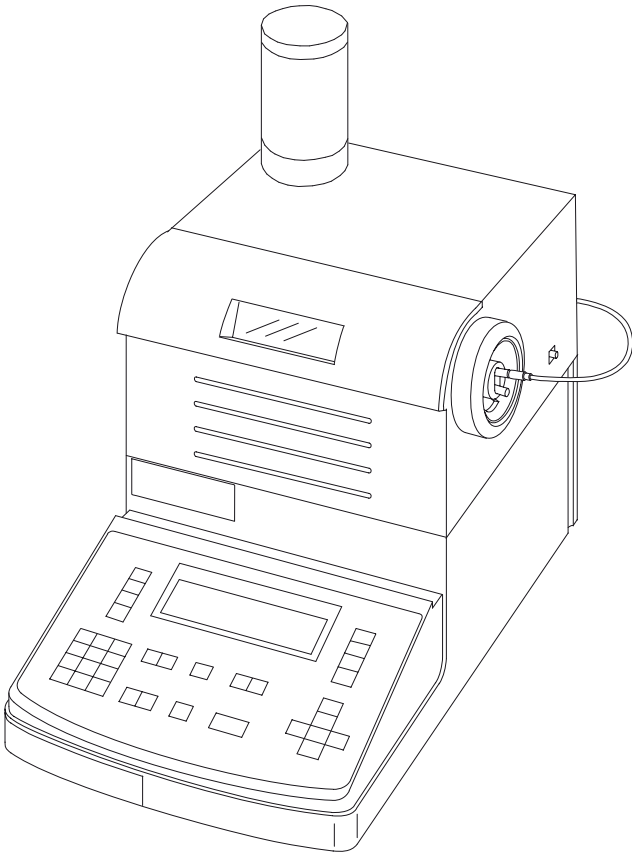
Operating Instructions



DE40/DE45 DeltaRange/DE51

Density Meters

Contents

1. Introduction

The DE40, DE45 DeltaRange and DE51 Density Meters measure the density "d" of gases and liquids using the oscillating body method.
They are distinguished by their temperature range and their measurement accuracy. All three instruments:

- come with two certified water standards.
- measure gases and liquids with densities (d) in the range 0 … 3 g/cm^3.
  (Limit of error: DE40: 0.0001 g/cm^3 / DE45 DeltaRange: 0.00002 … 0.00005 g/cm^3 / DE51: 0.00002 g/cm^3).
- need a minimum amount of sample (1.2 milliliters) for measurement.
- keep the temperature of the sample being measured constant thanks to a built-in Peltier thermostat control (DE40 and DE45 DeltaRange between 4 and 90 °C, DE51: between 4 and 70 °C).
- are suitable to measure highly viscous samples (automatic correction of the viscosity error).
- have 10 methods stored in their memory, which may easily be adapted to suit your needs.
- show the density relative to water (specific gravity) at 4 °C (d_4^t) or at the measurement temperature (d_t^t).
- calculate and display directly the concentrations of solutions using tables or entered data of measured standard solutions.
- calculate the density of solutions for a desired temperature using entered temperature functions.
- have a built-in check function that allows to periodically verify the accuracy of the instrument without changing the instrument settings.
- store a maximum of 100 measured values.
- perform statistical evaluations (mean value, standard deviation, relative standard deviation) and allow the recalculation of results.
- use Memory Cards for data storage, sample files and method transfer.
- have built-in special application tables which allow the automatic conversion of the measured density into Brix degree (sugar concentration) or alcohol concentration (% v/v).
- have built-in the API temperature compensation tables to automatically report the density of oil products at the reference temperature of 15° C (or 60°F), according to ASTM D 1250.

In order to use the DE density meters in an appropriate way the following pumps and sample changers are available:
- A built-in air pump. This pump provides dried air to dry the measuring cell after the cleaning. Sampling and rinsing are done manually using a syringe.
- A built-in Peristaltic Sampling Pump PSU-DE. This accessory allows to aspire the sample, drain and rinse the cell with the peristaltic pump, allowing an excellent control of the sampling speed. For samples of up to 3000 mPa*s viscosity.
- The Automatic Sampling and Cleaning Unit SC1. For fully automatic measurements of single samples. Just place the vial on the tray and press measure. The system will do the measurement, and clean and dry itself in the end, so that it is ready for the next sample when it arrives.
- The sample changer SC30. To measure series of up to 30 samples in a row fully automatically.

The sampling pump or the SC1 and SC30 automation units enable the DE density meters furthermore to detect the main sources for measurement errors (such as air bubbles, inhomogeneous samples) automatically.

The three built-in RS-232C interfaces allow the attachment of a computer for transferring of experimental data, a barcode reader for reading of sample identifications and operator names and a printer for printing out of the entered parameters and data as well as results.

2. Safety measures

The DE40 DE45 DeltaRange and DE51 Density Meters have been tested for the intended purposes documented in these Operating Instructions. However, this does not absolve you from the responsibility of performing your own tests whether the product supplied by us is suitable for your intended methods and purposes. You should, therefore, observe the following safety measures.

Measures for your protection

Risk of electric shock

- Ensure that you plug the power cable supplied into a socket which is grounded! A technical defect could be lethal in the absence of grounding.
- Switch the instrument off and disconnect the power cable when you change blown fuses!

Risk of explosion

- Do not work in areas with danger of explosion! The housings of the DE40, DE45 DeltaRange and DE51 Density Meters are not gas tight (danger of explosion due to spark formation, corrosion by gas seeping into the instrument).

Measures for operational safety

Caution

- Clean the measuring cells immediately after a measurement of strong acids or bases. They can damage the density meter cell's U-shaped tube.
- Only use fuses of the specified type when they need to be exchanged.
- Exclude the following environmental influences:
  - powerful vibrations
  - direct sunlight and sudden changes in temperature
  - corrosive gases
  - very dusty environment
  - high atmospheric humidity
  - temperatures below 5°C and above 35°C
  - powerful electric or magnetic fields which influence the power supply through large load fluctuations.
  - sharp fluctuations in temperature, including draft.

- If the instrument is not going to be used for a longer period of time, clean the density measuring cell before putting the instrument away. We recommend storing the instrument in the cardboard box in which it was delivered.
- Avoid storage under excessive ambient conditions such as too high or too low temperatures; high humidity or very dusty areas will damage the instrument.

3. Density

3.1 Definition of density

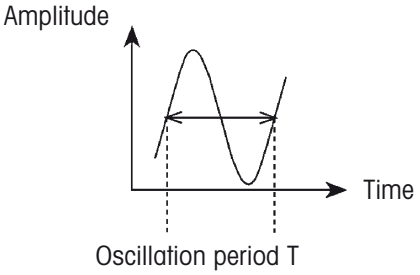
The density ρ is the quotient of the mass m and the volume V of a substance (mass density). As the density depends on the temperature, the latter must always be specified.

The specific gravity is the ratio of the density ρ of a substance to the reference density ρ_0 of a reference substance under conditions which must be specified separately for both substances.

If desired, the DE density meters will calculate the relative density (specific gravity). The density of water at 4°C (d_4^t), or at measurement temperature (d_t^t) is used as the reference density. Therefore, the density of pure water as a function of temperature is stored in the instrument.

3.2 Measuring principle for density

The density measurement of the DE density meters is based on the electromagnetically induced oscillation of a U-shaped glass tube. A magnet is fixed to the U-shaped tube and a so-called transmitter induces the oscillation. The period of oscillation is measured by a sensor.
One complete back and forth movement of a vibration is a period, its duration is the period of oscillation T.



The number of periods per second is the frequency f. Each glass tube vibrates at a so-called characteristic or natural frequency. This changes when the tube is filled with a gas or liquid. The frequency is a function of the mass. When the mass increases, the frequency decreases, i.e., the period of oscillation T increases.

$$f = \frac{1}{T}\,[s^{-1}]$$

$$T = 2\pi \sqrt{\frac{\rho V_c + m_c}{K}}$$

ρ = Density of sample in measuring cell [g/cm³]
V_c = Volume of sample (capacity of tube) [cm³]
m_c = Mass of the measuring cell [g]
K = Measuring cell constant [g*s²]

It follows that

$$\rho = \frac{K}{4\pi^2 V_c} T^2 - \frac{m_c}{V_c}$$

The density ρ and the period of oscillation T are related as follows:

$\rho = AT^2 + B$ (see illustration)

A and B are constants that are determined by the elasticity, structure and mass of the measuring cell. As the mass varies from tube to tube, these constants must be determined by measurement. We refer

to this as a factor determination or adjustment of the instrument. The factor of the measurement tube is calculated by measuring the period of oscillation T of two standard substances of known density (usually air and water):

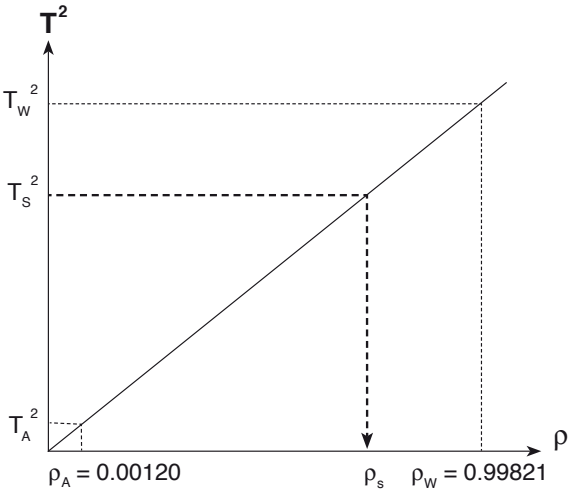
$$F = \frac{K}{4\pi^2 V_c} T^2 = \frac{\rho_A - \rho_W}{T_A^2 - T_W^2}$$

ρ_A = Density of air [g/cm^3]
ρ_W = Density of water [g/cm^3]
T_A = Oscillation period of the air measurement [s]
T_W = Oscillation period of the water measurement [s]

The unknown density of a substance ρ_S is calculated after the factor determination by measurement of its period of oscillation (T_S) using the following formula:

$$F(T_A^2 - T_S^2) = (\rho_A - \rho_S)$$

Solving for ρ_S results in: $\rho_S = \rho_A - F(T_A^2 - T_S^2)$



The factor F is temperature dependent. The volume of the measuring cell and its period of oscillation change with temperature. Thus, it is necessary to determine the factor of the cell at the same temperature as the samples are measured.

The period of oscillation described here is used to calculate the measuring cell factor and, from that, the density of the unknown sample. This period of oscillation is not displayed on the instrument. The DE density meters display only the so-called T-value, which is directly related to the period of oscillation T. Thus, the T-value is an auxiliary value making the most of the display possibilities of the instrument, using integers only and no decimals.

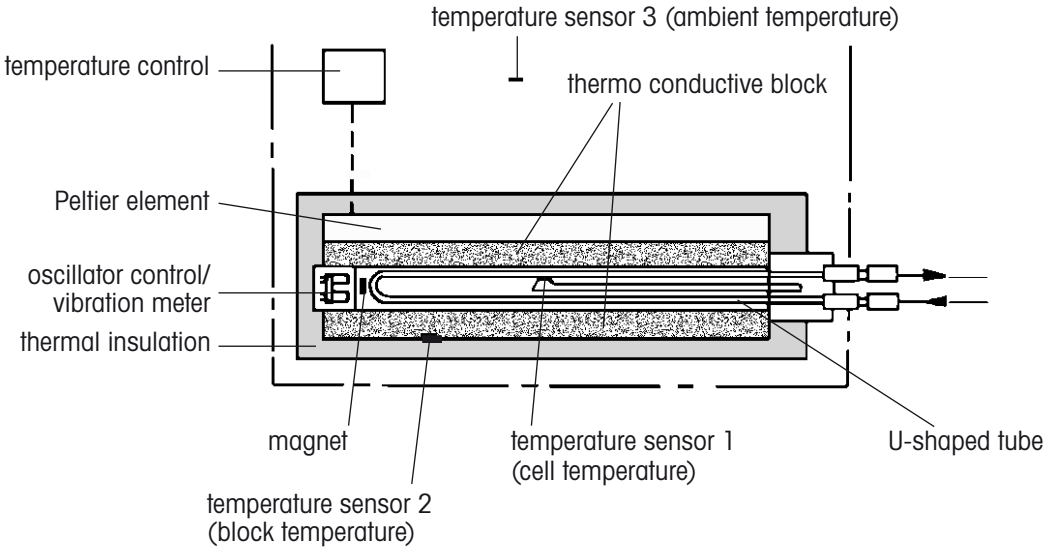
3.3 Anatomy of the density measuring cell and temperature control

Accurate density measurements require very accurate temperature control and measurement.

Because the temperature of the sample cannot be measured directly in the U-shaped tube without distorting the measurement of the frequency, the temperature is measured indirectly. The temperature is measured in three different locations:

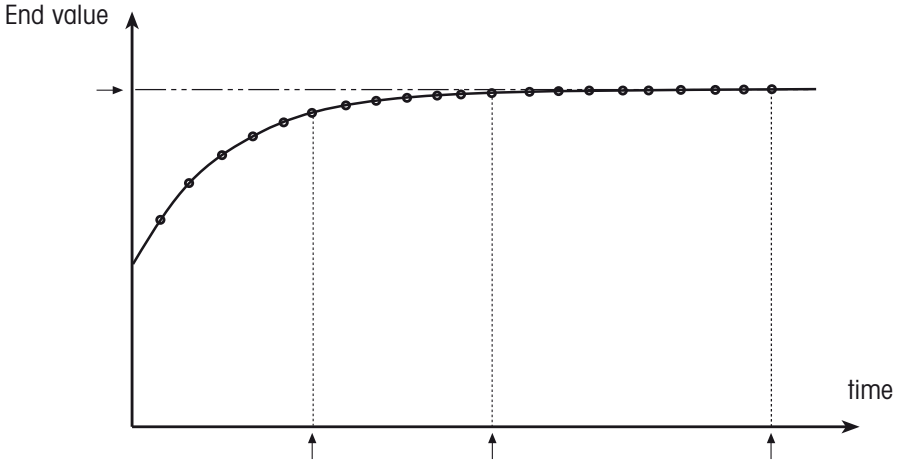
Measurment	Location
Temperature 1	sensor in measuring cell (certified), directly above the surface of the U-shaped tube. This temperature is shown as the actual temperature on the display (cell temperature).
Temperature 2	temperature of the thermoblock (block temperature, not displayed).
Temperature 3	reference temperature taken on the inside of the instrument (ambient temperature, not displayed).

These three temperatures are used to control the thermostat (Peltier element) heating or cooling the thermoblock.



During a measurement the sample temperature has to be adjusted (heated up or cooled down) to match the selected measuring temperature exactly. The density of the sample changes during heating or cooling (the density is temperature dependent!) and, therefore, so does the resonance frequency of the U-shaped tube. The sample temperature is exactly the same as the selected temperature (and the cell temperature, sensor 1) as soon as the oscillation frequency remains stable. It takes quite a long time, however, until this thermal equilibrium is reached. In order to shorten the time required for the measurement, the DE density meters allow selecting a so-called stability criterion for collecting measurement data. With this feature, the time required for the measurement may be shortened without losing much accuracy.

Stability	**Criterion**
0	The instrument waits until the measured signal (T-value) is stable (ΔT_{val} ± 4 during 77 s). The density is measured with the accuracy as specified for the instrument.
1	The final T-value is extrapolated with a patented algorithm from the course of the slope ($\Delta T_{val}/\Delta$temp.), and then the density is calculated. This reduces the time required for the measurement by approx. one half while the result (i.e. density), in most cases, is identical to that yielded using stability 0.
2	The final T-value is extrapolated at an earlier point with a patented algorithm from the course of the slope ($\Delta T_{val}/\Delta$temp.), allowing a slightly higher uncertainty, and then the density is calculated. Thus the measurement time is reduced by about one half again, while the final decimal of the result yielded may differ ± 1 or 2 compared to the true value (yielded with stability 0).

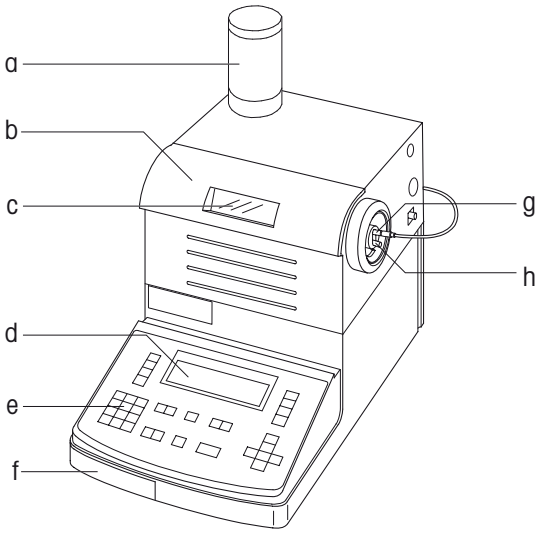


4. The instruments

4.1 Front and rear view

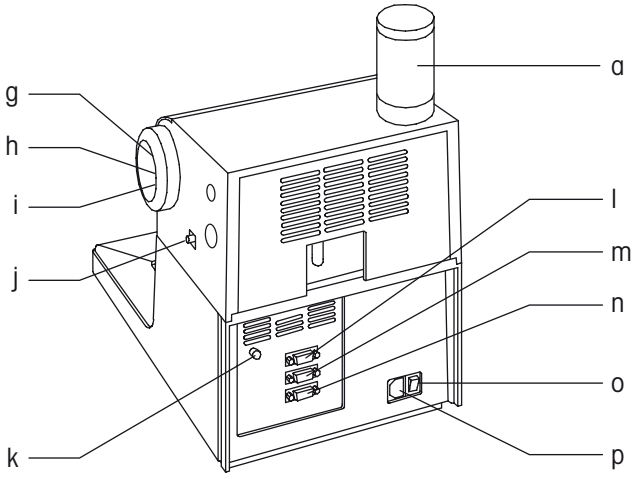
Front view

Part	Description
a	Desiccator
b	Density measuring cell
c	Cell window
d	LC display
e	Keypad
f	Memory card slot
g	Outlet density measuring cell
h	Inlet density measuring cell



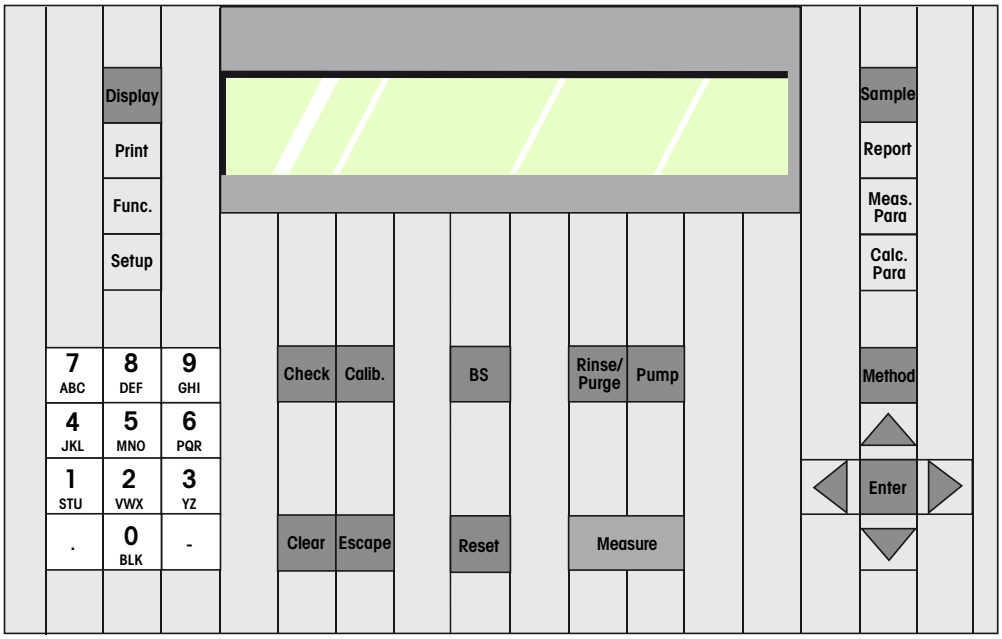
Back view

Part	Description
g	Outlet density measuring cell
h	Inlet density measuring cell
i	Drain for liquids
j	Dry air outlet
k	Connector for autmation unit (SC1/SC30)
l	Printer interface
m	AUX. interface (barcode reader
n	RS232C interface (computer)
o	Power switch
p	AC power connector



Part	Description
a	Desiccator To dry the meassuring cell. Filled with silica gel.
b	Density measuring cell (oscillating U-shaped tube) With Peltier thermostat and light.
c	Cell window (density measuring cell) Allows you to look into the measuring cell (check for contamination or air bubbles).
d	LC display Seven-line LCD to show the measurement results, conditions and settings.
e	Keypad (alphanumeric) To start measurements, enter measurement conditions, calculation parameters, etc.
f	Memory card slot To load and download data, methods and sample files; to load applications, upgrade software, etc.
g	Outlet density measuring cell Connects to the drain tube.
h	Outlet density measuring cell Connect the sampling tube (PSU-DE) or the syring adapter here.
i	Drain hole To drain sample or cleaning liquids (in case of damaged tube joints).
j	Dry air out To dry the measuring cell. Dryed air is pumped form the desiccator through the cell.
k	Connects to the automation unit (SC1/SC30).
l	Interface for a printer To connect a serial matrix printer.
m	Interface for a barcode reader (AUX.) To connect a barcode reader.
n	Interface for a computer (RS232C) To connect a computer (e.g., for data acquisition with the LabX direct software).
o	Power switch
p	AC power connector Connector for the mains cable. The DE density meter adapts automatically to the line voltage of a country as long as it is within the range of 100 to 240V.

4.2 Keypad



Key	Meaning	Description
Sample	Sample	Entry of sample parameters such as sample number and ID. Activation of the viscosity correction.
Report	Report[1)]	Definition of the printing format for the results. Three formats are available: (1) Short: minimal printing format. (2) GLP: format complying with GLP requirements. (3) Variable: User defined format.
Meas. Para	Measuring Parameters[1)]	Definition of the measuring parameters: Method name (8 characters, alphanumeric). - Stability (criteria for the acceptance of measurements). - Time limit for measurements. - Sample sequence (sampling, draining, rinsing, drying of measuring cell, testing the density measuring cell). - Adjustment data. If the measuring cell has not been adjusted with air and water (standard setting): entry of the nominal densities of the two standards used for the adjustment.
Calc. Para	Calculation Parameters[1)]	Definition of the calculation parameters: - Selection of the dimension for the density (d, d(t/t), d(t/4)). - Selection of the calculation formula or entry of concentration tables for calculating results (e.g., concentrations) from density. Selection of built-in concentration tables (Brix, alcohol). - Temperature compensation (formula, table, or according to API). - Decimals for the results (density or calculated results).

[1)] May be defined for each of the 9 measuring methods individually.

Method	Method	Select the measuring method (0 to 9). The method is selected by pressing the "Up", "Down" or the corresponding number key. Method 0 ("CALIB") is reserved for adjustment of the instrument.

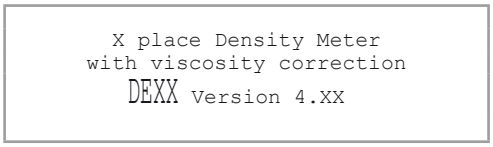
Key	Meaning	Description		
Display	Display	Toggle between numerics, capital or small letters when entering text, or to select result displays.		
Print	Print	Print measuring methods, stored results and instrument settings.		
Func.	Function	Access to the following functions:		
		(0)	Data File:	Access to stored results.
		(1)	Sample File:	Enable/disable sample sequences.
		(2)	Method File:	Transfer methods from the instrument to a memory card and vice versa.
		(3)	Changer:	Selection of the automation unit (SC1/SC30).
		(4)	Factor:	Access adjustment factors. Activate the viscosity correction for adjustment.
		(5)	Set Check:	Entry of the used standards, nominal values and tolerances for daily and periodic instrument tests.
		(6)	Periodic:	Definition of the intervals for periodic adjustments and instrument tests. Display of stored adjustment and instrument test results.
		(7)	Multiple Meas.:	Conduct multiple measurements of a sample, enable/disable automatic error detection and automatic statistics.
		(8)	CARD Utility:	Handling of stored data on memory cards (e.g., load special applications).
		(9)	Memory Clear:	Delete data stored in the instrument's memory
Setup	Setup	Access to the following instrument settings:		
		(0)	Interface:	Configure the serial interfaces (for printer, barcode reader and PC).
		(1)	Date&Time:	Set date and time.
		(2)	Op.Names/Units:	Entry of concentration units, user names.
		(3)	Serial/Version:	Display of the serial and version number of the DE density meter.
		(4)	LCD Contrast:	Set contrast for the LC display.
		(5)	International:	Select format for date and temperature (°C/°F), enter atmospheric pressure.
		(6)	Lock:	Limit access to certain functions with a password.
		(7)	Beep:	Enable/disable and selection of type of acoustic signal.
		(8)	Temperature:	Re-align the built-in temperature sensors.
Check	Check	Perform an instrument test: daily (always active) or periodic (only when due).		
Calib.	Calibration	Perform an adjustment		
BS	Backspace	Backspace to delete characters.		
Rinse/ Purge	Rinse/Purge	Activates an automatic rinsing cycle according to the settings in the sequence of method "O.CALIB" (only active with SC1 or SC30 automation units).		
Pump	Pump	Switch an external pump on/off (disabled with the SC1/SC30 automation units).		

Key	Meaning	Description
Clear	Clear	Clear an entire input field or go back to the last setting (undo).
Esc.	Escape	Return to the main display (results of the last measurement are not deleted).
Reset	Reset	Abort a measurement or adjustment and return to the main display (results of the last measurement are deleted).
Measure	Measure	Start a measurement or a measurement series (SC30).
7 ABC	0 - 9	Select an item from a list (menu, list with results, etc.) or enter an alphanumeric character (selection of capital/small letters or numerals is done with the **Display** key). Press twice for B and three times for C. Enter a blank space with the **BLK** key.
.	Dot	When entering concentration units and formulas ("Setup > 2.Op.Names > Units" menu): for "%", "(" and ")" select alphanumeric input with the **Display** key ("A" or "a" appears on the top right of the display) and press the **dot** key once, twice or three times.
–	Hyphen	When entering concentration units and formulas ("Setup > 2.Op.Names > Units" menu): for "+", "/" and "*" select alphanumeric input with the **Display** key ("A" or "a" appears on the top right of the display) and press the hyphen key once, twice or three times.
Enter	Enter	Confirmation of an entry. This key is referred to with **Enter** in these Operating Instructions.
▲ ◀ ▶ ▼		Keys to move the cursor. The ◀ and ▶ keys are also used for selections in the menus. To select an option in a menu (Function, Setup) or a method, results, etc. in a list, direct entry of the corresponding number via the alphanumeric keypad is usually quicker than using the arrow keys.

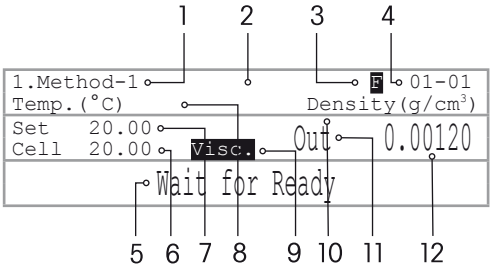
4.3 Display

The DE density meters come equipped with a seven line LC display with 40 characters per line. When the instrument is switched on (rear of the instrument), the following message appears on the display:

The software version (4.XX) appears for a short time. The software version can also be displayed under "Setup/3. Serial/Version".



After a few seconds the main display appears. The message "Wait for Ready" blinks until both measuring cells have reached their set temperatures. If the measuring cell has been adjusted, the message "Ready" appears, if not, the message "No Calibration" appears.



The following information is shown on the main display

1	Number and name of the measuring method.
2	Sample description. This field can be empty (e.g., when the instrument is switched on for the first time).
3	"F" appears when the sample file has been turned on. This is always the case when an SC30 sample changer is attached.
4	Sample number. The sample number consists of two parts, e.g., 01-02. The first two-digit number (ranging from 00 to 98) is the number of the measurement series. In the instrument, it is also referred to as the "High Sample No.". If you use your own specific series number for each type of sample when measuring various types of samples, it is easy to evaluate the stored results statistically afterwards. The next two-digit number (ranging from 00 to 99) is the sample's number. In the instrument it is also referred to as the "Low Sample No.". This number is automatically increased by 1 with each measurement.
5	Status line. Status, error messages and instructions for the user are displayed here.
6	Actual temperature of the measuring cell.
7	Set temperature of the density measuring cell.
8	Selected temperature unit.
9	"Visc." only appears if the viscosity correction has been activated.
10	Unit for the measured value of the density measurement cell (g/cm³) or concentration. In such cases you can toggle between results by pressing the **Display** key. Brix (calculated from the refractive index) is displayed as "(%)".
11	Error message of the automatic error detection.
12	Measured density or result. The density (g/cm³) or a calculated result (toggle with the **Display** key, refer to item 10) is displayed here.

5. Measures for correct measurements

The DE density meter's **Repeat Meas.** and **Check** functions ensure that you can easily identify errors due to the instrument or the measured samples. The efficient rinse/purge and drying function of the SC1/ SC30 Sample Delivery and Cleaning Unit and the METTLER TOLEDO sealable sample vials assist you in eliminating potential sources of error.

The most common errors in determining density are

Incorrect adjustment of the instrument

Due to electronic long-term drift, contamination or chemical erosion, the measuring cell of the DE density meter needs to be adjusted from time to time. Each adjustment causes the instrument settings to be changed.

If the adjustment is not carried out properly, all subsequent measurements will be incorrect!
We recommend you to check the measuring accuracy of your DE density meter daily (or if you work with an SC30 before each series) with the "Check" function (instrument test). Running such an instrument test is easy (refer to section 6.5). If the instrument test fails, proceed as follows:

- Thoroughly clean or dry again, making sure to use solvents that can completely dissolve your samples.
- Repeat the instrument test.
- Readjust the instrument only, if this second instrument test also fails.

Changes in the sample prior to measurement

Density of your samples can change if the samples are left standing around uncovered. Therefore, use closed containers for critical samples, or use METTLER TOLEDO's sealable sample vials for your measurements. On the SC1 and SC30 automation units, these sample vials are only opened shortly before the measurement. This prevents a change in the samples due to evaporation or contamination.

Inhomogeneous samples, gas bubbles and solvent residue in the system

These error sources are spotted automatically by the DE density meter's "Repeat Meas." function usable with PSU-DE, SC1 and SC30. We therefore recommend that you perform all your measurements with this function active (refer to section 11.8.3). If the error message "Out" of the "Repeat Meas." function appears often on the display, make sure that

- the samples are not contaminated.
- the samples have been degassed completely prior to the measurements.
- the connecting tubes (SC1/SC30 - DE density meter) are connected tightly.
- the solvent (rinse-1) can completely dissolve the sample.
- the time allotted for the rinse/purge and drying cycle in the measuring method is sufficient for a complete cleaning and drying of the system.

High viscosity of the sample

When measuring viscous samples without correcting for viscosity, the resulting densities will be slightly too high (refer to section 7.3). Therefore, activate the automatic viscosity correction when measuring samples with a viscosity > 7 mPa·s.

Cross contamination

By selecting an appropriate rinsing fluid and cycle in the measuring method, this source of errors can be eliminated with the SC1 and SC30 automation units (the sample nozzle is cleaned and dried after each measurement inside **and** outside!).

Incorrect preparation of the sample

Highly concentrated liquids have a tendency to form concentration gradients and, therefore, need to be mixed thoroughly before sampling.

6. Getting started

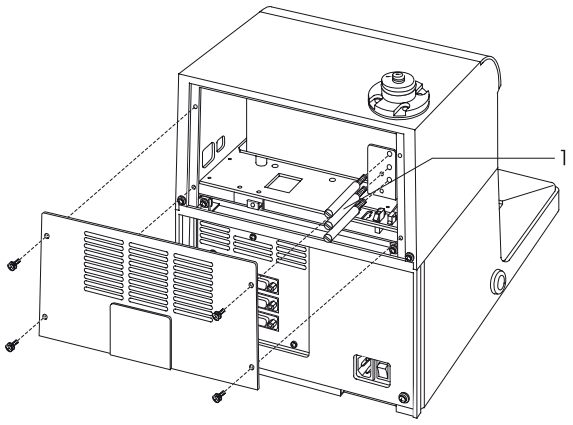
This section explains how to set up the DE density meter to adjust (calibrate) the instrument and how to perform your first measurements with the system. In this section, the practical example of a concentration determination of a saline solution via measurements of density will familiarize you with the most important features of the DE density meter.

We presume that you operate this measuring system (DE density meter and SC1/SC30 automation unit) in combination with a RS-P42 printer and a Heron-G D130 barcode reader. If this is not the case, you may skip the corresponding sections.

6.1 Setting up the measuring system

6.1.1 Loosening the three transporation security screws

After unpacking the DE density meter, but before connecting it to the power main, you must loosen or remove the three transport locking screws. Remove the top panel on the rear of the instrument and loosen the three big screws (1). These three screws serve as transportation locks to secure the density measuring cell. For proper operation of the instrument, they must be loosened or removed. Keep the screws for future transports. Remount the back panel.



Mount a purge unit (air pump) or a PSU-DE (Peristaltic Sampling Unit) if you are not working with a sample changer (refer to sections 14 and 15).
When the instrument is switched on the first time, it is recommended to reset it to its default values as described, refer to section 11.10 (function 9, memory clear: all parameter).

6.1.2 Connecting the SC1 or SC30 automation unit

Connect the SC1 or SC30 Sample Delivery and Cleaning Unit to your DE density meter as described in the Operating Instructions of the automation unit.

i Using the SC30 Automation Unit, make sure that "Auto" for "Stop Mode" is selected (refer to SC30's Operating Instructions).

6.1.3 Connecting a printer and a barcode reader

– Connect the RS-P42 printer to the "Printer" port on the DE density meter.

i Make sure that the DIP switch 1 on the printer is set to "ON", and the DIP switch 2 is set to "OFF". The DIP switch can be found under the cover below the paper feed (refer to RS-P42 Operating Instructions).

– Connect the RS-P42 printer to the power supply.
– Connect the Heron-G D130 barcode reader to the "AUX." port on the DE density meter.
– Switch on the instruments and the printer.

6.2 Setting up the DE density meter

6.2.1 Setting up the peripheral instruments

6.2.1.1 Automation unit (SC1/SC30)

– Press **Func.**

– In the "Function" menu select and confirm "3. Changer". The "Changer" menu opens.

```
< Function >

0.Data File          5.Set Check
1.Sample File        6.Periodic
2.Method File        7.Multiple Meas.
3.Changer            8.Card Utility
4.Factor             9.Memory Clear
```

Select **none** if the purge pump or the PSU-DE is installed.

– Using the Sampling and Cleaning Unit select and confirm "SC1" for "Changer".

– Select and confirm "On" for "Rinse / Purge" and"Off" for "Drain+Prerinse".

```
Changer >

Changer         :<SC1 >
Rinse / Purge   :Off On
Drain+Prerinse :Off On
Exit            :[Execute]
```

– Using the Sample Changer select and confirm "SC30" for "Changer.

– Select and confirm the following items:

- "Off" for "Calib.",
- "Current" for "Start Position", and
- "On" for "Rinse /Purge" and "Off" for "Drain+Prerinse".

```
< Changer >
Changer         :<SC30 >
Calib.          :Off On
Start Position :Home Current
Rinse / Purge   :Off On
Drain+Prerinse :Off On
Exit            :[Execute]
```

If you want to use the sample recovery function of the SC1 or SC30, "Drain+Prerinse" has to be switched "Off", otherwise the samples will not be pushed back into the vial after the measurements!
The detailed description of the "Changer" menu is in section 11.4.

6.2.1.2 RS-P42 printer

– Press **Setup**.

– In the "Setup" menu select and confirm "0. Interface". The "Interface" menu opens.

```
< Setup >

0.Interface       5.International
1.Date & Time     6.Lock
2.Op.Names/Units  7.Beep
3.Serial/Version  8.Temperature
4.LCD Contrast
```

– Select and confirm "1. Printer".

```
< Interface >

0. RS-232C
1. Printer
2. Barcode(AUX)
```

– In the "Printer" menu select and confirm "GA-" for "Printer".

```
< Printer >

Printer    :IDP- DP- GA- Other
Exit       :[Execute]
```

6.2.1.3 Barcode reader

In the Interface menu (refer to section **6.2.1.2**.) select and confirm "2. Barcode(AUX)". The "Barcode(AUX)" menu opens.

– Select and confirm the following items:
  - "On" for "Barcode(AUX)",
  - "9600" for "Baud Rate",
  - "None" for "Parity",
  - "1" for "Stop Bits", and
  - "8" for "Data Bits"

```
          < Barcode(AUX)>
Barcode(AUX) :Off On
Baud Rate    :<9600>
Parity       :Even Odd None
Stop Bits    :1 2
Data Bits    :7 8
```

– Enter and confirm the following items:
  - "1" for "Start Pos.", and
  - "0" for "Read Length".

– Select and confirm "CR+LF" for "Delimiter".

```
          < Barcode(AUX)>
Start Pos.   :[1]
Read Length  :[0]
Delimiter    :<CR+LF>
Exit         :[Execute]
```

– To open the main display, press **Reset**.

– Scan in the two barcodes "Reset" and "Mode RS232" one after the other with the barcode reader in order to configure it:

Reset

Mode RS232

To check whether the reader is functioning properly, scan in the barcode "Operator 1". If "Operator :" does not appear for a short time in the status line, check whether the barcode reader is connected properly and the settings in the "Barcode(AUX)" menu are correct.

```
1.Method-1                    F  01-01
Temp. (°C)                Density(g/cm³)
Dens. 20.00 0.00120
Set   20.00
Cell  20.00   Visc.            0.0010
Operator:
```

Operator 1

6.2.2 User and country specific settings

The following menu items are selected and confirmed in the "Setup" menu (available by pressing **Set-up**).

6.2.2.1 Date and time

– Select and confirm "1. Date & Time".

– Enter and confirm the current date ("Day", "Month", "Year") and time ("Hour", "Minutes").

The date's format can be selected in the "Setup menu under the 5. item "International".

```
          < Date & Time >

        04/07/2007 15:18

Day :[24]          Hour    :[15]
Month :[ 2]        Minutes :[18]
Year :[2002]       Exit    :[Execute]
```

6.2.2.2 Operator names

– Select and confirm "2. Op.Names/Units".
– Select and confirm "1. Operator Names".

```
        < Op.Names/Units >

      0.Concentration Units
      1.Operator Names
```

– In the "Operator Names" menu enter a list of future operators using the DE density meter (up to ten names may be entered)
– Confirm each name.

```
          < Operator Names >                ▼

Operator :                 >

Name 1   :[                 ]
Name 2   :[                 ]
Name 3   :[                 ]
```

- Press **Display** to enter capital / small letters or numerals.
- If you have a barcode reader, make a photocopy of the list in Appendix A.2.3 and fill in the names as you have entered them at the instrument.

6.2.2.3 Concentration units

In the "Op.Names/Units" menu (refer to 6.2.2.2) select and confirm "0. Concentration Units". The Concentration Units menu opens.

– For example, enter "%NaCl" in "Unit 1".
"%NaCl" is entered as concentration unit, because this section describes how a concentration determination of a saline solution is performed.

```
      < Concentration Units >
Unit 1 : [%NaCl]
Unit 2 : [ ]
Unit 3 : [ ]
Unit 4 : [ ]
Unit 5 : [ ]
Exit : [Execute]
```

"%" can be entered using the hyphen **-** key. The input mode must be set to capital or small letters (toggle with the **Display** key).

6.2.2.4 Atmospheric pressure

– Select and confirm "5. International"

For "Air Pressure" enter the standard atmospheric pressure for your location. The standard atmospheric pressure for various altitudes above sea level can be found in the table in section 12.6. In the same section you will find a detailed description of this menu.

```
          < International >

Date          : <DD/MM/YYYY>
Temp.Unit     : °C °F
Air Pressure : [ 1013.00]hPa
Exit          : [Execute]
```

6.2.3 Activation of automatic error detection

– Press **Func**.
– In "Function" menu select and confirm "7. Multiple Meas.".

– In the "Multiple Meas." menu select and confirm "2. Repeat Meas.". The "Repeat Meas." menu opens.

```
          < Multiple Meas. >

           0. Auto Start
           1. Auto Statistics
           2. Repeat Meas.
```

– For PSU-DE or SC1 / SC30 select and confirm "On" for "Repeat Meas.". Further options appear in this menu.

```
          < Repeat Meas. >

Repeat Meas .    :   Off On
Repetitions :[3]
Movement Ratio :[ 25]%
SD Limit :[ 0.00010] g/cm3
Exit :[Execute]
```

For syring leave to "off".

– Enter and confirm the following values: "3" for "Repetitions", "25" for "Movement Ratio", "0.00010" for "SD Limit".

You should not enter an SD Limit that is smaller than two times of the instrument resolution.

With the above settings, each sample is measured three times: After the first measurement the sample is moved forwards twice in the system and measured again after each forward movement. If the standard deviation of the three resulting values for density is higher than values specified in "SD Limit", an error message is displayed and printed out.

A detailed description of the "Repeat Meas." function can be found in section "11.8.3".

6.2.4 Setting up the instrument test

From time to time, the DE density meter needs to be checked (verified) with the built-in instrument test function. In this section, the settings for performing such an instrument test with distilled water are shown.

– In the "Function" menu (refer to 6.2.1.1) select and confirm "5. Set Check". The "Set Check" menu opens.
– Select and confirm "Daily" for "Check".
– Enter and confirm"water" for "Standard")
– Enter and confirm the following values for:
  • "Ref.Value" (in our case the theoretical density of water at 20°C), and
  • "Tolerance" (the measured value's highest permissible deviation during the instrument test) according the illustration on the right.

```
            < Set Check >

Check          :Daily Periodic
Standard       :[water]
Ref.Value      :[ 0.99821] g/cm3
Tolerance      :[ 0.00005] g/cm3
Exit           :[Execute]
```

The tolerance should not be set lower than two times of the instrument resolution.

6.2.5 Entering the method for adjustment

6.2.5.1 Deleting all methods

Prior to entering the method for adjustment and for the salt determination, you should delete all methods in the DE density meter's main memory (i.e., return to the default settings):

– Press **Func** to open the "Function" menu.
– Select and confirm "9. Memory Clear".
– In the "Memory Clear" menu select and confirm "4. Method Parameter". The "Method Parameter Clear" menu opens.

```
          < Memory Clear >

0.Measured Data 4.Method Parameter
1.Sample File 5.All parameter
2.Periodic Check
3.Periodic Calib.
```

– Select and confirm "Yes" for "Clear Execute". All of the DE density meter's methods are returned to the default settings.

```
      < Method Parameter Clear >

     Clear Execute ? No Yes
```

6.2.5.2 Enter the parameters for adjustment

– To open the "Method List" menu press **Method**.
– Select and confirm the 0. method "CALIB". This method is reserved only for adjustment of the instrument. This means, no measurements can be performed.

– Press **Meas.Para**. The "CALIB" method's parameters are displayed, i.e., the method name and the temperature of the measuring cell. The criterion for stability for acceptance of the measured value of the density measurement ("Stability") should always be set to 0 for this "CALIB" method (most exact measurement).

  The maximum duration of measurement ("Limit Time") can be left at the default value of 600 s.
– Enter the settings for the sequence according to the table in section 9.5 "Sequence" (the parameters "Calib." and "Measurement Temp. will only be displayed and cannot be changed).
– Select "Off" for the sequence when working with a syringe.

A detailed description of the sequence settings can be found in "9.5 Sequence".

```
Method 0    < Meas. Parameter >   ▼

Method Name          :[CALIB. ]
Measurement Temp.    :[ 20.00]°C
Stability (0-2)      :[0]
Limit Time           :[ 600]s
Sequence             :Off On
```

By setting up the sequence ("Sampling", "O.S.Rate", "Sampling Limit", "Drain", "Drain Rate", "Rinse-1", "Rinse- 1 Time", "Rinse-2", "Rinse-2 Time", "Purge", "Purge Time" and "Cell Test") you define the times for sampling as well as for draining, rinsing (with two different solvents) and drying of the measuring cells.

```
Method 0    < Meas. Parameter >   ▼▲

Sampling             :Off Set Auto
O.S.Rate             :[ 170]%
Sampling Limit       :[ 120]s
Drain                :Off Set Auto
Drain Rate           :[ 100]%
```

```
Method 0    < Meas. Parameter >   ▼▲
Rinse-1              :Off Set
Rinse-1 Time         :[ 60]s
Rinse-2              :Off Set
Rinse-2 Time         :[ 10]s
Purge                :Off Set Auto
Purge Time           :[ 120]s
```

With "Cell Test" an automatic test of the measuring cell can be performed.

```
Method 0    < Meas. Parameter >   ▲

Cell Test            :Off On
Calib.               :<Air&Water>
Exit                 :[Execute]
```

6.2.6 Entering the method for measurements

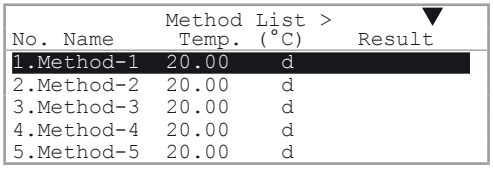
A method for performing a measurement consists of three parts: the measuring parameters (access them with the **Meas.Para** key), the calculation parameters (entering of a calculation formula for the results, access the parameters with the **Calc.Para** key) and the settings for the printout of the results (access them with the **Report** key).
In total, there are ten methods available, nine for your measurements and one for adjustment (method 0).

Please be aware that no measurements can be performed with method 0. Therefore, the **Sample**, **Report**, **Calc.Para**, **Measure** and the **Check** keys will not work when method 0 is selected as active method.

6.2.6.1 Entry of the measurement parameters

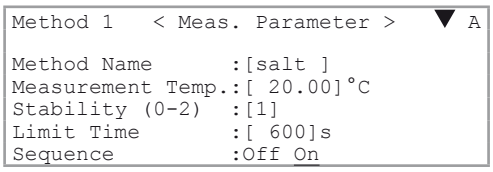
– Press **Method**.

– Select and confirm the 1. method "Method-1".



– Press **Meas.Para**.

– Enter and confirm for both "salt" for "Method Name" and "1" for "Stability". The remaining parameters can be set as shown in the table of section 9.5.



A detailed description of the sequence settings can be found in section 9.5. For this, leave "Calib." at the <Air&Water>" setting (in this case, the measurements are based on an adjustment of the measuring cells with air and water).

6.2.6.2 Entering calculation parameters

You can now enter a concentration table (density vs. concentration) so that the results of the density are displayed directly as salt concentration.

For example, the relationships between density (d) and the salt concentration of an aqueous sodium chloride solution at 20°C is as follows:

Concentration NaCl [wt.-%]	d (20°C) [g/cm³]
0.00	0.9982
0.10	0.9989
0.20	0.9997
0.30	1.0004
0.40	1.0011
0.50	1.0018
0.60	1.0025
0.70	1.0032
0.80	1.0039
0.90	1.0046
1.00	1.0053
1.10	1.0060
1.20	1.0068
1.30	1.0075
1.40	1.0082
1.50	1.0089
1.60	1.0096
1.70	1.0103
1.80	1.0110
1.90	1.0117
2.00	1.0125

Further concentration tables can be found on the Internet at www.density.com.

– Press **Calc.Para**.
– Select and confirm "1. Result".

```
Method 1       < Calc. Parameter >

    0.Density
    1.Result
    2.Temperature Compensation
    3.Decimals
```

– Select and confirm "Conc." for "Result". Additional items appear in the "Result" menu.

```
Method 1       < Result >

Result           :<Conc.        >
Exit             :[Execute]
```

– Select and confirm the following items: "%NaCl" for "Conc.Unit" and "A+By+Cy^2" for "Conc.Formula".
– Leave "Data Replace" at the set values.

With these settings, the DE density meter performs a regression analysis on the density table you entered, using a 2nd order polynomial equation.

```
Method 1       < Result >                ▼

Result           :<Conc.        >
Conc.Unit        :<%NaCl>
Conc.Formula     :<A+By+Cy2
Parameter Set    :Table Coefficient
Data Replace     :<x<-d-R   >
```

– Enter and confirm "21" for "Data No." (the density/concentration table consists of 21 data pairs)
– Select "Conc.Table:[Execute]" and press **Enter** to enter the density/concentration table.

```
Method 1       < Result >                ▲

Data No.(2-30)   :[21]
Enter Conc.Table :[Execute]
Exit             :[Execute]
```

– In density/concentration table you can jump from one column to the other by using the **Enter** key.

Wrong entries can be cleared with "Clear".

– Confirm each entered value with **Enter**.
– After you have entered all data sets, select "Get Para" and confirm it.

```
Method 1       < Conc.Table >            ▲
No.          Conc.            Density
18       [ 1.70000]         [ 1.0103]
19       [ 1.80000]         [ 1.0110]
20       [ 1.90000]         [ 1.0117]
21       [ 2.00000]         [ 1.0125]
Edit     Clear     GetPara.     Exit
```

The coefficients of the polynomial (A, B, C) as well as a graph of the curve (d-R/concentration) are displayed. R is the mean of all entered density values (not the correlation coefficient). The instrument replaces the density values with the density values minus the mean (x<-d-R, refer to "Data Replace" parameters, above), in order to optimize the algorithm used for the regression analysis (calculation with smaller values).

– Press **Enter**. A table with all deviations between calculated (with the polynomial) and actual concentrations appears (if no typing error is detected).
– Select and confirm "Exit".

A detailed description of the calculation parameters can be found in section "10".

– Press **Calc.Para** to set the number of decimals (i.e., the digits after the decimal point) for the display and printout of the results.
– Select and confirm "3. Decimals".
– In the "Decimals" menu enter and confirm 2 for "Conc."

```
Method 1    < Decimals >

    Density   (0-5):[5]
    Conc.     (0-5):[2]
    Brix      (0-3):[3]
    Alcohol   (0-2):[2]
    Exit           :[Execute]
```

The salt concentration (calculated from the density) will be displayed with two digits after the decimal point. A higher resolution in the display of the concentration would not make any sense, because the entered tables do not permit a more precise calculation!

6.2.6.3 Setting the formats for the printout of the results

– Press **Report**.

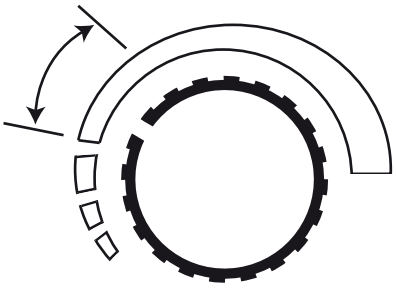
The **Report** key allows you to determine the content of the printout of the results.

– Select and confirm "GLP" for "Format".

With this setting a complete list of all parameters is printed out after each measurement. A detailed description of the available formats for the printout of the results can be found in section 9.

6.3 Setting the sampling speed (with PSU-DE, SC1, SC30)

The samples should not be pumped trough the measuring cell too quickly, as air bubbles may form and falsify the measured values. The sampling speed must be set on the potentiometer on the PSU-DE, SC1 or SC30 in such a way that a liquid sample (e.g., water) reaches the measuring instrument's density measuring cell within approximately 3 seconds of sample pump activation.
If viscous samples are measured with an SC1 or SC30, the sampling speed will automatically adapt to the viscosity of the sample.



Set the sampling speed on the potentiometer of the PSU-DE, SC1 or SC30 as shown in the drawing (for more details see the Operating Instructions of your automation unit).

6.4 Adjusting the DE density meter

The DE density meter must be switched on for at least 30 minutes before adjustment.

Because the measuring system is being used for the first time and all the cleaning liquids' tubes are empty (in case of an SC1/SC30) a thorough cleaning cycle has to be performed first.

If you are using the air pump with syringe:
– Flush the cell a few times with solvent (water, 0.3% Deconex).
– Then flush it a few times with a highly volatile solvent (like methanol, acetone, ethanol 100%).
– Connect the desiccator tube to the cell outlet tube,
– Press the **Pump** key, and keep it pressed for about two seconds until the message 'Purge Checking' appears. Thus the pump will stop automatically when the cell is completely dry (both cell temperature and T-value have become stable).

If you are using the PSU-DE:
– Press **Pump**, and toggle the switch up to activate the maximum speed of the pump.
– Flush the cell a few times with solvent (water, 0.3% Deconex), making sure to insert a number of air bubbles to create a turbulent flow.
– Then flush it a few times with a highly volatile solvent (like methanol, acetone, ethanol 100%).
– Let the pump running without liquid for about 10 seconds to empty also the tube in the peristaltic pump.
– Hold an empty beaker under the sample inlet tube, or cover it with a tissue,
– before toggling the switch down to activate the dry air pump (Attention: This reverses the flow through the cell!).
– The pump will then stop automatically after the time defined in method '0.Calib.'

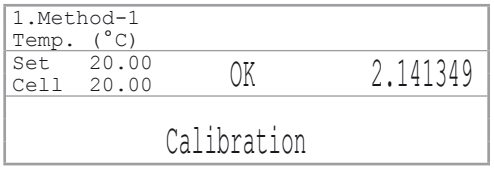
If you are using SC1 or SC30:

– Press **Rinse/Purge**. The system is cleaned and dried according to the settings entered for the sequence in method 0.
– Fill a sample vial to at least 70% with a density standard or deionized or distilled water and seal it.

Make sure that that there are no air bubbles in the water!

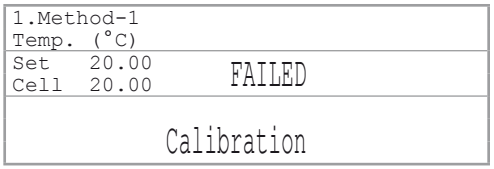
– Select your user name from the list with the barcode reader (see Appendix A.2.3). Your name appears in the status line of the display.
– If you don't have a barcode reader, press **Setup**, select and confirm "2. Op.Names/Units".
– In the "Op.Names/Units" menu select and confirm "1. Operator Names" .
– Select (using the ◀ or ▶ keys) and confirm your name in the "Operator" field.
– Press **Calib** and follow the instructions on the display (the message will differ, depending on the setting in the "Function" "3. Changer").

When the adjustment is terminated, the message "Calibration OK" appears on the display and the result of the adjustment is printed out.



At the end of the process the measuring cell has to be cleaned and dried again (performed automatically with SC1 or SC30).

If the instrument was not able to perform the adjustment, the error message "Failed" will appear.



If this is the case, please check the following and then repeat the adjustment:

– Are the cleaning fluids selected and connected properly, i.e., is the distilled water used as "Rinse 1" and the highly volatile solvent (acetone) as "Rinse 2"?
– Are all tube joints screwed tight?
– Was the cap of the sample vial with the distilled water screwed tight (with SC1 or SC30)?
– Are the settings for the sequence in method 0 ("CALIB.") correct (refer to section 6.2.5.2)?

6.5 Performing an instrument test and measurements

6.5.1 Preparation of the samples

Prepare a saline solution with a salt content between 0.5 and 1.5 % NaCl by weight: weigh 0.5 - 1.5 g of analytically pure NaCl into a 250 ml beaker and then fill it with distilled or deionized water to exactly 100 g. Stir the solution until the salt has dissolved completely. Immediately fill some sample vials to about 80% with the solution and seal them (with SC1 / SC30).

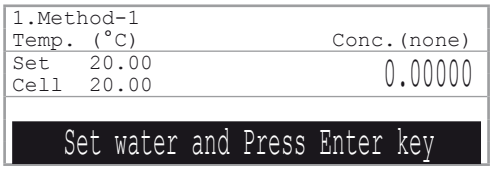
Before starting the measurements, you will perform an instrument test (refer to section 6). Fill a sample vial to about 80% capacity with distilled water and seal it (with SC1 / SC30).

6.5.2 Performing an instrument test and measurements

6.5.2.1 Instrument test

– Select the operator name with the barcode reader or with the keypad as described in section 7.4.

– Press **Check**. The message "Set water and Press Enter Key" appears on the display.



Syringe:

– Inject the water slowly into the measuring cell with your syringe, and confirm with **Enter**.

PSU-DE:

– Insert the aspiration tube into the vessel containing the water, and confirm with **Enter**.

SC1:

– Place the vial with the distilled water into SC1.

– Press **Enter** to start the instrument test.

– Confirm "Sampling Speed?" "Low".

– Confirm "Exit:[Execute]" . The instrument test is performed.

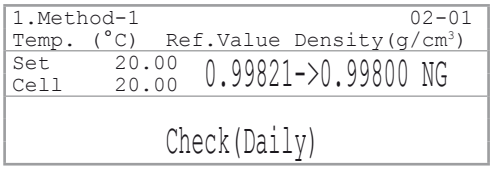
Finally, the result of the test is displayed and printed out.

The system will now automatically clean and dry the measuring cell and tubes.

Syringe or PSU-DE:

– Clean and dry the cell as described in section 6.4

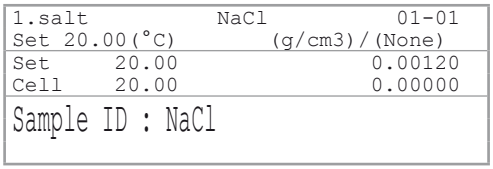
If the instrument test fails, a corresponding error message appears ("NG", see in the illustration) on the display. Using SC1, check whether the tube connections (at the sampling nozzle of the SC1 and between the measuring cells of the DE density meter) are really tight and repeat the instrument test. Should the instrument test fail a second time, the instrument needs to be readjusted.



6.5.2.2 Measurements

Select the operator name with the barcode reader or with the keypad as described in section 7.4.

Enter the name of your sample.



With barcode reader:

– Scan the barcode "NaCl".

The sample name ("NaCl") appears on the status line of the display.

NaCl

Without barcode reader:

- Press **Sample**. A menu to enter the sample data (sample name and number) appears on the display.
- Enter and confirm "NaCl" as "Sample ID".
- Press **Display** to toggle between capital or small letters and numerals.
- Confirm "Exit:[Execute]".

```
              < Sample >

Sample No.      :[01]-[01]
Sample ID       :[NaCl     ]
Viscosity       :Off On High
Exit            :[Execute]
```

Syringe:

- Inject the sample slowly into the measuring cell with your syringe, and press **Measure**.

PSU-DE:

- Make sure the aspiration tube is inserted in the sample and **Measure**.

SC1:

- Place a vial with the sample into the SC1.
- Press **Measure** on the DE density meter. The measurement is started, during the measurement the message "Measuring" appears on the display.

- A triple determination of your sample is performed (automatic error detection, refer to section 11.8.3).
- At any time during the measurement the result is displayed and you can use the **Display** key to toggle between "(%NaCl)" (calculated salt content in % by weight), "(g/cm^3)" (density and refractive index), and oscillation value.

When the measurements are done, the mean value of the three determinations is displayed and the mean value plus the standard deviation of the three results is printed out.
Should the standard deviation be higher than the value you specified, the message "Out" appears together with the corresponding result on the display and the error message "--- Out of limit ---" is printed. If this is the case, please check the following:

- Are any of the connecting tubes leaking?
- Are there any bubbles in the sample vial?
- Are there any solid particles (dust) in the sample vials?

Syringe or PSU-DE:

- Clean and dry the cell as described in section 6.4.

SC1:

- The system has been automatically cleaned and dried in the end.

The result of the measurement remains frozen on the display, until either **Measure** or **Reset** is pressed. Pressing **Reset** brings back the "Ready" display, showing the currently measured density of the empty cell. This density should now correspond to the one obtained for air in the adjustment.

If the density differs by more than rounding from the one in the adjustment, the cleaning was not sufficient and/or the drying was not complete. In such a case adapt the use of the solvents and / or increase the drying time to ensure proper cleaning and complete drying.

6.5.3 Performing an instrument test and measurements with SC30

6.5.3.1 Entering the sample data

Please make sure that method 1 is selected as the active method ("1.salt" must appear on the upper left of the main display).

– Press **Sample** in order to enter the sample data:
– Enter 4 for the "No. of Samples" (instrument test + 3 samples of saline solution) and 1 for "Next Meas. No." (measurements are to begin with the first sample).
– Select and confirm "Current" for "Method" (the instrument test and all measurements are performed according to the same method) and "Create" for "Parameters".

```
< Sample >                    ▼

Sample File      :Skip   Load   Save
No. of Samples   :[ 4]
Next Meas.No.    :[ 1]
Method           :Current   Variable
Parameters       :Create    Edit
```

– Enter and confirm 2 for the "No. of Series" (number of series) (instrument test and measurements).
– Confirm "Set Parameter :[Execute]" in order to enter the sample data.

```
< Sample >                    ▲

No. of series    :[2]
Set Parameter    :[Execute]
Exit :[Execute]
```

– Enter the sample data for the instrument test.
– Using the barcode reader enter the barcode "CHECKSTD" (see below) in the "Sample ID" field (sample identification). If you do not have a barcode reader, press **Check** when the cursor is in the "Sample ID" field and confirm it.
– Enter and confirm 1 for the "No. of samples" (amount of samples) and for the sample number ("High Sample No." and "Low Sample No."). The "Method No." field cannot be changed because you have selected "Current" (presently active) for "Method" (see above). With this setting all measurements are performed with the same method (i.e., with the currently selected method).

```
< Sample >  Series No.1(of 2)  ▼

Sample ID          :[CHECKSTD ]
No.of samples      :[ 1] (1-1)
High Sample No.    :[ 1]
Low Sample No.     :[ 1]
Method No.         :[ 1]
```

– Select and confirm "Low" for "Sampling Speed" and "Off" for "Viscosity" (distilled water does not need to be corrected for a density measuring error due to viscosity).
– Confirm "Next Series: [Execute]".

```
< Sample >  Series No.1(of 2)  ▲

Sampling Speed     :Low   High
Viscosity          :Off   On
Next Series        :[Execute]
```

– Enter the sample data for the saline solution.
– Using the barcode reader enter the barcode "NaCl" (see below) in the "Sample ID" field (sample identification). If you do not have a barcode reader, enter and confirm the sample name via the keypad when the cursor is in the "Sample ID" field.
– Enter and confirm 3 for the "No. of samples" (amount of samples), 2 for the "High Sample No." and 1 for the "Low Sample No.". The "Method No." field cannot be changed (see above).

```
< Sample >  Series No.2(of 2)  ▼

Sample ID          :[NaCl ]
No. of samples     :[ 3] (2-4)
High Sample No.    :[ 2]
Low Sample No.     :[ 1]
Method No.         :[1] Edit
```

– Select and confirm "Low" for "Sampling Speed" and "Off" for "Viscosity" (the saline solution does not need to be corrected for a density measuring error due to viscosity).

```
     < Sample >  Series No.2(of 2) ▲

Sampling Speed      :Low   High
Viscosity           :Off   On
Save & Exit         :[Execute]
Exit                :[Execute]
```

If you want to measure viscous samples, you must select "On" for both these settings, refer to section 7.3).

– Confirm "Save & Exit: [Execute]".

CHECKSTD

NaCl

– If you confirm "Edit" you can view a table of the data just entered. (If you do not wish to do this, simply press **Escape**).

```
            < Sample >                ▼

 Sample File     :Skip    Load   Save
 No. of Samples :[ 4]
 Next Meas.No.  :[ 1]
 Method         :Current    Variable
 Parameters     :Create   Edit
```

"Edit No." is the number of the sample to appear on the first line of the table.

– Confirm the default value 1.
– Confirm "Set Parameter" the "Sample List" table will appear.

```
            < Sample >                ▲

Edit No.          :[ 1]
Set Parameter     :[Execute]
Exit              :[Execute]
```

The table shows the running sample number ("No."), measuring method for each sample ("M"), the two sample numbers ("S.No."), the sample identification ("Sample ID"), as well as an indication whether or not the viscosity correction was activated ("Vis."). You can edit this table or enter the sample file in form of a table (refer to 7.2.2).

```
            < Sample List>
No.  M  S.No.   Sample ID    Sp  Vis.
 1   1  01-01 CHECKSTD       Lo  Off
 2   1  02-01 NaCl          Lo  Off
 3   1  02-02 NaCl          Lo  Off
 4   1  02-03 NaCl          Lo  Off
```

6.5.3.2 Performing the instrument test and the measurements

For SC30:

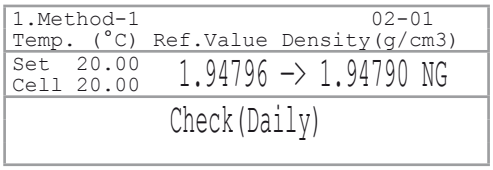
– Place the sample vials in the turntable in the following order:
  • distilled water (for the instrument test)
  • 3 samples (saline solutions)
– Select the user name with the barcode reader or the keypad as described in section 7.4 and press **Measure**. The instrument test and the measurements will be performed automatically in succession. The results are displayed after the instrument test and each measurement and are printed out in GLP format.

At any time during the measurement you can use the **Display** key to toggle between "(%NaCl)" (calculated salt content in % by weight), "(g/cm^3)" (density), and oscillation value.

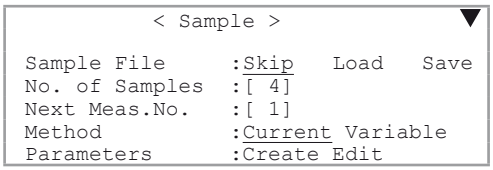
Please be aware that for each measurement (with the exception of water for the instrument test) a triple determination is performed (automatic error detection, refer to section "6.2.3") and that the means (and the standard deviation) of the three determinations are printed out at the end. Should one of the standard deviations be higher than the value you specified, "Out" appears on the display and the error message "--- Out of limit ---" is printed. If this error message appears for more than one sample, please check the following:

- Are any of the connecting tubes leaking?
- Are there any bubbles in the sample vial?
- Are there any solid particles (dust) in the sample vials?
- Is the fluid used for "Rinse 2" really highly volatile (could there be water in the solvent)?
- Have the settings for the sequence for method 1 ("salt") been made correctly?

If the instrument test fails, a corresponding error message appears ("NG", see in the illustration) on the display and the measurements of the samples are not performed.



- In this case, check whether the vials have been placed in the proper sequence on the turntable (i.e., that the saline solution was not mistakenly used for the instrument test).
- Repeat the instrument test. Press **Step** on the SC30 until the vial with the distilled water is in front.
- Exchange the sample vial for the instrument test of the turntable.
- Press **Sample**. "Next Meas.No." (number of the next measurement) now contains a 2 (the instrument test has already been completed).
- Overwrite and confirm this value with 1.
- Press **Measure**. The instrument test is performed again and then the samples are measured. Should the instrument test fail a second time, the instrument needs to be readjusted (see section "6.4").



7. Sample (number / identification) and sample file

If an sample changer (SC1 Sample Delivery and Cleaning Unit) is connected to the DE density meter, the sample file always appears when you press the **Sample** key. If no sample changer is connected (or if it has not been configured correctly, refer to section 6.2.1.1) and the sample file has been switched off (refer to section 11.2), a menu appears to enter data for a single sample.

7.1 Menu to enter data for a single sample

– Press **Sample**.

In the "Sample" menu you can enter sample data such as sample number and sample identification.
The sample number ("Sample No.") consists of two parts, e.g., [03]-[01].

```
              < Sample >

Sample No.    :[03]-[01]
Sample No.    :[         ]
Viscosity     :Off  On  High
Exit          :[Excecute]
```

The first two-digit number (ranging from 00 to 98) is the number of the measurement series. In the instrument it is referred to as the "High Sample No.". If you use your own specific series number for each type of sample when measuring various types of samples, it is easy to evaluate the stored results statistically afterwards.
The next two-digit number (ranging from 00 to 99) is increased by 1 with each measurement.

In addition to the two numbers, you can define a sample identification ("Sample ID", max. 10 characters, incl. space, dot, hyphen, etc.), e.g., a sample name or a batch number. The sample identification can be entered via the keypad or the barcode reader. If you are entering the sample identification with the keypad, you can toggle between capital and small letters and numerals using the **Display** key.

To enter a sample identification with the barcode reader without changing the sample number, you do not have to press **Sample**:

Make sure that "Result", "Ready" or "Calibration" shows on the bottom line of the display. Scan the barcode. The sample identification will appear for a short time on the bottom line. It will also appear in the first line, provided "Ready" was on the bottom line before entering the barcode. If "Result" or "Calibration" was on the bottom line, the sample identification will only appear on the first line after **Measure** has been pressed.

```
1.salt        NaCl          01-01
Temp. (°C)                  Density(g/cm3)
Set   20.00
Cell  20.00                  0.00120
Sample ID : NaCl
```

– Set "Viscosity" to "On" when you plan to measure a sample with a higher viscosity (>7 mPa·s) or to "High" when the viscosity of the samples to be measured is higher than 5'000 mPa·s. If you want to work with the automatic correction for density measuring errors due to viscosity ("Viscosity" "On" or "High"), the instrument must have been adjusted with activated viscosity correction (refer to section 7.3).

7.2 Menu to enter a sample file

If you operate your DE density meter together with a sample changer (SC30), or if the sample file has been switched on (refer to section 11.2), the following **Sample** menu appears when you press **Sample**:

The first line ("**Sample File**") is usually skipped, unless you want to save a sample file to a memory card or load a sample file from a memory card (refer to sections 13.1.8 to 13.1.10).

```
              < Sample >                    ▼

Sample File     :Skip   Load   Save
No. of Samples  :[    3]
Next Meas.No.   :[    1]
Method          :Current   Variable
Parameters      :Create   Edit
```

"**No. of Samples**" is the number of samples to be measured. This number can be higher than 30 even though the turntable of the SC30 is only designed for 30 samples. "No. of Samples" can be changed during the measurement process. Example: Enter 12 for "No. of Samples" if you want to measure 12 samples. If an additional 13 samples are added after starting the measurement, you can increase the number to 25.

"**Next Meas No.**" is the number of the next measurement (relative to the position in the sample file). It is increased by 1 after each measurement.

"**Method**" "**Current**" means that all measurements are performed with the same (i.e., currently selected) method. "**Method**" "**Variable**" allows measurements with various methods.

– Select and confirm "Create" for the item "Parameters", if you want to enter the sample file in the dialogue format. Select "Edit" when the sample file is to be displayed in the form of a table which can be edited.

In the two following sections you can find a description of the input formats for sample files, either in dialogue format ("Create") or in table format ("Edit"), illustrated by the following example:

Presuming you would like to:

– measure a series of 12 grape juice and 7 orange juice samples.
– perform an instrument test prior to the measurements (i.e., measure a water sample, refer to sections 11.6, 11.7).
– measure the samples in two different ways:
  • by using different methods for each type of sample, i.e., method 1 for the instrument test (CheckStd), method 2 for the grape juice samples (GrapeJ.) and method 3 for the orange juice samples (OrangeJ.).
  • by using the same method (method 2, GrapeJ.) for the test and all measurements.

First you must enter the three different methods: One for the instrument test (method 1, CheckStd), one for the grape juice (method 2, GrapeJ.) and one for the orange juice (method 3, OrangeJ.):

	Method 1	**Method 2**	**Method 3**
Method name	CheckStd	GrapeJ.	OrangeJ.
Measuring temperature	20.00°C	20.00°C	20.00°C
Stability	0	1	2

Make sure that "Changer" "SC30" has been selected in the "Function / 3.Changer" (refer to section 11.4).

Now you can enter the sample file with the method numbers, sample numbers and sample identities for each of the series. To enter the sample file the following two possibilities are described: using a dialogue format (Create) or a table format (Edit).

7.2.1 Creating a sample file using a dialogue format (Create)

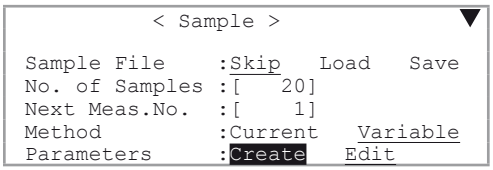
In this mode the sample file is created in a dialogue format. The DE density meter asks you how many series (group of samples) you want to measure (in our case three), which method is to be used for the measurements of each series, etc.

If the sample name cannot be entered with a barcode reader, or when the series is to be measured with different methods, then this is the quickest way of entering a sample file. In our example each type of sample is measured with a different method.

– Press **Sample**.

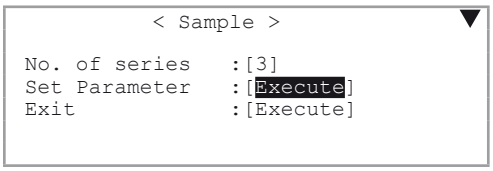
– In the "Sample" menu enter and confirm 20 for "No. of Samples" (the whole series is made up of 20 samples: 1 test standard, 12 grape and 7 orange juice samples).

- Select and confirm "Variable" for "Method" as well as "Create" for "Parameters".



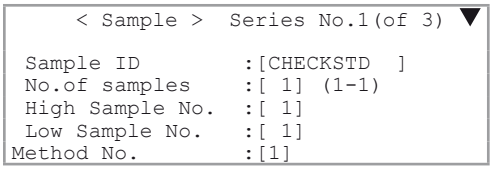
– Enter and confirm "3" for "No. of series" (number of series: test standard, grape and orange juice).

– Confirm "Set Parameter: [Execute]".

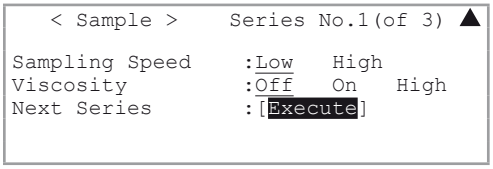


– While the cursor is in the "Sample ID" input field, press **Check**. "CHECKSTD" (instrument test) appears as sample identification. Confirm with **Enter**.

– Enter and confirm "1" for "No. of samples", for "High Sample No." and "Low Sample No." and for "Method No." (refer to section 6.5.3.1).



– You can leave the "Sampling Speed" at "Low" and the density measurement's viscosity correction on "Off" for all three series. Move the cursor down and confirm "Next Series: [Execute]" in order to enter the second series (grape juice).



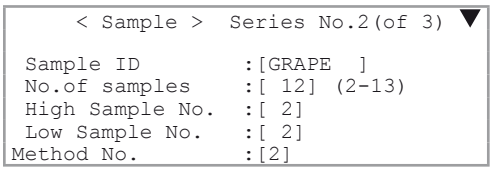
If some of your samples are viscous, you can activate the viscosity correction for the density measurements ("Viscosity") (Select and confirm "On"). For very viscous samples you may also set the sampling speed to "High" so that those samples are pumped into the measuring cells at maximum speed (the set sampling speed then does not have any influence on the pumping speed).

– Enter and confirm the sample identity (e.g., GRAPE) with the keypad or the barcode reader (for a barcode example, refer to sections 12.1.3, appendix A2.1).

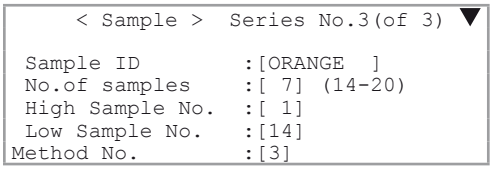
– Enter and confirm 12 for "No. of Samples".

– Enter and confirm 2 for the "Method No."

– Move the cursor to "Next Series: [Execute]" and confirm with **Enter**.

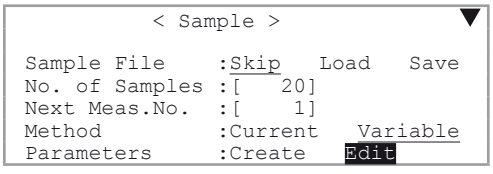


– Enter the sample identity (e.g., "ORANGE") and 7 for the "No. of samples" and 3 for the "Method No.". Confirm "Save & Exit:[Execute]" with <Enter>.



You can look at the sample file you have created:

– Select and confirm "Edit" for "Parameters".



– Confirm the default value 1 for "Edit No." (this is the sample that will appear on the first line of the table).
– Confirm "Set Parameter: [Execute]".

```
< Sample >

Edit No.        :[  1]
Set Parameter   :[Execute]
Exit            :[Execute]
```

The sample file is displayed. You can print it out using **Print**. Also you can change it (refer to section 7.2.2").

– Press **Escape** to leave the sample file.

Now you can place the samples into the turntable.

– Select the user name (refer to section 12.3.2) and press **Measure** to start the measurements.

```
< Sample List>
No.M  S.No.    Sample ID     Sp    Vis.
 1 1  01-01    CHECKSTD      Lo    Off
 2 2  01-02    GRAPE         Lo    Off
 3 2  01-03    GRAPE         Lo    Off
 4 2  01-04    GRAPE         Lo    Off
 5 2  01-05    GRAPE         Lo    Off
 6 2  01-06    GRAPE         Lo    Off
 7 2  01-07    GRAPE         Lo    Off
 8 2  01-08    GRAPE         Lo    Off
 9 2  01-09    GRAPE         Lo    Off
10 2  01-10    GRAPE         Lo    Off
11 2  01-11    GRAPE         Lo    Off
12 2  01-12    GRAPE         Lo    Off
13 2  01-13    GRAPE         Lo    Off
14 3  01-14    ORANGE        Lo    Off
15 3  01-15    ORANGE        Lo    Off
16 3  01-16    ORANGE        Lo    Off
17 3  01-17    ORANGE        Lo    Off
18 3  01-18    ORANGE        Lo    Off
19 3  01-19    ORANGE        Lo    Off
20 3  01-20    ORANGE        Lo    Off
```

7.2.2 Creating a sample file using a table format (Edit)

In this mode, the sample file can be entered directly as a table. If all samples are to be measured with the same method and a barcode reader is used to enter the sample names, then this is the most efficient method to enter a sample file. In this section, you will find a description of how to enter a sample file with a barcode reader.

– Press **Method**, select and confirm method 1 ("GrapeJ.").
– Press **Sample**.

– Enter and confirm 20 for "No. of Samples" (the whole series consists of 20 samples).
– Select and confirm "Current" for "Method".
– Select and confirm "Edit" for "Parameters".

```
< Sample >

Sample File     :Skip   Load   Save
No. of Samples  :[   20]
Next Meas.No.   :[    1]
Method          :Current   Variable
Parameters      :Create   Edit
```

– Confirm "Set Parameter: [Execute]".

The sample file appears. Move the cursor to the first line of the column "Sample ID" and enter the barcode CHECKSTD:

```
< Sample >

Edit No.        :[  1]
Set Parameter   :[Execute]
Exit            :[Execute]
```

CHECKSTD

Then enter the barcode GRAPE twelve times

GRAPE

and the barcode ORANGE seven times.

ORANGE

< Sample List>

No.M	S.No.	Sample ID	Sp	Vis.
1 1	01-01		Lo	Off
2 1	01-02		Lo	Off
3 1	01-03		Lo	Off
4 1	01-04		Lo	Off
5 1	01-05		Lo	Off
6 1	01-06		Lo	Off
7 1	01-07		Lo	Off
8 1	01-08		Lo	Off
9 1	01-09		Lo	Off
10 1	01-10		Lo	Off
11 1	01-11		Lo	Off
12 1	01-12		Lo	Off
13 1	01-13		Lo	Off
14 1	01-14		Lo	Off
15 1	01-15		Lo	Off
16 1	01-16		Lo	Off
17 1	01-17		Lo	Off
18 1	01-18		Lo	Off
19 1	01-19		Lo	Off
20 1	01-20		Lo	Off

The settings for the sampling speed ("Sp") and the viscosity correction for the density measurements ("Vis.") can, if necessary (to measure viscous samples), be changed for each sample individually using the the ◀ or ▶ keys.
Press **Escape** to leave the sample file. Place the samples into the turntable. Select the user name (refer to section 7.3.2) and press **Measure** to start the measurements.

7.3 Viscosity correction

Density measurements of viscous samples without viscosity correction result in slightly higher results on the DE density meter. The reason for this is that the oscillation of the U-shaped tube is attenuated by shear forces which appear in viscous samples. The measured oscillation frequency is too low for such samples, and the displayed density, therefore, is too high. Example: for pure glycerine (viscosity 1490 mPa·s at 20°C), the DE density meter would display a density that was at least 0.0007 g/cm^3 too high without viscosity correction.

To avoid false measurements, density measurements of samples with a viscosity > 7 mPa*s have to be performed with activated viscosity correction.

Measurements with viscosity correction take longer. The instrument performs three measurements under different conditions, analyzes the occurring harmonic oscillations and, from that, determines the attenuation constant dependent on the sample's viscosity. Using the attenuation constant, the instrument then calculates the viscosity of the sample, ascertains the measuring error due to viscosity and directly displays the corrected value for density.

The viscosity correction is automatic for samples with a viscosity <5'000 mPa·s, i.e., the measuring error caused by the samples viscosity is properly corrected by the DE density meter without the user having to enter the viscosity of the sample. For samples with a very high viscosity > 5'000 mPa·s (in general even honey has a viscosity <5'000 mPa·s!), "High" must be selected for the viscosity correction in order to get correct results.

If you are not sure whether a correction for viscosity is necessary for your samples, you should perform a measurements with activated correction for viscosity and set the printout format to "GLP" (refer to section 6.2.6.3). The printout will then contain both values calculated with and without correction for viscosity. Comparison of the two results will help you in assessing the significance of the measuring error that was caused by the viscosity of the sample.

How to choose between "On" and "High" for samples which are highly viscous?
Measure the sample with both settings, setting the Report format to GLP.

- Both viscosity corrected densities are identical: The setting "High" can be used, to shorten the measuring time.
- The viscosity corrected density with 'High' is lower (i.e. bigger correction) than the one with "On", the setting "On" has to be used.

- The measurement with the setting "On" gives zero correction for this highly viscous sample: The viscosity of the sample must be higher than about 5'000 mPa·s. The setting "High" must be used in this case for correct results.

To perform measurements with viscosity correction, the DE density meter must have been adjusted with activated viscosity correction (refer to section 11.5.2). If you attempt to perform a measurement with viscosity correction without having adjusted the instrument with activated viscosity correction, the error message "No calibration(Visc.On)" appears as soon as Measure is pressed, and no measurement will be made!

To activate the viscosity correction, press **Sample**.

If the Purge pump, PSU-DE, or SC1 is connected, select and confirm "On" or "High" for "Viscosity".

If an SC30 is connected, select and confirm "On" or "High" for "Viscosity" ("Create" mode) or select "Vis." "On" or "Hi" in the sample file ("Edit" mode) for the samples which require viscosity correction, refer to section 7.3.

The message "Visc." now appears in the main display.

If the DE density meter has never been adjusted with activated viscosity correction at the presently set temperature, the message "No Calibration(Visc.On)" will also blink in the status line.

With activated viscosity correction, the settings for the stability of the measured value ("Stability") in the measuring parameters have no meaning. All measurements with viscosity correction are performed automatically, using "Stability" 0.

When performing a measurement with activated viscosity correction, the DE density meter waits until the measured oscillation frequency is stable, which it announces with a beep. Then it proceeds with the measurements necessary for the viscosity correction.

8. Report (password protected)

Using **Report** you can define the content for the printout of the current method's results. The report key is not active, if method 0 ("CALIB.") has been selected.

– Select the method for which you want to set the printout format (**Method** key, refer to section 10) and then press **Report**. The following menu will appear:

You can select between "Off", "Short", "GLP" and "Variable" for the printout's format.

"Off": No report is printed at the end of the measurements.

```
Method 1    < Report >

   Format       :<Short >
   Exit         :[Execute]
```

"Short": Only prints out the most important parameters (e.g., results, date and time, etc.) after each measurement.

"GLP" provides a complete list of parameters after each measurement (refer to table below).

If you select and confirm "Variable", a list of parameters appears that can be printed out. You can select the desired parameters individually by setting the parameter's option to "On" (the parameter is printed out) or "Off" (the parameter is not printed out).

```
Method 1    < Report >                    ▼

  Format       :<Variable>
  Model/Serial :Off On
  Sample No.   :Off On
  Date&Time    :Off On
  Sample ID :Off On
```

```
Method 1    < Report >                    ▼▲

  Method No. :Off On
  Meas.Temp. :Off On
  Period T   :Off On
  Meas.Data  :Off On
  Temp.Comp. :Off On
```

```
Method 1    < Report >                    ▲

   Result       :Off On
   Meas.Time    :Off On
   Operator Name:Off On
   Exit         :[Execute]
```

		Short	GLP	Variable
Model, series, version	(Model/Serial)		X	optional
Sample number	(Sample No.)		X	optional
Date and time	(Date&Time)	X	X	optional
Sample identification	(Sample ID)		X	optional
Method number and name	(Method No.)		X	optional
Measuring temperature	(Meas.Temp.)	X	X	optional
Period T	(Period T)		X	optional
Measuring data	(Meas.Data)		X	optional
Temperature compensation	(Temp.Comp.)		X	optional
Results	(Result)	X	X	optional
Duration of measurement	(Meas.Time)		X	optional
User name	(Operator Name)		X	optional

9. Measuring parameters (password protected)

This section describes how measuring parameters can be defined for methods. You have a total of 10 methods at your disposal. Method 0 is reserved for adjusting the instrument and is activated by pressing **Calib**. Methods 1 to 9 are used for measurements.

The default settings (preset values) for the parameters are as follows:

Method 0:

Parameter		Default setting
Method name	(Method Name)	(CALIB.); cannot be changed
Temperature meas. cell	(Measuring temperature)	(20.0°C); cannot be changed
Stability criteria	(Stability)	0
Maximum measuring time	(Limit Time)	600 s
Sequence	(Sequence)	Off

The temperature of the measuring cell cannot be changed in method 0! When pressing **Calib.**, the one from the currently selected method is used.

Method 1 to 9:

Parameter		Default setting
Method name	(Method Name)	Method-x
Temperature meas. cell	(Meas.Temp)	20.00°C
Stability criteria	(Stability)	1
Maximum measuring time	(Limit Time)	600 s
Sequence	(Sequence)	Off
Adjustment mode	(Calib.)	Air&Water

– Press **Method** and select the method you would like to change, or enter the number of the method.
– Confirm your choice.

```
          < Method List >                ▼
No.   Name       Temp.(°C)       Result
0.CALIB.
1.Method-1       20.00           d
2.Method-2       20.00           d
3.Method-3       20.00           d
4.Method-4       20.00           d
```

9.1 Method name

Each method can be named (up to 8 characters). The name of Method 0 ("CALIB.") cannot be changed.

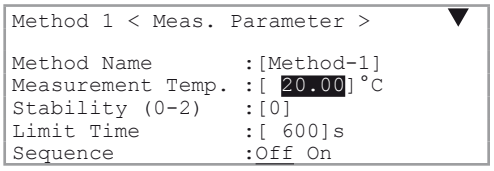
– Press **Meas.Para**.
– Press **Clear**. to delete the previous name ("Method Name").
– Enter the desired name. (Press **Display** to toggle between capital letters, small letters and numerals)

```
Method 1 < Meas. Parameter >          ▼

Method Name        :[Method-1]
Measurement Temp.  :[ 20.00]°C
Stability (0-2)    :[0]
Limit Time         :[ 600]s
Sequence           :Off On
```

Special characters can be entered with the barcode reader (refer to Appendix 2).

9.2 Measuring temperature (Meas.Temp.)

– Enter and confirm the required measuring temperature for the measuring cell (from 4°C to 70°C for DE51; from 4°C to 90°C for DE40 and DE45 Delta-Range).



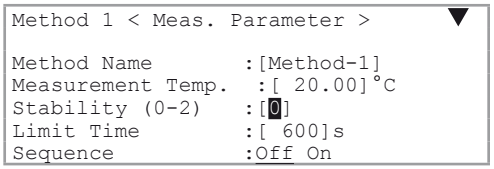
If the temperature of the measuring cell has been changed, the DE density meter must be readjusted. Exception: If an adjustment has already been done at the new temperature, no new adjustment of the DE density meter is required. In all other cases the message "No Calibration" appears on the display. After changing the temperature, the instrument needs to be given enough time to stabilize the temperature in the measuring cell (refer to table below).

Increase temperature:				**Decrease** temperature:			
from	to	difference	waiting time	from	to	difference	waiting time
10°C	20°C	+10°C	30 Min.	20°C	10°C	–10°C	60 Min.
20°C	30°C	+10°C	30 Min.	30°C	20°C	–10°C	60 Min.
15°C	50°C	+35°C	45 Min.	50°C	15°C	–35°C	90 Min.

9.3 Measurement stability (Stability)

This option allows you to speed up the density measurements: You can select between high accuracy with longer measuring times and lower accuracy with shorter measuring times.

– Enter the required measurement stability (0, 1 or 2) and confirm it.



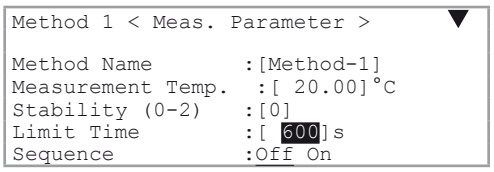
Stability	Criterion
0	Highest stability. The density value is only accepted after the measuring signal (T value) is stable. Longest measuring time.
1	High stability. The final value of the T value is extrapolated and the density is calculated based on that. Intermediate measuring time (about half of the time necessary for stability 0).
2	Low stability. The final value of the T value is extrapolated from fewer values and the density is calculated based on that. Shortest measuring time (about 1/4 of the time necessary for stability 0).

The Stability is automatically set to "0" when the viscosity correction is activated (refer to section 7.3).

9.4 Maximum duration of measurement (Limit Time)

When the maximum duration of measurement is reached, the measurement is aborted and the measured value is accepted even if the signal's stability has not been reached. In this case, the message "Result (Time over)" appears in the display and the error message "Time over" is printed out.

– Enter and confirm the maximum duration of the measurement.
– Enter 0 if you do not want a time limit.



If there is an air bubble in the cell, the measurement will never terminate when the "Limit Time" is set to "0"s.

9.5 Sequence (Sequence: sampling, draining, rinsing, drying)

The settings of these parameters depend mainly on which kind of automation you are using with your density meter. This can be manual sampling with syringe, the peristaltic sampling unit PSU-DE, or one of the automation units SC1 or SC30. The table gives you some suggested starting values for these parameters. The parameters are explained below.

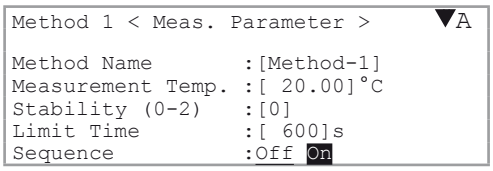
Of course they will need to be optimized (validated) for your specific application, i.e. for the samples to be measured and the solvents to be used.

Sequence parameters	Syringe operation with Purge pump	PSU-DE	SC1 / SC30
	0.Calib./ Method-x	0.Calib./ Method-x	0.Calib./ Method-x
Sequence	Off	On	On
Sampling		Auto	Auto
O.S. Rate		120	170 / 120
Sampling Limit		240	240
Drain		Off	On
Drain Rate		-	95
Rinse-1		Set	Set
Rinse-1 Time		200 / 120	30 / 20
Rinse-2		Off	On
Rinse-2 Time		-	20 / 15
Purge		Off	On
Purge Time		-	Auto *) / 180
Cell Test		Off	Off
Calib.	<Air&Water>	<Air&Water>	<Air&Water>

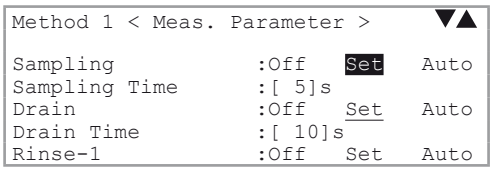
*) If your SC1/SC30 is equipped with the power pump unit PPU you should not use Auto, but enter 180 seconds instead (for details see the manual of your SC1 or SC30).

The sequence settings define the times for sampling as well as draining, rinsing (with two different solvents) and drying of the measuring cells.

– Select and confirm "On" for "Sequence" to activate the sampling sequence.



– Select the type of the sampling procedure ("Sampling"):



Set:	Enter the time for sampling in seconds.
Auto:	Recommended setting. The density measuring cell detects the sample and turns off the pump automatically.
Off:	No sampling

If you have selected "Set", you must enter the sampling time ("Sampling Time", 0 to 9999 sec.). A sampling time of 10 to 15 seconds should suffice for most non-viscous samples (the sampling speed has to be set on the SC1 or SC30 automation unit, refer to section 7.3).

If you have selected "Auto", you have to enter an over-sampling rate ("O.S.Rate") with a time limit for sampling ("Sampling Limit").

```
Method 1 < Meas. Parameter >          ▼▲

Sampling              :Off   Set   Auto
O.S.Rate              :[120]%
Sampling Limit        :[ 0]s
Drain                 :Off   Set   Auto
Drain Time            :[ 10]s
```

With sampling set to "Auto", the DE density meter detects the markedly different measuring signal when the sample enters the density measuring cell and turns the pump off according to the set over-sampling rate ("O.S.Rate", refer to below). The sampling time is, therefore, automatically adjusted to the viscosity of the sample.

"Sampling Auto" only works when the density measuring cell is empty before sampling. If you want to use the automatic error detection "Repeat Meas." (refer to section 11.8.3), then "Sampling" must be set to "Auto" in all methods.

O.S.Rate:	This measures the time the sample needs to get to the density measuring cell after the pump has been activated and adds the "O.S.Rate" (over-sampling rate) to this time. Example: If the over-sampling rate has been set to 120% (recommended setting using SC1 or SC30) and the sample needs 5 seconds to reach the density measuring cell, then the pump stops after 13.5 seconds.
Sampling Limit:	This is the maximum time for sampling. If no sample happens to be in the sample vial or the sample cannot be pumped, the pump switches off automatically after this time has run out.

– Select the type of procedure for draining the measuring cell ("Drain"):

Set:	Enter the time for draining in seconds.
Auto:	Recommended setting. The draining time is calculated based on the sampling time.
Off:	No draining.

```
Method 1 < Meas. Parameter >          ▼▲

Drain                 :Off   Set   Auto
Drain Time            :[ 10]s
Rinse-1               :Off   Set
Rinse-1 Time          :[ 10]s
Rinse-2               :Off   Set
```

If you have selected "Set", you must enter the draining time ("Drain Time", 0 to 9999 sec.). A draining time of 15 to 25 seconds should suffice for most non-viscous samples.

Setting the draining time to "Auto" is only possible if "Sampling" has also been set to "Auto" (recommended setting).
The "Drain Rate" establishes how long draining shall take in reference to sampling. If the "Drain Rate" is set to 100% and the complete sampling procedure (including the over-sampling rate, refer to example above) takes 13.5 seconds, then the pump to drain the measuring cell will also be turned on for 13.5 seconds.

```
Method 1 < Meas. Parameter >          ▼▲

Drain                 :Off   Set   Auto
Drain Time            :[ 10]s
Rinse-1               :Off   Set
Rinse-1 Time          :[ 10]s
Rinse-2               :Off   Set
```

The measuring cells can be rinsed with up to two solvents. First with a solvent ("Rinse-1") capable of dissolving the sample, and then with a highly volatile solvent ("Rinse-2") to ensure complete and quick drying of the measuring cells.

Both rinsing cycles can be switched off ("Off") or on ("Set") individually. The time for the two rinsing procedures "Rinse-1 Time" (with solvent 1) and "Rinse-2 Time" (with solvent 2) is entered directly in seconds (0 to 9999 s).

```
Method 1 < Meas. Parameter >      ▼▲

Drain               :Off   Set   Auto
Drain Time          :[ 10]s
Rinse-1             :Off   Set
Rinse-1 Time        :[ 10]s
Rinse-2             :Off   Set
```

After rinsing, dry air is pumped through the measuring cell for drying.

– Select the type of procedure for setting the drying time ("Purge"):

Set:	Enter the drying time in seconds ("Purge Time", 0 to 9999 s).
Auto:	Recommended setting. The DE measures the oscillation of the density measuring cell during the drying procedure and switches the pump off when it becomes stable (i.e., the density measuring cell is dry).
Off:	No drying of the measuring cell.

```
Method 1 < Meas. Parameter >      ▼▲

Rinse-1 Time        :[ 10]s
Purge               :Off Set Auto
Purge Time Set      :[ 180]s
Cell Test           : Off On
Calib.              :<Air&Water>
```

```
Method 1 < Meas. Parameter >      ▼▲

Rinse-1 Time        :[ 10]s
Purge               :Off Set Auto
Cell Test           ::Off On
Calib.              :<Air&Water>
Exit                :[Execute]
```

If the measuring cell is rinsed and dried after each measurement ("Set" or "Auto" was selected for "Purge"), then an automatic test of the density measuring cell can be added at the end of the sequence.

– To activate this test, select and confirm "Cell Test".
– Enter the required tolerance ("Reliability") for the cell test.

```
Method 1 < Meas. Parameter >      ▼▲

Rinse-1 Time        :[ 10]s
Purge               :Off Set Auto
Cell Test           :Off On
Reliability :[10]
Calib.              :<Air&Water>
```

This cell test verifies that it is clean and dry after each measurement. At the end of the drying cycle, the instrument measures the density of the dry air and compares it with the theoretical value (stored in the instrument's memory). This comparison requires that you enter a tolerance value ("Reliability"). This value is the maximum allowed difference between the density measured in the test and the theoretical density of air. The default value of 10 signifies that the density measured in the test may deviate at most by $10 \cdot 10^{-5}$ g/cm^3 for DE45 Delta Range, DE51 or $10 \cdot 10^{-4}$ g/cm^3 for DE40, from the theoretical value. The result of the test appears on the display and is printed out ("Cell Test OK" or "Cell Test Failed"). The "Cell Test" must be set to "Off" the first time the density measuring cell is adjusted at a specific temperature.

For SC1 / SC30

The sequence defined in method "0" ("CALIB.") is tied to the **Rinse/Purge** key of the DE density meter (only active with SC1 or SC30). By pressing **Rinse/Purge**, the measuring cells are drained, rinsed and dried according to the sequence defined in the settings of method 0. If the cell test is set to "On" in method 0, an additional cell test is performed. If the settings for sequence are selected correctly in method 0 ("CALIB.") (i.e., you ensure a complete draining, cleaning and drying of the measuring cells) and the cell test is activated in this method, it may easily be checked, whether the DE density meter's density measuring cell has been contaminated. For this purpose you simply have to press **Rinse/Purge**.

The sequence defined in method "0" is also carried out before actually starting the adjustment when the **Calib**. key is pressed, as long as the "Rinse/Purge" option in the "Changer" menu (refer to section 11.4) is set to "On". That guarantees that the DE density meter's measuring cell is always clean and completely dry before an adjustment is performed. After completing an adjustment, the sequence defined in method "0" is repeated.

To ensure a simple testing of the density measuring cell with **Rinse/Purge** and a correct adjustment of the DE density meter the following settings should be selected for the sequence in method "0" ("CALIB."):

Rinse-1:	On
Rinse-1 Time:	60 s (or more, a complete cleaning of the measuring cell must be ensured!)
Rinse 2:	On
Rinse-2 Time:	20 s (or more, a complete cleaning of the measuring cell must be ensured!)
Purge:	Auto
Cell Test:	On (testing the density measuring cell)
Reliability:	10

Before activating the cell test:

Make sure that at least two good and correct (repeatable) adjustments are stored at the measuring temperature. Otherwise the message "NG" will result all the times.

9.6 Calibration mode (Calib.: adjustment with other standards)

This menu item allows you to adjust the measuring cells with special density standards (instead of with water and air):

- Set and confirm "Calib." to "Other STD" in order to perform the adjustment of the measuring cells with any two density standards.
- Enter the two standards' nominal densities at measuring temperature ("STD-1 Dens." and "STD-2 Dens.") and confirm both entries.

```
Method 1 < Meas. Parameter >          ▲

Calib.                  :<Other STD>
STD-1 Density           :[0.99821]
STD-2 Density           :[1.49320]
Exit                    :[Execute]
```

For SC1 or SC30: If one of the two standards used to adjust the DE density meter should have an extremely high viscosity, then you can set the sampling speed to high:

- SC1 or SC30 is selected (refer to section 11.4).
- Select and confirm "High" for "STD-1 Samp.Speed" or "STD-2 Samp.Speed", respectively.

```
Method 1 < Meas. Parameter >          ▼▲

Calib.                  :<Other STD>
STD-1 Density           :[0.99821]
STD-1 Samp.Speed        :Low   High
STD-2 Density           :[1.49320]
STD-2 Samp.Speed        :Low   High
```

- The cell test for the density measuring cell is not available if "Other STD" has been selected for "Calib.". For adjustments you should use exclusively very precise and chemically stable standards (otherwise, the measuring cells will produce faulty results!).
- It is not possible to perform viscosity corrected measurements, or to perform viscosity corrected adjustments if "Other STD" has been selected for **Calib.**

10. Calculation parameters (password protected)

Using **Calc.Para** you can define how the results of the currently selected method are to be calculated, and displayed. The **Calc.Para** key is not active if method 0 ("CALIB.") has been selected.

– Select the method for which you want to set the calculation parameters using **Method** (refer to section 9) and then press **Calc.Para**.

```
Method 1     < Calc. Parameter >

    0.Density
    1.Result
    2.Temperature Compensation
    3.Decimals
```

10.1 Density: d, d(t/4), d(t/t)

– Press **Calc.Para**.
– Select and confirm the first item "Density".
– Select and confirm the density to be displayed.
– Confirm "Exit:[Execute]" with <Enter>.

```
Method 1          < Density >

Density :d d(t/4) d(t/t)

Exit :[Execute]
```

d:	density (absolute density) [g/cm^3]
d(t/4):	specific gravity in relation to the density of water at 4°C [-]. For example at 20°C, d(t/4) = d_4^{20}
d(t/t):	specific gravity in relation to the density of water at the measuring temperature [-], for example at 20°C, d(t/t) = d_{20}^{20}

The unit selected for density here is the unit which is also used as "d" in "Data Replace [x]" and as "x" in the "Result" menu's calculations (refer to section 10.2.1).

10.2 Result (Density, Concentration, BRIX, ALCOHOL)

In addition to density (as referred to in the settings above), the DE density meter can calculate and display a concentration result. This result is calculated based on concentration tables (density/concentration) and the measured density. Furthermore, you have the possibility to use the results to convert the measured density to alcohol content (ethanol content in percent by volume) or Brix (sucrose content in percent by weight). The latter concentrations are calculated by DE density meter by means of built-in tables (see appendix).

– Press **Calc.Para**.
– Select and confirm "1. Result".

Now you can select the desired calculation procedure. After confirming your choice for the result additional lines appears on the "Result" menu's display, depending on what procedure you selected.

```
Method 1        < Result >

Result             :<Brix   >
Exit               :[Execute]
```

The following kinds of calculations are available:

d:	Density (no calculation!). The density displayed is the one you selected under "Density" (refer to section 10.1).

Brix:	BRIX is the term for the sucrose content of an aqueous sucrose solution in percent by weight (also called BRIX degrees). The Brix table stored in the DE density meters is based on table 109 of the NBS Circular 440 (NBS: National Bureau of Standards, since 1988: National Institute of Standards and Technology, NIST). This table is valid for a temperature of 20°C only. You therefore have to select a measuring temperature of 20°C. Brix measurements of such samples as milk or soft drinks result in relative measurement values: the actual sucrose content cannot be determined directly because the density is influenced by all the components that are present in the sample.
Alcohol:	Ethanol content of aqueous solutions in percent by volume, calculated from the density. There are two tables stored in the DE density meters: One for measurements at 20°C (OIML table IV a) and one for measurements at 60°F (table n° 3 of the NBS circular 19).*1 The two tables are valid for the temperatures of 20°C and 60°F only. You therefore have to select a temperature of either 20°C or 60°F for the density measuring cell when performing alcohol measurements! Alcohol measurements of samples which do not only contain water and ethanol (as e.g. wine) do not yield correct alcohol concentrations, because the density of such samples also depends on the other dissolved contents.
Conc.:	Concentrations (normally of a two-component solution) based on the density. A concentration table (density/concentration) with up to 30 data pairs per table can be entered for the calculations. These data pairs can be obtained either by measurement (i.e., the density of a series of samples with a known concentration must be determined), by downloading them from our Internet home page www.density.com, or out of books (e.g., the "Handbook of Chemistry and Physics"). The concentrations are calculated based on first, second or third order polynomials. You can set the order of the polynomial, and the polynomial's coefficients are determined by means of a regression analysis by the DE density meter and then displayed. You can also enter the polynomial directly (i.e., without entering a concentration table). This allows the concentration function to be used to convert the density into other units (e.g., Baumé or API degrees, refer to section 10.2.1).

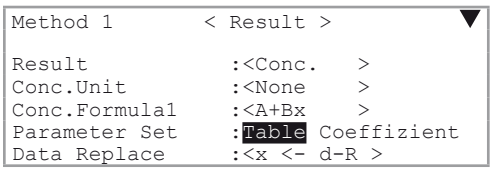
*1: The appropriate table is selected according to the temperature unit as defined in Setup 5 International (refer to section 12.6)

10.2.1 Calculating concentrations based on density (Conc.)

Select "Conc." for "Result" if you want to
- determine the concentration of a two-component solution based on density.
- convert the density into other units.

The selected density (specific gravity, resp.) in the "Density" menu is always used to calculate "Result" (refer to section 10.1)

- Select and confirm "Conc." for "Result".
- Define the unit (dimension) for your results.
- Select and confirm the required concentration unit "Conc.Unit".



The following units are available: none, %, ppm, mg/g, mg/mL, mg/L, g/L, mEq/L, mol/L, g/cm^3 and up to five freely definable names for units. These five names can be entered in the "Setup>Op. Names/ Units>Concentration Units" menu (refer to section 12.3.1).

- Then you have to select the formula ("Conc.Formula") to calculate the results.

Should you not know your concentration formula (a concentration table has been entered), select the one with the best match for your data pairs. In most cases it is recommended to use a second order polynomial for the calculations.
Hence, there are two ways to program a concentration formula:

– You can select a suitable formula "1/(A+BX)". Polynomials of first, second or third order are available. Enter the related coefficients directly.
– You can enter a concentration table (pairs of data made up of density or refractive index and the concentration). With it you have the instrument to calculate the coefficients,.

10.2.1.1 Direct entry of concentration formulas

This section describes the procedure to enter a formula for calculating a concentration by means of an example: the calculation of Apparent Extract in beer based on specific gravity.

The formula to convert specific gravity (d^{20}_{20}) into % Apparent Extract is:

% Apparent Extract = $-460.234 + 662.649 \cdot d^{20}_{20} - 202.414 \cdot [d^{20}_{20}]^2$

The following steps have to be considered to display the results of the density measurement directly in % Apparent Extract:

– Enter "%Extr" for the name of the result unit in the "Setup>Op.Names/ Units>Concentration Units" menu (refer to section 12.3.1).

Make sure that the temperature of the density measuring cell ("Meas.Temp.") defined in the current method is set to 20.00°C (refer to section 9.2).

– Press **Calc.Para**
– Select and confirm "0.Density". In the "Density" menu select "d(t/t)" as the unit for density (refer to section 10.1).
– Confirm "Exit:[Execute]".
– In the "Calc.Parameter" menu, select and confirm "1.Result".

– In the "Result" menu select and confirm "x←d" for "Data Replace".
– Select and confirm "Conc." for "Result".
– Select and confirm "%Extr" for "Conc.Unit".
– Select and confirm "A+Bx+Cx²" for "Conc.Formula".
– Select and confirm "Coefficient" for "Parameter Set" (direct entry of the concentration formula without a table).

```
Method 1        < Result >          ▼

Result            :<Conc.   >
Conc.Unit         :<%Extr>
Conc.Formula      :<A+Bx+Cx2  >
Parameter Set     :Table Coeffizient
Data Replace      :<x <- d>
```

– Enter and confirm the values for A, B and C.
– Select and confirm "Execute".
– Press **Reset**.

```
Method 1        < Result >          ▲

A           :    [- 460.234]x10[ 0]
B           :    [ 662.649]x10[ 0]
C           :    [- 202.414]x10[ 0]
Exit        :    [Execute]
```

The DE density meter is now in a position to display and print out the measured density directly in %Apparent Extract. The number of decimal places for the results can be defined under "Calc.Para>3. Decimals" (refer to section 10.4). Should the density (g/cm³) appear in the display instead of the calculated result (%Extr), then press **Display** to switch the results (refer to section 4.2).

Concentration functions can also be used to convert the density into other units.

For Example:
Conversion of density into API degrees. The formula for converting density into API degrees is:

API degrees = $[(1/ d^{60F}_{60F}) - 1] \cdot 141.5 + 10$

Below you can find a compilation of some commonly used conversion formulas for density in a table.

Conversion formula:	This is the formula to convert density (or relative density) into the corresponding unit. On the second line of this column you can refer to the formula ("Conc.Formula") which you must select in the "Result" menu for the conversion into the appropriate unit.
Meas. temp.:	This temperature (in °C) must be entered in the measuring parameters either as "Meas.Temp." (refer to section 9.2). "--" means that you can enter any measuring temperature.
Density unit:	You must select this unit for density in the "Density" menu (refer to section 10.1). This column is used only in Table 1.
Data replace:	Settings for "Data Replace [x]". Please be aware that you must select "Coefficient" for "Parameter Set" before you change the settings for "Data Replace[x]"!
Coefficient	Enter these coefficients (A, B and C) for the corresponding result.

Table 1: Converting density into another unit ("Result1"):

Unit	Conversion formula	Meas. temp. [°C]	Density unit	Data replace	Coefficients	
					A	B
Heavy Baumé deg.[1)]	((1/d)–1)•–144.3 A+Bx	15.00	d(t/4)	x←1/d–1	0	–144.3
Light Baumé deg.[1)]	((1/d)–1)•144.3+10 A+Bx	15.00	d(t/4)	x←1/d–1	10	144.3
Jap. Sake degrees	((1/d)–1)•1443 A+Bx	15.00	d(t/4)	x←1/d–1	0	1443
API degrees	((1/d)–1)•141.5+10 A+Bx	15.56[2)]	d(t/t)	x←1/d–1	10	141.5
Twadell degrees	(d–1)•200 A+Bx	--	d(t/4)	x←d–1	0	200
Milk degrees	(d–1)•1000 A+Bx	--	d(t/4)	x←d–1	0	1000

[1)] In the USA: replace 144.3 with 145
[2)] 15.56°C corresponds to 60°F

10.2.1.2 Entering concentration tables

This section describes the procedure for entering a concentration table by means of an example: the determination of the sulfuric acid concentration based on the density of an aqueous solution.

Concentration table for an aqueous sulfuric acid solution (taken from "Handbook of Chemistry and Physics").

	H_2SO_4 Concentration (in % by weight)	**d_4^{20}** (at 20°C)
1	0.0	0.9982
2	10	1.0661
3	20	1.1398
4	30	1.2191
5	40	1.3028
6	50	1.3952
7	60	1.4987
8	70	1.6105
9	80	1.7272
10	90	1.8144

You can find further concentration tables on our Internet home page www.density.com.

In order for the DE density meter to display and print out the density directly in percent by weight of sulfuric acid, the following steps must be taken:

- Make sure that the temperature of the measuring cell ("Meas.Temp.") is set to 20.00°C in the currently selected method (refer to section 9.2).
- Press **Calc.Para**, select and confirm "Result".
- Select and confirm "Conc." for "Result".
- Select and confirm "%" for "Conc.Unit".
- Select the required concentration formula for your application. In this example "A+Bx+Cx²" is selected.
- Select and confirm "Table" for "Parameter Set" (entering a concentration table).

```
Method 1        < Result >                ▼

Result             :<Conc.    >
Conc.Unit          :<%   >
Conc.Formula      :<A+Bx+Cx2  >
Parameter Set      :Table Coeffizient
Data Replace       :<x <-d-R>
```

- Enter and confirm 10 for "Data No." (number of data pairs).
- Confirm "Enter Conc.Table:[Execute]" (entering a concentration table).

```
Method 1        < Result >                ▲

Data No.(3-30)       :[10]
Enter Conc.Table     :[Execute]
Exit                 :[Execute]
```

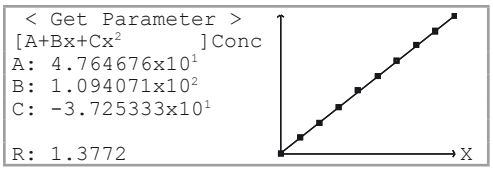
- Enter the data pairs according to the table. Confirm each value.

```
Method 1       < Conc.Table >              ▼
No.      Conc.              Density
 1      [00.00000]        [ 0.99821]
 2      [10.00000]        [ 1.0661]
 3      [20.00000]        [ 1.1398]
 4      [30.00000]        [ 1.2191]
Edit       Clear     GetPara.     Exit
```

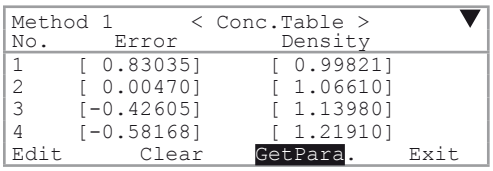
- After all data pairs have been entered, select and confirm "GetPara.".

```
Method 1       < Conc.Table >              ▲
No.      Conc.              Density
 7      [60.00000]        [ 1.4987]
 8      [70.00000]        [ 1.6105]
 9      [80.00000]        [ 1.7272]
10      [90.00000]        [ 1.8144]
Edit       Clear     GetPara.     Exit
```

– The coefficients of the polynomial (A, B and C) as well as the graph of the curve (d-R/concentration) are displayed. R is the mean of all density values (and **not** the correlation coefficient!).



– Press **Enter**. The concentrations are calculated using the coefficients. A table with the deviations between calculated and actual concentration ("Error") is displayed.



The values A, B and C are the coefficients of the selected function. R is the mean of all entered density values. The DE density meter replaces the density values for the regression analysis with the density values minus the mean of all density values (x←d-R') in order to optimize the algorithm used (calculations with low numbers). The values A, B, C and R can be used to enter the concentration function in a second DE density meter without having to enter the entire table. In this case, please be aware that "x←d-R" must be selected for "Data Replace[x]".

– Press **Escape**. The DE density meter can display and print out the measured density values directly as sulfuric acid percent by weight (only within the range of 0 to 90%). The results' decimal places can be defined under "Calc.Para/Decimals" (refer to section 10.4). Should the density (d) appear on the display during the measurements instead of the calculated result (%), press **Display** to switch to display the results (refer to section 4.2).

10.3 Temperature compensation

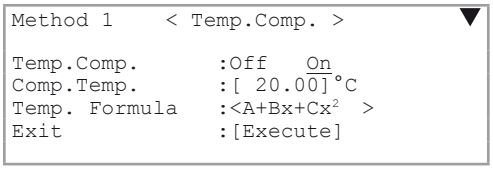
Temperature compensation allows you to measure a sample at one temperature and to convert the measurements to another temperature. Temperature compensation is utilized in the following cases:

– Density need to be determined at 15°C, but the sample is very viscous at that temperature. Such samples need to be heated in order to enable them to be pumped into the measuring cells.
– To speed up the measurement. If, for example, the samples are at a temperature of 35°C, but their densities need to be determined at 15°C, then you can set the cell temperature to 35°C and convert the measured values to a temperature of 15°C.
– If density needs to be determined at a temperature out of the DE density meter's range of measuring temperatures (e.g., at 100°C). In this case, you can set the cell temperature to 50°C and convert the results to a temperature of 100°C.

To use the temperature compensation, you need to know the temperature dependency of the sample's density.

There are two ways to enter the temperature dependency of density:

– Entering temperature compensation tables (pairs of data made up of the temperature and the corresponding density). In this case, the coefficient of the temperature compensation function is calculated by the DE.
– Entering a formula for the temperature compensation.
– Press **Calc.Para**.
– Select and confirm "2. Temperature Compensation".
– Select and confirm "On" for "Temp.Comp.".



10.3.1 Entering a temperature compensation table

The temperature dependency of density can be expressed as follows:

$d_c = k \bullet f(T)$ (for the density)

The temperature dependency of density is contingent upon the ingredients of the sample and is, therefore, not equal for all samples. If only samples whose densities have approximately the same temperature dependence are measured with one particular method, then you can determine the density of this type of sample at various temperatures and enter the results (i.e., the data pairs density/temperature) into the DE density meter. The DE density meter then calculates the density of the measured samples automatically for a particular temperature ("Comp.Temp").

The DE density meter performs these temperature compensation calculations based on polynomials of first, second or third order (the order of the polynomial can be selected) or by linear interpolation. These calculations are performed by the instrument as follows:

$$d_c = \left(\frac{f(T_c)}{f(T_M)} \right) \bullet d_M$$

with

d_c	density temperature compensated
T_c	reference temperature ("Comp.Temp.")
T_M	measuring temperature
d_M	density at measuring temperature
f	polynomial function (determined by the DE density meter)

Enter the reference temperature ("Comp.Temp.") to which the measurements need to be converted.

- Select and confirm the required function ("Temp. Formula") for the temperature compensation: "Interpolation" (linear interpolation) or a polynomial of first, second or third order.
- Select and confirm "Table" for "Parameter Set".
- Enter and confirm the number of data pairs (density/temperature) for "Data No. (2-30)".
- Select and confirm Temp.Table:[Execute]".

```
Method 1    < Temp.Comp. >
Temp.Comp.       :Off   On
Comp.Temp.       :[ 20.00]°C
Temp. Formula    :<A+Bx+Cx²  >
Parameter Set    :Table Coefficient
Data No.(2-30)   :[ 4]
```

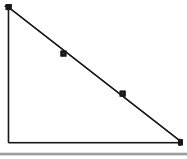
```
Method 1    < Temp.Comp. >
Enter Temp.Table:[Execute]
Exit :[Execute]
```

- Enter the temperature compensation table (data pairs density/temperature). Confirm each entry.
- Select and confirm "Get Para.".

```
Method 1     < Temp.Table >
No.  Temp[°C]        Density
1    [ 38.00]       [ 0.99297]
2    [ 40.00]       [ 0.99222]
3    [ 42.00]       [ 0.99144]
4    [ 44.00]       [ 0.99033]
 Edit   Clear GetPara.    Exit
```

The coefficients (A, B, C and R, depending on the selected formula) and a graph of the curve (temperature/density) are displayed. Please be aware that R is not a correlation coefficient. It is the mean of all entered temperatures.

```
 < Get Parameter >
[A+Bx+Cx²     ] d
A: 9.918526x10⁻¹
B:-4.350007x10⁻⁴
C:-2.250075x10⁻⁵

R: 41.00000
```



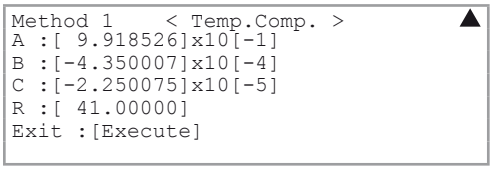
By pressing **Enter** again, the formula and the coefficients used to calculate the densities for the different temperatures are displayed. The table displayed shows how well these measured values coincide with the original data.

10.3.2 Entering a formula for temperature compensation

For density measurement

– Enter and confirm the reference temperature ("Comp.Temp.") to which the measurements need to be converted.
– Select and confirm the desired formula ("Temp.Formula") for the temperature compensation (a polynomial of the first, second or third order).
– Select and confirm "Coefficient" for "Parameter Set".

– Enter the coefficients for the formula (A, B, C and R, depending on the selected formula). R is the mean of all temperatures. Confirm each entry.
– Confirm "Exit:[Execute]".



10.3.3 Temperature compensation according to API

In the DE density meters, the following tables are available to do temperature compensation according to API:

A) Compensation to 15.00°C
The instrument must be set up to measure in °C (refer to Setup 5: International):

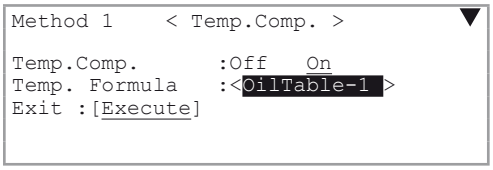
OilTable-1:	For **crude oils**, according to table 53A of the API standard (ASTM D 1250 Table 53A).
OilTable-2:	For **oil products**, according to table 53B of the API standard (ASTM D 1250 Table 53B).
OilTable-3:	For refined **lubricants**, according to table 53D of the API standard (ASTM D 1250, Table 53D).

B) Compensation to 60°F (corresponding to 15.56°C)
The instrument must be set up to measure in °F (see Setup 5: International):

OilTable-1:	For **crude oils**, according to the table 5A of the API standard (ASTM D 1250 Table 5A).
OilTable-2:	For **oil products**, according to the table 5B of the API standard (ASTM D 1250 Table 5B).
OilTable-3:	For refined **lubricants**, according to the table 5B of the API standard (ASTM D 1250 Table 5B) .

To activate the temperature compensation of the density values according to API proceed as follows:

– Select and confirm "On" for "Temp.Comp."
– Select and confirm "OilTable-1", "OilTable-2" or "OilTable-3" (according to the type of product you want to measure with the method) for "Temp. Formula".
– Confirm "Exit:[Execute]" .



– Do not enter "Comp.Temp". The temperature compensation is always done for a reference temperature of 15°C or 60°F depending on the selected temperature unit.
– Do not forget to activate the viscosity correction if you measure highly viscous samples (refer to section 7.3).
– It is not possible to compensate the density to 15.00°C when the chosen temperature unit is °F. Measurements done in °F are compensated to 60°F (corresponding to 15.56°C!) by definition. It is not possible to enter a different compensation temperature.

10.4 Decimals

– Press **Calc.Para**.
– Select and confirm "3. Decimals".
– Enter and confirm the number of decimal places (i.e., places after the decimal point) for the display and printout of the results.

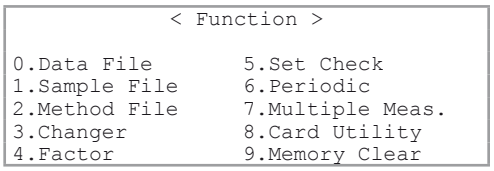
```
Method 1   < Decimals >

Density      (0-5):[5]
Conc. (0-5)       :[5]
Brix (0-3)        :[3]
Alcohol (0-2)     :[2]
Exit              :[Execute]
```

Density:	Density or specific gravity
Conc.:	Calculated concentration
Brix:	Sucrose content in percent by weight.
Alcohol:	Ethanol content in percent by volume.

– The measured values of the corresponding method will be displayed and printed out with the selected number of digits after the decimal point.

11. Functions (password protected)

– Press **Func**. If the password protection is activated (refer to section 12.7) you will be prompted to enter the password.
– Select and confirm the required function by pressing the corresponding numeric key (keys <0> to <9>) or by using the arrow keys.

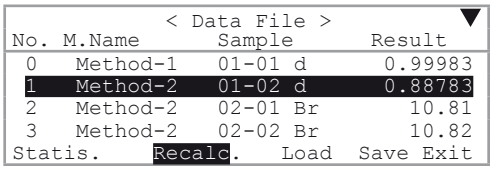


11.1 Stored results (Function 0: Data File)

The results of the last 100 measurements are automatically stored in the DE density meter. If 100 results have already been stored and a measurement is performed, then the oldest result is overwritten by the most recent (FIFO). The stored results can be accessed with the "Data File" function: you can do recalculations or statistical evaluations of the stored results or mark them as invalid so that they will not be included in statistical calculations. You can also save the stored results to a memory card or reload them from a memory card into the DE density meter.

– Press **Func.**
– Select and confirm the item "0. Data File".

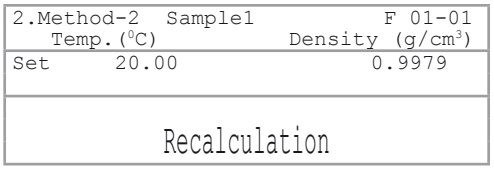
The stored results are displayed together with the measuring method used.



If many results have been stored in the DE density meter, press the **0** key to display the first four results (0 to 3), and **1** to **9** to display the next blocks of data (results 10 to 13, 20 to 23, etc.).
To display additional information about a stored result (sample number, sample identification, calculated results) proceed as follows:

– Select the desired result.
– Select and confirm "Recalc."

You can select "Statis." (statistics), "Recalc." (recalculations), "Load" or "Save" (store results on a memory card or load them back into the DE density meter). Thereby, the options "Load" and "Save" require memory cards. These options are described in more detail in sections 13.1.2 and 13.1.4.
– Press **Reset** to return to the main display.



11.1.1 Statistical evaluations

The DE density meters offer two possibilities to statistically evaluate results. The mean and the standard deviation can either be calculated automatically after each measurement (see section 11.8.2) or after concluding the measurements (i.e., with the data stored in the instrument). This section describes how you can calculate the mean, standard deviation and relative standard deviation of the stored results. The relative standard deviation is also called the coefficient of variation (CV).

The data stored in the DE density meter can be filtered for a statistical evaluation, allowing a useful evaluation of a particular group of results. For example, you can statistically evaluate all measurements that have the same sample identification or include all results with the same unit in your calculations (e.g., the mean of all Brix determinations). The selection of the results to be used in the statistical evaluation is done with so-called filters, which can be combined. In your statistical calculations you can, for example, include only those results that have been measured with method 2 and have the same "High Sample Number".
– In the "Data File" menu (refer to section 11.1) select and confirm "Statis". The "Statistics" menu opens.

– Activate the required filters by moving the cursor to the corresponding filters and switch them on or off.
– Example: If you want to include all samples that have been measured with method 2, have d (density) as unit and have the same "High Sample Number" of "01", then you have to activate the filters according to the illustration on the right.

You can set "Data Print" to "On" if you want to print out a table with all individual results in addition to the statistical data.

```
          < Statistics >
Result             :<d >
Method No.         :<Off>
Method Name        :<Off>
High Sample No.    :<Off>
Data Print         :<Off>
Statistics         :[Execute]
```

```
          < Statistics >
Result             :<d >
Method No.         :<On>    [2]
Method Name        :<Off>
High Sample No.    :<On>    [1]
Data Print         :<Off>
Statistics         :[Execute]
```

The results of the statistical calculations appear on the display.

– You can print them out by pressing **Print**.
– To return to the "Statistics" menu, confirm "Exit:[Execute]".

```
            < Function >

0.Data File        5.Set Check
1.Sample File      6.Periodic
2.Method File      7.Multiple Meas.
3.Changer          8.Card Utility
4.Factor           9.Memory Clear
```

11.1.2 Recalculations

This function allows the recalculation of individual results stored in the instrument. The result in question is selected, the calculation parameters ("Calc.Parameter", i.e., type of result, calculation formula, temperature compensation and decimal places) are changed and the result is then recalculated based on the changes made.

The following example demonstrates how you can convert the result of a density measurement (d) into Brix.

– In the "Data File" display (refer to section 11.1) select the result you wish to recalculate.
– Select and confirm "Recalc.". The result of the measurement is displayed.
– Press **Calc.Para**.

– Select and confirm "1. Result" (in addition to the result unit, you can change the settings for temperature compensation and the number of decimal places to be displayed and printed out).

```
Recalc. < Calc. Parameter >

   0.Density
   1.Result
   2.Temperature Compensation
   3.Decimals
```

– Select and confirm "Brix" for "Result".

```
Recalc.  <Result >

Result     :<Brix >
Exit       :[Execute]
```

– Press **Func**.
– Select and confirm "0. Data File".
– Confirm "Recalc." The recalculated result (d in Brix) is displayed.

```
            < Data File >
No. M.Name       Sample       Result
 0   Method-1    01-01 d       0.99983
 1   Method-2    01-02 d       0.88783
 2   Method-2    02-01 Br        10.81
 3   Method-2    02-02 Br        10.82
Statis.    Recalc.   Load  Save Exit
```

11.1.3 Marking stored results as invalid

Stored results can be marked as invalid with an asterisk. Results marked in such a manner are not included in statistical evaluations.

– In the Data File display (refer to section 11.1) select the result you want to mark invalid.
– Press **Display** to mark the result. The result is marked with an asterisk (*) (press the **Display** again to remove the mark).

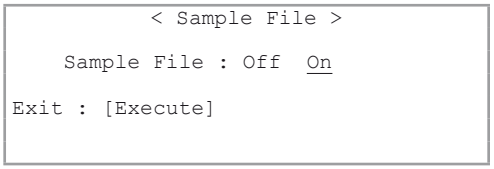
Results marked with an asterisk are not included in statistical evaluations. If the results of a statistical analysis are printed out and "Data Print" has been set to "On", then the marked results are printed also, however, they are marked with an asterisk in front of their sample number.

11.2 Sample file (Function 1: Sample File)

SC30:
If an SC30 has been selected in the function "3. Changer" (refer to section 11.4), the sample file is automatically switched on ("F" appears in the first line of the main display) and cannot be switched off.

SC1 / PSU-DE:
The sample file may be used if the DE density meter is operated with an SC1 Sample Delivery and Cleaning Unit, for example to always perform standard measurements in the same order. In such cases proceed as follows:

– Press **Func**.
– Select and confirm function "1. Sample File".
– Select and confirm "On" for "Sample File"



Further information about the sample file can be found in section 7.2.

11.3 Method file (Function 2: Method File)

The "Method File" function is used to save a method to a memory card or to load it back into the DE density meter from a memory card. The functions are described in the sections 13.1.5 and 13.1.7.

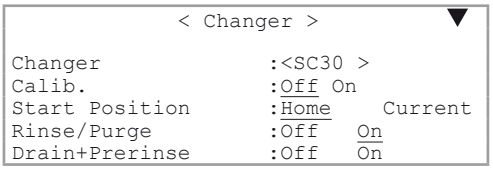
11.4 Automation units (Function 3: Changer)

This function is used to configure the connected automation unit (SC1 or SC30 Sample Delivery and Cleaning Unit).

– Press **Func.**
– Select and confirm "3. Changer".
– In the "Changer" menu, you can select and confirm one of the following changer units:
  • SC30
  • SC1
  • "None": For working with an air pump or with the PSU-DE.

For SC30 additional options are available:

– Select and confirm "On" for the item "Calib." if you want to adjust the DE density meter automatically prior to each sample series. For this, you have to put a vial with a calibration standard (usually deionized water) in the first position (No.1) of the turntable. If the DE is to be adjusted automatically, you should set "On" for "Rinse/Purge".



Please be aware of the fact that each adjustment leads to changes in the instrument settings. If an adjustment is not performed correctly, then all following measurements will be incorrect! Therefore, we recommend that you check your DE density meter daily (better before each sample series) with the "Check" function (instrument test), rather than performing frequent adjustments. Readjust the instrument only after the instrument test has failed twice in a row (refer to section 11.7.2). **For this reason, we recommend you set "Calib." to "Off".**

For the item "Start Position" you can select the following:

- **"Home"**: The first sample vial of a sample series (or the one containing the deionized water for adjustment) has to be placed in position 1 on the turntable.
- "Current": The first vial of a sample series can be placed in any position of the turntable (automatic vial detection).

If you want to interrupt a running series in order to perform an urgent measurement (refer to "Emergency Sample" function, section 11.4), the "Start Position" has to be set to "Home".

The method "Rinse/Purge" is used for the automatically draining, rinsing and drying the entire system prior to each adjustment of the DE density meter. The sequence for this is always the one defined in the method "CALIB." In order to ensure correct adjustments "Rinse/Purge" should always be set to "On"!

The method "Drain + Prerinse" can be used to add a small amount of the first rinsing solvent already towards the end of the draining cycle, while the pump is running at low speed. This removes the greater part of the sample before the first rinsing cycle starts and the solvent gets the full speed of the membrane pump. This can be required when viscous samples are measured, where the inner surface of the tubes can still be covered with a thick film.

The drain mode of SC1 / SC30 has to be set to drain for this!

We recommend the following setting:

- With a new type SC1 / SC30 with peristaltic pump: Set "Drain + Prerinse" to "Off". If you measure a viscous samples, activate the sample recovery function (Return Mode to return in the SC1 / SC30). This is the shortest path length and therefore the quickest way to empty the tubes.

- With an old type of SC1 / SC30 without peristaltic pump: Set "Drain+Prerinse to "On". This is especially recommended when measuring viscous samples. For normal non-viscous samples it can also be left to "Off".

If you want to use the sample recovery function of the SC1 or SC30, "Drain+Prerinse" must be switched "Off", otherwise the samples will not be pushed back into the vials after the measurements!

Measuring urgent samples ("Emergency Sample")

For SC30: If a sample has to be measured urgently and a sample series is already running on the SC30, press **Measure**. The sample number of the currently measured sample appears in reverse display. As soon as the current measurement is completed (including rinsing and drying of the measuring cells), the "Emergency Parameter" menu will appear on the display:

- Select and confirm "Emergency" for "Next Sequence".
- Enter the number of the method ("Method No.") to be used for measuring the urgent sample.
- Select the sampling speed for the sample (High or Low).
- Confirm "Exit: [Execute]"

```
        <Emergency Parameter>

Next Sequence     :<Emergency>
Method No.        :[2]
Sampling Speed    :<Low>
Exit              :[Excecute]
```

The sample rack rotates until position 1 is in front. The message "Emer. Samp. at H.P. Press Enter key**."** appears in the status line of the display. Place the urgent sample in position 1 on the sample rack and press **Enter**. The sample is measured. Afterwards, the current series is continued.

For using the Emergency sample function, the SC30 must be specified with "Home" for "Start Position", in function 3.

11.5 Factor (Function 4)

Using this function the following is performed:

- displaying the data of the last adjustment of the density measuring cell.
- activating the viscosity correction for the adjustments of the density measuring cell.

- Press **Func.**
- Select and confirm the item "4. Factor" to display the data of the last adjustment of the density measuring cell. The "Factor" menu opens.
- Select and confim the item "0. Factor" to display the data of the last adjustment of the density measuring cell.
- Select and confim the item "1 .Viscosity for Calib."" to activate the viscosity correction for the adjustment of the density meter.

```
            < Factor >


       0. Factor
       1.Viscosity for Calib.
```

11.5.1 Displaying the data of the currently valid adjustment

You can change the adjustment data for the density measuring cell. If you know the oscillation period T and the density d for air ("Air T/d") and water ("Water T/d") at the density measuring cell's temperature ("Temp."), you can enter these values. If you change one of the above values, the line "Correct:[Execute]" appears in the "Factor" menu. Confirm "Correct:[Execute]" to store the changed adjustment data. The newly calculated factor appears on the display.

```
             < Factor >
Temp.      :[ 20.00]°C
Air T/d    :[ 845401]/[ 0.00118]
Water T/d  :[ 1106305]/[ 0.99821]
Correct    :[Execute]
Factor     :[ 2.141349]
Exit       :[Excecute]
```

11.5.2 Activating the viscosity correction for adjustment

To perform density measurements with viscosity correction, the DE density meter must have been adjusted with activated viscosity correction at the selected measuring temperature at least once, otherwise the error message "No calibration(Visc.On)" appears.

The viscosity corrected adjustments can only be performed, if air and water are used for this purpose.

To activate the viscosity correction for adjustments, proceed as follows:

- Select and confirm "On" for "Viscosity".
- Confirm "Exit:[Execute]"

```
      < Viscosity for Calib >

Viscosity     : Off On
Exit          :[Excecute]
```

11.6 Configuring the instrument test (Function 5: Set Check)

The DE density meters should be checked sporadically with the built-in instrument test function. To perform such an instrument test, press **Check** and you are prompted to perform a measurement with a standard with known density.

Using SC30 (Sample Delivery and Cleaning unit) the DE density meter also performs an instrument test if a sample with the sample identification "CHECKSTD" is being measured. For SC30 it is normally easier to perform an instrument test at the beginning of a sample series.
With the "Set Check" function you can define the nominal density for the standard to be used in the instrument test as well as the maximum deviation allowed for the measured density.

There are two kinds of instrument tests: "Daily" and "Periodic".
The time interval for the periodic instrument test can be defined with item "6. Periodic" (refer to section 11.7.1).

If a periodic instrument test has been installed, the DE density meter automatically prompts the user to perform an instrument test when the defined time interval (e.g., every day or week) has run out. If the user ignores the prompt or the instrument test fails, all subsequent measurements are marked with an exclamation point (after the sample number). With a periodic instrument test, you can, therefore, ensure that the DE density meters are always properly adjusted, because its measuring precision **must** be checked in the defined time intervals.

When the **Check** key is pressed, the DE density meter prompts the user to perform an instrument test (daily, or periodic test if due) as follows, for an example of using SC30:

Using an SC30:

- The turntable rotates until position 1 is in front. The message "Set STANDARD at H.P. and Press Enter Key" appears (instead of "STANDARD" the name you defined for the standard appears). Place the sample vial for the test in position 1 of the turntable and press **Enter** to confirm.

```
1.Method-1                          F 01-01
Temp. (°C)                  Density(g/cm³)
Set 20.00
Cell 20.00                        0.00120

        Set STANDARD at H.P. and
```

Working with syringe, PSU-DE or SC1:

- The message "Set STANDARD and Press Enter Key" appears (instead of "STANDARD" the name you defined for the standard appears). Transfer the sample into the measuring cell, or place the sample vial for the test in the SC1 and press **Enter**.

```
1.Method-1                          F 01-01
Temp. (°C)                  Density(g/cm³)
Set 20.00
Cell 20.00                        0.00120

      Set STANDARD and Press Enter Key
```

Viscosity correction is only available in combination with the setting "Air & Water" for **Calib.** (in the sequence). With the setting "Other Standards" it is not possible to perform viscosity corrected measurements.

You are now asked to select the sampling speed for the standard.

- Select and confirm "Low" if you are using a standard with a low viscosity (such as water) or "High" if you use a standard with a high viscosity
- Confirm "Exit:[Execute]" using **Enter**.

```
< Sampling Speed >

Sampling Speed?  : Low High
Exit             :[Excecute]
```

The DE density meter performs the instrument test. The message "Checking" appears in the status line of the display.
After completion of the instrument test, the result appears on the display.

If the test failed, the error message "NG" (not good) appears.

The results of the periodic tests are stored in the instrument (refer to section 11.7.1). The results of the daily tests are not saved in the instrument. They are only exported through the RS interface (to a computer if connected),

- To set up the instrument test, press **Func.**
- Select and confirm "5. Set Check".
- Select and confirm "Daily" for "Check" if you want to set up the daily test or "Periodic" if you want to set up the periodic test.
- Enter and confirm the theoretical density at measuring temperature ("Ref.Value") of the standard to be used for the instrument test and the maximum permissible deviation of the instrument test's measured value ("Tolerance").

```
< Set Check >

Check          :Daily    Periodic
Standard       :[water ]
Ref.Value      :[ 0.99821] g/cm³
Tolerance      :[ 0.00005] g/cm³
Exit           :[Execute]
```

Take into account, if the uncertainty of a certified standard such as the tolerance is simply entered, the uncertainty only includes the components of the standards itself and the equipment used for the calibration of the standard. However this uncertainty does not allow for any components originating from your instrument (i.e. instrument specification).

So far, the check, the uncertainty of the standard and the instrument specification (limit of error, for density and temperature) should be summed up and entered as the tolerance, to avoid false "Fails" of the check.

11.7 Periodic instrument tests and adjustments (Function 6: Periodic)

This function allows you to define the time intervals for the periodic instrument tests and adjustments, as well as display and print the results of adjustments and periodic instrument tests stored in the DE density meters. The function can also be used to save the results of periodic instrument tests and adjustments to a memory card or load them back into the instrument.

11.7.1 Periodic instrument tests (Checks)

- Press **Func.**
- Select and confirm "6. Periodic".

If you wish to display and print out results of already performed instrument tests stored in the instrument or to define the time interval for the periodic tests, select and confirm "Check" for "Periodic"

```
< Periodic >                    ▼
Periodic       :Check   Calib.
Check History  :Skip  Load  Save
Next Check Date :09/09/2007
Check Alarm    :Off    On
Check Interval :[ 7]day
Show Check List :[Execute]
```

Check History

This function allows you to save a list of the results of the last ten periodic instrument tests of the instrument to a memory card or load it back into the DE density meter (refer to sections 13.1.11 and 13.1.13).

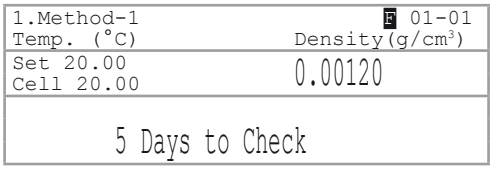
Next Check Date

This is the date at which the next periodic instrument test must be performed. You cannot change this field.

Check Alarm

To activate the alarm, select and confirm "On". Once the alarm is activated, the following messages remind the user, when the **Measure** key is pressed or the instrument is switched on, that a periodic instrument test needs to be performed immediately or within a short time:

When a periodic instrument test is due within five or fewer days:



When a periodic instrument test needs to be performed immediately:

When a periodic instrument test was due the previous day or earlier but was not performed:

As soon as a periodic test has been successfully completed, these messages no longer appear.

When the messages "Check Day!" or "Check Day Over!" appear on the display, it is still possible to do measurements. However, the results obtained this way are marked with an exclamation point ("!") in the data file and on the printout (after the sample number).

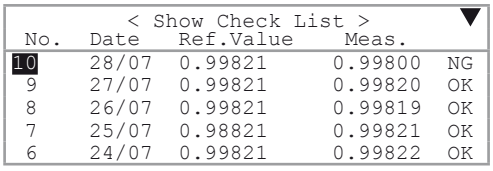
Check Interval

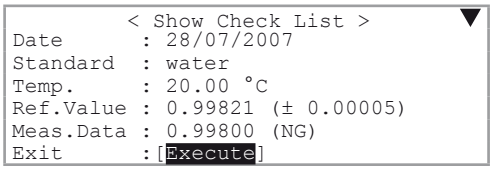
You can define how often a periodic instrument test is to be performed.

– Enter and confirm the desired time interval in days. If you enter "0", an instrument test is due right away.

Show Check List

– Confirm "Show Check List:[Execute]" to display the results of the last ten periodic instrument tests.
– Press **Print** to print out the whole list with all the details
– To display a detailed report of a particular instrument test, select the desired result and press **Enter**. ("(NG)" means that the test was negative.)
– Confirm "Exit:[Execute]" to return to the list of instrument test results.





11.7.2 Periodic adjustments

This function allows you to define how often the DE density meters need to be adjusted, as well as display and print the adjustment results stored in DE. It can also be used to save the results to a memory card or load them back into the instrument.

Each adjustment changes the internal settings of the instrument. Take into account, if an adjustment is not performed correctly, then all following measurements will be incorrect! Therefore, we recommend that you do **not** adjust your DE density meter at set time intervals.

The instrument should be adjusted only if:

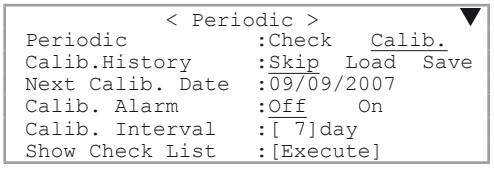
- a periodic instrument test has failed twice in a row.
- the measuring temperature of the measuring cell has been changed and if the measuring cell has not been adjusted at the new measuring temperatures yet.

The results of all adjustments ("normal" and "periodic") are automatically stored in the DE density meter. You can view the results of the last ten adjustments for the measuring cell at any time and print them out in a list for documentation purposes.

– Press **Func.**

– Select and confirm "6. Periodic".

If you wish to display and print out results of the adjustments already performed and stored in the instrument or to define the time interval for the periodic adjustments, select and confirm "Calib." (adjustment) for "Periodic"



Calib. History

With this function you can save a list of the results of the last ten adjustments of the selected measuring cell ("Sensor") to a memory card or load it back into the DE density meter (refer to sections 13.1.11 and 13.1.13).

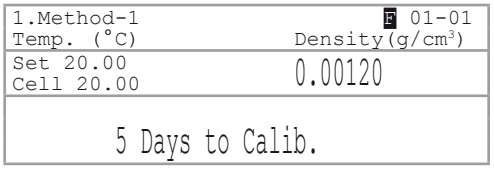
Next Calib. Date

This is the date at which the next periodic adjustment must be performed. You cannot change this field.

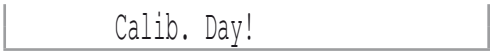
Calib. Alarm

To activate the alarm, select and confirm "On". Once the alarm is activated, the following messages remind the operator, when the **Measure** key is pressed or the instrument is switched on, that an adjustment needs to be performed immediately or within a short time:

When a periodic adjustment is due within five or fewer days:



When a periodic adjustment needs to be performed immediately:



When a periodic adjustment was due the previous day or earlier but was not performed:

As soon as an adjustment has been successfully completed, these messages no longer appear.

When the message "Calib. Day!" or "Calib.Day Over!" appears, it is still possible to perform measurements. However, the results are marked with an exclamation point ("!") in the data file and on the printout (after the sample number).

Calib. Interval

You can define how often a periodic adjustment is to be performed. Enter and confirm the desired time interval in days. If you enter 0, an adjustment is due right away.

Show Calib. List

– Confirm "Show Calib. List:[Execute]" to display the results of the last ten adjustments.
– Press **Print** to print out the whole list with all the details
– To display a detailed report of a particular adjustment, select the desired result and press **Enter**.
– Confirm "Exit:[Execute]" to return to the list of adjustment results.

```
          < Show Calib. List >
 No.   Date    Temp.(°C)     Factor
10     28/07   20.00        2.019132 OK
 9     27/07   20.00        2.019139 OK
 8     26/07   20.00        2.019137 OK
 7     25/07   20.00        2.019135 OK
 6     24/07   20.00        2.019132 OK
```

```
          < Show Calib. List >
Date       : 28/07/2007
Temp.      : 20.00 °C
Air        :T= 854476 d= 0.00120
Water      :T= 1106305 d= 0.99821
Factor     : 2.019132(OK)
Exit       :[Execute]
```

11.8 Multiple measurements (Function 7: Multiple Meas.)

This function is used for

- automatic execution of sample measurements in fixed time intervals ("Auto Start"). Repeated measurements of a sample are usually implemented to determine changes in density during a chemical reaction.
  Basically, there are two possibilities:
  - The reaction takes place in the measuring cell and the density is measured at fixed time intervals. In this case, we recommend you fill the DE density meters measuring cell either manually (e.g., with a syringe) or by activating the sampling pump of the SC1 or SC30 manually. Please note that the "Sequence" in the method used for these measurements must be set to "Off".
  - The reaction takes place in a reactor, and the reaction mixture is fed into the measuring cell at fixed time intervals via an external pump (e.g., a peristaltic pump).

- automatic printout of statistical evaluations of the measured results ("Auto Statistics").
- automatic detection of the most frequent sources of errors (air bubbles, rinsing solvent residue in the measuring cells, inhomogeneous samples, etc.) when performing density determinations ("Repeat Meas.").

– Press **Func.**
– Select and confirm "7. Multiple Meas."
– Select and confirm the required function.

```
          < Multiple Meas. >

          0. Auto Start
          1. Auto Statistics
          2. Repeat Meas.
```

11.8.1 Starting measurements automatically (Auto Start)

This function is not available if an SC30 sample changer is connected.

– To perform repeated measurements of the same sample at fixed time intervals, set "Auto Start" to "On".

```
            < Auto Start >

          Auto Start :Off On
          Exit :[Execute]
```

"Auto Start" and "Repeat Meas." can be combined when working with an automatic sampling unit PSU-DE or SC1.

– To perform repeated measurements of the same sample at fixed time intervals, set "Auto Start" to "On".

```
< Auto Start >

Auto Start      :Off On
Interval Time   :[ 10]min
No. of Cycles   :[ 0]
Exit            :[Execute]
```

- "Interval Time" is the time interval between two measurements (0 to 9999 minutes). Enter "0" if you want the measurements to follow each other immediately (i.e., there is no waiting time between two measurements).
- "No. of Cycles" is the number of measurements (0 to 99) that have to be executed. Enter "0" if you wish to perform as many measurements as you like (in this case, you have to press **Reset** to stop the measurements).

11.8.2 Automatic statistical evaluations (Auto Statistics)

– To print out statistical data (that is, absolute and relative standard deviation) automatically after the measurements, set and confirm "On" for "Auto Statistics".

```
< Auto Statistics >                    ▼

Auto Statistics       :Off  On
Print Mode            :Always Group
High Sample No.Reset  :Off On
Method No. Reset      :Off On
Sample ID Reset       :Off On
```

The statistical data is only printed out and not displayed.

- Print Mode": The setting "Always" prints out statistical data after each measurement except after the first measurement in a group of samples. The "Group" setting prints out the statistical data only after the last measurement in a group of samples has been completed.

The following three options help in grouping the results for automatic statistical evaluation. The statistics are automatically reset at the beginning of a new group of samples. If "Print Mode" is set to "Group", then the statics are only printed after the last result of a group.

- "High Sample No. Reset": A group consists of consecutive results with the same "High Sample Number". If the "High Sample Number" changes, a new group begins.
- "Method No. Reset": A group consists of consecutive samples measured with the same method. If another method is activated, a new group begins.
- "Sample ID Reset": A group consists of consecutive samples with the same sample identification. If a sample with another sample identification is measured, a new group begins.
- Switch the desired options "On" or "Off". The three options can be combined. For example, if you have switched on the options "High Sample No. Reset" and "Method No. Reset", a new group begins when the "High Sample Number" or the current method changes.

For example:
If the sample series described in section 7.2 is measured with the settings of "High Sample No. Reset"="Off", "Method No. Reset"="Off" and "Sample ID Reset"="On", the statistics will be calculated for two groups. One group with the sample identification of "GRAPE" and one group with the sample identification "ORANGE".

– Confirm "Manual Reset:[Execute]" in order to reset the statistical data manually.
– Confirm "Exit:[Execute]" to leave the "Auto Statistics" function.

```
< Auto Statistics >                    ▼

Manual Reset          :[Execute]
Exit                  :[Execute]
```

The data for Auto Statistics are not only reset if one of the selected conditions is fulfilled or when the data are reset manually. They are also reset if:

- the DE density meter is switched off.
- data are deleted from the memory (measured data, sample file or all parameters refer to section 13.1.3).

– the number of results in a group exceeds 100. In this case, the statistics are printed out and then reset.

11.8.3 Automatic error detection (Repeat Meas.)

Applying the "Repeat Meas." function, the DE density meter is in a position to automatically detect the most frequent errors which may occur during the measurement of density and, consequently, to warn the user accordingly on the printout. The "Repeat Meas." function of the DE density meter automatically detects the following sources of errors:

- air bubbles that have found their way into the measuring cell or formed during the measurement (degassing of the sample when being heated).
- rinsing solvent residue in the tubes or the measuring cell.
- solid particles in the sample (e.g., dust).
- inhomogeneity of the sample.

The "Repeat Meas." function also allows you to perform multiple measurements with the same sample.

Advantages:

- less sample needed for multiple measurements.
- mean and standard deviation of the results are printed out automatically.
- execution of multiple measurements is less time consuming.
- repeatability of the results is improved.

Make sure that "Sampling" is set to "Auto" in all methods you use for the measurements (refer to section 11.8.1) otherwise the "Repeat Meas." function will not work!

The "Repeat Meas." function works as follows:

The sample is moved into the measuring cells, the measurement is performed and the results are saved. Afterwards the sampling pump is activated again for a short time ("**Movement Ratio**") in order to move the sample forward and another measurement is performed and the results are saved. The last step is repeated several times. You can define the number of "**Repetitions**". At the end, the DE density meter calculates the standard deviation for the results of the measured densities and compares it to the limits you defined for the standard deviation of the measurement parameter ("**SD Limit**"). At the end of the measurement the mean and the standard deviation for the measured values are printed out. If the standard deviation of the measured values is above the set limit, "Out" appears on the display and the error message "--- Out of limit ---" is printed out.

For example:
If an air bubble is in the density measuring cell during the first measurement, it moves forward in the measuring cell (or leaves it) during the following cycles. The results of the individual measurements are, in this case, different (and consequently the standard deviation is high), "Out" appears on the display and the error message "--- Out of limit ---" is printed out.

The results obtained with the "Repeat Meas." function switched on are treated like normal single measurements by the DE density meter, i.e., only the mean value of the measured density/concentration is printed out, stored and used for further result calculations. It is not possible to access the single values.

– To activate the automatic error detection, select and confirm "On" for "Repeat Meas."

```
          < Repeat Meas. >
Repeat Meas.       :   Off On
Repetitions         :[3]
Movement Ratio     :[ 25]%
SD Limit           :[ 0.0005]g/cm³
Exit               :[Excecute]
```

- "Repetitions" is the number of measuring cycles (movements and measurements of the sample) performed during a measurement (2 to 9). Recommended setting: 3.
- "Movement Ratio" defines how long the pump is activated between measuring cycles in order to move the sample forwards. The time is in relation to the time the sample needed prior to the measurement to get from the sample vial into the measuring cell. This ensures that all samples, regardless of their viscosity, are moved approximately the same distance between cycles.

Recommended setting for "Movement Ratio": 25%.

For example:

If a sample takes 10 seconds to get from the sample vial into the density measuring cell (please note, that "Sampling" must be set to "Auto" in the measuring parameters!) and the "Movement Ratio" is set to 25%, the pump is activated for 2.5 seconds to move the sample forward between measuring cycles.

- "SD Limit" is the limit for the standard deviation of the individual results. The values must be selected in agreement with the homogeneity of the measured samples (lower for homogeneous samples, higher for inhomogeneous samples). The value selected for "SD Limit" should under no circumstances be lower than twice the repeatability of the results according to the technical specifications of the DE density meter's measuring cells:

DE40	: 0.0002 g/cm^3
DE45 DeltaRange	: 0.00002 g/cm^3
DE51	: 0.00002 g/cm^3

Measurements take a little longer if performed with the "Repeat Meas." function switched on. In order to get reliable results, we nevertheless recommend that you perform all measurements with the "Repeat Meas." function switched on. To shorten the measuring time, it is better to set the stability criteria for the measured values of the density measurement to 1 or 2 ("Stability", refer to section 9.3), instead of running the measurements without the "Repeat Meas." function!

11.9 Memory card function (Function 8: Card Utility)

This function is used for memory cards.

– Press **Func.**

– Select and confirm the function "8. CARD Utility".

For more information about the handling of memory cards, refer to section 13.

```
          < CARD Utility >

0.File Delete     5.CARD Information
1.Format
2.Install Table
3.Uninstall Table
4.Table Capacity
```

11.10 Clearing the memory (Function 9: Memory Clear)

This function allows you to delete all data (measuring methods, instrument test results and adjustment data) from the DE density meter's main memory.

– Press **Func.**

– Select and confirm the function "9. Memory Clear".

– Select and confirm the required option: results ("Measured Data"), "Sample File", periodic instrument test results ("Periodic Check"), adjustment results ("Periodic Calib."), measuring methods ("Method Parameter"), calculation formulas ("User Formula") or all the data ("All Parameter").

```
          < Memory Clear >

 0.Measured Data  4.Method Parameter
 1.Sample File    5.All Parameter
 2.Periodic Check
 3.Periodic Calib.
```

– To confirm your choice again select "Yes". The data you confirmed are erased (i.e., returned to the factory settings).

The function "5. All Parameter" does not delete any concentration tables for special applications (from memory cards for special applications) stored in the instrument.

```
       < Measured Data Clear >


   Clear Execute ? No  Yes
```

12. Setup (password protected)

– Press **Setup**. Once the password protection is activated (refer to section 12.7), you will be prompted to enter the password.
– Select and confirm the required option. In the following the related options are described in details.

```
< Setup >

0.Interface        5.International
1.Date & Time      6.Lock
2.Op.Names/Units   7.Temperature
3.Serial/Version
4.LCD Contrast
```

12.1 Interfaces (Setup 0: Interface)

This menu is used to configure the serial interfaces for the printer, computer and barcode reader.

– Select and confirm "0. Interface"
– Select and confirm the desired serial interface ("0. RS-232C" for the Computer, "1. Printer" for the printer or "2.Barcode(AUX)" for the barcode reader)

```
< Interface >

0.RS-232C
1.Printer
2.Barcode(AUX)
```

12.1.1 Setting up the RS-232C interface for the computer (RS-232C)

This option allows you to configure the serial interface to connect a computer. With METTLER TOLEDO's LabX® direct density & refractometry software you can save your measurement results, instrument tests and adjustment data either directly as Microsoft EXCEL® table or as an ASCII text file.

The computer's interface parameters must match those on the DE density meter.

– In the "Interface" menu, select and confirm "0. RS-232C"
– Select and confirm the settings for the serial interface.

```
< RS-232C >                    ▼
Baud Rate      :<4800>
Parity         :Even  Odd  None
Stop Bits      :1  2
Data Bits      :7  8
Out Form.      :<=V3.0     V4.0
Exit           :[Excecute]
```

12.1.2 Setting up the interface for the printer (Printer)

We recommend you use the METTLER TOLEDO RS-P42 printer with the DE density meter.

Make sure that the DIP switch 1 of the printer is "On" and the DIP switch 2 is "Off". The DIP switch is under the cover below the paper feed (refer to Operating Instructions of the RS-P42).

– In the "Interface" menu, select and confirm "1. Printer".

– Select and confirm "GA-" for "Printer" if you are using a RS-P42 printer, or "Other" if you are using some other serial printer ("IDP-" and "DP-" printers are not used).

```
< Printer >

Printer        :IDP- DP- GA- Other
Exit           :[Excecute]
```

The setting "GA" uses the following parameters: baudrate 1200, 1 stop bit, 8 data bit, no parity, hardware handshake.

– If you want to select "Other", then you must select the communication parameters according to the settings on your printer:

```
< Printer >

Printer        :IDP- DP- GA- Other
Baud Rate      :<1200>
Parity         :Even  Odd  None
Stop Bits      :1  2
Data Bits      :7  8
```

12.1.3 Setting up the interface for the barcode reader (Barcode(AUX))

We recommend to use the METTLER TOLEDO Heron-G D130 barcode reader together with the DE density meter. The settings shown here are valid for this barcode reader. If you want to use some other manufacturer's barcode reader you must make sure that the "Delimiter" and the communication parameters of your barcode reader are set correctly (i.e., as on the DE density meter).

Our service department does not support barcode readers of other manufacturers.

– In the "Interface" menu select and confirm "2. Barcode(AUX)".

– Select "On" for "Barcode(AUX)", "9600" for "Baud Rate", "None" for "Parity", "1" for "Stop Bits" and "8" for "Data Bits".

```
          < Barcode(AUX)>                ▼

Barcode(AUX)    :Off  On
Baud Rate       :<9600>
Parity          :Even  Odd  None
Stop Bits       :1  2
Data Bits       :7  8
```

– Enter and confirm 1 for "Start Pos." and 0 for "Read Length".

– Select and confirm "CR+LF" for "Delimiter".

– Press **Reset**.

```
          < Barcode(AUX)>                ▲

Start Pos.      :[1]
Read Length     :[ 0]
Delimiter       :<CR+LF>
Exit            :[Execute]
```

"**Start Pos**" specifies from which position barcodes containing a sample identification have to be read. If the barcodes need to be read from the beginning (i.e., starting with the first character), you have to enter 1 for "Start Pos.".

"**Read Length**" defines how many characters of the barcodes containing sample identifications must be read. A sample identification can contain a maximum of ten characters. If 0 has been entered for "Read Length", the maximum possible number of characters will be scanned.

"**Delimiter**" refers to the ASCII characters the barcode reader sends at the end of each barcode transmission.

– Connect the Heron-G D130 barcode reader to the "AUX." port on the DE density meter.

– Scan in the two barcodes "Reset" and "Mode RS232" in succession in order to configure the barcode reader:

Reset

Mode RS232

Operator 1

– To test whether the barcode reader is working properly, scan the barcode "Operator 1".

  If "Operator :" does not appear for a short time in the status line, check whether the barcode reader is connected properly and that the settings made in the "Barcode(AUX)" menu are correct.

```
1.Method-1      :)-<OK>-(:      01-01
Temp. (°C) nD (None)
Set 20.00
Cell 20.00

                Ready
```

Additionally, barcodes to configure your METTLER TOLEDO barcode reader can be found in the appendix (refer to section A.2).

12.2 Date and Time (Setup 1: Date & Time)

This menu is used to set the date and time of day.

– Press **Setup**.
– Enter and confirm the date ("Day", "Month", "Year") and the time ("Hour", "Minutes").

The format for the date can be specified in the setup menu under "5. International" (refer to section 12.6).

```
< Date & Time >

09/08/2007   17:02

Day    :[ 9]    Hour     :[17]
Month  :[ 8]    Minutes  :[ 2]
Year   :[2007]   Exit     :[Execute]
```

12.3 Definition of operator names and concentration units (Setup 2: Op.Names/Units)

You can define additional concentration units and operator names.

– Press **Setup**.
– Select and confirm "2. Op.Names/Units".
– You can select and confirm "0. Concentration Units" or "1. Operator Names".

```
< Op.Names/Units >

0. Concentration Units
1.Operator Names
```

12.3.1 Concentration Units

You can enter up to five names for concentration units with up to five characters each. These names can be assigned to the calculated results ("Result1" and "Result2", refer to section 11.2).

– Select and confirm "0. Concentration Units".
– Enter and confirm names for the concentration units.

```
< Concentration Units >        A
Unit 1 : [ ]
Unit 2 : [ ]
Unit 3 : [ ]
Unit 4 : [ ]
Unit 5 : [ ]
Exit          :[Excecute]
```

Special characters can be entered by repeated pressing of the <·> (dot) and <-> (hyphen) keys. The special characters which appear are dependent on the input mode you have chosen for the keypad. The input mode can be changed by pressing **Display**. You can toggle between capital letters (an "A" appears on the upper right of the display), small letters (an "a" appears on the upper right of the display) or numerals (a "1" appears on the upper right of the display).

Key	**Display mode**	**Character** (press once, twice or three times, respectively)
<.>	A	% ( )
(dot)	a	% ( )
	1	. . .
<->	A	+ / *
(hyphen)	a	+ / *
	1	- - -

Additional special characters can be entered with the barcode reader (refer to section A.2).

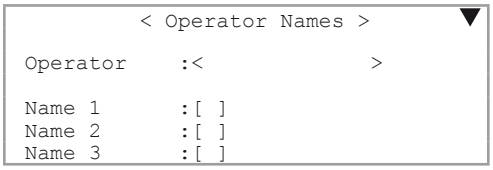
12.3.2 Operator Names

You can save up to 10 operator names in the DE density meter. These names can contain up to 25 characters.

– Select and confirm "1. Operator Names".

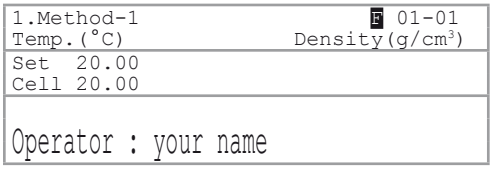
Prior to a measurement, you have two possibilities to select the current operator from the list of names you entered:

– **With the keypad:** Move the cursor to the "Operator" field. Select and confirm your name. (You can press **Display** to enter capital and small letters, or numerals).
– Leave the menu with **Escape**.



It is not possible to select a name with the keypad if the password protection is activated (refer to section 12.7).

– **With the barcode reader:** Press **Escape** key to leave the "Operator Names" menu. In the appendix (section A.2.3) you can find a list with ten barcodes. A name ("Name 1" to "Name 10") is assigned to each barcode.



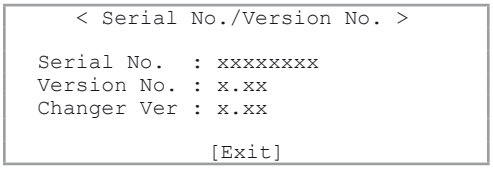
When you scan in one of these barcodes, the related operator is selected from the list available in the instrument. The name appears in the status line of the main display for a short time.

12.4 Serial/Version number (Setup 3: Serial/Version)

In this menu you can display the software version and the serial number of the DE density meter, as well as the SC1 or SC30 automation unit's software version ("Changer Ver").

– In the "Setup" menu select and confirm "3. Serial/Version"

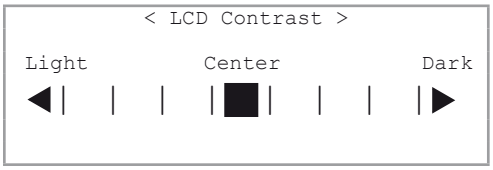
The "Changer Ver" line appears only if an automation unit is connected to the DE density meter.



12.5 LCD contrast (Setup 4: LCD Contrast)

In this menu you can set the contrast for the DE density meter's display.

– In the "Setup" menu select and confirm "4. LCD Contrast".
– Adjust the contrast with the ◀ and ▶ keys and confirm with **Enter**.



12.6 International (Setup 5: International)

You can select the format for the date and the temperature unit. Also you can enter the atmospheric pressure of the DE density meter's location.

– In the "Setup" menu select and confirm "5. International".
– Select and confirm the format for the "Date" (YYYY = year / MM = month / DD = day).
– Select and confirm the temperature unit ("Temp. Unit", °C = degrees Celsius / °F = degrees Fahrenheit)
– Enter and confirm the atmospheric pressure of your location

```
          < International >

Date          :<DD/MM/YYYY>
Temp.Unit     :°C  °F
Air Pressure:[ 1013.25]hPa
Exit          :[Execute]
```

The density of air is depending on the atmospheric pressure. Therefore, you must enter the correct atmospheric pressure in order to guarantee that the DE density meter will be adjusted correctly (if you adjust with air and water). The standard atmospheric pressure for different elevations can be found in the following table:

Elevation above sea level		Atmospheric pressure	Elevation above sea level		Atmospheric pressure
[m]	[feet]	[hPa]	[m]	[feet]	[hPa]
0	0	1013	1300	4265	867
100	328	1001	1400	4593	856
200	656	990	1500	4921	846
300	984	978	1600	5249	835
400	1312	966	1700	5577	825
500	1640	955	1800	5906	815
600	1969	943	1900	6234	805
700	2297	932	2000	6562	795
800	2625	921	2100	6890	785
900	2953	910	2200	7218	776
1000	3281	899	2300	7546	766
1100	3609	888	2400	7874	756
1200	3937	877	2500	8202	747

For other elevations (H, in meters) you can calculate the standard atmospheric pressure according to the following formula:

$p\ [hPa] = -1.3 \cdot 10^{-10} \cdot H^3 + 5.76524 \cdot 10^{-6} \cdot H^2 - 0.120119 \cdot H + 1013.2479$

The calculated values or the values in the table are standard values for atmospheric pressure at various elevations. The actual atmospheric pressure at your location can be obtained using a barometer and then entered in the DE density meter.

12.7 Password lock (Setup 6: Lock)

You can protect your measuring methods and settings on the DE density meter from unauthorized or unintentional changes with a password (secret code with up to 8 characters).

If access to the measuring methods and settings are protected with a password, the operator is prompted to enter the password if the following keys are pressed: **Func.**, **Setup**, **Report**, **Meas.Para** or the **Calc. Para** key.

- In the Setup menu select and confirm "6. Lock".
- Select and confirm "On" to activate the "Password Lock".
- Enter and confirm a password.
- Enter and confirm the same password a second time ("Confirm Password") to exclude typing errors.
- Confirm "Lock:[Execute]" to activate password protection.

```
< Password Lock >

Password Lock     :Off On
Password          :[********]
Confirm Password  :[********]
Lock Execute      :[Execute]
```

Keep your password in a safe place in case you forget it. If you cannot remember your password, you must contact METTLER TOLEDO's technical service!

12.8 Beep (Setup 7: Beep)

If the beep is activated, the DE density meter confirms each keystroke with a sound. When a measurement has been completed or an error occurred, the DE density meter will beep several times. In this menu, you can select the type of beep or turn the beep off. You can hear the selected beep at the end of the measurement or for an error.

- In the Setup menu select and confirm "7. Beep".
- Select and confirm "On" for "Beep".
- Select the desired type of beep. When you confirm with **Enter** you hear the selected beep ("Type1", "Type2", "Type3" or "Type4").
- Confirm "Exit:[Execute]" to leave the menu.

```
< Beep >
Beep      :Off On
Beep Type :<Type1>
Exit      :[Execute]
```

12.9 Temperature adjustment (Setup 8: Temperature)

The density cell is equipped with three built-in thermistors. One is in the measuring cell, another in the thermo conductive block and one is in the housing of the instrument. These three sensors are used to control the built-in Peltier thermostat in the measuring cell. If the temperature of the measuring cell permanently deviates from the temperature as set in the current method, a temperature adjustment should be performed. The temperature adjustment realigns the thermistor in the thermo conductive block with the certified thermistor in the measuring cell.

- In the Setup menu select and confirm "8. Temperature".
- Select and confirm the required type of temperature adjustment.

```
< Temperature >

0. Calibration
1. Adjust
```

There are two different ways to do temperature calibration:

1. "Calibration" is performed over the whole temperature range (in steps of 5°C). This type of temperature calibration is used if you observe a difference between the Set Temperature (selected in the method "Measurement Temp.") and the Cell Temperature (shown in the main display) of more than 0.05°C (in equilibrium). This temperature adjustment lasts several hours.

2. "Adjust" performs a one-point adjustment at the temperature of the currently selected method (correcting the offset between the block and the cell temperature). Perform this type of temperature calibration if the difference between the Temperature (selected in the method "Measurement Temp.") and the Cell Temperature (shown in the main display) is less than 0.05°C (in equilibrium).

– If you want to use the "Calibration" function, select and confirm "Yes" for "Execute".

This full range procedure takes several hours.

```
< Temperature Calibration>

     Execute    :<Yes>
     Exit       :[Execute]
```

– If you want to use the "Adjust" function, select and confirm "Yes" for "Execute".

This adjustment involves only the storage of the new offset and is performed immediately.

```
< Temperature Adjust>

Set Temp.     :[   20.00°C]
Block         :[   20.00°C]
Cell          :[   20.00°C]
Execute       :<Yes>
Exit          :[Execute]
```

13. Memory cards

This section describes the use of memory cards. There are two types of memory cards that can be applied to the DE density meter:

- **Cards to store data (SRAM cards).** These cards are used to store results of measurements, adjustments, instrument tests as well as measuring methods and sample files (order no. ME 51324004).
- **Memory cards to load special applications (flash cards).** These cards contain concentration tables for special applications (for detailed information contact your local METTLER TOLEDO representative).

13.1 Data memory cards

13.1.1 Display of available and used storage space

Data memory cards come equipped with a lithium battery and have a storage capacity of 1 MB. This storage capacity allows you to store

- 982 methods
- 498 files with sample data
- 10 files with up to 100 measurement results per file
- 675 files with up to 10 adjustment results per file
- 1012 files with up to 10 periodic instrument test results per file
- 1057 files with up to 5 calculation formulas per file

If a combination of methods, sample files and results from adjustments, instrument tests and measurements are to be stored on one card, then the available space decreases. To determine available space on a memory card, proceed as follows:

- Press **Func.**
- Select and confirm "8. CARD Utility".
- Insert the memory card into the slot on the front left side of the DE density meter.
- Select and confirm "5. Card Information"

```
          < CARD Utility >

0.File Delete      5.CARD Information
1.Format
2.Install Table
3.Uninstall Table
4.Table Capacity
```

The number of "Used" and available ("Unused") spaces for files containing measuring methods ("Method File"), sample files ("Sample File"), measurement results ("Meas.Data File") and formulas ("Formula File") is displayed.

- Confirm "Exit" to return to the "CARD Utility" menu.

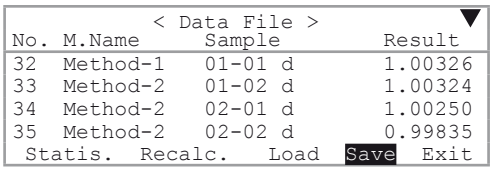
```
        < Card Information >
  Type              Used      Unused
Method File     :  [  0]     [ 982]
Sample File     :  [ 0]      [ 498]
Meas.Data File  :  [ 0]      [ 10]
Formula File    :  [ 0]      [1057]
                 [Exit]
```

13.1.2 Saving results

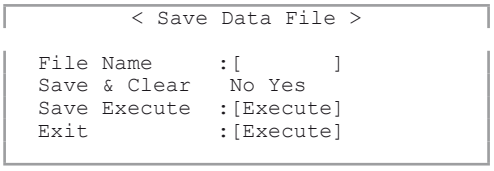
Measurement results can be saved to a memory card or loaded back into the DE density meter from a memory card. The DE density meter saves the results of up to 100 measurements in its main memory. You can save these data to a memory card in the form of a file.

- Press **Func.**
- Select and confirm "0. Data File".

– Insert the memory card into the slot on the front left side of the DE density meter.
– Select and confirm "Save".



– Enter the "File Name" you want to use for saving the results.



- The name can contain up to 8 characters. Special characters ("." or "-") are not allowed.
- If you wish to delete the results from the DE density meters memory after you have loaded them onto the memory card, select and confirm "Yes" for "Save & Clear".

– Confirm "Save Execute:[Execute]".

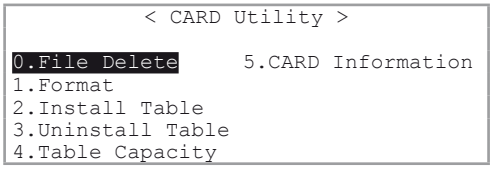
The results are then saved to the memory card and the message "Now Saving" appears on the display. When the process is finished, the message "File save is complete." appears on the display.
– Press **Enter** to return to the "Data File" menu.

13.1.3 Deleting results

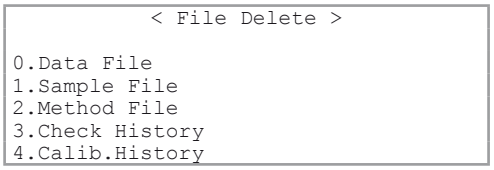
To delete results from the DE density meter's main memory, proceed as described in section 11.10.

To delete a file containing measurement results from a memory card, proceed as follows:

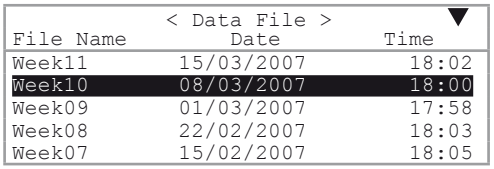
– Press **Func.**
– Select and confirm "8. CARD Utility".
– Insert the memory card into the slot on the front left side of the DE density meter.
– Select and confirm "0. File Delete"



– Select and confirm "0. Data File".

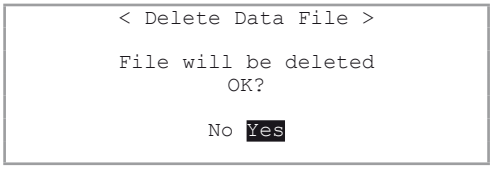


– Select and confirm the file you want to delete.



– Select and confirm"Yes".

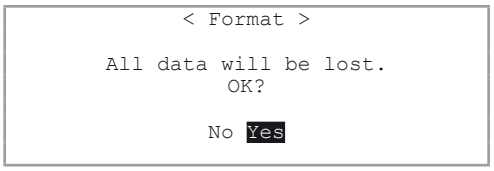
A message appears informing you that the file will be deleted. At the end of the delete process, the message "File delete is complete" is displayed. Confirm this message.



If you want to delete all information stored on a card (results, methods, etc.), select and confirm "1. Format" in the "CARD Utility" menu.

– Select and confirm"Yes".

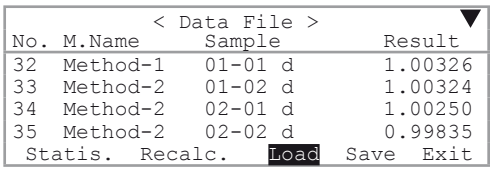
All information stored on the card will be deleted.



13.1.4 Loading results

If you wish to load a file containing results from a memory card into the DE density meter, proceed as follows:

– Press **Func.**
– Select and confirm "0. Data File".
– Insert the memory card into the slot on the front left side of the DE density meter.
– Select and confirm "Load".
– Select the file you want to load into the DE density meter.
– In the "Load Data File" menu select and confirm "Yes".



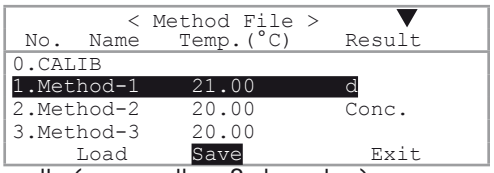
All results stored in the DE density meter will be overwritten by the results uploaded from the memory card.

The results are uploaded from the memory card. At the end of the loading process the message "File load is complete" appears. Confirm this message to return to the "Data File" menu.

13.1.5 Saving methods

You can save methods to a memory card. The DE density meter saves ten methods in its internal memory. These methods can be saved to a memory card and transferred to another DE density meter if required. This is very helpful if a method has been developed in a central lab and needs to be distributed to other labs after its release.

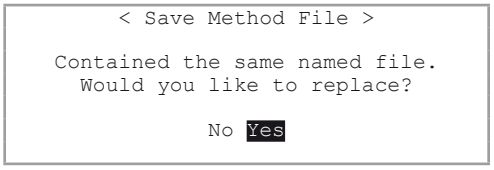
– Press **Func.**
– Select and confirm "2. Method File".
– Insert the memory card into the slot on the front left side of the DE density meter.
– Select and confirm "Save".



– Enter the "File Name" you want to use for saving the results (no more than 8 characters).
– Confirm "Save Execute:[Execute]".

If there already is a method with the same name on the memory card, you will be asked if you would like to replace the method on the memory card with the new one.

– Select and confirm "Yes" if you want to overwrite the method.
– If you do not want to replace the method on the memory card, confirm "No".



At the end of the saving process the message "File save is complete." appears on the display. Confirm this message to return to the "Method File" menu.

13.1.6 Deleting methods

To delete methods from the DE density meter's internal memory, proceed as described in section 11.10.

To delete a method from a memory card, proceed as follows (refer to section 13.1.6):

– Press **Func.**
– Select and confirm "8. CARD Utility".
– Insert the memory card into the slot on the front left side of the DE density meter.
– Select and confirm "0. File Delete".
– In the "File Delete" menu select and confirm "2. Method File". A list of methods saved in the memory card appear.
– Select and confirm the method you want to delete.

```
          < CARD Utility >

0.File Delete      5.CARD Information
1.Format
2.Install Table
3.Uninstall Table
4.Table Capacity
```

13.1.7 Loading methods

If you want to load a method from a memory card into the DE density meter, insert the memory card into the slot on the front left side of the instrument and proceed as follows:

– Press **Func.**
– Select and confirm "2. Method File".

First, you have to define which of the methods is to be overwritten. Select a method you do not need anymore.

– Select and confirm "Load".

```
          < Method File >                ▼
 No.  Name    Temp.(°C)     Result
0.CALIB
1.Method-1     21.00        d
2.Method-2     20.00        Conc.
3.Method-3     20.00
     Load      Save           Exit
```

– Select and confirm the method you want to load into the DE density meter

```
                < Load Method File >      ▼
File Name          Date          Time
GRAPE          15/03/2007        18:02
LEMON          08/03/2007        18:00
APPLE          01/03/2007        17:58
ORANGE         22/02/2007        18:03
MANGO          15/02/2007        18:05
```

– Select and confirm"Yes".

When the loading process is finished, the message "File load is complete" appears on the display. Confirm this message to return to the "Method File" menu.

```
        < Delete Data File >

        File will be deleted
                OK?

              No Yes
```

– Repeat the above steps if you wish to load several methods.
– When all desired methods have been loaded, select and confirm "Exit" in the "Method File" menu.

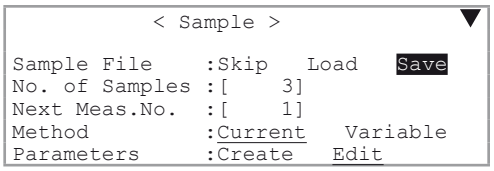
Be sure that no method in the instrument will be overwritten which is still needed!

13.1.8 Saving sample files

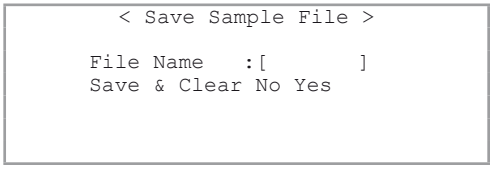
Sample files can also be saved to memory cards or loaded back into the DE density meter. If you have already entered a sample file and wish to save it, insert a memory card into the slot on the front left side of the instrument, and proceed as follows:

– Make sure that the sample file has been switched on (refer to section 11.2).
– Press **Sample**.

– Select and confirm "Save".



– Enter the file name for which you want to save your sample file. The name can contain up to 8 characters. Special characters ("." or "-") are not allowed.
– Confirm "Save Execute:[Execute]". The sample file is saved to the memory card and the message "Now Saving" appears on the display. When the process is finished, the message "File save is complete" appears.
– Press **Enter** to return to the "Sample" menu.



If you want to delete the sample file from the DE density meter memory after you have loaded it onto the memory card, select and confirm "Yes" for "Save & Clear".

13.1.9 Deleting sample files

To delete sample files from the DE density meter's internal memory, proceed as described in section 11.10.

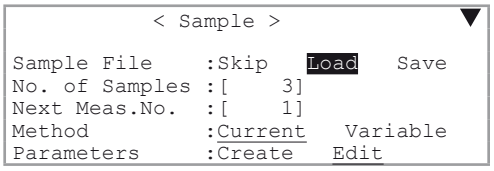
To delete a sample file from a memory card, proceed as follows (refer to section 13.1.3):

– Insert the memory card into the slot on the front left side of the instrument.
– Press **Func.**
– Select and confirm "8. CARD Utility"
– In the "CARD Utility" menu select and confirm "0. File Delete".
– In the menu "File Delete" select and confirm "1.Sample File". A list of sample files stored on the memory card appears. Select and confirm the sample file you want to delete.

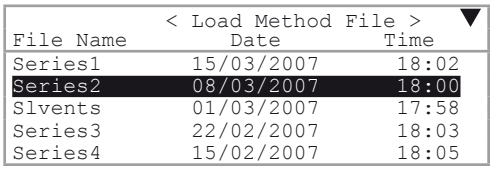
13.1.10 Loading sample files

If you want to load a sample file from a memory card into the DE density meter, insert the memory card into the slot on the front left side of the instrument and proceed as follows:

– Make sure that the sample file has been switched on (refer to section 11.2).
– Press **Sample**.
– Select and confirm "Load".

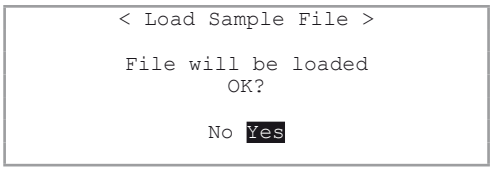


– Select and confirm the the sample file you want to load into the DE density meter



– Select and confirm "Yes".

When the loading process is finished, the message "File load is complete." appears on the display. Confirm this message to return to the "Sample File" menu.



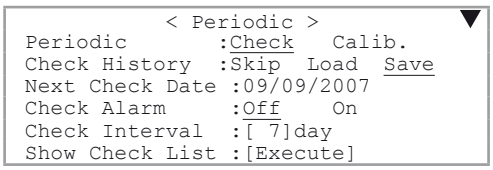
The sample file stored in the DE density meter will be overwritten during loading of a sample file from a memory card!

13.1.11 Saving instrument tests and adjustment data

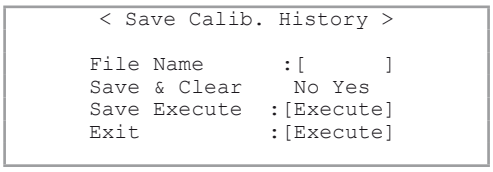
The results of the last ten adjustments and periodic instrument tests are automatically saved in the DE density meter. If an eleventh periodic instrument test or an eleventh adjustment is performed, the oldest saved data sets will be overwritten with the new ones. To prevent losing results of already performed periodic instrument tests or adjustments, they can be saved to a memory card. To do this, proceed as follows:

– Insert the memory card into the slot on the front left side of the instrument.
– Press **Func.**
– Select and confirm "6. Periodic".

– Select and confirm "Check" or "Calib." for "Periodic"., respectively. "Check" is used for test results, "Calib." for adjustment results.
– Select and confirm "Save" for "Check History".



– Enter the file name for which you want to save the periodic instrument tests or adjustments. The name can contain up to 8 characters. Special characters ("." or "-") are not allowed.
– Confirm "Save Execute:[Execute]". The data files are saved to the memory card and the message "Now Saving" appears on the display. When the process is finished, the message "File save is complete." appears.
– Press **Enter** to return to the "Periodic" menu.



If you want to delete the the data of the last periodic instrument tests or adjustments from the DE density meter memory after you have loaded it onto the memory card, select and confirm "Yes" for "Save & Clear".

13.1.12 Deleting instrument test and adjustment data

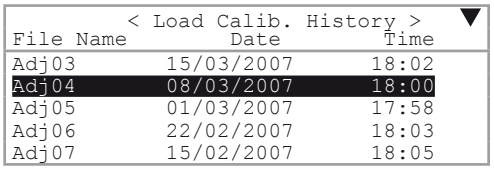
To delete a file of periodic instrument test and adjustment results from a memory card, proceed as follows:

– Insert the memory card into the slot on the front left side of the instrument.
– Press **Func.**
– Select and confirm "8. CARD Utility".
– In the "CARD Utility" menu select and confirm "0. File Delete" (refer to section 13.1.3)
– In the menu "File Delete", you can select "3. Check History" if you want to delete periodic instrument test data, or "4. Calib.History" if you want to delete adjustment results. A list of periodic instrument tests or adjustment files stored on the memory card appears.
– Select and confirm the file you want to delete.

13.1.13 Loading instrument tests and adjustment data

If you want to load periodic instrument tests and adjustment data from a memory card into the DE density meter, proceed as follows:

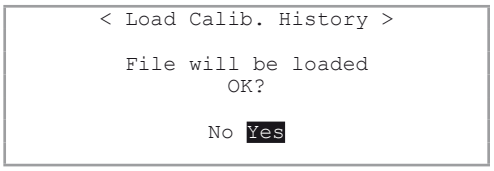
– Insert the memory card into the slot on the front left side of the instrument.
– Press **Func.**
– Select and confirm the type of file you want to load ("Check" for periodic instrument test results, "Calib." for adjustment results).
– In the "Periodic" menu (refer to section 11.7.1) select and confirm "Load" for "Check History".
– Select and confirm the periodic instrument test or adjustment file you want to load into the DE density meter.



– Select and confirm"Yes".

When the loading process is finished, the message "File load is complete." appears on the display.

– Confirm this message to return to the "Periodic" menu.



The current adjustment parameters stored in the DE density meter will be overwritten with the adjustment data coming from the memory card!.

13.2 Cards for special applications

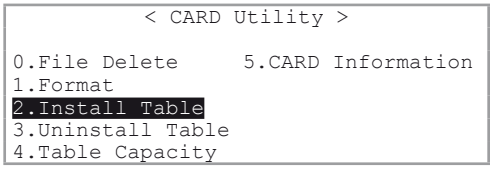
Your METTLER TOLEDO representative can supply you with concentration or temperature compensation tables on memory cards. These memory cards have a storage capacity of 2 MB. Loading them into the DE density meter deletes them from the memory card. Hence, the cards are empty after loading. The tables on the DE density meter, however, can be loaded back onto the card at any time and then loaded into another instrument. For this reason, you should keep the empty cards in a safe place.

13.2.1 Loading tables into the instrument (install table)

To load tables for special applications into your DE density meter, proceed as follows:

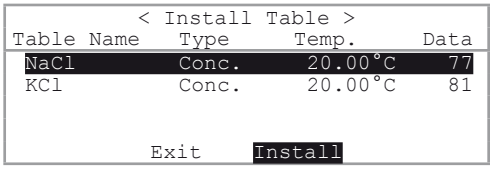
– Press **Func.**
– Select and confirm "8. CARD Utility".
– Insert the memory card into the slot on the front left side of the DE density meter.
– Select and confirm "2. Install Table".

The tables available on the card are displayed.

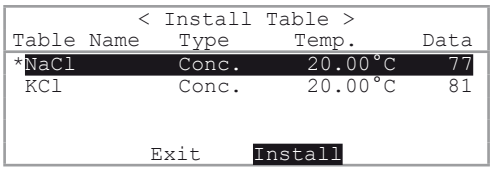


– Select the table you want to load.
– Select and confirm "Install".

Now, the table is installed. At the end of the procedure, the message "Table install is complete" appears on the display. Confirm this message with **Enter**.



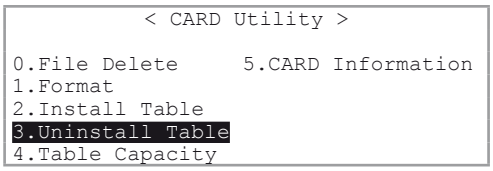
The asterisk (*) to the left of the table (NaCl) signals that it has been loaded into the DE density meter and removed from the memory card. The table can be loaded back onto the card at any time (refer to section 13.2.4).



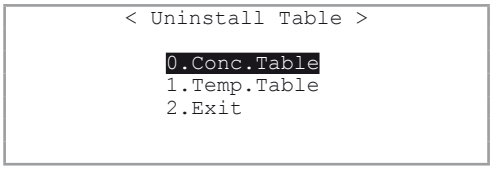
This concentration table is now accessible from **Calc.Para**. of each method, such as Brix or Alcohol. This is also valid for each temperature compensation table that was installed in the above described way, for example: "Oil table-1".

13.2.4 Loading tables back onto the memory card (uninstall table)

- Press **Func.**
- Select and confirm "8. CARD Utility".
- Insert the memory card into the slot on the front left side of the DE density meter.
- Select and confirm "3. Uninstall Table".

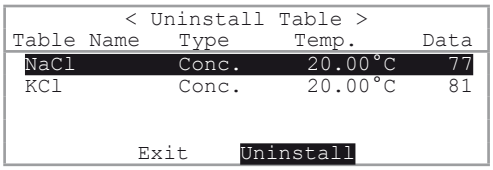


- Select and confirm "0. Conc.Table" if you are loading a concentration table or "1. Temp.Table" if you are loading a temperature compensation table back onto the memory card. A list of tables you can load back onto the memory card appears.



- Select the table you want to load back onto the memory card.
- Select and confirm "Uninstall".

The table is loaded back onto the card and the message "Now Uninstall..." appears in the display. Confirm the message "Table uninstall is complete." at the end of the procedure using **Enter**.



14. Purge unit (air pump, optional)

The air pump is a membrane pump which is used to dry the cell. If the DE density meter is equipped with an air pump only, the samples and the solvents used to rinse the cell have to be injected manually into the measuring cell by means of a syringe. The DE density meter should be equipped with an air pump for the following samples:

- highly viscous samples have to be measured
- the samples to be measured tend to degas
- normally only a very small amount of sample is available to do the measurements
- samples have to be measured which form dangerous mixtures among them or with the solvents used to rinse the cell

In all the other cases we recommend you equip the DE density meter with a peristaltic sampling pump PSU-DE (refer to section 15) or an automaton unit SC1 or SC30.

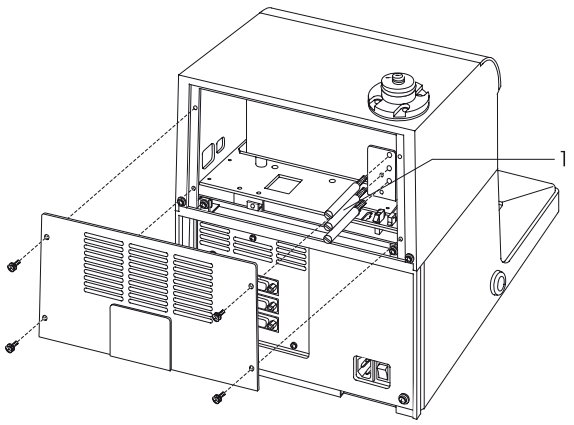
14.1 Safety measures

Measures for your safety

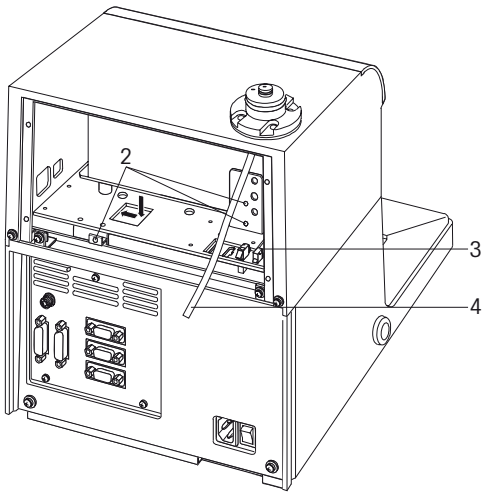
Make sure to switch off the Density meter and disconnect the power cable before installing the purge unit!

14.2 Installation

– Switch off the DE density meter and disconnect the power cable.
– Unscrew the four screws fastened to the rear panel and remove it.
– Remove the three large transportation security screws (1). These screws are used as transportation security to hold the measuring cell (mounted on shock absorbers) firmly against the chassis during transportation. Make sure to keep these screws for future need of re-shipping.



– Insert the purge unit, move it to the left and secure it with the three screws (2).
– Connect the pump connector (3) and the dry air tube (4).
– Mount the rear panel with the four screws.
– Mount the desiccator on top of the instrument.
– Connect the desiccator tube to the "Dry air outlet" of the instrument.



15. Automatic sampling pump PSU-DE

The PSU-DE Sampling Unit (**P**eristaltic **S**ampling **U**nit) can be installed in all METTLER TOLEDO DE40, DE45 DeltaRange and DE51 density meters. It is not necessary to update the instrument firmware for operation.
The PSU-DE is equipped with two pumps, a peristaltic pump and a membrane pump. It allows the semi-automatic measurement of individual samples which have viscosities up to 3000 mPa.s and do not tend to degas. The PSU-DE automates the following steps when performing density determinations (steps in square brackets must be done manually):

[Dipping the aspiration tube into the sample]

– Filling the measuring cell before the measurements:
  - The measuring cell is filled by means of a peristaltic pump (reduced speed).
  - The samples are aspirated (sucked) into the measuring cell through the aspiration tube. The filling rate can be set accurately using the potentiometer. Measurement errors caused by filling the measuring cell too rapidly can thus be avoided.
  - If automatic sampling is activated, the pump stops automatically when the measuring cell is full.
  - In general, there is no need to transfer samples to another vessel because the shape of the PSU-DE aspiration tube can be adapted to the type of sample vessel used. With the PSU-DE, samples can be taken directly from very different containers such as sample vials, beakers or bottles.
  - The position of the tip of the aspiration tube remains unchanged during the measurement. Automatic multiple sample measurements are therefore easily performed. The most frequent sources of error that occur in density determinations (e.g. air bubbles, inhomogeneous samples and solvent residues in the system) are automatically detected and the user is warned.

[Remove of the aspiration tube from the sample]

– Draining the measuring cell after the measurement:
  - The measuring cell is drained by means of a peristaltic pump (maximum speed).

[Dipping the aspiration tube into one or more rinsing liquids]

– Cleaning the measuring cell after measurements:
  - The measuring cell is cleaned by means of a peristaltic pump (maximum speed).

[Dipping the aspiration tube into an empty beaker]

– Drying the measuring cell after cleaning:
  - The measuring cell is dried by means of a membrane pump (blowing dry air through it).
  - If desired, the density meter automatically detects when the drying process is completed and switches off the membrane pump.

The PSU-DE reduces the amount of work involved in performing density measurements and allows the measuring cell to be thoroughly cleaned and dried. In addition, it helps to detect possible sources of error that occur when performing density measurements and rules out the possibility of incorrect results.

For the installation instructions and the specific operation guide please refer to the manual of the PSU-DE (ME-51710385).

16. Error messages and malfunctions

16.1 Error messages

Error message	Cause	Action
X Days to Check X Days to Calib.	An adjustment or an instrument test must be performed within the next few days.	
Check Day! Calib. Day! Check Day Over! Calib. Day Over!	The instrument must be tested or adjusted immediately.	Perform instrument test or adjustment (refer to section 11.7).
Nozzle Error!	The sampling nozzle of the SC1/SC30 automation unit is blocked.	Press **Stop** on the automation unit. Remove obstacle. Replace nozzle if it is bent.
Table Error!	The SC30's turntable is not in place or blocked.	Mount the SC30's turntable or remove obstacle.
Check connect Cable.	The SC1/SC30 automation unit is not connected properly.	Connect cable correctly or replace it.
Remove the interference	The SC1/SC30's sampling nozzle is blocked.	Remove the obstacle.
Changer Error!	The automation unit (SC1/SC30) cannot be activated.	Check the automation unit and the connecting cable. Check that the correct changer is selected in the function "3. Changer".
No Calibration(Visc.On)	A density measurement was attempted with viscosity correction without having adjusted the DE density meter with the viscosity correction turned on.	Adjust with viscosity correction turned on (refer to section 11.5)
Internal Cell Error!	The density measuring cell is defective.	Switch instrument off and call METTLER TOLEDO's technical service.
Temp.Calib. Error! Temp.Calib. Time Over!	A temperature sensor or a Peltier thermostat is defective.	Switch instrument off and call METTLER TOLEDO's technical service.
Contained the same named file	An attempt was made to save two files with the same name to a memory card.	Select another name.
No FLASH CARD!	An attempt was made to install new instrument software from an SRAM card.	Insert the correct (flash) card and repeat the procedure.
CARD is protected.	Write protection is activated (front of the SRAM card).	Deactivate write protection and repeat the procedure.
CARD Battery Error	The SRAM card's lithium battery is dead.	Replace lithium battery.

16.2 Malfunctions

Malfunction	Cause	Action
Instrument cannot be switched on	Cable not connected properly; blown fuse	Check supply cable and fuses. If necessary, replace fuses (T3.15A/250V)
Report, **Sample**, **Calc.Para** and **Measure** keys do not work.	Method "0.CALIB" is selected.	Press **Method** and select another method.
The "Ready" message does not appear.	Air intake on the back side of the DE density meter is clogged.	Remove obstacles from air intake. Call METTLER TOLEDO's technical service.
Saved data (e.g., adjustments) are being lost.	The DE density meter's internal battery is dead.	Switch off instrument and call METTLER TOLEDO's technical service.
The RS-P42 printer does not work.	The DIP switches on the printer are set incorrectly. The transfer parameters for the printer interface are set incorrectly.	Refer to chapter 12.1.2. Wrong cable used.
The display remains blank.	The contrast has been tampered with.	Adjust the display's contrast (refer to section 12.5)
The measurement results are not repeatable.	The samples are not homogenous, there are air bubbles in the measuring cell, vibrations, measuring cell is contaminated.	Check the mentioned causes (refer to section 11.8.3). Find vibration-free location for the DE density meter. Clean measuring cell carefully.
Density measurements take very long, the measured value is not stable.	Air bubbles in the density measuring cell. Sample tends to degas or contains highly volatile components. The sample is very viscous.	Check tube connections. Degas sample. Heat sample before measurement above density measuring cell's temperature.
Sampling takes very long.	Incorrect setting of the sampling speed on the automation unit. Sample is too viscous.	Increase sampling speed on the SC1/SC30 automation unit (refer to section 11.4).
Density measurements of degassed, distilled water takes very long.	Density measuring cell could be defective.	Switch off instrument and call METTLER TOLEDO's technical service.
Adjustment of the density measuring cell with air and water takes very long at increased temperature.	Air bubbles form in the measuring cell due to heating up of the water.	Boil the distilled water immediately before adjustment, or degas it at cell temperature in an ultrasonic bath. When the water is transferred into the measuring cell, the DE should cool it down.

17. Maintenance

17.1 Internal battery

The internal battery to buffer the DE density meter' s main memory has a life cycle of approx. 5 years if always kept charged. To prevent a loss of data, have the battery replaced every 4 - 5 years by METTLER TOLEDO's technical service.

17.2 Main power supply voltage, mains fuse

The DE density meter adjusts automatically to mains voltages within the range of 100 to 240 V (50/60 Hz frequency).

Replace blown fuses as follows:

Switch off the instrument. Remove all cable and tube connections. Place the instrument on its back. Remove the small metal plate on the bottom of the instrument (four screws). Replace the blown fuses and remount the small metal plate. Be sure to use the correct fuses: T3.15 A / 250 V.

17.3 Replacing the silica gel

The silica gel[1] in the desiccator has to be replaced when it has changed color from dark blue (dry) to pink (damp). If this is not done, complete drying of the measuring cells (and, thereby, a correct adjustment of the density measuring cell with air) is no longer possible!

[1]The one included in the standard delivery. Other products may have differing color changes!

17.4 Replacing the density cell's tube nozzles

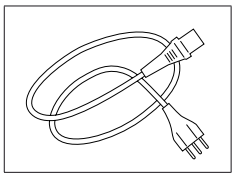
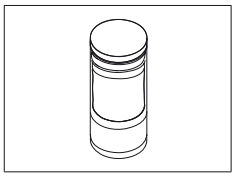
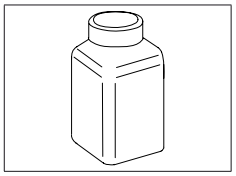
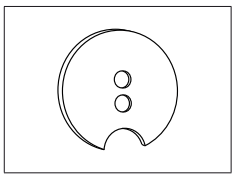
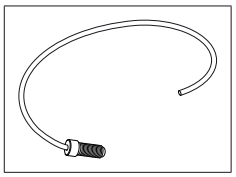
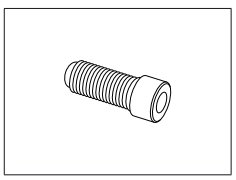
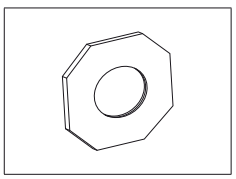
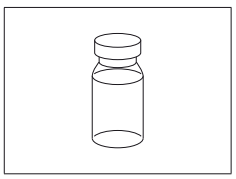
If you frequently find air bubbles in the density measuring cell which do not originate from the sample itself, the tube nozzles may be leaking and need to be replaced by METTLER TOLEDO`s technical servive.

17.5 Disposal

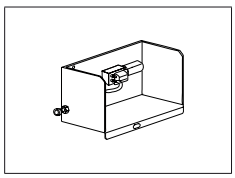
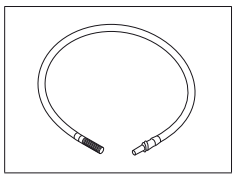
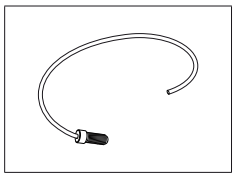
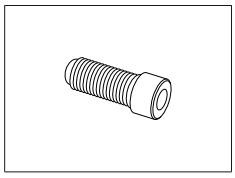
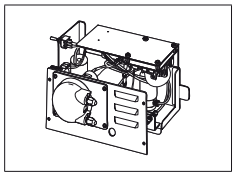
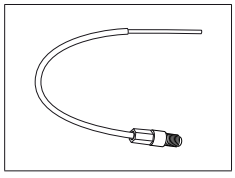
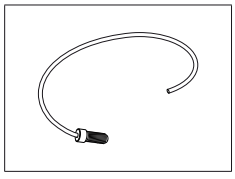
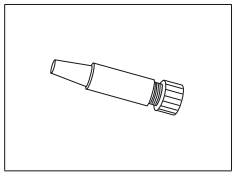
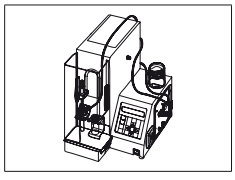
In conformance with the European Directive 2002/96/EC on Waste Electrical and Electronic Equipment (WEEE) this device may not be disposed of in domestic waste. This also applies to countries outside the EU, per their specific requirements.
Please dispose of this product in accordance with local regulations at the collecting point specified for electrical and electronic equipment.
If you have any questions, please contact the responsible authority or the distributor from which you purchased this device.
Should this device be passed on to other parties (for private or professional use), the content of this regulation must also be related.
Thank you for your contribution to environmental protection.

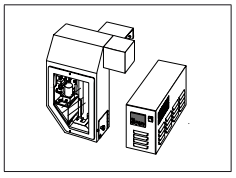
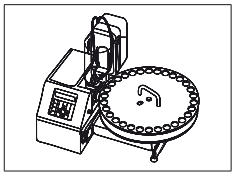
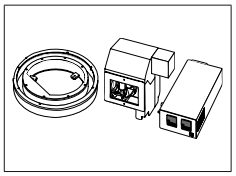
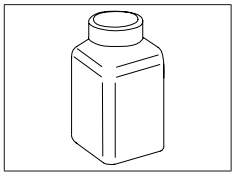
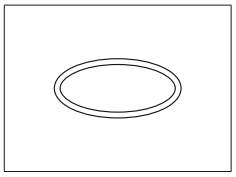
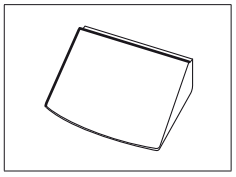
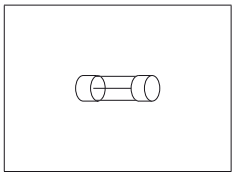
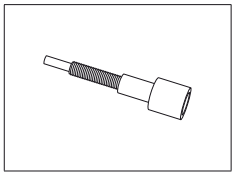
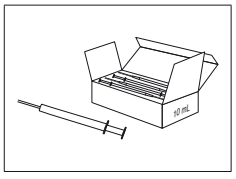
18. Accessories

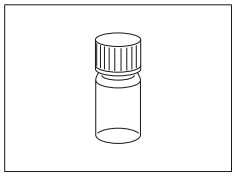
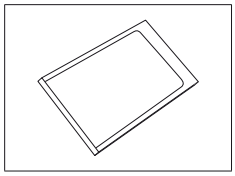
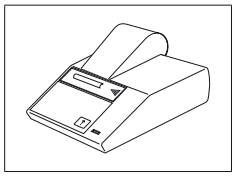
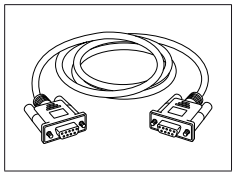
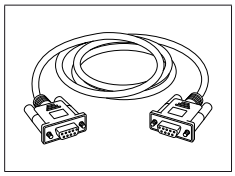
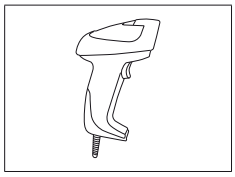
18.1 Standard Equipment

	Description	Order Number
	Power cable (country-specific)	
	Dessiccator tower	51322012
	Silica gel 0.5 kg (Color changes from dark blue to pink)	-
	Protective cover for cell inlet (3 pcs.)	51324636
	Sampling/drain tubes w. connector to cell, L = 30 cm (2 pcs.)	51324641
	Syringe adapters (PP) (2 pcs.)	51324635
	Counter nut for syringe adapter	51324637
	Certified density standards (d^{20} = 0.998… g/cm^3) (2 pcs.)	51338011
	- Hexagonal wrench	51340263
	- Certificate of compliance	51107684
	- Final inspection and Test Report	51107681
	- Material Safety Data Sheets of Silica gel	51107675

18.2 Optional Equipment

	Description	Order Number
	Purge pump (air pump, for manual sampling with a syringe)	51321502
	Desiccator tube for dry air (Tygon)	51322065
	Sampling/drain tubes, L = 30 cm	51324641
	Syringe adapter (PP)	51324635
	PSU-DE (for automatic sampling with peristaltic pump)	PSU-DE
	Aspiration tube, L = 29 cm	51321702
	Sampling/drain tube, L = 30 cm	51324641
	Joint for sampling/drain tube (connector to valve)	51328035
	SC1 Sample Delivery and Cleaning Unit	SC1

	Description	Order Number
	Heating Option for SC1	51326301
	SC30 Sample Changer (30 samples)	SC30
	Heating Option for SC30	51327300
	Silica gel 1 kg (color change from dark purple to light pink)	105080
	Set O-ring and seal for desiccator tower	51322041
	In use cover (3 pcs.)	51107667
	Fuse T 3.15A	51522100
	Cell connectors (tube adapter)	51324638
	Plastic syringes 10 mL (set of 100)	71482

	Description	Order Number
	Certified standards 9 mL vial, with certificate for density and refractive index	
	- Water (d^{20} = 0.998.. g/cm^3, n_D^{20} = 1.33…)	51338010
	- Dodecane (d^{20} = 0.749.. g/cm^3, n_D^{20} = 1.422…)	51338012
	- Dichlorotoluene (d^{20} = 1.250.. g/cm^3, n_D^{20} = 1.546…)	51338013
	- Bromonaphthalene (d^{20} = 1.481.. g/cm3, n_D^{20} = 1.658…)	51338014
	Memory Card for data, methods, sample file storage	51324004
	Alphanumeric printer (serial) including	RS-P42
	- Set of paper rolls (5 pcs)	72456
	- Ribbon cartridge (black)	65975
	Connection cable (not included in RS-P42!)	51190362
LabX	LabX® direct density & refractometry, for data storage only	51324103
LiQC	LiQC Standard, for data storage and system control, biometric user management (software and fingerprint reader)	51327317
	Connection cable (DExx to PC)	51190362
LiQC	LiQC Multi Device software incl. Device Controller, for multi parameter measurements and full barcode support (including all cables), fingerprint reader and biometric user management	51327315
	Heron-G D130 barcode reader (without cable)	21901297
	- Cable for Heron-G D130	21901340

19. Technical Data

Instrument			DE40	DE45 DeltaRange	DE51
Density					
Measuring range	d	[g/cm³]	0.0001 … 3	0.00001 … 3	0.00001 … 3
Limit of error	d	[g/cm³]	1×10^{-4}	2×10^{-5} (0-1 g/cm³) 5×10^{-5} (1-3 g/cm³)	2×10^{-5}
Repeatability	d	[g/cm³]	1×10^{-4}	1×10^{-5}	1×10^{-5}
Resolution	d		1×10^{-4}	1×10^{-5}	1×10^{-5}
Concentration					
Alcohol					
Measuring range		[v/v %]	0 … 100	0 … 100	0 … 100
Limit of error		[v/v %]	0.1	0.02	0.02
Repeatability		[v/v %]	0.1	0.01	0.01
Brix%					
Measuring range		[%Brix]	0 … 83*)	0 … 83*)	0 … 83*)
Limit of error			0.03	0.02	0.006
Repeatability			0.03	0.015	0.003
				* up to 100% by extrapolation	
Temperature					
Control			Peltier	Peltier	Peltier
Range	T	[°C]	4 … 90	4 … 90	4 … 70
Limit of error	T	[°C]	0.05 (10 … 30) 0.10 (4 … 90)	0.02 (15 … 20) 0.05 (4 … 90)	0.02 (10 … 30) 0.05 (4 … 70)
Viscosity correction			yes	yes	yes
Sample required			min. 1.2 mL (manual injection with syringe) min. 2 mL (automated operation with optional PSU-DE)		
Typical measuring time			1 to 4 minutes (manual operation) 2 to 10 minutes (full cycle in programmed automated operation)		

Power supply	Input voltage	100 – 240 VAC ±10%
	Input frequency	50 – 60 Hz
	Power consumption	200 W
Dimensions	Width	270 mm
	Depth	400 mm
	Height	410 mm
	Weight	15 kg
Material	Housing	Polyester
	Sample contacted by materials	Borosilicate glass, PTFE
Ambient conditions	Ambient temperature	+5 °C…+35 °C
	Relative humidity	Max. 85% (non-condensing) at 40 °C
	Use	In interior spaces
	Overvoltage category	II
	Pollution degree	2
External I/O	RS-232C	For computer
	RS-232C	For external printer
	RS-232C	For barcoder reader
	Special serial interface	For sample changer
	Memory Card	PCMCIA (PC Card)
Display	LCD	7 lines, backlit
Measuring method	U-tube	Oscillating

MemoCard (Short instructions)

Sample — **Sample file input**
(no. of samples, sample identification, methods, viscosity correction)

Report — **Selection of printout format**
off, short, GLP, variable

Meas. Para — **Set measurement parameters**
method name
measuring temperatures
stability
time limit for measurement
sequence (ON/OFF)
sampling
draining
Rinse-1, Rinse-2
purge
Cell test
Standards for adjustments

Calc. Para — **Calculation parameters**
result
density (d, d^t_1, d^t_4)
d, Brix, Conc., Alcohol,
concentration
(enter table or coefficient)
(calculation with formula)
temperature compensation
(enter table or coefficient, API)
decimals for results
(d, Brix, Conc., Alcohol,)

Method — **Method selection**
methods 0 to 9

Display — **Input mode for keyboard (for text fields)**
A: capital letters (A, B, C, ...)
a: small letters (a, b, c, ...)
1: numerals (0, 1, 2, ...)
Selecting display of results
density, results, oscillation
(dependent on setting in Setup 8)

Print — **Print instrument settings**

Measure — **Start measurement**
(including sample sequence, provided Sequence set to ON)

Func. — **Functions**
0. Data file (in the memory)
1. Sample file (ON/OFF)
2. Method file
3. Changer (setup)
4. Factor
factor adjustment (display)
activate viscosity correction for adjustment
5. Set Check (daily and periodic)
(name, value, tolerance)
6. Periodic tests and adjustments
(enter interval, save to memory card, show list of results)
7. Multiple measurements
(Autostart, Autostatistics, automatic error detection)
8. CARD Utility
9. Memory clear

Setup — **Setup**
0. Interfaces
(printer, barcode reader, RS-232)
1. Date & time
2. Enter user name, units, calculation formulas (Conc.2)
3. Display serial/version no.
4. LCD contrast
5. International
format for date and temperature (°C/°F)
6. Lock (password)
7. Beep
8. Temperature calibration

Check — **Run instrument test**
periodic test (if due)
daily test (on all other days)

Calib. — **Adjust instrument**

BS — **Backspace** (erase)

Rinse/ Purge — **Rinse/Purge** (according to sequence in 0 "CALIB.") (only active with SC1 / SC30)

Pump — **Pump** ON/OFF, for external pump (air pump, PSU- DE); not active with SC1 / SC30)

Clear — **Clear entry**
(twice to return to previous setting)

Esc. — **Escape** (result remains on main display)

Reset — **Back to main display** (result deleted)

Appendix 1: Density tables

A1.1 Density table for dry air

The density of dry air at a specified temperature T and a specific atmospheric pressure p is calculated according to the following formula:

$$d(g/cm^3) = \frac{0.0012932}{1+0.00367 \bullet T(°C)} \bullet \frac{p(mmHg)}{760}$$

The following table contains the density values for dry air at an air pressure of 760 mm Hg stored in the DR Combined Meter. Intermediate values are interpolated by means of a La Grange polynomial.

Temp. [°C]	Density [g/cm³]	Temp. [°C]	Density [g/cm³]	Temp. [°C]	Density [g/cm³]
0	0.00129	31	0.00116	62	0.00105
1	0.00129	32	0.00116	63	0.00105
2	0.00128	33	0.00115	64	0.00105
3	0.00128	34	0.00115	65	0.00104
4	0.00127	35	0.00115	66	0.00104
5	0.00127	36	0.00114	67	0.00104
6	0.00127	37	0.00114	68	0.00103
7	0.00126	38	0.00113	69	0.00103
8	0.00126	39	0.00113	70	0.00103
9	0.00125	40	0.00113	71	0.00103
10	0.00125	41	0.00112	72	0.00102
11	0.00124	42	0.00112	73	0.00102
12	0.00124	43	0.00112	74	0.00102
13	0.00123	44	0.00111	75	0.00101
14	0.00123	45	0.00111	76	0.00101
15	0.00123	46	0.00111	77	0.00101
16	0.00122	47	0.00110	78	0.00101
17	0.00122	48	0.00110	79	0.00100
18	0.00121	49	0.00110	80	0.00100
19	0.00121	50	0.00109	81	0.00100
20	0.00120	51	0.00109	82	0.00099
21	0.00120	52	0.00109	83	0.00099
22	0.00120	53	0.00108	84	0.00099
23	0.00119	54	0.00108	85	0.00099
24	0.00119	55	0.00108	86	0.00098
25	0.00118	56	0.00107	87	0.00098
26	0.00118	57	0.00107	88	0.00098
27	0.00118	58	0.00107	89	0.00097
28	0.00117	59	0.00106	90	0.00097
29	0.00117	60	0.00106		
30	0.00116	61	0.00106		

Chemical Handbook Fundamental Version, Rev. 3, Table 5.1 (1984).

(760 mmHg = 1013 hPa)

A1.2 Density table for pure water

The following table contains the density values for pure water at an air pressure of 760 mm Hg stored in the DE Density Meter:

Temp. [°C]	Density [g/cm³]	Temp. [°C]	Density [g/cm³]	Temp. [°C]	Density [g/cm³]
0	0.99984	20	0.99821	40	0.99222
1	0.99990	21	0.99799	41	0.99183
2	0.99994	22	0.99777	42	0.99144
3	0.99996	23	0.99754	43	0.99104
4	0.99997	24	0.99730	44	0.99063
5	0.99996	25	0.99705	45	0.99022
6	0.99994	26	0.99679	46	0.98980
7	0.99990	27	0.99652	47	0.98937
8	0.99985	28	0.99624	48	0.98894
9	0.99978	29	0.99595	49	0.98849
10	0.99970	30	0.99565	50	0.98805
11	0.99961	31	0.99534	55	0.98570
12	0.99950	32	0.99503	60	0.98321
13	0.99938	33	0.99471	65	0.98057
14	0.99925	34	0.99437	70	0.97779
15	0.99910	35	0.99404	75	0.97486
16	0.99894	36	0.99369	80	0.97183
17	0.99878	37	0.99333	85	0.96862
18	0.99860	38	0.99297	90	0.96532
19	0.99841	39	0.99260		

Chemical Handbook Fundamental Version, Rev. 3, Table 5.2 (1984).
(760 mmHg = 1013 hPa)

A1.3 Density tables of alcohol / water mixtures

The DE40, DE45 DeltaRange and DE51 Density Meters have two built-in tables for the determination of the alcohol content of aqueous solutions (vol/vol%). According to the selected unit for the temperature measurement (°C/°F) the instrument selects one of the two tables to calculate the ethanol content from the density:

– If °F is selected as temperature unit, then table n° 3 of the NBS Circular 19 is used. Please note the "Measurement Temp." in the methods used to perform the alcohol determinations has to be set to 60.00°F!

– If °C is selected as temperature unit, then OIML table IVa is used. Please note the "Measurement Temp." in the methods used to perform the alcohol determinations has to be set to 20.00°C!

Intermediate values are calculated in both cases by La Grange interpolation.

Table n° 3, NBS Circular 19

The table stored in the instrument contains only the S.G. values (not the densities).

Ethanol (% v/v)	S.G. (60°F/60°F)	Density (g/cm³)	Ethanol (% v/v)	S.G. (60°F/60°F)	Density (g/cm³)	Ethanol (% v/v)	S.G. (60°F/60°F)	Density (g/cm³)
0.0	1.00000	0.99901	34.0	0.96041	0.95946	68.0	0.89489	0.89401
1.0	0.99850	0.99752	35.0	0.95908	0.95813	69.0	0.89245	0.89157
2.0	0.99703	0.99605	36.0	0.95770	0.95676	70.0	0.88999	0.88911
3.0	0.99559	0.99461	37.0	0.95628	0.95534	71.0	0.88751	0.88663
4.0	0.99419	0.99321	38.0	0.95482	0.95388	72.0	0.88499	0.88412
5.0	0.99282	0.99184	39.0	0.95332	0.95238	73.0	0.88244	0.88157
6.0	0.99150	0.99052	40.0	0.95178	0.95084	74.0	0.87987	0.87900
7.0	0.99022	0.98924	41.0	0.95020	0.94926	75.0	0.87728	0.87642
8.0	0.98899	0.98801	42.0	0.94858	0.94764	76.0	0.87465	0.87379
9.0	0.98779	0.98682	43.0	0.94693	0.94600	77.0	0.87199	0.87113
10.0	0.98661	0.98564	44.0	0.94524	0.94431	78.0	0.86929	0.86843
11.0	0.98544	0.98447	45.0	0.94351	0.94258	79.0	0.86656	0.86571
12.0	0.98430	0.98333	46.0	0.94174	0.94081	80.0	0.86380	0.86295
13.0	0.98319	0.98222	47.0	0.93993	0.93900	81.0	0.86100	0.86015
14.0	0.98210	0.98113	48.0	0.93808	0.93716	82.0	0.85817	0.85732
15.0	0.98104	0.98007	49.0	0.93619	0.93527	83.0	0.85531	0.85447
16.0	0.97998	0.97901	50.0	0.93426	0.93334	84.0	0.85240	0.85156
17.0	0.97895	0.97798	51.0	0.93230	0.93138	85.0	0.84944	0.84860
18.0	0.97794	0.97698	52.0	0.93031	0.92939	86.0	0.84642	0.84559
19.0	0.97694	0.97598	53.0	0.92830	0.92738	87.0	0.84336	0.84253
20.0	0.97596	0.97500	54.0	0.92626	0.92535	88.0	0.84025	0.83942
21.0	0.97496	0.97400	55.0	0.92419	0.92328	89.0	0.83707	0.83624
22.0	0.97395	0.97299	56.0	0.92210	0.92119	90.0	0.83382	0.83300
23.0	0.97293	0.97197	57.0	0.91999	0.91908	91.0	0.83049	0.82967
24.0	0.97189	0.97093	58.0	0.91784	0.91694	92.0	0.82705	0.82623
25.0	0.97084	0.96988	59.0	0.91565	0.91475	93.0	0.82351	0.82270
26.0	0.96978	0.96882	60.0	0.91344	0.91254	94.0	0.81984	0.81903
27.0	0.96870	0.96774	61.0	0.91120	0.91030	95.0	0.81603	0.81523
28.0	0.96760	0.96665	62.0	0.90893	0.90803	96.0	0.81206	0.81126
29.0	0.96648	0.96553	63.0	0.90664	0.90575	97.0	0.80792	0.80712
30.0	0.96534	0.96439	64.0	0.90434	0.90345	98.0	0.80356	0.80277
31.0	0.96418	0.96323	65.0	0.90202	0.90113	99.0	0.79889	0.79810
32.0	0.96296	0.96201	66.0	0.89967	0.89878	100.0	0.79385	0.79307
33.0	0.96170	0.96075	67.0	0.89729	0.89641			

OIML table IVa

Ethanol (% $^{v}/_{v}$)	Density [g/cm³]	Ethanol (% $^{v}/_{v}$)	Density [g/cm³]	Ethanol (% $^{v}/_{v}$)	Density [g/cm³]
0.0	0.99820	5.1	0.99092	10.1	0.98459
0.1	0.99805	5.2	0.99079	10.2	0.98447
0.2	0.99790	5.3	0.99065	10.3	0.98435
0.3	0.99775	5.4	0.99052	10.4	0.98423
0.4	0.99759	5.5	0.99039	10.5	0.98411
0.5	0.99744	5.6	0.99026	10.6	0.98399
0.6	0.99729	5.7	0.99012	10.7	0.98388
0.7	0.99714	5.8	0.98999	10.8	0.98376
0.8	0.99699	5.9	0.98986	10.9	0.98364
0.9	0.99685	6.0	0.98973	11.0	0.98352
1.0	0.99670	6.1	0.98960	11.1	0.98340
1.1	0.99655	6.2	0.98947	11.2	0.98329
1.2	0.99640	6.3	0.98934	11.3	0.98317
1.3	0.99625	6.4	0.98921	11.4	0.98305
1.4	0.99611	6.5	0.98908	11.5	0.98294
1.5	0.99596	6.6	0.98895	11.6	0.98282
1.6	0.99581	6.7	0.98882	11.7	0.98270
1.7	0.99567	6.8	0.98869	11.8	0.98259
1.8	0.99552	6.9	0.98856	11.9	0.98247
1.9	0.99538	7.0	0.98843	12.0	0.98235
2.0	0.99523	7.1	0.98830	12.1	0.98224
2.1	0.99509	7.2	0.98818	12.2	0.98212
2.2	0.99494	7.3	0.98805	12.3	0.98201
2.3	0.99480	7.4	0.98792	12.4	0.98189
2.4	0.99466	7.5	0.98779	12.5	0.98178
2.5	0.99451	7.6	0.98767	12.6	0.98167
2.6	0.99437	7.7	0.98754	12.7	0.98155
2.7	0.99423	7.8	0.98742	12.8	0.98144
2.8	0.99409	7.9	0.98729	12.9	0.98132
2.9	0.99395	8.0	0.98716	13.0	0.98121
3.0	0.99381	8.1	0.98704	13.1	0.98110
3.1	0.99366	8.2	0.98691	13.2	0.98098
3.2	0.99352	8.3	0.98679	13.3	0.98087
3.3	0.99338	8.4	0.98666	13.4	0.98076
3.4	0.99324	8.5	0.98654	13.5	0.98064
3.5	0.99311	8.6	0.98642	13.6	0.98053
3.6	0.99297	8.7	0.98629	13.7	0.98042
3.7	0.99283	8.8	0.98617	13.8	0.98031
3.8	0.99269	8.9	0.98605	13.9	0.98019
3.9	0.99255	9.0	0.98592	14.0	0.98008
4.0	0.99241	9.1	0.98580	14.1	0.97997
4.1	0.99228	9.2	0.98568	14.2	0.97986
4.2	0.99214	9.3	0.98556	14.3	0.97975
4.3	0.99200	9.4	0.98544	14.4	0.97964
4.4	0.99187	9.5	0.98531	14.5	0.97952
4.5	0.99173	9.6	0.98519	14.6	0.97941
4.6	0.99159	9.7	0.98507	14.7	0.97930
4.7	0.99146	9.8	0.98495	14.8	0.97919
4.8	0.99132	9.9	0.98483	14.9	0.97908
4.9	0.99119	10.0	0.98471	15.0	0.97897
5.0	0.99106				

Ethanol (% $^{v}/_{v}$)	Density [g/cm³]	Ethanol (% $^{v}/_{v}$)	Density [g/cm³]	Ethanol (% $^{v}/_{v}$)	Density [g/cm³]
15.1	0.97886	20.1	0.97345	25.1	0.96799
15.2	0.97875	20.2	0.97334	25.2	0.96787
15.3	0.97864	20.3	0.97324	25.3	0.96776
15.4	0.97853	20.4	0.97313	25.4	0.96765
15.5	0.97842	20.5	0.97302	25.5	0.96753
15.6	0.97831	20.6	0.97291	25.6	0.96742
15.7	0.97820	20.7	0.97280	25.7	0.96731
15.8	0.97809	20.8	0.97270	25.8	0.96719
15.9	0.97798	20.9	0.97259	25.9	0.96708
16.0	0.97787	21.0	0.97248	26.0	0.96697
16.1	0.97776	21.1	0.97237	26.1	0.96685
16.2	0.97765	21.2	0.97227	26.2	0.96674
16.3	0.97755	21.3	0.97216	26.3	0.96662
16.4	0.97744	21.4	0.97205	26.4	0.96651
16.5	0.97733	21.5	0.97194	26.5	0.96639
16.6	0.97722	21.6	0.97183	26.6	0.96628
16.7	0.97711	21.7	0.97173	26.7	0.96616
16.8	0.97700	21.8	0.97162	26.8	0.96605
16.9	0.97689	21.9	0.97151	26.9	0.96593
17.0	0.97679	22.0	0.97140	27.0	0.96581
17.1	0.97668	22.1	0.97129	27.1	0.96570
17.2	0.97657	22.2	0.97118	27.2	0.96558
17.3	0.97646	22.3	0.97108	27.3	0.96546
17.4	0.97635	22.4	0.97097	27.4	0.96535
17.5	0.97625	22.5	0.97086	27.5	0.96523
17.6	0.97614	22.6	0.97075	27.6	0.96511
17.7	0.97603	22.7	0.97064	27.7	0.96499
17.8	0.97592	22.8	0.97053	27.8	0.96488
17.9	0.97581	22.9	0.97042	27.9	0.96476
18.0	0.97571	23.0	0.97031	28.0	0.96464
18.1	0.97560	23.1	0.97020	28.1	0.96452
18.2	0.97549	23.2	0.97009	28.2	0.96440
18.3	0.97538	23.3	0.96998	28.3	0.96428
18.4	0.97528	23.4	0.96987	28.4	0.96416
18.5	0.97517	23.5	0.96976	28.5	0.96404
18.6	0.97506	23.6	0.96965	28.6	0.96392
18.7	0.97495	23.7	0.96954	28.7	0.96380
18.8	0.97485	23.8	0.96943	28.8	0.96368
18.9	0.97474	23.9	0.96932	28.9	0.96356
19.0	0.97463	24.0	0.96921	29.0	0.96344
19.1	0.97452	24.1	0.96910	29.1	0.96332
19.2	0.97442	24.2	0.96899	29.2	0.96320
19.3	0.97431	24.3	0.96888	29.3	0.96307
19.4	0.97420	24.4	0.96877	29.4	0.96295
19.5	0.97409	24.5	0.96866	29.5	0.96283
19.6	0.97399	24.6	0.96855	29.6	0.96271
19.7	0.97388	24.7	0.96843	29.7	0.96258
19.8	0.97377	24.8	0.96832	29.8	0.96246
19.9	0.97366	24.9	0.96821	29.9	0.96233
20.0	0.97356	25.0	0.96810	30.0	0.96221

Ethanol (% $^{v}/_{v}$)	Density [g/cm³]	Ethanol (% $^{v}/_{v}$)	Density [g/cm³]	Ethanol (% $^{v}/_{v}$)	Density [g/cm³]
30.1	0.96209	35.1	0.95544	40.1	0.94788
30.2	0.96196	35.2	0.95530	40.2	0.94772
30.3	0.96184	35.3	0.95516	40.3	0.94756
30.4	0.96171	35.4	0.95502	40.4	0.94740
30.5	0.96159	35.5	0.95488	40.5	0.94724
30.6	0.96146	35.6	0.95473	40.6	0.94708
30.7	0.96133	35.7	0.95459	40.7	0.94691
30.8	0.96121	35.8	0.95444	40.8	0.94675
30.9	0.96108	35.9	0.95430	40.9	0.94658
31.0	0.96095	36.0	0.95415	41.0	0.94642
31.1	0.96082	36.1	0.95401	41.1	0.94626
31.2	0.96070	36.2	0.95386	41.2	0.94609
31.3	0.96057	36.3	0.95372	41.3	0.94593
31.4	0.96044	36.4	0.95357	41.4	0.94576
31.5	0.96031	36.5	0.95342	41.5	0.94559
31.6	0.96018	36.6	0.95328	41.6	0.94543
31.7	0.96005	36.7	0.95313	41.7	0.94526
31.8	0.95992	36.8	0.95298	41.8	0.94509
31.9	0.95979	36.9	0.95283	41.9	0.94493
32.0	0.95966	37.0	0.95269	42.0	0.94476
32.1	0.95953	37.1	0.95254	42.1	0.94459
32.2	0.95940	37.2	0.95239	42.2	0.94442
32.3	0.95927	37.3	0.95224	42.3	0.94425
32.4	0.95914	37.4	0.95209	42.4	0.94408
32.5	0.95901	37.5	0.95194	42.5	0.94391
32.6	0.95887	37.6	0.95179	42.6	0.94374
32.7	0.95874	37.7	0.95163	42.7	0.94357
32.8	0.95861	37.8	0.95148	42.8	0.94340
32.9	0.95847	37.9	0.95133	42.9	0.94323
33.0	0.95834	38.0	0.95118	43.0	0.94306
33.1	0.95820	38.1	0.95102	43.1	0.94288
33.2	0.95807	38.2	0.95087	43.2	0.94271
33.3	0.95794	38.3	0.95072	43.3	0.94254
33.4	0.95780	38.4	0.95056	43.4	0.94237
33.5	0.95766	38.5	0.95041	43.5	0.94219
33.6	0.95753	38.6	0.95025	43.6	0.94202
33.7	0.95739	38.7	0.95010	43.7	0.94184
33.8	0.95726	38.8	0.94994	43.8	0.94167
33.9	0.95712	38.9	0.94979	43.9	0.94149
34.0	0.95698	39.0	0.94963	44.0	0.94132
34.1	0.95684	39.1	0.94947	44.1	0.94114
34.2	0.95670	39.2	0.94932	44.2	0.94097
34.3	0.95657	39.3	0.94916	44.3	0.94079
34.4	0.95643	39.4	0.94900	44.4	0.94061
34.5	0.95629	39.5	0.94884	44.5	0.94043
34.6	0.95615	39.6	0.94868	44.6	0.94026
34.7	0.95601	39.7	0.94852	44.7	0.94008
34.8	0.95587	39.8	0.94837	44.8	0.93990
34.9	0.95573	39.9	0.94821	44.9	0.93972
35.0	0.95559	40.0	0.94805	45.0	0.93954

Ethanol (% $^{v}/_{v}$)	Density [g/cm³]	Ethanol (% $^{v}/_{v}$)	Density [g/cm³]	Ethanol (% $^{v}/_{v}$)	Density [g/cm³]
45.1	0.93936	50.1	0.92995	55.1	0.91975
45.2	0.93918	50.2	0.92975	55.2	0.91954
45.3	0.93900	50.3	0.92955	55.3	0.91933
45.4	0.93882	50.4	0.92935	55.4	0.91912
45.5	0.93864	50.5	0.92916	55.5	0.91891
45.6	0.93846	50.6	0.92896	55.6	0.91869
45.7	0.93828	50.7	0.92876	55.7	0.91848
45.8	0.93810	50.8	0.92856	55.8	0.91827
45.9	0.93791	50.9	0.92836	55.9	0.91806
46.0	0.93773	51.0	0.92816	56.0	0.91784
46.1	0.93755	51.1	0.92796	56.1	0.91763
46.2	0.93736	51.2	0.92777	56.2	0.91742
46.3	0.93718	51.3	0.92757	56.3	0.91720
46.4	0.93700	51.4	0.92736	56.4	0.91699
46.5	0.93681	51.5	0.92716	56.5	0.91677
46.6	0.93663	51.6	0.92696	56.6	0.91656
46.7	0.93644	51.7	0.92676	56.7	0.91635
46.8	0.93626	51.8	0.92656	56.8	0.91613
46.9	0.93607	51.9	0.92636	56.9	0.91591
47.0	0.93588	52.0	0.92616	57.0	0.91570
47.1	0.93570	52.1	0.92595	57.1	0.91548
47.2	0.93551	52.2	0.92575	57.2	0.91527
47.3	0.93532	52.3	0.92555	57.3	0.91505
47.4	0.93514	52.4	0.92535	57.4	0.91483
47.5	0.93495	52.5	0.92514	57.5	0.91462
47.6	0.93476	52.6	0.92494	57.6	0.91440
47.7	0.93457	52.7	0.92473	57.7	0.91418
47.8	0.93438	52.8	0.92453	57.8	0.91397
47.9	0.93419	52.9	0.92432	57.9	0.91375
48.0	0.93400	53.0	0.92412	58.0	0.91353
48.1	0.93381	53.1	0.92391	58.1	0.91331
48.2	0.93362	53.2	0.92371	58.2	0.91309
48.3	0.93343	53.3	0.92350	58.3	0.91287
48.4	0.93324	53.4	0.92330	58.4	0.91265
48.5	0.93305	53.5	0.92309	58.5	0.91243
48.6	0.93286	53.6	0.92288	58.6	0.91222
48.7	0.93267	53.7	0.92268	58.7	0.91200
48.8	0.93247	53.8	0.92247	58.8	0.91178
48.9	0.93228	53.9	0.92226	58.9	0.91155
49.0	0.93209	54.0	0.92206	59.0	0.91133
49.1	0.93190	54.1	0.92185	59.1	0.91111
49.2	0.93170	54.2	0.92164	59.2	0.91089
49.3	0.93151	54.3	0.92143	59.3	0.91067
49.4	0.93131	54.4	0.92122	59.4	0.91045
49.5	0.93112	54.5	0.92101	59.5	0.91023
49.6	0.93092	54.6	0.92080	59.6	0.91001
49.7	0.93073	54.7	0.92059	59.7	0.90978
49.8	0.93053	54.8	0.92038	59.8	0.90956
49.9	0.93034	54.9	0.92017	59.9	0.90934
50.0	0.93014	55.0	0.91996	60.0	0.90911

Ethanol (% $^{v}/_{v}$)	Density [g/cm³]	Ethanol (% $^{v}/_{v}$)	Density [g/cm³]	Ethanol (% $^{v}/_{v}$)	Density [g/cm³]
60.1	0.90889	65.1	0.89742	70.1	0.88531
60.2	0.90867	65.2	0.89718	70.2	0.88506
60.3	0.90844	65.3	0.89694	70.3	0.88482
60.4	0.90822	65.4	0.89671	70.4	0.88457
60.5	0.90800	65.5	0.89647	70.5	0.88432
60.6	0.90777	65.6	0.89623	70.6	0.88407
60.7	0.90755	65.7	0.89600	70.7	0.88382
60.8	0.90732	65.8	0.89576	70.8	0.88357
60.9	0.90710	65.9	0.89552	70.9	0.88332
61.0	0.90687	66.0	0.89528	71.0	0.88306
61.1	0.90664	66.1	0.89505	71.1	0.88281
61.2	0.90642	66.2	0.89481	71.2	0.88256
61.3	0.90619	66.3	0.89457	71.3	0.88231
61.4	0.90597	66.4	0.89433	71.4	0.88206
61.5	0.90574	66.5	0.89409	71.5	0.88181
61.6	0.90551	66.6	0.89385	71.6	0.88155
61.7	0.90529	66.7	0.89361	71.7	0.88130
61.8	0.90506	66.8	0.89337	71.8	0.88105
61.9	0.90483	66.9	0.89313	71.9	0.88079
62.0	0.90460	67.0	0.89289	72.0	0.88054
62.1	0.90437	67.1	0.89265	72.1	0.88029
62.2	0.90415	67.2	0.89241	72.2	0.88003
62.3	0.90392	67.3	0.89217	72.3	0.87978
62.4	0.90369	67.4	0.89193	72.4	0.87952
62.5	0.90346	67.5	0.89169	72.5	0.87927
62.6	0.90323	67.6	0.89145	72.6	0.87901
62.7	0.90300	67.7	0.89120	72.7	0.87875
62.8	0.90277	67.8	0.89096	72.8	0.87850
62.9	0.90254	67.9	0.89072	72.9	0.87824
63.0	0.90231	68.0	0.89048	73.0	0.87799
63.1	0.90208	68.1	0.89023	73.1	0.87773
63.2	0.90185	68.2	0.88999	73.2	0.87747
63.3	0.90162	68.3	0.88975	73.3	0.87721
63.4	0.90139	68.4	0.88950	73.4	0.87696
63.5	0.90115	68.5	0.88926	73.5	0.87670
63.6	0.90092	68.6	0.88901	73.6	0.87644
63.7	0.90069	68.7	0.88877	73.7	0.87618
63.8	0.90046	68.8	0.88852	73.8	0.87592
63.9	0.90023	68.9	0.88828	73.9	0.87566
64.0	0.89999	69.0	0.88803	74.0	0.87540
64.1	0.89976	69.1	0.88779	74.1	0.87514
64.2	0.89953	69.2	0.88754	74.2	0.87488
64.3	0.89929	69.3	0.88729	74.3	0.87462
64.4	0.89906	69.4	0.88705	74.4	0.87436
64.5	0.89882	69.5	0.88680	74.5	0.87410
64.6	0.89859	69.6	0.88655	74.6	0.87384
64.7	0.89836	69.7	0.88631	74.7	0.87358
64.8	0.89812	69.8	0.88606	74.8	0.87332
64.9	0.89789	69.9	0.88581	74.9	0.87306
65.0	0.89765	70.0	0.88556	75.0	0.87279

Ethanol (% v/v)	Density [g/cm³]	Ethanol (% v/v)	Density [g/cm³]	Ethanol (% v/v)	Density [g/cm³]
75.1	0.87253	80.1	0.85899	85.1	0.84455
75.2	0.87227	80.2	0.85871	85.2	0.84425
75.3	0.87200	80.3	0.85843	85.3	0.84395
75.4	0.87174	80.4	0.85815	85.4	0.84365
75.5	0.87148	80.5	0.85787	85.5	0.84335
75.6	0.87121	80.6	0.85759	85.6	0.84305
75.7	0.87095	80.7	0.85731	85.7	0.84275
75.8	0.87068	80.8	0.85703	85.8	0.84244
75.9	0.87042	80.9	0.85675	85.9	0.84214
76.0	0.87015	81.0	0.85646	86.0	0.84184
76.1	0.86989	81.1	0.85618	86.1	0.84153
76.2	0.86962	81.2	0.85590	86.2	0.84123
76.3	0.86935	81.3	0.85562	86.3	0.84092
76.4	0.86909	81.4	0.85533	86.4	0.84062
76.5	0.86882	81.5	0.85505	86.5	0.84031
76.6	0.86855	81.6	0.85476	86.6	0.84000
76.7	0.86828	81.7	0.85448	86.7	0.83970
76.8	0.86802	81.8	0.85419	86.8	0.83939
76.9	0.86775	81.9	0.85391	86.9	0.83908
77.0	0.86748	82.0	0.85362	87.0	0.83877
77.1	0.86721	82.1	0.85334	87.1	0.83846
77.2	0.86694	82.2	0.85305	87.2	0.83815
77.3	0.86667	82.3	0.85276	87.3	0.83784
77.4	0.86640	82.4	0.85248	87.4	0.83752
77.5	0.86613	82.5	0.85219	87.5	0.83721
77.6	0.86586	82.6	0.85190	87.6	0.83690
77.7	0.86559	82.7	0.85161	87.7	0.83659
77.8	0.86532	82.8	0.85132	87.8	0.83627
77.9	0.86505	82.9	0.85103	87.9	0.83596
78.0	0.86478	83.0	0.85074	88.0	0.83564
78.1	0.86450	83.1	0.85045	88.1	0.83532
78.2	0.86423	83.2	0.85016	88.2	0.83501
78.3	0.86396	83.3	0.84987	88.3	0.83469
78.4	0.86369	83.4	0.84958	88.4	0.83437
78.5	0.86341	83.5	0.84929	88.5	0.83405
78.6	0.86314	83.6	0.84899	88.6	0.83373
78.7	0.86286	83.7	0.84870	88.7	0.83341
78.8	0.86259	83.8	0.84841	88.8	0.83309
78.9	0.86231	83.9	0.84811	88.9	0.83277
79.0	0.86204	84.0	0.84782	89.0	0.83245
79.1	0.86176	84.1	0.84753	89.1	0.83212
79.2	0.86149	84.2	0.84723	89.2	0.83180
79.3	0.86121	84.3	0.84693	89.3	0.83148
79.4	0.86094	84.4	0.84664	89.4	0.83115
79.5	0.86066	84.5	0.84634	89.5	0.83082
79.6	0.86038	84.6	0.84605	89.6	0.83050
79.7	0.86010	84.7	0.84575	89.7	0.83017
79.8	0.85983	84.8	0.84545	89.8	0.82984
79.9	0.85955	84.9	0.84515	89.9	0.82951
80.0	0.85927	85.0	0.84485	90.0	0.82918

Ethanol (% $^{v}/_{v}$)	Density [g/cm³]	Ethanol (% $^{v}/_{v}$)	Density [g/cm³]
90.1	0.82885	95.1	0.81099
90.2	0.82852	95.2	0.81060
90.3	0.82819	95.3	0.81021
90.4	0.82785	95.4	0.80982
90.5	0.82752	95.5	0.80942
90.6	0.82718	95.6	0.80902
90.7	0.82685	95.7	0.80863
90.8	0.82651	95.8	0.80823
90.9	0.82617	95.9	0.80782
91.0	0.82583	96.0	0.80742
91.1	0.82549	96.1	0.80701
91.2	0.82515	96.2	0.80661
91.3	0.82481	96.3	0.80620
91.4	0.82447	96.4	0.80578
91.5	0.82413	96.5	0.80537
91.6	0.82378	96.6	0.80496
91.7	0.82344	96.7	0.80454
91.8	0.82309	96.8	0.80412
91.9	0.82274	96.9	0.80370
92.0	0.82239	97.0	0.80327
92.1	0.82204	97.1	0.80285
92.2	0.82169	97.2	0.80242
92.3	0.82134	97.3	0.80199
92.4	0.82099	97.4	0.80155
92.5	0.82063	97.5	0.80112
92.6	0.82028	97.6	0.80068
92.7	0.81992	97.7	0.80024
92.8	0.81957	97.8	0.79980
92.9	0.81921	97.9	0.79935
93.0	0.81885	98.0	0.79890
93.1	0.81849	98.1	0.79845
93.2	0.81812	98.2	0.79800
93.3	0.81776	98.3	0.79754
93.4	0.81740	98.4	0.79708
93.5	0.81703	98.5	0.79662
93.6	0.81666	98.6	0.79615
93.7	0.81630	98.7	0.79568
93.8	0.81593	98.8	0.79521
93.9	0.81555	98.9	0.79473
94.0	0.81518	99.0	0.79425
94.1	0.81481	99.1	0.79377
94.2	0.81443	99.2	0.79328
94.3	0.81406	99.3	0.79279
94.4	0.81368	99.4	0.79230
94.5	0.81330	99.5	0.79180
94.6	0.81292	99.6	0.79129
94.7	0.81254	99.7	0.79079
94.8	0.81215	99.8	0.79028
94.9	0.81177	99.9	0.78976
95.0	0.81138	100.0	0.78924

A1.4 Density table of aqueous sucrose solutions

The DE40, DE45 DeltaRange and DE51 Density Meters have a built-in table for the determination of the sucrose content in (w/w %, Brix) of aqueous solutions. The Brix table stored in the instrument is based on table 109 of the NBS Circular 440. This table is valid for a temperature of 20°C only. The "Measurement Temp." of the methods used to perform Brix determination has therefore to be set to 20.00°C.

Intermediate values are calculated by La Grange interpolation.

Table 109, NBS circular 440

The table stored in the instrument contains only the S.G. values (not the densities).

Brix/ (%)	S.G. (20°C / 20°C)	Density (g/cm³)	Brix/ (%)	S.G. (20°C / 20°C)	Density (g/cm³)
0.0	1.00000	0.99821	42,0	1.18887	1.18674
1.0	1.00389	1.00209	43.0	1.19410	1.19196
2.0	1.00779	1.00599	44.0	1.19936	1.19721
3.0	1.01172	1.00991	45.0	1.20467	1.20251
4.0	1.01567	1.01385	46.0	1.21001	1.20784
5.0	1.01965	1.01782	47.0	1.21538	1.21320
6.0	1.02366	1.02183	48.0	1.22080	1.21861
7.0	1.02770	1.02586	49.0	1.22625	1.22406
8.0	1.03176	1.02991	50.0	1.23174	1.22954
9.0	1.03586	1.03401	51.0	1.23727	1.23506
10.0	1.03998	1.03812	52.0	1.24284	1.24062
11.0	1.04413	1.04226	53.0	1.24844	1.24621
12.0	1.04831	1.04643	54.0	1.25408	1.25184
13.0	1.05252	1.05064	55.0	1.25976	1.25751
14.0	1.05677	1.05488	56.0	1.26548	1.26321
15.0	1.06104	1.05914	57.0	1.27123	1.26895
16.0	1.06534	1.06343	58.0	1.27703	1.27474
17.0	1.06968	1.06777	59.0	1.28286	1.28056
18.0	1.07404	1.07212	60.0	1.28873	1.28642
19.0	1.07844	1.07651	61.0	1.29464	1.29232
20.0	1.08287	1.08093	62.0	1.30059	1.29826
21.0	1.08733	1.08538	63.0	1.30657	1.30423
22.0	1.09183	1.08988	64.0	1.31260	1.31025
23.0	1.09636	1.09440	65.0	1.31866	1.31630
24.0	1.10092	1.09895	66.0	1.32476	1.32239
25.0	1.10551	1.10353	67.0	1.33090	1.32852
26.0	1.11014	1.10815	68.0	1.33708	1.33469
27.0	1.11480	1.11280	69.0	1.34330	1.34090
28.0	1.11949	1.11749	70.0	1.34956	1.34714
29.0	1.12422	1.12221	71.0	1.35585	1.35342
30.0	1.12898	1.12696	72.0	1.36218	1.35974
31.0	1.13378	1.13175	73.0	1.36856	1.36611
32.0	1.13861	1.13657	74.0	1.37496	1.37250
33.0	1.14347	1.14142	75.0	1.38141	1.37894
34.0	1.14837	1.14631	76.0	1.38790	1.38542
35.0	1.15331	1.15125	77.0	1.39442	1.39192
36.0	1.15828	1.15621	78.0	1.40098	1.39847
37.0	1.16329	1.16121	79.0	1.40758	1.40506
38.0	1.16833	1.16624	80.0	1.41421	1.41168
39.0	1.17341	1.17131	81.0	1.42088	1.41834
40.0	1.17853	1.17642	82.0	1.42759	1.42503
41.0	1.18368	1.18156	83.0	1.43434	1.43177

Appendix 2: Barcode reader

A.2.1 Configuration of the METTLER TOLEDO Heron-G D130 barcode reader

The following barcodes are used to configure the Heron-G D130 barcode reader:

– "**Reset**", "**Mode RS232**": If the barcode reader is not working properly, proceed as follows:
  - disconnect it from the DE Density Meter
  - reconnect it to the DE Density Meter (AUX. port)
  - scan the barcode "Reset", to restore the manufacturer's settings
  - scan the barcode "Mode RS232", to configure the reader for the DE Density Meter.

  If the barcode reader still does not work, check the settings on the DE density meter (refer to section 6.1.3; 12.1.3).

– "**Beep medium**", "**Beep off**": Scan these barcodes to adjust the volume of the acoustic signal of the barcode reader. To reset the volume to "full", you must scan the barcodes "Reset" and then "Mode RS232".

Reset

Mode RS232

Beep medium

Beep off

A.2.2 Special characters

The barcode reader may be used to scan in sample identifications, method names, sample names and names for units containing special characters which may not be entered via the instrument's keypad. You must therefore create the desired barcode and scan it into the corresponding input field instead of typing in the text via the keypad.

The following special characters cannot be entered via the keypad. They are, however, supported by the DE40/DE45 DeltaRange/DE51 density meters and the METTLER TOLEDO RS-P42 printer:

[ ]	#	$	!	'	*	/	+	,	(
) =	?	"	:	;	_	~	<	>	&

A.2.3 Operator names

The barcode reader may be used to select an operator name from the list entered in the "Operator Names" menu (refer to section 12.3.2). This selection is done directly in the main display, i.e., the user may scan in the the operator name with the barcode reader and press **Measure** without having to perform any additional keystrokes.

Below you will find a list of the barcodes used to select the operator name. In order to make it easy for the operators to identify themselves before doing measurements, we recommend you either make a photocopy of this list, complete it with the corresponding operator names and hang it somewhere near the instrument, or hand out a name tag containing the corresponding barcode to each operator of the instrument.

No.	Operator name	Operator barcode	CODE128
1	----------		110513010100
2	----------		110513010101
3	----------		110513010102
4	----------		110513010103
5	----------		110513010104
6	----------		110513010105
7	----------		110513010106
8	----------		110513010107
9	----------		110513010108
10	----------		110513010109

Operator barcode

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