



HD 32.1 INSTRUMENT FOR STUDYING, MEASURING AND CONTROLLING THE MICROCLIMATE

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:

- EN ISO 7726:** Ergonomics of the thermal environment - Instruments for measuring physical quantities.
- EN ISO 7730:** Moderate Thermal Environments - Determination of the PMV and PPD indices and specification of the condition for thermal comfort.
- EN ISO 27243:** Hot environments. Estimation of the heat stress on working man, based on the WBGT Index (Wet bulb Globe temperature).
- EN ISO 7933:** Ergonomics of the thermal environment - Analytical determination and interpretation of heat stress using calculation of the predicted heat strain.
- ENV ISO 11079:** Evaluation of cold environments - Determination of required clothing insulation (IREQ).
- EN 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.

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

- **t_r** : Mean radiant temperature
- **PMV** : Predicted Mean Vote
- **PPD** : Predicted Percentage Dissatisfied
- **DR** : Draught Rating
- **t_o** : Operative temperature

- **IS** : Scharlau Index
- **DI** : Thom Index
- **THI** : Thermohygrometric Index
- **RSI** : Relative Strain Index
- **SSI** : New Summer Simmer Index
- **HI** : Heat Index
- **H** : Humidex Index
- **T_{eq}** : 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_{Indoor}** : Wet bulb Globe temperature
- **WBGT_{Outdoor}** : Wet bulb Globe temperature in the presence of radiation
- **SW_p** : Sweat rate
- **E_p** : Predicted evaporative heat flow
- **PHS** : $T_{re} - \text{Water loss} - D_{lim tre} - D_{limloss50} - D_{limloss95}$
- **IREQ** : Required clothing insulation
- **DLE** : Duration Limit Exposure
- **RT** : Recovery time
- **WCI** : Wind chill index
- **PD_v** : Percentage Dissatisfied due to vertical temperature difference (head-ankles)
- **PD_f** : Percentage Dissatisfied due to floor temperature
- **PD_Δ** : Percentage Dissatisfied due to radiant asymmetry
- **FLD** : Average Day Light Factor

The calculation of the FLD index requires light measurement (photometric probe LP-471PHOT). 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, CO and CO₂ probes).

TECHNICAL SPECIFICATIONS

Instrument

Dimensions (Length x Width x Height)	220x180x50 mm
Weight	1100 g (with batteries)
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 With hotwire probe @ 5m/s: 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
Response time	1Hz

Temperature measurement with instrument

Pt100 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
Accuracy	±0.1%RH
Temperature drift @20°C	0.02%RH/°C
Drift after 1 year	0.1%RH/year



Microclimate - WBGT

EXPLANATORY TABLES - HOW TO USE PROBES FOR MICROCLIMATIC MEASUREMENTS

DeltaLog10 Software	Operating program	Main calculated indices	Environments	Standard																																
DeltaLog10 BASIC	A Prog.	<table border="0"> <tr> <td>t_a :</td> <td>Air temperature</td> <td>IS :</td> <td>Scharlau Index</td> </tr> <tr> <td>t_r :</td> <td>Mean radiant temperature</td> <td>DI :</td> <td>Thom Index</td> </tr> <tr> <td>PMV :</td> <td>Predicted mean vote</td> <td>THI :</td> <td>Thermohygrometric Index</td> </tr> <tr> <td>PPD :</td> <td>Predicted Percentage Dissatisfied</td> <td>RSI :</td> <td>Relative Strain Index</td> </tr> <tr> <td>DR :</td> <td>Draught rating</td> <td>SSI :</td> <td>New Summer Simmer Index</td> </tr> <tr> <td>t_o :</td> <td>Operative temperature</td> <td>HI :</td> <td>Heat Index</td> </tr> <tr> <td></td> <td></td> <td>H :</td> <td>Humidex Index</td> </tr> <tr> <td></td> <td></td> <td>T_{eq} :</td> <td>Equivalent Temperature Index</td> </tr> </table> <p>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".</p>	t_a :	Air temperature	IS :	Scharlau Index	t_r :	Mean radiant temperature	DI :	Thom Index	PMV :	Predicted mean vote	THI :	Thermohygrometric Index	PPD :	Predicted Percentage Dissatisfied	RSI :	Relative Strain Index	DR :	Draught rating	SSI :	New Summer Simmer Index	t_o :	Operative temperature	HI :	Heat Index			H :	Humidex Index			T_{eq} :	Equivalent Temperature Index	Moderate	EN ISO 7730
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Connections

Input for probes with SICRAM module 8 male 8-pole DIN 45326 connectors

RS232C Serial interface

Type Galvanically isolated RS232C
 Baud rate Configurable between 1200 and 38400 baud
 Data Bit 8
 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

Storage internal

to select between: 15, 30 seconds,
 1, 2, 5, 10, 15, 20, 30 minutes and 1 hour

Printing internal

to select between: 15, 30 seconds,
 1, 2, 5, 10, 15, 20, 30 minutes and 1 hour

EMC standards

Safety EN61000-4-2, EN61010-1 level 3
 Electrostatic discharge EN61000-4-2 level 3
 Electrical Fast Transients EN61000-4-4 level 3,
 EN61000-4-5 level 3
 Voltage variations EN61000-4-11

Electromagnetic interference susceptibility IEC1000-4-3

Electromagnetic interference emission EN55020 class B

The following table explains how to use the operating programs and the different software applications available.

A series of probes specially designed for different applications completes the instrument.

Delta Ohm is SIT Centre no. 124. Therefore, it can calibrate the probes employed and issue their SIT certificates.

Table of probes for HD32.1 A operating program: Microclimatic Analysis

TP3207	Dry bulb temperature probe.
TP3275	Globe temperature probe Ø 150mm (alternatively TP3276).
TP3276	Globe temperature probe Ø 50mm (alternatively TP3275).
HP3217DM	Two-sensor probe for measuring natural wet bulb temperature and dry bulb temperature (alternatively: HP3201 and TP3207).
AP3203	Omnidirectional hotwire probe (0°C...80°C)
AP3203-F	Omnidirectional hotwire probe (-30°C...+30°C)
HP3201	Natural wet bulb temperature probe.
HP3217R	Combined temperature and relative humidity probe.

The following table lists all the necessary probes for determining the microclimatic indices.

The following indices are obtained by using the **DeltaLog10 BASIC** software:

Each line shows the combination of probes to use for calculating the indices

	TP3207	TP3275	TP3276	AP3203	AP3203-F	HP3201	HP3217R	HP3217DM
t_a : Air temperature.	•							•
t_r : Mean radiant temperature.	•	•		•	•			•
PMV : Predicted mean vote. PPD : Predicted Percentage Dissatisfied	•	•	•	•	•	•	•	•
DR : Draught rating.	•			•	•			•
t_o : Operative temperature.	•	•		•	•			•
T_{eq} : Equivalent temperature. (necessary for measuring: atmospheric pressure)	•							•
IS : Scharlau Index								•
DI : Thom Index								•
THI : Thermohygroscopic Index								•
RSI : Relative Strain Index								•
SSI : New Summer Simmer Index								•
HI : Heat Index								•
H : Humidex Index								•
T_{eq} : 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"								

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

	TP3207	TP3275	TP3276	AP3203	HP3201	HP3217R	HP3217DM
WBGT Indoor : Wet bulb globe temperature		•			•		
WBGT Outdoor : Wet bulb globe temperature in the presence of radiation	•	•			•		
SW_r : Sweat rate Ep : Predicted evaporative heat flow		•	•	•		•	•
PHS	(1)	T _{re}	•	•	•	•	
		Water loss	•	•	•	•	
		D _{lim tre}		•	•		•
		D _{limloss50}		•	•		•
		D _{limloss95}		•	•		•

(1) T_{re}: Predicted rectal temperature

D_{lim tre}: Maximum allowable exposure duration for heat storage

D_{limloss50}: Maximum allowable exposure duration for water loss, standard subject

D_{limloss95}: 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

			TP3207	TP3275	TP3276	AP3203-F ⁽³⁾	HP3201	HP3217	HP3217DM
⁽²⁾	IREQ:	Required clothing insulation	•	•		•		•	
	DLE:	Duration limit exposure	•		•			•	
	RT:	Recovery time		•		•		•	•
	WCI:	Wind chill index			•	•		•	•
					•	•		•	
			•			•			•

⁽²⁾ 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

⁽³⁾ AP3203: 0°C...+80°C

AP3203-F: -30°C...+30°C

Table of probes for HD32.1 B operating program: Analysis of Discomfort

TP3227K	Temperature probe composed of 2 independent probes, temperature of the head and abdomen.
TP3227PC	Temperature probe composed of 2 independent probes, temperature of the ankles and the floor.
TP3207P	Temperature probe Pt100 sensor, floor temperature.
TP3207TR	Probe for measuring radiant temperature (net-radiometer)

The following table lists all the necessary probe for determining the microclimatic indices.

The following indices are obtained by using the DeltaLog10 Analysis of Discomfort software:

Each line shows the combination of probes to use for calculating the indices

		TP3227K	TP3227PC	TP3207P	TP3207TR	LP 471 Phot
PD_v:	Percentage Dissatisfied with vertical temperature difference (head-ankles).	•	•			
PD_f:	Percentage Dissatisfied with floor temperature.		•			
PD_r:	Percentage Dissatisfied with radiant asymmetry.			•		
FLD:	Average Day Light Factor Requires HD32.1 program C					•



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, instruction manual. The instrument includes atmospheric pressure sensor.

DeltaLog10 Basic moderate environments Software (for operating systems from Windows 98 to Windows Vista).

DeltaLog10 Hot environments Software: The use of this software requires the complete HD32.1 basic Kit.

DeltaLog10 Cold environments Software: The use of this software requires the complete HD32.1 basic Kit.

DeltaLog10 Analysis of discomfort Software: The use of this software requires the B operating program: Analysis of discomfort and the complete HD32.1 basic Kit.

DeltaLog10 Physical Quantities Software: The use of this software requires the C operating program: Physical quantities 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, 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 4 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.

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



Microclimate - WBGT

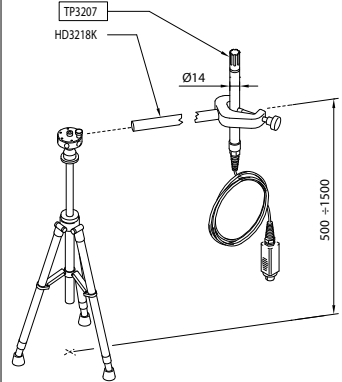
PROBES FOR OPERATING PROGRAMS:

A: Microclimatic Analysis

B: Analysis of Discomfort

TP3207: Temperature probe, Pt100 sensor. Probe stem \varnothing 14mm, 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.

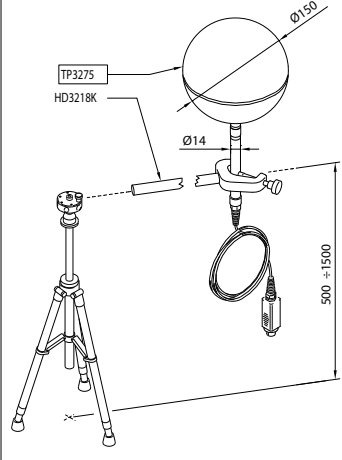
Measuring range: $-40^{\circ}\text{C} \dots +100^{\circ}\text{C}$



TP3275: Globe temperature probe, Pt100 sensor, globe \varnothing 150 mm. Stem \varnothing 14 mm, length 110 mm. Cable length 2 metres. Equipped with SICRAM module.

Used for measuring: **Mean radiant temperature, WBGT.**

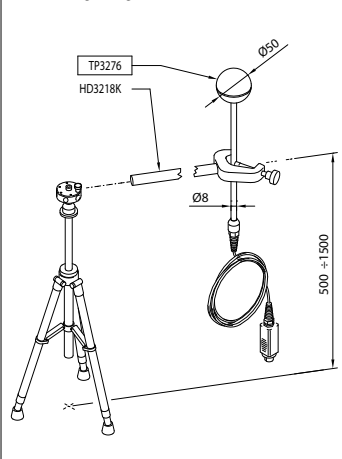
Measuring range: $-10^{\circ}\text{C} \dots +100^{\circ}\text{C}$



TP3276: Globe temperature probe, Pt100 sensor, globe \varnothing 50 mm. Stem \varnothing 8 mm, length 110 mm. Cable length 2 metres. Equipped with SICRAM module.

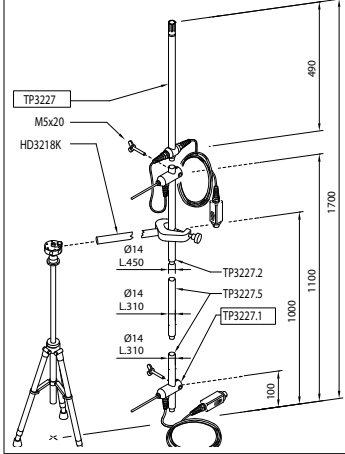
Used for measuring: **Mean radiant temperature, WBGT.**

Measuring range: $-10^{\circ}\text{C} \dots +100^{\circ}\text{C}$

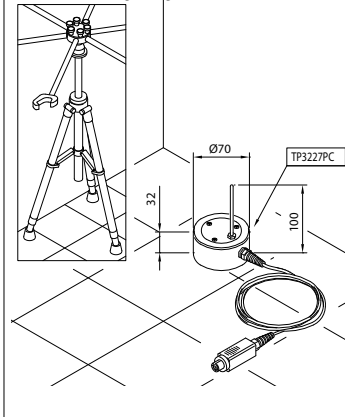


TP3227K: Temperature probe composed of 2 independent probes, Pt100 sensor. Stem diameter \varnothing 14 mm, length 500 mm. Cable length 2 metres. Equipped with double SICRAM module and TP3227.2 extension shaft \varnothing 14 mm, length 450 mm. Used for measuring **local discomfort due to vertical thermal gradient.** It can be used for studying subjects sitting or standing. The height of one probe can be regulated.

Measuring range: $-10^{\circ}\text{C} \dots +100^{\circ}\text{C}$

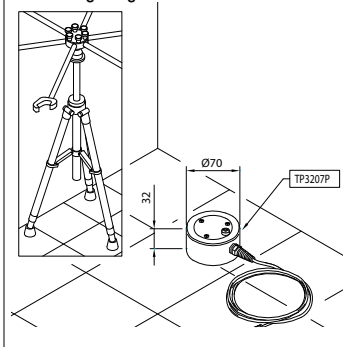


TP3227PC: Temperature probe composed of 2 independent probes, Pt100 sensor, one for measuring floor temperature (diameter \varnothing 70 mm, height 30 mm), the other for measuring temperature at the height of the ankles (diameter \varnothing 3 mm, height 100 mm). Cable length 2 metres. Equipped with double SICRAM module. Used for measuring **local discomfort due to vertical thermal gradient.** Measuring range: $-10^{\circ}\text{C} \dots +100^{\circ}\text{C}$

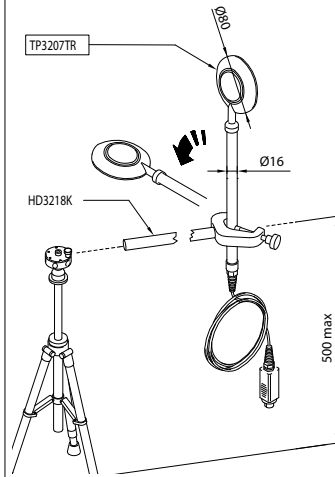


TP3207P: Pt100 sensor temperature probe, for measuring floor temperature (diameter \varnothing 70 mm, height 30 mm). Cable 2 meters long. Equipped with SICRAM module. Used for the assessment of dissatisfied people to floor temperature due to radiant asymmetry.

Measuring range $-10^{\circ}\text{C} \dots +100^{\circ}\text{C}$



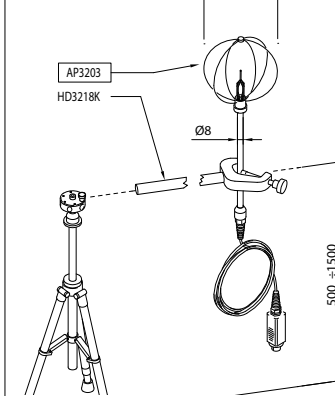
TP3207TR: Probe for measuring radiant temperature. Probe stem \varnothing 16 mm, length 250 mm. Cable length 2 metres. Equipped with SICRAM module. Used for the **evaluation of dissatisfied people due to radiant asymmetry.** Measuring range: $0^{\circ}\text{C} \dots +60^{\circ}\text{C}$



AP3203: Omnidirectional hotwire probe. Measuring range: air velocity 0-5 m/s. Probe stem \varnothing 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.

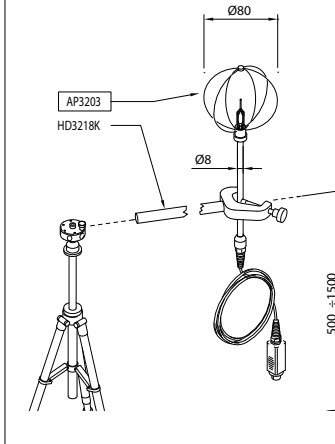
Measuring range: $0^{\circ}\text{C} \dots +80^{\circ}\text{C}$



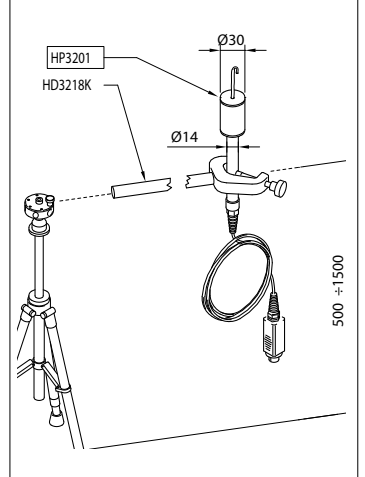
AP3203-F: Omnidirectional hotwire probe. Measuring range: air velocity 0-5 m/s. Probe stem \varnothing 14 mm, length 110 mm. Cable length 2 metres. Equipped with SICRAM module.

Used for calculating the following indices: **IREQ, WCI, DLE, RT, PMV, PPD, SR.** Used for calculating Mean radiant temperature.

Measuring range: $-30^{\circ}\text{C} \dots +30^{\circ}\text{C}$



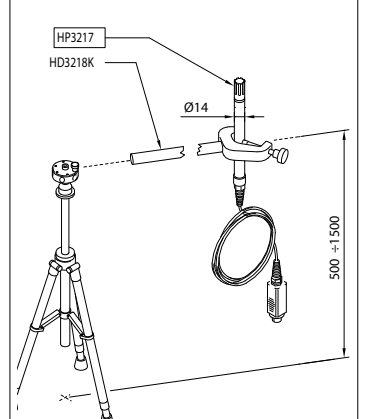
HP3201: Natural wet bulb probe. Pt100 sensor. Probe stem \varnothing 14 mm, length 110 mm. Cable length 2 metres. Equipped with SICRAM module, spare braid and 50cc. distilled water. Used for measuring: **WBGT.** Measuring range: $4^{\circ}\text{C} \dots +80^{\circ}\text{C}$



HHP3217R: Combined temperature and relative humidity probe. Capacitive RH sensor, Pt100 temperature sensor. Probe stem \varnothing 14 mm, length 110 mm. Cable length 2 metres. Equipped with SICRAM module.

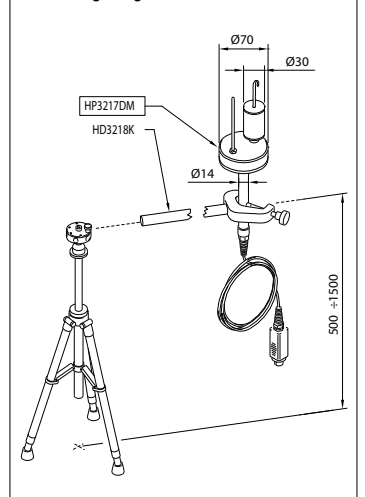
Used for calculating the following indices: **IREQ, WCI, DLE, RT, PMV, PPD, SR.**

Measuring range: $40^{\circ}\text{C} \dots +100^{\circ}\text{C}$



HP3217DM: Double natural wet bulb probe and temperature probe (dry bulb). Probe stem \varnothing 14 mm, length 110 mm. Cable length 2 metres. Equipped with double SICRAM module, spare braid and 50cc. distilled water.

Measuring range: $4^{\circ}\text{C} \dots +80^{\circ}\text{C}$



TECHNICAL DATA OF PROBES AND MODULES EQUIPPED WITH INSTRUMENT
Temperature probes Pt100 sensor with SICRAM module

Model	Type	App. range	Accuracy
TP472I	Immersion	-196°C...+500°C	±0.25°C (-196°C...+350°C) ±0.4°C (+350°C...+500°C)
TP472I.0	Immersion	-50°C...+400°C	±0.25°C (-50°C...+350°C) ±0.4°C (+350°C...+400°C)
TP473P	Penetration	-50°C...+400°C	±0.25°C (-50°C...+350°C) ±0.4°C (+350°C...+400°C)
TP473P.0	Penetration	-50°C...+400°C	±0.25°C (-50°C...+350°C) ±0.4°C (+350°C...+400°C)
TP474C	Contact	-50°C...+400°C	±0.3°C (-50°C...+350°C) ±0.4°C (+350°C...+400°C)
TP474C.0	Contact	-50°C...+400°C	±0.3°C (-50°C...+350°C) ±0.4°C (+350°C...+400°C)
TP475A.0	Air	-50°C...+250°C	±0.3°C (-50°C...+250°C)
TP472I.5	Immersion	-50°C...+400°C	±0.3°C (-50°C...+350°C) ±0.4°C (+350°C...+400°C)
TP472I.10	Immersion	-50°C...+400°C	±0.30°C (-50°C...+350°C) ±0.4°C (+350°C...+400°C)
TP49A	Immersion	-70°C...+400°C	±0.25°C (-50°C...+350°C) ±0.4°C (+350°C...+400°C)
TP49AC	Contact	-70°C...+400°C	±0.25°C (-50°C...+350°C) ±0.4°C (+350°C...+400°C)
TP49AP	Penetration	-70°C...+400°C	±0.25°C (-50°C...+350°C) ±0.4°C (+350°C...+400°C)
TP875	Globethermometer Ø 150mm	-30°C...+120°C	±0.25°C
TP876	Globethermometer Ø 50mm	-30°C...+120°C	±0.25°C
TP87	Immersion	-50°C...+200°C	±0.25°C
TP878 TP878.1	For solar panels	+5°C...+80°C	±0.25°C
TP879	For compost	-20°C...+120°C	±0.25°C

Common characteristics
 Temperature drift @ 20°C

0.003%/°C

4 wire Pt100 and 2 wire Pt1000 Probes

Model	Type	Application range	Accuracy
TP47.100	Pt100 4 wires	-50...+400°C	Class A
TP47.1000	Pt1000 2 wires	-50...+400°C	Class A

Common characteristics
 Temperature drift @ 20°C
 Pt100 0.003%/°C
 Pt1000 0.005%/°C

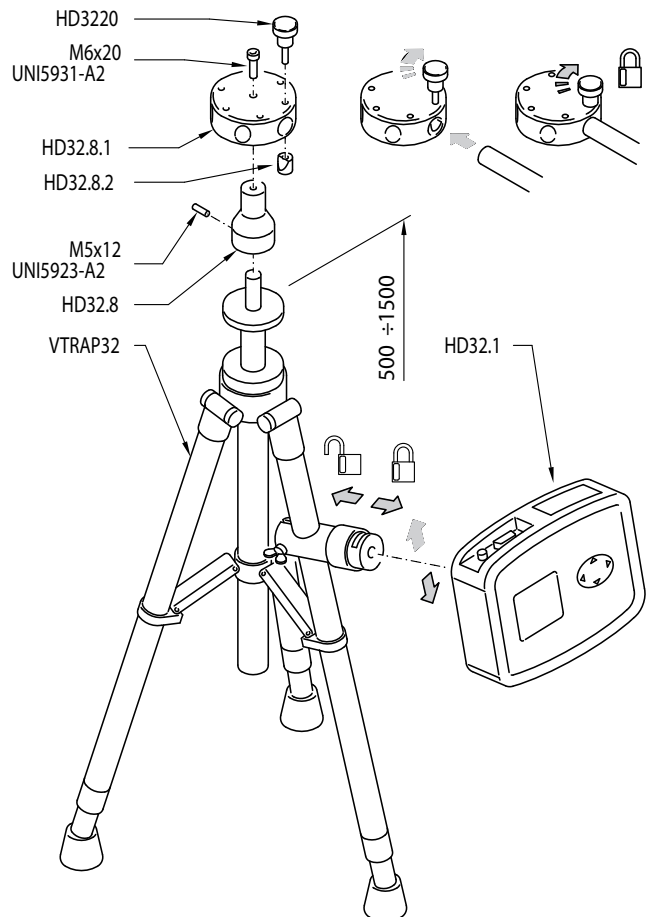
Probes equipped with SICRAM module

- TP472I:** Immersion probe, Pt100sensor. Stem Ø 3 mm, length 300 mm. Cable 2 meters long.
- TP472I.0:** Immersion probe, Pt100sensor. Stem Ø 3 mm, length 230 mm. Cable 2 meters long.
- TP473P:** Penetration probe, Pt100sensor. Stem Ø 4mm, length 150 mm. Cable 2 meters long.
- TP473P.0:** Penetration probe, Pt100sensor. Stem Ø 4mm, length 150 mm. Cable 2 meters long.
- TP474C:** Contact probe, Pt100sensor. Stem Ø 4mm, length 230mm, contact surface Ø 5mm. Cable 2 meters long.
- TP474C.0:** Contact probe, Pt100sensor. Stem Ø 4mm, length 230mm, contact surface Ø 5mm. Cable 2 meters long.
- TP475A.0:** Air probe, Pt100sensor. Stem Ø 4mm, length 230mm. Cable 2 meters long.
- TP472I.5:** Immersion probe, Pt100sensor. Stem Ø 6mm, length 500 mm. Cable 2 meters long.
- TP472I.10:** Immersion probe, Pt100sensor. Stem Ø 6mm, length 1,000mm. Cable 2 meters long.

- TP49A:** Immersion probe, Pt100sensor. Stem Ø 2.7mm, length 150mm. Cable 2 meters long. Aluminium handle.
- TP49AC:** Contact probe, Pt100sensor. Stem Ø 4 mm, length 150mm. Cable 2 meters long. Aluminium handle.
- TP49AP:** Penetration probe, Pt100sensor. Stem Ø 2.7mm, length 150mm. Cable 2 meters long. Aluminium handle.
- TP875:** Globe thermometer Ø 150 mm with handle. Cable 2 meters long.
- TP876:** Globe thermometer Ø 50 mm with handle. Cable 2 meters long.
- TP87:** Immersion probe, Pt100sensor. Stem Ø 3 mm, length 70 mm. Cable 2 meters long.
- TP878:** Contact probe for solar panels. Cable 2 meters long.
- TP878.1:** Contact probe for solar panels. Cable 5 meters long
- TP879:** Penetration probe for compost. Stem Ø 8 mm, length 1 meter. Cable 2 meters long.

Temperature probes without SICRAM module

- TP47.100:** Direct 4 wires Pt100 sensor immersion probe. Stem Ø 3 mm, length 230mm. 4 wires connection cable with connector, 2 meters long.
- TP47.1000:** Pt1000 sensor immersion probe. Stem Ø 3 mm, length 230mm. 2 wires connection cable with connector, 2 meters long.
- TP47:** Only connector for probe connection without SICRAM module: direct 3 and 4 wires Pt100, 2 wires Pt1000.



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Relative humidity and temperature probes using SICRAM module

Model	Temperature sensor	Working range		Accuracy	
		%RH	Temperature	%RH	Temp
HP472ACR	Pt100	0...100%RH	-20°C...+80°C	0°C...40°C	±0.3°C
HP572ACR	Thermocouple K	0...100%RH	-20°C...+80°C	±1,5%RH (5...90%RH)	±0.5°C
HP473ACR	Pt100	0...100%RH	-20°C...+80°C	±2,5%RH (90...100%RH)	±0.3°C
HP474ACR	Pt100	0...100%RH	-40°C...+150°C		±0.3°C
HP475ACR	Pt100	0...100%RH	-40°C...+150°C	-40°C...150°C (180°C)	±0.3°C
HP475AC1R	Pt100	0...100%RH	-40°C...+150°C	±(1,5+0,02 times the displayed value)	±0.3°C
HP477DCR	Pt100	0...100%RH	-40°C...+150°C		±0.3°C
HP478ACR	Pt100	0...100%RH	-40°C...+150°C		±0.3°C

Common characteristics

Relative humidity

Sensor	Capacitive
Typical capacity @30%RH	300pF
Temperature drift @ 20°C	0.02%/RH/°C
Response time %RH at constant temperature	10sec (10÷80%RH; air speed=2m/s, at constant temperature)

Temperature with Pt100 sensor

Temperature drift @ 20°C	0.003%/°C
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Temperature with thermocouple K - HP572AC

Resolution	0.1°C
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 14x110 mm. 2m connecting cable.

HP474ACR: %RH and temperature combined probe. Dimensions: handle Ø 26x130 mm, probe Ø 14x210 mm. 2m 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 13.5x75 mm.

HP475AC1R: %RH and temperature combined probe. 2 m connection cable. Handle Ø 26x110 mm. Stainless steel stem Ø 14x480 mm.

HP477DCR: %RH and temperature combined sword probe. 2 m connecting cable. Handle Ø 26x110 mm. Probe tube 18x4 mm, length 520 mm.

HP478ACR: %RH and temperature combined probe. Dimensions Ø 14x130 mm. 5m connection cable.



PROBES AND MODULES TECHNICAL DATA EQUIPPED WITH INSTRUMENT

Wind speed measurement probes

Hot-wire probes: AP471 S1 - AP471 S2 - AP471 S3 - AP471 S4 - AP471 S5

	AP471 S1 - AP471 S3	AP471 S2	AP471 S4 AP471 S5
Type of measure	Air speed, calculated flow rate, air temperature		
Type of sensor			
Speed	NTC thermistor	Omnidirectional NTC thermistor	
Temperature	NTC thermistor	NTC thermistor	
Measurement range			
Speed	0,1...40m/s	0,1...5m/s	
Temperature	-25...+80°C	-25...+80°C	0...80°C
Measurement resolution:			
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	±0.1 m/s (0...0.99 m/s)	±0.05m/s (0...0.99 m/s)	
	±0.3 m/s (1.00...9.99 m/s)	±0.15m/s (1.00...5.00 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 @ 20 m/s with alkaline batteries	Approx. 30 hours @ 5 m/s with alkaline batteries	
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	~2m		

Vane probes: AP472 S1... - AP472 S2 - AP472 S4...

	AP472 S1...	AP472 S2	AP472 S4...			
			L	LT	H	HT
Type of measure	Air speed, calculated flow rate, air temperature	Air speed, calculated flow rate	Air speed, calculated flow rate.	Air speed, calculated flow rate, air temperature.	Air speed, calculated flow rate.	Air speed, calculated flow rate, air temperature.
Diameter	100mm	60mm	16mm			
Type of measurement						
Speed	Vane	Vane	Vane			
Temperature	K thermocouple	----	----	K thermo couple	----	K thermo couple
Measurement range						
Speed (m/s)	0.6...25	0.5...20	0.8...20		10...40	
Temperature (°C)	-25...+80 (*)		-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	----	----	0.1°C	----	0.1°C
Accuracy						
Speed	±(0.3 m/s +1.5%f.s.)	±(0.3m/s +1.5%f.s.)	±(0.4 m/s +1.5%f.s.)			
Temperature	±0.8°C	----	----	±0.8°C	----	±0.8°C
Minimum speed	0.6m/s	0.5m/s	0.8m/s		10m/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	~2m					

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

**Probes complete with SICRAM module
AIR speed measurement probes**

Hot-wire PROBES:

- AP471 S1:** Hot-wire telescopic probe, measuring range: 0.1...40m/s. Cable length 2 metres.
- AP471 S2:** Omnidirectional hot-wire probe, measuring range: 0.1...5m/s. Cable length 2 metres.
- AP471 S3:** Hot-wire telescopic probe with terminal tip for easy position, measuring range: 0.1...40m/s. Cable length 2 metres.
- AP471 S4:** Omnidirectional hot-wire telescopic probe with base, measuring range: 0.1...5m/s. Cable length 2 metres.
- AP471 S5:** Omnidirectional hot-wire telescopic probe, measuring range: 0.1...5m/s. Cable length 2 metres.

Vane probes:

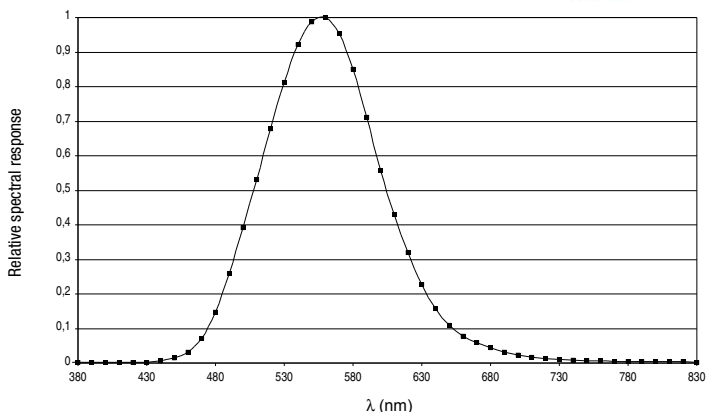
- AP472 S1L:** Vane probe with thermocouple, Ø 100mm. Speed from 0.6 to 25m/s; temperature from -25 to 80°C. Cable length 2 metres.
- AP472 S2:** Vane probe, Ø 60mm. Speed from 0.5 to 20m/s. Cable length 2 metres.
- AP472 S4L:** Vane probe, Ø 16mm. Speed from 0.8 to 20m/s. Cable length 2 metres.
- AP472 S4LT:** Vane probe with thermocouple, Ø 16mm, speed from 0.8 to 20m/s. Temperature from -25 to 80°C with thermocouple K sensor. Cable length 2 metres.
- AP472 S4H:** Vane probe, Ø 16mm speed from 10 to 40m/s. Cable length 2 metres.
- AP472 S4HT:** Vane probe with thermocouple, Ø 16mm speed from 10 to 50m/s. Temperature from -25 to 80°C with thermocouple K sensor. Cable length 2 metres.

Technical characteristics of photometric and radiometric probes complete with SICRAM module equipped with the instruments

ILLUMINANCE measurement probe LP 471 PHOT				
Measurement range (lux):	0.01...199.99	...1999.9	...19999	...199.99·10 ³
Resolution (lux):	0.01	0.1	1	0.01·10 ³
Spectral range:	in agreement with standard photopic curve V(λ)			
Class	C (B on request)			
Calibration uncertainty:	<4%			
f'1 (in agreement with photopic response V(λ)):	<8%			
f ₂ (response according to the cosine law):	<3%			
f ₃ (linearity):	<1%			
f ₄ (instrument reading error):	<0.5%			
f ₅ (fatigue):	<0.5%			
α (temp. coefficient) f ₆ (T)	<0.05%K			
Drift after 1 year:	<1%			
Functioning temperature:	0...50°C			
Reference Standards	CIE n.69 - UNI 11142			

Photometric probe for **ILLUMINANCE** measurement, spectral response in agreement with standard photopic vision, diffuser for cosine correction.
Measurement range: 0.01 lux...200·10³ lux.
CIE69, UNI11142

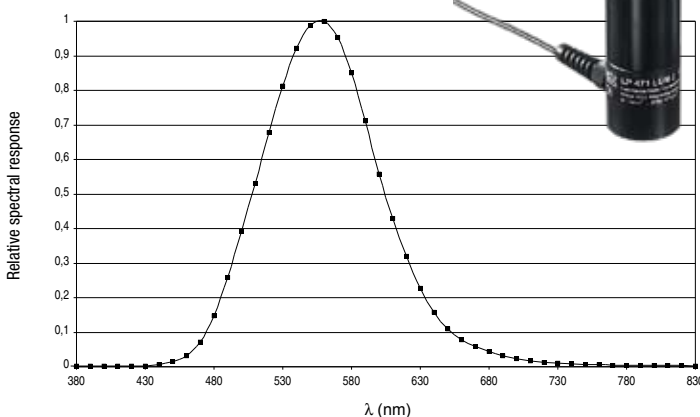
Typical response curve: LP 471 PHOT



LUMINANCE measurement probe LP 471 LUM 2				
Measurement range (cd/m ²):	0.1...1999.9	...19999	...199.99·10 ³	...1999.9·10 ³
Resolution (cd/m ²):	0.1	1	0.01·10 ³	0.1·10 ³
Optical angle:	2°			
Spectral range:	in agreement with standard photopic curve V(λ)			
Class	C			
Calibration uncertainty:	<5%			
f'1 (in agreement with photopic response V(λ)):	<8%			
f ₃ (linearity):	<1%			
f ₄ (instrument reading error):	<0.5%			
f ₅ (fatigue):	<0.5%			
α (temp. coefficient) f ₆ (T)	<0.05%K			
Drift after 1 year:	<1%			
Functioning temperature:	0...50°C			
Reference Standards	CIE n.69 - UNI 11142			

Photometric probe for **LUMINANCE** measurement, spectral response in agreement with standard photopic vision, vision angle 2°.
Measurement range: 0.1 cd/m²...2000·10³ cd/m².

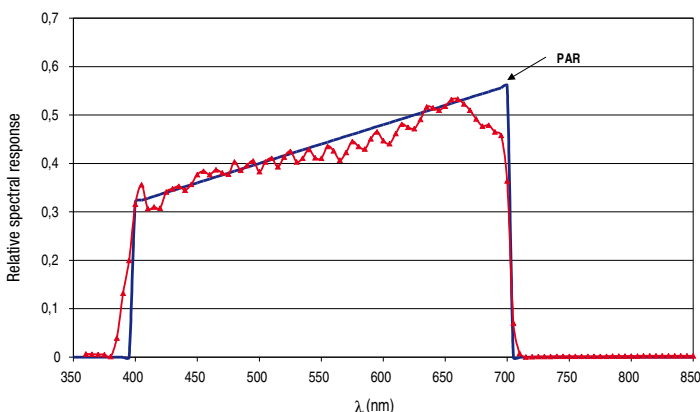
Typical response curve: LP 471 LUM2



Quantum radiometric probe for the measurement of the photon flow across the chlorophyll range PAR LP 471 PAR			
Measurement range (μmol/m ² ·s ⁻¹):	0.01...199.99	200.0...1999.9	2000...10000
Resolution (μmol/m ² ·s ⁻¹):	0.01	0.1	1
Spectral range:	400nm...700nm		
Calibration uncertainty:	<5%		
f ₃ (linearity):	<1%		
f ₄ (instrument reading error):	±1digit		
f ₅ (fatigue):	<0.5%		
Drift after 1 year:	<1%		
Working temperature:	0...50°C		

Quantum radiometric probe for the measurement of the photon flow across the chlorophyll range **PAR** (Photosynthetically Active Radiation 400nm...700nm), measurement in μmol/m²·s. Measurement range: 0.01μmol/m²·s⁻¹...10·10³μmol/m²·s⁻¹.

Typical response curve: LP 471 PAR

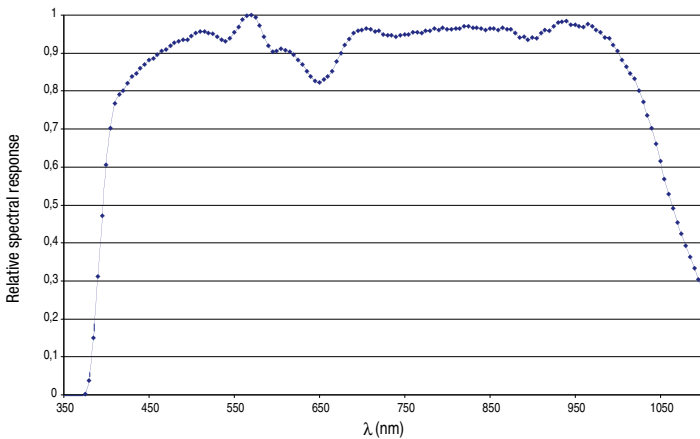


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IRRADIANCE measurement probe LP 471 RAD				
Measurement range (W/m ²):	0.1·10 ⁻³ ... 999.9·10 ⁻³	1.000 ... 19.999	20.00 ... 199.99	200.0 ... 1999.9
Resolution (W/m ²):	0.1·10 ⁻³	0.001	0.01	0.1
Spectral range:	400nm...1050nm			
Calibration uncertainty:	<5%			
f ₃ (linearity):	<1%			
f ₄ (instrument reading error):	±1 digit			
f ₅ (fatigue):	<0.5%			
Drift after 1 year:	<1%			
Working temperature:	0...50°C			

Radiometric probe for **IRRADIANCE** measurement in the spectral range 400nm...1050nm, diffuser for cosine correction. Measurement range: 0.1·10⁻³W/m² ... 2000 W/m².

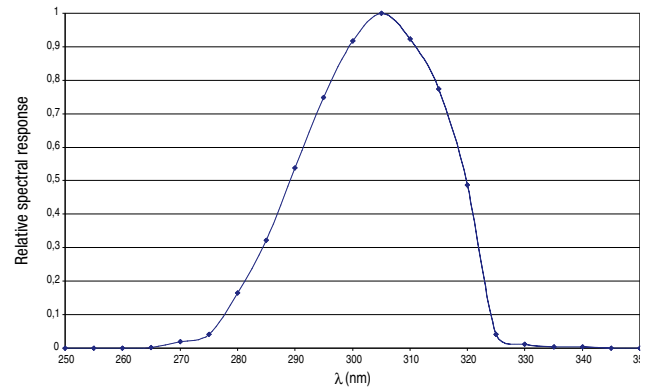
Typical response curve: LP 471 RAD



IRRADIANCE measurement probe LP 471 UVB				
Measurement range (W/m ²):	0.1·10 ⁻³ ... 999.9·10 ⁻³	1.000 ... 19.999	20.00 ... 199.99	200.0 ... 1999.9
Resolution (W/m ²):	0.1·10 ⁻³	0.001	0.01	0.1
Spectral range:	280nm...315nm (Peak 305nm)			
Calibration uncertainty:	<5%			
f ₃ (linearity):	<2%			
f ₄ (instrument reading error):	±1 digit			
f ₅ (fatigue):	<0.5%			
Drift after 1 year:	<2%			
Working temperature:	0...50°C			

Radiometric probe for **IRRADIANCE** measurement, in the spectral range 280nm...315nm, peak 305nm, **UVB**. Measurement range: 0.1·10⁻³W/m²...2000 W/m².

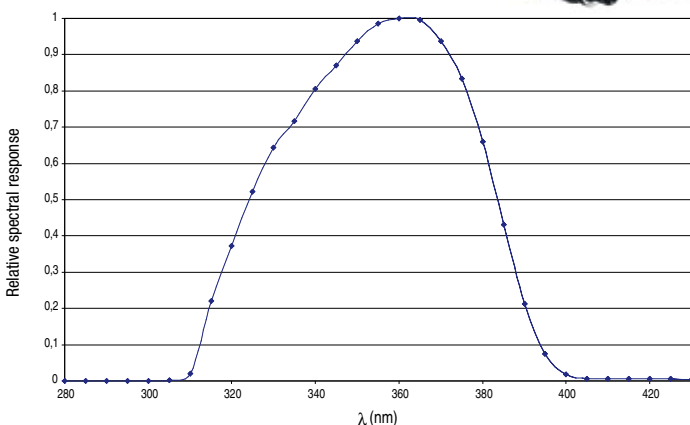
Typical response curve: LP 471 UVB



IRRADIANCE measurement probe LP 471 UVA				
Measurement range (W/m ²):	0.1·10 ⁻³ ... 999.9·10 ⁻³	1.000 ... 19.999	20.00 ... 199.99	200.0 ... 1999.9
Resolution (W/m ²):	0.1·10 ⁻³	0.001	0.01	0.1
Spectral range:	315nm...400nm (Peak 360nm)			
Calibration uncertainty:	<5%			
f ₃ (linearity):	<1%			
f ₄ (instrument reading error):	±1 digit			
f ₅ (fatigue):	<0.5%			
Drift after 1 year:	<2%			
Working temperature:	0...50°C			

Radiometric probe for **IRRADIANCE** measurement, in the 315nm...400nm, peak 360nm, **UVA** spectral range. Measurement range: 0.1·10⁻³W/m²...2000 W/m².

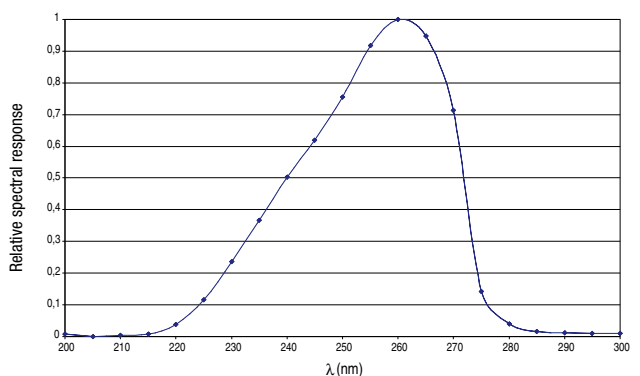
Typical response curve: LP 471 UVA



IRRADIANCE measurement probe LP 471 UVC				
Measurement range (W/m ²):	0.1·10 ⁻³ ... 999.9·10 ⁻³	1.000 ... 19.999	20.00 ... 199.99	200.0 ... 1999.9
Resolution (W/m ²):	0.1·10 ⁻³	0.001	0.01	0.1
Spectral range:	220nm...280nm (Peak 260nm)			
Calibration uncertainty:	<5%			
f ₃ (linearity):	<1%			
f ₄ (instrument reading error):	±1 digit			
f ₅ (fatigue):	<0.5%			
Drift after 1 year:	<2%			
Working temperature:	0...50°C			

Radiometric probe for **IRRADIANCE** measurement, in the spectral range 220nm...280nm, peak 260nm, **UVC**. Measurement range: 0.1·10⁻³W/m²...2000 W/m².

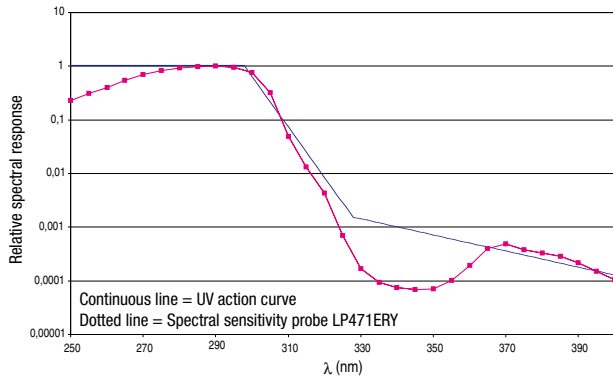
Typical response curve: LP 471 UVC



Measurement probe LP 471ERY of TOTAL EFFECTIVE IRRADIANCE (W/m^2) according to the UV action curve UV (CEI EN 60335-2-27)				
Measurement range (W_{eff}/m^2):	0.1·10 ⁻³ ... 999.9·10 ⁻³	1.000 ... 19.999	20.00 ... 199.99	200.0 ... 1999.9
Resolution (W_{eff}/m^2):	0.1·10 ⁻³	0.001	0.01	0.1
Spectral range:	UV action curve for erythema measurement (250nm...400nm)			
Calibration uncertainty:	<15%			
f_s (linearity):	<3%			
f_d (instrument reading error)	±1 digit			
f_n (fatigue):	<0.5%			
Drift after 1 year	<2%			
Working temperature:	0...50°C			
Reference standard	CEI EN 60335-2-27			

Radiometric probe for **EFFECTIVE TOTAL IRRADIANCE** (W_{eff}/m^2) according to the UV action curve (CEI EN 60335-2-27). Spectral range: 250 nm...400 nm, Measurement range: 0.1·10⁻³ W_{eff}/m^2 ... 2000 W_{eff}/m^2

Typical response curve: LP 471 ERY



The probe LP 471 ERY measures the effective total irradiance (W_{eff}/m^2) according to the UV action curve (CEI EN 60335-2-27). A particular type of photodiode and a combination of special filters bring the spectral response closer to the UV action curve. CEI EN 60335-2-27 standards establish a maximum allowable dose of 100J/m² for first-time exposure and an annual dose of 15000J/m². The typical spectral response curve of LP 471 ERY is shown in the Figure together with the UV action curve. The good accordance between the two curves enables the instrument to take reliable measurements of different types of lamps (and filters) used at present for tanning machines.

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: 0.01 lux...200·10³ lux.
- LP 471 LUM 2:** Photometric probe for **LUMINANCE** measurement complete with SICRAM module, spectral response in agreement with standard photopic vision, vision angle 2°. Measurement range: 0.1 cd/m²...2000·10³ 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 $\mu\text{mol}/m^2\cdot\text{s}^{-1}$, diffuser for cosine correction. Measurement range: 0.01 $\mu\text{mol}/m^2\cdot\text{s}^{-1}$...10·10³ $\mu\text{mol}/m^2\cdot\text{s}^{-1}$.
- LP 471 RAD:** Radiometric probe for **IRRADIANCE** measurement complete with SICRAM module; in the 400nm...1050nm spectral range, diffuser for cosine correction. Measurement range: 0.1·10⁻³ W/m^2 ...2000 W/m^2 .
- 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: 0.1·10⁻³ W/m^2 ...2000 W/m^2 .
- LP 471 UVB:** Radiometric probe for **IRRADIANCE** measurement complete with SICRAM module, in the 280nm...315nm, peak 305nm, **UVB** spectral range, quartz diffuser for cosine correction. Measurement range: 0.1·10⁻³ W/m^2 ...2000 W/m^2 .
- LP 471 UVC:** Radiometric probe for **IRRADIANCE** measurement complete with SICRAM module, in the 220nm...280nm, peak 260nm, **UVC** spectral range, quartz diffuser for cosine correction. Measurement range: 0.1·10⁻³ W/m^2 ...2000 W/m^2 .
- LP 471 ERY:** Radiometric probe for **EFFECTIVE TOTAL IRRADIANCE** (W_{eff}/m^2) according to the UV action curve (CEI EN 60335-2-27) complete with SICRAM module. Spectral range: 250 nm...400 nm, quartz diffuser for cosine correction. Measurement range: 0.1·10⁻³ W_{eff}/m^2 ... 2000 W_{eff}/m^2 .
- LP BL:** Base with levelling device (except LP 471 LUM 2).

CO and CO₂ probes equipped with SICRAM module

- HD320A2:** Carbon monoxide (CO) probe, fullscale 500ppm. 2m cable. Complete with SICRAM module.
- HD320B2:** CO₂ probe, fullscale 500 ppm. Ø 14 mm, total length 200 mm. 2 m cable. Complete with SICRAM module.



HD320A2



HD320A

HD320B