

Method of evaluating the thermal performance of enclosures

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British Standard

ICS 31.240

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Method of evaluating the thermal performance of enclosures
(IEC 62194:2005)

Méthode d'évaluation de la performance
thermique des enveloppes
(CEI 62194:2005)

Verfahren zur Bewertung
der Wärmeleistung von Gehäusen
(IEC 62194:2005)

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CENELEC

European Committee for Electrotechnical Standardization
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Foreword

The text of document 48D/324/FDIS, future edition 1 of IEC 62194, prepared by SC 48D, Mechanical structures for electronic equipment, of IEC TC 48, Electromechanical components and mechanical structures for electronic equipment, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 62194 on 2005-09-01.

The following dates were fixed:

- | | | |
|--|-------|------------|
| – latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement | (dop) | 2006-06-01 |
| – latest date by which the national standards conflicting with the EN have to be withdrawn | (dow) | 2008-09-01 |

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 62194:2005 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 60297-2	NOTE	Harmonized as HD 493.2 S1:1988 (not modified).
IEC 60721	NOTE	Harmonized in EN 60721 series (not modified).
IEC 60917-2	NOTE	Harmonized as EN 60917-2:1994 (not modified).
IEC 61587-1	NOTE	Harmonized as EN 61587-1:1999 (not modified).
IEC 61969-1	NOTE	Harmonized as EN 61969-1:2000 (not modified).
IEC 61969-2	NOTE	Harmonized as EN 61969-2:2000 (not modified).
IEC 61969-3	NOTE	Harmonized as EN 61969-3:2001 (not modified).

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INTRODUCTION

When installing enclosures with electronic components, the climatic conditions are very important, as the function of the electronics is affected by the ambient temperature. Because of heat load and solar radiation, the enclosures become hot. Since the heat transfer via the enclosure surface is often not sufficient, a climate control unit may be required to maintain tolerable enclosure internal conditions. For the enclosure design, the effect of the solar radiation was either estimated via the solar constant or added with a fixed value for heat load. Closer observation of the radiation allows for a more accurate and cost-efficient method of enclosure thermal performance evaluation.

There are existing standards defining the environmental conditions: for outdoor enclosures, IEC 61969-3 and EN 300 019 and, for indoor enclosures, IEC 60721, EN 300 019, and IEC 61587-1.

Dimensional standards referred to for outdoor enclosures are IEC 61969-1 and IEC 61969-2, and, for indoor enclosures, IEC 60297-2, EN 300 119 and IEC 60917-2.

As requested by users and manufacturers, a unified heat management property of empty enclosures had to be developed. This standard establishes a method of thermal performance evaluation for enclosures.

METHOD OF EVALUATING THE THERMAL PERFORMANCE OF ENCLOSURES

1 Scope

This International Standard provides a method of thermal performance evaluation for empty indoor enclosures according to IEC 60917 and IEC 60297, and, for outdoor enclosures according to IEC 61969.

This standard contains criteria to determine the thermal absorption factors relating to

- principles of enclosure design;
- internal heat load;
- sun radiation.

The enclosure absorption factor is intended to provide a common value for comparing and selecting enclosures built in accordance with this standard.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60297 (all parts), *Dimensions of mechanical structures of the 482,6 mm (19 in) series*

IEC 60721-2-4, *Classification of environmental conditions – Part 2-4: Environmental conditions appearing in nature – Solar radiation and temperature*

IEC 60917 (all parts), *Modular order for the development of mechanical structures for electronic equipment practices*

IEC 61969 (all parts), *Mechanical structures for electronic equipment – Outdoor enclosures*

3 Terms, definitions, symbols and abbreviations

3.1 Definition of enclosure design principles

The enclosure design influences heat flow. The following enclosure types are defined and illustrated in Figure 1.

- A Single-wall
- B Double-wall (with insulation/without insulation/with or without airflow)
- C Single-wall and sun-shield
- D Double-wall and sun-shield (with insulation/without insulation/with or without airflow)

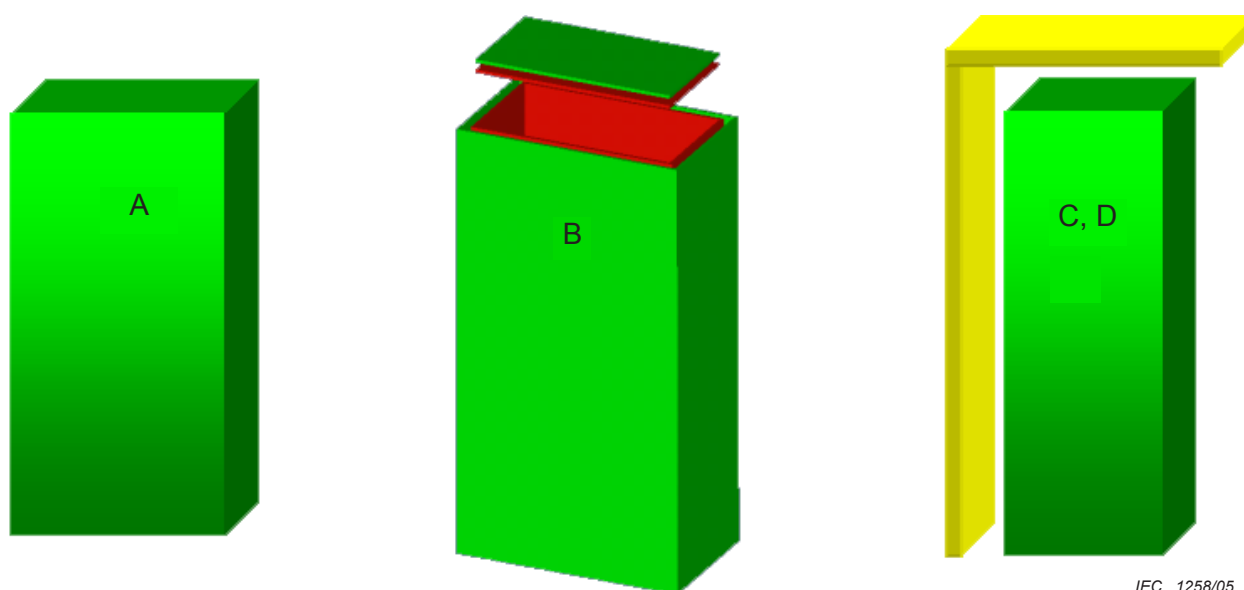


Figure 1 – Enclosure types

3.2 Symbols and abbreviated terms

A	Area of the surfaces of the enclosure excluding the bottom in square metres (m ²)
$\bar{A}$	Material absorption factor
$\bar{A}_E$	Enclosure absorption factor
A_W	Cross-section of the double wall in square metres (m ²)
a_W	Wall azimuth angle
a_0	Sun azimuth angle
c_F	Corrective factor for double-wall calculation (simple method)
$c_{p,air}$	Specific heat capacity of air in joules per kilogram and per kelvin (J/(kg K))
h	Sun-height angle
k	Heat transfer rate in watts per square meter and per kelvin (W/(m ² K))
P	Heat load in watts (W)

$\dot{Q}_{Tr}$	Heat transfer through enclosure walls caused by transmission in watts (W)
$\dot{Q}_{vent}$	Heat transfer transported by the airflow between the double wall in watts (W)
$\dot{q}_{dif}$	Diffuse solar radiation in watts per square metre (W/m ²)
$\dot{q}_g$	Solar radiation received on horizontal surfaces in watts per square metre (global radiation) (W/m ²)
$\dot{q}_i$	Specific internal heat load in watts per square metre (W/m ²)
$\dot{q}_s$	Solar total radiation received through the atmosphere in watts per square metre (W/m ²) (normal direction to the sun)
$\dot{q}_w$	Solar radiation (direct and diffuse) on the enclosure wall in watts per square metre (W/m ²)
s_j	Material thickness of material j used for the wall in metres (m)
T_A	Ambient air temperature in kelvins (K)
T_W	Wall temperature on the outside of the enclosure in kelvins (K)
t_a	Ambient temperature in degrees Celsius (°C)
$t_{a,max}$	Maximum ambient temperature in degrees Celsius (°C)
t_i	Average temperature inside the enclosure in degrees Celsius (°C)
$t_{i,max}$	Maximum allowed temperature inside the enclosure in degrees Celsius (°C)
t_m	Air temperature between the double wall in degrees Celsius (°C)
t_w	Wall temperature on the outside of the enclosure in degrees Celsius (°C)
t_{wi}	Wall temperature of the interior wall of a double-wall enclosure in degrees Celsius (°C)
w	Wind speed in metres per second (m/s)
w_w	Air speed between the double wall in metres per second (m/s)
α_{ka}	Convection heat transfer coefficient outside in watts per square metre and per kelvin (W/(m ² K))
α_{ki}	Convection heat transfer coefficient inside in watts per square metre and per kelvin (W/(m ² K))
α_{rad}	Radiation heat transfer coefficient in watts per square metre and per kelvin (W/(m ² K))
ε	Emissivity of the enclosure surface treatment
θ	Incident angle
λ_j	Thermal conductivity of material j used for the wall in watts per metre and per kelvin (W/(m K))
ρ_{air}	Density of air in kilograms per cubic metre (kg/m ³)

4 Flow chart for establishing the absorption factor

The flow chart shown in Figure 2 describes the different steps that are necessary for the determination of the thermal performance of the enclosure. The details of the different steps are explained in the clauses following this chart.

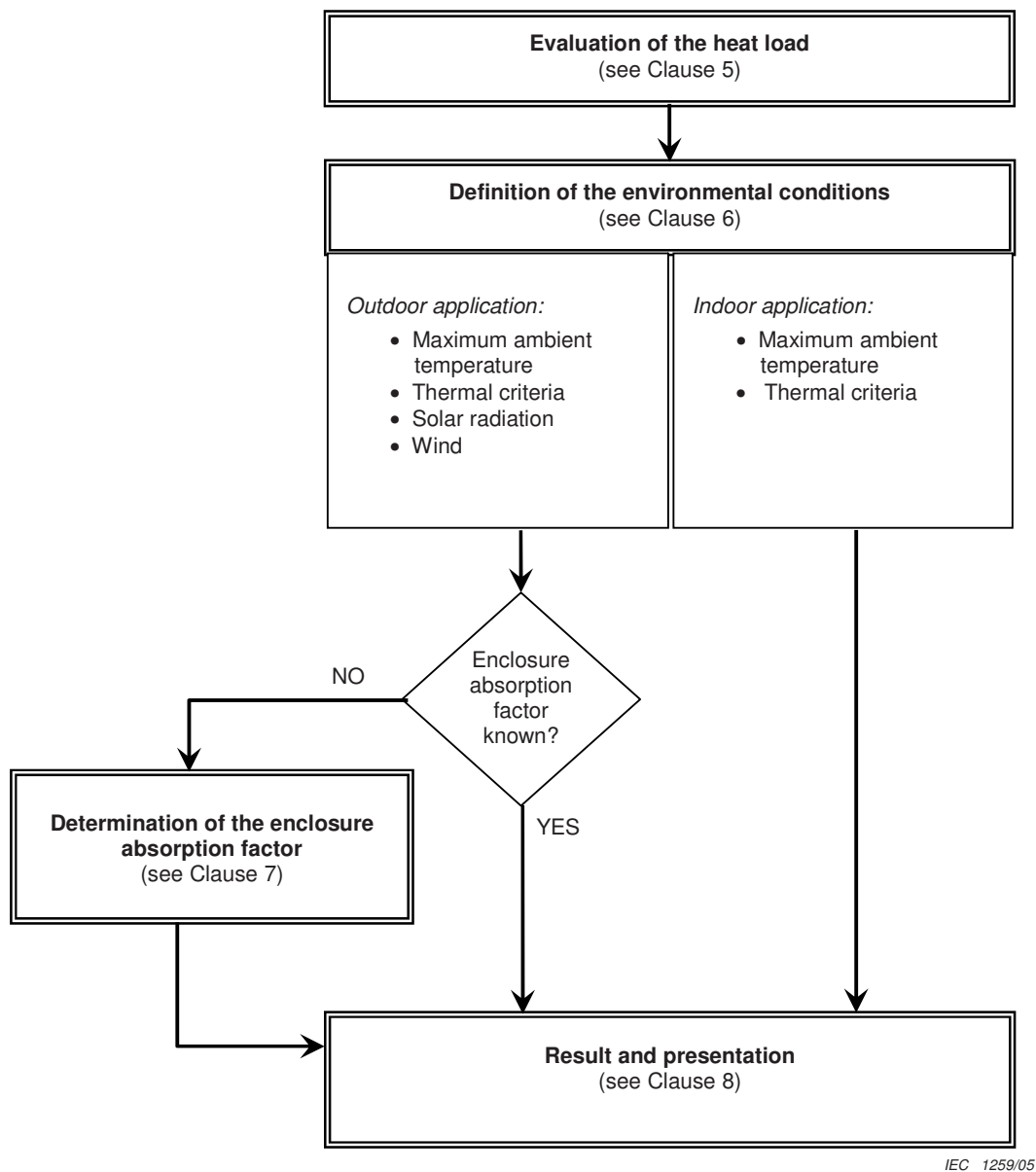


Figure 2 – Flow chart for establishing the absorption factor