



Laboratory
technical
sales manual

LIEBHERR
Quality, Design and Innovation

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LKPv and LGPv laboratory appliances with Profi electronic controller

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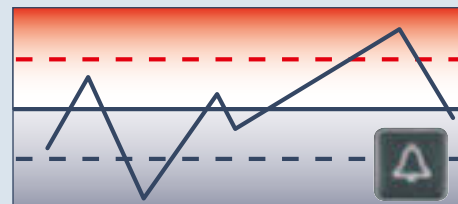
Alarm, memory and safety functions

Liebherr MediLine refrigerators and freezers with Profi electronic controller help to protect your inventory. These cabinets offer a variety of alarm, memory and safety features designed to greatly reduce the risk of loss of contents.

Temperature, door opening and power failure alarms

High and low temperature alarms

All LKPv and LGPv models have integrated high and low internal air temperature alarms with both audio and visual signals. The factory settings for the alarm limits are $+3/-2$ K in relation to the set temperature. If the set temperature is altered to meet a specific storage temperature requirement then the alarm settings move in parallel and do not need to be adjusted separately. To avoid any unnecessary triggering of the alarm (following intentional opening of the door for example), these appliances feature a temperature alarm delay, which can be adjusted as required.



Door opening alarm

All LKPv and LGPv models register when doors are left open or ajar and have an integrated audio and visual door opening alarm. This alarm has a 1 minute delay which can be adjusted.



Power failure alarm

All LKPv and LGPv models have a battery back-up which operates an audio and visual alarm immediately upon power failure. Both the integrated temperature data logger and the optional external temperature monitoring via the RS 485 interface continue to function during power failure for up to 72 hrs.



Internal system alarms

The following alarms are related to internal self-checks of the refrigeration system and the electronic controller probes. While these might not be immediately relevant to the everyday operation of the cabinets they do provide added security by warning probably before the air temperature probe registers an alarm condition. They also provide a service engineer with valuable information thus allowing quicker intervention.

High condenser temperature alarm

This integrated audio and visual alarm warns of excessive condenser temperatures possibly caused by e.g. high ambient temperatures or blocked air-flow to or from the refrigeration system.



Low evaporator temperature alarm

This integrated audio and visual alarm warns of low evaporator temperatures possibly caused by e.g. defective air-circulation fan or blocked internal air-flow. This alarm will possibly warn much sooner than the high or low temperature alarm.



Probe failure alarm

As a self-control system, defective probes are registered and the controller cause an audio and visual alarm signal. In case of an air-probe error the controller has pre-defined operating modes to maintain the internal temperature at $+5^{\circ}\text{C}$ on refrigerators or at -20°C on freezers.



Internal memory functions

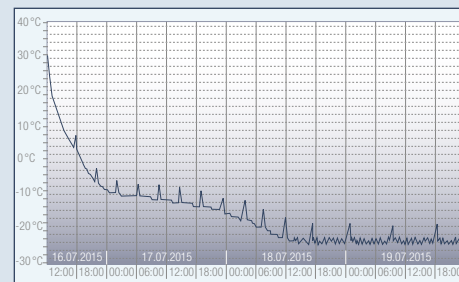
Internal alarm memory

This function stores to memory details of the last 30 alarms: time and date of the start and the end of the alarm condition, the type of the alarm condition and the maximum and minimum internal air temperatures measured during this alarm condition period are registered.



Internal temperature memory

This function stores to the memory the internal temperature profile at 4-minute intervals. 2800 temperature logs are stored to memory, which corresponds to approximately a 7-day logging period.



Special safety functions

Solid-state relay for maximum reliability

The LKPv and LGPv models all have a solid-state relay guaranteed to > 1 billion compressor start cycles. As well as allowing very accurate temperature control this feature practically excludes the possibility of burnt relay contacts as a cause for extreme internal temperatures.



Double fan cooling

All LKPv and LGPv models have a double internal fan arrangement so that in case of one defective fan the cooling system continues to function at reduced capacity. The highly reliable fans Liebherr uses are guaranteed to 80 000 hrs operating time.



Temperature and alarm documentation

Liebherr MediLine refrigerators and freezers with Profi electronic controller help to protect your inventory. The appliances offer a variety of features and options that are specifically designed to allow remote monitoring of interior temperatures, product temperatures and alarm events, in order to provide comprehensive documentation of the storage conditions.

External temperature and alarm monitoring connections

Infrared interface and optional infrared key

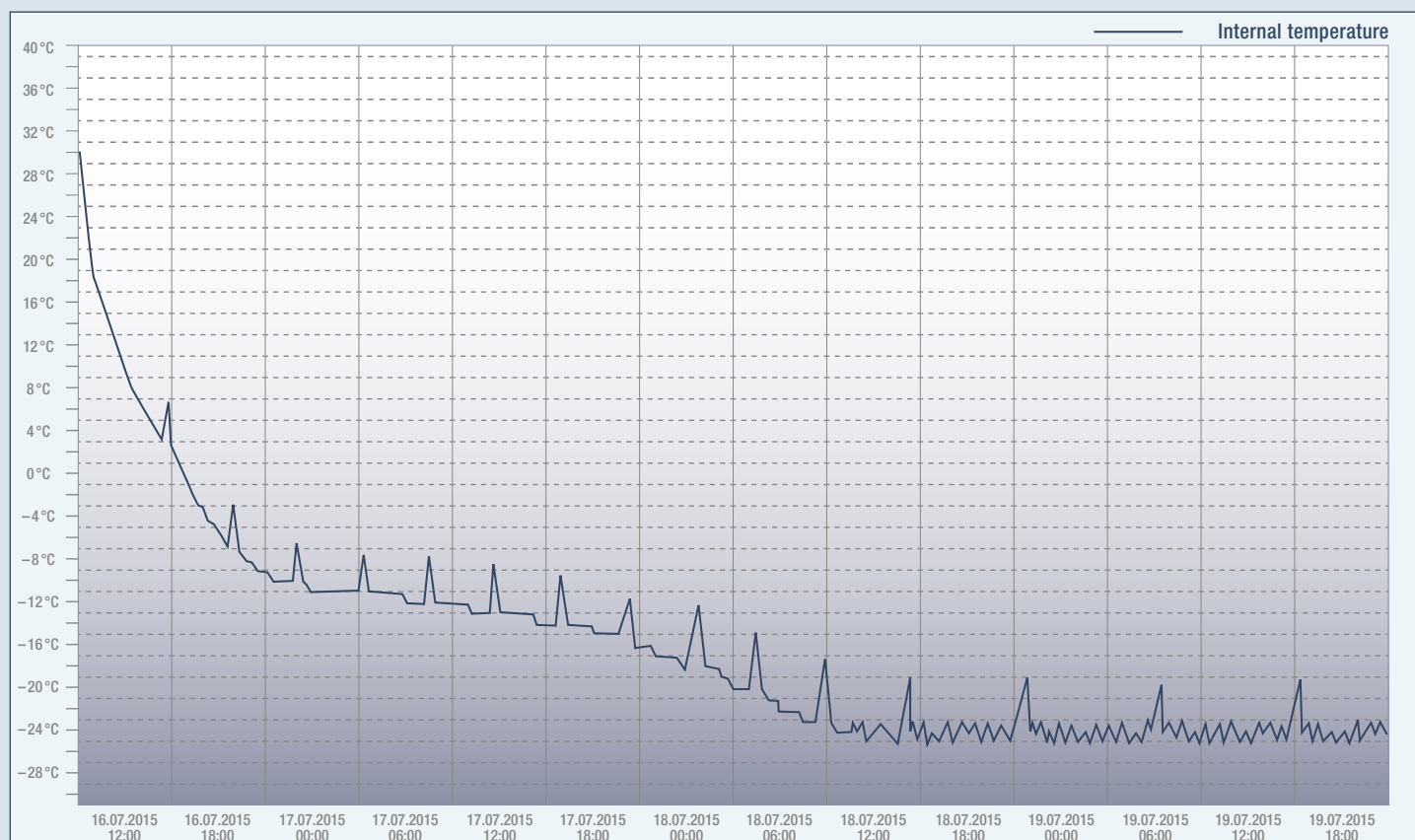
All LKPv and LGPv models have an integrated temperature data logger which stores up to 2800 air-probe temperature values recorded at 4 minute intervals, which equals approximately 7.7 days. In order to use this data an infrared device ("key") is available as an optional extra. The data is transferred from the infrared interface on the cabinet to the "infrared key". This "key" is then connected by cable to a PC or laptop and the data is transferred onto the dedicated software on the PC. Only one set of data i.e. from one cabinet, can be transferred at one time.



The optional kit includes all the necessary components: key, cable and software including manual. The software allows visualisation and analysis of the temperature data in various formats including a graph. The data can also be exported to Excel, Word and other standard formats for storage or further analysis.



Example: visualisation of temperature data

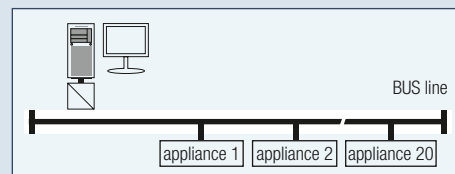


RS 485 interface and optional signal converter

All LKPv and LGPv models have an RS 485 interface. If an RS 485 monitoring system is not already in place, a converter kit is available as an optional extra to convert the RS 485 signal to an RS 232 signal and allow connection to a PC or laptop.



The RS 485 bus connection is made using standard shielded data cables, e.g. type LiYCY 2 x 0,14 mm². The maximum possible length of the data lines depends on the quality of the components used. The maximum range is 500 m. A maximum of 20 appliances can be wired in series.



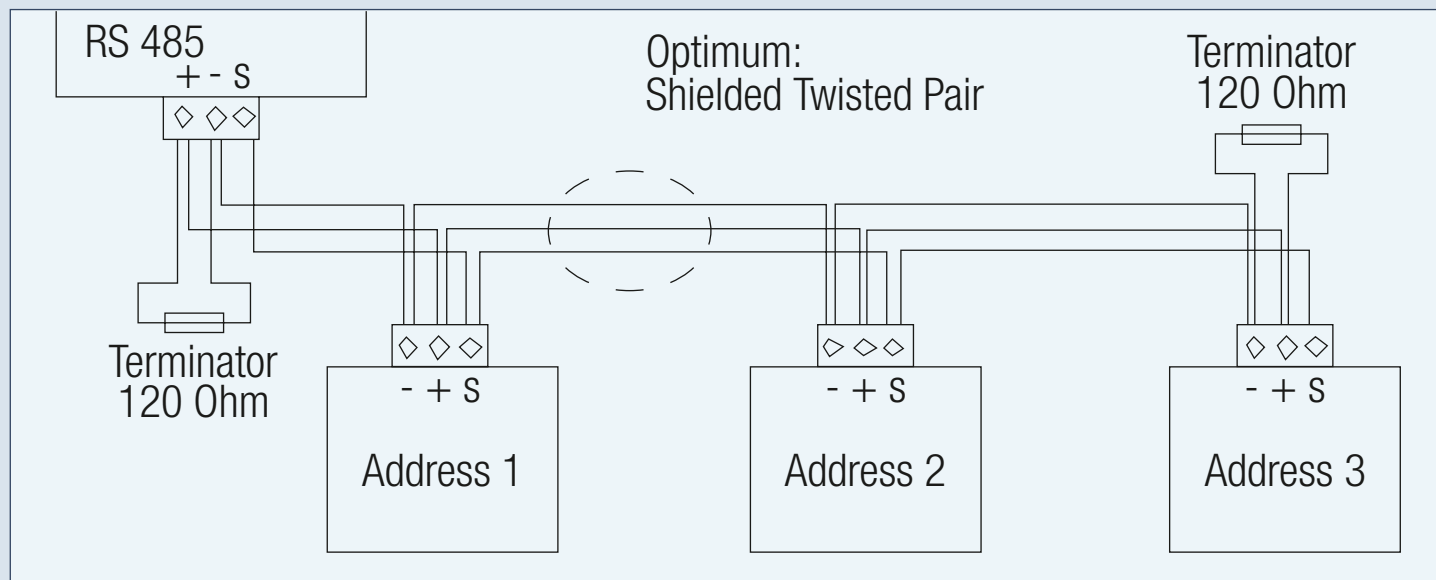
Dedicated software is provided in the accessory package allowing visualisation, analysis and export to other formats for storage. The software reads the air-probe temperature at 2 minute intervals and records alarm conditions. When an alarm condition is registered the software will warn on the PC on which the software is running. If this PC is not supervised (e.g. at night or over weekends) then the alarm signal might not be recognised. In order to avoid unrecognised alarms the software includes an email function, which sends an email in case of an alarm condition to predefined email addresses. These emails can be easily checked with a smartphone. Therefore the user will be warned without having direct access to a computer.



Networking

Both laboratory appliances with Profi electronic controller as well as laboratory appliances with Comfort electronic controller can be networked using the same Liebherr accessory package "Interface converter with monitoring software".

Example: RS 485 network



External alarm contact connection

Volt-free contact

All LKPV and LGPV models have an integrated volt-free contact. The relay contact can be wired into a warning system in the building which would advise e.g. security personnel or a janitor outside of working hours. Warning systems with audio or visual alarms are possible.

The following example shows a circuit with a visual alarm. Either normal operation or alarm condition or both can be indicated. Either AC or DC circuits are possible, max. AC 230 V / 5 A.

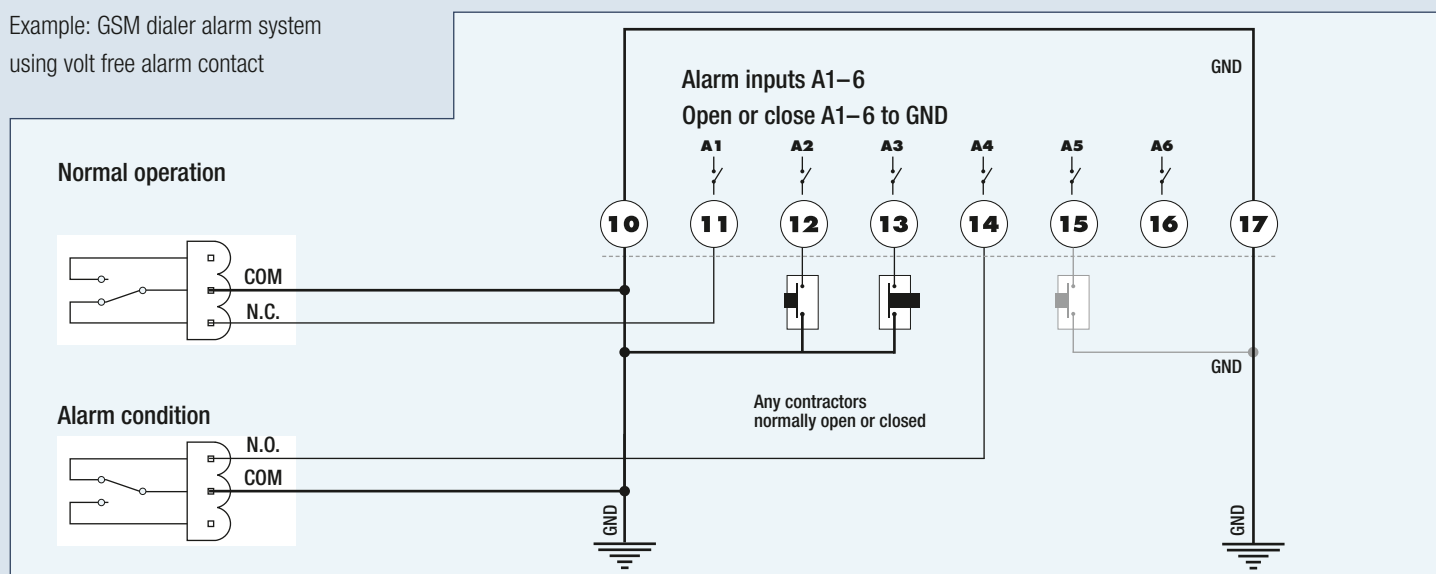
Example: visual alarm system using volt free alarm contact



Alternatively, if no internal warning system is in place and additional wiring inside the building is problematical, the volt-free contact can be used in conjunction with e.g. a GSM alarm dialer. There are many different versions of GSM alarm dialers available on the market which either call a telephone number and/or send a text message in case of an alarm. Depending on the specification of the alarm dialer, potentially many appliances can be connected to one dialer. Being GSM appliances, only a SIM card and a power supply are required.

The following example shows a circuit with a GSM dialer: A change in relay setting activates the alarm function of the dialer and thus initiates either a telephone call or an SMS to pre-defined numbers with a pre-recorded message. The dialer in the example has 6 addressed alarm inputs. This could be 6 individual appliances or 6 rooms, each with several appliances wired in series.

Example: GSM dialer alarm system using volt free alarm contact



In spite of all efforts to produce appliances of unequalled reliability, Liebherr strongly recommends that the volt-free contact is wired into some kind of independent and external warning system. Please take a few moments to consider the value of the contents of the refrigerators and freezers under your supervision. The cost of such a warning system is often negligible in comparison to the value of the contents.

Product temperature monitoring connection

Interface for optional NTC product temperature probe

All LKPv and LGPv models have an integrated interface for connecting an optional available NTC product temperature probe to the Profi electronic controller. The controller can be set to display either the internal air temperature, as registered by the air probe or the temperature registered by the product probe or both. Also the temperature alarm limits as well as the temperature alarm delay for the product temperature probe can be adjusted by the user to suit individual requirements. In addition the product temperature can be monitored on an external documentation system via the RS 485 interface.

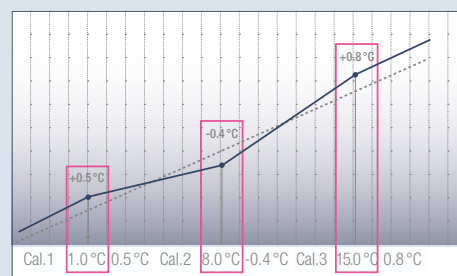


Whereas the air probe is in a fixed position, the product probe will be located by the user, e.g. in a phial or in a measurement package in order to simulate a product temperature.

The product temperature probe is water resistant and resistant to corrosion (IP 68 and AISI 316). It complies with all relevant NSF standards.



Due to possible tolerances of the product temperature probe the temperature displayed can differ from the product probe temperature. Using the calibration function, the temperature displayed can be aligned with the product probe temperature at as many as three temperature points. The correction value for the compensation of the differences can be adjusted in 0,1°C steps.



Safety feature table

Laboratory appliances with Profi electronic controller	LKPv 6520	LKPv 6523	LKPv 8420	LKPv 1420	LKPv 1423	LGPv 6520	LGPv 8420	LGPv 1420
Spark-free interior	No	No	No	No	No	No	No	No
High / low temperature alarm, audio and visual	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Door opening alarm, audio and visual	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Power failure alarm through battery backup for 72h, audio and visual	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Volt-free contact for external alarm signal	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
RS 485 data transfer interface	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Infrared data transfer interface	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Infrared data transfer key with data monitoring software	Accessory	Accessory	Accessory	Accessory	Accessory	Accessory	Accessory	Accessory
RS 485 / RS 232 converter with data monitoring software	Accessory	Accessory	Accessory	Accessory	Accessory	Accessory	Accessory	Accessory
NTC product temperature probe	Accessory	Accessory	Accessory	Accessory	Accessory	Accessory	Accessory	Accessory
Internal alarm memory	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Min. / max. temperature memory	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Access port for e.g. PT 100 probe	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Probe failure alarm	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Condenser and evaporator temperature alarms	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Temperature consistency and distribution according to EN 60068-3

The Liebherr laboratory cabinets are all tested in-house to the EN 60068-3 test procedure. The measurement results for the appliance setups can be found in the results section. Please note the measurements are for the specific appliances tested and are for reference only. Liebherr's development facility is certified to ISO 17025 (general requirements for the competence of testing and calibration laboratories).

Description of the EN 60068-3 test procedure

The general test conditions are as follows:

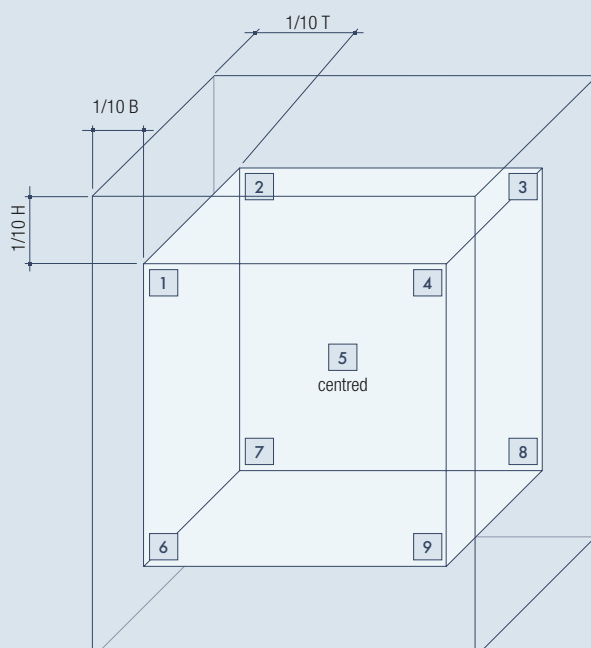
- Ambient temperature +25 °C
- 60 % relative humidity
- Refrigerator set temperature +5 °C
- Freezer set temperature -20 °C
- Maximum deviation of the mean temperature value (including measurement uncertainty) for laboratory refrigerators with Profi electronic controller:
+/- 3K from the set interior temperature
- Maximum deviation of the mean temperature value (including measurement uncertainty) for laboratory freezers with Profi electronic controller:
+/- 5K from the set interior temperature

Measurements are made using 9 x PT 100 air temperature probes positioned in accordance with EN 60068-3.

"Unless specifically stipulated, the temperature probes are located at equal distances from the walls of 1/10 of each of the dimensions of the internal volume (w/h/d). The location of the probes used for characterisation forms a supposedly representative sample of the working space."

The characterisation is performed using nine probes; one located at each corner, one in the centre of the working space.

Location of the probes used for characterisation



Cabinets are tested empty over a period of 24 hrs including defrost cycles.

Test criteria for characterising the temperature consistency and distribution

1) Gradient or homogeneity: “The gradient $H\theta$ is the maximum difference, obtained in an achieved environment, between the mean values of measurements θ_{mj} increased by their expanded uncertainty U_{mj} , within the working space during the measurement time.”

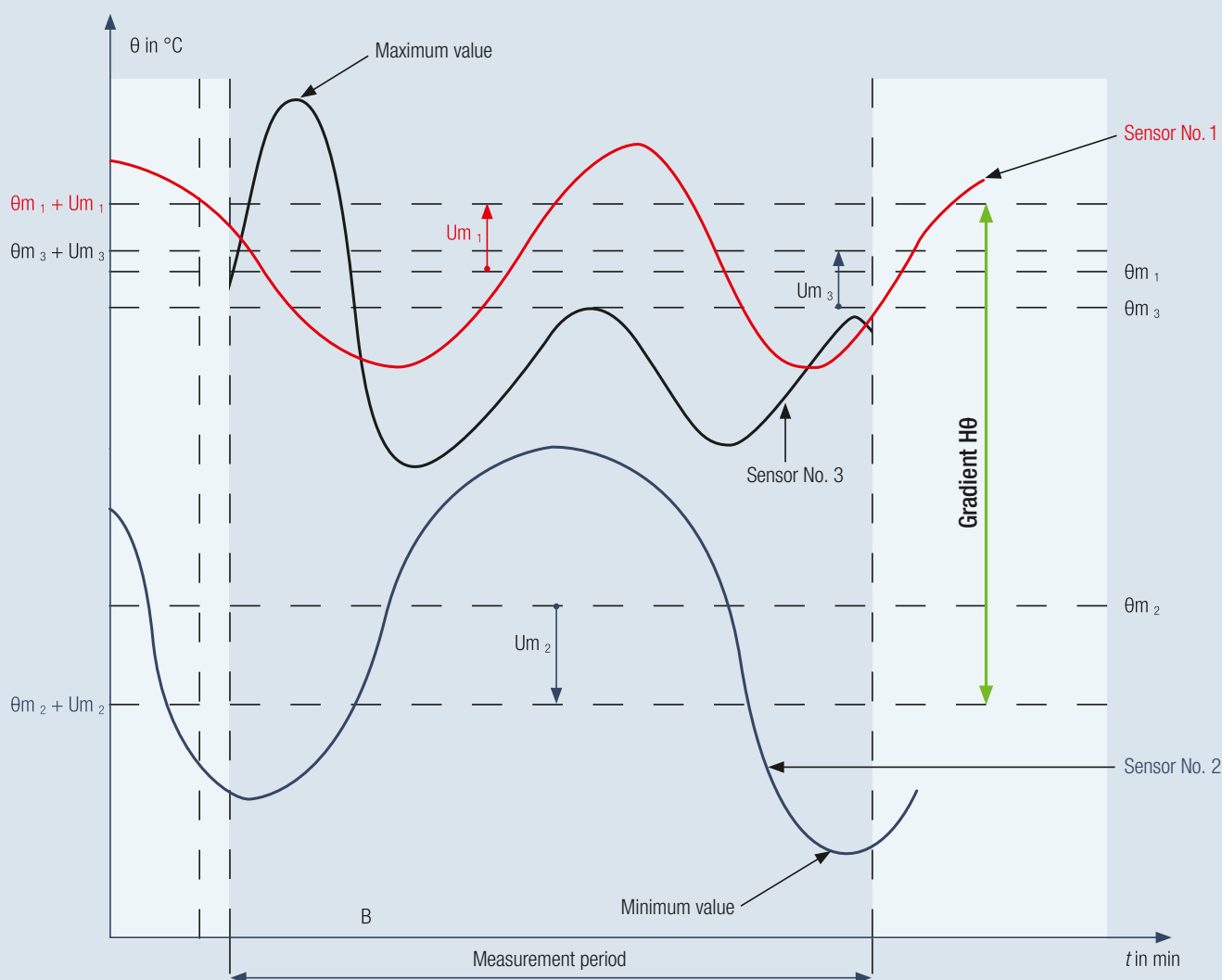
Gradient: “Distribution of temperatures within the chamber”

$$H\theta = \max (\theta_{mj} + U_{mj}) - \min (\theta_{mj} - U_{mj})$$

max = (mean value warmest probe + expanded measurement uncertainty)

min = (mean value coldest probe – expanded measurement uncertainty)

Example: Gradient/Homogeneity

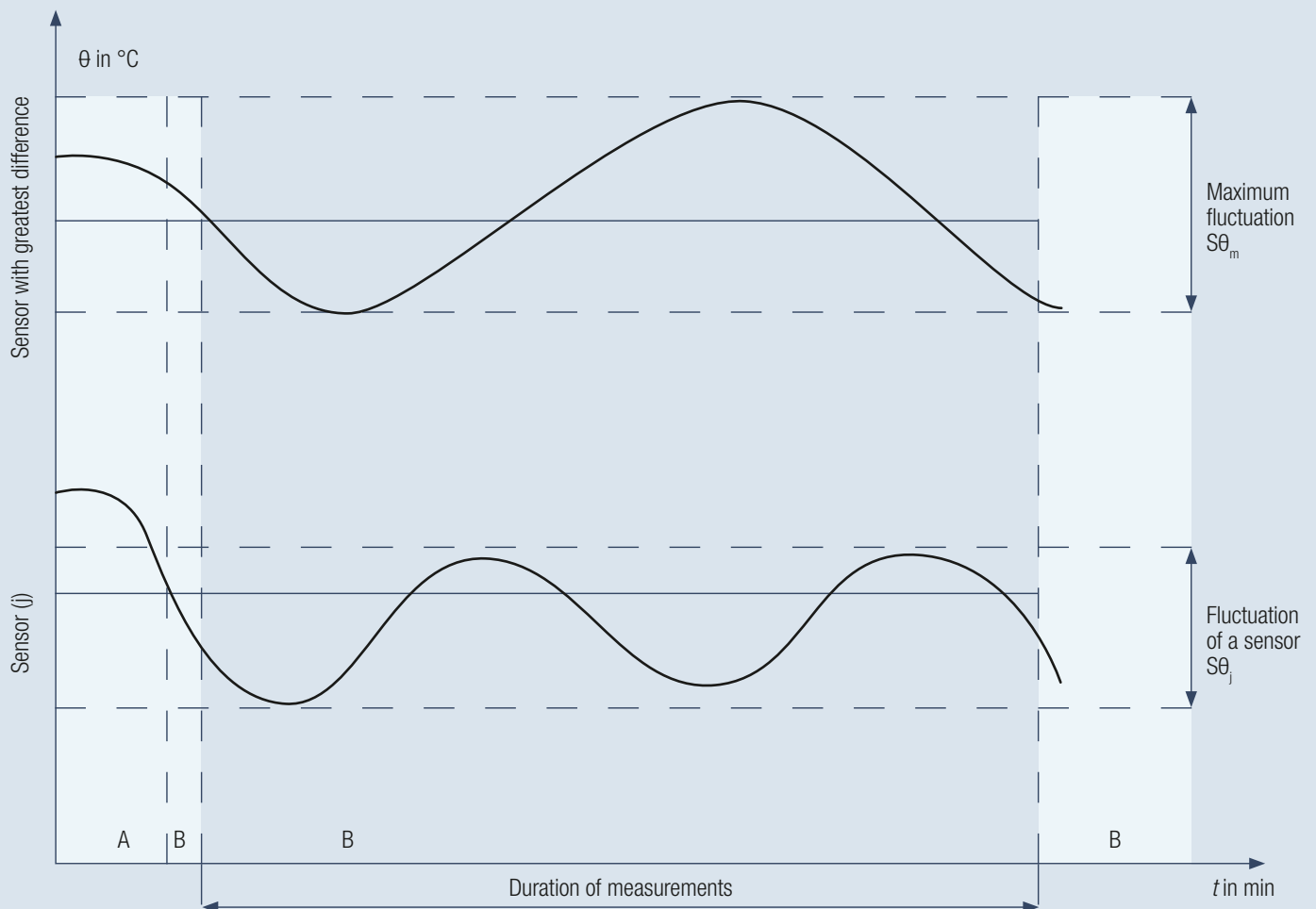


The gradient indicates the temperature distribution within the cabinets. Especially in the laboratory sector optimum temperature distribution is crucial to guarantee the safe storage of samples or other products at any place within the unit. The lower the gradient the better is the temperature distribution within the unit.

2) Fluctuation: “The characterisation of the temperature fluctuation within the working space enables to determine the variation in maximum temperature at a measurement point of the working space during the measurement time.”

- Fluctuation of the point $S\theta_j$: The difference between the maximum and minimum values measured at point j during the duration of measurements
- Maximum fluctuation, $S\theta_M$: Maximum value of all fluctuation values $S\theta_j$ during the duration of measurements

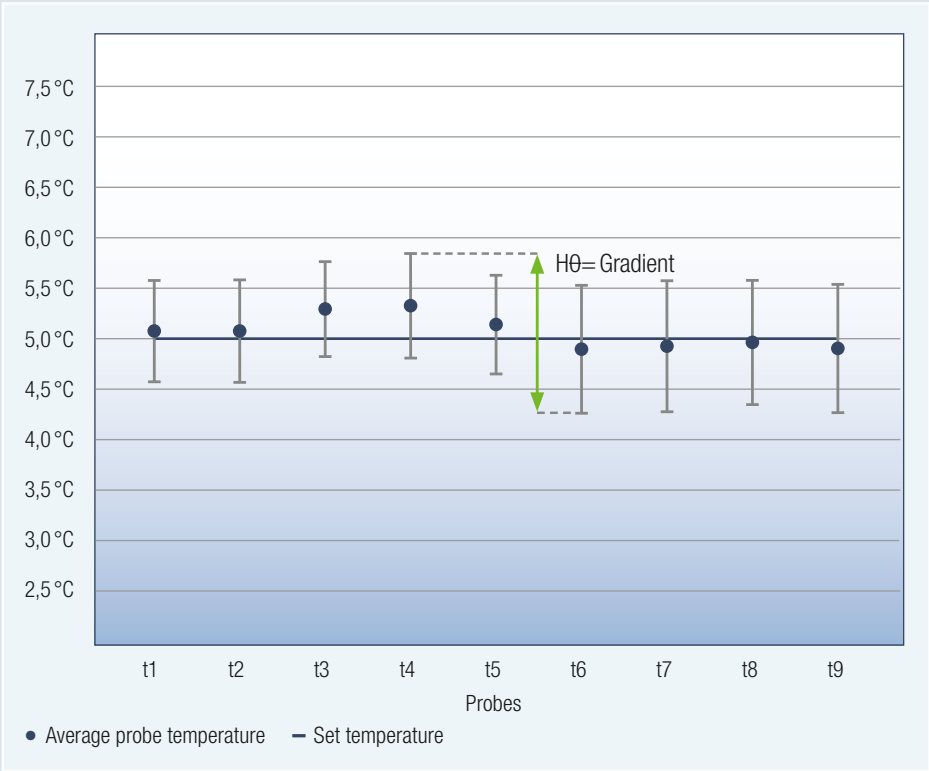
Example: Fluctuation



Results according to EN 60068-3 for laboratory appliances LKPv und LGPv

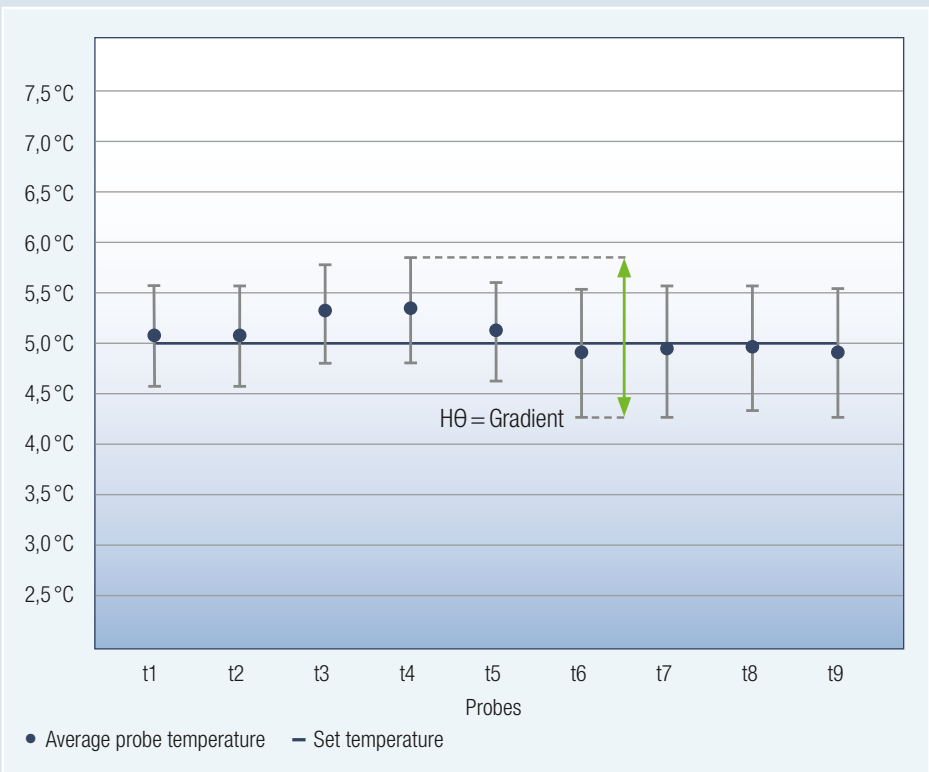
The evaluation of air temperatures of the LKPv and LGPv models according to EN 60068-3 using 9 PT 100 temperature probes shows the following results:

LKPv 6520



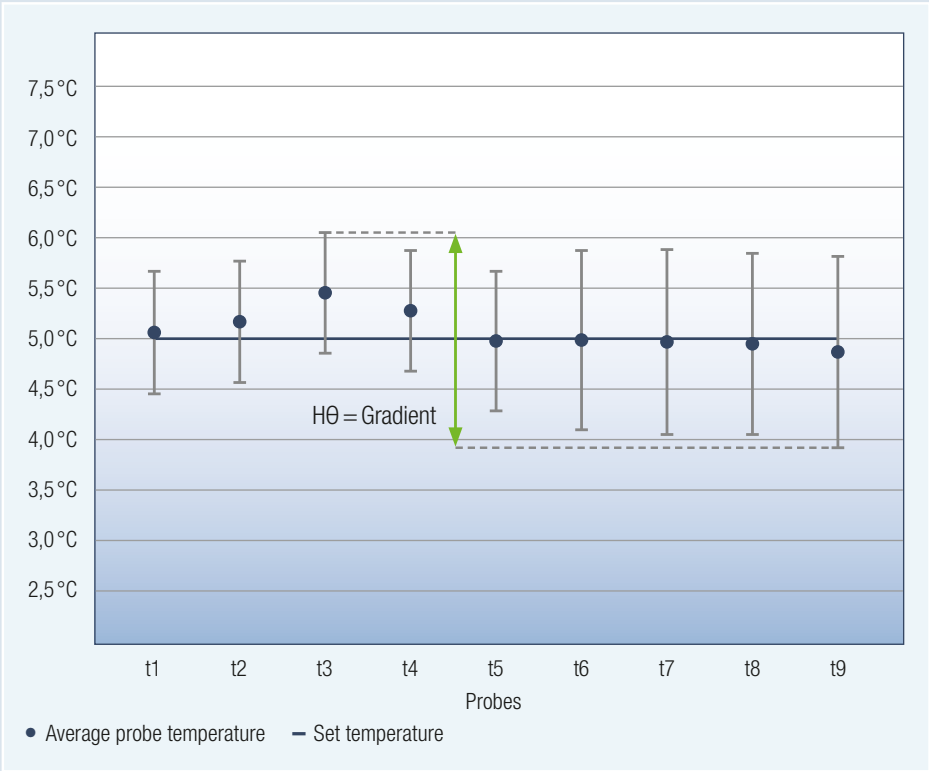
Gradient Hθ : 1.8 K
Max. fluctuation: 1.0 K

LKPv 6523



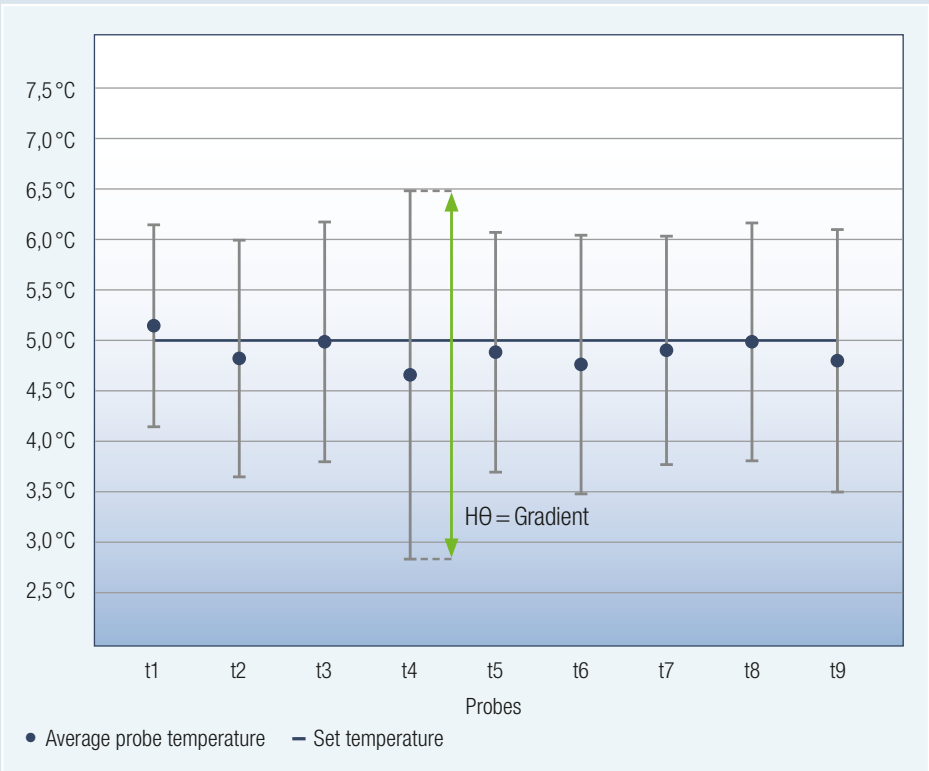
Gradient Hθ : 1.8 K
Max. fluctuation: 1.0 K

LKPv 8420



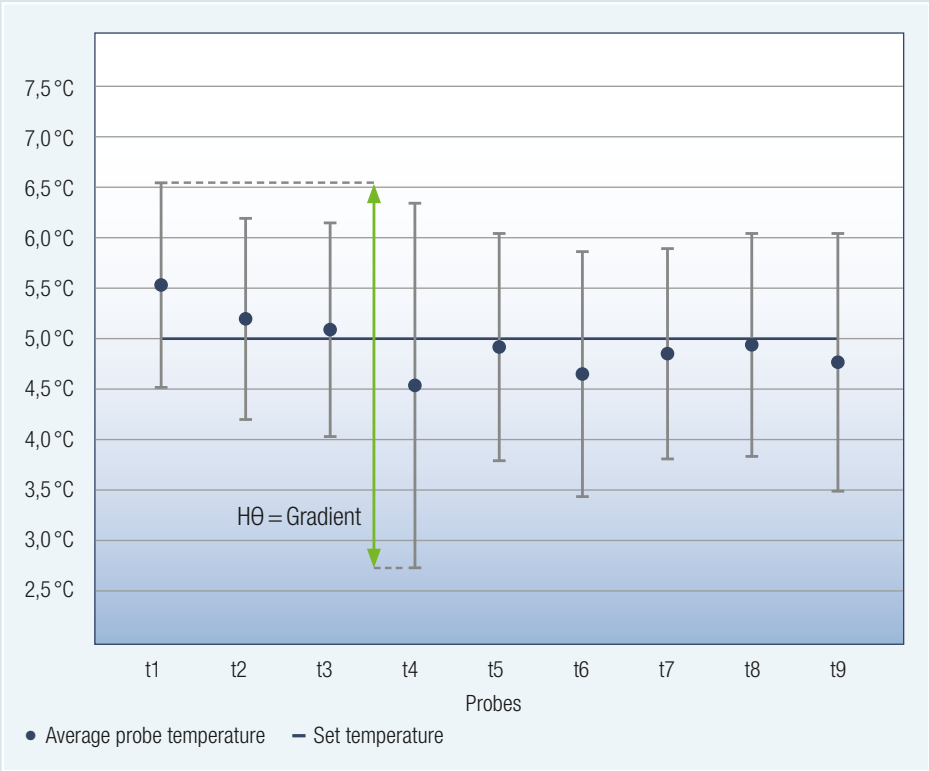
Gradient HΘ: **2.9K**
Max. fluctuation: **1.8 K**

LKPv 1420



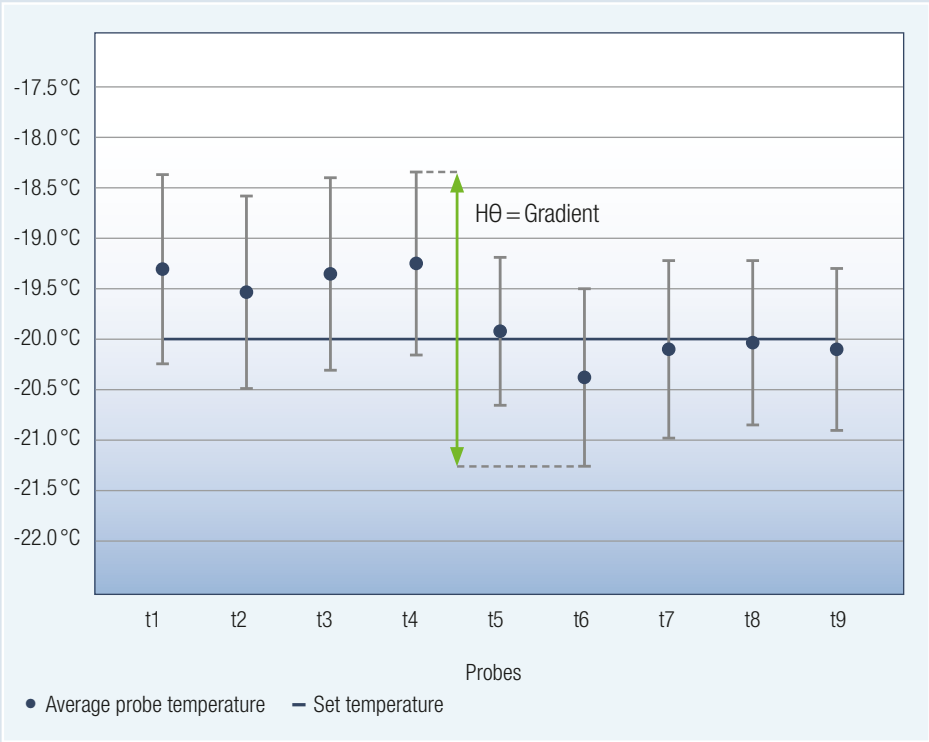
Gradient HΘ: **3.3K**
Max. fluctuation: **2.9K**

LKPv 1423



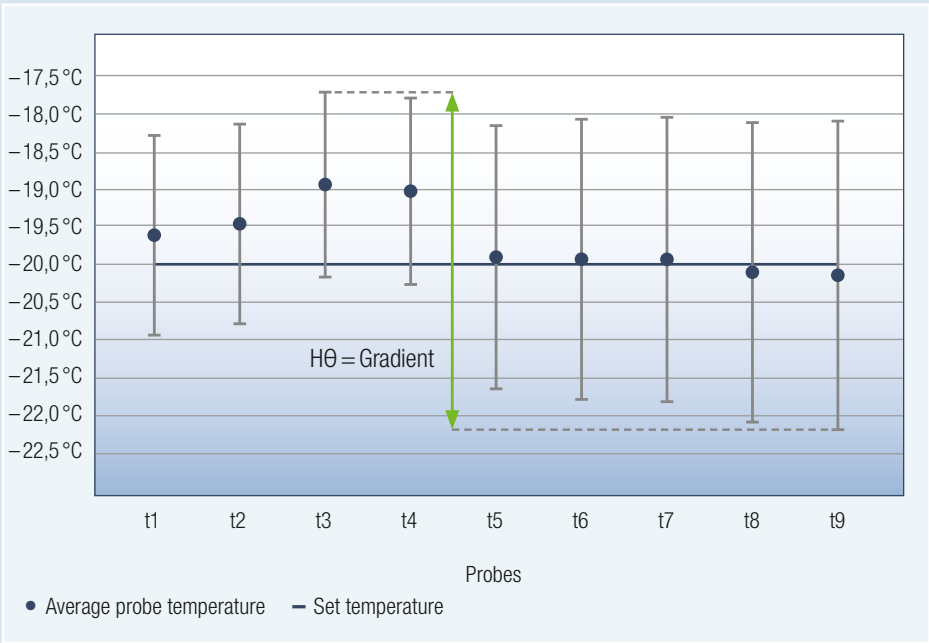
Gradient H0: 4.7 K
Max. fluctuation: 3.9 K

LGPv 6520



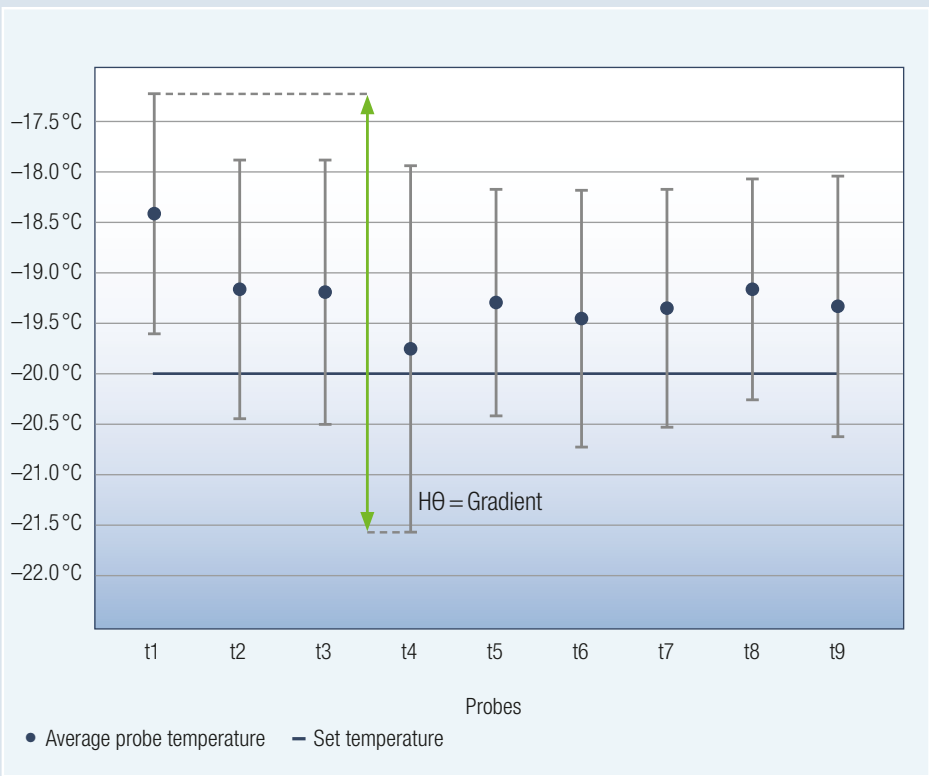
Gradient H0: 5.2 K
Max. fluctuation: 3.6 K

LGPv 8420



Gradient HΘ: 7.1 K
Max. fluctuation: 5.7 K

LGPv 1420



Gradient HΘ: 7.5 K
Max. fluctuation: 6.7 K

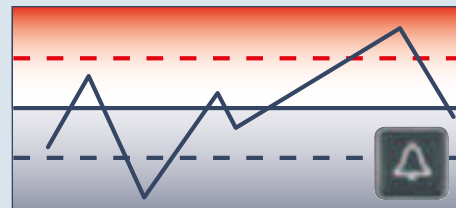
Alarm, memory and safety functions

Liebherr Mediline refrigerators and freezers with Comfort electronic controller help to protect your inventory. These cabinets offer a variety of alarm, memory and safety features designed to greatly reduce the risk of loss of contents.

Temperature, door opening and power failure alarms

High and low temperature alarms

All LK(U)v, LC(ex)v, LK(U)exv, LG(U)ex and LGT models have integrated high and low internal air temperature alarms with both audio and visual signals. The factory settings for the alarm limits are $+3/-3$ K in relation to the set temperature: If the set temperature is altered to meet a specific storage temperature requirement then the alarm settings move in parallel and do not need to be adjusted separately. There is a 15 minutes delay to avoid unwanted alarms due to e.g. door opening. The alarm parameters can however be adjusted by the user to suit individual requirements.



Door opening alarm

All LK(U)v, LC(ex)v, LK(U)exv, LG(U)ex and LGT models register when doors are left open or ajar and have an integrated audio and visual door opening alarm. The alarm has a delay period of 1 minute, and this can be extended to 5 minutes if required.



Power failure alarm

In the event of a power failure that lasts longer than 1 minute, and when the set temperature alarm thresholds have been exceeded, all LK(U)v, LC(ex)v, LK(U)exv, LG(U)ex and LGT models trigger a visual power failure alarm once the mains power has been restored. The power failure alarm remains until it is manually reset.



Internal system alarm

The following alarm is related to internal self-checks of the electronic controller probes. While this might not be immediately relevant to the every-day operation of the cabinets it does provide added security by warning probably before the air temperature probe registers an alarm condition.

Probe failure alarm

As a self-control system, defective probes are registered and the controller causes an audio and visual alarm signal. In case of an air-probe error the controller has pre-defined operating modes to maintain the internal temperature at $+5^{\circ}\text{C}$ on refrigerators or at -20°C on freezers.



Internal memory functions

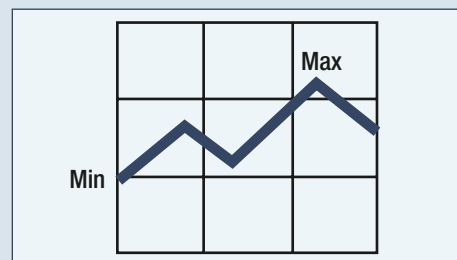
Internal alarm memory

This function stores to memory details of the last three temperature and power failure alarms. Time and date of the start and the duration of the alarm conditions are registered.



Min. / max. temperature memory

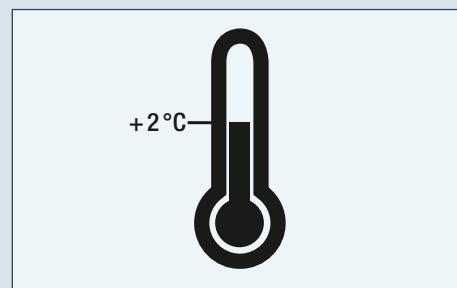
After reaching the set temperature for the first time, the Comfort electronic controller begins continuously to store to memory the highest and lowest internal temperatures registered. These minimum and maximum temperatures can be read out from the memory. After reading the min./max. memory, the values can either be reset or left in the memory. Normally the values would be noted by the user and the memory reset in order to define the next period to be registered. The controller also registers the time elapsed since the last reset up to a period of ~ 40 days.



Special safety function

Electro-mechanical +2°C safety thermostat for laboratory refrigerators with Comfort electronic controller

In order to ensure maximum reliability, the Comfort electronic controller has a heavy-duty compressor relay thus reducing the possibility of burned relay contacts. Should however a defect occur, an additional safety thermostat backs up the controller to prevent the product temperature from dropping below +2 °C.



Temperature and alarm documentation

Liebherr MediLine refrigerators and freezers with Comfort electronic controller help to protect your inventory. These cabinets offer a variety of features and options designed both for external monitoring of the internal temperatures, the product temperatures and alarm conditions to greatly reduce the risk of loss of contents.

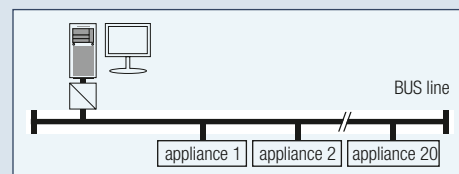
External temperature and alarm monitoring connection

RS 485 interface and optional signal converter

All LK(U)v, LC(ex)v, LK(U)exv, LG(U)ex and LGT models have an integrated RS 485 interface. If an RS 485 monitoring system is not already in place, a converter kit is available as an optional extra to convert the R 485 signal to an RS 232 signal and allow connection to a PC or laptop.

The RS 485 bus connection is made using standard shielded data cables, e.g. type LiYCY 2 x 0,14 mm². The maximum possible length of the data lines depends on the quality of the components used. The maximum range is 500 m. A maximum of 20 appliances can be wired in series.

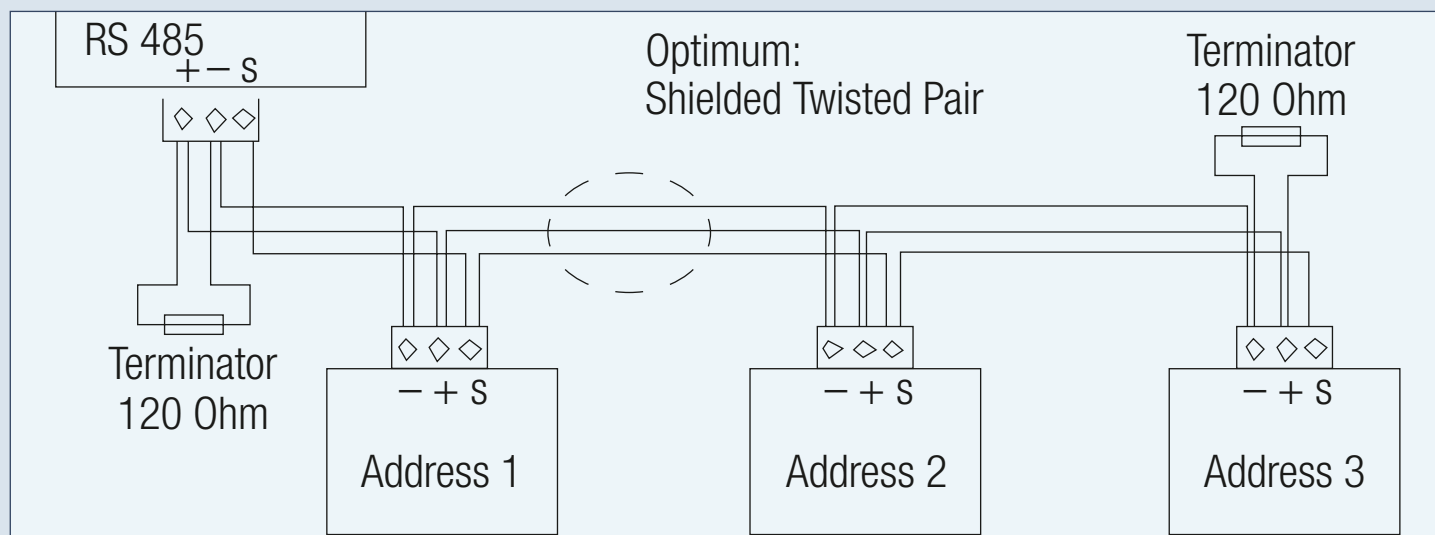
Dedicated software is provided in the accessory package allowing visualisation, analysis and export to other formats for storage. The software reads the air-probe temperature at 2 minute intervals and records alarm conditions. When an alarm condition is registered the software will warn on the PC on which the software is running: if this PC is not supervised (e.g. at night or over weekends) then the alarm signal might not be recognised. In order to avoid unrecognised alarms the software includes an email function, which sends an email in case of an alarm condition to predefined email addresses. These emails can be easily checked with a smartphone. Therefore the user will be warned without having direct access to a computer.



Networking

Both laboratory appliances with Profi electronic controller as well as laboratory appliances with Comfort electronic controller can be networked using the same Liebherr accessory package "Interface converter with monitoring software".

Example: RS 485 network



External alarm contact connection

Volt-free contact

All LK(U)v, LC(ex)v, LK(U)exv, LG(U)ex and LGT models have an integrated volt-free contact. The relay contact can be wired into a warning system in the building which would advise e.g. security personnel or a janitor outside of working hours. Warning systems with audio or visual alarms are possible.

The following example shows a circuit with a visual alarm. Either normal operation or alarm condition or both can be indicated. Either AC or DC circuits are possible. The connection is designed for a maximum of 42 V / 8 A SELV (Safety Extra Low Voltage) DC supply (min. current 150 mA).

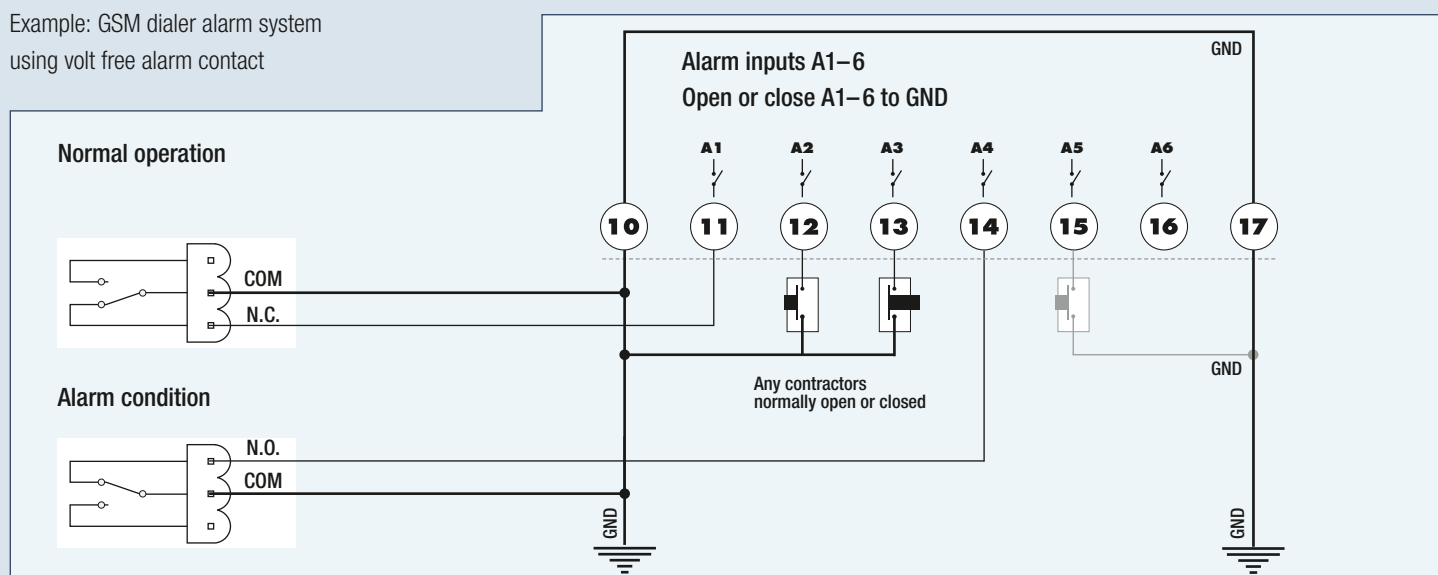
Example: visual alarm system using volt free alarm contact



Alternatively, if no internal warning system is in place and additional wiring inside the building is problematical, the volt-free contact can be used in conjunction with e.g. a GSM alarm dialer. There are many different versions of GSM alarm dialers available on the market which either call a telephone number and/or send a text message in case of an alarm. Depending on the specification of GSM alarm dialers, potentially many appliances can be connected to one dialer. Being GSM appliances, only a SIM card and a power supply are required.

The following example shows a circuit with a GSM dialer: A change in relay setting activates the alarm function of the dialer and thus initiates either a telephone call or an SMS to pre-defined numbers with a pre-recorded message. The dialer in the example has 6 addressed alarm inputs. This could be 6 individual appliances or 6 rooms, each with several appliances wired in series.

Example: GSM dialer alarm system using volt free alarm contact



In spite of all efforts to produce appliances of unequalled reliability, Liebherr strongly recommends that the volt-free contact is wired into some kind of independent and external warning system. Please take a few moments to consider the value of the contents of the refrigerators and freezers under your supervision. The cost of such a warning system is often negligible in comparison to the value of the contents.

Product temperature monitoring connection

Interface for optional NTC product temperature probe

All LK(U)v, LC(ex)v, LK(U)exv, LG(U)ex and LGT models have an integrated interface for connecting an optional available NTC product temperature probe to the Comfort electronic controller. The controller can be set to display either the internal air temperature, as registered by the air probe, or the temperature registered by the product probe. Depending on this selection the temperature alarm limits are related either to the air probe or to the product probe. In addition the product temperature can be monitored on an external documentation system via the RS 485 interface.

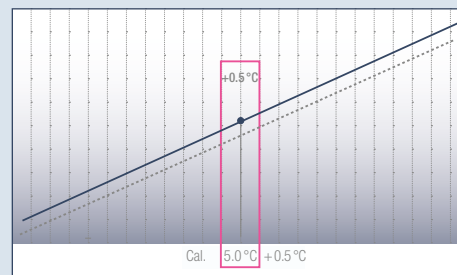


Whereas the air probe is in a fixed position, the product probe will be located by the user, e.g. in a phial or in a measurement package in order to simulate a product temperature.

The product temperature probe is water resistant and resistant to corrosion (IP 68 and AISI 316). It complies with all relevant NSF standards.



Due to possible tolerances of the product temperature probe the temperature displayed can differ from the product probe temperature. Using the calibration function, the temperature displayed can be aligned with the product probe temperature. The correction value for the compensation of the differences can be adjusted in 0,1°C steps.



Safety feature table

Laboratory appliances with Comfort electronic controller	LKUv 1610	LKUv 1613	LKUexv 1610	LGUex 1500	LKv 3910	LKv 3913	LKexv 3910	LGex 3410	LCv 4010	LCexv 4010
Spark-free interior	No	No	Yes	Yes	No	No	Yes	Yes	No	Yes
High / low temperature alarm, audio and visual	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Door opening alarm, audio and visual	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Power failure warning after power supply is returned, visual	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Volt-free contact for external alarm signal	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
RS 485 data transfer interface	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
RS 485 / RS 232 converter with data monitoring software	Accessory	Accessory	Accessory	Accessory	Accessory	Accessory	Accessory	Accessory	Accessory	Accessory
NTC product temperature probe	Accessory	Accessory	Accessory	Accessory	Accessory	Accessory	Accessory	Accessory	Accessory	Accessory
Internal alarm memory	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Min. / max. temperature memory	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
+ 2°C safety thermostat	Yes	Yes	Yes	No	Yes	Yes	Yes	No	For fridge compartment	For fridge compartment
Access port for e.g. PT 100 probe	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Probe failure alarm	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Low temperature freezers to -45°C	LGT 2325	LGT 3725	LGT 4725
Spark-free interior	No	No	No
High / low temperature alarm, audio and visual	Yes	Yes	Yes
Lid-open alarm, audio and visual	Yes	Yes	Yes
Power failure warning after power supply is returned, visual	Yes	Yes	Yes
Volt-free contact for external alarm signal	Yes	Yes	Yes
RS 485 data transfer interface	Yes	Yes	Yes
RS 485 / RS 232 converter with data monitoring software	Accessory	Accessory	Accessory
NTC product temperature probe	Accessory	Accessory	Accessory
Internal alarm memory	Yes	Yes	Yes
Min. / max. temperature memory	Yes	Yes	Yes
Access port for e.g. PT 100 probe	Yes	Yes	Yes
Probe failure alarm	Yes	Yes	Yes

Temperature consistency and distribution according to EN 60068-3

The Liebherr laboratory cabinets are all tested in-house to the EN 60068-3 test procedure. The measurement results for the appliance setups can be found in the results section. Please note the measurements are for the specific appliances tested and are for reference only. Liebherr's development facility is certified to ISO 17025 (general requirements for the competence of testing and calibration laboratories).

Description of the EN 60068-3 test procedure

The general test conditions are as follows:

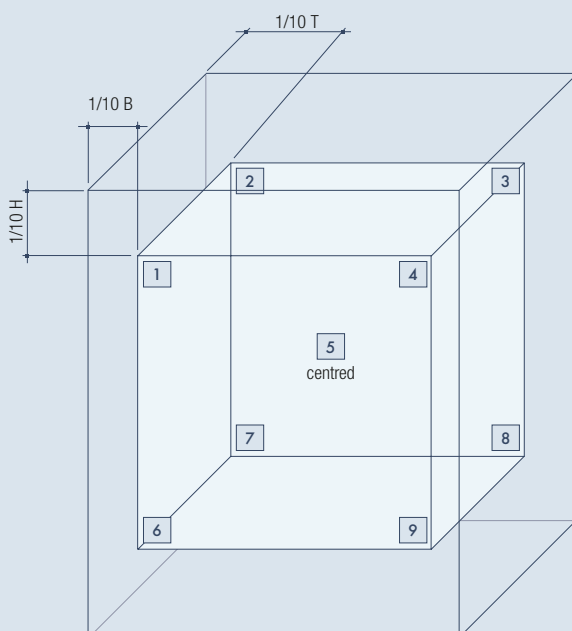
- Ambient temperature +25 °C
- 60 % relative humidity
- Refrigerator set temperature +5 °C
- Freezer set temperature -20 °C
- Low temperature freezer set temperature -45 °C
- Maximum deviation of the mean temperature value (including measurement uncertainty) for laboratory refrigerators with Comfort electronic controller:
+/- 3 K from the set interior temperature
- Maximum deviation of the mean temperature value (including measurement uncertainty) for laboratory freezers with Comfort electronic controller:
+/- 5 K from the set interior temperature
- Maximum deviation of the mean temperature value (including measurement uncertainty) for laboratory refrigerators with analogue controls:
+/- 5 K from the set interior temperature

Measurements are made using 9 xPT 100 air temperature probes positioned in accordance with EN 60068-3.

"Unless specifically stipulated, the temperature probes are located at equal distances from the walls of 1/10 of each of the dimensions of the internal volume (w/h/d). The location of the probes used for characterisation forms a supposedly representative sample of the working space."

The characterisation is performed using nine probes; one located at each corner, one in the centre of the working space.

Location of the probes used for characterisation



Cabinets are tested empty over a period of 24 hrs including defrost cycles.

Test criteria for characterising the temperature consistency and distribution

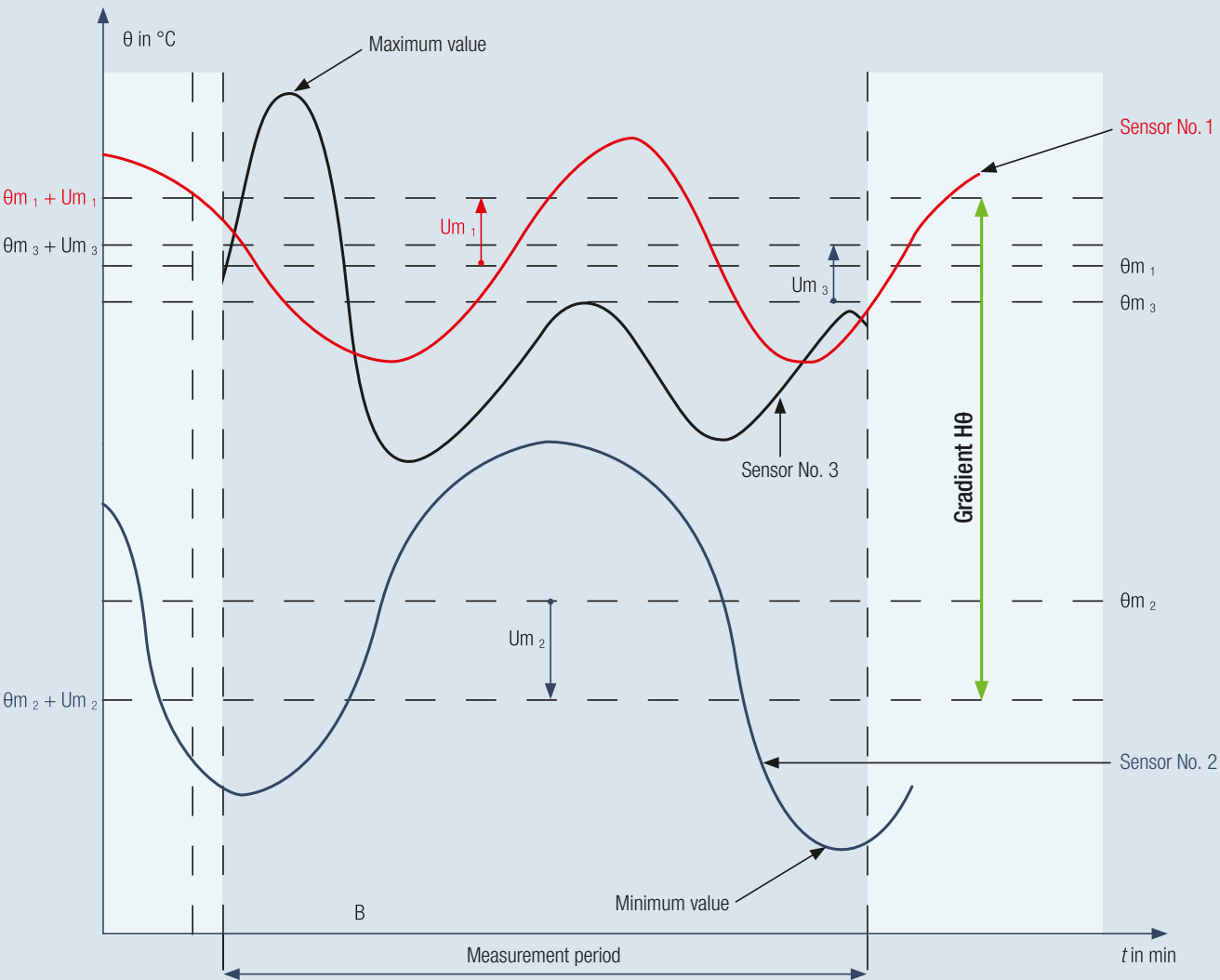
1) **Gradient** or **homogeneity**: “The gradient $H\theta$ is the maximum difference, obtained in an achieved environment, between the mean values of measurements θ_{mj} increased by their expanded uncertainty U_{mj} , within the working space during the measurement time.”

Gradient: “Distribution of temperatures within the chamber”

$$H\theta = \max (\theta_{mj} + U_{mj}) - \min (\theta_{mj} - U_{mj})$$

max = (mean value warmest probe + expanded measurement uncertainty)
min = (mean value coldest probe – expanded measurement uncertainty)

Example: Gradient / Homogeneity

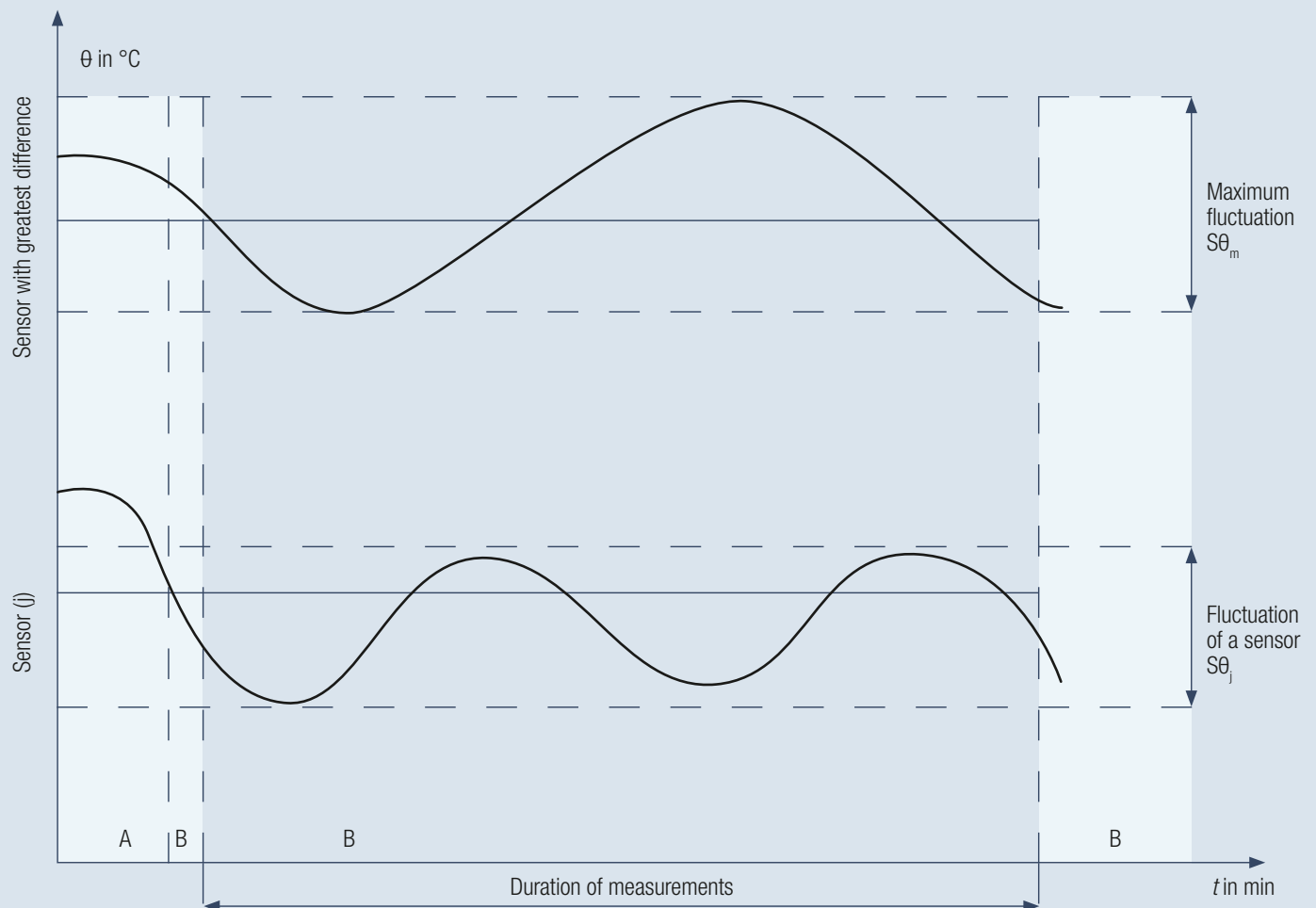


The gradient indicates the temperature distribution within the cabinets. Especially in the laboratory sector optimum temperature distribution is crucial to guarantee the safe storage of samples or other products at any place within the unit. The lower the gradient the better is the temperature distribution within the unit.

2) Fluctuation: “The characterisation of the temperature fluctuation within the working space enables to determine the variation in maximum temperature at a measurement point of the working space during the measurement time.”

- Fluctuation of the point $S\theta_j$: The difference between the maximum and minimum values measured at point j during the duration of measurements
- Maximum fluctuation, $S\theta_M$: Maximum value of all fluctuation values $S\theta_j$ during the duration of measurements

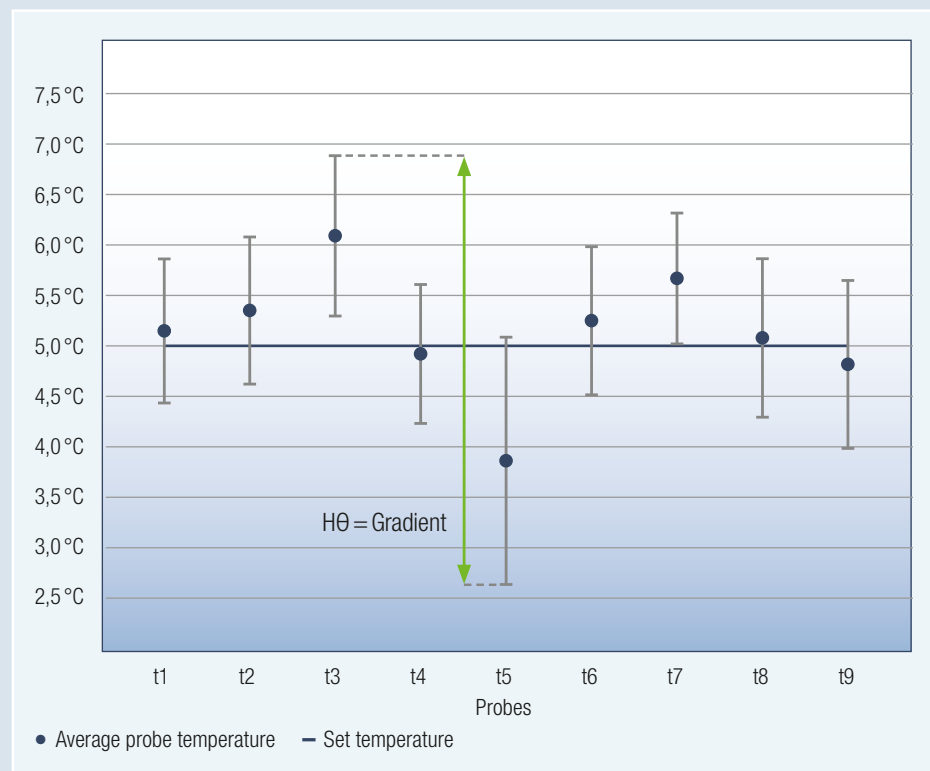
Example: Fluctuation



Results according to EN 60068-3 for laboratory appliances LK(U)v, LC(ex)v, LK(U)exv, LG(U)ex and LGT

The evaluation of air temperatures of the LK(U)v, LC(ex)v, LK(U)exv, LG(U)ex and LGPv models according to EN 60068-3 using 9 PT 100 temperature probes shows the following results:

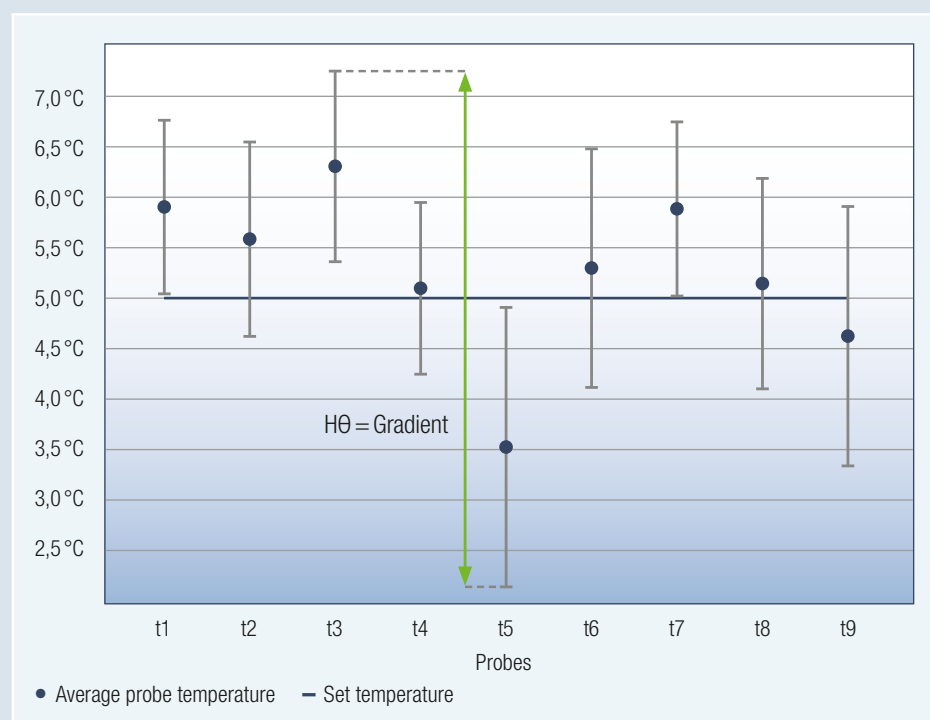
LKUv 1610



Gradient HΘ: **6.2K**

Max. fluctuation: **4.6K**

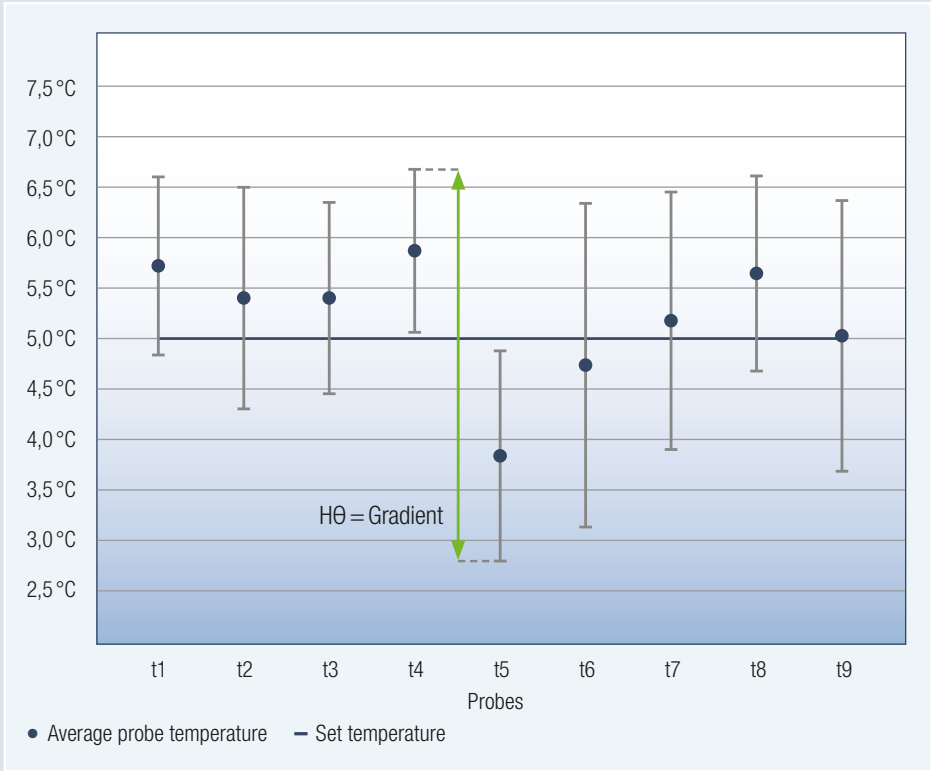
LKUv 1613



Gradient HΘ: **6.9K**

Max. fluctuation: **4.9K**

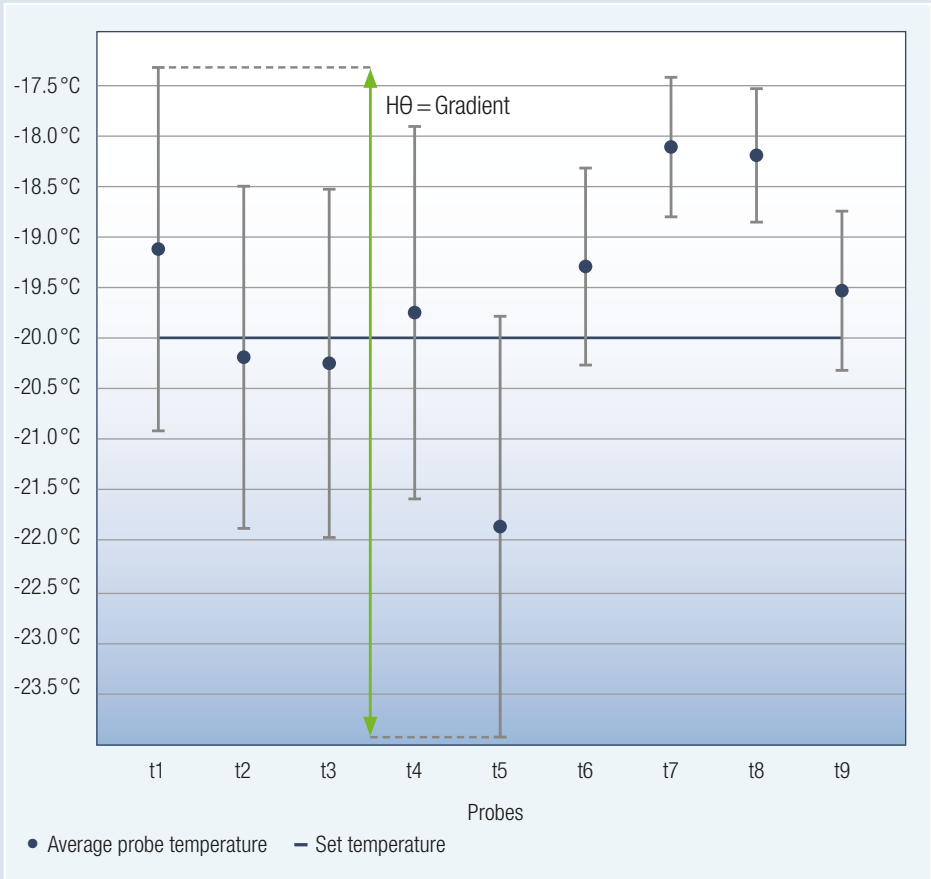
LKUexv 1610



Gradient $H\Theta$: **5.3 K**

Max. fluctuation: **4.8 K**

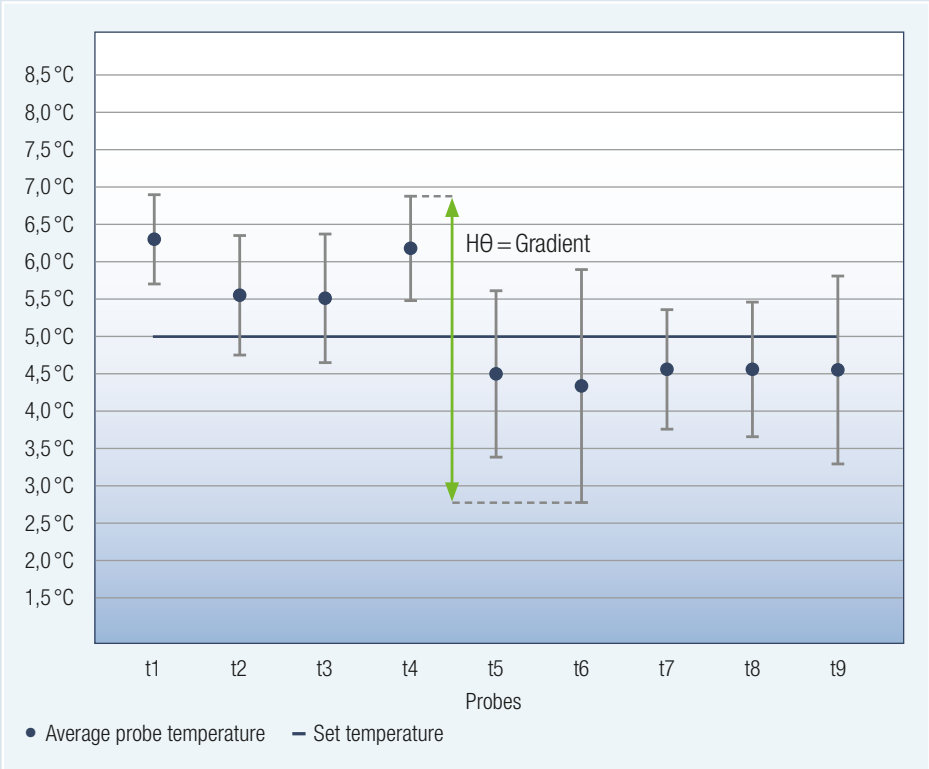
LGUex 1500



Gradient $H\Theta$: **6.4 K**

Max. fluctuation: **3.3 K**

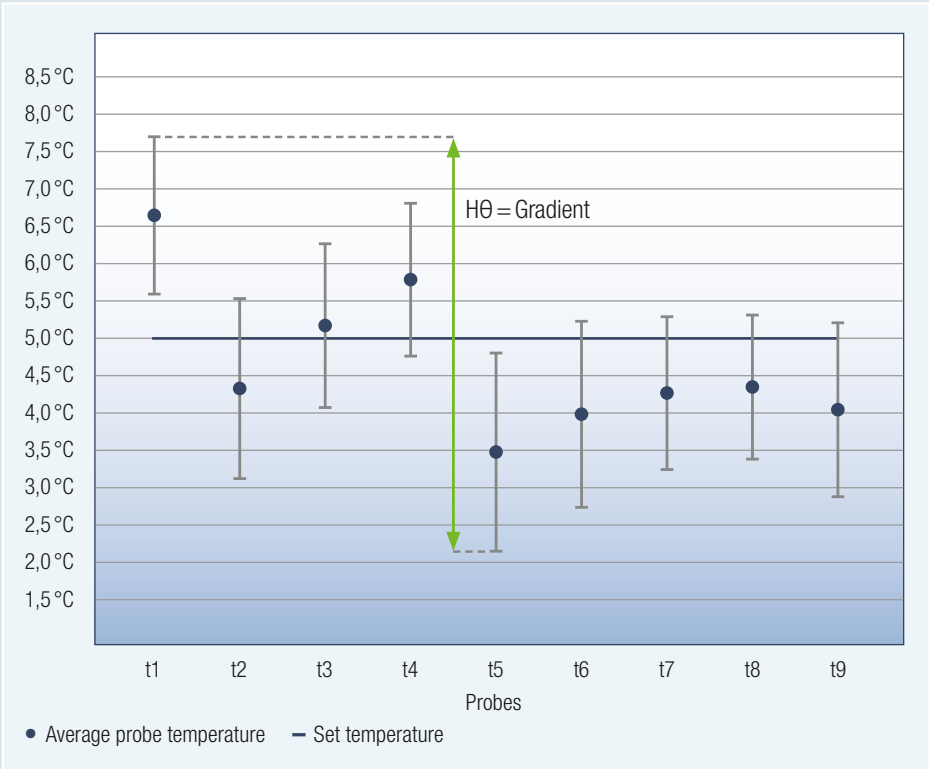
LKv 3910



Gradient HΘ: **4.8 K**

Max. fluctuation: **3.6 K**

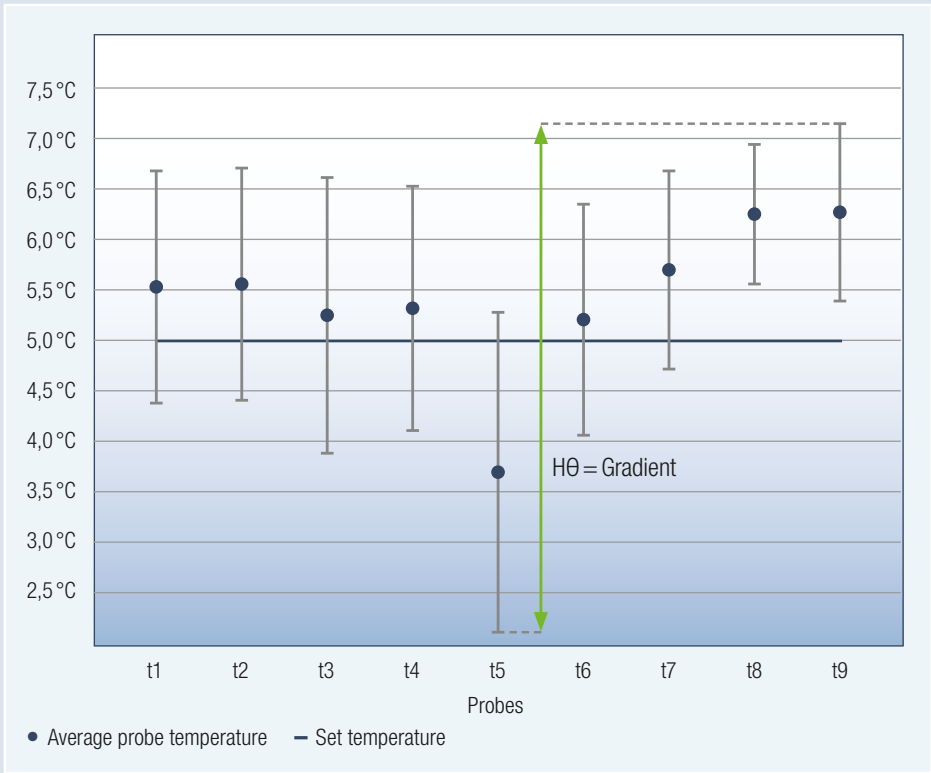
LKv 3913



Gradient HΘ: **7.7 K**

Max. fluctuation: **4.7 K**

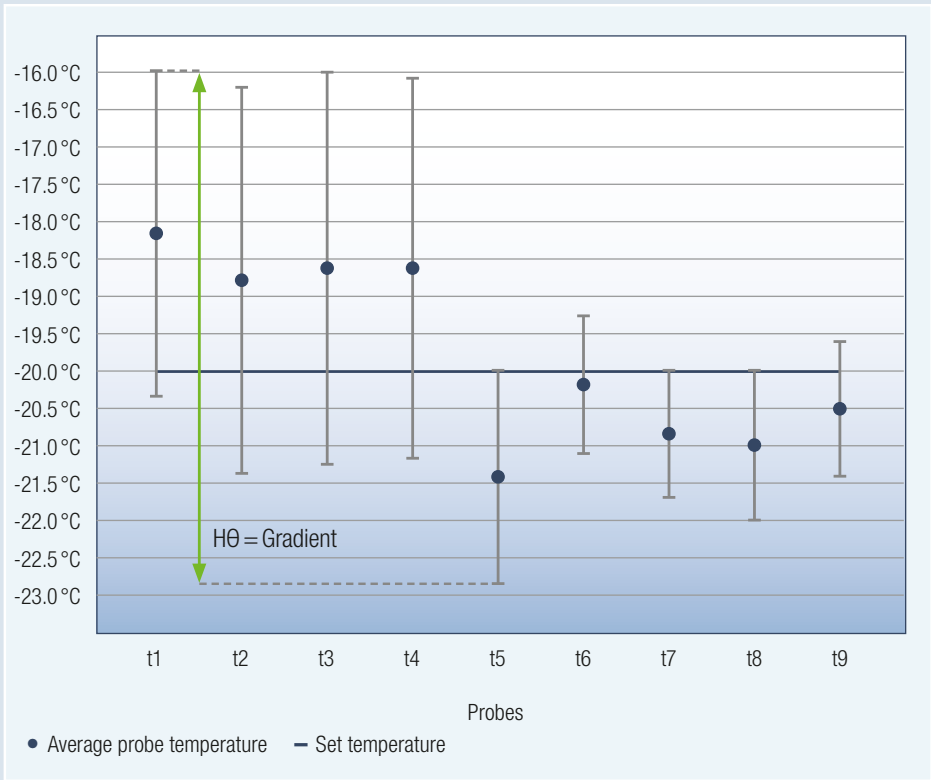
LKexv 3910



Gradient $H\Theta$: 6.7 K

Max. fluctuation: 5.1 K

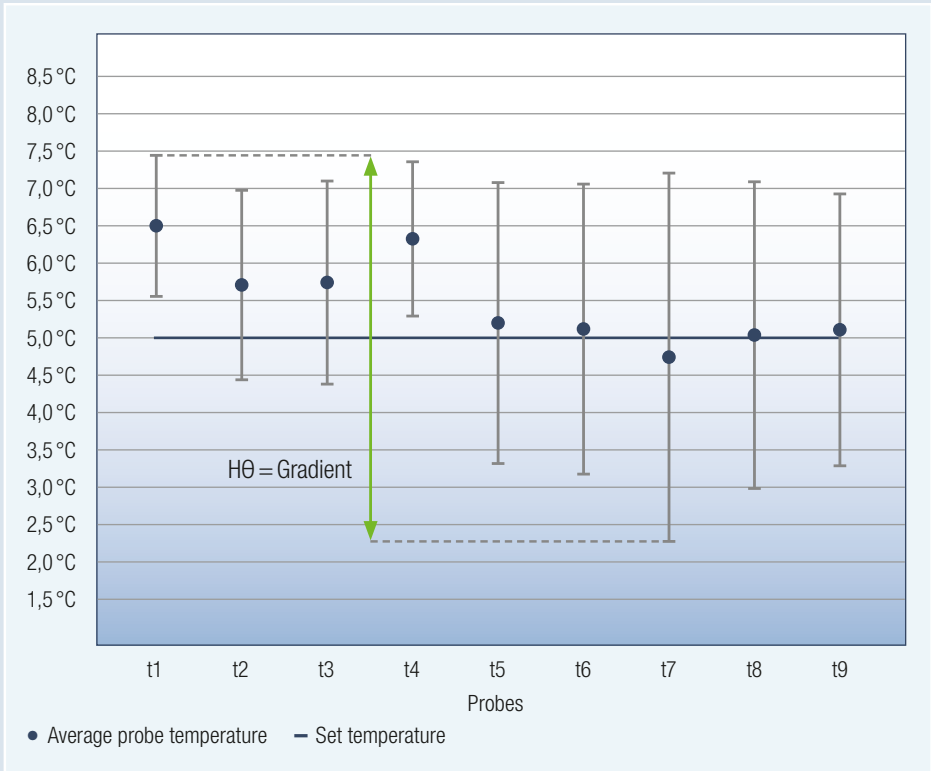
LGex 3410



Gradient $H\Theta$: 6.5 K

Max. fluctuation: 4.2 K

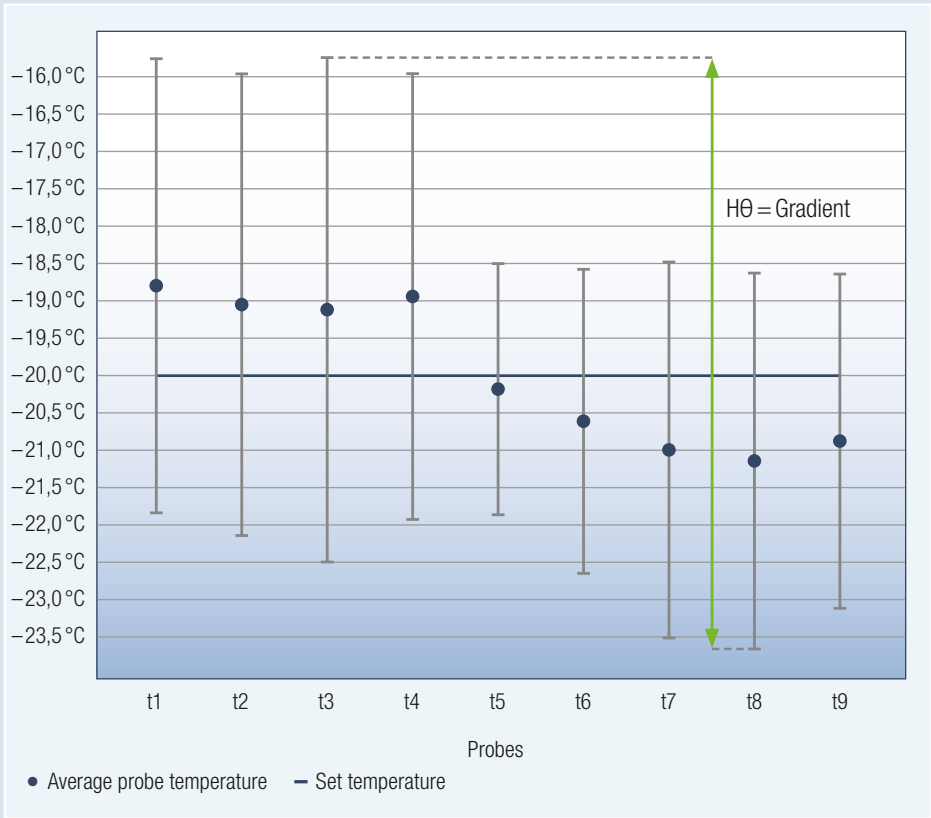
LCv 4010 – Evaluation of refrigerator compartment



Gradient Hθ: **6.5K**

Max. fluctuation: **5.7K**

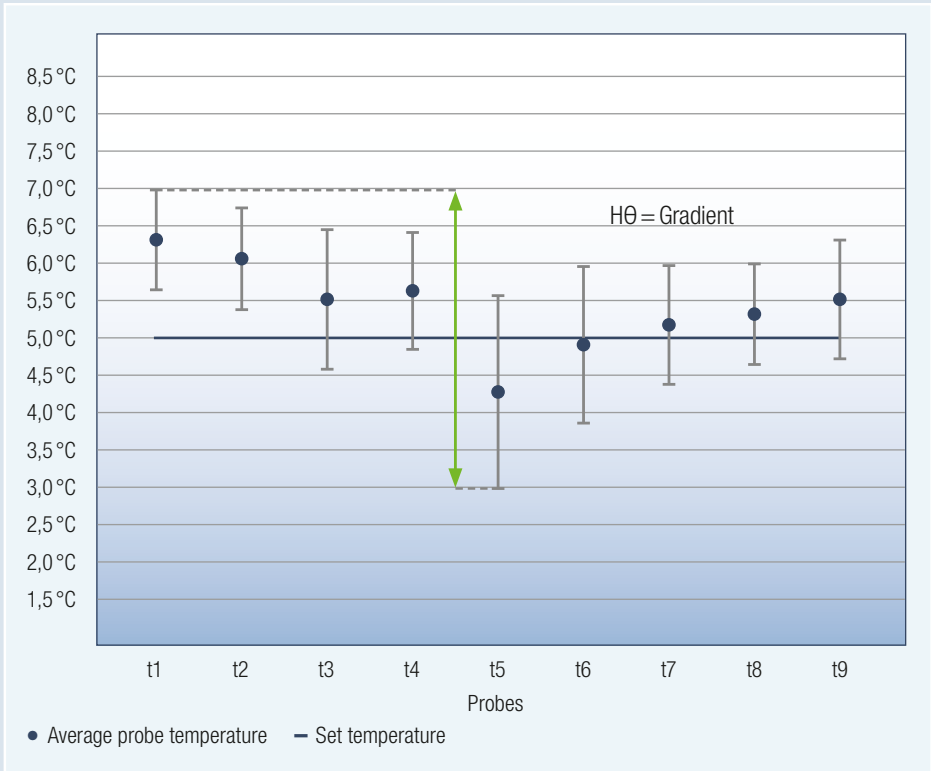
LCv 4010 – Evaluation of freezer compartment



Gradient Hθ: **7.3K**

Max. fluctuation: **5.5K**

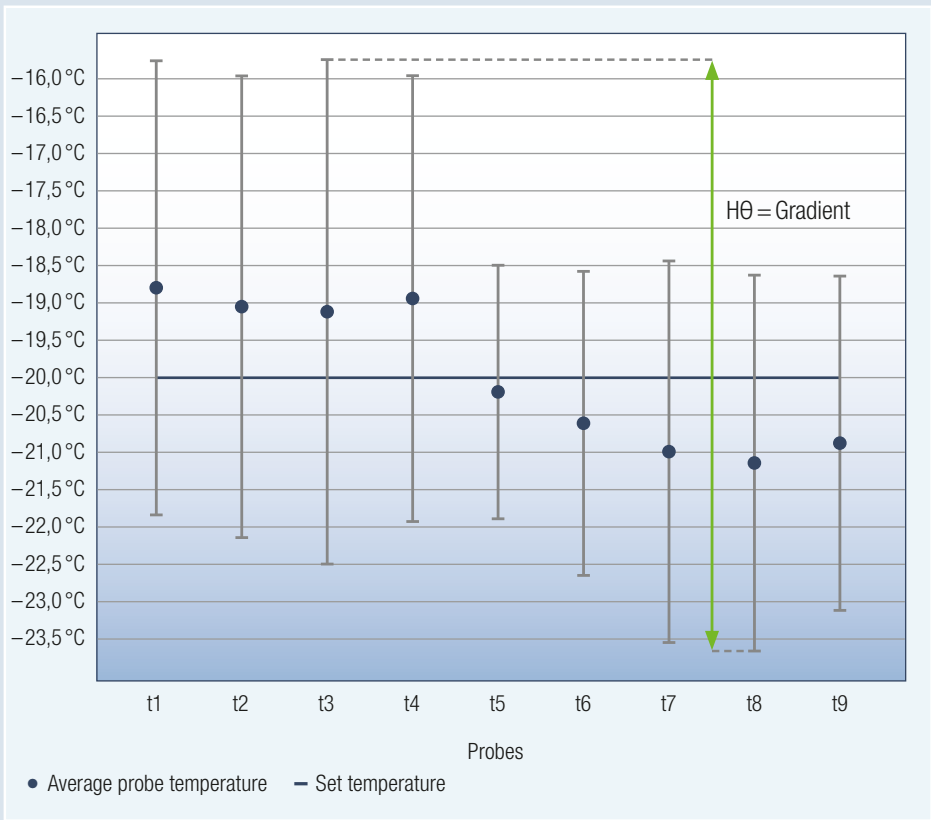
LCexv 4010 – Evaluation of refrigerator compartment



Gradient $H\theta$: **5.3K**

Max. fluctuation: **3.9K**

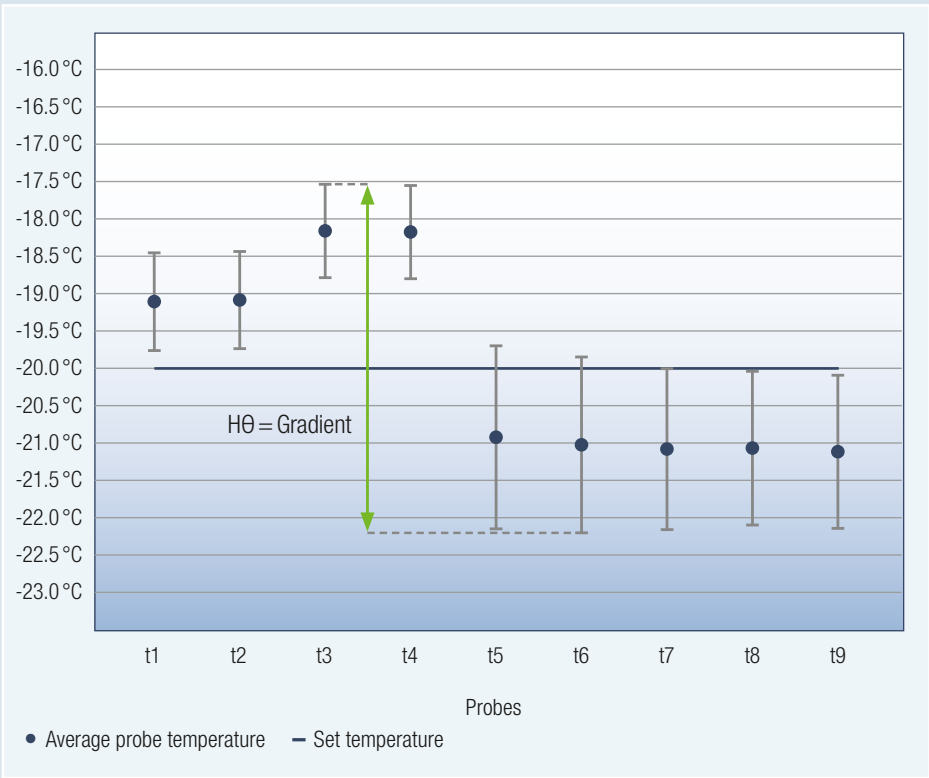
LCexv 4010 – Evaluation of freezer compartment



Gradient $H\theta$: **7.3K**

Max. fluctuation: **5.5K**

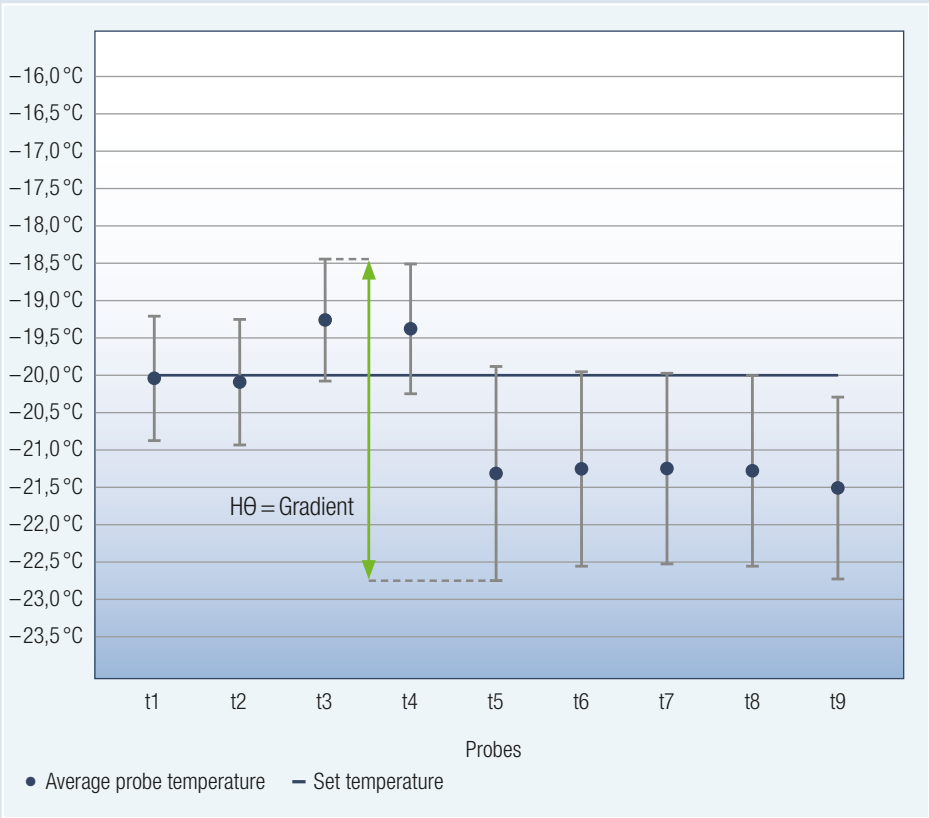
LGT 2325 *



Gradient HΘ: **4.6K**
Max. fluctuation: **1.9K**

*If the cabinet is operated at -20 °C it is recommended to reduce the predefined offset of 2.7 K to 1.0 K (see user manual).

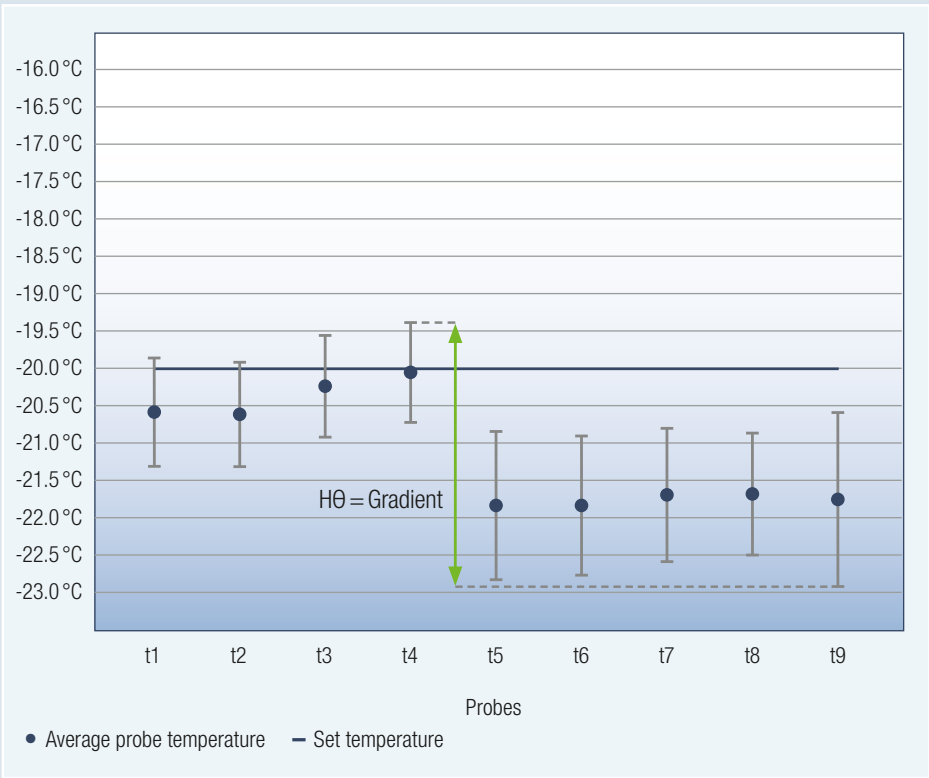
LGT 3725 *



Gradient HΘ: **4.1K**
Max. fluctuation: **2.2K**

*If the cabinet is operated at -20 °C it is recommended to reduce the predefined offset of 2.7 K to 1.0 K (see user manual).

LGT 4725 *



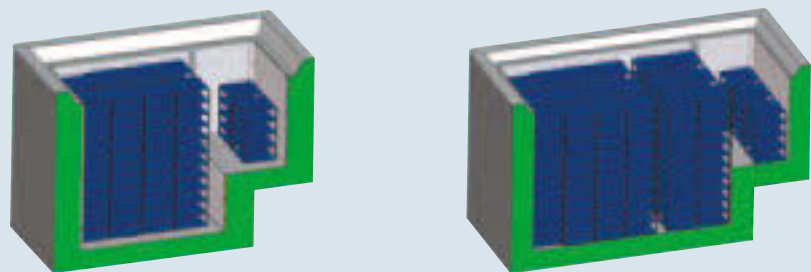
Gradient HΘ: 3.4K

Max. fluctuation: 1.8K

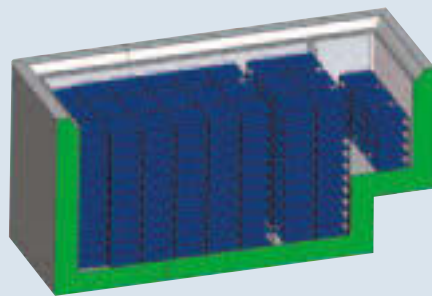
*If the cabinet is operated at -20 °C it is recommended to reduce the predefined offset of 2.7 K to 1.0 K (see user manual).

Loading plan: low temperature chest freezers with kryo racks

(height of kryo boxes 50 mm)



	LGT 2325	LGT 3725
Interior dimensions (W/D/H) in mm	889/410/630	1170/500/650
Number of racks:140/140/604 mm	8	18
Number of racks:140/140/222 mm	2	3
Number of boxes: 130/130/50 mm	96	210
Maximum height of racks:	630 mm	650 mm
Maximum height of racks above the compressor:	375 mm	380 mm



	LGT 4725
Interior dimensions (W/D/H) in mm	1445/500/650
Number of racks: 140/140/604 mm	24
Number of racks: 140/140/222 mm	3
Number of boxes: 130/130/50 mm	276
Maximum height of racks:	650 mm
Maximum height of racks above the compressor:	380 mm

Pharmacy refrigerators compliant with DIN 58345

In order to comply with the DIN 58345 standard, the MKv and MKUv models have the following specifications. Otherwise the MKv and MKUv models have the same features as the LKv and LKUv equivalents:

- To avoid any unwanted manipulation, the set temperature is fixed at +5°C to guarantee maximum safety
- Likewise the offset values of the probes cannot be changed
- Also alarm limits cannot be changed from the default values +2°C/+8°C
- An additional probe is positioned at the warmest point within the unit and this temperature is displayed on the controller
- In order to prevent product loss or detriment due to incorrect storage, an integrated evaporator cover keeps products away from the cold surface of the evaporator
- In the event of unnoticed power failure, the integrated power failure detector activates and maintains electronic temperature recording so that the temperature profile continues to be documented

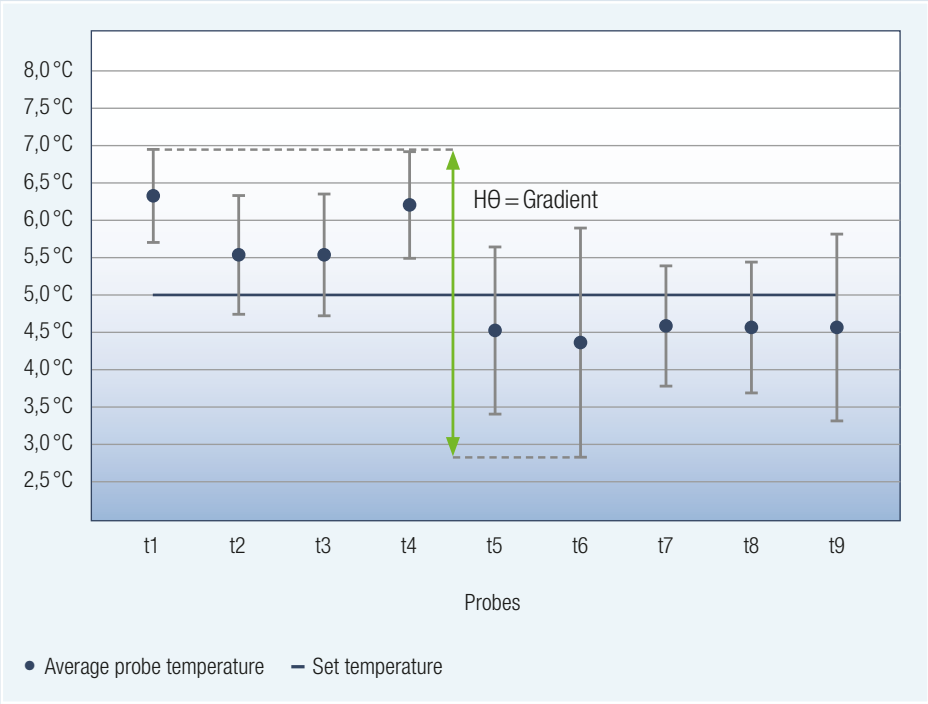
Safety feature table

Pharmacy refrigerators compliant with DIN 58345	MKv 3910	MKv 3913	MKUv 1610	MKUv 1613
Spark-free interior	No	No	No	No
High / low temperature alarm, audio and visual	Yes	Yes	Yes	Yes
Door opening alarm, audio and visual	Yes	Yes	Yes	Yes
Power failure warning immediately upon power failure	Yes	Yes	Yes	Yes
Volt-free contact for external alarm signal	Yes	Yes	Yes	Yes
RS 485 data transfer interface	Yes	Yes	Yes	Yes
RS 485 / RS 232 converter with data monitoring software	Accessory	Accessory	Accessory	Accessory
NTC product temperature probe	Yes	Yes	Yes	Yes
Internal alarm memory	Yes	Yes	Yes	Yes
Min. / max. temperature memory	Yes	Yes	Yes	Yes
+2°C safety thermostat	Yes	Yes	Yes	Yes
Access port for e.g. PT 100 probe	Yes	Yes	Yes	Yes
Probe failure alarm	Yes	Yes	Yes	Yes

Results according to EN 60068-3 for pharmacy refrigerators compliant with DIN 58345

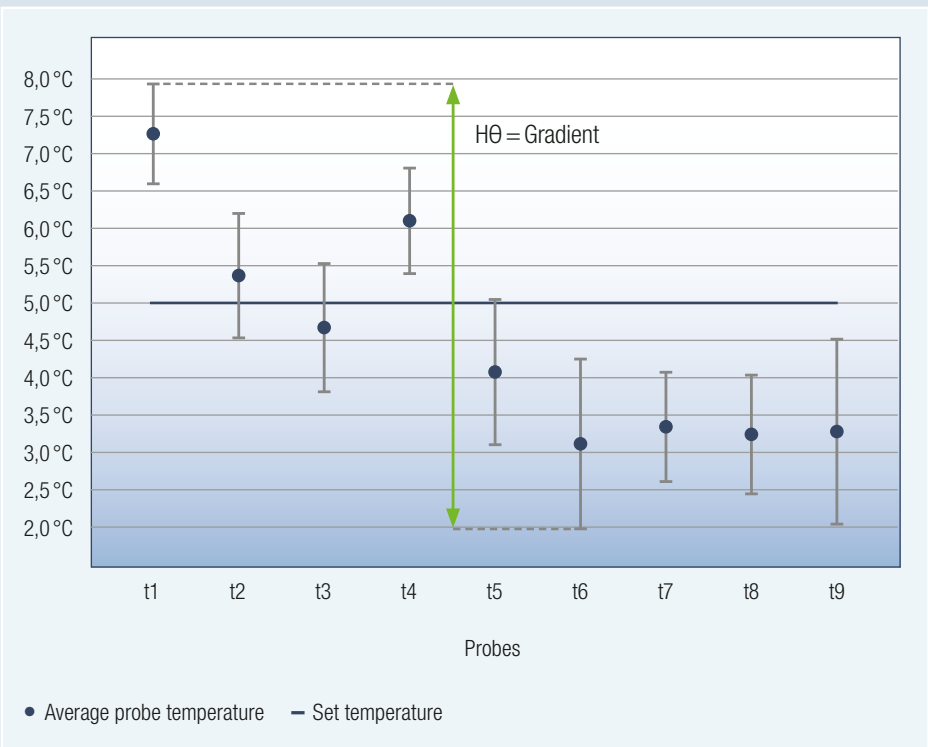
The evaluation of air temperatures of the MK(U)v models according to EN 60068-3 using 9 PT 100 temperature probes shows the following results. Please note that these values are only for reference:

MKv 3910



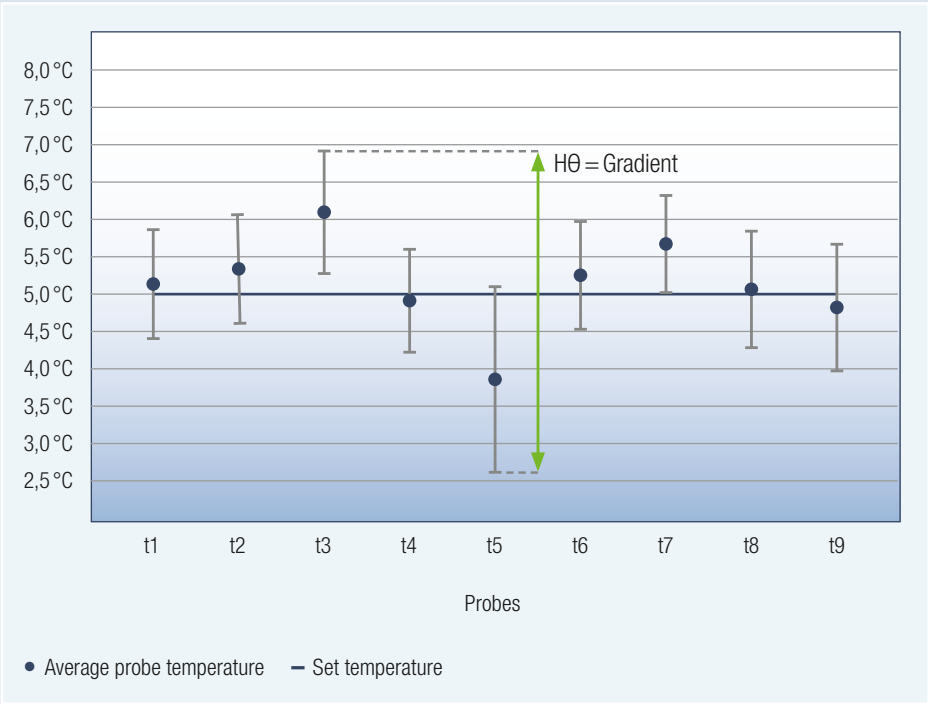
Gradient H0: 4.8K
Max. fluctuation: 3.6K

MKv 3913



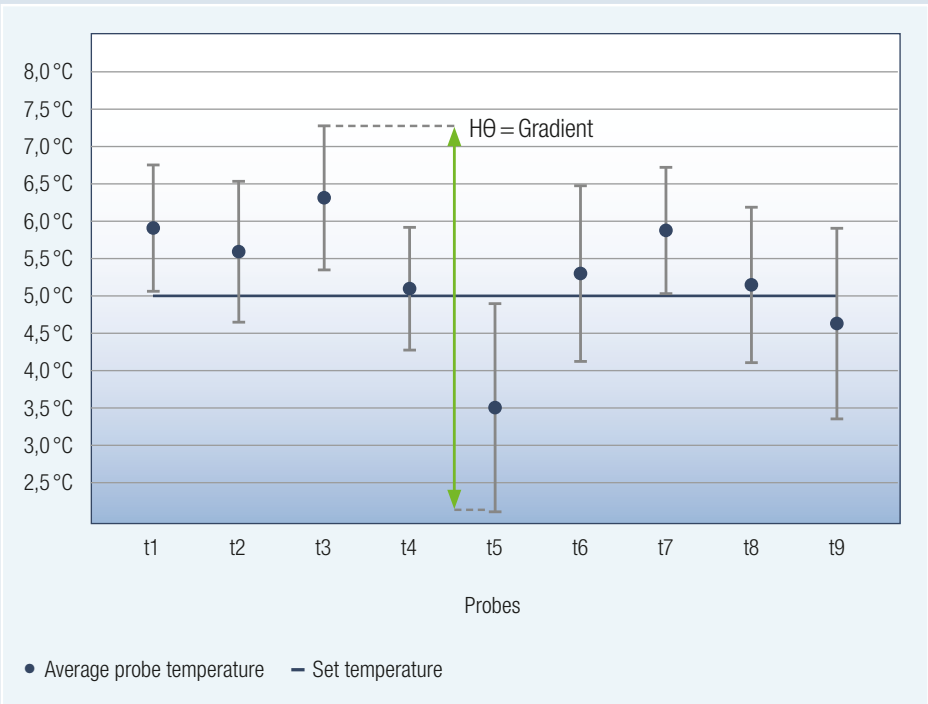
Gradient H0: 7.1K
Max. fluctuation: 3.9K

MKUv 1610



Gradient H0: **6.2K**
Max. fluctuation: **4.6K**

MKUv 1613



Gradient H0: **6.9K**
Max. fluctuation: **4.9K**

LKexv laboratory appliances with analogue controls and spark-free interior

The LKexv 5400, LKexv 3600, LKexv 2600 and LKexv 1800 laboratory appliances, with analogue controls and spark-free interiors, are suitable for the storage of explosive or highly flammable materials in sealed containers. These appliances are designed to conform to ATEX directive 2014/34/EU (formerly 94/9/EG), in the application range II 3G Ex nA II T6. The interior of refrigeration appliances within this category is designed for applications where a potentially explosive atmosphere can temporarily or exceptionally occur as a result of air mixing with gases or vapours. The maximum surface temperature for the T6 temperature class is +85°C. This means that substances with ignition temperature higher than +85°C can be stored. This is the best temperature class rating available in the directive.

Equipment features

- Analogue control with a temperature range of +1°C to +15°C
- Digital temperature display
- Lock
- ATEX label, including cleaning information

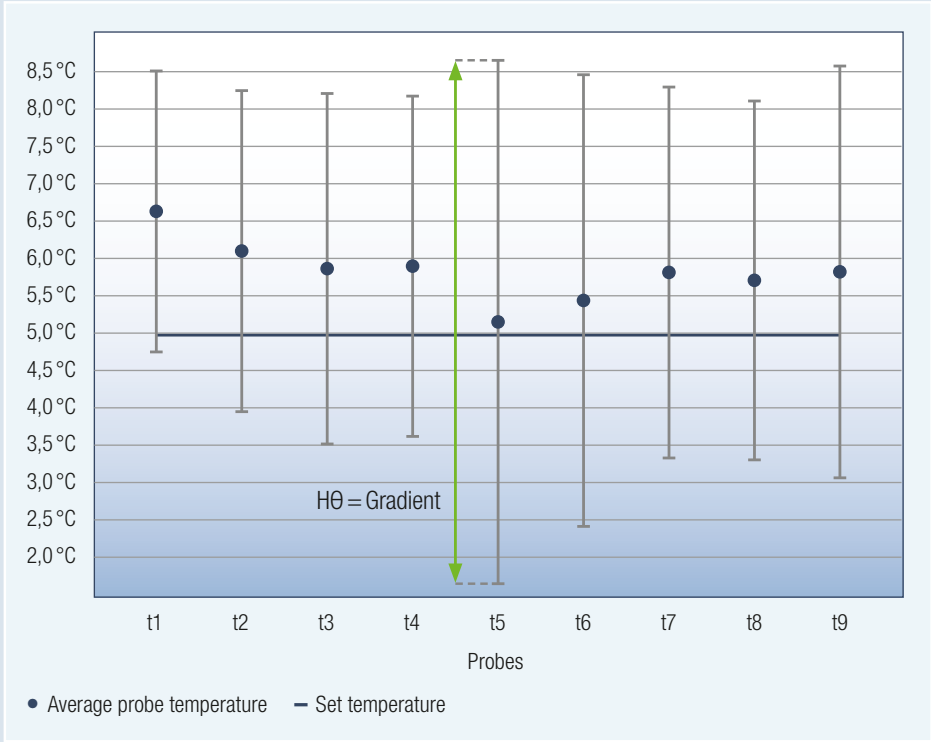
Safety feature table

Laboratory appliances with analogue controls and spark-free interior	LKexv 5400	LKexv 3600	LKexv 2600	LKexv 1800
Spark-free interior	Yes	Yes	Yes	Yes
High / low temperature alarm, audio and visual	No	No	No	No
Door opening alarm, audio and visual	No	No	No	No
Power failure warning immediately upon power failure	No	No	No	No
Volt-free contact for external alarm signal	No	No	No	No
RS 485 data transfer interface	No	No	No	No
RS 485 / RS 232 converter with data monitoring software	No	No	No	No
NTC product temperature probe	No	No	No	No
Internal alarm memory	No	No	No	No
Min. / max. temperature memory	No	No	No	No
+ 2°C safety thermostat	No	No	No	No
Access port for e.g. PT100 probe	No	No	No	No
Probe failure alarm	No	No	No	No

Results according to EN 60068-3 for laboratory appliances LKexv

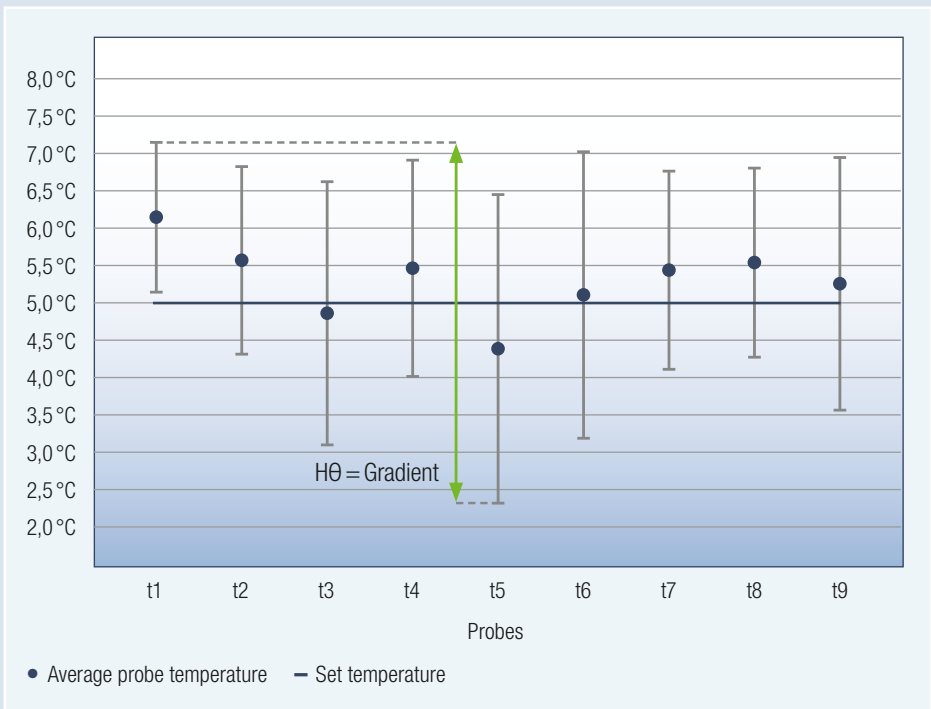
The evaluation of the interior air temperatures in accordance with the EN 60068-3 environmental testing procedure, measured with PT 100 temperature probes, yields the following results. Please note that these values are only for reference:

LKexv 5400



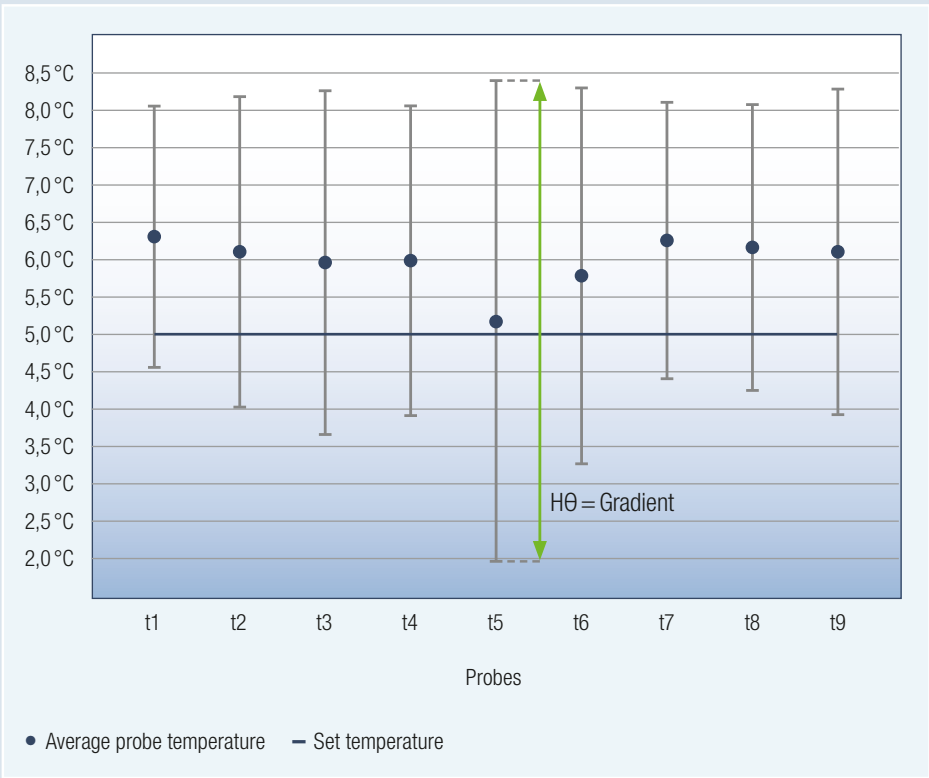
Gradient Hθ: **6.5K**
Max. fluctuation: **5.8K**

LKexv 3600



Gradient Hθ: **4.4K**
Max. fluctuation: **3.0K**

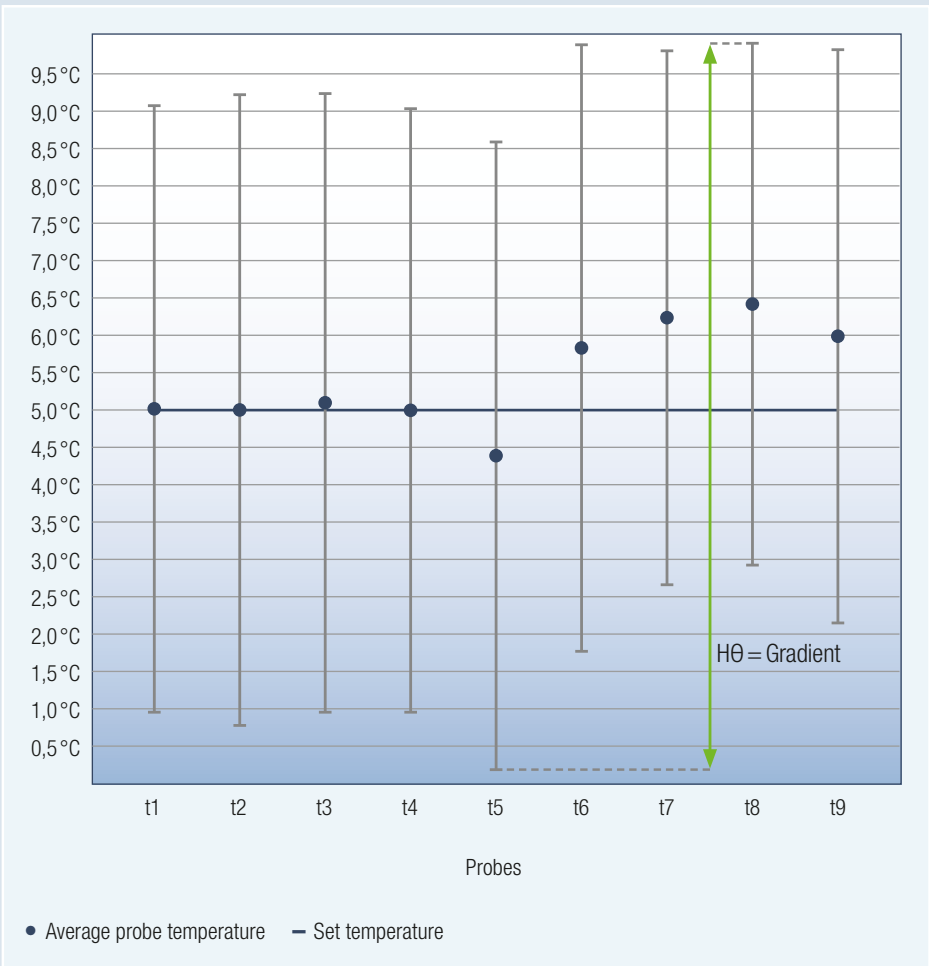
LKexv 2600



Gradient HΘ: **6.1 K**

Max. fluctuation: **5.5 K**

LKexv 1800



Gradient HΘ: **9.4 K**

Max. fluctuation: **7.4 K**

Liebherr laboratory refrigerators or freezers do not comply with the German Institute for Standardisation norm DIN 58371 regarding the requirements for the storage of conserved blood and DIN 58375 regarding the requirements for the storage of blood plasma. The MKv and MKUv models comply with the German Institute for Standardisation norm DIN 58345 which refers to the specification of pharmacy refrigerators. All other Liebherr refrigerators and freezers in this catalogue do not comply with this standard.