments	Density + Sound Module	Air/Water Adjustment
			Temperature Range Adjustment
			High Density/Viscosity Adjustment
			Atmospheric Pressure Sensor Adjustment
			Special Adjustments
			Reset To Factory Adjustment
Data Memory	Measured Data		
	Statistic		
	Delete Measured Data		
	Audit Trail		
	Check Data		
	Delete Audit Trail		
	Adjustment Data	Density + Sound Module	Density Adjustment
			Sound Adjustment
			Temperature Adjustment
			Density Adjustment KB Graph
			Special Adjustment
Methods	Method Settings	Density & Sound (Current Method)	Activate Modules/Constants[a]
			Density Module
			Sound Module
			Display Layout
			Result Output
			Limits
			Multiple Measurement Settings
			Formula Parameters
			Quick Settings Management
		Density (not visc.-corr.) & Sound	
		Sound	
		Sulfuric Acid & Oleum	
		Density only	
	Method Management		

Methods	Method Visibility		
Setup	Measuring System Settings	Sample List	Sample List Settings
			User-defined Data Fields
			Sample List Warnings
			Mandatory Data Fields
		Camera	
		Air Pump	
	Control Panel	Date and Time	
		Regional Settings	
		Input Units	
		Printer Management	
		Network	
		Instrument Name and Location	
		Screen Saver	
		Feedback Beeps	
		Calibrate Touch Screen	
		Calibrate External Touch Screen	
		Keyboard and Bar Code Settings	
		Advanced Camera Settings	
	System Security	Security Level	
		Audit Trail	
		Electronic Signature	
		Logon Settings	
		Increased Security	
	Users Management[b]		
	Printout Settings	Automatic Printout	
		Report Management	
		Select Logos	
		Import Logos	
		Name and Address	
	Favorites Management		
	Data Browser Settings		
	Expert Settings	User Functions Management	
		Calculator	
		Group Calculator	
		Checks Management	
		Data Memory Settings	

Service	Backup Instrument Settings	
	Restore Instrument Settings	
	Update	User Interface Firmware
		Module Firmware
		Install Language Pack
		Logging Configuration
	System Information	
	Live Raw Data	DMA Density
		Calculations
		DCB - Air Pump
		DMA Density - Air Pressure
		DCB - Environment
		DCB - CAN Connector

a. Only if a "Constant" user function was created and/or if a module is connected
b. Users of any user group may change their own password

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