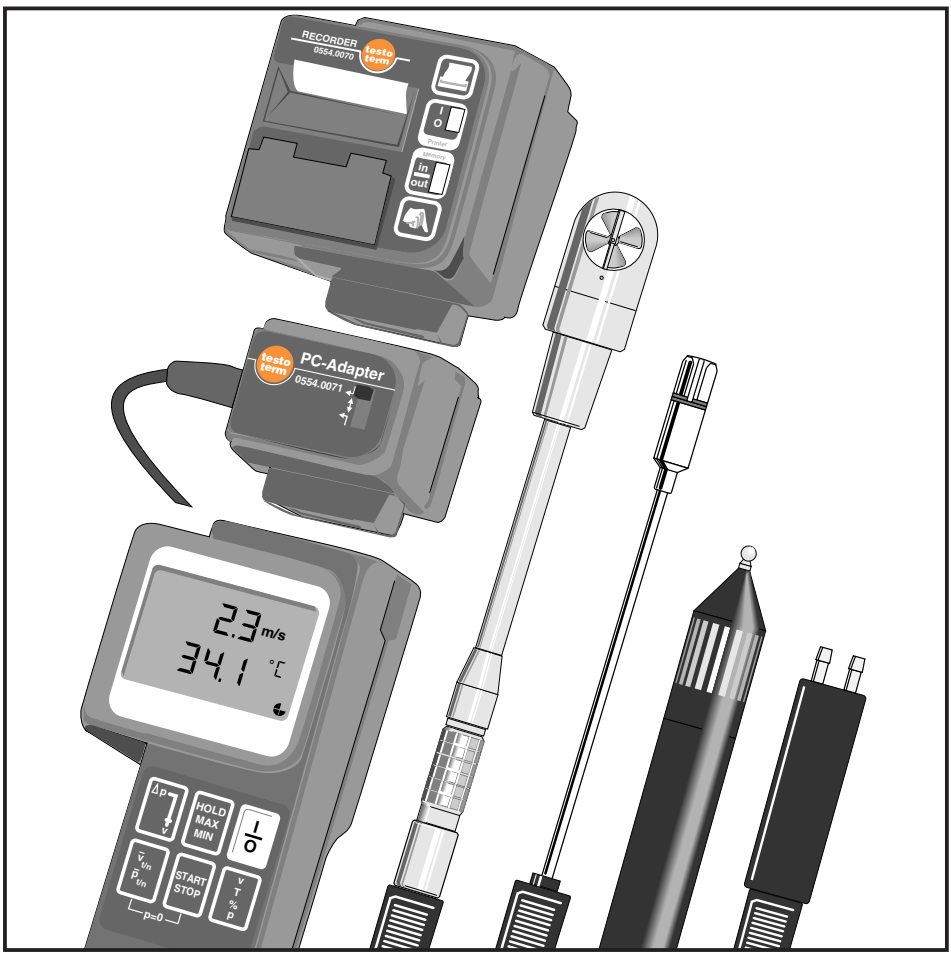
testo 452

Instant Action Anemometer

Instruction Manual



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Caution remarks

PLEASE READ BEFORE PUTTING INTO SERVICE!

Never use mains unit 0554.0088 together with batteries! Risk of explosion! Remove batteries or replace with rechargeable batteries!

Do not measure on mains voltage fed parts!

Observe measuring ranges!
Overheating will destroy the sensors.

Observe permissible storage and transport temperatures and permissible operating temperatures (e.g. protect measuring instrument from direct sunlight)

Turn off the measuring instrument when a probe is plugged-in or replaced or when the configuration menu is changed (e.g. when PC Adapter is plugged-in), as the probe's characteristics values can only be read when turning on the instrument.

If the instrument is opened, improperly handled or if force is applied, no warranty will be granted!

The expandable measuring instrument **testo 452**, for storing, printing and evaluating data via a PC,is the result of many years experience in the development and production of measuring instruments to high standards. It is a complete system for the controlling of air conditioning.

With the aid of specialized probes air velocity can be measured in a range of 0 to 100 m/s (0 to 200 fpm), for use in open air velocities or in duct measurements. The technical data given is valid for the conditions under which the probes are calibrated. In most cases these parameters fulfill the conditions in everyday measurements.

These products were mainly developed for engineers with advanced knowledge and experience in everyday measurement technology. These instruments are mostly used in general air-conditioning and ventilation applications.

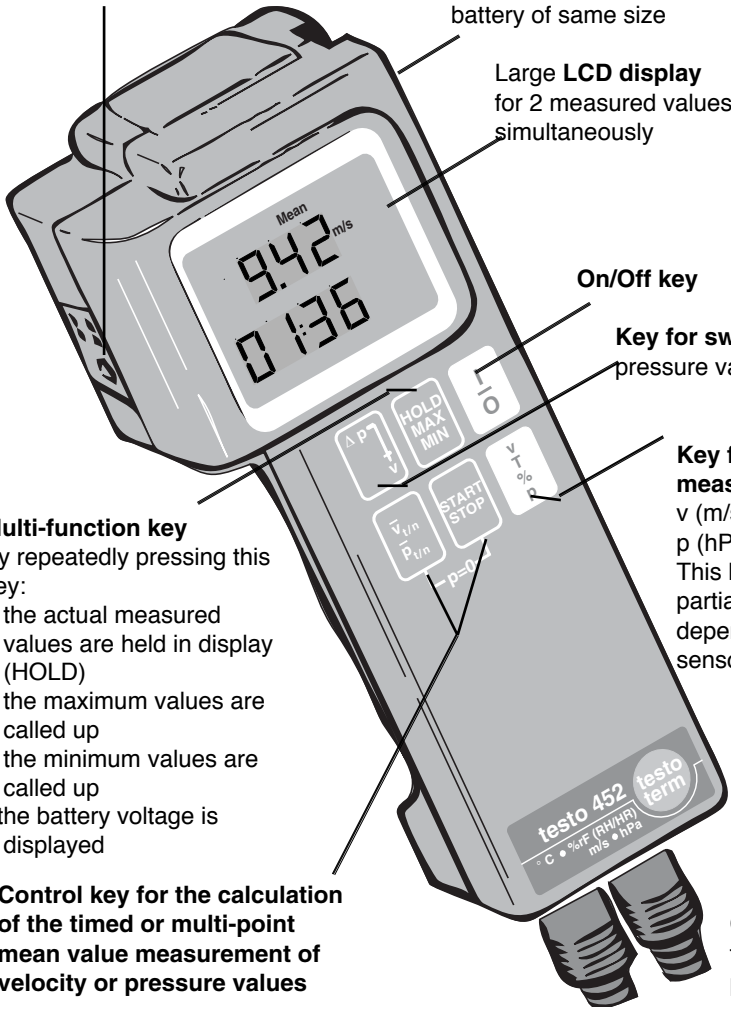
We expect those trained in measurement technology to be able to recognise the tolerances from the standard conditions and to be able to assess their effect on the measurement result. The following instructions should, therefore, be of some help.

Description

Connection socket for mains unit

Battery compartment (side of the instrument)
for 9V PP3 battery alcali-manganese IEC 6 LR 61 or rech. battery of same size

Large **LCD display**
for 2 measured values simultaneously



On/Off key

Key for switching between pressure values and flow values

Key fo conversion between measured quantites
v (m/s/fpm) - T (° C/F) - %(RH) - p (hPa)
This key loses its significance partially or completely depending on the measuring sensor connected

Multi-function key
By repeatedly pressing this key:
- the actual measured values are held in display (HOLD)
- the maximum values are called up
- the minimum values are called up
- the battery voltage is displayed

Control key for the calculation of the timed or multi-point mean value measurement of velocity or pressure values

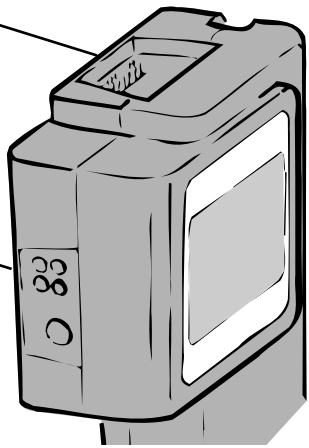
Connecting socket II
for **Humidity/**temperature **probes** (3-function probe)

Connecting socket I
for temperature probes, velocity probes and pressure probes

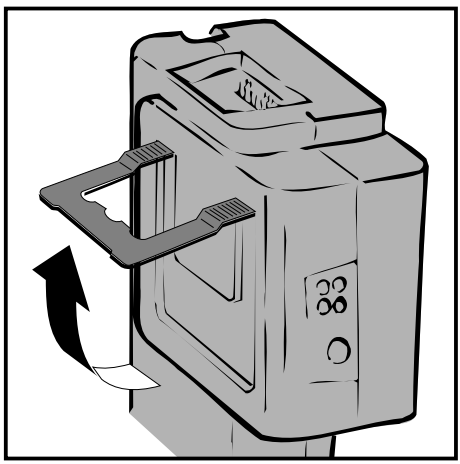
Analysis of measured data via:

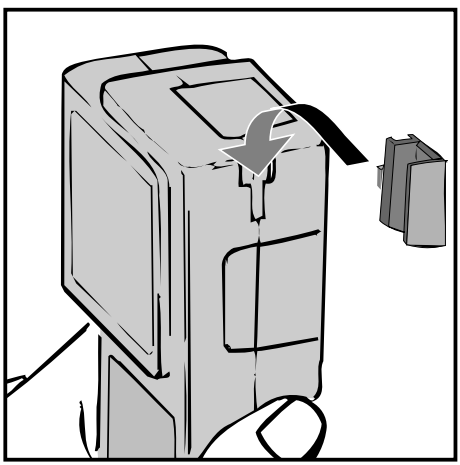
Interface
A logger (for storing and printing measured values) or a PC Adapter (for transferring measured data to a PC) can be connected

2 parallel analogue outputs



Guide rail
The holding device for the probe contained in the standard delivery enables a temperature or pressure probe to be connected to the instrument. Push the temperature probe into the holding device and then slide the holding device into the top of the guide rail



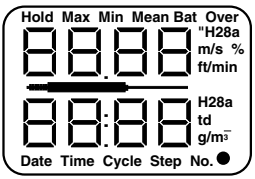


Bench/mounting bracket (on the back of the instrument)
In order to stand up the measuring instrument just pull out the bench stand..
In order to hang up the instrument, the mounting bracket has to be turned 180 °C. Press the two extremities of the bracket together and remove the bracket. Turn and replace into the guides.

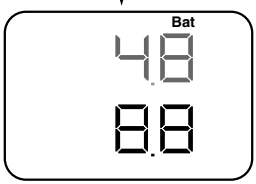
Measurement

Connect meas. probe!

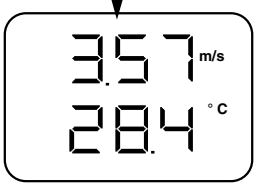
I/O **Switch-on meas. instrument!**



Segment test



Display of battery voltage of instrument and logger (if connected)

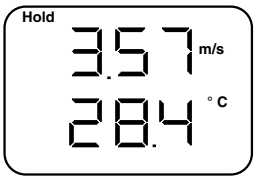


The actual meas. values are displayed (depending on the type of probe(s) connected)

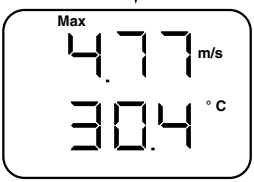
I/O **Switch off measuring instrument**

HOLD MAX MIN

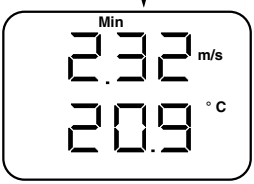
By repeatedly pressing this key...



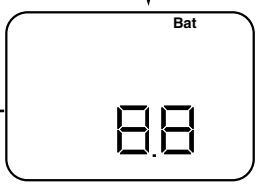
the actual measured values are held on the display



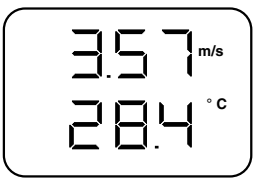
the current max. measured values are displayed



the current minimum measured values are displayed

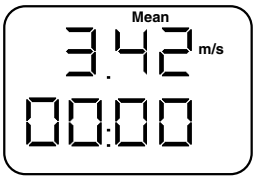


The actual battery voltage is displayed



(Measurement menu)

(1)



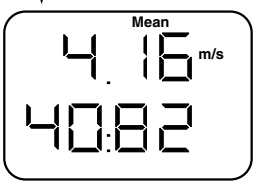
Ready for timed mean value measurement

START STOP

This procedure can be repeated as often as desired. During this time the instrument stores the actual measured values

START STOP

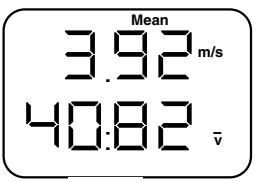
Bypass the timed mean value measurement and go directly to (2) the multi-point mean value measurement.



Actual meas. value

Total time over which the values will be determined

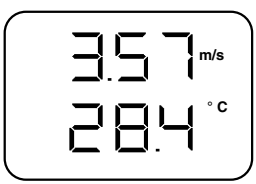
The flow values are determined in relation to time and are displayed



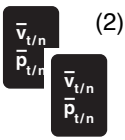
(2) multi-point mean value measurement, see p. 10

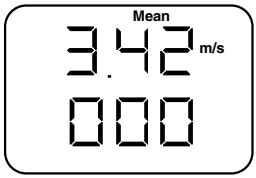
(1) Ready for another timed mean value measurement

Mulit-point mean value measurement



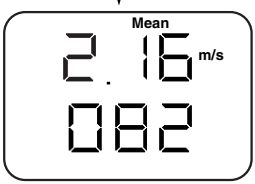
(Measurement menu)





Ready for a multi-point mean value measurement.

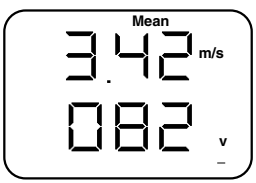
Whenever this key is pressed the current value is stored. The number of measured values is counted in the display.



Actual meas. value

Number of stored values

The flow values are determined arithmetically and are displayed

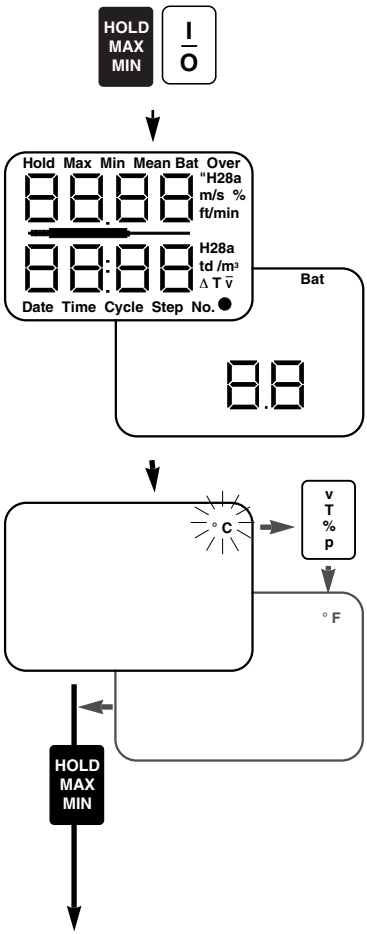


(1) Ready for another multi-point mean value measurement

You have now returned to the measurement menu

In order to reach the configuration menu, no probes should be connected to the instrument.

The adjustments remain stored even after the measuring instrument has been switched off, you must, however, reach the end of the configuration menu (signalled by a flashing probe).



Keep the HOLD/MAX/MIN key pressed, whilst switching-on the measuring instrument.

After a short segment test (approx. 2 seconds) and the display of the current battery voltage

the unit of temperature flashes in the display. This can be altered by pressing the **measured quantities** key v/T/%/p.

Other adjustments can be called up by using the **HOLD/MAX/MIN** key.

Possible adjustments :

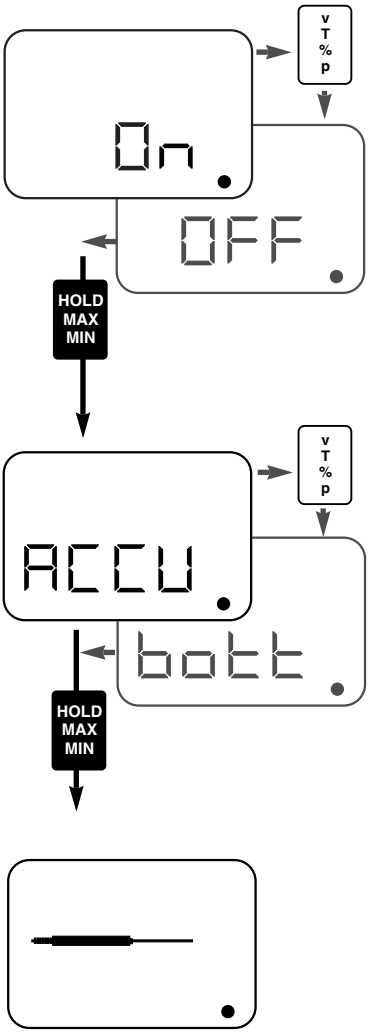
→ unit of meas.: ° C ↔ ° F
m/s ↔ ft/min
Dew point % ↔ absolute cont. g/m³

→ **Auto off-Function: On ↔ Off**

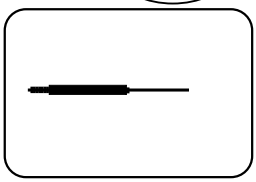
The meas. instrument switches itself off automatically 10 mins after any key has been pressed for the last time (to prevent endless measurements)

This function **must be switched off e.g. for continuous measurements or calibrations**
The bottom right-hand corner displays a symbol which indicates that the function is switched on. The 4-segment symbol represents a remaining time of 2.5 minutes per segment

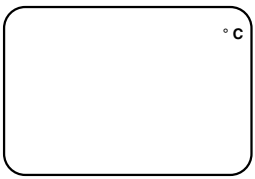
→ **Power supply battery ↔ rech. battery**
If set on "ACCU", the capacity of the rech. battery is only run down to 7.0 V, in order to avoid total discharge which would damage the rech. battery. If set on battery, the capacity can be run down to 6.2 V and thus the battery life is doubled.



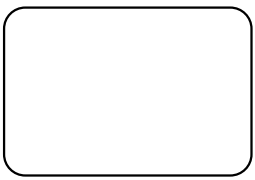
Switch off the measuring instrument, in order to connect the measuring probe.



When the instrument is switched on, the probes connected are registered.
If no probe is connected or the probe is defective the symbol opposite is displayed.



If a probe failure occurs during the measurement, the measured value fades and the measuring unit remains in display (→ return the probe for repair).



The probe functions - the measured value is beyond the measuring range. Please check whether the measuring range has been exceeded or whether the electronics are being confused by partly defective probes.

When velocity probes are used, error messages are not possible as the measuring instrument can not determine why no impulses are being transmitted. Defective probes can only be identified when the measured value is constant (despite a changing air velocity).

Technical data

Temperature

NiCr-NiAl	Meas. range:	-120.0 to +1370 ° C (-180 to +2500 ° F)
	Max. tolerance:	± 0.3 ° C (6 ° F) (in range -120 to- 50 ° C) (- 189 to - 60 ° F) ± 0.2 ° C (0.4 ° F) (in range -50 to +200 ° C) (- 60 to + 400 °F) ± 0.1 % of m. v. (from +200 ° C/+ 400 ° F)
	Resolution	0.1 ° 1 ° (above1000 °)
NTC	Meas. range	-40 to +70 °C (- 40 to + 160 ° F)
	Max. tolerance:	± 0.1 ° C (0.2 ° F) (in range -20 to +50 ° C) (0 to + 120 ° F) ± 0.2 ° C (0.4 ° F) (in remaining range)
	Resolution	0.1

This is instrument data. In order to calculate the system accuracy, the tolerances of the probes must be added (NiCr-NiAl according to DIN, NTC acc. to Uni-Norm - see description of probes and ordering data).

Velocity Vane probes	Meas. range:	0.2 to 60 m/s (40 to 9999 fpm)
	Max. tolerance:	- depends on type of probe, see ordering data -
	Resolution	0.1
therm. probes	Meas. range:	0 to 10 m/s (0 to 2000 fpm)
	Max tolerance:	± 0.05 m/s(100 fpm) ± 2.5% of m. v. (in range 0 to 2 m/s) (0 to 400 fpm) ± 0.5 m/s(100 fpm) ± 5% of m. v. (in range 2 to 10 m/s) (400 to 2000 fpm)
	Resolution:	0.01

These details of accuracy are only valid when the probes are correctly used and in optimal measuring conditions!
- see description of probes -

Pitot tube	Meas. range:	4 to 100 m/s (800 to 2000 fpm)
	Max. tolerance:	see description of probe
	Resolution:	0.01
Humidity		
Cap.	Meas. range:	0 to 100 %RH (Application range of the probe tip - the electronics should not be subjected to moisture/condensation)
Sensor	Max. tolerance:	± 2%RH (2 to 98 %RH)
	Resolution:	0.1
Pressure:	Meas. range:	0 to ±100 hPa (0 to ±40"H_2O
DMS-sensor	Max. tolerance:	± 0,1 hPa (±0.04"H_2O, 1% of m.v.> 8" H_2O) ± 1% v. Mw. (from 20 hPa)
	Resolution	0.01
Power supply		9 V PP3 block battery alcali-manganese IEC 6 LR 61 (or rech. batttery of same size) or via mains unit.
Measuring rate		1/seconds
Display		LCD, 2 line, height of characters 9 mm
Mean value meas.		timed or multi-point
Perm. operating temp.:		0 to +40 ° C(32 to 105 ° F)
Perm. storage and transport temp.:		-30 to +60 ° C (-20 to + 140 °F)

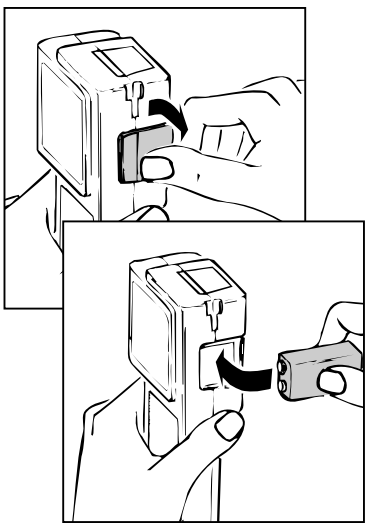
Power supply

→ **Battery operation**
with 9 V PP3 block battery **alcali manganese IEC 6 LR 61**
(Do not use zinc carbon batteries together with thermal probes as their source resistance is too great and the probe can not be supplied with sufficient energy→the instrument switches itself off)
or

→ **Rech. battery operation**
with NiCd rech. battery of the same size.
or

→ **Operation via mains unit 0554.0088.**
connection via socket on side of instrument.
Remove batteries from the meas. instrument. or replace with a rechargeable type
Risk of explosion!

Battery/rech. battery connection
The battery compartment is on the side of the instrument. In order to insert the battery/rech. battery, slide off the battery cover from the side of the instrument.
Please observe correct polarization! Close the battery/rech. battery compartment.



Battery control
If the battery voltage is less than 6.4 V (or 7.2 V for rech. batteries), (Bat) is displayed above the measured values indicating that the capacity of the batteries is reaching its end.
In order to prevent total discharge, the measuring instrument switches off automatically at 7.0 V when using rech. batteries. When using dry cell batteries, the battery voltage can reach 6.2 V.

The measuring instrument has an auto off function in order to avoid endless, unwanted measurements.

Observe the adjustments in the configuration menu (see page 11)!

Charging the rech. battery
The rechargeable battery can be charged outside the measuring instrument via the recharger 0554.0025.
Duration of approx. 13 hours

It is possible to recharge the rech. battery inside the measuring instrument via mains unit 0554.0088.
The meas. instrument is still operational whilst recharging. The duration of this procedure is 13 hours.

Battery life
testo 452 together with

→ **Temperature probe or vane probe 0635.9540** (standard vane probe)	
battery (alcali-manganese)	20 h
rech. battery	2.7 h
→ **Vane probe 0635.6045** (high temperature vane probe)	
battery (alcali-manganese)	3 h
rech. battery:	0.4 h
→ **Thermal probe 0635.1049**	
battery (alcali-manganese)	4 h
rech. battery	0.5 h

These are average values. This data may differ depending on the manufacturer of the batteries, storage conditions and production batch.

Description of probes

Temperature probes

Temperature probes, velocity probes, humidity probes, pressure probes or combined probes can be connected to **testo 452** .

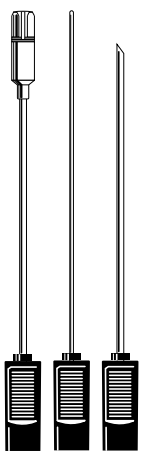
The measuring instrument recognises which type of probe is connected. The probe must, however, be connected before turning on the instrument → turn off the measuring instrument before changing any probes!

Temperature probes
As a rule all NiCr-NiAl probes with 8 pin DIN plugs from the **Testo** range can be connected.

NiCr-NiAl detectors are suitable for temperature measurements in a large measuring range (-200 to +1200 °C) (-320 to +2190 ° F) . Further advantages are: small dimensions, very quick response times.

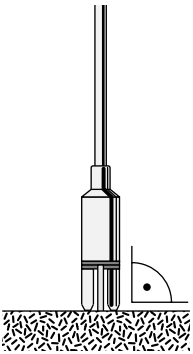
NTC detectors enable very accurate measurements in a relatively small measuring range (-40 to +70 °C) (-40 to +160 ° F).

Please observe the measuring range given for the temperature probe (see ordering data)! The measuring range of the instrument is not the same as that of the temperature probe!



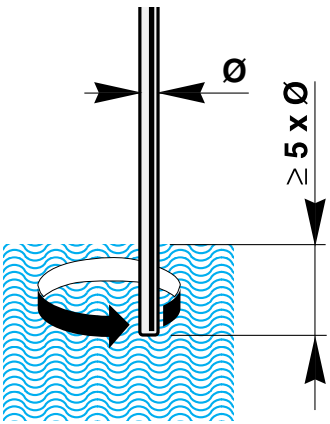
The accuracy of the temperature sensor type K (NiCr-NiAl) corresponds with the tolerances indicated in DIN IEC 584, part 2, class 1or 2 (see ordering data). The UNI Norm is valid for the NTC sensors.

You can choose between 4 different types of probe: surface probe, immersion probe, penetration probe and air probe.



General instructions for surface measurements

- Place the measuring tip in a vertical position.
- Use heat paste on rough surfaces for better heat conduction (up to max. +260°C/500 °F)
- Depending on the working surface the meas. value can differ - the highest meas. value is the best meas. value (→ maximum value stored).



General instructions for immersion, penetration or air measurements

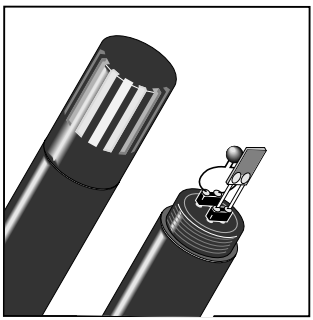
- The minimum depth of immersion in the medium to be measured, is approx. 5 x the diameter of the probe.
- The response times can be reduced by gently moving the probe

Time response

The response times are usually indicated as t_{99} (t_{99} representing the length of time the probe requires to register 99 % of the jump in temperature) .

Description of probes

Humidity probes



A capacitive sensor is combined with a NTC temperature sensor. The humdity sensor measures the relative air humidity according to the capacitive principle. Relative air humidity is a measure of the water vapour content in the air. Relative humidity means the relationship between the available absolute humdity and the maximum possible absolute humidity at the same temperature.

During measurements with humidity probes manufactured before 010* (see engraving on connecting part) the instrument must be switched to "Accu" (→ adjustment in configuration menu, see 11), as a power supply of less than 7.0 V can lead to incorrect results.

General instructions of use:
Depending on the application you can choose between 3 different probe constructions:
air probe for ambient humidity, immersion probe for measurements in loose goods or sword probes for measurements in stacked goods (e. g. paper)

For measurements in dusty or sandy atmospheres and/or an air velocity of above 10 m/s (2000 fpm), the protection cap should be replaced by a sintered cap made from polyethylene or stainless steel, in order to protect the sensitive sensor.

Maintenance
Humidity probes are maintenance-free, as long as they are used in "clean" atmospheres. If this is not the case e. g. during measurements in dusty environments, the humidity probes should occasionally be tested.

In order to calibrate the humidity probe we recommend the use of the control set containing lithium chloride(LiCl) 12 %RH and sodium chloride solutions (NaCl) 76 %RH, offered in the accessories, as their relative humidities are almost independent of temperature
(→ control and calibration set for humidity sensors).

Manufacturing date010
month(October)
last figure in the year1990

Table 1: Relationship between temperature, relative humidity and dew point.

During the automatic dew point calculation, temperature and relative humidity are measured first. The intersection point of both lines determines the dew point temperature

Description of probes

Combined probes

In order for temperature to be measured as an auxiliary parameter, many probes are offered as combined probes e. g. combined humidity/temperature probes or combined velocity/temperature probes.

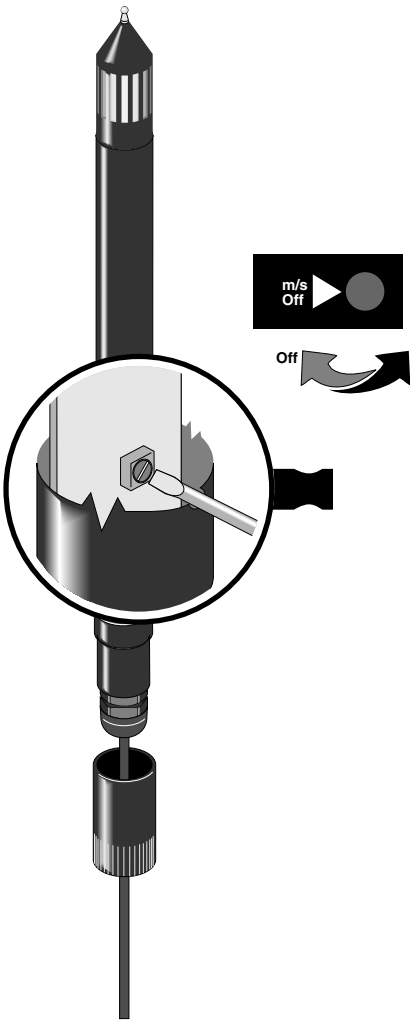
One particular combined probe is the **3 function probe.** The air flow value can be measured alongside temperature and humidity.

The 3 function probe is also maintenance-free, as long as it is used in clean environments.

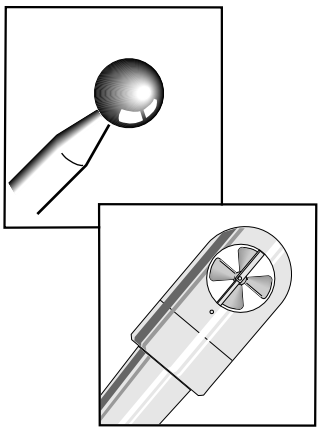
We do, however, recommend that the humidity probe be tested occasionally. For calibration work, switches are mounted under the sleeve at the lower end of the probe. Only use the calibration switches for calibration work together with a humidity calibration set. An accurate description of the calibration procedure is enclosed with the control and calibration set.

In order to connect the 3 function probe to the humidity pots of the calibration set, an adapter is available (see ordering data).

During testing or calibration work, the thermal sensor must be switched off (illustration).



Velocity probes- which probe where?



On

In the velocity measuring range of 0 to 100 m/s (0 to 20000 fpm) the respective optimal sensor can be connected, covering the three important ranges (lower and medium velocity range as well as the upper velocity range). Thermal sensors are used 0 to 10 m/s (0 to 2000 fpm). Vane probes enable optimal results in medium velocity ranges at an air speed of 4 to 40 m/s(800 to 8000 fpm) (type 0635.9540 up to 60 m/s). The large anemometer probe (type 0636.9349, Ø 100 mm) is particularly suitable for measurements of air flow at grids. The air flow is measured by a large surface, turbulence at grids or large differences in speed are averaged out.

Measurements in pipes and ducts can be effected if particular care is taken (see also VDI 2080 - measuring procedures and measuring instruments for air conditioning apparatus). As **Testo** calibrates all velocity probes in directed flow (free jet), these conditions should also be observed during the measurement.

In detail this means:

- If a probe is used to measure duct velocity the cross-sectional area of the probe should be 1/100 of the cross-section of the duct.
  (The cross-section of the duct should be 1 m^2 when a 20 mm probe is used at an immersion depth of 50 cm. Otherwise the velocity must be corrected in relation to the narrowing of the cross-section).
- Apart from directed flow, turbulent or swirling flow can appear in ducts. In order to avoid incorrect measuring results (errors up to 100%), measurements should if possible be effected in straight sections of the duct, i. e. the duct should be straight for a distance of 10 times the diameter of the duct/pipe infront of the place of measurement and 4 times the diameter of the duct/pipe behind the place of measurement .

There are "ifs" and "buts" for every sensor. Here, therefore, follows a list of all the points that should be taken into consideration with each sensor.

Description of probes

Velocity probes - which probe where?

General range: Choose the optimal velocity probe for your application

Temperature applications

up to + 70 ° C (+160 °F)

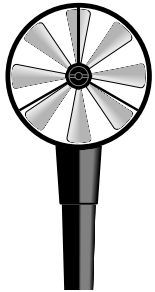
0635.1045
Ø 21 mm

up to + 70 ° C (+160 °F)

0635.1549
Ø 4 mm
0635.1049
Ø 6 mm

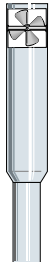
0635.1042
Ø 10 mm

up to + 60 ° C (+140 °F)



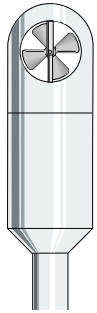
0635.9449
Ø 60 mm

up to + 100 ° C (+210 °F)



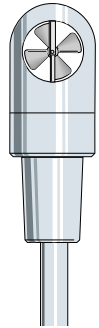
0635.9443
Ø 12 mm

up to + 350 ° C (+660 °F)



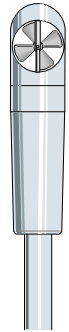
0635.6045
Ø 24 mm

up to + 140 ° C (+280 °F)



0635.9640
Ø 25 mm

up to +140 ° C (+280 °F)



0635.9540
Ø 16 mm

up to + 350° C (660 °F)
Pitot tubes

0635.2045
Ø 7 mm,
L = 500 mm
(without illus.)

0635.2145
Ø 7 mm,
L = 350 mm
(without illus.)

(together with
pressure probes
0635.1545)

0635.6045
Ø 25 mm

up to + 500° C (930 °F)
Pitot tubes
0635.2245
Ø 4 mm, L = 300 mm
(without illus.)

5 m/s 1000fpm

10 m/s 2000fpm

20 m/s 4000fpm

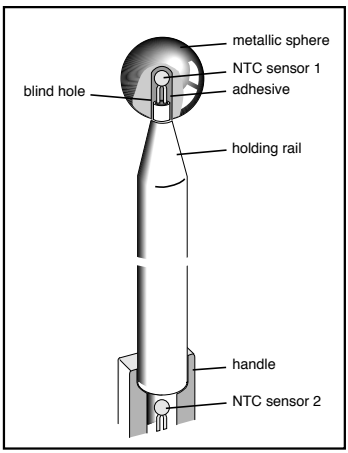
40 m/s 8000fpm

60 m/s 12000fpm

100 m/s 20000fpm

Velocity

Thermal velocity sensors are recommendable particularly in low ranges of velocity from 0 to 5 m/s (0 to 1000 fpm); e.g. for determining small flow values in unknown directions of flow (→ appearance of draughts).



Operation

The sensor comprises of an aluminium sphere which contains a NTC(1) temperature sensor in a blind hole. This NTC(1) is heated to a temperature of +100 °C (+210 °F) by an electric current. The heat (Joule) is dissipated into the aluminium evenly. The sphere is cooled by the cooler current or air hitting the sphere (the airflow). This causes the resistance of the NTC(1) to rise.
A regulating switch controls the electric resistance of the NTC in such a way that the temperature of NTC(1) remains constant.

The controlling current or heater voltage is a direct measure for the air velocity. The NTC(2) is used for temperature compensation of the signal NTC(1).

When thermal sensors are used, air velocity from all directions contribute to the measuring result. It is, therefore, understandable that when used in turbulent air currents, the measuring results will differ from those of vane probes as a result of the tubulence surrounding the probe.In such cases thermal velocity sensors will display higher measured values than vane probes

This should be observed when measuring in ducts. Depending on the construction of the duct, turbulent flow is to be expected even at few m/s (twist, cross-flow, vortex). Measurements should be effected, if possible, in straight parts of the duct away from bends, vents and junctions.

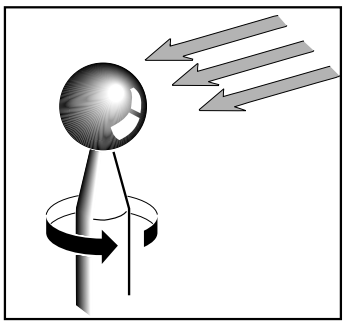
Description of probes

Thermal velocity probes

The duct should be straight for 10D in front of the point of measurement and 4D behind it. If an integrated flow-straightener is used, this can be reduced to 4-6 D in front of the point of measurement and 4D behind it (D = inner diameter of the duct).

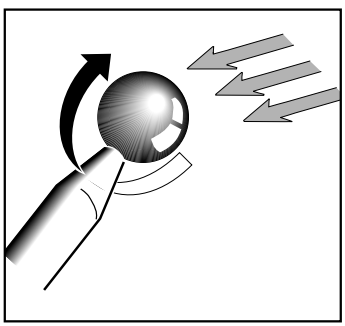
In directed flows, the meas. values vary according to the impingement angle . This tolerance is linked with among other things turbulent backwashes from the support tube to the sphere`s surface.

Sensor calibration
The thermal velocity sensors are calibrated in a direct flow in free jet (Ø 150 mm) at right angles to the holding rod. Should the conditions of application correspond with the calibration conditions, optimal measuring results will be obtained.



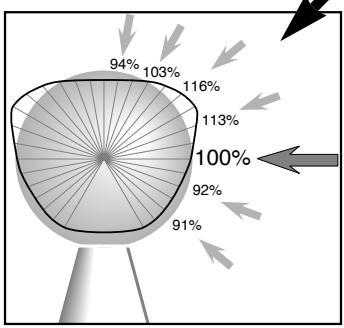
Possible tolerances due to leaning and twisting:
When a thermal velocity sensor is twisted at the holding rod, the flow always hits the holding rod at right angles **The tolerance of the meas. value is < 2.5 % of meas., value**

When a thermal velocity sensor is tipped by the support tube (dependent of the yaw angle). Due to the turbulent backwash from the support tube to the sphere's surface, different measured values can be recorded.



This tolerance can not be eliminated, but can, however, be reproduced.

The illustration opposite is valid for a velocity of approx. 2 m/s (400 fpm)



General instructions
The thermal velocity sensor takes approx. 10-30 seconds to warm up to a sphere temperature of +100 °C (+210 °F) after the instrument has been switched on.
The maximum value stored remains at 0,00 m/s/fpm for 15 sec , in order to eliminate the effect of the circuit closing operation.
The measuring sensor generally does not require maintenance.
Clean occasionnally with non-aggressive agents. The measuring elements can be cleaned with a soft cloth or a brush.

Do not extend or collapse the telescopic probe by pulling or pushing the sensor tip.

The temperature display is slightly higher in still air. Move the probe in order to prevent this effect (the technical data is valid from 0.2 m/s (40 fpm)

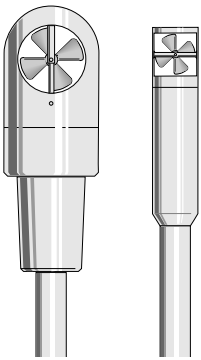
Technical data

Meas. range:	**Velocity:** **0 to 10 m/s (0 to 2000 fpm)** (optimal:0 to 5 m/s/ 0 to 1000 fpm) Measurements in the range 10 to 20 m/s/2000 to 4000 fpm can be effected, meas. values are displayed, however, no values can be given concerning accuracy. **Temperature:** **-20 to +70 °C (0 to +160 ° F)**
Max. tolerance: **(22 ° C/71 °F)**	0 to 2 m/s (0 to 400 fpm) (± 0.05 m/s;±2.5 % of m. v.) (± 10 fpm; ±2.5 % of m. v.) 2 to 10 m/s (400 to 2000 fpm) (± 0.5 m/s; ± 5.0 % of m. v.) (± 100 fpm; ± 5.0 % of m. v.)
Temperature compensation:	-10 to 60 °C (-10 to 140 ° F) tolerance above: < ± 0.2 % of m. v./° C
Response time t_{90}:	4 seconds
Geometry:	sphere, Ø 2.5 mm

Descritpion of probes

Vane probes

Vane measuring probes can be used in high speeds of up to 60 m/s (9999 fpm) (ideal in the range 4 to 40 m/s/ 800 to 8000 fpm). The amount of air flow is determined by the cross section of the vane probe and is then displayed. The vane probes are calibrated in a directed free jet of 500 mm (type 0635.9349, Ø 100 mm: in a free jet of 150 mm)



Measuring principle :
The measuring principle of the vane probe is based on the conversion of rotary motion into electronic pulses. The air flow current moves the vane. An inductive approximation switch “counts” the rotations of the vane and transmits a series of impulses, which are converted in the measuring instrument and are displayed as an air velocity value (with the exception of the high temperature probe: fibre optic conductor and reflector). The error caused by bearing friction (static friction) at the start of the measurement is corrected electronically.

Selection criteria:

→ Probe diameter

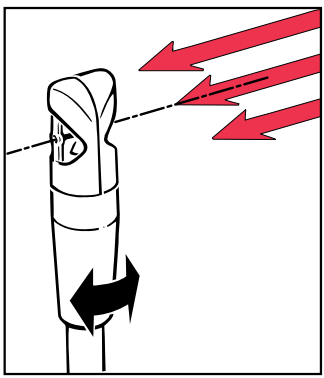
The larger the diameter of the vane probe,
- the less important the bearing properties (static and gliding friction).
- the more stable the reading is
- any large differences in speed lose importance compared with multi-point measurements
- the lower the permissible upper limit of the field of application (→ centrifugal force is a burden for the bearings or can bend the vane)

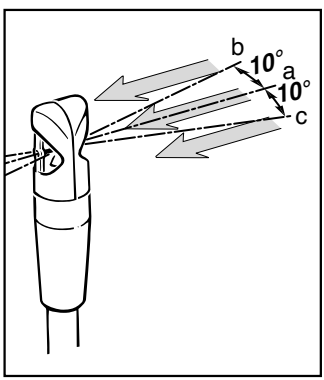
Large diameters are suitable for small to medium speeds and rough operating conditions. **Small diameters** are above all suitable for measurements in ducts, whose cross-section must be 100 times larger than the cross-section of the probe.

The 16 mm probe (type 0636.9540) can be used in most applications. It is large enough to have good starting qualities and small enough to cope with speeds of up to 60 m/s (9999 fpm).

→ **Temperature field of application**
By using special probes, short-term measurements in temperatures of up to +500 °C (+900 °F) can be effected!

→ **Probe material**
e. g. anti-corrosion stainless steel probes for measurements in aggressive gases





Positionning the vane probe in the air flow
The vane probe is placed correctly in the air flow, when the direction of the flow is parallel to the axis of the vane probe.

By slightly turning the probe in the air flow, the values displayed in the measuring instrument will change. The probe is correctly positionned when the value displayed is at its maximum.

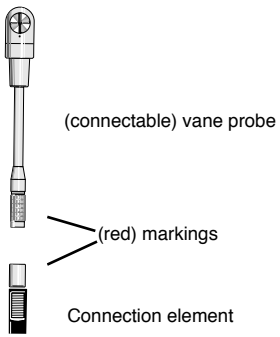
The rotational speed of the vane probe is dependent of the direction of the current.Turning the probe in the air flow can lead to a deviation in the meas. value. This deviation differs depending on the construction of the probe.

Turning the probe by 10° results in a mean deviation in the meas. value for standard probes:
- for probes of Ø 25 mm
  approx. +1.2 % (b) and -2.8 % (c)
- for probes of Ø 16 mm
  approx. +0.5 % (b) and -0.5 % (c)
- for probes with Ø 12 mm
  0 % (b) and approx. -2.0 % (c)

Description of probes

Vane probes

General operating instructions
The vane probe can be connected to the measuring instrument via a handle, a connecting lead or via a telescope. When connecting the plug and the connector, the red markers on both parts must be aligned.

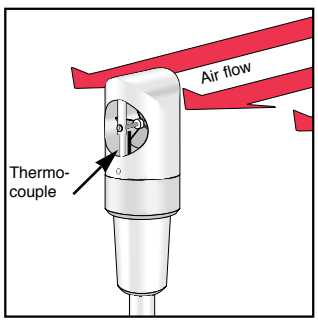


A locking ring (knurled ring) prevents the connection from being unintentionally broken. To break the connection, grip the probe at the knurled ring and pull. If handled correctly the connection can be released easily. Do not apply force, you could damage the connection!

Vane probes should only be used in the given temperature range (see ordering data)! Vane probes are not impact resistant!

Aggressive or soiled mediums can damage the measuring head. Very high accelerations can damage the vane and render it useless.

For temperature measurements with vane probes, the measuring head must be placed into the airflow according to the diagram, in order to keep the response times as short as possible.



If the vane is dirty, the measuring heads of new probes can be unscrewed (recognisable by the vertical thermocouple in the meas. head) from the main body of the probe and can be cleaned in an ultrasonic bath or carefully dipped in alchohol.
If old probes are used only the measuring tip should be dipped in alchohol. Vane probes are otherwise maintenance free.

Vane probes

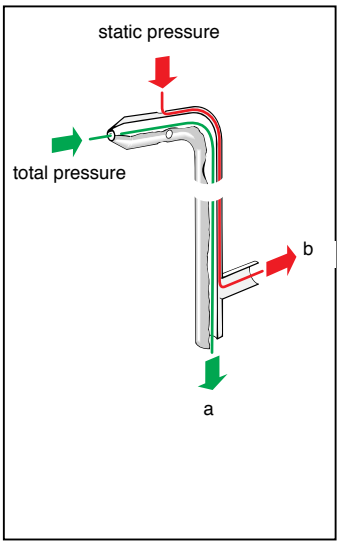
A swan neck can be connected between the probe and the connected element (handle, connecting lead or telescope) for measurements in inaccesible places.

By bending the swan neck to the desired position, otherwise inaccesible places can be easily reached. A holding set is available for the exact positionning of the vane probe (see ordering data).

Description of probes

Pitot tube

Pitot tubes together with differential pressure measurements are used for determining pressure and velocity. The advantage of this sensor is its simplicity. Mechanically the tube is stable and rugged. Unfavourable environmental conditions such as high temperatures, very dirty air or aggressive gases hardly effect the Pitot tube. A stainless steel version is available for extreme conditions (temperature application range up to +500 ° C/+ 930 °F!). Furthermore, as the Pitot tube has no moveable parts, it does not suffer any wear and tear.



Measuring principle
The opening of the Pitot tube detects the total pressure and directs it towards the pressure probe connection (a). The purely static pressure is absorbed by the slit on the side and is directed to the pressure probe connection (b). The resulting differential pressure is the flow independant dynamic pressure. This is analyzed and displayed.

Should the pressure values be converted into flow values, the basic parameter, air density, must be corrected at the beginning of the measurement. See chapter on measuring air density.

Connection
Two silicone tubes (see ordering data) connect the Pitot tube with the pressure sensor (see chapter: Description of probes/pressure probes).

Pressure probes

The pressure probe works with a differential pressure sensor according to the wire strain gauge principal. In the measuring range 0 to 100 hPa, reliable differential pressure measurements can be made through out the range.

The sensor has an overload protection in a range of up to150 hPa , damage can be expected if the sensor is used in higher pressures. Equally, measurements should be avoided in rapid pulses of pressure (e. g. controlling compressed air via electromagnetic valves), as it is not possible to know the peak pulse values.

For reproducable measurements, the pressure probe signal should be set to 0.00 hPa, without connecting the Pitot tube. If the pressure probe is connected the Start/Stop key must be held, whilst the $\overline{v/p}$ is pressed (quickly pressed together). This zero's any slight offset reading. The pressure probe must be used in the same plane as it was calibrated or else an additional error will result. We therefore recommend the magnetic holding set for pressure probes.

Measuring air density ρ

Calculated air velocity

The accuracy of the results depends on the determination of the environmental parameters. The influence of air pressure, temperature and humidity is unfortunately all too often underestimated.

With the aid of the following table, determine the mean annual air pressure for the height at the place of measurement and calculate the additional fluctuations with a barometer or ask for the exact air pressure value from your weather office

Table 2: ***Barometric formula for altitude***
Dependence of the air pressure on the local height

Height above s.l.	Air press. (hPa)	Height above s.l.	Air press. (hPa)	Height above s.l.	Air press. (hPa)	Height above s.l.	Air press. (hPa)
0	1013	1500	845	3000	700	4500	577
50	1107	1550	840	3050	696	4550	573
100	1001	1600	835	3100	692	4600	569
150	995	1650	830	3150	687	4650	565
200	989	1700	824	3200	683	4700	562
250	983	1750	819	3250	678	4750	558
300	977	1800	814	3300	674	4800	554
350	971	1850	809	3350	670	4850	550
400	966	1900	804	3400	666	4900	547
450	960	1950	799	3450	661	4950	543
500	954	2000	794	3500	657	5000	540
550	948	2050	789	3550	653		
600	943	2100	785	3600	649		
650	937	2150	780	3650	644		
700	931	2200	775	3700	640		
750	926	2250	770	3750	636		
800	**920**	2300	765	3800	632		
850	915	2350	760	3850	628		
900	909	2400	756	3900	624		
950	904	2450	751	3950	620		
1000	898	2500	746	4000	616		
1050	893	2550	742	4050	612		
1100	887	2600	737	4100	608		
1150	882	2650	732	4150	604		
1200	877	2700	728	4200	600		
1250	871	2750	723	4250	596		
1300	866	2800	719	4300	592		
1350	861	2850	714	4350	588		
1400	855	2900	709	4400	584		
1450	850	2950	705	4450	580		

Pressure and temperature dependancy of air density

The actual air pressure varies by ± 20 hPa from the mean annual air pressure according to the weather conditions. Please note that at ±25 hPa the density is influenced in the ten gramme range. During a direct measurement of the absolute pressure, this corresponds with an accuracy of ± 2.5 % of the meas. value at 1000 hPa. In the m/s display, this means an error of 1 to 4 % of the measured value can be expected. The critical area in low pressure conditions.

Example: You are 800 m above sea level. Here there is a mean annual pressure of 920 hPa. According to the barometer (1003 hPa) and height correction of the barometer (to 1013 hPa), the mean annual air pressure must be reduced by 10.

Add the difference between the ambient air pressure and the static process air pressure to this (air) pressure (e. g. excess pressure in the air duct to be measured - measurable with the pressure probe up to max. 100 hPa).

Example: We have determined a mean annual pressure of 920 hPa. Due to the static process pressure, 90 hPa should be added.
We, thus, have an absolute air pressure in an area of measurement of 1000 hPa.

The air density is dependent on temperature (i. e. if the temperature increases, the density decreases).

With the aid of table 3 you can determine air density as a function of pressure and temperature. A tolerance of ±1 ° C influences the density in the gramme range, i.e. ± 0.2 to 0.5 % of the velocity value displayed.

Example: We have measured a density of 1079 g/m^3 (at 50 ° C).

Measuring air density ρ

Table 3: Pressure and temperature dependancy of air density ρ

absolute air pressure (static) hPa

Temperature °C	750	800	850	900	950	1000	1050	1100	1150	1200	1250	1300	1350	1400
-20	1033	1102	1170	1239	1308	**1377**	1446	1515	1584	1652	1721	1790	1859	1928
-10	994	1060	1126	1192	1258	**1325**	1391	1457	1523	1590	1656	1722	1788	1855
0	957	1021	1085	1149	1212	**1276**	1340	1404	1468	1531	1595	1659	1723	1787
10	923	985	1046	1108	1170	**1231**	1293	1354	1416	1477	1539	1600	1662	1724
20	892	951	1011	1070	1130	**1189**	1249	1308	1368	1427	1486	1546	1605	1665
30	862	920	977	1035	1092	**1150**	1207	1265	1322	1380	1437	1495	1552	1610
40	835	891	946	1002	1058	**1113**	1169	1225	1280	1336	1391	1447	1503	1558
50	**809**	**863**	**917**	**971**	**1025**	**1079**	1133	1187	1241	1294	1348	1402	1456	1510
60	785	837	889	942	994	1046	1099	1151	1203	1256	1308	1360	1413	1465
70	762	813	863	914	965	1016	1067	1117	1168	1219	1270	1321	1371	1422
80	740	790	839	888	938	987	1036	1086	1135	1185	1234	1283	1333	1382
90	720	768	816	864	912	960	1008	1056	1104	1152	1200	1248	1296	1344
100	701	747	794	841	887	934	981	1028	1074	1121	1168	1214	1261	1308
110	682	728	773	819	864	910	955	1001	1046	1092	1137	1183	1228	1274
120	665	709	754	798	842	887	931	975	1020	1064	1108	1153	1197	1241
130	649	692	735	778	821	865	908	951	994	1038	1081	1124	1167	1211
140	633	675	717	759	802	844	886	928	970	1013	1055	1097	1139	1181
150	618	659	700	741	783	824	865	906	947	989	1030	1071	1112	1153
160	604	644	684	724	765	805	845	885	926	966	1006	1046	1086	1127
170	590	629	669	708	747	787	826	865	905	944	983	1023	1062	1101
180	577	615	654	692	731	769	808	846	885	923	962	1000	1039	1077
190	564	602	640	677	715	753	790	828	866	903	941	978	1016	1054
200	553	589	626	663	700	737	774	810	847	884	921	958	995	1031
210	541	577	613	649	685	722	758	794	830	866	902	938	974	1010
220	530	566	601	636	672	707	742	778	813	848	884	919	954	990
230	520	554	589	624	658	693	727	762	797	831	866	901	935	970
240	509	543	577	611	645	679	713	747	781	815	849	883	917	951
250	500	533	566	600	633	666	700	733	766	800	833	866	900	933
260	490	523	556	588	621	654	687	719	752	785	817	850	883	915
270	481	513	546	578	610	642	674	706	738	770	802	834	866	899
280	473	504	536	567	599	630	662	693	725	756	788	819	851	882
290	464	495	526	557	588	619	650	681	712	743	774	805	836	867
300	456	487	517	547	578	608	639	669	699	730	760	791	821	851
310	448	478	508	538	568	598	628	658	687	717	747	777	807	837
320	441	470	500	529	558	588	617	646	676	705	735	764	793	823
330	433	462	491	520	549	578	607	636	665	694	722	751	780	809
340	426	455	483	512	540	569	597	625	654	682	711	739	768	796
350	420	448	475	503	531	559	587	615	643	671	699	727	755	783
360	413	440	468	496	523	551	578	606	633	661	688	716	743	771
370	407	434	461	488	515	542	569	596	623	650	678	705	732	759
380	400	427	454	480	507	534	560	587	614	640	667	694	721	747
390	394	421	447	473	499	526	552	578	605	631	657	683	710	736
400	388	414	440	466	492	518	544	570	596	621	647	673	699	725
410	383	408	434	459	485	510	536	561	587	612	638	663	689	714
420	377	402	427	453	478	503	528	553	578	603	629	654	679	704
430	372	397	421	446	471	496	521	545	570	595	620	644	669	694
440	367	391	415	440	464	489	513	538	562	587	611	635	660	684
450	362	386	410	434	458	482	506	530	554	578	603	627	651	675

At the same temperature and same pressure, the density of damp air is less than the density of dry air. ±10%RH up to 70 ° C influences the density in the gramme range. At temperatures above 70 ° C, any additional influence without a high air humidity should be neglected. The velocity values are influenced by ±0 to 1% of the measured value within the range of table 3. Critical range: high humidity values at high temperature.

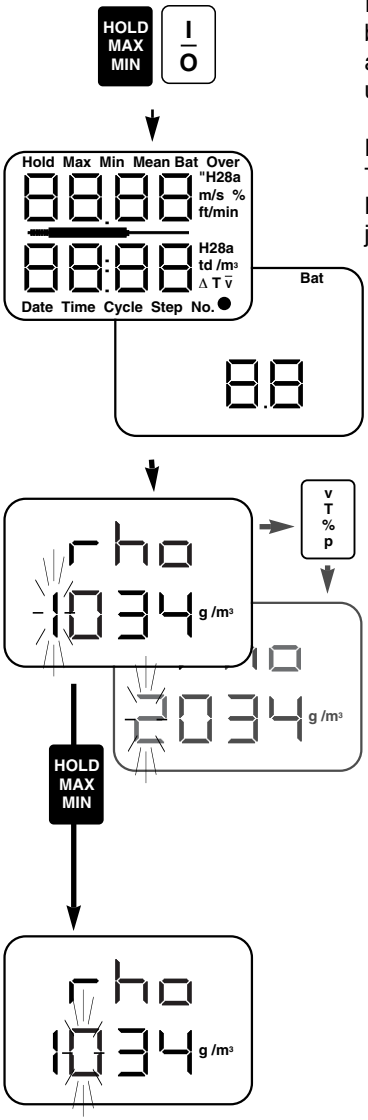
Take the corresponding correction factor from table 4 and subtract it from your pressure value.

Example: In our example we are counting on 70 % relative humidity. At at density of 1079 g/m³ we reach a correctional value of 35 (g/m³). We have to enter the value 1044 g/m³ into the measuring instrument.

Measuring air density ρ

Table 4: Correctional value - humidity

Temperature °C	% relative air humidity										
	0	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
-20	0	0	0	0	0	0	0	0	0	0	1
-18	0	0	0	0	0	0	0	0	1	1	1
-16	0	0	0	0	0	0	0	1	1	1	1
-14	0	0	0	0	0	0	1	1	1	1	1
-12	0	0	0	0	0	1	1	1	1	1	1
-10	0	0	0	0	1	1	1	1	1	1	1
-8	0	0	0	0	1	1	1	1	1	1	2
-6	0	0	0	1	1	1	1	1	1	2	2
-4	0	0	0	1	1	1	1	1	2	2	2
-2	0	0	1	1	1	1	2	2	2	2	3
0	0	0	1	1	1	1	2	2	2	3	3
2	0	0	1	1	1	2	2	2	3	3	3
4	0	0	1	1	2	2	2	3	3	3	4
6	0	0	1	1	2	2	3	3	4	4	4
8	0	1	1	2	2	3	3	4	4	5	5
10	0	1	1	2	2	3	3	4	5	5	6
12	0	1	1	2	3	3	4	5	5	6	6
14	0	1	1	2	3	4	4	5	6	7	7
16	0	1	2	2	3	4	5	6	7	7	8
18	0	1	2	3	4	5	6	7	7	8	9
20	0	1	2	3	4	5	6	7	8	9	10
22	0	1	2	4	5	6	7	8	9	11	12
24	0	1	3	4	5	7	8	9	11	12	13
26	0	1	3	4	6	7	9	10	12	13	15
28	0	2	3	5	7	8	10	12	13	15	16
30	0	2	4	6	7	9	11	13	15	17	18
32	0	2	4	6	8	10	12	14	16	18	20
34	0	2	5	7	9	11	14	16	18	20	23
36	0	3	5	8	10	13	15	18	20	23	25
38	0	3	6	8	11	14	17	20	22	25	28
40	0	3	6	9	12	15	19	22	25	28	31
42	0	3	7	10	14	17	21	24	27	31	34
44	0	4	8	11	15	19	23	26	30	34	38
46	0	4	8	12	17	21	25	29	33	37	42
48	0	5	9	14	18	23	27	32	37	41	46
50	0	5	10	15	20	25	30	35	40	45	50
52	0	6	11	17	22	28	33	39	44	50	55
54	0	6	12	18	24	30	36	42	48	54	60
56	0	7	13	20	26	33	40	46	53	59	66
58	0	7	14	22	29	36	43	50	58	65	72
60	0	8	16	24	31	39	47	55	63	71	79
62	0	9	17	26	34	43	51	60	69	77	86
64	0	9	19	28	37	47	56	65	75	84	93
66	0	10	20	30	41	51	61	71	81	91	101
68	0	11	22	33	44	55	66	77	88	99	110
70	0	12	24	36	48	60	72	84	95	107	119



Input

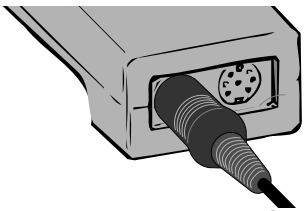
In order to enter the parameter, a pressure probe must be connected and the HOLD/MAX/MIN must be pressed and remain pressed when the instrument is switched on, untill "rho" is displayed.

Each of the flashing figures can be altered.
The v/T/%/p key changes the values,the HOLD/MAX/MIN key confirms the last adjustment and jumps the to the next figure.

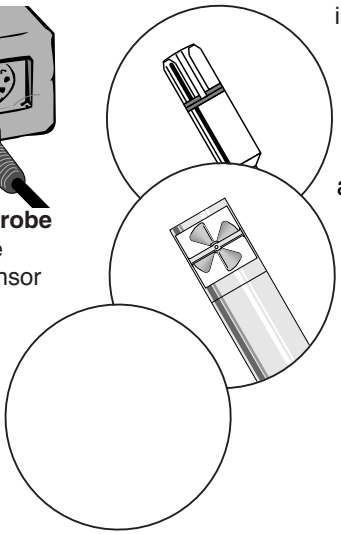
Display variations

Individual probes

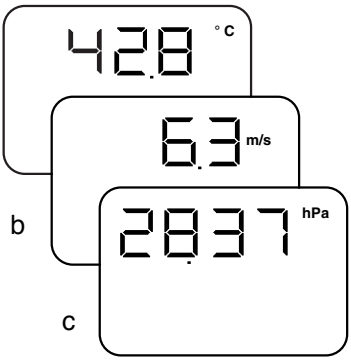
The following are connected:



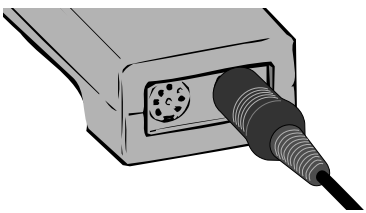
a. a **temperature probe**
or b. a **velocity probe** without temp. sensor e. g. 0635.9443
or c. **pressure probe**



The measured values appear in the top line of the display

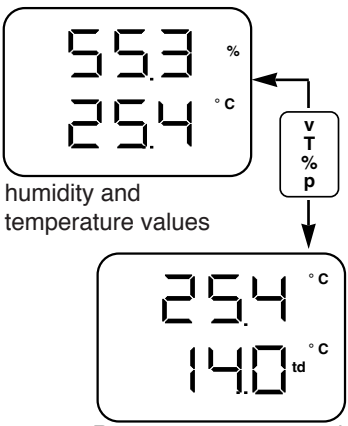


The following is connected:



a **combined humidity/ temperature probe**

The measured values are shown in 2 different displays:



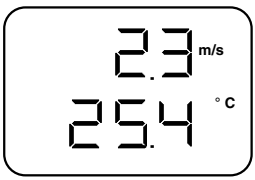
humidity and temperature values

Repeat temperature value and dew point temperature (or. absolute humidity in g/m³)

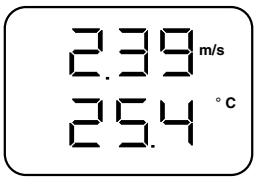
The following are connected:

The measured values appear in the display

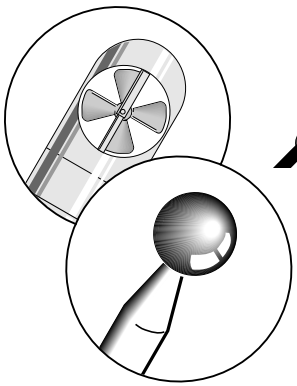
a.

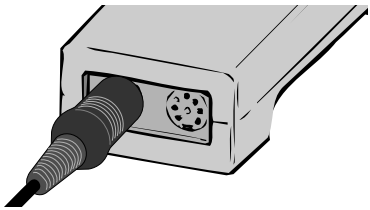


b.



Velocity and temperature values

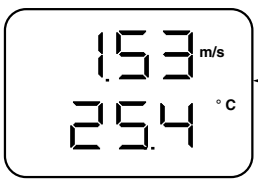




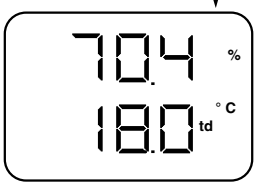
a combined velocity/ temperature probe with
a. vane probe
or b. thermal velocity probe

The following is connected:

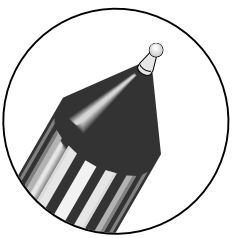
The measured values are shown 2 different displays:

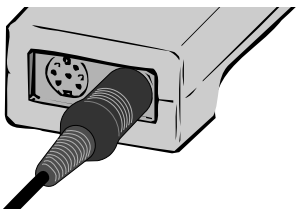


Velocity and temperature value



Humidity value
Dew point temperature
(or. absolute humidity in g/m³)



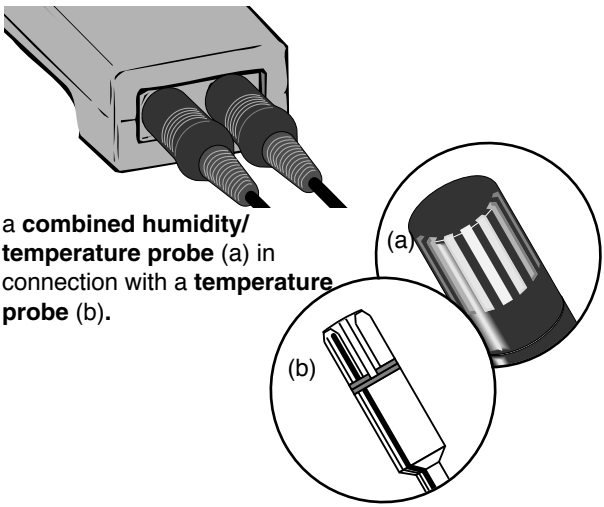


a 3 function probe

Display variations

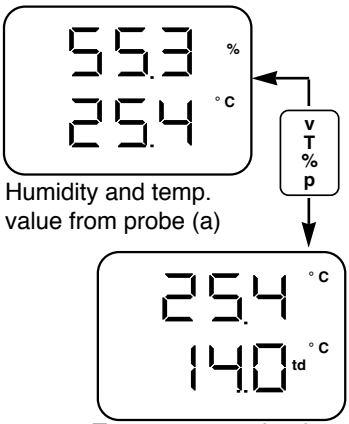
Connection variations

The following are connected:



a **combined humidity/ temperature probe** (a) in connection with a **temperature probe** (b)**.**

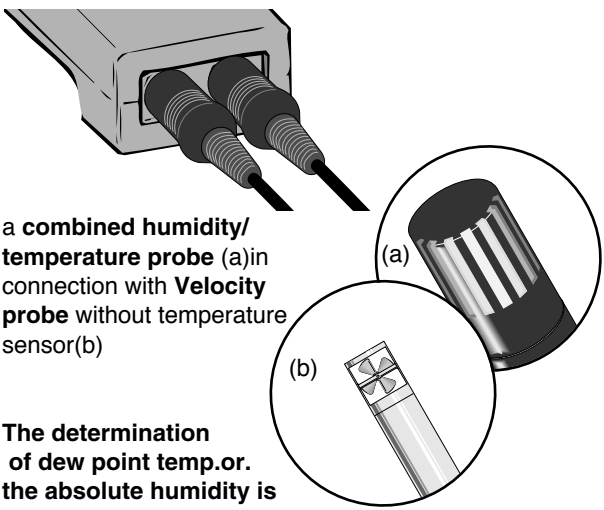
The measured values are shown in 2 displays:



Humidity and temp. value from probe (a)

Temperature value from probe (b)and dew point or. absolute content in g/m³ from probe (a)

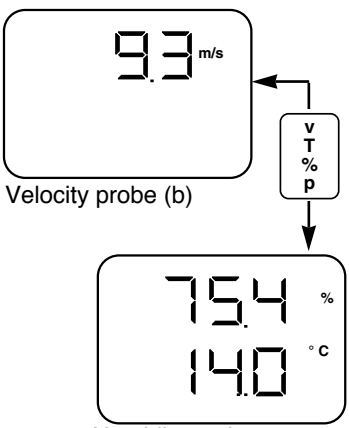
The following are connected:



a **combined humidity/ temperature probe** (a)in connection with **Velocity probe** without temperature sensor(b)

The determination of dew point temp.or. the absolute humidity is not applicable with this combination.

The measured values are shown in 2 different displays:

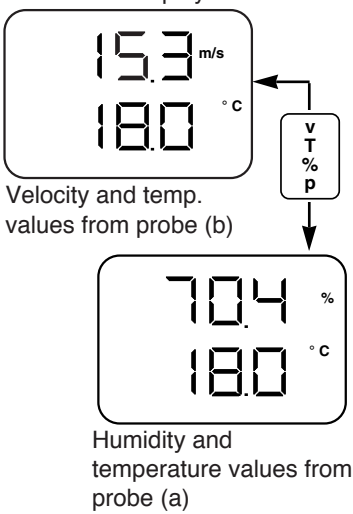


Velocity probe (b)

Humidity and temperature value(a).

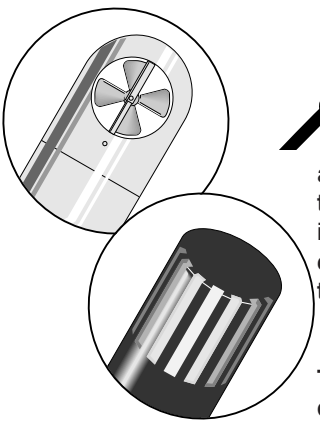
The following are connected:

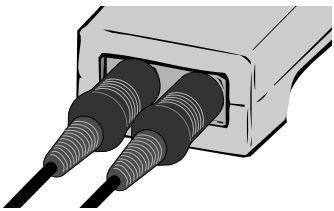
The measured values are shown on 2 displays:



Velocity and temp. values from probe (b)

Humidity and temperature values from probe (a)



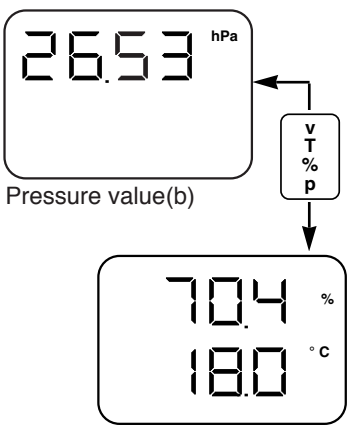


a **combined humidity/ temperature probe** (a) in connection with a **combined velocity/ temperature probe** (b)

The determination of the dew point temperature or absolute humidity is not applicable with this combination.

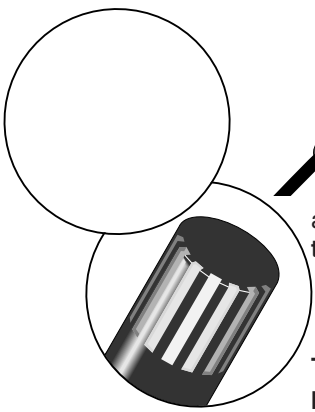
The following are connected:

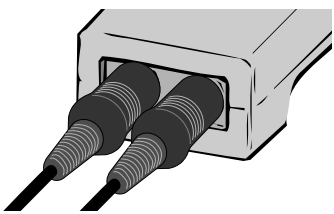
The measured values are shown in 2 displays:



Pressure value(b)

Humidity and temperature value (a)





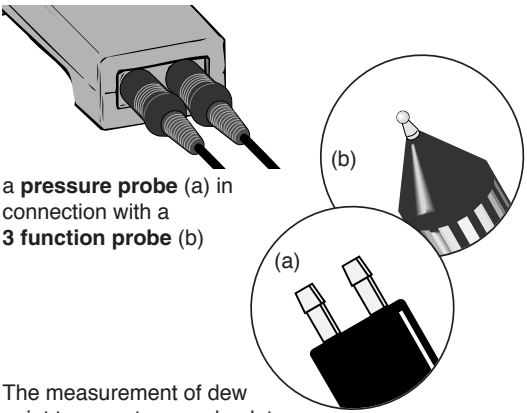
a **combined humidity/ temperature probe**(a) in connection with a **pressure probe**(b)

The determination of dew point temperature or absolute humidity is not applicable with this combination.

Display variations

Connection combinations

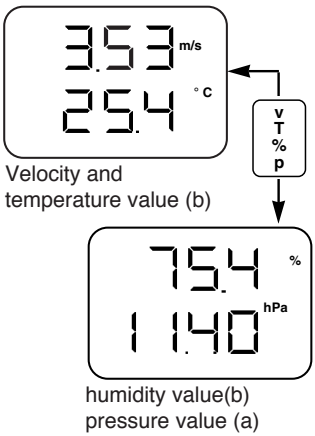
The following can be connected:



a **pressure probe** (a) in connection with a **3 function probe** (b)

The measurement of dew point temperature or absolute humidity is not applicable with this combination.

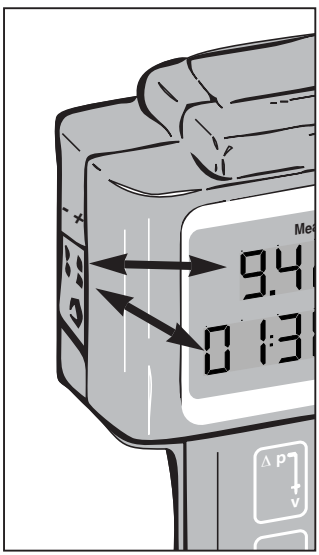
The measured values are shown in 2 different displays:



Velocity and temperature value (b)

humidity value(b)
pressure value (a)

testo 452 has two parallel analogue outputs. Depending on the probes plugged-in, different signals are given out at the analogue outputs. The value of the top display line is always the output from the top analogue output.



In order to connect the analogue output, please use the connecting lead 0409.0084 listed in the ordering data.

Output via:

Miniature sockets for
banana plugs Ø 2 mm.

Output signals:

Temperature

Temperature probe	1mV/ ° C (0.5 mV/°F)
Combined probe	10 mV/ ° C (5 mV/°F)
Exception:	
type 0635.6045	2 mV/ ° C (2 mV/°F)
Humidity	10mV/%RH
	0.5 mV/g/m³

Velocity

Vane probe	10 mV/ m/s (0.1 mV/fpm)
Thermal probe	50 mV/ m/s (0.2 mV/fpm)
Pressure	10 mV/hPa

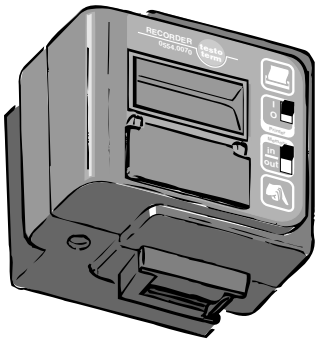
Load:

> 2kΩ

Observe correct polarization when connecting the analogue outputs!

Logger connection

for storing and printing measured values



testo 452 has an interface for plugging in a logger for storing and printing meas. values. A detailed instruction manual is supplied with the logger. Short instructions for use are given in the following.

The logger is simply plugged into the measuring instrument thus becoming a complete system for the control of air conditioning processes. The connection is mechanically locked. Press the key on the logger to detach.

The connection between the measuring instrument and logger is not protected against static discharge.When using meas. instrument without logger, protect the connection with the cover.

When using the mains unit remove the batteries from all connected instruments. Floating battery operation is possible with rech. battery.

As electricity is required for data buffering and rech. batteries also discharge themselves, please note the battery voltage when switching on the instrument again ! If the battery voltage of the logger is less than 4.0 V , the meas. values, for example, can no longer be printed. At 2.8 V the memory is cleared.

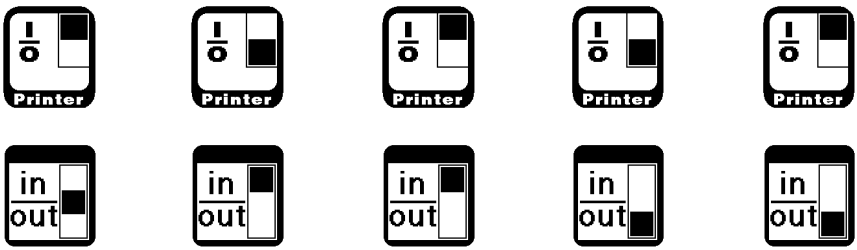
In order to prevent data going missing, we recommend the use of a mains unit together with rech. batteries.

When the batteries are changed, the memory is cleared !

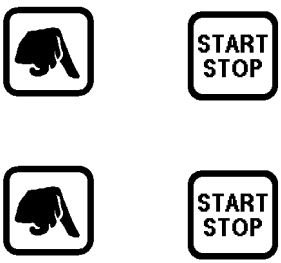
Connect the logger

Turn on meas. instrument

Print meas. values	Store meas. values	Store and print meas. values	Read out meas. values on the display	Read out meas. values on the display and print simultaneously



manual or automatic



The logger stores/prints the actual meas. values whenever a key is pressed.

The logger stores/prints the measured values according to the cycle time adjusted in the interval between the start/stop instructions.

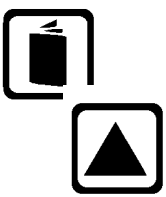
Programming printing/storing cycle
For the adjustment of the cycle time (intervals at which the logger shall store or print automatically), the memory key has to be in position "in".

The cycle time is freely selectable in the range between 1 sec. and 59 min 59 sec.

Programming pitch/start no.
The logger allocates a serial measured value number to each storage. During evaluation of the measured values, the distance between the measured value numbers to be stored can be determined (e. g. each 5th measured value is to be printed out → Step:"5").

Moreover, the stored value to be read out first can be determined (Start no.). The memory switch has to be on "out" and the printing mechanism must be switched off.

The individual numbers can be called by the turn-over key and changed by the arrow key. Confirm the adjustment by pressing the turn-over key.



Changing the paper
Open the paper housing on the top of the logger.Snip off the remaining paper from the roll and remove it using the paper feed!Cut new paper roll on the bias and insert the paper roll (thermo-printing paper!Pay attention to correct insertion) and insert using the paper feed (printer button on “l”).

There is protective cover on top of the printing mechanism, which can be removed. Open this cover occasionally in order to remove paper remainders.

When a combined velocity/temperature probe is connected, 120 sets of measured data fit on a roll of paper, i.e. 120 print-outs (date, time, no. of meas. value, flow value and temperature value) can be stored.

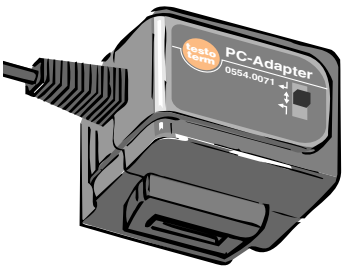
Clear the memory
On the lefthand side of the housing, there is a small slot. Behind this slot a small button is located, which can be operated with a pointed object. As an acknowledgement that the memory is clear, a sign is indicated in the display. Date and time are maintained.

Power supply

- battery/rech. battery operation (4 x 1,5/1,24 V micro) or
- operation via mains unit 0554.0088 via meas. instrument (as printing mechanism is not powered by the mains unit)

PC Adapter

Computer connection
for transferring measured data
to a Personal Computer



A detailed instruction manual is supplied with the PC Adapter, thus only short instructions are given in the following.

Simply plug in the PC Adapter for connection to the measuring instrument or the logger. The connection is mechanically locked. Press the key on the right-hand side of the PC Adapter (or logger) to detach.

Depending on the mode of operation, the switch on the PC Adapter has to be put into the corresponding position:

PC Adapter and logger

Measured values from the logger - when not connected to the measuring instrument - can only be read out when the logger is supplied by the mains unit (part no. 0554.0088).

PC Adapter and meas. instrument

The measured values are transferred directly to the PC.

PC Adapter, meas. instrument and logger

The meas. instrument communicates with the logger - the PC Adapter is only plugged in (has no function).

Installation of Software

- prepare a working copy
- adjust serial interface at PC
- start the programme by the entry:
  pc_adapt<Enter>

If you have a monochromic or a LCD screen (e. g. Laptops) call the programme as follows:

pc_adapt /2 <Enter>

A monochromic representation is thus obtained.

Proceed according to the information given by the dialogue instructions (bottom corner of screen).

A software PC Adapter - version 1.4 - is essential for communication between the measuring instrument testo 452 and the PC Adapter.

Ordering data

Measuring instrument,velocity probes

Description	Part no.
testo 452 incl. 9V block battery IEC 6 LR 61	**0560.4520**
Logger incl. 4 x 1.5 V micro batteries and 1 (thermo-) printing paper roll	**0554.0070**
PC Adapter for AT or compatible computer, incl. Software, XT connector, manual	**0554.0071**

Description velocity probes Vanes	Meas. range (max. tolerance m/s(fpm))	Part no.
Vane probe, Ø 12 mm) (connecting element necessary),	**0.6 to 20 m/s(120 to+4000 fpm)** (±2.5 % of final value)	**0635.9443**
Vane probe for integrated velocity measurements at a cross-section of Ø 60 mm Field of application:-20 to 60 °C (0 to +140° F)	**0.25 to +20.0 m/s (60 to 4000 fpm)** (±0.3 m/s/ 60 fpm)	**0635.9449**
Comb. vane/temperature probe, **Ø 25 mm**(connecting element necessary)	**0.4 to 40 m/s (80 to 8000 fpm)** (± 1% of final value) **-30 to 140 °C(-20 to +280 ° F)**	**0635.9640**
Comb. vane/temperature probe, **Ø 16 mm**(connecting element necessary) -30 to +140 °C (-20to +280 ° F)	**0.4 to 60 m/s (80 to +9999 fpm)** (± 0.4 up to 40 m/s) (± 80 fpm up to 8000 fpm)	**0635.9540**
Comb. vane/temperature probe, **Ø 25 mm**for long-term meas. up to +350 ° C (+660° F) (stainless steel)	**0.4 to 20 m/s (80 to 4000 fpm)** (± 2.5 % of f. v.) -40 to +350 °C (-40 to+660° F)	**0635.6045**

Connection elements for vane probes	
Connecting lead for vane probe (connectable), 1.5 m long	**0409.0045**
Telescope (extendable) for vane probes (connectable)	**0430.0945**
Handle for vane probes (connectable)	**0430.3545**
Swan neck (flexible connection between vane probe and connecting part)	**0430.0001**
Extension lead for vane probes (connectable), 1.5 m long	**0409.0005**

Description velocity probes Thermal probes	Meas. range (max. tolerance m/s)	Part no.
Thermal velocity probe (Ø 4 mm) for measurements in low velocity ranges	0 to 10.00 m/s (0 to 2000 fpm) -20.0 to +70.0 °C (-4 to + 160 °F)	**0635.1549**
Thermal velocity probe (Ø 6 mm) with telescope (max.length 760 mm) for measurements in low velocity ranges	0 to 10.00 m/s (0 to 2000 fpm) -20.0 to +70.0 °C (-4 to + 160 °F)	**0635.1049**
Very quick thermal probe with telescope for measurements in low velocity ranges	0 to 10.00 m/s (0 to 2000 fpm) 0 to 50.0 ° C (+32 to +120 °F)	**0635.1042**

Description pressure probe (Accessories)	Meas. range	Part no.
Pressure probe for velocity measurements with Pitot tube	0 to ±100 hPa	**0635.1545**
Pitot tube (brass chromium plated), $T_{max.}$ = +350 ° C (+660 °F) Ø 7 mm, L = 500 mm Ø 7 mm. L = 350 mm		**0635.2045** **0635.2145**
Pitot tube (stainless steel), $T_{max.}$ = +500 ° C (+930 °F) Ø 4mm, L = 300 mm		**0635.2245**
Silicone hose for connecting the Pitot tube to the pressure probe		**0554.0440**
Holding set for pressure probe		**0554.0431**

Description humidity probe, 3 function probe	Meas. range	Part no.
Combined humidity/temperature probe	0 to 100 %RH -20.0 to +70.0 ° C (-4 to + 160 °F)	**0636.9760**
3 function probe	0 to 100 %RH 0 to 10.00 m/s (0 to 2000 fpm) -20.0 to +70.0 ° C (-4 to + 160 °F)	**0636.1045**
Spare sensor %RH		**0420.0019**
Sintered cap of polyethylene for humidity probes		**0554.0643**
Sintered cap of stainless steel for humidity probes		**0554.0640**
Control and calibration set for humidity probes		**0554.0648**
Control and storage humidity for humidity probes (33 %RH)		**0554.0653**
Adapter for connecting 3 function probe to humidity pots		**0554.0661**

Ordering data/warranty

Description Temperature probe for	Meas. range	Part no.
Surface meas. (very fast) t_{99}= 3 sec	**-200 to 500 ° C(390 to 930 °F)**	**0600.0194**[2)]
Surface meas. (rugged)	**-200 to 500 ° C(390 to 930 °F)**	**0600.9993**[1)]
with widened meas. tip for flat surfaces, t_{99}= 25 sec		
Meas. in liquids + gases, t_{99}= 1 sec	**-200 to +600 ° C(390 to 1110 °F)**	**0600.0493**[1)]
Meas. in gas. mediums, t_{99}= 9 sec	**-200 to +600 ° C(390 to 1110 °F)**	**0600.9794**[1)]
Adapter for connection to **thermocouples** type K		**0600.1693**[1)]

[1)] DIN IEC 584, part 2, class 1
[2)] DIN IEC 584, part 2, class 2

Accessories	Part no.
Silicone heat paste (14 g) for surface measurements	**0554.0004**
9 V **rech. battery** for meas. insturment (instead of battery)	**0515.0025**
Recharger for external recharge of rech. batt.	**0554.0025**
Set of rech. batteries (4 x 1.24 V micro) **for logger**	**0515.0088**
Mains unit for mains operation and for charging the rech. batteries (instrument and logger)	**0554.0088**
1 pack of **printing paper** (5 pcs) f. logger	**0554.0149**
Connecting lead for measuring sensor (length 5 m) (not suitable for thermal velocity probes0636.6045/0635.1545)	**0409.0063**
Holding set for meas. probes (handle-Ø max. 15 mm)	**0554.0430**
Drill for sampling holes (Ø 25.4 mm)	**0554.0099**
Covering stopper (Package unit = 50 pcs) Ø 25.4 mm	**0554.4001**
Connecting lead for 1 x **analogue output**	**0409.0084**
Carrying case (leather) for meas. instrument	**0516.0090**
Carrying case (leather) for meas. instrument and logger	**0516.0091**
Service case (plastic) for meas. instrument and probes	**0516.0106**
Service case (plastic) for meas. instrument, logger, PC Adapter and probes	**0516.0145**
Service case (aluminium) for meas. instrument, logger, PC Adapter and probes	**0516.0149**

Warranty:
Meas. instrument: 24 months
Probes:12 months
Logger:12 months(excluding printer)
PC Adapter: 12 months
- except for improper handling -