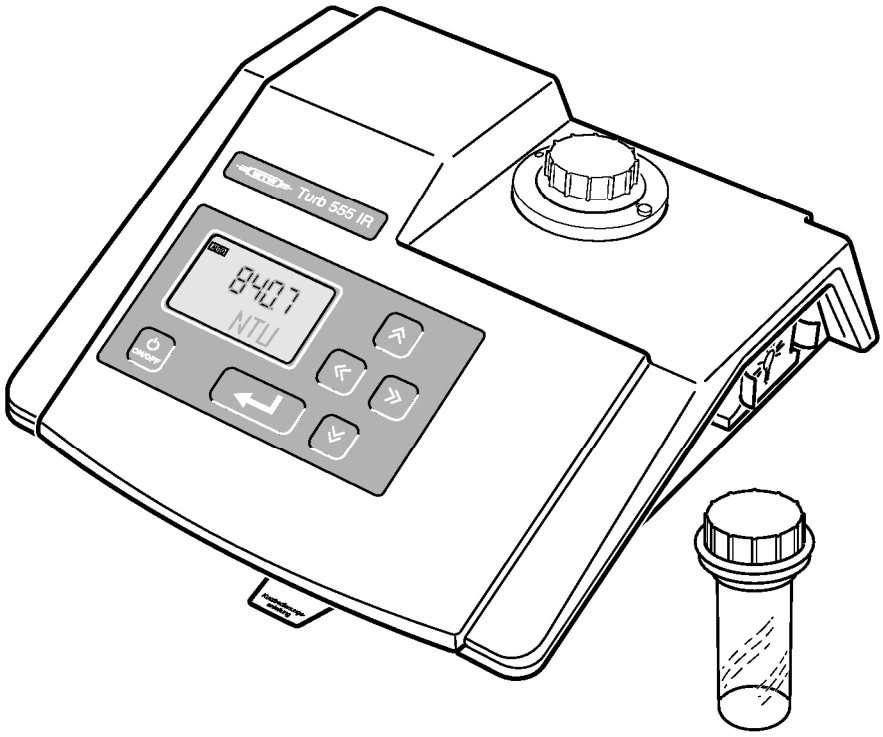
Operating Manual

Turb 555 /
Turb 555 IR



Distributed by:

Turbidity measuring instrument

ba41113d04 02/2006

Accuracy when going to press

The use of advanced technology and the high quality standard of our instruments are the result of a continuous development. This may result in differences between this operating manual and your instrument. Also, we cannot guarantee that there are absolutely no errors in this manual. Therefore, we are sure you will understand that we cannot accept any legal claims resulting from the data, figures or descriptions.

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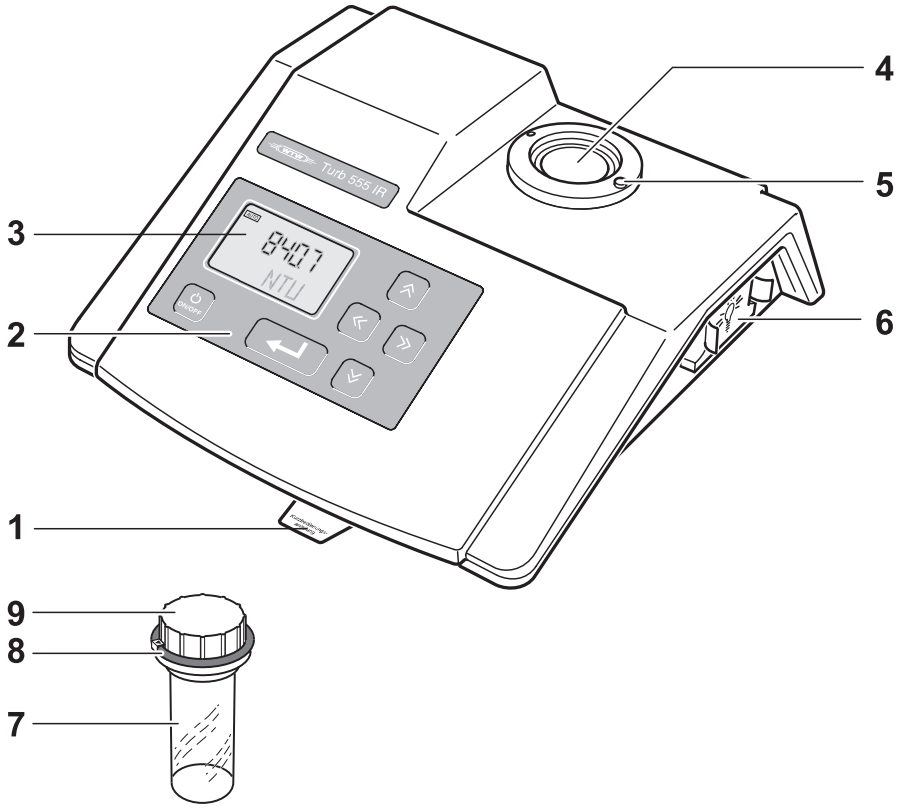
1 Overview

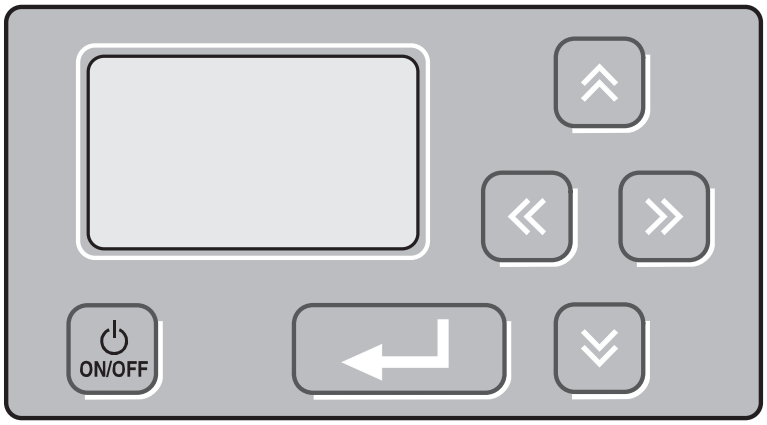
The Turb 555 / Turb 555 IR lets you perform turbidity measurements easily and reliably.
The measuring method used in the Turb 555 IR corresponds to the ISO 7027 / DIN 27027. The measuring method used in the Turb 555 follows the US EPA construction recommendations.



1 Short instructions
2 Keypad
3 Display
4 Cuvette shaft
5 Marker pin
6 Lamp module
7 Cuvette
8 Marker ring
9 Light protection cap

1.1 Operation pad

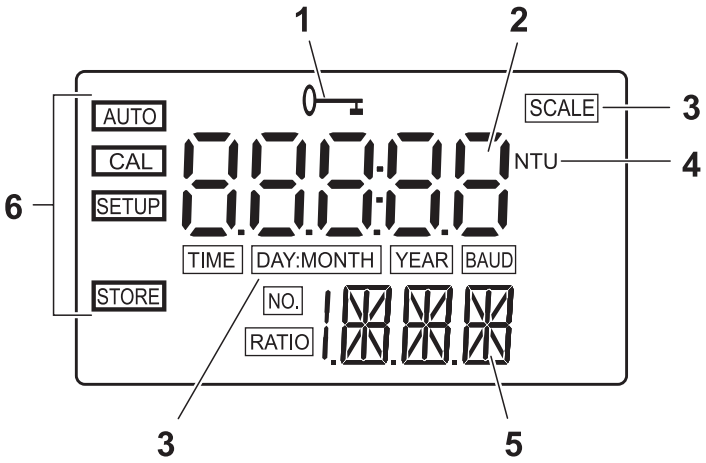
The Turb 555 / Turb 555 IR is operated via a 6 key touch pad and a display (LCD):



Key	Function
ON/OFF	Switch the measuring instrument on/off
↵	Confirm input Save/output measured value
⌃	Increase values Select settings
⌄	Reduce values Select settings
«	Scroll one menu page backwards
»	Scroll one menu page forwards

1.2 Display

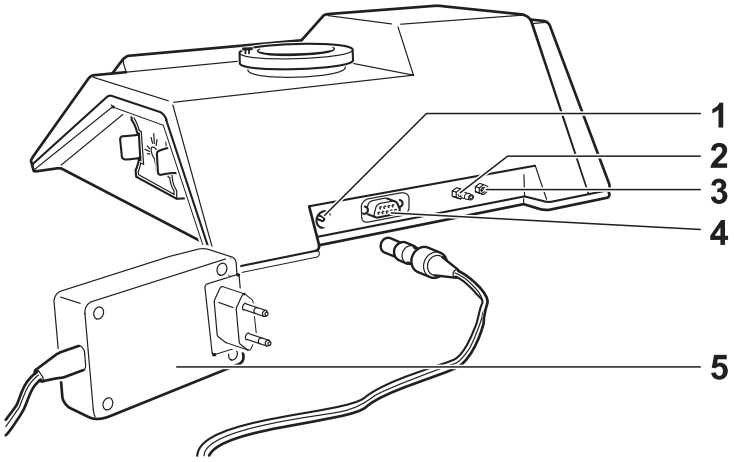
The display is integrated in the touch pad. It has the following possible indications:



1	Code symbol: Prompt to input the code
2	Measured value
3	User guidance symbols
4	Unit (only active during calibration)
5	Unit / User guidance / Error messages
6	Status indicators

The display has a background illumination which facilitates reading the displayed information even when the ambient light is bad.

1.3 Sockets



1	Socket for plug-in power supply unit
2	Dry air purge system inlet
3	Dry air purge system outlet
4	RS232 interface
5	Plug-in power supply unit

2 Safety

This operating manual contains basic instructions that you must follow during the commissioning, operation and maintenance of the measuring instrument. Consequently, all responsible personnel must read this operating manual before working with the measuring instrument.
The operating manual must always be available within the vicinity of the measuring instrument.

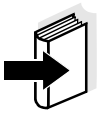
Target group

The measuring instrument was developed for use in the laboratory. Thus, we assume that, as a result of their professional training and experience, the operators will know the necessary safety precautions to take when handling chemicals.

Symbols used

Warning
indicates instructions that have to be followed to prevent damage to your instrument.

Note
indicates notes that draw your attention to special features.



Note
indicates cross-references to other documents, e. g. application reports.

2.1 Authorized use

This instrument is authorized exclusively for turbidity measurements in the laboratory.
The technical specifications as given in chapter TECHNICAL DATA, must be observed. Only the operation and running of the measuring instrument according to the instructions given in this operating manual is authorized. Any other use is considered **unauthorized**.

2.2 General safety instructions

This instrument left the factory in a safe and secure technical condition.

Function and operating safety

The smooth functioning and operational safety of the measuring instrument can only be guaranteed if the generally applicable safety measures and the specific safety instructions in this operating manual are followed during operation.

The smooth functioning and operational safety of the measuring instrument can only be guaranteed under the climatic conditions specified in the chapter TECHNICAL DATA.

If the instrument was transported from a cold environment to a warm environment, the formation of condensate can lead to the faulty functioning of the instrument. In this event, wait until the temperature of the instrument reaches room temperature before putting the instrument back into operation.

Safe operation

If safe operation is no longer possible, the instrument must be taken out of service and secured against inadvertent operation!
Safe operation is no longer possible if the measuring instrument

- has been damaged in transport
- has been stored under adverse conditions for a lengthy period of time
- is visibly damaged
- no longer operates as described in this manual.

If you are in any doubt, please contact the supplier of the instrument.

Obligations of the operator

The purchaser of this measuring instrument must ensure that the following laws and guidelines are observed when using dangerous substances:

- EEC directives for protective labor legislation
- National protective labor legislation
- Safety regulations
- Safety datasheets of the chemical manufacturers.

3 Commissioning

Scope of delivery

- Turb 555 or Turb 555 IR laboratory measuring instrument with short instructions
- Operating manual
- Universal plug-in power supply unit with country-specific adapters
- Plastic box with 4 calibration standards (0.02 / 10 / 100 / 1750 NTU) including marker rings
- Three empty cuvettes with marker rings

3.1 Initial commissioning

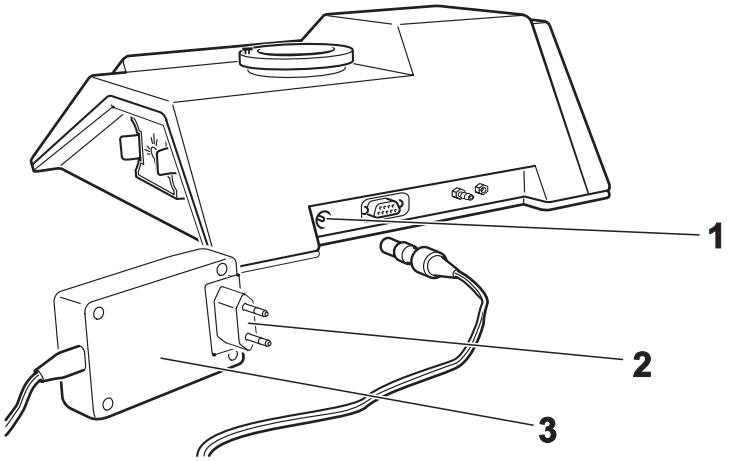
Inserting the short instructions

The first time the instrument is commissioned, you must insert the card that was delivered containing the short instructions into the underside of the measuring instrument:

1	Turn the instrument around and carefully put it down.
2	Insert the card with the short instructions so that the English side is not visible.
3	Turn the instrument around again. The short instructions card can now be pulled forward from under the instrument.

3.2 Connecting the plug-in power supply unit

1	Plug the original WTW plug-in power supply unit (3) into the socket (1) of the measuring instrument.
2	Plug the suitable adapter (2) into the plug-in power supply unit.
3	Connect the plug-in power supply unit to an easily accessible mains socket.



3.3 Switching on the measuring instrument

1	Place the measuring instrument on a flat surface and protect it from intense light and heat.
2	Press the ■ key. The measuring instrument automatically switches to the measuring mode: A measured value and the AUTO display appear.

Sample display

3	Set the date and time, if necessary (see section 4.5 SETTING UP THE INSTRUMENT).
4	Wait until the warm-up period is over.

Warm-up period

For routine measurements without special accuracy requirements, a warm-up period of 5 minutes is sufficient. For high precision measurements, the warm-up period should be 30 minutes minimum. This is also valid when you want to calibrate your instrument. Only then we can guarantee that the instrument measures with the accuracy specified in chapter 7 TECHNICAL DATA.

Note
Even if the instrument is not measuring, always leave a cuvette plugged in the cuvette shaft so that the cuvette shaft is protected against dust.

4 Operation

4.1 Instructions for operating

4.1.1 Marking and aligning cuvettes

Even completely clean quality cuvettes exhibit tiny directional differences in their light transmittance. Therefore, each cuvette should be marked - both the measuring cuvettes as well as the cuvettes with the calibration standards (refer to section 2130 of the "Standard Methods for the Examination of Water and Wastewater", 19th edition). Consequently, each cuvette can always be inserted in the correct position and you can achieve precise and reproducible measuring results.

Cleaning the cuvette

The cuvette must be absolutely clean (see section 5.2.2 CLEANING THE CUVETTES).

Marking the cuvette

This is how to mark a cuvette (empty or full):

1	The cuvette must be closed with the black light protection cap. Make sure that the outside of the cuvette is clean, dry, and free of fingerprints.
2	Insert the cuvette in the cuvette shaft of the turbidimeter.
3	Slowly rotate the cuvette through one complete rotation (by 360°).
4	Watch the display of the turbidimeter while you rotate the cuvette. Leave the cuvette in the position that gives the lowest display.
5	Attach a marker ring to the black light protection cap of the cuvette. The arrow on the marker ring must point to the marker pin on the casing of the cuvette shaft.
6	Leave the marker ring on the light protection cap of the cuvette. This cuvette is now permanently marked.

Note
Always use the cuvette and the light protection cap together; only in this way is the cuvette marked.

Aligning a marked cuvette

A marked cuvette is aligned as follows:

1	Insert the cuvette in the cuvette shaft of the turbidimeter.
2	Align the marked cuvette so that the arrow on the marker ring points to the marker pin on the locking collar of the cuvette shaft.

Aligning an unmarked cuvette

An unmarked cuvette is aligned as follows:

1	Insert the cuvette in the cuvette shaft of the turbidimeter.
2	Slowly rotate the cuvette through one complete rotation (by 360°).
3	Watch the display of the turbidimeter while you rotate the cuvette. Leave the cuvette in the position that gives the lowest display.

Balancing cuvettes

Even insignificant variations in the glass affect the measured value. For this reason, always use the same cuvette or balance a pair of cuvettes for low turbidity values:

1	Fill the first cuvette with the sample, align it and mark it (see section 4.1.1 MARKING AND ALIGNING CUVETTES).
2	Fill the second cuvette with the same sample and insert it into the cuvette shaft.
3	Rotate the cuvette until the same measured value is displayed as for the first cuvette.
4	Mark the cuvette with a marker ring.

4.1.2 Venting the sample

Air bubbles in the sample affect the measuring result to a massive extent because they have a large scattering effect on the incident light. Larger air bubbles cause sudden changes in the measured values whereas smaller air bubbles are recorded by the instrument as turbidity. Therefore, avoid or remove air bubbles:

Avoiding or removing air bubbles

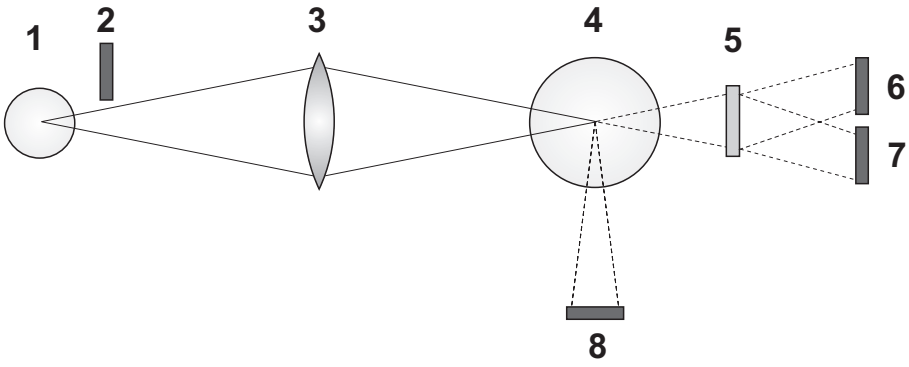
- During sampling, ensure all movement is kept to a minimum
- If necessary, vent the sample (ultrasonic baths, heating or adding a surface-active substance to reduce the surface tension)
- Use a pour-through vessel.

4.2 Measuring turbidity

4.2.1 Measuring methods of the Turb 555 and Turb 555 IR

Measuring system

The measuring system consists of a light source, the cuvette with the sample, a beam splitter and a total of four light detectors:



1	Light source: Tungsten lamp (Turb 555) or infrared light source (Turb 555 IR)
2	Reference detector
3	Lens
4	Cell with sample
5	Beam splitter
6	Transmission detector for low transmission (high turbidity)
7	Transmission detector for high transmission (low turbidity)
8	Nephelometric detector

Measuring methods

The Turb 555 /Turb 555 IR can measure with different measuring methods. To do so, the measuring signals of the four detectors are evaluated differently.

Nephelometric (90° scattered light) measurement	The rays of the undissolved particles scattered in a 90° angle are measured. The measuring result is given in NTU or FNU.
Transmission measurement	The intensity of the rays going through the sample is measured. The measuring result is given in FAU.
Ratio measurement	The relation of the transmission measurement to the 90° scattered light measurement is measured. This procedure compensates for the light that is reduced by the color of a sample. The measuring result is given in NTU (Ratio) or FNU (Ratio).

The specified measuring unit determines whether a 90° scattered light measurement or a transmission measurement is performed.

Note
A Ratio measurement is only possible if you have selected NTU or FNU as the measuring unit.

You can select the following measuring units (see section 4.5.2 SETTINGS):

Measuring units Turb 555

- **NTU** = **N**ephelometric **T**urbidity **U**nits (90°scattered light measurement). Nephelometric turbidity unit according to section 2130 of the "Standard Methods for the Examination of Water and Wastewater", 19th edition.
- **EBC** = **E**uropean **B**rewery **C**ommission (90°scattered light measurement). Nephelometric turbidity unit, used by the European Brewery Commission (Conversion: 0.245 EBC = 1 NTU).
- **NEPHELO** (90°scattered light measurement) Nephelometric turbidity unit, used in microbiological research (Conversion: 6.7 Nephelo = 1 NTU).

Measuring units Turb 555 IR

- **NTU** = **N**ephelometric **T**urbidity **U**nits (90°scattered light measurement). Nephelometric turbidity unit according to section 2130 of the "Standard Methods for the Examination of Water and Wastewater", 19th edition.
- **FNU** = **F**ormazin **N**ephelometric **U**nits (90°scattered light measurement). Nephelometric turbidity unit. This unit is only applicable if the instrument is calibrated with formazin standards. It is used for measurements according to DIN 27027 / ISO 7027 (Conversion: 1 FNU = 1 NTU).
- **FAU** = **F**ormazin **A**ttenuation **U**nits (transmission measurement). Formazin attenuation unit for measurements according to DIN 27027 / ISO 7027 over 40 FNU.

4.2.2 Single measurements

Preparatory activities

Perform the following preparatory activities when you want to measure (see section 3.3 SWITCHING ON THE MEASURING INSTRUMENT):

1	Switch on the measuring instrument.
2	Wait until the warm-up period is over.

Note
Incorrect calibration of the turbidimeter will result in incorrect measured values.
Carry out the calibration regularly at the specified fixed intervals.

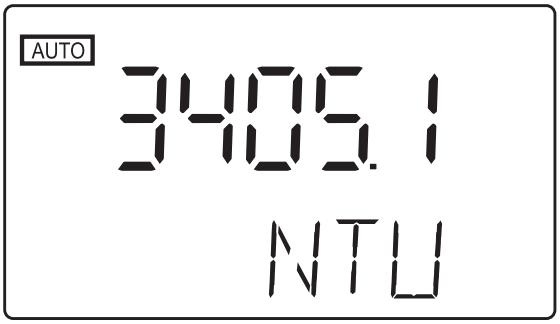
Note
The outside of the cuvette always has to be clean, dry, and free of fingerprints. Clean the cuvette before starting to measure (see section 5.2.2 CLEANING THE CUVETTES). Only hold the cuvettes by the top or by the black light protection cap.

Measuring

How to measure the turbidity of a sample:

1	Rinse out a clean cuvette with the sample to be measured: Pour approximately 20 ml sample into the cuvette. Close the cuvette and rotate it several times before throwing the sample away.
2	Repeat the rinsing procedure twice more.
3	Fill the cuvette with the sample to be measured (approx. 30 ml). Close the cuvette with the black light protection cap.
4	Make sure that the outside of the cuvette is clean, dry, and free of fingerprints.

5	Insert the cuvette in the cuvette shaft of the turbidimeter.
6	Align the cuvette (see section 4.1.1 MARKING AND ALIGNING CUVETTES).
7	Wait for a stable measured value and read it.



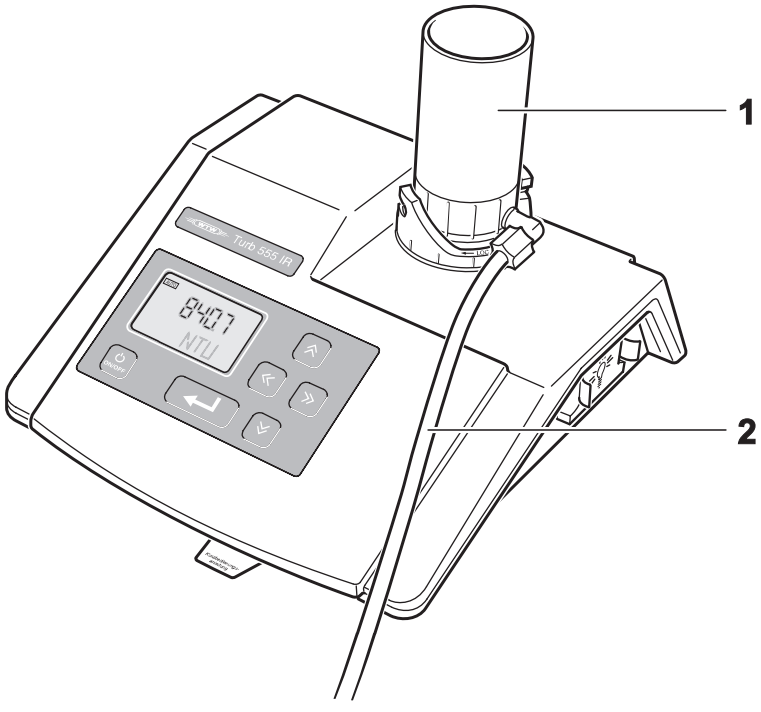
8	How to output measured values to the printer or PC refer to section 4.6.2 OUTPUT OF MEASURED VALUES.
9	Repeat steps 1 to 8 for all samples.

4.2.3 Measuring turbidity using the pour-through vessel (accessory)

The pour-through vessel (WTW order number 600 600) fits any Turb 555 /Turb 555 IR instrument and enables you to measure several samples one after the other quickly and easily. Any interference effects caused by air bubbles are reduced. Besides, you do not have to use balanced cuvettes for comparative measurements as always the same cuvette is used.

Note

If you measure cold samples, the outside of the cuvette may mist up after the sample is poured in causing the measured value to be much too high. Therefore, we recommed to purge the cuvette shaft with dry air or nitrogen (see section 4.2.4). Otherwise, you have to wait until the sample has reached room temperature before filling.

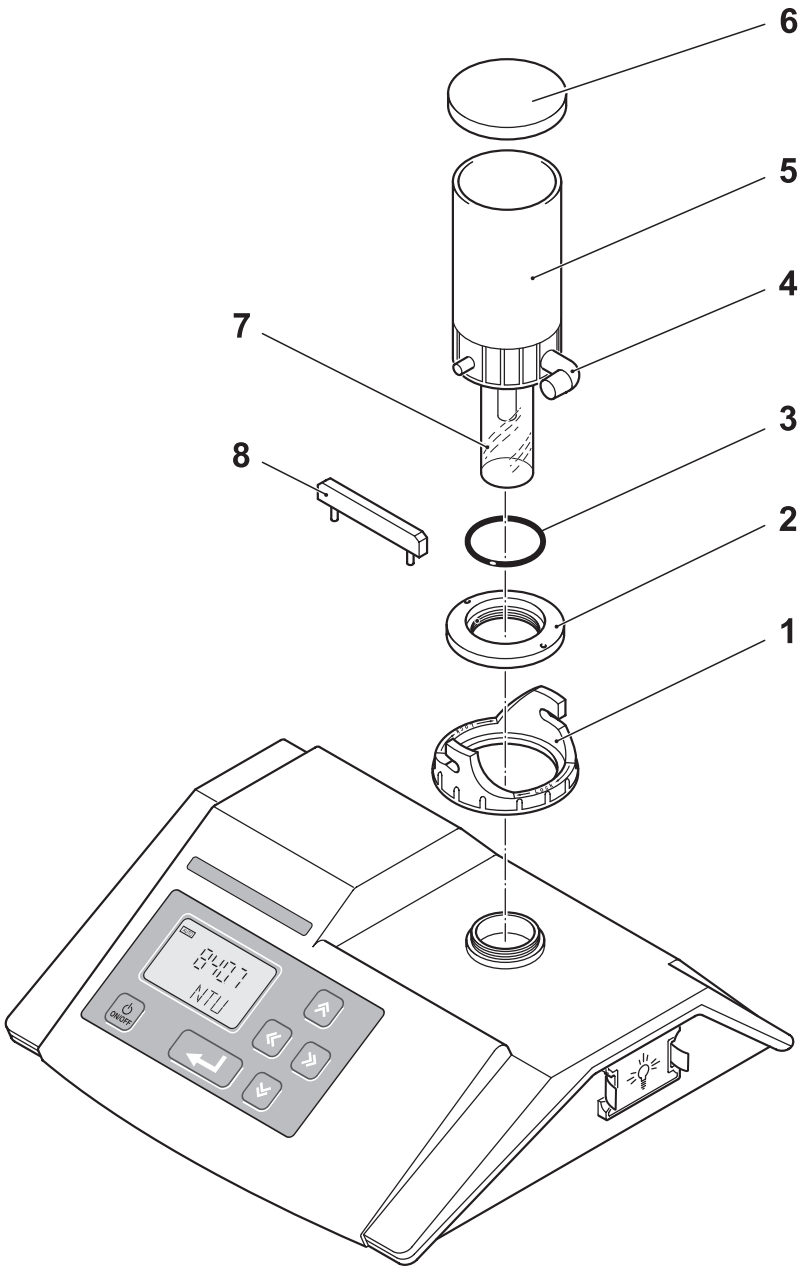


1	Pour-through vessel
2	Outlet hose

Preparatory activities

Switch on your instrument before installing the pour-through vessel. Thus, the warm-up period of your instrument will be over after the installation and you will be able to start measuring immediately (warm-up period, see section 3.3 SWITCHING ON THE MEASURING INSTRUMENT).

Installing the pour-through vessel



To install the pour-through vessel, proceed as follows:

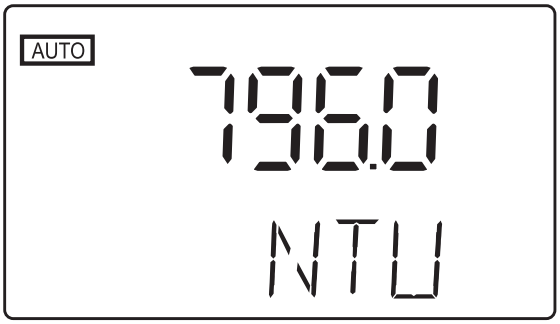
1	Pull the white marker pin out of the locking collar (2) of the cuvette shaft.
2	Using the spanner wrench provided (8), unscrew and remove the locking collar (2).
3	Place the fixing ring (1) on the cuvette shaft.
4	Reattach the locking collar (2) and tighten it up using the spanner wrench (8).
5	Insert the white marker pin again in one of the holes on the locking collar.
6	Insert the sealing ring provided (3) into the locking collar of the cuvette shaft.
7	Screw the screw-in cuvette (7) into the base of the pour-through vessel (5).
8	Make sure that the outside of the cuvette is clean, dry, and free of fingerprints.
9	Insert the flow-through vessel (5) with the cuvette at the bottom into the cuvette shaft of the measuring instrument.
10	Align the pour-through vessel with the cuvette (see section 4.1.1 MARKING AND ALIGNING CUVETTES).
11	Leave the pour-through vessel in this position and hold it by the lower, knurled section.
12	Using the other hand, turn the fixing ring (1) clockwise so that it clicks into place and secures the pour-through vessel.
13	Plug the outlet hose on the outlet (4) and position it so that its end is lower than the pour-through vessel and the sample can run out into a suitable vessel or drain.
14	Replace the lid (6).

Note
The pour-through vessel can remain installed until the next calibration.

Note
If you use the pour-through vessel, you do not need to rinse the cuvette 3x with the sample. The sample rinses the cuvette as it flows through. Even the forming of air bubbles is considerably reduced.

Measuring

1	Remove the lid from the pour-through vessel.
2	Slowly pour approximately 500 ml sample into the container of the pour-through vessel. The sample runs through the vessel into the cuvette and any excess sample runs out again through the outlet hose. In this way, any "old" sample liquid that remains will be displaced.
3	When no more liquid runs out of the outlet hose, wait for a stable measured value and read it.



4	How to output measured values to the printer or PC refer to section 4.6.2 OUTPUT OF MEASURED VALUES.
5	Repeat steps 1 to 4 for all samples.

4.2.4 Measuring turbidity using the flow-through vessel (accessory)

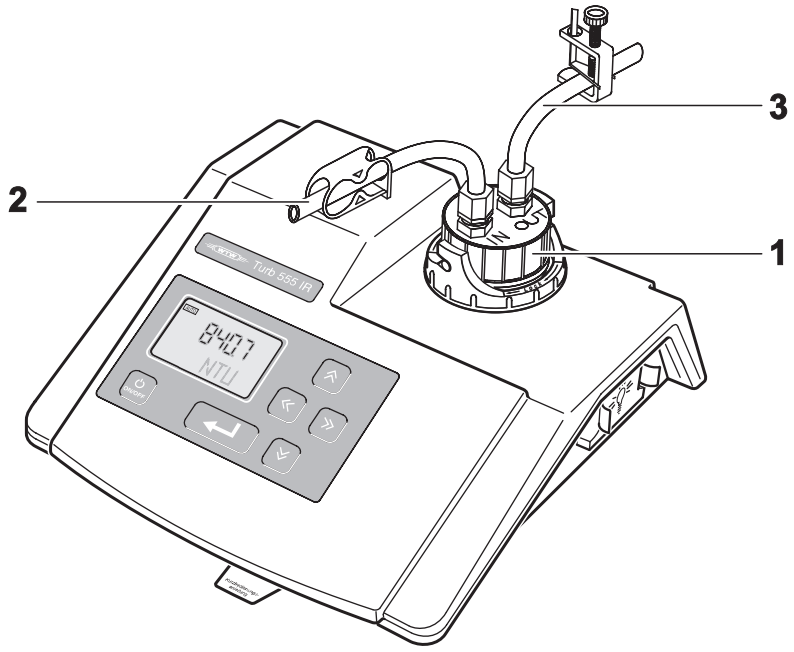
The flow-through vessel (WTW order number 600 606) fits to each Turb 555 /Turb 555 IR instrument and enables you to continuously measure a sample flowing through and to notice turbidity changes immediately. Using the periodical measured value output, you can output the current measured values periodically to a printer or PC connected.

Connection values

Maximum pressure:	4 bar (60 psi)
Recommended flow-through quantity:	2-5.5 l/min (0.5-1.5 gpm)

Note

Measuring with the flow-through vessel makes it necessary to purge the cuvette shaft with dry air or nitrogen. Otherwise, the outside of the cuvette may mist up after pouring in due to a cold sample, causing the measured value to be much too high.



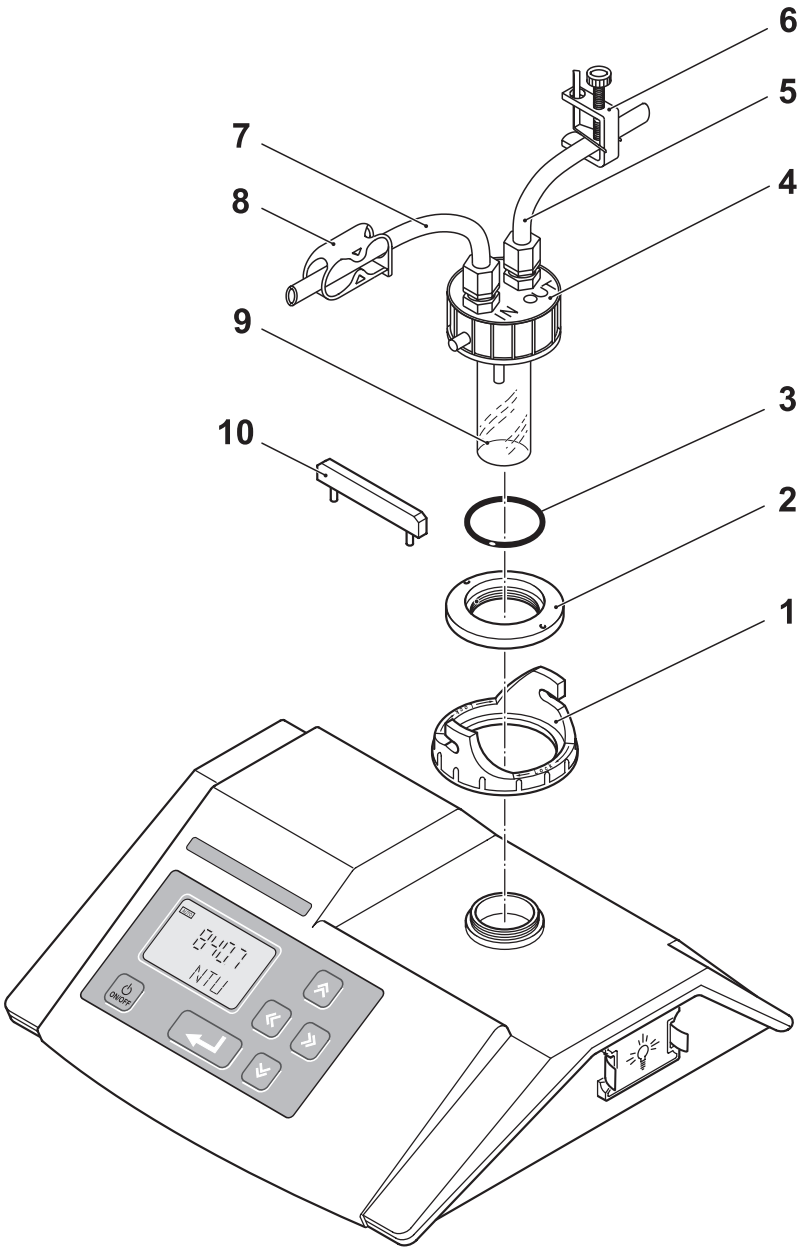
1	Flow-through vessel
2	Inlet hose

3	Outlet hose

Preparatory activities

Switch on your instrument before installing the flow-through vessel. Thus, the warm-up period of your instrument will be over after the installation and you will be able to start measuring immediately (warm-up period, see section 3.3 SWITCHING ON THE MEASURING INSTRUMENT).

Installing the flow-through vessel



To install your flow-through vessel, proceed as follows:

1	Pull the white marker pin out of the locking collar (2) of the cuvette shaft.
2	Using the spanner wrench provided (10), unscrew and remove the locking collar (2).
3	Place the fixing ring (1) on the cuvette shaft.
4	Reattach the locking collar (2) and tighten it up using the spanner wrench (10). The fixing ring can easily be rotated now.
5	Insert the white marker pin again in one of the holes on the locking collar.
6	Insert the sealing ring provided (3) into the locking collar of the cuvette shaft.
7	Screw the screw-in cuvette (9) into the lid (4).
8	Make sure that the outside of the cuvette is clean, dry, and free of fingerprints.
9	Insert the flow-through vessel with the cuvette at the base into the cuvette shaft of the measuring instrument and press it in tightly.
10	Align the pour-through vessel with the cuvette (see section 4.1.1 MARKING AND ALIGNING CUVETTES).
11	Leave the flow-through vessel in this position and hold it.
12	Using the other hand, turn the fixing ring (1) clockwise so that it clicks into place and secures the flow-through vessel.
13	Determine how long the hoses for the inlet (7) and outlet (5) have to be. Cut the black hose enclosed in two suitable pieces.
14	Attach a black hose fitting to each of the hoses. Thread a nut on each of the hoses so that the thread of the nut points to the hose fitting.

15	Attach the tubes to the flow-through vessel by screwing the nuts to the threads of the flow-through vessel. When doing so, observe the marking of the threads: in = inlet, out = outlet.
16	Attach a clamp (6 and 8, not contained in the scope of delivery) to the inlet hose and outlet hose each.
17	Connect the hose ends to the sample inlet and drain.

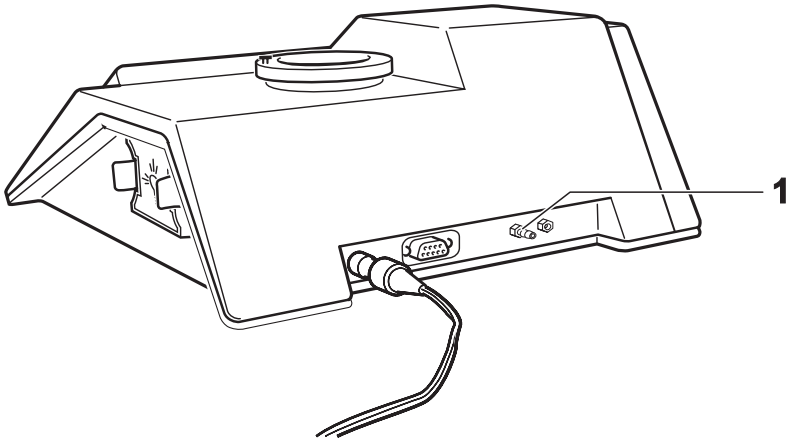
Warning
The drain must be pressure-free to avoid damage to the tubing system!

Note
The flow-through vessel can remain installed until the next calibration.

Note
If you use the flow-through vessel, you do not need to rinse the cuvette 3x with the sample. The sample rinses the cuvette as it flows through. Even the forming of air bubbles is considerably reduced.

Connecting the cuvette shaft purging

Proceed as follows:



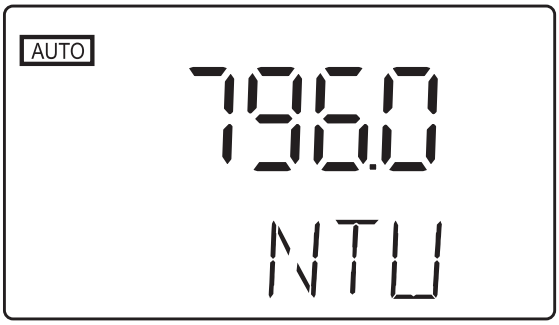
1	Connect the purging gas source to the fitting (1) on the back of the instrument using a suitable hose.
2	Turn on the purging gas.
3	Adjust supply values.

Supply values

Maximum pressure:	4 bar (60 psi)
Recommended flow-through quantity:	2-5.5 l/min (0.5-1.5 gpm)

Measuring

1	Provide sample flow.
2	Read the measured value.



3	How to output measured values to the printer or PC refer to section 4.6.2 OUTPUT OF MEASURED VALUES.

4.3 Access codes

4.3.1 General information

The Turb 555 /Turb 555 IR has a code function with two different access codes:

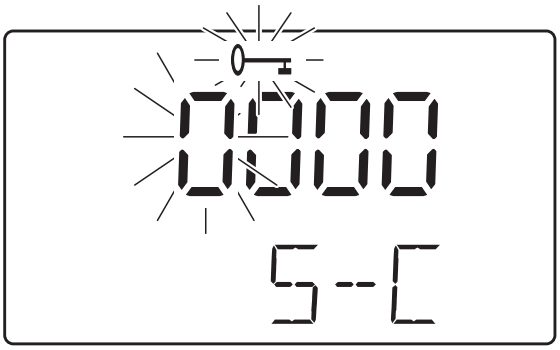
- Calibration code to protect the calibration data
- Setup code to protect the instrument configuration

Measured values that were determined while the code function was active are given the "QC" (Quality Control) identifier when output to the printer/PC (see section 4.6.2 OUTPUT OF MEASURED VALUES).

You can switch the code function on or off and alter the access codes (see section 4.5 SETTING UP THE INSTRUMENT).

4.3.2 Entering access codes

When the code function is switched on, it is only possible to calibrate or alter the instrument configuration after the relevant code number has been input.



Entering the codes

To enter the calibration or setup code, proceed as follows:

1	With the ⌃ or ⌄ key set the first digit of the code.
2	Press ↵.
3	With the ⌃ or ⌄ key set the second digit of the code.
4	Press ↵.
5	With the ⌃ or ⌄ key set the third digit of the code.
6	Press ↵.
7	With the ⌃ or ⌄ key set the last digit of the code.
8	Press ↵. When the correct code was input, the first menu of the calibration or of the instrument setup is displayed.

Note
When a wrong code was input, the instrument automatically returns to the normal measuring mode (AUTO display).

4.4 Calibration

4.4.1 Basic information on calibration

Why calibrate?

As for any measuring instrument, the measuring accuracy of the Turb 555 /Turb 555 IR has to be checked and adjusted at regular intervals.

When to calibrate?

Under normal conditions, we recommend to calibrate the measuring instrument at least every three months. You can set the time between two calibrations in the instrument setup. When the time interval has expired, the instrument shows by a flashing CAL symbol that a calibration is due. Additionally, the instrument has to be calibrated each time the lamp has been replaced.

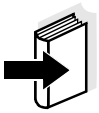
Referencing Formazin In Ratio Mode Using the Turb 555 / Turb 555 IR

For the ratio mode, there are no standard procedures.
The provided AMCO Standards 10 and 100 NTU in the calibration kit are designed for nephelometric measurements up to 1000 NTU.
If you perform a user defined process and quality control by measuring turbidity in ratio mode you can use the AMCO standards, but take into consideration that the measured values may not read the same as values measured in non-ratio (nephelometric) mode (90° scattered light).
To perform ratio measurements that reference formazin with values below 100 NTU it is necessary to first prepare two formazin calibration standards of 10 NTU and 100 NTU.
Perform the calibration procedure as described in your operator's manual, but use the two formazin calibration standards instead of the AMCO standards of the calibration kit.
Please note that formazin in a diluted form is unstable and must be used immediately after preparation.

4.4.2 Calibration procedures

You have the following possibilities to calibrate the Turb 555 /Turb 555 IR:

- Five-point calibration according to the preset calibration program (section 4.4.4). To achieve the accuracy specified in the Technical Data in the whole measuring range you have to carry out this calibration.
- User-defined calibration over a limited interval (section 4.4.5).
- Single-point calibration. This is a special user-defined calibration and only to be recommended as a temporary solution. The calibration timer is not reset. After a single-point calibration, measuring is only possible near the calibration point and with reduced accuracy.



Note
For measurements according to DIN/ISO or Standard Methods, it is absolutely necessary to calibrate with Formazin. For more information, see application report 998 255 PREPARATION OF FORMAZIN PRIMARY STANDARD.

Calibration points and measuring ranges

For an optimum calibration over the whole measuring range of the instrument, you need the following five calibration standards:

- 0.02 NTU
- 10 NTU
- 100 NTU
- 1750 NTU
- 10000 NTU (available as accessory, see chapter 8 ACCESSORIES, OPTIONS)

You can also calibrate with less than five calibration standards if the measured values expected are in a limited range. When selecting the calibration points, however, the following rules have to be observed:

- The measuring range to be expected must be between two calibration points.

- If there are more possible calibration points between the start and end of the calibration interval, they must be used.
- Always carry out the calibration in the sequence from the highest to the lowest value.

Note
When you observe these rules, the instruments measures with the accuracy specified in chapter 7 TECHNICAL DATA within the calibration interval.

Course of the measurement during calibration

A calibration standard is measured in several cycles. In each measuring cycle, all four of the system detectors are scanned one after the other.

For a precise calibration, a certain number of measuring cycles per calibration standard is required. The number of the remaining measuring cycles is displayed in the lower display line. After the last measuring cycle the calibration step is finished.

For the 10 NTU and 100 NTU calibration standards, the calibration step is automatically repeated once.

4.4.3 Preparing the calibration

Perform the following preparatory activities when you want to calibrate:

1	Switching on the measuring instrument.
2	Wait until the 30 minutes warm-up period is over.
3	Keep the calibration standards ready.
4	Make sure that the outsides of the cuvettes are clean, dry, and free of fingerprints.

Warning
Never open the cuvettes with the calibration standards.

4.4.4 Five-point calibration

Calibration sequence

For the five-point calibration according to the calibration program, the instrument is calibrated with the following calibration standards in the following sequence:

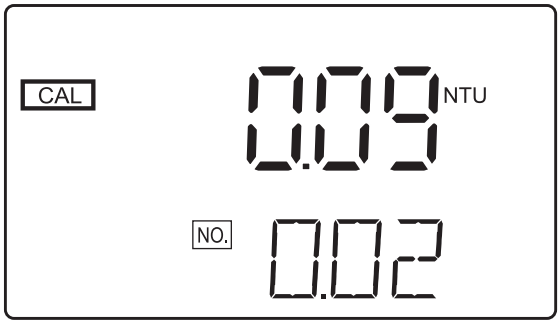
0.02 > 1750 > 10000 > 100 > 10 > 0.02 NTU

Note
If, after the end of a calibration step, you do not continue the calibration within 5 minutes, the instrument automatically returns to the normal measuring mode. It will then continue to work with the previous calibration data.

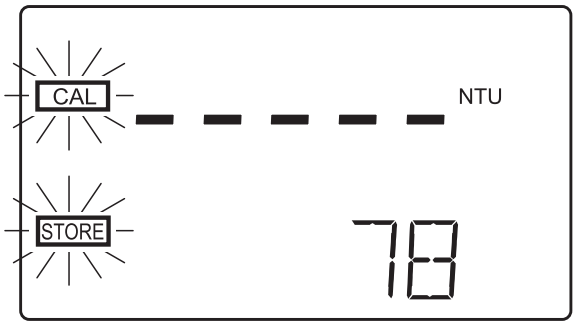
Calibration

To calibrate your measuring instrument using the calibration program, proceed as follows:

1	In the normal measuring mode, press the ⌃⌃ or ⌄⌄ key until the CAL indicator appears on the left part of the display.
2	If necessary, enter the calibration code (section 4.3 ACCESS CODES).
3	Press ↵. In the lower display line, the instrument asks you to insert the 0.02 NTU calibration standard.



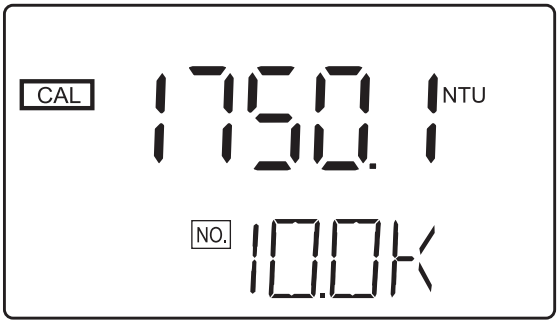
4	Insert the 0.02 NTU calibration standard into the cuvette shaft.
5	Align the cuvette.
6	Press the ↵ key. During the calibration step, the CAL and STORE symbols flash. The lower display line shows the remaining measuring cycles until the end of the calibration step.



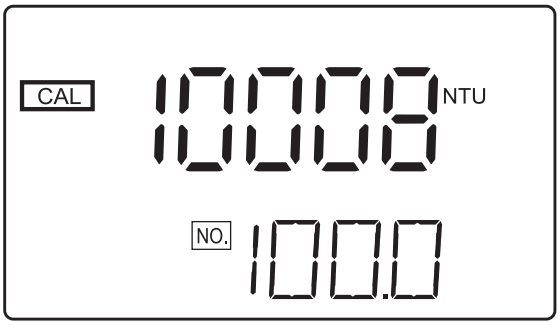
7	Wait until the calibration step is finished. The instrument asks you to insert the next calibration standard (*1.75K* = 1750 NTU).

8	Insert the 1750 NTU calibration standard into the cuvette shaft.

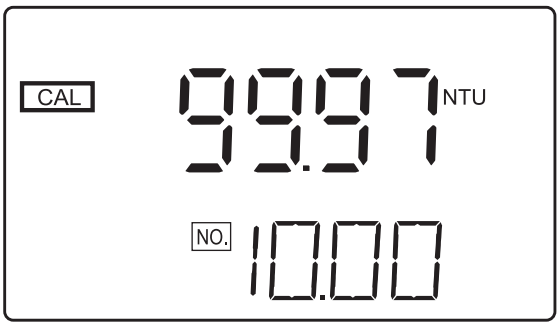
9	Align the cuvette.
10	Press the ↵ key. During the calibration step, the CAL and STORE symbols flash. The lower display line shows the remaining measuring cycles until the end of the calibration step.
11	Wait until the calibration step is finished. In the lower display line, the instrument asks you to insert the next calibration standard (*10.0K* = 10000 NTU).



12	Insert the 10000 NTU calibration standard into the cuvette shaft.
13	Align the cuvette.
14	Press the ↵ key. During the calibration step, the CAL and STORE symbols flash. The lower display line shows the remaining measuring cycles until the end of the calibration step.
15	Wait until the calibration step is finished. The instrument asks you to insert the next calibration standard (*100.0* = 100 NTU).

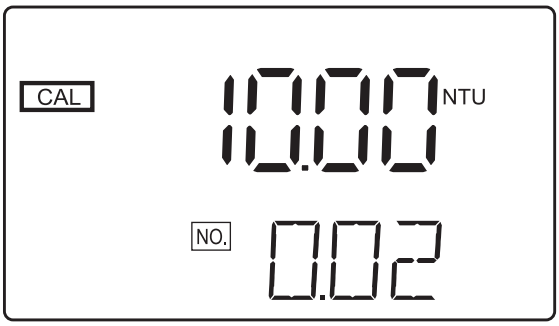


16	Insert the 100 NTU calibration standard into the cuvette shaft.
17	Align the cuvette.
18	Press the ↵ key. During the calibration step, the CAL and STORE symbols flash. The lower display line shows the remaining measuring cycles until the end of the calibration step. Then, the calibration step is carried out once more.
19	Wait until the calibration step is finished. The instrument asks you to insert the next calibration standard (*10.00* = 10 NTU).



20	Insert the 10 NTU calibration standard into the cuvette shaft.
21	Align the cuvette.

22	Press the ↵ key. During the calibration step, the CAL and STORE symbols flash. The lower display line shows the remaining measuring cycles until the end of the calibration step. Then, the calibration step is carried out once more.
23	Wait until the calibration step is finished. The instrument asks you to insert the next calibration standard (0.02 NTU) once more.

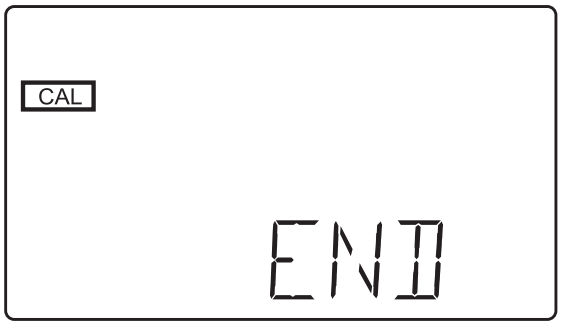


24	Insert the 0.02 NTU calibration standard into the cuvette shaft.
25	Align the cuvette.
26	Press the ↵ key. During the calibration step, the CAL and STORE symbols flash. The lower display line shows the remaining measuring cycles until the end of the calibration step.
27	Wait until the calibration step is finished and *END* appears in the lower display line.
28	Press the ↵ key. The calibration program is finished. The instrument automatically returns to the normal measuring mode (AUTO is displayed). If a printer or PC is connected and switched on, a calibration record is automatically output (see section 4.6.3 CALIBRATION RECORD).

Terminating the calibration prematurely

To terminate the calibration process before the scheduled end, proceed as follows:

1	Wait until the current calibration step is finished and the instrument asks you to insert the next calibration standard.
2	Press the ⏫ or ⏬ key until *END* is displayed in the lower display line.



3	Press the ↵ key. The instrument returns to the measuring mode (AUTO is displayed). If a printer or PC is connected and switched on, a calibration record is automatically output (see section 4.6.3 CALIBRATION RECORD).

Note
If you have not carried out all calibration steps correctly, the instrument cannot measure with the specified accuracy.

Note
You can switch off the instrument only after you have finished or terminated the calibration according to the program.

Calibration record

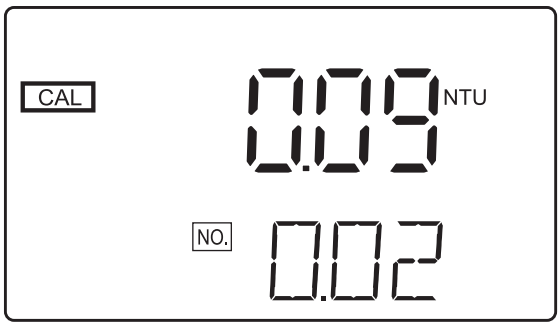
If a printer or PC is connected and switched on, a calibration record is automatically output (sample printout, see section 4.6.3).

4.4.5 User-defined calibration

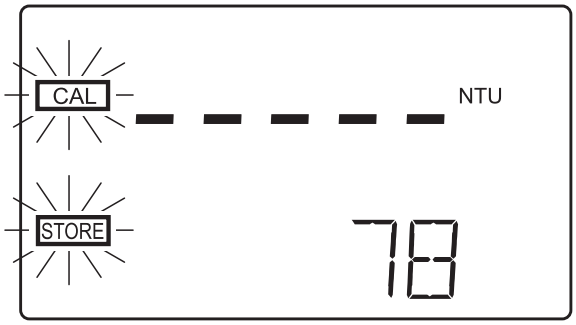
Calibration

This is how you calibrate your measuring instrument according to a procedure selected by you:

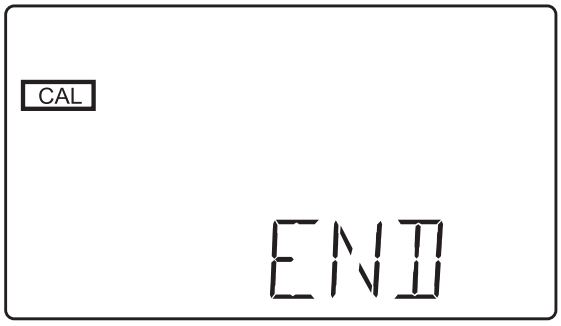
1	In the normal measuring mode, press the ⌃ or ⌄ key until the CAL indicator appears on the left part of the display.
2	Press ↵.
3	If necessary, enter the calibration code (section 4.3 ACCESS CODES).
4	Press ↵. In the lower display line, the instrument asks you to insert the 0.02 NTU calibration standard.



5	With the ⌃ or ⌄ key, change the calibration standard or keep the setting.
6	Insert the displayed calibration standard into the cuvette shaft.
7	Align the cuvette.
8	Press the ↵ key. During the calibration step, the CAL and STORE symbols flash. The lower display line shows the remaining measuring cycles until the end of the calibration step.



9	Wait until the calibration step is finished. The instrument asks you to insert the next calibration standard according to the calibration program.
10	Repeat the steps 5 to 9 until all required calibration standards have been measured.
11	Press the ⏫ or ⏬ key until *END* is displayed in the lower display line.



12	Press the ↵ key. The instrument returns to the measuring mode (AUTO is displayed).

4.5 Setting up the instrument

4.5.1 General information

In the normal measuring mode, you can adjust the Turb 555 /Turb 555 IR to your requirements using the setup function at any time. You can alter the following settings:

- Measuring procedure / measured unit
- Ratio method (on or off)
- Resolution
- Code function (on or off)
- Calibration and setup code
- Periodical output of measured values to the RS232 interface (on or off)
- Output interval of the periodical measured value output
- Baud rate of the RS232 interface
- Calibration interval (1 - 180 days)
  After the selected calibration interval has expired, the Cal indicator appears on the display until the measuring instrument is recalibrated.
- Date
- Time

The settings remain stored in the instrument.

Note
Settings are made in this measuring instrument following a compelled guidance. If you have called up the setting function once, you can only leave this function if you have run through all the settings one after the other with the « or » key, until *END* is displayed in the lower display line. Then confirm with the ↵ key. The instrument returns to the normal measuring mode. You can switch off the instrument only after you have left the setting function.

4.5.2 Settings

If you want to change the instrument setup, proceed as follows:

1	In the normal measuring mode, press the ⌃ or ⌄ key until the SETUP indicator appears on the left part of the display.
2	Press ↵.
3	If necessary, enter the setup code (section 4.3 ACCESS CODES).

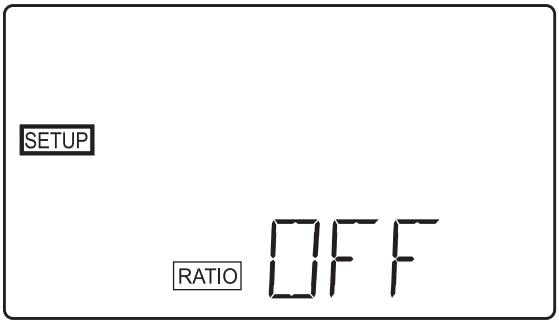
Selecting the measuring unit

You can select the unit in the following menu (SCALE display). For more detailed information on the individual units and the measuring methods they are based on, see section 4.2.1.

4	Press the ⌃ or ⌄ key to select the required unit. Options: Turb 555: *NTU -> EBC -> NEPHELO* Turb 555 IR: *NTU -> FNU -> FAU*
5	Confirm your selection with ↵.

Ratio

In the following menu, you can select the measurement according to the Ratio method (RATIO is displayed). For more detailed information on the Ratio method, see section 4.2.1.



6	Press the ⏫ or ⏬ key to switch the measurement according to the Ratio method on or off.
7	Confirm your selection with ↵.

Resolution

In the following menu, you can select the resolution (*RES* is displayed in the lower display line). The current resolution appears in the upper display line.

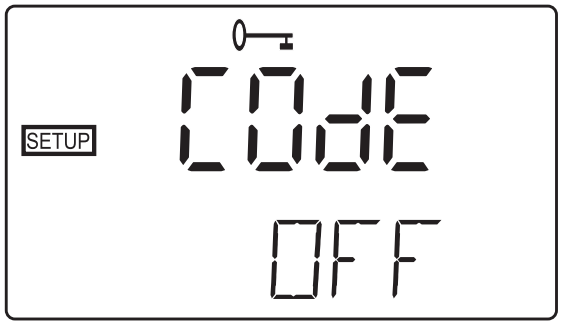
8	Press the ⏫ or ⏬ key to select the required resolution. Options: *0.1 -> 0.01-> 0.001-> 0.0001*
9	Confirm your selection with ↵.

Code function

In the following menu, you can activate/deactivate the code function and change the calibration or setup code (*Code* is displayed in the upper display line).

Note
When the code function is activated, all measured values output to the printer/PC are given the "QC" (Quality Control) identifier, provided that the calibration interval has not expired (see section 4.6.2 OUTPUT OF MEASURED VALUES).

To select the code function, proceed as follows:

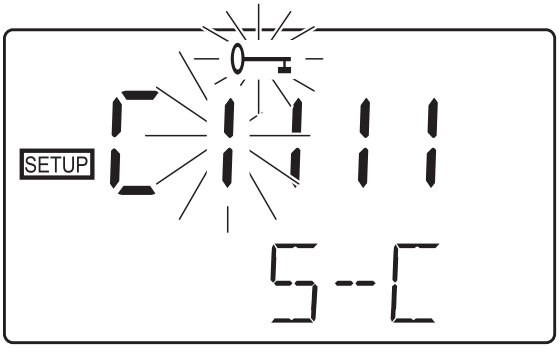


10	Press the ⏫ or ⏬ key to switch the code function on or off.
11	Confirm your selection with ↵.

When you have switched on the code function, the menus to change the two codes appear (steps 12 to 21). If you want to keep the existing codes, press ⏭ instead of ↵. In this case, the next setup menu (PRINT) will appear immediately.

Changing the calibration code

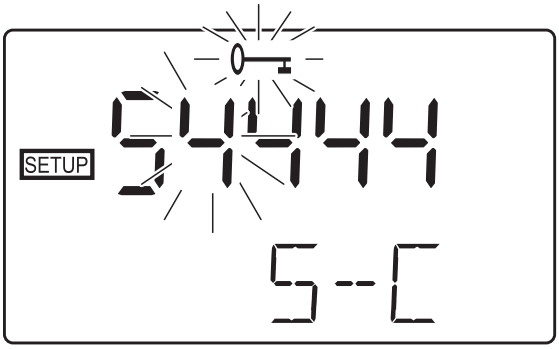
You can change the calibration code in the following menu (*C* is displayed):



12	With the ⌃ or ⌄ key change the first digit of the code.
13	Press ↵.
14	With the ⌃ or ⌄ key change the second digit of the code.
15	Press ↵.
16	With the ⌃ or ⌄ key change the third digit of the code.
17	Press ↵.
18	With the ⌃ or ⌄ key change the last digit of the code.
19	Confirm the calibration code with ↵. The menu to change the setup code appears.

Changing the setup code

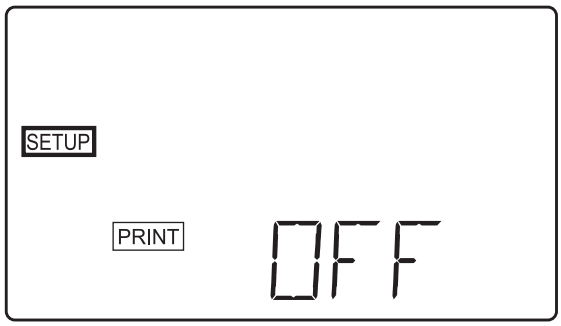
You can change the setup code in the following menu (*S* is displayed):



20	Repeat the steps 12 to 18.
21	Confirm the setup code with ↵. The next setup menu appears (PRINT).

Periodical measured value output

In the following menu, you can switch the periodical measured value output to the RS232 interface on and off, and you can set the output interval (PRINT is displayed). For more information on outputting measured values, see section 4.6.2.



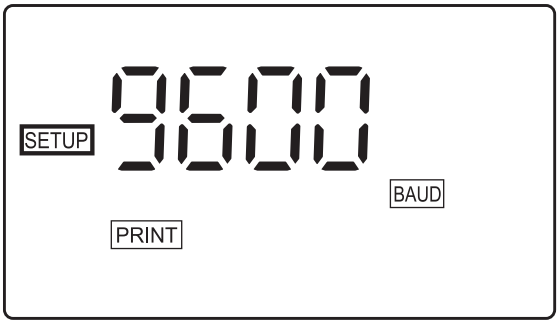
22	With the ⌃ or ⌄ key select the required output interval. Options: *OFF -> 5 SEC -> 30 SEC -> 1 MIN -> 5 MIN -> 15 MIN -> 30 MIN -> 1 HR*
23	Confirm your selection with ↵. The next setup menu appears (*INT*).

When you have switched on the periodical measured value output, the menu to set the baud rate appears (steps 24 to 25). If you want to keep the existing baud rate, press » instead of ↵. In this case, the next setup menu (*INT*) will appear immediately.

Note
When the periodical measured value output is switched on, the function to output current measured values by pressing the ↵ key is blocked.

Setting the baud rate

To select the baud rate proceed as follows:



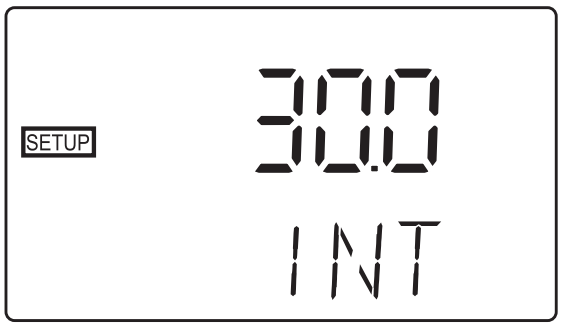
24	With the ⏫ or ⏬ key select the required baud rate. Options: *1200 -> 2400 -> 4800 -> 9600*
25	Confirm your selection with ↵.

Calibration interval

In the following menu, you can select the calibration interval (*INT* is displayed in the lower display line).

Note
When the calibration interval has not expired and the code function is activated, all measured values output to the printer/PC are given the "QC" (Quality Control) identifier (see section 4.6.2 OUTPUT OF MEASURED VALUES). When you have exceeded the calibration interval, you can continue to measure. In this case, the measured values are output without the "QC" identifier.

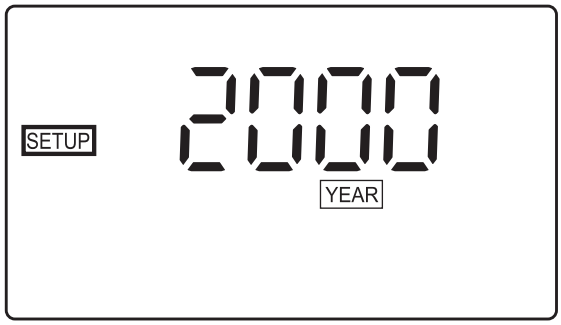
To set the calibration interval, proceed as follows:



26	To change the calibration interval, press ⏫ or ⏬ until the required number of days is displayed. Options: *0.0* ... *180* If you do not want to be automatically reminded when a calibration is due, select *0.0.*
27	Confirm your selection with ↵.

Year

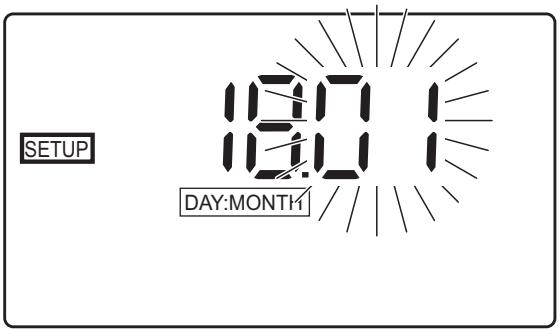
In the following menu, you can set the year (YEAR is displayed).



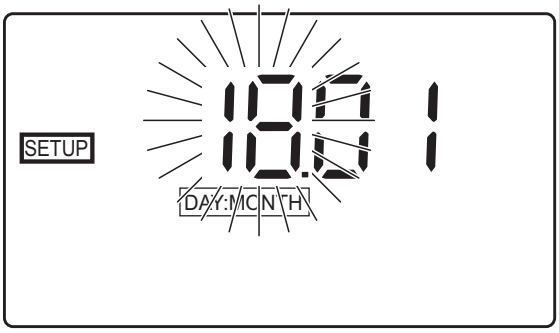
28	To change the year, press ⏫ or ⏬.
29	Confirm your selection with ↵.

Day and month

In the following menu, you can set the day and month (DAY:MONTH is displayed). The month display flashes.

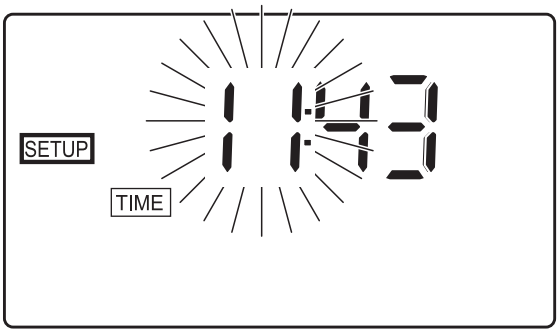


30	To change the month, press ⏫ or ⏬.
31	Confirm your selection with ↵. The day display flashes.

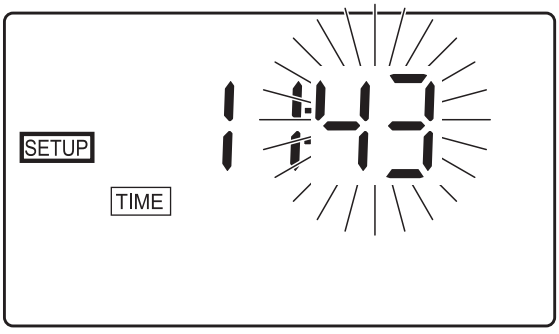


32	To change the day, press ⌃ or ⌄.
33	Confirm your selection with ↵.

Time In the following menu, you can set the time (TIME is displayed). The hour display flashes.



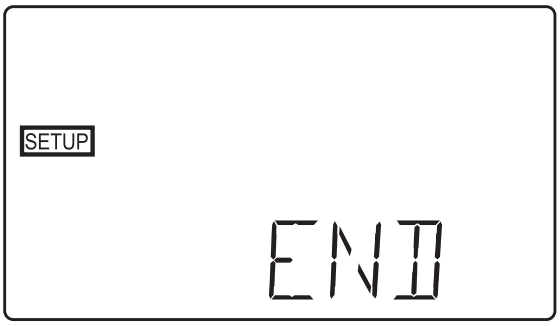
34	To change the hour, press ⌃ or ⌄.
35	Confirm your selection with ↵. The minute display flashes.



36	To change the minute, press ⏫ or ⏬.
37	Confirm your selection with ↵.

End of the setup program

After the time has been input, the *END* display appears in the lower display line.



38	Terminate the setup program with ↵. The instrument saves the new settings and returns to the normal measuring mode.

Note

You can skip individual menus by using the ⏭ key at any time. With ⏮ you can scroll back through the menus.

4.5.3 Resetting to default settings (Reset)

Default settings

In a reset, the following functions are reset to the default settings (initialized):

Setting point	Default setting
Unit	NTU
Ratio method	Off
Resolution	0.01 NTU
Code function	Off
Periodical measured value output	On
Output interval	5 seconds
Baud rate	9600 baud
Calibration interval	30 days

To reset the settings proceed as follows:

1	Press the « key and hold it down.
2	Simultaneously press the » key. All the display elements appear (for up to 2 minutes). Subsequently the instrument switches itself off.
3	Switch the instrument on again.

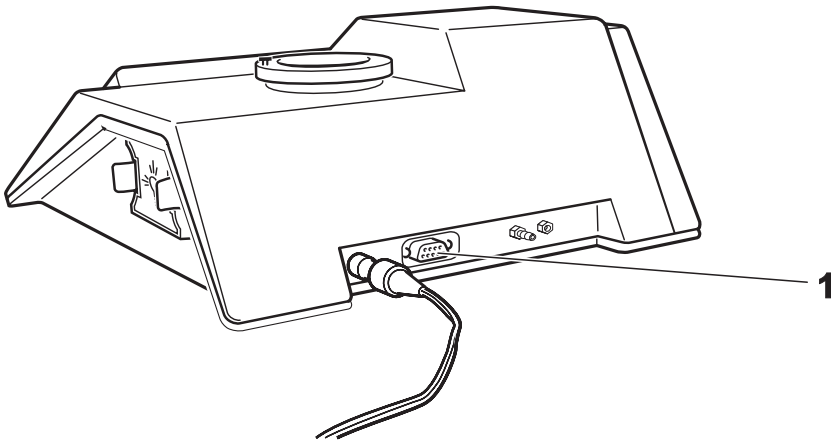
The settings have been reset to the default condition. The instrument continues to operate in the normal measuring mode. The date and time do not have to be set again.

Note
After a reset, the instrument works temporarily with a factory calibration. Recalibrate the instrument in order to measure with the optimum accuracy.

4.6 Documentation

When the instrument is connected to a printer or PC as an output device, you can record measured values. Information on suitable cables or the printer can be found in chapter 8 ACCESSORIES, OPTIONS.

4.6.1 Connecting the printer or PC



1	Connect the printer/PC cable to the RS232 interface (1) of the instrument.
2	Connect the printer/PC cable to the printer/PC.

4.6.2 Output of measured values

Depending on whether the periodical measured value output is switched on or off, you have two possibilities to transmit measured values to a printer or PC via the RS232 interface:

- Periodical measured value output *switched off*:
  By pressing the ↵ key, the current measured value is output together with the date and time.
- Periodical measured value output *switched on*:
  The measured values are automatically output at regular intervals. The output interval can be set.

Time base

The output times always refer to a full hour of the selected time.
Samples:

Current time	Calibration interval	First measured value at
11:59	30 min	12:00
12:02	30 min	12:30
12:02	5 min	12:05
12:21	5 min	12:25
12:21	15 min	12:30

Note
When the periodical measured value output is switched on, the function to output current measured values by pressing the ↵ key is blocked.

Sample printout: Measuring

```
1949.47 NTU  24 Jan 2000  11:59:54  Ratio  QC
102.73 NTU  24 Jan 2000  12:03:30  Ratio  QC
2018.65 NTU  24 Jan 2000  12:26:23  QC
5.68 NTU  24 Jan 2000  13:04:48  QC
76.99 NTU  24 Jan 2000  13:22:08  QC
1776.74 NTU  24 Jan 2000  13:38:21  QC
```

Data output

The following data is output:

- Measured value with unit
- Date
- Time
- "Ratio", when the instrument has measured with the Ratio method
- "QC" (Quality Control), when the code function was active and the calibration interval was not exceeded during the measurement.

4.6.3 Calibration record

If a printer or PC is connected and switched on, a calibration record is automatically output at the end of the calibration.

Sample printout: Calibration

```
Date: 29 Mar 2000  14:04:37
Last Cal: 29 Mar 2000  14:04:35
Cal. Interval: 30 Day(s)
QC-Security Code OFF
0.02 NTU 29 Mar 2000 14:04:35
10.0 NTU 29 Mar 2000 14:01:53
100.0 NTU 26 Mar 2000 12:56:31
1750. NTU 29 Mar 2000 13:49:00
10000 NTU 20 Mar 2000 10:51:27


Next Cal: 28 Apr 2000
```

Data output

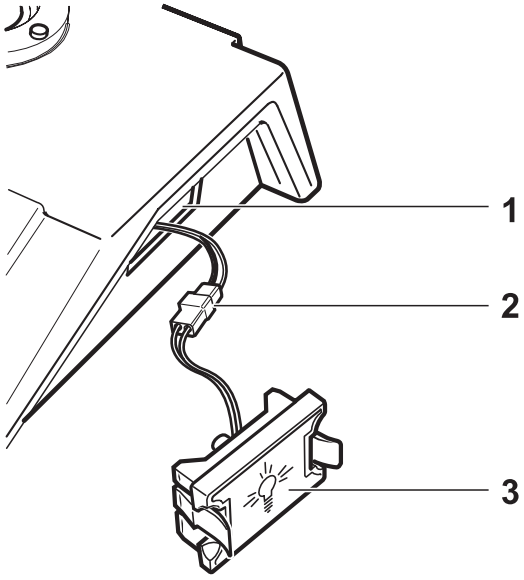
The following data is output:

Date	Date and time of the current calibration
Last Cal	Date and time of the last calibration
Cal Interval	Selected calibration interval
QC-Security Code	Code function "ON" or "OFF"
0.02 NTU	Calibration standards with the date of the last successful calibration
10.0 NTU	
100.0 NTU	
1750. NTU	
10000 NTU	
Next Cal	Date of the next calibration according to the calibration interval

5 Maintenance, cleaning, disposal

5.1 Replacing the lamp module

The lamp module can easily be replaced if it is defective. You will find the order number for the spare lamp module in chapter 8 ACCESSORIES, OPTIONS. Proceed as follows to replace the module:



1	Switch the measuring instrument off and disconnect it from the mains.
2	Take out the lamp module (3): Press the two grips gently together and carefully pull out the lamp module until the plug-in connection (2) is visible.
3	Pull the plug-in connection (2) apart and, thus, remove the lamp module. Do not pull on the wires while doing this.
4	Plug in the new lamp module to the plug-in connection of the instrument. Do not touch the lamp with the fingers.
5	Stow the wires in the opening (1) of the measuring instrument again. Make sure that the wires are not placed in front of the lamp and that they are not in the way of the lamp module.

6	Insert the new lamp module (lamp symbol must be vertical), so that it locks into place and a click can be heard.
7	Connect the instrument to the mains supply and switch it on.
8	Calibrate the instrument (see section 4.4 CALIBRATION). The instrument is now ready for operation again.

5.2 Cleaning

5.2.1 Cleaning the measuring instrument

Occasionally wipe the outside of the measuring instrument with a damp, lint-free cloth. Disinfect the housing with isopropanol as required.

Warning
Avoid contact with acetone or similar detergents that contain solvents as these can damage the housing. Remove any splashes immediately.

5.2.2 Cleaning the cuvettes

Cuvettes used for measuring turbidity must be clean. Therefore, clean them regularly:

1	Clean the cuvettes inside and out with hydrochloric acid or laboratory soap.
2	Rinse out several times with distilled water.
3	Let them dry in the air.
4	Only hold the cuvettes by the top or by the light protection cap so that the optical path is not impaired.

Note
Scratches in the glass change the optical characteristics of the cuvette and falsify the measured value. For this reason, never use scratched cuvettes!

5.3 Disposal

Packing

This measuring instrument is sent out in a protective transport packing.
We recommend: Keep the packing material in case you have to send the measuring instrument back for service. The original packing prevents the measuring instrument from being damaged during transport.

Measuring instrument

Dispose of the measuring instrument as electronic waste at an appropriate collection point. It is illegal to dispose of it in household refuse.

Calibration standards

The used calibration standards can be disposed of in household refuse.

6 What to do if...

"- - - - -" display

Cause	Remedy
– The instrument is measuring but the measured value is not yet stable	– Wait for a stable measured value
– There is a foreign body in the cuvette shaft	– Remove the foreign body

Display "Or"

Cause	Remedy
– Measuring range exceeded	– During measurement: This cannot be remedied. Sample is not suitable for the measurement – During calibration: Ignore the message and continue the calibration as usual. The instrument will be properly calibrated.

CAL display flashes

Cause	Remedy
– The adjusted calibration interval has expired	– Calibrate the instrument (see section 4.4)

Measured values that are obviously too high

Cause	Remedy
– Cuvette contaminated	– Clean the cuvette
– Cuvette scratched	– Replace the cuvette
– Cuvette misted up	– Regulate the temperature of the sample before measuring – Run the instrument with the dry air purge system (see section 4.2.4)
– Air bubbles in the cuvette	– Remove air bubbles
– Measuring instrument has to be calibrated	– Calibrate the measuring instrument

The sample does not run out of the pour-through vessel

Cause	Remedy
– The end of the outlet hose is placed too high	– Place the end of the hose lower than the measuring instrument
– There is a foreign body in the pour-through vessel	– Remove the foreign body

Warning *W-01*

Cause	Remedy
– The light source is defective	– Replace the lamp module

Warning message	Cause	Remedy
W-02, W-03, W-04, W-05, **or** ***WNG***	– Wrong or erroneous calibration standards used, or – Instrument error	– Repeat the calibration using the correct calibration standards – Check the lamp – If the error cannot be remedied, have the instrument repaired by the WTW service department

Warning	Cause	Remedy
W-06	– Calibration error: Incorrect 0.02 NTU or 10.0 NTU calibration standard used	– Repeat the calibration using the correct calibration standards

Warning	Cause	Remedy
W-07	– Calibration error: Incorrect 10.0 NTU or 100 NTU calibration standard used	– Repeat the calibration using the correct calibration standards

Warning	Cause	Remedy
W-08	– Calibration error: Incorrect 100 NTU or 1750 NTU calibration standard used	– Repeat the calibration using the correct calibration standards. Make sure the 1750 NTU standard was well mixed.

Error message *E-01* or *SFE*	Cause	Remedy
	– Severe instrument error	– Have the instrument repaired by the WTW service department

The instrument does not react on keypressing	Cause	Remedy
	– No energy supply	– Connect the plug-in power supply to the measuring instrument and the mains power supply

Note
If a malfunction cannot be remedied please contact the WTW service department.

7 Technical data

Ambient temperature

Storage	- 25 °C ... + 65 °C
Operation	+10 °C ... + 50 °C

Power supply

Plug-in power supply unit	Friwo FW7207/15 Friwo Part-No. 1812285 Input: 100 - 240 V~ ± 10% / 47 - 63 Hz / 400 mA (Installation category II) Output: 15 VDC / 1 A
Backup batteries	2 x 3,0 V Lithium battery, soldered in the instrument
Battery life time	approx. 10 years, To be replaced by service personnel only.

Dimensions, weight

Depth	290 mm
Width	252 mm
Height	100 mm
Weight	1 kg

Sample temperature 10 - 40 °C

Measuring principle

- Nephelometric, Ratio method selectable
- Transmission (Turb 555 IR only)

Light source

Turb 555	**Turb 555 IR**
Tungsten lamp	Infrared LED

Measuring ranges

Unit	Turb 555	Turb 555 IR
NTU	0 - 10 000	0 - 10 000
FNU	---	0 - 10 000
EBC	0 - 2 450	0 - 2 450
NEPHELO	0 - 67 000	---
FAU	---	0 - 10 000

Resolution

In the range 0.0001 - 9.9999 NTU	max 0.0001 NTU
In the range 10.000 - 99.999 NTU	max 0.001 NTU
In the range 100.00 - 999.99 NTU	max 0.01 NTU
In the range 1000.0 - 9999.9 NTU	max 0.1 NTU

Accuracy (± 1 digit)

In the range 0 - 1 000 NTU	± 2 % of the measured value + 0.01 NTU
In the range 1 000 - 4 000 NTU	± 5 % of the measured value
In the range 4 000 - 10 000 NTU	± 10 % of the measured value

Reproducibility ± 1 % of the measured value or ± 0.01 NTU

Response time Less than 6 seconds

Calibration Automatic 1 - 5 point calibration

Recorder output Bi-directional RS232 output

Test certificates CE, cETLus

Other data

- Automatic self-check
- Integrated real-time clock
- GLP function (calibration interval monitoring)
- Safety access codes for calibration and instrument setup

8 Accessories, Options

Turb 555

Description	Model	Order no.
Set of calibration standards for Turb 555 0.02 / 10.0 / 100 / 1750 NTU	Kal. Kit P Turb 555	600545
10000 NTU calibration standard for Turb 555	Kal.-Std. 10000 NTU WL	600546
Spare lamp module for Turb 555	Lamp Turb 550/555-WL	600603

Turb 555 IR

Description	Model	Order no.
Set of calibration standards for Turb 555 IR 0.02 / 10.0 / 100 / 1750 NTU	Kal. Kit P Turb 555 IR	600543
10000 NTU calibration standard for Turb 555 IR	Kal.-Std. 10000 NTU IR	600544
Spare lamp module for Turb 555 IR	Lamp Turb 550/555-IR	600604

General accessories

Description	Model	Order no.
Pour-through vessel	D-Turb	600600
Flow-through vessel	Flow-Turb	600605

Description	Model	Order no.
Empty cuvettes, set of 3 pieces	Cell Turb/SET	600601
Cuvette holder for 6 cuvettes, collapsible	KS-Turb	600602
Cable to connect to a printer	AK/LQ300	250746
Cable to connect to a PC	AK Labor	902758
Printer for normal paper	LQ 300	250046

9 Lists

This chapter provides additional information and orientation aids.

Abbreviations The list of abbreviations explains abbreviations that appear on the display or when dealing with the instrument.

Index The index helps you to find the topics that you are looking for.

Abbreviations

Auto	Automatic measuring mode
Cal	Calibration
O-r	Measuring range exceeded
EBC	European Brewery Convention Units
NTU	Nephelometric turbidity units
FTU	Formazin turbidity units
FNU	Nephelometric Formazin units
FAU	Formazin attenuation units
W01 - W05	Warning message (see WHAT TO DO IF ...)
WNG	Warning message (see WHAT TO DO IF ...)
E1 - E5	Error message (see WHAT TO DO IF ...)
SFE	Error message (see WHAT TO DO IF ...)

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