



testo 480 · Climate measuring instrument

Instruction manual



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2 Safety and the environment



2.1. About this document

Symbols and writing standards

Representation	Explanation
	Warning advice, risk level according to the signal word: Warning! Serious physical injury may occur. Caution! Slight physical injury or damage to the equipment may occur. > Implement the specified precautionary measures.
	Note: Basic or further information.
1. ...	Action: more steps, the sequence must be followed.
2. ...	
> ...	Action: a step or an optional step.
- ...	Result of an action.
Menu	Elements of the instrument, the instrument display or the program interface.
[OK]	Control keys of the instrument or buttons of the program interface.
... ...	Functions/paths within a menu.
"..."	Example entries

Warnings

Always pay attention to information that is marked by the following warnings with warning pictograms. Implement the specified precautionary measures.

Representation	Explanation
	indicates circumstances that may lead to damage to the products
	indicates potential minor injuries

2.2. Ensure safety

- > Only operate the product properly, for its intended purpose and within the parameters specified in the technical data. Do not use any force.
- > Dangers may also arise from the systems being measured or the measuring environment: Note the safety regulations valid in your area when performing the measurements.
- > Do not perform contact measurements on non-insulated, live parts.
- > Do not store the product together with solvents. Do not use any desiccants.
- > Carry out only the maintenance and repair work on this instrument that is described in the documentation. Follow the prescribed steps exactly. Use only original spare parts from Testo.
- > Temperatures given on probes relate only to the measuring range of the sensors. Do not expose handles and feed lines to temperatures in excess of 40 °C (104 °F), unless they are expressly permitted for higher temperatures.
- > After the final measurement, allow probes and probe shafts to cool down sufficiently in order to avoid burns from the hot sensor tip or the probe shaft.
- > Improper use of rechargeable batteries can lead to destruction or injuries by means of current surges, fire or escaping chemicals. The following instructions must be observed to avoid such hazards:
 - Only use in accordance with the directions in the instruction manual.
 - Do not short, take apart or modify.
 - Do not expose to heavy impacts, water, fire or temperatures above 60 °C.
 - Do not store in the proximity of metal objects.
 - Do not use leaky or damaged rechargeable batteries. In the event of contact with battery acid: Thoroughly wash affected area with water and consult a doctor, if necessary.
 - Only charge in the instrument or the recommended charging station.
 - Immediately stop the charging process if this is not completed in the given time.

- In the event of improper function or signs of overheating, immediately remove the rechargeable battery from the measuring instrument/charging station. Caution: Rechargeable battery may be hot!

Use

- > Please read this documentation through carefully and familiarize yourself with the product before putting it to use. Pay particular attention to the safety instructions and warning advice in order to prevent injuries and damage to the products.
- > Keep this document to hand so that you can refer to it when necessary.
- > Hand this documentation on to any subsequent users of the product.

2.3. Protecting the environment

- > Dispose of faulty rechargeable batteries/spent batteries in accordance with the valid legal specifications.
- > At the end of its useful life, send the product to the separate collection for electric and electronic devices (observe local regulations) or return the product to Testo for disposal.

3 Specifications

3.1. Use

The testo 480 is a measuring instrument for measuring climate-related parameters. The testo 480 is ideal for comfort level measurements for the workplace evaluation and flow measurements in and at ventilation and air-conditioning systems. The instrument is only to be used by qualified expert personnel. Then product must not be used in explosive environments!

3.2. Technical data

Hand-held instrument

Feature	Values
Measurement parameters	<ul style="list-style-type: none"> • Temperature (°C, °F, difference-°C, difference-°F) • Humidity (%RH, td°C, td°F, wet bulb °C, wet bulb °F, g/m³, g/ft³, g/kg, g/lb, kJ/kg, BTU/lb, ppm, Vol%) • Flow velocity (m/s, ft/m) • Pressure (Pa, hPa, mbar, kPa, bar, psi, inH₂O, inHg, mmH₂O, Torr) • CO₂ (ppm, Vol%) • Lux (Lux, footcandle)
Sensor connections	<ul style="list-style-type: none"> • 2x temperature (TC type K) • 1x differential pressure • 3x digital probes (flow, humidity, temperature, CO₂, Lux, absolute pressure)
Interfaces	<ul style="list-style-type: none"> • Mini USB • Infrared for testo report printer • SD card • Mains connection
Internal memory capacity	1.8 GB (approx. 60,000,000 measuring values)
Rechargeable battery life	Approx. 17 h (hand instrument without probe with 50% display brightness)
Measuring cycle	0.5 s
Operating temperature	0 to +40 °C
Storage temperature	-20 to +60 °C
Dimensions	81 mm x 235 mm x 39 mm
Housing material	ABS, TPE, PMMA
Weight	Approx. 435 g
IP protection class	30 (with connected probes)

Integrated measurement (at 22 °C, ±1 digit)

Feature	Values
Temperature (TC type K; internal reference point measurement: measuring range 0 to +40 °C, accuracy ±0.5 °C)	<p>Measuring range: -200.0 to +1370.0 °C Accuracy: ±(0.3 °C + 0.1 % of meas. val.) Resolution: 0.1 °C</p> <hr/> <p>i The accuracy information applies in an adjusted, stable temperature state. Plugging in the mains unit, charging the battery or adding digital probes can distort this temporarily, and additional errors may occur.</p>
Differential pressure	<p>Measuring range: -100 to +100 hPa Accuracy¹: 0...+25 hPa: ±(0,3 Pa + 1% of meas. val.) +25.001 to +100hPa: ±(0,1 hPa + 1.5% of meas. val.)</p> <p>Resolution: 0.001 hPa</p> <hr/> <p>i The accuracy specification applies immediately after zeroing of the sensor. For long-term measurements, mains operation with fully-charged battery is recommended.</p> <p>Temperature coefficient: <0.01% FS/K typical</p>
Absolute pressure	<p>Measuring range: +700 to +1100 hPa Accuracy: ±3 hPa Resolution: 0.1 hPa</p>

¹ Only with positive pressures

Standards, tests, warranty

Feature	Values
EU Directive	2014/30/EC
Vibration	IEC 60068-2-6
Warranty	2 years, warranty conditions: see www.testo.com/warranty

Mains unit (0554 8808) for continuous measurements and battery charging

Feature	Values
Output voltage	5 V / 4 A

Lithium battery

Feature	Values
Charging option	In instrument
Charge time	Approx. 8 h
Battery life	Approx. 17 h (hand instrument without probe with 50% display brightness)
Ambient temperature	0 – 40 °C / 32 – 104 °F
Long-term storage temperature	<23 °C / <73 °F

4 Product description

4.1. Overview

4.1.1. Hand instrument



- 1 Display
- 2 Mini USB interface (right-hand side of instrument)
- 3 Control buttons and trackpad (navigation field)
- 4 SD card slot (right-hand side of instrument)

5 Magnetic holder (on back)

⚠ WARNING

Magnetic field

May be harmful to those with pacemakers.

> Keep a minimum distance of 15 cm between pacemaker and instrument.

ATTENTION

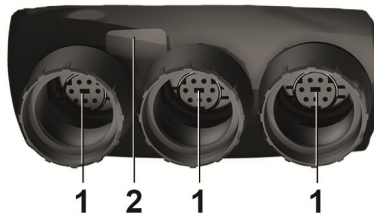
Magnetic field

Damage to other devices!

> Keep a safe distance away from products which could be damaged by the effects of magnetism (e.g. monitors, computers or credit cards).

4.1.2. Instrument connections and interfaces

Top

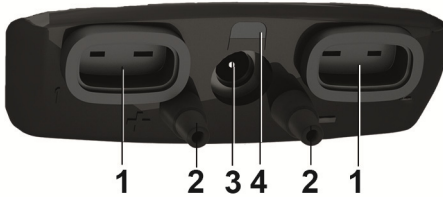


- 1 Probe sockets for digital probes
- 2 IR interface for printouts with testo report printer (art. no. 0554 0549)

⚠ CAUTION

Risk of injury from infrared beam!





> Do not direct infrared beam at human eyes!




Bottom

- 1 TC connection for temperature probe type K
- 2 Connections for differential pressure (+/- sign on the instrument)
- 3 Mains socket
- 4 Status LED, mains socket

Status	Explanation
LED off	Rechargeable battery is not charging
LED on, lights up	Rechargeable battery is charging
LED on, flashes slowly	Rechargeable battery is not charging, instrument/battery temperature too high
LED on, flashes quickly	Rechargeable battery is not charging, battery faulty

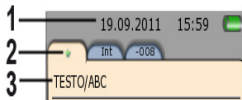
4.1.3. Controls

Button	Functions
	Switch measuring instrument on / off
	<p>The following symbols are used to operate the trackpad. see Navigating in the menu, page 18.</p> <p>Move your finger on the trackpad to scroll up or down on the screen.</p> <p> Move your finger smoothly over the trackpad from top to bottom: scrolls down.</p> <p>Move your finger smoothly over the trackpad from bottom to top: scrolls up.</p> <p> Move your finger smoothly over the trackpad from left to right: scrolls right.</p> <p>Move your finger smoothly over the trackpad from right to left: scrolls left.</p>





Button	Functions
	Briefly touch the trackpad with your finger to confirm the selection. When confirming, you should notice a click similarly to pressing a button.
[Esc]	Back, cancel function
	Open main menu, save settings
[~]	Configurable button for quick access to a frequently used function. The button is not preassigned at the factory. Configure button, see Performing settings, page 21.
	Explorer is opened, see Explorer menu, page 27.

4.1.4. Display


Status line and tabs



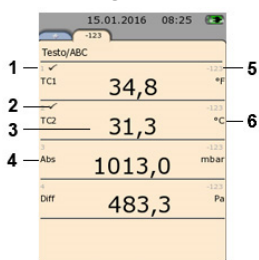
1 Status bar (dark grey background):

Icon	Explanation
	There is no SD card in the instrument
	Printing
05.05.2011 am 09:08	Date and time
	Battery operation Indication of remaining capacity of the rech. batt. by the colour and fill level of the battery symbol (green = 5-100%, red = < 5%)
	Mains operation Indication of remaining capacity of rech. batt: see above

2 Tabs:

Tab name	Explanation
 (Favourites tab)	<p>The Favourites tab is the actual work area for the instrument see Favourites tab, page 25.</p> <p>Here, measurement values of various probes can be combined into one measurement, and measuring programs can be run, saved and printed.</p>
Int	<p>Measurement values of the internal sensors and connected TC probes are displayed.</p>
<p>-881 (Example; the last three digits of the serial number of the probe are displayed. The full serial number of the probe is shown on a label on the probe.)</p>	<p>An additional tab is displayed for each connected probe with the measurement values of the probe and the calculated parameters. The tabs are displayed in the order in which the probes were connected to the instrument.</p>

- 3 Info field of register tabs: display of the selected measuring location/measuring point. The displayed measuring point can be selected in Explorer, see Explorer menu, page 27.

Measuring view

- 1 Line number
- 2 Indication that the reading is also displayed in the Favourites tab.
- 3 Reading
- 4 Measurement parameter
- 5 Probe designation
- 6 Unit

The measuring view can be changed individually for each tab, see Setting the measurement display, page 22.

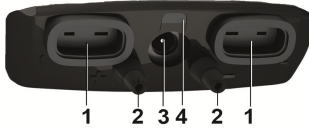
5 First steps

5.1. Commissioning

Initial charging of rechargeable battery


The testo 480 is delivered with a partially charged battery. Charge the battery fully before using it for the first time.

1. Connect the mains unit to the mains socket (3).












2. Connect the mains plug to a power socket.
 - Battery charging is started: status LED (4) lights up.
 - The battery is fully charged: status LED (4) is off.
3. Disconnect instrument from the mains unit.
 - After initial charging of the rech. battery, the instrument is ready for use.


Switching on

1. Switch the instrument on with .
 - The start screen appears.

For initial commissioning or after a factory reset, the **Initial operation** menu is opened automatically. Set the required menu language:


- > Call up the required selection list with .
2. Select the language with  and confirm with .
 - Instrument language is changed.
3. Set the date and time with  and  and confirm with .
4. Select ISO/US units with  and confirm with .

 The setting only relates to the measured values and can be individually adjusted for each measurement value if required.

5.  → **Save and close**.
 - The current measurement values are displayed. The instrument is now operational.

Switching off

i Unsaved measurement values are lost when the instrument is switched off.

-
- > Switch the instrument off with .

Connecting probes / sensors

Probes are detected automatically by the instrument.

Make sure the connections are secure, but do not use force!

- > Insert the probe connector into the probe socket:
- Bottom of the instrument: TC probe (type K)
 - Top of the instrument: digital probe:

i Push/pull plug-in connections protect digital probes from being unintentionally disconnected from the instrument.

-
- > Connect pressure tubes to + and -.



Caution! Danger of injury caused by the pressure tube jumping away from the connection socket!

- > Ensure correct connection.
-

Removing probes

Thermocouple (TC) probe:

- > Unplug connector from the socket.

Digital probe:

1. Pull back outer sleeve to release the push/pull plug-in connection.
2. Unplug connector from the socket.



Connecting the mains unit




If the mains unit is connected, the instrument is powered automatically via the mains unit.

i When power is supplied via the mains unit, the instrument may heat up. This may increase the measurement uncertainty during TC measurement.

1. Plug the mains unit instrument connector (art. no. 0554 8808) into the mains socket on the bottom of the instrument.
2. Plug the mains unit plug into a mains socket.
 - The instrument is supplied with power via the mains unit and battery charging begins automatically.

5.2. Getting to know the product







5.2.1. Navigating in the menu

1. Press .
 - The **Options** menu is opened. Selected function is highlighted white.
2. Select navigation/function:
 -  Move the trackpad down to select the menu item.
 -  Briefly touch the trackpad with your finger to confirm the selection.
 - Press **[Esc]** to cancel the action and switch to measuring mode.



Short form

This document uses a short form for describing operating steps (e.g. calling up a function).

Example: calling up **Min/Max** function

Short form	 →	Display	→ Min/Max.
Steps required	1. Open Main menu:  .	2. Select Display menu:  .	4. Select Min/Max menu:  .
		3. Confirm selection:  .	5. Confirm selection:  .


5.2.2. Calling up a function

1. Select function: .
 - A box appears around the selected function.
2. Confirm selection: .
 - The selected function is opened.

5.2.3. Exit the menu

> Press **[Esc]**.



Before the entered data or measurement data may be lost, a confirmation prompt always appears, which must be confirmed with .

Or

>  → **Save and close**.

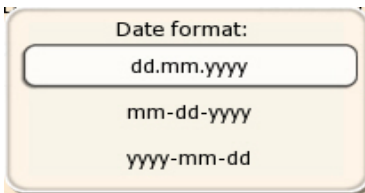
5.2.4. Switching to another tab








- > Select the required tab: .
- Required tab is activated and all other tabs are greyed out.

5.2.5. Entering values










Some functions require values (numbers, units, characters) to be entered. Depending on the function that is chosen, the values are entered via either a list field or an input editor.

List field



1. Select the value to be changed (numerical value, unit): ,  (depending on the selected function).
2. Press .
3. Set value: ,  (depending on the selected function).
4. Confirm the entry: .
5. Repeat steps 1 and 4 as required.
6. Save the entry:  → **Save and close**.

Input editor


1. Select the value to be changed (character): , .
2. Accept value: .
 - Options:
 - > Toggle between upper / lower case characters:
 -  Select
 - > Toggle between characters and numbers: select  or .
 - > Insert space: select .
 - > Delete character in front of cursor: select .
3. Repeat steps 1 and 2 as required.
4. Save the entry: select .


5.2.6. Saving values

- >  → **Save and close.**

6 Using the product

6.1. Performing settings

1. Press .
- The **Options** configuration menu is opened.
2. Select **Settings** and set parameters:





Symbol	Explanation
Energy brightness	The brightness of the display can be adapted to suit ambient conditions.
Trackpad	It is possible to set the response time of the trackpad.
Speed-dial keys	Functions that are frequently required can be assigned to one of the two function keys [-] .
Energy management	The time frame for automatically switching off the instrument (Auto off:) or the display illumination (Energy-saving mode).
Date/time	Various displays can be selected.
Password	<p>When password protection is enabled, all these functions can only be carried out by entering the password:</p> <ul style="list-style-type: none"> • Instrument factory reset • Probe reset • Firmware update • Change/deactivate password • Probe name <p> If you forget the password, it can only be reset by Testo Service</p> <p>Password protection is not set as default.</p>
Units	It is possible to toggle between ISO and US units. The setting only relates to the unit of the measured parameters, not to the calculated parameters.

Symbol	Explanation
Norm data	The temperature and absolute pressure values for the internal calculation of the standard flow rate can be changed. Factory-set: 25 °C, 1013.25 hPa
Pressure settings	Selection of the additional information that should be included on a measurement value printout.
Language	The instrument language is set. Select a language that you can understand well.
Factory reset	The instrument is reset to the factory settings: <ul style="list-style-type: none"> • Settings • Adjustment data • Password deactivated • Favourites are deleted from the internal tab. Favourites remain on the probe tab.














- Exit the configuration menu: **[ESC]** → **[ESC]**
 - Instrument switches to the measuring view.

6.2. Setting the measurement display

The measurement display can be set individually for each probe tab. These settings are saved in the probe and also apply when the probe is next connected.

- Select the tab for which the measurement display is to be changed: press .
- Press .
 - The **Options** configuration menu is opened.
- Press  to select the **Display** menu.
- Open the **Display** menu: press .
 - The **Display** menu contains three different sub-menus

Selectable sub-menus

Representation	Explanation
Min/Max	<p>When the function  is enabled, each line in the measuring view shows: mean value, min. value and max. value.</p> <p>Disable function:  →  → Display → Min/Max → .</p>
Parameter display	<p>The individual measurement parameters can be changed in the parameter display:</p> <ul style="list-style-type: none"> • Change measurement parameters and units: press  to select the line and press  to activate, see Calculated measurement parameters, page 23. • Move/delete/insert lines . Exit function: [ESC]. • Copy lines to Favourites tab . Lines displayed on the Favourites tab are indicated with a tick (✓). Exit function:  → Save and close. • Close Parameter display sub-menu:  → Save and close and back to the sub-menu selection.
Number of lines	<p>Selects how many lines should be displayed at the same time.</p> <p>If not all lines can be displayed at the same time, a scrollbar appears on the right. The remaining lines can be displayed with .</p> <p>> Select number of lines: press  and confirm with . Exit function: [ESC].</p>

5. Close **Display**: **[ESC]** → **[ESC]**
 - Instrument switches to the measuring view.

6.2.1. Calculated measurement parameters

The following calculated measurement parameters can – depending on the connected probes – also be included in the measurement value display for the measured parameters.

Operating flow rate

Value calculated from measured air velocity multiplied by the cross-section under the prevailing conditions in the application (e.g. 56 °C, 920 hPa).

Standard flow rate

Value calculated from the operating flow rate and relating to the values entered under norm data (e.g. 25 °C, 1013 hPa). To edit norm data, see Performing settings, page 21.

Dampness degree (pressure-dependent)

Unit g/kg: Describes how many grams of water are contained in a kg of dry air. It is used to calculate the absolute pressure entered under norm data.

Water content

Indicates the volume percentage of water vapour in the measured gas. Unit is not absolute (ppm or %).

Dewpoint

Temperature at which condensation of the water vapour in the gas occurs.

Psychrometer temperature (pressure-dependent)

Wet-bulb temperature of a psychrometer. It is used to calculate the absolute pressure entered under norm data







Enthalpy











Heat content of the measured gas. Unit kJ/kg or BTU/lb.

Absolute humidity

Describes how many grams of water are contained in a cubic metre of the currently measured gas. Unit g/m³.

Calculated measurement parameters can be inserted in the display as follows:


1. Select the tab for which the parameter display needs to be changed: press .
2. Press .
- The **Options** configuration menu is opened.
3. Press  to select **Display**.
4. Open the **Display** menu: press .
5. In the **Display** menu, press  to select the **Parameter display** sub-menu and open with .

6. Select **Insert line**  and confirm with .
7. In this view, select the measurement parameter and the unit required:
 - For the measurement parameter, press  to call up all measured and calculated measurement parameters which the selected probe can provide. Select the required measurement parameter  and confirm with .
 - For the unit, press  to call up all available units for the measurement parameter. Select the unit required  and confirm with .
8. Save changes:  → **Save and close**.
9. Exit the **Parameter display** sub-menu:  → **Save and close**.
10. Quit Display menu: **[ESC]** → **[ESC]**



From firmware 1.11 onwards, newly inserted lines are automatically copied to the Favourites tab.

6.3. Favourites tab

The Favourites tab  is the actual work area for the instrument. Here, measurement values of various probes can be combined into one measurement, and measuring programs can be run, saved and printed.

Only the measurement values displayed on the Favourites tab are saved in the measurement protocol.

When the probe is first connected, all measurable parameters are transferred over to the Favourites tab. Calculated measurement parameters must be added manually on the Favourites tab.

Adjusting the displayed measurement parameters

>  → **Display** → **Parameter display** → 

6.4. Probe menu

Call up function:

>  → **Probe menu.**

Adjustable parameters

Symbol	Explanation
Damping (moving average)	Damping type and duration can be individually adjusted. Damping can be activated/deactivated.
Probe info	Probe name, serial number and probe type are displayed.
Probe name	Probe name can be edited.
Adjustment info	<p>The probe-specific adjustment data saved on the probe can be displayed.</p> <hr/> <p>i The digital probes allow direct measurement and signal conversion in the probe. This technology means that measurement uncertainty caused by the instrument is no longer an issue.</p> <p>The probe can be calibrated without a hand instrument.</p> <p>Entering the adjustment data via the EasyClimate software generates a zero-error display.</p>
Humidity adjustment	<p>Humidity adjustment is possible with the following probes:</p> <ul style="list-style-type: none"> • Humidity probe • IAQ probe • Thermal air flow measuring head and humidity probe <hr/> <p>i When a thermal air flow measuring head and humidity probe is used, the probe must be deactivated before the adjustment.</p>

Symbol	Explanation
Probe reset	Probe is reset to the factory settings: <ul style="list-style-type: none"> • Measurement value display • Probe name • Adjustment table • Humidity adjustment • Damping

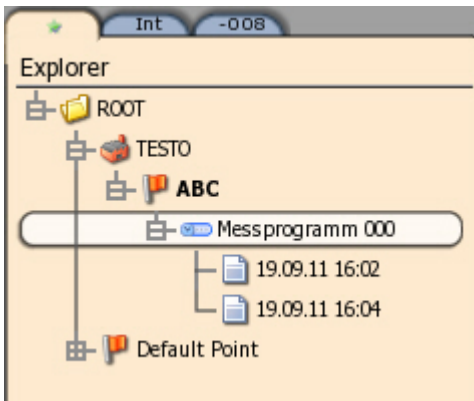
6.5. Explorer menu


In Explorer, all saved measurement values are displayed with the assigned data like the measuring program and customer data in a set structure.










i Measurement values that were not saved are lost when the measuring instrument is switched off!

Calling up the Explorer view

- > Press [Folder icon].
- Explorer structure is displayed.



Icon	Feature
	<p>i The root folder is a default folder, which cannot be deleted, moved or renamed.</p> <p>The folder is used to structure data and is where all elements (such as folders, measuring locations, measuring points, etc.) are saved.</p>



	Selection collapses sub-tree.
	Selection expands sub-tree.
	Factory-set measuring point under which the measuring programs are saved if no specific measuring location is created.
	Measuring location documenting the name and address of the customer. A measuring location can have several measuring points.
	Measuring point (e.g. ventilation shaft 1) documenting the location description with measurement-related parameters, e.g. cross-sections. A measuring point can have several measuring programs.
	Measuring program documenting the measuring process and the start and stop criteria for the measurement (e.g. continuous or punctual measurement).
	Grid measurement (standards-compliant air flow and volumetric flow rate measurement in ventilation and air-conditioning systems), see Grid measurement, page 34.
	Turbulence measurement (standards-compliant measurement of comfort), see Turbulence measurement, page 38.
	Report of the saved measurement data i All settings configured in the Explorer structure before measurement are stored in the protocol and cannot be subsequently changed.

i The Explorer structure can also be edited via the EasyClimate software and re-imported into the instrument.




Creating a new folder

A folder is always created in another folder.

Folders are used for structure and to make orientation within the measurement archive easier.


1. Select the (root) folder in which the new folder is to be created.
2.  → **New folder**.
3. Enter name via the input editor.
4. Finalise the entry:  → **Save and close**.

Other folder options

-  → **New measuring location**: create new measuring location in the selected folder.
-  → **Edit folder**: change the name of an existing folder.
-  → **Delete folder**: delete an existing folder, including the locations created therein.


Creating a new location

A location is always created in a folder. Customer-specific information can be assigned to the measuring location.




1. Select the folder in which the location is to be created.
2.  → **New measuring location**.



Name is a required field. The name must be at least 1 character long. It is not possible to create a new measuring location otherwise. Any further information is optional.


3. Enter values via the input editor.
4. Finalise the entry:  → **Save and close**.

Other measuring location options


- >  → **New measuring point**: create new measuring point in the selected measuring location.
- >  → **Edit measuring location**: make changes to an existing location.
- >  → **Delete measuring location**: delete an existing measuring location, including the measuring points created therein.

Creating a new measuring point




A measuring point is always created under a measuring location. The relevant system data is entered in the measuring point.






1. Select the measuring location in which the measuring point is to be created.
2.  → **New measuring point**.

3. Enter the parameters.

Parameters	Explanation
Name	Name under which the measuring point is saved in Explorer.
Temperature, relative humidity and absolute pressure	This information is used to calculate the air density. The values can either be entered or measured. The selection is indicated by the check mark. For measured values, the serial number (abbreviation: SN) of the relevant probe that will provide the reading must be selected.
Flow rate correction factor	Due to pressure drops in the system, the measured volume flow may be smaller than the actual volume flow. The measured volume flow can be corrected via the flow rate correction factor. The flow rate correction factor has a directly proportional effect on the measurement result and is usually set at 1.00. Once the factor is changed, the result is multiplied by the flow rate correction factor.
Pitot tube factor	See Section 6.6.6.
Channel geometry	Entering a channel geometry is required if the operating or standard volumetric flow needs to be determined. You can choose between round and square channel shape (confirm selection with ). As well as the direct channel shape, the "c factor" function (see Section 6.6.9) or funnel can also be selected (see Section 6.6.7)
Electrical power	The electrical power can be set in W, kW or Btu/h. This data is purely for informational purposes and is not incorporated in any measurement result.

4. Finalise the entry:  → **Save and close.****Other measuring point options**

- >  → **Select measuring point:** measuring point is selected and displayed in the status line in the measuring view. Reports are saved under the selected measuring point.
- >  → **Edit measuring point:** make changes to an existing measuring point.
- >  → **Delete measuring point:** delete an existing measuring point, including the measurement protocols saved for it.

- >  → **New measuring program**: determine parameters for a new custom measurement. To create a new measuring program, see Measuring program, page 32
- >  → **New grid measurement**: carry out grid measurement, see Grid measurement, page 34.
- >  → **New turbulence measurement**: carry out turbulence measurement, see Turbulence measurement, page 38
- >  → **New PMV/PPD measurement**: Carrying out a PMV/PPD measurement, see PMV/PPD measurement, page 46.
- >  → **New WBGT measurement**: Carrying out a WBGT measurement, see WBGT measurement, page 44.




6.6. Measurements & Measuring programs

General measurement information

- Depending on the measurement parameter to be measured, certain probes must be plugged into the instrument.
- Some (thermal) probes require a warming-up phase until they are ready to measure.
- Before every measurement, wait until the adjustment phase is over. The adjustment phase ensures that the readings have stabilized.
- For some measurement parameters, additional calculation parameters must be set to ensure correct measurement results, see Performing settings, page 21.

6.6.1. Retaining (“holding”) measurement values

Displayed measurement values can be held on the Favourites or Probe tabs and printed out. The measurement values cannot be saved in one measurement protocol.

- >  → **Hold**.
- The measurement value is retained.  is displayed.
- > Cancel Hold:  → **Hold**.

Held measurement values can be printed see Printing measurement values, page 52

The measuring values can be saved in one measurement protocol.

6.6.2. Quick back-up

With quick back-up, the current measuring values are saved to the folder selected for the measurement.

If no measuring point has been selected, the measurement protocols are saved under "Default Point".

>  → **Quick back-up.**





- Measuring values are saved.


6.6.3. Measuring program



You can customise measuring programs to match the relevant measuring task (e.g. timed or multi-point storage). These measuring programs are linked to a specific measuring point. After the measurement, the relevant measurement protocols are saved under the measuring program.

For creating a new measuring program,



A measuring program is always created under a measuring point.

1. Press .
 - Explorer structure is displayed.
2. Select measuring point:  and confirm with .
3.  → **New measuring program.**
4. Determine parameters.


Parameter	Explanation
Name	Name under which the measuring program is saved in Explorer.
Measuring point	Measuring point to which the measuring program is assigned.
Measuring type	<ul style="list-style-type: none"> • Continuous: Mean calculation across a specific period • Punctual: Mean calculation across individual current values buffered via  or button on probe handle. • Continuous/Punctual: At each point a mean value is calculated according to the end criterion set (Duration or Number of values). At the end of the measurement, an overall mean value is calculated.

Parameter	Explanation
Measuring rate	Interval at which the measurement values are recorded.
Start criterion	<ul style="list-style-type: none"> Manual: Measurement is triggered via . <hr/> <p>i On the probe handle there is a button, which can also be used to start the measurement.</p> <hr/> <ul style="list-style-type: none"> Date/Time: Measurement starts at a set time.
End criterion	<ul style="list-style-type: none"> Manual: Measurement is ended via  → End. Date/Time: Measurement ends at a set time. Duration: measurement ends after a set duration has lapsed. Number of values: measurement ends after a sequence of measured values.



i The measuring program only applies to the Favourites tab. Only the values displayed on the Favourites tab are saved in the measurement protocol.

5. Save setting and navigate to the measuring program: select  → **Save and start measurement**.
- > If you do not want the measurement to start immediately: select  → **Save and close**.

i Another way to create a measuring program in the Favourites tab under the selected measuring point:



- >  → **Application** → **Measuring program**.

Starting a measuring program

1. Select required measuring program.
2.  → **Start measuring program**.
- > Depending on the selected start criterion, the measurement must be started via .

i If a start date has been set, the program starts automatically. In the case of a manual start, the measurement must be triggered as described.

Other measuring program options

- >  → **Edit measuring program**: make changes to an existing measuring program.
- >  → **Delete measuring program**: delete an existing measuring program.

6.6.4. Grid measurement

There are various options for measuring the air and volumetric flow rate in ventilation and air-conditioning systems. These are distinguishable by the measuring range in particular. For the testo 480, there are three different flow probes:

- Thermal probes (incl. temperature measurement and possibly humidity measurement) for low flow speeds
- 16 mm wheel measuring head (incl. temperature measurement) for average flow velocities
- Pitot tube for measurements at high velocities and in heavily contaminated flows with a high percentage of particles



Detailed background information on grid measurement and carrying it out can be found in the Testo **Ambient Air Measurement for Practical Users** field guide. You can request a free copy or download it from www.testo.com.


Selecting a suitable measuring point

The main prerequisite for accurate measurement is the suitability of the measuring point. Minimum distances from points of discontinuity must be observed:




- From points of discontinuity upstream of the flow, observe a clearance of at least six times the hydraulic diameter $D_h = 4A/U$ (A: channel cross-section, U: channel circumference).
- From points of discontinuity downstream of the flow, observe a clearance of at least twice the hydraulic diameter $D_h = 4A/U$ (A: channel cross-section, U: channel circumference).




Preparing for measurement



- ✓ 16 mm wheel measuring head, thermal air flow measuring head and humidity probe or Pitot tube is connected.
1. Switch the instrument on.
 2. Create a new measuring point in Explorer under the required measuring location.
 3. Set the following parameters:

Parameter	Values
Temperature, Relative humidity and Absolute pressure	The parameters must be correctly entered or measured. This affects the measurement with Pitot tube. Thermal probe has an internal absolute pressure sensor. No entry is required here.
Flow rate correction factor	Must be 1.00 (has a proportional effect on the flow rate).
Pitot factor	Only has to be entered for measurement with Pitot tube, see Pitot tube measurement, page 38.
Channel geometry	Profile and dimensions of the channel. Select channel geometry with  :
Electric power	Manual input value, only used for logging.


4. In Explorer, under the created measuring point, create a new grid measurement, see Explorer menu, page 27.
5. Make the following settings to suit the measuring point:

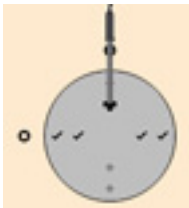
Parameter	Values
Measuring type	Punctual or Continuous/Punctual The end criterion can be defined individually depending on the selection.
Nominal volumetric flow	 The measured volume flow is shown in the same unit of measurement as the unit of measurement of the reference volume flow.
Probe	Select probe via serial number with  .  If a Pitot tube is connected, the differential pressure is measured when INT is selected.
Layout Measuring points	The number of measuring points depends on the distance from the point of discontinuity and irregularities in the profile. More information can be found in the Testo "Ambient Air Measurement for Practical Users" field guide.

Hole position	Depending on channel accessibility, select the hole position with  and/or  . Confirm the selection with  .
Edge spacing	For example, damping of the channel wall can be taken into consideration. Entered values influence the coordination of the measuring points.
Uncertainties Channel	Estimated uncertainty of the channel dimensions. Entered value is taken into account in the flow rate calculation.
Uncertainties Density (air density, only for Pitot tube measurement)	When all relevant measurement parameters (temperature, relative humidity, absolute pressure) are measured, the value can be set to 0.

6. Save setting and navigate to the measuring program: select  → **Save and start measurement.**
- > If you do not want the measurement to start immediately: select  → **Save and close.**

Performing the measurement

- ✓ All points under "Preparing for measurement" have been carried out.
- 1. Position the probe at the grid measurement point shown in the form of a chart on the display.
- 2. With  or the integrated measurement button on the probe, transfer the measured value, or start the continuous/punctual measurement.
- The measured point is indicated with a tick.





- The position of the measuring point is automatically moved to the next point on the display and the new immersion depth required is displayed. The immersion depth of the probe can be found on the scale of the probe shaft.


3. Repeat steps 1 and 2 until all points have been measured.
 - The individual velocity measurement values are used to calculate the mean flow velocity, from which the volumetric air flow is then calculated.


i If high differences in flow velocities are ascertained over the cross-section, the number of measuring points is to be increased.

The number of measuring points is then adequate if the measurement value for each area is representative for its immediate surroundings, i.e. if it can be regarded as a genuine mean value for its portion of the area.

-
4. Before the measurement is completed, any measured point can be approached. If this point needs to be remeasured →  → **Repeat measurement.**

i As soon as all measuring points have been input, "Measurement completed" is displayed. The whole measurement can be repeated →  → **Repeat HVAC measurement.**

-
5. Close the measurement program:  → **Save and close.**
 - The display automatically switches to the measurement protocol view.

The HVAC protocol contains multiple views, which can be changed via .

- Values Result: End result (mean value) and deviation of the flow velocity and volumetric flow parameters.
- Graphic Result: Channel view with the results per measuring point.
- HVAC program parameters: preset parameters for the measurement (e.g. channel geometry).
- Density parameters: preset values for calculating the density (temperature, humidity, absolute pressure).

6.6.5. Turbulence measurement

A connected turbulence probe 0628 0143 enables the turbulence to be calculated for the flow value in accordance with DIN EN 13779.

The turbulence probe 0628 0143 has an internal absolute pressure sensor used to carry out automatic compensation. There is no need to enter an absolute pressure value here.

Preparing for measurement

- ✓ Turbulence probe 0628 0143 is connected.
-



From firmware 1.11 onwards, up to 3 turbulence probes can be connected at the same time.

Carrying out a measurement

1. Press .
 - Explorer structure is displayed.
 2. Select/create required measuring point.
-



The settings in the measuring point have no effects on the measurement result.

3. → **New turbulence measurement.**
 - Turbulence calculation window is opened.
4. Start measurement: .
 - Turbulence determination is started. It takes 180 sec., but can also be ended early.
 - When measurement is completed: turbulence is displayed in %, calculated according the formula:

$$Turb = \frac{\sqrt{\frac{1}{n-1} * \sum_{i=1}^n (xi - \bar{x})^2}}{\bar{U}} * 100$$

and draught rating as per EN ISO 7730 is displayed.

5. → **Save and close.**
 - Measurement protocol is saved under the selected measuring point.

6.6.6. Pitot tube measurement

To measure flow with a Pitot tube, the following parameters must be entered in the measuring point (manual entry or measured values).

- Temperature
- Relative humidity
- Absolute pressure

Int -008

★

Edit measuring point

TEST0

Name: ABC

Temperature

✓ entered 20,00 °C

measured SN: ----

Relative humidity

✓ entered 50,0 %

measured SN: ----

Absolute pressure

✓ entered 1013,25 hPa

measured SN: ----

Flow rate correction factor

These three parameter

These three parameters are taken into account in the calculation of the flow.

The Pitot factor for Pitot tubes is generally the same and must be entered:

- Prandtl Pitot tubes (0635 2045, 0635 2145, 0635 2345), Pitot tube factor: 1.00
- Straight Pitot tubes (0635 2043, 0635 2143, 0635 2243), Pitot tube factor: 0.67
- Air flow velocity matrix (ID no. 0699 7077): Pitot tube factor: 0.82

For Pitot tubes from other manufacturers, the Pitot factor can be found in the instruction manual or you should ask your supplier.

For carrying out the measurement, see Measuring program, page 32 or see Grid measurement, page 34RLT-Messung.

6.6.7. Measurement with the funnel





Function available from firmware version 1.11 onwards.


A flow rate funnel is required to determine the flow rate on ventilation systems. The measurement can be carried out with a 100 mm vane probe in conjunction with the testovent 417 funnel set (order no. 0563 4170). Alternatively, a thermal anemometer (order no. 0635 1543) can also be used in conjunction with the testovent 410 (order no. 0554 0410) or testovent 415 (order no. 0554 0415) funnel.

The funnels differ in size and are suitable for outlets up to 200x200 mm and 330x330 mm respectively. When selecting the relevant funnel, make sure that the opening of the funnel covers the grille completely and tightly.

Preparing for measurement

1. Secure the anemometer probe in the funnel handle.
2. Connect the anemometer probe to the instrument.
3. Switch the instrument on.
4. Configure the probes tab so that the required measurement parameters appear on the Favourites tab, see Favourites tab, page 25.
5. Create a new measuring point in Explorer ([) under the required measuring location: [] → **New measuring point**
6. Set the following parameters:

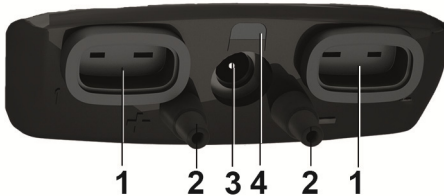
Parameters	Values
Name	Name under which the measuring point is saved in Explorer.
Temperature, relative humidity and absolute pressure	Input optional, parameter is not taken into account for this calculation.
Flow rate correction factor	The set value has a directly proportional effect on the result and is typically set at 1.00.
Pitot tube factor	If funnel channel geometry is selected, this field has no influence on the measurement result. This input is only enabled for Pitot tube measurements, see Pitot tube measurement, page 38.
Channel geometry	Select the funnel used via the trackpad. For the relevant designation, please refer to the funnel's type plate.
Electrical power	Input optional, parameter is not taken into account for this calculation.

7. Save settings: [] → Save and select.
8. Create a new measuring program under the newly created measuring point, see Measuring program, page 32. Carry out the measurement on the basis of this data.

6.6.8. Pressure measurement

The testo 480 has an internal absolute and differential pressure sensor. The pressure measurement values are therefore displayed on the **Int** tab.

1. Connect pressure tubes for differential pressure measurement (2) to + and -.



Caution! Danger of injury caused by the pressure tube jumping away from the connection socket!

> Ensure correct connection.

2. Switch the instrument on with **[ON]**.
3. Position the instrument ready for measurement and stabilise.



The parameter display depends on the position of the pressure sensor.

4. Zero parameter display: **[Z]** → **Zero**.
 - Current pressure measurement value appears on the **Int** tab in the set unit.
 - > Change pressure unit in the parameter display: **[U]** → **Display** → **Parameter display** → **[U]** → Select measurement parameter from list → **[U]** → **[U]** → **Save and close**.

If the measurement values fluctuate widely, it is advisable to damp the measurement values. Damping is activated in the probe menu see Probe menu, page **26**.

6.6.9. Determination of volume flow using differential pressure and k factor



Setting available as of firmware version 1.10.

The testo 480 can determine the volume flow by measuring the reference resistance and entering the so-called k factor. This is a really simple process, especially for tasks involving setting air outlets, because the measuring instrument can stay connected

while the setting is carried out, which means the change in volume flow can be read off directly.

This process for determining volume flow can always be used when there are appropriate specifications available from the component manufacturer. In line with this, the differential pressure is measured at a position specified by the manufacturer or supplier. The volume flow is determined from the differential pressure via a component-specific k factor using a mathematical equation:

$$Volume\ flow = k * \sqrt{\Delta P}$$

The following is an equivalent way of expressing the above formula:

$$Volume\ flow = k \times (\Delta p)^{0.5}$$

With:

Δp : measured differential pressure in Pa


k : system-specific conversion factor




If the manufacturer gives the k factor based on a differential pressure measured using Pa as the unit, this can be entered directly into the testo 480 without any conversion.

If the k factor given is based on another pressure unit, then this must be converted before entry into the testo 480:

k factor - differential pressure unit	Conversion factor
hPa	0.1
mbar	0.1
mm HG	0.086613
in HG	0.017185
mm WS	0.31933
lp.p.sq.ft.	0.14452
psi	0.012043
inches H ₂ O	0.063361

Carrying out a measurement


1. Switch the instrument on with .

- > Configure the parameter display so that differential pressure and volume flow are shown in the favourites tab, see Setting the measurement display, page 22.
- 2. Create new measuring point:  → Select measuring location  →  → **New measuring point**.






Alternatively, the default point can be changed.

- > Set parameters at the measuring point:

Parameters	Explanation
Temperature, relative humidity and absolute pressure	Input optional, parameters are not taken into account for this calculation.
Flow rate correction factor	Input optional, parameter is not taken into account for this calculation.
Pitot tube factor	Input optional, parameter is not taken into account for this calculation.
Channel geometry	Select the c factor / volume flow function with  . Enter the component-specific k factor. Select the volume flow unit for which the manufacturer has defined the k factor.
Electrical power	Input optional, parameter is not taken into account for this calculation.










Optional entries are listed in the protocol.

- 3. Enable measuring point:  → **Save and select**
- 4. Create new measuring program:  → **New measuring program**
- > Perform settings: See Measuring program, page 32.
- 5. Save settings:  → **Save and close**
 - The newly created measuring program is marked in Explorer.
- 6. Switch to the measuring view: Press **[Esc]**.

7. Check whether the parameters **reference volume flow** and/or **differential pressure** appear in the Favourites tab.
8. Position the instrument ready for measurement and stabilize.

i The differential pressure parameter display depends on the position of the pressure sensor. The parameter display must be zeroed.

9. Zero pressure sensor: Press  to select the **INT** tab →  →  → **Zero** → 
- > Attach the measurement hoses to the instrument's differential pressure connections and at the position specified by the manufacturer.
10. Select the previously created measurement program in Explorer.
11. Start measuring program:  →  → **Start measuring program** → .

6.6.10. CO₂ measurement

- The CO₂ probe measures the absolute pressure. The displayed CO₂ value is compensated automatically in line with the absolute pressure.
- Due to the sensor, the probe has a relatively high power consumption. For continuous measurements, use a mains unit for the power supply.
- To avoid the effects of the CO₂ content of respired air, hold the probe as far away from your body as possible.
- If sudden changes occur in the concentration, the probe will require approx. 30 - 60 sec. to adapt to the environment. Gently waving the probe reduces the adjustment period.

6.6.11. WBGT measurement

i Measurement program available as of firmware version 1.05.

i Make sure that the specific instrument and cable temperatures are not exceeded. Extension cables should be used for high radiation temperatures in particular.

With the WBGT set, the WBGT (Wet Bulb Globe Temperature) climate index is determined as per DIN 33403 or ISO 7243. The WBGT index is used to determine the maximum permissible exposure time at workplaces exposed to heat (e.g. steel industry, foundries, glass industry or blast furnaces).

To calculate the WBGT, 3 different temperatures must be measured:

- Radiation temperature T_g (globe thermometer)
- Ambient temperature T_a
- Wet bulb temperature T_{nw} (temperature of a naturally ventilated psychrometer)

The calculation is carried out with the following formulas:

$$\text{WBGT} = 0.7 \times T_{nw} + 0.3 \times T_g$$

$$\text{WBGTS} = 0.7 \times T_{nw} + 0.2 \times T_g + 0.1 \times T_a$$

Preparing for measurement



- ✓ Globe thermometer, wet bulb temperature and air temperature probes are connected and mounted on a tripod.
1. Switch the instrument on.

Selecting a suitable measuring point




The settings in the measuring point have no effects on the measurement result.

Performing a measurement

- ✓ All points under "Preparing for measurement" have been carried out.
1. Press .
 - Explorer structure is displayed.
 2. Select the desired measuring point.
 3.  → **New WBGT measurement.**
 - WBGT measurement is opened.
 4. Select the serial number (SN) for the individual probe.



- In the case of digital probes, the probe name appears. As long as the probe has not been renamed, it is always identified by the last three digits of the serial number.
- When connecting analog thermocouples, **Int [TE1]** or **Int [TE2]** appears as the serial number, depending on which connector was selected.

5. Select measuring type and measuring rate.
6. Set criteria for start and end of the measurement.
7.  → **Save and start measurement**



During the measurement, the values are calculated from the current measuring values.

After the measurement, a calculation is carried out based on mean values.

8.  → **Save and close**

- Measurement protocol is saved under the selected measuring point.

6.6.12. PMV/PPD measurement



Measurement program available as of firmware version 1.05.

The PMV/PPD measurement determines the comfort level (PMV = Predicted Mean Vote) and the relative discomfort (PPD = Predicted Percentage Dissatisfied) e.g. at workstations and is described in the ISO 7730.

The mean radiation temperature required for determining PMV/PPD is calculated in the testo 480 from the measurement parameters of globe temperature, ambient temperature and air speed. The formula is based on forced convection and applies to standard bulbs with 150 mm diameter.²

Necessary measuring values

- Mean radiation temperature in °C = t_r
- Globe temperature in °C = t_g
- Ambient temperature in °C = t_a
- Air speed in m/s = v_a

$$tr = [(tg+273)^4+2.5*10^8*va^0.6*(tg-ta)]^{1/4}-273$$

Factors to be entered

- Clothing
Clothing reduces body heat losses and is therefore classified based on its insulating value.
The insulating effect of clothing is given in the unit clo or m² °K/W (1 clo = 0.155 m² °K/W).
The clo value can be calculated by adding together the values of the individual items of clothing.
Insulating values for individual items of clothing can be found in ISO 7730.
Alternatively, a ~~clo~~-range can be selected.

² Source: DIN EN ISO 7726

- **Activity**
The metabolic rate gives the energy released by oxidation processes in the human body, and depends on muscle activity. The metabolic rate is given in met or W/m^2 (1 met = $58.2 W/m^2$ body surface area). The average adult has a body surface area of $1.7 m^2$. In a state of thermal comfort, a person with a metabolic rate of 1 met has heat loss of approx. 100 W. When calculating the metabolic rate, a mean value of the activity of the relevant person affected within the past hour must be used. Met values for various activities can also be found in ISO 7730.

Input parameters for clothing

Parameter in clo	Parameter in m^2K/W	Explanation
0 – 0.02		No clothing
0.03 – 0.29	0.005 – 0.045	Underwear
0.30 – 0.49	0.046 – 0.077	Shorts and T-shirt
0.50 – 0.79	0.078 – 0.122	Trousers and T-shirt
0.80 – 1.29	0.123 – 0.200	Light business wear
1.30 – 1.79	0.201 – 0.277	Warm business wear
1.80 – 2.29	0.278 – 0.355	Jacket or coat
2.30 – 2.79	0.356 – 0.432	Warm winter clothing
2.80 – 3.00	0.433 – 0.465	Extremely warm winter clothing

Input parameters for activity

Parameter in met	Parameter in W/m^2	Explanation
0.1 – 0.7	6 – 45	Lying down, relaxed
0.8 – 0.9	46 – 57	Sitting down, relaxed
1.0 – 1.1	58 – 59	Seated activity
1.2 – 1.5	70 – 92	Standing up
1.6 – 1.7	93 – 104	Standing up, light activity
1.8 – 1.9	105 – 115	Standing up, moderate activity

Parameter in met	Parameter in W/m ²	Explanation
2.0 – 2.3	116 – 139	Slow walking
2.4 – 2.9	140 – 174	Quick walking
3.0 – 3.4	175 – 203	Strenuous activity
3.5 – 4.0	204 - 233	Extremely strenuous activity

i The factors to be entered refer to the ISO 7730 Appendix B and C.


i We recommend using the following probes:

- Globe thermometer (0602 0743)
- Humidity probe (0636 9743), alternatively IAQ probe (0632 1543)
- Comfort probe (0628 0143)
- Tripod (0554 0743)

Preparing for measurement

- ✓ Globe thermometer, humidity probe and comfort probe are connected and mounted on a tripod.
1. Switch the instrument on.

Performing a measurement

- ✓ All points under "Preparing for measurement" have been carried out.
1. Press .
 - Explorer structure is displayed.
 2. Select the desired measuring point.


i The settings in the measuring point have no effects on the measurement result.

3.  → **New PPMV/PPD measurement.**
- PMV/PPD measurement is opened.

4. Select the serial number (SN) for the individual probe.





- In the case of digital probes, the probe name appears. As long as the probe has not been renamed, it is always identified by the last three digits of the serial number.
- When connecting analog thermocouples, **Int [TE1]** or **Int [TE2]** appears as the serial number, depending on which connector was selected.

5. Specify parameters and unit for clothing and activity.
6. Select measuring type and measuring rate.
7. Set criteria for start and end of the measurement.
8.  → **Save and start measurement**

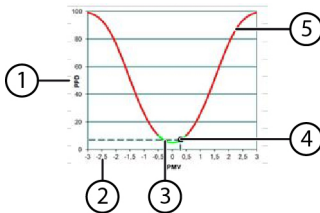


During the measurement, the values are calculated from the current readings.

After the measurement, a calculation is carried out based on mean values.

9.  → **Save and close**
- Measurement protocol is saved under the selected measuring point.
10. The measurement protocol is displayed.
11.  → **Graphic**

Graphical representation



- 1 PPD axis, scale from 0% to 100%
- 2 PMV axis, scale from -3 to +3
- 3 Green area of curve from -0.5 to 0.5 PMV
- 4 Calculated point from PPD and PMV.
- 5 Critical area of curve

Formula for display

$$PPD = 100 - 95 \cdot \exp(-0.03353 \cdot PMV^4 - 0.2179 \cdot PMV^2)$$



From firmware version 1.11 onwards, when using the IAQ probe 0632 1543 the CO₂ content can be stored at the same time, in addition to the PMV/PPD measurement.

6.6.13. **Calculating the normal effective temperature (NET)**

i Measurement program available from firmware version 1.11 onwards.

Make sure that the specific instrument and cable temperatures are not exceeded. Extension cables should be used for high radiation temperatures in particular.

The normal effective temperature NET is a climate index and is typically used in workplaces exposed to heat, where the influence of thermal radiation may be disregarded and long-sleeved clothing worn.

Climate indices are always used when the complex thermal stresses on an individual, caused by various influencing factors, are summarized in a numerical value.

The normal effective temperature is calculated in accordance with DIN EN 33403-3:2001.

The normal effective temperature NET is usually expressed in °C and is applicable to clothed persons and in climates with no additional thermal radiation.

Necessary measurement parameters

- Radiation temperature in °C = t_g (optional)
 - Air temperature in °C = t_a
 - Air humidity in %RH = RH t_{nw}
 - Air velocity in m/s = v_a
-

i We recommend using the following probes:


- Globe thermometer (0602 0743) (optional)
 - Humidity probe (0636 9743), alternatively IAQ probe (0632 1543)
 - Comfort probe (0628 0143)
 - Tripod (0554 0743)
-

Preparing for measurement


- ✓ Globe thermometer, humidity probe and comfort probe are connected and mounted on the tripod.
- > Switch the instrument on.

Carrying out a measurement

- ✓ All points under "Preparing for measurement" have been carried out.


1. Press .
- Explorer structure is displayed.
2. Select the required measuring point.

i The settings in the measuring point have no effects on the measurement result.



3.  → **New NET measurement**
- NET measurement is opened.
4. Select the serial number (SN) for the individual probe.

i

- In the case of digital probes, the probe name appears. As long as the probe has not been renamed, it is always identified by the last three digits of the serial number.
- When connecting analog thermocouples, **Int [TE1]** or **Int [TE2]** appears as the serial number, depending on which connector was selected.

5. Select measuring type and measuring rate.
6. Set criteria for start and end of the measurement.
7.  → **Save and start measurement.**

i During the measurement, the values are calculated from the current readings.
After the measurement, a calculation is carried out based on mean values.

8.  → **Save and close**
- Measurement protocol is saved under the selected measuring point.
9. The measurement protocol is displayed.
10.  → **Graphic.**

6.6.14. Saving measurement values


All measurement protocols displayed in Explorer are saved in the internal instrument memory.

Saving measurement values on an SD card

1. Insert SD card into the SD card slot (right-hand side of instrument).

i Only SD cards with max. 2 GB space can be used.

2. Select root folder in the Explorer view.

3.  → **Export**.

- An export message is displayed.


Importing measurement values from an SD card

i When importing data from an SD card, **all** data in the internal instrument memory is overwritten.

1. Insert SD card into the SD card slot (right-hand side of instrument).

i Only SD cards with max. 2 GB space can be used.

2. Select root folder in the Explorer view.

3.  → **Import**.

- A list of importable data is displayed.

4. Select the required entry.

- An import message is displayed.

6.6.15. Printing measurement values

i Selection of the additional information that should be included on a measurement value printout, see Performing settings, page 21.

From measuring mode

✓ testo printer (0554 0549) is switched on.

✓ Required tab has been selected.

1. Align IR interfaces on the top of the testo 480 and testo printer.

2. Select  → **Print**.

- The set measuring view and  are displayed.

- Printout of the currently displayed readings is generated.

CAUTION



Risk of injury from infrared beam!

- > Do not direct infrared beam at human eyes!

From the instrument memory

✓ testo printer (0554 0549) has been switched on.

1. Press .




2. Navigate to the saved measuring protocol.
3. Select  → **Open measurement protocol**.
 - Measurement data view is opened.
4. Align IR interfaces on the top of the testo 480 and testo printer.
5. Select  → **Print**.
 - The printout is generated.

i The saved measurement protocols can also be displayed via the testo EasyClimate software.

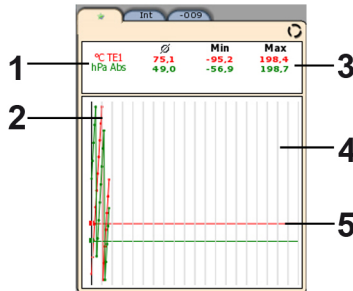
6.6.16. Display measuring values graphically

Measuring values of max. four measurement parameters can be displayed as a colour graphic over a period of 110 seconds. In the case of longer time frames, the oldest values are deleted and replaced by the new ones. The graphic mode is purely a display mode, i.e. the measuring values cannot be stored.

Selection of the displayed measurement parameters is based on the display sequence in measuring mode.

- First measurement parameter displayed: red
 - Second measurement parameter displayed: green
 - Third measurement parameter displayed: blue
 - Fourth measurement parameter displayed: violet
1. Select the required tab.
 - > If necessary change the order of the measurement parameters, as only the first four measurement parameters are displayed.
 2.  → **Graphic mode**.
 - Graphic mode is activated .
 - > Exit graphic mode:  → **Graphic mode** or **[ESC]**.

i The values are deleted when switching tabs, however graphic mode is not terminated. On returning to the tab, the measurement starts again in graphic mode.



- 1 Displayed measuring values
- 2 Graphically displayed measuring value
- 3 Average, minimum and maximum values since graphic mode selection
- 4 Vertical scaling marking (5 seconds)
- 5 Specific x-axis of the respective measurement parameter in the same colour as the graphically displayed measuring value

6.6.17. Transferring measurement values

i To view and evaluate the measurement results on the PC, you need the testo EasyClimate software.

1. Switch on the testo 480.
 2. Connect the instrument to the PC with a mini USB cable.
 - Instrument is identified by the PC as a USB mass storage device. The operating system automatically assigns the instrument memory a drive letter. This is displayed in Windows Explorer.
-

i When the instrument is connected to the PC, the instrument control keys are locked. As soon as the instrument is disconnected from the PC, it can be operated again via the control keys.

3. For carrying out an instrument readout via testo EasyClimate software and processing data, see separate testo EasyClimate software instrument manual.

7 Maintaining the product

Cleaning the instrument

- > If the housing of the instrument is dirty, clean it with a damp cloth.

Do not use any aggressive cleaning agents or solvents! Weak household cleaning agents and soap suds may be used.

7.1.1. Battery care

- > Charge new rechargeable battery fully before commissioning.
- > At low ambient temperatures, the rechargeable battery running time decreases. This reduces the available useful life.
- > Do not store the rechargeable battery for long periods when discharged. (The best storage conditions are at 50-80 % charge level and 10-20 °C ambient temperature; charge fully before using again).
- > The rechargeable battery life depends on the storage, operating and ambient conditions. The available useful life of the rechargeable battery reduces more and more with frequent use. If the useful life is significantly shortened, the rechargeable battery should be replaced.

7.1.2. Carrying out humidity adjustment


In humidity calibration, the measurement parameter of the connected probe is adjusted to the reference value at the two standard adjustment points 11.3 % RH and 75.3 % RH and the deviations between the measuring value and the nominal value are minimised across the entire measuring range.

The Testo adjustment set provides a reference value to calculate the offset for a humidity adjustment.




Humidity adjustment is possible with the following probes:

- Humidity probe
- IAQ probe
- Thermal air flow measuring head and humidity probe



When a thermal air flow measuring head and humidity probe is used, the probe must be deactivated before the adjustment ( → **Switch off flow probe**). The probe can only then be exposed to the reference conditions.


- ✓ Instrument is switched on and probe is connected.

- ✓ Probe is already exposed to reference conditions (e.g. salt pot) for an adequate adjustment time.
 - Adjustment time for humidity probe at least 30 min
 - Adjustment time for IAQ probe at least 1 h
 - Adjustment time for thermal air flow measuring head and humidity probe at least 3 h
- ✓ Tab for the relevant probe is activated.
- 1.  → **Probe menu** → **Humidity adjustment**.
- 2. Select reference value used (11.3%RH/75.3%RH).
- 3.  → **Adjustment**.
 - A pop-up window with the remaining adjustment time is displayed.
- 4.  → **End**.
 - Adjustment menu is closed.
- 5. Carry out adjustment for the second adjustment point.


7.1.3.

Carrying out a firmware update

Updated firmware can be installed on the instrument.

 A firmware update can also be carried out with testo EasyClimate.




- ✓ Instrument is switched on.
- 1. Download the current firmware file from www.testo.com/download-center (registration required).
- 2. Unzip downloaded zip file.
- 3. Connect the instrument to the PC with a mini USB cable.
 - Instrument is identified by the PC as a USB mass storage device. The operating system automatically assigns the instrument memory a drive letter. This is displayed in Windows Explorer.

 When the instrument is connected to the PC, the instrument control buttons are locked. As soon as the instrument is disconnected from the PC, it can be operated again via the control buttons.

- 4. Copy unzipped firmware file and **res** folder to **Update** folder.
- 5. Log out instrument from Windows (safely remove hardware).
- 6. Unplug USB cable.
- 7. Switch the instrument off.
- 8. Switch the instrument on.
 - Firmware has been updated.

8 Tips and assistance

8.1. Questions and answers

Question	Possible causes / solution
 flashes	Rechargeable battery is low. > Switch to mains operation.
++++ lights up instead of the measurement parameter display	The value is above the permissible measuring range. > Keep to the permissible measuring range.
+---- lights up instead of the measurement parameter display	The value is below the permissible measuring range. > Keep to the permissible measuring range.
---- lights up instead of the measurement parameter display	Instrument sensor is faulty. > Contact your dealer or the Testo Customer Service.
Data cannot be copied to the SD card or imported from the SD card.	SD card is write-protected. > Cancel write protection (small slider control on the SD card).
Instrument no longer responds when a button is pressed.	Internal error has occurred. 1. Hold down  for >10 sec. - The instrument is switched off. 2. Switch instrument on with  .

If we could not answer your question, please contact your dealer or Testo Customer Service. For contact data, see back of this document or website www.testo.com/service-contact.

8.2. Accessories and spare parts

Description	Article no.
System case for comfort level measurement	0516 4801
System case for grid measurements	0516 4800
Tripod for workplace evaluation with holders for hand instrument and probe; can also be used as probe extension, e.g. for 100 mm probe	0554 0743

Description	Article no.
Connection hose, silicone-free, 5 m, load to max. 700 hPa	0554 0453
Connection hose, silicone, 5 m, load to max. 700 hPa	0554 0440
Funnel set comprising funnel for disc valves (Ø 200 mm) and funnel for fans (330 x 330 mm) for supply and exhaust air	0563 4170
Testovent 410, flow rate funnel, Ø 340 mm/330 x 330 mm, incl. case	0554 0410
Testovent 415, flow rate funnel, Ø 210 mm/190 x 190 mm, incl. case	0554 0415
Testo high speed printer with wireless infrared interface, 1 roll of thermal paper and 4 AA batteries	0554 0549

For a complete list of all accessories and spare parts, please refer to the product catalogues and brochures or look up our website www.testo.com

