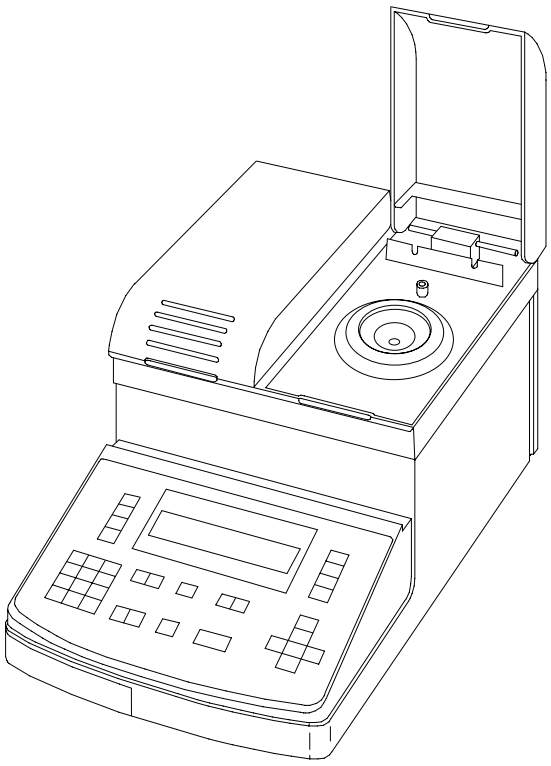
Operating Instructions



Version 4.0

RE40
Refractometer

Contents Page

1. Introduction

The RE40 refractometer is used for the simple determination of the refractive index of liquid samples. It has the following strong points:

- measures samples with a refractive index in the range 1.3200 to 1.7000.
- needs a minimum amount of sample (min. 0.4 milliliters) for measurement.
- keeps the temperature of the sample being measured constant between 15 and 70 °C thanks to a built-in Peltier thermostat control (no water bath required).
- has ten methods stored in its memory, which you can change to suit your measurements.
- displays the sugar content of appropriate samples directly in BRIX degrees.
- is able to directly display the concentration of solutions using tables.
- stores up to 100 measured values.
- performs statistical evaluations (mean value, standard deviation, relative standard deviation) and allows recalculation of results.

To the RE40 refractometer you can attach:

- a METTLER TOLEDO GA42 printer to print out entered parameters, data and results.
- a METTLER TOLEDO barcode reader DLC7070 to read in barcodes for sample IDs and operator names.
- an SC24 sample changer to perform measurement series automatically.
- a DE40, DE45 or DE51 Density Meter to determine the density and refractive index simultaneously.
- a computer to transfer experimental data.

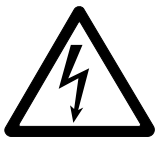
Features of the RE40 refractometer:

- The light source for measurement is an LED which is maintenance free (unlike conventional light bulbs that blow from time to time).
- The measurement prism is made of sapphire, which is strongly resistant to corrosion, very rigid and of high thermal conductivity.

2. Safety measures

The instrument has been tested for the experiments and intended purposes documented in the Operating Instructions. However, this does not absolve you from the responsibility of performing your own tests of the product supplied by us regarding its suitability for the methods and purposes you intend to use it for. You should therefore observe the following safety measures.

Measures for your protection



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

– Do not work in a hazardous area! The housing of the refractometer is not gas tight (explosion hazard through spark formation, corrosion by gas diffusion into the instrument).

Measures for operational safety

– Do not add samples with hard objects made of glass, metal or ceramics! They could damage the prism.
– Clean the prism immediately after measuring strong acids and bases! These could attack the prism.
– Use only fuses of the specified type if you need to change them!
– Exclude the following environmental influences:
  • powerful vibrations,
  • direct sunlight and sharp changes in temperature,
  • exposure to corrosive gases,
  • very dusty places,
  • 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!

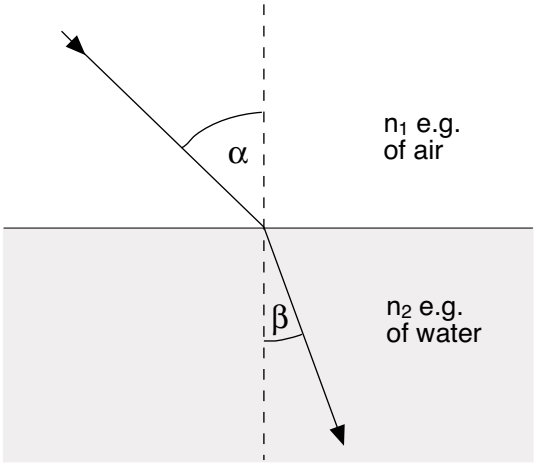
– If the instrument is not going to be used for a longer period of time, clean the prism carefully. To store the instrument use the cardboard box in which it was first delivered.

  Avoid storage under excessive ambient conditions including too high or too low temperature, high humidity or very dusty areas.

3. Refractive Index

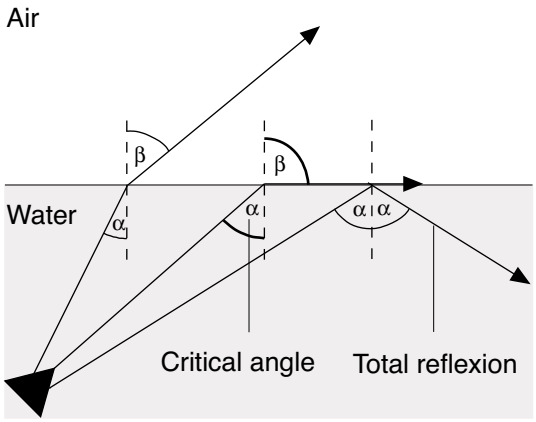
3.1 Definition of refractive index

The refractive index n of a substance is the ratio of the velocity of a ray of light in a vacuum to its velocity in the medium (unitless).



If a ray of light at a particular angle passes from air to water (optically less dense to optically more dense medium), it changes its direction except when the incident light is vertical. According to Snell's law of refraction, the ratio of the refractive indices of the two media is proportional to the ratio of the angle of refraction and angle of incidence of the ray of light:

$$\frac{n_1}{n_2} = \frac{\sin \beta}{\sin \alpha}$$



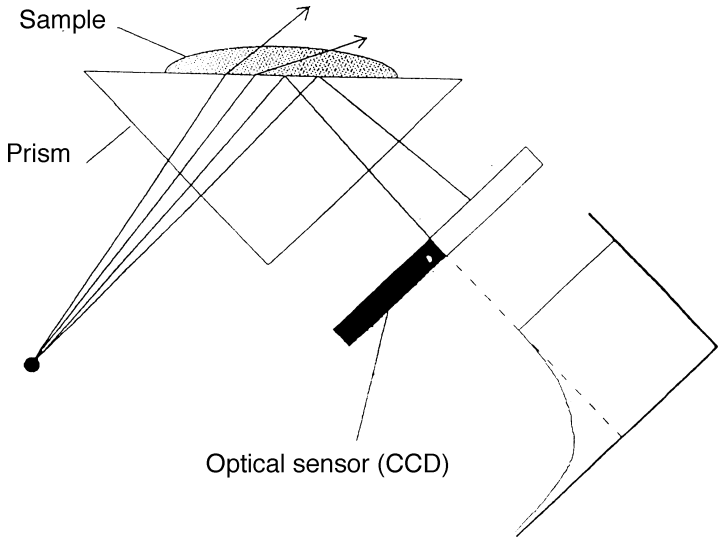
If a ray of light passes into an optically less dense medium from an optically more dense medium, it also changes its direction. If the angle of incidence α is increased, it reaches a critical value (angle of refraction $\beta = 90°$) at which the ray of light no longer passes into the optically less dense medium. If this "critical angle" is exceeded, total reflection occurs. The critical angle α is used to calculate the refractive index:

$$\beta = 90° \rightarrow \sin \beta = 1$$

$$n_1 = \frac{n_2}{\sin \alpha}$$

As the refraction depends on the wavelength of the incident light, the refractive index is measured at the wavelength of the D line of sodium (589.3 nm) as standard and symbolized by n_D.
The refractive index depends not only on the wavelength used to measure it, but also on the temperature of the solution being measured. The standard temperature is 20 °C. If measurements are performed at a different temperature, e.g. 25 °C, this must be specified: n_D^{25}.

3.2 Measurement principle



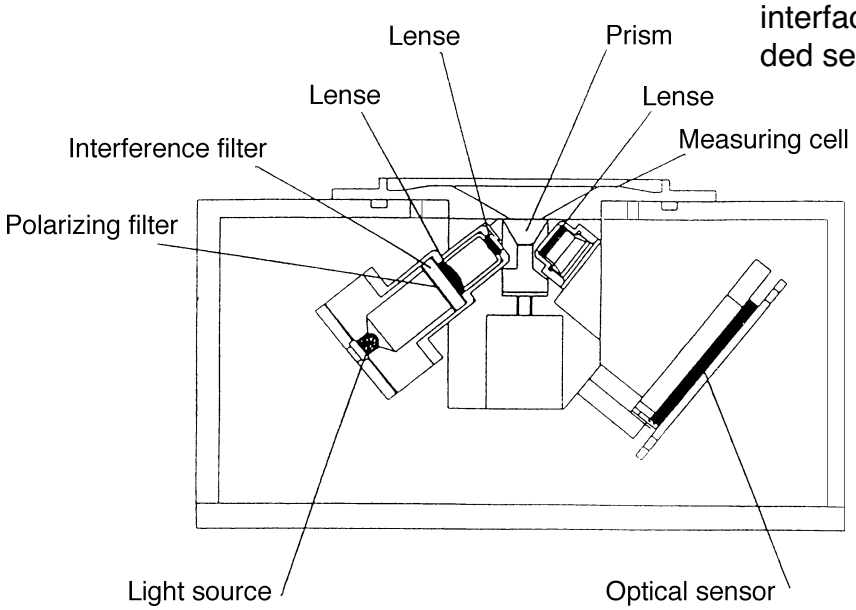
The light emitted by the RE40 passes through the prism and encounters the sample. It is partially refracted (angle of incidence < critical angle) and partially reflected (angle of incidence > critical angle).

The reflected light is recorded using an optical sensor (CCD). The boundary between the dark and light areas represents the critical angle needed to calculate the refractive index.

Setup of the measurement system

The light source is a light emitting diode (LED) whose beam passes through a polarizing filter, an interference filter (589.3 nm) and various lenses before it passes through the sapphire prism and encounters the sample. The reflected light (angle > critical angle) is led via a lens to the optical sensor, which records the critical angle.

The temperature at the prism-sample interface is measured by the embedded sensor.

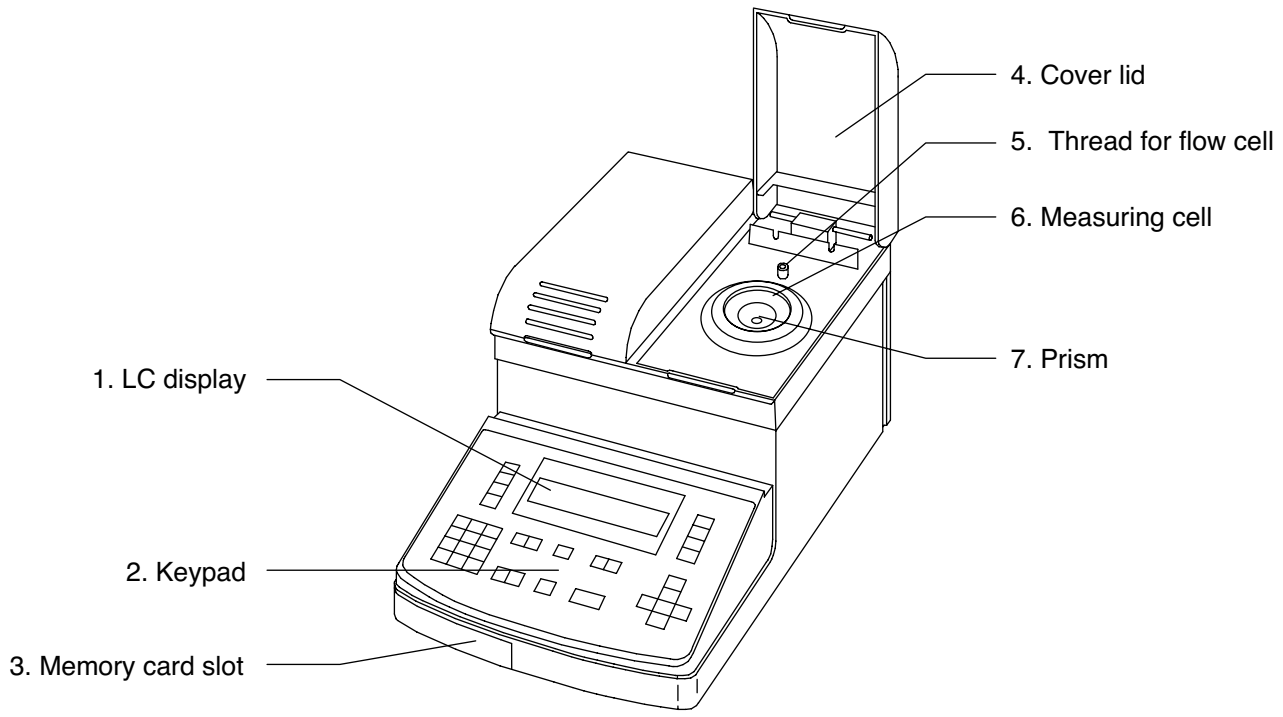


3.3 Conversion to other units

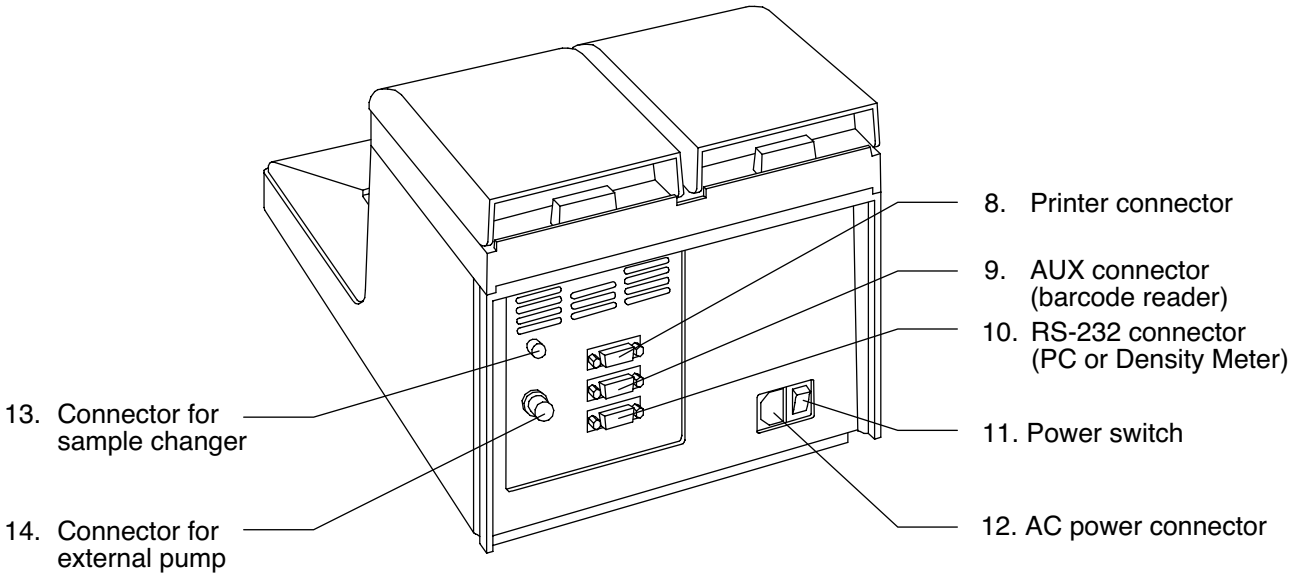
The measured refractive index can be converted into other units, depending on the application. The most commonly used units are BRIX, WORT, ZEISS, etc. See section 9.1 for more information.

4. The instrument

Front view



Rear view



4.1. General overview

1. LC display
   The RE40 has a two-line liquid crystal display.

2. Keypad
   Start measurement, input of measurement conditions or calculation parameters are operated on these keys.

3. Memory Card slot for software upgrade.

4. Cover lid
   When closed it protects the measuring cell and eliminates incoming dispersed light during measurement. When opened it prevents sample liquid from splashing to the rear of the instrument.

5. Thread for flow cell
   Thread to mount a flow cell unit (FCU, see section 13).

6. Measuring cell
   The sample is pipetted in the center of this stainless steel cone. The minimum amount of sample (0.4 ml) is indicated by a ring mark.

7. Prism
   The prism is made of sapphire, which is resistant to corrosion and physical damage.

8. Printer connector
   To connect an external printer.

9. AUX connector
   To connect a barcode reader.

10. RS232 connector
    To connect a personal computer or a Density Meter (DE40, DE45 or DE51).

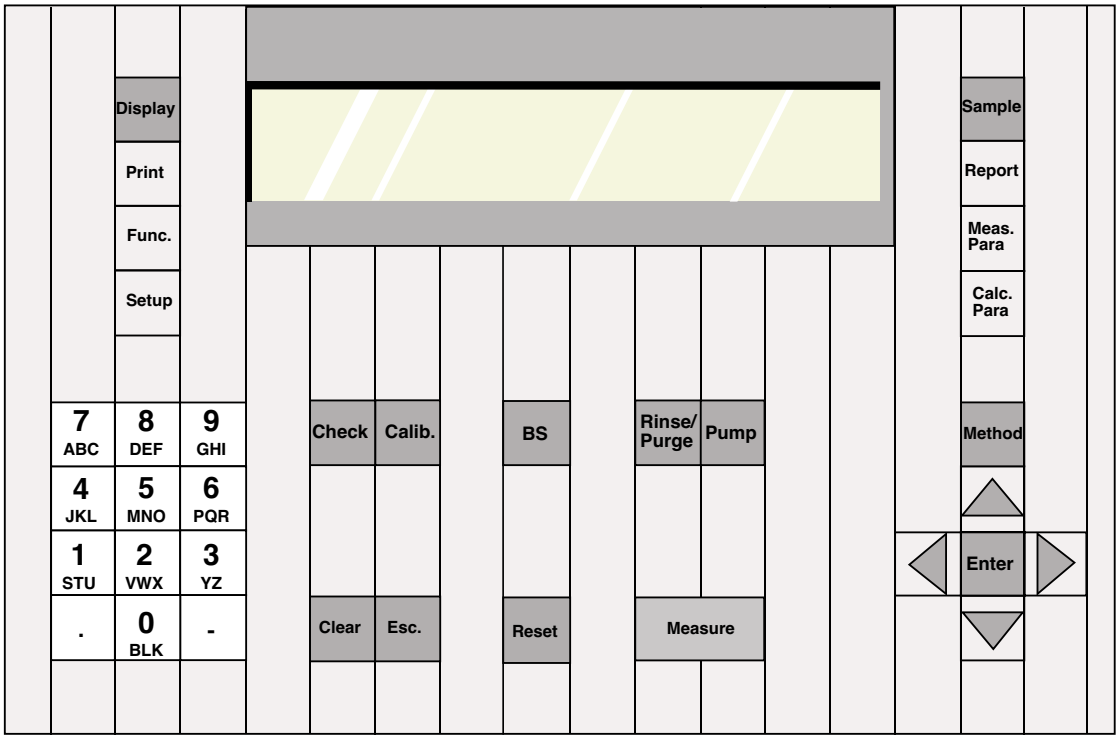
11. Power switch

12. AC power connector (IN)
    Automatically adjusts to line voltages in the range between 100 and 240 V AC.

13. EXT. connector for sample changer
    To connect an SC24 or a CHG-241 sample changer.

14. EXT PUMP connector for an external pump.

4.2. Keypad



Sample — Sample: To enter sample parameters, such as sample number and ID.

Report — Report: To define the print format for results.
There are three formats:
(1) Short: Minimum printing format.
(2) GLP: Format which complies with GLP requirements.
(3) Variable: User defined printing format.

Meas. Para — Measuring parameters: To define measuring parameters:
- Method name (8 characters, alphanumerical),
- Measuring temperature (from 15 to 70 °C),
- Stability (0, 1 or 2),
- Wait Time (0 to 9999 s),
- Sample sequence (sampling, drain, rinse and purge).

Calc. Para — Calculation parameters: To define calculation parameters:
- Result (n_D, BRIX or Concentration). To define concentration function.
- Temperature compensation.
- Decimals (n_D, BRIX or Concentration, according to selected result).

Method — Method — To select method (0 to 9). Selection is done either by pressing the "Up", "Down" or the corresponding number key.

Display — Display — To select between numerics, capital or small letters when entering parameters. To change between result displays (nD, Brix).

Print — Print — To print settings (e.g. method, tables, calibration and check data, etc.).

Function — Function — To access the following functions:

(0) Data File: To handle stored results.
(1) Sample File: To enable / disable sample sequences.
(2) Changer: To select type of automation unit (SC24, CHG241, etc.).
(3) DE Connect: To connect a DE Density Meter.
(4) Set Check: To enter name of standard, ref. value and tolerance for daily and periodic checks.
(5) Periodic Check: To define intervals for periodic checks and to display stored checks.
(6) Periodic Calibration: To define intervals for periodic adjustments and to display stored adjustments.
(7) Multiple Meas.: To do multiple measurements of one sample, to enable / disable auto statistics.
(8) Memory Clear: To delete data stored in the instrument.

Setup — Setup — To access the following parameters:

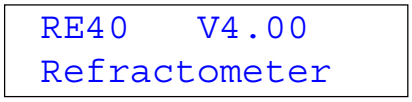
(0) Interface:	To configure the serial ports (RS232C, AUX. and PRINTER) for printer, PC and barcode reader
(1) Date & Time:	To set data and time
(2) Op.Names/Units:	To enter operator names and concentration units
(3) Serial/Version:	To display serial and version number of the unit
(4) LCD Contrast:	To adjust the contrast of LC display
(5) International:	To select date format and temp. unit (°C/°F)
(6) Lock:	To limit the access to certain functions with a password.
(7) Beep:	To enable / disable the acoustic signal
(8) Temp.Calib:	To perform a temperature calibration
(8) Calib.Mode:	To define the procedure for adjustment

Check — Check — To perform a check: daily (always) or precision (only when due).

Calib.	Calibration	To perform an adjustment.
BS	Backspace	To erase preceding letter or numeral.
Rinse/ Purge	Rinse/Purge	For SC24 sample changer. Runs an automatic rinse and purge cycle, according to the parameters selected in method 0. CALIB.
Pump	Pump	To start / stop external sampling pump.
Clear	Clear	To erase whole input field or to recall previous setting (undo).
Esc.	Escape	To return to main display (result of last measurement is not erased).
Reset	Reset	To abort a measurement or an adjustment and to return to "Ready" main display (result of last measurement is erased).
Measure	Measure	To start a measurement.
7 ABC	0 – 9 key	To select an item in the menus 'Function' and 'Setup'. To enter alphanumeric characters (the selection capital/ small letters or numbers is done with the <Display> key). To select B, press twice, for C press three times. Blanks may be entered with the <0 (BLK)> key.
. –		Dot and hyphen key. "/" and "%" may be entered by pressing the hyphen key twice or three times.
Enter	Enter	To confirm an 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 in the menus.
	Down ▼	When selecting an option from the menus 'Function' or 'Setup' it is normally quicker to type in the corresponding number with the <0> ... <9>keys rather than to use the arrow keys.

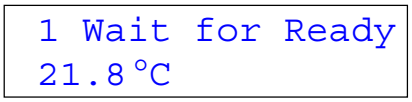
4.3 Display

The RE40 refractometer has a two line LC display with 15 characters per line. When the power is turned on (power switch on the rear of the instrument), the following message appears on the display:



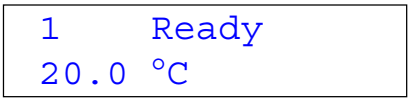
The software version appears for a short time. This software version can also be displayed under Setup 3 "Serial/Version".

After a few seconds the main display will appears:



The message "Wait for Ready" blinks until the cell temperature reaches the set temperature.

Due to the temperature control algorithm used, the cell temperature can momentarily cross the set temperature (overshoot or undershoot). It takes approximately 15 minutes until the set temperature is reached. For accurate results, however, you should allow the instrument to stabilize for at least 30 minutes after having turned it on or changed the measuring temperature.



When the set temperature is reached, "Ready" appears at the bottom of the display.

The number display in the upper left corner shows to the selected method; in this case method n° 1.

4.4 Measures for correct measurements

- Always adjust the instrument at the temperature the samples are measured!
- Check the instrument from time to time measuring reference standards.
- Use soft paper tissues or washed gauze to clean and to dry the prism.
- Use deionized water to clean the cell after measuring aqueous samples. For organic samples use a suitable organic solvent such as toluene, ethanol or acetone. If the solvent used doesn't evaporate quickly enough, use a second solvent like acetone to wipe the first one off and dry the cell.
- Never use cotton wool as its fibres could adhere to the prism and influence the measurement!
- Make sure that the ring mark is always covered by the sample when doing measurements (minimum sample volume: approximately 0.4 mL).
- Always stir the sample on the prism carefully to allow air bubbles to escape!
- Ensure that the samples to be measured are homogeneous. Viscous and highly concentrated liquids must be mixed thoroughly before a sample is taken.

Take special care if the samples to be measured have properties such as described below:

- High-concentration: Such samples may have a large concentration change due to evaporation of solvent during the measurement. This may result in poor repeatability of the results or a wide difference between the measured and the true value. When working at elevated temperatures, these errors are more likely to happen. If you have to measure such samples
  - use a FCU-520 flow cell unit and take care not to expose the sample to air for a long time.
  - do not perform the measurements at low temperatures, because this could lead to crystallization and thus to light scattering.
- Colloidal samples, such as milk, etc.: Light is scattered by the colloidal particles which causes poor repeatability. In the worst case, no measurement is possible.
- Volatile samples: The measurement may last long or the results yielded are erroneous for the following reason: Part of the sample evaporates during the measurement and the surface of the prism is cooled down due to the evaporation energy. This may cause a malfunction of the temperature control of the RE40. Therefore, when measuring such samples, set the measurement temperature as low as possible and use a vapor proof lid (ME 51322114).
- Samples which tend to foam: Foam or air bubbles on the surface of the prism scatter the light and cause poor repeatability of the results. In the worst case, no measurement is possible.

5. Getting started

5.1 Setting up the instrument

5.1.1 Printer (Setup 0)

If you are working without printer you can skip this section and go directly to section 5.1.2. To connect a GA42 printer, perform the following steps:

- Make sure that the DIP switch 2 in ON on the GA42 printer (see GA42 operating instructions).
- Press the <Setup> key .

Setup (0-9)? 0 Interface	Press the <0> key to select '0.Interface'. Confirm with <Enter>.
Interface? Printer→	Select 'Printer' with the ▶ key. Confirm with <Enter>.
Printer? GA-→	Select 'GA-' with the ▶ key. Confirm with <Enter>.

- To choose the format for the printout of the results press the <Report> key. Choose between 'Off', 'Short', 'GLP' and 'Variable' (see section 7 "Report").
- Press the <Reset> key.

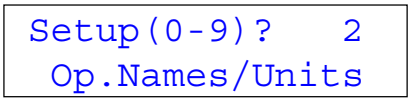
5.1.2 Date and time (Setup 1)

Press the <Setup> key.

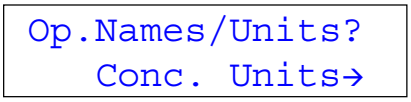
Setup(0-9)? 1 Date&Time	Press the <1> key to select '1.Date&Time'. Confirm with <Enter>.
Date & Time: 15/04/200111:27	The current date and time are displayed. Press <Enter>.
Date DD/MM/YYYY? 20/06/2001	Enter the correct date (the date format is selected in the menu Setup '5. International') and confirm with <Enter>.
Time? 11:27	Enter the correct time and press <Enter>.

5.1.3 Enter operator names (Setup 2)

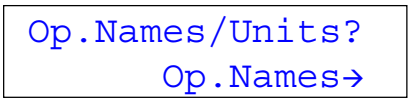
Press the <Setup> key.



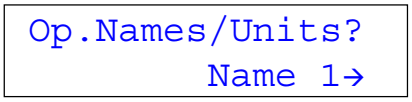
Press the <2> key to select '2. Op.Names/Units'. Confirm with <Enter>.



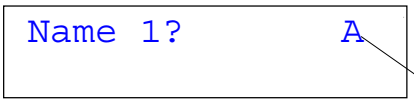
If 'Conc. Units' appears on the display, press the ▶ to select 'Op.Names'.



Confirm 'Op.Names' with <Enter>.



Confirm 'Name 1' with <Enter>.



Input a name of a future operator of the instrument and confirm with <Enter>.

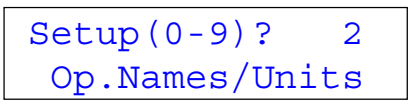
The capital A means that the alphanumerical keyboard is in entry mode for capital letters. Press the <Display> key to change the entry mode:

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

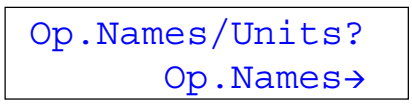
Hint: You may enter special characters with the '-' key or with a barcode reader. See Annex 3, section A.3.2 for more details.

Enter the names of other future operators (up to 10 names may be entered) as described above.

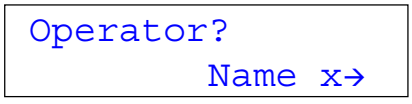
Select the number (name) of the current operator: Press the <Setup> key.



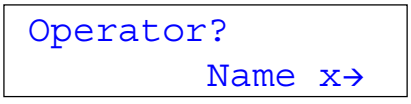
Confirm 'OpNames/Units' with <Enter>.



Confirm 'Op.Names' with <Enter>.



Press <Enter>.



Select the current operator with the ◀ or the ▶ key.

Confirm with <Enter> and press <Reset>.

Hint: The easiest way to select an operator from the list it with a barcode reader. See Annex 3, section A.3.3 for more details.

The instrument is now ready for adjustment and the first measurement.

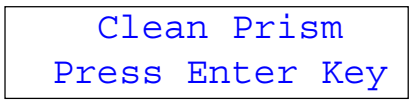
5.2 Performing the first adjustment (calibration)

After turning on the instrument allow at least 15 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.

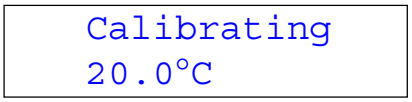
Note: The instrument should always be adjusted at the measuring temperature to assure correct measurement.

Method n° 0 ("CALIB.") is dedicated to the adjustment of the instrument, i.e. whenever the <Calib.> key is pressed, method 0 is activated. It is not possible to carry out sample measurements while method 0 is selected. It is not possible, either, to change the name of this method or its measuring temperature. The temperature for method 0 is always taken from the previously active method (because the instrument has to be adjusted at the same temperature as the samples are measured).
We recommend to always use **Stability 0** for adjustment. This is the default (factory) setting in method n°0 (see section 8 for further details).

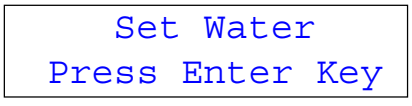


Press the <CALIB.> key and follow the directions on the display:

Open the cover lid and clean the measuring cell (the prism) thoroughly with water and ethanol. Then wipe it dry with a soft tissue, like soft paper towels or washed gauze. Close the lid and press <Enter>.

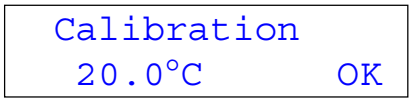


While adjusting to the air value the display shows shortly "Calibrating".



Put distilled water on the measuring cell until the ring mark is covered (approximately 0.4 mL).

Press <Enter>. "Calibrating" flashes on the display during adjustment to the water value.



When the adjustment is done the display shows the message "Calibration OK".

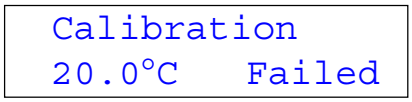
The results of the adjustment are printed out:

```
[Calibration]
Date : 29/06/2001 11:15

Result      : OK
Temperature :  20.0 °C

        OLD ---> NEW
Water
  nD   1.3331   1.3330

Operator : Smith

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

The "OLD" value is the refractive index of water measured with the old adjustment settings.

The "NEW" value is the theoretical refractive index of water. This value is assigned to the actual reading.

The values of the last 10 adjustments are stored. They can be viewed and printed out at any time (see list of adjustments, section 10.7)



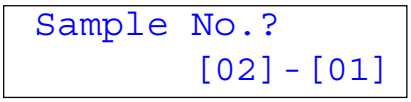
If the instrument fails to do the adjustment the message "Failed" appears.

In such a case make sure that the water you use for adjustment is really of appropriate quality (i.e. distilled or correctly deionized). Clean the prism well, wipe it dry, and repeat the adjustment. If the adjustment still does not succeed, contact your METTLER TOLEDO Service for technical assistance.

5.3 Perform a measurement

Perform a measurement with one of your samples.

Press the <Sample> key to enter the sample data: sample number and sample ID.



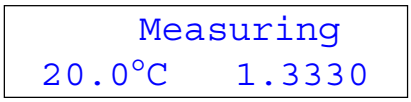
Enter the sample number, for example 02-01: press <2> <Enter> <1> <Enter>.

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

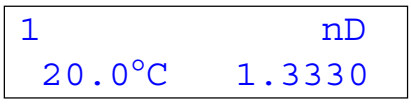
Note: To enter a sample ID with a barcode reader without changing the sample numbers, you do not even have to press the <Sample> key (see section 6).

Put sample on the measuring cell until the ring mark is covered (approximately 0.4 mL) and stir carefully to remove any air bubbles from the surface of the prism.

Close the cover lid and press <Measure> (the green key).



The display flashes during the measurement.



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

```
Model       : RE40
Serial No.  : MSA08504
Version No. 4.00
Sample:

   --------------

*** R e s u l t ***

Sample No.      02-01

Date : 29/06/2001 12:07
Sample ID    : xxxxxxx
Method No.   : 1
Method Name : Method-1
Meas.Temp.   :  20.0 °C
nD:             1.3330

Meas.Time    : 00:00:05


Operator:Smith

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

Example of a GLP print of such a n_D measurement.

6. Sample (Number and ID and Sample File)

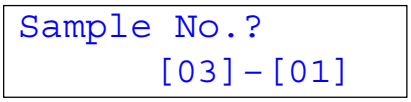
Press the <Sample> key to define your sample identifications such as sample number and sample ID.

The sample number (**Sample No.**) consists of two parts: for example [03]–[01].

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 either directly after each measurement or later on.

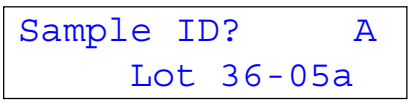
The second two-digit number – ranging from 00 to 99 – is automatically increased by one after each measurement.

Additionally you can define a **Sample ID** (max. 10 characters including "space", "period", "hyphen", etc.), for example a sample name or the Lot number. The Sample ID may be entered either via the keypad or with a barcode reader.



Press the <Sample key>.

Enter the sample numbers. Confirm each entry with <Enter>.



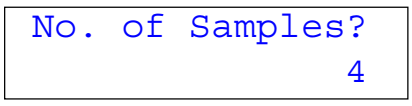
Enter the sample ID using the alphanumeric keys (max. 10 characters including "space", "period" and "hyphen") or read it in with a Barcode reader.

To enter a sample ID with a barcode reader without changing the sample numbers, you do not even have to press the <Sample> key!

6.1 Sample File (sample changer)

If a sample changer (see Function 2 "Changer") is connected to the RE40 or if the sample file is set to on (see Function 1 "Sample File"), another display will appear when the <Sample> key is pressed:

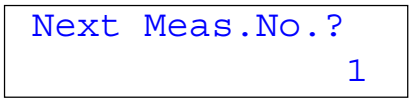
No. of Samples:



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 confirm with <Enter>. 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. Enter 1 and confirm with <Enter>.

Method? Variable→	Here you can select if you want to perform all measurements with the same **Method** (**Current**, i.e. the one currently selected) or with different methods (**Variable**). The selection is done with the ◀ or the ▶ key. Confirm with <Enter>.
Edit No.? 1	Enter which sample in the sample file you want to edit (if you are entering a new sample file you have to enter 1 here) and confirm with <Enter>.
001;Method No.? 1	This display appears only it you have selected 'Variable' above. Enter the number of the method which has to be used to measure sample n° 1.
001;Sample No.? [01]-[01]	Enter the series and the sample number for the first measurement. Confirm both entries with <Enter>.
001;Sample ID.? _	Enter the sample ID using the alphanumeric keys, or read it in with a barcode reader. **Hint:** Use the <Display> key to enter numbers, capital and small letters.
001;Samp.Spd.? Low→	This display appears only if a sample changer is connected to the RE40. Choose the sampling speed for the transfer of the sample with the ◀ or the ▶ key. Confirm with <Enter>. 'Low' means the reduced speed ("SAMPLING ADJ." valve on the sample changer) for normal samples, 'High' means maximum pump speed for high viscous samples. Confirm with <Enter>.

Now repeat the last four steps for all samples you want to measure. When you have entered all parameters, exit the sample file by pressing the <Reset> key.

Hint: Press the <Sample> and then the <Print> key to print out the sample file.

Example:

Let's assume that you want to

- measure a series of 12 samples of grape juice and 7 samples of orange juice
- carry out a check of the instrument (i.e. to measure a sample of water, see section 10.5) before the samples are measured
- use a different method to measure each type of sample, i.e. using Method-1 (CheckStd) for the check, Method-2 (GrapeJ.) for the grape juice samples and Method-3 (OrangeJ.) for the orange juice samples.

First you must set up 3 different methods: One to carry out the check (Method-1, CheckStd), one for the grape juice (Method-2, GrapeJ.) and one for the orange juice (Method-3, OrangeJ.):

	Method-1	**Method-2**	**Method-3**
Method Name	CheckStd	GrapeJ.	OrangeJ.
Meas.Temp.	20.00 °C	20.00 °C	20.00 °C
Stability	0	1	2

Then you have to enter the sample file:
- Enter 20 for 'No. of Samples' and 1 for 'Next Meas.No.'
- Select 'Variable' for 'Method'.
- Enter the 'Method No.', the 'Sample No.' and the 'Sample ID' for all the 20 samples as shown in the table below.
- Select 'Samp. Spd.' 'Low' for all the samples.
- Press the <Reset> key.
- Put your samples on the sample changer and press the <Measure> key.

< Sample List>

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

This sample file will run a check, measure the 12 Grape juices and the 7 orange juices using the corresponding methods.

Hint:

Press the <Check> key to input the sample name 'CHECKSTD'.

Use the barcodes below if you want to enter the sample IDs with a barcode reader:

7. Report (password protected)

The <Report> key allows you to define the contents for the printout of the results.
In order to do so, select the method for which you want to define the printout (<Method> key).
Then press the <Report> key. The following menu appears:

```
Format?
          Short→
```

With the ◀ or ▶ key you may toggle between 'Off', 'Short', 'GLP' and 'Variable' for the format of the printouts. With 'Off' nothing is printed out after the measurements. With 'Short' only the most important parameters (such as the result, date and time, etc.) will be printed out after each measurement. With 'GLP' a complete list of all the parameters will be print out after each measurement (see table below). Select the desired format and confirm your selection with <Enter>.

```
Format?
       Variable→
```

If you select 'Variable' as a format and confirm it with <Enter>, a list of all possible parameters is shown and you may define for each one whether or not it should be printed out after the measurements: Select 'Off' or 'On' with the ◀ or ▶ key and confirm your selections with <Enter>.

```
Model/Serial?
             Off→
```

	Short	GLP	Variable
Model/Serial		X	choice
Sample No.	X	X	choice
Date & Time	X	X	choice
Sample ID		X	choice
Method No.*)		X	choice
Meas.Temp.	X	X	choice
n_D	X	X	choice
Temp. Comp.		X	choice
Result	X	X	choice
Meas. Time		X	choice
Operator Name		X	choice

*) and Method Name

These report parameters can be set individually for each of the 9 methods.

8. Measuring parameters (password protected)

This section describes how to set the measuring parameters for the methods. There is a total of ten methods available. Method 0 is reserved for the adjustment of the instrument and is activated whenever the <Calib.> key is pressed. The methods 1...9 are used to carry out the measurements.
All the methods have preset parameters. The default values are as follows:

Method 0:	**Parameter**	**Default value**
	Method name	CALIB.
	Measuring temperature	20.0 °C
	Stability	0
	Wait time	0 s
	Sequence	Off

Method 1 ...9:	**Parameter**	**Default value**
	Method name	Method-x
	Measuring temperature	20.0°C
	Stability	1
	Wait time	0 s
	Sequence	Off

```
METHOD ? 1 nD
Method-1   20.0°C
```

Press the <Method> key.

Select the method which you want to modify with the ▲ or ▼ key or enter the method number. Press <Enter> to confirm.

8.1 Method name

This option is used to assign a name (max. length 8 characters) to each method. You can enter names according to products or according to operators, depending on your needs. Please note that the name of method 0 (CALIB.) cannot be changed.

Press the <Meas.Para> key.

```
Method Name?     A
       Method-1
```

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

Press the <Display> key to select the input mode of the keyboard:

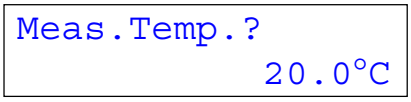
A: capital letters (A, B, C, ...)
a: small letters (a, b, c, d, ...)
1: numbers (0, 1, 2, 3, ...)

Confirm your input with <Enter>.

Hint: You may enter special characters with the '-' key or with a barcode reader (see Annex 3, section A.3.2 for more details).

8.2 Measuring temperature

This display appears after entering the method name (see previous section).



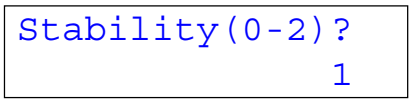
Enter the desired measuring temperature (15 °C ... 70 °C) and confirm with <Enter>. After changing the measuring temperature, the instrument should be allowed to stabilize for at least 1 hour to ensure accurate results.

Please note:

- After every change of the measurement temperature, the RE40 has to be readjusted.
- The temperature of Method 0 ('CALIB.') cannot be changed. The temperature of this method is set automatically to the one of the method which was active when the <Calib.> key was pressed.

8.3 Measurement stability

This option is used to set the measurement stability. This allows you to select between high accuracy but longer measuring time, or lower accuracy with shorter measuring time.



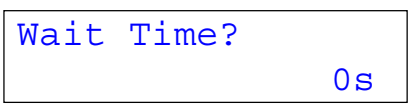
This display appears after entering the measuring temperature (see previous section).

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

Stability: 0: Measurement repeatability of $1x10^{-4*)}$
1: Measurement repeatability of $2x10^{-4*)}$
2: Measurement repeatability of $5x10^{-4*)}$
*) depending on sample composition and measuring conditions.

8.4 Wait time

The wait time is a time delay between the activation via the <Measure> key and the start of the measurement. It can be used to allow a sample to cool down or to heat up before the measurement is started and is especially useful when the difference between sample temperature and measuring temperature is large (more than 10 °C).

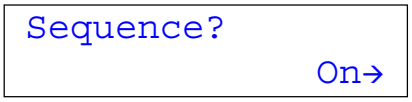


This display appears after entering the stability (see previous section).

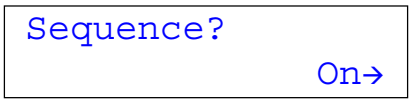
Enter your wait time (0 ... 9999 s) and confirm with <Enter>.

8.5 Sequence (sampling, drain, rinse, purge)

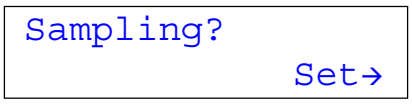
The sample sequence is used if the RE40 is connected to an automatic sampling unit (for example the sample changer SC24). If you are using the RE40 in combination with a DE density meter this sequence will be used for the DE/RE combination. The sample sequence allows you to define sampling time, drain time, rinsing times (for two different solvents) and purge time, and may therefore be used to set up an SOP (Standard Operating Procedure) for your measurements.



This display appears after entering the wait time (see previous section).



Select "On" with the ▶ key to activate a sample sequence. Confirm with <Enter>.

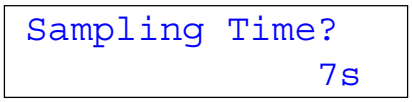


Select the type of sampling procedure with the ▶ key and confirm with <Enter>.

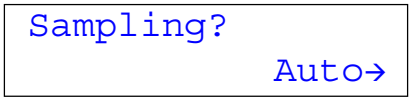
Set : The time for sampling is set by the operator.

Auto: The instrument detects the sample and turns the pump off automatically.

Off: Sampling is disabled.

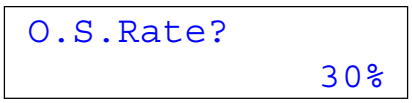


If you select '**Set**' you must enter the 'Sampling Time' (0 ... 9999 s). For most non-viscous samples a sampling time of about 5 to 10 s at an optimal sampling speed of about 2 to 4 cm/s should be sufficient (speed adjustment is done with the Sampling Adj. control on the SC24).

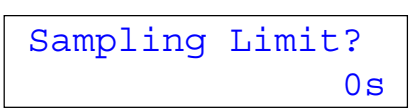


If '**Auto**' is selected you must enter the 'O.S. Rate (over sampling rate) and a 'Sampling Limit'.

Sampling Auto: The instrument detects the sharp change in the measuring signal when the sample enters the cell and stops the sampling pump. 'Sampling Auto' only works, if the cell is completely clean and dry before sampling is started.



O.S.Rate: The RE40 will detect how much time the sample needs from starting the pump until it reaches the measuring cell and will add the O.S.Rate to this time. Example: If the 'Over Sampling Rate' is set to 70% and it takes 10 seconds for the sample to reach the measuring cell, the pump stops after 17 seconds.



Sampling Limit: This is the sampling time which will not be exceeded. If for example there is no sample in a sample vial on the sample changer, the sampling pump stops automatically after this time.

```
Drain?
              Set→
```

Select the input mode for the drain time (i.e. time to empty the cell) with the ▶ key and confirm with <Enter>.

Set : Manual input of the drain time.

Auto: Drain time is set automatically by the instrument.

Off: No draining.

```
Drain Time?
               10s
```

If you select '**Set**' you must enter the 'Drain Time' (0 ... 9999 s). A typical drain time for non-viscous samples is about 10 s to 20 s.

```
Drain?
              Auto→
```

If '**Auto**' is selected you must enter the 'Drain Rate'.

Drain Auto: This option only makes sense if 'Sampling' is set to 'Auto'. 'Drain Auto' means that the time for draining is based on the time which was required for sampling.

```
Drain Rate?
               70%
```

Drain Rate: The RE40 takes this percentage of the total sampling time to determine the drain time. If the 'Drain Rate' is set to 70% and the total sampling time (including 'O.S.Rate', see example on previous page) was 8.5 seconds, the pump will be switched on for 5.95 seconds to drain the cell.

The cell may be rinsed with two different solvents: First with a solvent ('Rinse-1') which must dissolve the sample and then with a solvent ('Rinse-2') which must be volatile in order to quickly and completely dry the cell (important if you want to use the auto sampling feature!).

```
Rinse-1?
              Set→
```

Select between 'Off' (Rinse-1 disabled) and 'Set' (Rinse-1 enabled) with the ▶ key and confirm with <Enter>.

```
Rinse-1?
               10s
```

If 'Set' is selected for' Rinse-1' you must enter the Rinse-1 time (0 ... 9999 s).

```
Rinse-2?
              Set→
```

Select between 'Off' (Rinse-2 disabled) and 'Set' (Rinse-2 enabled) with the ▶ key and confirm with <Enter>.

```
Rinse-2?
               10s
```

If 'Set' is selected for' Rinse-2' you must enter the Rinse-2 time (0 ... 9999 s).

```
Purge?
              Set→
```

At the end of the measuring cycle, air is pumped trough the cell to dry it.
Select between 'Off' (Purge disabled) and 'Set' (Purge enabled) with the ▶ key and confirm with <Enter>.

```
Purge Time?
              120s
```

If 'Set' is selected for' Purge' you must enter a time for purging (0 ... 9999 s).

9. Calculation parameters (password protected)

This section explains how to select the type of results (n_D, BRIX, concentration), how to do temperature compensation and how to do concentration determinations. It also explains how to format the printout of the results (numbers of digits after the decimal point). The calculation parameters can be set individually for each of the 9 methods.

9.1 Result (n_D, BRIX or Concentration)

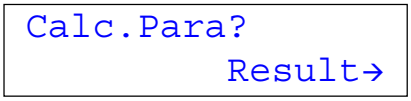
This section describes how to select the type of results: n_D, BRIX or Concentration.

n_D: This is the refractive index, measured at the given temperature with the D-line of sodium (wavelength of 589.3 nm).

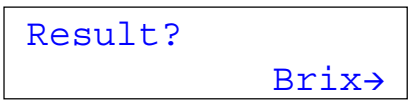
BRIX Designation for the weight percent sucrose content of a sucrose/water solution (BRIX). The refractive index of the samples is measured, converted into BRIX and displayed. The conversion into BRIX is based on tabulated values of sucrose solutions (ICUMSA, T = 20°C, see Annex 2) stored in the RE40.
BRIX measurement works strictly according to the existing tables. The ICUMSA BRIX tables assign BRIX values to specified refractive index values at 20 °C only. No other temperatures are available. If the measurement is done at 40 °C, the BRIX value assigned to the measured refractive index value is based on the ICUMSA table at 20°C.
If a measuring temperature other than 20°C has been selected, the temperature compensation must be ON (see section 9.2) to get correct BRIX values. The RE40 will then use corrective terms from the OIML R108 (resp. R124) to display the correct BRIX value at 20°C.
The BRIX values, with e.g. milk, are relative values: They do not specify the actual sucrose concentration, as the refractive index also depends on all other dissolved substances. See Annex 2 for more information.

Concentration Determination of the concentration of two component solutions (e.g. aqueous solutions of glycerol or acetone). In order to do this, the RE40 must know the coefficients of the polynomial calculation function. This means that you must either enter these coefficients or enter a table of refractive index vs. concentration (up to 30 data pairs per method) for the type of solution you want to measure. This concentration data can be derived either from several measurements (i.e. you have to measure the refractive index of a series of solutions of known concentrations), from our Internet Homepage **www. refractometry. com** or from the literature (e.g. Handbook of Chemistry and Physics).
The concentration function can also be used to convert the refractive index into other units (e.g. Wort or Zeiss values). See Case 1 below for more information.

Press the <Calc.Para> key.

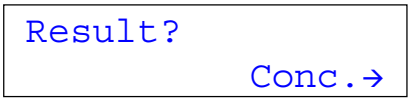


Select 'Result' with the ▶ key.
Confirm with <Enter>.



Press the ▶ key to select the unit in which the results should be displayed and printed. Confirm with <Enter>.
The following units for the results are available:
- nD (refractive index)
- Brix (sugar concentration)
- Conc. (user defined concentration)

Concentration (Conc.)



Select 'Conc.' with the ▶ key.
Confirm with <Enter>.

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 Refractometry Internet Homepage: **www.refractometry.com**.

There are two ways to program a concentration function, either by selecting an appropriate formula and entering the corresponding factors directly (provided that the function for your result calculation is already known) or by entering a concentration table (data pairs of refractive index and corresponding concentration).

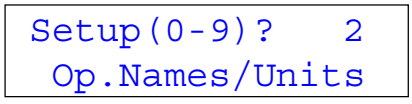
First you must select a unit for your results.

Select 'Conc.Unit' with the ▶ key. Confirm with <Enter>.

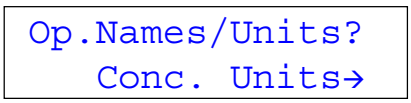
The following units are available: No unit, %, ppm, mg/g, mg/mL, mg/L, g/L, mEq/L, mol/L, g/cm^3, user defined unit names 1 ... 5 *)

*) If you would like to label your results with a unit which is not mentioned above (as for example '%NaCl'), you may enter a corresponding unit name with up to 5 characters as follows:

Press the <Setup> key.



Press the <2> key to select 'Op.Names/Units' and confirm with <Enter>.



Select 'Conc. Units' with the ▶ key. Confirm with <Enter>.

Unit 1? A _

Enter the unit names you need (up to 5 names may be entered). Confirm each entry with <Enter>

Hint: '-', '/' and '%' may be entered by pressing the <-> key 1, 2 or 3 times. Other special characters you may read in with the barcode reader (see Annex 3, section A.3.3).

Now you have to select the formula to calculate the results. If your concentration function is already known, select this function. If your concentration function is not known (input of concentration table) select the formula which best fits. As a rule of thumb we recommend selecting $A+Bx+Cx^2$ (2^{nd} order polynomial) if you don't know which formula to select.

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

We will describe this function using an example: Measurement of WORT concentration in the brew kettle (beer). This WORT concentration function is as follows:

$$\textbf{\% WORT} = -9972.4 + 13822 \times \mathbf{n_D} - 4760.9 \times \mathbf{n_D^2}$$

The following steps have to be performed at the RE40:

Conc.Unit? A %WORT→	Enter "%WORT" as a concentration unit (see above). Select this unit with the ▶ key. Confirm with <Enter>.
Conc.? A Conc.Formula→	Confirm with 'Conc.Formula' with <Enter>.
Conc.Formula? A+BX+CXX→	Select 'A+Bx+Cxx' with the ▶ key. Confirm with <Enter>.
Conc.? Parameter Set→	Confirm 'Parameter Set' with <Enter>.
Parameter Set? Coefficient→	Select 'Coefficient' with the ▶ key. Confirm with <Enter>.
Data Replace? x▪nD→	Select 'x<-nD' with the ▶ key. Confirm with <Enter>.
A? -9972.4E+0	Enter the A value. Confirm with <Enter>

```
B?
        13822.0E+0
```

Enter the B value. Confirm with <Enter>

```
C?
        -4760.9E+0
```

Enter the C value. Confirm with <Enter>.

Now the RE40 has been programmed to measure concentration of %WORT. Add a WORT solution from the brew kettle to the measuring cell until the ring mark is covered (approximately 0.4 mL). After pressing the <Measure> key, the following values will be displayed:

```
     Measuring
20.0°C       4.59
```

During the measurement the temperature and the concentration are displayed.

```
1     %WORT   Conc.
 20.0°C       4.59
```

At the end of the measurement the final result will be displayed and printed out directly as %WORT concentration.

Hint: you can select the number of decimal places under 'Calc. Para. / Decimals' (see section 9.3).

Note: The concentration function can also be used to convert the refractive index into other units, e.g. into Zeiss values (used with old refractometers). The function used to convert refractive index into Zeiss values is:

Zeiss = 2965.063 - 7007.752 x $\mathbf{n_D}$ + 3596.889 x $\mathbf{n_D^2}$

Case 2: Input of concentration table (The concentration function is not known)

We will describe this function using an example: Measurement of glycerol concentration (aqueous solution). You enter a concentration table (data pairs of refractive index and corresponding concentration) and the RE40 will automatically determine the correct coefficients for the concentration function.

Concentration table for Glycerol (source "Handbook of Chemistry and Physics").

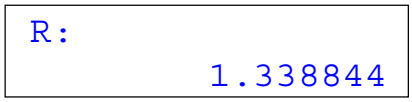
Hint: See our Internet Homepage **www.refractometry.com** for other concentration tables.

	Concentration (in %)	**n_D (at 20 °C)**
1	1.00	1.3342
2	2.00	1.3353
3	3.00	1.3365
4	4.00	1.3376
5	5.00	1.3388
6	6.00	1.3400
7	7.00	1.3412
8	8.00	1.3424
9	9.00	1.3436

Conc.Unit? A %→	Select '%' with the ▶ key. Confirm with <Enter>.
Conc.Unit? A Conc.Formula→	Confirm 'Conc.Formula' with <Enter>.
Conc.Formula? A+BX+CXX→	Select 'A+Bx+Cxx' with the ▶ key. Confirm with <Enter>.
Conc.? Parameter Set→	Confirm 'Parameter Set' with <Enter>.
Conc.? Conc.Table→	Select 'Conc.Table' with the ▶ key. Confirm with <Enter>.
Data No.(3-30)? 9	Enter the number corresponding to the number of data pairs to be entered (up to 30, 9 in this example).
Conc.Table? Edit→	Select 'Edit' with the ▶ key. Confirm with <Enter>.
No. 1 Conc.? 1.00	Enter the first concentration, 1.00 in this example. Confirm with <Enter>.
No. 1 Conc.? 1.00	Enter the corresponding refractive index, 1.3342 in this example.

Enter all the other data pairs according to the table.

Conc.Table? Get Parameter→	Select 'Get Parameter' with the ▶ key. Confirm with <Enter>.
A: 5.033537E+0	The A value is displayed. Press <Enter>.
B: 8.488441E+2	The B value is displayed. Press <Enter>.
C: -3.625021E+3	The C value is displayed. Press <Enter>.



The R value is displayed. Press <Enter>

The A, B and C values are the coefficients of the selected function. The R value is the mean value of all the entered refractive index values (**not** the correlation coefficient). The instrument replaces the nD values with the values "nD minus mean" (nD-R) to optimize the algorithm used for the fit.

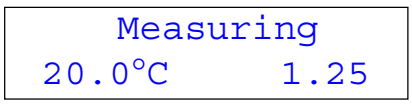
Note: These values – A, B, C and R – can be used to input the concentration function directly without having to enter the table again. In this case R is the mean value of all values of the refractive index and x<-nD-R should be selected as 'Data Replace' for the function.

Hint: You may print out the concentration table with the <Print> key. The printout includes a table showing the deviation between the calculated concentrations and the original concentration data:

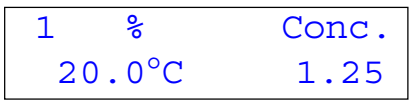
<Fitting Result>

No.	Conc.-Err	nD
01	0.0130	1.3342
02	-0.0207	1.3353
03	0.0236	1.3365
04	-0.0284	1.3376
05	-0.0042	1.3388
06	0.0096	1.34
07	0.0129	1.3412
08	0.0058	1.3424
09	-0.0117	1.3436

The RE40 is now programmed to measure the concentration of glycerol. Add an aqueous solution of glycerol to the measuring cell until the ring mark is covered (approximately 0.4 mL). After pressing the <Measure> key, the following values will be displayed:



During the measurement the temperature and the concentration are displayed.



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

Note: You can select the number of decimal places under 'Calc. Para. / Decimals' (see section 9.3).

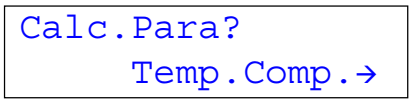
9.2 Temperature compensation

This section explains how to set the temperature compensation. Temperature compensation allows you to speed up your measurements without losing much accuracy (i.e. when working with Stability 1 or 2, see section 8.3) or to measure the samples at one temperature and compensate the results to another temperature. The latter is required if the samples are highly viscous or even solid (e.g. paraffin). In such cases you must heat up the samples to yield them liquid enough (e.g. to 50° C) to be measured, but you might want their refractive index for a temperature of 20° C. Temperature compensation is thus useful in the following cases:

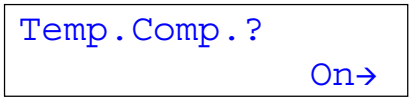
- Speed up the measurement. For example, if your sample is at 40 °C and you have to get the refractive index at 20 °C you can set the measuring temperature to 40 °C and compensate the result to 20 °C (provided you know the slope of the refractive index against temperature of your specific sample).
- Measurement temperature out of range. For example if you need to get the refractive index at 10 °C (minimum measuring temperature of RE40 is 15 °C). You can set the measuring temperature to 20 °C and compensate the result to 10 °C (provided you know the slope of the refractive index against temperature of your specific sample).

Note: This option works differently for BRIX measurements, as there is a specific BRIX temperature compensation table already installed (according to ICUMSA). This BRIX temperature compensation is done whenever the temperature compensation is turned on.

Press the <Calc.Para> key.

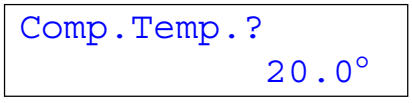


Select 'Temp.Comp.' with the ▶ key. Confirm with <Enter>.



Select 'On' with the ▶ key. Confirm with <Enter>.

Enter the 'Slope' of the refractive index against temperature of your specific sample (see below). Confirm with <Enter>.



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

If the refractive index of a sample is 1.3334 (n_{D1}) at 15.0°C (T_1) and 1.3319 (n_{D2}) at 30°C (T_2) the slope to be entered is calculated as follows:

$$\text{Slope} = \frac{n_{D1} - n_{D2}}{T_2 - T_1} = \frac{1.3334 - 1.3319}{30 - 15} = 0.0001$$

Note: Temperature compensated nD values have **nDt** as unit name.

9.3 Decimals

This section explains how to select the number of decimal places (i.e. digits after the decimal point) for your results display and printout (n_D, BRIX, concentration).

Press the <Calc.Para> key.

Calc.Para? Decimals→	Select 'Decimals' with the ▶ key. Confirm with <Enter>.
nD Decimals (0-4)? 4	Enter the number of decimals for the refractive index. Confirm with <Enter>
Conc.Decimals (0-4)? 4	This option is only available if 'Conc.' has been selected under 'Calc.Para / Result'.
Brix Decimals (0-1)? 1	This option is only available if 'Brix' has been selected under 'Calc.Para / Result'.

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

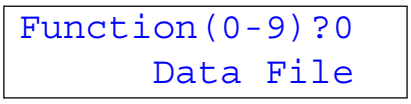
10. Functions (password protected)

10.1 Data File (Function 0)

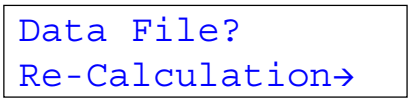
The results of the last 100 measurements are automatically stored in the RE40. If 100 results are already stored, the oldest one is overwritten by the result of the next measurement (FIFO). The stored results may be accessed by means of the 'Data File' function. This function allows to view and process the results. You can either do a recalculation of measured results, statistics on the results or delete single results i.e. mark them so that they are not considered in the statistics calculations.

Note: To view stored measured data, use the "Data deletion" function and skip the delete step.

Press the <Func.> key.



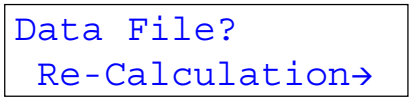
Press the <0> key and confirm with <Enter>.



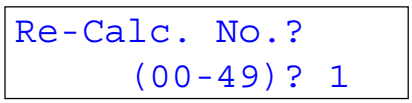
Now select with the ◀ and keys ▶ between 'Statistics', 'Re-calculation' and 'Data Deletion' and confirm with <Enter>.

10.1.1 Recalculation

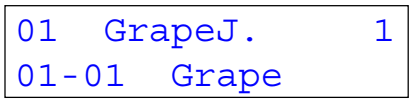
This function allows the recalculation of single results. You may change the unit, the calculation formula (or calculation table) or the slope for the temperature compensation in the respective method to the desired one (like nD to Brix, or different coefficients in the calculation formula). Example: If sample n° 1 was measured using nD as unit and you want to have the same result displayed as Brix, you have to proceed as follows:



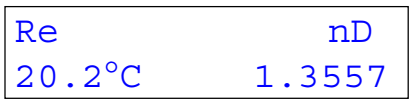
Select 'Re-calculation' with the and ◀ and keys ▶ and confirm with <Enter>.



Now enter the number (on our case 1, available range appears on the display) of the result to be recalculated and press <Enter>.



Now the sample parameters of the chosen measurement are shown:
1st line: number (in data file) / method name / method n°
2nd line: sample number / sample ID



Press <Enter>. 'Re' and the result unit appear on the first line, on the second line the temperature and the result are shown.

Calc.Para.? Result→	Press the <Calc.Para> key. Select 'Result' with the ▶ key and confirm with <Enter>.
Result? Brix→	Select 'Brix' with the ▶ key and confirm with <Enter>. Press the <Escape> key.
Re nD 20.2°C 1.3557	The result appears on the display (not recalculated)..
Re % Brix 20.0°C 15.0	Press the <Display> key. The recalculated result appears on the display. You may print the recalculated result with the <Print> key.

10.1.2 Statistics

The RE40 allows you to do a statistical evaluation of your results. The statistical evaluation may be done either automatically after each measurement (see section 10.8.2) or manually with the results stored in the data file. In this section you will find a description of how to calculate the mean value (Mean), the standard deviation (SD) and the relative standard deviation (RSD) from a series of results stored in the data file. The relative standard deviation is the same as the coefficient of variation (CV).

The results stored in the data file may be filtered so that useful statistical evaluation can be obtained after a day's work. This means that you may include in your statistics only the results yielded with a certain method or the results with the same sample name or those with the same unit for the result (i.e. include in the statistics all the Brix measurements without including the nD measurements). The selection of the results is done by so called filters (see below) which may be combined (i.e. you may include in your statistics for example the results yielded with method number two **AND** which have the same high sample number).

Method No.? On→	After selecting <Statistics> and confirmation with <Enter>, you are asked if you want to group the results according to the method number (method name). If you want to do so, select 'On' with the ▶ key and confirm with <Enter>.
Method No.? 1 Method-1	Enter the method number for which you want a statistical evaluation of the results.
High Sample No.? 01	Next you are asked for the High Sample Number (i.e. the series number, the first two-digit number of the sample number) of the results which should be included in the statistics. Enter the desired High Sample Number and confirm with <Enter>.

```
Result?
                  nD→
```

You can now group your results further and select the result unit (n_D, Brix, Conc.) to perform the statistics on a special group only. Select the desired unit with the ▶ key and confirm with <Enter>.

```
Data Print?
                  On→
```

If you want to print out the statistics together with a table containing all the single results set 'Data Print' to 'On' with the ▶ key and confirm with <Enter>.

```
Results:          37
Mean    :    1.3337
```

On the display appear the number of results included in the statistics and the mean value. Press <Enter>.

```
SD      :   0.0005
RSD     :   0.0375%
```

The absolute and the relative standard deviation appear. You may switch back to the previous display with the ▲ key.

```
<Statistics>
Date : 30/10/2001 12:05
Sample No.(High) : 01
Method No.   : 1
Result       : nD

Results:  37
Mean    :  1.3337
SD      :  0.0005
RSD     :  0.0375 %


Operator:Smith
         -------------
        ----------------
```

Press the <Print> key to print out the statistics. The example print out is obtained with the 'Data Print' feature turned off.

Press the ▼ key to reenter the statistics menu.

Press <Reset> to leave this function.

10.1.3 Data Deletion

This function allows the exclusion of single results from the statistics calculation by marking them with an asterisk.

```
Data File?
   Data Deletion→
```

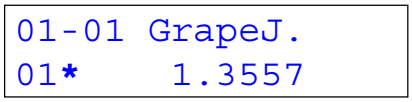
Select 'Data Deletion' with the with the ◀ and keys ▶ and confirm with <Enter>.

```
Deletion No.?
     (00-52)?1
```

The number of stored results appears. Enter the number of the result which you want to exclude of the given range and confirm with <Enter>.

```
01-01 GrapeJ.
01      1.3557
```

The selected result appears on the display. You may browse trough the results with the ◀ and ▶ keys.

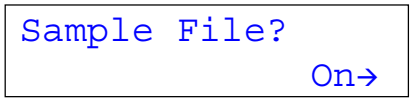


Press the <Display> key to exclude the result. An asterix appears. Press the <Display> key to include it again.

Now you can resume the statistics calculation and print the results without the marked measurements. If you selected 'Data Print' 'On' the excluded measurements are printed out 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. Press the <Func.> key and then the <1> key. Confirm with <Enter>.



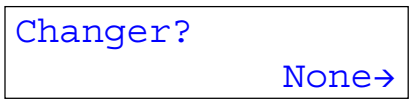
It is automatically set to 'On' when a sample changer is selected (see function 2).

The sample file may also be used without a sample changer to always run standard measurements in the same sequence. In such cases select 'On' with the ▶ key and confirm with <Enter>. See section 6.1 "Sample File" for more information.

10.3 Changer (Function 2)

Here you can select the type of automation unit (as for example the sample changer SC24) connected to the RE40.

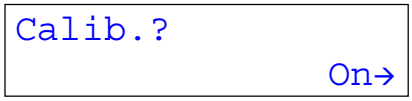
Press the <Func.> key and then the <2> key. Confirm with <Enter>.



Choose the desired automation unit (None, DCU-300, SC24, CHG-241) with ▶ key and confirm with <Enter>.

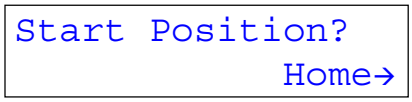
Note: Select CHG-241 if you connect a CHG-260.

If you select the SC24 sample changer, more options appear:



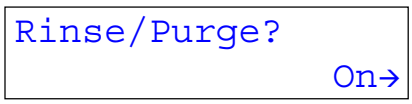
If you want to adjust the RE40 automatically at the beginning of a series select 'Calib.' 'On' with the ▶ key and confirm with <Enter>.

If 'Calib.' is set to 'On' you must put a vial with deionized water in the first position and the samples to be measured in the following positions on the rack. If you want to adjust the RE40 automatically before the sample series is measured, you should set 'Rinse/Purge' to 'On' (see below).



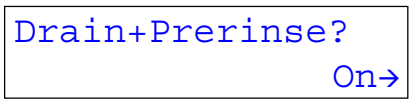
Select 'Start Position' 'Home' or 'Current' with the ▶ key and confirm with <Enter>.

'Start Position' 'Home': The first sample vial (or the one containing deionized water for adjustment, see below) is located in position 1 of the sample rack. 'Current': the first vial of the series is located one position before the sample nozzle of the sample changer. If you want to measure urgent samples (i.e. interrupt the current series in order to carry out an urgent measurement, see 'Example' below), the 'Start Position' must be set to 'Home'.



Select 'Rinse/Purge' 'On' with the ▶ key and confirm with <Enter> if you want to clean the system automatically before the series is measured.

'Rinse/Purge' is used to automatically drain, rinse and purge the whole system before an adjustment of the RE40 is done at the beginning of a sample series (i.e. if 'Calib' set to 'On'). The sequence used for the 'Rinse/Purge' is always the one defined in Method '0.CALIB.'. We recommend to set 'Rinse/Purge' always to 'On' if the RE40 is adjusted (i.e. if 'Calib.' is set to 'On') before the samples are measured.

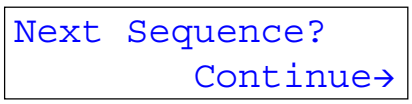


If you want to measure highly viscous samples select 'Drain+PreRinse' 'On' with the ▶ key and confirm with <Enter>.

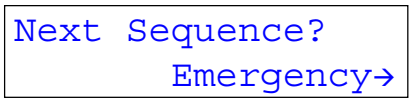
'Drain+Prerinse' should be set to 'On' if highly viscous samples are measured. If the inner surface of the tubes is still covered with a thick film of the highly viscous sample when the first rinse cycle starts, a high pressure is built up and the system could leak. With 'Drain+Prerinse' set to 'On', a small amount of the first rinsing solvent is already injected during the drain cycle (i.e. when air is pumped trough the system to push the sample out) so that most of the sample is removed before the first rinsing solvent is injected.

It may happen that after you have started the measurement of the samples a new sample comes in which has to be measured immediately. The SC24 sample changer has an '**emergency sample**' feature, which allows to run this urgent sample without having to stop a running series. Please note, that this feature only works if the 'Start Position' is set to 'Home'.

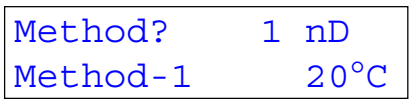
Press the <Measure> key when a series of samples is running on the sample changer and an emergency sample has to be measured. As soon as the current measurement has finished (including rinsing and purging), the following message is displayed:



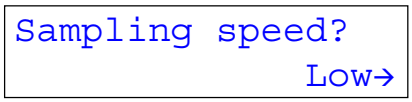
If you do not want to measure the urgent sample confirm 'Continue' with <Enter>.



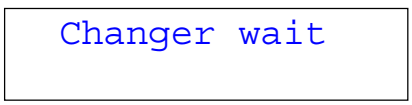
If you want to measure the urgent sample, select 'Emergency' with the ▶ key and confirm with <Enter>.



Select the method which you want to use to measure the urgent sample with the ▲ or the ▼ key. Confirm with <Enter>.



Select the sampling speed with the ▶ key and confirm with <Enter>. Select 'High' for highly viscous samples, 'Low' for low viscous samples.



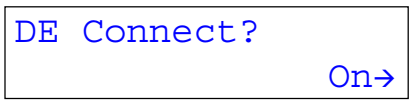
The turntable of the sample changer now rotates until the first position is in front.

On the display the message 'Emer. Samp. at H.P.' 'Press Enter Key' appears. Put the emergency sample in position 1 of the turntable and press <Enter>. The sample is measured and the current running series is resumed afterwards.

10.4 Connection to a DE Density Meter (Function 3)

Here you define whether you have connected a density meter (DE40, DE45 or DE51) to the refractometer. Connecting a density meter enables you to measure the density and the refractive index of the same samples at the same time. This saves sample and time and also reduces waste. If you want to connect a DE density meter to the RE40 you must proceed as follows:

Press the <Func.> key and then the <3> key. Confirm with <Enter>.



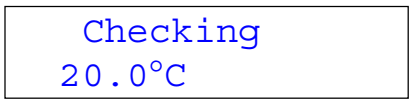
Select 'DE Connect' 'On' with the ▶ key and confirm with <Enter>.

10.5 Set check (Function 4)

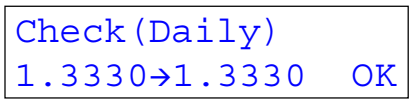
The sophisticated check functions of the RE40 ensure reliable results. When the <Check> key is pressed, the user is requested to carry out a measurement with a check standard. Its name, the nominal refractive index, and a tolerance can be defined by the lab manager. There are two different types of checks: 'Daily' and 'Periodic'. 'Periodic' means that the lab manager may force the users of the RE40 to carry out a check at defined time intervals (e.g. every day or every week). If the <Check> key is pressed and no 'Periodic' check is due, a 'Daily' check is done.

If the <Check> key is pressed, the RE40 requests the user to carry out a (daily or periodic) check as follows:

Instead of 'STANDARD' the name of the standard (defined as below) appears. The user must then fill the measuring cell with standard up to the ring mark and press the <Enter> key to start the check.

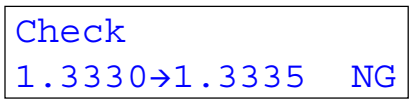


The RE40 then carries out the check, using the measuring parameters of the active method.



The result of the check ('Daily') or ('Periodic') is displayed.

In the second line of the display the theoretical (left) and the measured refractive index (right) are displayed.

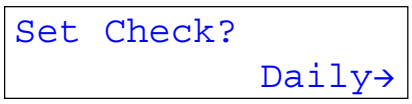


If the check fails, 'NG' (not good) appears as error message.

The results of the periodic checks are stored in the instrument (see section 10.6). Results of daily checks are not stored.

With function '4. Set Check' you may enter the name ('Standard'), the nominal refractive index ('Ref.Value') and the tolerance ('Tolerance') for the standards used for the daily and the periodic checks.

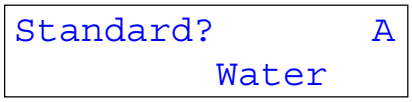
Press the <Func.> key and then the <4> key. Confirm with <Enter>.



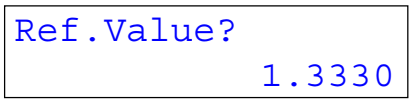
Select either 'Daily' or 'Periodic' with the ◀ and ▶ keys and confirm with <Enter>.

10.5.1 Set Daily Check

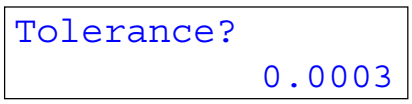
This check is used mainly to control the working condition of the instrument. Is the instrument really clean and dry? Did the previous operator really clean the cell after measuring his sample? Pressing the <Check> key will always activate a daily check, unless a periodic check is due (see also section 10.6).
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. which is readily available and has a stable and well known composition. In the example below, water is used for the daily check.



Enter the name of the check standard (max. 10 characters) using the alphanumeric keys and confirm with <Enter>.



Enter the nominal refractive index (as nD not Brix!) of the check standard and confirm with <Enter>.



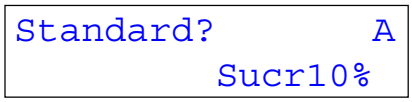
Enter the tolerance (maximum allowed deviation from the theoretical value) for the check measurement and confirm with <Enter>.

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.

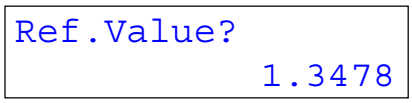
10.5.2 Set Periodic Check

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 subsequent measurements 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 10.6. When no periodic check is due it will start a daily check.
Instead of performing frequent adjustments we suggest you perform frequent checks with a standard solution. As long as this periodic check is successful, there is no need to adjust the instrument. The results of periodic checks are stored automatically in the instrument.
If the periodic check fails, the operator should carefully clean and dry the measuring cell and repeat the periodic check. The instrument should be adjusted only if this second check fails (see section 10.7)! If the periodic check fails very frequently (every second or third time) you should contact your local supplier for servicing and closer support.

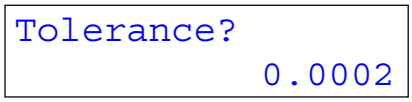
As standard for the periodic check you can either use a commercially available standard of well-defined accuracy (a certified reference standard) or a standard that is prepared in-house strictly according to an SOP. For example a freshly prepared solution of 10.00 % sucrose in doubly distilled water - i.e. weigh 10.00 g sucrose into a flask and fill up with doubly distilled water to exactly 100.00 g - could be used for this purpose.



Enter the name of the check standard (max. 10 characters) using the alphanumeric keys and confirm with <Enter>.



Enter the nominal refractive index (as nD not Brix!) of the check standard and confirm with <Enter>.

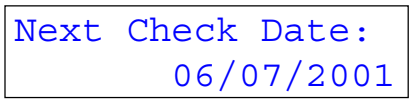


Enter the tolerance (maximum allowed deviation from the theoretical value) for the periodic check and confirm with <Enter>.

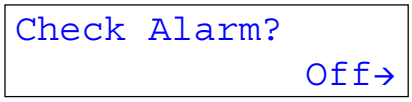
10.6 Periodic Check (Function 5)

This function is used to set the intervals of the periodic check. This function is also used to display and print the last check data stored in the instrument.

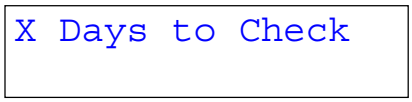
Press the <Func.> key and then the <5> key. Confirm with <Enter>.



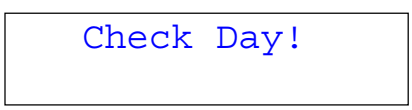
The date when the next periodic check will have to be performed appears on the display. This due date is calculated automatically by the instrument according to the settings described below. Confirm with <Enter>.



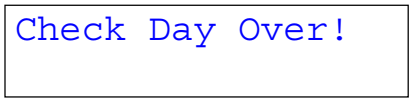
To activate the check function, set the 'Check Alarm' to 'On' with the ▶ key and confirm with <Enter>. Upon pressing the <Measure> key or turning on the instrument the user will then be requested to carry out a periodic check (if due) or informed if the date for the next periodic check comes close, by the following messages:



If a periodic check is due within 5 days or less.



If a periodic check is due on the same day.



If the periodic check was due the day before or earlier.

As soon as the periodic check is performed, these messages do not appear any more.
It is still possible to carry out measurements even if a 'Check Day!' or a 'Check Day Over!' message appears on the display. The results obtained this way, however, will be marked with an exclamation mark ("!") in the printouts (after the sample number) and in the data file.

If 'Off' is selected for 'Check Alarm', the periodic check is not active i.e. whenever the <Check> key is pressed, a daily check is performed.

```
Check Interval?
              XDay
```

Enter the 'Check Interval' (in days) and confirm with <Enter>

Note: If 0 is entered, a periodic check is due immediately.

```
Show Check List?
              No→
```

If you want to display a list of the last 10 checks performed select 'Yes' with the ▶ key and confirm with <Enter>. To print the whole list press the <Print> key.

```
01; Toluene     OK
30/10       1.4962
```

The most recent check result is displayed. You can browse through all the check results using the ▲ and ▼ keys.

```
     No Data
  Press Any Key!
```

If no periodic checks are stored, an error message appears. Press any key to return to the 'Function' menu.

10.7 Periodic adjustment, resp. calibration (Function 6)

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

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 subsequent measurements will be wrong. We therefore recommend you adjust the instrument only if

- a periodic check fails twice in a row (see section 10.5.2)
- if the measurement temperature has been changed. In this case you must readjust the instrument.

The results of all the adjustments ('normal' and 'periodic') are automatically stored. You can view the last 10 adjustments performed at any time and also, as shown below, print out this list for documentation purposes.

Press the <Func.> key and then the <6> key. Confirm with <Enter>.

```
Next Calib. Date:
       06/07/2001
```

The date when the next periodic adjustment will have to be performed appears on the display. This due date is calculated automatically by the instrument according to the settings described below. Confirm with <Enter>.

```
Calib.Alarm?
             Off→
```

To activate the periodic adjustment function, set the 'Calib. Alarm' to 'On' with the ▶ key and confirm with <Enter>. Upon pressing the <Measure> key or turning on the instrument the user will then be requested to carry out a periodic adjustment (if due) or informed if the date for the next periodic adjustment comes close, by the following messages:

```
 X Days to Calib.
```

If a periodic adjustment is due within 5 days or less.

```
    Calib.Day!
```

If a periodic adjustment is due on the same day.

```
Calib.Day Over!
```

If the periodic adjustment was due the day before or earlier.

As soon as an adjustment is performed, these messages do not appear any more.
It is still possible to carry out measurements even if a 'Calib.Day!' or a 'Calib.Day Over!' message appears on the display. The results obtained this way, however, will be marked with an exclamation mark ("!") in the printouts (after the sample number) and in the data file.

```
Calib.Interval?
             XDay
```

Enter the 'Calib.Interval' (in days) and confirm with <Enter>

Note: If 0 is entered, an adjustment is due immediately.

```
Show Check List?
             No→
```

If you want to display a list of the last 10 adjustments performed select 'Yes' with the ▶ key and confirm with <Enter>. To print the whole list press the <Print> key.

Note: The result of all the adjustments are stored (not only the ones of the periodic adjustments!).

```
01;30/10/2001  OK
1.3329 → 1.3330
```

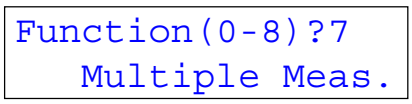
The result of the most recent adjustment is displayed. You can browse through all the adjustment results using the ▲ and ▼ keys.

```
     No Data
  Press Any Key!
```

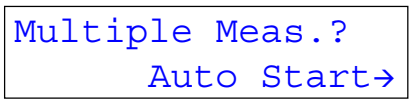
If no adjustments are stored, an error message appears. Press any key to return to the 'Function' menu.

10.8 Multiple Measurements (Function 7)

This function is used for
- repetitive measurements in one sample. It can not be used when the RE40 is connected to a sample changer.
- doing automatic statistics.

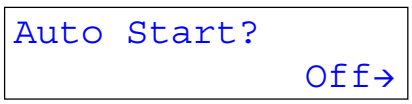


Press the <Func.> and the <7> key. Confirm with <Enter>.

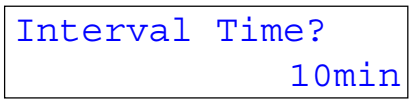


Select between 'Auto Start' and 'Auto Statis.' with the ▶ key and confirm with <Enter>.

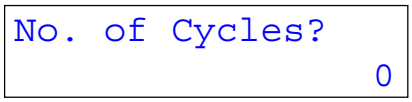
10.8.1 Auto Start



To do repetitive measurements of the same sample in fix time intervals, set 'Auto Start' to 'On' with the ▶ key and confirm with <Enter>.



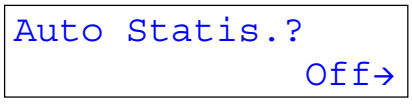
If you have set 'Auto Start' to 'On', you may now define the time interval between two measurements. Enter 0 to start the next measurement immediately after the end of the current measurement. Confirm your input with <Enter>.



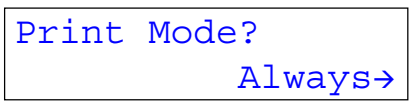
Enter the number of repetitive measurements to be performed with the sample and confirm with <Enter>.

Enter 0 for continuous measurement (infinite number of cycles). In this case you must press the <Reset> key to stop the measurements.

10.8.2 Auto Statistics

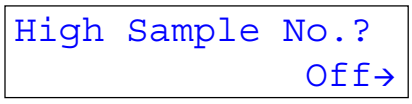


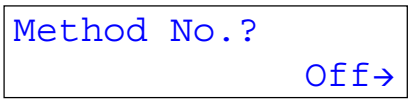
To get an automatic printout of statistical data (mean value, absolute and relative standard deviation) after the measurements, set 'Auto Statis.' to 'On' with the ▶ key and confirm with <Enter>. Please note that the statistical data will not appear on the display (only on the printout!).

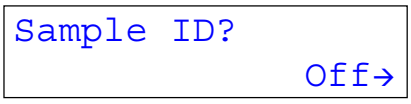


Define the 'Print Mode' with the ▶ key and confirm with <Enter>. You may select between 'Always' and 'Group'. 'Always' means that the statistics are printed out after each result, except after the first one of the group. 'Group' means that the statistics are printed out when the last sample of a group is measured. The option 'Group' works only if the 'Sample File' is 'On'

The following three options serve to group results for auto statistics. The statistics are automatically reset when a new group starts. If 'Print Mode' is set to 'Group', the statistics are printed out only together with the last result of a group.



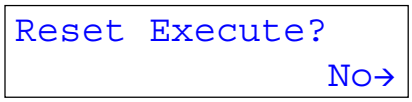




'High Sample No.': A group consists of consecutive results with the same High Sample Number. If the High Sample Number changes, a new group starts.
'Method No.': A group consists of consecutive results yielded with measurements done with the same method. If a different method is activated, a new group starts.
'Sample ID': A group consists of consecutive results of samples with the same Sample ID. When a sample with a different Sample ID is measured, a new group starts.

Turn the desired option 'On' or 'Off' with the ◀ or the ▶ key. Confirm with <Enter>. The three options may be combined. If for example both 'High Sample No.' and 'Method No.' are turned on, a new group starts when the High Sample Number or when the active method changes.

Examples:
- If the series as given in section 6.1 is measured with 'High Sample No.' 'Off', 'Method No.' 'On' and 'Sample ID' 'Off', statistics will be done for two groups of samples, because the 'ORANGE' and the 'GRAPE' samples are measured with different methods.
- If the same measurements would be done using the same method for the check and for all the measurements and if all the samples would have the same High Sample Number, you would have to set 'Sample ID' to 'On' in order to get statistics for the two groups of samples.



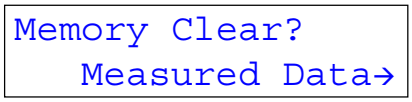
Select 'Reset Execute?' 'Yes' with the ▶ key and confirm with <Enter> to manually reset the statistics data (see below).

Please note that the data for Auto Statistics is not only reset if one of the selected conditions is met or if it is reset manually. It is reset as well if
- the instrument is switched off.
- a Memory Clear is executed (Measured Data, Sample File or All Parameter, see section 10.9)
- the sample file is turned on or off.
- a number of 100 results is reached for the current group (in this case the statistics will be printed out and reset).

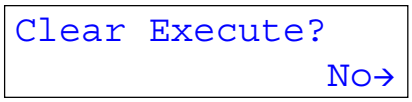
10.9 Memory Clear (Function 8)

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

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



Select the desired option with the ◀ or the ▶ keys: 'Measured Data', 'Sample File', 'Periodic Check', 'Periodic Calib.', 'Method Para.', 'All Parameter'. Confirm your choice with <Enter>.



Select 'Yes' to confirm your choice and press <Enter>.

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

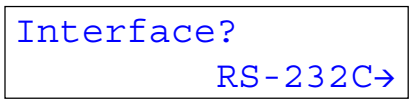
11. Setup (password protected)

Press the <Setup> key. To print out the whole setup, you may press the <Print> key when the menu <Setup> is displayed.

11.1 Interface (Setup 0)

This option is used to configurate the RS-232C serial interfaces for the printer, personal computer and barcode reader.

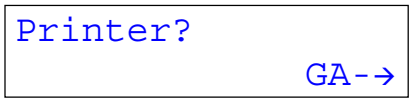
Press the <Setup> and then the <0> key. Confirm with <Enter>.



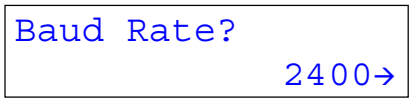
Select the desired serial interface ('RS-232C', Printer' or 'Barcode(AUX)' with the ▶ key and confirm with <Enter>.

11.1.1 Printer setup

We recommend you use a GA42 printer from METTLER TOLEDO together with the RE40. Make sure that the DIP switch 2 is ON in the GA42 printer (see operating instructions of the GA42).



Select 'GA-' if you are working with a GA42 printer, or 'Other' if you want to use another serial printer, with the ◀ or the ▶ key (see below). Confirm with <Enter>.



If you select 'Other' for 'Printer', you must select the 'Baud Rate', the 'Parity', the 'Stop Bits' and the 'Data Bits' with the ▶ key and confirm your selections with <Enter>.

The following printers are predefined:

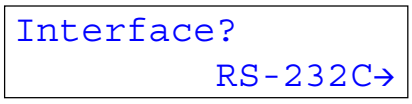
GA- : for GA42 and SPRINTER printer from METTLER TOLEDO.
Other: for all serial printers. Selection of:
- Baud rate (300, 600, **1200**, 2400,....)
- Parity (**none**, even, odd)
- Stop bits (1, **2**)
- Data bits (7, **8**)

These parameters have to be set according to the specifications of your printer. The bold settings correspond to the GA42 printer settings.

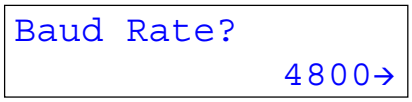
IDP- : not used
DP- : not used

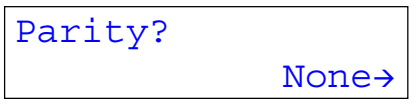
11.1.2 RS-232C Interface setup

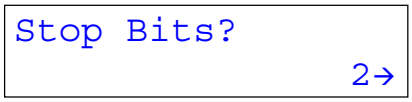
This option is used to configure the RS-232C interface either to connect a computer or to connect a DE40, DE45 or DE51 Density Meter for simultaneous measurement of refractive index and density (or specific gravity). In both cases you have to make sure that the other equipment (computer or DExx) has been configured with the same values.

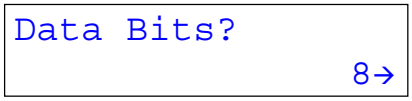


Select 'RS-232C' with the ▶ key. Confirm with <Enter>.



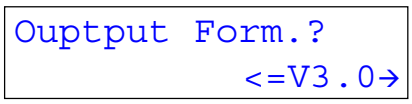






Select the following values according to the settings of the serial interface of your computer or your DExx Density Meter with the ▶ key. Confirm each setting with <Enter>.

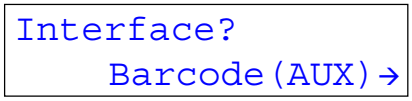
The settings shown here are the default setting for the DataCapture software.



The parameter 'Outp.Form' has to be selected with the ▶ key according to the computer software you are using. If you are working with a DataCapture program < 2.0 or with your own software which was developed to be used with an RE40 equipped with a software version <= 3.0, you have to set 'Outp.Form' to '<=V3.0'. Confirm your selection with <Enter>.

11.1.3 Barcode (AUX) setup

We recommend you use a DLC7070 barcode reader from METTLER TOLEDO. The settings shown here are valid for this type of barcode reader. If you want to use another type of barcode reader with the RE40, please ensure that the terminator of your barcode reader is set correctly (i.e. the same as in the RE40) and that the settings for its serial interface are the same as the ones for the RE40.



If you want to connect a barcode reader to the RE40 select 'Barcode(AUX)' with the ▶ key. Confirm with <Enter>.

Barcode(AUX)? On→	Select 'On' with the ▶ key and confirm with <Enter>.
Baud Rate? 9600→	For the METTLER TOLEDO DLC7070 barcode reader select the settings as shown here with the ▶ key. Confirm each setting with <Enter>.
Parity? None→	
Stop Bits? 2→	
Data Bits? 8→	
Start Pos.? 1→	'Start Pos.' is to define from which position barcodes containing a Sample ID have to be read. If you want to read these barcodes from the beginning (i.e. from the first character on) you have to enter '1' for 'Start. Pos'. Confirm your entry with <Enter>.
Read Length? 0→	'Read Length' is to define how many characters of the barcodes containing a Sample ID have to be read. A Sample ID may consist of a maximum of 10 characters. If '0' is entered for 'Read Length', the maximum number of characters is read in. Confirm your entry with <Enter>.
Delimiter? CR+LF→	'Delimiter' are the ASCII characters the barcode reader sends at the end of each barcode transmission. For the METTLER TOLEDO DLC7070 barcode reader select 'CR+LF' as 'Delimiter' with the ▶ key and confirm with <Enter>.

Important: We recommend to use only the METTLER TOLEDO DLC7070 barcode reader for the RE40. Our technical service does not support any other type of barcode reader.

Connect the DLC7070 barcode reader to the 'AUX.' port of the RE40.
To setup the barcode reader, read in the two barcodes 'Reset' and 'Mode RS232' below. To test whether the barcode reader works, ensure that the sample file is off (see section 10.2) and read the barcode 'Test Pattern'.


Reset


Mode RS232


Test Pattern

Press the <Sample> key.

```
Sample No.?
        [XX]-[XX]
```

Press the <Enter> key twice.

```
Sample ID
     :)-<OK>-(:
```

The test pattern ':)-<OK>-(:' should appear as sample name.

More barcodes to configure the METTLER TOLEDO barcode reader DLC7070 can be found in Annex 3, section A.3.1.

11.2 Date and Time (Setup 1)

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

Press the <Setup> and then the <1> key. Confirm with <Enter>.

```
Date&Time?
2001/06/30  14:56
```

The current date and time are displayed.
Press <Enter>.

```
Date DD/MM/YYYY?
     20/06/2001
```

Enter the date (the date format is selected in the menu Setup '5.International') and confirm with <Enter>.

```
Time?
            11:27
```

Enter the correct time and press <Enter>.

11.3 Operator Names / Units (Setup 2)

This option is used to enter a list of operator names and names for concentration units.

Press the <Setup> key and then the <2> key. Press the <Enter> key.

```
Op.Names/Units?
     Conc.Units →
```

Select 'Op.Names' or 'Conc.Units' with the ▶ key. Confirm with <Enter>.

11.3.1 Concentration units

Unit 1? A

You may enter a list of up to 5 names for concentration units. Confirm each name with <Enter>.

Use the <Display> key to enter capital letters, small letters and numbers. The characters '-', '/' and '%' may be entered by pressing the <-> key 1, 2 or 3 times, respectively. Other special characters you may read in with the barcode reader (see Annex 3, section A.3.2).
The names you enter in the list may then be selected as 'Conc.Unit' in the menu 'Result' (see section 9.1).

11.3.2 Operator names

Name 1? A

You may enter a list of 10 operator names. Use the <Display> key to enter capital letters, small letter or numbers . You may also use the barcode reader to read in the operator names. Confirm each name with <Enter>.

You have two possibilities to select the current operator out of the list you have entered:

- **With the keypad:** See section 5.1.3. Please note that it is not possible to select operator names if the <Setup> key is locked with a password (see section 11.7).
- **With the barcode reader:** Press <Escape> to leave the menu. In the appendix (Annex 3, section A.3.3) you find a list with 10 barcodes. Each of these barcodes is assigned to one of the names ('Name 1' ... 'Name10') of the list.

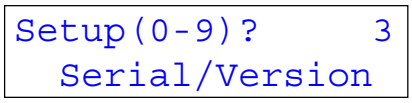
  With a barcode reader it is thus easy to read in both the operator name and the Sample ID. If you do single measurements (sample file off) you just have to read the barcode containing the Sample ID and the corresponding barcode from the list to select the operator name, then you put your sample on the prism and press the <Measure> key. It does not matter in which order you read the two barcodes (you may also select the operator name first and then read the Sample ID).

  Note: If the instrument is locked with a password, operator names may not be selected from the list with the keypad (the menu 'Setup' is locked!), they have to be selected with the barcode reader.

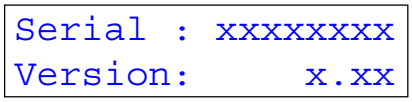
11.4 Serial/Version number (Setup 3)

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

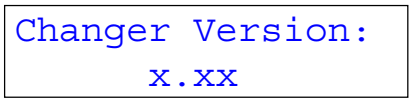
Press the <Setup> key and then the <3> key.



Press the <Enter> key.



The serial number of the RE40 as well as the software version are displayed. Press the <Enter> key.

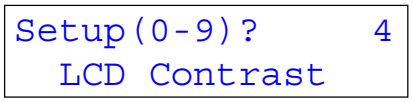


If a sample changer SC24 is connected to the RE40 the software version of the SC24 is displayed.

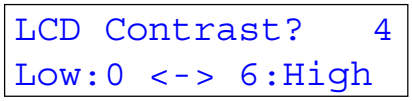
11.5 LCD Contrast (Setup 4)

This option is used to adjust the contrast of the LC display.

Press the <Setup> key and then the <4> key.



Press the <Enter> key.

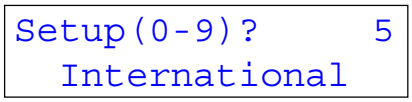


Press the corresponding number key on the alphanumerical keyboard (0:low, 3:normal, 6:high). Confirm with <Enter>.

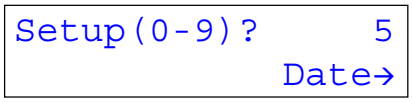
11.6 International (Setup 5)

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

Press the <Setup> key and then the <5> key.



Press the <Enter> key.



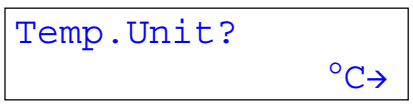
Select 'Date' or 'Temp.Unit' with the ▶ key.
Confirm with <Enter>.

11.6.1 Setup date format

Select the date format with the ▶ key. Confirm with <Enter>.

YYYY: Year
MM : Month
DD : Day

11.6.2 Setup temperature unit

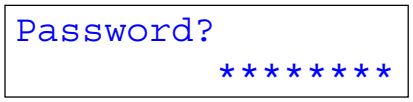


Select the temperature unit with the ▶ key.
Confirm with <Enter>.

°C : degree Celsius
°F : degree Fahrenheit

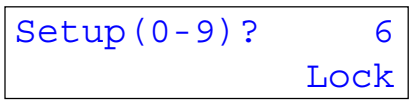
11.7 Lock with password (Setup 6)

This option is used to prevent unintended or unauthorized modifications of measuring methods and settings of the instrument.

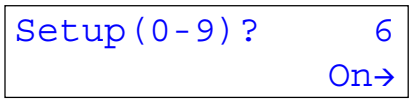


If the password lock is activated, the user is prompted for a password when pressing the <Func.>, the <Setup>, the <Report>, the <Meas.Para> or the <Calc.Para> keys.

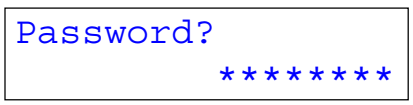
Press the <Setup> key and then the <6> key.



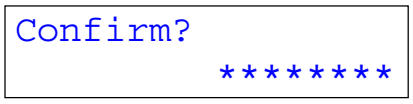
Press the <Enter> key.



Select 'On' with the ▶ key.
Confirm with <Enter>.



Enter your password and confirm with <Enter>.



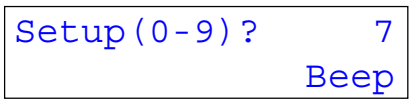
Enter your password a second time to confirm the correct spelling and confirm with <Enter>.

Make sure you keep your password in a safe place in case you forget it. If you have forgotten your password you will need to call the METTLER TOLEDO service!

11.8 Beep (Setup 7)

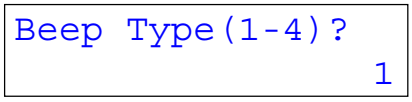
If the Beep option is activated, the RE40 confirms every keystroke with a beep. When a measurement has finished or if an error occurs, the RE40 beeps several times. The type of these latter beeps may be selected with this function.

Press the <Setup> key and then the <7> key.



Press the <Enter> key.

Select 'On' with the ▶ key.
Confirm with <Enter>.



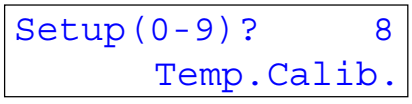
Select the type of beep (end of measurement or error) with the numeric keypad and confirm with <Enter>. You hear the selected type of beep as confirmation.

The following 'Beep Types' are available:
- 1: Short tone and long intervals.
- 2: Long tone and long intervals.
- 3: Short tone and short intervals.
- 4: Long tone and short intervals.

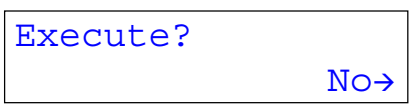
11.9 Temperature calibration (Setup 8)

The RE40 has three built in thermistors which ensure an accurate temperature measurement at the sample/prism interface. The temperature which is displayed in the main display as cell temperature is calculated from the temperatures measured by the three thermistors (it is impossible to measure the temperature with a sensor directly in the interface sample/prism!) and the three measured temperatures are also used for the temperature control of the thermostat. If the cell temperature displayed in the main display constantly differs more than 0.5 °C from the 'Meas.Temp' set in the active method, you should carry out a temperature calibration as explained below:

Press the <Setup> key and then the <8> key.



Press the <Enter> key.



Select 'Yes' with the ▶ key and confirm with <Enter> to start the temperature calibration.

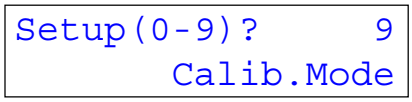
A multiple point adjustment, in steps of 5°C, is done over the entire temperature range. This calibration procedure will adjust the internal thermistors to the certified thermistor in the measuring cell. The temperature calibration lasts approximately two hours.

11.10 Adjustment mode (Setup 9)

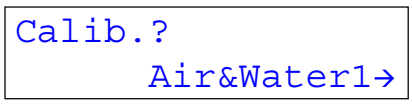
In normal operation you should always leave the adjustment mode on the default setting '**Air&Water 1**'

It may be, however, that the refractive indices obtained with another type of equipment you have been using or you still use are slightly different from the ones obtained with the RE40. It may be that you want to get the same results with the RE40 as the ones yielded with your other equipment. For this purpose, the RE40 offers two additional calibration modes: A '**Zero Span**' adjustment to setup the RE40 in a way that it yields the same results as an other equipment and a '**Air&Water2**' adjustment which is used to readjust the RE40 with air and water from time to time after having carried out a 'Zero Span' adjustment.

Press the <Setup> key and then the <9> key.



Press the <Enter> key.



Select the desired calibration mode 'Air&Water1', 'Air&Water2' or 'Zero Span' with the ▶ key and confirm with <Enter>.

Air&Water1

This is the normal mode. The stored values of air and water are used for the adjustment. Please note, that an 'Air&Water1' adjustment deletes previously stored Zero Span data (see below).

Air&Water2

This mode is only used if a Zero-Span adjustment (see below) has been performed. The adjustment is performed based on the results of the Zero-Span adjustment, using the stored values of air and water. In this mode the results of a previous Zero-Span adjustment remain active. This is basically an offset adjustment, while the zero span is a linearity adjustment.

Zero Span

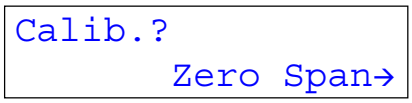
This mode allows to adjust the instrument with special standards whose refractive index is exactly known.

Example:

You have two standards, which yield the following refractive indices measured on the RE40 and measured on an other instrument you are using to determine refractive indices:

	Other equipment	**RE40**	
Standard 1:	1.3650	1.3634	('Zero')
Standard 2:	1.3772	1.3771	('Span')

If you want to get the same results on the RE40 as the ones you get with the other equipment you must do the following:

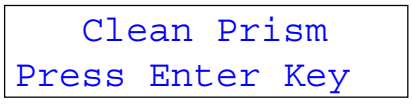


Select 'Zero Span' with the ▶ key and confirm with <Enter>.

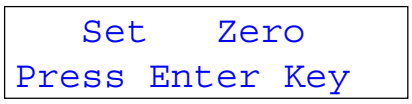
Enter the refractive index of standard 1 determined with the other equipment as 'Zero' and confirm with <Enter>.

Enter the refractive index of standard 2 determined with the other equipment as 'Span' and confirm with <Enter>.

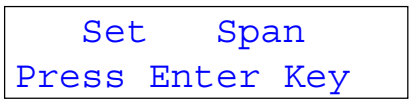
Press the <Calib.> key.



Ensure that the prism is clean and dry, close the lid and press the <Enter> key. Follow the instructions on the display:

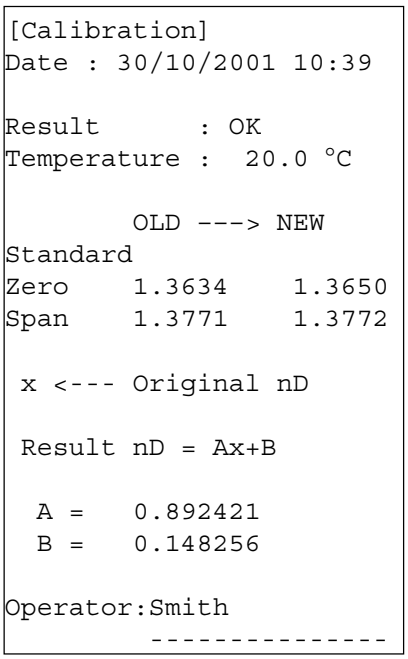


Put the first standard on the measuring cell until the ring mark is covered and press <Enter>.



Put the second standard on the measuring cell until the ring mark is covered and press <Enter>.

The calibration mode is now automatically set to 'Air&Water2'.



The formula used to calculate the results is printed out.

The RE40 will calculate the results of your measurements according to the formula:

Result nD = Ax + B

with x = original refractive index.

The result for a sample having a refractive index of 1.3666 will thus be displayed as 1.3678.

As long as you want to have your results corrected according to the Zero Span adjustment, you must use 'Air&Water2' to readjust your RE40 with water.

If you want to disable the Zero Span correction, you must perform an 'Air&Water1' adjustment.

12. Error messages and malfunctions

Messages appear in the display for several errors and malfunctions; causes and corrective measures for these and other faults are listed below.

Error message	Cause	Measure
`Prism not Clear`	You have not cleaned the prism for a zero point calibration.	First clean the prism and then calibrate.
`No measure`	You have no sample in the measuring cell and have pressed the <Measure> key or the refractive index of the sample is out of the measuring range.	Add a sample and repeat the measurement.
`Temp.Calib.Err1!` `Temp.Calib.Err2!`	Error during temperature calibration.	Turn the instrument off and call the METTLER TOLEDO service.
`Nozzle Error!`[1)]	Sampling nozzle does not work properly.	- Remove obstacle. - Replace nozzle if broken.
`Table Error!`[1)]	Turntable of sample changer is blocked.	- Remove obstacle.
`Temp.Error`	The temperature sensor of the thermostat control is broken.	Switch the instrument off and call METTLER TOLEDO service.
`Connect.Error!`[1)]	SC24 is not connected correctly.	Check connection cable.
`DE Error!`[2)]	DE/RE connection cable is not connected.	Check connection cable.

1) These messages appear only if an SC24 sample changer is connected to the RE40.
2) This message appears only if a DE Density Meter is connected to the RE40.

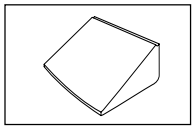
Malfunction	Possible cause	Measure
Instrument can not be switched on.	Cable not plugged in properly, fuse blown.	Check power cable and fuses.
Stored data has been lost (e.g. date).	Internal battery dead.	Switch the instrument off and call METTLER TOLEDO service.
Measurements of same sample not reproducible	Prism faulty.	Switch instrument off and call METTLER TOLEDO service.
Blank display.	Display contrast is set to minimum or maximum.	Change contrast setting (see section 11.5).
No response when pressing the <Report>, <Sample>, <Calc.Para> or <Measure> key.	Method '0.CALIB.' is selected.	Press the <Method> key and select another method.

13. Standard and optional equipment

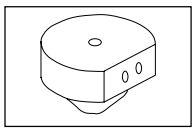
13.1 Standard equipment

	Order No.
One Refractometer	RE40
Operating Instructions	517110122
One power cable	in accordance with your order

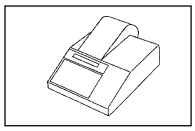
13.2 Optional equipment



In use cover (3 pcs.) 51107667

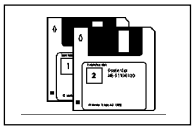


Flow cell unit FCU-520
including
- one suction tube of FEP
- one connection tube of FEP
- one holder
- one fastener screw
- O-ring (Kalrez)



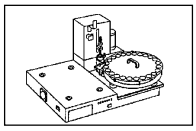
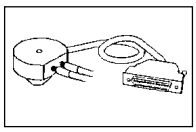
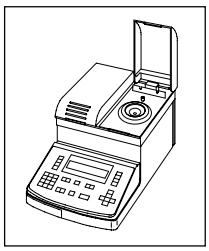
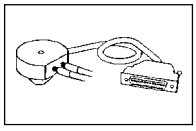
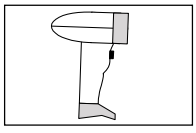
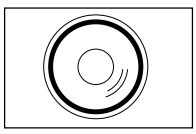
GA42 printer:

- 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

		Order No.
	SC24 Sample Changer	51321302
	SC24 connection set (including FCU-520) - Connection set RE-SC24 - To connect a DE/RE combination additionally required: - Connection cable	 51322068 51190362
	Density Meters The following Density Meters can be connected to the RE40/50 refractometers for simultaneous measurement of density and refractive index) - DE40, 4 decimal places with viscosity correction - DE45, 4,5 decimal places with viscosity correction and Alcohol, Brix, HFCS, API tables - DE51, 5 decimal places with viscosity correction and Alcohol, Brix, HFCS, API tables	 51320300 51320303 51320302
	Connection set to Density Meters (including FCU-520) - DE/RE connection set	 51322010
	Barcode reader DLC7070	21900879
	Vapor proof lid (for the measurement of volatile samples)	51322114

MemoCard RE40 (Short instructions)

Sample **Sample No, Sample ID**
(and number of samples if Sample file ON)

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
nD
BRIX
Concentration
(enter table)
(enter coefficients)
Temperature compensation
(enter table)
(enter coefficients)

Decimals
for nD
for nDt (if temp.comp. select.)
for BRIX (if BRIX selected)
for Conc. (if Conc. selected)

Method **Method selection**
Method 0 to 9

Display **Entry mode for keyboard**
A: capital letters (A, B, C...)
a: small letters (a, b, c...)
1: numbers (0, 1, 2...)

Print **Print message or parameter**

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

Func. **Function selection**
0. Data file
1. Sample file (ON/OFF)
2. Changer
3. DE connect
4. Set check
(name, value, tolerance)
5. Periodic check
(check interval)
(show check list)
6. Periodic calibration (adjustment)
(calibration interval)
(show calibration list)
7. Multiple measurement
(autostart and auto statistics)
8. Memory clear

Setup **Setup selection**
0. Interface
(Printer, barcode reader, RS-232)
1. Date & Time
2. Operator names, unit names
3. Serial/Version No.
4. LCD contrast
5. International
(date format)
(°C or °F)
6. Lock (Password)
7. Beep
8. Temperature calibration
9. Calibration mode

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

Calib. **Perform adjustment**

BS **Backspace** (erase)

Rinse/ Purge **Rinse/Purge**, for SC24
(Sequence must be ON)

Pump **Pump** ON/OFF, for external pump

Clear **Clear entry** (2x to recall previous setting)

Esc. **Escape**

Reset **Return to main display**

Annex 1: Refractive index table of pure water

The instrument has the refractive index of water stored according to the following table:

Temp. [°C]	n_D	Temp. [°C]	n_D	Temp. [°C]	n_D
10	**1.33374**	**40**	**1.33053**	**70**	**1.32516**
11	1.33368	41	1.33038	71	1.32494
12	1.33361	42	1.33024	72	1.32472
13	1.33354	43	1.33009	73	1.32449
14	1.33347	44	1.32993	74	1.32427
15	**1.33340**	**45**	**1.32978**	**75**	**1.32404**
16	1.33332	46	1.32962	76	1.32382
17	1.33324	47	1.32946	77	1.32360
18	1.33316	48	1.32930	78	1.32338
19	1.33308	49	1.32913	79	1.32315
20	**1.33299**	**50**	**1.32897**	**80**	**1.32293**
21	1.33290	51	1.32881	81	1.32271
22	1.33281	52	1.32864	82	1.32248
23	1.33271	53	1.32848	83	1.32225
24	1.33261	54	1.32831	84	1.32202
25	**1.33251**	**55**	**1.32814**	**85**	**1.32179**
26	1.33240	56	1.32796	86	1.32155
27	1.33229	57	1.32778	87	1.32131
28	1.33218	58	1.32760	88	1.32107
29	1.33205	59	1.32741	89	1.32082
30	**1.33193**	**60**	**1.32722**	**90**	**1.32057**
31	1.33180	61	1.32702	91	1.32032
32	1.33166	62	1.32682	92	1.32007
33	1.33152	63	1.32662	93	1.31982
34	1.33137	64	1.32642	94	1.31956
35	**1.33123**	**65**	**1.32621**	**95**	**1.31930**
36	1.33109	66	1.32600	96	1.31903
37	1.33095	67	1.32580	97	1.31876
38	1.33081	68	1.32559	98	1.31848
39	1.33067	69	1.32537	99	1.31820
				100	**1.31791**

The table stored in the instrument contains the refractive index of water in steps of 5°C (bold in the table above). The intermediate values are calculated by La-grange interpolation.

The table is based on the table given in the 'Handbook of Chemistry and Physics', 56th Edition (absolute refractive index of water). The refractive index values are divided by the refractive index of air at the corresponding temperatures. The refractive index of air was calculated according to the formula given in the 'Handbook of Chemistry and Physics', 75th Edition.

Annex 2: BRIX Table

The stored conversion tables in the instrument are based on: 'Adjusted refractometer values for the concentration of sucrose in water at 20 °C (λ = 589.3 nm)', 16th session of the International Commission of Uniform Methods for Sugar Analysis (ICUMSA), 1974.

The temperature correction tables used in the instrument are based on the International Recommendation OIML R 108 ('Refractometers for the measurement of the sugar content of fruit juices', Edition 1993, E).

BRIX table

BRIX %	Refractive Index n_D^{20}	BRIX %	Refractive Index n_D^{20}	BRIX %	Refractive Index n_D^{20}
0	1.33299	30	1.38115	60	1.44193
1	1.33442	31	1.38296	61	1.44420
2	1.33586	32	1.38478	62	1.44650
3	1.33732	33	1.38661	63	1.44881
4	1.33879	34	1.38846	64	1.45113
5	1.34026	35	1.39032	65	1.45348
6	1.34175	36	1.39220	66	1.45584
7	1.34325	37	1.39409	67	1.45822
8	1.34476	38	1.39600	68	1.46061
9	1.34629	39	1.39792	69	1.46303
10	1.34782	40	1.39986	70	1.46546
11	1.34937	41	1.40181	71	1.46790
12	1.35093	42	1.40378	72	1.47037
13	1.35250	43	1.40576	73	1.47285
14	1.35408	44	1.40776	74	1.47535
15	1.35568	45	1.40978	75	1.47787
16	1.35729	46	1.41181	76	1.48040
17	1.35891	47	1.41385	77	1.48295
18	1.36054	48	1.41592	78	1.48552
19	1.36218	49	1.41799	79	1.48810
20	1.36384	50	1.42009	80	1.49071
21	1.36551	51	1.42220	81	1.49333
22	1.36720	52	1.42432	82	1.49597
23	1.36889	53	1.42647	83	1.49862
24	1.37060	54	1.42862	84	1.50129
25	1.37233	55	1.43080	85	1.50398
26	1.37406	56	1.43299		
27	1.37582	57	1.43520		
28	1.37758	58	1.43743		
29	1.37936	59	1.43967		

Annex 3: Barcode Reader

A.3.1 Configuration of the METTLER TOLEDO DLC 7070 barcode reader

The following barcodes serve to configure the DLC 7070 barcode reader from METTLER TOLEDO:

- **'Reset', 'Mode RS232':** If the barcode reader should fail to work, proceed as follows:
  - disconnect it from the RE40
  - connect it again
  - read the 'Reset' barcode to restore the factory settings
  - read the 'Mode RS232' barcode to set it up for the RE40.

  If the barcode reader still does not work, check the setup of the RE40 (see section 11.1.3).
- **'Beep medium', 'Beep off':** Read these barcodes to adjust the volume of the acoustic signal of the barcode reader. To reset the volume to 'full', you must read the barcodes 'Reset' and then 'Mode RS232'.

Reset

Mode RS232

Beep medium

Beep off

A.3.2 Special characters

The barcode reader may be used to read in sample IDs, method names, sample names and names for units containing special characters which may not be entered via the keypad of the RE40. You therefore have to create the desired barcode and read it into the corresponding input field instead of typing in the text via the keypad.

The following special characters cannot be entered via the keypad. They are, however, supported by the RE40 and the METTLER TOLEDO GA42 printer:

[ ] # $! ' * / + , ( )
= ? " : ; _ < > &

A.3.3 Operator names

The barcode reader may be used to select an operator name from the list entered in the menu 'Setup / Op.Names Units' (see section 11.3.2). This selection is done directly in the main display, i.e. the user may read in the sample name and the operator name with the barcode reader and press the <Measure> key without having to perform any additional keystrokes.

Below you will find a list of the barcodes used to select the operator name. In order to make it easy for the operators to identify themselves before doing measurements we recommend you either make a photocopy of this list, complete it with the corresponding operator names and hang it somewhere near the instrument, or hand out a name tag containing the corresponding barcode to each operator of the instrument.

N°	operator name	operator barcode	CODE128
1	_____		110513010100
2	_____		110513010101
3	_____		110513010102
4	_____		110513010103
5	_____		110513010104
6	_____		110513010105
7	_____		110513010106
8	_____		110513010107
9	_____		110513010108
10	_____		110513010109

Specifications

Type and model name	RE40 refractometer	
Measuring method	optical detection of critical angle with Na-D line (589.3 nm)	
Measuring range	n_D	1.3200 ... 1.7000
	BRIX	0.0 ... 85.0% (according to ICUMSA tables) 85.0 ... 100.0 % (extrapolated from ICUMSA tables)
Limit of error	n_D	0.0001
	BRIX	0.1 % (0 ... 85%)
Repeatability	n_D	1×10^{-4} (experimental standard deviation)
	BRIX	0.1 % (experimental standard deviation)
Resolution	n_D	0.0001
	BRIX	0.1 %
Temperature control	Peltier	
Temperature range	T	15 ... 70 °C
Temperature precision	T	0.1 °C (display)
Temp. compensation range	for BRIX	10 ... 40 °C
Sample required	min. 0.4 mL	
Typical measuring time	~ 15 sec (depending on the sample)	
Display	LCD (Liquid crystal display), 2 line display	
Ambient conditions	1) Temperature:	5 ... 35 °C
	2) Humidity:	below 85 % RH (no condensation)
Materials (sample contacted)	Sapphire, stainless steel SUS316, perfluoroelastomer	
Power source	AC 100 – 240 V, 50/60 Hz	
Power consumption	60 W	
Dimension	270 mm (W) x 400 mm (D) x 225 mm (H)	
Weight	9 kg	

Index

Symbols

A

B

C

D

E

F

G

I

K

L

M

O

P

R

S

T

U

V

W

Z

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 likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

To protect your METTLER TOLEDO product's future:
METTLER TOLEDO Service assures the quality, measuring accuracy and preservation of value of all METTLER TOLEDO products for years to come.
Please send for full details about our attractive terms of service.
Thank you.

Printed on 100% chlorine-free paper, for the sake of our environment.

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Subject to technical changes.

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