

USER MANUAL

ULTRASONIC FLOW METER

PCE-TDS 200 SERIES

ENGLISH



User manuals in various languages (français, italiano, español, português, nederlands, türk, polski) can be found via our product search on:
www.pce-instruments.com

SAFETY NOTES

Please read this manual carefully and completely before you use the device for the first time. The device may only be used by qualified personnel and repaired by PCE Instruments personnel. Damage or injuries caused by non-observance of the manual are excluded from our liability and not covered by our warranty.

- » The device must only be used as described in this instruction manual. If used otherwise, this can cause dangerous situations for the user and damage to the meter.
- » The instrument may only be used if the environmental conditions (temperature, relative humidity,...) are within the ranges stated in the technical specifications. Do not expose the device to extreme temperatures, direct sunlight, extreme humidity or moisture.
- » Do not expose the device to shocks or strong vibrations.
- » The case should only be opened by qualified PCE Instruments personnel.
- » Never use the instrument when your hands are wet.
- » You must not make any technical changes to the device.
- » The appliance should only be cleaned with a damp cloth. Use only pH-neutral cleaner, no abrasives or solvents.
- » The device must only be used with accessories from PCE Instruments or equivalent.
- » Before each use, inspect the case for visible damage. If any damage is visible, do not use the device.
- » Do not use the instrument in explosive atmospheres.
- » The measurement range as stated in the specifications must not be exceeded under any circumstances.
- » Non-observance of the safety notes can cause damage to the device and injuries to the user.

We do not assume liability for printing errors or any other mistakes in this manual.

We expressly point to our general guarantee terms which can be found in our general terms of business.

INTRODUCTION

The ultrasonic flowmeter precisely measures flow velocity, volume flow and heat quantity in pipe systems with high accuracy and reproducibility. An installation aid graphically indicates the correct sensor position and signal quality. The measured values are recorded on an internal memory and can be exported via software as .csv or PDF and displayed live. For heat quantity measurement, two thermocouples are used to calculate the heat quantity based on the temperature difference and the flow rate. The device can optionally be equipped with an ISO or DAkkS calibration certificate. The ultrasonic flowmeter is subject to a 100 % factory test to ensure the highest quality standards and measuring accuracy.

SPECIFICATIONS

Technical specifications

Handheld device

Model	PCE-TDS 200 Series
Measured parameters	PCE-TDS 200: flow velocity, volume flow and volume PCE-TDS 200+: flow velocity, volume flow, volume, temperature, heat output and heat quantity
Flow measurement	
Measurement range	±32 m/s
Resolution	0.001 m/s
Accuracy	DN ≥50 mm / approx. 2 in: ±1.5 % of rdg. for velocities >0.3 m/s DN <50 mm / approx. 2 in: ±3.5 % of rdg. for velocities >0.3 m/s
Repeatability	±0.5 % of rdg.
Media	all liquids with an impurity of <5 %
Temperature measurement (PCE-TDS 200+ only)	
Measurement range	Type B: +600...+1800 °C / +1,112 ... +3,272 °F Type E: -100... +900 °C / -148 ... +1,652 °F Type J: -100... +1150 °C / -148 ... +2,102 °F Type K: -100... +1370 °C / -148 ... +2,498 °F Type N: -100... +1150 °C / -148 ... +2,102 °F Type R: 0... +1700 °C / +32 ... +3,092 °F Type S: 0... +1500 °C / +32 ... +2,732 °F Type T: -100... +400 °C / -148 ... +752 °F
Accuracy measuring input	Type B: ± (0.5 % + 3 °C / 37.4 °F) Type E: ± (0.4 % + 1 °C / 33.8 °F) Type J: ± (0.4 % + 1 °C / 33.8 °F) Type K: ± (0.4 % + 1 °C / 33.8 °F) Type N: ± (0.4 % + 1 °C / 33.8 °F) Type R: ± (0.5 % + 3 °C / 37.4 °F) Type S: ± (0.5 % + 3 °C / 37.4 °F) Type T: ± (0.4 % + 1 °C / 33.8 °F)
Resolution	0.1 °C / 32.18 °F

General	
Display	2.8" LCD
Units	metric / imperial
Menu languages	English, German, French, Spanish, Italian, Dutch, Portuguese, Turkish, Polish, Russian, Chinese, Danish, Japanese
Operating and storage conditions	Temperature: -20 ... +65 °C / -4 ... 149 °F Humidity: 10 ... 95 % RH, non-condensing
Data logger	32 GB memory capacity / 100 records with a maximum of 100.000 data points per record
Interface	USB (for online measurement and to read out internal memory)
Protection class	IP 52
Power supply	Internal: rechargeable LiPo battery (3.7 V, 2500 mAh) External: USB 5 VDC, 500 mA

Sensors

Sensor type / order code	PCE-TDS 200 S sensor	PCE-TDS 200 M sensor	PCE-TDS 200 SR sensor	PCE-TDS 200 MR sensor	PCE-TDS 200 L sensor
Sensor cable length	5 m approx. 197 in	5 m approx. 197 in	5 m approx. 197 in	5 m approx. 197 in	5 m approx. 197 in
Nominal diameter	DN 15 ... 100 20 ... 108 mm approx. 3/4 ... 4 in	DN 50 ... 700 57 ... 720 mm approx. 2 ... 28 in	DN 15 ... 100 20 ... 108 mm approx. 3/4 ... 4 in	DN 50 ... 700 57 ... 720 mm approx. 2 ... 28 in	DN 300 ... 6000 300 ... 6000 mm approx. 12 ... 236 in
Liquid temperature	-30 ... 160 °C -22 ... 320 °F	-30 ... 160 °C -22 ... 320 °F	-30 ... 160 °C -22 ... 320 °F	-30 ... 160 °C -22 ... 320 °F	-30 ... 160 °C -22 ... 320 °F
Dimensions	45 x 30 x 30 mm 1.7 x 1.1 x 1.1 in	70 x 40 x 40 mm 2.8 x 1.6 x 1.6 in	200 x 25 x 25 mm 7.9 x 1.0 x 1.0 in	280 x 40 x 40 mm 11.0 x 1.6 x 1.6 in	91 x 52 x 44 mm 3.6 x 2 x 1.7 in
Weight	75 g / 0.16 lb	260 g / 0.57 lb	250 g / 0.55 lb	1080 g / 2.38 lb	530 g / 1.17 lb

Models of the series

The delivery and functional scope of the PCE-TDS 200 series depends on the model. A basic distinction is made between the PCE-TDS 200 and PCE-TDS 200+ product series. The devices of the PCE-TDS 200 product series are mere flow meters. In addition to measuring flow, the devices of the PCE-TDS 200+ series also measure the heat output and heat quantity. Therefore, two TF-RA330 temperature sensors are always included with these devices. The models with their included sensors are listed below. Each model is also available as a PCE-TDS 200+ version.

Product code	Sensors included
PCE-TDS 200 S	2x PCE-TDS 200 S sensor
PCE-TDS 200 M	2x PCE-TDS 200 M sensor
PCE-TDS 200 L	2 x PCE-TDS 200 L sensor
PCE-TDS 200 SM	2 x PCE-TDS 200 S sensor 2 x PCE-TDS 200 M sensor
PCE-TDS 200 SL	2 x PCE-TDS 200 S sensor 2 x PCE-TDS 200 L sensor
PCE-TDS 200 ML	2 x PCE-TDS 200 M sensor 2 x PCE-TDS 200 L sensor
PCE-TDS 200 SR	1x PCE-TDS 200 SR sensor
PCE-TDS 200 MR	1x PCE-TDS 200 MR sensor

Optional accessories

Product code	Description
PCE-TDS 200 S Sensor	Flow sensors for pipes DN 15 ... 100 (without rail)
PCE-TDS 200 M Sensor	Flow sensors for pipes DN 50 ... 700 (without rail)
PCE-TDS 200 L Sensor	Flow sensors for pipes DN 300 ... 6000 (without rail)
PCE-TDS 200 SR Sensor	Flow sensors for pipes DN 15 ... 100 (on rail)
PCE-TDS 200 MR Sensor	Flow sensors for pipes DN 50 ... 700 (on rail)
TT-GEL	Ultrasonic coupling gel for temperatures -10 ... 80 °C (100 ml)
K-GEL	Ultrasonic coupling gel for temperatures up to 350 °C (100 ml)
PCE-TDS 200-SC05	2 x 5 m Sensor cable for PCE-TDS 200 Series
TF-RA330	Pipe contact sensor (PCE-TDS 200+ only)
PCE-TDS 200 SW	Software for flow meter

SYSTEM DESCRIPTION

Device

Front side

- 1 - Sensor sockets
- 2 - Display
- 3 - Keys
- 4 - USB port



Top side

- 5 - Flow sensor connection (front sensor)
- 6 - Flow sensor connection (back sensor)
- 7 - Temperature sensor connection (channel 2)
- 8 - Temperature sensor connection (channel 1)



Function keys

Key	Description	Functions
	On/Off	Turn meter on/off
	Menu	Open main menu
	Back	Cancel, return, reset maximum value
	OK	Confirm
	Rec	Open data logger dialogue
	Up	Navigate up
	Down	Navigate down
	Right	Navigate right
	Left	Navigate left

GETTING STARTED

Power supply

The meter is powered by an internal rechargeable LiPo battery. With a fully charged battery, an operating time of approx. 8 ... 10 hours is possible, depending on the brightness of the display.

The battery is charged via the USB socket at the bottom of the meter, using a suitable USB charger. The charging process can be shortened by switching off the device during the charging process.

The current charge level of the battery is displayed in the status bar at the top right. As soon as the charge level of the battery is no longer sufficient for proper operation of the instrument, it switches off automatically and the screen shown below is displayed.

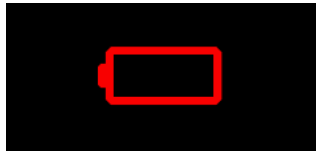


Fig. 1 Automatic power off

Preparation

The meter is switched on by pressing the ON/OFF key. When the device is switched on, the start screen appears for approx. 1 second and then the device enters the measurement screen. To switch off the meter, keep the ON/OFF key pressed. A dialogue with a countdown now appears on the display to announce that the instrument is about to power off.

The flow sensors are connected by simply plugging them into the sockets provided at the top of the device. They are disconnected by pulling the plugs, touching the ribbed surface to unlock the plug connection. Screw the plugs into the sensors using the knurled nut.

The thermocouples are also connected by plugging them into the sockets provided. The plugs have a wide and a narrow contact. These determine the orientation of the plug when it is plugged in.

MENU

The main menu can be opened at any time by pressing the MENU key. The arrow keys are used to navigate between the menu items which can be activated with the OK key. Submenus can be left with the BACK key. The main menu of the PCE-TDS 200 series consists of the submenus Measurement, Data logger, Settings, Calibration, Manual and Info. The submenus are explained in more detail in the following chapters.

Measurement

In the submenu Measurement, the options relevant for the measurement can be set:

Pipe, medium, sensors, measurement method, temperature, units, alarm, overview display, damping, absolute values and lower threshold.

Pipe

In the Pipe menu, all parameters of the pipe are set. The following parameters are to be set:

Parameter	Description
Pipe material	Material of the pipe Selection of standard materials or custom entry of the transversal sound velocity Custom » See „Custom pipe materials“ Metals » Copper CU » Steel FE » Stainless steel VA » Aluminium AL » Brass ME » Cast iron CI » Iron FE » Nickel NI » Titanium TI » Zinc ZI Plastics » Acrylic AC » Polyethylene PE » Polypropylene PP » Polyvinylchloride PVC » Nylon NY Stainless steels » V2A » V4A » 1.4301 » 1.4305 » 1.4307 » 1.4310 » 1.4401 » 1.4404 » 1.4541 » 1.4550 » AISI 302 » AISI 303 » AISI 304 » AISI 304L » AISI 316 » AISI 316Ti » AISI 321 » AISI 347 The abbreviations for the standard materials are shown in the Pipe menu in the Pipe material menu item.

Pipe wall thickness	Wall thickness of the pipe
Inner diameter	Inner diameter of the pipe
Outer diameter	Outer diameter of the pipe
Liner material	Material of the pipe liner Selection of standard materials or custom entry of the longitudinal sound velocity » No liner » Custom » Epoxy resin » Rubber » Mortar » Polystyrol PS » Polyethylene PE » Polytetrafluorethylene PTFE » Polyurethane PU » Polypropylene PP
Wall thickness of liner	Wall thickness of the der pipe liner

The material selection is made via selection menus. The numerical parameters are edited via an input dialogue. Each decimal place can be selected with the RIGHT/LEFT arrow keys and edited with the UP/DOWN arrow keys.

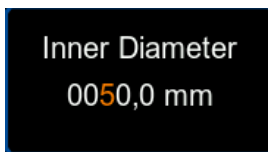


Fig. 2 Input dialogue

To completely set the pipe parameters, first set the pipe material via the selection menu. Then enter the wall thickness of the pipe via an input dialogue. In the next step, you can enter either the inner or the outer diameter; the other variable is calculated automatically on the basis of the parameters. The last settings to be entered are the liner material and the wall thickness of the lining.

The pipe parameters that have now been completely set can be saved as a preset to avoid having to enter all the parameters again. To save the parameters, select the menu item Save as preset. Successful storage is confirmed by a dialogue.

The saved presets are now listed in the Presets menu. The name of the presets is composed of the material abbreviation, the outer diameter, the inner diameter and the pipe wall thickness. By selecting a preset, all pipe parameters are adopted.

Custom pipe materials

In this menu, it is possible to create up to 100 user-defined pipe materials. To create a new pipe material, select the menu item Add material and enter the desired name using the keyboard and confirm with the Enter symbol at the bottom right of the keyboard.

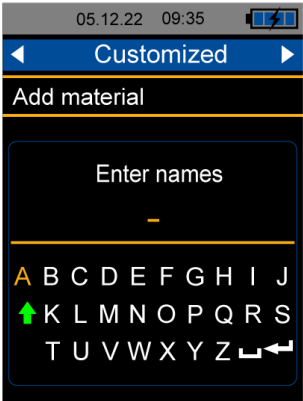


Fig. 3 Add material

After confirming, a dialog for entering the transverse sound velocity of the material opens.

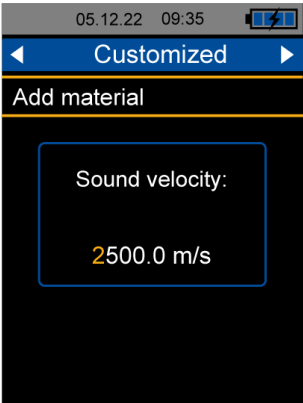


Fig. 4 Entering the transverse sound velocity

After confirming with the OK button, the material is saved and executed in the list. Selecting the material opens a dialog that displays the properties of the material and contains the options Select, Edit and Delete.

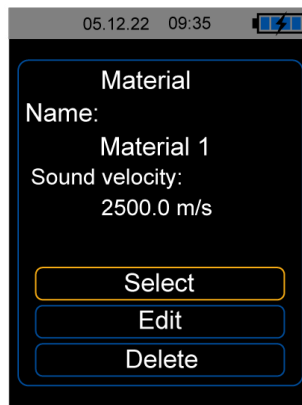


Fig. 5 Dialog for selecting, editing and deleting a pipe material

Medium

The Medium menu allows you to select one of the standard media or to enter the sound velocity and kinematic viscosity of a user-defined medium. The following standard media are available:

- » Water
- » Sea water
- » Oil
- » Crude oil
- » Methanol
- » Ethanol
- » Diesel
- » Gasoline
- » Petroleum

A user-defined medium is selected by entering the sound velocity and the kinematic viscosity of the medium. To do this, select the menu item Custom. A dialogue for entering the sound velocity opens. Here, each decimal place can be selected with the RIGHT/LEFT arrow keys and edited with the UP/DOWN arrow keys.

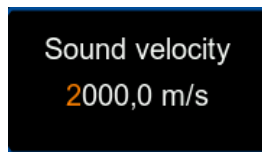


Fig. 6 Input dialogue sound velocity

Then confirm with the OK key. The dialogue changes so that you can enter the kinematic viscosity. Enter the kinematic viscosity of your medium and confirm again with the OK key. The dialogue is closed and the parameters are adopted.

Note: The kinematic viscosity can be calculated from the dynamic viscosity and the density of the medium using the following formula.

$$\text{Kinematic viscosity [mm}^2/\text{s]} = \frac{\text{dynamic viscosity [mPa} \cdot \text{s]}}{1000 \cdot \text{density } \left[\frac{\text{kg}}{\text{m}^3}\right]}$$

Sensors

The flow sensors used are selected in the Sensors menu. The following sensors are available for selection.

Sensor description	Possible measuring methods	Pipe diameter
TDS-S	Z, V, N, W	20 ... 108 mm / 0.79 ... 4.25 in
TDS-M	Z, V, N, W	57 ... 720 mm / 2.24 ... 28.35 in
TDS-L	Z, V, N, W	315 ... 6000 mm / 12.40 ... 236.22 in
TDS-SR	V, W	20 ... 108 mm / 0.79 ... 4.25 in
TDS-MR	Z, V, N, W	57... 720 mm / 2.24 ... 28.35 in

Measurement method

In the Measurement method menu, the method for mounting the sensors is selected. The Z, V, N and W methods are available for selection. A more detailed explanation of the measurement methods can be found in the chapter „Measuring principle and measuring methods“.

Temperature

The Temperature menu is used to enter the manual compensation temperature. This is used for compensation of the sound velocity and the kinematic viscosity for the medium water (all other media are not temperature compensated).

In addition, the thermocouple types and any offsets required for the two temperature measurement channels are set in this menu (PCE-TDS 200+ only).

To set a thermocouple type, select the Type menu item for the desired channel with the OK key. The thermocouple type displayed in the menu item on the right now appears in orange. With the arrow keys UP/DOWN, you can now select between the different types (B,E,J,K,N,R,S,T). The setting is adopted by confirming with the OK key again.

To enter an offset, select the corresponding menu item by pressing the OK key. A dialogue for entering the offset opens.



Fig. 7 Input dialogue offset channel 1

Here, each decimal place can be selected with the RIGHT/LEFT arrow keys and edited with the UP/DOWN arrow keys.

Units

This menu allows you to set the units of all measured parameters. The following chart shows the available units.

Parameter	Unit	Abbreviation
Dimensions	Millimetres Inches	[mm] [in]
Flow velocity	Metres per second Feet per second	[m/s] [ft/s]
Volume flow*	Cubic metres Litres USA gallons Imperial gallons Million USA gallons Cubic feet USA barrels Imperial barrels Oil barrels	[m³] [l] [gal] [igl] [mgl] [cf] [bal] [ib] [ob]
	*The time can be specified per day, per hour, per minute and per second.	
Volume	Cubic metres Litres USA gallons Imperial gallons Million USA gallons Cubic feet USA barrels Imperial barrels Oil barrels	[m³] [l] [gal] [igl] [mgl] [cf] [bal] [ib] [ob]
Temperature	Celsius Fahrenheit	[°C] [°F]

PCE-TDS 200+		
Heat quantity	Joules Kilojoules Megajoules Watt hours Kilowatt hours Megawatt hours British thermal units Kilo British thermal units Mega British thermal units	[J] [kJ] [MJ] [Wh] [kWh] [MWh] [Btu] [kBtu] [MBtu]
Heat output	Watts Kilowatts Megawatts Joules per hour Kilojoules per hour Megajoules per hour British thermal units per hour Kilo British thermal units per hour Mega British thermal units per hour	[W] [kW] [MW] [J/h] [kJ/h] [MJ/h] [Btu/h] [kBtu/h] [MBtu/h]
Cost	Euros Pounds Dollars Turkish lira Zloty Yuans	€ £ \$ TL Zł ¥
The costs per unit of heat quantity (for example costs per kWh) can be entered via a dialogue by selecting the menu item Costs per unit.		

Alert

The configuration for the visual and audible alarm of the meter is carried out in the Alert menu. Five modes are available for monitoring.

Mode	Description
Off	The alarm is deactivated.
Above	The alarm is triggered when the measured parameter exceeds the upper limit value.
Below	The alarm is triggered when the measured parameter falls below the lower limit value.
Window mode	The alarm is triggered when the measured parameter lies between the upper and the lower limit value.
Inverse window mode	The alarm is triggered when the measured parameter lies outside the range between the upper and the lower limit value.

In addition to selecting the alert mode, the measured parameter to be monitored can be selected under the menu item Measured parameter.

The limit values can be set under the menu item Limits by selecting the respective menu item with the help of an input dialogue.

Overview screen

The meter enables the numerical and graphical display of several measured parameters in the measurement display, the Overview screen. It is possible to display up to four individually selectable measured parameters numerically and up to two individually selectable measured parameters graphically. The selection of the measured parameters to be displayed is made under the menu items Graphical view and Numerical view by placing check marks.

Damping

The damping influences the measured parameters flow velocity and volume flow. It can be set to a value within the range of 0 ... 60 s. The setting 0 s deactivates the damping of the measurement.

Absolute values

The Absolute values menu item makes it possible to prevent negative values from being displayed for the parameters flow velocity and volume flow. With the setting ON, in case of a negative volume flow, the measured value is displayed with a positive sign. The arrangement of the upstream and downstream sensor thus has no influence on the sign in front of the measured values in terms of the flow direction.

Lower cutoff

The Lower cutoff represents the flow velocity above which the meter displays a flow velocity of 0 m/s. In the event that the zero point fluctuates despite a set zero point, this value can be increased.

Distance indication

This option can be used to show or hide the distance display in the installation view. The distance display is hidden by default.

Reset settings

This menu item can be used to reset the settings from the Measurement menu to the following default values. The reset must also be confirmed in a dialog.

Parameter	Default value
Pipe material	Copper
Inner diameter	50
Pipe wall thickness	1
Liner material	No liner
Wall thickness of liner	0
Medium	Water
Sensors	TDS-M
Measurement method	V-Method
Damping	10 s
Lower cutoff	0.05 m/s

Settings overview

The settings overview shows all parameters relevant for the measurement as well as the signal quality.

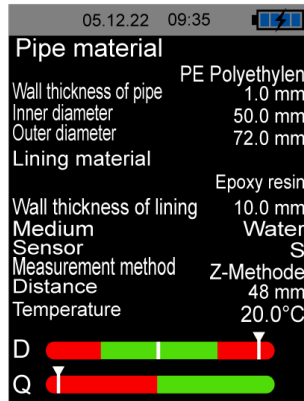


Fig. 8 Overview of all measurement settings

The overview is particularly useful for support requests in order to provide our support staff with all relevant information. In this case, a photo of the sensors on the pipe is also helpful to identify and resolve potential faults.

Data logger

The Data logger of the instrument allows to record all measured parameters. The time period as well as the memory interval can be freely configured with the help of this menu.

Note: To prevent the meter from accidentally switching off during recording, manual switch-off is not possible and automatic power off is deactivated.

Start condition

The data logger can be started either manually by pressing a key while you are in the data logger dialogue or automatically from a date that is set in this menu.

Stop condition

Three different options are available for stopping the data logger. It can be stopped manually by pressing a key when you are in the data logger dialogue, on a certain date or after an adjustable time interval.

Interval

The time interval for saving the measured values can be set to a value between 1 s and 12 h via an input dialogue.

Records

In this menu, all saved records are displayed and by selecting a record, information on the start and stop time as well as the number of saved data points are displayed. One data point reflects the one-time storage of all measured parameters listed hereinafter for the models PCE-TDS 200 and PCE-TDS 200+.

Model	Saved measured parameter per data point
PCE-TDS 200	Flow velocity, volume flow, volume
PCE-TDS 200+	Flow velocity, volume flow, volume, temperature channel 1, temperature channel 2, temperature difference, heat output, heat quantity, cost

Note: If the maximum number of 100,000 data points for the current recording is reached, the device automatically starts another new recording.

Delete all

By selecting this menu item and confirming via the dialogue, all saved data records are deleted.

Data logger dialogue

The data logger dialogue can be opened in any screen via the REC key and shows the current settings as well as the status of the data logger. When the dialogue is open, a recording can be started or stopped at any time by pressing and holding OK. In addition, the data logger menu opens when the dialogue is open and the MENU key is pressed.

Note: If the maximum number of records (a maximum of 100 records is possible) is reached, the error message SD card error is displayed in the dialogue. In this case, it is necessary to delete one or more records to be able to add more records.

User menu

With the PCE-TDS 200, up to 10 different users can be stored in the menu, whereby the measuring device can be protected with a 4-digit password. When a data recording is carried out, it is noted in the log which user carried out the measurement and which user calibrated the measuring device.

Creating users

You can create a maximum of 10 users in the user menu. A maximum of 25 characters are available for the name and 4 numbers for the password.

Delete user

Users can be deleted in this menu. You need the respective password to delete a user.

Change password

The password entered can be changed here.

If you have forgotten the password, press the UP/DOWN arrow buttons simultaneously for 5 seconds; the password is then reset and a new password must be assigned.

User login

Here you can set whether the meter uses the user login when it is switched on. This setting then applies to all created users. You can activate the user login, in which case each user must log in with the stored password, or you can deactivate the user login, in which case the device starts without a login.

Setting

Decimal separator

Either a dot or a comma can be selected as the decimal separator for measured values.

Date & time

The date and time can be set in this menu. In addition, the date and time format can be selected.

Display

In this tab, the screen brightness can be adjusted between 50 and 100 %. Automatic dimming can also be set. After the set time, the display is dimmed to a lower brightness to save power or switched off completely. Pressing any button returns the brightness to the original setting.

Language

The following menu languages are available: English, German, French, Spanish, Italian, Dutch, Portuguese, Turkish, Polish, Russian and Chinese.

Note: To reset an incorrectly set language, switch off the meter using the ON/OFF key. Then switch on the meter while pressing and holding the BACK key. You will automatically be taken to the language settings. The default setting of the meter is English.

Auto power off

This option can be used to activate an automatic power-off function for the device. The instrument switches off when the auto power off mode is activated if no key has been pressed for a certain period of time. You can select 1 minute, 5 minutes or 15 minutes. In addition, automatic power off can be completely deactivated.

Factory settings

With the help of this option, the device can be reset to the factory settings. A distinction is made between the device settings and the pipe presets. These can be reset separately.

When resetting the device settings, the default values for the measurement parameters and the remaining menu options are restored.

When resetting the pipe presets, all presets saved on the meter will be deleted.

Calibration

The Calibration menu allows you to set a scaling factor that can be determined by calibration.

Since a special measurement setup is required for calibration, this menu is protected by a code.

Please send the device to PCE Instruments for calibration. You will find our contact details at the end of the manual.

Manual

A QR code is displayed in this menu. The QR code can be scanned with an appropriate reader such as a mobile phone and leads directly to this user manual.

Info

The Info menu displays the model name, serial number and firmware version.

MEASUREMENT

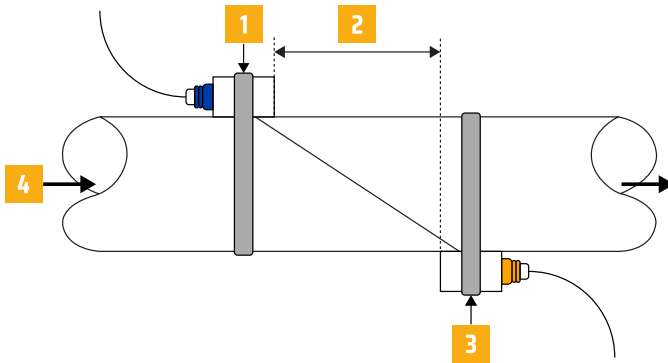
Measuring principle and measuring methods

The flow meter enables the flow velocity of liquids in pipes to be measured without interfering with the pipe and without affecting the flow in the pipe. However, it does not matter whether the piping is unpainted or painted.

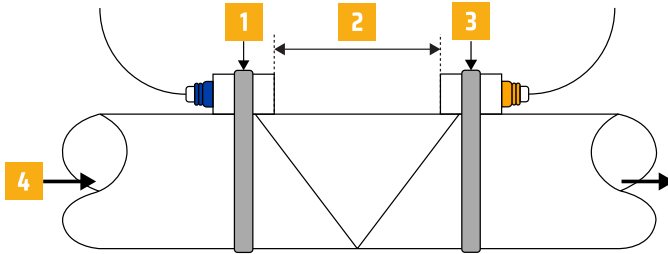
To enable non-invasive measurement, the PCE-TDS 200 uses two sensors that work as both ultrasonic transmitters and receivers. The sensors are attached to the outside of the pipe wall at a defined distance. To enable the transmission of the ultrasound, a coupling gel must be applied to the sensors in this case. When ultrasonic signals are transmitted with and against the flow direction of the liquid, differences in transit time occur which can be converted into the flow velocity.

The sensors can be mounted according to four different measurement methods which are shown below.

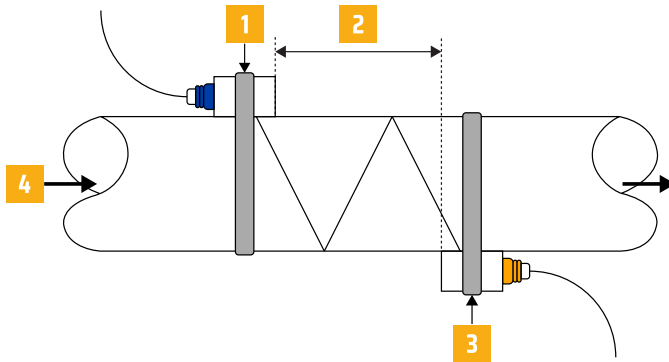
Z method



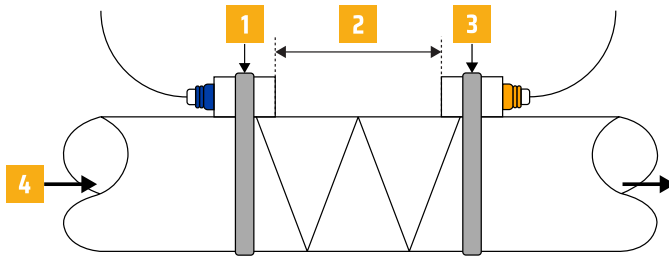
V method



N method



W method



1 Upstream sensor, 2 Sensor distance, 3 Downstream sensor, 4 Flow direction

The more frequently the sound crosses the liquid, the more accurately even very small flow velocities can be measured. However, the signal strength decreases with each crossing, which is why the W and N method cannot be used for every pipe, for example.

It is recommended to use the V method if the pipe parameters allow it as this produces the best results in terms of signal quality and zero point stability. However, if the signal quality is too low, the Z method can be used.

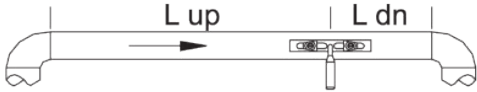
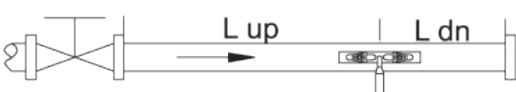
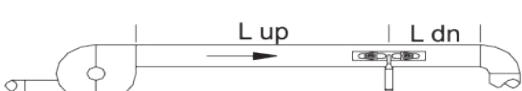
Getting started

Measuring location

The first step of the installation should be to find a suitable place to mount the sensors. This is a prerequisite for obtaining accurate measurement results. For this, a basic knowledge of the pipelines / the piping system is necessary.

Therefore, an infinitely long, straight pipe would be the ideal position. The liquid should not have any air pockets or impurities. The piping can be vertical or horizontal. To avoid inaccuracies due to turbulence in the liquid, a straight flow-calming section should be considered upstream and downstream of the measuring location. Generally speaking, the length upstream of the measuring location should be at least 10 x the pipe diameter and downstream of the measuring location 5 x the pipe diameter.

The following chart shows some examples of good positions:

Pipe routings and sensor position	Upstream	Downstream
	$L_{up} \times \varnothing$	$L_{dn} \times \varnothing$
	10D	5D
	10D	5D
	10D	5D
	12D	5D
	20D	5D
	20D	5D
	30D	5D

Sensor installation

The PCE-TDS 200 has piezoelectric sensors which can transmit and also receive ultrasonic waves. The time the ultrasonic waves take to pass through the pipe walls and the liquid allows conclusions about the flow velocity. Since the transit time of the ultrasonic pulses is very short, the sensors should be installed as precisely as possible to ensure highest system accuracy.

Take the following steps to install the sensors:

- 1 Some pipes have a liner. There can be a boundary layer between the outer diameter of the pipe and the inner liner. This boundary layer can divert or weaken the ultrasonic waves. In this case, a measurement will be very difficult. The same applies to external coatings on the pipe, such as paint. This must be removed before the measurement so that you can measure.

- 2 Find an ideal position in the piping system, i. e. a straight section with new and clean pipes with even surfaces.
- 3 It is very important that the pipes are clean. Grind or polish the locations where you would like to place the sensors so that the contact surface is even.
- 4 There must not be an air gap between the sensors and the surface of the pipe. Attach the sensors using sufficient contact gel. Also, tighten the fastening straps firmly enough so that the position of the sensors cannot change during the measurement.
- 5 To avoid air bubbles from causing measurement errors, place the sensors on the pipe laterally. Note that in this case, the flow could not be calculated correctly by the device due to the pipe not being completely filled.

Spacing between the sensors

The distance between the upstream and the downstream sensor can be seen in the installation view of the measurement screen. The window specifies the inner distance between the two sensors which can be used as an indication for the sensor installation. The fine adjustment is carried out by arranging the spacing in a way that the distance indicator is as central as possible within the graph.

In order for the PCE-TDS 200 to calculate the correct distance, the following parameters must be entered beforehand:

- (1) Outer diameter of the pipe
- (2) Material thickness of the pipe
- (3) Material of the pipe
- (4) Material thickness of the pipe liner
- (5) Material of the pipe liner
- (6) Type of liquid
- (7) Type of connected sensors
- (8) Mounting method of the sensors
- (9) Temperature of the medium

Procedure

To carry out a measurement, it is first necessary to set all parameters in the Measurement menu completely in line with the pipe used, the medium, the sensors, the measurement method and the temperature. After all parameters have been set and checked, go back to the measurement screen and navigate to the installation view. The installation view shows the measurement method, the set sensors and the distance between the sensors.

Note: Note that in the case of the Z method, the sensors may also overlap.

Mount the sensors according to the described measurement method with the appropriate distance and apply sufficient coupling gel to the sensors. The meter should now be able to receive a signal and display this via the quality indicator. If the quality indicator is within the green range, you can continue with the distance setup. If there is no signal or the signal is poor, check the settings again and follow the preparation steps described above.

Now adjust the distance of the sensors so that the distance indicator is as central as possible within the green area. A good setting is shown below.

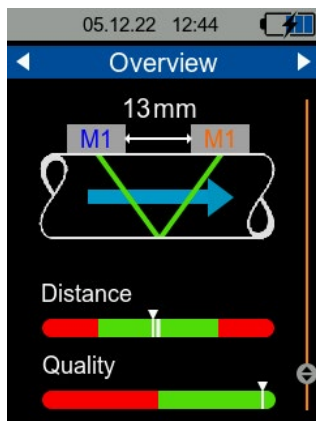


Fig. 9 Installation view with good setting

After setting the distance, the meter is ready for operation and the measurement can be made. Since the zero point may be shifted depending on the measuring conditions (installation, pipe material, etc.), it is possible to reset the zero point in the installation view.

To do this, it is necessary to ensure that the liquid in the pipe does not move!

In the installation view, press and hold the OK key until the confirmation dialogue opens and confirm the setting of the zero point. While the meter is determining the zero point, a waiting dialogue is displayed. After this has closed, the zero point is set.

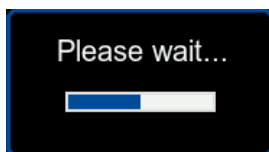


Fig. 10 Waiting dialogue

In order to carry out a heat quantity and heat output measurement, it is also necessary to connect the temperature sensors to the device and attach them to the corresponding measuring locations. Temperature channel 1 must be attached to the warmer measuring location (e. g. the feed line of a heating system) and channel 2 to the colder measuring location (e. g. the return line of a heating system).

Measurement display

Navigation

To ensure a clear presentation of the measured parameters, the measurement display consists of several views. Each view represents a measured parameter which is displayed in the upper blue area of the view. Switching between the views of the measured parameters is possible with the RIGHT and LEFT arrow keys. Some parameter views also have several formats for displaying the parameter, such as the simple numerical display, the graphical display or the display of the statistical values (minimum value, maximum value and average). The display format can be changed using the UP and DOWN arrow keys. The following illustrations show the different display formats for viewing the parameter flow velocity.

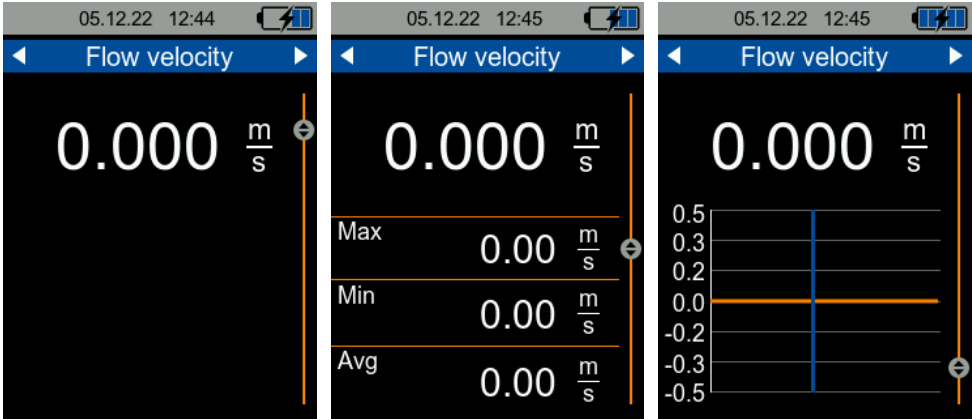


Fig. 11 Numerical, statistical and graphical representation

The following chart shows the available formats of representation of the measured parameters.

	Flow velocity	Volume flow	Heat output	Heat quantity	Temperature
Numerical	Flow velocity	Volume flow, volume sum, volume positive, volume negative	Heat output	Heat quantity, cost	Temperature channel 1, channel 2 and difference
Statistical	Minimum, maximum and average value of the flow velocity	Minimum, maximum and average value of the volume flow	Heat output	-	Minimum, maximum and average value for temperature channel 1, channel 2 and difference
Graphical	Flow velocity	Volume flow	Heat output	-	Temperature channel 1, channel 2

In addition to the parameter views, the measurement display has an overview. The overview shows the numerical and graphical representation.

The numerical display enables the presentation of up to four freely selectable measured parameters. In the graphical display, two measured parameters can be displayed graphically parallel to each other. The selection of the displayed parameters is made via the menu Overview screen.

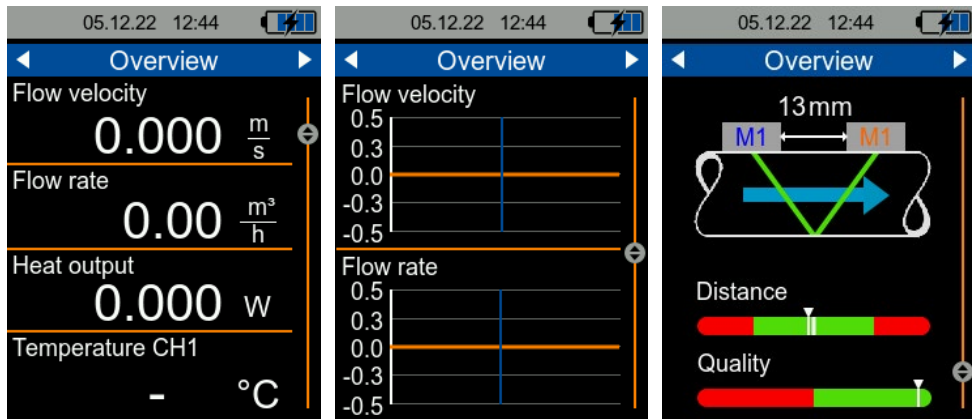


Fig. 12 Formats of representation of the Overview screen

Keyboard shortcuts

To simplify navigation to the overview display, press the BACK key once. Pressing the BACK key again takes you to the installation view.

Resetting the currently displayed statistical values is possible by holding down the OK key. This is possible in the statistical display of the views flow velocity, flow rate, heat output and temperature.

In the numerical displays of the heat quantity and flow rate views, the volume flow counter or the measured heat quantity can be reset to 0 by holding down the OK key.

SERVICE

Measurement

Differences between materials

The reproducibility and measuring accuracy are directly dependent on the input of the pipe and medium parameters. It is therefore important to know the characteristics of the system and to enter them correctly in the settings.

A frequently unknown parameter is the sound velocity of the pipe. If the entered sound velocity does not correspond to the actual sound velocity, the device cannot correctly determine the distance between the sensors, which makes installation more difficult.

The sound velocities stored in the device are average values which may not correspond to the properties of the pipe. Particularly with alloys such as stainless steel, large deviations can occur.

Attaching the sensors

The installation of the sensors is particularly relevant for long-term measurements in order to prevent a change in position. Therefore, make sure that the fastening straps ensure that the sensors are firmly attached. Depending on the application, it may also be helpful to attach the sensor cables to the pipe to prevent the sensors from sagging due to the weight of the sensor cables.

Measurement on small pipes

For pipes with a diameter < 35 mm, installation using the Z method is generally recommended. It is theoretically possible to use the V, N and W methods, but in practice these are more prone to errors during installation, which is why the Z method is recommended in this case.

Function test of the sensors

To test the function of the sensors without the influence of a pipe, proceed as follows.

1. Set the pipe inside diameter to 20 mm, the pipe wall thickness to 1 mm and select No lining.
2. Select the Z method.
3. Navigate to the installation view
4. Apply some coupling gel to the sensors and hold them in a Z-arrangement on top of each other.
5. The quality display should now show a reception quality, provided the sensors are OK.

Support request

We can best help you with support requests if we have all the necessary information about the measurement application. A summary of the relevant measurement parameters can be found in the device under the settings overview in the Measurement menu.

Photos of the sensors on the pipe are also useful for identifying and solving installation problems.

Firmwareupdate

Download the flash and update software via the following link.

<https://www.pce-instruments.com/deutsch/software/PCE-TDS-200-plus-flash.zip>

1. Make sure that the measuring device is switched off
2. Hold the menu button and briefly press the power button after one second.
3. Then hold the menu button for two more seconds. The screen of the device should now remain black, if the device still starts, the process must be repeated.
4. Connect the measuring device to the PC via the USB-C cable
5. Now start the update software. The firmware will now be updated.
6. After the update process is complete, the device will start normally.

Reset language

To reset an incorrectly set language, switch off the meter using the ON/OFF key. Then switch on the meter while pressing and holding the BACK key. You will automatically be taken to the language settings. The default setting of the meter is English.

DISPOSAL

For the disposal of batteries in the EU, the (EU) 2023/1542 directive of the European Parliament applies. Due to the contained pollutants, batteries must not be disposed of as household waste. They must be given to collection points designed for that purpose. In order to comply with the EU directive 2012/19/EU we take our devices back. We either re-use them or give them to a recycling company which disposes of the devices in line with law. For countries outside the EU, batteries and devices should be disposed of in accordance with your local waste regulations. If you have any questions, please contact PCE Instruments.

CONTACT INFORMATION

Germany

PCE Deutschland GmbH
Im Langel 26
D-59872 Meschede
Deutschland
Tel.: +49 (0) 2903 976 99 0
Fax: +49 (0) 2903 976 99 29
info@pce-instruments.com
www.pce-instruments.com/deutsch

United Kingdom

PCE Instruments UK Ltd
Trafford House
Chester Rd, Old Trafford
Manchester M32 0RS
United Kingdom
Tel: +44 (0) 161 464902 0
Fax: +44 (0) 161 464902 9
info@pce-instruments.co.uk
www.pce-instruments.com/english

The Netherlands

PCE Brookhuis B.V.
Twentepoort West 17
7609 RD Almelo
Nederland
Telefoon: +31 (0)53 737 01 92
info@pcebenelux.nl
www.pce-instruments.com/dutch

France

PCE Instruments France EURL
23, rue de Strasbourg
67250 Soultz-Sous-Forêts
France
Téléphone: +33 (0) 972 3537 17
Numéro de fax: +33 (0) 972 3537 18
info@pce-france.fr
www.pce-instruments.com/french

Italy

PCE Italia s.r.l.
Via Pesciatina 878 / B-Interno 6
55010 Loc. Gragnano
Capannori (Lucca)
Italia
Telefono: +39 0583 975 114
Fax: +39 0583 974 824
info@pce-italia.it
www.pce-instruments.com/italiano

United States of America

PCE Americas Inc.
1201 Jupiter Park Drive, Suite 8
Jupiter / Palm Beach
33458 FL
USA
Tel: +1 (561) 320-9162
Fax: +1 (561) 320-9176
info@pce-americas.com
www.pce-instruments.com/us

Spain

PCE Ibérica S.L.
Calle Mula, 8
02500 Tobarra (Albacete)
España
Tel. : +34 967 543 548
info@pce-iberica.es
www.pce-instruments.com/espanol

Turkey

PCE Teknik Cihazları Ltd.Şti.
Halkalı Merkez Mah.
Pehlivan Sok. No.6/C
34303 Küçükçekmece - İstanbul
Türkiye
Tel: 0212 471 11 47
Faks: 0212 705 53 93
info@pce-cihazlari.com.tr
www.pce-instruments.com/turkish

Denmark

PCE Instruments Denmark ApS
Birk Centerpark 40
7400 Herning
Denmark
Tel.: +45 70 30 53 08
kontakt@pce-instruments.com
www.pce-instruments.com/dansk