The Thermal Microclimate HD32.1 instrument is manufactured by Delta Ohm Srl and it allows studying, measuring and controlling the Microclimate in the workplace, in compliance with the following standards:

- ISO 7730: Moderate Thermal Environments - Determination of the PMV and PPD indices and specification of the condition for thermal comfort.
- ISO 7243: Wet bulb Globe temperature.
- ISO 11079: Evaluation of cold environments - Determination of required clothing insulation (IREQ).
- ISO 8996: Ergonomics of the thermal environment - Determination of metabolic rate.

Thanks to specific software: Moderate environments, Hot environments, Cold environments and Discomfort, as well as specific probes, the instrument can perform the following measurements:

- Globe temperature
- Natural wet bulb temperature
- Ambient temperature
- Atmospheric pressure
- Relative Humidity
- Air velocity
- Air temperature at the height of the head (1.7m subject standing; 1.1m subject sitting).
- Air temperature at the height of the abdomen (1.1 m subject standing; 0.6m subject sitting).
- Air temperature at the height of the ankles (0.1 m).
- Temperature at the floor level.
- Net radiation temperature.
- Net radiation.
- Radiant temperature asymmetry.
- Illuminance, luminance, PAR, irradiance, CO and CO₂.
- Differential pressure with respect to the atmosphere (± 10mbar ... ±2bar)

According to measurements performed, HD32.1, together with its specific software, calculates the following parameters:

- Tₐ : Mean radiant temperature
- PMV : Predicted Mean Vote
- PPD : Predicted Percentage Dissatisfied
- DR : Draught Rating
- tₜ : Operative temperature
- IS : Scharlau Index
- DI : Thom Index
- THI : Thermolhygrometric Index
- RSI : Relative Strain Index
- SSI : New Summer Simmer Index
- HI : Heat Index
- H : Humidex Index
- Tₑq : Equivalent Temperature Index

To compute the calculation of these indexes, temperature and relative humidity of the air have to be detected and the measured values to be inserted in the table “Discomfort indexes”.

- WBGT : Wet bulb Globe temperature
- WBGTₑq : Wet bulb Globe temperature in the presence of radiation
- SWₑq : Sweat rate
- Eₑq : Predicted evaporative heat flow
- PHS : Tₑq - Water loss - Dₑqïdiv - Dₑqïdiv50 - Dₑqïdiv95
- IREQ : Required clothing insulation
- DLE : Duration Limit Exposure
- RT : Recovery time
- WCI : Wind chill index
- PDₑq : Percentage Dissatisfied due to vertical temperature difference (head-ankles)
- PD_f : Percentage Dissatisfied due to floor temperature
- PD_r : Percentage Dissatisfied due to radiant asymmetry
- FLD : Average Day Light Factor

The calculation of the FLD index requires light measurement (photometric probe LP471PHOT). Requires program “HD32.1 prog. C”.

Three operating programs are already uploaded on the instrument and they can be used according to the analysis:

- HD32.1 A operating program: Analysis of the Microclimate in moderate, hot and cold environments.
- HD32.1 B operating program: Analysis of Discomfort in moderate environments.
- HD32.1 C operating program: Measurement of Physical Quantities for general purposes.

The HD32.1 together with C operating program turns into a multifunction datalogger instrument displaying maximum, minimum and average values. By connecting SICRAM probes, the instrument allows measuring temperature, temperature and relative humidity, air velocity, flow, light (with photometric/radiometric probes), differential pressure with respect to the atmosphere, CO and CO₂.

TECHNICAL SPECIFICATIONS INSTRUMENT

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Dimensions (Length x Width x Height)</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>HD 32.1</td>
<td>220x180x50 mm</td>
<td>1100 g (with batteries)</td>
</tr>
</tbody>
</table>
Materials: ABS, Polycarbonate and Aluminium
Display: Backlit, dot matrix 128x64 dots, visible area 56x38mm

Operative conditions:
- Operative temperature: -5 ... 50°C
- Storage temperature: -25 ... 65°C
- Operative Relative Humidity: 0 ... 90% RH non condensing

Protection class: IP64

Instrument uncertainty: ± 1 digit @ 20°C

Power supply:
- Mains adapter (code SWD10) 12Vdc/1A
- Batteries: Four 1.5V batteries size C-BABY

Autonomy:
- With temperature and RH probes:
  - 200 hours with 7800mAh alkaline batteries
  - 100 hours with 7800mAh alkaline batteries
- Power absorbed (instrument off): < 45μA

Security of stored data: Unlimited

Atmospheric pressure measurement with inbuilt sensor:
- Accuracy: ±0.5hPa
- Resolution: 0.1hPa
- Response time: 1s

Temperature measurement with instrument:
- P100 measuring range: -200 ... +650°C
- Resolution: 0.01°C in the range ±199.99°C, 0.1°C outside this range
- Accuracy: ±0.01°C in the range ±199.99°C, ± 0.1°C outside this range
- Temperature drift @20°C: 0.003%/°C
- Drift after 1 year: 0.1°C/year

Instrument relative humidity measurement (capacitive sensor):
- Measuring range: 0 ... 100%RH
- Resolution: 0.1%RH
- Temperature drift @20°C: 0.02%RH/°C
- Drift after 1 year: 0.1%RH/year

Connections:
- Input for probes with SICRAM module: 8 male 8-pole DIN 45326 connectors
- RS232C Serial interface: Galvanically isolated RS232C
  - Baud rate: Configurable between 1200 and 38400 baud
  - Parity: None
  - Stop Bit: 1
  - Flow control: Xon/Xoff
  - Serial cable length: Max 15m
- USB Interface: Type 1.1 - 2.0 galvanically isolated

Memory:
- Divided in 64 blocks

Storage capacity:
- 67600 storages of 8 inputs each

Security of stored data:
- Unlimited

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- Accuracy: ±0.5hPa
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- USB Interface: Type 1.1 - 2.0 galvanically isolated

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- Divided in 64 blocks

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- Resolution: 0.1hPa
- Response time: 1s

Temperature measurement with instrument:
- P100 measuring range: -200 ... +650°C
- Resolution: 0.01°C in the range ±199.99°C, 0.1°C outside this range
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- Measuring range: 0 ... 100%RH
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- Drift after 1 year: 0.1%RH/year

Connections:
- Input for probes with SICRAM module: 8 male 8-pole DIN 45326 connectors
- RS232C Serial interface: Galvanically isolated RS232C
  - Baud rate: Configurable between 1200 and 38400 baud
  - Parity: None
  - Stop Bit: 1
  - Flow control: Xon/Xoff
  - Serial cable length: Max 15m
- USB Interface: Type 1.1 - 2.0 galvanically isolated

Memory:
- Divided in 64 blocks

Storage capacity:
- 67600 storages of 8 inputs each

Security of stored data:
- Unlimited

EXPLANATORY TABLES - HOW TO USE PROBES FOR MICROCLIMATIC MEASUREMENTS

<table>
<thead>
<tr>
<th>DeltaLog10 Software</th>
<th>Operating program</th>
<th>Main calculated indices</th>
<th>Environments</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>DeltaLog10 BASIC</td>
<td>A Prog.</td>
<td>Air temperature</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mean radiant temperature</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Predicted mean vote</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Predicted Percentage Dissatisfied</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Draught rating</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Operative temperature</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>IS : Scharlau Index</td>
<td>Moderate</td>
<td>ISO 7730</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DI : Thorn Index</td>
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<tr>
<td></td>
<td></td>
<td>TH : Thermohygrometric Index</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>RSI : Relative Strain Index</td>
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<tr>
<td></td>
<td></td>
<td>SSI : New Summer Simmer Index</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>HI : Heat Index</td>
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<tr>
<td></td>
<td></td>
<td>H : Humidex Index</td>
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<tr>
<td></td>
<td></td>
<td>Tm : Equivalent Temperature Index</td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>To compute the calculation of these indexes, temperature and relative humidity of the air have to be detected and the measured values to be inserted in the table “Discomfort indexes”.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DeltaLog10 Hot environments</td>
<td>A Prog.</td>
<td>WBGT : Wet bulb globe temperature</td>
<td>Severe hot</td>
<td>ISO 7243</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SW : Sweat rate</td>
<td></td>
<td>ISO 7933</td>
</tr>
<tr>
<td></td>
<td></td>
<td>E * : Predicted evaporative heat flow</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>PHS : Predicted Heat Strain Model</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DeltaLog10 Cold Environments</td>
<td>A Prog.</td>
<td>IREQ : Required clothing insulation</td>
<td>Severe cold</td>
<td>ISO 11079</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DLE : Duration limit exposure</td>
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<tr>
<td></td>
<td></td>
<td>RT : Recovery time</td>
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<td></td>
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<tr>
<td></td>
<td></td>
<td>WCI : Wind chill index</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DeltaLog10 Analysis of Discomfort</td>
<td>B Prog.</td>
<td>PD : Percentage Dissatisfied due to vertical temperature difference (head-ankles).</td>
<td>Moderate</td>
<td>ISO 7730</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PD : Percentage Dissatisfied due to floor temperature</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>PD : Percentage Dissatisfied due to radiant asymmetry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DeltaLog10 C Prog.</td>
<td>C Prog.</td>
<td>Air temperature</td>
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<tr>
<td></td>
<td></td>
<td>RH-t : Humidity-temperature</td>
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<td></td>
<td></td>
<td>V* : Air velocity, temperature and flow</td>
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<td></td>
<td></td>
<td>Lux : Illuminance</td>
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<tr>
<td></td>
<td></td>
<td>cd/m² : Luminance</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>µW/cm² : Irradiance</td>
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<tr>
<td></td>
<td></td>
<td>W/m² : Irradiance</td>
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<tr>
<td></td>
<td></td>
<td>µmol/m²:s : PAR</td>
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<tr>
<td></td>
<td></td>
<td>ppm : CO and CO₂</td>
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<tr>
<td></td>
<td></td>
<td>ΔP : Differential pressure with respect to the atmosphere</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>FLD : Average Day Light Factor</td>
<td>General purposes</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>The calculation of the FLD index requires light measurement (photometric probe LP471PHOT). Requires program “HD32.1 prog. C”</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The following indices are obtained by using the DeltaLog10 Hot environments software: Each line shows the combination of probes to use for calculating the indices

<table>
<thead>
<tr>
<th>WBGT Indoor: Wet bulb globe temperature</th>
<th>TP3207</th>
<th>TP3275</th>
<th>TP3276</th>
<th>AP3203</th>
<th>AP3203-F</th>
<th>HP3217R</th>
<th>HP3217DM</th>
</tr>
</thead>
<tbody>
<tr>
<td>WBGT Outdoor: Wet bulb globe temperature in the presence of radiation</td>
<td></td>
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</tr>
<tr>
<td>SW : Sweat rate</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>EIH : Predicted evaporative heat flow</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHS : Predicted Percentage Dissatisfied</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

\[ T_r \]: Predicted rectal temperature

Water Loss: Loss of water

\[ D_{lim50} \]: Maximum allowable exposure duration for water loss, standard subject

\[ D_{lim95} \]: Maximum allowable exposure duration for water loss, 95% of the working population

The following indices are obtained by using the DeltaLog10 Cold environments software: Each line shows the combination of probes to use for calculating the indices

<table>
<thead>
<tr>
<th>PHD: Predicted Heating Degree</th>
<th>TP3207</th>
<th>TP3275</th>
<th>TP3276</th>
<th>AP3203</th>
<th>AP3203-F</th>
<th>HP3217R</th>
<th>HP3217DM</th>
</tr>
</thead>
</table>

Using IREQ, DLE, RT, WCI it is possible to calculate:

- Ratio of surface area of the clothed body to the surface area of the nude body
- Mean skin temperature
- Fraction of wet skin
- Total convective heat conduction
- Total radiative heat conduction
- Partial water pressure at ambient temperature
- Surface temperature of clothing
- Evaporative resistance of limiting layer and clothing
- Heat exchange by evaporation
- Respiratory heat exchange by convection and evaporation
- Heat exchange by radiation
- Heat exchange by convection
- Duration limit exposure
- Required clothing insulation
- Intrinsic clothing insulation

\[ AP3203: 0°C…+80°C \]
\[ AP3203-F: -30°C…+30°C \]
### Table of Probes for HD32.1 B Operating Program: Analysis of Discomfort

<table>
<thead>
<tr>
<th>Probe Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TP3227K</td>
<td>Temperature probe composed of 2 independent probes, temperature of the head and abdomen.</td>
</tr>
<tr>
<td>TP3227PC</td>
<td>Temperature probe composed of 2 independent probes, temperature of the ankles and the floor.</td>
</tr>
<tr>
<td>TP3207P</td>
<td>Temperature probe Pt100 sensor, floor temperature.</td>
</tr>
<tr>
<td>TP3207TR</td>
<td>Probe for measuring radiant temperature (net-radiometer)</td>
</tr>
</tbody>
</table>

The following table lists all the necessary probes for determining the microclimatic indices. The following indices are obtained by using the DeltaLog10 Analysis of Discomfort software:

<table>
<thead>
<tr>
<th>Indices</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PDv</td>
<td>Percentage Dissatisfied with vertical temperature difference (head-ankles).</td>
</tr>
<tr>
<td>PDf</td>
<td>Percentage Dissatisfied with floor temperature.</td>
</tr>
<tr>
<td>PD6</td>
<td>Percentage Dissatisfied with radiant asymmetry.</td>
</tr>
<tr>
<td>FLD</td>
<td>Average Day Light Factor. Requires HD32.1 program C</td>
</tr>
</tbody>
</table>

### Ordering Codes

- **HD32.1 Kit basic**: It is composed of HD32.1 instrument, A operating program: Analysis of the Microclimate, four 1.5V alkaline batteries size C-BABY, instructions manual. The instrument includes atmospheric pressure sensor.
- **DeltaLog10 Basic moderate environments Software** (for Windows®).
- **DeltaLog10 Hot environments Software (code MC1)**: The use of this software requires the complete HD32.1 basic Kit.
- **DeltaLog10 Cold environments Software (code MC2)**: The use of this software requires the complete HD32.1 basic Kit.
- **DeltaLog10 Analysis of discomfort Software (code MC3)**: The use of this software requires the B operating program: Analysis of discomfort and the complete HD32.1 basic Kit.

- **HD32.1 Program B - Discomfort Analysis**: HD32.1 program for discomfort measurements in moderate environments. Requires the software DeltaLog10 Discomfort Analysis.
- **HD32.1 Program C - Physical Quantities**: HD32.1 program for the measurements of temperature, relative humidity, light, air speed, differential pressure with respect to the atmosphere, concentration of CO and CO₂. Requires the software DeltaLog10 Discomfort Analysis.

Probes, holder, case and cables must be ordered separately.

### Accessories:

- **VTRAP32**: Tripod equipped with 6-input head and 5 probe holders code HD3218K
- **9CPRS232**: Connection cable 9 - pole Sub-D female connector for RS232C.
- **CP22**: USB 2.0 connection cable connector type A - connector type B.
- **BAG32**: Carrying case for the HD32 and its accessories.
- **SWD10**: 100-240Vac/12Vdc-1A Stabilized mains power supply.
- **HD3218K**: Probe shaft
- **AM32**: Two-clamp shaft for two probes
- **AQC**: 200cc. distilled water and 3 braids for HP3201 or HP3217DM probes.
- **CPA**: extension cable for PP 473 S1 ... S8 differential pressure probes.

Delta Ohm metrological laboratories are Accredia LAT accredited in Temperature, Humidity, Pressure, Photometry/Radiometry, Acoustics and Air velocity. Probes can be supplied with calibration certificate on request.

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**TP3227PC**: Temperature probe with dual Pt100 sensor. It measures floor temperature and the temperature at the ankles.
Probes for operating programs:
A: Microclimatic Analysis
B: Analysis of Discomfort

TP3207: Temperature probe, Pt100 sensor. Probe stem Ø 14 mm, length 140 mm. Cable length 2 metres. Equipped with SICRAM module.
Used for calculating the following indices: IREQ, WCI, DLE, RT, PMV, PPD, WBGT, SR.
Used for calculating Mean radiant temperature.
Measuring range: -40°C…+100°C

TP3275: Globe temperature probe, Pt100 sensor, globe Ø 150 mm. Stem Ø 14 mm, length 110 mm. Cable length 2 metres. Equipped with SICRAM module.
Used for measuring: Mean radiant temperature, WBGT.
Measuring range: -10°C…+100°C

TP3276: Globe temperature probe, Pt100 sensor, globe Ø 50 mm. Stem Ø 8 mm, length 110 mm. Cable length 2 metres. Equipped with SICRAM module.
Used for measuring: Mean radiant temperature, WBGT.
Measuring range: -10°C…+100°C

TP3227T: Temperature probe composed of 2 independent probes, Pt100 sensor. Stem diameter Ø 14 mm, length 500 mm. Cable length 2 metres. Equipped with double SICRAM module and TP3227.2 extension shaft Ø 14 mm, length 450 mm. Used for measuring local discomfort due to vertical thermal gradient. It can be used for studying subjects sitting or standing. The height of one probe can be regulated.
Measuring range: -10°C…+100°C

TP3227PC: Temperature probe composed of 2 independent probes, Pt100 sensor, one for measuring floor temperature (diameter Ø 70 mm, height 30 mm), the other for measuring temperature at the height of the ankles (diameter Ø 3 mm, height 100 mm). Cable length 2 metres. Equipped with double SICRAM module.
Used for calculating the following indices: IREQ, WCI, DLE, RT, PMV, PPD, SR. Used for calculating Mean radiant temperature.
Measuring range: 500°C…+1500°C

AP3203: Omnidirectional hotwire probe.
Measuring range: air velocity 0.05÷5 m/s.
Probe stem Ø 14 mm, length 110 mm. Cable length 2 metres. Equipped with SICRAM module.
Used for calculating the following indices: IREQ, WCI, DLE, RT, PMV, PPD, SR. Used for calculating Mean radiant temperature.
Measuring range: 500°C…+1500°C

HP3201: Natural wet bulb probe. Pt100 sensor. Probe stem Ø 14 mm, length 110 mm. Cable length 2 metres. Equipped with SICRAM module, spare braid and 50cc. distilled water.
Used for measuring: WBGT.
Measuring range: 4°C…+80°C

HP3217T: Combined temperature and relative humidity probe. Capacitive RH sensor, Pt100 temperature sensor. Probe stem Ø 14 mm, length 110 mm. Cable length 2 metres. Equipped with SICRAM module.
Used for calculating the following indices: IREQ, WCI, DLE, RT, PMV, PPD, SR. Used for calculating Mean radiant temperature.
Measuring range: -40°C…+100°C, 0…100%RH.

HP3217DM: Double natural wet bulb probe and temperature probe (dry bulb). Probe stem Ø 14 mm, length 110 mm. Cable length 2 metres. Equipped with double SICRAM module, spare braid and 50cc. distilled water.
Measuring range: 4°C…+80°C
TECHNICAL DATA OF PROBES AND MODULES EQUIPPED WITH INSTRUMENT
Temperature probes Pt100 sensor with SICRAM module

<table>
<thead>
<tr>
<th>Model</th>
<th>Type</th>
<th>App. range</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>TP472I</td>
<td>Immersion</td>
<td>-196°C…+500°C</td>
<td>±0.25°C (-196°C…+300°C)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>±0.5°C (+300°C…+500°C)</td>
</tr>
<tr>
<td>TP472I.0</td>
<td>Immersion</td>
<td>-50°C…+300°C</td>
<td>±0.25°C (-50°C…+300°C)</td>
</tr>
<tr>
<td></td>
<td>Penetration</td>
<td>-50°C…+300°C</td>
<td>±0.25°C (-50°C…+300°C)</td>
</tr>
<tr>
<td></td>
<td>Contact</td>
<td>-50°C…+300°C</td>
<td>±0.3°C (-50°C…+300°C)</td>
</tr>
<tr>
<td></td>
<td>Air</td>
<td>-50°C…+250°C</td>
<td>±0.3°C (-50°C…+250°C)</td>
</tr>
<tr>
<td>TP472I.5</td>
<td>Penetration</td>
<td>-50°C…+400°C</td>
<td>±0.3°C (-50°C…+300°C)</td>
</tr>
<tr>
<td></td>
<td>Penetration</td>
<td>-50°C…+400°C</td>
<td>±0.6°C (+300°C…+400°C)</td>
</tr>
</tbody>
</table>

Common characteristics
Temperature drift @ 20°C 0.003%/°C

Probes equipped with SICRAM module
TP472I: Immersion probe, Pt100 wirewound sensor. Stem Ø 3 mm, length 300 mm. Cable 2 meters long.
TP472I.0: Immersion probe, Pt100 thin film sensor. Stem Ø 3 mm, length 230 mm. Cable 2 meters long.
TP473P0: Penetration probe, Pt100 sensor. Stem Ø 4mm, length 150 mm. Cable 2 meters long.
TP474C: Contact probe, Pt100 thin film sensor. Stem Ø 4mm, length 230mm, contact surface Ø 5mm. Cable 2 meters long.
TP475A: Air probe, Pt100 thin film sensor. Stem Ø 4mm, length 230mm. Cable 2 meters long.
TP472I.5: Penetration probe, Pt100 thin film sensor. Stem Ø 6mm, length 500 mm. Cable 2 meters long.
TP472I.10: Penetration probe, Pt100 thin film sensor. Stem Ø 6mm, length 1,000mm. Cable 2 meters long.
### Relative humidity and temperature probes using SICRAM module

<table>
<thead>
<tr>
<th>Model</th>
<th>Temperature sensor</th>
<th>Working range</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>HP472ACR</td>
<td>Pt100</td>
<td>0…100%RH, -20°C…+80°C</td>
<td>±1.5%RH, ±2%RH</td>
</tr>
<tr>
<td>HP473ACR</td>
<td>Thermocouple K</td>
<td>0…100%RH, -20°C…+80°C</td>
<td>±0.5°C</td>
</tr>
<tr>
<td>HP474ACR</td>
<td>Pt100</td>
<td>0…100%RH, -40°C…+150°C</td>
<td>±0.3°C</td>
</tr>
<tr>
<td>HP475ACR</td>
<td>Pt100</td>
<td>0…100%RH, -40°C…+150°C</td>
<td>±0.3°C</td>
</tr>
<tr>
<td>HP475AC1R</td>
<td>Pt100</td>
<td>0…100%RH, -40°C…+180°C</td>
<td>±0.3°C</td>
</tr>
<tr>
<td>HP477DCR</td>
<td>Pt100</td>
<td>0…100%RH, -40°C…+150°C</td>
<td>±0.3°C</td>
</tr>
<tr>
<td>HP478ACR</td>
<td>Pt100</td>
<td>0…100%RH, -40°C…+150°C</td>
<td>±0.3°C</td>
</tr>
</tbody>
</table>

**Common characteristics**

- **Relative humidity**
  - Sensor: Capacitive
  - Temperature drift @ 20°C: 0.02%RH/°C
  - Response time %RH: 10 sec (10–80%RH; air speed=2 m/s, at constant temperature)

#### Temperature with Pt100 sensor
- Temperature drift @ 20°C: 0.003%/°C

#### Temperature with thermocouple K - HP572AC
- Temperature drift @ 20°C: 0.02%/°C

**Relative humidity and temperature probes complete with SICRAM module**

- **HP472ACR**: %RH and temperature combined probe. Dimensions Ø 26x170 mm. 2 m connecting cable.
- **HP572ACR**: %RH and temperature combined probe, K thermocouple sensor. Dimensions Ø 26x170 mm. 2 m connecting cable.
- **HP473ACR**: %RH and temperature combined probe. Dimensions: handle Ø 26x130 mm, probe Ø 14x215 mm. 2 m connecting cable.
- **HP474ACR**: %RH and temperature combined probe. Dimensions: handle Ø 26x130 mm, probe Ø 14x215 mm. 2 m connecting cable.
- **HP475ACR**: %RH and temperature combined probe. 2 m connecting cable. Handle Ø 26x110 mm. Stainless-steel tube Ø 12x560 mm. Terminal tip Ø 14x75 mm.
- **HP475AC1R**: %RH and temperature combined probe. 2 m connecting cable. Handle Ø 26x110 mm. Probe tube 18x4 mm, length 520 mm.
- **HP477DCR**: %RH and temperature combined sword probe. 2 m connecting cable. Handle Ø 26x110 mm. Probe tube 18x4 mm, length 520 mm. Stainless-steel tube Ø 12x560 mm. Terminal tip Ø 14x75 mm.
- **HP478ACR**: %RH and temperature combined probe. Dimensions Ø 14x130 mm. 5 m connecting cable.

### PROBES AND MODULES TECHNICAL DATA EQUIPPED WITH INSTRUMENT

#### Hot-wire probes: AP471 S1 - AP471 S2 - AP471 S3 - AP471 S4

<table>
<thead>
<tr>
<th>Model</th>
<th>Type of measure</th>
<th>Type of sensor</th>
</tr>
</thead>
<tbody>
<tr>
<td>AP471 S1</td>
<td>Air speed, calculated flow rate</td>
<td>Omnidirectional NTC thermistor</td>
</tr>
<tr>
<td>AP471 S2</td>
<td>Air speed, calculated flow rate</td>
<td>NTC thermistor</td>
</tr>
<tr>
<td>AP471 S3</td>
<td>Air speed, calculated flow rate</td>
<td>NTC thermistor</td>
</tr>
<tr>
<td>AP471 S4</td>
<td>Air speed, calculated flow rate</td>
<td>NTC thermistor</td>
</tr>
</tbody>
</table>

#### Wind speed measurement probes

- **Speed**: 0.01 m/s, 0.1 km/h, 1 ft/min, 0.1 mph, 0.1 knot
- **Temperature**: 0.1°C

#### Measurement accuracy:
- **Speed**: ±0.2 m/s (0…0.99 m/s), ±0.4 m/s (1.00…1.99 m/s), ±0.8 m/s (10.00…40.0 m/s)
- **Temperature**: ±0.8°C (-10…+80°C)

- **Minimum speed**: 0.1 m/s
- **Air temperature compensation**: 0…+80°C
- **Sensor working conditions**: Clean air, RH<80%
- **Battery life**: Approx. 20 hours @ 2 m/s with alkaline batteries. Approx. 30 hours @ 5 m/s with alkaline batteries

**Unit of Measurement**

<table>
<thead>
<tr>
<th>Speed</th>
<th>m/s – km/h – ft/min – mph – knot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow rate</td>
<td>l/s – m³/s – m³/min – m³/h – ft³/s – ft³/min</td>
</tr>
<tr>
<td>Pipeline section for flow rate calculation</td>
<td>0.0001…1.9999 m²</td>
</tr>
<tr>
<td>Cable length</td>
<td>~2 m</td>
</tr>
</tbody>
</table>

#### (*) The indicated value refers to the vane’s working range.

#### Vane probes: AP472 S1 - AP472 S2

<table>
<thead>
<tr>
<th>Model</th>
<th>Type of measure</th>
<th>Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>AP472 S1</td>
<td>Air speed, calculated flow rate</td>
<td>100 mm</td>
</tr>
<tr>
<td>AP472 S2</td>
<td>Air speed, calculated flow rate</td>
<td>60 mm</td>
</tr>
</tbody>
</table>

**Type of measurement**

- **Speed**: Vane
- **Temperature**: K thermocouple

**Measurement range**

- **Speed (m/s)**: 0.6…25
- **Temperature (°C)**: -25…+80 (*)

**Resolution**

- **Speed**: 0.01 m/s, 0.1 km/h, 1 ft/min, 0.1 mph, 0.1 knot
- **Temperature**: 0.1°C

**Accuracy**

- **Speed**: ±(0.4 m/s + 1.5%f.s.), ±(0.4 m/s + 1.5%f.s.)
- **Temperature**: ±0.8°C

**Minimum speed**: 0.6 m/s

**Unit of Measurement**

- **Speed**: m/s – km/h – ft/min – mph – knot
- **Flow rate**: l/s – m³/s – m³/min – m³/h – ft³/s – ft³/min
- **Pipeline section for flow rate calculation**: 0.0001…1.9999 m²
- **Cable length**: ~2 m
Probes complete with SICRAM module

AIR speed hot-wire probes

AP471 S1: Hot-wire telescopic probe, measuring range: 0.1…40m/s. Cable length 2 metres.
AP471 S2: Omni-directional hot-wire probe, measuring range: 0.1…5m/s. Cable length 2 metres.
AP471 S3: Hot-wire telescopic probe with pliable terminal tip, measuring range: 0.1…40m/s. Cable length 2 metres.
AP471 S4: Omni-directional hot-wire telescopic probe with base, measuring range: 0.1…5m/s. Cable length 2 metres.

Vane probes:

AP472 S1: Vane probe with K thermocouple, Ø 100mm. Speed from 0.6 to 25m/s; temperature from -25 to 80°C. Cable length 2 metres.
AP472 S2: Vane probe, Ø 60mm. Speed from 0.5 to 20m/s. Cable length 2 metres.

Technical characteristics of photometric and radiometric probes complete with SICRAM module.

<table>
<thead>
<tr>
<th>ILLUMINANCE measurement probe LP 471 PHOT</th>
<th>LUMINANCE measurement probe LP 471 LUM 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement range (lux):</td>
<td>Measurement range (cd/m²):</td>
</tr>
<tr>
<td>0.01…199.99…1999…1999.9…1999.9…10°</td>
<td>0.1…1999.9…19999…1999.9…10°</td>
</tr>
<tr>
<td>Resolution (lux):</td>
<td>Resolution (cd/m²):</td>
</tr>
<tr>
<td>0.01 0.1 1 0.01·10°</td>
<td>0.1 1 0.1·10°</td>
</tr>
<tr>
<td>Spectral range:</td>
<td>Spectral range:</td>
</tr>
<tr>
<td>in agreement with standard photopic curve</td>
<td>in agreement with standard photopic curve</td>
</tr>
<tr>
<td>V(λ)</td>
<td>V(λ)</td>
</tr>
<tr>
<td>Class</td>
<td>Class</td>
</tr>
<tr>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>Calibration uncertainty:</td>
<td>Calibration uncertainty:</td>
</tr>
<tr>
<td>&lt;4%</td>
<td>&lt;5%</td>
</tr>
<tr>
<td>f₁ (in agreement with photopic response V(λ)):</td>
<td>f₁ (in agreement with photopic response V(λ)):</td>
</tr>
<tr>
<td>&lt;6%</td>
<td>&lt;6%</td>
</tr>
<tr>
<td>f₂ (response according to the cosine law):</td>
<td>f₂ (response according to the cosine law):</td>
</tr>
<tr>
<td>&lt;3%</td>
<td>&lt;3%</td>
</tr>
<tr>
<td>f₃ (linearity):</td>
<td>f₃ (linearity):</td>
</tr>
<tr>
<td>&lt;1%</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>f₄ (instrument reading error):</td>
<td>f₄ (instrument reading error):</td>
</tr>
<tr>
<td>&lt;0.5%</td>
<td>&lt;0.5%</td>
</tr>
<tr>
<td>f₅ (fatigue):</td>
<td>f₅ (fatigue):</td>
</tr>
<tr>
<td>&lt;0.5%</td>
<td>&lt;0.5%</td>
</tr>
<tr>
<td>α (temp. coefficient) f₅ (T)</td>
<td>α (temp. coefficient) f₅ (T)</td>
</tr>
<tr>
<td>&lt;0.05%K</td>
<td>&lt;0.05%K</td>
</tr>
<tr>
<td>Drift after 1 year:</td>
<td>Drift after 1 year:</td>
</tr>
<tr>
<td>&lt;1%</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Functioning temperature:</td>
<td>Functioning temperature:</td>
</tr>
<tr>
<td>0…50°C</td>
<td>0…50°C</td>
</tr>
<tr>
<td>Reference Standards</td>
<td>Reference Standards</td>
</tr>
<tr>
<td>CIE n.69 - UNI 11142</td>
<td>CIE n.69 - UNI 11142</td>
</tr>
</tbody>
</table>

Photometric probe for ILLUMINANCE measurement, spectral response in agreement with standard photopic vision, diffuser for cosine correction. Measurement range: 0.01 lux…200 10¹ lux.

Typical response curve: LP 471 PHOT

Quantum radiometric probe for the measurement of the photon flow across the chlorophyll range PAR LP 471 PAR

<table>
<thead>
<tr>
<th>Measurement range (μmol/m²s):</th>
<th>0.01…199.99…200.0…1999.9…2000…10000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resolution (μmol/m²s):</td>
<td>0.01 1 0.1·10°</td>
</tr>
<tr>
<td>Spectral range:</td>
<td>400nm…700nm</td>
</tr>
<tr>
<td>Calibration uncertainty:</td>
<td>&lt;5%</td>
</tr>
<tr>
<td>f₁ (in agreement with photopic response V(λ)):</td>
<td>f₁ (in agreement with photopic response V(λ)):</td>
</tr>
<tr>
<td>&lt;6%</td>
<td>&lt;6%</td>
</tr>
<tr>
<td>f₂ (linearity):</td>
<td>f₂ (linearity):</td>
</tr>
<tr>
<td>&lt;1%</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>f₄ (instrument reading error):</td>
<td>f₄ (instrument reading error):</td>
</tr>
<tr>
<td>±1digit</td>
<td>±1digit</td>
</tr>
<tr>
<td>f₅ (fatigue):</td>
<td>f₅ (fatigue):</td>
</tr>
<tr>
<td>&lt;0.5%</td>
<td>&lt;0.5%</td>
</tr>
<tr>
<td>Drift after 1 year:</td>
<td>Drift after 1 year:</td>
</tr>
<tr>
<td>&lt;1%</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Working temperature:</td>
<td>Working temperature:</td>
</tr>
<tr>
<td>0…50°C</td>
<td>0…50°C</td>
</tr>
</tbody>
</table>

Quantum radiometric probe for the measurement of the photon flow across the chlorophyll range PAR (Photosynthetically Active Radiation 400nm…700nm), measurement in μmol/m²s. Measurement range: 0.01μmol/m²s…10 10²μmol/m²s.

Typical response curve: LP 471 PAR
Radiometric probe for IRRADIANCE measurement in the spectral range 400nm…1050nm, diffuser for cosine correction. Measurement range: 0.1 - 10³ W/m²…2000 W/m².

Typical response curve: LP 471 RAD

Radiometric probe for IRRADIANCE measurement, in the UVA spectral range, 315nm…400nm, peak 360nm. Measurement range: 0.1 - 10³ W/m²…2000 W/m².

Typical response curve: LP 471 UVA

Radiometric probe for IRRADIANCE measurement, in the UVC spectral range 220nm…280nm, peak 260nm. Measurement range: 0.1 - 10³ W/m²…2000 W/m².

Typical response curve: LP 471 UVC

Radiometric probe for IRRADIANCE measurement in the UVB spectral range 280nm…315nm, peak 305nm - 310nm. Measurement range: 0.1 - 10³ W/m²…2000 W/m².

Typical response curve: LP 471 UVB
Probes complete with SICRAM module
LP 471 PHOT: Photometric probe for ILLUMINANCE measurement complete with SICRAM module; spectral response in agreement with standard photopic vision; diffuser for cosine correction. Measurement range: 0.01lux…2000 lux.
LP 471 LUM2: Photometric probe for LUMINANCE measurement complete with SICRAM module; spectral response in agreement with standard photopic vision; vision angle 2°. Measurement range: 0.1cd/m²…20000 cd/m².
LP 471 PAR: Quantum radiometric probe for the measurement of the photon flow across the chlorophyll range PAR (Photosynthetically Active Radiation 400nm…700nm) complete with SICRAM, measurement in μmol/m²s, diffuser for cosine correction. Measurement range: 0.01μmol/m²s…100μmol/m²s.
LP 471 RAD: Radiometric probe for IRRADIANCE measurement complete with SICRAM module; in the 400nm…1050nm spectral range, diffuser for cosine correction. Measurement range: 0.1·10⁻³W/m²…2000 W/m².
LP 471 UVA: Radiometric probe for IRRADIANCE measurement complete with SICRAM module: in the 315nm…400nm, peak 360nm, UVA spectral range, quartz diffuser for cosine correction. Measurement range: 0.1·10⁻³W/m²…2000 W/m².

The radiometric probe LP 471 BLUE measures irradiance (W/m²) in spectral band of blue light. The probe consists of a photodiode plus an appropriate filter and it is provided with diffuser for proper measure in accordance with the cosine law. The spectral response curve of the probe allows to measure the radiation effective for damages caused by blue light – curve B (λ) – according to the standards ACGIH / ICNIRP in the spectral range from 380nm to 550nm. The optical radiation radiation in this portion of the spectrum can produce photochemical damage to the retina. Another application field of the monitoring of the irradiance by blue light used in therapies of neonatal jaundice.

Probes complete with SICRAM module
LP 471 PHOT: Photometric probe for ILLUMINANCE measurement complete with SICRAM module; spectral response in agreement with standard photopic vision; diffuser for cosine correction. Measurement range: 0.01lux…2000 lux.
LP 471 LUM2: Photometric probe for LUMINANCE measurement complete with SICRAM module; spectral response in agreement with standard photopic vision; vision angle 2°. Measurement range: 0.1cd/m²…20000 cd/m².
LP 471 PAR: Quantum radiometric probe for the measurement of the photon flow across the chlorophyll range PAR (Photosynthetically Active Radiation 400nm…700nm) complete with SICRAM, measurement in μmol/m²s, diffuser for cosine correction. Measurement range: 0.01μmol/m²s…100μmol/m²s.
LP 471 RAD: Radiometric probe for IRRADIANCE measurement complete with SICRAM module; in the 400nm…1050nm spectral range, diffuser for cosine correction. Measurement range: 0.1·10⁻³W/m²…2000 W/m².
LP 471 UVA: Radiometric probe for IRRADIANCE measurement complete with SICRAM module: in the 315nm…400nm, peak 360nm, UVA spectral range, quartz diffuser for cosine correction. Measurement range: 0.1·10⁻³W/m²…2000 W/m².

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