

# Meteorological Thermometers and Digital Systems

For meteorology, geology, climate measurements, chemical analytics as well as industry and research applications

## Catalogue 5



Ludwig Schneider 

High-precision measuring instruments for temperature and density

# DKD calibration laboratory for temperature and density

Ludwig Schneider is one of the world's leading manufacturers of precision measuring instruments for temperature and density. Based on these experiences its subsidiary company Ludwig Schneider Messtechnik GmbH (LSM) offers calibration services for temperature measurements for more than 15 years.

Since 2005 LSM has been the first private-sector company in Germany with DKD accreditation for density measurements of hydrometers.

International customers of the chemical, pharmaceutical, mineral oil/refinery, food processing industries and oceanography are using the LSM calibration services.

## DKD accreditation

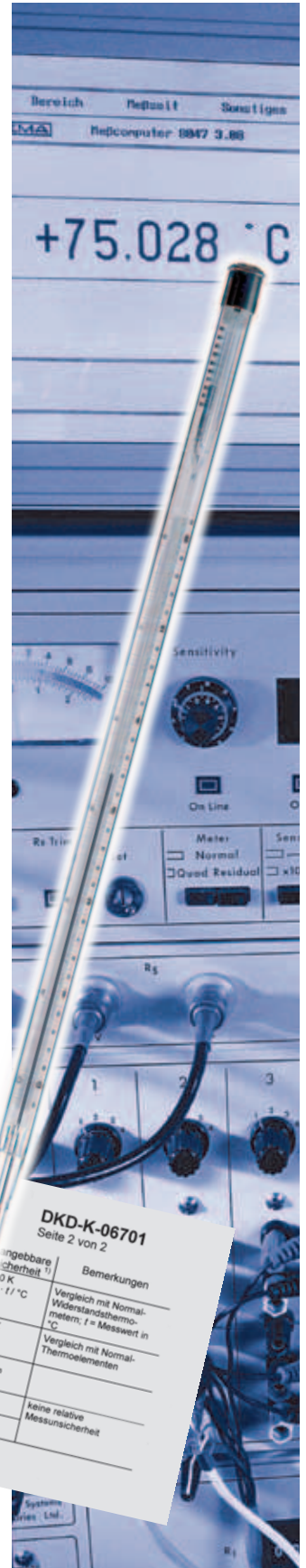
Ludwig Schneider Messtechnik is accredited under registration number DKD-K-06701 by the Accreditation Body „Deutscher Kalibrierdienst“ (DKD) and fully complies with the requirements of ISO/IEC 17025.

United under the International Laboratory Accreditation Cooperation (ILAC), 52 nations at present have contractually agreed to mutually accept the calibration results of the signatories' accredited calibration laboratories according to ISO/IEC 17025.



## Our range of services

- Fixed-point calibration of interpolation thermometers
- Comparative measurements of resistance thermometers, thermocouples, liquid-in-glass thermometers, temperature indicators, temperature block calibrators
- Adjustment of digital/analog measured data acquisition systems
- Calculation of specific constants on the basis of ITS-90 deviation functions, Van Dusen equations, polynomial functions
- Documentation of calibration results: DKD calibration certificates, manufacturers test certificates, conformity statements, compliance with QM codes and standards (DIN, ASTM, BS, IEC, etc.)



**Ludwig Schneider  
Messtechnik GmbH**

Postfach 1561 · 97865 Wertheim  
Am Eichamt 4 · 97877 Wertheim  
Tel.: +49-93 42-85 60-28  
Fax: +49-93 42-8 43 99  
Mail: info@ludwig-schneider.de  
www.ludwig-schneider.de

Anlage 04 zur Akkreditierungsurkunde des Kalibrierlaboratoriums

Messgröße / Kalibriergegenstand	Messbereich / Messspanne	Messbedingungen / Verfahren	k:	M:
Temperatur-Blockkalibratoren	-30 °C bis 133 °C > 133 °C bis 660 °C			
Dichte-Ärkonometer und abgeleitete Instrumente	0 °C bis 660 °C > 660 °C bis 1000 °C > 1000 °C bis 1300 °C			
Gehalt-Alkoholometer	450 kg/m <sup>3</sup> bis 2000 kg/m <sup>3</sup>	Auftriebwägung		
Gehalt-Saccharimeter	0 % bis 100 % 0 % bis 70 %	Auftriebwägung Auftriebwägung		

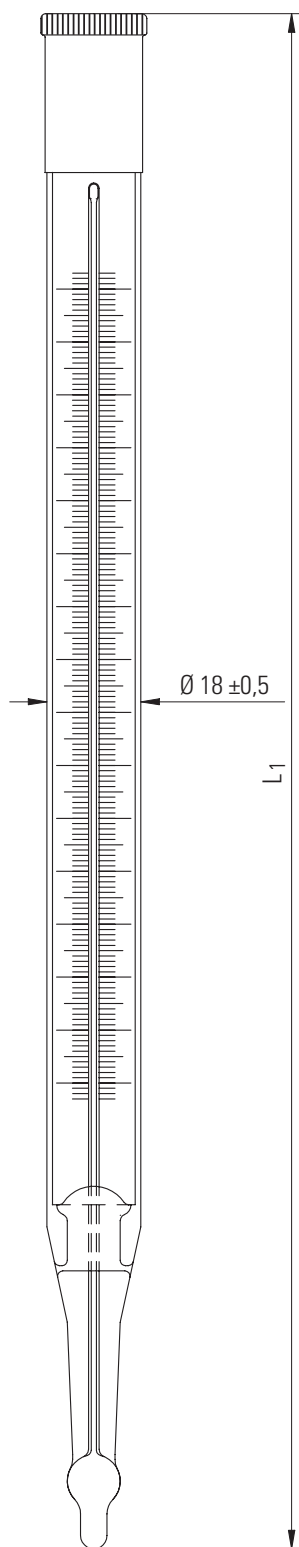
DKD-K-06701  
Seite 2 von 2

angegebene Sicherheit (%)	Bemerkungen
± 0,1 °C	Vergleich mit Normal-Widerstandsthermometern; t = Messwert in °C
± 0,5 K ± 0,5 K ± 0,5 K	Vergleich mit Normal-Thermoelementen
± 0,1 kg/m <sup>3</sup>	
± 0,18 %	keine relative Messunsicherheit
± 0,12 %	

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# Maximum thermometers acc. to DIN 58654



## Meteorological precision maximum thermometers

acc. to DIN 58654

Capillary: blue reflecting, prismatic

Filling: Hg

Immersion: total

With metal cap

Suitable for official certification

Maximum thermometers are determined for meteorological measurements with subsequent reading of maximum temperatures. They are equipped with a capillary constriction (the mercury column cannot flow back by itself, even after cooling). In advance of the next measurement the column has to be shaken back to room temperature (similar to fever thermometers).

Measuring range	Scale	Total length $L_1$	Ref. No.
°C	°C	mm	
-30 +50	0.5	300	1162006
-20 +60	0.5	300	1162007
-30 +50	0.2	360	1162010
-20 +60	0.2	360	1162011

Further measuring ranges on request.

## Accessory:

Stand for both, a maximum and a minimum thermometer consisting of:

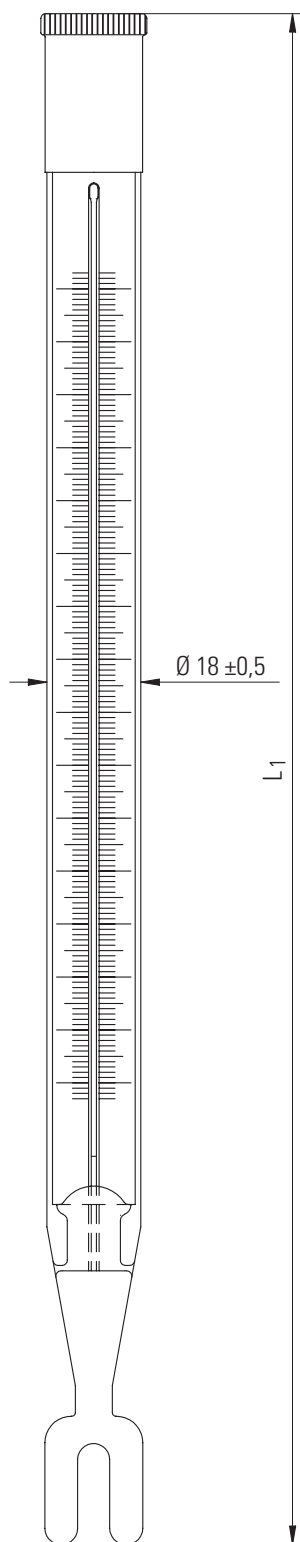
tripod, rod and bracket for two thermometers

**Ref.-No: 205601**

## Additional Order No.

- ...../01 Officially calibrated without certificate
- ...../02 Officially calibr. with cert.
- ...../03 With work certificate
- ...../04 With DKD calibration cert.

# Minimum thermometers acc. to DIN 58653



## Meteorological precision minimum thermometers

acc. to DIN 58653

Capillary: colourless, round

Filling: alcohol, red

Immersion: total

With blue index marker

With metal cap

Suitable for official certification

Minimum thermometers are determined for meteorological measurements with subsequent reading of minimum temperatures and have to be operated in a horizontal position. In case of sinking temperature the index marker below the wetting filling will be pulled downward and remains in this position. In advance of the next measurement the upper part of the thermometer must be tilted downward to ensure that the index marker returns to the bottom of the filling.

Measuring range	Scale	Total length $L_1$	Ref. No.
°C	°C	mm	
-40 +40	0.5	300	1162109
-30 +50	0.5	300	1162110
-40 +40	0.2	360	1162114
-30 +50	0.2	360	1162115

Further measuring ranges on request.

### Accessory:

Stand for both, a maximum and a minimum thermometer consisting of:

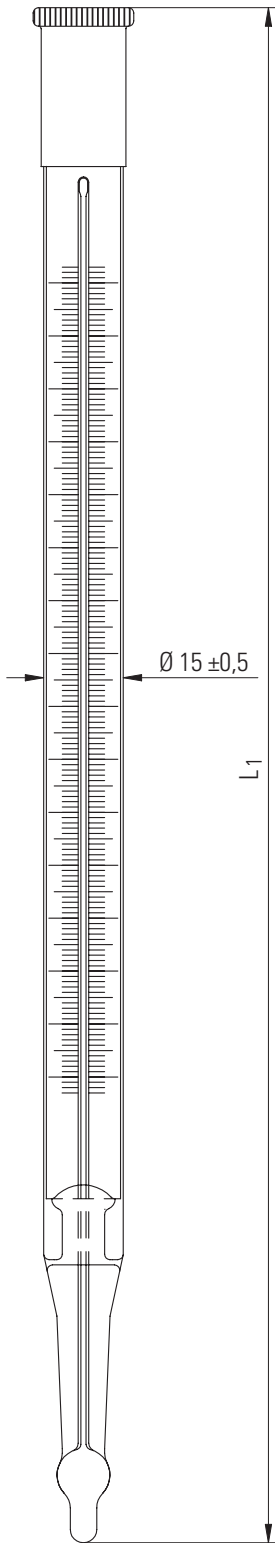
tripod, rod and bracket for two thermometers

**Ref.-No: 205601**

### Additional Order No.

- ...../01 Officially calibrated without certificate
- ...../02 Officially calibr. with cert.
- ...../03 With work certificate
- ...../04 With DKD calibration cert.

# Psychrometer thermometers acc. to August/DIN 58660



## Precision psychrometer thermometer acc. to August (DIN 58660)

Capillary: blue reflecting, prismatic  
Filling: Hg  
Immersion: total  
With metal cap  
Suitable for official certification

Measuring range	Scale	Total length $L_1$	Ref. No.
°C	°C	mm	
-35 +40	0.2	370	1162202

# Station psychrometer thermometers

## Station psychrometer thermometers

Capillary: blue reflecting, prismatic  
Filling: Hg  
Immersion: total  
With metal cap  
Suitable for official certification

Measuring range	Scale	Total length $L_1$	Ref. No.
°C	°C	mm	
-30 +50	0.5	320	1162804
-20 +60	0.5	320	1162805
-30 +50	0.2	360	1162809
-20 +60	0.2	360	1162810

Further measuring ranges on request.

### Available accessories:

Stand for two psychrometer thermometers consisting of:  
tripod, rod and bracket for two thermometers  
and lower support with moisture wick and water deposit

**Ref. No. : 205501**

### Spare moisture wick

Dimensions: W 18 x L 1,000 mm

**Ref. No. : 8000060**

### Additional Order No.

...../01 Officially calibrated without  
certificate  
...../02 Officially calibr. with cert.  
...../03 With work certificate  
...../04 With DKD calibration cert.

# Aspiration psychrometers acc. to Assmann/DIN 58661

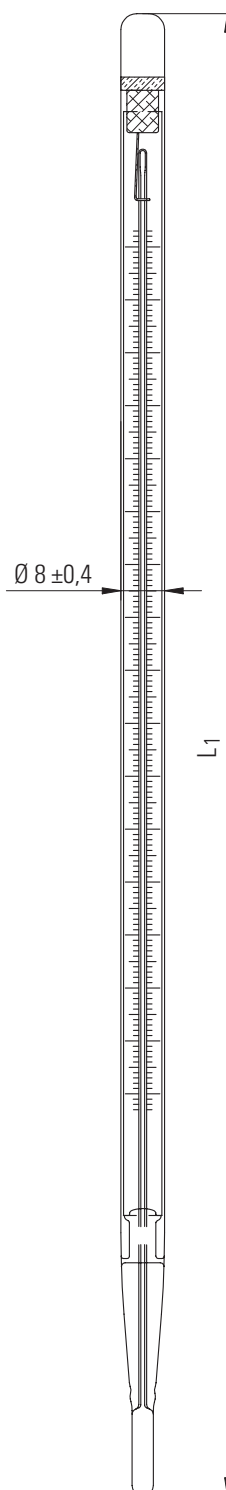
## Precision aspiration psychrometer acc. to Assmann (DIN 50012)

Complete ready to use device with spring aspirator and two thermometers acc. to DIN 58661  
 Measuring range: -35...+45 °C (scale: 0.2 °C)  
 Spring aspirator: 2 m/s airspeed  
 Moistening: water deposit for one thermometer  
 Dimensions: approx. H 420 x 90 mm dia.

**Ref. No.: 7601031**

### Delivery contents:

Spare moisture wick,  
 graphical evaluation chart,  
 mounting screw,  
 instrument case



## Substitute thermometers

acc. to DIN 58661  
 Capillary: blue reflecting,  
 prismatic  
 Filling: Hg  
 Immersion: total  
 Suitable for official certification

Measur. range °C	Scale °C	Total length mm	Ref. No. $L_1$
-35 +40	0.2	280	1162402
-20 +50	0.2	280	1162403
-10 +60	0.2	280	1162404

### Additional Order No.

- ...../01 Officially calibrated without certificate
- ...../02 Officially calibr. with cert.
- ...../03 With work certificate
- ...../04 With DKD calibration cert.

# Precision swinging psychrometers

## Precision swinging psychrometer

Metal casing with hinged handle  
 Complete ready to use device  
 with two thermometers acc. to DIN 58661  
 Measuring range: -35...+45 °C (scale: 0.2 °C)

**Ref. No.: 1162601**

## Delivery contents:

Moisturing tube,  
 spare moisture wick,  
 graphical evaluation chart



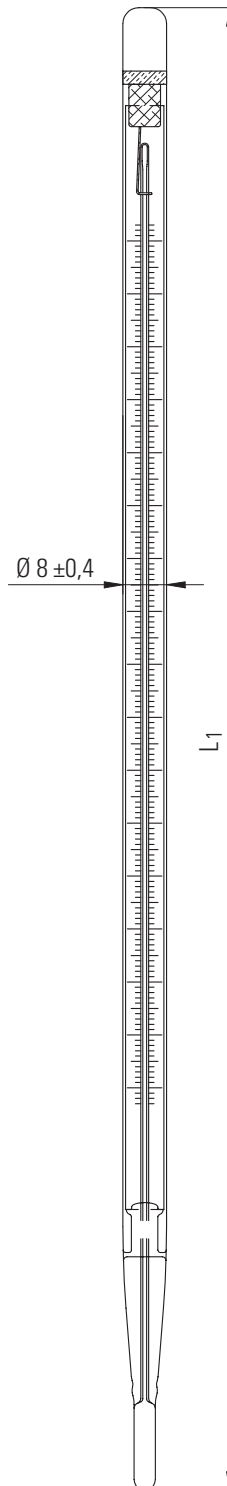
## Available Accessories:

Leather case for precision swinging psychrometer

**Ref. No.: 206801**

Spare graphical evaluation chart

**Ref. No.: 206901**



## Substitute thermometers

acc. to DIN 58661  
 Capillary: blue reflecting,  
 prismatic  
 Filling: Hg  
 Immersion: total  
 Suitable for official certification

Measur. range °C	Scale °C	Total length L <sub>1</sub> mm	Ref. No.
-35 +40	0.2	280	1162402
-20 +50	0.2	280	1162403
-10 +60	0.2	280	1162404

## Additional Order No.

- ...../01 Officially calibrated without certificate
- ...../02 Officially calibr. with cert.
- ...../03 With work certificate
- ...../04 With DKD calibration cert.



# Swinging psychrometers

## Swinging psychrometer

(basic version)

Casing: plastic, black

With evaluation slide bar and operating manual

Complete ready to use device with two thermometers

Measuring range: -5...+50 °C (scale: 0.5 °C)

With moisturing deposit and moisture wick

**Ref. No.: 1162603**

## Substitute thermometers

For swinging psychrometer  
(basic version)

Measuring range: -5...+ 50 °C

Scale: 0.5 °C

Filling: alcohol, red

Capillary: white, prismatic

Immersion: total

Total length: 123 mm

**Ref. No.: 2545204**



# Psychrometer for plants

## Psychrometer for plants

Complete ready to use device with two thermometers,

water deposit and graphical evaluation chart

Mounted on laquered wooden plate with suspension ring

Dimensions: H 250 x W 110 mm

Measuring range °C	Scale °C	Filling	Capillary	Ref. No.
-10 +60	0.5	Hg	colourless, prismatic	1172001
0 +50	0.5	red/blue	colourless, prismatic	1172002

## Spare thermometers

Scale: 0.5 °C

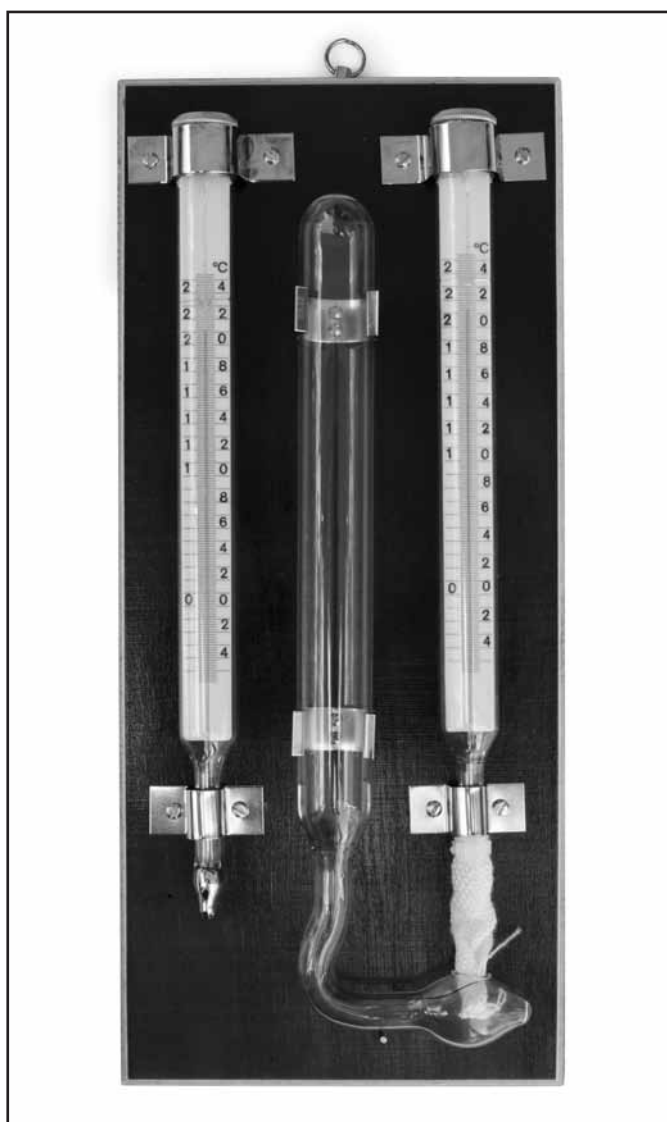
Immersion: total

Capillary: colourless, prismatic

Dimension: Total length  $L_1 = 195$ ,  
14-15 mm dia.

With metal cap

Measuring range °C	Filling	Ref. No.
-10 +60	Hg	8172401
0 +50	red	8172501
0 +50	blue	8172601



# Maximum and minimum thermometers, ordinary thermometer

**Maximum thermometers**  
 Stem type (6-7 mm dia.)  
 Scale: 0.5 °C  
 Filling: Hg  
 Immersion: total  
 Total length  $L_1$ : 325 mm  
 With flat bottom  
 For shaking  
 Suitable for official certification

Measuring range °C	Capillary	Ref. No.
-38 +50	white, round	1172203
-38 +50	blue prismatic	1172207

**Additional Order No.**  
 ...../01 Officially calibrated without certificate  
 ...../02 Officially calibr. with cert.  
 ...../03 With work certificate  
 ...../04 With DKD calibration cert.

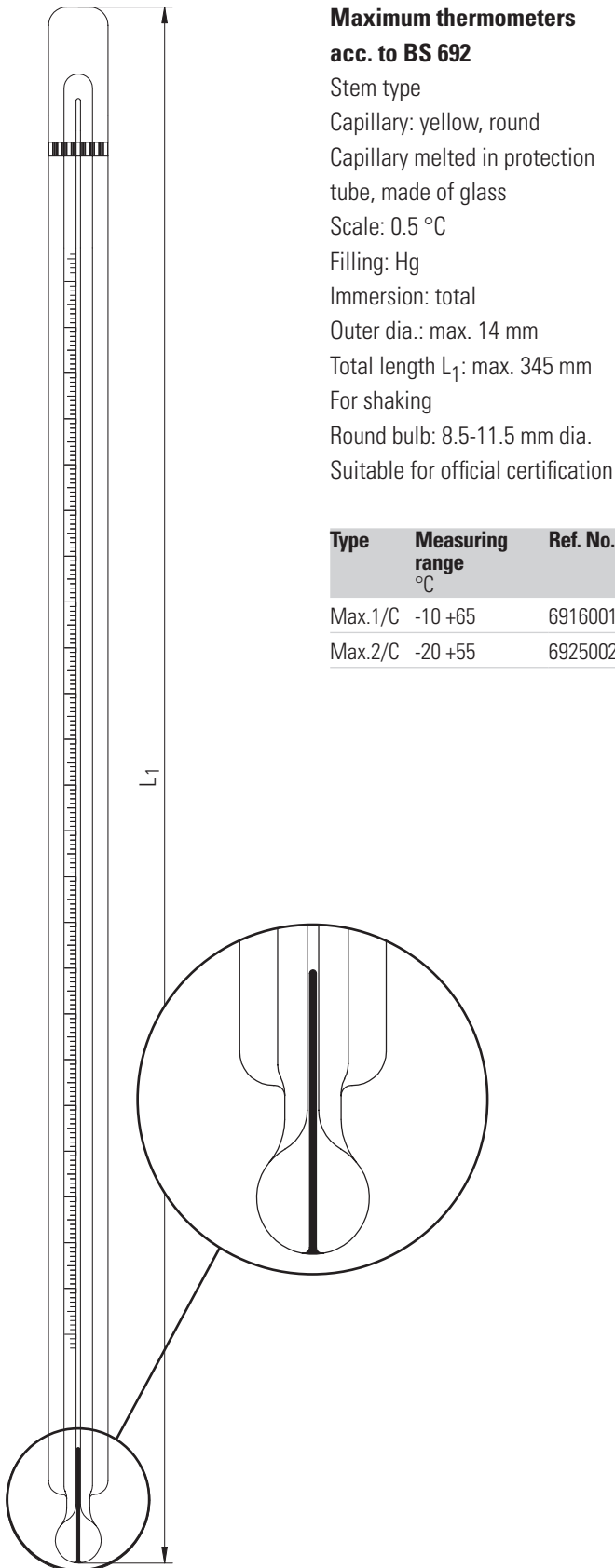
**Minimum thermometers**  
 Stem type (6-7 mm dia.)  
 Scale: 0.5 °C,  
 Filling: alcohol, red  
 Capillary: white, round  
 Immersion: total  
 Total length  $L_1$ : 325 mm  
 With flat bottom  
 Suitable for official certification

Measuring range °C	Ref. No.
-70 +45	1172301
-38 +40	1172304

**Ordinary thermometer**  
 Stem type (6-7 mm dia.)  
 Scale: 0.5 °C  
 Filling: Hg  
 Capillary: yellow, round  
 Immersion: total  
 Total length  $L_1$ : 300 mm  
 With flat bottom  
 Suitable for official certification

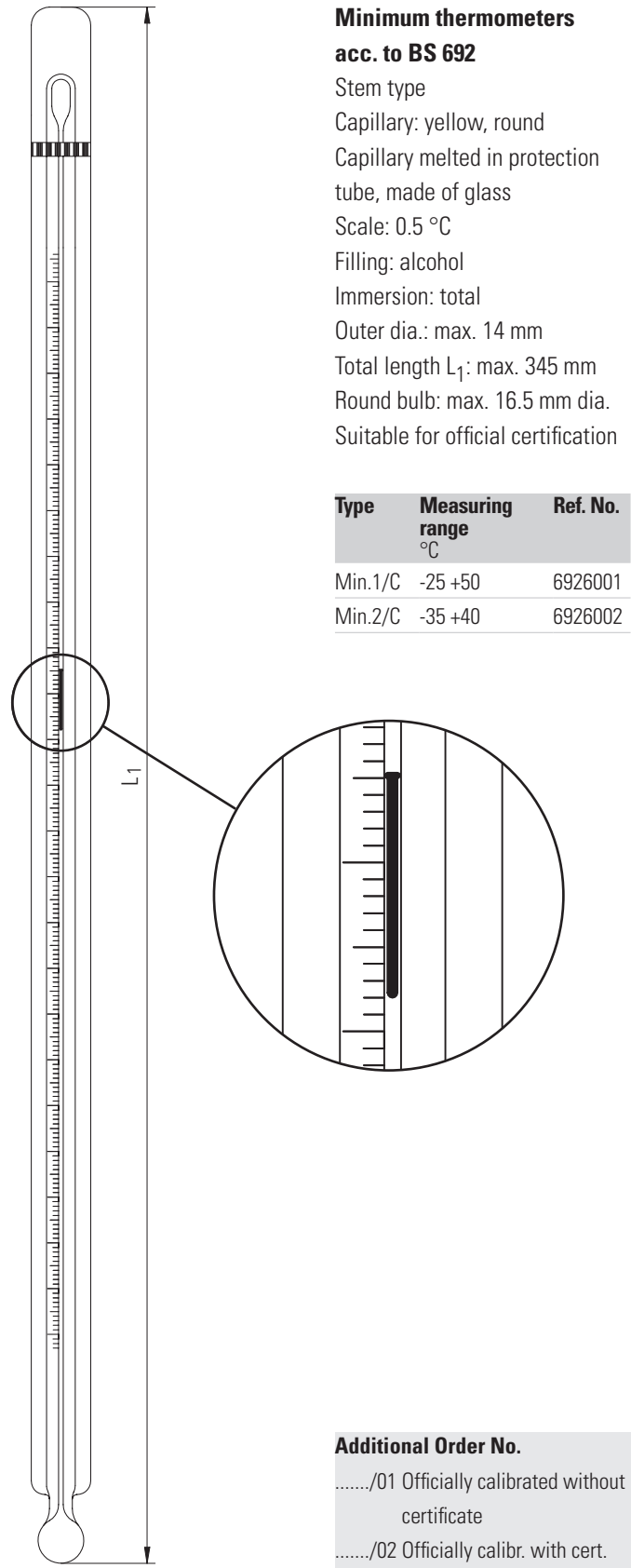
Measuring range °C	Ref. No.
-38 +45	1172310

# Meteorological thermometers acc. to BS 692



**Maximum thermometers  
acc. to BS 692**  
 Stem type  
 Capillary: yellow, round  
 Capillary melted in protection  
 tube, made of glass  
 Scale: 0.5 °C  
 Filling: Hg  
 Immersion: total  
 Outer dia.: max. 14 mm  
 Total length L<sub>1</sub>: max. 345 mm  
 For shaking  
 Round bulb: 8.5-11.5 mm dia.  
 Suitable for official certification

Type	Measuring range °C	Ref. No.
Max.1/C	-10 +65	6916001
Max.2/C	-20 +55	6925002

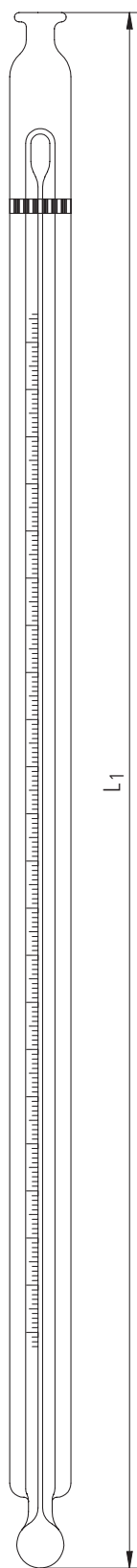


**Minimum thermometers  
acc. to BS 692**  
 Stem type  
 Capillary: yellow, round  
 Capillary melted in protection  
 tube, made of glass  
 Scale: 0.5 °C  
 Filling: alcohol  
 Immersion: total  
 Outer dia.: max. 14 mm  
 Total length L<sub>1</sub>: max. 345 mm  
 Round bulb: max. 16.5 mm dia.  
 Suitable for official certification

Type	Measuring range °C	Ref. No.
Min.1/C	-25 +50	6926001
Min.2/C	-35 +40	6926002

**Additional Order No.**  
 ...../01 Officially calibrated without  
 certificate  
 ...../02 Officially calibr. with cert.  
 ...../03 With work certificate  
 ...../04 With DKD calibration cert.

# Meteorological thermometers acc. to BS 692



## Ordinary thermometers

### acc. to BS 692

Stem type

Capillary: yellow, round

Capillary melted in protection tube, made of glass

Scale: 0.5 °C

Filling: Hg

Immersion: total

Outer dia.: max. 14 mm

Total length  $L_1$ : max. 330 mm

Round bulb: 8.5-11.5 mm dia.

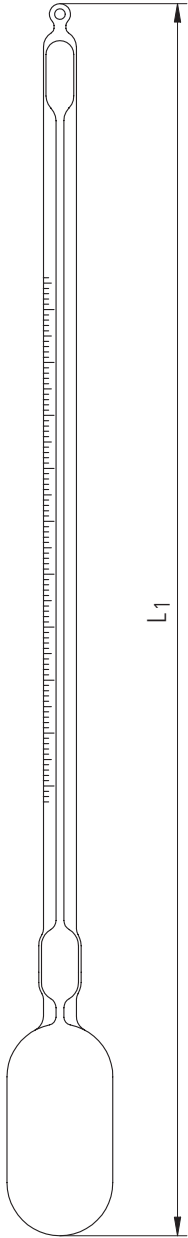
Suitable for official certification

Type	Measuring range °C	Ref. No.
Ord.1/C	-20 +55	6920001
Ord.2/C	-30 +45	6920002

### Additional Order No.

- ...../01 Officially calibrated without certificate
- ...../02 Officially calibr. with cert.
- ...../03 With work certificate
- ...../04 With DKD calibration cert.

# Kata thermometers acc. to Hill



## Kata thermometers acc. to Hill

Stem type

Capillary: white, round

Filling: alcohol, red

Ring marks at 35 °C and 38 °C

With test certificate

Type	Total length mm	Ref. No.
Bulb blank	240	1172401
Bulb silver-plated	240	1172402

These thermometers are indexed with two exact adjusted ring marks and in connection with various accessory devices they are used to measure the degree of heat exchange between bodies and their surrounding air by considering the air flow (acc. to DIN 1946).

# Globe thermometers



## Globe thermometers

Design acc. to DIN 16189

For room climate measurements

Casing: aluminium, brass coloured, H 200 x W 36 mm

With suspension ring

Globe: copper, black, matt, 150 mm dia.

Measuring range	Scale	Filling	Capillary	Ref. No.
°C	°C			
0 +60	1	blue	white prismatic	1669501
0 +100	1	blue	white prismatic	1669505

## Spare Capillary for globe thermometer

Measuring range	Scale	Filling	Capillary	Ref. No.
°C	°C			
0 +60	1	blue	white prismatic	1693258-111
0 +100	1	blue	white prismatic	1693308-111

## Spare globe for globe thermometer

Copper, black, matt, 150 mm dia.

**Ref. No.: 741401**

# Soil thermometers acc. to DIN 58655

## Precision soil thermometers acc. to DIN 58655

Angle: 150° (to the back)

Upper part: 18 mm dia., length 345 mm

Lower part: 9-10 mm dia. (from built-in length 30 mm with rim)

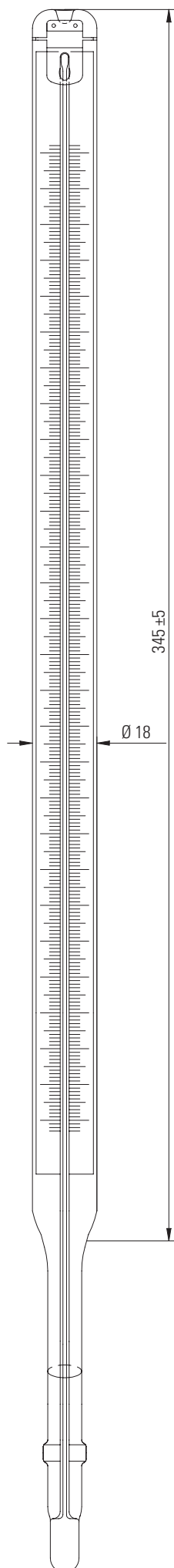
Capillary: yellow prismatic

Scale: 0.2 °C

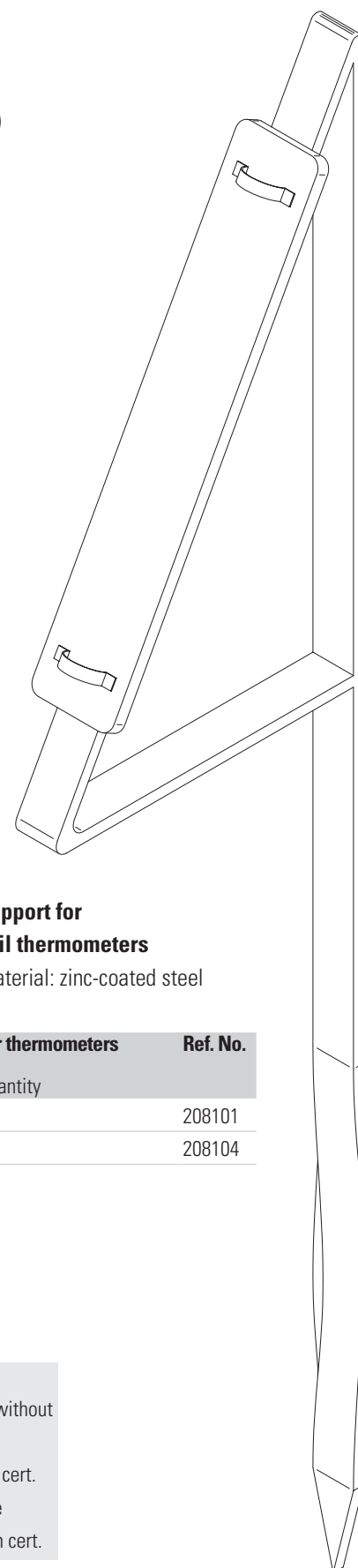
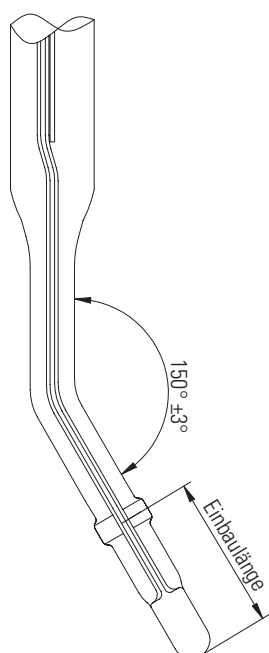
Filling: Hg

Immersion: total

Suitable for official certification



Measuring range °C	Built-in length mm	Ref. No.
-25 +60	0	1172500
-25 +60	20	1172501
-25 +60	30	1172502
-25 +60	60	1172503
-25 +60	110	1172504
-25 +60	160	1172505
-25 +60	210	1172506
-25 +60	310	1172507
-25 +60	410	1172508
-25 +60	500	1172509
-25 +60	1000	1172510
-10 +55	50	1172634
-10 +55	100	1172635
-10 +55	200	1172636
-10 +55	300	1172637



## Support for soil thermometers

Material: zinc-coated steel

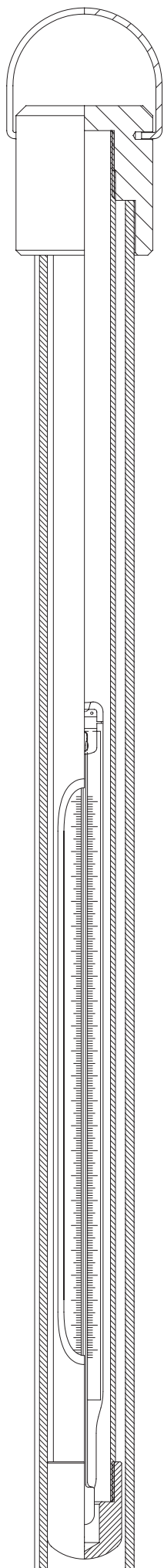
For thermometers	Ref. No.
Quantity	
1	208101
4	208104

## Additional Order No.

- ...../01 Officially calibrated without certificate
- ...../02 Officially calibr. with cert.
- ...../03 With work certificate
- ...../04 With DKD calibration cert.



# Soil depth thermometers acc. to DIN 58664



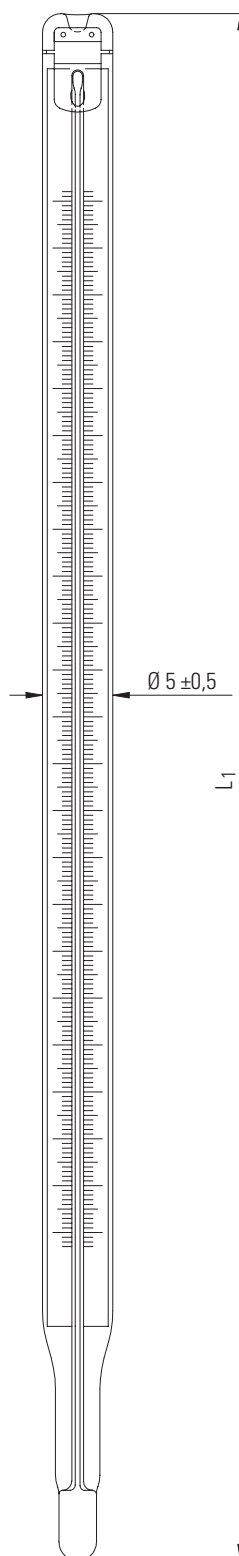
## Precision soil depth thermometers acc. to DIN 58664

For measurements in depths from 300 up to 1,000 mm  
 Measuring range: -10...+30 °C  
 Scale: 0.1 °C  
 Filling: Hg  
 Capillary: blue reflect. prismatic  
 Immersion: total  
 Complete set consisting of guide tube (plastic), protective cap and gasket  
 Suitable for official certification

Built-in length	Ref. No.
mm	
500	1172802
1000	1172803

## Additional Order No.

...../01 Officially calibrated without certificate  
 ...../02 Officially calibr. with cert.  
 ...../03 With work certificate  
 ...../04 With DKD calibration cert.



## Spare thermometer acc. to DIN 58664

Total length  $L_1$ : 330 mm

**Ref. No.: 1172801**

## Spare protection case

(without thermometer)

Built-in length	Ref. No.
mm	
500	208301
1000	208302

# Tank and dipping thermometers

## Precision tank and dipping thermometers

With integrated dipper for sampling and simultaneous temperature measurements



## Thermometer inserts (without protection case)

Immersion: total

Suitable for official certification

Measuring range °C	Scale °C	Filling	Capillary	Total length mm	Ref. No.
-10 +50	0.5	Hg	blue reflecting prismatic	245	1182901
-10 +50	0.5	red	yellow prismatic	245	1182904
-10 +100	0.5	Hg	blue reflecting prismatic	245	1182902
-10 +100	0.5	red	yellow prismatic	245	1182906
-10 +35	0.2	Hg	blue reflecting prismatic	245	1182907
-38 +50	0.2	Hg	blue reflecting prismatic	345	1182908
0 +50	0.2	Hg	blue reflecting prismatic	345	1182909

## Protection cases with rotary scale cover

Dipper: Length 75 mm, 32 mm dia.

With suspension ring

Material	Top part dimensions mm	For insert total length mm	Ref. No.
Brass	H 200 x B 20	245	1182205
Stainless steel	H 200 x B 20	245	1182206
Brass	H 300 x B 20	345	1182207

## Hanging Chain

Material	Ref. No./Meter
Brass, nickel-plated	306000
Stainless steel	306001

## Additional Order No.

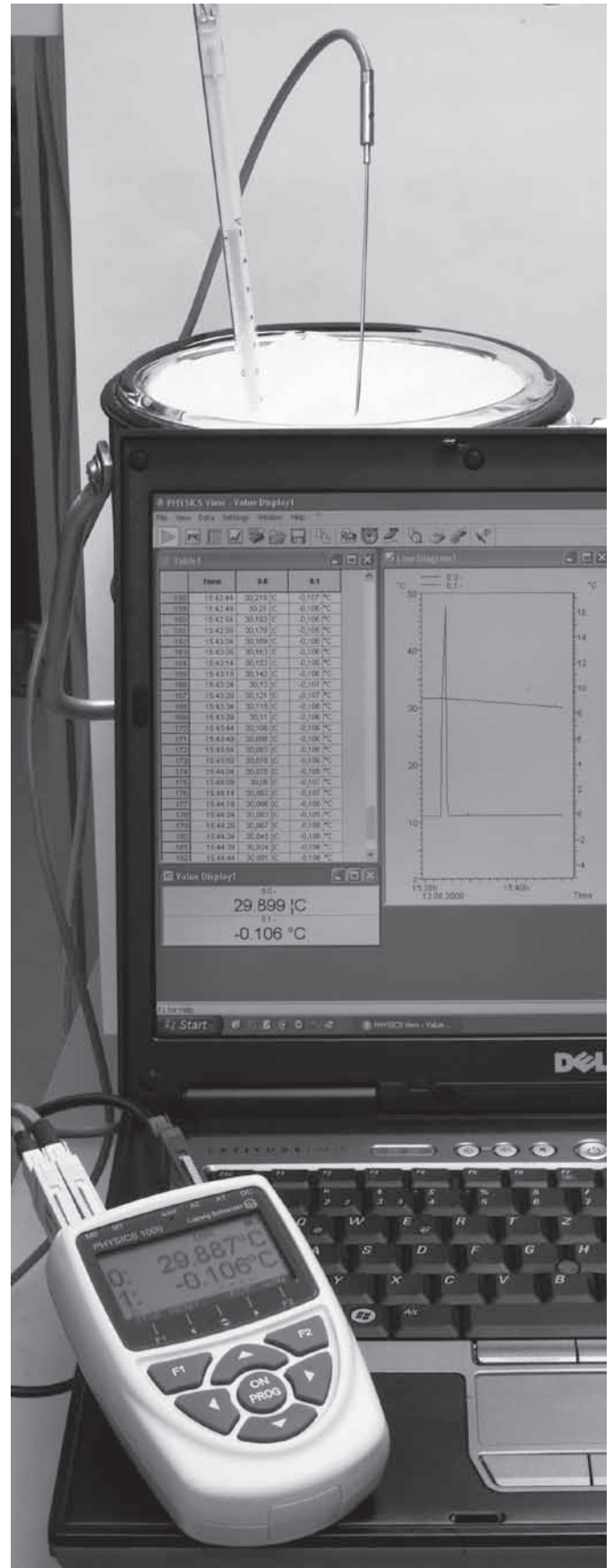
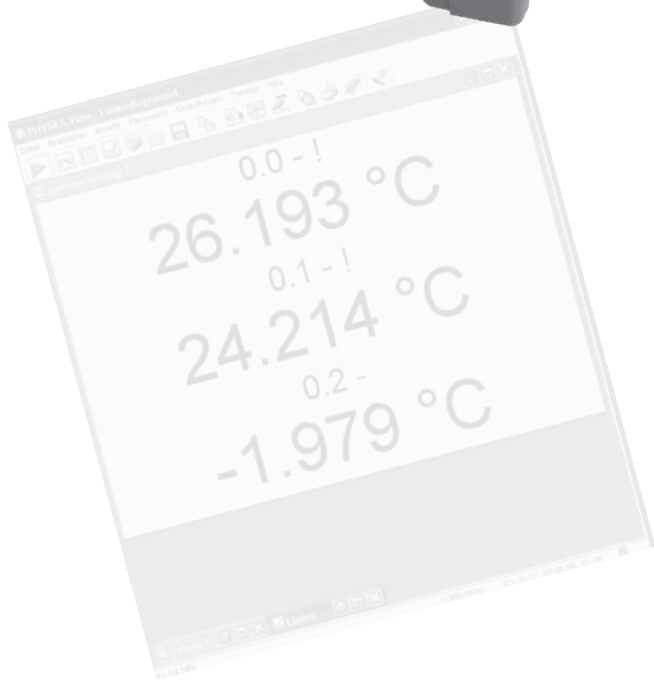
- ...../01 Officially calibrated without certificate
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- ...../03 With work certificate
- ...../04 With DKD calibration cert.

# PHYSICS digital measuring devices, sensors, software and accessories

Ludwig Schneider offers a comprehensive programme of high-precision digital measuring devices, which have a good reputation in meteorology, water analytics, chemistry, biotechnology, industry as well as in research and science.

If you have any queries regarding measuring technology with digital systems or if you need further informations about sensors which are not in this catalogue, please contact us.

The product range covers the ultra-high resolution device PHYSICS 1000 and the digital measuring devices PHYSICS 300 and PHYSICS 51, which are introduced on the next two pages as well as our software PHYSICS View and a wide programme of sensors and accessories.



# Highly variable precision digital measuring device PHYSICS 300

Complex digital measuring device with data logger function for precise measurements in meteorology, water analytics, chemistry, biotechnology, industry, research and development etc.

## Measurement units PHYSICS 300

*mbar, Pa, lux, °C, °F, Hz, kJ/kg, %H, ppm, mA, V, min, W/m<sup>2</sup>, mS, bar, g/Kg, m/s, pH*

With PHYSICS 300 a wide variety of measurement tasks and functions is achievable e.g. temperature (Pt100, thermocouples, NTC, infrared), air humidity, air flow, pressure, power, flow rate, electrical values etc. Up to 3 channels or 3 measuring points can be covered simultaneously and subject to type of probe 4 internal per function channels can be processed.

## Technical data PHYSICS 300

Measuring input:	3 input channels for some 65 measuring units
Galvanic isolation:	Semiconductor relais (50 V)
Kanäle:	4 channels/plugs for dual probes and function channels, 4 internal channels (e.g. balance/channel)
AD converter:	Delta-Sigma 16 bit, 2.5 or 10 M/s
Probe voltage:	Battery operation: 9 V, max. 150 mA, Mains operation: 12 V, max. 150 mA
Output:	2 output channels for analog, data, trigger, relay cable, memory modules etc.
Display graphic:	128 x 64 pixel, 8 lines
Display illumination:	2 LEDs, white
Keyboard:	7 silicone keys
Internal memory:	59 kB EEPROM (12000 values)
Batteries:	3 Mignon Alkaline
Mains adapter:	230 V (AC) to 12 V (DC), 200 mA, (galvanically isolated)
DC adapter cable:	10-30 V, 0,25 A (galvanically isolated)
Casing:	ABS (max. 70 °C), light grey
Operating temperature:	-10 up to +60 °C
Operating air humidity:	10 up to 90 % r.H. (non condensing)
Degree of protection:	IP 54
Dimensions and weight:	L 127 x W 83 x H 42 mm, 290 g
<b>Ref-No.:</b>	<b>59234</b>

## Additional order no.:

...../03 with works certificate (for the measuring unit temperature)  
...../04 with DKD certificate (for the measuring unit temperature)



## Technical features

- Compact shape and ergonomic design
- 3 galvanically separated input channels, various measuring units
- Intelligent probe display with probe specific functions
- Resolution options 0.01 or 0.1
- Measuring functions: measuring value, zero-setting, set-point adjustment
- 2-step adjustment, scaling (optional: multi-point calibration for temperature values)
- Functions: max./min. value documentation
- Average value by time, single values or Measuring points
- Measuring menu free programmable (numeric or graph display)
- Interfaces: USB, RS232, Ethernet, Bluetooth, analog
- Memory (various data logger functions programmable)
  - Internal: EEPROM memory for up to 12000 values (as linear or ring memory configurable)
  - External: memory plug with MM card connectable
- Sleep mode for long-term documentations
- Language selection: German, English, French

# Precision digital measuring device

## PHYSICS 51

Digital measuring device for thermocouples (Type K, N, L, U, T, S), NTC resistance thermometers, infrared temperature probes, capacitive humidity probes, winged wheel, speed of rotation, frequency and speed of rotation as well as for the connection of voltage and current measuring units. Subject to type of probe 4 internal function channel data can be processed.

### Technical data PHYSICS 51

Measuring input:	1 input channel
Galvanic isolation:	Semiconductor relays (50 V)
Channels:	4 channels/plugs for dual probes and function channels
AD converter:	Delta-Sigma 15 bit resolution
Output:	2 output channels
Display graphic:	128 x 64 pixel, 8 lines
Display illumination:	2 LEDs, white
Keyboard:	7 silicone keys
Batteries:	3 Mignon Alkaline
Mains adapter:	230 V (AC) to 12 V (DC), 200 mA, (galvanically isolated)
DC adapter cable:	10-30 V, 0.25 A (galvanically isolated)
Casing:	ABS (max. 70 °C), light grey
Operating temperature:	-10 to +60 °C
Operating air humidity:	10 to 90 % r.H. (non condensing)
Degree of protection:	IP 54
Dimensions and weight:	L 127 x W 83 x H 42 mm, 290 g
<b>Ref-No.:</b>	<b>59235</b>



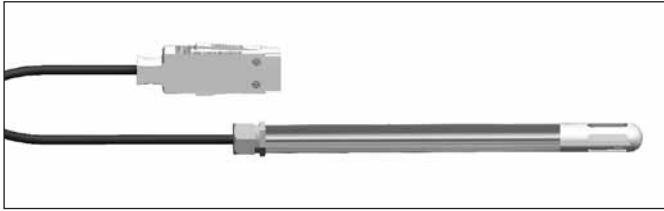
### Technical features

- Compact shape and ergonomic design
- 1 input channel for thermocouples, NTC resistance thermometers, humidity probes etc.
- Measuring functions: measuring value, zero-setting, max./min. value documentation
- 2-step adjustment, scaling (optional: multi-point calibration for temperature values)
- Interfaces: USB, RS232, Ethernet, Bluetooth, analog
- Test functions: segment monitoring, range monitoring, sensor breakage indication, battery voltage check and display
- Memory plug with MM Card connectable
- Sleep mode for long-term documentations
- Language selection: German, English, French

### Additional order no.:

...../03 with works certificate (for the measuring unit temperature)  
 ...../04 with DKD certificate (for the measuring unit temperature)

# Sensors for PHYSICS digital measuring devices



## Capacitive humidity sensor

Measuring range: 5...98 % r.H./-20...+80 °C

Accuracy:  $\pm 2$  % r.H. in the range <90 % r.H. at nominal conditions

Reproducibility: <1 % r.H. at nominal conditions

Nominal conditions: 25 °C

Sensor: capacitive

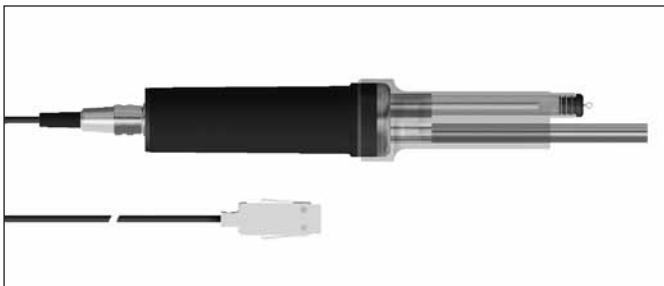
Dimensions: L 160 x 12 mm dia.

Sensor tube made of stainless steel

Cable length: 1,500 mm

**Suitable for PHYSICS 300 and PHYSICS 51**

**Ref. No.: 59644**



## Humidity psychrometer

Hand-held psychrometer

Measuring range: 10...100 % r.H. at 0...60 °C

Determination of: dry temperature, relative humidity, dew point, mixture ratio, humid temperature, partial vapour pressure

Accuracy:  $\pm 1$  % r.H. at nominal conditions

Reproducibility: <1 % r.H. at nominal conditions

Nominal conditions: 25 °C, 1,013 mbar, 50 % r.H.

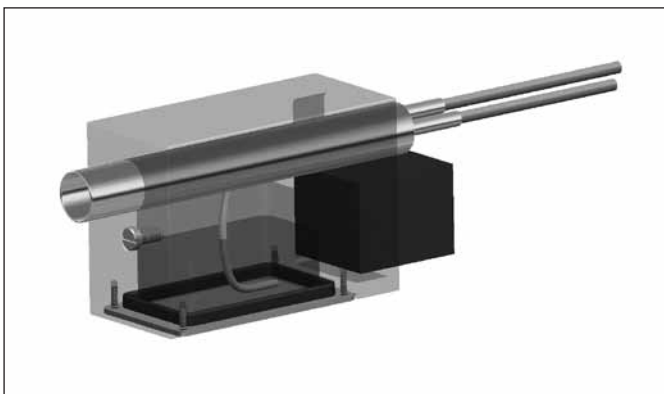
Sensor: 2 x NTC

Dimensions: L 245 x 50 mm dia.

Cable length: 1,500 mm

**Suitable for PHYSICS 300 and PHYSICS 51**

**Ref. No.: 59638**



## Humidity psychrometer

### Suitable for high temperatures and long-term measurements

Psychrometer encoder

Measuring range: 10...100 % r.H. at 0...90 °C

Determination of: dry temperature, relative humidity, dew point, mixture ratio, humid temperature, partial vapour pressure

Accuracy:  $\pm 1$  % r.H. at nominal conditions

Reproducibility: <1 % r.H. at nominal conditions

Nominal conditions: 25 °C, 1,013 mbar, 50 % r.H.

Sensor: 2 x Pt100

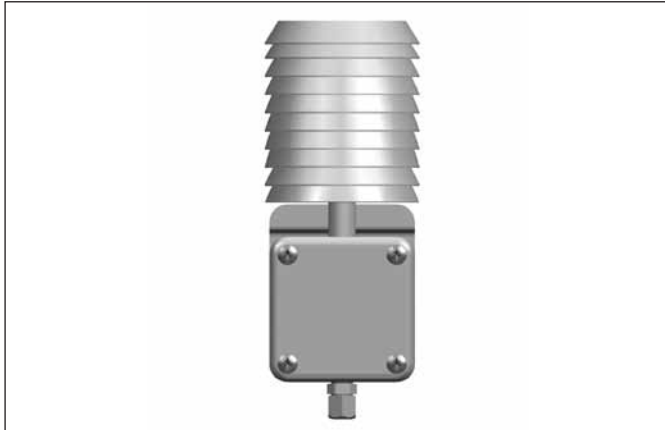
Dimensions: L 175 x W 50 x H 75 mm

Cable length: 2 x 5,000 mm

**Suitable for PHYSICS 300**

**Ref. No.: 59937**

# Sensors for PHYSICS digital measuring devices



## Humidity/temperature sensor

With electronic box in all-weather protective housing

Sensor cable connection: screw terminals

Supply voltage via PHYSICS device

Measuring range: -30...60 °C/0...90 % r.H. (non-condensing)

Accuracy:  $\pm 2$  % r.H. in the range <90 % r.H. at nominal conditions

Reproducibility: <1 % r.H. at nominal conditions

Nominal conditions: 25 °C

Sensor: capacitive, NTC Typ N

Dimensions: H 100 x 85 mm dia. (box: L 80 x W 80 x H 25 mm)

**Suitable for PHYSICS 300 and PHYSICS 51**

**Ref. No.: 59938**



## Room climate sensor/globe thermometer

Wet Bulb Globe Temperature measuring (WBGT)

Measuring range: -50...200 °C

Accuracy:  $\pm 0,4$  % at nominal conditions

Nominal conditions: 25 °C

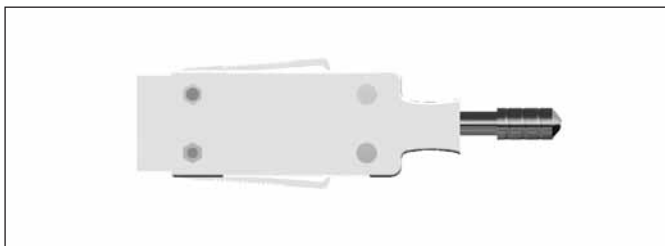
Sensor: PT100 (B/4)

Dimensions: approx. 150 mm dia.

Cable length: 3,000 mm

**Suitable for PHYSICS 300 and PHYSICS 51**

**Ref. No.: 59639**



## Sensor for barometric pressure

Compact design

With hose connector 5 mm dia.

Measuring range: 700...1,050 mbar (0...1,050 mbar)

Accuracy: 0.5 % of final value

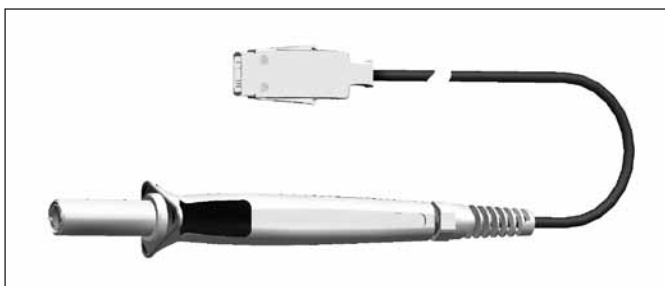
Nominal conditions: 25 °C

Sensor: piezo-resistive pressure sensor

Dimensions: L 90 x H 20 x D 7,6 mm

**Suitable for PHYSICS 300 and PHYSICS 51**

**Ref. No.: 59645**



## Infrared temperature sensor

With handle and cable

Measuring range: -20...350 °C

Sensor: infrared sensor

Dimensions: L 250 x H 45 mm

Cable length: 1,000 mm

**Suitable for PHYSICS 300 and PHYSICS 51**

**Ref. No.: 59128**

Further sensors on request.

# Temperature sensors for PHYSICS digital measuring devices



## Immersion resistance thermometer Pt100

Measuring range: -90...+350 °C

Sensor: Pt100 acc. to DIN EN 60751 Class A, 4-wire connection

Nominal length (NL): 250 mm

Sensor: stainless steel, 3 mm dia.

Handle: plastic (max. 100 °C)

Cable: 4 x 0.22 mm<sup>2</sup> Teflon, silicone insulated

Cable length: 2,000 mm

**Suitable for PHYSICS 300**

**Ref. No.: 59954**



## Insertion resistance thermometer Pt100

Measuring range: -50...+200 °C

Sensor: Pt100 acc. to DIN EN 60751 Class A, 4-wire connection

Nominal length (NL): 150 mm

Sensor: stainless steel, 4 mm dia., with tip

Handle: plastic (max. 100 °C)

Cable: 4 x 0.22 mm<sup>2</sup> Teflon, silicone insulated

Cable length: 2,000 mm

**Suitable for PHYSICS 300**

**Ref. No.: 59966**



## Immersion thermocouples Type K

Sensor: thermo couple NiCr-Ni Type K acc. to DIN EN 60584 class 2

Nominal length (NL): 250 mm

Handle: plastic (max. 100 °C)

Cable: 2 x 0.22 mm<sup>2</sup>, Teflon, silicone insulated

Cable length: 2,000 mm

**Suitable for PHYSICS 300 and PHYSICS 51**

**Ref. No.: 59961** Measuring range: -100...+500 °C, sensor: 1.5 mm dia.

**Ref. No.: 59962** Measuring range: -100...+800 °C, sensor: 3 mm dia.



## Insertion thermocouple Type K

Measuring range: -50...+200 °C

Sensor: thermo couple NiCr-Ni Type K acc. to DIN EN 60584 class 2

Nominal length (NL): 150 mm

Sensor: stainless steel, 3 mm dia., with tip

Handle: plastic (max. 100 °C)

Cable: 2 x 0.22 mm<sup>2</sup>, Teflon, silicone insulated

Cable length: 2,000 mm

**Suitable for PHYSICS 300 and PHYSICS 51**

**Ref. No.: 59963**

Further sensors on request.

**Additional order no.:**

...../03 with works certificate

...../04 with DKD certificate



# Accessories for PHYSICS digital measuring devices

Beside the accessories shown on this page we offer a wide programme of sensors for the PHYSICS digital measuring devices (see our separate data sheets).

Please ask for these data sheets by specifying your measuring tasks e.g. temperature, humidity, pressure, air flow, power, flow rate, electrical values etc.

Available accessories	Ref.-No.
Mains adapter 230 V, 200 mA	57090
Mains adapter 115 V, 300 mA (US)	58802
USB cable (galvanically isolated, max. 115.2 kB)	57091
RS232 cable (galvanically isolated, max. 115.2 kB)	55855
Ethernet cable (galvanically isolated, max. 115.2 kB)	57512
Bluetooth adapter plug, class 2	58321
Memory plug with MM card for further measuring values	57733
Software PHYSICS view	58306



## Case for digital measuring device and accessories

Stable hard protective case with foam inserts (without content)

**Ref. No.: 57844**



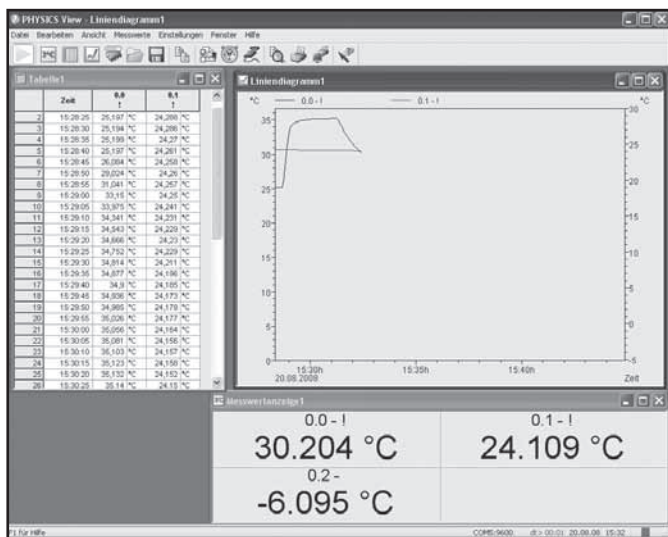
## Holster for digital measuring device

Stable protective cover (grey) with combi-bracket for standing/hanging

**Ref. No.: 58804**

# Software PHYSICS View

## Suitable software for PHYSICS digital measuring devices



PHYSICS View is a software package that can be used to evaluate and display measured data on PHYSICS devices with 2-3 measuring inputs (PHYSICS 300).

PHYSICS View runs under MS-Windows and can be used to drive a PHYSICS device with up to four measuring points. As soon as the connection between the computer and the measuring instrument has been established the program detects and lists these measuring points automatically. The measured values are then read at a sampling rate selected by the user. Various interfaces like USB, RS232, Ethernet or Bluetooth are available.

### Data logger

The measured values memory on a PHYSICS data logger (max. 4 measuring points) can be read out, displayed as a line chart or table, and saved to a file. The parameters needed to operate the measuring instrument can be set via a dialog and programmed with PHYSICS View.

### Display of measured values

The recorded data can be displayed in numeric form, in a table, and as a line chart. It is possible to display just one measuring point or several measuring points at the same time in different modes.

### Saving measured values

Measured values can be saved in the form of line charts or tables.

### Printing out

PHYSICS View can also be used directly to print out diagrams, tables, or a list of all measuring points with their associated correction values, e.g. for the purposes of technical documentation. The results can be viewed before print out. The program is compatible with all printer types that can be used with MS-Windows.

### Documentation

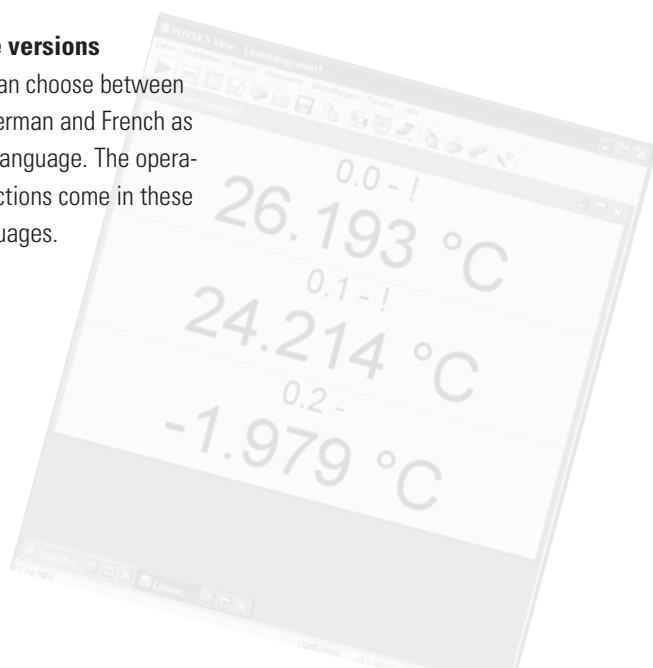
To compile protocols using some other software the line charts, tables, and lists in PHYSICS View can be copied via the MS-Windows clip-board to other application programs.

### System requirements

PHYSICS View runs under MS-Windows 98/2000/NT/XP and VISTA.

### Language versions

The user can choose between English, German and French as the menu language. The operating instructions come in these three languages.





# Technical information

## Filling liquids

### Thermometers with wetting liquid

Instructions for thermometers with separated indicator liquid

For many types of thermometer, the use of wetting thermometric liquids is essential. Different liquids are used according to the properties of the thermometer and their purpose (see technical data on thermometric liquids).

The following instructions only apply to procedures for thermometers filled with wetting liquids.

1. Before using these thermometers with wetting liquid, check whether any indicator liquid has separated off into the top of the capillary. Unlike the coloured indicator liquid, the separated liquid is generally colourless and can easily be overlooked.
2. All types of thermometer which are filled with wetting liquid have an expansion chamber at the top end of the capillary. By heating the temperature probe carefully, the indicator liquid can be coaxed up into this expansion chamber and combined again with the separated liquid. If necessary, it can be assisted in this by using a powerful centrifuge with the temperature probe pointing downwards.
3. If there is still a small amount of liquid remaining at the end of the expansion chamber, this has to be flame-heated carefully at this point (cigarette lighter, Bunsen burner or spirit burner) in order to combine it with the separated liquid by repeatedly heating the temperature probe while holding the thermometer upright.

The possible evaporation of the indicator liquid in the capillary is a physically induced phenomenon which cannot always be avoided in the event of poor storage or if conditions are unfavourable. It is definitely not a manufacturing defect, however, and provided that it is handled properly it will also not affect the guaranteed precision of the thermometer type used.

### Instructions on reuniting separated indicator columns

Handling after shipping damage (separated indicator columns)

Rough or incorrect handling in transport may cause the thermometric indicator liquid in the capillary opening to separate. The same effect can be caused by similar circumstances or by incorrect storage and improper use. **A production fault is therefore not involved. This is purely a physically induced phenomenon.**

In most cases, columns can be reunited by the users themselves. If the following advice is not successful, the problem can only be rectified by the manufacturer. A separated and reunited indicator column does not affect the guaranteed precision of the thermometer types used.

1. Most thermometers have an expansion chamber at the top. If the thermometer's measurement range does not exceed 300 °C, the separated indicator column can be reunited by simply coaxing the mercury up by warming it with a flame. After the indicator column has been reunited, the instrument is left to cool down and it is ensured that the entire indicator liquid returns from the expansion chamber into the capillary opening. If the first attempt has been unsuccessful, we recommend repeating the procedure several times.
2. In the case of very wide capillary openings, separated indicator columns can also be reunited by powerful centrifuging as with a clinical thermometer, whereby the temperature probe must point downwards.
3. As another alternative method, we recommend undercooling the temperature probe using a salt-ice mixture or dry ice (CO<sub>2</sub>) if available. The temperature probe is cooled down until all separated parts reunite in the indicator capillary and all entrained gases are above the indicator liquid. Particular attention must be paid to ensure that, when the thermometer warms up and the temperature increases, it is held upright in order to allow the indicator liquid to go up into the indicator capillary without any entrained gases. Particular care must be taken when checking whether there are any entrained gases remaining in the probe. If this is the case, however, the process must be repeated.

# Technical information

## Filling liquids

### Thermometer filling liquids

Technical data of thermometric fillings

Thermometric fillings are divided into two groups, **wetting and non-wetting** liquids.

The excellent thermometric properties of mercury (including the fact that there is no ageing and no wetting of the glass surface as well as good expansion linearity over a wide temperature range) make mercury essential as an indicator liquid for precision thermometers and define the outstanding serviceability through precision and durability.

The table below gives an overview of the main filling liquids used together with their operating limits and their most common abbreviations. The upper and lower limits are defined by physical properties such as melting point and boiling point.

### Technical data of thermometric fillings

Filling liquids	Abbreviation	Lower limit °C	Upper limit °C	Characteristics
Mercury	Hg	-38.5	+800	non-wetting
Mercury thallium alloy	Hg-Tl	-58	approx. +150	non-wetting
Gallium alloy	Ga	0	approx. +1200	non-wetting
Technical pentane	C <sub>5</sub> H <sub>12</sub>	-200	approx. +35	wetting
Ethanol	C <sub>2</sub> H <sub>6</sub> O	-110	approx. +100	wetting
Pentanol	C <sub>5</sub> H <sub>12</sub> O	-115	approx. +135	wetting
Toluene	C <sub>7</sub> H <sub>8</sub>	-90	approx. +100	wetting
Creosote	—	approx. -40	approx. +210	wetting
Petroleum	C <sub>5</sub> H <sub>12</sub>	approx. -45	approx. +160	wetting
i-amyl benzoate	C <sub>12</sub> H <sub>16</sub> O <sub>2</sub>	approx. -40	approx. +220	wetting

# Technical information

## Deviation limits

### Standardized tolerances acc. to EO 14-1

According to the German standard "Eichordnung EO 14-1" the following deviation limits for the most usual thermometers are specified:

Deviation limits for thermometers with **wetting** thermometric fillings (immersion: total):

Temperature range	Calibration tolerance at scale unit			
	0.5 °C	1 °C	2 °C	5 °C
from -200 °C up to -110 °C	—	±3 °C	±4 °C	±5 °C
above -110 °C up to -10 °C	±1 °C	±2 °C	±4 °C	±5 °C
above -10 °C up to +110 °C	±1 °C	±2 °C	±3 °C	±5 °C
above +110 °C up to +210 °C	—	±3 °C	±4 °C	±5 °C

Deviation limits for thermometers with **non-wetting** thermometric fillings (immersion: total):

Temperature range	Calibration tolerance at scale unit						
	0.05 °C	0.1 °C	0.2 °C	0.5 °C	1 °C	2 °C	5 °C
from -58 °C up to -10 °C	—	±0.3 °C	±0.4 °C	±0.5 °C	±1 °C	±2 °C	±5 °C
above -10 °C up to +110 °C	±0.1 °C	±0.2 °C	±0.3 °C	±0.5 °C	±1 °C	±2 °C	±5 °C
above +110 °C up to +210 °C	—	—	±0.4 °C	±0.5 °C	±1 °C	±2 °C	±5 °C
above +210 °C up to +410 °C	—	—	—	±1 °C	±2 °C	±2 °C	±5 °C
above +410 °C up to +610 °C	—	—	—	—	±3 °C	±4 °C	±5 °C
above +610 °C	—	—	—	—	—	±10 °C	±10 °C



# Product summary

- Catalogue 1 **Engine Thermometers**
- Catalogue 2 **General Purpose Thermometers**
- Catalogue 3/4 **Precision Laboratory Thermometers & Sets, Ground Joint Thermometers**
- Catalogue 5 **Meteorological Thermometers and Digital Measuring Devices**
- Catalogue 6 **Precision Thermometers for Material Testing**
- Catalogue 7 **Precision Contact Thermometers**
- Catalogue 8 **Thermometers for Special Applications**
- Catalogue 9 **Precision Hydrometers and Refractometers**
- Catalogue 10 **Dial Thermometers**
- Catalogue 11 **Digital Measuring Devices**
- Catalogue 12 **Resistance Thermometers and Thermocouples**
- Catalogue 13 **Cable Thermo Sensors**

**Ludwig Schneider** 

**Ludwig Schneider GmbH & Co. KG**

Postfach 1561 · 97865 Wertheim

Am Eichamt 4 · 97877 Wertheim

Tel.: +49-93 42-8560-0 · Fax: +49-93 42-846 71

e-Mail: [info@ludwig-schneider.de](mailto:info@ludwig-schneider.de)

[www.ludwig-schneider.com](http://www.ludwig-schneider.com)