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# INTERNATIONAL STANDARD

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**Low-voltage electrical installations -**
**Part 8-81: Functional aspects - Energy efficiency**



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# Low-voltage electrical installations - Part 8-81: Functional aspects - Energy efficiency

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IEC 60364-8-81 has been prepared by IEC technical committee 64: Electrical installations and protection against electric shock. It is an International Standard.

This first edition cancels and replaces the second edition of IEC 60364-8-1 published in 2019. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) modified numbering that allows IEC 60364-7 subparts to amend this document;
b) alignment of the definitions with IEC 60050-826;
c) introduction of minimum energy moment method in Annex A;
d) improvements in Annex B;

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

| Draft | Report on voting |
|---|---|
| 64/2799/FDIS | 64/2818/RVD |

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.

It has the status of a group energy efficiency publication in accordance with IEC Guide 118.

A list of all parts in the IEC 60364 series, published under the general title *Low-voltage electrical installations*, can be found on the IEC website.

The reader's attention is drawn to the fact that Annex C lists all of the "in-some-country" clauses on differing practices of a less permanent nature relating to the subject of this document.

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– withdrawn, or
– revised.

# INTRODUCTION

The optimization of electrical energy usage can be facilitated by appropriate design and installation considerations. An electrical installation can provide the required level of service and safety for the lowest electrical consumption. This is considered by designers as a general requirement of their design procedures in order to establish the best use of electrical energy. In addition to the many parameters taken into account in the design of electrical installations, more importance is nowadays focused on reducing losses within the system and its use. It is important therefore that the design of the whole installation takes into account inputs from users, suppliers and utilities.

It is important that this document covers existing electrical installations in buildings, in addition to new installations. It is in the refurbishment of existing buildings that significant overall improvements in energy efficiency can be achieved.

The optimization of the use of electricity is based on energy efficiency management, which is based on the price of electricity, electrical consumption and real-time adaptation. Efficiency is checked by measurement during the whole life of the electrical installation. This helps identify opportunities for any improvements and corrections. Improvements and corrections can be implemented by redesign or equipment replacement. The aim is to provide a design for an efficient electrical installation which allows an energy management process to suit the user's needs, and in accordance with an acceptable investment. This document first introduces the different measures to provide an energy efficient installation based on kilowatt-hour (kWh) saving. It then provides guidance on giving priority to the measures depending on the return of investment, in other words the saving of electrical energy and reduction of electrical power costs divided by the amount of investment.

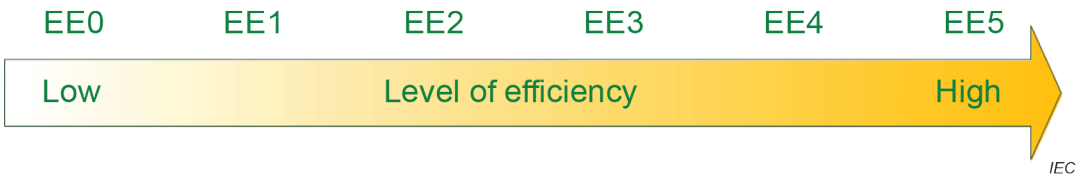


This document is intended to provide requirements and recommendations for the electrical part of the energy management system addressed by ISO 50001.



It introduces requirements, recommendations and methods for the design and the energy efficiency assessment of an electrical installation within the framework of an energy efficiency management approach in order to get the best permanent functionally equivalent service for the lowest electrical energy consumption and the most acceptable energy availability and economic balance.

The assessment method described in Annex B based on the electrical energy efficiency of the installation allows a classification of an energy efficiency installation according to the levels in Figure 1.




NOTE Account can be taken, if appropriate, of induced works (civil works, compartmentalization) and the necessity to expect, or not, the modifiability of the installation.

**Figure 1 – Classification levels for energy efficiency installations**

This document introduces requirements and recommendations to design the adequate installation in order to give the tenant or the user or, for example, the energy manager the ability to improve the management of the energy performance of the installation.

All requirements and recommendations of this document enhance the requirements contained in Parts 1 to 8 of the IEC 60364 series.

# 81 Energy efficiency

## 81.1 Scope

This part of IEC 60364 provides additional requirements, measures and recommendations for the design, erection, operation and verification of all types of low-voltage electrical installation including local production and storage of energy for optimizing the overall efficient use of electricity.

It introduces requirements, recommendations and methods for the design and the energy efficiency (EE) assessment of an electrical installation within the framework of an energy efficiency management approach in order to get the best permanent functionally equivalent service for the lowest electrical energy consumption and the optimal availability and acceptable cost-effectiveness.

These requirements, recommendations and methods apply, within the scope of the IEC 60364 series, for new installations and modification of existing installations.

This document is applicable to the electrical installation of a building or system and does not apply to products. The energy efficiency of products and their operational requirements are covered by the relevant product standards.

It is possible that another standard provides specific requirements for a particular system or installation application (e.g. manufacturing system covered by ISO 20140 series).

This document does not specifically provide requirements for building automation systems. The contribution of building automation systems to improve energy efficiency of the installation is considered.



This group energy efficiency publication is primarily intended to be used as an energy efficiency standard for the low-voltage electrical installations mentioned in the scope, but is also intended to be used by technical committees in the preparation of publications, in accordance with the principles laid down in IEC Guide 118.

## 81.2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 60688, *Electrical measuring transducers for converting AC and DC electrical quantities to analogue or digital signals*

IEC 61557-12, *Electrical safety in low voltage distribution systems up to 1 000 V AC and 1 500 V DC - Equipment for testing, measuring or monitoring of protective measures - Part 12: Power metering and monitoring devices (PMD)*

IEC 61869-2, *Instrument transformers - Part 2: Additional requirements for current transformers*

IEC 62053-21, *Electricity metering equipment - Particular requirements - Part 21: Static meters for AC active energy (classes 0,5, 1 and 2)*

IEC 62053-22, *Electricity metering equipment - Particular requirements - Part 22: Static meters for AC active energy (classes 0,1 S, 0,2 S and 0,5 S)*

IEC Guide 118, *Preparation of basic and group energy efficiency publications including energy efficiency aspects*

## 81.3 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

### 81.3.1 General

**81.3.1.1**
**zone**
area or surface defining a part of an installation

Note 1 to entry: A zone can be, for example, a kitchen of 20 $m^2$ or a storage area of 500 $m^2$.

**81.3.1.2**
**current-using equipment**
electric equipment intended to convert electric energy into another form of energy

Note 1 to entry: Light, heat, and mechanical energy are examples of other forms of energy.

[SOURCE: IEC 60050-826:2022, 826-16-02, modified – Note 1 to entry has been reworded.]



**81.3.1.3**
**electrical installation**
assembly of electrical equipment to fulfil specific purposes

[SOURCE: IEC 60050-826:2022, 826-10-01]

**81.3.1.4**
**usage**
type of application for which electricity is used

EXAMPLE Lighting, heating.

**81.3.1.5**
**load energy profile**
figure representing the energy consumption (Y-axis) within a period of time (X-axis) based on measurements for a mesh or a group of meshes

EXAMPLE Hourly consumption of energy for a period of a week.

**81.3.1.6**
**power demand profile**
figure representing the power demand (Y-axis) for a given integration period within a period of time (X-axis) based on measurements for a mesh or a group of meshes

**81.3.1.7**
**electrical energy efficiency**
**EEE**
optimized usage of electrical energy

Note 1 to entry: The optimization includes both technical, economic and environmental aspects.

[SOURCE: IEC 60050-826:2022, 826-19-01]

**81.3.1.8**
**mesh**
one or more circuits of the electrical installation for one or more zones including one or more services supplying a group of electrical equipment for the purpose of electrical energy efficiency

**81.3.1.9**
**active electrical energy efficiency measure**
operational measure either manually or automatically controlled for optimizing the energy usage of the electrical installation

EXAMPLE Thermostat control, occupancy lighting control, building optimization control systems.

[SOURCE: IEC 60050-826:2022, 826-19-02, modified – EXAMPLE has been added.]

**81.3.1.10**
**passive electrical energy efficiency measure**
measure for optimizing the energy usage of the electrical installation by selection and erection of electrical equipment other than control equipment



EXAMPLE Selection and location of transformer, cross-section of cables, routing of wiring system, sub-division of circuits.

[SOURCE: IEC 60050-826:2022, 826-19-03, modified – EXAMPLE has been added.]



**81.3.1.11**
**electrical installation efficiency class**
defined level of energy efficiency for an electrical installation

**81.3.1.12**
**driving parameter**
external factor that affects energy efficiency

EXAMPLE Regulation, environmental conditions, occupancy, energy prices and management requirements, mode of operation, duty cycle, load curves, state, operating, parameters, indoor temperature, lighting levels, production volume.

**81.3.1.13**
**barycentre method**
procedure to optimize the position of energy source(s) and loads in consideration of energy efficiency

**81.3.1.14**
**energy efficiency assessment**
process to determine the electrical installation efficiency class of an installation

### 81.3.2 Electrical energy management

**81.3.2.1**
**electrical energy management system**
**EEMS**
system monitoring, operating, controlling and managing energy resources and loads of the installations

**81.3.2.2**
**load shedding**
method of optimizing demand by controlling the electrical loads for variable periods of time

**81.3.2.3**
**demand response**
change in electric usage by end-user customers from their normal consumption patterns in response to changes in the price of electricity over time, or to incentive payments designed to induce lower electricity use at times of high wholesale market prices or when system reliability is jeopardized

**81.3.2.4**
**user interface**
means that allows the user to monitor or control the electrical installation, or both, locally or remotely

EXAMPLE Visual or audible signal, local display, remote display, push button.

### 81.3.3 Energy measurement



**81.3.3.1**
**measurement**
process of obtaining one or more values that can reasonably be attributed to a quantity



[SOURCE IEC 60050-112:2010, 112-04-01, modified – The notes to entry have been deleted.

**81.3.3.2**
**monitoring**
continuing procedure for the collection and assessment of pertinent information, including measurements, for the purpose of identifying deviations and determining the effectiveness of the plans and procedures

[SOURCE: IEC 60050-881:1983, 881-16-02, modified – In the definition, "identifying deviations and" has been added and "for radiation protection" has been deleted.]

**81.3.3.3**
**power metering and monitoring device**
**PMD**
combination in one or more devices of several functional modules dedicated to metering and monitoring electrical parameters in energy distribution systems or electrical installations, used for applications such as energy efficiency, power monitoring and network performance

**81.3.3.4**
**billing**
process that allows energy suppliers or their representatives to invoice their customers in accordance with a defined contract

Note 1 to entry: These applications can be covered by international standards, regulations such as measuring instruments directive (MID) in Europe or National Measurement Institute (NMI) in Australia, or utility specifications.

**81.3.3.5**
**sub-billing**
process that allows the property manager to allocate an energy invoice from the energy supplier and charges as appropriate to specific tenants

**81.3.3.6**
**cost allocation**
process that allows a facility manager to account for energy costs from internal cost centres that consume energy

EXAMPLE Process line, test and inspection, administration.

**81.3.3.7**
**estimation**
process of judging one or more values that can be attributed to a quantity

Note 1 to entry: Estimation by a competent person can provide data of a reasonable accuracy.

**81.3.3.8**
**forecast**
estimate of the expected value of a parameter at a given future date

**81.3.3.9**
**total harmonic distortion of the voltage wave**
**$THD_U$**
ratio of the RMS value of the harmonic content of an alternating quantity (voltage) to the RMS value of the fundamental component of the quantity (voltage)



**81.3.3.10**
**total harmonic distortion of the current wave**
**$THD_I$**

ratio of the RMS value of the harmonic content of an alternating quantity (current) to the RMS value of the fundamental component of the quantity (current)

**81.3.3.11**
**degree day**
unit representing a fall of 1 °C below a specified average outdoor temperature for one day

Note 1 to entry: The degree day is used to determine the heating requirements of buildings.

Note 2 to entry: The specified average outdoor temperature is usually 18 °C.

### 81.3.4 Sectors of activity

**81.3.4.1**
**residential installation**
premises designed and constructed for private habitation and including associated areas

Note 1 to entry: Associated areas include common areas, garages, gardens, pools.

**81.3.4.2**
**commercial installation**
premises designed and constructed for commercial operations

EXAMPLE Offices, retail, distribution centres, public buildings, banks, hotels, hospitals, schools.

**81.3.4.3**
**industrial installation**
premises designed and constructed for manufacturing and processing operations

EXAMPLE Factories, workshops.

**81.3.4.4**
**infrastructure installation**
system or premises designed and constructed for transport or utility operations

EXAMPLE Airport terminals, port facilities, transport facilities.

### 81.3.5 Abbreviated terms

BS bonus
DB distribution board
DSO distribution system operator
EEE electrical energy efficiency
EM energy management
HVAC heating, ventilation and air conditioning
HV/LV high voltage / low voltage
ICT information and communications technologies
KPI key performance indicator
MA performance maintenance
PDS power drive system
PM power monitoring
PMD power metering and monitoring device
PV photovoltaic
THD total harmonic distortion
UPS uninterruptible power supplies
2D two-dimensional
3D three-dimensional



## 81.4 General

### 81.4.1 Fundamental principles

#### 81.4.1.1 Safety of the electrical installation

The requirements and recommendations of this part of IEC 60364 do not impair safety requirements included in other parts of the IEC 60364 series.

#### 81.4.1.2 Availability of electrical energy and user decision

Energy efficiency management shall not reduce electrical availability or services or operation below the level desired by the user.

The electrical installation shall have provisions for overriding the energy efficiency management settings in accordance with the user's decision.

EXAMPLE 1 If someone is ill, the user can decide to heat the room to a higher temperature, even during peak consumption.

EXAMPLE 2 If a company receives an urgent delivery order, there can be a need for the workshop to operate at an unexpected hour.

#### 81.4.1.3 Design principles

The design principles of this document take into account the following aspects:

– load energy profile (active and reactive energy);
– availability of local generation and storage;
– reduction of energy losses in the electrical installation;
– the arrangement of the circuits with regard to energy efficiency (meshes, see 81.7.4);
– the customer's power use distribution over time;
– the tariff structure offered by the supplier of the electrical energy;
– maintaining the quality of service and the performance of the electrical installation.

In order to verify the achievement of electrical energy efficiency measures, an overall energy efficiency assessment should be made.

### 81.4.2 Energy efficiency assessment for electrical installations

#### 81.4.2.1 General

Assessment of installations shall be performed in accordance with Annex B. This assessment should be achieved preferably by measurement. It can be alternatively achieved by calculation.

The frequency of periodic inspection of an installation shall be determined having regard to the type of installation and equipment, its use and operation, the frequency and quality of maintenance, factors liable to influence energy efficiency and the external influences to which it is subjected. The results and recommendations of the previous report, if any, shall be taken into account.



The maximum interval for follow-up energy efficiency assessments should not exceed:



– five years for commercial;
– three years for industrial and infrastructure.

#### 81.4.2.2 Action plan following an assessment in accordance with Annex B

Where assessment is performed on a new installation and the assessment identified an electrical installation efficiency class lower than required, the identified variances shall be corrected.

Where periodic assessment identifies that the electrical installation efficiency class is not at the expected level, an action plan should be taken to achieve the required or desired electrical installation efficiency class.

### 81.5 Sectors of activities

For electrical energy efficiency (EEE), four sectors are identified, each having particular characteristics requiring specific methodology of implementation:

– residential installations;
– commercial installations;
– industrial installations;
– infrastructure installations.

Categorization is intended to facilitate the comparison between similar installations.