



Level



Pressure



Flow



Temperature



Liquid
Analysis



Registration



Systems
Components



Services

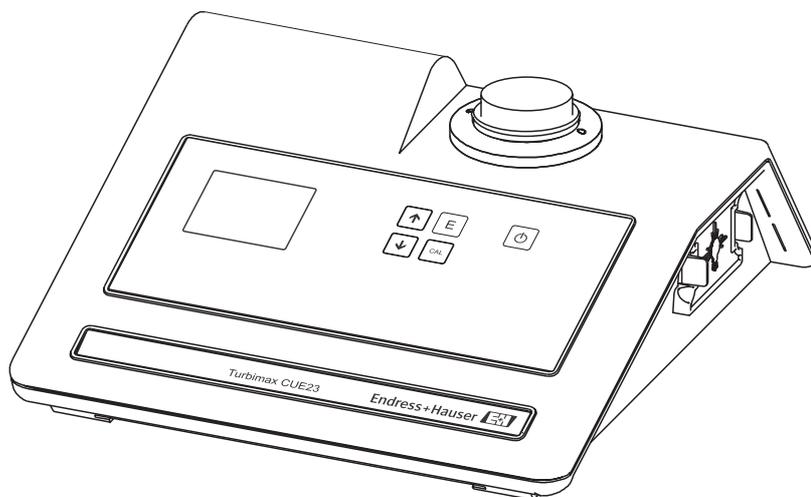


Solutions

Operating Instructions

Turbimax CUE23 / CUE24

Turbidimeter for laboratory measurement



Brief operating instructions

This explains how to use these Operating Instructions to commission your turbidimeter quickly and safely:

→ Page 4 ff.	Safety instructions
→ Page 5	General safety instructions and explanations of the safety icons are provided in the section in question. Specific safety instructions are provided at the appropriate position. Their level of importance can be seen from the icon: ⚠ Warning, ⚡ Caution, 📌 Note.
▼	
→ Page 7	Installation
	The installation conditions, such as the dimensions of the device, are illustrated here.
▼	
→ Page 9 ff.	Display and operating elements
	Use this section to familiarize yourself with the operation of the device.
▼	
→ Page 10 ff.	Configuration
→ Page 12 ff.	Here, you can find all the important steps for configuring your turbidimeter. These sections provide information on grab sample and flow-through measurement.
▼	
→ Page 13 ff.	Calibration
	Here, you can find out how to calibrate your turbidimeter.
▼	
→ Page 16 ff.	Maintenance
	Here, you can find information on important maintenance activities, for example, cleaning the cuvette and replacing the lamp.
▼	
→ Page 18 ff.	Accessories
	Here, you can find an overview of available accessories.
▼	
→ Page 19 ff.	Troubleshooting
→ Page 19 ff.	If faults occur during operation, use the check lists to localize and remedy them. A list of available spare parts.
▼	
→ Page 22	Technical data
→ Page 21 ff.	Dimensions Ambient and process conditions, weight, materials etc.

1 Safety instructions

1.1 Designated use

The Turbimax CUE23 / CUE24 turbidimeters have been designed for laboratory measurement of the turbidity of process water and drinking water. The infrared light instrument, CUE23, meets the design criteria on turbidity measurement specified in ISO 7027 and DIN 27027. The white light instrument, CUE24, meets the design criteria specified by US EPA 180.1.

Any other use than the one described here compromises the safety of persons and the entire measuring system and is, therefore, not permitted.

The manufacturer is not liable for damage caused by improper or non-designated use.

1.2 Installation, commissioning and operation

Please note the following items:

- Installation, commissioning, operation and maintenance of the measuring system must only be carried out by trained technical personnel.
The technical personnel must be authorised for the specified activities by the system operator.
- Electrical connection must only be carried out by a certified electrician.
- Technical personnel must have read and understood these Operating Instructions and must adhere to them.
- Before commissioning the entire measuring point, check all the connections for correctness. Ensure that electrical cables and hose connections are not damaged.
- Do not operate damaged products and secure them against unintentional commissioning. Mark the damaged product as being defective.
- Measuring point faults may only be rectified by authorised and specially trained personnel.
- If faults can not be rectified, the products must be taken out of service and secured against unintentional commissioning.
- Repairs not described in these Operating Instructions may only be carried out at the manufacturer's or by the service organisation.

1.3 Operational safety

The measuring system has been designed and tested according to the state of the art and left the factory in perfect functioning order.

Relevant regulations and European standards have been met.

As the user, you are responsible for complying with the following safety conditions:

- Installation instructions
- Local prevailing standards and regulations.

Immunity to interference

This instrument has been tested for electromagnetic compatibility in industrial use according to applicable European standards.

Protection against interference as specified above is valid only for an instrument connected according to the instructions in these Operating Instructions.

1.4 Return

If the system has to be repaired, please return it *cleaned* to the sales center responsible. Please use the original packaging, if possible.

1.5 Notes on safety icons and symbols

Safety icons



Warning!

This symbol alerts you to hazards. They can cause serious damage to the instrument or to persons if ignored.



Caution!

This symbol alerts you to possible faults which could arise from incorrect operation. They could cause damage to the instrument if ignored.



Note!

This symbol indicates important items of information.

Electrical symbols



Direct Current (DC)

A terminal at which DC is applied or through which DC flows.



Alternating Current (AC)

A terminal at which (sine-form) AC is applied or through which AC flows.



Ground connecting

A terminal, which, from the user's point of view, is already grounded using a grounding system.



Protective earth terminal

A terminal which must be grounded before other connections may be set up.



Alarm relay



Input



Output



DC voltage source



Temperature sensor

2 Identification

2.1 Device designation

2.1.1 Nameplate

Compare the order number on the nameplate with your order.
The device version can be identified from this number.

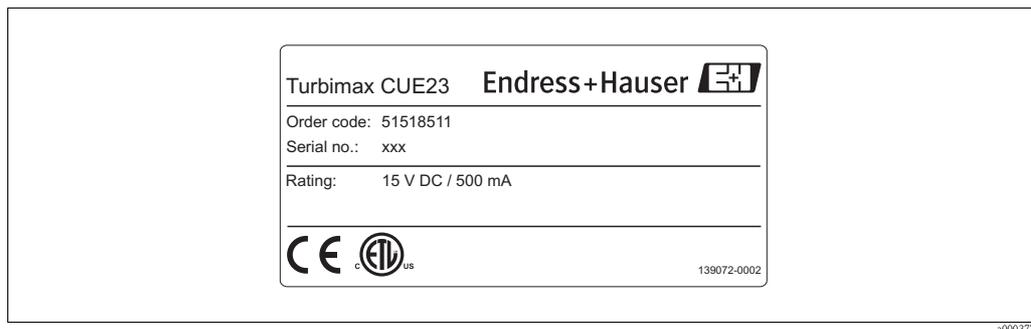


Fig. 1: CUE23 nameplate (example)

2.1.2 Ordering information

- Turbimax CUE23
Turbidimeter with infrared light source for laboratory measurement compliant to ISO 7027
Order no.: 51518511
- Turbimax CUE24
Turbidimeter with white light source for laboratory measurement compliant to U.S. EPA 180.1
Order no.: 51518513

2.2 Scope of delivery

The scope of delivery comprises:

- 1 Turbimax CUE23 / CUE24 turbidimeter
- 1 Calibration kit including
 - 0.02 NTU standard
 - 10.0 NTU standard
 - 1000 NTU standard
 - 2 empty sample cuvettes with black light shields
- 1 Power supply unit
- 1 Operating Instructions BA396C/07/en

If you have any questions, please contact your supplier or your sales center responsible.

2.3 Certificates and approvals

Declaration of conformity

The product meets the legal requirements of the harmonized European standards.
The manufacturer confirms compliance with the standards by affixing the **CE** symbol.

3 Installation

3.1 Quick installation guide

3.1.1 Measuring system

The measuring system comprises:

- Turbimax CUE23 / CUE24 turbidimeter
- Power supply unit
- Sample cuvette with light shield
- Indexing ring

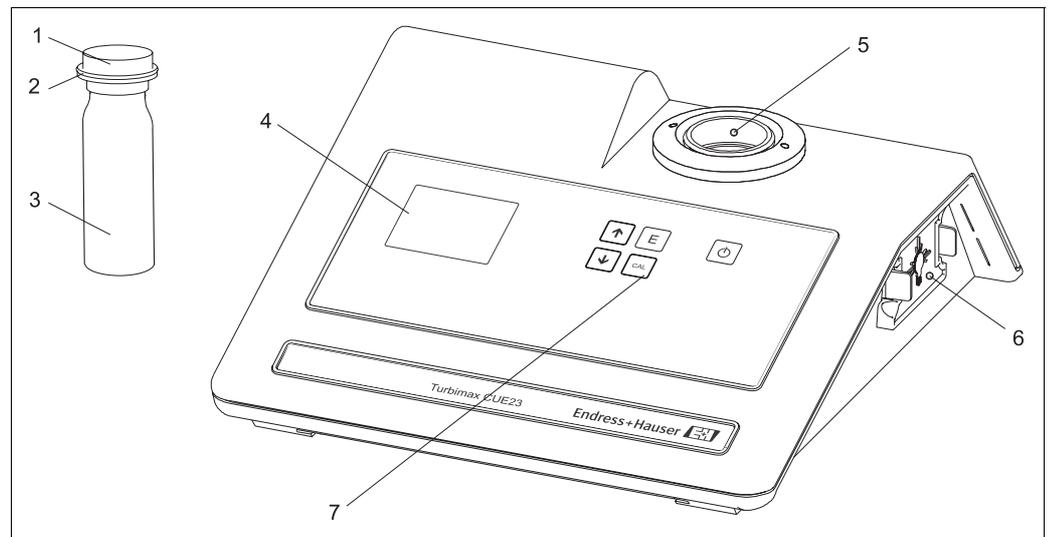


Fig. 2: Turbimax CUE23 measuring system (example)

- | | | | |
|---|--------------------|---|--------------|
| 1 | Black light-shield | 5 | Optical well |
| 2 | Indexing ring | 6 | Lamp module |
| 3 | Sample cuvette | 7 | Touch pad |
| 4 | Display | | |

3.2 Incoming acceptance, transport, storage

- Make sure the packaging is undamaged!
Inform the supplier about damage to the packaging.
Keep the damaged packaging until the matter has been settled.
- Make sure the contents are undamaged!
Inform the supplier about damage to the delivery contents.
Keep the damaged products until the matter has been settled.
- Check that the scope of delivery is complete and agrees with your order and the shipping documents.
- The packaging material used to store or to transport the product must provide shock protection and humidity protection. The original packaging offers the best protection. Also, keep to the approved ambient conditions (see "Technical data").
- If you have any questions, please contact your supplier or your sales center responsible.

3.3 Installation conditions

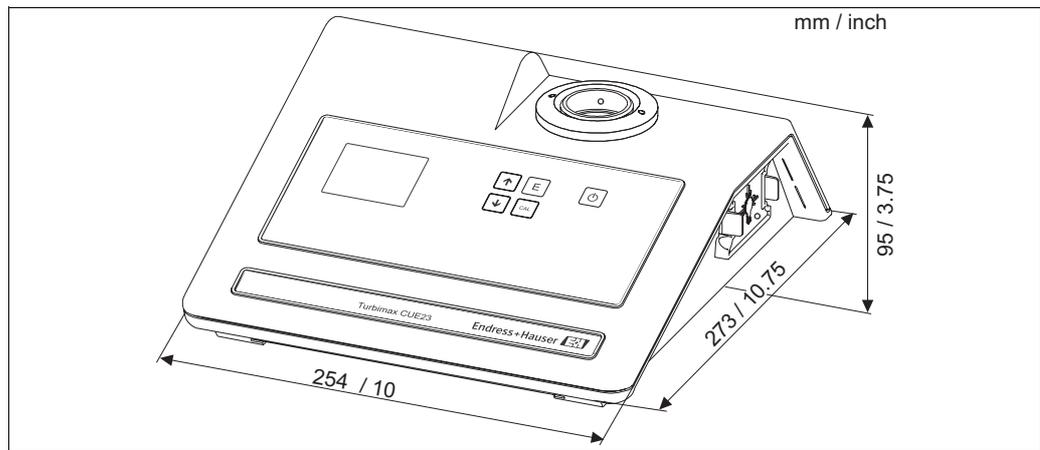


Fig. 3: Dimensions

3.4 Installation instructions

- Place the Turbimax CUE23 / CUE24 in its designated location.
- Connect the included power supply to the power plug connector on the back panel.
- If you want to print or record measured values, connect a printer or recorder to the RS-232 port on the back panel.

3.5 Post-installation check

- Check that the instrument is placed in a dry location.
- Make sure that the power supply and RS-232 plugs are correctly connected.

4 Operation

4.1 Display and operating elements

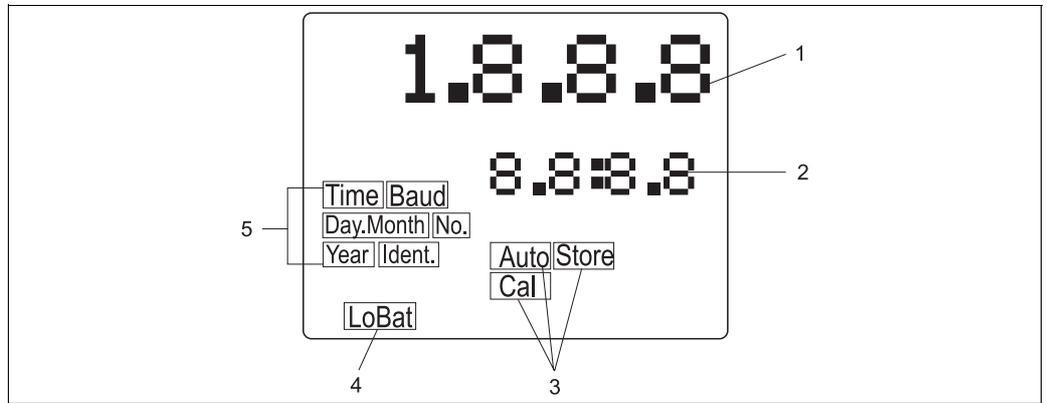


Abb. 4: Display

- 1 Display of turbidity levels and user guidance
- 2 Display of stored turbidity readings, error messages, user guidance
- 3 Status indicators
- 4 Battery status, flashes when batteries need to be replaced
- 5 Indicators providing guidance in the customer settings and calibration routines

4.2 Key assignment

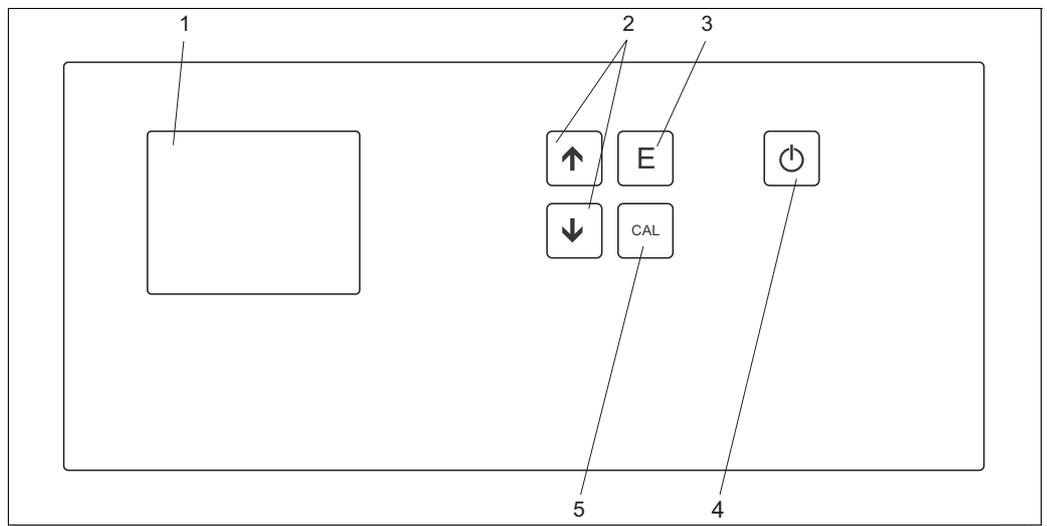


Fig. 5: Operating elements

- 1 Display
- 2 keys used to set numerical values and to scroll through lists; pressing both arrow keys simultaneously, enters the configuration mode
- 3 key used to store values on the screen and to output turbidity data to the printer
- 4 key used to turn the Turbimax on or off
- 5 key used to enter or exit calibration mode

5 Commissioning

5.1 Function check



Warning!
Check all connections for correctness.

5.2 Switching on

1. Familiarize yourself with the operation of the transmitter prior to switching on the device. For this purpose, read sections 1 "Safety instructions" and 4 "Operation" in particular.
2. Apply power to the instrument and allow the unit to warm up (at least 30 minutes).
3. Configure the instrument according to your needs.
4. Perform grab sample measurement.

5.3 Instrument configuration

Turbimax provides you with the ability to customize your instrument according to your needs at any time during normal operation.
To enter instrument configuration, press the  and  keys simultaneously when the instrument is in normal automatic mode.



Note!
You cannot access instrument configuration during calibration.

5.3.1 Setting the date

Year

Function	Selection	Info
Year	1990 ...	Set the proper year here. This date is used as basis for the stored or printed sample information.

Day and month

Function	Selection	Info
Day and month	xx.yy	Select the correct month and day. The number on the right corresponds to the month. To move from setting the month to setting the day, press the  key. This date is used as basis for the stored or printed sample information.  Note! The instrument automatically adjusts for leap years.

Time

Function	Selection	Info
Time	00:00 ... 23:59	Set the proper time here. The time is displayed in 24 hour format. The number flashing corresponds to the hour. To move from hours to minutes, press the [E] key. This time is used as basis for the stored or printed sample information.

5.3.2 Setting the calibration interval

Function	Selection	Info
Int. (interval)	0 ... 99 Default: 30	Select the number of days that you wish to have between scheduled calibrations. In normal automatic mode, if you exceed this number of days between calibrations, the "Cal" block will flash until you re-calibrate the instrument.

5.3.3 Setting the printing function

The printing option allows you to print out information on the sample in the optical well by pushing the **[E]** key in normal automatic mode.

The format of the information is time, date and turbidity level (see below).

14:30	10 JAN 2005	996.7 NTU
14:33	10 JAN 2005	0.025 NTU
14:40	10 JAN 2005	4.003 NTU
14:50	10 JAN 2005	0.021 NTU

Fig. 6: Printout of sample information

Also, a specific message will be printed out upon exit or completion of the calibration routine (see below). This printout shows all the information that is pertinent to the calibration status of the instrument.

DATE:	10 JAN 2005	14:26
LAST CAL:	10 JAN 2005	14:26
CALIBRATION INTERVAL:	30 DAYS	
CALIBRATION POINTS:		
STANDARD	DATE	TIME
0.02 NTU	10 JAN 2005	14:26
10.0 NTU	10 JAN 2005	14:25
1000.0 NTU	10 JAN 2005	14:24
30 DAYS UNTIL NEXT CALIBRATION		

Fig. 7: Printout of calibration information

Function	Selection	Info
Print (Prt)	Selection <ul style="list-style-type: none"> ■ On ■ OFF Default: OFF	By turning on the printing function, you instruct the instrument to print out specific information.
On		
Baud rate (Baud)	1200, 2400, 4800, 9600	Select the required baud rate for operation of your printer. The other RS232 parameters are fixed at 2 stop bits, 8 data bits, and odd parity.

5.4 Routine operation

The standard measuring method used with the Turbimax is grab sample measurement.



Caution!

Never pour liquid directly into the sample well of the instrument. Always use a cuvette. The Turbimax will accurately measure the turbidity of a sample using only cuvettes with the black light shield on the cuvette (provided by Endress+Hauser).

Perform the following steps to measure the turbidity of a sample:

1. Turn the instrument on. It will be in normal mode (the "Auto" block should be illuminated). Allow the instrument to warm up for at least 30 minutes.
2. Sample approximately 100 ml of the process stream as you would normally do for turbidity measurement.
3. Obtain a clean and dry sample cuvette.
4. Rinse the cuvette with approximately 20 ml of the sample water (2/3 of cuvette volume), capping the cuvette with the black light shield and inverting several times.
5. Discard the 20 ml of used sample and repeat the rinsing procedure two more times.
6. Completely fill the rinsed cuvette with the remaining portion (approximately 30 ml) of the grab sample and then cap the cuvette with the black light shield. Ensure that the outside of the cuvette is dry, clean and free from smudges¹.
7. Place the cuvette in the instrument and index it to the lowest reading:
 - Rotate the cuvette slowly throughout one complete revolution (360°).
 - While rotating the sample cuvette, observe the display and locate the position in which the cuvette provides the lowest turbidity reading.
 - This position is the indexed position of the cuvette.
8. Once the cuvette is indexed, record the reading displayed on the instrument as the sample turbidity.
9. Repeat steps 2 through 8 for all of your samples.



Note!

- If you are measuring and comparing more than one sample, pressing the **[E]** key will display the latest reading. In addition, if you have selected printer output in the instrument configuration, pressing the **[E]** key will output data to the RS232 port.
- The Turbimax may display "--" for a few seconds while it determines the correct reading.
- An indication of "Or" (over-range) in the upper row of the display indicates that the sample in the sample well is higher than 1000 NTU.

1) Any typical glass cleaner can be used along with a lint-free cloth, or tissue, to clean the outside of the cuvette.

5.5 Instrument calibration

The instrument was calibrated and tested prior to leaving the factory. Therefore, it is possible to use it directly out of the box. Under normal conditions, recalibration is recommended at least once every three months¹.

5.5.1 Calibration standards

We recommend that the following standards be used during calibration to achieve the full-scale accuracy stated in this manual:

- 0.02 NTU calibration standard
- 10.0 NTU calibration standard
- 1000 NTU calibration standard

These primary calibration standards are more stable than Formazin and have a minimum shelf life of 12 months. Prior to recalibration, review the expiration dates to ensure that the standards have not expired.

If you use Formazin to calibrate the instrument, make sure that a fresh stock suspension of Formazin is used to achieve the accuracy quoted for the instrument.



Note!

The 10.0 NTU standard is only guaranteed to hold its value for 12 months when stored in the plastic bottle. After pouring it into the glass cuvette, it should be used immediately for calibration and then be disposed of. If the 10.0 NTU standard is stored in the glass cuvette for extended periods of time, it should be used as a reference standard only.

5.5.2 Indexing calibration cuvettes

To achieve greatest accuracy and account for normal scratches and aberrations in cuvette glass when calibrating, we recommend indexing the cuvettes.

Standards and standard kits purchased from Endress+Hauser are supplied with indexing rings.

The following steps allow repeatable indexing of calibration standards:

1. Slowly rotate the standard inside the optical well, one complete revolution (360°).
2. While rotating the standard, observe the measured turbidity and locate the position of the cuvette having the lowest reading.
3. With the calibration standard positioned at the location having the lowest turbidity reading, install the indexing ring over the cap on the standard so that the pointer of the indexing ring faces directly forward.

When using the standards in future, always insert the standard so that the pointer of the indexing ring faces directly forward. Slowly rotate the standard back and forth about 5° to find the lowest point. The standard is then indexed and ready for use.

1) The EPA recommends that on-line turbidimeters be calibrated with a primary standard at least once every three months if they are to be used for EPA reporting.

5.5.3 Three-point calibration

Even though it is possible to calibrate the Turbimax using any sequence of the prescribed calibration standards, to achieve the stated accuracy you must use the procedure below to calibrate the instrument.

Step one:

1. Press the  key to select the calibration function.
The "Ident" block and the "Cal" block will illuminate on the display.
2. The turbidity value displayed in the lower row of the display should read 1000 NTU. This is the first standard that must be used in calibration.

 Note!

If you want to perform a two-point calibration for potable water, press the  key to bypass the 1000 NTU and proceed to "Step two".

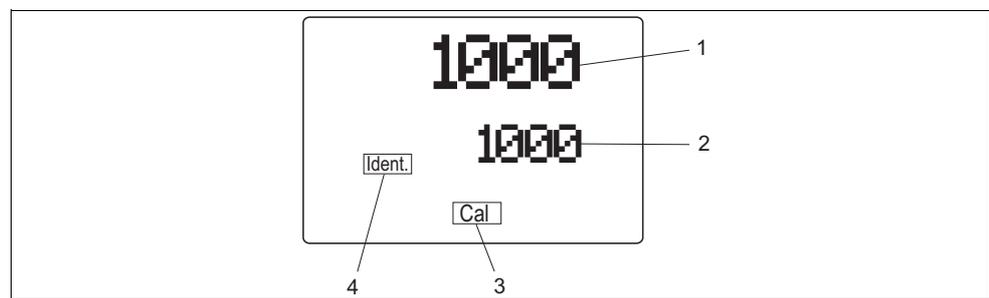


Fig. 8: Display appearance during calibration with the 1000 NTU standard

- 1 Actual turbidity reading of the sample in the well
- 2 Required standard for the calibration step
- 3 Calibration block indicating that the instrument is in calibration mode
- 4 Identifier block

3. Insert the requested 1000 NTU standard so that the pointer of the indexing ring faces directly forward.
4. Index the standard to the lowest value on the upper display by slowly rotating it back and forth about 5°. Wait for the reading to stabilize.
5. Press the  key. The instrument will calibrate on the 1000 NTU level (the "Store" block will flash) and the upper row of the display should display 1000 NTU.

Step two:

1. The lower row of the display now shows that the 10.0 NTU standard should be placed in the optical well.
2. Insert the requested 10.0 NTU standard so that the pointer of the indexing ring faces directly forward.
3. Index the standard to the lowest value on the upper display by slowly rotating it back and forth about 5°. Wait for the reading to stabilize.
4. Press the  key. The instrument will calibrate on the 10.0 NTU level (the "Store" block will flash) and the upper row of the display should display 10.0 NTU.

Step three:

1. The lower row of the display now shows that the 0.02 NTU standard should be placed in the optical well.
2. Insert the 0.02 NTU standard so that the pointer of the indexing ring faces directly forward.
3. Index the standard to the lowest value on the upper display by slowly rotating it back and forth about 5°. Wait for the reading to stabilize.
4. Press the  key. The instrument will calibrate on the 0.02 NTU level.
5. The instrument automatically exits out of the calibration mode and returns to the normal automatic mode. The display should read 0.02 NTU since this is the turbidity level of the standard that is still in the well.
6. At this point, you have calibrated the instrument so that it measures accurately across its full range. Proceed to use the Turbimax normally.

**Note!**

- At any point in time during calibration, you can cycle through the required calibration points (0.02 NTU, 10.0 NTU, 1000 NTU) by pressing either the  or  keys to individually calibrate with a particular calibration standard.
If you wish to exit the calibration mode, you may do so at any time simply by pressing the  key. However, exiting the calibration process without completing the steps for calibration may cause the accuracy of the instrument to be diminished.
- The Turbimax will perform some system self-diagnostics during calibration. If an error occurs, an error message will be displayed in the lower row (see section "System errors").

6 Maintenance

The Turbimax CUE23 / CUE24 has been designed for ease of use and simple operation. When not in use, make sure that the instrument has been turned off and that a clean sample cuvette fitted with a black light shield cap has been placed in the optical well. This will ensure that a minimum amount of dust and debris will be able to settle on the optics of the instrument.

Take all the necessary measures in time to ensure the operational safety and reliability of the entire measuring system.

Maintenance work at the instrument comprises:

- Cleaning the cuvette
- Replacing the lamp
- Replacing the batteries

6.1 Cleaning the cuvette

Measurement cuvettes should be clean and free of marks or scratches. To clean a cuvette, proceed as follows:

1. Clean the interior and exterior with a detergent solution.
2. Rinse the cuvette thoroughly 8 to 10 times with distilled or deionized water to eliminate the possibility of detergent build-up and streaking.
3. Store the cleaned and dried cuvette with the black light shield cap on the cuvette.

During normal operation you may use any typical glass cleaner along with a lint free cloth, or tissue, to clean the outside of the cuvettes.

6.2 Replacing the lamp

Periodically, the lamp module will require replacement. An error message will be displayed when replacement is required. We recommend to keep a spare lamp for each Turbimax on hand at all times to ensure continuous use of the instrument.

To replace the lamp, proceed as follows:

1. Turn off the instrument.
2. Remove the lamp module from the instrument. To do so, squeeze the two side tabs (pos. 1) on the module inward while pulling the module out of the instrument.

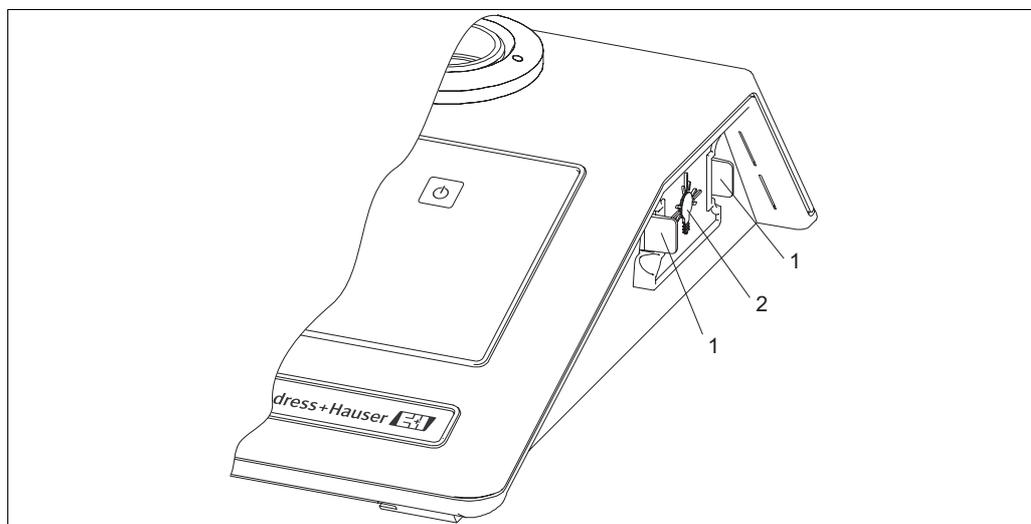


Fig. 9: Turbimax lamp module

- 1 Side tabs
- 2 Light bulb icon

3. Pull the module away from the instrument until the in-line power connector is exposed (about 150 ... 200 mm / 6 ... 8 inches).
4. Unfasten the connector by holding on to the white in-line connector and pulling the in-line connector apart.
 Caution!
Do **not** hold on to the wires.
5. Connect the new lamp module to the in-line power connector.
6. Feed the wire back into the instrument. Make sure that it does not get in the way of the lamp or lamp holder.
7. Make sure that the light bulb icon (pos. 2) on the back of the lamp module is upright. Press the module into the instrument until you hear it click firmly into place.
 Note!
The side tabs may need to be pressed outward until they click to secure the new lamp module. If they do not click the lamp module securely in place, check that the power wire is not obstructing the lamp module.
8. Turn on the instrument and re-calibrate it.
 Note!
The instrument **must be re-calibrated** after lamp module replacement.
9. Resume normal operation.

6.3 Replacing the batteries

The backup of calibration and customer settings requires power. For this reason, the Turbimax should be plugged in when not in use. If the instrument is unplugged from the wall receptacle or the provided power supply, the batteries in the instrument will provide the backup power. As these batteries are non rechargeable and have a finite life, they will need replacement if the instrument is left unplugged for long periods of time.

We recommend that the battery replacement is performed at Endress+Hauser. Please contact your responsible service.

7 Accessories

7.1 Calibration solutions

Calibration kit CUE21 / CUE22 / CUE23 / CUE24, full range

- 0.02 NTU
- 10.0 NTU
- 1000 NTU

Order no.: 51518580

7.2 Cuvettes

- Sample cuvettes CUE23 / CUE24
incl. caps, 3 pcs.

Order no.: 51518581

8 Troubleshooting

8.1 Troubleshooting instructions

The instrument provides you with two levels of specific diagnostic information.

- System warning messages
Warning messages are for your use and do not reduce the performance of the instrument.
- System error messages
Error messages indicate a problem with the instrument operation. This problem can usually be corrected by the operator.

Refer to the sections "System warning messages" and "System error messages" to localize and rectify a warning condition or an error.

8.2 System error messages

The Turbimax has five error codes, each assessing a different component or system of components in the instrument. The following table lists the error messages and their associated meanings.

Error message	Associated meaning	Typical cause	Tests and / or corrective measures
E-01	Overall light level detected is too low during calibration	Wrong standard is in the optical well or lamp failure	Turn the instrument off and then back on, recalibrate the instrument. If the error persists, please contact the responsible service to rectify the error.
E-02	Overall light level is too high during calibration	Wrong standard is in the optical well	
E-03	Amount of light detected between 0.02 NTU and 10.0 NTU is too small during calibration	Wrong standard is in the optical well or bad A/D circuitry	
E-04	Amount of light detected between 10.0 NTU and 1000 NTU is too small during calibration	Wrong standard is in the optical well or bad A/D circuitry	
E-05	Amount of light detected is too low during normal mode	Lamp failure	Replace the lamp with a spare lamp module.

8.3 System warnings

Warning	Possible cause	Tests and / or corrective measures
Flashing "Cal" block	Instrument needs to be re-calibrated.	Re-calibrate the instrument. We recommend calibration every 30 days.
Flashing "LoBat" block	Backup batteries are low	Contact the responsible service to replace the batteries.

8.4 Spare parts

Designation and content	Order number spare part kit
Tungsten lamp module	Contact the responsible service.
Batteries (set of 2)	Contact the responsible service.

8.5 Return

If the system has to be repaired, please return it *cleaned* to the sales center responsible.
Please use the original packaging, if possible.

8.6 Disposal

The device contains electronic components and must therefore be disposed of in accordance with regulations on the disposal of electronic waste.
Please observe local regulations.

9 Technical data

9.1 Input

Measured variable	Turbidity
Measuring range	0 ... 1000 NTU

9.2 Output

Recorder output	Uni-directional RS-232 output
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9.3 Power supply

Power supply unit	15 V DC / 1 A adaptable for 100 ... 240 VAC
Supply voltage	12 V DC

9.4 Performance characteristics

Response time	< 6 s
Reference temperature	25 °C / 77 °F
Resolution	0.01 NTU in the range 0.00 ... 9.99 NTU 0.1 NTU in the range 10.0 ... 99.9 NTU 1 NTU in the range 100 ... 1000 NTU
Maximum measured error	±2 % of reading or ±0.01 NTU whichever is greater
Repeatability	±1 % of reading or ±0.01 NTU whichever is greater

9.5 Environment

Storage temperature	-20 ... +60 °C / -4 ... +140 °F
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9.6 Process

Ambient temperature	10 ... 40 °C / 50 ... 104 °F
Medium temperature range	0 ... 50 °C / 32 ... 122 °F

9.7 Mechanical construction

Dimensions	H x W x D:	95 x 254 x 273 mm / 3.75 x 10 x 10.75 inches
Weight	1.3 kg (2.9 lbs.)	
Materials	Housing: Sample cuvette:	ABS Borosilicate glass
Light source	Turbimax CUE23:	Infrared LED, 860 nm
	Turbimax CUE24:	Quick connect Tungsten lamp, ~600 nm, 2250 °K

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