Operating Instructions

METTLER TOLEDO
DE40, DE50 and DE51 Density Meters

V2.00

Contents

Contents

1. Introduction

The DE40 and DE50/DE51 Density Meters measure the density d of gases, liquids and solutions using the oscillating body method. They are distinguished by their temperature range and their measurement accuracy. All three instruments:

- come with five certified water standards.
- measure gases, liquids and solutions with densities (d) in the range 0 to 3 g/cm^3 (DE40: with 0.0001 g/cm^3; DE50/DE51: with 0.00001 g/cm^3).
- need a minimum amount of substance (1.2 millilitres) for measurement.
- keep the temperature of the sample being measured constant thanks to a built-in thermostat control (DE40: between 4 and 90 °C, DE50/DE51: between 4 and 70 °C).
- have 10 methods stored in their memory, which you can change to suit your measurements.
- show the density relative to water (specific gravity) at 4 °C (d_4^t) or at the measurement temperature (d_t^t).
- calculate the concentration of a solution using tables or entered data of measured standard solutions.
- calculate the density of a solution for a desired temperature using an entered temperature function.
- have a built-in check function that allows to periodically check 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.

Special Application Memory Cards are available for all three instruments which allow the automatic conversion of the experimental data into BRIX degrees, or alcohol concentration. A special API software converts the density of oil products measured at elevated temperatures automatically into the density at 15 °C (or 60 °F).

You can use an automatic sampling unit to perform continuous measurements; the built-in RS-232C interface allows attachment of a computer to transfer experimental data. Print out the entered parameters and data as well as results on a printer (option).

You can connect your instrument to a RE40 or RE50 refractometer to perform simultaneous measurements of density and refractive index with one sample.

Connection of a SC24 sample changer allows fully automated measurements, even in combination with a refractometer (RE40 or RE50).

Note: Examples of the density given in these Operating Instructions are for the DE50/DE51.

2. Safety measures

Measures for your safety

– Ensure that you plug the power cable supplied into a socket which is grounded! In the absence of grounding, a technical fault could be lethal.
– Switch the instrument off and disconnect the power cable if you change blown fuses! An electric shock could be lethal.

– Never work in a hazardous area! The housing of the instruments is not gas tight (explosion hazard through spark formation, corrosion by gas diffusion into the instruments).

– Measure readily inflammable, toxic and corrosive substances in a fume hood and comply with the usual lab regulations!

Measures for operational safety

– Check the set operating voltage before you switch on the instrument! The instrument will be damaged if the operating voltage does not match the line voltage.
– Do not clean the measurement tube with concentrated sodium hydroxide (caustic soda, NaOH) or hydrofluoric acid (HF)! Both substances chemically attack the measurement tube.
– Use only fuses of the specified type if you need to change them!
– Exclude the following environmental influences:
  • powerful vibrations.
  • direct sunlight.
  • 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!

3. The density

3.1 Definition

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

$$\rho = \frac{m}{V} \quad [kg/m^3] \text{ or } [g/cm^3]$$

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

$$d = \frac{\rho}{\rho_0} \quad [1]$$

Note: The DE40/DE50/DE51 calculate the relative density: the density of water at 4 °C (d_t^t) or at the measurement temperature (d_t^t) is available as a reference. For this purpose, the density of pure water as a function of temperature is stored in the instruments.

3.2 Measurement principle

The density measurement of the DE40 and the DE50/DE51 is based on the electromagnetically induced oscillation of a glass U-tube.

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 substance. The frequency is a function of the mass. When the mass increases, the frequency decreases, in other words period of oscillation T incrases.

A magnet is fixed to the measurement tube in the DE40/DE50/DE51 which is made to oscillate by a transmitter. A sensor measures the period of oscillation T.

Amplitude / Time / Oscillation period T

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

Magnet

Oscillator/ Vibration meter

Measurement tube of defined volumetric capacity
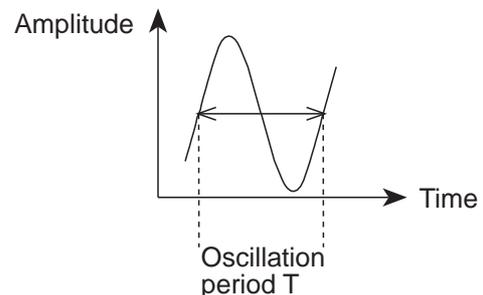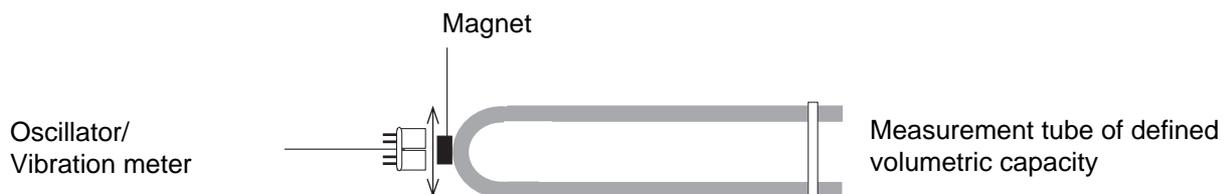
The period of oscillation T is obtained from the equation:

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

ρ = Density of sample in measurement tube [g/cm^3]
V_c = Volume of sample (capacity of tube) [cm^3]
m_c = Mass of measurement tube [g]
K = Measurement tube constant [g/s^2]

It follows that

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

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

$\rho = A\,T^2 + B$ (see illustration)

A and B are constants which are determined by the elasticity, structure and mass of the measurement tube. As the mass varies from tube to tube, it 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, e.g. air and water:

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

ρ_A = Density of air [g/cm^3]
ρ_W = Density of water [g/cm^3]
T_A = Period of oscillation of the air measurement [s]
T_W = Period of oscillation of the water measurement [s]
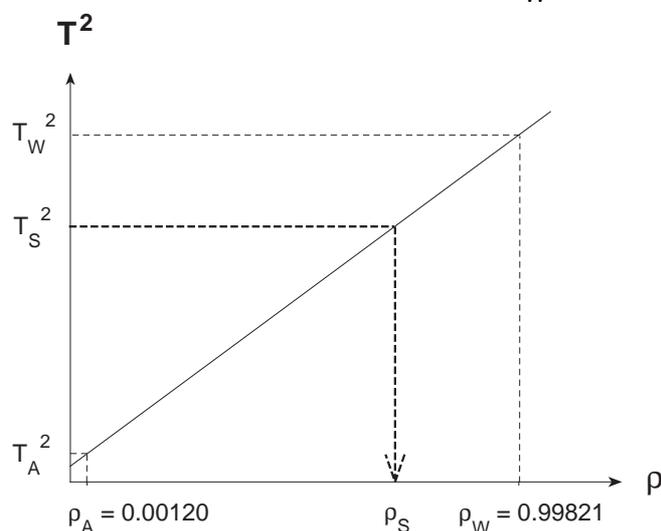
The unknown density of a substance ρ_S is calculated after the factor determination by measurement of its period of oscillation using the following formula:

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

Solving for ρ_S gives:

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

Note: The factor is temperature dependent. The volume of the measurement tube and its period of oscillation change with temperature. It is thus necessary to determine the factor of the cell for the temperature at which you measure your samples!

The here described period of oscillation T is used to calculate the tube factor and from that the density of the unknown sample. But this period of oscillation is not displayed on the instrument. The DE40/DE50/DE51 display only the so-called T-value which is directly related to the period of oscillation T:

Period of oscillation T = T-value • Z • 0.2 μsec • (1/600)

$$\text{with: } Z = 10 \quad \text{for DE50/DE51}$$
$$Z = 100 \quad \text{for DE40}$$
$$\text{T-value} \quad \text{shown as T on the display of the instrument}$$

So the T-value is an auxiliary value that makes use of the maximum display possibilities of the instrument, using only digits and no decimals. This gives the maximum resolution especially for the determination of the stability.

The stability for accepting the measured T-value can be set at three different levels (see Section 8.3) to reduce measurement time, according to the need of the customer:

Stability 0: The stability of the measured signal (T-value) is waited for: $\Delta T_{val} \leq 4$ within 77 s for the DE50/DE51, and $\Delta T_{val} \leq 1$ within 49 s for the DE40. The density is measured with an accuracy of $\pm 1 * 10^{-5}$ (DE40: $\pm 1 * 10^{-4}$).

Stability 1: The final T-value is extrapolated with a patented algorithm from the course of the slope ($\Delta T_{val}/\Delta temp.$), and the density is calculated. This cuts the measurement time about by half while the result (i.e. density) in most cases is identical to that of stability 0.

Stability 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 the density is calculated. Thus the measurement time is cut about by half again, while the density for most of the samples lies within $\pm$ 1 or 2 digits of that of stability 0.
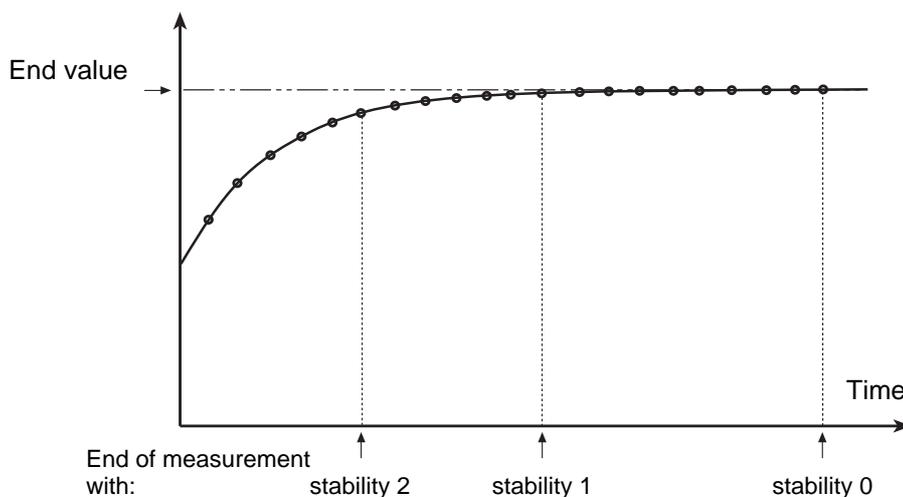
3.3 Construction of the measuring cell and temperature control

For correct density measurements a very accurate temperature control and measurement must be guaranteed.

As the temperature in the sample can not be measured directly without disturbing the measurement of the oscillation, a different approach is used. The temperature is measured in three different spots:

- temperature 1: sensor placed in the measuring cell, directly over the surface of the measurement tube. This temperature is shown on the status display (cell temperature).

- temperature 2: temperature of the thermoblock, not displayed (block temperature).

- temperature 3: reference temperature inside the instrument, not displayed (ambient temperature).

From these three temperatures the actual temperature in the sample is calculated with a patented algorithm.
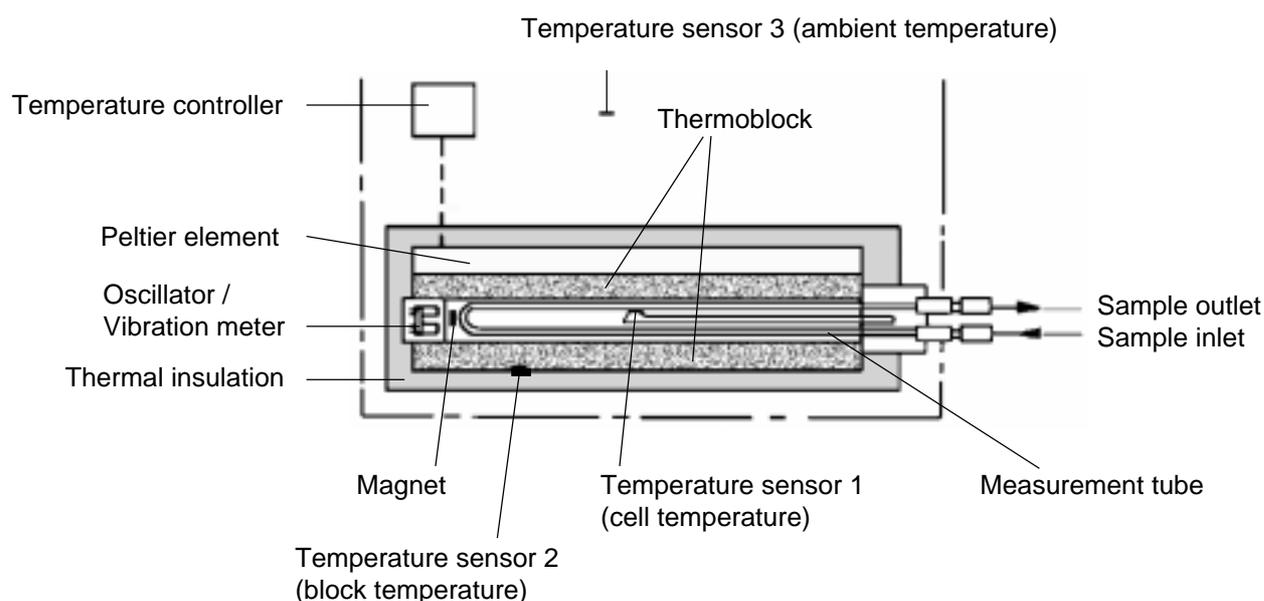
The cell temperature is compared with the inputted set temperature. The temperature controller uses this cellblock/set difference to control the thermoelectric module (Peltier element) which heats or cools the thermostatic block accordingly.

4.   The instrument

Front view

1.   Desiccator

2. Measuring cell

3. Cell window

4. LCD display

5. Keypad

6. Memory card slot

16. Connector to dry air

17. Pump in connector
(only withASU-DE)

7. Sampling speed
control (only with
ASU-DE)

8. Sampling/Drain switch
(only with ASU-DE)

9. Drain tube

10. Waste bottle
(only with ASU-DE)

11. Sampling tube

12. GA42 printer (optional)
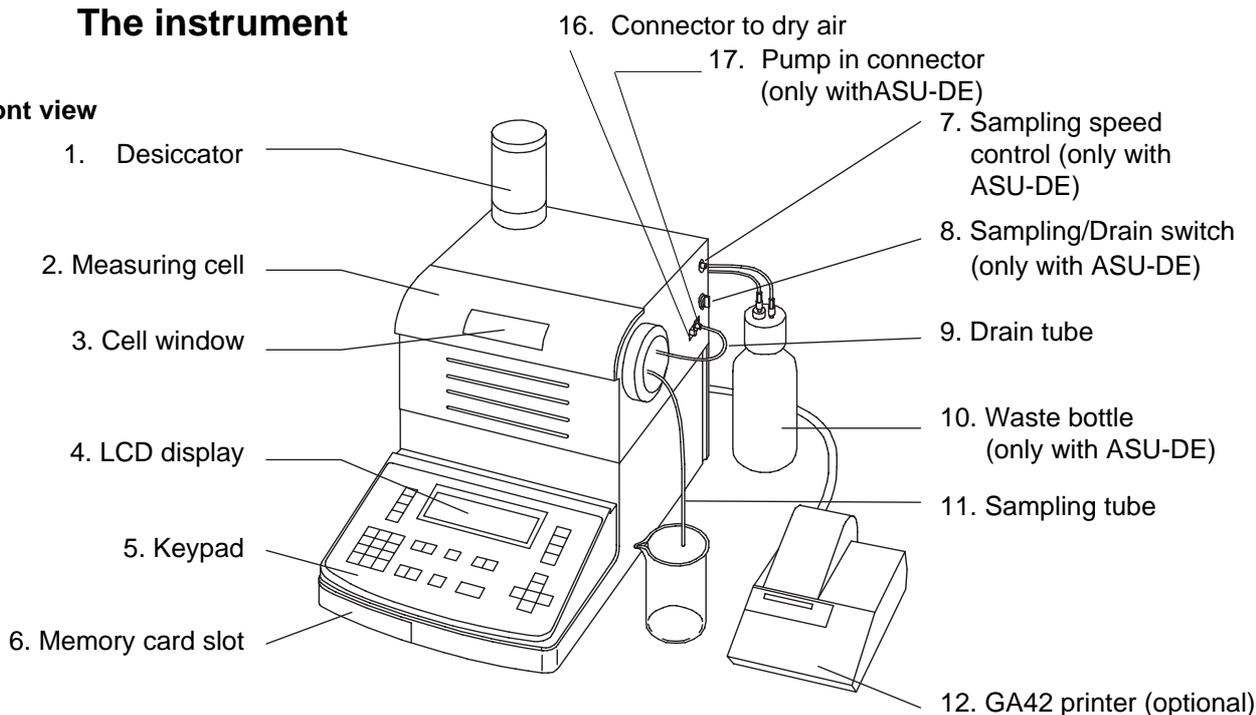
1.   Desiccator
For drying the measuring cell. Filled with silica gel.

2.   Measuring cell
Thermostated measuring cell (Oscillating glas U-tube).

3.   Cell window
To have a view into the measuring cell (check for air bubbles).

4.   LC display
The DE40, DE50 and DE51 have a seven-line liquid crystal display that shows measurement results, conditions or parameters.

5.   Keypad (alphanumeric)
Start measurement, input of measurement conditions or calculation parameters are operated on keys.

6.   Memory card slot
To load and download data method and sample files and to load applications.

7.   Sampling speed control (ASU-DE)
To set the sampling speed (high for high viscous samples, low for low viscous samples).

8.   Sampling/Drain switch
When Sampling position is selected, the speed is controlled by the Sampling speed control. When Drain position is selected, the speed is set to maximum (not controlled).

9.   Drain tube
Connects the measuring cell out to the pump in (ASU-DE) or to a waste (without ASU-DE).

10. Waste bottle (ASU-DE)
Collects waste liquid (sample and rinsing solutions).

11. Sampling tube (ASU-DE)
Connect to the measuring cell in.

12. GA42 Printer (optional)
METTLER TOLEDO matrix printer.

Rear view

13. Measuring cell out

14. Measuring cell in

15. Drain hole

16. Dry air out

17. Pump in connector (only with ASU-DE)

18. Sample changer connector

26. Ext. cell or AD-510

19. Waste bottle tube connection (only with ASU-DE)

20. Pump exhaust (only with ASU-DE)

21. Printer connector

22. RS-232C connector

23. Power switch

24. AC power connector
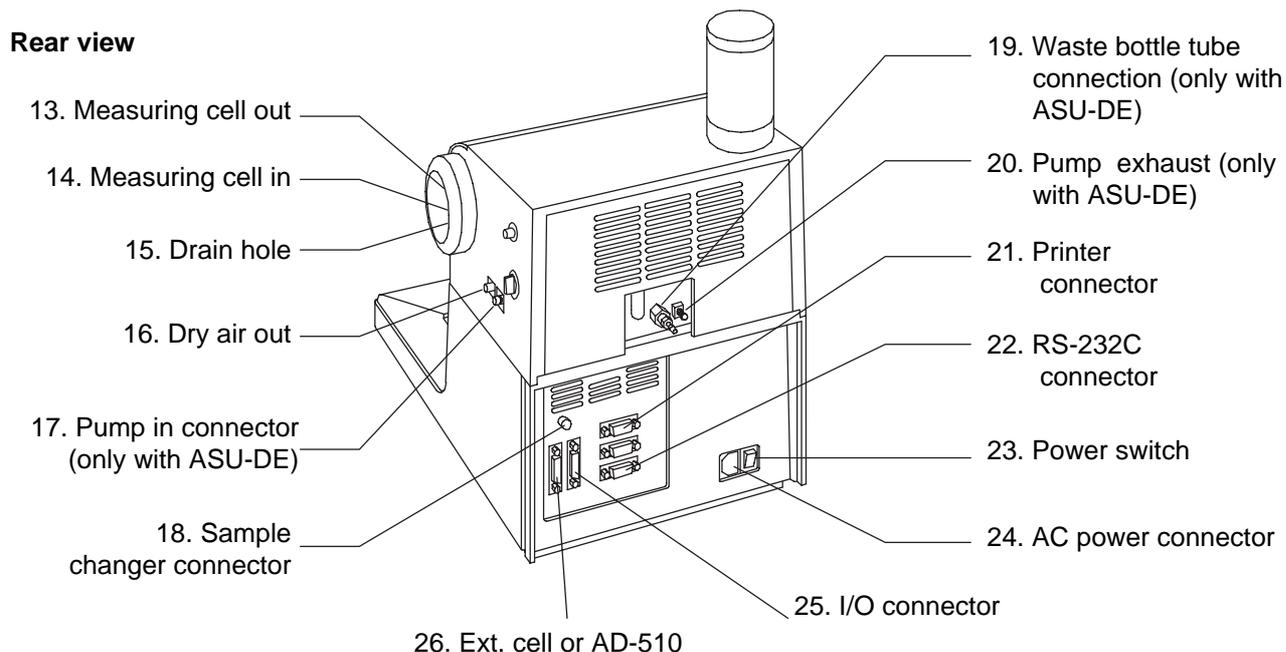
25. I/O connector

13. Measuring cell out
Measuring cell ouput connector. Connect the drain tube here (9).

14. Measuring cell in
Measuring cell input connector. Connect the sampling tube here (ASU-DE) or a syringe (no ASU-DE).

15. Drain hole
To drain sample or rinsing solutions in case of leakage.

16. Dry air out
To dry the measuring cell connect the sampling tube (11) to this connector which is attached the desiccator (1).

17. Pump in connector (ASU-DE)
Connect the drain tube here (ASU-DE).

18. Connector for sample changer
connection of the SC24, SC24H, SC24L, CHG-260B sample changer, or the DCU-300B auto rinsing unit.

19. Waste bottle tube connection (ASU-DE)
Connect these tubes to the waste bottle lid (black tube to the higher connector: air suction; white tube to the main lid: sample in).

20. Pump Exhaust
The exhaust air from the waste bottle goes out here.

21. Printer connector
This is for connection to an external printer(GA42 printer).

22. RS-232C connector
This is for connection to a personal computer or to our RE40 and RE50 refractometers.

23. Power switch
The power of DE40/50/51 is turned on or off by this switch.

24. AC power connector
Connect the power cable to the power supply. The instrument will automatically adjust its power supply unit to the specific line voltage of your country as long as this is in the range between 100 and 240 V AC.

25. I/O connector
For connection of the SOP40 or SOP50.

26. Ext. cell
Connector for an external cell (option) or for the automatic drain unit AD-510 (option).

4.2.   Keyboard
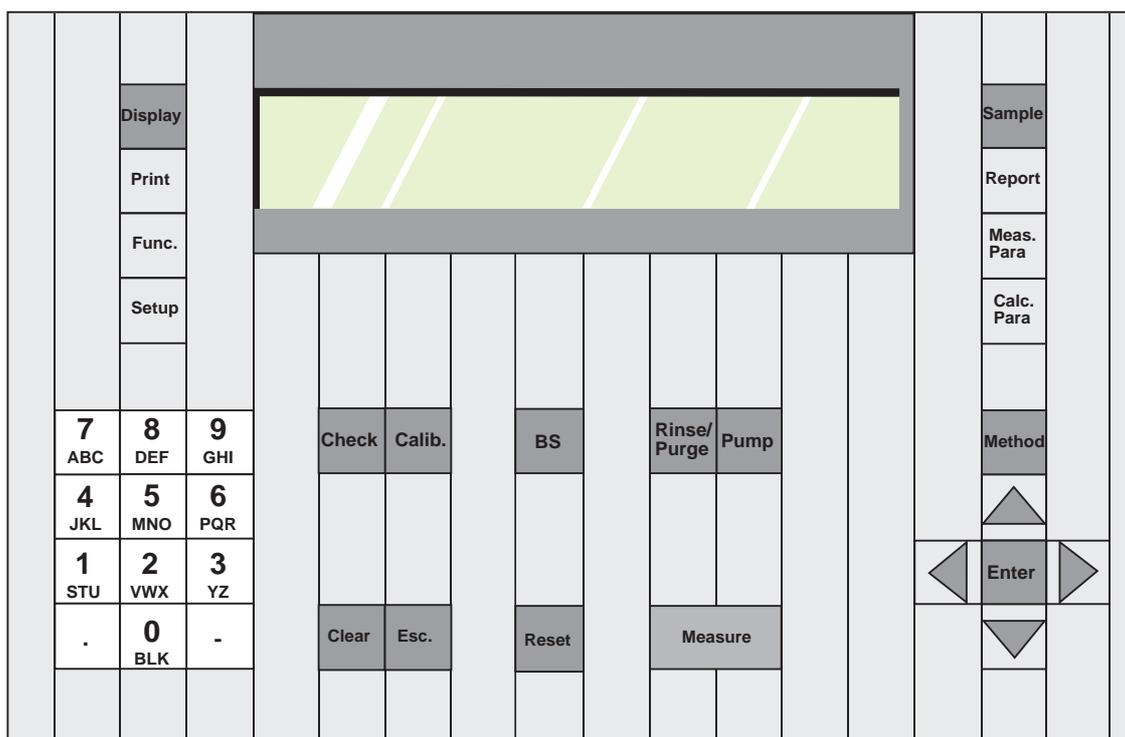
Description of each key and its function:

Sample	Sample:	Key to set up sample parameters, like sample number and ID/No.

Report   Report: Key to change print format.
There are three kinds of format for printing.
(1) Short: Short form for printing minimum necessity of result data.
(2) GLP: GLP form, which complies with GLP requirements.
(3) Variable: User defined printing format.

Meas. Para   Measuring parameter   Key to change measuring parameter:
- Method name (8 characters, alphanumerical),
- Measuring temperature (from 15 to 70 °C),
- Stability (0, 1 or 2),
- Limit Time,
- Sample sequence (sampling, drain, rinse, purge and cell test),
- Calibration mode (air & water, other standards)

Calc. Para   Calculation parameter   Key to change calculation parameter:
- Result (d, d(t/t), d(t/4), application software). Setup concentration function.

Method	Method:	Key to select the method (0 to 9). The selection is done either by pressing the "Up" and "Down" key or by pressing the corresponding number key.	

Display — Display: Key to change display or select numerics, capital or smallleters.

Print — Print: Key to print the displayed message or parameters.

Function — Function: Key to select following functions:

(0) Data File (statistics, delete data, re-calculate),
(1) Sample File,
(2) Method File,
(3) Changer (DCU-300, SC24, CHG-241),
(4) Factor (adjustment factor),
(5) Set Check (name, ref.value, tolerance),
(6) Periodic Check, Periodic Calibration (interval, show list),
(7) Auto Start (multiple measurement),
(8) CARD utility (install applications),
(9) Memory Clear (meas.data, meas.para, check list, calib. list, etc...).

Setup — Setup: Key to select the setup parameters as follows:

(0) Interface: Set up the RS-232C and the printer
(1) Date & Time: Set up date and time
(2) Name: Register name (laboratory or operator)
(3) Serial/Ver. No.: Display serial and version No. of the unit
(4) LCD Contrast: Adjust brightness of LC display
(5) International: Select format for date and select unit (°C/°F) for temperature
(6) Lock: Set up a password for protection
(7) Beep: Select beep (on / off, duration)
(8) Temp.Calib: Run temperature calibration

Check — Check: Key to start the instrument check: daily (always active) or precision (only when due).

Calib. — Calibration: Key to start a calibration.

BS — Backspace: Key to erase one preceding letter or numeral.

Rinse/Purge — Rinse/Purge With SC24 sample changers only. Runs an automatic rinse and purge cycle, according to the selected sample sequence (see Meas.Para).

Pump	Pump	For ASU-DE sampling pump. Starts and stops the pump.
Clear	Clear:	Key to erase the whole entry (2 x to clear names)
Esc.	Escape:	Key to return to the main display
Reset	Reset:	Key to abort a measurement or a calibration and to return to main display.
Measure	Measure:	Key to start a measurement
7 ABC	0 – 9 key	Key to enter alphanumeric characters (the selection capital/small letter or number is done with the <Display> key). To select B, press twice, for C press three times. On the key with the number 0 there is BLK (BLK = blank) to insert blank spaces..
. –		Dot and hyphen key
Enter	Enter	Key to confirm key entry. This key is also called [Enter] key in this manual.
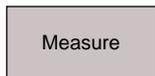
Up
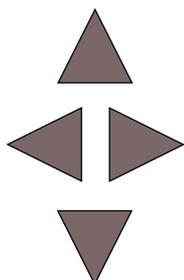
Left, Right ⎬ Keys to move the cursor. The Left and Right keys are also used for selection within the menus.

Down

4.3   Display

The DE40, DE50 and DE51 density meters have a seven line LCD display with 40 characters per line. When the power is turned on (power switch on the rear of the instrument), the following message will appear on the display.

```
    5 place Density Meter

    DE50              Version X.XX

```
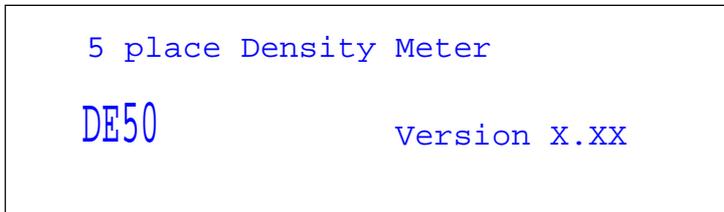
The software version appears for a short time. This software version can also be displayed under Setup 3 "Serial/Version".

After a few seconds the main display will appear:

```
0.Method-0                    01-01
Temp.(°C)               Oscillation

Set  20.00
Cell 21.42                    845393
         Wait for Ready
```
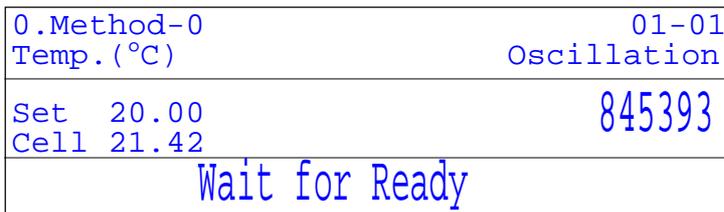
The message "Wait for Reay" will blink until the cell temperature reaches the set temperature.

Once the cell temperature has reached the set temperature:

```
0.Method-0                    01-01
Temp.(°C)               Oscillation

Set  20.00
Cell 20.00                    845393
         No Calibration
```
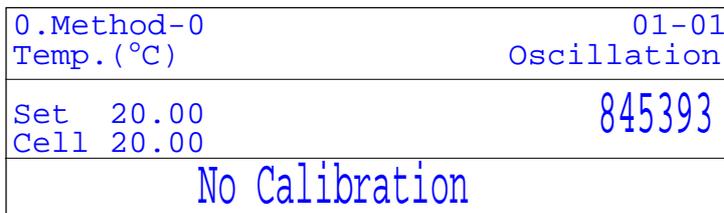
The "No calibration" message appears if the instrument has not been calibrated before or if a Memory Clear has been performed (see section 10.10 "Memory Clear").

Note: The Oscillation value is the T-value described in section 3.2 "Measurement principle".

```
0.Method-0                    01-01
Temp.(°C)             Density(g/cm3)

Set  20.00
Cell 20.00                   0.00120
         No Calibration
```
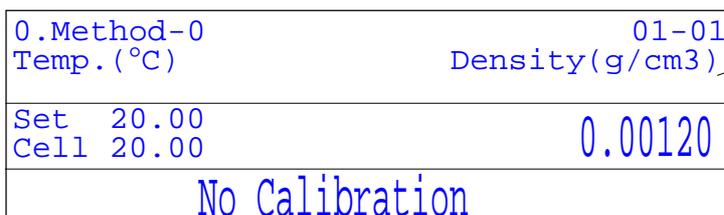
You can toggle between all available units by pressing the <DISPLAY> key:
- Oscillation (T-value)
- Density [d(t/4, d(t/t)] (1)
- Concentration (2)
- ALCOHOL (3)
- BRIX (3)

(1) Selection of d, d(t/t: Specific Gravity), d(t/4) is done under Calc.Para – Density.

(2) Selection of Concentration is done under Calc.Para – Result.

(3) Selection of ALCOHOL, BRIX is done under Calc.Para – Result, but requires to install the application from a special Application Memory Card (see section 13).

5.   Getting started

Before connecting the power cord after unpacking the instrument loosen or remove the three security screws: remove the backplane in the upper part of the instrument and loosen the three large screws (marked with red) just right of the pump box (refer to section 15.2 for more help).
These screws are used as a transportation security only to hold in place the measuring cell during shipment. For correct operation they must be loosened or removed.

When the instrument is switched on the first time, it is recommended to reset it electronically to its default values as described in section 10.10 (function 9, memory clear: all parameter).

5.1   Setting up the instrument

5.1.1   Printer (Setup 0)

If you work without printer you can skip this section and go directly to section 5.1.2.
Perform the following steps if you have a GA42 printer to connect:
- Make sure that the DIP switch 2 is ON on the GA42 printer.
- Press the <SETUP> key.

```
            < Setup >

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

Select "0.Interface". Confirm with <ENTER>.

```
          < Interface >


        0.RS-232C
        1.Printer
```

Select "1.Printer". Confirm with <ENTER>.

```
          < Printer >

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

Select "GA-" with the → key.
Confirm with <ENTER>.

- To choose the format of the printed results press the <REPORT> key and choose between "None", "Short", "GLP" and "Variable" (see section 7 "Report").
- Then press the <RESET> key.

5.1.2 Date and time (Setup 1)

- Press the <SETUP> key.

```
          < Setup >

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

Select "1.Date&Time". Confirm with <ENTER>.

```
        < Date & Time >

       16/07/1998  17:24

 Day   :[16]    Hour   :[17]
 Month :[ 7]    Minutes:[22]
 Year  :[1998]  Exit   :[Execute]
```

Actual date and time are displayed. Press <ENTER> key.

Enter date and time (the date format is selected in the menu Setup „5. International") and confirm with <ENTER>.

5.1.3 Enter the lab name (Setup 2)

- Press the <SETUP> key.

```
          < Setup >

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

Select „2. Name". Confirm with <ENTER>.
The capital A means that the alphanumerical keyboard is in entry mode for capital letters. Press the <DISPLAY> key to change the entry mode:

```
          < Name >              A

    Name  : [Quality Lab 1   ]

    Exit  : [Execute]
```

A: capital letters (A, B, C, D, ..)
a: small letters (a, b, c, d, ...)
1: numbers (0, 1, 2, 3, 4, ...)

Enter the lab name or the instrument name using the alphanumeric keys, e.g. „Quality Lab 1", and confirm with <ENTER>. The instrument is now ready for calibration and the first measurements.

5.2 Performing the first adjustment (calibration)

For correct measurements the instrument should always be adjusted at the measuring temperature.

After turning on the instrument allow at least 20 minutes for the instrument to warm up before performing the first adjustment.

Note:
According to the International Vocabulary of Basic and General Terms in Metrology from DIN the operation of bringing a measuring instrument into a state of performance suitable for its use is called adjustment.

The earlier used term calibration should not be used anymore for this purpose as soon as instrument settings are changed or adapted in order to ensure correct measurement values.

We recommend to select one method which you will dedicate to the adjustment:

```
Method 9    < Meas.Parameter >    VA

Method Name       :[ADJUST ]
Measurement Temp.:[ 20.00]°C
Stability         :[0]
Limit Time        :[    0]s
Sequence          : Off   On
```

Select
Stability 0
and **Limit Time 0 s.**

5.2.1   Clean the measuring cell

a) If you have a sampling pump ASU-DE:

- Insert the sampling tube into a beaker containing a high volatile solvent (e.g. acetone or ethanol).
- Press the <PUMP> key . Flush the measuring cell during approximately 10 s. Adjust the sampling speed with the *Sampling Adj.* control at the rear right side of the instrument so that it takes approximately 5 s from starting the pump to fill the measuring cell (the solvent appears in the drain tube at the top of the cell). During the pumping it is recommended to remove the sampling tube from the beaker and insert it again to create some air bubbles. This will result in a much more efficient cleaning.
- Remove the sampling tube from the beaker.
- Press the <PUMP> key again to stop the pump.

b) If you don't have a sampling pump ASU-DE (only a built-in air pump):

- Flush the measuring cell using a syringe filled with approx. 10 mL of high volatile solvent (e.g. acetone or ethanol). Suck back the remaining solvant with the syringe.

5.2.2   Dry (purge) the measuring cell

If you have a sampling pump ASU-DE or not, the following steps will be the same:

- Insert the sampling tube into the dry air outlet (white connector without black ring).
- Keep the <PUMP> key pressed for approx. 2 s (until the message "Purge Checking" appears on the display.

```
9.ADJUST                      01-01
Temp.(°C)              Oscillation

Set  20.00                 845393
Cell 20.00
         Purge Checking
```

This Purge Checking will automatically turn off the pump when the cell will be dry, i.e. when the oscillation value doesn't change anymore.

Note: you can also stop the pump yourself by pressing the <PUMP> key .

5.2.3   Performing the air adjustment

Whether you have a sampling pump ASU-DE or not, the following steps will be the same:

- Press the <CALIB.> and follow the directions on the display:

```
9.ADJUST                    01-01
Temp.(°C)            Oscillation

Set   20.00              845393
Cell  20.00
          Purge OK?
```

If the cell is really clean and dry, press <ENTER>.

```
9.ADJUST                    01-01
Temp.(°C)            Oscillation

Set   20.00              845393
Cell  20.00
          Calibrating
```

While adjusting to the air value the display shows:

```
9.ADJUST                    01-01
Temp.(°C)            Oscillation

Set   20.00              845393
Cell  20.00
          Set Water
```

Wait until the next message is displayed.

5.2.4   Performing the water adjustment

- Open a vial of certified water (one of the five delivered water standards). This water will be used for the adjustment.

Note: you can also use bi-distilled water, but we recommend to use our certified water for traceability.

a) If you have a sampling pump ASU-DE:
- Remove the sampling tube from the measuring cell.
- Remove the drain tube connection from the ASU-DE pump (white connector with black ring).

b) The next steps will be the same wether you have a sampling pump ASU-DE or not:
- Pierce the septum of the certified water standard with the tip of the syringe.
- Fill the syringe with approx. 8 mL of certified water.
- Remove the tip of the syringe and insert the syringe in the sample inlet (lower measuring tube connection).
- Perform an analytical rinse, i.e. fill approx. 2 mL carefully, wait for 10 s without removing the syringe, then fill in again 2 mL very carefully. During the filling watch carefully that no air bubbles enter the measuring cell.

- Leave the syringe in the sample inlet .
- Press <ENTER>.

```
9.ADJUST                    01-01
Temp.(°C)             Oscillation

Set   20.00
Cell  20.00                1086415
          Calibrating
```

While adjusting to the water value the display shows:

```
9.ADJUST
Temp.(°C)

Set   20.00     OK      2.141349
Cell  20.00
          Calibration
```

At the end the calibration result is displayed. The number on the right side is the calibration factor (see section 3.2 "Measuring principle") and can be considered as a cell constant.

```
[Calibration]
Date : 29/06/1998 11:15

Result      : OK
Temperature :  20.0 °C

         OLD ---> NEW
Air
 T      845392    845393
 d      0.00120   0.00120

Water
 T      1086413   1086415
 d      0.99820   0.99821

Factor
      2.141345  2.141349

Name : Quality Lab 1
      ----------------
```

The results of the adjustment are printed on the attached printer:

```
9.ADUST
Temp.(°C)

Set   20.00    FAILED
Cell  20.00
          Calibration
```

When the instrument fails to do the adjustment it will show the error message:

In such a case clean the measuring cell well, dry it, and repeat the adjustment. If it fails again, then exchange the pure water (make sure it really is of the appropriate quality. i.e. our certified water standard, doubly distilled or correctly deionized). If the adjustment still does not succeed, contact your dealer for technical assistance.

5.3 Perform a measurement

Perform for example two measurements with your standard sample.

5.3.1 Set the parameter of the method

- Press the <MEAS.PARA> key.

```
Method 0     < Meas.Parameter >    VA

Method Name      :[TestMeth]
Measurement Temp.:[ 20.00]°C
Stability        :[1]
Limit Time       :[   600]s
Sequence         : Off   On
```

Enter your method name and measuring temperature. Leave stability and limit time as given. Select "Sequence On" with the → key (with ASU-DE). The sequence has to be "Off" without ASU-DE.

```
Method 0     < Meas.Parameter >    VA

Sampling      : Off   Set   Auto
Sampling Time :[   5]s
Drain         : Off   Set   Auto
Drain Time    :[  10]s
Rinse-1       : Off   Set
```

Setting of the sequence with ASU-DE: Set the parameters according to the following displays.

```
Method 0     < Meas.Parameter >    VA

Rinse-1 Time  :[   5]s
Rinse-2       : Off   Set   Auto
Purge         : Off   Set   Auto
Purge Time    :[  60]s
Cell Test     : Off   On
```

```
Method 0     < Meas.Parameter >

Calib.        :<Air&Water>
Exit          : [Execute]
```

5.3.2 Define the sample file (with or without ASU-DE)

- Press <SAMPLE> to enter the sample data: sample number and sample ID.

```
            < Sample >

  Sample No. : [02]-[01]
  Sample ID  : [ORANGE    ]
  Exit       : [Execute]
```

Enter sample no, for example 02-01: press 2 <ENTER> 1 <ENTER>.

Enter your sample ID using the alphanumeric keys (max. 10 characters) and confirm with <ENTER>.

5.3.3 Sampling with ASU-DE

- Dip the sampling tube into the beaker containing your sample.
- Press the <MEASURE> key.

```
11.TestMeth         ORANGE    02-01
Temp.(°C)                 Oscillation

Set  20.00                  1086414
Cell 20.86
            Sampling
```

The sampling will be done automatically, according to the predefined time.

Once the sampling is done, remove the sampling tube from the beaker.

5.3.4 Sampling without ASU-DE

- Fill the syringe with approx. 3 mL of your sample.
- Insert the syringe in the sample inlet (lower measuring tube connection).
- Fill the measuring cell with the syringe (approx. 2 mL). During the filling watch carefully that no air bubbles enter the measuring cell.
- Leave the syringe in the sample inlet.

5.3.5 Measurement

```
0.TestMeth          ORANGE     2-01
Temp.(°C)                 Oscillation
                          1086414
Set  20.00
Cell 20.86
            Measuring
```

Press the <MEASURE> key.

Press the <DISPLAY> key to switch from **Oscillation** to **Density**.

```
0.TestMeth          ORANGE    02-01
Temp.(°C)              Density(g/cm3)

Set  20.00                  0.99820
Cell 20.00
            Result
```

When the measurement is finished, the result is displayed and printed.

Note: This printout corresponds to the selection GLP for the report. See section 7 "Report" for more information.

```
*** Result ***

Sample No.    02-01

Date : 29/06/1998 11:15
Sample ID   : ORANGE
Method No.  : 0
Method Name : TestMeth
Meas.Temp.  : 20.00 °C
Period T    : 1086422
d[g/cm3]    : 0.99821

Meas.Time  : 00:00:36

Name : Quality Lab 1
       --------------
```

5.3.6 Cleaning and rinsing of the cell with ASU-DE

```
0.TestMeth          ORANGE      02-01
Temp.(°C)               Density(g/cm3)

Set  20.00                    0.99820
Cell 20.00
           Set Rinse-1
```

Follow the instructions on the display for the rinsing and purging. Use a highly volatile solvent (e.g. acetone or ethanol) for the rinsing.

5.3.7 Cleaning the cell without ASU-DE

- suck back the sample into the syringe.
- flush the measuring cell with appropriate solvent.
- if necessary flush again with a highly volatile solvent (for example acetone or ethanol) to facilitate the drying of the cell.
- dry the measuring cell according to section 5.2.2.

6. Sample (Number and ID) and Sample File

Here you can define your sample identifications like sample number and sample ID.

The sample number is composed of two parts: for example [03]–[01].

[03]: The first two-digit number – ranging from 00 to 98 – represents the series number of your measurement series. In the instrument it is called "High Sample No.". If you group your measurements of different sample types by this series number, you can conveniently process your data statistically later on.

[01]: The second two-digit number – ranging from 00 to 99 – is automatically increased by one per measurement.

Additionally you can define a sample ID, for example a sample name or the Lot number.

Press the <SAMPLE> key.

```
            < Sample >

  Sample No.  : [03]-[01]
  Sample ID   : [ORANGE    ]
  Viscosity   : off  on          (*)
  Exit        : [Execute]
```

Enter the sample ID using the alpha-numeric keys (max. 10 characters including "space", "period" and "hyphen").

(*) Appears with DE51, or with DE40 with viscosity correction (memory card).

6.1 Sample File (sample changer)

If you have connected a sample changer (see Function 3 "Changer") or set a sample file (see Function 1 "Sample File") another display will appear when pressing the <SAMPLE> key:

```
            < Sample >
Sample File      :Skip    Load    Save
Max.Meas.No.     :[  24]
Next.Meas.No     :[   1]
Method           :Current  Variable
Set Parameter    :[Execute]
Exit             :[Execute]
```

The first line is usually skipped, except when you want to SAVE OR load a sample file with a Memory Card (see section 12.8 to 12.10).

Max.Meas.No:
This is the total number of samples to be measured. This number can be higher than 24 (when used with the SC24). This number can be changed during the measurement. For example set this number to 12 if you have only 12 samples to measure when you start and change it later to 25 if you get 13 more samples to measure.

Next.Meas.No:
This is the next measurement number (according to the sample file). It is increased automatically after each measurement.

Method:
Here you can select if you want to perform all measurements with one method only (current method) or with different methods (variable).

Example:
You always get a series of 12 samples of grape juice and 7 samples of orange juice to measure. You want to check for each series your instrument with a check standard.
You will have to set up 3 different methods as follows:

	Method-0	**Method-1**	**Method-2**
Method Name	Grape.J	CheckStd	Orange.J
Meas.Temp.	20.00°C	20.00°C	20.00°C
Stability	2	0	2

You will the define a sample file as follows:

```
              < Sample >
Sample File     :Skip   Load   Save
Max.Meas.No.    :[   20]
Next.Meas.No    :[    1]
Method          :Current  Variable
Set Parameter   :[Execute]
Exit            :[Execute]
```

< Sample List>			
No.	M	S.No.	Sample ID
1	0	01-01	GRAPE
2	0	01-02	GRAPE
3	0	01-03	GRAPE
4	0	01-04	GRAPE
5	0	01-05	GRAPE
6	0	01-06	GRAPE
7	0	01-07	GRAPE
8	0	01-08	GRAPE
9	0	01-09	GRAPE
10	0	01-10	GRAPE
11	0	01-11	GRAPE
12	0	01-12	GRAPE
13	1	50-01	STANDARD
14	2	02-01	ORANGE
15	2	02-02	ORANGE
16	2	02-03	ORANGE
17	2	02-04	ORANGE
18	2	02-05	ORANGE
19	2	02-06	ORANGE
20	2	02-07	ORANGE

This sample file will run all 12 Grape juices with method 0 "Grape.J",

then the check standard with method 1 "CheckStd" (this method has a higher stability as it is required to check the instrument),

then run all 7 orange juices.

It will allow to run the statistics on each sample separately.

If the next series would be **without the first 12 grape juices**, you would have to select:
Max.Meas.No: 20
Next.Meas.No: 13

6.2   Viscosity correction

For viscosity corrected measurements the instrument has to be adjusted with the viscosity correction set to "On". Viscosity correction is available for the DE51 (standard) or for the DE40 (optional Memory Card).

Select "Viscosity" to be on in the Sample display as below.

```
         < Sample >

  Sample No.   : [03]-[01]
  Sample ID    : [ORANGE    ]
  Viscosity    : off  on          (*)
  Exit         : [Execute]
```

(*) This line appears only with the DE51, or the DE40 with viscosity correction (Memory Card.)

When working with a Sample File the viscosity correction can be chosen for each sample individually.

```
           < Sample List >
No.  M     S.No.Sample ID      Vis.
  1  1      01-01   ABC         On
  2  1      01-02   DEF         On
  3  1      01-03   GHI         On
  4  2      01-04   JKL         Off
  5  2      01-05   MNO         Off
```

The measurement display shows "Visc.", if the sample is measured with viscosity correction.

```
0.Method-0                      01-01
Temp.(°C)             Density (g/cm³)

Set   20.00                   1.23456
Cell  20.00   Visc.
            Measuring
```

Note: When Viscosity correction is chosen "On", the Stability of the measurement will be fixed to "O".

In viscosity correction mode the instrument first waits for stability, which will be signalized with a beep, and then starts the viscosity correction measurement.
In GLP mode the T-values without and with viscosity correction as well as the corrected density will be printed.

7.   Report (password protected)

In the <REPORT> menu you can choose the format of your printout according to the following table.

	Short	GLP	Variable
Name	X	X	X
Model, Serial, Version		X	choice
Sample No.	X	X	choice
Date & Time	X	X	choice
Sample ID		X	choice
Method No., Method name		X	choice
Meas.Temp.	X	X	choice
Period T		X	choice
Meas. Data		X	choice
Temp. Comp.		X	choice
Result	X	X	choice
Meas. Time		X	choice

These report parameters can be set individually for each of the 10 methods.

8. Measuring parameter (password protected)

This section describes how to set the measuring parameters for the methods. These measuring parameters can be set for each of the 10 methods:

Parameter	Default value
Method name	Method-x
Measuring temperature	20.0 °C
Stability (0-2)	1
Limit Time	0 s
Sequence	Off

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

Press the <METHOD> key.

First select the method for which you want to set the measuring parameters.

Press <ENTER> to confirm.

8.1 Method name

This option is used to define method names for each method. You can enter names according to products or according to operators, depending on your needs.

- Press the <Meas.Para> key.

```
Method 0    < Meas.Parameter >    VA

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

The default name is displayed. Press the <CLEAR> key twice to clear the name.

Press the <DISPLAY> key to select the input mode of the keyboard:
A: CAPITAL LETTERS (A, B, C,...)
a: small letters (a, b, c, d, ...)
1: numbers (0, 1, 2, 3, ...)

Examples of method names (either by product or by operator):

Product names	Operator names
Orange	Smith
Grape	Nelson
Lemon	McNeil
Apple	Gordon
.	.

Enter your method name using the alphanumeric keys (max. 8 characters) and confirm with <ENTER>.

8.2 Measuring temperature

This option is used to set the measuring temperature.

```
Method 0     < Meas.Parameter >    VA

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

Enter your measuring temperature (from 4 °C to 70 °C, 4 °C to 90 °C for DE40) and confirm with <ENTER>.

Note: After changing the set temperature make sure to allow enough time for the instrument to warm up.

To **increase** the temperature:				To **decrease** the temperature:			
from	to	change	time	from	to	change	time
10 °C $\Rightarrow$ 20°C		+10 °C	30 min	20 °C $\Rightarrow$ 10°C		-10°C	1 hour
20 °C $\Rightarrow$ 30°C		+10 °C	30 min	30 °C $\Rightarrow$ 20°C		-10°C	1 hour
20 °C $\Rightarrow$ 70°C		+50 °C	1 hour	70 °C $\Rightarrow$ 20°C		-50°C	2 hours

8.3 Measurement stability

This option is used to set the measurement stability, which allows to shorten the measuring time. See section 3.2 "Measurement principle" for more details.

```
Method 0     < Meas.Parameter >    VA

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

Enter your stability (0, 1 or 2) and confirm with <ENTER>.

0: Maximum stability. The measured signal (T-value) has to be stable before the density is accepted. Longest measuring time (Time-0).

1: High stability. The final T-value is extrapolated, and the density is calculated. Medium measuring time. (Time-1 is approximately 1/2 of Time-0) .

2: Low stability. The final T-value is extrapolated from less values, and the density is calculated. Lowest measuring time. (Time-2 is approximately $1/4$ of Time-0).

Note: Stability is fixed to zero when viscosity correction is active (section 6.2).

8.4 Limit time

This option is used to set the limit time. When this time limit is reached, the measurement is stopped and the measured value taken, even if it is not stable.

```
Method 0      < Meas.Parameter >    VA

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

Enter the limit time (enter 0 s for no limit time).

8.5 Sequence (sampling, drain, rinse, purge)

This option is used to set a sample sequence. This sample sequence is mainly used together with the sampling pump ASU-DE or with the sample changer SC24. It can be used as a SOP (Standard Operating Procedure) with the ASU-DE. This sample sequence allows you to define sampling time, drain time, rinsing times (for two different solutions) and purge time.

```
Method 0      < Meas.Parameter >    VA

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

Select sequence "On" with the → key to set a sample sequence. Confirm with <ENTER>.

```
Method 0      < Meas.Parameter >    VA

Sampling           : Off   Set   Auto
Sampling Time  :[    5]s
Drain              : Off   Set   Auto
Drain Time     :[   10]s
Rinse-1            : Off   Set
```

Select the input mode of the sampling time:
Set : Manual input, time is set by operator.
Auto: Automatic setting of sampling time. (see section 8.7)
Off : No sampling.

If you have selected "Set" you have to enter the sampling time (0 to 9999 s). For most of the non viscous samples we recommend a sampling time of 5 s. Once you have set the sampling time, adjust the sampling speed (Sampling Adj. control on the ASU-DE or on SC24) in order to get the sample in with this sample time.

```
Method 0      < Meas.Parameter >    VA

Sampling           : Off   Set   Auto
O.S.Rate       :[   70]%
Sampling Limit :[   0]s
Drain Time         : Off   Set   Auto
Drain Time         : [   10]s
```

If you have selected "Auto" you have to enter the "Over Sampling Rate" and the "Sampling Limit".

O.S.Rate: The instrument will detect how much time it needs from starting the pump until the sample reaches the measuring cell and will add the O.S.Rate to this time.

Sampling Limit: This is the sampling time which should not be exceeded. After this time the pump automatically stops.

```
Method 0    < Meas.Parameter >    VA

Sampling        : Off   Set   Auto
O.S.Rate        :[  70]%
Sampling Limit  :[  0]s
Drain           : Off   Set   Auto
Drain Time      : [ 10]s
```

Select the input mode of the drain time:

Set : Manual input, time is set by the operator.

Auto: Automatic setting of drain time. (see section 8.7).

Off : No draining.

If you have selected "Set" you have to enter the drain time (0 to 9999 s). A typical drain time for non-viscous samples is about 10 s to 20 s.

```
Method 0    < Meas.Parameter >    VA

Sampling        : Off   Set   Auto
O.S.Rate        :[  70]%
Sampling Limit  :[  0]s
Drain           : Off   Set   Auto
Drain Rate      : [ 100]%
```

If you have selected "Auto" you have to enter the Drain Rate. The instrument will use this percentage of the sampling time as drain time.

```
Method 0    < Meas.Parameter >    VA

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

Select the input mode of the Rinse-1 time:

Set : Manual input, time is set by operator.

Off : No Rinse-1.

If you have selected "Set" you have to enter the Rinse-1 time (0 to 9999 s). We recommend to use a dedicated solvent for your sample as Rinse-1 solution.

```
Method 0    < Meas.Parameter >    VA

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

Select the input mode of the Rinse-2 time:

Set : Manual input, time is set by operator.

Off : No Rinse-2.

If you have selected "Set" you have to enter the Rinse-2 time (0 to 9999 s). We recommend to use a volatile solvent as Rinse-2 solution (e.g. acetone). This will allow to speed up the purging of the measuring cell.

Select the input mode of the Purge time:

```
Method 0     < Meas.Parameter >     VA

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

Set: Manual input, time is set by the operator.

Off: No Purging.

Auto: Purge will stop automatically when the cell is dry, i.e. when the oscillation value doesn't change anymore.

If you have selected "Set" you have to enter the Purge time (0 to 9999 s).

If "Set" or "Auto" has been selected for the purge action you can set a "Cell Test" to be performed after the end of the drying action (purge).

```
Method 0  < Meas.Parameter >     VA

Cell Test        :Off  On
Reliability      :[10]
Calib.           :<Air & Water>
Exit             :[Execute]
```

Select Cell Test: "On" to perform an automatic cell test at the end of the purge sequence.

Enter the reliability value.

The "Cell Test" measures the density of the empty cell (air) and compares it to the theoretical density of air at this temperature (value is stored in the instrument). A reliability value can be entered, which stands for the maximum tolerated difference between the measured and theoretical density of air. Its default value is 10.

A reliability of 10 means: - DE40: $\pm 10 * 10^{-4}$ g/cm^3

                            - DE50 and DE51: $\pm 10 * 10^{-5}$ g/cm^3

8.6   Adjustment mode (Calibration selection)

This option is used whenever you want to select special standards for adjustment. The standard adjustment mode is with air & water.

```
Method 0  < Meas.Parameter >     VA

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

Select Calib.:<Other STD> to perform the adjustment with your own density standards.

Enter the values of these two density standards.

Note: The Cell Test is not available if you select "Other STD". Only very accurate density standards should be used for adjustment with other standards, otherwise your density meter could give wrong results.

8.7 Explanation of auto-sampling and auto-draining

You have selected "Auto" for the sampling and for the draining, for example with:

Over Sampling rate = 30%

Drain rate = 70%

If the time measured from starting the pump until the sample reaches the measuring cell (with ASU-DE or SC24) is 10 s, then the sampling and the drain time will be:

Sampling time = 10 + (10 x 0.30) = 13 s

Drain time = 13 x 0.70 = 0.91 s

When using this oversampling rate (O.S.Rate) make sure that the measurement cell as well as the ingoing tubings are empty and dry when you press the <MEASURE> key. The instrument detects the sharp change of the measurement signal caused by the sample entering the cell.

9. Calculation parameters (password protected)

This section describes how to select the type of results (density, specific gravity, concentration), the number of decimals for these results and how to set the parameters for the concentration calculation. These calculation parameters can be set for each of the 10 methods.

Press the <CALC.PARA> key.

```
Method 0   < Calc.Parameter >

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

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

Select CALC.PARA - Density

```
Method 0      < Density >

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

   Exit     :[Execute]
```

Select what density should be displayed and printed:

d: mass density (real density).

d(t/4): relative density referred to water at 4 °C.

d(t/t): relative density referred to water at the measurement temperature.

At 20 °C: $d(t/t) = d_{20}^{20}$ and $d(t/4) = d_4^{20}$

9.2   Result (Density, Concentration, BRIX, ALCOHOL, USER TABLE)

Select CALC.PARA - Result.

```
Method 0  < Result >

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

Select which result should be displayed and printed:

d: density, resp. d/t/t) or d(t/4), depending on the selected density (previous step).

Conc.: concentration.

Note: here you can also select concentration applications, if they have been previously loaded with a Memory Card (See also section 13 "Application Memory Cards): **BRIX, ALCOHOL, USER TABLE**.

Concentration

```
Method 0  < Result >

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

Select "Conc." with the → key.
Confirm with <ENTER>.

You will select this option if you want to determine the concentration of two-component solutions, e.g. aqueous solutions of glycerol or acetone. Ask your local representative for available concentration tables or download them from our Internet Homepage: **www.density.com**.

There are two ways to program a concentration function, either by entering this function directly (provided that this function is already known) or by entering a concentration table (data pairs of density and corresponding concentration).

First you have to select the unit for your concentration. This unit should be the same as that of the solution used: the instrument does not convert units.

```
Method 0  < Result >

Result       : <Conc.        >
Conc.Unit    : <None       >
Conc.Formula : <A+Bx           >
Parameter Set : Table  Coefficient
Data Replace : <x<-d-R  >
```

Select your "Conc.Unit" with the → key. Confirm with <ENTER>. Following units are available: No unit, %, ppm, mg/g, mg/mL, mg/L, g/L, Eq/L, mol/L, g/cm^3.

Then you have to select the concentration formula. If your concentration function is known already, select the same function. If your concentration function is not known (input of concentration table) select the formula which best fits your concentration. As a rule of thumb we recommend to select $A+Bx+Cx^2$ if you don't know which formula to select.

Case 1: Direct input of concentration function (known concentration function)

We will describe this function using an example: measurement of Apparent Extract in beer. The function to convert density into Apparent Extract is:

$$\textbf{Apparent Extract} = -460.234 + 662.649 \times d_{20}^{20} - 202.414 \times [d_{20}^{20}]^2$$

The following steps have to be performed:

```
Method 0  < Result >

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

Select "%" as Conc.Unit with the → key. Confirm with <ENTER>.

Select "A+Bx+Cxx" with the → key. Confirm with <ENTER>.

```
Method 0  < Result >

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

Select "Coefficient" with the → key.
Confirm with <ENTER>.

Select "x <- d" with the → key.
Confirm with <ENTER>. See also
paragraph "Constants used" on
page 41.

```
Method 0  < Result >

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

Enter the A, B and C values
Confirm with <ENTER>.

Now the DE40 (DE50 or DE51) has been programmed to measure APPARENT EXTRACT
in beer. Load the measuring cell with degased beer (any air bubbles would lead to wrong
results). After pressing <MEASURE>, the following values will be displayed:

```
0.Method-0                      01-01
Temp.(°C)                   Conc.(%)

Set  20.00
Cell 20.00                    1.8804
         Measuring
```

During the measurement the
temperature and the concentration
are displayed.

```
0.Method-0                      01-01
Temp.(°C)                   Conc.(%)

Set  20.00
Cell 20.00                    1.88
          Result
```

At the end of the measurement the
final result will be displayed
(APPARENT EXTRACT
concentration).

Note: you can select the number of
decimal places under "Calc.
Para.-Decimals".

Note: This concentration function can also be used to convert the density into other units,
e.g. into API degree. The function used to convert density into API degree is:

$$\textbf{API degree} = [(1/\mathbf{d}_{20}^{20}) - 1] \times 141.5 + 10$$

Case 2: Input of concentration table (concentration function unknown)

We will describe this function using an example: measurement of sulfuric acid concentration
(aqueous solution). You will have to enter a concentration table (data pairs of density and
corresponding concentration), the DE40 (DE50, DE51) will determine automatically the
correct coefficients for the concentration function.

Concentration table for sulfuric acid (from "Handbook of Chemistry and Physics").

	Concentration (in %)	d (at 20 °C)
1	10	1.0661
2	20	1.1398
3	30	1.2191
4	40	1.3028
5	50	1.3952
6	60	1.4987
7	70	1.6105
8	80	1.7272
9	90	1.8144

Note: see our Internet Homepage **www.density.com** for other concentration tables.

```
Method 0   < Result >

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

Select "%" with the → key. Confirm with <ENTER>.

Select "$A+Bx+Cx^2$" with the → key. Confirm with <ENTER>.

```
Method 0   < Result >

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

Select "Table" with the → key. Confirm with <ENTER>. The best results are obtained if <x← d-R> is selected for data replace (see note on next page).

```
Method 0   < Result >

Data No. (3-30) : [ 9]
Enter Conc.Table: [Execute]
Exit            : [Execute]
```

Enter the number corresponding to the number of data pairs to be entered (e.g. 9 in this example). Up to 30 data pairs can be entered.

```
Method 0   < Conc.Table >
No.    Conc.       Density      .
  1   [10.0000]   [ 1.06610]
  2   [20.0000]   [ 1.13980]
  3   [30.0000]   [ 1.21910]
  4   [40.0000]   [ 1.30280]
 Edit   Clear   Get Para.   Exit
```

Select "Edit" with the → key. Confirm with <ENTER>.
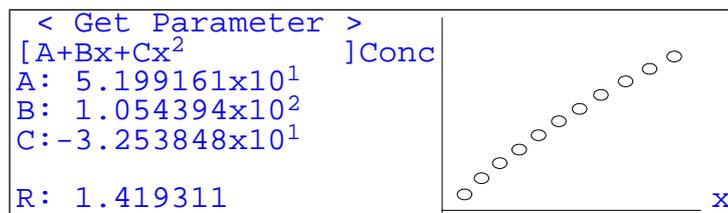
Enter the data pairs according to the table.

```
Method 0   < Conc.Table >
No.    Conc.       Density      .
  6   [60.0000]   [ 1.49870]
  7   [70.0000]   [ 1.61050]
  8   [80.0000]   [ 1.72720]
  9   [90.0000]   [ 1.81440]
 Edit   Clear   Get Para.   Exit
```

Enter all other data pairs according to the table.

Select "Get Parameter" with the → key. Confirm with <ENTER>.

```
 < Get Parameter >
[A+Bx+Cx²         ]Conc
A: 5.199161x10¹
B: 1.054394x10²
C:-3.253848x10¹

R: 1.419311              x
```

The results of the calculation are shown and can be printed.

Constants used

The A, B and C values are the **coefficients** of the selected function. The R value is the mean value of all the entered density values. The instrument replaces the density values with the density minus mean value (x←d-R) to optimize the algorithm used (compute lower values).

Note: these A, B, C and R values can be used to input the concentration function directly without having to enter the table again.
In this case R is the mean value of all density values and (x←d-R) should be selected as "Data Replace" for the function.

Now your density meter has been programmed to measure the concentration of sulfuric acid. Insert an aqueous solution of sulfuric acid into the measuring cell. After pressing <MEASURE>, the following values will be displayed:

```
0.Method-0              01-01
Temp.(°C)          Conc.(%)

Set  20.00
Cell 20.00           23.5176
        Measuring
```

During the measurement the temperature and the concentration are displayed.

At the end of the measurement the final result (sulfuric acid concentration) will be displayed.

```
0.Method-0              01-01
Temp.(°C)          Conc.(%)

Set  20.00
Cell 20.00             23.5
         Result
```

Note: you can select the number of decimal places under "Calc. Para.-Decimals".

9.3 Temperature compensation

This section describes how to set the temperature compensation. It allows to measure the sample at one temperature and compensate the result to another temperature. There are three main applications which use this temperature compensation:

- The sample is to viscous to be introduced into the measuring cell or even solid (e.g. paraffin). Therefore you need to heat the sample up to get it liquid enough to introduce it into the measuring cell (e.g. 60 °C) but you want to get the density at 15 °C.

Note: for one special application there is already an Application Memory Card available which allows to measure OIL products at any temperature and get the density at 15 °C or 60 °F. See section 14.1 "API software" for more information.

- Speed up the measurement. For example, if your sample comes at 40 °C and you have to get the density at 20 °C you can set the measuring temperature to 40 °C and compensate the result to 20 °C (provided you know the slope of the density against temperature of your specific sample).
- The reference temperature is out of the instrument range. For example if you have to get the density at 100° C (maximum measuring temperature of the DE50 is 70 °C). You can set the measuring temperature to 70 °C and compensate the result to 100 °C (provided you know the slope of the density against temperature of your specific sample).

Press the <Calc.Para> key.

```
Method 0   < Calc.Parameter >

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

Select "3.Temperature Compensation". Confirm with <ENTER>.

```
Method 0      < Temp.Comp>

Temp.Comp.       : Off    On
Exit             :[Execute]
```

Select "On" with the → key. Confirm with <ENTER>.

```
Method 0      < Temp.Comp>

Temp.Comp.       : Off    On
Comp.Temp.       :[  20.00]°C
Temp.Formula     :<A+Bx           >
Parameter Set    :Table   Coefficient
Data No.(2-30)   : 20]
```

Enter the temperature at which you want to have the result.

There are two ways to program a temperature compensation function, either by entering this function directly (provided that this function is already known) or by entering a temperature compensation table (data pairs of temperature and corresponding density). See previous section 9.2 Result:

Case 1: Direct input of concentration function   For input of temp.comp. function

Case 2: Input of concentration table   For input of temp.comp. table

9.4   Decimals

This section describes how to set the decimals for your results (d, concentration).

Press the <Calc.Para> key.

```
Method 0   < Calc.Parameter >

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

Select "3.Decimals". Confirm with <ENTER>.

```
Method 0      < Decimals >

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

Enter the number of decimals for the density (d) respectively specific gravity: d(t/t), d(t/4).

Enter the number of decimals for the different other options:

Conc: Concentration (must have been previously selected under Calc.Para-Result)

BRIX: Sugar concentration (must have been previously loaded with the Application Memory Card and selected under Calc.Para-Result)

Alcohol: Ethanol concentration (must have been previously loaded with the Application Memory Card and selected under Calc.Para-Result)

Note: The measured values will be displayed and printed out according to the selected settings.

10. Functions (password protected)

10.1 Data File (Function 0)

This function allows to view and process the measured data. You can either do a recalculation of measured results, statistics on the results or delete single data i.e. mark them so that they are not considered in the statistics calculations. You can also save these measured data on a Data Memory Card or load them from such a card for recalculation.

```
           < Function >

0.Data File        5.Set Check
1.Sample File      6.Periodic
2.Method File      7.Auto Start
3.Changer          8.CARD utility
4.Factor           9.Memory Clear
```

```
           < Data File >
 No. M.Name     Sample     Result   .
  0 Method-0   01-01 d   0.99820
  1 Method-0   01-02 d   0.99819
  2 Method-1   02-01 Br  10.81
  3 Method-1   02-02 Br  10.82
 Statis.  Recalc.   Load  Save   Exit
```

Select Function "0.Data File" and confirm with <ENTER>.

The measured data are displayed, together with the method and result type:
- d   : density
- dt : specific gravity (d(t/t))
- d4 : specific gravity (d(t/4))
- C   : concentration
- Br : BRIX
- Al : ALCOHOL

Now select with the ← and → keys between <Statistics>, <Recalc.>, <Load> and <Save> and confirm with <ENTER>.

Note 1: If you have many data stored, press 0 to display the first 4 data (0 to 3), and 1 to 9 to display the next blocks of data (10 to 13, 20 to 23, ... 90 to 93).

Note 2: The <Load> and <Save> options require a Data Memory Card. These options are described separately in section 12."Data Memory Cards".

10.1.1 Statistics

The function allows to process and view the measured data statistically. You can calculate the mean value (Mean), the standard deviation (SD) and the relative standard deviation (RSD). The relative standard deviation is the same as the coefficient of variation (CV).

The measured data can be filtered so that useful statistical results can be obtained after a days work. On the first level the method will give access to the respective data only. On the second level the series number (first two-digit number of the sample number) can be chosen for which the statistics is to be done.

Note: If too many filters are activated it is possible that all results are excluded.

```
         < Data File >
 No. M.Name     Sample     Result   .
  0 Method-0   01-01 d    0.99820
  1 Method-0   01-02 d    0.99819
  2 Method-1   02-01 Br   10.81
  3 Method-1   02-02 Br   10.82
 Statis.  Recalc.   Load   Save   Exit
```

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

```
        < Statistics Result >

    Results     :    4
    Mean        :   10.82 %
    SD          :    0.06 %
    RSD         :    0.54 %
    Exit        :[Execute]
```

After selecting <Statis.> and con-
firmation with <ENTER>, you can
select the filter to process only the
desired results: result, method no,
method name, high sample no.
Select the desired filter to be "On"
using the → key.

Now you select whether the
statistics results are to be printed
alone (Data Print "Off") or together
with a list of all the measured values
(Data Print "On").

The statistics is now shown on the
display.

```
<Statistics>
Date : 29/06/1998 17:29
Sample No.(High) : 01
Method No.  : 2

Results:   4
Mean    :   10.82 %
SD      :    0.06 %
RSD     :    0.54 %



Name : Quality Lab 1

             ----------------
```

To print the results of the statistics
calculation press the <PRINT> key.

Select Exit : [Execute] and confirm
with <ENTER> to exit.

10.1.2   Recalculation

This function allows to recalculate single measured values. Before you do this you have to
change the calculation formula (or calculation table) in the respective method to the desired
one (like density to BRIX, shown in this example). When you now enter the recalculation
menu the result will be shown directly according to the new calculation setting.

```
         < Data File >
 No. M.Name     Sample     Result   .
 11 Method-5   01-01 d    1.03981
 12 Method-5   01-02 d    1.03980
 13 Method-6   02-01 Br   10.81
 14 Method-6   02-02 Br   10.82
 Statis.  Recalc.   Load   Save   Exit
```

Select the data to be recalculated
with the <UP> and <DOWN> keys.

Select Recalc. with the ← and →
keys and confirm with <ENTER>.

```
0.Method-5                    01-02
Temp.(°C)          Density(g/cm3)

Set   20.00              1.03980
Cell  20.00
        Recalculation
```

Press the <CALC.PARA> key.

```
Recalc.  < Calc.Parameter >

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

Select "1.Result" and confirm with <ENTER>

```
Recalc.   < Result >

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

Select Brix with the $\rightarrow$ key and confirm with <ENTER>

Select Function 0.Data File again

```
         < Data File >
 No. M.Name      Sample     Result    .
 11 Method-5   01-01 d    1.03981
 12 Method-5   01-02 Br   10.40
 13 Method-6   02-01 Br   10.81
 14 Method-6   02-02 Br   10.82
 Statis.  Recalc.   Load  Save  Exit
```

The recalculated result is shown (from density to BRIX)

10.1.3   Data Deletion

This function allows to exclude single measured values from the statistics calculation by marking them with an asterisk (they are not deleted from the list).

```
         < Data File >
 No. M.Name      Sample     Result    .
  1 Method-0   01-01 d    10.81
  2 Method-0   01-02 Br    8.40
  3 Method-0   01-03 Br   10.81
  4 Method-0   01-04 Br   10.82
 Statis.  Recalc.   Load  Save  Exit
```

Select the data to be excluded with the <UP> and <DOWN> keys.

Exclude this data by pressing the <DISPLAY> key.

```
         < Data File >
 No. M.Name      Sample     Result    .
  1 Method-0   01-01 d    10.81
* 2 Method-0   01-02 Br    8.40
  3 Method-0   01-03 Br   10.81
  4 Method-0   01-04 Br   10.82
 Statis.  Recalc.   Load  Save  Exit
```

The excluded data is marked with an asterisk.

Now you can resume the statistics calculation again and then print the results without the marked measurements. If you selected the data print "On" the excluded measurements will be printed with an asterisk before the sample number.

10.2 Sample File (Function 1)

This function is used normally when the instrument is operated in connection with a sample changer.

```
         < Sample File >

    Sample File : Off   On

    Exit        : [Execute]
```

It is automatically set to ON when a Sample Changer has been selected (see Function 3).

It can also be used without Sample Changer to run standard measurements always in the same sequence. See also section 6.1 "Sample File" for more information.

10.3 Method File (Function 2)

This function is used together with a Data Memory Card to save and load a method file.

```
       < Method File >
No.    Name  Temp.(°C)   Result  .
0. ORANGE     20.0        d
1. GRAPE      20.0        d
2. LEMON      20.0        d
3. APPLE      20.0        d
     Load     Save      Exit
```

See section 12. "Data Memory Cards" for more information.

10.4 Changer (Function 3)

Here you can define the connected sample changer (SC24 or CHG-241) or auto sampling unit DCU-300.

Press function 3 (Changer) and confirm with <ENTER>.

```
          < Changer >

    Changer        : <SC24     >
    Exit           : [Execute]
```

Choose the desired equipment using the → key:
None, DCU-300, SC24, SOP40, SOP50 or CHG-241. Confirm with <ENTER>.

When choosing the SC24 you can define whether the measuring series is started with a calibration (On) or not (Off).

Note: Select CHG-241 if you connect a CHG-260.

```
            < Changer >

   Changer       : <SC24    >
   Calib.        : Off   On
   Start Position : Home   Current
   Exit          : [Execute]
```

Selecting Calib. "On" means that in the starting position there has to be a vial with deionized water, and that sample vials are placed after this position. When pressing <MEASURE> the instrument will first perform a calibration with air and water. Only after this will the sample measurement be done.

```
            < Changer >

   Changer       : <SC24    >
   Calib.        : Off   On
   Start Position : Home   Current
   Exit          : [Execute]
```

Here you can define the starting position on the turntable. You can select that measurements are started at "Home" (number 1 on the turntable) or "Current" (the actual position on the turntable). Confirm with <ENTER>.

10.5   Factor (Function 4)

If you know the period of oscillation T and the density of air and water for a particular temperature, you can enter these values here manually for the calculation of the factor.

```
             < Factor >
Temp.     :[  20.00]°C
Air T/d   :[   845401]/[ 0.00120]
Water T/d :[ 1086417]/[ 0.99821]
Correct   :[Execute]
Factor    :[  2.141349]
Exit      :[Execute]
```

10.6   Set check (Function 5)

In this function you can set up define the substances - name, rated value and allowed tolerances - you want to use as standard check samples either for the daily or the periodic check.

Select function 5 - Set Check - and confirm with <ENTER>.

```
           < Set Check >

   Check       :Daily   Periodic
   Standard    :[Fl. Carbon ]
   Ref.Value   :[   1.94796]g/cm3
   Tolerance   :[   0.00004]g/cm3
   Exit        :[Execute]
```

With the ← and → keys select either "Daily" or "Periodic" and confirm with <ENTER>.

10.6.1   Daily Check

This check is used mainly to control the working condition of the instrument. Is the instrument really clean and dry? Did the previous operator really clean the cell after measuring his sample?

Pressing the Check key will always activate a daily check, unless a periodic check is due (see also section 10.7).

Normally deionized or bi-distilled water is used for this purpose. Of course any other solution can be used that suites the purpose i.e. is readily and in abundance available as well as has a stable and well known composition.

```
              < Set Check >

   Check          :Daily   Periodic
   Standard        :[Water        ]
   Ref.Value       :[     0.99821]g/cm3
   Tolerance       :[     0.00008]g/cm3
   Exit            :[Execute]
```

This example uses water as daily check solution.

The results of this daily check are not stored in the instrument. They are just meant to check whether the instrument is really ready for the next measurement.

10.6.2   Periodic Check

This check is used mainly to verify whether a new adjustment of the instrument is necessary or not. Every adjustment of the instrument means that the instrument settings are changed. This can be dangerous if it is not done correctly because all the measurements afterwards will be wrong.
Pressing the check key will start a periodic check only when such a test is due according to the settings in section 10.7.1. When no periodic check is due it will start a daily check.

So instead of actually performing frequent adjustments we suggest to perform frequent checks with an exactly known standard solution. As long as this periodic check is done successfully, there is no need to adjust the instrument. The results of periodic check are read automatically in the instrument. Should the periodic check fail, the operator should carefully clean and dry the measuring cell and then repeat the periodic check. If it still fails, then the instrument should be adjusted again: press the <Calib.> key and follow the instructions of the instrument.

If the periodic check fails too often even after re-adjusting the instrument - like every second or third time - then you should contact your local supplier for servicing and closer support.

```
              < Set Check >

   Check          :Daily   Periodic
   Standard        :[Toluene      ]
   Ref.Value       :[     0.86683]g/cm3
   Tolerance       :[     0.00002]g/cm3
   Exit            :[Execute]
```

This example uses toluene as periodic check solution.

The results of this periodic check are stored in the instrument. They can be retrieved under Function "6. Periodic" and "Show Check List".

We recommend to use our certified density standards for a periodic instrument check:

ME-51338002	Water	0.99... g/cm^3	+/- 0.00001
ME-51338003	Beverage syrup	1.04... g/cm^3	+/- 0.00010
ME-51338004	Dichlorotoluene	1.26... g/cm^3	+/- 0.00002
ME-51338005	Fluorocarbon	1.95... g/cm^3	+/- 0.00002

10.7 Periodic (Function 6)

This function is used to set the intervals of the periodic adjustment (calibration) as well as the periodic check. This function is also used to display and print the last adjustment data and check data stored in the instrument.

10.7.1 Periodic Check

Select function 6 "Periodic" and confirm with <ENTER>.

```
          < Periodic>
Periodic        :Check  Calib.
Next Check Date :19/07)1998
Check Alarm     :Off  On
Check Interval  :[  7]day
Show Check List :[Execute]
Exit            :[Execute]
```

The display will show the due date for the next periodic check. This due date is calculated automatically by the instrument according to following settings. Confirm with <ENTER>.

```
          < Periodic>
Periodic        :Check  Calib.
Next Check Date :19/07)1998
Check Alarm     :Off  On
Check Interval  :[  7]day
Show Check List :[Execute]
Exit            :[Execute]
```

Select the periodic check (Check Alarm) to be "On" or "Off", and confirm with <ENTER>.

If "On" is selected, the instrument will give one of the following messages when it is turned on: "X Days To Check" as a remainder, "Check Day" on the due date, and "Check Day Over!" on the following days. Each of these displays will return to the "Ready" display after a while. If "Off" is selected, the periodic check is not active i.e. whenever you press check, a daily check is performed.
While running the instrument will not display a message, but pressing the Check key will start a periodic check.

```
          < Periodic>
Periodic        :Check  Calib.
Next Check Date :19/07)1998
Check Alarm     :Off  On
Check Interval  :[  7]day
Show Check List :[Execute]
Exit            :[Execute]
```

Enter the check interval (in days) and confirm with <ENTER>

Note: Enter 0 Day to force a periodic check on today's date. This will especially be required if the periodic check has failed, in order to perform it again.

```
            < Periodic>
 Periodic          :Check   Calib.
 Next Calib.Date  :19/07)1998
 Check Alarm       :Off   On
 Check Interval    :[   7]day
 Show Check List   :[Execute]
 Exit              :[Execute]
```

Select Show Check List Execute to display the list of the last 10 checks performed

The whole list can be printed pressing the <PRINT> key.

```
          < Show Check List >
 No.   Date    Ref.Value     Meas.     .
 10   13/07    0.86683     0.86686   NG
  9    6/07    0.86683     0.86685   OK
  8   29/06    0.86683     0.86684   OK
  7   22/06    0.86683     0.86684   OK
  6   15/06    0.86683     0.86682   OK
```

The results of such a periodic check are automatically stored in the instrument. You can view the last 10 checks performed.

Select the data you are interested in and press <ENTER> to get the full data dispayed.

```
           < Show Check List >
 Date       :13/07/1998
 Standard   :TOLUENE
 Temp.      : 20.00 °C
 Ref.Value : 0.86683   (+- 0.00002)
 Meas.Data : 0.88686   (NG)
 Exit       :[Execute]
```

10.7.2 Periodic Adjustment (Calibration)

The instrument has to be adjusted from time to time. You can either choose the time according to your special needs i.e. perform it when the periodic check fails for example two times successively, or you can define a certain time period after which the instrument will remind you to repeat the adjustment.

The results of these adjustments will automatically be stored by the instrument. You can view at any time the last 10 adjustments performed and also print out the list for documentation purposes as described below.

Select function 6 "Periodic Calib." and confirm with <ENTER>.

```
            < Periodic>
 Periodic          :Check   Calib.
 Next Calib.Date  :19/07)1998
 Calib.Alarm       :Off   On
 Calib.Interval    :[   7]day
 Show Calib.List   :[Execute]
 Exit              :[Execute]
```

The display will show the due date for the next periodic adjustment. This due date is calculated automatically by the instrument according to following settings. Confirm with <ENTER>.

```
            < Periodic>
 Periodic          :Check   Calib.
 Next Calib.Date  :19/07)1998
 Calib.Alarm       :Off    On
 Calib.Interval    :[   7]day
 Show Calib.List   :[Execute]
 Exit              :[Execute]
```

Select the periodic adjustment (Calib. Alarm) to be "On" or "Off", and confirm with <ENTER>.

If "On" is selected, the instrument will give one of the following messages when it is turned on: "X Days to Calib" as a remainder, "Calib. Day" on the due date, and "Calib. Day Over!" on the following days. Each of these displays will return to the "Ready" display after a while.
If "Off" is selected, the instrument will not remain you to readjust.

```
              < Periodic>
 Periodic          :Check  Calib.
 Next Check Date   :19/07)1998
 Calib. Alarm      :Off  On
 Calib.Interval    :[  7]day
 Show Calib.List   :[Execute]
 Exit              :[Execute]
```

Enter the adjustment interval (in days) and confirm with <ENTER>.

Note: Enter 0 Day to force a periodic adjustment on today's date.

```
              < Periodic>
 Periodic          :Check  Calib.
 Next Calib.Date   :19/07)1998
 Calib.Alarm       :Off  On
 Calib.Interval    :[  7]day
 Show Calib.List   :[Execute]
 Exit              :[Execute]
```

Select Show Calib.List Execute to display the list of the last 10 adjustments performed.

```
          < Show Calib.List >
No.  Date     Temp.(°C)    Factor      .
10   13/07      20.00     2.142349   OK
 9    6/07      20.00     2.142342   OK
 8   29/06      20.00     2.142337   OK
 7   22/06      20.00     2.142338   OK
 6   15/06      20.00     2.142335   OK
```

The results of such a periodic adjustment are automatically stored in the instrument. You can view the last 10 adjustments performed. Select the data you are interested in and press <ENTER>.

```
          < Show Calib.List >
Date       :13/07/1998
Temp.      : 20.00 °C
Air        :T=   845401  d= 0.00120
Water      :T=  1086417  d= 0.99821
Factor     : 2.142349 (OK)
Exit       :[Execute]
```

By pressing the print key the whole list is printed.

10.8   Auto Start (Function 7)

This function is used mainly for repetitive measurements in one sample. It can not be turned on when there is a connection to a sample changer or to a DCU.

```
         < Auto Start >

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

Press <Function> 7 and confirm with <ENTER>.

Select "On" or "Off" and confirm with <ENTER>.

```
          < Auto Start >

  Auto Start       :Off  On
  Interval Time    :[    10]min
  Meas.Times       :[ 0]
  Exit             :[Execute]
```

When you have chosen "On", you can define the time interval between two measurements. Confirm with <ENTER>. Enter 0 to start the next measurement imme-diately after the end of the actual measurement (no time interval).

In "Meas. Times" you define the number of repetitive measurements to be performed with this sample. Enter 0 for continuous measurement. In this case press Reset to stop the measurements.

10.9   CARD Utility (Function 8)

This function is used together with the Memory Cards.

```
          < CARD Utility >

0.Data Delete      5.Table Capacity
1.Sample Delete    6.Install Table
2.Method Delete    7.Uninstall Table
3.Format
4.CARD Information
```

See section 12 "Data Memory Cards" and section 13 "Application Memory Cards" for more information.

10.10 Memory Clear (Function 9)

This function is used to reset all parameters to default (factory setting), for instance to initialize the memory after a serious malfunction of the instrument.

You can also selectively reset single records like the adjustment data (Calib. data), the check records, the sample files or the method parameters.

```
        < Memory Clear >

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

Press <Function> 9 and confirm with <ENTER>.

Select the desired option: "Measured Data", "Sample File", "Periodic Check", "Periodic Calib.", "Method Para.", "All Parameter", and confirm your choice with <ENTER>.

```
     < Measured Data Clear >


    Clear Execute ?  No  Yes
```

Select "Yes" to confirm your choice again and press <ENTER>.

The chosen data or parameters are now deleted and the respective factory settings are active again.

Note: The function "5. All Parameter" doesn't delete any downloaded special application tables (from flash memory cards).

11. Setup (password protected)

11.1 Interface (Setup 0)

This option is used to define the RS-232C serial interface and the serial printer.

Press the <SETUP> key.

```
          < Setup >

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

Select "0.Interface". Confirm with <ENTER>.

```
         < Interface >

         0.RS-232C
         1.Printer
```

Select "Printer" with the → key in order to setup the printer or "RS-232C" to define the serial interface.

11.1.1 RS-232C Interface setup

This option is used to setup the RS-232C interface either for connecting a computer or for connecting a RE40 or RE50 refractometer for simultaneous measurement of refractive index and density (or specific gravity). In both cases you have to make sure that the other equipment (computer or RExx) is setup with the same values.

```
         < RS-232C >

   Baud Rate  :<4800>
   Parity     :Even  Odd  None
   Stop Bits  :1   2
   Data Bits  :7   8
   Exit       :[Execute]
```

Select the following values according to your computer setup or to your RE40 resp. RE50 setup. In case you connect a RExx refractometer, use "Setup 0: Interface" at the refractometer to make sure that both setups are identical.

11.1.2 Printer setup

We recommend to select the GA42 printer from METTLER TOLEDO. Make sure that the DIP switch 2 is ON on the GA42 printer.

```
            < Printer >

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


```

The following printers are predefined:

GA-:   for GA42 and SPRINTER printer from METTLER TOLEDO.

Other: for all serial printers. Selection of:
- Baud rate (300, 600, **1200**, 2400,....)
- Parity (**none**, even, odd)
- Stop bits (1, **2**)
- Data bits (7, **8**)

These parameters have to be set according to the specifications of your printer.

The bold settings are active for the GA42 printer.

IDP-:   not used

DP-:   not used

11.2   Date and Time (Setup 1)

This option is used to enter the actual date and time.

Press the <SETUP> key.

```
            < Setup >

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

Select "1.Date&Time". Confirm with <ENTER>.

```
          < Date & Time >

         12/07/1998  17:12

 Day   :[12]    Hour    :[17]
 Month :[ 7]    Minutes :[12]
 Year  :[1998]  Exit    :[Execute]
```

Actual date and time are displayed. Press <ENTER> key.

Enter date and time (the date format is selected in the menu Setup „5.International") and confirm with <ENTER>.

11.3 Name (Setup 2)

This option is used to enter the laboratory name (or company or operator).

Press the <SETUP> key.

```
              < Setup >

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

Select "2.Name". Confirm with <ENTER>.

```
          < Name >                A

  Name   :[Quality Lab 1   ]

  Exit   :[Execute]
```

The capital A means that the alphanumerical keyboard is in entry mode for capital letters. Press the <DISPLAY> key to change the entry mode:
A: capital letters (A, B, C, D, ..)
a: small letters (a, b, c, d, ...)
1: numbers (0, 1, 2, 3, 4, ...)

11.4 Serial/Version number (Setup 3)

This option is used to identify the software version and the serial number of your instrument without having to switch off the instrument.

- Press the <SETUP> key.

```
              < Setup >

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

Select "3.Serial/Version".

```
      < Serial No./Version No.>

  Serial No.    :   xxxxxxxx
  Version No.   :   x.xx


             [Exit]
```

Press the <ENTER> key. The serial number of your instrument as well as the software version are displayed.

11.5 LCD Contrast (Setup 4)

This option is used to adjust the contrast of the LCD display in your instrument.

Press the <SETUP> key.

```
            < Setup >

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

Select "4.LCD Contrast".
Confirm with <ENTER>.

```
         < LCD Contrast >

 Light          Center          Dark
   <|  |  |  |  |  |  |  |  |  |  |>
```

Select the LCD contrast with the ←
and → keys. Confirm with
 <ENTER>.

11.6 International (Setup 5)

This option is used to select the date format and the unit for the temperature.

Press the <SETUP> key.

```
            < Setup >

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

Select "5.International".
Confirm with <ENTER>.

```
        < International >

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

Select your date format with the →
key: YYYY: Year
          MM : Month
          DD : Day

Select your temperature unit with the
→ key: °C : degree Celsius
          °F : degree Fahrenheit

11.7   Lock with password (Setup 6)

Press the <SETUP> key.

```
            < Setup >

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

Select "6.Lock".
Confirm with <ENTER>.

Select "On" with the → key.
Confirm with <ENTER>.

```
        < Password Lock >

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

Enter your password. Make sure to keep it in a safe place in case you would forget it.

Enter your password a second time to confirm the correct spelling.

In case you would have forgotten your password you will need to call the METTLER TOLEDO service.

11.8   Beep (Setup 7)

Press the <SETUP> key.

```
            < Setup >

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

Select "7.Beep".
Confirm with <ENTER>.

Select "On" with the → key.
Confirm with <ENTER>.

```
            < Beep >

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

Enter your beep selection:

Type1: long and fast

Type2: long and slow

Type3: short and fast

Type4: short and slow

11.9   Temperature calibration (Setup 8)

Press the <SETUP> key.

```
            < Setup >

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

Select "8.Temperature".

Confirm with <ENTER>.

```
         < Temperature >

         0.Calibration
         1.Adjust
```

Select either "1.Adjust" (single point) or "0.Calibration" (multiple point over the hole temperature range).
Confirm with <ENTER>.

Adjust:
Performs a one-point adjustment at the measuring temperature (correcting the offset). Select this option when the difference between Set Temperature and Cell Temperature is **less than 0.5 °C** (in equilibrium).

Calibration:
Performs a multiple point adjustment, in steps of 5 °C, over the entire temperature range. Select this option when the difference between Set Temperature and Cell Temperature is **0.5 °C or higher** (in equilibrium). This temperature calibration takes approximately two hours! This temperature calibration will adjust the internal thermistors to the certified thermistor in the measuring cell over the whole temperature range.

12. Memory Cards (DE40, DE50 and DE51)

The following two sections describe the use of the memory cards. There are two types of memory cards to be used with the DE40, DE50 and DE51 density meters:

Data Memory Card: SRAM cards.
     For measurement data, methods and sample files (ME-51324004).

Application Memory Card: FLASH cards.
     For the following applications:
     - ALCOHOL   (ME-51324000)
     - BRIX   (ME-51324001)
     - API   (ME-51324002)
     - VISCOSITY CORRECTION   (ME-51324003)
     - CONCENTRATION TABLES   (ask your local representative)

12.1 Data Memory Cards: data, methods, sample files

These Data Memory Cards are SRAM cards, have a capacity of 1 MB and use a lithium battery. The cards are used to store measurement data, methods or/and sample files. You can store up to:

     982 Methods (if only methods are stored),

     498 Sample files (if only sample files are stored),

     10 Data files, each file containing up to 100 data (if only data files are stored).

If you store a combination of methods, sample files and data files the number of available free space will decrease. In order to see how much free space is available, perform following steps:

Press the <FUNCTION> key.

```
        < Function >

0.Data File      5.Set Check
1.Sample File    6.Periodic
2.Method File    7.Auto Start
3.Changer        8.CARD utility
4.Factor         9.Memory Clear
```

Select "8.CARD utility". Confirm with <ENTER>

Insert a Data Memory Card into the slot on the front left part of the instrument.

```
        < CARD utility >

0.Data delete     5.Table Capacity
1.Sample delete   6.Install Table
2.Method delete   7.Uninstall Table
3.Format
4.CARD Information
```

Select "4.CARD Information". Confirm with <ENTER>.

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


            [Exit]
```

12.2   Save measured data

With the Data Memory Card you can save data on the card or load data from the card. The DE40, DE50 and DE51 store up to 100 measurement data in the internal memory. These data can be saved on a memory card as one single data file. Let's assume that you have already performed 35 measurements.

Press the <FUNC> key.

```
        < Function >

0.Data File      5.Set Check
1.Sample File    6.Periodic
2.Method File    7.Auto Start
3.Changer        8.CARD utility
4.Factor         9.Memory Clear
```

Select "0.Data File". Confirm with <ENTER>.

```
        < Data File >
No.   M.Name   Sample    Result  .
32 ORANGE      01-10 d     1.0326
33 GRAPE       02-01 d     1.0024
34 GRAPE       02-02 d     1.0025
35 GRAPE       02-03 d     1.0024
Statis.  Recalc.  Load  Save Exit
```

Note: If you have many data stored, press 0 to display the first 4 data (0 to 3), and 1 to 9 to display the next blocks of data (10 to 13, 20 to 23, ... 90 to 93).

Insert a Data Memory Card into the slot on the front left part of the instrument.

Select "Save" with the → key. Confirm with <ENTER>.

```
        < Save Data File >

    File Name    : [WEEK24  ]
    Save Execute : [Execute]
    Exit         : [Execute]
```

Enter the name under which you want to store the measurement data (max. 8 characters).

Note: Blank spaces are not allowed.

Press <ENTER> twice (confirm Save Execute and Exit).

```
        < Save Data File >

            Now Saving ...
```

Wait until all data have been saved.

```
        File save is complete

                [ OK ]
```

Press <ENTER>.

Your data are now saved on the memory card, you can clear the internal memory of the instrument (see next section).

12.3   Clear measured data

Let's assume that you have saved the previously performed 35 measurements (previous section). Once your data are saved on the memory card you can clear the internal memory of the instrument.

Press the <FUNC> key.

```
        < Function >

0.Data File      5.Set Check
1.Sample File    6.Periodic
2.Method File    7.Auto Start
3.Changer        8.CARD utility
4.Factor         9.Memory Clear
```

Select "9.Memory Clear". Confirm with <ENTER>.

```
        < Memory Clear >

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

Select "0.Measured Data". Confirm with <ENTER>.

```
        < Memory Data Clear >


    Clear Execute ?  No   Yes
```

Select "Yes" with the → key. Confirm with <ENTER>.

A beep sound will indicate that the memory has been cleared.

12.4   Load measured data

This may be used for example to recalculate some results you have already stored on a Memory Card. Press the <FUNC> key.

```
          < Function >

0.Data File      5.Set Check
1.Sample File    6.Periodic
2.Method File    7.Auto Start
3.Changer        8.CARD utility
4.Factor         9.Memory Clear
```

Select "0.Data File". Confirm with <ENTER>.

```
         < Data File >
No.   M.Name   Sample   Result


          Data not exist.

          Exit        Load
```

Insert the Data Memory Card with the previously stored data into the slot on the front left part of the instrument.

Select "Load". Confirm with <ENTER>.

```
        < Load Data File >
File Name     Date        Time
WEEK24     06/12/1998    18:02
WEEK23     06/05/1998    18:14
WEEK22     05/29/1998    17:25
WEEK21     05/22/1998    17:45
WEEK20     05/15/1998    18:25
```

Select the Data File you want to load with the <UP> and <DOWN> keys. Confirm with <ENTER>.

```
       < Load Data File >

     File will be loaded.

            OK ?

          No    Yes
```

Select "Yes" with the → key. Confirm with <ENTER>.

```
      < Load Data File >

        Now Loading ...
```

Wait until the data file has been loaded.

```
      File load is complete

            [ OK ]
```

Press <ENTER>.

```
      < Function >

0.Data File      5.Set Check
1.Sample File    6.Periodic
2.Method File    7.Auto Start
3.Changer        8.CARD utility
4.Factor         9.Memory Clear
```

You can now display the loaded data. Press the <FUNC> key.

```
        < Data File >
No.   M.Name    Sample    Result  .
32 ORANGE       01-10 d      1.0326
33 GRAPE        02-01 d      1.0024
34 GRAPE        02-02 d      1.0025
35 GRAPE        02-03 d      1.0024
Statis.  Recalc.  Load   Save  Exit
```

Select "0.Data File". Confirm with <ENTER>.

Note: if you have many data stored, press 0 to display the first 4 data (0 to 3), and 1 to 9 to display the next blocks of data (10 to 13, 20 to 23, ... 90 to 93).

12.5   Save method

With the Data Memory Card you can save methods on the card or load methods from the card. The DE40, DE50 and DE51 store up to 10 methods in the internal memory. These methods can be saved on a memory card and transferred to another instrument. This is especially useful to develop a method in a central laboratory and once this method has been validated to distribute it to all other laboratories.

```
      < Function >

0.Data File      5.Set Check
1.Sample File    6.Periodic
2.Method File    7.Auto Start
3.Changer        8.CARD utility
4.Factor         9.Memory Clear
```

Press the <FUNC> key.

Select "2.Method File". Confirm with <ENTER>.

```
        < Method File >
No.    Name   Temp.(°C)    Result  .
0.  ORANGE      20.0        d
1.  GRAPE       20.0        d
2.  LEMON       20.0        d
3.  APPLE       20.0        d
      Load      Save      Exit
```

Select the method you want to save with the <UP> and <DOWN> keys.

Select "Save" with the → key. Confirm with <ENTER>.

```
     < Save Method File >

   File Name    : [GRAPE   ]
   Save Execute : [Execute]
   Exit         : [Execute]
```

Enter the name under which you want to store the method (max. 8 characters).

Press <ENTER> twice (confirm Save Execute and Exit).

```
    < Save Method File >

      Now Saving ...
```

Wait until method has been saved.

```



    File save is complete

          [ OK ]
```

Press <ENTER>.

12.6   Clear internal method

Let's assume that you have saved the previously defined methods (previous section). Once your methods are saved on the memory card you can clear the internal memory of the instrument.

```
        < Function >

0.Data File      5.Set Check
1.Sample File    6.Periodic
2.Method File    7.Auto Start
3.Changer        8.CARD utility
4.Factor         9.Memory Clear
```

Press the <FUNC> key.

Select "9.Memory Clear". Confirm with <ENTER>.

```
        < Memory Clear >

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

Select "4.Method Parameter". Confirm with <ENTER>.

```
    < Method Parameter Clear >


   Clear Execute ?  No   Yes
```

Select "Yes" with the → key. Confirm with <ENTER>.

A beep sound will indicate that the memory has been cleared.

12.7   Load method

```
        < Function >

0.Data File       5.Set Check
1.Sample File     6.Periodic
2.Method File     7.Auto Start
3.Changer         8.CARD utility
4.Factor          9.Memory Clear
```

Press the <FUNC> key.

Select "2.Method File". Confirm with <ENTER>.

```
         < Method File >
No.   Name   Temp.(°C)   Result   .
0. Method-0    20.0       d
1. Method-1    20.0       d
2. Method-2    20.0       d
3. Method-3    20.0       d
      Load    Save      Exit
```

First you have to select where you want to load the method. Select the method you want to **overwrite** with the one to be loaded with the <UP> and <DOWN> keys.

Select "Load" with the → key. Confirm with <ENTER>.

```
        < Load Method File >
File Name     Date        Time    .
GRAPE      06/12/1998     18:02
LEMON      06/05/1998     18:14
APPLE      05/29/1998     17:25
ORANGE     05/22/1998     17:45
SPRITE     05/15/1998     18:25
```

Select the method you want to load with the <UP> and <DOWN> keys. Confirm with <ENTER>.

```
       < Load Method File >

      File will be loaded.

            OK ?
            No   Yes
```

Select "Yes" with the → key and confirm with <ENTER>.

```
       < Load Method File >

        Now Loading ...


```

Wait until the method has been loaded.

```



      File load is complete

            [ OK ]

```

Press <ENTER>.

```
        < Method File >
No.   Name  Temp.(°C)   Result   .
0. Method-0    20.0        d
1. ORANGE      20.0        d
2. Method-2    20.0        d
3. Method-3    20.0        d
     Load    Save     Exit
```

Repeat the previous steps if you want to load more methods, being careful not to overwrite an already defined method: select a free method "Method-x" to be overwritten.

```
        < Method File >
No.   Name  Temp.(°C)   Result   .
0. Method-0    20.0        d
1. ORANGE      20.0        d
2. Method-2    20.0        d
3. Method-3    20.0        d
     Load    Save     Exit
```

Select "Exit" with the → key. Confirm with <ENTER>.

12.8   Save sample file

With the Data Memory Card you can save sample files to the card or load sample files from the card. The DE40, DE50 and DE51 store up to 498 sample files in the internal memory. These sample files are usually used together with the sample changer, in order to run samples according to a predefined sequence (sample names, method to be used, etc...). They can also be used as a SOP (Standard Operating Procedure) if no sample changer is connected. See section 6.1 for the description of sample files. Let's assume that you have already defined such a sample file.

```
        < Function >

0.Data File      5.Set Check
1.Sample File    6.Periodic
2.Method File    7.Auto Start
3.Changer        8.CARD utility
4.Factor         9.Memory Clear
```

Press the <FUNC> key.

Select "1.Sample File". Confirm with <ENTER>.

```
       < Sample File >

   Sample File  : Off   On

   Exit         : [Execute]

```

Select "On" with the → key. Confirm with <ENTER>.

Press the <SAMPLE> key.

```
         < Sample >
Sample File    :Skip  Load  Save
Max.Meas.No.   :[ 24]
Next Meas.No.  :[  1]
Method         :Current Variable
Set Parameter  :[Execute]
Exit           :[Execute]
```

Select "Save" with the → key. Confirm with <ENTER>.

```
     < Save Sample File >

   File Name    : [COKE24  ]
   Save Execute : [Execute]
   Exit         : [Execute]
```

Enter the name under which you want to store the sample file (max. 8 characters).

```
     < Save Sample File >

         Now Saving ...
```

Press <ENTER> twice (confirm Save Execute and Exit).

Wait until:

```
     File save is complete

             [ OK ]
```

Press <ENTER>.

12.9   Clear internal sample file

Let's assume that you have saved the previously defined sample file (previous section). Once your sample file is saved on the memory card you can clear the internal memory of the instrument.

Press the <FUNC> key.

```
         < Function >

0.Data File      5.Set Check
1.Sample File    6.Periodic
2.Method File    7.Auto Start
3.Changer        8.CARD utility
4.Factor         9.Memory Clear
```

Select "9.Memory Clear". Confirm with <ENTER>.

```
        < Memory Clear >

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

Select "1.Sample File". Confirm with <ENTER>.

```
     < Sample File Clear >

   Clear Execute ?  No   Yes
```

Select "Yes" with the −> key. Confirm with <ENTER>.

A beep sound will indicate that the memory has been cleared.

12.10   Load sample file

```
        < Sample >
Sample File    :Skip  Load  Save
Max.Meas.No.   :[ 24]
Next Meas.No.  :[  1]
Method         :Current Variable
Set Parameter  :[Execute]
Exit           :[Execute]
```

Press the <SAMPLE> key.

Select "Load" with the → key.
Confirm with <ENTER>.

```
      < Load Sample File >
File Name     Date        Time   .
COKE24     06/12/1998     18:02
COKE10     06/05/1998     18:14
SPRITE24   05/29/1998     17:25
SPRITE10   05/22/1998     17:45
LIGHT24    05/15/1998     18:25
```

Select the sample file you want to load with the <UP> and <DOWN> keys. Confirm with <ENTER>.

```
      < Load Sample File >

      File will be loaded.

            OK ?
          No  Yes
```

Select "Yes" with the → key.
Confirm with <ENTER>.

```
      < Load Sample File >

         Now Loading ...
```

Wait until the sample file has been loaded.

```

      File load is complete

           [ OK ]
```

Press <ENTER>.

13. Application Memory Cards: BRIX, ALCOHOL, API, VISCOSITY CORRECTION, USER TABLES

These Application Memory Cards are FLASH cards with a capacity of 2 MB. The cards are used to download special applications to your instrument. Once the application has been downloaded to the instrument it is removed from the Application Memory Card. In other words the Memory Card is empty, but can still be used to retrieve the application from the instrument, for example to transfer it to another instrument. Therefore make sure to keep the empty Application Memory Card in a safe place.

Note: The function "Memory Clear" "All Parameter" (in Function 9.5) doesn't clear the downloaded application.

13.1 How to download an application (Install table)

This section will show you how to download an application. Following Application Memory Cards are available:

- ALCOHOL   Alcohol concentration (Ethanol)   (ME-51324000)
- BRIX   Sugar concentration (Sucrose)   (ME-51324001)
- API   Petroleum products   (ME-51324002)
- VISCOSITY   Viscosity correction   (ME-51324003)
- CONCENTRATION TABLES (ask your local representative)

Insert the Application Memory Card into the slot on the front left part of the instrument.

Press the <FUNC> key.

```
        < CARD utility >

0.Data delete      5.Table Capacity
1.Sample delete    6.Install Table
2.Method delete    7.Uninstall Table
3.Format
4.CARD Information
```

Select "8.CARD utility". Confirm with <ENTER>.

```
  < Function >

  0.Data File      5.Set Check
  1.Sample File    6.Periodic
  2.Method File    7.Auto Start
  3.Changer        8.CARD utility
  4.Factor         9.Memory Clear
```

Select "6.Install Table". Confirm with <ENTER>.

Note: The following shows the BRIX application. For other applications just replace BRIX with your application (Alcohol, API, Viscosity correction, Concentration).

```
< Install Table >
Table  Name  Type    Temp.    Data.
 Brix         Conc.  20.00°C   85


        Exit       Install
```

Select the application to load with the <UP> and <DOWN> keys.

Select "Install" with the $\rightarrow$ key. Confirm with <ENTER>.

```
          < Install Table >

             Now Install ...



```

Wait until the installation has been done.

```
     Table install is complete


              [ OK ]


```

Press <ENTER>.

```
          < Install Table >
Table Name   Type       Temp.   Data.
*Brix        Conc.  20.00°C    85


         Exit       Install
```

The asterisk (*) on the left of the application (BRIX) shows that this application has been downloaded and removed from the Memory Card. This means that the Memory Card is empty, but can still be used to retrieve the application from the instrument (uninstall table).

13.2   How to select the application

The application has been downloaded to the instrument. You need now to define which method should be dedicated to this application.

Press <METHOD>.

```
          < Method List >
No.   Name   Temp.(°C)    Result   .
0. Method-0    20.0        d
1. Method-1    20.0        d
2. Method-2    20.0        d
3. Method-3    20.0        d
4. Method-4    20.0        d
```

Select the method you want to dedicate to this application with the <UP> and <DOWN> keys. Confirm with <ENTER>.

Press the <MEAS.PARA> key.

```
Method 1 <Meas.Parameter>

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

Set the measurement parameters according to your application (see section 8).

There are now three different selections, depending on the application:

1. Select concentration table: ALCOHOL, BRIX, CONCENTRATIONS.

2. Select temperature table: API.

3. Select viscosity correction: see section 6.2.

13.2.1 Select a concentration table: ALCOHOL, BRIX, CONCENTRATIONS

```
Method 1 <Calc.Parameter>

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

Press the <CALC.PARA> key.

Select "1.Result". Confirm with <ENTER>.

```
Method 1 <Result>

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

Select "Brix" (Alcohol, Concentration, according to your application). Confirm with <ENTER>.

Press <ENTER> (confirm Execute).

Press <METHOD>.

```
         < Method List >
No.   Name   Temp.(°C)   Result   .
0. Method-0    20.0        d
1. ORANGE      20.0        Brix
2. Method-2    20.0        d
3. Method-3    20.0        d
4. Method-4    20.0        d
```

The method list now should show you the selected method with the corresponding application.

13.2.2 Select a temperature table: API

```
Method 1 <Calc.Parameter>

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

Press the <CALC.PARA> key.

Select "2.Temperature Compensation". Confirm with <ENTER>.

```
Method 1 <Temp.Comp.>

Temp.Comp      : Off   On
Comp.Temp.     :[20.00]°C
Temp.Formula   :<Oil Table-1>
```

Select "Oil Table-1" (Oil Table-2 or Oil Table-3, according to your application) with the → key. See also section 14.1. Confirm with <ENTER>.

Press <RESET>.

13.3 How to retrieve an application (Uninstall table)

This section will show you how to retrieve an application from the instrument, for example to transfer it to another instrument.

Insert the empty Application Memory Card into the slot on the front left part of the instrument.

Press the <FUNC> key.

```
        < Function >

0.Data File     5.Set Check
1.Sample File   6.Periodic
2.Method File   7.Auto Start
3.Changer       8.CARD utility
4.Factor        9.Memory Clear
```

Select "8.CARD utility". Confirm with <ENTER>.

```
        < CARD utility >

0.Data delete     5.Table Capacity
1.Sample delete   6.Install Table
2.Method delete   7.Uninstall Table
3.Format
4.CARD Information
```

Select "7.Uninstall Table". Confirm with <ENTER>.

```
     < Uninstall Table >

        0.Conc.Table
        1.Temp.Table
        2.Exit
```

Select "**0.Conc.Table**" if your application is a concentration table: **BRIX, ALCOHOL, CONCENTRATION,** or select "**1.Temp.Table**" if your application is a temperature table: **API.**

Confirm with <ENTER>.

The asterisk (*) on the left of the application (BRIX) shows that this application has been downloaded and removed from the Memory Card. This means that the Memory Card is empty, but can still be used to retrieve the application from the instrument.

```
        < Uninstall Table >
Table Name   Type       Temp.    Data.
*Brix        Conc.  20.00°C     85


        Exit      Uninstall
```

Select the application to uninstall with the <UP> and <DOWN> keys.

Select "Uninstall" with the -> key.

Confirm with <ENTER>.

```
     < Uninstall Table >

        Now Uninstall ...

```

Wait until the application has been uninstalled.

```
Table uninstall is complete

         [ OK ]
```

Press <ENTER>.

```
   < Uninstall Table >

     0.Conc.Table
     1.Temp.Table
     2.Exit
```

Select "2.Exit" and confirm with <ENTER>.

The table on the Memory Card is no longer marked by an asterisk (*).

14. Description of the special applications: BRIX, ALCOHOL, API, VISCOSITY CORRECTION, COKE, USER TABLES

The standard software of the DE40/50/51 can be expanded by various software options (METTLER TOLEDO Service) that are available on Memory Card. This allows you to match the selection of the method parameters to your requirements.

14.1 API software

The density of crude oils, oil products or lubricants must in some cases be measured at elevated temperatures owing to their viscosity. With this software, stored tabulated values are used for the automatic conversion of this density to that at 15 °C or 60 °F, depending on the temperature unit you measure with. The tabulated values are based on API standard 2540 (API: American Petroleum Institute).
Under the parameters of the temperature compensation, select the required oil table (see Section 9.2 and 14.4).

Oil table 1: the density of **crude oils** is converted to the reference temperature of 15° C (or 60° F) according to table 53A of the API standard.

Oil table 2: the density of **oil products** is converted to the reference temperature of 15° C (or 60° F) according to table 53B of the API standard.

Oil table 3: the density of **lubricants** is converted to the reference temperature of 15° C (or 60° F) according to table 53D of the API standard.

To calculate the "API degrees", enter "$((1/d) - 1) * 141.5 + 10$" as concentration function (see Section 9.2 and 14.6).

14.2 Alcohol software

With this software the measured density of an alcoholic solution can be converted to the corresponding volume concentration of **Ethanol in water i.e. % $^v/_v$**. Two different conversion tables exist for this conversion, depending on the physical unit the temperature is measured (and the reference temperature):

14.2.1 Temperature measured in °F, with a reference temperature at 60 °F:

This option is activated by selecting the temperature unit °F (see Section 11.6). The stored values are based on table 3 of NBS Circular 19 (NBS: National Bureau of Standards, since 1988: National Institute of Standards and Technology). You must perform your measurements at 60 °F to obtain the correct ethanol content.

14.2.2 Temperature measured in °C, with a reference temperature at 20 °C:

This option is activated by selecting the temperature unit °C (see Section 11.6). The stored values are based on table IVa of OIML Guideline No. 22 (OIML: Organisation Internationale de Métrologie Légale). You must perform your measurements at 20 °C to obtain the correct ethanol content.

Under the parameters of the concentration calculation, select "Alcohol [%]" instead of a calculation function (see also Section 9.2). The density and the alcohol concentration are printed out as the result, e.g.:

		Accuracy	Reproducibility
DE40:	Alcoh 42.1 %	± 0.1 %	± 0.1 %
DE50/51:	Alcoh 42.09 %	± 0.01 %	± 0.01 %

Note: The alcohol values of measurements with, e.g. whisky, are relative values: They do not specify the actual concentration as the density also depends on all other dissolved substances of this beverage.

14.3   BRIX software

With the BRIX software the measured density of a sucrose/water solution can be converted to the weight percent sucrose content (°BRIX). The stored tabulated values are based on table 109 of NBS Circular 440 (NBS: National Bureau of Standards, since 1988: National Institute of Standards and Technology). The measurement temperature for the automatic conversion is 20 °C.

Under the parameters of the concentration calculation, select "BRIX [%]" instead of a calculation function (see also Section 9.2). The density and the BRIX degrees are printed out as the result, e.g.:

		Accuracy	Reproducibility (within 0 - 40 %)
DE40:	BRIX 10.23 %	± 0.03 %	± 0.03 %
DE50/51:	BRIX 10.234 %	± 0.003 %	± 0.003 %

Note: The BRIX values with, e.g. milk are relative values: They do not specify the actual sucrose concentration as the density also depends on all other dissolved substances of this beverage.

14.4   Viscosity correction

When measuring samples with higher viscosities (over 10 mPs), the oscillation tube technique shows a slightly higher value than the real density of the samples. This application corrects the systematic viscosity error when measuring samples with higher viscosities. See section 6.2. for more information.

14.5 Coke (Cola drinks)

This Memory Card allows to measure BRIX and HFCS42 (also called SOLIDS) of all Cola products, from beverages to the highly viscous syrup (concentrate). This card includes viscosity correction, required for syrup measurement and specially tuned up for Cola products. This viscosity correction is especially required for products over 40°BRIX (resp. 50°SOLIDS).

14.6 Coefficients for conversion to various concentration data

With all software you can convert the measured density directly to Baumé, Twadell, API or milk degrees:

In the Calc.Para menu select <Result>, <Conc.>, <Parameter Set>, <Coefficient>. Then:

– select the relative density d_4^t or d_t^t
– select the term for the x-axis under **Data Replace**,
– select **A + Bx** as calculation function,
– enter the coefficients A and B under **Manu Set**.

The "Conc" value is printed out as the result in each case.

Concentration	Conversion function	Parameter Entry				
		Meas. temperature [°C]	Relative density	Term of the x-axis	Coefficients of the function A + Bx	
					A	B
Heavy Baumé deg.[1]	$((1/d) - 1) * -144.3$	15.0	d_4^t	$(1/d) - 1$	0	-144.3
Light Baumé deg.[1]	$((1/d) - 1) * 144.3 + 10$	15.0	d_4^t	$(1/d) - 1$	10	144.3
Jap. Sake degrees	$((1/d) - 1) * 1443$	15.0	d_4^t	$(1/d) - 1$	0	1443
API degrees	$((1/d) - 1) * 141.5 + 10$	15.56 [2]	d_t^t	$(1/d) - 1$	10	141.5
Twadell degrees	$(d - 1) * 200$	- -	d_4^t	$d - 1$	0	200
Milk degrees	$(d - 1) * 1000$	- -	d_4^t	$d - 1$	0	1000

[1] Note: replace 144.3 by 145 for USA.
[2] 15.56 °C corresponds to 60 °F.

15. Automatic sampling pump ASU-DE (optional)

This optional automatic sampling unit replaces the air pump that comes with the basic installation. With its membrane pump it allows to aspire samples of low to medium viscosity (at the max. ca. 1000 mPa·s) directly into the measurement tube, to empty, rinse and dry it after the measurement.

The sequence described in section 8.5, used to control this routine, allows to eliminate operator specific influences on the measurement which usually occur when using a syringe. This option allows you to get reproducible results, regardless of the operator using the instrument.

This pump is also required together with the DCU-300B auto rinsing unit, the SOP40 and SOP50 and the CHG-260B sample changer.

Instead of using the standard waste bottle of the ASU-DE you can also use the automatic draining unit AD-510.

15.1 Safety measures

Measures for your safety
- Make sure to switch off the DE40, DE50 or DE51 and disconnect the power cable before installing the automatic sampling pump ASU-DE!
- Make sure that the solvents used to rinse the measurement tube do not form dangerous mixtures or reactions when combined with the sample solutions or other solvents, since all solutions are dejected into the same waste bottle!
- Connect the exhaust tube to a system capable of disposing of poisonous or corrosive gases!

Measures for operational safety
- Empty the waste bottle (drain pot) before it is filled to the rim! Otherwise the waste solution is sucked into the pump and ejected through the exhaust. This could even damage the pump.
- The material in contact with the liquid for sampling is made of glass, Teflon or carbon. Do not use any sample that may corrode the material.
  Samples of high viscosity cannot be aspirated. Maximum viscosity that can be pumped is approximately 1000 mPa·s.

15.2   Installation

- Switch off the DE40/DE50/DE51 and disconnect the power cable.
- Place the unit backside down as shown to attach two rails for the holder of the waste bottle.
  Fasten Rail 1 by two screws. Slide in the board into rail 1 and 2, and then fasten rail 2 by two screws.
- The board can be slid under the instrument if it is not in use.
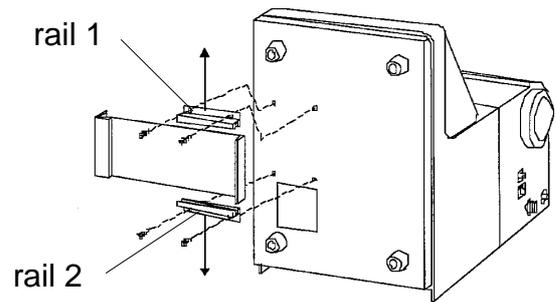
- Detach rear panel and plate. Undo the four screws fastened to the rear panel and pull the small plate out of the panel as shown (sits very tight).
- Remove the three large screws (marked with red) just right of the air pump unit. These screws are used as transportation security to hold the measuring cell, which is mounted on shock absorbers, firmly against the chassis during transportation. Make sure to keep these screws for future need of re-shipping.
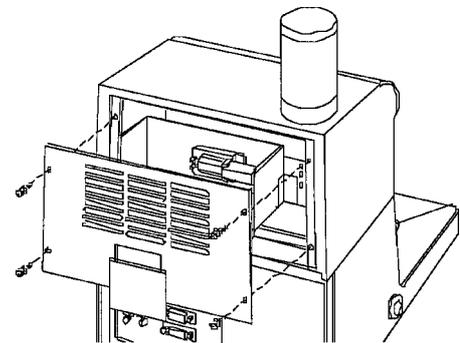
- Remove the air pump.
  a) Undo three screws fastened to the pump unit.
  b) Disconnect the pump connector (1) and dry air tube (2).
  c) Move the pump unit first to the right (ca. 3 cm), then up and remove it.
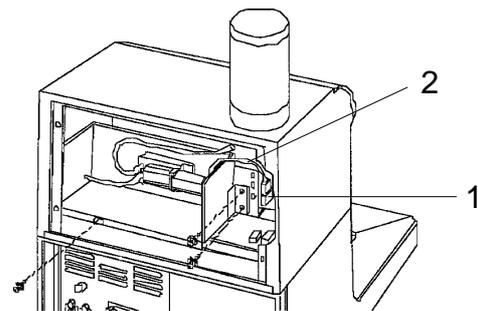
Note: Disconnect the dry air tube carefully in order to avoid damage.

- Install the ASU-DE in the place of the air pump.

    a) Slide in the ASU-DE down and to the left, adjusting its bottom fitting to the angle hole of the main unit.

    b) Fasten the ASU-DE by the three screws which were used to hold the air pump.

    c) Connect the pump connector (3 black, 2-poles) and solenoid connector (4 white, 3 poles) to the main unit.

    d) Connect the dry tube (5) to the joint for the desicator tower.
- Install rear panel (Follow reverse steps from above).
- Attach the supplied seal (Align to line "A").
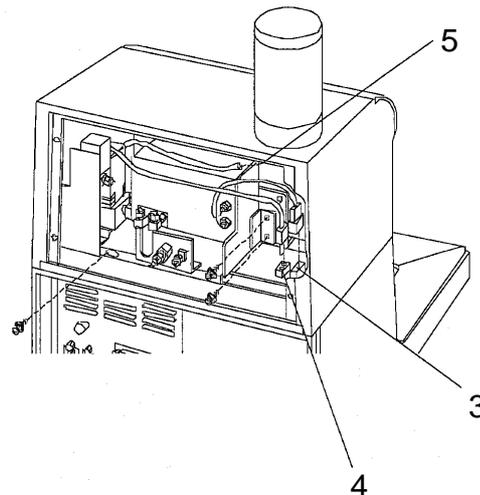
- Connect the air tube (tygon, with Teflon connector at one and PP connector at the other) to the dry air out (without black tightening clamp).

- Insert the sampling tube (one connector only) into the measuring cell inlet (lower port), connect the drain tube (two connectors) to the measuring cell out (upper port) to the pump-in connector (black clamp).
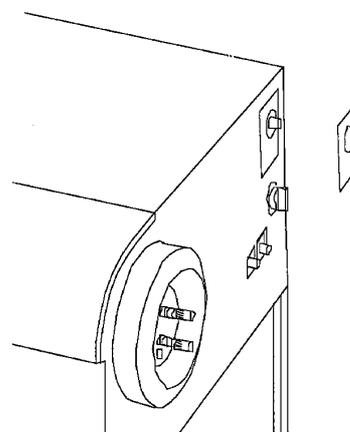
Note: Make sure the white Teflon tube nozzles are firmly tightened clockwise.

Warning:

If using samples and rinsing solutions which could create poisonous or corrosive gases, connect the exhaust tube to the exhaust connector and lead the other end to a system capable of disposing of these gases.
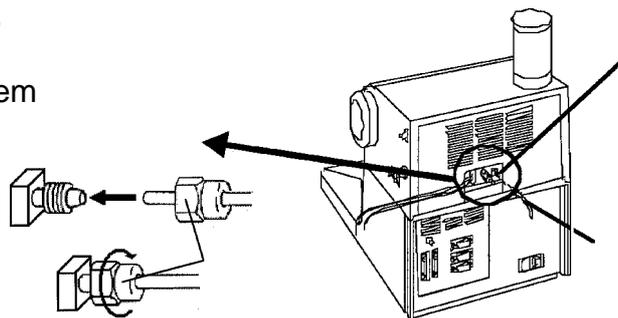
- Connecting the waste bottle:
  Connect the black tube from the pump unit to the higher connector of the bottle cap and tighten the screw firmly. Push the transparent tube from the pump unit into the ohter connector of the bottle cap, so that it protrudes ca. 30 mm below. Then tighten the screw firmly.
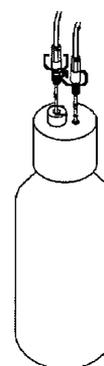
Note: If the connectors are not screwed in tightly, the pump will not (or hardly) be able to move the sample.

- Pull out the plate for the waste bottle on the left side of the instrument, place the white plastic mug on it, and put the waste bottle in the mug.

16. Error Messages and Malfunctions

16.1 Error Messages

Error message	Cause	Measure
Nozzle error	The sampling nozzle did not move normaly (SC24, DCU-300 or SOP50.	Remove the obstacle. Replace the nozzle if it is bent or borken. Press [Stop] key to reset the error.
Table error	The rotation of the turnable was not normal (SC24).	Remove the obstacle. Press [Stop] key to reset the error.
Temperature control error	The set temperature can not be reached within 2 hours after start.	Switch off the instrument and call METTLER TOLEDO service.
Communication error	Cable not connected correctly. Wrong instrument selected in Function 3.	Check connection of the communication cable. Check that the correct instrument is selected in "Function 3": SC24, CHG, DCU.
Viscosity Correction Error	No adjustment with viscosity correction. Air bubbles or smudge in the cell.	Perform adjustment with viscosity correction on. Check measuring cell.

16.2 Malfunction

Malfunction	Cause	Measure
Instrument can not be switched	Cable not plugged in properly, fuse blown.	Check power cable and mains. Replace fuse if blown (T3.15A/250V).
No "Ready" message is reached.	Air inlet at rear of the instrument blocked. Cooling fan not operating.	Remove obstacles that block the air inlet. Call METTLER TOLEDO service for help.
Stored data are lost (e.g. time)	The internal battery is discharged.	Swich off the instrument and call METTLER TOLEDO service.
Printer not printing.	DIP switch of printer not set correctly. Wrong communication setting for printer.	Check DIP switch setting of the printer. Check setings in "Setup 0".

Malfunction	Cause	Measure
Nothing displayed	Contrast has been changed.	Call METTLER TOLEDO service for help.
No key entry possible		Call METTLER TOLEDO service for help.
Measurement not reproducible	Sample not homogeneous, air bubbles in the measuring tube, measurement temperature unstable. Is the bench vibrating? Cell contaminated with old sample.	Check factors mentioned. Check if temperature is stabilized. Measurement cell filled completely? Place instrument on a non-vibrating bench. Clean measuring cell thoroughly.
Air bubbles in the sample i.e. measurement never ends or measuring times vary greatly.	Leaking connections? Sample likely to produce bubbles or mixture containing components with low coiling point? High sample viscosity?	Check connections. Degass sample (ultrasonic bath or heating) or measure at reduced temperature. Use a syringe or warm up the sample.
Long sampling time.	Wrong setting of the flow control valve. Sample viscosity too high.	Adjust the sampling speed to your sample with the valve. Use a syringe to inject the sample.
Measurement of distilled water free of air bubbles takes too long.		Switch off the instrument and call the METTLER TOLEDO service.
Adjustment of the instrument with air and water at higher temperatures takes too long.	Air or gas bubbles are generated by the heating-up of the water in the measuring cell.	Boil the distilled water, or degass it in an ultrasonic bath (at least at the measuring temperature), and inject it at this higher temperature to avoid formation of air or gas bubbles.

17. Maintenance

17.1 Changing internal battery

The battery is used for data storage and has a service life of around 5 years when it is kept charged. We thus recommend switching the instrument on now and then to ensure the battery remains operational during this time.

17.2 Power line voltage, power line, fuse

The DE40/50/51 will adapt automatically to the power line voltage in the range of 100 to 240V and 50/60 Hz.

Changing blown fuses:
- Switch off the instrument and disconnect all cables on the rear of the instrument.
- Put the instrument on the rear side.
- Remove the small plate at the instrument's bottom plate by unscrewing the 2 screws.
- Change the blown fuse(s) and put the small plate in place again. Make sure to use the correct fuse type for replacement: T3.15A / 250V.

17.3 Replacing the silicagel

- Replace the silicagel of the drying tube when it becomes pink. If this is not done the drying of the measurement tube (and thus the adjustment with dry air) is no longer assured.
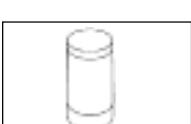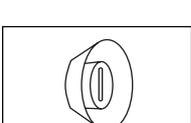
17.4 Replacing the tube nozzles

If you find air bubbles in the measurement tube on every sample injection which do not originate from the sample itself, the tube nozzle may be leaking or damaged. To change the tube nozzles, proceed as follows:
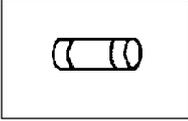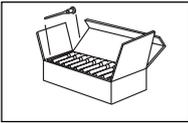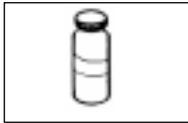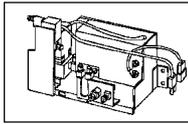- Carefully remove the protective silicone cap that holds the nozzles correctly in place. Make sure not to tear at the rim, but hold its strong middle part with your fingers.
- Unscrew the tube nozzle anticlockwise and then screw in the new one tightly by hand. Do not apply pressure as this would damage the measurement tube.
- Then put the protective silicone cap in place again with the squared hole at the bottom so that leaking liquid from the cell unit can flow out.
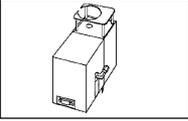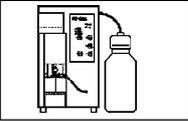
18. Standard and optional equipment

18.1 Standard equipment

Order No.
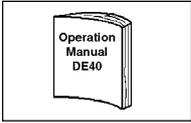
	Operating instructions Englisch	51709838
	Sampling/Drain tubes, 2 pcs (without joint)	51328032
	Joint for Sampling/Drain tube (PTFE/PP)	51328035
	Teflon tube nozzle (for connection to measuring cell)	51328027
	Tube nozzle special (to use with joint with thread)	51322238
	Joint with thread for Sampling/Drain tube (to be used with tube nozzle special)	51322239
	Exhaust tube (1m)	51328133
	Desiccator	51322012
	Silica gel 1kg	105080
	Protective rubber for sample inlet	51322045
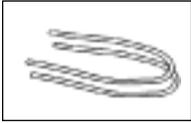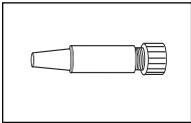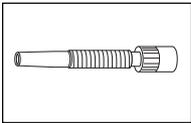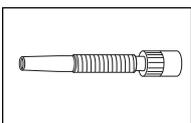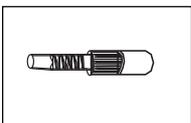
18.2   Optional equipment
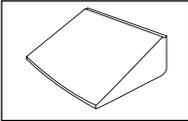
	In use cover	51107119
	Fuse T3.15A	51522100
	Plastic syringe 10mL (set of 100)	71482

Certified density standards:
8 mL vials, with certificate
- Water (0.99… g/cm^3 +/- 0.00001)   51338002
- Beverage sirup (1.04… g/cm^3 +/- 0.00010)   51338003
- Dichlorotoluene(1.26… g/cm^3 +/- 0.00002)   51338004
- Fluorocarbon (1.95… g/cm^3 +/- 0.00002)   51338005

Memory Cards:
- Data, methods and sample file storage   51324004
- Alcohol   51324000
- BRIX   51324001
- API   51324002
- Coke BRIX & solids   51324009
- Viscosity correction (for DE40)   51324003

GA42 printer:
- Alphanumerical printer (serial)   GA42
- Set of paper rolls (5 pcs)   00072456
- Ribbon catridge (black)   00065975
- Connection cable (not included)   51190362
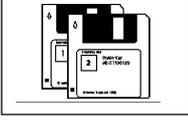
PC software (for Windows 95 & 98):
- Data transfer software to EXCEL (version 7.0 or later)   51324100
- Data transfer software for DE/RE combination   51324101
- Connection cable to computer   51190362

ASU-DE sampling pump
- Sampling pump   51321500
- Waste bottle (250 mL) with lid   51322011

	AD-510 Auto Drain Unit (requires ASU-DE)	51321807
	DCU-300B Auto Rinsing Unit (requires ASU-DE)	51321805
	CHG-260B Sample Changer (60 samples)	51321208
	SOP40 Sample Operation Programmer, 4 steps	51321600
	SOP50 Sample Operation Programmer, 5 steps	51321601
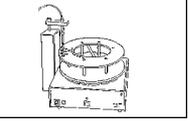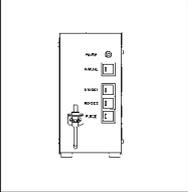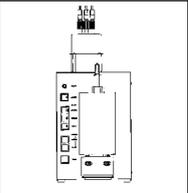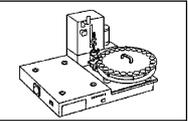
SC24 Sample Changers
- SC24 (basic version)   51321300
- SC24H (high temperature version, electrical heating) 51321301
- SC24L (low temperature version, requires water bath) 51321302
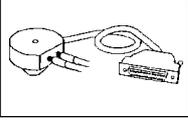
SC24 connection sets
- Connection to DE40/50/51   51322007
- Connection to DE/RE combination   51322009

Refractometers
The following refractometers can be connected to the
DE40/50/51 density meters for simultaneous measurement
of density and refractive index)
- RE40, 4 decimal places   51320400
- RE50, 5 decimal places   51320401
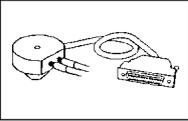
Refractometer connection sets
- DE/RE connection set (basic version)   51322010
- SC24 connection set to DE/RE combination   51322009

MemoCard DE40/50/51 (Short Instructions)

Sample · **Sample No, Sample ID**
  (and number of samples if
  Sample file ON)
  Viscosity correction (DE51, DE40 with
  Memory Card Viscosity)

Report · **Select print format**
  off
  short
  GLP
  variable

Meas. Para · **Set measurement parameter**
  Method name
  Measuring temperature
  Stability
  Wait time
  Sequence (ON/OFF)
    Sampling
    Drain
    Rinse-1
    Rinse-2
    Purge

Calc. Para · **Calculation parameter**
  Result
    d, d_t^t, d_4^t
    BRIX, API, Alcohol (if selected)
    Concentration
      (enter table)
      (enter coefficients)
  Temperature compensation
    (enter coefficients)
  Decimals
    for d^t
    for d_t^t, d_4^t (if temp.comp. select.)
    BRIX, API, Alcohol (if selected)
    for Conc. (if Conc. selected)

Method · **Method selection**
  Method 0 to 9

Display · **Display selection**
  Density
  Oscillation
  BRIX, API, Alcohol (if so selected)
  Conc. (if Conc. selected)

Print · **Print message or parameter**

Measure · **Start measurement**
  (including sample sequence
   if Sequence ON)

Function · **Function selection**
  0. Data file
  1. Sample file (ON/OFF)
  2. Method File
  3. Changer
  4. Factor
  5. Set check
      (name, value, tolerance)
  6. Periodic (check and adjustment)
      (check interval)
      (show check list)
  7. Autostart
  8. Card utility
  9. Memory clear

Setup · **Setup selection**
  0. Interface
      (Printer, RS-232)
  1. Date & Time
  2. Name
  3. Serial/Version No.
  4. LCD contrast
  5. International
      (date format)
      (°C or °F)
  6. Lock
  7. Beep
  8. Temperature calibration

Check · **Run instrument check**
  Periodic check (on check date)
  Daily check (all other dates)

Calib. · **Perform adjustment**

BS · **Backspace** (erase)

Rinse/ Purge · **Rinse/Purge**, only for SC24 and DCU-300
  (Sequence must be ON)

Pump · **Pump** ON/OFF, for ASU-DE

Clear · **Clear entry** (2 x to clear name)

Esc. · **Escape**

Reset · **Return to main display**

Annex 1: Density table of dried air

The density of dried air at a specified temperature t and a atmospheric pressure of 760 mm Hg is calculated according to the following formula:

$$d \ (g/cm^3) \ = \ \frac{0.0012932}{1 + 0.00367 \times t \ (°C)} \quad x \quad \frac{p \ (mm \ Hg)}{760}$$

The values stored in the instrument are listed in the table below. Intermediate values are interpolated according to the LaGrange polynomial.

Temp. [°C]	Density [g/cm³]	Temp. [°C]	Density [g/cm³]	Temp. [°C]	Density [g/cm³]	Temp. [°C]	Density [g/cm³]
0	0.00129	25	0.00118	50	0.00109	75	0.00101
1	0.00129	26	0.00118	51	0.00109	76	0.00101
2	0.00128	27	0.00118	52	0.00109	77	0.00101
3	0.00128	28	0.00117	53	0.00108	78	0.00101
4	0.00127	29	0.00117	54	0.00108	79	0.00100
5	0.00127	30	0.00116	55	0.00108	80	0.00100
6	0.00127	31	0.00116	56	0.00107	81	0.00100
7	0.00126	32	0.00116	57	0.00107	82	0.00099
8	0.00126	33	0.00115	58	0.00107	83	0.00099
9	0.00125	34	0.00115	59	0.00106	84	0.00099
10	0.00125	35	0.00115	60	0.00106	85	0.00099
11	0.00124	36	0.00114	61	0.00106	86	0.00098
12	0.00124	37	0.00114	62	0.00105	87	0.00098
13	0.00123	38	0.00113	63	0.00105	88	0.00098
14	0.00123	39	0.00113	64	0.00105	89	0.00097
15	0.00123	40	0.00113	65	0.00104	90	0.00097
16	0.00122	41	0.00112	66	0.00104		
17	0.00122	42	0.00112	67	0.00104		
18	0.00121	43	0.00112	68	0.00103		
19	0.00121	44	0.00111	69	0.00103		
20	0.00120	45	0.00111	70	0.00103		
21	0.00120	46	0.00111	71	0.00103		
22	0.00120	47	0.00110	72	0.00102		
23	0.00119	48	0.00110	73	0.00102		
24	0.00119	49	0.00110	74	0.00102		

Chemical Handbook Fundamental Version, Rev. 3, Table 5.1 (1984).

Annex 2: Density table of pure water

The instrument has stored the density of water at 760 mm Hg according to the following table:

Temp. [°C]	Density [g/cm³]	Temp. [°C]	Density [g/cm³]	Temp. [°C]	Density [g/cm³]
0	0.99984	25	0.99705	50	0.98805
1	0.99990	26	0.99679	55	0.98570
2	0.99994	27	0.99652	60	0.98321
3	0.99996	28	0.99624	65	0.98057
4	0.99997	29	0.99595	70	0.97779
5	0.99996	30	0.99565	75	0.97486
6	0.99994	31	0.99534	80	0.97183
7	0.99990	32	0.99503	85	0.96862
8	0.99985	33	0.99471	90	0.96532
9	0.99978	34	0.99438		
10	0.99970	35	0.99404		
11	0.99961	36	0.99369		
12	0.99950	37	0.99333		
13	0.99938	38	0.99297		
14	0.99925	39	0.99260		
15	0.99910	40	0.99222		
16	0.99894	41	0.99183		
17	0.99878	42	0.99144		
18	0.99860	43	0.99104		
19	0.99841	44	0.99033		
20	0.99821	45	0.99022		
21	0.99799	46	0.98980		
22	0.99777	47	0.98937		
23	0.99754	48	0.98894		
24	0.99730	49	0.98849		

Chemical Handbook Fundamental Version, Rev. 3, Table 5.2 (1984).

Specifications

Type and model name	Digital density meter DE40, DE50, DE51	
Measuring method	Oscillating U-tube	

Density		**DE40**	**DE50, DE51**
Measuring range	d	0.0001 to 3 g/cm^3	0.00001 to 3 g/cm^3
Limit of error	d	1×10^{-4}	2×10^{-5}
Repeatability	d	1×10^{-4}	1×10^{-5}
Resolution	d	1×10^{-4}	1×10^{-5}

Temperature

Control	Peltier		
Range	T	4 – 90 °C	4 – 70 °C
Precision	T	0.05 °C (10 to 30 °C)	0.02 °C (10 to 30°)
	T	0.1 °C (4 to 90 °C)	0.05 (4 to 70 °C)

Viscosity compensation	Memory Card (option)	DE50: not possible DE51: standard

Sample required	min. 1.2 mL (manual injection with syringe) min. 2 mL (automated operation with optional pump)
Typical meas. times	1 to 4 minutes (manual operation) 2 to 10 minutes (programmed automated operation)
Display	LCD (Liquid crystal display): 7 line display, backlit
External I/O	1 RS-232C (for computer and combination) 1 RS-232C (for external printer) 1 special serial interface (for sample changer) 1 Memory Card (PCIMCIA)
Ambient condition	1) Temperature: 5 ~ 35 °C 2) Humidity: below 85 % RH (no condensation)
Power source	AC 100-240 V, 50/60 Hz
Power consumption	200 W
Dimension	270 mm (W) x 400 mm (D) x 410 mm (H)
Weight	15 kg

FCC Rules and Radio Interference Regulations

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to both Part 15 of the FCC Rules and the radio interference regulations of the Canadian Department of Communications. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is like to cause harmful interference in which case the user will be required to correct the interference at his own expense.

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