Refractometers

RE40D/RE50

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1. Introduction

The RE40D and RE50 Refractometers are used for the simple determination of the refractive index of liquid samples. The measurements are done using a method based on total reflection. With this method even dark samples may be measured without any difficulty. The RE Refractometers are practically maintenance-free, thanks to the latest technical developments – no moving parts, long-life LED light source and inert sapphire prism.

The RE40D and RE50 Refractometers

– measure samples with a refractive index in the range of 1.3200 … 1.7000 (RE40D) or 1.32000 … 1.58000 (RE50).

– need a minimum amount of sample (approximately 0.4 milliliters) for measurement.

– keep the temperature of the sample being measured constant in the range of 15.0 to 70.0°C (RE40D) or 15.00 to 50.00°C (RE50) by means of a built-in Peltier thermostat (no water bath necessary).

– calculate the samples' refractive indices for any reference temperature based on user-defined temperature functions.

– display the refractive index of the samples directly in Brix degrees or in HFCS (High Fructose Corn Syrup, RE50 only) if so desired.

– are capable of directly converting and displaying the measurement values into any other units (e.g. Zeiss) based on user-defined formulas.

– are suitable for determination of concentrations. Concentrations are automatically calculated based on the refractive indices according to user-defined formulas or concentration tables.

– provide statistical evaluations (mean, standard deviation, relative standard deviation) of the results.

– allow entry of ten measuring methods. One of these methods is reserved for adjustment (calibration) of the instrument.

– can be tested easily with the built-in check function. This function allows regular testing of the accuracy of measurement without changing the instrument's settings.

– have three serial interfaces to connect a printer, a barcode reader and a computer, as well as a port to control an automation unit (SC1 or SC30, see following page).

The RE50 Refractometer

– stores methods, measured data and sample files on memory cards. As a result, transferring methods to another RE50 Refractometer poses no problem at all.

Important:

An SC1 or an SC30 Sample Delivery and Cleaning Unit (option) turn your RE Refractometer into a fully automated measuring system for the measurement of individual samples (SC1) or series of samples (SC30). The Sample Delivery and Cleaning Units not only reduce the work involved in the determination of refractive index, they also help to prevent measurement errors, save cleaning solutions and increase safety in the workplace.

The procedure for doing measurements, adjustments and tests of the measurement accuracy of the RE Refractometer depends on whether the instrument is operated manually or together with an automation unit (SC1 or SC30). For this reason, the paragraphs are marked in these Operating Instructions as follows:

These paragraphs you have to observe only if you operate your RE Refractometer manually (i.e. without SC1 or SC30 automation unit).

These paragraphs you have to observe if you operate your RE Refractometer with an SC1 Sample Delivery and Cleaning Unit for the measurement of individual samples.

These paragraphs you have to observe if you operate your RE Refractometer with an SC30 Sample Delivery and Cleaning Unit for the measurement of sample series (sample changer).

2. Safety measures

The RE40D and RE50 Refractometers have been tested for the intended purposes documented in these Operating Instructions. However, this does not absolve you from the responsibility of performing your own tests wether the product supplied by us is suitable for your intended methods and purposes. You should, therefore, observe the following safety measures.

Measures for your protection

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

- Do not use the instrument in areas with danger of explosion! The housing of the RE Refractometers is not gas tight (danger of explosion due to spark formation, corrosion by gas seeping into the instrument).

Measures for operational safety

- Clean the prism immediately after a measurement of strong acids and bases. They can damage the prism or the stainless steel cone.
- Only use fuses of the specified type when they need to be exchanged.
- Exclude the following environmental influences:
  - powerful vibrations
  - direct sunlight and sudden changes in temperature
  - corrosive gases
  - very dusty environment
  - high atmospheric humidity
  - temperatures below 5 °C and above 35 °C
  - strong drafts
  - powerful electric or magnetic fields which influence the power supply trough large load fluctuations.

- To apply the samples do not use any hard objects such as metal, glass or ceramic as they could damage the prism.

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

3. Refractive index

3.1 Definition of the 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).
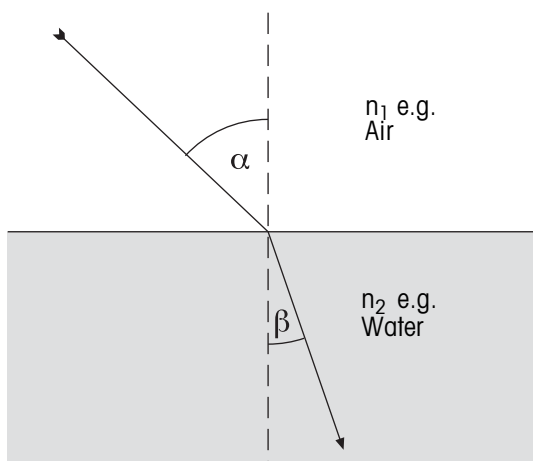
If a ray of light passes from an optically less dense medium to a denser one (e.g., from air to water) at a particular angle, it changes direction; if the incident light meets the new medium vertically, there is no change in direction. According to Snell's law of refraction, the ratio of the refractive indices of the two media is proportional to the ratio of the angle of refraction and the angle of incidence of the ray of light:

$$\frac{n_1}{n_2} = \frac{\sin \beta}{\sin \alpha}$$
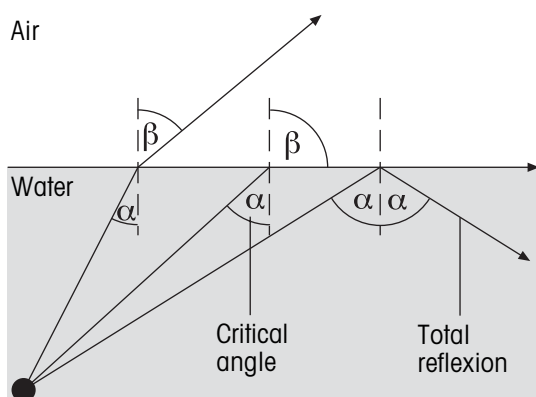
If a ray of light passes into an optically less dense medium from a denser one, it also changes direction. If the angle of incidence α is increased, it reaches a critical value at which the ray of light no longer passes into the less dense medium (angle of refraction $\beta = 90°$). When exceeding this "critical angle", total reflection occurs. The critical angle α is used to calculate the refractive index:

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

As the refraction depends on the wavelength of the incident light, the standard refractive index n is measured at the D line of sodium (wave length 589.3 nm) and symbolized by n_D.

The refractive index depends not only on the wavelength of the incident light, but also on the temperature of the sample 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 Measuring principle
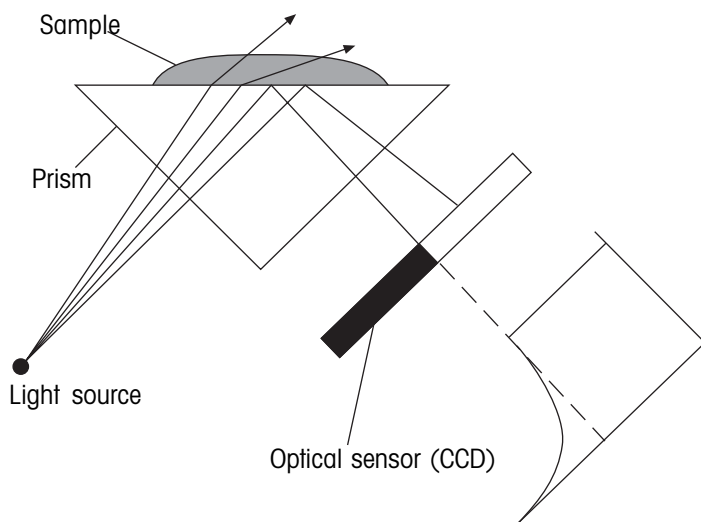
The light emitted by light source passes through the prism and encounters the sample. It is partially refracted (angle of incidence < critical angle) and partially reflected (angle of incidence > critical angle).

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.

3.3 Anatomy of the measuring cell

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 hits the sample. The reflected light (angle of incidence > critical angle) is led via a lens to the optical sensor, which records the critical angle.
The temperature at the intermediate prism/sample zone is measured by a built-in sensor.
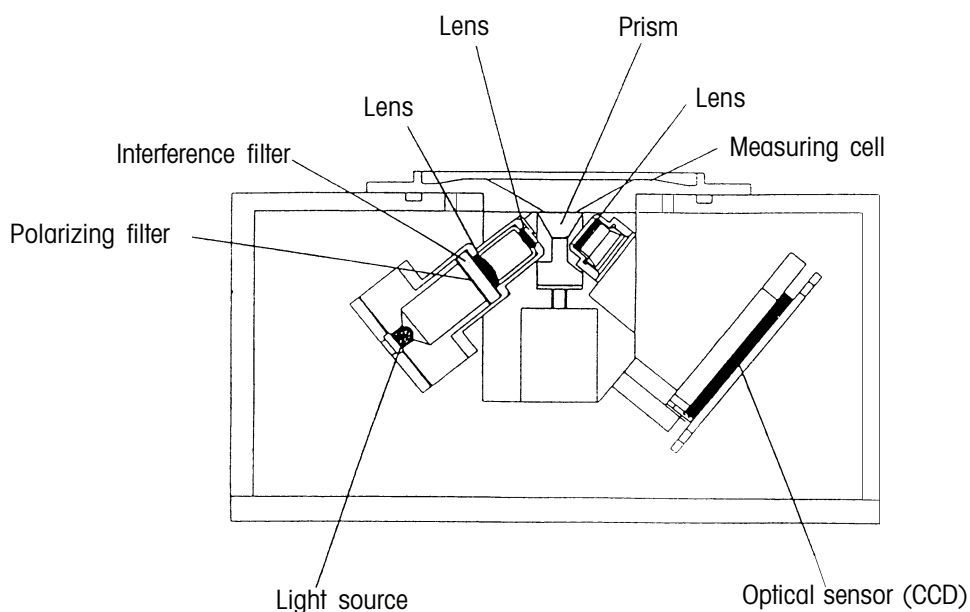
4. The instrument

4.1 Front and rear view

Front view

4. Cover lid

5. Thread for flow cell

6. Measuring cell

7. Prism

1. LC display

2. Keypad

3. Memory card slot

Rear view

8. Printer interface

9. AUX. interface (barcode reader)

10. RS232C interface (computer)

11. Power switch

12. AC power connector

13. Connector for automation-unit (SC1, SC30)

14. Connector for external pump
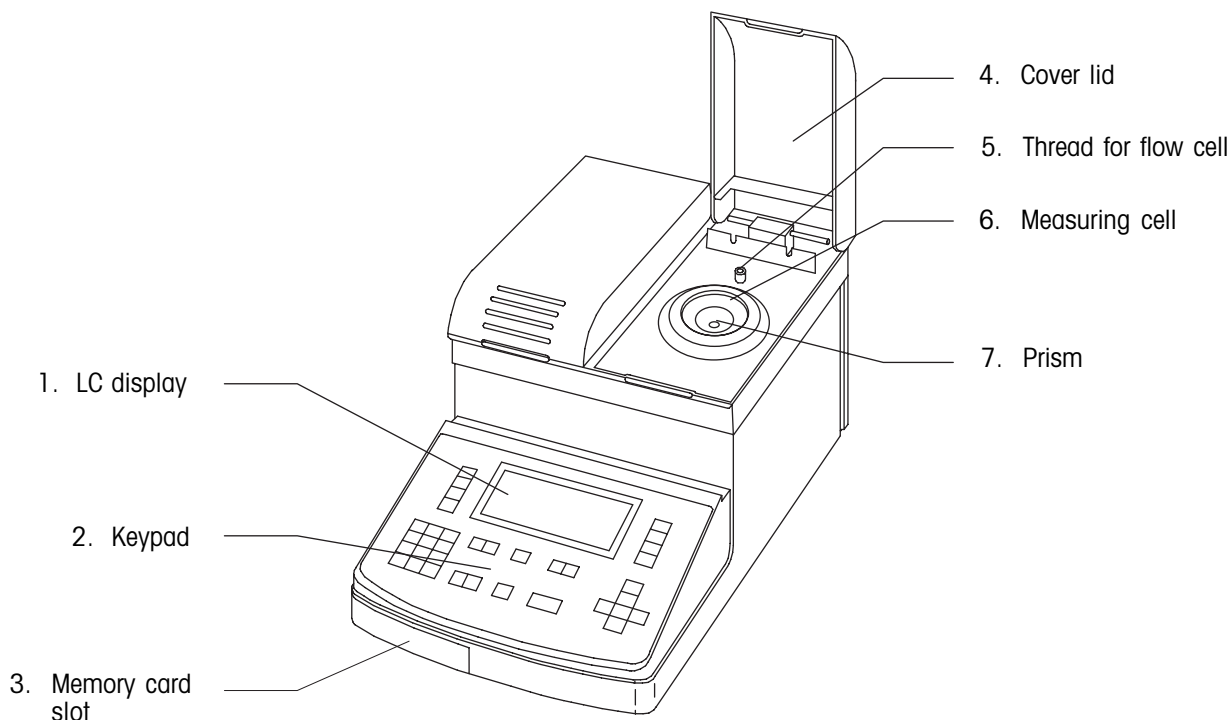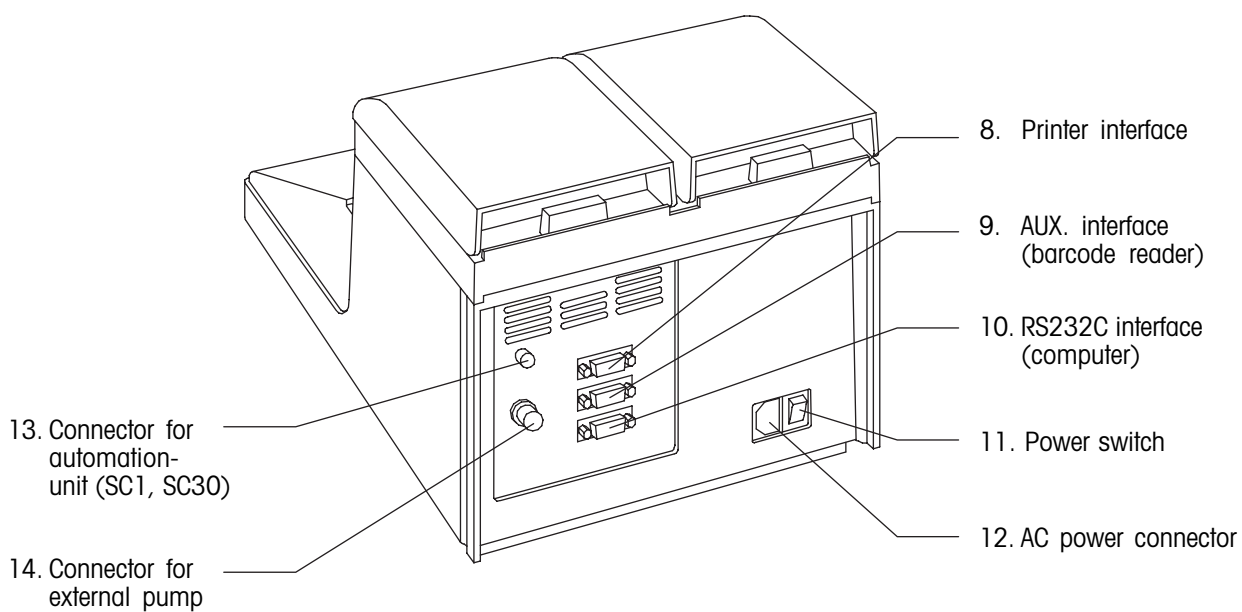
General overview

1. LC display
   Seven-line LCD to show the measurement results, conditions and settings.

2. Keypad (alphanumeric)
   To start measurements, enter measurement conditions, calculation parameters, etc.

3. Memory card slot
   To upgrade the instrument's software.
   To load and download data, methods and sample files (RE50 only).

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

5. Thread for flow cell (FCU)
   Thread to mount a flow cell unit (to connect an SC1 or SC30 automation unit).

6. Measuring cell
   When doing measurements manually, the sample is pipetted in the center of the 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 strongly resistant to corrosion, very rigid and of high thermal conductivity.

8. Interface for a printer
   To connect a serial matrix printer.

9. Interface for a barcode reader (AUX.)
   To connect a barcode reader.

10. Interface for a computer (RS232C)
    To connect a computer (e.g. for data acquisition with the DataCapture software) or a METTLER TOLEDO DE40/45/51 Density Meter.

11. Power switch

12. AC power connector
    Connector for the mains cable. The RE Refractometers adapt automatically to the line voltage of a country as long as it is within the range of 100 to 240 V.

13. Connector for an automation unit (EXT.)
    Control connector for a Sample Delivery and Cleaning Unit (SC1 or SC30).

14. Connector for an external pump (EXT PUMP)
    For the automatic execution of sample measurements (e.g. of an reaction mixture in a reactor) in fixed time intervals a peristaltic pump may be connected here.
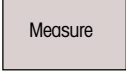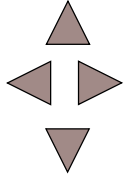
4.2   Keypad

Sample	Sample	Entry of sample parameters such as sample number and ID. Entry of a sample file (with SC30).
Report	Report	Definition of the printing format for the results. Three formats are available: (1) Short: minimal printing format. (2) GLP: format complying with GLP requirements. (3) Variable: User defined format.
Meas. Para	Measuring Parameters	Definition of the measuring parameters: - Method name (8 characters, alphanumeric). - Stability (criteria for the acceptance of measurements). - Waiting time (prior to measurement, 0 … 9999 s). - Sample sequence used if the instrument is connected to an automation unit SC1 or SC30 (definition of the times for sampling, draining, rinsing and drying of the measuring cell).
Calc. Para	Calculation Parameters	Definition of the calculation parameters: - Selection of the unit for the result (nD, Brix, HFCS, concentration, etc.). - Selection of the calculation formula or entry of concentration tables for converting the measured refractive index into any other units. - Decimals for the results (refractive index, Brix, HFCS and calculated results). - Temperature compensation. Input of a formula or a table to covert the measured refractive indices to a temperature other than the measuring temperature.

The printing format as well as the measuring and calculation parameters ("Report", "Meas.Para" and "Calc.Para" keys) may be defined for each of the 9 measuring methods individually.

Method	Method	Select the measuring method (0 … 9). The method is selected by pressing the "Up", "Down" or the corresponding number key. Method 0 ("CALIB") is reserved for adjustment of the instrument.
Display	Display	Toggle between numerics, capital and small letters when entering text. Select result display (toggle between nD, Brix, HFCS and user defined units) after a measurement.
Print	Print	Print measuring methods, stored results and instrument settings.
Func.	Function	Access to the following functions:

40D 50   **Model** ("(-)" = menu not available)

40D	50		
(0)	(0)	Data File:	Access to stored results.
(1)	(1)	Sample File:	Enable/disable sample sequences (for SC30).
(-)	(2)	Method File:	Transfer methods from the instrument to a memory card and vice versa.
(2)	(3)	Changer:	Selection of the automation unit (SC1 or SC30).
(3)	(4)	DE Connect:	To connect a DE Density Meter.
(4)	(5)	Set Check:	Entry of the names and the nominal refractive indices of the standards used for daily and periodic instrument tests. Definition of the maximum deviation of the measured value accepted when doing instrument tests.
(5)	(6)	Periodic:	Definition of the intervals for periodic adjustments and instrument tests. Display of the stored adjustment and instrument test results.
(6)	(7)	Multiple Meas.:	Conduct multiple measurements of one sample. Enable/disable automatic error detection (only available with SC1 and SC30). Automatic statistics.
(-)	(8)	CARD Utility:	Handling of stored data on memory cards (e.g., load special applications).
(7)	(9)	Memory Clear:	Delete data stored in the instrument's memory.

Setup	Setup	Access to the following instrument settings:

40D 50   **Model** ("(-)" = menu not available)

40D	50		
(0)	(0)	Interface:	Configure the serial interfaces (for printer, barcode reader and PC).
(1)	(1)	Date&Time:	Set date and time.
(2)	(2)	Op.Names/Units:	Entry of operator names and concentration units.
(3)	(3)	Serial/Version:	Display of the serial and version number of the instrument.
(4)	(4)	LCD Contrast:	Set contrast for the LC display.
(5)	(5)	International:	Select format for date and temperature (°C/°F).
(6)	(6)	Lock:	Limit access to certain functions with a password.
(7)	(7)	Beep:	Enable/disable and selection of type of acoustic signal.
(8)	(8)	Temp.Calib:	Execute adjustment of temperature measurement.
(-)	(9)	Calibration Mode:	Define type of adjustment.

Check	Check	Perform an instrument test: daily (always active) or periodic (only when due).

Calib.	Calibration	Perform an adjustment.
BS	Backspace	Backspace to delete characters.
Rinse/ Purge	Rinse/Purge	Only available if an automation unit (SC1, SC30) is connected to the instrument: Activates an automatic rinsing and purging cycle according to the settings in the sequence of method "0.CALIB".
Pump	Pump	Switch an external pump (connected to EXT PUMP) on/off.
Clear	Clear	Clear an entire input field or go back to the last setting (undo).
Esc.	Escape	Return to the main display (result of the last measurement is not deleted).
Reset	Reset	Abort a measurement and return to the main display (the result of the last measurement is deleted).
Measure	Measure	Start a measurement (or a measurement series, SC30).
7 ABC	0 … 9	Select an item from a list (menu, list with results, etc.) or enter an alphanumeric character (select capital/small letters or numerals with the <Display> key). Press twice for B and three times for C. Enter a blank space with the <0 (BLK)> key.
.	Dot	
–	Hyphen	When entering concentration units (menu "Setup/2.OP.Names/Units"): For "%" and "/" press the hyphen key twice or three times, respectively.
Enter	Enter	Confirmation of an entry. This key is referred to with <Enter> in these Operating Instructions.
▲	up	▲ Keys to move the cursor. The ◄ and ► keys are also used for selections in the menus.
◄ ►	left/right	◄► To select an option in a menu (Function/Setup). To select a method, results, etc. in a list. In the latter case, direct entry of the corresponding number via the alphanumeric keypad is usually quicker than using the arrow keys.
▼	down	▼

4.3   Display

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

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

```
              Refractometer

          REXX  Version X.XX
```
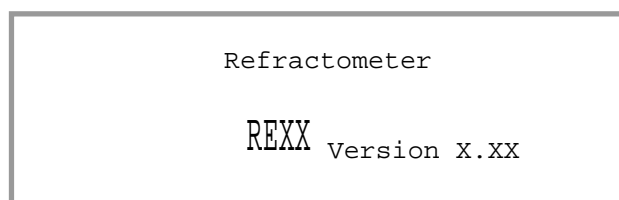
After a few seconds the main display appears. The message "Wait for Ready" blinks until the measuring cell has reached the set temperature. Then, if the measuring cell has been adjusted, the message "Ready" appears, if not, the message "No Calibration" appears.

```
                 1      2        3  4

1.Method-1                       F  01-01
Temp.(°C)                          nD (None)
Set    20.00      Out              1.33299
Cell   20.00
           Wait for Ready

          5  6  7     8   9  10
```
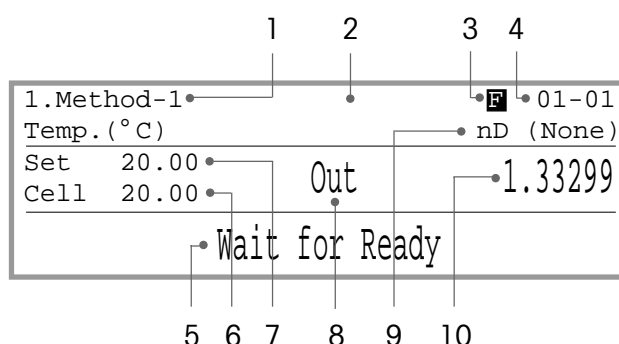
The following information is shown on the main display:

1   Number and name of the measuring method.

2   Sample identification. This field can be empty (e.g., when the instrument is switched on for the first time).

3   "F" appears when the sample file is turned on. This is always the case if an SC30 Sample Delivery and Cleaning Unit is attached.

4   Sample number. The sample number consists of two parts, e.g., 01-02.
     The first two-digit number (ranging from 00 to 98) is the number of the measurement series. It is also referred to as the "High Sample No.". If you use your own specific series number for each type of sample when measuring various types of samples, it is easy to evaluate the stored results statistically afterwards. The next two digit number (ranging from 00 to 99) is the sample's number. In the instrument it is also referred to as the "Low Sample No.". This number is automatically increased by 1 after each measurement.

5   Status line. Status, error messages and instructions for the operator are displayed here.

6   Measured temperature of the refractive index measuring cell.

7   Set temperature of the measuring cell according to the currently selected measuring method.

8   Error message of the automatic error detection (only available if the RE Refractometer is used together with an SC1 or an SC30 Sample Delivery and Cleaning Unit).

9   Unit for the measured value according to the currently selected measuring method (nD, Brix(%), HFCS42, HFCS55, Conc.).

10   Measured value. The measured value only appears after having started a measurement. After completion of a measurement, the unit for the measured value may be selected with the <Display> key (e.g., nD or Brix(%)).

5.   Measures for correct measurements

The RE Refractometer's "Repeat Meas." (automatic error detection, only available with attached SC1 or SC30 automation unit) and "Check" functions ensure that you can easily identify errors due to the instrument or the measured samples. To ensure correct measurements please pay attention to the following:

– After turning on the instrument or changing the measuring temperature, it takes approximately 15 minutes for the measuring cell to reach the set temperature. To ensure correct measurements, however, you should give the instrument at least 30 minutes to stabilize the temperature of the measuring cell before you perform a measurement or an adjustment.

– Adjust the instrument after each change of measuring temperature.

– Check the measuring accuracy of the instrument regularly with refractive index standards. In section 16.2 you can find refractive index standards suitable for this purpose.

– Ensure that the samples to be measured are homogeneous. Viscous and highly concentrated liquids must be mixed thoroughly before a sample is taken.

– Use soft paper tissues or washed gauze to clean the measuring cell and to dry the prism. Never use cotton swabs for this purpose, as their fibers could adhere to the prism and cause faulty measurements.

– 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. In order to speed up drying of the measuring cell, we recommend you use a second highly volatile solvent such as acetone to wipe the first one off.

– Make sure that the ring mark is always covered by the sample when doing measurements (minimum sample volume: approximately 0.4 mL).

– Prior to measurement always stir the sample on the prism carefully to allow air bubbles to escape.
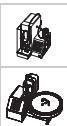
– For the first rinsing liquid ("RINSE 1") use a solvent capable of dissolving your samples. If you have to measure both aqueous samples and samples which contain oil and fat, you may use an aqueous solution with a surfactant as first rinsing liquid. Add approximately 25% v/v of ethanol to this surfactant solution in order to prevent excessive foam formation (during rinsing, the liquid is mixed with air!).

– Use a highly volatile solvent (e.g., acetone) as second rinsing liquid in order to ensure a complete drying of the measuring cell.

– Dismantle the flow cell (FCU) at certain time intervals and clean the surface of the prism with a soft paper tissue dampened with an appropriate cleaning solvent. After cleaning refit the flow cell unit and press the "Rinse/Purge" key on the Refractometer.

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

– **Highly concentrated samples**

The concentration of such samples may change during the measurement due to evaporation of solvent. This may result in poor repeatability of results or a wide difference between the measured and the true value. When working at elevated temperatures, these errors are more likely to occur. If you must measure such samples:

– if possible use an automation unit (SC1 or SC30). When working with a flow cell unit, an evaporation of the solvent during the measurements may be ruled out. Store the samples in METTLER TOLEDOS's sealable sample vials until they are measured.

– 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.)**

Colloidal particles scatter light, which causes poor repeatability of the measured value. In the worst case, no measurement is possible.

– Activate the "Repeat.Meas" function and enter a value of at least 3 for "Repetitions" (see section 11.8.3). Multiple measurements of each sample will then be performed and the mean value of the measurements is calculated and displayed. If the measurements are excessively affected by scattered light the message "Out" appears on the display and an error message is printed out.

– **Highly volatile samples**

The measurements may take long or the results might be 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 the temperature control of the measuring cell to malfunction. Therefore, when measuring such samples, set the measuring temperature as low as possible and cover the measuring cell with a vapor proof lid (ME 51322114), or use an automation unit (SC1 or SC30) for the measurements.

Store the samples in METTLER TOLEDOS's sealable sample vials until they are measured.

– **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.

6.   Getting started

This section explains how to set up the RE Refractometer, adjust it and perform the first measurements. A practical example, the determination of the sugar content (BRIX) of orange juice, will familiarize you with the most important features of the RE Refractometer.

We presume that you operate your RE Refractometer with a GA42 printer and a DLC7070 barcode reader. If this is not the case, you may skip the corresponding sections.

Certain procedures to do the set up, measurements, adjustments and tests of measurement accuracy of the RE Refractometer and entering methods are different depending on whether you operate your measuring instrument manually or with an automation unit (SC1 or SC30). This section describes all the three possibilities, and the corresponding paragraphs are marked accordingly (see section 1).

6.1   Setting up the measuring system

6.1.1   Connecting an SC1 or SC30 automation unit

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

6.1.2   Connecting the printer and the barcode reader

Connect the GA42 printer to the printer port of the RE Refractometer. Make sure that the DIP switch 2 on the printer is set to ON. The DIP switch can be found under the battery cover (see GA42 Operating Instructions). Connect the GA42 printer to the power supply.

Connect the DLC7070 barcode reader to the "AUX." port of the RE Refractometer.

Switch on the GA42 printer and the RE Refractometer (and the automation unit, if connected).

6.2 Setting up the RE Refractometer

6.2.1 Setting up the peripheral instruments

6.2.1.1 Automation unit

Press the <Func.> key on the RE Refractometer. Select "3.Changer" (or "2.Changer", RE40D) with the <3> (<2>) key and confirm with <Enter>.

```
            < Function >

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

Select "SC1" for "Changer" with the ▶ key and confirm with <Enter>. More options appear in the "Changer" menu:

Select "On" for "Rinse / Purge" and for "Drain+Prerinse" with the ▶ key. Confirm both settings with <Enter>.

```
            < Changer >

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

Select "SC30" for "Changer" with the ▶ key and confirm with <Enter>. More options appear in the "Changer" menu:

Select "Off" for "Calib.", "Home" for "Start Position" and "On" for "Rinse /Purge" and for "Drain+Prerinse" with the ◀ or ▶ key. Confirm all settings with <Enter>.

```
            < Changer >           ▼

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

An exact description of this menu can be found in section 11.4.

6.2.1.2 GA42 printer

Press the <Setup> key. Select "0.Interface" with the <0> key and confirm with <Enter>.

```
            < Setup >

0.Interface        5.International
1.Date & Time      6.Lock
2.Op.Names/Units   7.Beep
3.Serial/Version   8.Temp.Calib.
4.LCD Contrast     9.Calibration Mode
```

Select "1.Printer" with the ▼ key and confirm with <Enter>.

```
            < Interface >

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

Select "GA-" for "Printer" with the ▶ key and confirm with <Enter>.

```
           < Printer >

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

6.2.1.3 Barcode reader

Press the <Setup> key. Select "O.Interface" with the <O> key and confirm with <Enter>.

Select "2.BarCode(AUX)" with the ▼ key and confirm with <Enter>.

```
          < Interface >

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

Select "On" for "Barcode(AUX)", "9600" for "Baud Rate", "None" for "Parity", "1" for "Stop Bits" and "8" for "Data Bits" with the ◀ and ▶ keys. Confirm each setting with <Enter>.

```
        < Barcode(AUX)>         ▼

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

Enter "1" for "Start Pos." and "0" for "Read Length". Confirm both entries with <Enter>.
Select "CR+LF" for "Delimiter" with the ▶ key and confirm with <Enter>.

```
        < Barcode(AUX)>         ▲

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

Press the <Reset> key. The main display appears.

To configure the barcode reader, scan in the two barcodes "Reset" and "Mode RS232" one after the other:

Reset

Mode RS232

Operator 1

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

```
1.Method-1                     01-01
Temp.(°C)                  nD (None)
Set    20.00
Cell   20.02

Operator :
```

6.2.2 User and country specific settings

6.2.2.1 Date and time

Press the <Setup> key. Select "1.Date & Time" and confirm with <Enter>.

Enter the date ("Day", "Month", "Year") and the time of day ("Hour", "Minutes"). Confirm your entries with <Enter>.
The date's format can be selected in the Setup menu under "5.International".

```
            < Date & Time >

          24/02/2002 15:18

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

6.2.2.2 Operator names

Press the <Setup> key. Select "2.Op.Names/Units" and confirm with <Enter>.

Select "1.Operator Names" and confirm with <Enter>.

```
            < Op.Names/Units >

          0.Concentration Units
          1.Operator Names
```

Press the ▼ key to get to the input field "Name 1". Enter a list of future operators of the RE Refractometer (up to ten names may be entered) and confirm each name with <Enter>. Press the <Display> key to enter capital/ small letters or numerals.

```
          < Operator Names >       ▼

Operator :<              >

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

If you have a barcode reader, make a photocopy of the list in appendix A.4.3 and fill in the names as you have entered them on the instrument.

6.2.3 Activating the automatic error detection

The "Repeat Meas." function enables the RE Refractometers to automatically detect the most frequent sources of errors in refractive index measurements. Please note that this function is only available if you use your RE Refractometer together with an automation unit (SC1 or SC30).

Press the <Func.> key. Select "7.Multiple Meas." (or "6.Multiple Meas.", RE40D) and confirm with <Enter>.

In the menu "Multiple Meas." select "2.Repeat Meas." and confirm with <Enter>.

```
          < Multiple Meas. >

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

Select "On" for "Repeat Meas." and confirm with <Enter>. Further options appear in the "Repeat Meas." menu.

Enter 3 for "Repetitions" and 25 for "Movement Ratio". Enter a value of 0.00010 for "SD Limit" , if you work with an RE50 Refractometer. If you work with an RE40D Refractometer, enter a value of 0.0002 for "SD Limit". Confirm each entry with <Enter>.

```
          < Repeat Meas. >
Repeat Meas.      :Off On
Repetitions       :[3]
Movement Ratio    :[    25]%
SD Limit          :[ 0.00010]nD
Exit              :[Execute]
```

With the above settings, each sample will be measured three times: After the first measurement the sample is moved forwards twice in the system and measured again after each forward movement. If the standard deviation of the three measured refractive indices is above the value specified in "SD Limit" an error message is displayed and printed out.

A detailed description of the "Repeat Meas." function can be found in section 12.8.3.

6.2.4 Setting up the instrument test

The measuring accuracy of the RE Refractometer needs to be checked from time to time with the built-in instrument test function (see section 11.6). In this section, the settings are shown for performing such instrument tests with distilled water.

Press the <Func.> key. Select "5.Set Check" (or "4.Set Check", RE40D) and confirm with <Enter>.

Set up the instrument test. Select "Daily" for "Check" with the ◀ key and confirm with <Enter>. Enter the values for "Ref.Value" (in our case the theoretical refractive index of water at 20 °C, if you are working with an RE40D enter a value of 1.3330) and for "Tolerance" (the measured value's highest permissible deviation during the instrument test, if you are working with an

```
          < Set Check >

Check         :Daily Periodic
Standard      :[Water      ]
Ref.Value     :[  1.33299]
Tolerance     :[  0.00005]
Exit          :[Execute]
```

RE40D enter a value of 0.0001) and the name of the standard ("Standard") according to the illustration on the right. Confirm each entry with <Enter>.

6.2.5 Entering the method for adjustment

6.2.5.1 Deleting all methods

Prior to entering the methods for adjustment and for the sugar determinations, you should delete all methods in the RE Refractometer's main memory (i.e., return them to the default settings):

Press the <Func.> key. Select "9.Memory Clear" (or "7.Memory Clear", RE40D) and confirm with <Enter>.

Select "4.Method Parameter" and confirm with <Enter>.

```
          < Memory Clear >

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

Select "Yes" for "Clear Execute" and confirm with <Enter>. All of the RE Refractometer's methods are returned to the default settings.

```
        < Method Parameter Clear >

     Clear Execute ? No  Yes
```

6.2.5.2 Entering the parameters for adjustment

Press the <Method> key.

Select "O.CALIB." with the <0> key and confirm with <Enter>. Method 0 is reserved for adjustment of the instrument. No measurements can be performed with this method!

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

Press the <Meas.Para> key. The "O.CALIB." method's parameters are displayed. The name of this method ("Method Name") and the temperature of the measuring cell ("Meas.Temp.") are displayed, but cannot be changed. The criterium for stability for acceptance of the measured value ("Stability") should always be set to 0 in method 0 (most accurate measurement), because this method is used for adjustment. The waiting time ("Wait Time") can also be left at 0 s.

```
Method 0   < Meas. Parameter >      ▼

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

If you use your Refractometer without an attached automation unit, leave the setting for "Sequence" at "Off" and press the <Esc.> key.

If your RE Refractometer is equipped with an automation unit, select "On" for "Sequence" with the ▶ key and confirm with <Enter>. Additional lines for setting up the sequence appear in the menu.

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

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

By setting up the sequence ("Sampling", "O.S.Rate", "Sampling Limit", "Drain", "Drain Rate", "Rinse-1", "Rinse-1 Time", "Rinse-2", "Rinse-2 Time", "Purge" and "Purge Time") you define the times for sampling as well as for draining, rinsing (with two different solvents) and drying of the measuring cell. Enter the settings for the sequence according to the illustrations on the right.

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

 Rinse-1                  :Off Set
 Rinse-1 Time             :[  15]s
 Rinse-2                  :Off Set
 Rinse-2 Time             :[  10]s
 Purge                    :Off Set
```

Confirm "Exit:[Execute]" with <Enter>.

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

```
Method 0  < Meas. Parameter >      ▲

Purge Time             :[  240]s
Exit                   :[Execute]


```

6.2.6   Entering the method for measurements

A method for performing a measurement consists of three parts: the measuring parameters (access them with the <Meas.Para> key), the calculation parameters (entering of a calculation formula for the results, access the parameters with the <Calc.Para> key) and the settings for the printout of the results (access them with the <Report> key).

On the whole, there are ten methods at your disposal, nine for your measurements and one for adjustment of the Refractometer (method 0). Please be aware that no measurements can be performed with method 0. Therefore, the <Sample>, <Report>, <Calc.Para>, <Measure> and the <Check> keys will not work when method 0 is selected as active method.

6.2.6.1   Entering the measurement parameters

Press the <Method> key.

Select method 1 ("Method-1") with the <1> key and confirm with <Enter>.

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

Press the <Meas.Para> key.

Enter "Fr.Juice" for "Method Name" and 0 for "Stability". Confirm both entries with <Enter>. The measuring temperature ("Meas.Temp.") and the wait time ("Wait Time") can be left at their default settings.

```
Method 1  < Meas. Parameter >      ▼

Method Name          :[Fr.Juice]
Meas.Temp.           :[ 20.00]°C
Stability (0-2)      :[0]
Wait Time            :[   0]s
Sequence             :Off On
```

If you use your Refractometer without an attached automation unit, leave the setting for "Sequence" at "Off" and press the <Esc.> key.
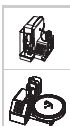
If your RE Refractometer is equipped with an automation unit, select "On" for "Sequence" with the ▶ key and confirm with <Enter>. Additional lines for setting up the sequence appear in the menu.

By setting up the sequence ("Sampling", "O.S.Rate", "Sampling Limit", "Drain", "Drain Rate", "Rinse-1", "Rinse-1 Time", "Rinse-2", "Rinse-2 Time", "Purge" and "Purge Time") you define the times for sampling as well as for draining, rinsing (with two different solvents) and drying of the measuring cell. Enter the settings for the sequence according to the illustrations on the right.

Confirm "Exit:[Execute]" with <Enter>.

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

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

Sampling                 :Off Set Auto
O.S.Rate                 :[ 150]%
Sampling Limit           :[  120]s
Drain                    :Off Set Auto
Drain Rate               :[ 100]%
```

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

Rinse-1                  :Off Set
Rinse-1 Time             :[   10]s
Rinse-2                  :Off Set
Rinse-2 Time             :[    5]s
Purge                    :Off Set
```

```
Method 1  < Meas. Parameter >       ▲

Purge Time               :[  120]s
Exit                     :[Execute]
```

6.2.6.2 Entering the calculation parameters

You will now define that the measuring results obtained with method 1 have to be displayed and printed out in BRIX (i.e., as sucrose content in percent by weight).

Press the <Calc.Para> key. Select "0.Result" with the <0> key and confirm with <Enter>. "2.Decimals" is to define the number of decimal places for the display and the printout of the results.

```
Method 1  < Calc. Parameter >

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

Select "BRIX" for "Result" with the ▶ key and confirm with <Enter>. Confirm "Exit:[Execute]" with <Enter>.

```
Method 1     < Result >

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

6.2.6.3 Setting the format for the printout of the results

Press the <Report> key.

The <Report> key allows you to determine the content of the printout of the results. Select 'GLP' for 'Format' with the ▶ key and confirm with <Enter>. With this setting a complete list of all parameters is printed out after each measurement. A detailed description of the available formats for the printout of the results can be found in section 8.

```
Method 1   < Report >

   Format      :<GLP      >
   Exit        :[Execute]


```

6.3   Adjusting the RE Refractometer

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 when instrument settings are changed or adapted in order to ensure correct measurement values.

Important:

– The RE Refractometer must be turned on at least 30 minutes before it is adjusted.

– To ensure correct measurements, the instrument must be adjusted at the measuring temperature. Adjust the RE Refractometer after each change of the measuring temperature.

– Method 0 ("CALIB.") is reserved for adjusting the instrument, i.e., all the adjustments are done according to the settings of method 0 regardless of the currently selected method. Only the measuring temperature is adapted to the one of the currently selected method, because the instrument has to be adjusted at the same temperature as the samples are measured. This ensures that all the adjustments of the instrument are performed under the same conditions (i.e., the ones you defined in method 0). There is thus no need to select method 0 prior to adjustment of the instrument.

– The results of the last 10 adjustments are stored in the instrument and may be displayed and printed out at any time (see section 11.7.2).

With the barcode reader select your operator name from the list (see Appendix A.4.3). Your name appears in the status line of the display.

```
1.Fr.Juice                        01-01
Temp.(°C)                        Brix(%)
Set   20.00
Cell  20.00
 Operator: Your name
```

If you don't have a barcode reader, press the <Setup> key, select "2.Op.Names/Units" and confirm with <Enter>. Select "1.Operator Names" in the in the "Op.Names/Units" menu and confirm with <Enter>. Select your name in the "Operator" field with the ◀ or ▶ key and confirm with <Enter>. Press the <Escape> key.

Fill a sample vial to about 60% with distilled or deionized water or a water refractive index standard and seal it. Make sure that the slits in the cap's white membrane are facing downwards and that there are no air bubbles in the water!

Press the <Calib.> key and follow the instructions on the display:

Open the cover lid and clean the measuring cell (the prism) thoroughly with water and ethanol. Wipe the prism dry with a soft paper tissue. Close cover the lid and press <Enter>. The instrument is adjusted with air, the message "Calibrating" appears shortly on the display.

```
1.Fr.Juice
Temp.(°C)
Set    20.00
Cell   20.00

    Clean Prism and Press Enter Key
```

Put distilled water or a water refractive index standard on the measuring cell until the ring mark is covered (approximately 0.4 mL). Close the cover lid and press <Enter>. The message "Calibrating" flashes on the display during the adjustment to the water value.

```
1.Fr.Juice
Temp.(°C)
Set    20.00
Cell   20.00

    Set Water and Press Enter Key
```

When the adjustment is done "OK" appears on the display and the result of the adjustment is printed out.

```
1.Fr.Juice
Temp.(°C)
Set    20.00       OK
Cell   20.00

          Calibration
```

If the instrument was not able to perform the adjustment, the error message "Failed" appears on the display instead of "OK". If this is the case, make sure that the water you used 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 representative for technical assistance.

Clean the measuring cell as described in section 5.

Place the sample vial into the SC1 and confirm the message "Set Water and Press Enter Key" with the <Enter> key on the RE Refractometer. The measuring cell is now cleaned and dried and then adjusted first with air and then with water. The message "Calibration OK" appears on the display and the result of the adjustment is printed out. At the end of the process the measuring cell is cleaned and dried again.

The turntable of the SC30 rotates until position 1 is in front. On the display the message "Set Water at H.P. / Press Enter Key" appears. Place the sample vial in position 1 of the turntable and press the <Enter> key on the RE Refractometer. The SC30's turntable rotates until the vial is at the sampling position. The measuring cell is now cleaned and dried and then adjusted first with air and then with water. The message "Calibration OK" appears on the display and the result of the adjustment is printed out. At the end of the process the measuring cell is cleaned and dried again.

If the instrument was not able to perform the adjustment (error message "Failed") please check the following and then repeat the adjustment:

– Are the cleaning liquids connected properly, i.e., is the distilled water connected to the "Rinse 1" port and the highly volatile solvent (acetone) to the "Rinse 2" port?

– Are all the tube connections tight?

– Was the cap of the sample vial with the distilled water screwed tight and the white membrane properly in place?

– Are all the settings for the sequence in method 0 ("CALIB.") correct (see section 6.2.5.2)?

6.4 Performing an instrument test and measurements

6.4.1 Performing instrument test and measurement manually or with SC1

6.4.1.1 Instrument test

Select the operator name with the barcode reader or with the keypad as described in section 6.3.

Press the <Check> key. The message "Set water and Press Enter Key" appears on the display.

```
1.Fr.Juice
Temp.(°C)
Set    20.00
Cell   20.00
Set water and Press Enter Key
```

Put distilled water or an water refractive index standard on the measuring cell until the ring mark is covered. Close the cover lid and press the <Enter> key to start the instrument test.

Fill a sample vial to about 60% with distilled or deionized water or a water refractive index standard, seal it and place it into the SC1. Press the <Enter> key to start the instrument test. Confirm "Sampling Speed?" "Low" with <Enter>. Confirm "Exit:[Execute]" with <Enter>. The instrument test is performed.

The result of the test is displayed and printed out.

```
1.Fr.Juice
Temp.(°C)     Ref.Value        nD
Set    20.00
Cell   20.00   1.33299  ->  1.33298 OK
              Check(Daily)
```

If the instrument test fails, the error message "NG" appears on the display. If this is the case, repeat the instrument test. Should the instrument test fail a second time, the instrument needs to be readjusted (see section 6.3).

```
1.Fr.Juice
Temp.(°C)     Ref.Value        nD
Set    20.00
Cell   20.00   1.33299  ->  1.33200 NG
              Check(Daily)
```

Clean the measuring cell as described in section 5.

6.4.1.2 Measurement

Select the operator name with the barcode reader or with the keypad as described in section 6.3.

Enter the name of your sample. If a barcode reader is available, scan in the barcode "Orange". The sample name ("Orange") appears in the status line of the display.

```
1.Fr.Juice                        01-01
Temp.(°C)                       Brix(%)
Set   20.00
Cell  20.00
Sample ID: Orange
```

Orange

If you don't have a barcode reader, press the <Sample> key. A menu to enter the sample data (sample name and number) appears on the display.

Enter "Orange" as "Sample ID" and confirm with <Enter>. Press the <Display> key to toggle between capital/small letters and numerals. Confirm "Exit:[Execute]" with <Enter>.

```
              < Sample >

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

Put orange juice on the measuring cell until the ring mark is covered. Stir the sample carefully in order to remove any air bubbles from the surface of the prism. Close the cover lid and press the <Measure> key. The measurement is started, during the measurement the message "Measuring" appears on the display.

```
1.Fr.Juice        Orange          01-01
Temp.(°C)                       Brix(%)
Set   20.00
Cell  20.00                      11.28
              Result
```

When the measurement has finished, the result is displayed and printed out. Clean the measuring cell as described in section 5.

Fill a sample vial to about 80% with orange juice and seal it if you are not going to measure your sample immediately. Make sure that the slits in the cap's white membrane are facing downwards. Place the vial into the SC1. Press either the <Measure> key on the RE Refractometer or the <Start> key on the SC1 to start the measurement. The measurement is started, during the measurement the message "Measuring" appears on the display. Please note that a triple determination of your sample is performed (automatic error detection, see section 6.2.3).

When the measurements are done, the mean value of the three determinations is displayed and the mean value plus the standard deviation of the three results is printed out.

Should the standard deviation of the three measured refractive indices be higher than the value you entered in the menu "Repeat.Meas" ("SD Limit", 0.00010 for the RE50, 0.0002 for the RE40D, respectively), the message "Out" appears on the display.

```
1.Fr.Juice        Orange          01-01
Temp.(°C)                       Brix(%)
Set   20.00
Cell  20.00       Out            11.28
              Result
```

If this is the case, repeat the measurement. If the message "Out" appears again on the display your orange juice sample very probably contains a lot of solid particles (pulp) which cause scattered light and therefore measuring errors.

If you need to do very accurate measurements (error < 0.1 BRIX) you have to filter the orange juice prior to measurement. If you can accept a lower accuracy for the results, you simply may enter a higher value for "SD Limit" in the "Repeat Meas." menu.

6.4.2 Performing instrument test and measurements with SC30

6.4.2.1 Preparing the samples, entering the sample data

Prior to the measurements you will perform an instrument test. For this purpose, fill a sample vial to about 80% with distilled water and seal it. Fill another three sample vials to about 80% with your orange juice samples and seal them. Make sure that the slits in the white membrane (in the cap) are facing downwards. Place the sample vials in the SC30's turntable as follows (press the <Step> key on the SC30's keypad if required in order to rotate position 1 of the turntable in front):

− Position 1: distilled water
− Positions 2 … 4: orange juice

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

Press the <Sample > key on the RE Refractometer in order to enter the sample data.

The first line of this menu appears on the RE50 Refractometer only (see section 13). Enter 4 for "No. of Samples" (instrument test + 3 samples of orange juice) and 1 for "Next Meas. No." (measurements are to begin with the first sample). Select "Current" for "Method" (the instrument test and all measurements are

```
     < Sample >              ▼

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

performed according to the same, i.e., the currently selected method) and "Create" for "Parameters" with the ◀ key and confirm with <Enter>.

Enter 2 for "No. of series" (2 series, instrument test and measurements) and confirm with <Enter>.

Confirm "Set Parameter:Execute" with <Enter> in order to enter the sample data.

```
     < Sample >              ▲

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

Enter the sample data for the instrument test. With the barcode reader scan the barcode "CHECKSTD" (see following page) in the "Sample ID" field (sample identification).

If you do not have a barcode reader, press the <Check> key when the cursor is in the "Sample ID" field and confirm with <Enter>.

```
  < Sample >  Series No.1(of 2)  ▼

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

Enter 1 for "No. of samples" (number of samples) and for the sample numbers ("High Sample No." and "Low Sample No.") and confirm your entries with <Enter>. The "Method No." cannot be changed because you have selected "Current" for "Method" (see above). With this setting all measurements are performed with the same method (i.e., with the currently selected method).

Select "Low" for "Sampling Speed" with the ◀ key and confirm with <Enter>. Confirm "Next Series: [Execute]" with <Enter>.

```
    < Sample >   Series No.1(of 2) ▲

Sampling Speed  :Low  High
Next Series     :[Execute]
```

Enter the sample data for the orange juice samples. With the barcode reader scan the barcode "Orange" (see below) in the "Sample ID" field (sample identification). If you do not have a barcode reader, enter the sample name via the keypad and confirm with <Enter> (press the <Display> key to enter capital/

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

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

small letters or numerals). Enter 3 for "No. of samples" (number of samples), 2 for "High Sample No.", and 1 for "Low Sample No.". Confirm your entries with <Enter>. The "Method No." field may not be changed (see above).

Select "Low" for "Sampling Speed" with the ◀ key and confirm with <Enter>. Confirm "Save & Exit: [Execute]" with <Enter>.

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

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

CHECKSTD   Orange

If you confirm "Edit" with <Enter>, you can view a table of the data just entered (if you do not wish to do this, simply press the <Escape> key.)

```
        < Sample >             ▼

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

"Edit No." is the number of the sample to appear on the first line of the table. Confirm the default value 1 with <Enter>. Confirm "Set Parameter" with <Enter> and the table will appear.

```
        < Sample >             ▲

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

The table shows the running sample number ("No."), the measuring method ("M"), the two sample numbers ("S.No."), the sample identifications ("Sample ID") as well as the sampling speed ("Speed") for each sample.

```
         < Sample List>
No. M  S.No.   Sample ID    Speed
  1 1  01-01   CHECKSTD     Low
  2 1  02-01   Orange       Low
  3 1  02-02   Orange       Low
  4 1  02-03   Orange       Low
```

You can edit this table or enter the sample file directly in form of a table (see section 7.2.2).

6.4.2.2 Performing the instrument test and the measurements

Select the operator name with the barcode reader or the keypad as described in section 6.3 and press the <Measure> key. The instrument test and the measurements will be performed automatically in succession. The results are displayed after each measurement and printed out in GLP format.

Please note that for each measurement (with the exception of the water for the instrument test) a triple determination is performed (automatic error detection, see section 6.2.3) and the means (and the standard deviations) of the three results are printed out. Should one of the standard deviations be higher than the value you specified, the message "Out" appears on the display and the error message "--- Out of limit ---" is printed out. If this error message appears for more than one sample, your orange juice sample probably contains a lot of solid particles (pulp) which cause scattered light and therefore measuring errors. If you need to do very accurate measurements (error < 0.1 BRIX) you have to filter your samples prior to measurement. If you can accept a lower accuracy for the results, you may simply enter a higher value for "SD Limit" in the "Repeat Meas." menu (see section 6.2.3).

If the instrument test fails, a corresponding error message ("NG", see illustration) appears on the display and the measurements of the samples are not performed. If this is the case, please check whether the vials have been placed in the proper sequence on the turntable (i.e., that no orange juice sample was mistak-

```
1.Fr.Juice                    F   01-01
Temp.(°C)      Ref.Value          nD
Set    20.00
              1.33299  ->  1.33200 NG
Cell   20.00
              Check(Daily)
```

enly used for the instrument test) and repeat the instrument test. Press the <Step> key on the SC30 until position 1 of the turntable is in front. Put in a new sample vial in position 1 of the turntable.

Press the <Sample> key. "Next Meas.No." (number of the next measurement) now contains a 2 (because the instrument test has already been performed). Overwrite this value with 1 and confirm with <Enter>. Press the <Measure> key. The instrument test is performed again and then the samples are mea-

```
         < Sample >              ▼

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

sured. Should the instrument test fail a second time, the instrument needs to be readjusted (see section 6.3).

7. Sample (number/identification) and sample file

If a SC30 Sample Delivery and Cleaning Unit (sample changer) is attached to the RE Refractometer, the sample file always appears when you press the **<Sample>** key. If no sample changer is connected (or if it has not been configured correctly, see section 6.2.1) and the sample file has been switched off (see section 11.2), a menu to enter data for a single sample appears.

7.1 Menu to enter data for a single sample

If the sample file is switched off, when you press the <Sample> key a menu to enter sample data (sample numbers and sample identification) appears.

```
            < Sample >

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

The sample number ("**Sample No.**") consists of two parts, e.g. [01]-[01].

The first two-digit number (ranging from 00 to 98) is the number of the measurement series. In the instrument it is referred to as the "High Sample No.". If you use your own specific series number for each type of sample when measuring various types of samples, it is easy to evaluate the stored results statistically afterwards (see section 11.1.1).

The next two-digit number (ranging from 00 to 99) is automatically increased by 1 with each measurement.

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

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

Make sure that "Result", "Ready" or "Calibration" appears on the bottom line of the display and then scan the barcode. The sample identification will appear for a short time on the bottom line. If "Ready" was on the bottom line before entering the barcode, it will also appear in the first line,

```
1.Method-1                      01-01
Temp.(°C)                    nD(None)
Set    20.00
Cell   20.00
Sample ID: water
```

If "Result" or "Calibration" was on the bottom line, the sample identification will only appear on the first line after the <Measure> key has been pressed.

7.2   Menu to enter a sample file (sample changer)

If you operate your RE Refractometer together with a sample changer (SC30) or if the sample file has been switched on (see section 11.2), a menu to enter a sample file appears when you press the <Sample> key:

The first line ("**Sample File**") only appears on the RE50 Refractometer. This line is most often skipped, unless you wish to store a sample file onto a memory card or load a sample file from a memory card (see sections 13.1.8 and 13.1.10).

```
           < Sample >              ▼

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

"**No. of Samples**" is the number of samples to be measured. This number can be higher than 48 even though the turntable of the SC30 Sample Delivery and Cleaning Unit is only designed for 30 or 48 samples. "No. of Samples" can be changed during the measurement process. Example: Enter 12 for "No. of Samples" if you want to measure 12 samples. If an additional 13 samples are added after starting the measurement, you can increase the number to 25.

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

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

Select "**Parameters**" "**Create**" and confirm with <Enter>, if you want to enter the sample file in dialogue format. Select "**Parameters**" "**Edit**" when the sample file is to be displayed in the form of a table which can be edited.

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

Presuming you would like to:

- measure a series of 12 grape juice and 7 orange juice samples.
- perform an instrument test prior to the measurements (i.e., measure a water sample, see section 6.4.2.1).
- measure the sample in two different ways:
  - by using different methods for each type of sample, i.e., method 1 for the instrument test (CheckStd), method 2 for the grape juice samples (GrapeJ.) and method 3 for the orange juice samples (OrangeJ.).
  - by using the same method (method 2, GrapeJ.) for the test and all measurements.

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

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

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

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

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

Press the <Sample> key.

Enter 20 for "No. of Samples" (the whole series is made up of 20 samples: 1 test standard, 12 grape and 7 orange juice samples). Confirm your entry with <Enter>. Move the cursor to "Method" and select "Variable" (with the ◄ or ► key). Confirm with <Enter>. Select "Parameters" "Create" with the ◄ key and confirm with <Enter>.

```
           < Sample >              ▼

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

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

Confirm "Set Parameter: [Execute]" with <Enter>.

```
           < Sample >              ▲

No. of series  :[3]
Set Parameter  :[Execute]
Exit           :[Execute]
```

While the cursor is in the "Sample ID" input field, press the <Check> key. "CHECKSTD" (instrument test) appears as sample identification. Confirm this with <Enter>. Enter 1 for "No. of samples" (number of samples) and "Method No.", and confirm with <Enter>. (For "High Sample No." and "Low Sample No." see section 7.1).

```
   < Sample >   Series No.1(of 3)  ▼

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

You can leave the "Sampling Speed" at "Low". Move the cursor down and confirm "Next Series: [Execute]" with <Enter> in order to enter the data for the second series (grape juice).

```
   < Sample >   Series No.1(of 3) ▲

Sampling Speed :Low  High
Next Series    :[Execute]
```

If some of your samples are viscous you may set the sampling speed to "High" with the ► key so that those samples are pumped into the measuring cells at maximum speed (the sampling speed set on the SC30 then does not have any influence on the pumping speed).

Enter the sample identification (e.g., "GRAPE") with the keypad or the barcode reader (for a barcode example, see section 7.2.2). Confirm with <Enter>. Enter 12 for "No. of Samples". Confirm with <Enter>. Enter 2 for the "Method No." and confirm with <Enter>. Move the cursor to "Next Series: [Execute]" and confirm with <Enter>.

```
   < Sample >   Series No.2(of 3)  ▼

Sample ID        :[GRAPE      ]
No.of samples    :[ 12] (2-13)
High Sample No. :[ 2]
Low Sample No.   :[ 2]
Method No.       :[2]
```

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

```
   < Sample >   Series No.3(of 3)  ▼

Sample ID        :[ORANGE     ]
No.of samples    :[  7] (14-20)
High Sample No. :[ 1]
Low Sample No.   :[14]
Method No.       :[3]
```

```
   < Sample >   Series No.3(of 3) ▲

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

You can now look at the sample file you have created. To do this, confirm "Edit" with <Enter>.

```
   < Sample >                      ▼

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

Confirm the default value of 1 for "Edit No." (this is the sample that will appear on the first line of the table) with <Enter>. Go to "Set Parameter:[Execute]" and confirm with <Enter>.

```
   < Sample >                      ▲

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

The sample file is displayed and you can print it out (with the <Print> key) or change it (see section 7.2.2). Press the <Escape> key to leave the sample file.

Now you can place the samples into the turntable of the SC30. Select the operator name (see section 12.3.2) and press the <Measure> key to start the measurements.

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

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

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

Press the <Method> key, select method 1 ("GrapeJ.") and confirm with <Enter>.

Press the <Sample> key.

Enter 20 for the "No. of Samples" (the whole series consists of 20 samples) and confirm with <Enter>. Move the cursor to "Method" and select "Current" (current method) with the ◄ key. Confirm with <Enter>. Select "Edit" for "Parameters" and confirm with <Enter>.

```
          < Sample >               ▼

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

Enter 1 for "Edit No." 1 and confirm with <Enter>. Confirm "Set Parameter:[Execute]" with <Enter>.

```
          < Sample >               ▲

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

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

CHECKSTD

Then scan the barcode GRAPE twelve times

GRAPE

and the barcode ORANGE seven times.

ORANGE

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

The settings for the sampling speed ("Sp") can, if necessary (to measure viscous samples), be changed for each sample individually with the ◄ or ► key (confirm with <Enter>).

Press the <Escape> key to leave the sample file. Place the samples into the turntable of the SC30. Select the operator name (see section 12.3.2) and press the <Measure> key to start the measurements.

8. Report (password protected)

With the **<Report>** key you can define the content for the printout of the currently selected method's results. The report key is not active if method 0 ("CALIB.") has been selected. Select the method for which you wish to set the printout format (<Method> key, see section 9) and then press the <Report> key. The following menu will appear:

With the ◀ or ▶ key you can select between "Off", "Short", "GLP" and "Variable" for the printout's format. "Off" means no report is printed at the end of the measurements. "Short" only prints out the most important parameters (e.g., results, date and time, etc.) after each measurement. "GLP" provides a complete list of parameters after each measurement (see table below).

```
Method 1    < Report >

   Format         :<Short   >
   Exit           :[Execute]



```

If you chose "Variable" and confirm with <Enter>, a list of parameters that can be printed out appears. You can choose the desired parameters individually by setting the parameter's option to "On" (the parameter is printed out) or "Off" (the parameter is not printed out) with the ◀ or ▶ key and confirming with <Enter>.

```
Method 1    < Report >          ▼

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

```
Method 1    < Report >          ▲▼

   Method No.   :Off   On
   Meas.Temp.   :Off   On
   nD           :Off   On
   Temp.Comp.   :Off   On
   Result       :Off   On
```

```
Method 1    < Report >          ▲

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


```

		Short	GLP	Variable
Model, series, version	(Model/Serial)		X	choice
Sample number	(Sample No.)	X	X	choice
Date and time	(Date&Time)	X	X	choice
Sample identification	(Sample ID)		X	choice
Method number and name	(Method No.)		X	choice
Measuring temperature	(Meas.Temp.)	X	X	choice
Refractive index	(nD)	X	X	choice
Temperature compensation	(Temp.Comp.)		X	choice
Results	(Result)	X	X	choice
Duration of measurement	(Meas.Time)		X	choice
Operator name	(Operator Name)		X	choice

9. Measuring parameters (password protected)

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

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

Method 0:

Parameter		Default setting
Method name	(Method Name)	CALIB.
Stability criteria	(Stability)	0
Waiting time	(Wait Time)	0 s
Sequence	(Sequence)	Off

The temperature of the measuring cell cannot be changed in method 0! When you press the <Calib.> key, it is carried over from the currently selected method!

Methods 1 to 9:

Parameter		Default setting
Method name	(Method Name)	Method-x
Temperature measuring cell	(Meas.Temp.)	20.00 °C
Stability criteria	(Stability)	1
Waiting time	(Wait Time)	0 s
Sequence	(Sequence)	Off

Press the **<Method>** key. Select the method you would like to modify with the ▲ or ▼ key or enter the number of the method. Confirm your choice with <Enter>.

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

9.1   Method Name

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

Press the **<Meas.Para>** key.

Press the <Clear> key to delete the previous name ("Method Name"). Enter the desired name. Press the <Display> key to toggle between capital letters, small letters and numerals. Confirm your entry with <Enter>.

```
Method 1  < Meas. Parameter >        ▼

Method Name            :[Method-X]
Meas.Temp.             :[ 20.00]°C
Stability (0-2)        :[1]
Wait Time              :[   0]s
Sequence               :Off On
```

Note: Special characters can be entered with the barcode reader (see Appendix, section A.4.2).

9.2   Measuring temperature (Meas.Temp.)

Enter the desired measuring temperature ("Meas.Temp.", 15 to 50 °C for the RE50, 15 to 70 °C for the RE40D) and confirm with <Enter>.

```
Method 1  < Meas. Parameter >        ▼

Method Name            :[Method-X]
Meas.Temp.             :[ 20.00]°C
Stability (0-2)        :[1]
Wait Time              :[   0]s
Sequence               :Off On
```

Attention:

– If the measuring temperature has been changed, the RE Refractometer must be readjusted.
– After changing the measuring temperature you should give the instrument enough time (at least 30 minutes) to stabilize the temperature of the measuring cell before you adjust it.

9.3   Measurement stability (Stability)

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

Enter the desired measurement stability ("Stability", 0, 1 or 2) and confirm with <Enter>. (0 = highest accuracy, longest measuring time).

```
Method 1  < Meas. Parameter >        ▼

Method Name            :[Method-X]
Meas.Temp.             :[ 20.00]°C
Stability (0-2)        :[1]
Wait Time              :[   0]s
Sequence               :Off On
```

The repeatability of the measuring results not only depends on the value selected for "Stability", it also depends on the nature of the measured sample and the measuring conditions. You may roughly assume that the repeatability of the measuring results yielded with stability 0 is about 1 to 2 on the last digit of the resolution of the measuring instrument (nD, i.e. ± 0.00002 for the RE50 and ± 0.0001 for the RE40D) and with stability 2 about 5 on the last digit.

9.4 Waiting time (Wait Time)

The waiting time is the amount of time the instrument waits to start the measurement after the <Measure> key has been pressed. The waiting time ensures that the sample has enough time to heat up or cool down to the measuring temperature. If the difference between sample and measuring temperature is more than 10°C, you should implement a waiting time.

Enter the desired waiting time ("Wait Time", 0 to 9999 s) and confirm with <Enter>.

```
Method 1  < Meas. Parameter >        ▼

Method Name              :[Method-X]
Meas.Temp.               :[ 20.00]°C
Stability (0-2)          :[1]
Wait Time                :[█   0]s
Sequence                 :Off On
```

9.5 Sequence (Sequence: sampling, draining, rinsing, purging)
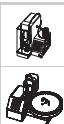
If you operate your RE Refractometer with an automation unit (SC1 or SC30), the sequence settings define the times for sampling as well as for draining, rinsing (with two different solvents) and drying of the measuring cell.

Select "**Sequence**" "On" with the ▶ key to activate the **sampling sequence**. Confirm with <Enter>.

```
Method 1  < Meas. Parameter >        ▼

Method Name              :[Method-X]
Meas.Temp.               :[ 20.00]°C
Stability (0-2)          :[1]
Wait Time                :[   0]s
Sequence                 :Off On
```

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

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

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

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

Sampling                 :Off Set Auto
Sampling Time            :[  15]s
Drain                    :Off Set Auto
Drain Rate               :[ 100]%
Rinse-1                  :Off Set
```

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

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

Sampling                 :Off Set Auto
O.S.Rate                 :[ 150]%
Sampling Limit           :[ 120]s
Drain                    :Off Set Auto
Drain Rate               :[ 100]%
```
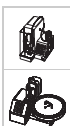
With sampling set to "Auto", the RE Refractometer detects the markedly different measuring signal when the sample enters the measuring cell and turns the pump off according to the set over-sampling rate ("O.S.Rate", see below). The sampling time is, therefore, automatically adjusted to the viscosity of the sample. **Attention:** Please be aware that "Sampling Auto" only functions when the measuring cell is empty and more or less dry before sampling. If you want to use the automatic error detection ("Repeat Meas.", see section 11.8.3), then "Sampling" must be set to "Auto" in all methods.

O.S.Rate: The RE Refractometer measures the time the sample needs to get to the measuring cell after the pump has been activated and adds the "O.S. Rate" (over-sampling rate) to this time. Example: If the over-sampling rate has been set to 150% (recommended setting) and the sample needs 5 seconds to reach the measuring cell, then the pump stops after 12.5 seconds. The "O.S.Rate" ensures that impurities which might remain in the measuring cell (e.g., remaining rinsing liquid) are removed by the sample before the measurement is performed. In order to ensure accurate measurements you should thus (provided you have enough quantity of the samples to be measured) enter a rather high value for "O.S. Rate" (e.g., 200%).

Sampling Limit: This is the maximum time for sampling. If no sample happens to be in the sample vial, the pump switches off automatically after this time has run out.

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

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

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

Sampling              :Off Set Auto
O.S.Rate              :[ 150]%
Sampling Limit        :[ 120]s
Drain                 :Off Set Auto
Drain Time            :[  15]s
```

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

Setting the draining time of the measuring cell to "**Auto**" only makes sense if "Sampling" has also been set to "Auto" (recommended setting, see above).

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

Sampling              :Off Set Auto
O.S.Rate              :[ 150]%
Sampling Limit        :[ 120]s
Drain                 :Off Set Auto
Drain Rate            :[ 100]%
```

The "**Drain Rate**" establishes how long draining shall take with respect to sampling. If the "**Drain Rate**" is set to 100% and the complete sampling procedure (including the over-sampling rate, see example above) takes 12.5 seconds, then the pump to drain the measuring cell will also be turned on for 12.5 seconds.
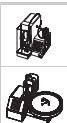
The measuring cell can be **rinsed** with two solvents. First with a solvent ("**Rinse-1**") capable of dissolving the sample, and then with a highly volatile solvent ("**Rinse-2**") to ensure complete and quick drying of the measuring cell.

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

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

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

After rinsing, air is pumped through the measuring cell to **dry** it.

Enter the **drying time** ("**Purge**"):

Set: Enter the drying time in seconds ("**Purge Time**", 0 to 9999 s).

Off: No drying of the measuring cell.

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

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

```
Method 1   < Meas. Parameter >       ▲

Purge Time               :[  120]s
Exit                     :[Execute]
```

Important:

– If you want to work with "Sampling" "Auto", you must ensure that the time for drying ("Purge Time") is long enough to completely dry the measuring cell.

– The sequence defined in method 0 ("Calib.") is tied to the **<Rinse/Purge> key** of the RE Refractometer. By pressing the <Rinse/Purge> key, the measuring cell is drained, rinsed and dried according to the sequence defined in method 0.

– The sequence defined in method 0 is also carried out when the **<Calib.> key** is pressed, as long as the "Rinse / Purge" option in the "Changer" menu (see section 11.4) is set to "On", i.e., the measuring cell is cleaned **before** each adjustment according to the settings in the sequence of method 0. This guarantees that the measuring cell of the RE Refractometer is always clean and completely dry before an adjustment is performed.

To ensure reliable adjustments of the RE Refractometer you should thus select the times for rinsing and drying of the measuring cell ("Rinse-1 Time", "Rinse-2 Time" and "Purge Time") in method 0 long enough to ensure a complete cleaning and drying of the measuring cell (see example in section 6.2.5.2). You should also select "On" for the parameter "Rinse Purge" in the "Changer" menu (see section 11.4).

10. Calculation parameters (password protected)

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

Select the method for which you want to set the calculation parameters (<Method> key, see section 9) and then press the <Calc.Para> key.

```
Method 1  < Calc. Parameter >

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

10.1 Result (refractive index, Brix, HFCS, concentration)

The RE Refractometers can display and print out the result of your measurements as refractive index (nD), as sugar content (BRIX, HFCS42, HFCS55, the latter two available on the RE50 only) and as a concentration calculated based on the measured refractive index.

Press the <Calc.Para> key. Select "0.Result" and confirm with <Enter>.

Now you can select the desired unit for the result with the ◄ and ► keys. After confirming your choice for the unit of the result with <Enter>, depending on the unit selected additional lines will appear in the "Result" menu's display.

```
Method 1      < Result >

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

The following kinds of calculations are available for "Result":

nD: Refractive index, measured at the given temperature with the D-line of sodium (wavelength 589.3 nm).

BRIX: BRIX is the term for the sucrose content of an aqueous sucrose solution in percent by weight (also called BRIX degrees). Conversion of the refractive index to BRIX is based on the table stored in the instrument (according to ICUMSA, see Appendix 2). This table contains only refractive index/BRIX data pairs valid at a temperature of 20 °C. If the measurements are performed at, for example, 40 °C, then the conversion of the refractive index into BRIX is done based on the ICUMSA table for 20 °C (thus, the results are not correct!). For this reason, if BRIX measurements are made at temperatures other than 20 °C, the temperature compensation must be activated (see section 10.3). With the temperature compensation activated, the RE Refractometer applies correction values according to OIML R108 (R124, resp.) in order to correct the BRIX values.

Brix measurements of such samples as milk or soft drinks result in relative measurement values: the actual sucrose content is not determined, because the refractive index of such samples also depends on other contents (not only sucrose!) dissolved in the sample.

HFCS: (RE50 only). HFCS stands for High-Fructose Corn Syrup. These syrups are manufactured from natural corn syrup and consist of inverted (or isomerized) sugar, i.e., a mixture of dextrose, fructose, maltose and sucrose. They are classified according to their fructose content. Mainly three different HFCS are in use: a mixture containing 42% fructose (HFCS42), one containing 55% fructose (HFCS55) and a third one containing 90% fructose (HFCS90). Inverted sugar concentration denominates the concentration in weight % of an isomerized sugar solution. Inverted sugar concentration can be calculated from the refractive index of the inverted sugar solution measured at 20°C (n_D^{20}). The RE50 Refractometer has built-in conversion tables ("Physical Properties Table", Corn Products, 1991) for two of the mixtures: HFCS42 and HFCS55. Since a temperature compensation table is also stored in this instrument, it is able to convert the measuring results for a temperature of 20°C, as long as the measuring temperature is within the range of 20 to 50°C and the temperature compensation is activated. See Appendix 3 for further information.

Conc.: Determination of a concentration (normally in two component mixtures) based on the refractive index. The corresponding concentration tables (refractive indices / concentrations) with up to 30 data pairs per table can be entered for the calculations. These data pairs can be obtained either by measurement (i.e., the refractive indices of a series of solutions with a known concentration must be determined), by downloading them from our website www.refractometry.com or from the literature (e.g., "Handbook of Chemistry and Physics"). The concentrations are calculated based on first, second or third order polynomials. You can select the order of the polynomial, and the polynomial's coefficients are determined by means of a regression analysis by the RE Refractometer and then displayed. You can also enter the polynomial directly (i.e., without entering a concentration table). This allows the concentration function to be used to convert the refractive index into other units (e.g. Zeiss values).

User table: (RE50 only). Similar to the above unit "Conc.", the User Tables are used to determine the concentration of two component mixtures. These tables are available on specific Memory Cards and can be downloaded directly into the RE50. Each table has a capacity of 200 data pairs (refractive index / concentration). Up to 9 tables consisting of 200 data pairs can be stored in the RE50 Refractometer.

User Tables are only available on special request. Ask your local METTLER TOLEDO representative for further information.

10.1.1 Calculating concentrations, converting into other units (Conc.)

Select this type of calculation if you want to

– determine the concentration of two-component mixtures based on the refractive index.
– convert the refractive index into other units.

Select "Conc." with the ▶ key and confirm with <Enter>.

```
Method 1      < Result >                ▼

Result1              :<Conc.         >
Conc.Unit            :<None >
Conc.Formula         :<A+Bx            >
Parameter Set        :Table Coefficient
Data Replace         :<x←nD     >
```

First, you may define the unit (dimension) for your results.

Select the desired unit ("**Conc.Unit**") with the ◀ and ▶ keys and confirm your choice with <Enter>. The following units are available: none, %, ppm, mg/g, mg/mL, mg/L, g/L, mEq/L, mol/L as well as up to five freely definable names for units. These five names can be entered in the "Setup / Op.Names/Units / Concentration Units" menu (see section 12.3.1).

```
Method 1      < Result >                ▼

Result1              :<Conc.          >
Conc.Unit            :<None >
Conc.Formula         :<A+Bx            >
Parameter Set        :Table Coefficient
Data Replace         :<x←nD     >
```

There are two ways two to program a concentration formula: either you select a suitable formula (1/(A+BX) as well as polynomials of first, second or third order are available) and enter the corresponding coefficients directly, or you enter a concentration table (data pairs refractive index / concentration), select the desired formula. The RE Refractometer then determines the coefficients of the selected formula by regression analysis or it calculates the results by linear interpolation based on the table entered.

10.1.1.1 Direct entry of concentration formulas

This section describes the procedure to enter a formula for converting the refractive index into another unit, the Zeiss number :

The formula to convert the refractive index (n_D^{20}) into Zeiss units (Zeiss, water = 15.00) is:

$$\text{Zeiss} = 2965.063 - 7007.752 \cdot n_D^{20} - 3596.889 \cdot [n_D^{20}]^2$$

The following steps have to be taken in order for the RE Refractometer to display the results of the refractive index measurements directly in Zeiss units:

– Enter "Zeiss" as name for the results ("Setup"/"Op.Names/Units"/"Concentration Units" menu, see section 12.3.1).
– Make sure that the measuring temperature ("Meas.Temp.") defined in the currently selected method is set to 20.00°C (see section 9.2).
– Press the <Calc.Para> key.
– In the "Calc.Parameter" menu, select "0.Result" and confirm with <Enter>.

– In the "Result" menu select "Conc." for "Result" with the ▶ key and confirm with <Enter> (see section 10.1.1).

```
Method 1     < Result >              ▼

Result                 :<Conc.          >
Conc.Unit              :<Zeiss >
Conc.Formula           :<A+Bx+Cx²        >
Parameter Set          :Table Coefficient
Data Replace           :<x←nD     >
```

– Select "Zeiss" for "Conc.Unit" with the ▶ key and confirm with <Enter>.

– Select "A+Bx+Cx²" for "Conc.Formula" with the ▶ key and confirm with <Enter>.

– Select "Coefficient" for "Parameter Set" (direct entry of the concentration formula without a table) with the ▶ key and confirm with <Enter>.

– Select "x←nD" for "Data Replace" with the ▶ key and confirm with <Enter>.

– Enter the values for A, B and C according to the picture. Confirm each value with <Enter>.

– Confirm "Exit:[Execute]" with <Enter>.

```
Method 1     < Result >              ▲

A                      :[ 2965.063]x10[ 0]
B                      :[-7007.752]x10[ 0]
C                      :[-3596.889]x10[ 0]
Exit                   :[Execute]
```

The RE Refractometer is now in a position to display the measured refractive index directly in Zeiss. The number of decimal places for the results can be defined under "Calc.Para/Decimals" (see section 10.3).

10.1.1.2 Entering concentration tables

This section describes the procedure for entering a concentration table by means of an example: the determination of the glycerol content of an aqueous solution based on the refractive index.

Concentration table for an aqueous glycerol solution (source: "Handbook of Chemistry and Physics").

Note:
You can find further concentration tables on our website www.refractometry.com.

	Concentration (in % by weight)	n_D (at 20 °C)
1	0.00	1.3330
2	1.00	1.3342
3	2.00	1.3353
4	3.00	1.3365
5	4.00	1.3376
6	5.00	1.3388
7	6.00	1.3400
8	7.00	1.3412
9	8.00	1.3424
10	9.00	1.3436

In order for the RE Refractometer to display and print out the measuring results directly in percent by weight of glycerol, the following steps must be taken:

– Make sure that the measuring temperature ("Meas.Temp.") in the parameters of the currently selected method is set to 20.00°C (see section 9.2).

– Press the <Calc.Para> key, select "0.Result" and confirm with <Enter>.

– Select "Conc." for "Result" with the ▶ key and con-
firm with <Enter> (see section 10.1.1).

– Select "%" for "Conc.Unit" with the ▶ key and con-
firm with <Enter>.

– Select "A+Bx+Cx^2" for "Conc.Formula" with the ▶
key and confirm with <Enter>.

```
Method 1      < Result >              ▼

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

– Select "Table" for "Parameter Set" (entering a concentration table) with the ◀ key and confirm with <Enter>.
(The parameter "Data Replace" may not be modified.)

– Enter 10 for "Data No." (number of data pairs) and
confirm with <Enter>.

– Confirm "Enter Conc.Table:[Execute]" (entering a
concentration table) with <Enter>.

```
Method 1      < Result >              ▲

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

– Enter the data pairs according to the table. Confirm
each value with <Enter>.

```
Method 1       < Conc.Table >         ▼
No.      Conc.           nD
 1   [ 0.00000]      [ 1.33300]
 2   [ 1.00000]      [ 1.33420]
 3   [ 2.00000]      [ 1.33530]
 4   [ 3.00000]      [ 1.33650]
 Edit    Clear    GetPara.    Exit
```
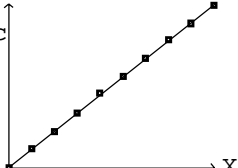
– After all data pairs have been entered, select
"GetPara." with the ▶ key and confirm with <Enter>.

```
Method 1       < Conc.Table >         ▲
No.      Conc.           nD
 7   [ 6.00000]      [ 1.34000]
 8   [ 7.00000]      [ 1.34120]
 9   [ 8.00000]      [ 1.34240]
10   [ 9.00000]      [ 1.34360]
 Edit    Clear    GetPara.    Exit
```

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

```
 < Get Parameter >
[A+Bx+Cx²           ]Conc
A: 4.531631x10⁰
B: 8.506406x10²
C:-2.777562x10³

R: 1.338260                      X
```

– Press <Enter>. The concentrations are calculated
using the coefficients. A table with the deviations be-
tween calculated and actual concentrations ("Error")
is displayed.

```
Method 1       < Conc.Table >         ▲
No.      Error           nD
 7   [ 0.00342]      [ 1.34000]
 8   [ 0.00856]      [ 1.34120]
 9   [ 0.00569]      [ 1.34240]
10   [-0.00507]      [ 1.34360]
 Edit    Clear    GetPara.    Exit
```

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

– Press the <Escape> key. The RE Refractometer can now display and print out the measured refractive indices directly as glycerol percent by weight in the range of 0 to 9% . The results' decimal places can be defined under "Calc.Para/Decimals" (see section 10.3).

10.2   Temperature compensation

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

– The refractive index needs to be determined at e.g., 15 °C, but the sample is very viscous at that temperature. Such samples need to be heated in order to enable them to be pumped into the measuring cells.

– To speed up the measurement. If, for example, the samples are at a temperature of 35 °C, but their refractive indices need to be determined at 15 °C, then you can set the cell temperature to 35 °C and convert the measured values to a temperature of 15 °C.

– The refractive index needs to be determined at a temperature out of the RE Refractometer's range of measuring temperatures (e.g., at 100 °C). In this case, you can set the cell temperature to 50 °C and convert the measured values to a temperature of 100 °C.

To use the temperature compensation, you need to know the temperature dependence of your sample's refractive index.

There are two ways to enter the temperature dependence of the refractive index:

– Entering a temperature compensation table (pairs of data made up of the temperature and the corresponding refractive index). In this case, the coefficient of the temperature compensation function is calculated by the RE50 Refractometer (this function is available only on this instrument).

– Entering a coefficient for the temperature compensation.

Hint

If you have selected BRIX as unit for your measuring results and activated the temperature compensation, the results of your measurements are corrected if the measuring temperature is not 20.00 °C. This calculation is done based on a temperature compensation table (according to ICUMSA) stored in the instrument.

– Press the <Calc.Para> key. Select "1.Temperature Compensation" and confirm with <Enter>.

– Select "Temp.Comp." "On" with the ▶ key and confirm with <Enter>.

```
Method 1      < Temp.Comp. >

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


```

10.2.1 Entering a temperature compensation table

This function is available on the RE50 Refractometer only.

The temperature dependency of the refractive index can be expressed as follows: $n_{D_c} = k \cdot f(T)$

The temperature dependency of the refractive index is contingent upon the composition of the sample and is therefore not equal for all samples. If only samples whose refractive indices have approximately the same temperature dependence are measured with one particular method, then you can determine the refractive index of this type of sample at various temperatures and enter the results (i.e., the data refractive index / temperature) into the RE50 Refractometer. The RE50 Refractometer then calculates the refractive index of the measured samples automatically for a particular temperature ("Comp.Temp").

The RE50 Refractometer performs these temperature compensation calculations based on polynomials of first, second or third order (the order of the polynomial can be selected) or by linear interpolation. These calculations are performed by the instrument as follows:

$$n_D^{T_o} = \frac{f(T_c)}{f(T_M)} \cdot n_D^{T_M}$$

with

$n_D^{T_o}$ refr. index temperature compensated

T_c reference temperature ("Comp.Temp.")

T_M measuring temperature

$n_D^{T_M}$ refr. index at measuring temperature

f polynomial function
(determined by the RE50)

Enter the reference temperature ("Comp.Temp.") to which the measurements need to be converted. Confirm it with <Enter>. Select "Table" for "Parameter Set" with the ◄ key and confirm with <Enter>. With the ► key, select the desired function ("Temp.Formula") for the temperature compensation: "Interpolation" (linear interpolation) or a polynomial of first, second or third

```
Method 1      < Temp.Comp. >          ▼

Temp.Comp.            :Off On
Comp.Temp.           :[   20.00]°C
Parameter Set        :Table Coefficient
Temp.Formula         :<A+Bx+Cx²        >
Data No.             :[  4]
```
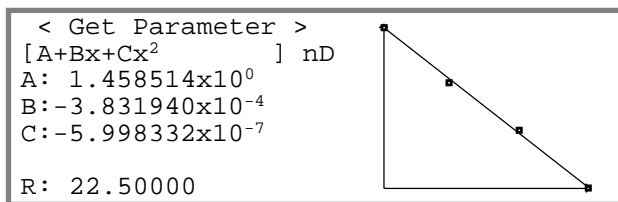
order and confirm with <Enter>. Enter the number of data pairs (refractive index / temperature) you want to enter ("Data No.") and confirm with <Enter>.

Confirm "Enter Temp.Table:[Execute]" with <Enter>.

```
Method 1      < Temp.Comp. >          ▲

Enter Temp.Table  :[Execute]
Exit              :[Execute]
```

Enter the temperature compensation table (data pairs refractive index / temperature). Confirm each entry with <Enter>. Select "Get Para." with the ► key and confirm with <Enter>.

```
Method 1        < Temp.Table >
No.   Temp[°C]            nD
 1  [    15.00]      [ 1.46136]
 2  [    20.00]      [ 1.45945]
 3  [    25.00]      [ 1.45757]
 4  [    30.00]      [ 1.45560]
 Edit    Clear    GetPara.     Exit
```

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

```
 < Get Parameter >
[A+Bx+Cx²        ] nD
A: 1.458514x10⁰
B:-3.831940x10⁻⁴
C:-5.998332x10⁻⁷

R: 22.50000
```

By pressing the <Enter> key again, the formula and the coefficients used to calculate the refractive indices for the different temperatures are displayed. The table displayed shows how well these calculated values coincide with the original data.

```
Method 1      < Temp.Table >
No.   Temp[°C]         Error
 1   [   15.00]    [-0.00001]
 2   [   20.00]    [ 0.00002]
 3   [   25.00]    [-0.00002]
 4   [   30.00]    [ 0.00001]
  Edit    Clear    GetPara.    Exit
```

10.2.2 Input of a coefficient for temperature compensation

With this function only a linear temperature compensation is possible. For this reason you cannot enter a temperature compensation formula, but must enter a slope.

Example:

If the refractive index of a sample is 1.33340 ($n_D^{T_1}$) at 15°C (T_1) and 1.33191 ($n_D^{T_2}$) at 30°C (T_2) the "Slope" is calculated as follows:

$$\text{Slope} \cdot 1000 = \frac{n_D^{T_1} - n_D^{T_2}}{T_2 - T_1} \cdot 1000 = \frac{1.33340 - 1.33191}{30 - 15} \cdot 1000 = 0.0993$$

Enter the reference temperature ("Comp.Temp."), to which the refractive indices need to be converted. Confirm with <Enter>. With the ▶ key, select "Coefficient" for "Parameter Set" and confirm with <Enter> (this parameter does not appear on the RE40D Refractometer). Calculate the "Slope" as described above and enter the value. Confirm with <Enter>. Confirm "Exit:[Execute]" with <Enter>.

```
Method 1    < Temp.Comp. >        ▼

Temp.Comp.        :Off On
Comp.Temp.        :[  20.00]°C
Parameter Set     :Table Coefficient
Slope             :[0.0993] / 1000
Exit              :[Execute]
```

10.3   Decimals

Press the <Calc.Para> key (see section 10). Select "2.Decimals" and confirm with <Enter>.

Enter the number of decimal places (i.e., places after the decimal point) for the display and printout of the results. Confirm each entry with <Enter>.

```
Method 1   < Decimals >              ▼

   nD               (0-5):[5]
   nDt              (0-5):[5]
   Brix             (0-2):[2]
   Conc.            (0-5):[5]
   HFCS42           (0-2):[2]
```

Confirm "Exit:[Execute]" with <Enter>.

```
Method 1   < Decimals >              ▲

   HFCS55           (0-2):[2]
   Exit                :[Execute]


```

nD: Refractive index (RE40D: 0 to 4 decimal places)
nDt: Temperature compensated refractive index (RE40D: 0 to 4 decimal places)
Conc.:   Calculated concentrations (RE40D: 0 to 4 decimal places)
Brix: Sucrose content in percent per weight (RE40D: 0 or 1 decimal place)
HFCS42/55:   Inverted sugar concentration (High-Fructose Corn Syrup) (available on the RE50 only)

11.   Functions (password protected)

Press the **<Func.>** key. If the password protection is activated (see section 12.7) you will be prompted to enter the password.

Select the desired function by pressing the corresponding numeric key (keys <0> to <9>) or by using the arrow keys and confirm with <Enter>.

The "Function" menu is slightly different depending on the model of the RE Refractometer (see pictures). The texts in braces (e.g., {"2.Changer"}) concern the RE40D Refractometer. Options which are not available on the RE40D Refractometer are written in gray letters (e.g., Load).

RE40D Refractometer

```
         < Function >

0.Data File        4.Set Check
1.Sample File      5.Periodic
2.Changer          6.Multiple Meas.
3.DE Connect       7.Memory Clear
```

RE50 Refractometer

```
         < Function >

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

11.1   Stored results (Function 0: Data File)

The results of the last 100 measurements are automatically stored in the RE Refractometer. If 100 results have already been stored and a measurement is performed, then the oldest result is overwritten by the most recent (FIFO). The stored results can be accessed with the "Data File" function: you can do recalculations or statistical evaluations of the stored results or mark them as invalid so that they will not be included in statistical calculations. Furthermore, the RE50 Refractometer offers the possibility to save the stored results to a memory card or to reload them from a memory card into the instrument.

Press the <Func.> key. Select function "0.Data File" and confirm with <Enter>.

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

```
      < Data File >            ▼
No. M.Name     Sample      Result
 0  Method-1  01-01  nD    1.34818
 1  Method-1  01-02  nD    1.34821
 2  Method-2  02-01  Br      10.81
 3  Method-2  02-02  Br      10.82
Statis.  Recalc.  Load  Save   Exit
```

If many results have been stored in the RE Refractometer, press the <0> key to display the first four results (0 to 3), and the <1> to <9> keys to display the next blocks of data (results 10 to 13, 20 to 23, etc.).

To display additional information about a stored result (sample number, sample identification, calculated results, etc.) proceed as follows:

Select the desired result with the ▲ and ▼ keys. Select "Recalc." with the ◄ or ► key and confirm with <Enter>.

```
          < Data File >              ▼
No. M.Name      Sample        Result
 0  Method-1   01-01   nD    1.34818
 1  Method-1   01-02   nD    1.34821
 2  Method-2   02-01   Br      10.81
 3  Method-2   02-02   Br      10.82
Statis.  Recalc.  Load  Save   Exit
```

Press <Reset> to return to the main display.

```
1.Method-1      Sample2         01-02
Temp.(°C)                    nD (None)
Set   20.00
Cell  20.00                  1.34821

            Recalculation
```

Select "Statis." (statistics), "Recalc." (recalculations), "Load" or "Save" (store results on a memory card or load them back into the RE50 Refractometer) with the ◄ or ► key and confirm with <Enter>.

The options "Load" and "Save" are available on the RE50 Refractometer only. These options require a memory card and are described in more detail in sections 13.1.2 and 13.1.4.

11.1.1 Statistical evaluations

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

The data stored in the RE Refractometer can be filtered for a statistical evaluation, allowing a useful evaluation of a particular group of results. For example, you can statistically evaluate all measurements that have the same sample identification or include all results with the same unit in your calculations (e.g., the mean of all BRIX determinations, without including the refractive index measurements). The selection of the results to be included in the statistical evaluation is done with so-called filters, which can be combined. In your statistical calculations you can, for instance, include only those results that have been measured with method 2 and have the same "High Sample Number".

Select "Statis." with the ◄ key and confirm with <Enter>.

```
          < Data File >              ▼
No. M.Name      Sample        Result
 0  Method-1   01-01   nD    1.34818
 1  Method-1   01-02   nD    1.34821
 2  Method-2   02-01   Br      10.81
 3  Method-2   02-02   Br      10.82
Statis.  Recalc.  Load  Save   Exit
```

The filters are displayed. Activate the desired filters by moving the cursor with the ▲ and ▼ key to the corresponding filters and switching them on or off with the ◄ or ► key. Enter the appropriate options for the filters (see below). Confirm each entry with <Enter>.

```
          < Statistics >              ▼
Result            :<nD        >
Method No.        :<On>     [1]
Method Name       :<Off>
High Sample No. :<On>       [01]
Data Print        :<Off>
Statistics        :[Execute]
```

Example: If you want to include all samples that have been measured with method 1, have nD (refractive index) as unit and the same "High Sample Number" of "01", then you have to activate the filters according to the illustration above.

Set "Data Print" to "On" if you want to print out a table with all individual results in addition to the statistical data. Confirm "Statistics:[Execute]" with <Enter>.

The results of the statistical calculations appear on the display. You can print them out by pressing the <Print> key. To return to the "Statistics" menu, confirm "Exit:[Execute]" with <Enter>

```
      < Statistics Results >

Results        :    2
Mean           :1.34820
SD             :0.00010
RSD            :0.00742   %
Exit           :[Execute]
```

11.1.2 Recalculations

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

The following example demonstrates how you can convert the result of a refractive index measurement (n_D) into BRIX.

Select the result you wish to recalculate with the ▲ or ▼ key (in our example, result no. 1).

Select "Recalc." with the ◄ or ► key and confirm with <Enter>.

```
          < Data File >            ▼
No. M.Name    Sample      Result
 0  Method-1  01-01   nD   1.34818
 1  Method-1  01-02   nD   1.34821
 2  Method-2  02-01   Br     10.81
 3  Method-2  02-02   Br     10.82
Statis.  Recalc.  Load  Save    Exit
```

The result of the measurement is displayed. Press the <Calc.Para> key.

```
1.Method-1      Sample2          01-02
Temp.(°C)                    nD (None)
Set    20.00
Cell   20.00                  1.34821

              Recalculation
```

Select "0.Result" and confirm with <Enter>. (In addition to the result unit, you can change the settings for temperature compensation and the number of decimal places to be displayed and printed out.)

```
Recalc.    < Calc. Parameter >

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

Select "Brix" for "Result" with the ◀ or ▶ key and confirm with <Enter>.

```
Recalc.        < Result >

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

Press the <Func.> key and select "0.Data File". Confirm "Recalc." with <Enter>.

The recalculated result (nD in Brix) is displayed.

```
           < Data File >          ▼
No. M.Name      Sample      Result
 0  Method-1   01-01   nD   1.34818
 1  Method-1   01-02   Br     10.47
 2  Method-2   02-01   Br     10.81
 3  Method-2   02-02   Br     10.82
Statis.  Recalc.  Load  Save   Exit
```

11.1.3 Marking stored results as invalid

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

Select the result you want to mark invalid with the ▲ or ▼ key (in our example, result no. 1).

Press the <Display> key to mark the result.
The result is now marked with an asterisk (*). (Press the <Display> again to remove the mark.)

```
           < Data File >          ▼
No. M.Name      Sample      Result
 0  Method-1   01-01   nD   1.34818
*1  Method-1   01-02   Br     10.47
 2  Method-2   02-01   Br     10.81
 3  Method-2   02-02   Br     10.82
Statis.  Recalc.  Load  Save   Exit
```

Results marked with an asterisk are not included in statistical evaluations. If the results of a statistical analysis are printed out and "Data Print" has been set to "On", then the marked results are printed, but marked with an asterisk.

11.2 Sample file (Function 1: Sample File)

This function may not be used if an SC30 Sample Delivery and Cleaning Unit (sample changer) is connected to the RE Refractometer. If an SC30 has been selected in the function "3.Changer" {"2.Changer"} function, the sample file is automatically switched on ("F" appears in the first line of the main display) and cannot be switched off.

The sample file may also be used if the RE Refractometer is operated without sample changer, for example to always perform standard measurements in the same order. In such cases proceed as follows:

Press the <Func.> key. Select function "1.Sample File" and confirm with <Enter>.

Select "Sample File" "On" with the ▶ key and confirm with <Enter>. Confirm "Exit:[Execute]" with <Enter>.

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

```
         < Sample File >

   Sample File : Off   On

   Exit        : [Execute]
```

11.3 Method file (Function 2: Method File, RE50 only)

The function "Method File" is available on the RE50 Refractometer only. It is utilized to save methods on a memory card or to load them back into the RE50 Refractometer. A description of this function can be found in sections 13.1.5 and 13.1.7.

11.4 Automation units (Function 3 {2}: Changer)

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

Press the <Func.> key. Select function "3.Changer" {"2.Changer"} and confirm with <Enter>.

Select "SC1" for "Changer" with the ▶ key and confirm with <Enter>.

```
        < Changer >              ▼

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

Select "SC30" for "Changer" with the ▶ key and confirm with <Enter>.

```
        < Changer >              ▼

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

Further options appear in the menu. Select the desired option with the ▲ and ▼ key and change its setting with the ◀ or ▶ key. Confirm each change with <Enter>.

Switch "**Calib.**" to "On", if you want to adjust the RE Refractometer prior to each sample series. In this case you must always put a vial with a calibration standard (usually deionized water) in the first position of the turntable. The samples to be measured should then be placed in the subsequent positions on the turntable. If the RE Refractometer is to be adjusted automatically prior to any sample series, then you should also set "Rinse/Purge" to "On" (see below).

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

"**Start Position**" "**Home**": The first sample vial of a sample series (or the one containing the deionized water for adjustment) must be placed in position 1 on the turntable. "**Current**": The first vial of a sample series can be placed on the turntable in the position where the sampling mechanism is. If you want the option of interrupting a running series in order to perform an urgent measurement (see "Emergency Sample" function), then "Start Position" must be set to "Home".

"**Rinse/Purge**" is used to automatically drain, rinse and dry the measuring cell **prior** to each adjustment of the RE Refractometer. The sequence for this is always the one defined in the method "O.CALIB". **In order to ensure correct adjustments "Rinse/Purge" should always be set to "On"!**

"**Drain+Prerinse**" must be set to "On" if highly viscous samples are to be measured. If the inner surface of the tubes is still covered with a thick film of the viscous sample when the first rinsing cycle starts, pressure begins to build up and the system could become leaky. If "Drain+Prerinse" is turned on, a small amount of the first rinsing solvent is already injected during the draining cycle (i.e., when air is blown through the system in order to push the sample out). This removes most of the sample out of the system before the first rinsing cycle begins.

Measuring urgent samples ("Emergency Sample")

If a sample needs to be measured urgently and a sample series is already running on the SC30 Sample Delivery and Cleaning Unit, press the <Measure> key. The sample number of the currently measured sample appears in reverse display. As soon as the current measurement is completed (including rinsing and drying of the measuring cell), the following menu will appear on the display:

Select "Next Sequence" "Emergency" with the ▶ key and confirm with <Enter>.

```
       <Emergency Parameter>

Next Sequence      :<Emergency>
Exit               :[Execute]
```

Enter the number of the method ("Method No.") with which the urgent sample is to be measured. Define the sampling speed for the sample with the ▶ key ("Low" or "High"). Confirm "Exit:[Execute]" with <Enter>.

```
       <Emergency Parameter>

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

The turntable of the SC30 Sample Delivery and Cleaning Unit rotates until position 1 is in front. The message "Emer. Samp. at H.P." "Press Enter key" appears in the status line of the display. Place the urgent sample in position 1 on the sample rack and press <Enter>. The sample is measured. Afterwards, the current series is continued.

11.5   Connecting a DE Density Meter (Function 4 {3}: DE Connect)

Here you define whether you have connected a DE Density Meter (DE40, DE45 or DE51) to the RE 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 your RE Refractometer you must proceed as follows:

Press the <Func.> key. Select Function "4.DE Connect" {"3.DE Connect"} and confirm with <Enter>.

Select "DE Connect" "On" with the ▶ key and confirm with <Enter>. Confirm "Exit:[Execute]" with <Enter>.

```
              < DE Connect>

DE Connect          :Off On
Exit                :[Execute]
```

11.6   Configuring the instrument test (Function 5 {4}: Set Check)

The measuring accuracy of the RE Refractometers should be checked sporadically with the built-in instrument test function. To perform such an instrument test, press the <Check>-key and you are prompted to perform a measurement with a standard with a known refractive index.

The RE Refractometer also performs an instrument test if you work with an SC30 Sample Delivery and Cleaning Unit and measure a sample with the sample identification "CHECKSTD" (see section 6.4.2).

With the function "Set Check" you can define the nominal refractive index for the standard to be used in the instrument test as well as the maximum deviation allowed for the measured value.

There are two kinds of instrument tests: "Daily" and "Periodic". The interval for the periodic instrument test can be defined with function "6.Periodic" {"5.Periodic"} (see section 11.7). If a periodic instrument test has been installed, the RE Refractometer automatically prompts the operator to perform an instrument test when the defined time interval (e.g., every day or week) has run out. If the operator ignores the prompt or if the instrument test fails, all subsequent measurements are marked with an exclamation point after the sample number. With a periodic instrument test, you can, therefore, ensure that the RE Refractometer is always properly adjusted, because its measuring precision **must** be checked in the defined time intervals.

In section 6.4.1.1 you find a description of how to perform an instrument test if you operate your RE Refractometer manually or with an SC1 Sample Delivery and Cleaning Unit.
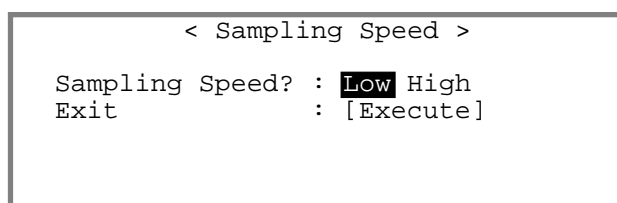
If have an SC30 Sample Delivery and Cleaning Unit connected to your RE Refractometer, it is normally easier to perform an instrument test at the beginning of a sample series (see section 6.4.2.1).

When the **<Check>** key is pressed, the RE Refractometer prompts the user to perform an instrument test (daily, or periodic test if due) as follows:

The turntable of the SC30 Sample Delivery and Cleaning Unit rotates until position 1 is in front. On the display of the RE Refractometer the message "Set STANDARD at H.P. and Press Enter Key" (instead of "STANDARD" the name you defined for the standard appears, see below). Place the sample vial containing the standard for the instrument test in position 1 of the turntable and press <Enter>.

```
1.Method-1                      F
Temp.(°C)
Set    20.00
Cell   20.00
━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━
     Set STANDARD at H.P. and
```

You are now asked to select the sampling speed for the standard. Select "Low" if you are using a standard with a low viscosity (such as water) or "High" if you use a standard with a high viscosity with the ◄ or ► key and confirm with <Enter>. Confirm "Exit:[Execute]" with <Enter>.

```
        < Sampling Speed >

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

The menu "Sampling Speed" also appears if you are working with an SC1 sample delivery and cleaning unit (see section 6.4.1.1).

During the instrument test, the message "Checking" appears on the status line of the display.

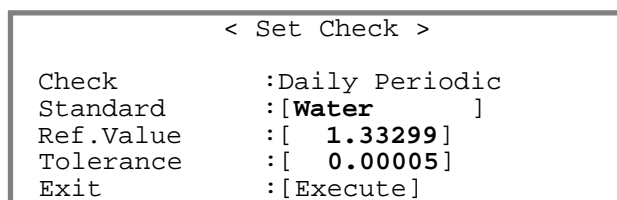After completion of the instrument test, the result appears on the display.

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

```
1.Fru.Saft
Temp.(°C)     Ref.Value        nD
Set    20.00
Cell   20.00   1.33299  ->  1.33298 OK

          Check(Daily)
```
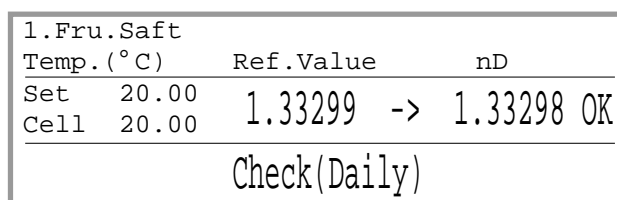
The results of periodic instrument tests are stored in the instrument (see section 11.7.1). The results of daily instrument tests are not saved.

To set up the instrument test, press the <Func.> key, select "5.Set Check" {"4.Set Check"} and confirm with <Enter>.

With the ◄ or ► key, select "Daily" if you want to set up the daily test, or "Periodic" if you want to set up the periodic test, and confirm with <Enter>. Enter the theoretical refractive index at the measuring temperature ("Ref.Value") of the standard to be used for the instrument test. Enter the maximum permissible deviation of the instrument test's measured value ("Tolerance"). Confirm each entry with <Enter>.

```
          < Set Check >

Check         :Daily Periodic
Standard      :[**Water       **]
Ref.Value     :[  **1.33299**]
Tolerance     :[  **0.00005**]
Exit          :[Execute]
```

11.7 Periodic instrument tests and adjustments (Function 6 {5}: Periodic)

With this function you can define the time intervals for the periodic instrument tests and adjustments, as well as display and print the results of adjustments and periodic instrument tests stored in the RE Refractometer. On the RE50 Refractometer this function can also be used to save the results of periodic instrument tests and adjustments to a memory card or load them back into the instrument.

11.7.1 Periodic instrument tests

Press the <Func.> key. Select "6.Periodic" {"5.Periodic"} and confirm with <Enter>.

If you wish to display and print out results of already performed instrument tests stored in the instrument, or to define the time interval for the periodic tests, use the ◀ key to select "Check" (instrument test) for "**Periodic**" and confirm with <Enter>.

```
          < Periodic >           ▼
Periodic          :Check   Calib.
Check.History     :Skip  Load  Save
Next Check Date :20/04/2002
Check Alarm       :Off  On
Check Interval  :[  7]day
Show Check List :[Execute]
```

Check History (RE50 only)

With this function you can save a list of the results of the last ten periodic instrument tests to a memory card or load it back into the RE50 Refractometer (see sections 13.1.11 and 13.1.13).

Next Check Date

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

Check Alarm

To activate the alarm, select "On" with the ▶ key and confirm with <Enter>. Once the alarm is activated, the following messages remind the user, when s/he presses the <Measure> key or switches the instrument on, that a periodic instrument test needs to be performed immediately or within a short time:

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

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

         5 Days to Check
```

When a periodic instrument test needs to be performed immediately:

```
         Check Day!
```

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

```
         Check Day Over!
```

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

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

Check Interval

Here you define how often a periodic instrument test is to be performed. Enter the desired time interval in days and confirm with <Enter>. If you enter 0, an instrument test is due right away.

Show Check List

Confirm "Show Check List:[Execute]" with <Enter> to display the results of the last ten periodic instrument tests performed.

Press the <Print> key to print out the whole list.

To display a detailed report of a particular instrument test, select the desired result with the ▲ and ▼ keys and press <Enter>.

In this case, "(NG)" means that the instrument test failed.

Confirm "Exit:[Execute]" with <Enter> to return to the list of instrument test results.

```
          < Show Check List >        ▼
No. Date       Ref.Value    Meas.
 10  28/04      1.49620     1.49626  NG
  9  27/04      1.49620     1.49621  OK
  8  26/04      1.49620     1.49621  OK
  7  25/04      1.49620     1.49620  OK
  6  24/04      1.49620     1.49618  OK
```

```
          < Show Check List >
Date       :28/04/2002
Standard   :Toluol
Temp.      : 20.00 °C
Ref.Value  : 1.49620   (± 0.00005)
Meas.Data  : 1.49626   (NG)
Exit       :[Execute]
```

11.7.2 Periodic adjustments

With this function you can define how often the RE Refractometer needs to be adjusted, as well as display and print the results of adjustments stored in the RE Refractometer. On the RE50 Refractometer this function can also be used to save the results of adjustments to a memory card or load them back into the instrument.
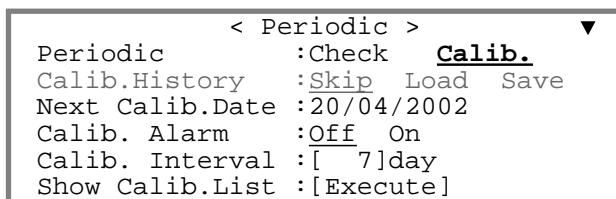
Each adjustment changes internal settings of the instrument. This can be dangerous: If an adjustment is not performed correctly, then all following measurements will be incorrect! Therefore, we recommend you do **not** adjust your RE Refractometer at set time intervals. The instrument should be adjusted only if:

– an instrument test has failed twice in a row.

– the measuring temperature has been changed. In this case you must readjust your RE Refractometer.

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

Press the <Func.> key. Select "6.Periodic" {"5.Peridodic"} and confirm with <Enter>.

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

```
         < Periodic >              ▼
Periodic         :Check   Calib.
Calib.History    :Skip  Load  Save
Next Calib.Date :20/04/2002
Calib. Alarm     :Off  On
Calib. Interval :[  7]day
Show Calib.List :[Execute]
```

Calib. History (RE50 only)

With this function you can save a list of the results of the last ten adjustments to a memory card or load it back into the RE50 Refractometer (see sections 13.1.11 and 13.1.13).

Next Calib. Date

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

Calib. Alarm

To activate the alarm, select "On" with the ▶ key and confirm with <Enter>. Once the alarm is activated, the following messages remind the operator, when s/he presses the <Measure> key or switches the instrument on, that an adjustment needs to be performed immediately or within a short time:

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

```
1.Method-1                    01-01
Temp.(°C)                 nD (None)
Set    20.00
Cell   20.00
───────────────────────────────────
           5 Days to Calib.
```
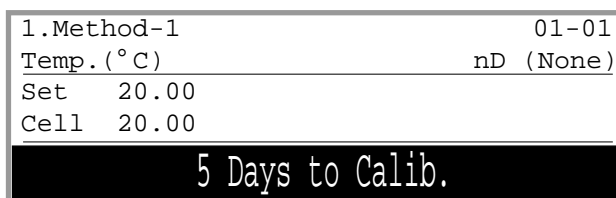
When a periodic adjustment needs to be performed immediately:
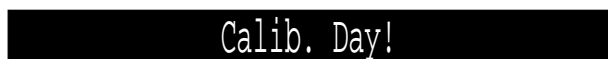
When a periodic adjustment was due the previous day or earlier but was not performed:

```
           Calib. Day!
```

```
           Calib. Day Over!
```

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

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

Calib. Interval

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

Show Calib. List

Confirm "Show Calib. List:[Execute]" with <Enter> to display a list of the results of the last 10 adjustments.

Press the <Print> key to print out the whole list.

To display a detailed report of a particular adjustment, select the desired result with the ▲ and ▼ keys and press <Enter>.

```
          < Show Calib. List >      ▼
No.   Date      Temp.(°C)    NEW
 10  28/04      20.00      1.33299   OK
  9  27/03      20.00      1.33299   OK
  8  05/02      20.00      1.33299   OK
  7  04/01      20.00      1.33299   OK
  6  23/12      20.00      1.33299   OK
```

Confirm "Exit:[Execute]" with <Enter> to return to the list of adjustment results.

```
          < Show Calib. List >
Date      :28/04/2002
Temp.     : 20.00 °C
Water     :  1.33305 ->  1.33299
Exit      :[Execute]
```

11.8   Multiple measurements (Function 7 {6}: Multiple Meas.)

This function is used for

– **automatic execution of sample measurements in fixed time intervals ("Auto Start").** Repeated measurements of a sample are normally used to determine changes in the refractive index during a chemical reaction.

Basically, there are two possibilities:

• The reaction takes place directly on the measuring cell and the refractive index is measured at fixed time intervals. In this case we recommend you cover the measuring cell with a vapor proof lid (ME 51322114).

• The reaction takes place in a reactor, and the reaction mixture is fed into the measuring cell at fixed time intervals via an external pump (e.g., a peristaltic pump, controlled via the "Ext.Pump" port of the RE Refractometer). The "Sequence" in the method used for such measurements must be turned "On" and the "Sampling Time" must be set long enough to make sure that the measuring cell can be filled completely with new reaction mixture from the reactor before each measurement.

– **automatic printout of statistical evaluations of the measured results ("Auto Statistics").**

– **automatic detection of the most frequent sources of errors (rinsing solvent residue in the measuring cell, inhomogeneous samples, scattered light, etc.) when performing refractive index determinations ("Repeat Meas.").**

Press the <Func.> key. Select "7.Multiple Meas." {"6.Multiple Meas."} and confirm with <Enter>.

Select the desired function with the ▲ and ▼ keys. Confirm with <Enter>.

```
            < Multiple Meas. >

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

11.8.1 Starting measurements automatically (Auto Start)

Please note that this function is not available if an automation unit (SC1 or SC30) is connected. Therefore, make sure that "Changer" in the "3.Changer" {"2.Changer"} menu is set to "None" (see section 11.4).

To perform repeated measurements of the same sample at fixed time intervals, set "Auto Start" to "On" with the ▶ key and confirm with <Enter>. More options appear in the "Auto Start" menu.

```
            < Auto Start >

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

Now you can define how often and at which time intervals the automatic measurement is to be performed.

"**Interval Time**" is the time interval between two measurements (0 to 9999 minutes). Enter 0 if you want the measurements to follow each other immediately (i.e., there is no waiting time between two measurements).

"**No. of Cycles**" is the number of measurements (0 to 99) that have to be executed. Enter 0 if you wish to perform as many measurements as you like (in this case, you have to press the <Reset> key in order to stop the measurements).

11.8.2 Automatic statistical evaluations (Auto Statistics)

To print out statistical data (mean, absolute and relative standard deviation) automatically after the measurements, set "Auto Statistics" to "On" with the ▶ key and confirm with <Enter>. Please note that statistical data is only printed out and not displayed.

```
        < Auto Statistics >        ▼

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

"**Print Mode**": The setting "**Always**" prints out statistical data after each measurement except after the first measurement in a group of samples (see below). The "**Group**" setting prints out the statistical data only after the last measurement in group of samples has been completed. The setting "Group" works only if the data file is switched on.

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

"**High Sample No. Reset**": A group consists of consecutive results with the same "High Sample Number". If the "High Sample Number" changes, a new group begins.

"**Method No. Reset**": A group consists of consecutive samples measured with the same method. If another method is activated, a new group begins.

"**Sample ID Reset**": A group consists of consecutive samples with the same sample identification. If a sample with another sample identification is measured, a new group begins.

Switch the desired options "On" or "Off" with the ◀ or ▶ key and confirm with <Enter>. The three options can be combined. For example, if you have switched on the options "High Sample No. Reset" and "Sample No. Reset", a new group begins when the "High Sample Number" **or** the current method changes.

Example:

If the sample series described in section 7.2.1 is measured with the settings of "High Sample No. Reset" = "Off", "Method No. Reset" = "Off" and "Sample ID Reset" = "On", the statistics will be calculated for two groups: One group with the sample identification "GRAPE" and one group with the sample identification "ORANGE".

Confirm "Manual Reset:[Execute]" with <Enter> in order to reset the statistical data manually (see below).

Confirm "Exit:[Execute]" with <Enter> to leave the "Auto Statistics" function.

```
        < Auto Statistics >       ▲

Manual Reset           :[Execute]
Exit                   :[Execute]


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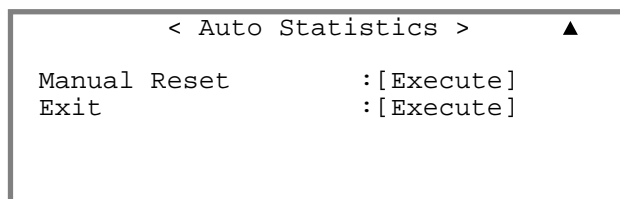
Please note that the data for Auto Statistics are not only reset if one of the selected conditions is fulfilled or when the data are reset manually. They are also reset if:

– the RE Refractometer is switched off.

– data are deleted from the memory (measured data, sample file or all parameters, see section 11.10).

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

11.8.3 Automatic error detection (Repeat Meas.)
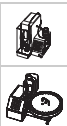
The "Repeat Meas." function is only available if the RE Refractometer is used together with an automation unit (SC1 or SC30). With this function the RE Refractometer is able to automatically detect the most frequent errors which may occur during the measurement of refractive index, and, consequently, to warn the operator accordingly. The "Repeat Meas." function of the RE Refractometers automatically detects e.g., the following sources of errors:

– rinsing solvent residue in the tubes or the measuring cell

– solid particles in the sample (scattered light!)

– inhomogeneity of the sample.

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

– less sample needed for multiple measurements.

– mean and standard deviation of the results are printed out automatically.

– execution of multiple measurements is less time consuming.

– repeatability of the results is improved.

Important: make sure that "Sampling" is set to "Auto" in all methods you use for the measurements (see section 9.5) otherwise the "Repeat Meas." function will not work!

The "Repeat Meas." function works as follows:

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

Example: If there was remaining rinsing liquid in the measuring cell during the first measurement, it leaves the measuring cell during the subsequent cycles. The results of the individual measurements are, in this case, different (and consequently the standard deviation is high), "Out" appears on the display and the error message "--- Out of limit.---" is printed out.

The results obtained with the "Repeat Meas." function switched on are treated like normal single mea-surements by the RE Refractometer, i.e. only the means of the refractive index measurements are printed out, stored and used for further result calculations (BRIX, Conc.).

To activate the automatic error detection, select "Repeat Meas." "On" with the ▶ key and confirm with <Enter>.

```
           < Repeat Meas. >
Repeat Meas.    :   Off  On
Repetitions     :[3]
Movement Ratio  :[      25]%
SD Limit        :[  0.0010] nD
Exit            :[Execute]
```

"**Repetitions**" is the number of measuring cycles (movements and measurements of the sample) performed during a measurement (2 to 9). Recommended setting: 3.

"**Movement Ratio**" defines how long the pump is activated between measuring cycles in order to move the sample forwards. The time is in relation to the time the sample needed prior to the measurement to get from the sample vial into the measuring cell. This ensures that all samples, regardless of their viscosity, are moved approximately the same distance between cycles. Recommended setting for "Movement Ratio": 25%.

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

"**SD Limit**" is the limit for the standard deviation of the individual results. This value must be selected in agreement with the homogeneity of the measured samples (lower for homogeneous samples, higher for inhomogeneous samples). The value selected for "SD Limit" should under no circumstances be lower than twice the repeatability of the results according to the technical specifications of the RE Refractometer, i.e. at least 0.00004 for the RE50 Refractometer and 0.0002 for the RE40D Refractometer.

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

11.9   Memory card functions (Function 8: Card Utility, RE50 only)

This function is available on the RE50 Refractometer only and is used in connection with memory cards.

Press the <Func.> key. Select "8.CARD Utility" and confirm with <Enter>.

Further information about this menu can be found in section 13.

```
          < CARD Utility >

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

11.10 Clearing the memory (Function 9 {7}: Memory Clear)

With this function data (measuring methods, instrument test results and adjustment data, etc.) can be erased from the RE Refractometer's main memory.

Press the <Func.> key. Select the function "9.Memory Clear" {"7.Memory Clear"} and confirm with <Enter>.

Select the desired option by pressing the corresponding numeric key (keys <0> to <5>) or the arrow keys: results ("Measured Data"), "Sample File", periodic instrument test results ("Periodic Check"), adjustment results ("Periodic Calib."), measuring methods ("Method Parameter") or all the data ("All Parameter"). Confirm your choice with <Enter>.

```
         < Memory Clear >

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

To confirm your choice again select "Yes" with the ▶ key and confirm with <Enter>.

The data you selected are erased (i.e., returned to the factory settings).

```
      < Measured Data Clear >


   Clear Execute ?   No   Yes

```

"5.All Parameter" does not delete any concentration tables for special applications (from memory cards for special applications, see section 13.2) stored in the instrument.

12.   Setup (password protected)

Press the **<Setup>** key. Once the password protection is activated (see section 12.7), you will be prompted to enter the password.

Select the desired option by pressing the corresponding numeric key (keys <0> to <9>) or the arrow keys and confirm with <Enter>. The option "9.Calibration Mode" is not available on the RE40D Refractometer.

```
            < Setup >

0.Interface        5.International
1.Date & Time      6.Lock
2.Op.Names/Units   7.Beep
3.Serial/Version   8.Temp.Calib.
4.LCD Contrast     9.Calibration Mode
```

12.1   Interfaces (Setup 0: Interface)

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

Press the <Setup> key. Select "0.Interface" and confirm with <Enter>.

Select the desired serial interface ("0.RS-232C" for the Computer, "1.Printer" for the printer or "2.Barcode(AUX)" for the barcode reader) with the ▲ and ▼ keys. Confirm with <Enter>.

```
            < Interface >

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

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

This option is used to configure the serial interface to connect a computer. With METTLER TOLEDO's DataCapture software you can save your measurement results, instrument tests and adjustment data either directly as a Microsoft EXCEL® table or as an ASCII text file. Please note that the computer's interface parameters must match those on the RE Refractometer.

Press the <Setup> key. Select "0.Interface" and confirm with <Enter>. In the "Interface" menu select "0.RS-232C" and confirm with <Enter>.

Select the settings for the serial interface with the ◄ and ► keys and confirm each setting with <Enter>

Select the settings shown in the illustration if you wish to work with the DataCapture software.

```
            < RS-232C >
Baud Rate    :<4800>
Parity       :Even Odd None
Stop Bits    :1 2
Data Bits    :7 8
Output Form.:<=3.0 4.0
Exit         :[Execute]
```

If you are using a DataCapture Program which version is < 2.0 or your own computer software, developed to be used with an RE Refractometer equipped with a software version <= 3.0, then you must select "<=3.0" for "Output Form." .

12.1.2 Setting up the interface for the printer (Printer)

We recommend you use the METTLER TOLEDO GA42 printer with the RE Refractometer. Make sure that the DIP switch 2 of the printer is ON. The DIP switch is under the battery cover (see GA42 Operating Instructions).

Press the <Setup> key. Select "0.Interface" and confirm with <Enter>. In the "Interface" menu select "1.Printer" and confirm with <Enter>.

Select "GA-" for 'Printer' with the ▶ key if you are using a GA42 printer, or "Other" if you are using some other serial printer. Confirm with <Enter>. ("IDP-" and "DP-" printers are not used.)

```
              < Printer >

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


```

If you have selected "Other", you must select the communication parameters according to the settings on your printer:

Set the communication parameters with the ◀ and ▶ keys and confirm them with <Enter>

```
              < Printer >
Printer      :IDP-  DP-  GA-   Other
Baud Rate    :<9600>
Parity       :Even Odd None
Stop Bits    :1   2
Data Bits    :7   8
Exit         :[Execute]
```

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

We recommend you use the METTLER TOLEDO DLC7070 barcode reader with the RE Refractometer. The settings shown here are valid for this barcode reader. If you want to use some other manufacturer's barcode reader you must make sure that the "Delimiter" and the communication parameters of your barcode reader are set correctly (i.e., as on the RE Refractometer).

Please note that our service department does not support barcode readers of other manufacturers.

Press the <Setup> key. Select "0.Interface" and confirm with <Enter>. In the "Interface" menu select "2.BarCode(AUX)" and confirm with <Enter>.

Select "On" for "Barcode(AUX)", "9600" for "Baud Rate", "None" for "Parity", "1" for "Stop Bits" and "8" for "Data Bits" with the ◀ and ▶ keys. Confirm each setting with <Enter>.

```
           < Barcode(AUX)>            ▼

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

Enter 1 for "Start Pos." and 0 for "Read Length" (see below). Confirm both entries with <Enter>. Select "CR+LF" for "Delimiter" with the ◀ or ▶ key and confirm with <Enter>.

Press the <Reset>-key.

```
         < Barcode(AUX)>          ▲

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

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

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

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

Connect the DLC7070 barcode reader to the "AUX." port on the RE Refractometer.

Scan in the two barcodes "Reset" and "Mode RS232" in succession in order to configure the DLC7070 barcode reader:

Reset

Mode RS232
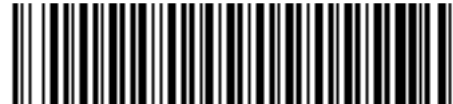
Operator 1

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

```
1.Method-1                    F 01-01
d   20.00(°C)          (g/cm³)/(nD)
Dens. 20.00                  0.00120
R.I.  20.53                  0.00000

Operator :
```

Further barcodes to configure your METTLER TOLEDO DLC7070 barcode reader can be found in the appendix (section A.4.1)

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

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

Press the <Setup> key. Select "1.Date & Time" and confirm with <Enter>.

Enter the date ("Day", "Month", "Year") and the time ("Hour", "Minutes"). Confirm your entries with <Enter>.

The format for the data can be defined in the setup menu under "5.International" (see section 12.6).

```
          < Date & Time >

          24/02/2002 15:18

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

12.3   Operator names / Units (Setup 2: Op.Names/Units)

This menu is used to save names for concentration units and operator names in the RE Refractometer.

Press the <Setup> key. Select "2.Op.Names/Units" and confirm with <Enter>.

Select "0.Concentration Units" or "1.Operator Names"
with the ▲ or ▼ key. Confirm with <Enter>.

```
        < Op.Names/Units >

0.Concentration Units
1.Operator Names
```

12.3.1   Concentration Units

In this menu, you can enter up to five names for concentration units with up to five characters each. These names can be assigned to the calculated results ("Conc.", see section 10.1).

Press the <Setup> key. Select "2.Op.Names/Units" and confirm with <Enter>. In the "Op.Names/Units" menu select "0.Concentration Units" and confirm with <Enter>.

Enter the desired names for the concentration units.
Confirm each entered unit name with <Enter>.

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

The characters "-", "/", and "%" can be entered by pressing the <-> key (hyphen) 1, 2 or 3 times, respectively.

Additional special characters can be entered with the barcode reader (see section A.4.2).

12.3.2 Operator Names

In this menu, you can save up to 10 operator names in the RE Refractometer. These names can contain up to 25 characters.

Press the <Setup> key. Select "2.Op.Names/Units" and confirm with <Enter>. In the "Op.Names/Units" menu select "1.Operator Names" and confirm with <Enter>.

Move the cursor to "Name 1" with the ▼ key and enter an operator name. Confirm the name with <Enter>.
Then enter the next names ("Name 2" to "Name 10"). Confirm each name with <Enter>.

```
            < Operator Names >         ▼

Operator :<████████████████>

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

Press the <Display> key, in order to enter capital and small letters (or numerals). You can also use the barcode reader to enter names.

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

– **With the keypad:** Move the cursor to the "Operator" field. With the ◄ and ► keys, select your name and confirm it with <Enter>. Leave the menu with the <Escape> key. Please note that it is not possible to select a name with the keypad if the password protection is activated (see section 12.7).

– **With the barcode reader:** Press the <Escape> key to leave the "Operator Names" menu. In the Appendix (section A.4.3) you can find a list with ten barcodes. A name ("Name 1" to "Name 10") is assigned to each barcode.

When you scan in one of these barcodes, the corresponding operator is selected and the name appears in the status line of the main display for a short time.

```
1.Method-1
Temp.(°C)
Set   20.00
Cell  20.02

Operator : Your name
```

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

In this menu you can display the software version of the RE Refractometer and of the automation unit (SC1, SC30) connected to it.

Press the <Setup> key. Select "3.Serial/Version" and confirm with <Enter>.

The serial number ("Serial No.") and the software version ("Version No.") of the RE Refractometer as well as the automation unit's software version ("Changer Ver") are displayed.

The "Changer Ver" line appears only if an automation unit (SC1 or SC30) is connected to the RE Refractometer.

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

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

            [Exit]
```
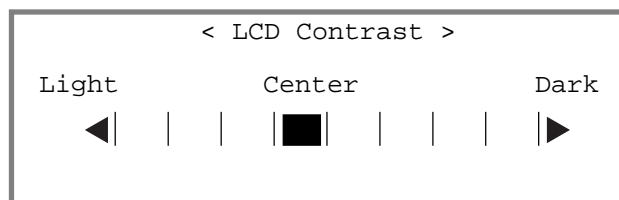
12.5   LCD contrast (Setup 4: LCD Contrast)

In this menu you can set the contrast for the RE Refractometer's display.

Press the <Setup> key. Select "4.LCD Contrast" and confirm with <Enter>.

Adjust the contrast with the ◀ and ▶ keys.
Confirm with <Enter>.

```
             < LCD Contrast >

 Light           Center           Dark
   ◀|   |   |  |■|   |   |   |  |▶
```

12.6   International (Setup 5: International)

In this menu the format for the date and the temperature unit are selected.

Press the <Setup> key. Select "5.International" and confirm with <Enter>.

Select the format for the date with the ▶ key
(DD = day / MM = month / YYYY = year). Confirm with
<Enter>.

Select the temperature unit ("Temp.Unit", °C = degrees
Celsius / °F = degrees Fahrenheit) with the ◀ and ▶
keys. Confirm with <Enter>.

```
             < International >
 Date         :<DD/MM/YYYY>
 Temp.Unit    :°C  °F
 Exit         :[Execute]
```
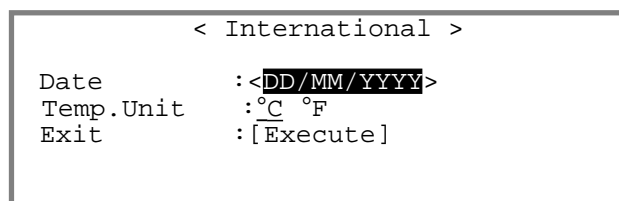
12.7   Password lock (Setup 6: Lock)

You can protect your measuring methods and settings on the RE Refractometer from unauthorized or unintentional changes with a password of up to 8 characters.

If access to the measuring methods and settings is protected with a password, the operator is prompted to enter the password when s/he presses the <Func.>, <Setup>, <Report>, <Meas.Para.> or the <Calc.Para.> key.

```
 Password ?      :[********]
```
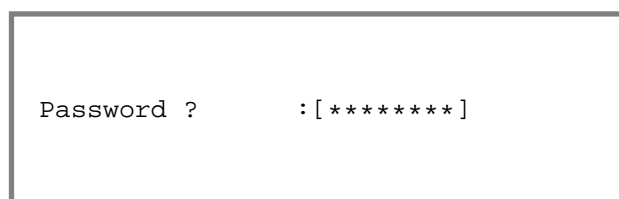
Press the <Setup> key. Select "6.Lock" and confirm
with <Enter>.

To activate the password lock, select "On" with the ▶
key and confirm with <Enter>.

```
             < Password Lock >
 Password Lock    :Off  On
```
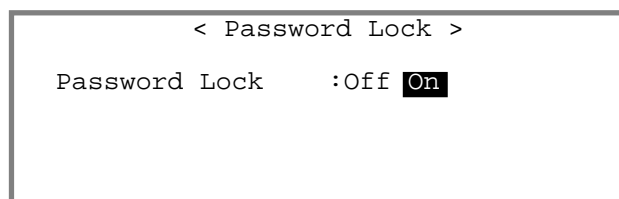
Enter a password with the <0> to <9> keys and con-
firm it with <Enter>.

Enter the same password a second time ("Confirm
Password") to exclude typing errors. Confirm it with
<Enter>.

Confirm "Lock:[Execute]" with <Enter> to activate
password protection.

```
           < Password Lock >

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

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

12.8   Beep (Setup 7: Beep)

If the beep is activated, the RE Refractometer confirms each keystroke with a sound. When a measurement has
been completed or an error occurred, the RE Refractometer will beep several times. In this menu, you can select
the type of beep or turn the beep off.

Press the <Setup> key. Select "7.Beep" and confirm with <Enter>.

To turn on the beep, select "On" with the ▶ key and
confirm with <Enter>.

You can hear the selected beep ("Beep Type", end of
measurement or error). Select the desired type of beep
with the ◀ or ▶ key. When you confirm with <Enter>
you hear the selected beep ('"Type1", '"Type2",
"Type3" or "Type4").
Confirm "Exit:[Execute]" with <Enter> to leave the
menu.

```
              < Beep >

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


12.9   Temperature adjustment (Setup 8: Temp.Adjust)

The RE Refractometers are equipped with three built-in thermistors to ensure an accurate measurement of the
temperature on the surface of the prism. The temperature of the measuring cell displayed by the RE Refractometer
is calculated based on the temperatures measured by the three thermistors (it is impossible to measure the
temperature with a sensor directly at the sample/prism interface!). The three measured temperatures are also
used for temperature control by the Peltier thermostat. If the cell temperature displayed in the main display
("Cell") constantly differs more than 0.5 °C from the measuring temperature ("Set"), you should perform a tem-
perature calibration. During such a temperature calibration, which lasts approximately two hours and is done in
steps of 5 °C, all the built-in thermistors are adjusted to the certified thermistor located in the prism.

Press the <Setup> key. Select "9.Temp.Adjust" and confirm with <Enter>.

Select "Calibration" "Yes" with the ▶ key and confirm
with <Enter> to start the temperature adjustment.

```
           < Temp.Calib. >

Calibration    :No Yes
Exit           :[Execute]
```

12.10 Type of adjustment (Setup 9: Calibration Mode, RE50 only)

This option is available on the RE50 Refractometer only. It may be that the results you obtain with a Refractometer from another supplier which you have been using or still use are slightly different from the ones you obtain with the RE50 Refractometer. The so called "**Zero Span**" adjustment enables you to get exactly the same results with the RE50 Refractometer as the ones yielded with your other instrument. When performing a "Zero Span" adjustment, the difference between the measuring values of both instruments is stored in the RE50. The RE50 then corrects the results of your measurements such that they are exactly the same as the ones obtained with the other instrument. In order to prevent the stored deviation from deleting from the memory of the RE50 when doing further adjustments with air and water, these must be performed with the so called "**Air&Water2**" adjustment.

Press the <Setup> key. Select "9.Calibration Mode" and confirm with <Enter>.

Select the desired type of adjustment ("Calib.") with the
◀ and ▶ keys and confirm with <Enter>.

```
        < Calibration Mode >

Calib.          :<Air&Water1>
Exit            :[Execute]


```

Air&Water1

This is the standard setting. The adjustment of the RE50 is done based on the values for air and water stored in the instrument. Please note that the data of a previously performed "Zero Span" adjustment is deleted when performing an "Air&Water1" adjustment.

Air&Water2

This type of adjustment is only used once a "Zero Span" adjustment has been performed (see below). When performing an "Air&Water2" adjustment, the instrument is adjusted based on the stored values for air and water, taking into account the deviation determined in the "Zero Span" adjustment. An "Air&Water2" adjustment thus serves to correct the long term drift of the measuring cell without disabling the correction for linearity determined in the "Zero Span" adjustment.

Zero Span

The "Zero Span" is used to adjust the RE50 Refractometer with 2 liquids, whose refractive indices were previously determined with another Refractometer.

Example:

Measuring 2 samples once with the RE50 Refractometer and once with another Refractometer you obtain the following refractive indices:

	Other Refractometer	RE50 Refractometer	
Sample 1:	1.36500	1.36342	("Zero")
Sample 2:	1.37720	1.37709	("Span")

If you want to get the same results on the RE50 Refractometer as the ones you get with the other instrument you must proceed as follows:

Select "Zero Span" for "Calib." and confirm with <Enter>.

Enter the refractive indices obtained with the other instrument: The refractive index obtained with sample 1 as "Zero" and the refractive index obtained with sample 2 as "Span". Confirm both entries with <Enter>. Confirm "Exit:[Execute]" with <Enter>.

```
         < Calibration Mode >

Calib.            :<Zero Span >
Zero              :[ 1.36500]
Span              :[ 1.37720]
Exit              :[Execute]
```

If you are working with an SC1 or an SC30 automation unit, you may define in the menu above whether sampling for the two samples should be done at low or at high speed. Below you only find a description of how to perform a "Zero Span" adjustment manually. If you are working with an automation unit, simply fill two sample vials to about 80% with each of the samples and put them one after the other in the SC1 or in positions 1 and 2 on the turntable of the SC30 when performing the "Zero Span" adjustment.

Press the <Calib.> key.

Make sure that the prism is clean and dry, close the cover lid and press the <Enter> key.

Follow the instructions on the display:

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

     Clean Prism and Press Enter Key
```

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

```
     Set Zero and Press Enter Key
```

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

```
     Set Span and Press Enter Key
```

After concluding the "Zero Span" adjustment, the type of adjustment ("Calib.") is automatically set to "Air&Water2".

The data for the correction of the measuring values are printed out. You may display these data. Therefore you must proceed as follows (see section 11.7.2): Press the <Func.> key. Select "6.Periodic" and confirm with <Enter>. Select "Calib." for "Periodic" and confirm with <Enter>. Confirm "Show Calib.List:[Execute]" with <Enter>. A list of the last 10 adjustments is displayed.

Select the "Zero Span" adjustment with the ▲ and ▼ keys and confirm with <Enter>.

```
          < Show Calib. List >      ▼
No.   Date      Temp.(°C)    NEW
 10   28/04       20.00      Zero Span OK
  9   27/03       20.00      1.33299   OK
  8   05/02       20.00      1.33299   OK
  7   04/01       20.00      1.33299   OK
  6   23/12       20.00      1.33299   OK
```

The result of your "Zero Span" adjustment is displayed.

```
          < Show Calib. List >
Date      :28/04/2002
Temp.     : 20.00 °C
Zero      : 1.36342   ->  1.36500
Span      : 1.37709   ->  1.37720
A         : 0.892421  B:  0.148256
Exit      :[Execute]
```

The RE50 Refractometer will now correct the results of your measurements according to the following equation:

$n_D = Ax + B$ with n_D displayed (corrected) result
                          x   non-corrected result
                          A, B   coefficients determined in the "Zero Span" adjustment

Example: If you now measure a sample whose refractive index is 1.36655 (non-corrected result) with the RE50 Refractometer, the instrument will show 1.36779 as result (corrected result).

As long as you want to have your results corrected according to the "Zero Span" adjustment, you must use "Air&Water2" to readjust the RE Refractometer with air and water.

To disable the "Zero Span" correction, perform an "Air&Water1" adjustment.

13. Memory Cards (RE50 only)

Memory Cards may only be used with the RE50 Refractometer. There are two types of memory cards that can be used on the RE50 Refractometer:

– **Cards to store data (SRAM cards).** These cards are used to store results of measurements, adjustments, instrument tests as well as measuring methods and sample files (order no. ME 51324004).

– **Memory cards to load special applications (flash cards).** These cards contain concentration tables for special applications (for detailed information contact your local METTLER TOLEDO representative).

13.1 Data memory cards

13.1.1 Displaying the available and used storage space

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

– 982 methods

– 498 files with sample data or

– 10 files with up to 100 measurement results per file or

– 675 files with up to 10 adjustments per file or

– 1012 files with up to 10 periodic instrument test results per file.

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

Press the <Func.> key. Select "8.CARD Utility" and confirm with <Enter>.

Insert a memory card into the slot on the front left side of the RE50 Refractometer. Select "5.Card Information" and confirm <Enter>.

```
          < CARD Utility >

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

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

Confirm "Exit" with <Enter> to return to the "CARD Utility" menu.

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

              [Exit]
```

13.1.2 Saving results

Measurement results can be saved to a memory card or loaded back into the RE50 Refractometer from a memory card. The RE50 Refractometer saves the results of up to 100 measurements in its main memory. You can save these data to a memory card in the form of a file.

Press the <Func.> key. Select "0.Data File" and confirm with <Enter>.

Insert a memory card into the slot on the front left side of the instrument. Select "Save" with the ▶ key and confirm with <Enter>.

```
     < Data File >                ▼
No.  M.Name     Sample        Result
 0   Method-1   01-01   nD    1.34818
 1   Method-1   01-02   nD    1.34821
 2   Method-2   02-01   Br      10.81
 3   Method-2   02-02   Br      10.82
Statis.  Recalc.  Load  Save  Exit
```

Enter the file name you want to use for saving the results. This name can contain up to 8 characters. Special characters ("." or "-") are not allowed. If you wish to delete the results from the RE50 Refractometer's memory after you have saved them on the memory card, select "Yes" for "Save & Clear" with the ▶ key and confirm with <Enter>. Confirm "Save Execute:[Execute]" with <Enter>.

```
       < Save Data File >

  File Name    :[        ]
  Save & Clear  No Yes
  Save Execute :[Execute]
  Exit         :[Execute]
```

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

13.1.3 Deleting results

To delete results from the RE50 Refractometer's main memory, proceed as described in section 11.10.

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

Press the <Func.> key. Select "8.CARD Utility" and confirm with <Enter>.

Insert the memory card into the slot on the front left side of the instrument. Select "0.File Delete" and confirm with <Enter>.

```
          < CARD Utility >

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

Select "0.Data File" and confirm with <Enter>.

```
           < File Delete >

0.Data File          5.Formula File
1.Sample File
2.Method File
3.Check History
4.Calib.History
```

Select the file you want to delete with the ▲ and ▼ keys. Confirm with <Enter>.

```
        < Delete Data File >       ▼
File Name        Date          Time
Week11       15/03/2002       18:02
Week10       08/03/2002       18:00
Week09       01/03/2002       17:58
Week08       22/02/2002       18:03
Week07       15/02/2002       18:05
```

Select "Yes" with the ▶ key and confirm with <Enter>. A message appears informing you that the file will be deleted. At the end of the delete process, the message "File delete is complete" is displayed. Confirm this message with <Enter>.

```
     < Delete Data File >

     File will be deleted
            OK?

         No  Yes
```

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

```
       < CARD Utility >

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

Select "Yes" with the ▶ key and confirm with <Enter>. All information stored on the card will be deleted.

```
         < Format >

     All data will be lost.
            OK?

         No  Yes
```

13.1.4 Loading results

If you wish to load a file containing results from a memory card into the RE50 Refractometer, proceed as follows:

Press the <Func.> key. Select "0.Data File" and confirm with <Enter>.

Insert the memory card into the slot on the front left side of the instrument. Select "Load" with the ◀ or ▶ key and confirm with <Enter>.

```
        < Data File >            ▼
No. M.Name    Sample      Result
 0  Method-1  01-01   nD   1.34818
 1  Method-1  01-02   nD   1.34821
 2  Method-2  02-01   Br    10.81
 3  Method-2  02-02   Br    10.82
Statis.  Recalc.  Load  Save   Exit
```

Select the file you wish to load into the RE50 Refractometer with the ▲ and ▼ keys.
Confirm with <Enter>.

```
        < Data File >            ▼
File Name        Date          Time
Week11       15/03/2002       18:02
Week10       08/03/2002       18:00
Week09       01/03/2002       17:58
Week08       22/02/2002       18:03
Week07       15/02/2002       18:05
```

Select "Yes" with the ▶ key and confirm with <Enter>.

Beware: All results stored in the RE50 Refractometer will be overwritten by the results uploaded from the memory card!

```
< Load Data File >

File will be loaded.
      OK?

   No  Yes
```

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

13.1.5 Saving methods

Methods can be saved to a memory card or loaded back into the RE50 Refractometer from a memory card. The RE50 Refractometer stores 10 methods in its internal memory. These methods can be saved to a memory card and transferred to another RE50 Refractometer when needed. This is very helpful if a method has been developed in a central lab and needs to be distributed to other labs after its release.

Press the <Func.> key. Select "2.Method File" and confirm with <Enter>.

Insert the memory card into the slot on the front left side of the instrument. Select the method you want to save with the ▲ and ▼ keys.

Select "Save" with the ▶ key and confirm with <Enter>.

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

Enter the name under which you wish to save the method (no more than 8 characters). Confirm "Save Execute:[Execute]" with <Enter> to save the method to the memory card.

```
    < Save Method File >

  File Name    :[Method-1]
  Save Execute :[Execute]
  Exit         :[Execute]
```

If there already is a method with the same name on the memory card, you will be asked if you would like to replace the method on the memory card with the new one. Select "Yes" with the ▶ key if you want to overwrite the method and confirm with <Enter>. If you do not want to replace the method on the memory card, confirm "No" with <Enter>.

```
    < Save Method File >

  Contained the same named file.
   Would you like to replace?

         No  Yes
```

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

13.1.6 Deleting methods

To delete methods from the RE50 Refractometer's internal memory, proceed as described in section 11.10.

To delete a method from a memory card, proceed as follows (see section 13.1.3): Insert the memory card into the slot on the front left side of the instrument. Press the <Func.> key, select "8.CARD Utility" and confirm with <Enter>. In the "CARD Utility" menu select "0.File Delete" and confirm with <Enter>. In the menu "File Delete" select "2.Method File" and confirm with <Enter>. A list of methods stored on the memory card appears. Select the method you want to delete and confirm with <Enter>.

13.1.7 Loading methods

If you want to load a method from a memory card into the RE50 Refractometer, insert the memory card into the slot on the front left side of the instrument and proceed as follows:

Press the <Func.> key. Select "2.Method File" and confirm with <Enter>.

First, you have to define which of the methods stored in the RE50 is to be overwritten. Select a method you do not need anymore with the ▲ and ▼ keys.

Select "Load" with the ◄ key and confirm with <Enter>.

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

Select the method you want to load into the RE50 Refractometer with the ▲ and ▼ keys. Confirm with <Enter>.

```
      < Load Method File >           ▼
File Name        Date            Time
GRAPE            15/03/2002        12:03
LEMON            08/03/2002        17:00
APPLE            01/03/2002        14:45
ORANGE           21/02/2002        12:00
MANGO            13/02/2002        09:15
```

Select "Yes" with the ► key and confirm with <Enter>. When the loading process is finished, the message "File load is complete." appears on the display. Confirm this message with <Enter> to return to the "Method File" menu.

```
      < Load Method File >

       File will be loaded.
             OK?

           No  Yes
```

Repeat the above steps if you wish to load several methods. Be sure not to overwrite a method in the instrument that is still needed! When all desired methods have been loaded, select "Exit" in the "Method File" menu and confirm with <Enter>.

13.1.8 Saving sample files

Sample files can also be saved to memory cards or loaded back into the RE50 Refractometer. If you have already entered a sample file and wish to save it, insert a memory card into the slot on the front left side of the instrument, and proceed as follows:

Make sure that the sample file has been switched on (see section 11.2). Press the <Sample> key.

Select "Save" with the ▶ key and confirm with <Enter>.

```
        < Sample >              ▼

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

Enter the file name under which you wish to save your sample file. This name can contain up to 8 characters. Special characters ("." or "-") are not allowed. If you wish to delete the sample file from the RE50 Refractometer's memory after you have loaded it onto the memory card, select "Yes" for "Save & Clear" with the ▶ key and confirm with <Enter>. Confirm "Save

```
      < Save Sample File >

  File Name    :[        ]
  Save & Clear  No Yes
  Save Execute :[Execute]
  Exit         :[Execute]
```

Execute:[Execute]" with <Enter>. The sample file is then saved to the memory card and the message "Now Saving" appears on the display. When the process is finished, the message "File save is complete." appears on the display. Press <Enter> to return to the "Sample" menu.

13.1.9 Deleting sample files

To delete the sample file from the RE50 Refractometer's internal memory, proceed as described in section 11.10.

To delete a sample file from a memory card, proceed as follows (see section 13.1.3): Insert the memory card into the slot on the front left side of the instrument. Press the <Func.> key, select "8.CARD Utility" and confirm with <Enter>. In the "CARD Utility" menu select "0.File Delete" and confirm with <Enter>. In the menu "File Delete" select "1.Sample File" and confirm with <Enter>. A list of the sample files stored on the memory card appears. Select the sample file you want to delete and confirm with <Enter>.

13.1.10 Loading sample files

If you wish to load a sample file from a memory card into the RE50 Refractometer, proceed as follows:

Make sure that the sample file is switched on (see section 11.2). Press the <Sample> key.

Insert a memory card into the slot on the front left side of the instrument. Select "Load" with the ▶ key and confirm with <Enter>.

```
        < Sample >              ▼

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

Select the sample file you want to load into the RE50 Refractometer with the ▲ and ▼ keys. Confirm with <Enter>.

```
      < Load Sample File >      ▼
File Name       Date        Time
Series1      13/03/2002     13:08
Series2      08/03/2002     16:01
Solvents     21/02/2002     07:46
Series3      20/02/2002     10:10
Series4      14/02/2002     09:53
```

Select "Yes" with the ▶ key and confirm with <Enter>. When the loading process is finished, the message "File load is complete." appears on the display. Confirm this message with <Enter> to return to the "Sample File" menu.

```
      < Load Sample File >

      File will be loaded.
              OK?

            No  Yes
```

Beware: The sample file stored in the RE50 Refractometer will be overwritten during loading of a sample file from a memory card!

13.1.11 Saving instrument tests and adjustment data

The results of the last ten adjustments and periodic instrument tests are automatically saved in the RE50 Refractometer. If an eleventh periodic instrument test or an eleventh adjustment is performed, the oldest saved data sets will be overwritten with the new ones. To prevent losing results of already performed periodic instrument tests or adjustments, they can be saved to a memory card. To do this, proceed as follows:

Press the <Func.> key. Select "6.Periodic" and confirm with <Enter>.

Insert a memory card into the slot on the left front side of the instrument. Under "Periodic" select which kind of data you wish to save with the ◀ and ▶ keys ("Check" for test results, "Calib." for adjustment results). Confirm with <Enter>. Select "Save" for "Check History" (or "Calib.History") with the ▶ key and confirm with <Enter>

```
         < Periodic >          ▼
Periodic         :Check    Calib.
Check.History    :Skip  Load  Save
Next Check Date :20/04/2002
Check Alarm      :Off  On
Check Interval   :[  7]day
Show Check List :[Execute]
```

Enter the file name under which you want to save the periodic instrument tests or adjustments. This name can be up to eight characters long. Special characters (space, "." or "-") are not allowed. If you wish to delete the data of the last periodic instrument tests or adjustments from the RE50 Refractometer's memory after you have loaded them onto the memory card, select "Yes"

```
     < Save Calib. History >

File Name    :[        ]
Save & Clear  No Yes
Save Execute :[Execute]
Exit         :[Execute]
```

for "Save & Clear" with the ▶ key and confirm with <Enter>. Confirm "Save Execute:[Execute]" with <Enter>. The data files are then saved to the memory card and the message "Now Saving" appears on the display. When the process is finished, the message "File save is complete." appears on the display. Press <Enter> to return to the "Periodic" menu.

13.1.12 Deleting instrument test and adjustment data

To delete periodic instrument test and adjustment data from the RE50 Refractometer's internal memory, proceed as described in section 11.10.

To delete a file of periodic instrument test and adjustment results from a memory card, proceed as follows (see section 13.1.3): Insert the memory card into the slot on the front left side of the instrument. Press the <Func.> key, select "8.CARD Utility" and confirm with <Enter>. In the "CARD Utility" menu select "0.File Delete" and confirm with <Enter>. In the menu "File Delete", select "3.Check History" if you wish to delete periodic instrument test data, or "4.Calib.History" if you wish to delete adjustment results. Confirm with <Enter>. A list of periodic instrument tests or adjustment files stored on the memory card appears. Select the file you want to delete and confirm with <Enter>.

13.1.13 Loading instrument tests and adjustment data

If you wish to load periodic instrument tests and adjustment data from a memory card into the RE50 Refractometer, proceed as follows:

Press the <Func.> key. Select "6.Periodic" and confirm with <Enter>.

Insert a memory card into the slot on the front left side of the instrument. Under "Periodic" select the type of file you want to load ("Check" for periodic instrument test results, "Calib." for adjustment results) with the ◀ and ▶ keys and confirm with <Enter>. Select "Load" for "Check History" (or "Calib.History") with the ▶ key and confirm with <Enter>.

```
         < Periodic >          ▼
Periodic       :Check    Calib.
Check.History  :Skip  Load  Save
Next Check Date :20/04/2002
Check Alarm     :Off  On
Check Interval  :[  7]day
Show Check List :[Execute]
```

Select the file you want to load into the RE50 Refractometer with the ▲ and ▼ keys. Confirm with <Enter>.

```
      < Load Calib. History >    ▼
File Name        Date        Time
Adj03         28/06/2002      17:00
Adj04         31/05/2002      16:53
Adj05         26/04/2002      17:01
Adj06         29/03/2002      16:54
Adj07         22/02/2002      17:05
```

Select "Yes" with the ▶ key and confirm with <Enter>. When the loading process is finished, the message "File load is complete." appears on the display. Confirm this message with <Enter> to return to the "Periodic" menu.

```
     < Load Calib. History >

        File will be loaded.
               OK?

            No  Yes
```

Beware: The current adjustment parameters stored in the RE50 Refractometer will be overwritten with the adjustment data coming from the memory card!

13.2   Memory cards for special applications

Your METTLER TOLEDO representative can supply you with concentration or temperature compensation tables for special applications on memory cards. These memory cards have a storage capacity of 2 MB. Loading them into the RE50 Refractometer deletes them from the memory card. Hence, the cards are empty after loading. The tables on the RE50 Refractometer, however, can be loaded back onto the card at any time and then loaded into another instrument. For this reason, you should keep the empty cards in a safe place.

13.2.1   Loading tables into the instrument (Install table)

To load tables for special applications into your RE50 Refractometer, proceed as follows:

Press the <Func.> key. Select "8.CARD Utility" and confirm with <Enter>.

Insert the memory card with the tables into the slot on the front left side of the instrument. In the "CARD Utility" menu select "2.Install Table" and confirm with <Enter>.

```
          < CARD Utility >

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

The tables available on the card are displayed. Select the table you wish to load with the ▲ and ▼ keys.

Select "Install" with the ▶ key and confirm with <Enter>.

```
          < Install Table >
Table Name     Type    Temp.      Data
 NaCl          Conc.   20.00°C      77
 KCl           Conc.   20.00°C      81


         Exit        Install
```

The table is then installed. At the end of the procedure, the message "Table install is complete" appears on the display. Confirm this message with <Enter>.

The asterisk (∗) to the left of the table (NaCl) signals that it has been loaded into the RE50 Refractometer and removed from the memory card. The table can be loaded back onto the card at any time (see section 13.2.4).

```
          < Install Table >
Table Name     Type    Temp.      Data
*NaCl          Conc.   20.00°C      77
 KCl           Conc.   20.00°C      81


         Exit        Install
```

13.2.2 Using concentration tables in methods

Define in which method the concentration table is to be used. Press the <Method> key.

Select the desired method (method 1 to 9) with the ▲ and ▼ keys. Confirm with <Enter>.

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

Press the <Meas.Para> key. Enter the measuring parameters according to your application (see section 9). Press the <Calc.Para> key. In the "Calc. Parameter" menu select "0.Result" and confirm with <Enter> (see section 10).

You can now assign the just installed concentration table to "Result" with the ▶ key. Confirm with <Enter>.

```
Method 1     < Result >

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

When you press the <Method> key, the corresponding concentration table assigned to one or several methods appears as "Result" in the list of methods.

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

13.2.3 Using temperature compensation tables in methods

Define in which method the temperature compensation table is to be used. Press the <Method> key. Select the desired method (method 1 to 9) with the ▲ and ▼ keys. Confirm with <Enter>.

Press the <Meas.Para> key. Enter the measuring parameters according to your application (see section 9). Press the <Calc.Para> key. In the "Calc. Parameter" menu select "1.Temperature Compensation" and confirm with <Enter> (see section 10).

Select "Temp.Comp." "On" with the ▶ key and confirm with <Enter>. Enter the reference temperature ("Comp.Temp.") to which the measured values are to be converted. Confirm with <Enter>. Under "Temp. Formula" you can now select the temperature compensation table downloaded from the memory card with the ▶ key.

```
Method 1     < Temp.Comp. >            ▼

Temp.Comp.          :Off On
Comp.Temp.          :[  20.00]°C
Parameter Set       :Table Coefficient
Temp.Formula        :<Honey     >
Exit                :[Execute]
```

13.2.4 Loading tables back onto the memory card (Uninstall Table)

To load a concentration or a temperature compensation table from the RE50 Refractometer back onto a memory card, please proceed as follows:

Press the <Func.> key. Select "8.CARD Utility" and confirm with <Enter>.

Insert the memory card with the tables into the slot on the front left side of the instrument. In the "CARD Utility" menu select "3.Uninstall Table" and confirm with <Enter>.

```
        < CARD Utility >

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

Select "0.Conc.Table" if you are loading a concentration table or "1.Temp.Table" if you are loading a temperature compensation table back onto the memory card. Confirm with <Enter>.

```
       < Uninstall Table >

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

A list of tables you can load back onto the memory card appears. Select the table you want to load back onto the memory card with the ▲ and ▼ keys. Select "Uninstall" with the ▶ key and confirm with <Enter>. The table is loaded back onto the card and the message "Now Uninstall…" appears in the display. Confirm the message "Table uninstall is complete." at the end of the procedure with <Enter>.

```
       < Uninstall Table >
 Table Name    Type    Temp.       Data
*NaCl         Conc.    20.00°C       77
 KCl          Conc.    20.00°C       81


        Exit         Uninstall
```

14. Error messages and malfunctions

14.1 Error messages

Error message	Cause	Action
X Days to Check X Days to Calib.	An adjustment or an instrument test must be performed within the next few days.	
Check Day! Calib. Day! Check Day Over! Calib. Day Over!	The instrument must be tested or adjusted immediately.	Perform instrument test or adjustment (see section 11.7).
No Measure	There was no sample in the refractive index measuring cell.	Put sample on the prism. Adjust sequence in the measuring parameters (SC1, SC30).
Prism not Clear	The prism was dirty when performing an adjustment with air.	Clean the prism and repeat the adjustment. Check rinsing liquids and the sequence in method 0 ("Calib.") (SC1, SC30).
Sensor Error!	The refractive index measuring cell is defective.	Switch off the instrument and call METTLER TOLEDO's technical service.
Temp.Calib. Error! Temp.Calib. Time Over!	A temperature sensor or the Peltier thermostat is defective.	Switch off the instrument and and call METTLER TOLEDO's technical service.
DE Error!	The DE/RE connection cable is not connected properly.	Check the connection cable.
Nozzle Error!	The sampling nozzle of the automation unit (SC1, SC30) is blocked.	Press the <Stop> key on the automation unit. Remove the obstacle. Replace the sampling nozzle if it is bent.
Check connect Cable.	The connection cable to the automation unit (SC1, SC30) is faulty.	Connect cable correctly or replace it.
Remove the interference	The sampling nozzle of the automation unit (SC1, SC30) is blocked.	Remove the obstacle.
Changer Error!	No communication possible with the automation unit (SC1, SC30).	Check the automation unit and the connection cable.
Table Error!	The turntable of the SC30 is not in place or is blocked.	Mount the turntable correctly or remove the obstacle. Press the <Step> key (SC30).

Error message (RE50 only)	Cause	Action
Contained the same named file	An attempt was made to save two files with the same name to a memory card.	Select another name.
No FLASH CARD !	An attempt was made to install new instrument software from an SRAM card.	Insert correct (flash) card and repeat the procedure.
CARD is protected.	Write protection is activated (in front on the SRAM card).	Deactivate write protection and repeat the procedure.
CARD Battery Error	The SRAM card's lithium battery is dead.	Replace lithium battery.

14.2   Malfunctions

Malfunction	Cause	Action
Instrument cannot be switched on.	Cable not connected properly; blown fuse.	Check power supply cable and fuse. Replace fuse if necessary (T3.15A/250V).
<Report>, <Sample>, <Calc.Para>, <Measure> keys do not work.	Method "0.CALIB" is selected.	Press <Method> key and select another method.
The "Ready" message does not appear.	Air intake on the back side of the RE Refractometer is clogged.	Remove obstacles from air intake. Call METTLER TOLEDO's technical service.
Saved data (e.g., adjustments) are being lost.	The RE Refractometer's internal battery is dead.	Switch off the instrument and call METTLER TOLEDO's technical service.
The GA42 printer does not work.	The DIP switches on the printer are set incorrectly. Wrong settings for the printer interface.	See section 6.2.1.2
The display remains empty.	The contrast has been tampered with.	Adjust the display's contrast. (see section 12.5)
The instrument may not be adjusted.	The surface of the prism is dirty.	Clean the surface of the prism with a soft paper tissue (no cotton swaps) dampened in an appropriate solvent.
Sampling takes very long.	Incorrect setting of the sampling speed (SC1, SC30). Sample is too viscous.	Increase the sampling speed on the automation unit.

15. Maintenance

15.1 Cleaning the measuring cell

The surface of the prism in the refractive index measuring cell must be cleaned manually at certain time intervals (depending on the type of samples measured). To do this, remove the black flow cell cover on the measuring cell. Clean the surface of the prism with a soft paper tissue dampened with an appropriate cleaning solvent. Please make sure that the surface of the prism is not scratched (do not use an abrasive cleanser!). Do not use cotton swaps to clean the prism's surface because fibers can settle on it and cause faulty measurements. Install the black flow cell unit. Make sure the O-ring of the flow cell unit is in the correct position when installing it!

15.2 Internal battery

The internal battery to buffer the RE Refractometer's main memory has a life cycle of approx. 5 years if always kept charged. To prevent loss of data, have the battery replaced every 4 - 5 years by METTLER TOLEDO's technical service.

15.3 Main power supply voltage, mains fuse
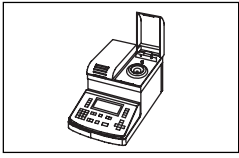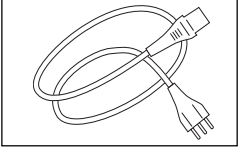
The RE Refractometers adjusts automatically to mains voltages within the range of 100 to 240 V (50/60 Hz frequency).

Replace blown fuses as follows:
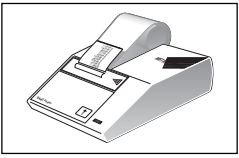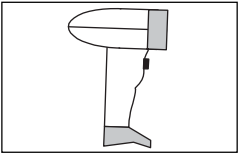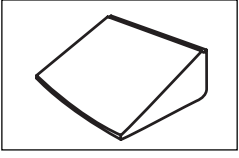
Switch off the instrument. Remove all cable and tube connections. Place the instrument on its back. Remove the small metal plate on the bottom of the instrument (four screws). Replace the blown fuses and reinstall the small metal plate. Be sure to use the correct fuses: T3.15A / 250 V.

16. Standard and optional equipment

16.1 Standard equipment

		Order no.
	RE40D Refractometer or RE50 Refractometer	**RE40D** **RE50**
	1 Operating instructions English	**51710126**
	1 Power cable	**according to your order**

16.2 Optional equipment

		Order no.
	1 GA42 printer alphanumeric printer (serial) 5 Paper rolls 1 Ribbon cartridge (black) 1 Connecting cable (printer - RE Refractometer)	**GA42** **00072456** **00065975** **51190362**
	1 Barcode reader DLC7070	**21900879**
	3 Protective covers	**51107667**
	1 Vapor proof lid for the measurement of volatile samples	**51322114**

Order no.

1 Memory card (for the RE50 Refractometer only)
for storing data, methods
and sample files **51324004**
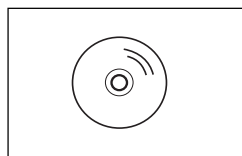
1 PC Software
DataCapture, for Windows 98, 2000, ME and XP **51324100**
1 Connection cable (PC - RE Refractometer) **51190362**
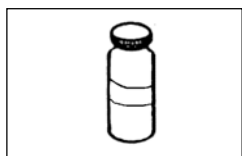
Certified refractive index standards
8 mL vials or ampoules, with certificate
– Water (n_D^{20} 1.33... +/- 0.00002) **51338007**
– Methylsilicone oil (n_D^{20} 1.405... / +/- 0.00002) **51338008**
– Silicon oil AN (n_D^{20} 1.560... +/- 0.00002) **51338009**
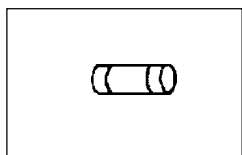
1 Fuse T3.15A **51322100**
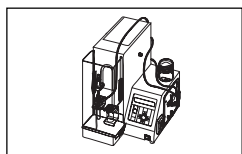
1 SC1 Sample Delivery and Cleaning Unit
automation unit for the measurement of individual samples **SC1**
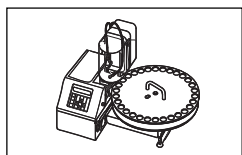
1 SC30 Sample Delivery and Cleaning Unit
automation unit for the measurement of series of samples **SC30**
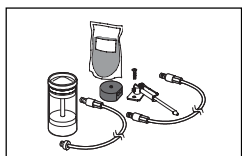
1 Connection kit SC1 or SC30 - RE Refractometer
required for connection of an automation unit **51322068**

MemoCard RE40D (short instructions)

Sample	**Sample data input**

Sample | **Sample data input**
sample identification, number
or sample file (SC30)

Report | **Selection of printout format**
off
short
GLP
variable

Meas. Para | **Set measurement parameters**
method name
measuring temperature
stability (criteria to accept measured value)
wait time
sequence (ON/OFF, for SC1 and SC30)
  sampling
  draining
  rinse-1, rinse-2
  purge

Calc. Para | **Calculation parameters**
result
  nD, nDt (temperature compensated)
  Brix
  concentration based on nD (Conc.)
    (enter table or coefficients)
temperature compensation
  (enter coefficient)
decimals for results
  (nD, nDt, Brix, Conc.)

Method | **Method selection**
methods 0 to 9

Display | **Input mode for keypad**
(for text fields)
A: capital letters (A, B, C…)
a: small letters (a, b, c …)
1: numerals (0, 1, 2 …)
Selecting display of results
after a measurement has finished
nD, Brix, Conc.

Print | **Print instrument settings**

Measure | **Start measurements**
with SC1 and SC30:
including sample sequence (sampling
plus draining, rinsing and drying
of the measuring cell)

Func. | **Functions**
0. Measuring results (in the memory)
1. Sample file (ON/OFF)
2. Automation unit (setup)
3. Connection of a Density Meter
4. Setup instrument test (daily and periodic)
   (name, value, tolerance)
5. Periodic tests and adjustments
   (enter interval,
   show list of results)
6. Multiple measurements
   (autostart, autostatistics,
   automatic error detection)
7. Delete memory

Setup | **Setup**
0. Interfaces
   (printer, barcode reader, PC)
1. Date & time
2. Enter operator names and names for
   measurement units
3. Display serial/version no.
4. Adjust contrast of LCD
5. International
   format for date and temperature (°C / °F)
6. Lock with a password
7. Beep
8. Temperature adjustment

Check | **Run instrument test**
periodic test (if due)
daily test (on all other days)

Calib. | **Adjust instrument**

BS | **Backspace** (erase)

Rinse/ Purge | **Rinse/purge**
only available with SC1 and SC30:
Clean the measuring cell according to
the sequence defined in method 0 "CALIB"

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

Clear | **Clear entry**
(press twice to return to previous setting)

Esc. | **Escape** (result remains on main display)

Reset | **Back to main display** (result is deleted)

MemoCard RE50 (short instructions)

Sample	**Sample data input**
	sample identification, number
	or sample file (SC30)
Report	**Selection of printout format**
	off
	short
	GLP
	variable
Meas. Para	**Set measurement parameters**
	method name
	measuring temperature
	stability (criteria to accept measured value)
	wait time
	sequence (ON/OFF, for SC1 and SC30)
	sampling
	draining
	rinse-1, rinse-2
	purge
Calc. Para	**Calculation parameters**
	result
	nD, nDt (temperature compensated)
	Brix
	HFCS42, HFCS55
	concentration based on nD (Conc.)
	(enter table of coefficients)
	temperature compensation
	(enter table or coefficients)
	decimals for results
	(nD, nDt, Brix, HFCS, Conc.)
Method	**Method selection**
	methods 0 to 9
Display	**Input mode for keypad (for text fields)**
	A: capital letters (A, B, C...)
	a: small letters (a, b, c ...)
	1: numerals (0, 1, 2 ...)
	Selecting display of results
	after a measurement has finished
	nD, Brix, Conc., HFCS
Print	**Print instrument settings**
Measure	**Start measurements**
	with SC1 and SC30:
	including sample sequence (sampling
	plus draining, rinsing and drying
	of the measuring cell)

Func.	**Functions**
	0. Measuring results (in the memory)
	1. Sample file (ON/OFF)
	2. Method file (memory card)
	3. Automation unit (setup)
	4. Connection of a Density Meter
	5. Setup instrument test (daily and periodic) (name, value, tolerance)
	6. Periodic tests and adjustments (enter interval, show list of results)
	7. Multiple measurements (autostart, autostatistics automatic error detection)
	8. Auxiliary programs for memory cards
	9. Delete memory
Setup	**Setup**
	0. Interfaces (printer, barcode reader, PC)
	1. Date & time
	2. Enter operator names and names for measurement units
	3. Display serial/version no.
	4. Adjust contrast of LCD
	5. International format for data and temperature (°C / °F)
	6. Lock with a password
	7. Beep
	8. Temperature adjustment
	9. Adjustment mode
Check	**Run instrument test**
	periodic test (if due)
	daily test (on all other days)
Calib.	**Adjust instrument**
BS	**Backspace** (erase)
Rinse/ Purge	**Rinse/purge**
	only available with SC1 and SC30:
	Clean the measuring cell according to
	the sequence defined in method 0 "CALIB"
Pump	**Pump** ON/OFF, for external pump
Clear	**Clear entry**
	(press twice to return to previous setting)
Esc.	**Escape** (result remains on main display)
Reset	**Back to main display** (result is deleted)

Appendix 1: Refractive index table for pure water

The refractive index values for pure water are stored in the RE Refractometer as follows:

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 RE Refractometers contains the refractive index values for water in steps of 5 °C (printed in bold in the table). The intermediate values are interpolated by means of La Grange polynomial.
This table is based on the table 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 (therefore, the above table contains relative refractive indices). The refractive index of air was calculated according to the formula given in the "Handbook of Chemistry and Physics" (75th Edition).

Appendix 2: BRIX table

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

The RE Refractometer calculate Brix% by means of a La Grange interpolation of the above values.

Appendix 3: HFCS42 and HFCS55 (inverted sugars)

HFCS stands for High-Fructose Corn Syrup. These syrups are manufactured from natural corn syrup and consist of inverted (or isomerized) sugar, i.e., a mixture of dextrose, fructose, maltose and sucrose. They are classified according to their fructose content. Mainly three different HFCS are in use: a mixture containing 42% fructose (HFCS42), one containing 55% fructose (HFCS55) and a third one containing 90% fructose (HFCS90). Inverted sugar concentration denominates the concentration in weight % of an isomerized sugar solution. Inverted sugar concentration can be calculated from the refractive index of the inverted sugar solution measured at 20 °C (n_D^{20}). The RE50 Refractometer has built-in conversion tables ("Physical Properties Table", Corn Products, 1991) for two of the mixtures: HFCS42 and HFCS55. Since a temperature compensation table is also stored in this instrument, it is able to convert the measuring results for a temperature of 20 °C, as long as the measuring temperature is within the range of 20 to 50 °C and the temperature compensation is turned on.

The relation between inverted sugar concentration and refractive index varies with the composition of the inverted sugar. Compositions of the inverted sugar syrups HFCS42 and HFCS55 are shown below.

	HFCS42	HFC55
Fructose	42.50%	55.40%
Dextrose	52.50%	40.30%
Maltose	3.00%	3.00%
Sucrose	0.00%	0.0%
Maltotriose DP3	0.70%	0.40%
Oligosaccharide DP4	1.30%	0.90%
Sulfated Ash	0.03%	0.05%

A.3.1 HFCS42 table (0 to 76 solids%)

[Physical Properties Table Corn Products, 1991]

HFCS42 solids%	refr. index n_D^{20}	Brix%	HFCS42 solids%	refr. index n_D^{20}	Brix%	HFCS42 solids%	refr. index n_D^{20}	Brix%
0.0	1.33299	0.00	31.0	1.38236	30.69	62.0	1.44387	60.88
1.0	1.33441	1.00	32.0	1.38414	31.67	63.0	1.44608	61.84
2.0	1.33585	1.98	33.0	1.38594	32.65	64.0	1.44831	62.81
3.0	1.33729	2.98	34.0	1.38775	33.64	65.0	1.45055	63.78
4.0	1.33874	3.97	35.0	1.38957	34.61	66.0	1.45281	64.74
5.0	1.34021	4.97	36.0	1.39141	35.60	67.0	1.45508	65.71
6.0	1.34169	5.95	37.0	1.39325	36.58	68.0	1.45737	66.67
7.0	1.34318	6.95	38.0	1.39511	37.55	69.0	1.45968	67.64
8.0	1.34468	7.94	39.0	1.39699	38.53	70.0	1.46200	68.60
9.0	1.34619	8.93	40.0	1.39887	39.51	71.0	1.46433	69.56
10.0	1.34771	9.93	41.0	1.40077	40.49	72.0	1.46669	70.53
11.0	1.34924	10.92	42.0	1.40269	41.47	73.0	1.46905	71.49
12.0	1.35078	11.90	43.0	1.40461	42.44	74.0	1.47144	72.46
13.0	1.35234	12.90	44.0	1.40655	43.42	75.0	1.47384	73.42
14.0	1.35391	13.90	45.0	1.40851	44.39	76.0	1.47626	74.38
15.0	1.35549	14.89	46.0	1.41048	45.36			
16.0	1.35708	15.87	47.0	1.41246	46.34			
17.0	1.35868	16.87	48.0	1.41445	47.31			
18.0	1.36029	17.86	49.0	1.41646	48.28			
19.0	1.36192	18.85	50.0	1.41848	49.26			
20.0	1.36355	19.84	51.0	1.42052	50.22			
21.0	1.36520	20.83	52.0	1.42257	51.20			
22.0	1.36686	21.81	53.0	1.42464	52.16			
23.0	1.36854	22.80	54.0	1.42671	53.14			
24.0	1.37022	23.79	55.0	1.42881	54.11			
25.0	1.37192	24.78	56.0	1.43092	55.07			
26.0	1.37363	25.76	57.0	1.43304	56.04			
27.0	1.37535	26.75	58.0	1.43518	57.01			
28.0	1.37708	27.74	59.0	1.43733	57.98			
29.0	1.37883	28.72	60.0	1.43949	58.95			
30.0	1.38059	29.71	61.0	1.44168	59.91			

The RE50 Refractometer calculates HFCS42 solids% by means of a La Grange interpolation of the above values.

A.3.2 HFCS55 table (0 to 80 % solids)

[Physical Properties Table Corn Products, 1991]

HFCS55 solids%	refr. index n_D^{20}	Brix%	HFCS55 solids%	refr. index n_D^{20}	Brix%	HFCS55 solids%	refr. index n_D^{20}	Brix%
0.0	1.33299	0.00	31.0	1.38233	30.68	62.0	1.44383	60.86
1.0	1.33441	0.99	32.0	1.38411	31.65	63.0	1.44604	61.83
2.0	1.33584	1.98	33.0	1.38591	32.64	64.0	1.44827	62.79
3.0	1.33728	2.97	34.0	1.38772	33.61	65.0	1.45051	63.75
4.0	1.33874	3.97	35.0	1.38954	34.60	66.0	1.45276	64.72
5.0	1.34020	4.96	36.0	1.39137	35.58	67.0	1.45504	65.69
6.0	1.34168	5.94	37.0	1.39322	36.55	68.0	1.45732	66.65
7.0	1.34316	6.94	38.0	1.39508	37.54	69.0	1.45963	67.62
8.0	1.34466	7.94	39.0	1.39696	38.52	70.0	1.46194	68.57
9.0	1.34617	8.92	40.0	1.39884	39.49	71.0	1.46428	69.54
10.0	1.34769	9.91	41.0	1.40074	40.47	72.0	1.46663	70.50
11.0	1.34922	10.91	42.0	1.40266	41.45	73.0	1.46899	71.47
12.0	1.35076	11.89	43.0	1.40458	42.42	74.0	1.47137	72.43
13.0	1.35232	12.89	44.0	1.40652	43.40	75.0	1.47377	73.39
14.0	1.35389	13.88	45.0	1.40848	44.38	76.0	1.47619	74.35
15.0	1.35546	14.88	46.0	1.41044	45.35	77.0	1.47862	75.31
16.0	1.35705	15.86	47.0	1.41243	46.32	78.0	1.48106	76.28
17.0	1.35865	16.85	48.0	1.41442	47.29	79.0	1.48353	77.24
18.0	1.36027	17.85	49.0	1.41643	48.27	80.0	1.48601	78.20
19.0	1.36189	18.83	50.0	1.41845	49.24			
20.0	1.36353	19.82	51.0	1.42049	50.21			
21.0	1.36518	20.81	52.0	1.42254	51.18			
22.0	1.36684	21.79	53.0	1.42460	52.15			
23.0	1.36851	22.79	54.0	1.42668	53.12			
24.0	1.37019	23.78	55.0	1.42877	54.09			
25.0	1.37189	24.76	56.0	1.43088	55.06			
26.0	1.37360	25.75	57.0	1.43300	56.03			
27.0	1.37532	26.74	58.0	1.43514	56.99			
28.0	1.37705	27.71	59.0	1.43729	57.96			
29.0	1.37880	28.70	60.0	1.43946	58.93			
30.0	1.38056	29.69	61.0	1.44164	59.90			

The RE50 Refractometer calculates HFCS55 solids% by means of a La Grange interpolation of the above values.

Appendix 4: Barcode reader

A.4.1 Configuration of the METTLER TOLEDO DLC7070 barcode reader

The following barcodes are used to configure the DLC7070 barcode reader:

– "**Reset**", "**Mode RS232**": If the barcode reader is not working properly, proceed as follows:
  • disconnect it from the RE Refractometer
  • reconnect it to the RE Refractometer (AUX. port)
  • scan the barcode "Reset", to restore the manufacturer's settings
  • scan the barcode "Mode RS232", to configure the reader for the RE Refractometer.

  If the barcode reader still does not work, check the settings on the RE Refractometer (see section 12.1.3).

– **"Beep medium"**, "**Beep off**": Scan these barcodes to adjust the volume of the acoustic signal of the barcode reader. To reset the volume to "full", you must scan the barcodes "Reset" and then "Mode RS232".

Reset

Mode RS232

Beep medium

Beep off

A.4.2 Special characters

The barcode reader may be used to scan in sample identifications, method names, sample names and names for units containing special characters which may not be entered via the instrument's keypad. You must therefore create the desired barcode and scan it into the corresponding input field instead of typing in the text via the keypad.

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

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

A.4.3 Operator names

The barcode reader may be used to select an operator name from the list entered in the "Operator Names" menu (see section 12.3.2). This selection is done directly in the main display, i.e., the user may scan in 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.

No.	Operator name	Operator-barcode	CODE128
1	_____		110513010100
2	_____		110513010101
3	_____		110513010102
4	_____		110513010103
5	_____		110513010104
6	_____		110513010105
7	_____		110513010106
8	_____		110513010107
9	_____		110513010108
10	_____		110513010109

Technical data RE40D Refractometer

Instrument name		**RE40D Refractometer**
Measuring method		optical detection of the angle of total reflection light source: LED, wavelength 589.3 nm
Measuring range	nD BRIX	1.3200 to 1.7000 0.0 to 85.0% (according to ICUMSA tables) 85.0 to 100.0% (extrapolated from ICUMSA tables)
Limit of error	nD BRIX	0.0001 0.1% (0 to 85%)
Repeatability	nD BRIX	0.0001 (experimental standard deviation) 0.1% (experimental standard deviation)
Resolution	nD BRIX	0.0001 0.1%

Temperature
   Control
   Range
   Limit of error
   Compensation
	
	T
	T
	(for BRIX)
		
		Peltier
		15 to 70°C
		0.1°C
		to 20°C in the range of 10 to 40°C

Materials (in contact with sample)		sapphire, stainless steel SUS316, perfluoroelastomer
Amount of sample required		0.4 mL (minimal)
Time required per measurement		approx. 15 seconds (depending on the sample)
Display		LCD (liquid crystal display), 7 lines, backlit
External I/O		1 RS-232C ("Printer", for an external printer) 1 RS-232C ("AUX.", for a barcode reader) 1 RS-232C ("RS232C", for a computer) 1 connector for an automation unit ("EXT.") 1 connector for an external pump ("EXT. pump") 1 memory card (PCMCIA)
Ambient conditions		temperature: 5 to 35°C humidity: < 85% RH (no condensation)
Power source		AC 100 to 240 V , 50/60 Hz
Power consumption		60 W
Dimensions		270 mm (W) x 400 mm (D) x 225 mm (H)
Weight		9 kg

Technical data RE50 Refractometer

Instrument name		**RE50 Refractometer**
Measuring method		optical detection of the angle of total reflection light source: LED, wavelength 589.3 nm
Measuring range	nD BRIX	1.32000 to 1.58000 0.0 to 85.00% (according to ICUMSA tables) 85.00 to 100.00% (extrapolated from ICUMSA tables)
Limit of error	nD BRIX	0.00005 (1.32 to 1.40) / 0.00010 (1.40 to 1.58) 0.03% (0 to 85%)
Repeatability	nD BRIX	0.00002 (experimental standard deviation) 0.01% (experimental standard deviation)
Resolution	nD BRIX	0.00001 0.01%
Temperature Control Range Limit of error Compensation	 T T (for BRIX)	 Peltier 15 to 50°C 0.02°C to 20°C in the range of 10 to 40°C
Materials (in contact with the sample)		sapphire, stainless steel SUS316, perfluoroelastomer
Amount of sample required		0.4 mL
Time required per measurement		approx. 15 seconds (depending on the sample)
Display		LCD (liquid crystal display), 7 lines, backlit
External I/O		1 RS-232C ("Printer", for an external printer) 1 RS-232C ("AUX.", for a barcode reader) 1 RS-232C ("RS232C", for a computer) 1 connector for an automation unit ("EXT.") 1 connector for an external pump ("EXT. pump") 1 memory card (PCMCIA)
Ambient conditions		temperature: 5 to 35°C humidity: < 85% RH (no condensation)
Power source		AC 100 to 240 V , 50/60 Hz
Power consumption		60 W
Dimensions		270 mm (W) x 400 mm (D) x 225 mm (H)
Weight		9 kg

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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.
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Thank you.