

Operation Manual

Turbitronic P

Turbitronic II

05/2022 by NOVOMATICS GmbH



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Read this chapter carefully before the instrument will be taken into operation

1. Safety

Read operation manual before starting to work with the instrument. Make sure, that every operator fully understands every function of the instrument and each of its components.

1.1.Safety precautions

1. Before connecting the Turbitronic P to the power supply:

- **Ensure that the MAINS switch at the front panel is in off position**
 - **Ensure that the power voltage of your mains socket corresponds to the power voltage of the instrument**
 - **Ensure that the power cable plug is connected only to a power socket that has a protective earth contact. This applies equally, if an extension cable is used: the cable must contain an earth conductor!**
- 2. To effect grounding of the instrument case, the power plug must be inserted *before* connections are made to a computer or printer. The power plug must remain connected until all other units have been connected or disconnected.**
- 3. Any interruption of the ground connection (inside or outside the instrument) is prohibited.**
- 4. The instrument must be disconnected from all voltage source before it is opened for any adjustment, replacement or repair. The manufacturer does not take any responsibility for any adjustments, maintenance by the user. Consult NOVOMATICS or your distributor, if repairs seem to be necessary.**

5. Whenever it is likely that the safety of the instrument has been impaired, it should be made inoperative and secured against any unintended operation. Safety could be impaired if:
- (a) any case or cable shows visible damage,
 - (b) the instrument fails to perform the intended operation,
 - (c) it has been subjected to prolonged under unfavorable storage conditions,
 - (d) it has been subjected to severe transport stress.

1.2. Computer and printer connections

Before making any connections to a host computer or printer, ensure that the instrument is switched OFF. Ensure that the power plug is inserted. Otherwise, the instrument and/or the host computer may take damage because of static discharge.

2. Introduction

This chapter is providing information on the basic concept of the turbidity measurements.

Turbidity is defined as an optical property of a liquid caused by light scattering and absorption. This state will be caused by unsolved particles, for instance fine polymers or organic material. These particles solved in a liquid lead to haze or turbidity, if the light falls through the liquid. Easily said, turbidity is the opposite of clearness.

In the past, the turbidity detection could be determined on the manual way only. This test method had many sources of error and uncertainty due to poor reproducibility, variances in heating and cooling of the sample, inaccurate turbidity determination, etc.

As the turbidity measurement must be combined with the temperature measurement in case of the Turbitronic P, a special white LED photocell-system has been designed. This fiberglass photocell-system measures the absorption of the white light beam passing through the test tube. This makes the photocell more sensitive for low turbidity measurements.

The output signal of the photocell detection circuit decreases non-linear with increasing turbidity within the relevant turbidity range. The instrument is factory calibrated for turbidity but the operator is requested to approve it periodically. The user can determine which turbidity value is recognized as the cloud or clear point by program definition.

The photocell-system for turbidity measurement in the Turbitronic P has proven to be a rugged and reliable device, designed for continuous use in factory environment.

3. Features of Turbitronic P

The Turbitronic P is a fully automatic turbidity measuring unit for the determination of cloud points and opalescence turbidity changes related to temperature. The main features of the Turbitronic P are:

- Highly reproducible determination of turbidity of water based polymers versus temperature and time
- device independent turbidity measuring values expressed in NTU
- Highly reproducible cloud point detection and documentation
- Automatic microprocessor controlled test system for production and quality control applications in industrial production processes and R&D.
- Time-saving, fully automatic test method, independent on the analyst or circumstances.
- Accurate, reliable and easy to operate precision test system as well for laboratory use as for the production.
- Cost savings by higher production yields, improved final product quality and less labour costs.
- Different temperature profiles predefined by factory or user.
- Fast calibration procedure to define the turbidity detection range by user with standards references
- User definable stirring speed control to depress bubbles and to improve the accuracy.
- User definable temperature ramp control to improve the accuracy.
- Automatic controlled measuring of sample under test for time saving.
- Measurement result overview and comparison with date and time of the last 20 measurements by optional printing.
- User friendly for a high measurement efficiency.
- Use to use Windows software for remote control of the instrument via USB

4. Installations

4.1. Instrument installation

The Turbitronic P is an automatic test instrument for desktop use. It includes all required mechanic and electronic components and requires no installation experience.

When the Turbitronic P is put into operation, the following three connections must be made:

1. *The main cable for power supply. Please note, always an **earth connection** is available at the wall socket.*
2. *The USB cable between Turbitronic P and your Windows computer.*
3. *The two water hoses for outer water circulation. Connect these to a water tap (inlet) nearby and water drain (outlet). Open the water tap when operating the instrument. Close it when not needed to prevent any water leakage in operator's absence. If unfortunately closed the instrument is not damaged but cooling times can be much longer. The water flows only when cooling is needed so that water consumption is low.*

When the connections have been made, the equipment can be switched on by the main switch on front panel. If the self test proceeds without any failure the light of the **ready** led is illuminating after two seconds.

4.2. WinTurbi Software installation

There are two packages needed for instrument operation. Before starting make sure that the instrument is off and the USB cable is not connected to the computer.

4.2.1. Installation of WinTurbi software from USB flash drive

1. Insert the USB flash drive to install WinTurbi software
2. Start the program **winturbisetup.exe**
3. Follow the default adjustments by pressing **Next**

Installation of WinTurbi software from Internet

1. Visit: <http://www.novomatics.de/downloads/>
2. Login in with username and password
3. New users please fill out the registration request to receive login details
4. Download **winturbisetup.exe**
4. After downloading from Novomatics server start the program **winturbisetup.exe** manually
5. Follow the default adjustments by pressing **Next**
6. The WinTurbi will be installed, USB driver is placed at {install path}\driver, for example:
c:\program files\novomatics\winturbi\driver

Installation of Turbitronic P device driver

- 1) USB Driver installation

Please note WinTurbi operation is fully verified for Windows 10 only.

Execute CDM21224_Setup.exe as administrator found on your WinTurbi CDROM or within your WinTurbi installation path.

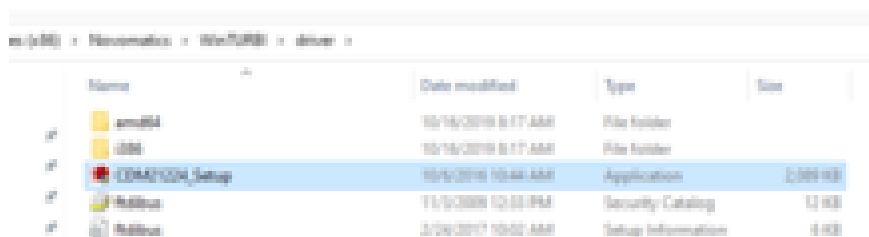


Figure 1 Setup Executable Run as administrator

You may see a message from 'User Access Control' asking 'Do you want to allow this app to make changes to your PC? If so, click yes to continue.

Press the Extract button. Follow all installation including license terms agreement acceptance shown and the driver will be automatically installed. From a legal point of view, the user must accept the license terms of the driver. Successful installation is shown in Figure 7 **wizard**

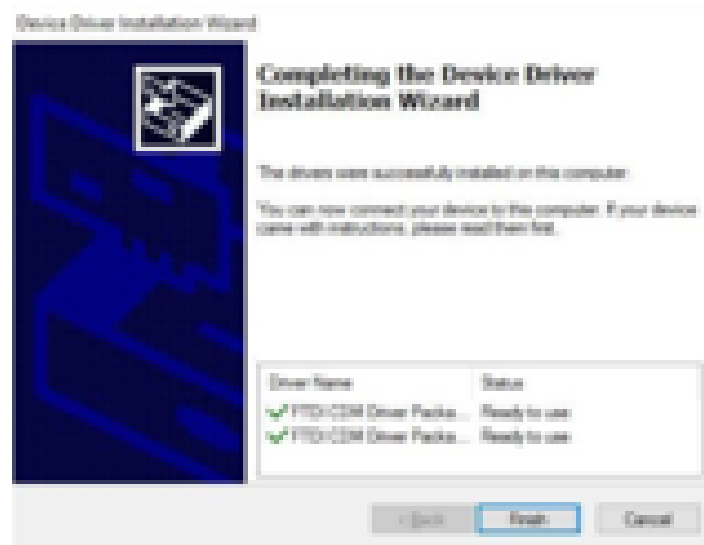


Figure 2 Driver Installation Completion

Switch on the instrument and make sure it is connected to PC via USB cable. The instrument appears as UMFT4222PROG within device manager now.

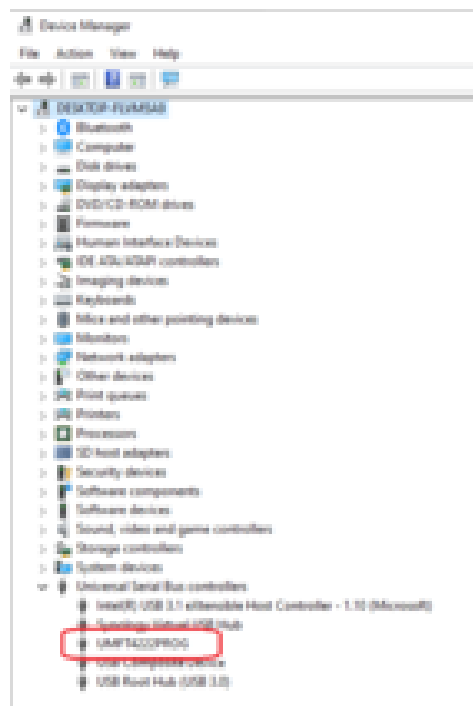


Figure 3 Turbitronic P is realized as UMFT4222PROG USB device

5. Safety Lock – Turbitronic P version

The Turbitronic P measures water based polymers up to temperatures of 150 °C in a pressure tight samples cell made of glass mainly. During the test the Turbitronic P closes the sample cell chamber automatically by the safety lock when the samples temperature is higher than 60 °C. When the temperature decreases 60 °C the sample cell chamber is opened automatically.

Firstly the operator is not being able to remove the hot samples cell under pressure; secondly in case of unexpected crack the sample cell is kept safely in its fixture.

Before closing the safety lock a red blinks three times. The force of the safety lock is supervised. In case of a blockage, for example the operator's finger, it turns back instantly due to prevent any injury.



Figure 4 Opened Safety Lock

Never try to turn the safety lock by hand. It can be damaged. The safety lock can be opened at higher temperatures on own risk. A warning appears and has to be acknowledged.

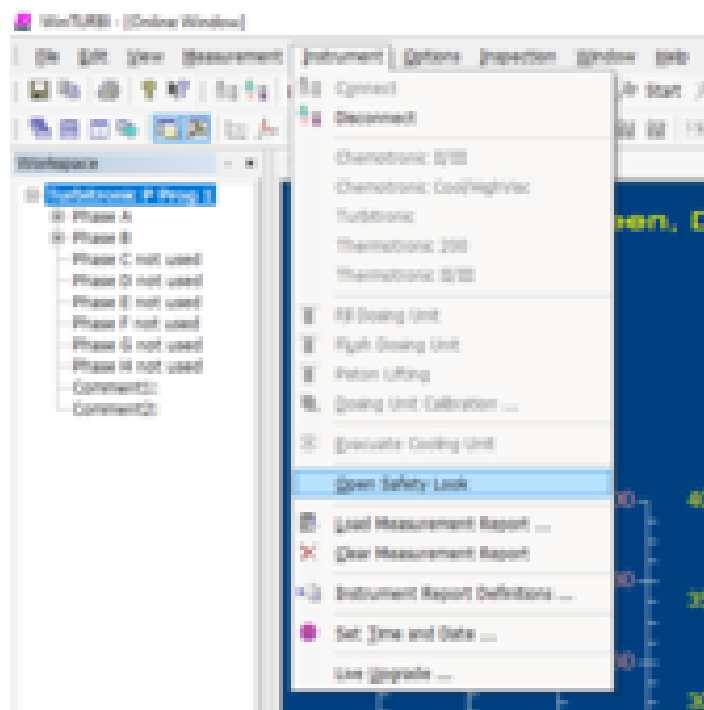


Figure 5 Open Safety Lock by operator

6. Principle of temperature measurement

The Turbitronic P determines the sample temperature in direct contact with sample under test. A pressure tight platinum temperature probe is placed into the glass tube for best thermal conductivity.

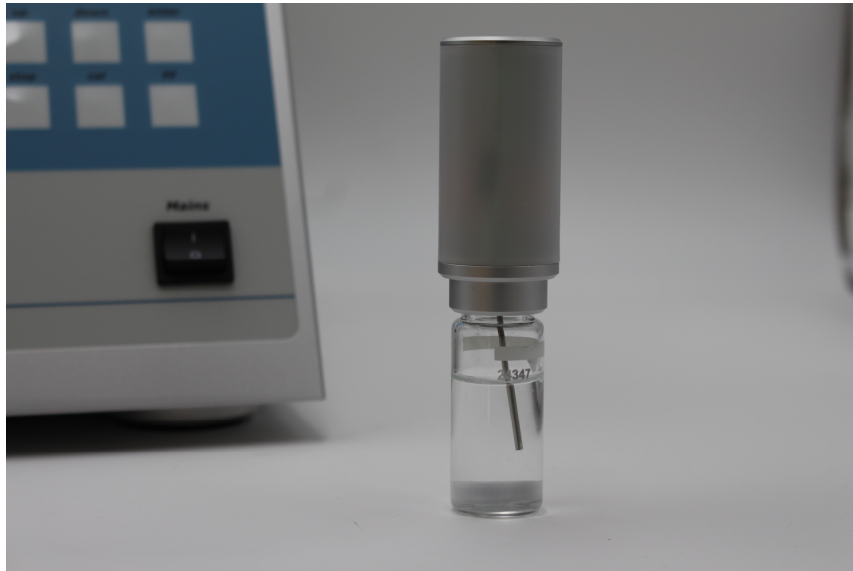


Figure 6 Glass measuring cell with embedded platinum temperature probe

When the sample cell is inserted into the measuring chamber the temperature value is transmitted wirelessly to the Turbitronic P.

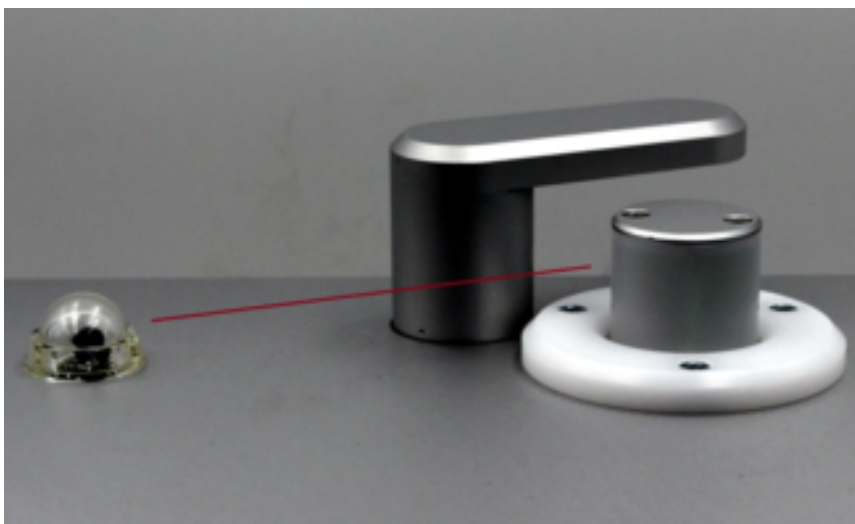


Figure 7 Infrared wireless connection to the instrument

The temperature probe doesn't require a battery. Its power is supplied by an alternating electromagnetic field.

7. Starting a first measurement

The preparation of measuring procedure is simple and quick:

- 1) Place the stirring bar into the glass tube and fill the tube with the sample under test till lower corner of white rectangle.
- 2) Close the glass tube by temperature probe



Figure 8 Prepared measuring tube

- 3) Insert the measuring tube into the instrument



Figure 9 Inserting prepared measuring tube

- 4) Go to Measurement/Measurement Preparation ... and enter the sample name in one of the comment fields.

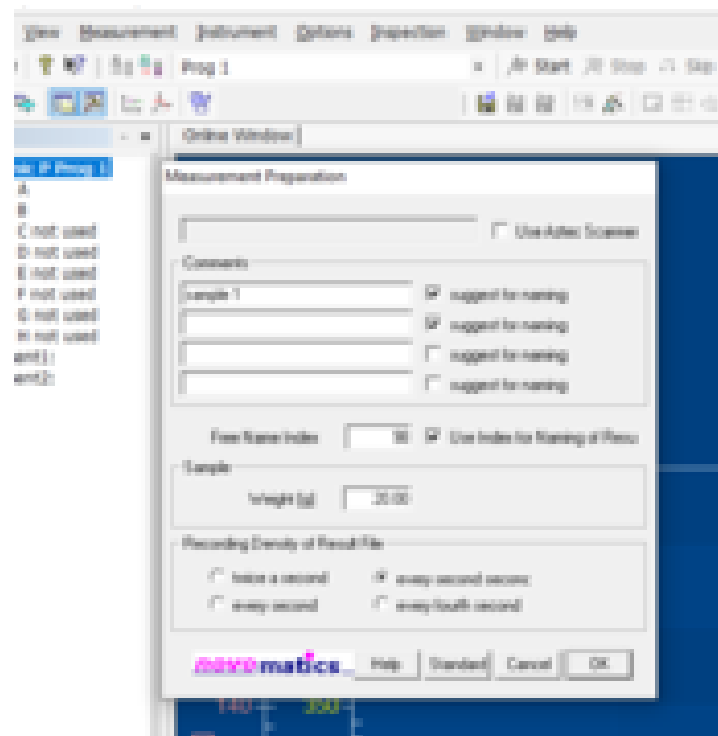


Figure 10 Enter the sample name in one of the comment fields

- 5) Go to Measurement/Turbitronic/Programs P... and check the program settings of your program, for example P1.

Turbitronic P Programs

Parameter	A	B	C	D
Speed(rpm)	240	240	240	240
soak Time(s)	10	10	10	10
final Temp (°C)	150.0	80.0	150.0	80.0
dT/dt (K/min)	10.0	10.0	10.0	10.0
stop	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Stop Program	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
CP at Turbidity (NTU)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
CP detection	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Action when CP detected	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Use for Averaging	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

☐ Zero NTU is calibrated (ZMT)
☒ Auto Calls Zero NTU at start

CP - Cloud Point

☐ CP Detection (for future use)

start delay of s ☐ use manual
 Continuous Temp/Glowl Setting ☐
 Enable in G4 mode ☒

Comment1
 Comment2

Program P1

Load File Save File Default
 Help Cancel OK

Figure 11 Check the program settings

These are the program standard settings of main parameter; check these according the settings above.

- 1) Usage of heating and cooling phase
- 2) Final temperature 150 °C using a ramp of 10 K/min
- 3) Stirring speed 240 rpm
- 6) Check whether the water inlet and outlet hoses are connected correctly and the water tap is opened for cooling water flow
- 7) Make sure your program, for example P1, is selected on toolbar and press the Start button
- 8) Now the measurement is started.
- 9) At the end of test the operator is requested to save the measuring file by suggested file name *.res

8. Program parameter settings

The actual software version supports up to four phases usable for program design. During program run the phases are processed one by one. A program consists of at least one phase.

Phase Parameter	Function
Speed [rpm]	The rotational speed of magnetic field that drives the magnetic bar
Dwell Time [s]	Dwell time at target temperature, it starts when the sample temperature is closer than 0.5 K to the final temperature
Final Temp [°C]	Final temperature or target temperature of that phase
dT/dt [K/min]	Slope of the temperature ramp, when not AFAP
AFAP	The final temperature is achieved as fast as possible
Stop program	Defines this phase as the last
General Parameter	Function
Zero NTU as calibrated (xxx)	Uses pre-calibration of Zero NTU, recommended for samples which have initial turbidity at the start of the program, Refer to 11.5. Zero calibration for further details
Auto Calib Zero NTU at start	Recommend setting for samples which are clear initially. An auto calibration is performed for Zero NTU
Automatic CP detection	Automatic cloud point detection is for future use
comments	To be printed out on cloud point report (optionally)
Program	Select one of eight programs to be edited
Load and Save File	Load and Save single programs from and to a file

Table 1 Program Parameter Settings

9. Reload a measuring file

The WinTurbi software uses a binary format for measuring results.

- 1) Go to Window/New 2D-diagram.
- 2) Click the right mouse button, Add Curve ...
- 3) Add the measurement of your choice
- 4) Modify axes, colors, etc by clicking right mouse button, Content ...

10. Stop settings between the measurements

Best practice is to keep the measuring chamber on low temperature between the measurements. Further starting the stirrer before the next test starts.

Go to Measurement/Turbitronic/Stops Conditions ...



Figure 12 Stop Conditions

11. Calibration of relevant parameters

11.1. Temperature calibration

In the Turbitronic P a powerful microprocessor system is installed for the control of all instrument functions. The wireless temperature probe is used to convert the analogue inputs of the platinum sensor into a digital signal which is transferred to the Turbitronic P. The wireless temperature probe uses internal references for long term stability. In case of any error "----" is shown on front panel display. A manual calibration is not required.

11.2. Rotation speed calibration

The speed of the magnetic stirring rod in the test tube is controlled by rotation of a strong permanent magnet. It is driven by a microprocessor controlled motor. The revolving speed is displayed on front panel. If a stirring speed is set within the Stop Conditions the magnetic stirring rod turns already before inserted completely into the measuring chamber. This effect allows the check of stirring function manually.

11.3. Time calibration

Due to the high accuracy of the built-in real time clock, there will be no short term deviations in the timing functions.

11.4. Turbidity calibration

At start of the test it auto calibration of turbidity is performed, It is assumed the sample has 0 NTU at the start temperature. Further changes in turbidity are related to that. Please make sure that your sample has really no turbidity at start, if not cool it down till it is completely clear.

The Turbitronic P expresses turbidity in Nephelometric Turbidity Units [NTU]. The value of the Nephelometric Turbidity Units is calculated by the light transfer through the samples and follows a non-linear relationship. That's why the instrument has to be calibrated with three standards. The Turbitronic P already factory calibrated but the calibration can be approved or re-newed anytime.

For that purpose prepare three calibration standards according chapter "12. Turbidity calibration standards" and keep them ready for insertion into the instrument. Please note the three

standards should be inserted without magnetic stirring bar but the tubes should be closed by temperature probe.

Go to Measurement/Turbitronic/Calib NTU... Insert the three standards 0, 100 and 250 NTU and press the respective **Set** button. Release the dialog with **OK** for taking over the new calibration. Release with cancel to keep the actual settings valid.



Figure 13 NTU Turbidity Calibration



Figure 14 Samples NTU Turbidity Calibration

11.5. Zero calibration

Zero calibration is required for sample which are already hazy at ambient. Just insert a **typical sample** which is definitely clear at room temperature and press the **Zero NTU** button. Usually demineralised water is not suitable because its different optical properties compared to typical

samples under test. A clear sample can have lower or higher light transfer mainly caused by differences in refraction index.

Refer to 8. Program parameter settings— **General parameter** how to apply it into program settings.

12. Operation modes

In accordance with the practical requirements of modern quality management systems two operation modes were implemented into the instrument. The first mode called **Prod-Mode** includes a limited function set only and is intended for the quality control generally. The second mode called **Lab Mode** allows the access to the complete function set and is intended for the laboratory control or to adjust the **Prod Mode**.

After switching on the actual mode is displayed in temperature display for two seconds. The following table gives an overview about each function set:

	Prod mode	Lab mode
program choose	no (standard prog)	yes
run a measurement	yes	yes
check the last 20 measurement data	yes	yes
Editing user programs	no	yes
set time and date	no	yes
turbidity calibration	no	yes

Table 2 Overview function sets

LAB-mode:

This mode is providing free entry to all functions without any limitation. One can set the temperature profiles, rotation speeds and turbidity levels according to the individual demands. Up to 8 menus can be stored and retrieved so that these can be used for particular samples that need different parameters.

Prod-mode:

This mode is meant for production control applications of the CHEMOTRONIC. In the quality assurance mode, only 1 standard is active and can be started. The upper row of push buttons on the front panel is inactive in this mode.

12.1. Change the operation mode

- 1) Press Sel button twice for entering into edit menu
- 2) Press **up/down** button till the actual mode **OP Lab** or **OP Prod** is blinking.
- 3) Press **enter** button for enabling mode change
- 4) Press **up/down** button for mode change and acknowledge by **enter** button

- 5) Now passcode is needed. Enter passcode by setting digit by digit, use **up/down** buttons for digit setting and **enter** button for going to next digit, the first passcode after leaving factory is **444444**
- 6) After successful setting the new operation mode is blinking for 2 seconds

12.2. Change the passcode

The operation is save only with unknown passcode. That's why the passcode should changes at next supervisor's opportunity. Please note that passcode can be changed only when the instrument is in the Lab mode.

- 1) Press Sel button twice for entering into edit menu
- 2) Press **up/down** buttons till the word **code** is shown.
- 3) Press the **enter** button, **co000000** is shown and the first **0** is blinking now
- 4) Enter actual passcode by setting digit by digit, use **up/down** buttons for digit setting and **enter** button for going to next digit, the first passcode after leaving factory is **444444**
- 5) When accepted **cn000000** is shown and the first **0** is blinking now
- 6) Enter new passcode by setting digit by digit, use **up/down** buttons for digit setting and **enter** button for going to next digit
- 7) When successfully entered the the new passcode is blinking for 2 sec.

13. Turbidity calibration standards

In turbidity measurements, primary turbidity standards are required as these are the only certified standards. By diluting a primary turbidity standard, a secondary standard can be made for actual use. The derived turbidity value is traceable to the original primary standard. It is accepted that dilutions are less stable and cannot be used over a longer period of time (max. 1 week). The definition of turbidity units is based on the polymer suspension FORMAZIN. A FORMAZIN primary turbidity standard is specified for 1000 Nephelometric Turbidity Units (NTU). A wide range of secondary standards can be made by dilution with distilled water (see calibration procedure). A 1000 NTU turbidity standard is stable for long period of time (max. 1 year). Titration of FORMAZIN has proven to be the fastest and most convenient means of an accurately working turbidity standard.

For recalibration of the turbidity, the special polymer suspension FORMAZIN is recommended (available from the manufacturer/supplier). FORMAZIN primary standards are supplied in sealed dark brown 0.1 l bottles and can be used till 1 year after supply date. In order to prepare a secondary standard, one can dissolve a small portion of the primary standard in distilled water by using standard glassware. The following table is providing the example ratios to be mixed.

Desired Standard	1000 NTU primary standard in 50 ml glass	Distilled water in 50 ml glass
250 NTU	12.5 ml	37.5 ml
100 NTU	5 ml	45 ml
0 NTU	0 ml	50 ml

Table 3 NTU example ratios

Swirl the glass to mix the solution. Then pour the prepared secondary standard into a Turbitronic P test tube and use the provided plastic covers for easy handling.



Figure 15 NTU Samples

Note:

Secondary standards are stable for less than the original stock (max. storage approx. 1 week under cool storage conditions). Therefore, it is recommended to use a secondary standard just once.

On special order, we can supply more stable premixed solutions with specific turbidity in small quantities. The min. turbidity value is 100 NTU in order to guarantee full compatibility with the Turbitronic P.

14. Failure detection and hazards

14.1. Failure detection

The Turbitronic P is provided with safety precautions in case of system fault occurs. The safety functions, performed by the microprocessor control unit, recognise the following failures:

detected failure	effect
1. Sample Temperature Probe not inserted or defect	Temp. Display: "----"
2. Temperature does not change	The measurement will be interrupted if there is a large difference between the internal temperature sensor and the Sample Temperature Probe
4. E 512	A program is selected for use of external stirrer but the external stirrer wasn't found by the Turbitronic P

Table 4 Overview failures

15. Photocell cleaning instructions

15.1. Inspection of photocell operation

When a clear sample inserted the photo cell signal has to 1000 or higher. When lower a warning appears at start of next measurement and it is recommended to clean up the photocell according next chapter.

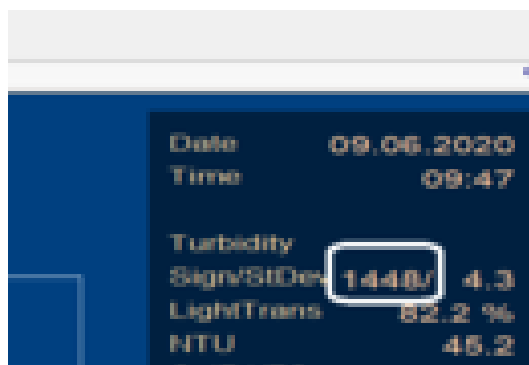


Figure 16 The white rectangle shows photo cell signal on right side of Online Window

15.2. Photocell cleaning procedure

For cleaning the photocell system it is not necessary to dismantle the instrument. By means of the cleaning brush and solvent (Isopropanol Alcohol) supplied with the instrument, direct cleaning is possible in a few minutes.

- Check the light transmission value according to the previous chapter.
- Wet the cleaning brush with some solvent, insert it and move it up and downwards to clean the photosensitive areas in the test tube cylinder.
- Insert a clean glass test tube filled with clear water or solvent into the instrument and check the intensity of the photocell again. The measured value should be over 300 units. If not, please repeat the cleaning procedure.
- Re-calibrate the turbidity measurement according to the calibration instructions

Note:

As a precautionary measure, the cleaning may be done on a day by day basis in order to prevent that dust and dirt will stick on the sensitive tip of the optical glass fibres.

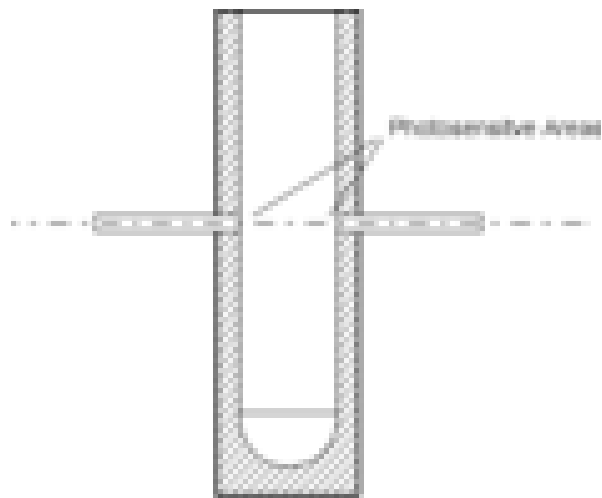


Figure 17 Inner arrangement of photosensitive areas

16. Failure check-list

16.1. Failure and problem curing

In case of a failure, the user can check several points himself, before contacting the service department. We are stating some common problems, which can be solved easily.

Problem	Points to check
the equipment cannot be powered up	check fuse, cables, connectors
the failure E1 interrupts a measurement unperiodically	defect of the temperature probe sensor, replace it
the cloud point measured is not correct	perform a turbidity calibration procedure
the cloud point measurements are not reproducible	<ol style="list-style-type: none"> 1. the efficient stirring speed is too slow 2. different sorts of glass tubes have been used without a new turbidity calibration 3. the tolerances of the weight determination of used mixture are too high 4. use of different program parameters, check the adjustments of speed, time, turbidity and hold temperature 5. The defined temperature gradient is too high.
failed turbidity calibration	<ol style="list-style-type: none"> 1. check the standards liquids 2. the pollution of sensor system is too strong, clean up the system
the time and date are lost after switching off	the capacity of lithium cell is exhausted

Table 5 Failure check list

Appendix

Technical Specification

Temperature	
Range:	5 - 150 °C standard 5 – 98 °C Turbitronic II version
Ramp:	1 - 10 K/min or as fast as possible
Accuracy:	±0.3 °C (±0.1 °C on request)
Stirring speed	
Range:	80 – 1200 rpm
Accuracy:	crystal controlled
Timing	Crystal controlled Real Time Clock
Accuracy:	+15 / -5 ppm
Turbidity	
Range:	0 - 1200 NTU
Measuring accuracy	± 0.1 °C
Mains Voltage:	110 V - 240 V
Mains Frequency:	50 - 60 Hz
Power Consumption:	200VA
Weight	13 kg
Dimensions (Width, Depth, Height)	270 x 295 x 400 (W x H x D)

Spare parts and test materials

Part number	Item
p/n 974002	platinum, wireless, pressure-tight temperature probe
p/n 974003	6 glass test tubes, 10 ml, Hach Id 2434706
p/n 974007	handling cover for calibration purposes
p/n 974004	magnetic stirring bars, 6 x 20 mm
p/n 974005	replacement silicon seals
p/n 973608	magnetic pick-up bar
p/n 974006	1000 NTU FORMAZIN turbidity standard (100 ml)
p/n 973620	WinTURBI application software for use with Turbitronic P - user friendly application software for Windows 10 - easy remote control, monitoring, instrument calibration - multiple graphs, reports and simplified documentation
p/n 973602	Citizen Thermo printer CT-S280 (optionally) for use with Turbitronic P - reports automatically cloud points, instrument states, measuring programs - compatible printer control cable
p/n 973603	paper rolls 58 mm width
p/n 97360201	printer cable for operation with Citizen printer CT-S280
p/n 97360202	ink ribbon cassette for printer Citizen Printer CT-S280

Factory and head office

GERMANY

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