



Instruction Manual and Safety Information

DMA 501 | DMA 1001

Density Meter

instrument software version: from 4.1.0
(Original Instructions)

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See the reference guide for a comprehensive description of the instrument.

Download Anton Paar documents for free from the Anton Paar website: <https://www.anton-paar.com>

1 Safety Instructions

- Read the documentation before using the instrument.
- Follow all hints and instructions in the documentation to ensure the correct use and safe functioning of the instrument.
- The documentation is a part of the product. Keep it for the complete working life of the product and make it easily accessible for all persons involved with the product. If you receive any additions or revisions to the documentation from Anton Paar GmbH, these must be treated as part of the documentation.
- Use only accessories, consumables, or spare parts supplied or approved by Anton Paar GmbH.
- Ensure that all operators have been trained beforehand to use the instrument safely and correctly.
- Ensure that the instrument is sufficiently supervised during operation.
- In case of damage or malfunction, do not continue operating the instrument. Do not operate the instrument under conditions which could result in damage to goods or injuries or loss of life.

1.1 Liability

- This document 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 to determine the applicability of regulatory limitations.
- Anton Paar GmbH only warrants the proper functioning of the instrument if no modifications are made to mechanics, electronics, or software.
- Use the instrument only for the purpose described in the documentation. Anton Paar GmbH is not liable for damages caused by incorrect use of the instrument.
- The results delivered by the instrument depend not only on the correct functioning of the instrument, but also on various other factors. We therefore recommend that you have the results checked (e.g. plausibility tested) by skilled persons before consequential actions are taken based on the results.

1.2 Installation and Use

- The installation procedure shall be carried out only by authorized persons who are familiar with the installation instructions.

Operation in areas with risk of explosion

- The instrument is **not** explosion-proof and therefore must not be operated in areas with risk of explosion.

General precautions

- Observe and adhere to your national safety regulations regarding the handling of all substances associated with your measurements (e.g. use safety goggles, gloves, respiratory protection, etc.).
- Samples and cleaning liquids that have been used in the measuring system are not suited for human consumption after use.
- Before a measurement check the wetted parts of the instrument for chemical resistance to the samples and cleaning agents used.
- Take care that the liquids (samples and cleaning agents) or gases that you use are chemically compatible when they come into contact with each other. They must not react exothermally or produce solid particles, which might stick to the inner walls of the measuring cells.
- Before you start a measurement or cleaning procedure, take care that all parts, in particular the measuring cells, the injection adapters, the hoses, and the waste vessel, are properly connected and in good condition.

1 Safety Instructions

- Before you start a measurement or cleaning procedure, check the injection adapters for leak tightness.
- Take measures that spilled liquids cannot get into plug connections or venting slots of electrical appliances.
- Install the instrument so that you can easily separate it from the mains supply (pull the power plug) at any time.

Precautions for flammable samples and cleaning agents

- Keep potential sources of ignition, like sparks or open flames, at a safe distance from the instrument.
- Place the instrument on a laboratory bench made of fireproof material, preferably bricks, ceramics, or stoneware.
- Store only the minimum required amount of sample, cleaning agents, and other flammable materials near the instrument.
- Do not spill sample/cleaning agents or leave their containers uncovered. Immediately remove spilled sample/cleaning agents.
- Ensure that the setup location is sufficiently ventilated. The environment of the instrument must be kept free of flammable gases and vapors.
- Provide fire-extinguishing equipment.

Transportation

- Empty the measuring cell and all hoses before you move or lift the instrument.
- To carry the instrument, put one hand into the recessed grip below the front, and grasp the metal ledge on the rear with the other hand.
- Do not hold the instrument by its bottom to avoid squeezing your fingers when you put down the instrument.
- Carry the instrument in front of you and keep it close to your body.

1.3 Service and Repairs

- Service and repair procedures may be carried out only by authorized persons or by Anton Paar GmbH.

1.4 Disposal

- Concerning the disposal of the instrument, observe the legal requirements in your country.

1.5 Conventions for Safety Messages

The following conventions for safety messages are used in this document:



WARNING

Description of risk

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



CAUTION

Description of risk

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

NOTICE

Description of risk

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

2 DMA 501 / DMA 1001 – An Overview

The compact DMA 501 / DMA 1001 density meter measures the density of liquid samples by use of the oscillating U-tube method that has been first introduced on the market by Anton Paar in 1967. It combines high precision with easy operation and robust design. The instrument will cope with almost any sample that you can fill and clean.

Accurate results in the shape required

The instrument corrects viscosity-related errors automatically. An integrated Pt 100 platinum thermometer together with Peltier elements provide an extremely precise thermostating of the sample.

The density value can be automatically converted into concentration values for numerous generic user products (already factory-programmed).

Precise sample filling

Accurate and repeatable results strongly depend on bubble-free filling ensured by the peristaltic pump optionally integrated in the instrument.

FillingCheck™ automatically detects gas bubbles in the measuring cell by an advanced analysis of its oscillation pattern, and will generate a warning message in that case. Additionally you can visually inspect the measuring cell on the real-time camera image (U-View™).

Intuitive user interface

Operate the instrument via the touchscreen user interface giving you the look and feel of a smart-phone. If you prefer, you can optionally connect an external keyboard or mouse and a barcode reader.

Data export/printouts

You can export all measured data as a PDF or CSV file onto any connected storage device. Data can be printed via USB, network, or serial port.

2.1 Intended Use of the Instrument

DMA 501 / DMA 1001 is capable of measuring nearly every liquid, independent of its composition and viscosity.

Typical samples include soft drinks, various types of oil, acids and bases, infusion solutions, pastes and creams from applications as diverse as petrochemicals, food & beverages, chemicals, pharmaceuticals and cosmetics.

Restrictions

Do not leave bases longer than necessary in the measuring cell, because the glass of the measuring cell is susceptible to attack by alkaline liquids.

Exclusions

- The instrument cannot measure solids.
- Do not measure hydrofluoric acid as it attacks the glass of the measuring cell.
- Do not fill substances that may harden inside the measuring cell.
- Do not mix substances inside the measuring cell if these substances may react chemically.
- Do not use mechanical action for cleaning the measuring cell.

IMPORTANT: *Always check if recommendations of the instrument (e.g. from the instrument's intelligent condition monitoring) are reasonable.*

2.2 Functional Components

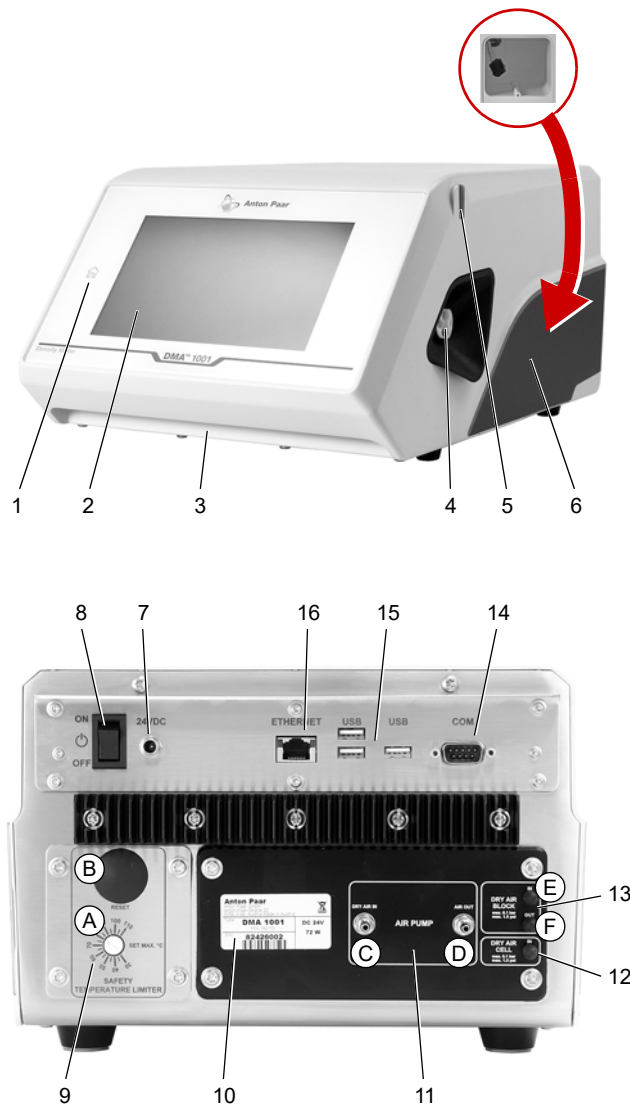


Fig. 1: Views of the instrument

Front

- 1 Home button
- 2 Touchscreen
- 3 Grip for transportation

Right side

- 4 Sample inlet and outlet
- 5 Socket for the syringe holder
- 6 Slot for the optional peristaltic pump
(to access lift off cover held by magnets)

Rear

- 7 DC power jack
 - 8 On/Off switch
 - 9 Safety temperature limiter (A) and reset button (B)
 - 10 Type plate with serial number (P/N = mat. no.)
- Air connectors on the rear**
- 11 Air pump (4.5 mm barbed), inlet (C) / outlet (D)
 - 12 Drying of measuring cell (4 mm barbed), inlet max. 0.1 bar (1.5 psi) rel.
 - 13 Drying of cell block (4 mm barbed), inlet (E) / outlet (F) max. 0.1 bar (1.5 psi) rel.

Interface connectors on the rear

- 14 COM / RS-232 serial port (DE-9M connector)
- 15 USB 2.0 sockets (type A), 3x
- 16 Ethernet terminal (RJ45 connector)

3 Installing the Instrument

3.1 Installation Requirements

To achieve best measurement results, operate the instrument under typical laboratory conditions:

- 23 ±2 °C (73.4 ±3.6 °F) ambient temperature,
- < 60 % relative humidity,
- no direct sunlight.

The setup location and surroundings must meet the minimum requirements specified under “Operating conditions” in the technical data (appendix A.2).

Also observe the safety instructions in section 1.

Allow the equipment to reach ambient temperature before installation. This is particularly important if the equipment has been stored or transported at lower temperatures.

IMPORTANT: *High humidity or a measuring temperature that is significantly below the ambient temperature may lead to condensation in the measuring cell. In this case take measures to avoid condensation as described in the reference guide.*

The right place

NOTICE

No spray water protection at the rear

Consider that the rear of the instrument is not protected against spray water, whereas the front, top, and sides are.

Place the instrument on a stable, flat desk that is free of vibrations and away from vibrating equipment.

To ensure temperature stability and trouble-free measurement, do **not** position your instrument:

- next to a heating facility,
- in a drafty place (e.g. near an air conditioning, ventilation system, or an open window),
- in direct sunlight.

Leave enough room (approx. 10 cm/4 in) between the cooling fins on the rear of the instrument and any wall. Also ensure that the heat can freely dissipate. Do not install the instrument in a cabinet.

The instrument requires an electrical outlet nearby:

- AC 100–240 V, 47–63 Hz, 1.5 A

3.2 Installation



WARNING

Risk of electric shock

Connect only voltages that comply with PELV (protective extra-low voltage) according to EN 61140 or with SELV (safety extra-low voltage) according to EN 60950 to any of the electrical connectors of the instrument, including the DC 24 V power supply.

3.2.1 Syringe Holder / Filling Hose Connections



Fig. 2: Mounting the syringe holder

- 1 Adapter Luer 1/4" UNF
- 2 Syringe holder
- 3 Hose 140x3x2 PTFE 2x1/4"-28 UNF
- 4 Sample inlet
- 5 Sample outlet

1. Take the syringe holder from the accessory kit.
2. Screw an adapter Luer 1/4" UNF, mat. no. 64792, into the upper screw hole (by the broader end of the tapered dovetail), see fig. 2.
3. Screw one end of the hose 140x3x2 PTFE, mat. no. 187223, into the lower screw hole.
4. Slide the tail of the syringe holder into the socket on the instrument (5, fig. 1).
5. Screw the free end of hose 140x3x2 PTFE into the sample inlet.

Choose any of the two hose connections, whichever suits your needs better. The other one will be the sample outlet.

3.2.2 Leak Tightness Test



CAUTION

Possible leakage of dangerous liquids

Dangerous liquids leaking from the instrument may cause injuries or risk of fire.

- Check the connections for leak tightness before you fill dangerous liquids.

1. Close the sample outlet (see fig. 2) tightly with a male Luer plug, mat. no. 63865.
2. Draw up air into a plastic syringe from the accessory kit, and attach the syringe to the adapter on the syringe holder.
3. Inject, with moderate pressure, the air in the syringe into the instrument.
4. Wait a few seconds, then release the plunger of the syringe.
 - If the connections are tight, the plunger of the syringe will be slowly pushed back by the pressure in the measuring cell.
 - If the connections are leaky, the plunger of the syringe will not move.
 - In this case tighten all adapters firmly and repeat the leak tightness test.
 - If the leak tightness test still fails after that, contact your local Anton Paar representative.

3.2.3 Waste Hose / Waste Vessel



CAUTION

Possible leakage of dangerous liquids

Dangerous liquids leaking from the instrument may cause injuries or risk of fire.

- Only use the supplied hose and waste vessel if their materials are resistant to your samples and cleaning liquids.
- If the supplied parts are not suitable, use other parts made of an appropriate material.

1. Screw one end of the hose 300x3x2 PTFE, mat. no. 3443, into the threaded hole in the cap of the waste vessel.
2. Screw the other end of the hose into the sample outlet of the instrument.

IMPORTANT: *Always keep the waste vessel closed with the cap during operation.*

3.2.4 Air Pump Hose

1. Cut a piece of approx. 60 cm/23 in length from the supplied silicone hose, mat. no. 57024.
2. Attach an adapter Luer cone, mat. no. 63863, to one end of the air pump hose.
3. Attach the other end of the air pump hose to the air pump outlet "AIR OUT" on the rear of the instrument (11D, fig. 1).

3.2.5 Optional Parts

For the installation of optional parts, refer to the particular instructions coming with the part or to the corresponding section in the reference guide.

3.2.6 Power Connection



WARNING

Risk of electric shock or fire

- Use only a power supply that has come with your instrument or that is explicitly provided for your instrument (DC 24 V complying with PELV [protective extra-low voltage] according to EN 61140).
- Connect the power supply only to an electrical outlet with protective earthing.

1. Connect the power supply to the DC power jack on the rear of the instrument (7, fig. 1) and fix the cable with the knurled sleeve.
2. Connect the power supply to a suitable electrical outlet with the supplied power cable.

3.3 Switching the Instrument On/Off

NOTICE

Possible damage due to wrong voltage


Before you switch on the instrument, make sure that the correct line voltage and line frequency are available (AC 100–240 V, 47–63 Hz).

- Use the On/Off switch on the rear of the instrument (8, fig. 1) to switch the instrument on or off. After the instrument has been turned on, the home screen will come up on the display.

Verification of software integrity

During the startup of the instrument the integrity of the instrument's program code is verified by the calculation and comparison of a hash value.

The hash value of your specific software version can be found in the system information:

- Select  *System Information* in the menu, then find "Software hash".

3.4 Performing First Checks

After installation set the instrument settings, see section 5.



Conclude initial setup with an air check and a water check (see section 8.1) to verify that your instrument is in perfect condition. Your instrument has been factory adjusted, but during transport the density adjustment may have been compromised.

- If both checks succeed, your instrument is ready for routine measurements.
- Else perform an air/water adjustment as described in section 8.2.

4 Operating the Instrument

See the reference guide for a comprehensive description of the instrument software and all available settings and functions.

TIP: *The home button (1, fig. 1) beside the display will always bring you back to the home screen, which is the place where you basically start all operations.*

- Tap *Menu*  to open the menu.
- Tap  to access the dashboard.

TIP: *If you do not see all functions described in this manual, if you cannot access certain settings, or if you cannot perform some procedures, this may be due to restricted user permissions. See the reference guide for a description of system security and user management.*

5 Instrument Settings

See the reference guide for a comprehensive description of all instrument settings.

For the configuration of installed options, see the instructions that come with the option.

5.1 Language and Regional Settings

- Select  *Settings* in the menu, then under *System* select  *Time & language*.

First of all you will want to set the system **language** so that you feel comfortable on the measuring system:

- Set *Language* to a language that you prefer.

On the occasion set the number format (decimal symbols etc.) and the date and time **formats**:



- Select *Format* according to your requirements.

Finally select the **keyboard layout** for the onscreen keyboard and the **keymap** for an optional USB keyboard (see also the reference guide):

- Set *Keyboard layout* and *HW keyboard keymap* appropriately.

5.2 Time Settings

Set the system time correctly so that the time stamps of measurements and system events are correct and traceable:

1. Select  *Settings* in the menu, then under *System* select  *Time & language*.
2. Set *Region* and *City* to your time zone.



Daylight saving time will be calculated automatically.

TIP: *The date and time formats are defined with the Format setting, see section 5.1.*

- To set date and time **manually**:
 - Set *Date* to the current date.
 - Set *Time* to the current time.
- Alternatively, set date and time via **time server**:
 - a. Configure a network connection first, see the reference guide.
 - b. Switch *Use time server* to "Yes".
The *Time servers* input field replaces the input fields *Date* and *Time*.
 - c. The *Time servers* setting depends on your network settings.



- If you have set up an **automatic** network configuration, you can leave the *Time servers* input field empty.
- If you have set up a **manual** network configuration, or if you want to specify a time server anyway:
 - Specify the address(es) of your time server(s) in the *Time servers* input field. Put each time server in a new line. Do not separate addresses by commas or semicolons etc.
- d. It depends on your time server when the system time will be synchronized. It may also be necessary to restart the instrument.



5.3 Display Brightness

1. Select  *Settings* in the menu, then under *Hardware* select  *Instrument settings*.
2. To set the *Display brightness*, drag the slider to a convenient position.

TIP: *The display brightness is reduced in case no user interaction has been detected the last 20 minutes. As soon as you touch the screen, the display brightness is back to its previous value.*



5.4 Camera Settings

To set all available properties of the camera image, select  *Settings* in the menu, then under *Hardware* select  *Camera*.

- Use the arrow buttons to browse through the camera settings.
- Tap  to align the camera image with the measuring cell:
 - a. Drag the red frame representing the camera view, and position it over the measuring cell.
 - b. Tap  to confirm the position.

5.5 Global Units




Global units will be used as default units in the measuring system:

1. Select  *Settings* in the menu, then under *System* select  *Global Units*.
2. Select a global unit for density and a global unit for temperature.

6 Measurement Settings – Products

6.1 Products


You can individually define the measurement settings for each of your products or sample varieties, and save them for repeated use:

1. Select  *Products* in the menu.
2. Tap  *Create Product*.
3. Specify a name and description for the product.
4. Define the measurement settings (see section 6.2).
5. Tap  to select an image for the representation of the product.
6. Tap *Save* to save the collection of measurement settings for the product.

TIP: *The instrument comes with several predefined product settings, which you can use as a template.*

6.2 Measurement Settings

Measurement settings comprise the measurement parameters (see section 6.3), the assignment of a dashboard, and a report configuration for the results.

- For measurements without predefined product, assign dashboard and report configuration under *Setup*  on the *Measurement spot*.

6.2.1 Dashboards

Dashboards serve to monitor your measurements.

The instrument already comes with dashboards predefined for various generic products. You can adapt them to your needs or define new dashboards according to your requirements. See the reference guide for details.

You can place the following widgets onto a dashboard of the instrument:

- the live camera image of the measuring cell (U-View™)
- measurement information (giving information about the current status of the measurement)
- display boxes for any measuring quantity listed in the appendix of the reference guide.

6.2.2 Reports

Measurement results are presented as reports, which you can access in the data explorer. See the reference guide for details on configuring reports.

TIP: *The report configuration can also be changed after the measurement. It is independent of the dashboard.*

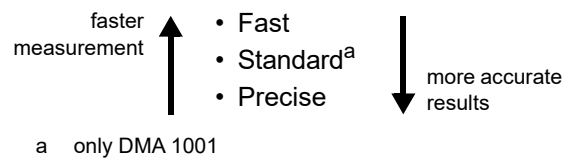
6.3 Measurement Parameters

6.3.1 Set Temperature

Set the measuring temperature here.

6.3.2 Measurement Performance

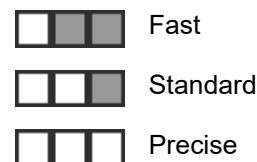
Select a measurement performance for the measurement:



Precise is the recommended standard setting. It ensures that the highest possible accuracy of the instrument is reached.

The *Density* widget includes a precision indicator showing the measurement performance set and the currently reached measurement performance (according to the stability criteria met). Read the precision indicator as follows (on the example of DMA 1001):

Indicator Measurement performance



White squares indicate the measurement performance set. Green squares indicate the measurement performance currently reached.

Indicator Measurement performance



Example: The measurement performance Precise has been set (white squares). Currently the measurement reaches measurement performance Standard (green squares).

6.3.3 Check Density Stability¹

Yes	The measurement result is determined when the temperature value as well as the density value are stable.
No	The measurement result is determined when the temperature value is stable.

TIP: “Yes” is the recommended standard setting. Select “No” if the characteristics of your sample prevent achieving density stability (inhomogeneous samples like toothpaste or unstable samples like H₂O₂).

6.3.4 Hold Time

The instrument will wait this time span after all specified stability conditions are met, and then determines the measurement result. This gives the sample time for temperature conditioning.

TIP: A hold time of 4 min for DMA 501 and 5 min for DMA 1001 is recommended when you measure without checking density stability. When you check density stability, the standard hold time is 0 min.

6.3.5 Timeout

If a stable measurement result cannot be achieved, the instrument will abort the measurement process after the specified timeout (e.g. 10 min).

The time span begins with measurement start.

TIP: A timeout may be caused by a filling error: In this case repeat the measurement. Or your sample is inhomogeneous: In this case deactivate checking for density stability (and set a hold time).

6.3.6 FillingCheck™

FillingCheck™ is an automatic bubble detection based on an advanced analysis of the U-tube’s oscillation pattern.

If applicable, a filling warning will be shown in the measurement information widget on the dashboard.

Yes	FillingCheck™ is active.
No	FillingCheck™ is deactivated.

TIP: Additionally check the filling visually by means of the built-in live camera (U-View™).

TIP: “Yes” is the standard setting. Select “No” if the detection of filling errors by FillingCheck™ obviously contradicts what you see in the live camera image.

TIP: FillingCheck™ provides excellent support to the operator for samples of low and medium viscosity ranges.

The sensitivity of this feature depends on a combination of density, viscosity, and temperature, and is not constant. For example, certain samples with high density (approx. 1.5 g/cm³) and medium viscosity (approx. 550 mPa·s) might generate a filling warning also for correctly filled samples. In all such cases, changing the measuring temperature may influence this combination so that FillingCheck™ continues working as expected.

Some samples may generate a filling warning even when filled without bubbles, e.g. highly viscous samples or samples containing inhomogeneities. In these cases we recommend to disable FillingCheck™ and perform repeated measurements to validate the quality of filling.

6.3.7 Other Measurement Parameters

Other measurement parameters may be available with installed options. For details see the respective manual of the option.

¹ Only available for measurement performance Precise.

7 Performing a Measurement

Table 1: Steps of a typical measurement cycle

	Step	see
A	Check that the measurement system is properly installed and in good working order, and that all conditions for a good measurement are met.	section 3.1, below
B	Perform a water check to verify the instrument's accuracy before you start your daily routine measurements.	section 8.1
	1 Define the measurement settings : Select a product or define the settings on the fly.	section 7.1 section 6
	2 Prepare your sample if required.	section 7.5
C	3 Fill the sample .	section 7.2 section 7.6
	4 Perform the measurement .	section 7.3
	5 Clean and dry the measuring cell.	section 9.1
D	Perform an air check to verify the efficiency of your cleaning and drying procedure after you have finished your daily routine measurements and the measuring cell has been cleaned and dried.	section 8.1

Preparatory steps

Before you start a measurement, check that:

- the measuring cell is clean and dry,
- hoses are connected correctly,
- hose connections are tight,
- the waste hose leads into the waste container,
- the volume of the waste container is large enough for the number of samples,
- suitable cleaning liquids are at hand.




To speed up measurements

- Bring the sample to measuring temperature in advance.
- Select a faster measurement performance and set measurement parameters so that the time for temperature conditioning of the sample becomes shorter (see section 6.3).

Consider, however, that your measurement results will become less accurate by proceeding so.

7.1 Starting a measurement

Start a measurement with defining the measurement settings. See section 6.3 for a description of available settings.

- To start a **product measurement**:
 - a. Select  *Products* in the menu, then select the specific product.
 - b. Check the measurement settings (or edit them), then tap *Create Measurement* .
- To define all measurement settings on the fly and perform a **measurement without pre-defined product**:
 - a. Select  *Measurement* in the menu.
 - b. Define the measurement settings.

7.2 Filling Sample

**WARNING****Risk of injuries and fire by liquids leaking**

Filling samples and cleaning liquids that the wetted parts are not resistant to will corrode the wetted parts. Sample leaking from corroded parts may cause serious injuries.

Before you fill any sample or cleaning liquid, in particular hazardous or flammable chemicals, into the instrument:

- Strictly follow all safety instructions concerning the use of chemicals and the use of flammable chemicals, see section 1.
- Make sure that all wetted parts are resistant to the filled-in liquid, see appendix A.3. Consider also the wetted parts of installed options.
- Make sure that you have suitable cleaning liquids at hand for cleaning the measuring cell, see section 9.1.

NOTICE**Corrosive samples require special care**

Samples with a moderate tendency to corrode borosilicate glass, such as strong alkali solutions (e.g. caustic soda), can be measured with the instrument. However:

- Remove corrosive samples immediately after measurement and rinse the measuring cell thoroughly.
- Check the validity of the adjustment more frequently than generally recommended.
- The measuring temperature for strong alkali solutions should not be higher than 20 °C (68 °F). Higher temperatures dramatically increase the speed of corrosion.

NOTICE**Proceeding in case of instrument leaks**

If liquid leaks from the draining hole by the sample inlet:

- Perform a leak tightness test as described in section 3.2.2.
- If the leak tightness test fails, contact your local Anton Paar representative.

You can fill the sample with a syringe or with an optional peristaltic pump. See the manual of the peristaltic pump for instructions on its installation and use.

To achieve highly accurate measuring results, fill the sample into the measuring cell steadily and without bubbles.

TIP: *Sample containing dissolved CO₂ will cause bubbles in the measuring cell, which render the measurement results invalid. Degas your sample carefully as described in section 7.5.*

NOTICE

Some organic solvents such as toluene, xylene or acetone may etch the instrument housing. Usually this occurs due to spilled sample or cleaning liquids.

- Remove any spilled liquids immediately as described in section 10.2.
- Use the protective cover in the case that spilling occurs.
- Detach the syringe holder from the instrument housing and position it at the side of the instrument to prevent etching on the housing where the syringe holder is located.

Sample amount




If the measuring cell is clean and dry, you need approx. 2 mL of sample.

If you measure without cleaning and drying between samples, you will 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 – FillingCheck™ and U-View™ (live camera image)

FillingCheck™ (see section 6.3.6) helps you detect bubbles during filling. Activate the function in the measurement settings.

Additionally check the filling visually by means of the built-in live camera (**U-View™**):

- Place the camera widget on the dashboard assigned to your measurement.
- Watch the live camera image on the dashboard during filling:
 - Tap on the image to open the camera screen.
 - Tap  to zoom in, tap  to zoom back out.
 - You can drag the zoomed image left or right to examine all parts of the measuring cell.
 - Tap  to close the camera screen.

The camera image will be saved with the measurement results.

7.2.1 Filling with a Syringe (Luer Tip)



WARNING

Risk of injuries by dangerous liquids leaking or spurting out

If you push the plunger of the syringe too hard, or if, e.g., the measuring cell breaks, dangerous liquids may leak or spurt out of ruptures causing injuries.

- Wear safety goggles and protective gloves when you fill dangerous liquids.

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

Filling position

- To achieve best measurement results, fill with the syringe attached to the syringe holder. This is the standard filling position.
- *Only in the case that the available amount of sample is very limited:*
 - Remove the adapter Luer 1/4" UNF from the syringe holder (1, fig. 2) and screw it into the sample inlet (4, fig. 2) of the instrument (instead of hose 3, fig. 2).
 - Use a 2 mL syringe for filling.

To fill with a syringe (Luer tip)

1. Connect the syringe (filled with sample) to the adapter Luer 1/4" UNF (1, fig. 2) on the syringe holder (or to the adapter mounted directly at the sample inlet of the instrument).
2. Push the plunger of the syringe slowly and steadily until a drop emerges from the sample outlet adapter.
3. Leave the syringe in the filling position during the measurement.

7.2.2 Filling with Optional Peristaltic Pump

See the manual of Xsample 200 High-Resistance.

7.3 Measurement Procedure



WARNING

Risk of fire and poisonous substances

In the very rare case of a malfunction of the temperature control, the measuring cell could heat up to 150 °C (302 °F).

- Set the safety temperature limiter (9A, fig. 1) on the rear of the instrument to a temperature that is safe for your sample (use a screwdriver).

IMPORTANT: If the adjustment temperature differs from the measuring temperature, give the measuring cell sufficient time for conditioning (approx. 1 hour per 10 °C/18 °F difference).

See section 8.2 for recommendations when to perform an adjustment before a measurement.

Particularly after temperature jumps the measurement results will be slightly drifting before they become stable. This is due to the intrinsic properties of glass, which the measuring cell is made of.

If you want to achieve best measurement results, give the measuring cell and sample enough time for temperature conditioning.

- As a rule of thumb allow for a conditioning time of 1 minute per every 10 °C (18 °F) difference between the temperature of the filled sample and the set measuring temperature.
- Additionally set a hold time (see section 6.3.4) of 4 min (DMA 501) / 5 min (DMA 1001) if you do not check density stability in your measurement.

If you measure density that is not viscosity-corrected, allow for a longer conditioning time: approx. 5 min if you check density stability, or approx. 10 min if you don't.

Initiating the measurement

- When you have verified that all measurement settings are correct, and the sample has been filled, tap **MEASURE**.

The measurement will be performed according to your settings. The progress bar shows the progress of the measurement.

When the measurement is finished, the results are displayed.

The results together with the camera image and a time stamp are automatically saved in the data memory.

- Tap




7 Performing a Measurement

- *DONE* to close the results and finish or
- *REMEASURE* to perform another measurement with the same settings.

7.4 Data Management

Saved data can be accessed in the data explorer:

- Measurements
- Checks
- Adjustments
- Products
- Audit trail (if activated)

1. Select  *Data Explorer* in the menu, then select one of the available data categories.
2. Select one of the saved data sets to see it.
Tap  to export a report, tap  to print it.

Find details in the reference guide.

7.5 Degassing Samples

There are various methods to degas 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. Pay attention to always treat all samples the same way in order to get reproducible measuring results.

IMPORTANT: *Be aware of the fact that the composition of some samples may slightly change during the pretreatment due to the evaporation of volatile components.*

Using a syringe

1. Fill the syringe with the sample and place a finger on it's opening.
2. Pull the piston to create a vacuum and release the finger to discharge the gas.
3. Repeat this procedure at least three times to make sure that no gas is left in the sample.

TIP: *The used syringe needs to be large enough to leave some space for creating the vacuum. Only up to two thirds of the syringe should be filled up.*

Boiling the sample



WARNING

Health risk with toxic components

Samples containing toxic volatile components can cause irritation and serious injuries to your eyes, skin, and mucous membranes as well as toxication.

- If your sample contains volatile components that are toxic, always handle it in an appropriate environment like under a fume hood, particularly when you boil your sample.



WARNING

Risk of fire and burns with flammable liquids

When you boil flammable liquids, there is a risk of fire. Serious injuries are possible.

- Do not boil flammable liquids.

1. Boil the liquid for several minutes to remove dissolved gas.
2. Fill the boiled liquid into a clean glass flask and cover it.
3. Wait until the liquid has cooled down approximately to measuring temperature.

Stirring the sample

- Stir your sample vigorously for 5–15 minutes (depending on the stirring equipment) until bubbling ceases.
- You can pour the sample through a paper filter after stirring to degas it even more efficiently.

Using an ultrasonic bath

- Put your sample for approx. 5–10 minutes into an ultrasonic bath until bubbling ceases.




7.6 Special Filling Techniques

See the reference guide for a discussion of special filling techniques concerning the following kinds of samples:

- bubbling samples
- suspensions and emulsions
- highly viscous samples
- pastes
- liquids in aerosol cans

8 Checks, Adjustments, Calibrations

8.1 Checks

1. Select  *Checks* in the menu, then select one of the already defined checks (or define a new one by tapping .
2. To edit the check parameters, tap .

You can define checks for virtually any measuring quantity available on the instrument.

- a. Edit the parameters as appropriate.

For a *water check* or *air check* select as follows:

- target type: "Quantity"
- target quantity: "Water density" or "Air Density", respectively

For a *custom check* select:

- target type: "Constant" and specify a target value to be tested with the check.

- b. Also specify max. upper and lower deviation and the correct temperature for the check.

Table 2: Factory settings for max. deviations (density)

DMA 501:	0.001 g/cm ³
DMA 1001:	0.0002 g/cm ³

- c. Save the settings.
3. Observe all hints on the screen and fill the check medium.
 - For a *water check*, use freshly degassed ultra-pure water.
 - For an *air check*, clean and dry the measuring cell thoroughly.

Use the camera image to check that the measuring cell is clean or that water has been filled bubble-free.
 4. Tap *START CHECK*.
 5. The summary of the check will show the check results and a recommendation if the check has failed and an adjustment is necessary.

IMPORTANT: We advise you to follow the recommendations.

All results are also saved in the data memory.

6. Tap *DONE* to close the summary.

If the water check has failed

We recommend taking corrective actions until the check is valid again:

- Examine the camera image included in the results to check that the water has been filled bubble-free.
- Check the quality of the water.
- Clean the measuring cell thoroughly.
- If above actions do not help, perform an air/water adjustment.

8.2 Adjustments

With an adjustment, a sample of exactly known measurement properties (standard) is measured, and the instrument constants are adjusted in a way that the instrument delivers the known correct results.

The instrument features a 2-point adjustment (air/water adjustment) and a wide range adjustment. DMA 1001 also features a 1-point adjustment (water adjustment) as the standard adjustment.

DMA 1001: After ten 1-point adjustments you are prompted to perform a 2-point adjustment for accuracy reasons.

- Perform a density adjustment if a check has failed and corrective actions have not helped.
- We recommend an air/water density adjustment if you relocate the instrument to a place where the ambient temperature differs by more than 10 °C (18 °F).
- *DMA 1001 only:* To achieve highest accuracy, we recommend to perform an air/water density adjustment after each temperature change (one hour after the required temperature has been reached).
- You will likely never need a wide range adjustment. Be aware that it will last several hours. However, a wide range adjustment may be useful when you adjust your instrument at a temperature in the middle of the range, and if subsequent measurements are out of specifications at other temperatures.


Performing an adjustment

For the air/water adjustment, the adjustment media are dry air and freshly degassed ultra-pure water.

DMA 1001: The 1-point water adjustment simply skips the air adjustment.

DMA 501 only: All adjustments are valid for the whole temperature range.

IMPORTANT: *You cannot use the peristaltic pump Xsample 200 for adjustments.*

1. Select  *Adjustments* in the menu, then select one of the available density adjustments.
2. Rinse and clean the measuring cell.

TIP: *If you use undenatured ethanol as the final rinsing liquid, only 3–4 min drying time are required.*

3. Tap *Start Air Pump* to dry the measuring cell.
4. Tap *DONE*.

5. Air adjustment:

- a. Enter the air humidity and the atmospheric pressure.
The air humidity is set to 50 % per default.
The atmospheric pressure displayed is measured automatically by a built-in sensor.

TIP: *The atmospheric pressure that you get from a local weather station is usually not the absolute atmospheric pressure, but a calculated atmospheric pressure value referenced to sea level.*

- b. Enter the adjustment temperature.

IMPORTANT: *We strongly recommend to adjust the instrument at the temperature at which you will perform your measurements (± 5 °C/ ± 9 °F).*

- c. Tap *START*.
The air adjustment routine is carried out.


6. Water adjustment:

- a. Fill freshly degassed ultra-pure water into the measuring cell.
Take care to fill the water without air bubbles.
- b. Tap *START*.
The water adjustment routine is carried out.

7. The results of the adjustment are shown.
Check the recommendation on the screen and apply or reject the adjustment.
All results are also saved in the data memory.

Reset adjustments to factory adjustment

You can reset the instrument's adjustments to the factory adjustment:

1. Select  *Adjustments* in the menu, then tap in the action box.
2. Switch the adjustment to "Yes".
3. Tap *Reset*.
Adjustments will be reset.

8.3 Calibrations

See the reference guide for information on calibrations.

9 Upkeep and Cleaning

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

9.1 Cleaning and Drying 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...

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

Cleaning liquids

Employ two cleaning liquids in a row:

- 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 so that drying of the cell is accelerated. Cleaning liquid 2 has to be a good solvent for cleaning liquid 1.

Table 3: Recommended cleaning liquids

sample	liquid 1	liquid 2
aqueous samples, beverages	water	non-denatured ethanol
petrochemical samples	petroleum naphtha	acetone

If you are not sure whether 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.

Cleaning and drying procedure



WARNING

Risk of injuries and fire by liquids leaking

Before you fill any sample or cleaning liquid, in particular hazardous or flammable chemicals, into the instrument:

- Strictly follow all safety instructions concerning the use of chemicals and the use of flammable chemicals, see section 1.
- Make sure that all wetted parts are resistant to the filled-in liquid, see appendix A.3. Consider also the wetted parts of installed options.


NOTICE

Risk of damaging the measuring cell


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

IMPORTANT: Observe all safety instructions given in section 7.2 that are applicable for cleaning agents.

See the manual of Xsample 200 High-Resistance for a description of the cleaning and drying procedure with the optional peristaltic pump.

1. Select  *Cleaning* in the menu.
2. Rinse the measuring cell with cleaning liquid 1 (minimum 5 mL).
If your sample is viscous or contains particles, use more cleaning liquid.
3. Empty the measuring cell (by filling air).
4. Rinse the measuring cell with cleaning liquid 2 (minimum 5 mL).
5. Empty the measuring cell.

IMPORTANT: Consider to install a drying cartridge (see reference guide) if the instrument's condition monitoring shows a warning.


6. Connect the adapter Luer cone of the air pump hose to the adapter Luer 1/4" UNF on the syringe holder (1, fig. 2) (or at the sample inlet).
7. On the *Cleaning* screen, tap  to start the air pump.
8. 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 tempera-

ture of the measuring cell (ethanol at 20 °C: approx. 5 min, acetone at 20 °C: approx. 3 min).

9. Tap **STOP**  to stop the air pump.

TIP: You can also set the air pump to turn off automatically:

- Tap  to open the pump settings.
- Switch Turn off when density is stable or Turn Off after Timeout on/off according to your requirements.
- Tap Save.

10. Disconnect the air pump hose from the syringe holder (or from the sample inlet).

9.2 Cleaning the Instrument Housing and the Touchscreen



WARNING

Before using any cleaning agents for the instrument's housing and touchscreen:

- Strictly follow all safety instructions concerning the use of chemicals and the use of flammable chemicals, see section 1.
- Make sure that all parts of the housing are resistant, see appendix A.3. In case of uncertainties contact Anton Paar GmbH.
- Decontaminate and remove aggressive sample residues on the instrument.

NOTICE

Corrosion due to unsuited means of cleaning

Using substances for cleaning that 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).



WARNING

Possible shock current over wet skin

In case of moist cleaning unplug the power supply from the instrument.

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

9.3 Storing the Instrument

Clean and dry the measuring cell before you store the instrument for more than one day. Otherwise algae may grow on the glass surface, which are difficult to remove.

If you store the instrument for less than one day, the measuring cell can be filled with ultra-pure water.

10 Maintenance and Repair

10.1 Maintenance Performed by an Authorized Anton Paar Service Engineer

The instrument requires no periodical maintenance. However, optional services are available from your local Anton Paar representative upon request.

Following parts are generally excluded from the warranty (wear and tear parts)

- syringes
- hoses
- adapters, connectors, fittings
- pump diaphragms
- filters
- O-rings, seals, gaskets
- cables
- fuses
- batteries
- desiccants
- protection foils and covers

All parts damaged in consequence of a fall of the instrument are generally excluded from the warranty as well.

10.2 Repair Performed by an Authorized Anton Paar Representative

In case your instrument needs repair, contact your local Anton Paar representative, who will take care of the necessary steps. If your instrument needs to be returned, request an RMA (Return Material Authorization Number). It must not be sent without the RMA and the filled "Safety Declaration for Instrument Repairs". Please make sure it is cleaned before return.

TIP: Contact your local Anton Paar representative from the Anton Paar website under "Contact" (<https://www.anton-paar.com>).

IMPORTANT: You must not return instruments that are contaminated by radioactive materials, infectious agents, or other harmful substances that cause health hazards.

Appendix A: Technical Data

A.1: Specifications

	DMA 501	DMA 1001
Density		
Measuring range	0–3 g/cm ³	
Repeatability s.d. ^a	0.0002 g/cm ³	0.00005 g/cm ³
Reproducibility s.d. ^a	0.0004 g/cm ³	0.00007 g/cm ³
Accuracy ^b	0.001 g/cm ³	0.0001 g/cm ³
Temperature		
Measuring range	15 °C to 40 °C (59 °F to 104 °F)	15 °C to 60 °C (59 °F to 140 °F)
Repeatability s.d. ^a	0.1 °C (0.2 °F)	0.02 °C (0.04 °F)
Accuracy ^b	0.3 °C (0.6 °F)	0.05 °C (0.09 °F)
Measurement		
Operating pressure sample	max. 10 bar (145 psi) absolute	
Sample volume	< 2 mL (incl. filling adapter)	
Sample viscosity	0–35,000 mPa·s	
Viscosity correction	yes, over the full range	
U-View™	yes	
FillingCheck™	yes	
Data memory	5000 results	

^a According to ISO 5725

^b Under ideal conditions and for low densities/viscosities

A.2: Instrument Data and Operating Conditions

Environmental conditions (EN 61010)	indoor use only
Ambient temperature	+5 °C to +35 °C (+41 °F to +95 °F) permissible operating temperature
Air humidity	10 % to 90 % relative humidity, non-condensing ^a
Altitude	max. 3000 m (9800 ft)
Pressure drying air	max. 0.1 bar (1.45 psi) relative
Pollution degree	2
Overvoltage category	II, for the supplied AC adapter
Display	7" TFT WVGA (800x480 px); PCAP touchscreen
Controls	touchscreen, optional keyboard, mouse, and barcode reader
Interfaces	1x Ethernet 3x USB 1x RS-232
Power supply	<i>instrument:</i> DC 24 V, 3 A <i>via supplied power supply:</i> AC 100–240 V, 47–63 Hz, 1.5 A
Power consumption	72 W
Dimensions (L x W x H)	375 mm x 265 mm x 180 mm (14.8 in x 10.4 in x 7.1 in)
Weight	13.5 kg (29.8 lbs)

^a Drying the measuring cell (see 12, fig. 1) is mandatory when humidity is condensing.

A.3: Wetted Parts and Housing Surface Materials

The following materials are in contact with the samples and cleaning agents:

Material	Part
Borosilicate glass	measuring cell
PTFE (polytetrafluoroethylene)	filling adapter and O-ring

Standard accessories

Material	Part
HDPE (high-density polyethylene)	waste vessel
Polypropylene / polyethylene	syringe
PTFE (polytetrafluoroethylene)	adapters, Luer plug, filling hose, waste hose
Tefzel	adapter Luer 1/4" UNF

Instrument housing surface materials

Material	Part
Edistir RK 451G	housing
Glass, chemically hardened	touchscreen
Steel 1.4301	protection plate

Appendix B: EU Declaration of Conformity

EU Declaration of Conformity

(original)



The Manufacturer **Anton Paar GmbH**, Anton-Paar-Str. 20, A-8054 Graz, Austria – Europe hereby declares that the product listed below

Product designation: **LABORATORY DENSITY METER DMA™ 501
DMA 501 EZ
LABORATORY DENSITY METER DMA™ 1001
DMA 1001 EZ**

Model: **DMA 501, DMA 1001**

Material number: 186376, 180173, 229962, 229961

is in conformity with the relevant European Union harmonisation legislation. This declaration of conformity is issued under the sole responsibility of the manufacturer.

Electromagnetic Compatibility (2014/30/EU, OJ L 96/79 of 29.3.2014)

Applied standards:

- EN 61326-1:2013 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 (2014/35/EU, OJ L 96/357 of 29.3.2014)

Applied standards:

- EN 61010-1:2010 Safety requirements for electrical equipment for measurement, control and laboratory use - Part 1: General requirements
- EN 61010-2-010:2014 Safety requirements for electrical equipment for measurement, control and laboratory use - Part 2-010: Particular requirements for laboratory equipment for the heating of Materials
- EN 62233:2008 Measurement methods for electromagnetic fields of household appliances and similar apparatus with regard to human exposure

RoHS Directive (2011/65/EU, OJ L 174/88 of 1.7.2011)

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