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Interested committees:

Title: BS EN IEC 63437 Ed.1.0 Test standard for refrigerated appliances for use with distributed renewable energy sources (off grid) or weak grid

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Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/Figure/ Table/Note	Type of comment	Commend (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	

PROJECT NUMBER:

IEC 63437 ED1

DATE OF CIRCULATION:

2024-08-09

CLOSING DATE FOR COMMENTS:

2024-11-01

SUPERSEDES DOCUMENTS:

59M/145/NP, 59M/146/RVN

IEC SC 59M : PERFORMANCE OF ELECTRICAL HOUSEHOLD AND SIMILAR COOLING AND FREEZING APPLIANCES

SECRETARIAT:

Italy

SECRETARY:

Ms Milena Presutto

OF INTEREST TO THE FOLLOWING COMMITTEES:

HORIZONTAL FUNCTION(S):

ASPECTS CONCERNED:

Energy Efficiency, Environment

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TITLE:

Off grid and unreliable grid refrigerating appliances for domestic and light commercial use - Characteristics and test methods - Performance requirements and energy consumption

NOTE FROM TC/SC OFFICERS:

The CD of IEC 63437 Ed1 has been prepared by SC59M/WG6 Test standard for refrigerated appliances for use with off grid or weak grid under the convenorship of Mr Patrick Becks.

The title of IEC 63437 Ed1 set at the time of the project approval was "Test standard for refrigerated appliances for use with distributed renewable energy sources (off grid) or weak grid". However during the preparation for the CD the SC59M/WG6 decided to change the title to "Off grid and unreliable grid refrigerating appliances for domestic and light commercial use – Characteristics and test methods – Performance requirements and energy consumption". The reasons for this change are mainly:

- the initial title does not provide any information of the kind of tests described. This standard is mainly describing tests related to performance and energy consumption, safety tests are not included for example. In addition the new title better describes the intended use - domestic and light commercial use - of the covered refrigerating appliances;
- the discussion within the WG6 lead to the change of the term "weak grid" to the term "unreliable grid", because the latter is considered much better describing in one word the actual situation of the electricity supply for these refrigerating appliances;
- at the same time the discussion within the WG6 lead to use the term "off grid" instead of "distributed renewable energy sources", since the term "off grid" is generally well known and accepted.

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**OFF GRID AND UNRELIABLE GRID REFRIGERATING APPLIANCES FOR
DOMESTIC AND LIGHT COMMERCIAL USE -
CHARACTERISTICS AND TEST METHODS – PERFORMANCE
REQUIREMENTS AND ENERGY CONSUMPTION**

FOREWORD

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IEC 63437 has been prepared by subcommittee 59M/WG6: Performance of electrical household and similar cooling and freezing appliances, of IEC technical committee 59: Performance of household and similar electrical appliances. It is an International Standard.

Background information and arguments for this standard are provided in Annex B.

The following print types are used in this international standard:

– requirements: in roman type;

– test variables: in *italic* type;

– notes: in small roman type.

– words in **bold** are defined in Clause 0;

The text of this International Standard is based on the following documents:

Draft	Report on voting

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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INTRODUCTION

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OFF GRID AND UNRELIABLE GRID REFRIGERATING APPLIANCES FOR DOMESTIC AND LIGHT COMMERCIAL USE- CHARACTERISTICS AND TEST METHODS – PERFORMANCE REQUIREMENTS AND ENERGY CONSUMPTION

1 Scope

This document specifies the essential characteristics of **off grid** and **unreliable grid refrigerating appliances** for domestic and similar use or **light commercial use**, cooled by internal natural or forced air convection. It defines input voltage supply signals for appliances designed for **unreliable grid** and **off grid** conditions.

An **unreliable grid** condition can be the result of disturbances on the electricity supply, such as **power outages**, or issues with power quality, such as voltage spikes and surges, that could cause performance challenges to refrigerating appliances. An **off grid** supply, in this context, is generated by a **solar panel** or a stand-alone solar home system that is not connected to the power grid. The standard simulates the power characteristics in off grid and unreliable grid conditions but does not prescribe requirements or test procedures to assess performance of generators, **solar panels**, solar home system or any other system generating a supply signal.

The supply signals defined in this document can also be used for evaluation of the performance of other **refrigerating appliances** such as medical or laboratory appliances, professional storage **refrigerators** and/or **freezers**, refrigerated display cabinets, beverage coolers or ice cream **freezers**.

This standard prescribes the test methods for measuring the functional performance characteristics and requirements. The standard does not apply to **refrigerating appliances** utilising fossil-fuelled absorption cooling technology.

This standard is applicable to any **refrigerating appliance** for domestic or **light commercial use** that has a **rated** performance to properly operate **off grid** or under **unreliable grid** operating conditions resisting power interruptions and supply variations. **Off grid** and **unreliable grid refrigerating appliances** are appliances intended to for use with standalone or intermittent and/or distorted electrical mains. Electrical mains supply is assumed to be alternating current (AC) for **unreliable grid** or direct current (DC) for **off grid**. The standard is also applicable to **hybrid refrigerating appliances**.

The test procedures primary focus on the performance of the overall **refrigerating appliances** and not on the specific performance of **auxiliary** components such as electrical batteries, **inverters** or **rectifiers** or any device intended to improve the power quality but external to the appliance itself. In case a **refrigerating appliance** is supplied with control unit, an **electrical battery**, a **voltage protector**, an **inverter** or a **rectifier** in the original product packaging, these components are considered as a component of the **refrigerating appliance** and should be connected during testing.

The tests defined in this standard aim to assess the fundamental design and functional operation of the **refrigerating appliance** as well as its resilience to given power quality issues.

Unreliable Grid (UG) refrigerating appliance categories in scope:

1. UG_{intermittent}: AC voltage supplied **refrigerating appliances** designed for proper operation during intermittent **power outages**, containing an internal **thermal store** and/or **electrical battery**.
2. UG_{distorted}: AC voltage **refrigerating appliances** designed for operation when connected to a **distorted grid** supply (for example **voltage sags** or **voltage surges**).

3. UG_{intermittent+distorted} AC voltage **refrigerating appliances** designed for operation with intermittent grid / **power outages** and **distorted grid** supply (combination of 1 and 2).

Table 1 – Unreliable grid refrigerating appliance categories

Unreliable grid category	Appliance configuration code	Functionality		Components present		
		Resisting AC power outages	Resisting AC voltage sags and voltage surges	Internal thermal store	Internal electrical battery present to supply	
					Compressor	Auxiliaries
UG _{intermittent}	A	Yes	No	Yes	No	
	B				No	Yes
	C			No	Yes	Yes
	D				Yes	No
UG _{distorted}	E	No	Yes	No	No	
UG _{intermittent+distorted}	F	Yes	Yes	Yes	No	
	G				No	Yes
	H			No	Yes	No
	I				Yes	

Off Grid (OG) refrigerating appliance categories in scope:

- OG_{SDD}: DC voltage supplied **solar direct drive refrigerating appliances**, designed for direct connection to a photovoltaic **solar panel**, containing an internal **thermal store** with an optional **electrical battery** to supply auxiliaries such as a controller, lighting or fans. The compressor of the appliance is directly supplied by the **solar panel**.
- OG_{battery supported}: DC voltage supplied, **electrical battery** supported solar **refrigerating appliance** designed for direct connection to a photovoltaic **solar panel**, incorporating an **electrical battery** to supply the compressor when there is insufficient solar power. These appliances may also have internal **thermal store**. The **electrical battery** is charged by the **solar panel** only. The battery should be part of the appliance or should be supplied in the same packaging of the appliance.
- OG_{intermittent}: DC voltage supplied **refrigerating appliance** designed for proper operation during **power outages**, containing an internal **thermal store** and/or **electrical battery**.
- OG_{continuous}: Continuous DC voltage supplied **refrigerating appliances**, without any internal **thermal store** and **electrical battery**.

Table 2 – Off grid refrigerating appliance categories

Off Grid category	Appliance configuration code	Functionality	Components present	
		Directly connected to a solar panel	Internal thermal store	Internal electrical battery present to supply
				Compressor Auxiliaries
OG _{SDD}	A	Yes	Yes	No
	B			No Yes
OG _{battery supported}	C			Yes Yes
	D		No	No
OG _{intermittent}	E	No	Yes	No Yes
	F			No
	G		No	Yes Yes
	H			No
OG _{continuous}	I	No	No	No

The standard also defines **Solar Irradiance Classes**, consisting of different irradiance patterns and, **Unreliable Grid Protection Codes**, describing various **power outages** and voltage disturbances of the electricity grid. These classes can also be applied for products outside the scope of this standard.

Refrigerating appliances that are out of scope in this document include AC **refrigerating appliances** designed for reliable, good quality continuous supply. As these refrigerating appliances are covered by IEC 62552-1-2-3: for domestic **refrigerating appliances**.

The standard does not define requirements for production sampling or conformity assessment or certification.

2 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

2.1 General

2.1.1 Refrigerating appliance

Insulated cabinet with one or more **compartments** that are controlled at **frozen or unfrozen compartment** temperatures and are of suitable size and equipped for household or small commercial use, cooled by a natural or forced convection air flow inside the **compartment** typically using vapor compression or thermo-electric refrigeration technology.

2.1.2 Refrigerator

Refrigerating appliance intended for the storage of **foodstuff**, with at least one **fresh food compartment**.

2.1.3 Refrigerator-freezer

Refrigerating appliance having at least one **unfrozen compartment** and at least one **freezer compartment**.

2.1.4 Freezer

Refrigerating appliance with only **frozen compartments** and at least one **freezer compartment**.

2.1.5 Light commercial use

Commercial activity generally consisting of sales of chilled beverages.

2.1.6 Variable temperature compartment

Compartment intended for use as two or more alternative compartment types (e.g. a compartment that can be either an **unfrozen compartment** or a **frozen compartment**) and which is capable of being set by a user to continuously maintain the operating temperature range applicable for each compartment type claimed at the **rated** climate class conditions.

2.1.7 Continuous supply refrigerating appliance

Refrigerating appliance designed for continuous (24/7) AC or DC power supply, generally without an **integrated thermal store or electrical battery**.

2.1.8 Solar direct drive (SDD) refrigerating appliance

DC supply **refrigerating appliance** designed for direct connection with a defined photovoltaic **solar panel**, generally containing an integrated **thermal store** to allow autonomous operation during the night or during cloudy days. Note that some **SDD appliances** may have a small **electrical battery** to supply auxiliaries such as a controller, lighting or fans.

2.1.9 Battery supported solar refrigerating appliances

DC supply **refrigerating appliance** designed for direct connection with a defined photovoltaic **solar panel**, containing an integrated **electrical battery** that is charged by the **solar panel** only, to allow autonomous operation of the compressor during the night.

2.1.10 Hybrid refrigerating appliance

Refrigerating appliance with the option to operate on an AC or DC voltage supply. These appliances are generally equipped with two input sockets: an AC input voltage socket and a DC voltage input socket.

2.1.11 Intermittent supply refrigerating appliance

Refrigerating appliance designed to tolerate intermittent power supply, generally containing an integrated **thermal store** and/or **electrical battery** allowing autonomous operation during periods when electrical mains supply is having an outage.

2.1.12 Distorted supply refrigerating appliance

Refrigerating appliance designed to tolerate disturbed (continuous or intermittent) power supply operation.

2.1.13 Foodstuff

Food and beverages intended for consumption.

2.1.14 Rated

Value declared by the manufacturer (e.g. volume, **energy consumption**, usage).

2.1.15 Auxiliary

An electrical component of the **refrigerating appliance**, excluding the compressor. Examples of auxiliary components are lighting, supply **voltage protectors**, fans, electrical heaters or control boards.

2.2 Unreliable grid supply

2.2.1 Unreliable grid

AC voltage electricity supply subject to **power outages** or power quality disturbances, that are outside the default specifications of a proper functioning public supply electricity grid.

2.2.2 Intermittent grid

Electricity supply facing **power outages**.

2.2.3 Distorted grid

Electricity supply facing disturbances in voltage level.

2.2.4 Unreliable grid nominal test voltage

Voltage supply applied for testing **unreliable grid refrigerating appliances** at non-disturbed supply conditions.

2.2.5 Power outage

An unexpected interruption in the electricity supply, causing a loss of power to end users.

2.2.6 Voltage sag

A sudden decrease of the electricity supply voltage.

2.2.7 Voltage surge

A sudden increase of the electrical supply voltage.

2.2.8 Intermittent supply class

A classification system for the different levels of intermittent power supply, defining the maximum **power outage** time per day for which an **unreliable grid refrigerating appliance** is designed to withstand.

2.2.9 Distorted supply class

A classification system for the different levels of voltage distortion, specifying the minimum and maximum voltage for which an **unreliable grid refrigerating appliance** is designed to withstand without causing any damage to appliance and while still ensuring proper operation.

2.2.10 Withstand supply class

A classification system for the range of supply voltage levels that a **refrigerating appliance** can tolerate without permanent damage. Proper functioning of the refrigerating appliance is not required during this test, but fuses must not be blown.

2.2.11 Unreliable grid class protection code

A classification system for the electrical protection of **unreliable grid refrigerating appliances**, defining the level of protection against **power outages** and voltage distortions. The **unreliable grid protection code** (UGP-Code) consists of three digits: UGP-Code-XYZ, where “X” represents the **intermittent supply class**, “Y” represents the **distorted supply class**, and “Z” represents the **voltage withstand supply class**.

2.2.12 Voltage protector

An automatic device that switches off the power supply of a **refrigerating appliance** when the supply voltage exceeds or falls below acceptable levels.

2.3 Off grid supply

2.3.1 Off grid

An area that are not connected to the electricity distribution network. In this standard, **off grid** supply refers to DC voltage supply

2.3.2 Off grid nominal test voltage

The nominal DC voltage is the standard voltage level that a refrigerating appliance is designed to operate with. The DC voltage supply should be used for testing **continuous** and **intermittent supply refrigerating appliances**. For appliances directly connected to **solar panels**, the nominal voltage value should correspond to the Maximum Power Point Voltage (Vmpp) of the connected **solar panel**.

2.3.3 Solar Irradiance class

A classification system that categorizes different irradiance patterns based on various horizontal irradiance levels.

2.3.4 Minimum supply time

The minimum number of hours per day that a **refrigerating appliance** needs in order to maintain its defined compartment temperatures when operating at the **rated** highest **ambient temperature**.

2.3.5 Functional irradiance supply

A test signal for measuring **minimum supply time**. For **refrigerating appliances** that can be directly connected to a **solar panel**, such as **solar direct drive refrigerating appliances**, the supply should set to the Maximum Power Point Voltage (V_{mpp}) of a **solar panel** to ensure for maximum power output. For this supply, the current shall not exceed the maximum output current of the **solar panel**.

2.4 Technical

2.4.1 Thermal store

A component used for storing and releasing thermal cooling energy. It stores cooling energy when electrical supply is available and releases cooling energy when electrical supply is low or unavailable. Note that the thermal store can be charged by various sources, including **solar panels**, other DC sources such as electrical battery, or AC sources such as the electricity grid.

2.4.2 Electrical battery

A component used for storing and releasing electrical energy. It stores energy when electrical supply is available and releases electricity when electrical supply is low or unavailable. Note that the electrical battery can be charged by various sources, including **solar panels**, other DC sources, or AC sources such as the electricity grid.

2.4.3 Charging time

The time required to load a **thermal store** or an **electrical battery** for optimal use of the **refrigerating appliance**.

2.4.4 Solar panel

Photovoltaic **solar panel**, which converts energy from sunlight into electrical energy.

2.4.5 Inverter

Electrical component converting a DC input voltage to an AC output voltage.

2.4.6 Rectifier

Electrical component converting an AC input voltage to a DC output voltage.

2.5 Compartments

2.5.1 Compartment

Enclosed space within a **refrigerating appliance**, which is directly accessible through one or more external doors or lids.

2.5.2 Unfrozen compartment

A compartment for the storage and preservation of unfrozen **foodstuff** where the storage compartment reference temperature is above 0 °C.

2.5.3 Frozen compartment

A compartment for the storage and preservation of frozen **foodstuff** where the storage compartment reference temperature is equal to or below -6 °C.

2.5.4 Fresh food compartment

A compartment for the storage and preservation of unfrozen **foodstuff**, with an average temperature of 4 °C, a minimum temperature of 0 °C and a maximum temperature of 8 °C.

2.5.5 Sub cellar compartment

A compartment for the storage and preservation of unfrozen **foodstuff**, with an average temperature of 8 °C, a minimum temperature of 0 °C and a maximum temperature of 12 °C.

2.5.6 Cellar compartment

A compartment for the storage and preservation of unfrozen **foodstuff**, with an average temperature of 12 °C, a minimum temperature of 2 °C and a maximum temperature of 14 °C.

2.5.7 Pantry compartment

A compartment for the storage and preservation of unfrozen **foodstuff**, with an average temperature of 17 °C, a minimum temperature of 14 °C and a maximum temperature of 17 °C.

2.5.8 Chill compartment

A compartment for the storage and preservation of **foodstuff**, with an average temperature of 2 °C, a minimum temperature of -3 °C and a maximum temperature of 3 °C.

2.5.9 Zero star compartment

A relatively small compartment generally located in a **fresh food compartment**, in which the temperature is between 0 and -9 °C and which can be used for the production and storage of ice (e.g. ice cubes).

2.5.10 One star compartment

A compartment where the storage temperature is not warmer than -6 °C.

2.5.11 Two star compartment

A compartment where the storage temperature is not warmer than -12 °C.

2.5.12 Three star compartment

A compartment where the storage temperature is not warmer than -18 °C.

2.5.13 Compartment volume

Internal volume of a specific compartment which is cooled by the refrigeration system.

2.5.14 Appliance volume

The sum of volume of each specific compartment.

2.5.15 Dummy shelf

A shelf or grid specially constructed with a thickness less than 10 mm that does not obstruct the internal airflow in a compartment of a chest type refrigerating appliances with a horizontal door or lid. The shelf is used for conducting the water cooling test and the water freezing test.

2.6 Performance characteristics**2.6.1 Starting current**

The electrical current needed to start the compressor of a **refrigerating appliance**.

2.6.2 Pull down time

The time for an empty compartment to reach the reference compartment temperature and charge a **thermal store** or an integrated **electrical battery** supplying the compressor, after being connected to a power source.

2.6.3 Water cooling time

The time for a compartment loaded with a defined amount of water stabilised at **ambient temperature** to cool to specific reference temperatures.

2.6.4 Water freezing time

The time for a compartment loaded with a defined amount of water stabilised at **ambient temperature** to freeze to specific reference temperatures.

2.6.5 Energy consumption

The amount of energy consumed by a refrigerating appliance measured while the nominal compartment is set at the coldest temperature specification.

2.6.6 High ambient storage and energy consumption

The amount of energy consumed by a refrigerating appliance and a measure of compartment temperature performance when the ambient temperature is set at the highest rated value.

2.6.7 Under voltage

A supply voltage that is set at a value lower than the **rated** voltage. If the **rated** input voltage is given as a range, the rated supply voltage defaults to the lowest value within that range. For example, if the range is 12-24 Vdc, the 12 V should be considered as the **rated** voltage.

2.6.8 Over voltage

A supply voltage set higher than the **rated** voltage. In case the **rated input voltage** is give a range, the rated supply voltage defaults to the highest value within that range. For example, if the range is 12-24 Vdc, the 24 V should be considered as the **rated** voltage.

2.6.9 Holdover time

The time in hours during which a **refrigerating appliance** can maintain desirable cooling temperature ranges, after being disconnected from the power supply.

2.6.10 Ambient temperature

Temperature of the air surrounding the **refrigerating appliance** during the test. This temperature is generally 32 °C, except for the storage temperature test which requires an **ambient temperature** of 38 or 43 °C for climate class ST and T appliances.

2.6.11 M-Container

A water container containing a temperature transducer with a solid mass described in 4.6 positioned in the geometrical centre of the water volume.

3 Compartment storage temperature specifications

Table 3 – Compartment temperature specification

Compartment name	Minimum compartment temperature T_{c_min} [°C]	Maximum compartment temperature T_{c_max} [°C]	Target temperature T_{cm} [°C] (*)
Pantry	14	20	17
Cellar	2	14	12
Sub cellar	0	12	8
Fresh food	0	8	4
Chill	-3	3	2
Zero star	-6	0	
One star			-6
Two star			-12
Three star			-18
S	Special classification, declaration of T_{cm} on the rating plate is required		

For the location of the temperature sensors, reference is made to clause 7.

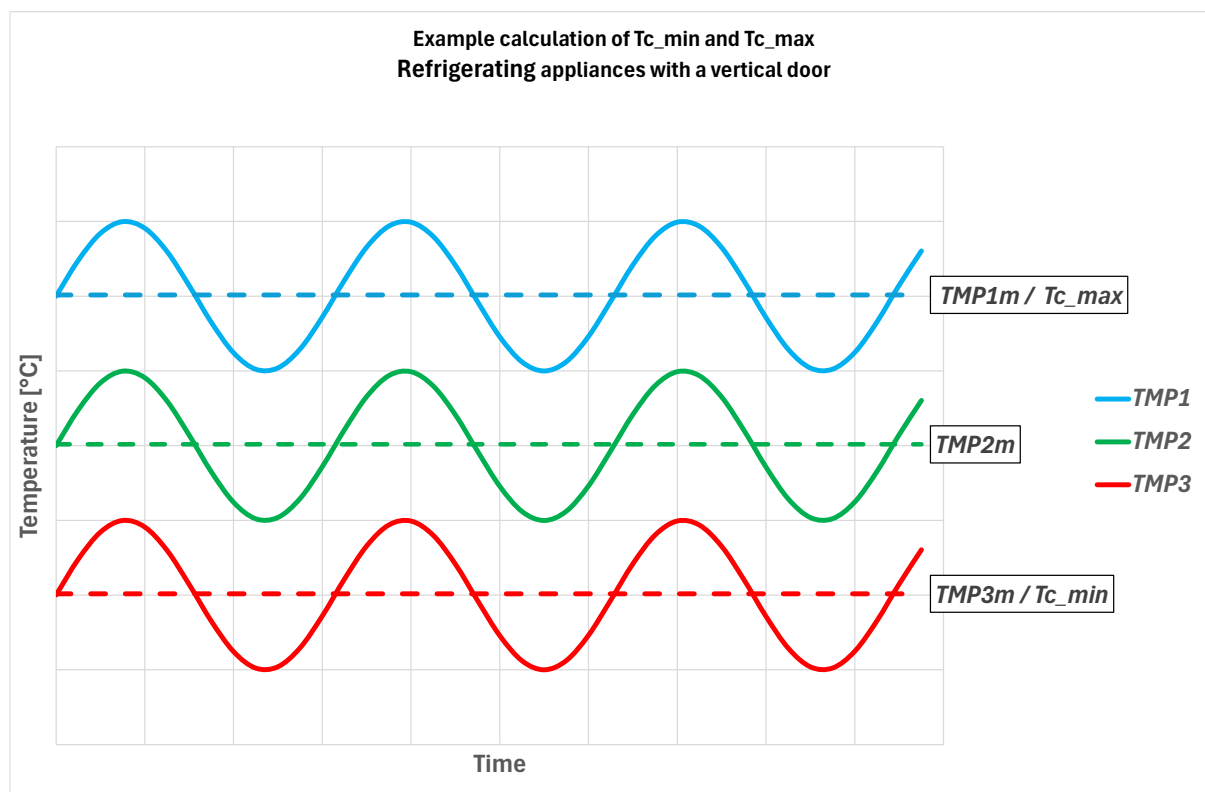
For the sampling rate of the temperature measurement reference is made to 4.6.

3.1 Calculation of T_{c_min} , T_{c_max} and T_{cm} for refrigerating appliances with a vertical door

For refrigerating appliances with a vertical door the following applies:

- $TMP1m$ is the average value of the $TMP1$ temperatures measured over the testing or stabilization period.
- $TMP2m$ is the average value of the $TMP2$ temperatures measured over the testing or stabilization period.
- $TMP3m$ is the average value of the $TMP3$ temperatures measured over the testing or stabilization period.
- T_{c_min} is the minimum value of $TMP1m$, $TMP2m$ and $TMP3m$.
- T_{c_max} is the maximum value of $TMP1m$, $TMP2m$ and $TMP3m$.
- T_{cm} is the average value of $TMP1m$, $TMP2m$ and $TMP3m$.

Figure 1 – Example calculation of T_{c_min} and T_{c_max} for refrigerating appliances with a vertical door



3.2 Calculation of T_{c_min} , T_{c_max} and T_{cm} for refrigerating appliances with a horizontal door or lid

For refrigerating appliances with a horizontal door or lid the following applies:

- $TMP11m$ is the average value of the $TMP11$ temperatures measured over the testing or stabilization period.
- $TMP12m$ is the average value of the $TMP12$ temperatures measured over the testing or stabilization period.
- $TMP13m$ is the average value of the $TMP13$ temperatures measured over the testing or stabilization period.
- $TMP14m$ is the average value of the $TMP14$ temperatures measured over the testing or stabilization period.
- $TMP15m$ is the average value of the $TMP15$ temperatures measured over the testing or stabilization period.
- T_{c_min} is the minimum value of $TMP11m$, $TMP12m$, $TMP13m$, $TMP14m$ and $TMP15m$.
- T_{c_max} is the maximum value of $TMP11m$, $TMP12m$, $TMP13m$, $TMP14m$ and $TMP15m$.
- T_{cm} is the average value of $TMP11m$, $TMP12m$, $TMP13m$, $TMP14m$ and $TMP15m$.