IEC 60364-8-1

Electrical energy efficiency within low-voltage electrical installations

Introduction

For many, energy measures revolve around the consideration of thermal issues in the building fabric with remedies such as insulation, glazing, and heat loss countermeasures. For others, it is lighting, albeit often constrained to merely installing low consumption systems. Those with significant heating requirements may see efficient boiler systems as the answer. All of the above are laudable and necessary, but they are passive countermeasures that largely mitigate energy loss rather than the energy deployed.

Active Energy Efficiency can be achieved where it is not only related to energy saving devices and equipment installed, but also that they are controlled to use only the energy required. It is this aspect of control that is critical to achieving the maximum efficiency.

It is the management of energy use through measurement, monitoring and control that effects permanent change. Moreover, compared with the costs (and technical skills necessary to avoid risks) of installing thermal solutions, energy control can be implemented at a relatively modest price and a very rapid payback. This is especially true when measured against escalating energy prices – most energy control solutions can be amortised within a few years.

A further very important factor that should drive Active Energy Efficiency from this point forward is the need to meet ambitious carbon reduction targets set by those governments in alliance with the Kyoto Protocol. In the built environment, for example, it is a fact that unless existing buildings (as well as all new build) are made energy efficient, it will simply be impossible to reach the targets set.

IEC 60364-8-1

Electrical energy efficiency within low-voltage electrical installations

Table of content

IEC 60364-8-1

Electrical energy efficiency within low-voltage electrical installations

1 Scope

This Part of IEC 60364 provides objectives and requirements aiming to obtain the highest possible service from an electrical installation for the lowest energy consumption.

This Part introduces requirements and advices for the design or refurbishing of an electrical installation with regards to electrical energy efficiency. It proposes a number of various electrical energy efficiency measures in all low voltage electrical installations as given in the scope of IEC 60364 from the origin of the installation including power supply, up to and including current-using-equipment.

This part of IEC 60364 can only be used together with to the other parts of IEC 60364. Clauses from this part cannot take precedence or replace other clauses of IEC 60364 parts 1 to 7.

The requirements provided within this standard are applicable for new buildings with new electrical installations, or to modifications or extensions of existing electrical installations.

This document only proposes minimum requirements for improving electrical energy efficiency. Additional requirements may be implemented within an electrical installation having additional or reinforced effects as those provided in this document.

Although adoption by national committees of international standards is not mandatory, this document may support for national regulations or legislation having as objective to encourage or require measures in all electrical installations for energy efficiency.

2 Normative references

To be completed

3 Definitions

3.1 Electrical energy efficiency

Consists in various measures adopted within the electrical installation in order to have the highest possible service for the lowest energy consumption

The electrical energy consumption relates to current-using equipment during either the normal operation or the stand-by operation of the electrical installation.

3.2 Current-using-equipment

Electric equipment intended to convert electric energy into another form of energy, for example light, heat, mechanical energy.

[IEV 826-16-02]

3.3 Electrical distribution system

Set of coordinated electrical equipment such as transformers, protection relays, circuit breakers, wires, bus-bars… for the purpose of powering current using equipment in electrical energy.

3.4 Installation monitoring system

Set of coordinated devices such as Performance Metering and Monitoring Devices, Power Quality Instruments, current sensors, voltage sensors and supervision software tools for the purpose of controlling and supervising electrical parameters in an electrical distribution system.

3.5 Electrical Energy Efficiency profile

Set of criteria resuming the electrical energy efficiency performance of an electrical installation.

4 Generals

4.1 Electrical Energy Efficiency and safety

All requirements of this part of the IEC 60364 shall not impair requirements included in other parts of this series of standard. Safety of persons and of properties remains of prime importance compared to energy efficiency statements.

4.2 Main sectors of economical activity

For a general approach of electrical energy efficiency, three main economical sectors may be identified, each having particular characteristics requiring specific methodology of implementation of electric energy efficiency:

- residential and small buildings
- medium and large buildings
- industry and infrastructure

5 Key points to address when designing new installations

5.1 Renewable power supplies

As the main objective of energy efficiency is the reduction of carbon emission, the use of renewable power energy should be considered when designing new electrical installation or up grading existing installations.

5.2 Voltage rating

For a constant power demand, increasing of rated voltage will decrease the current demand. From an electrical energy efficiency point of view, designer shall consider the advantages to select the highest rated voltage within the low-voltage range.

5.3 Optimization of power demand

In order to limit losses it is recommended that during the process of estimation the power demand rated power of electric motors and transformers are selected in such a way that they are likely to remain loaded as close as possible and as long as possible of their rated power during normal operation.

5.4 Determination of energy use

Intelligent energy management at the end use level is required to achieve sustainable and maximum reductions result of electricity consumption.

Designers and facility managers or building owner shall agree on the list of main usages of electrical energy as specific measurement or automation may be implemented for each main usage.

In this document the term usage corresponds to the type of application the electricity is used for. It may correspond to:

- lighting,
- heating,
- ventilation,
- air conditioning,
- specific process (cleaning, drying, …).

Other types of application may be listed which may include high energy current-using-equipment, or specific current-using-equipment.

5.5 Determination of zones

Intelligent energy management at the end use level is required to achieve sustainable and maximum reductions result of electricity consumption.

Designers and facility managers or building owner shall agree on the list of main zones on electrical energy consumption as specific measurement or automation may be implemented for each main zone.

In this document the term zone corresponds to area or location the electricity is used in. It may correspond to:

- workshop in industry,
- floor in building
- room in dwelling,
- swimming pool for a villa,
- kitchen for an hotel.

Other types of zones may be listed.

5.6 Impact on electrical installations architectures

Concern on electrical energy efficiency shall be at very first step when designing new electrical installations as definition and listing of different usages and zones shall impact the design of electrical installations. As permanent automation and control require measurement, monitoring and control, per usage or per zones, architecture of the electrical installations shall be designed such that installation of equipment needed for metering, automation and control shall be possible.

Main distribution switchboards shall be so designed as to segregate circuits supplying each areas or each usage selected. This requirement shall also apply to distribution switchboards where necessary.

6 Iterative process for existing installations

6.1 Presentation of iterative process

Implementation of electrical energy efficiency needs to have a global approach of the electrical installations as optimization of the electrical energy consumption requires consideration of all types and operations of these installations.

NOTE - As electrical energy efficiency is a global approach of electrical installations, many parameters have to be dealt with. Some of these parameters may have contradictory influence.

The requirements or recommendations of this document comply with the following statements:

- You don't change what you don't know, you don't know what you don't measure (see a and d)
- The right energy (see b) at the right time (see c)

a) As electrical energy efficiency is not different form other disciplines, rational approach shall be used as follows: **To audit the energy consumption** by measures for having an indication of the situation and the main avenues to pursue savings (where the main consumptions are, what the consumption pattern is). This initial measurement, together with some benchmarking information, will allow understanding how good or bad installation is, to define the main improvement axis and an estimation of what can be expected in terms of gains. It is recommended to have permanent measurement for comparison with further measurement.

b) To fix the basics on **equipment** or what is called passive electrical energy efficiency. Select or change old end use devices by low consumption ones (bulbs, motors, etc).

c) **To optimize through permanent automation or control** or what is called active electrical energy efficiency. As already highlighted, everything that consumes power must be addressed actively if sustained gains are to be made. Permanent control is critical to achieving the maximum efficiency (variable speed drives).

d) **To monitor, maintain and improve** the electrical installation. As targets are fixed over long timeframe, electrical energy efficiency programs are permanent improvement over the time. Therefore, frame services contracts are the ideal way to deal with these customer needs

6.2 Global methodology for the iterative process

6.2.1 Generals

As stated in clause 6.1 electrical energy efficiency approach corresponds to a permanent cycle to be followed during the whole life of the electrical installation. Once measurement have been performed (once, occasionally or permanently), provisions described in clause 7 needs to be performed. Then verification and maintenance should be done on regular basis.

Measurement of indicators as described in clause 7 should be done again followed by new provisions and new maintenance.

6.2.2 Energy performance contract

Facility managers or final users are invited to agree on an energy efficiency performance contract which should cover the following items:

- Initial audit and verification of the installation

- Appropriate accuracy of measuring equipment
- Permanent implementation of solutions improving the efficiency of the installation

6.2.3 Building management system

In existing installations reducing electrical consumption while keeping the same usage, will require a correct knowledge of electricity consumption per usage (ex: total electricity consumption needed for lighting) or per area (ex: total electricity consumption needed for one process).

Diagnosing electrical energy consumption is the first step to achieve electricity consumption reduction.

- Simply understanding where and how you use energy can yield up to 10% savings without any capital investment, using only procedural and behavioural changes.

Measuring equipment should be connected to an energy management system presenting a synthesis of all key parameters of energy efficiency.

6.2.4 Equipment performance

Electrical equipment installed in electrical installations complying with electrical energy efficiency requirements shall be selected in compliance with their relevant product standards (see IEC 60364-5-51).

6.2.5 Verification

As the general purpose of electrical energy efficiency is to reduce the total energy consumption, it is necessary to guarantee that efficiency of all measures implemented in the electrical installation for the entire life of this installation.

6.2.6 Maintenance

Apart from safety, maintenance is needed to keep plant in an acceptable condition. Maintenance of this kind must be reviewed on an economic and energy efficiency basis.

7 Achievement of methods and means worth for Electrical Energy Efficiency

7.1 Generals

Part 7 gives requirement for analysis or means that the designer of an electrical installation have to use to reach an achievement level. These levels are used to build installation profile and classes defined in clause 9.

These requirements are organised in 3 topics

- Efficiency of current using equipment
- Efficiency of electrical distribution system
- Installation monitoring system

7.2 Achievement Level (AL)

Four achievement levels ranked from AL1 to AL4 (AL4 being the highest level) applies to methodology, means or process set up in an installation.

7.3 Efficiency of current-using-equipment

7.3.1 Generals

Current-using-equipment efficiency is based on the following principles:

- Intrinsic efficiency of loads such as motors, lamps, heating equipment… (the right energy).
- Automation and regulation of the above loads (the right energy at the right time).

7.3.2 Motors

As about 95% of the cost generated by an asynchronous motor comes from its electrical energy consumption, asynchronous motors classified EFF1 (high efficiency) according to IEC 60034-30 should be preferably installed for applications that operated more than 3000h/year In the case where motors are often running below nominal conditions, variable speed drives should be installed for controlling motors. This is particularly the case where motors are used in flow systems (liquid, air …) and where power needed from motor depends on its speed

Table 1: **Required optimization analysis for motors**

Requirement	AL1	AL2	AL3	AL4
Residential and small building	---	---	---	---
Medium and large building	No consideration of efficiency class or drives	To analyse and optimize motors efficiency class & drives for 50% of installed power	To analyse and optimize motors efficiency class & drives for 70% of installed power	To analyse and optimize motors efficiency class & drives for 90% of installed power
Industry and infrastructure	No consideration of efficiency class or drives	To analyse and optimize motors efficiency class & drives for 50% of installed power	To analyse and optimize motors efficiency class & drives for 80% of installed power	To analyse and optimize motors efficiency class & drives for 95% of installed power

7.3.3 Lighting

Lighting can represent over 35% of energy consumption in buildings depending on the business. Lighting control is one of the easiest ways to save energy costs and one of the most common applications.

Table 2: Required optimization analysis for lighting

Requirement	**AL1**	**AL2**	**AL3**	**AL4**
Residential and small building	No special consideration	To consider lighting position with natural lighting sources and low	Automation according to natural lighting source or building use	Automation according to natural lighting source and building use

		consumption lamps	and to consider low consumption lamps	and to consider low consumption lamps
Medium and large building	No special consideration	To consider lighting position with natural lighting sources and low consumption lamps	Automation according to natural lighting source or building use and to consider low consumption lamps	Automation according to natural lighting source and building use and to consider low consumption lamps
Industry and infrastructure	No special consideration	To consider lighting position with natural lighting sources	Automation according to natural lighting source or building use	Automation according to natural lighting source and building use

Lamps may also be easily interchanged in luminaires. Correct selection of low electricity consumption lamps may be used. Compact Fluorescent Lamps (CFL) may be considered as economic lamps.

7.3.4 HVAC

Consideration of using variable speed drives system shall be given for efficient management of energy for intensive applications such as flow control of fans or pumps, or air compressing.

Table 3: Required optimization analysis for HVAC

Requirement	AL1	AL2	AL3	AL4
Residential and small building	No automation and control	Local equipment for automation and control	Equipment for automation and control at room level	Automation and control for complete building
Medium and large building	No automation and control	Local equipment for automation and control	Equipment for automation and control at room level	Automation and control for complete building
Industry and infrastructure	No automation and control	Local equipment for automation and control	Equipment for automation and control at room level	Automation and control for complete building

7.4 Efficiency of electrical distribution system

7.4.1 Generals

Efficiency of electrical distribution system is based on the following principles:

- Intrinsic efficiency of current carrying equipments such as transformers, busbars or cables.
- Topology of electrical distribution system, e.g. location of primary transformer and length of cables.

7.4.2 Transformers

Where private step down transformers are used to supply the electrical installation special care shall be taken on the type of transformer and specifically on its efficiency. Transformer efficiency depends on load.

Table 4: Required optimization analysis for transformer

Requirement	AL1	AL2	AL3	AL4
Residential and small building	---	---	---	---
Medium and large building	No special consideration	No special consideration	Selection of heavy duty & light duty transformers according to estimation of accumulated losses	Selection of all transformers according to estimation of accumulated losses
Industry and infrastructure	No special consideration	No special consideration	Selection of heavy duty & light duty transformers according to estimation of accumulated losses	Selection of all transformers according to estimation of accumulated losses

7.4.3 Wiring systems

7.4.3.1 Conductors

Beside transformers, conductors are the second sources of losses in the electrical distribution. Cross section of conductors and global architecture may be optimized to reduce losses.

Table 5: Required optimization analysis for wiring system

Requirement	AL1	AL2	AL3	AL4
Residential and small building	---	---	---	---
Medium and large building	No special consideration	To estimate wiring system losses	To locate sources and large current-using equipment according to minimum wiring system losses	To locate sources and current-using equipment according to minimum wiring system losses
Industry and infrastructure	No special consideration	To estimate wiring system losses	For large current-using-equipment, to consider selection of economical cross section of	To locate sources and current-using equipment according to minimum wiring system losses

			wiring system	

NOTE 1 – The impact of thermal losses, off load consumption and on load energy consumption of equipment connected in series with wiring system e.g. switchgear and controlgear, power monitor and relays included in an electrical circuit is negligible regarding the energy used in the load and in the energy transportation (typically less than 1/1000 of the load energy consumption).

7.4.3.2 Boxes

Erection of electrical installations shall not jeopardise general thermal insulation of the building (for instance, limitation of air flow through connecting boxes embedded in walls or partition may justify insulating installation box).

7.4.4 Compensation of reactive energy

Reduction of reactive energy consumption will improve electrical energy efficiency since maximum electrical energy will be transformed in active energy. Reduction of reactive energy will also reduce thermal losses in wiring systems, particularly in the low-voltage public distribution system. Reduction of reactive power will also reduce the energy losses in the transmission and distribution networks and in the customers' networks and the power to be transmitted in the transmission and distribution networks.

Table 6: Required optimization analysis for power factor correction

Requirement	AL1	AL2	AL3	AL4
Residential and small building	---	---	---	---
Medium and large building	No special consideration	Global compensation	Global compensation	Compensation by sector
Industry and infrastructure	No special consideration	Global compensation	Compensation by sector (with automation)	Compensation by sector (with automation) & individual compensation when Q>300kVAR

7.4.5 Electrical distribution equipment using semi-conductors

UPS, motor drives, motor soft starters are based on semi conductors. Where the power of these equipment is significant the designer shall select appropriate efficiency and control system to optimize the operations of these equipment.

Table 7: Required optimization analysis for electrical distribution equipment with semiconductors

Requirement	AL1	AL2	AL3	AL4
Residential and small building	---	---	---	---
Medium and large building	No specific requirement	To analyse and optimize device efficiency for 50% of installed power	To analyse and optimize device efficiency for 70% of installed power	To analyse and optimize device efficiency for 90% of installed power
Industry and infrastructure	No specific requirement	To analyse and optimize device efficiency for	To analyse and optimize device efficiency for	To analyse and optimize device efficiency for

		50% of installed power	80% of installed power	95% of installed power

7.4.6 Monitoring capability of the Electrical Distribution System

The electrical distribution system needs to meet the monitoring capability requirements.

In the case of a measurement by zone, each zone needs to have a dedicated feeder, allowing the installation monitoring system to perform the relevant measurements.

In the case of a measurement by usage, each usage needs to have a dedicated feeder, allowing the installation monitoring system to perform the relevant measurements.

7.5 Installation monitoring system

7.5.1 Generals

Installation monitoring system has 3 main objectives:

- **Control of performances & benchmarking**
- **Identification of energy use & consumption drift survey**
- **Power quality survey**

7.5.2 Energy

It is of prime importance, in term of electrical energy efficiency, to first measure current-using-equipment electricity consumption.

Table 8: Requirement for electrical energy (kWh) measurement

Requirement	AL1	AL2	AL3	AL4
Residential and small building	Global measurement	Global measurement	Global measurement	Measurement by usage and by zone
Medium and large building	Global measurement	Measurement by zone	Measurement by zone	Measurement by usage and by zone
Industry and infrastructure	Global measurement	Measurement by usage	Measurement by usage	Measurement by usage and by zone

7.5.3 Power demand as a function of time

Demand curve is necessary to analyse energy use and consumption drift.

Table 9: Requirement for power demand (kW) measurement

Requirement	AL1	AL2	AL3	AL4
Residential and small building	no specific requirement	Occasional measurement	Occasional measurement	Occasional measurement
Medium and large building	no specific requirement	Occasional measurement	Occasional measurement	Permanent measurement
Industry and	no specific	Occasional	Permanent	Permanent

infrastructure	requirement	measurement	measurement	measurement

7.5.4 Voltage

Voltage level has great influence on operation of current-using-equipment and therefore has some impact on the electrical energy efficiency of the electrical installation. In the case where the installation is supplied by a private power supply such as step-down power transformer, possibility of voltage adjustment exists at transformer level.

Table 10: Requirement for voltage (V) measurement

Requirement	AL1	AL2	AL3	AL4
Residential and small building	no specific requirement	Occasional measurement	Occasional measurement	Occasional measurement
Medium and large building	no specific requirement	Occasional measurement at main LV board(s)	Periodic measurement at main LV board(s)	Permanent measurement at main LV board(s) and loads
Industry and infrastructure	no specific requirement	Occasional measurement at main LV board(s)	Periodic measurement at main LV board(s)	Permanent measurement at main LV board(s)

Should voltage be measured, then measurement shall comply with IEC 61557-12.

7.5.5 Power factor

Power factor measurement is the best way to check the operation of power factor correction.

Table 11: Requirement for power factor (PF) measurement

Requirement	AL1	AL2	AL3	AL4
Residential and small building	no specific requirement	No measurement	No measurement	No measurement
Medium and large building	no specific requirement	Occasional measurement at main LV board(s)	Periodic measurement at main LV board(s)	Permanent measurement at main LV board(s) and loads
Industry and infrastructure	no specific requirement	Occasional measurement at main LV board(s)	Periodic measurement at main LV board(s)	Permanent measurement at main LV board(s)

7.5.6 Harmonics and inter-harmonics

These disturbances not only stress equipment due to overheating, but also and mainly generate additional power losses through wiring system. Therefore the measurement of THDu at the installation level and THDi at the current-using-equipment level for harmonics is recommended. Appropriate measurement for inter-harmonic should also be performed.

Table 12: Requirement for harmonics and inter-harmonics measurement

Requirement	AL1	AL2	AL3	AL4
Residential and small	---	---	---	---

building				
Medium and large building	no specific requirement	Occasional THDU and THDI measurement at the origin of the installation	Periodic THDU and THDI measurement and detailed harmonic spectrum at the origin of the installation	Permanent THDU and THDI measurement and detailed harmonic spectrum at the origin of the installation and for each main feeder
Industry and infrastructure	no specific requirement	Occasional THDU and THDI measurement at the origin of the installation	Periodic THDU and THDI measurement and detailed harmonic spectrum at the origin of the installation (including inter-harmonics)	Permanent THDU and THDI measurement and detailed harmonic spectrum at the origin of the installation and for each main feeder (including inter-harmonics)

7.6 Renewable energy

Table 13: Requirement for renewable energy

Requirement	AL1	AL2	AL3	AL4
Residential and small building	No action	No action	To study the benefit of renewable energy source	To install renewable energy source
Medium and large building	No action	No action	To study the benefit of renewable energy source	To install renewable energy source
Industry and infrastructure	No action	No action	To study the benefit of renewable energy source	To install renewable energy source

8 Performance levels worth for Electrical Energy Efficiency

8.1 Consumption distribution

Table 14: Minimum requirement for distribution of annual consumption

Segment	PL1	PL2	PL3	PL4
Residential and small building	---	---	---	---
Medium and large building	---	90% of annual consumption can be split between usages	95% of annual consumption can be split between usages	99% of annual consumption can be split between usages

		(lighting, HVAC, process, …)	(lighting, HVAC, process, …)	(lighting, HVAC, process, …) and between zones
Industry and infrastructure	---	90% of annual consumption can be split between usages (lighting, HVAC, process, …)	95% of annual consumption can be split between usages (lighting, HVAC, process, …)	99% of annual consumption can be split between usages (lighting, HVAC, process, …) and between zones

8.2 Performance level of installation power factor

Table 15: Minimum requirement for power factor

Segment	**PL1**	**PL2**	**PL3**	**PL4**
Residential and small building	---	---	---	---
Medium and large building	> 0,90	> 0,95	> 0,95	> 0,95
Industry and infrastructure	> 0,90	> 0,95	> 0,95	> 0,95

8.3 Performance level of transformer efficiency

Table 16: Minimum requirement for transformers efficiency

Segment	**PL1**	**PL2**	**PL3**	**PL4**
Residential and small building	---	---	---	---
Medium and large building	> 92%	> 92%	> 92%	> 92%
Industry and infrastructure	> 92%	> 92%	> 92%	> 92%

9 Installation profiles and installation classes

9.1 Installation profiles

Profiles will be made of two tables, one table resuming the Achievement levels specified in clause 7 and one table resuming the Performance levels in clause 8. An example of profile is given in annex B.

The installation profile may be used to improve the electrical energy efficiency of their electrical installation by trying to improve each level in the tables.

9.2 Installation classes

The purpose of using these classifications of installations is to rate the electrical energy efficiency of installations with pre-defined classes, then to improve it.

Four classes are defined, according to the following table:

Table 17: Electrical installation Energy efficiency classes

Installation classes	**AL (Achievement level) requirement**	**PL (Performance level) requirement**
Class A (Optimized installation)	90% of AL4 requirements specified in clause 7 are met	100% of PL4 requirements specified in clause 8 are met
Class B (Advanced installation)	70% of AL3 requirements specified in clause 7 are met	100% of PL3 requirements specified in clause 8 are met
Class C (Reference installation)	50% of AL2 requirements specified in clause 7 are met	100% of PL2 requirements specified in clause 8 are met
Class D (Lower installation)	Less than 50% of AL2 requirements specified in clause 7 are met	100% of PL1 requirements specified in clause 8 are met

Annex A

Informative

Performance Achievements

This informative annex is providing some informative information about relevant performance achievements. Those tables, that are complementary to the tables specified in clause 7, are only informative because the figures given below are very dependant of the countries and installations.

A.1 Renewable power supplies

Appropriate class for renewable energy shall be selected according to table 4

Table A1: Percentage of power generated by renewable power supply

Requirement	PL1	PL2	PL3	PL4
Residential and small building	0%	> 5%	> 10%	> 10%
Medium and large building	0%	> 5%	> 15%	> 20%
Industry and infrastructure	---	---	---	---

A.2 Consumption by m²

Table A2: Maximum energy consumption

Segment	PL1	PL2	PL3	PL4
Residential and small building	---	200 kWhep/m².	50 kWhep/m².	10 kWhep/m².
Medium and large building	---	200 kWhep/m².	50 kWhep/m².	10 kWhep/m².
Industry and infrastructure	---	---	---	---

A.3 Harmonics and inter-harmonics

Table A3: Maximum total harmonic distortion level THDU

Segment	PL1	PL2	PL3	PL4
Residential and small building	---	---	---	---
Medium and large building	---	8%	5%	5%
Industry and infrastructure	---	8%	5%	5%

Compatibility level for voltage distortion according to IEC 61000-2-4 shall not be exceeded. It is strongly recommended to provide an alarm signal as soon as THDi exceeds 5%

NOTE – Project of IEC 61000-3-14: Assessment of emission limits for the connection of disturbing installations to low-voltage power systems" is under consideration. This future document will be the IEC document for harmonics limitation applicable to LV installations.

A.4 Voltage drop

Table A4: Maximum voltage drop allowed in the electrical installations

Segment	PL1	PL2	PL3	PL4
Residential and small building	5%	3%	3%	3%
Medium and large building	Lighting 3% Other 5%	Lighting 3% Other 5%	3%	3%
Industry and infrastructure	Lighting 6% Other 8%	Lighting 6% Other 8%	6%	6%
Where main wiring systems of the installation have a length exceeding 100 m, these voltage drops may be increased by 0,005% per meter above this limit, without totally exceeding 0,5%.				
Voltage drops are estimated from powers absorbed by current-using-equipment, using if necessary simultaneity factors or if not known, values of design current of these circuits.				

NOTE 1 – Values corresponds to percentage compared to the rated voltage of the installation

NOTE 2 – higher voltage drop may be accepted

- For motor during starting period, and
- For other equipment having large inrush current;

provided that voltage variations remain within the limit specified by the corresponding standard.

NOTE 3 – The following temporary conditions are not considered:

- Transient overvoltages, and
- Voltage variations due to abnormal operation.

As a consequence of this voltage drop limitation, wiring systems lengths shall be limited, or use of bus bar trunking systems may e used, and correct balance of loads shall be verified.

Annex B

Informative

Example of profile for industry

The compilation of various levels (Achievement levels and Performances levels) proposed by this document may be used as a basis for building owners, factory managers or end user to build a profile concept for improving the electrical energy efficiency of their electrical installation by using the following tables.

This profile may also be used as a basis for future label of electrical installations of buildings.

For each type of application it is possible to estimate the level for each proposed recommendation.

Table B1: Example of Energy Efficiency profile for an industrial installation

Requirement	AL1	AL2	AL3	AL4
Motors	No consideration of efficiency class or drives	To analyse and optimize motors efficiency class & drives for 50% of installed power	To analyse and optimize motors efficiency class & drives for 80% of installed power	To analyse and optimize motors efficiency class & drives for 95% of installed power
Lighting	No special consideration	To consider lighting position with natural lighting sources	Automation according to natural lighting source or building use	Automation according to natural lighting source and building use
HVAC	No automation and control	Local equipment for automation and control	Equipment for automation and control at room level	Automation and control for complete building
Transformers	No special consideration	No special consideration	Selection of heavy duty & light duty transformers according to estimation of accumulated losses	Selection of all transformers according to estimation of accumulated losses
Wiring system	No special consideration	To estimate wiring system losses	For large current-using-equipment, to consider selection of economical cross section of wiring system	To locate sources and current-using equipment according to minimum wiring system losses
Reactive power compensation	No special consideration	Global compensation	Compensation by sector (with automation)	Compensation by sector (with automation)& individual compensation when

				Q>300kVAR
electrical distribution equipment with semiconductors	No specific requirement	To analyse and optimize device efficiency for 50% of installed power	To analyse and optimize device efficiency for 80% of installed power	To analyse and optimize device efficiency for 95% of installed power
Measurement	Global measurement	Measurement by usage	Measurement by usage	Measurement by usage and by zone
Power demand measurement	no specific requirement	Occasional measurement	Permanent measurement	Permanent measurement
Voltage measurement	no specific requirement	Occasional measurement at main LV board(s)	Periodic measurement at main LV board(s)	Permanent measurement at main LV board(s)
Power factor measurement	no specific requirement	Occasional measurement at main LV board(s)	Periodic measurement at main LV board(s)	Permanent measurement at main LV board(s)
Harmonics and inter-harmonics measurement	no specific requirement	Occasional THDU and THDI measurement at the origin of the installation	Periodic THDU and THDI measurement and detailed harmonic spectrum at the origin of the installation (including inter-harmonic)	Permanent THDU and THDI measurement and detailed harmonic spectrum at the origin of the installation and for each main feeder (including inter-harmonic)
Renewable energy	No action	No action	To study the benefit of renewable energy source	To install renewable energy source

Table B2: Example of Performance profile for an industrial installation

Requirement	**PL1**	**PL2**	**PL3**	**PL4**
Distribution of annual consumption	---	90% of annual consumption can be split between usages (lighting, HVAC, process, …)	95% of annual consumption can be split between usages (lighting, HVAC, process, …)	99% of annual consumption can be split between usages (lighting, HVAC, process, …) and between zones
Power Factor	> 0,90	> 0,95	> 0,95	> 0,95
Transformer efficiency	> 92%	> 92%	> 92%	> 92%