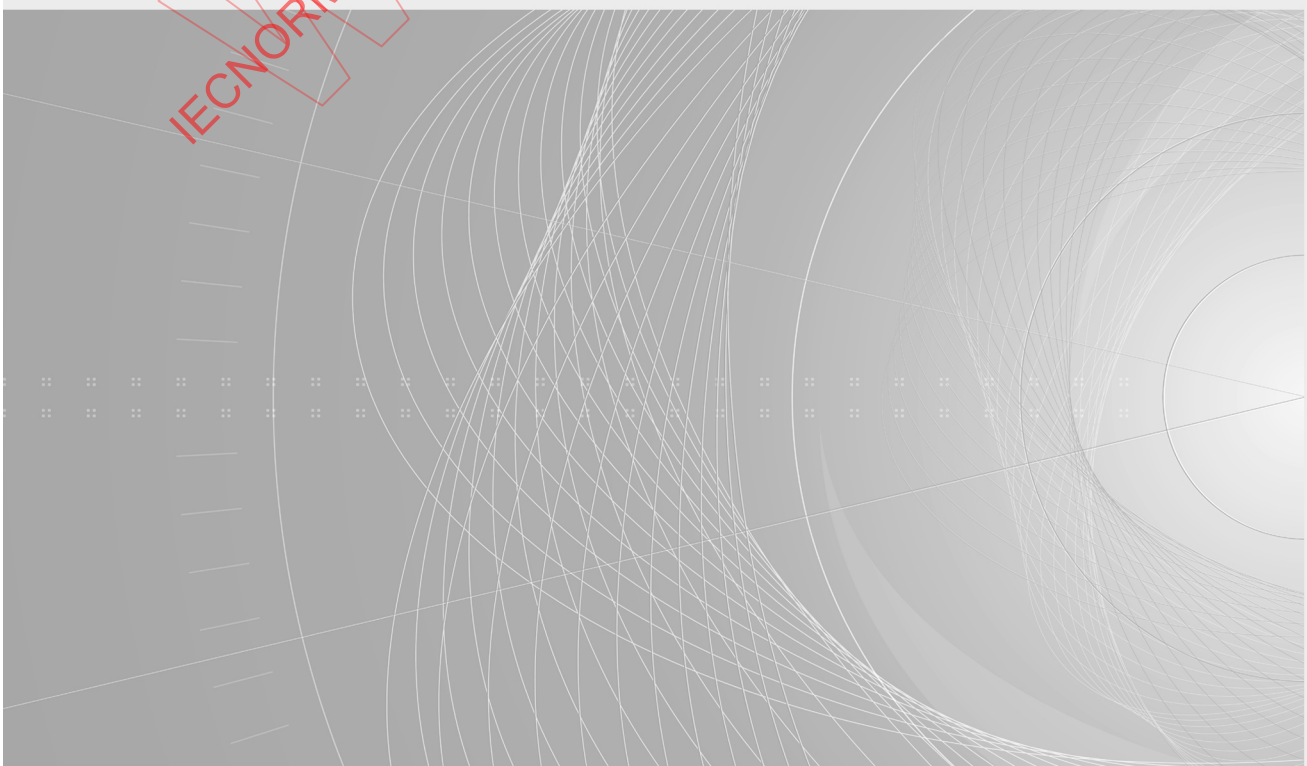
IEC 61892-1

Edition 2.0 2010-08

INTERNATIONAL STANDARD

Mobile and fixed offshore units – Electrical installations – Part 1: General requirements and conditions



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CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

MOBILE AND FIXED OFFSHORE UNITS – ELECTRICAL INSTALLATIONS –

Part 1: General requirements and conditions

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 61892-1 has been prepared by IEC technical committee 18: Electrical installations of ships and of mobile and fixed offshore units.

This second edition cancels and replaces the first edition published in 2001. This edition constitutes a technical revision.

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

a) the d.c.voltages given in Clause 1, have been updated in order to ensure uniform requirements for all parts of the standard;
b) the requirement to EMC has been rewritten to comply with the requirements of IEC 61000-2-4;
c) a clause regarding environmental impact has been added;
d) Annex A (Guidance on environmental conditions) has been deleted;

e) Annex B (Informative) regarding cold climate precautions has been added.

The text of this standard based on the following documents:

FDIS	Report on voting
18/1166/FDIS	18/1176/RVD

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

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of the IEC 61892 series can be found, under the general title *Mobile and fixed offshore units – Electrical installations*, on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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

A bilingual version of this publication may be issued at a later date.

INTRODUCTION

The IEC 61892 series of International Standards is intended to enable safety in the design, selection, installation, maintenance and use of electrical equipment for the generation, storage, distribution and utilization of electrical energy for all purposes in offshore units which are used for the purpose of exploration or exploitation of petroleum resources.

This part of the IEC 61892 series incorporates and co-ordinates, as far as possible, existing rules and forms a code of interpretation, where applicable, of the requirements of the International Maritime Organization, a guide for future regulations which may be prepared and a statement of practice for offshore unit owners, constructors and appropriate organizations.

This standard is based on equipment and practices which are in current use, but it is not intended in any way to impede development of new or improved techniques.

The ultimate aim has been to produce a set of International Standards exclusively for the offshore petroleum industry.

MOBILE AND FIXED OFFSHORE UNITS – ELECTRICAL INSTALLATIONS –

Part 1: General requirements and conditions

1 Scope

This part of IEC 61892 series contains provisions for electrical installations in mobile and fixed offshore units including pipeline, pumping or 'pigging' stations, compressor stations and exposed location single buoy moorings, used in the offshore petroleum industry for drilling, processing and storage purposes.

This International Standard applies to all installations, whether permanent, temporary, transportable or hand-held, to a.c. installations up to and including 35 000 V and d.c. installations up to and including 1 500 V (a.c. and d.c. voltages are nominal values).

This standard does not apply either to fixed equipment for medical purposes or to the electrical installations of tankers.

NOTE For medical rooms, see IEC 60364-7-710.

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 60034 (all parts), *Rotating electrical machines*

IEC 60034-1:2010, *Rotating electrical machines – Part 1: Rating and performance*

IEC 60079 (all parts), *Explosive atmospheres*

IEC 61000-2-4:2002, *Electromagnetic compatibility (EMC) – Part 2-4: Environment – Compatibility levels in industrial plants for low-frequency conducted disturbances*

IEC 61140, *Protection against electric shock – Common aspects for installation and equipment*

IEC 61892-2:2005, *Mobile and fixed offshore units – Electrical installations – Part 2: System design*

IEC 61892-7, *Mobile and fixed offshore units – Electrical installations – Part 7: Hazardous areas*

IMO-110E, IMO-111F and IMO 113S, *International Convention for the Safety of Life at Sea (SOLAS)*

IMO MODU Code, *Code for the construction and equipment of mobile offshore drilling units*

3 Terms and definitions

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

NOTE The terms and definitions included in this part are those having general application in the IEC 61892 series. Terms and definitions applying to particular apparatus or equipment are included in the other parts of IEC 61892.

3.1
appropriate authority
governmental body and/or classification society with whose rules a unit is required to comply

3.2
equipment
single apparatus or set of devices or apparatuses, or the set of main devices of an installation, or all devices necessary to perform a specific task

NOTE Examples of equipment are a power transformer, measuring equipment.

[IEC 60050-151:2001, 151-11-25, modified]

3.3
apparatus
device or assembly of devices which can be used as an independent unit for specific functions

[IEC 60050-151:2001, 151-11-22, modified]

3.4
room with a controlled atmosphere
room where the temperature and humidity can be controlled within specified limits

3.5
degree of protection provided by enclosures (of electrical apparatus)
measures applied to the enclosures of electrical equipment and apparatus to provide for :

1) protection of persons against contact with or approach to live parts and against contact with moving parts (other than smooth rotating shafts and the like) inside the enclosure and the protection of the apparatus against ingress of solid foreign bodies
2) protection of the apparatus inside the enclosure against harmful ingress of water

[IEC 60050-426:2008, 426-04-02, modified]

NOTE 1 For further information regarding degree of protection, see IEC 60529.

NOTE 2 Explanation of the numerals used for classification of degree of protection is given in Tables A.1 and A.2.

3.6
distribution board
assembly containing different types of switchgear and controlgear associated with one or more outgoing electric circuits fed from one or more incoming electric circuits, together with terminals for the neutral and protective conductors, if required

[IEC 60050-826:2004, 826-16-08, modified]

3.7
earth
general mass of the metal structure or hull of the unit

NOTE In the U.S.A. and Canada "ground" is used instead of "earth".

3.8
earthed
connected to the general mass of the structure or hull of the unit in such a manner as will ensure at all times an immediate discharge of electrical energy without danger

3.9
essential services
services essential for the navigation, steering or manoeuvring of the mobile unit, or for the safety of human life, or for special characteristics of the unit (for example special services)

3.10
frequency

3.10.1
cyclic frequency variation
periodic deviation in frequency during normal operation such as might be caused by regularly repeated loading

$$\text{Cyclic frequency variation} = \frac{\pm(f_{max} - f_{min}) \times 100}{2\, f_{nominal}} \%$$

3.10.2
frequency tolerance
maximum departure from nominal frequency during normal operation conditions excluding transient and cyclic frequency variations

NOTE Frequency tolerance is a steady state tolerance and includes variations caused by loads and governor characteristics. It also includes variations due to environmental conditions.

3.10.3
frequency transient
sudden change in frequency which goes outside the frequency tolerance limits and returns to and remains inside these limits within a specified recovery time after initiation of the disturbance (time range: seconds)

3.11
insulation

3.11.1
basic insulation
insulation of hazardous-live-parts which provides basic protection against electric shock

NOTE Basic insulation does not necessarily include insulation used exclusively for functional purposes.

[IEC 60050-195:1998, 195-06-06, modified]

3.11.2
supplementary insulation
independent insulation applied in addition to basic insulation, for fault protection in the event of a failure of basic insulation

[IEC 60050-195:1998, 195-06-07, modified]

3.12
live part
conductor or conductive part intended to be energized in normal operation, including a neutral conductor, but by convention not a PEN conductor or PEM conductor or PEL conductor

NOTE This concept does not necessarily imply a risk of electric shock.

[IEC 60050-195:1998, 195-02-19]

3.13
PEN conductor
conductor combining the functions of both a protective earthing conductor and a neutral conductor

[IEC 60050-195:1998, 195-02-12]

3.14
PEM conductor
conductor combining the functions of both a protective earthing conductor and a mid-point conductor

[IEC 60050-195:1998, 195-02-13]

3.15
PEL conductor
conductor combining the functions of both a protective earthing conductor and a line conductor

[IEC 60050-195:1998, 195-02-14]

3.16
petroleum
complex mixture of hydrocarbons that occurs in the earth in liquid or gaseous forms

3.17
point (in wiring)
any termination of the fixed wiring intended for the attachment of a luminaire or for connecting to the supply of a current-using appliance

3.18
spaces

3.18.1
accommodation spaces
spaces used for public spaces, corridors, lavatories, cabins, offices, crew quarters, hospitals, game and hobby rooms, pantries containing no cooking appliances and similar spaces

3.18.2
machinery spaces
spaces containing propelling machinery, boilers, oil fuel units, steam and internal combustion engines, hydrocarbon process equipment, water treatment and handling equipment, drilling and associated equipment, generators and major electrical machinery, oil filling stations, refrigerating, stabilizing, ventilation and air-conditioning machinery, and similar spaces and trunks to such spaces

3.18.3
public spaces
portions of the accommodation used for halls, dining rooms, lounges, and similar permanently enclosed spaces

3.19
voltages

3.19.1
voltage tolerance
maximum departure from nominal user voltage during normal operating conditions, excluding transient and cyclic voltage variations

NOTE Voltage tolerance is a steady state tolerance and includes voltage drop in cables and voltage regulator characteristics. It also includes variations due to environmental conditions.

3.19.2
voltage unbalance tolerance
difference between the highest and lowest phase to phase voltage

3.19.3
cyclic voltage variation
periodic voltage deviation (max. to min. r.m.s. values) of the nominal voltage, such as might be caused by regularly repeated loading

$$\text{Cyclic voltage variation} = \frac{\pm(U_{\max} - U_{\min}) \times 100}{2\,U_{\text{nominal}}}\ \%$$

3.19.4
voltage transient
sudden change in voltage (excluding spikes) which goes outside the nominal voltage tolerance limits and returns to and remains inside these limits within a specified recovery time after the initiation of the disturbance (time range: seconds)

3.20
recovery time

3.20.1
voltage transient recovery time
time elapsed from exceeding the normal voltage tolerance until the voltage recovers and remains within the normal tolerance limits

3.20.2
frequency transient recovery time
time elapsed from exceeding the normal frequency tolerance until the frequency recovers and remains within the frequency tolerance limits

3.21
waveform

3.21.1
total harmonic distortion
THD
ratio of the r.m.s. value of the sum of all the harmonic components up to a specified order (recommended notation "H") to the r.m.s. value of the fundamental component

$$\text{THD} = \sqrt{\sum_{h=2}^{h=H} \frac{(Q_h)^2}{(Q_1)^2}}$$

where

Q represents either current or voltage;

Q_1 is the r.m.s. value of the fundamental component;

h is the harmonic order;

Q_h is the r.m.s. value of the harmonic component of order h;

H is 50 for the purpose of the compatibility levels in this standard

NOTE THD takes account of harmonics only. For the case where interharmonics are to be included, reference is made to A.3.1 of IEC 61000-2-4:2002.

[IEC 61000-2-4:2002, 3.2.7]

3.21.2
single harmonic content
ratio of the effective r.m.s. value of that harmonic to the r.m.s. value of the fundamental expressed in per cent

4 General requirements and conditions

4.1 General

This clause contains conditions and requirements which are common to all equipment and installations in the IEC 61892 series.

Electrical installations in units shall be such that:

– essential services will be maintained under various emergency conditions;
– the safety of crew, contractors, visitors and unit will be ensured;
– the requirements with respect to safety in this standard are considered;
– the requirements of the International Convention for the Safety of Life at Sea (SOLAS) are met as far as applicable;
– the requirements of the IMO MODU Code are met as far as applicable.

NOTE Emergency conditions are normally defined in the safety assessment of the installation.

4.2 Workmanship and material

Good workmanship and adequate material are essential requirements for compliance with these standards.

4.3 Acceptance of substitutes or alternatives

Where in these standards any special type of equipment, construction, or arrangement is specified, the use of any other equipment, construction or arrangement is admissible, provided it is not less effective and reliable.

4.4 Additions and alterations

An addition or alteration, temporary or permanent, shall not be made to an existing installation until it has been ascertained that the ratings and the condition of existing accessories, conductors, switchgear, etc. affected, are adequate for the new situation.

Special attention is drawn to those factors affecting the existing system design such as current-carrying capacity, short-circuit level, voltage drop, harmonics, stability and proper discrimination of the protective devices.

4.5 Environmental conditions

4.5.1 General

Electrical equipment shall operate satisfactorily under various environmental conditions.

Environmental conditions are characterised by a number of variables:

– one set including mainly climatic conditions, biological conditions, conditions dependent upon chemically and mechanically active substances and mechanical conditions;
– another set dependent mainly upon locations in unit, operational patterns and transient conditions.

NOTE Further information regarding environmental conditions in conjunction with some selected locations, operational patterns and transient conditions which are considered to be generally representative can be found in IEC 60721-3-6.

4.5.2 Design parameters

4.5.2.1 General

Design parameters based on environmental conditions applicable to certain types of equipment may be determined according to location. Where no data is available, the following tables give recommended values.

NOTE In certain areas, e.g. arctic areas, lower temperatures than those given in the tables have to be taken into consideration. In certain areas, also a higher temperature than given in the tables has to be taken into consideration.

4.5.2.2 Temperature

In other parts of the IEC 61892 series, where no "high air temperature" has been specified as a design parameter for equipment, a value of 45 ºC shall apply.

Where equipment is designed to operate with temperatures higher or lower than those stated in Table 1, permissible temperature rises may be reduced or increased accordingly.

Table 1 – Operational design parameters – Ambient temperature

Type of equipment	Value °C
High air temperature	
Cables	45
Generators and motors	50
Switchgear	45
Transformers	45
Control and instrumentation	55
Other electrical equipment	45
Low air temperature	
Control and instrumentation	5 (general)
Control and instrumentation	–25 (open deck)
High water temperature	
Generators and motors	35

NOTE 1 The lower design temperature will normally be specified in the product standard.

NOTE 2 For batteries see 10.1.1 and 10.7 of IEC 61892-6.

4.5.2.3 Humidity, relative

Design values for relative humidity are given in Table 2.

Table 2 – Design parameters – Humidity, relative

Value	
%	°C
95	up to 45
70	above 45

4.6 Materials

In general, all electrical equipment shall be constructed of durable, flame-retardant, moisture-resistant materials, which are not subject to deterioration in the atmosphere and at the temperatures to which they are likely to be exposed.

Equipment enclosures located outdoor, in naturally ventilated and wash down areas shall be made of proven seawater resistant materials.

NOTE 1 Such material may be seawater resistant aluminium, stainless steel or UV resistant plastic material.

NOTE 2 For further information regarding environmental conditions, refer to IEC 60721-3-6.

4.7 Power supply system characteristics

4.7.1 General

Unless otherwise stated in other parts of this standard, equipment shall function when supplied from general distribution systems with due regard to voltage and frequency variations, harmonic distortion and conducted disturbances. The characteristics of general distribution systems are given in the following subclauses.

NOTE 1 Where the power supply is obtained from the shore, due regard should be paid to the effect that the quality of the supply, if different from that specified in this clause, may have on the performance of equipment.

NOTE 2 For systems where semiconductors are connected having a total rating which is a significant portion of the total system rating, it may be feasible to suppress the harmonics. Consideration should be given to taking appropriate measures to attenuate these effects of the distribution system so that safe operation is assured. Care should be taken in selecting consumers supplied from an electric power supply system with a higher harmonic content than specified in this clause.

NOTE 3 Electrical equipment which requires a higher quality power supply may need additional provisions to be made locally. Where additional equipment is fitted to achieve this higher quality power supply, it may be required to be duplicated and segregated to the same degree as the electrical equipment it supplies.

NOTE 4 Special attention should be paid to the installation of electrical equipment which may influence the quality of power supply on a local basis or react with any harmonics present on the general distribution system.

NOTE 5 Variable frequency/voltage systems may be admissible provided safe operation of the system is assured and equipment is suitably rated for the expected variations.

4.7.2 AC distribution systems

4.7.2.1 General

The voltages referred to in 4.7.2.2 and 4.7.3 are measured at the point where the equipment is installed.

4.7.2.2 Voltage characteristics

Tolerances are expressed in a percentage of the nominal voltage.

Voltages are root mean square (r.m.s.) unless otherwise stated.

Voltage tolerance (continuous).....	$^{+6}_{-10}$ %
Voltage unbalance tolerance including phase voltage unbalance as a result of unbalance of load according to IEC 61892-2.	7 %
Cyclic voltage variation (continuous).	2 %

Voltage transients:

slow transients e.g. due to load variations tolerance.....

(deviation from nominal voltage) ..... $^{+20}_{-20}$ %

voltage transients recovery time..... maximum 1,5 s

Where three-phase a.c. motors conforming to the IEC 60034 series are connected, then the system negative sequence component shall not exceed 1 % of the positive sequence component over a long period, or 1,5 % for a short period not exceeding a few minutes, and a zero sequence component not exceeding 1 % of the positive sequence component.

NOTE The sum of voltage excursions at any point on the system (tolerances and transients) from nominal voltage should not exceed $^{+20}_{-20}$ %.

4.7.2.3 Harmonic distortion (voltage waveform)

For voltage harmonic distortion, acceptance limits shall correspond to IEC 61000-2-4, Class 2. In addition no single harmonic shall exceed 5 %.

NOTE 1 IEC 61000-2-4, Class 2, requires that the THD shall not exceed 8 %.

NOTE 2 Other values may be considered subject to approval of the appropriate authority.

NOTE 3 Some equipment may require Class 1 (5 % and 3 %). Classification societies may have other requirements, which may be more stringent.

4.7.2.4 Frequency characteristics

Tolerances are expressed in a percentage of the nominal frequency.

Frequency tolerance (continuous) ..... $^{+5}_{-5}$ %

Cyclic frequency variation (continuous)..... 0,5 %

Frequency transient tolerance..... $^{+10}_{-10}$ %

Frequency transients recovery time..... maximum 5 s

NOTE The sum of frequency excursions at any point on the system (tolerances and transients) from nominal frequency should not exceed $^{+12,5}_{-12,5}$ %.

4.7.3 DC distribution systems

Tolerances are expressed in a percentage of the nominal voltage.

Voltage tolerance (continuous)..... $^{+10}_{-10}$ %

Cyclic voltage variation ..... 5 %

Voltage ripple (a.c. r.m.s. over steady d.c. voltage, battery in fully loaded condition) 10 %

NOTE 1 When battery chargers/(battery combinations) are used as d.c. power supply systems, adequate measures should be taken to keep the voltage within the specified limits during charging, quick charging and discharging of the battery.

NOTE 2 For control and instrumentation systems, see IEC 61892-2.

Fast transients e.g. spikes caused by switching, peak impulse voltage amplitude

24 V d.c. systems ..... 500 V

110 V d.c. systems ..... 1 500 V

220 V d.c. systems ..... 2 500 V

600 V d.c. system ..... 4 000 V

1 000 V d.c. system ..... 6 000 V

NOTE 3 The figures are in accordance with IEC 60664-1. Values for d.c. systems with rated voltage above 1 000 V are not given in that standard

4.8 Electrical apparatus for explosive gas atmospheres

When an apparatus is required to be suitable for use in explosive gas atmospheres, it shall comply with the requirements of IEC 61892-7.

Such equipment shall be constructed and tested in accordance with the requirements of the IEC 60079 series as required in IEC 61892-7 and be certified as fit for purpose for the actual ambient temperature and other environmental conditions, to the satisfaction of the appropriate authority.

NOTE In most countries, it is required that certification is done by an independent testing authority.

4.9 Precautions against galvanic corrosion

Suitable means shall be taken to prevent galvanic corrosion when securing dissimilar metals, for example aluminium to the structure or hull of a unit.

4.10 Clearance and creepage distances

The distances between live parts of different potential and between live parts and the cases of other earthed metal, whether across surfaces or in air, shall be adequate for the working voltage, having regard to the nature of the insulating material and the conditions of service.

NOTE Information regarding creepage and clearage distances are given in the specific equipment standards, referred to in IEC 61892-3.

4.11 Insulation

Insulating materials and insulated windings shall be resistant to moisture, sea air and oil vapour, unless special precautions are taken to protect insulants against such agents.

NOTE As a consequence of this clause, insulating materials in important applications, such as busbar supports, etc., should have sufficient resistance against tracking. It is recommended that the comparative tracking index of such materials be not less than 175 V when determined according to IEC 60112.

4.12 Maintenance and inspection

Equipment shall be so designed and installed as to permit its being maintained and inspected as required for all its parts.

NOTE Equipment should, to the extent possible be designed to allow for thermographic inspection. Where this is not possible, consideration should be given to installation of equipment for temperature monitoring.

4.13 Cable entries

Cable glands or bushings, or fittings for screwed conduits, shall be suitable for the intended cables and shall facilitate the cable entrance into the equipment. All entries shall maintain the degree of protection provided by the enclosure of the associated equipment.

NOTE For explosion protected equipment, it should be noted that gas or vapour leakage and propagation of flames may occur through the interstices between the strands of standard stranded conductors, or between individual cores of a cable. Construction methods as compacted strands, sealing of the individual strands, and inner sheath can be employed as means of reducing leakage and preventing propagation of flames.

4.14 Precautions against vibration and mechanical shock

Equipment shall be unaffected by vibration and shock likely to arise under normal service. Connections shall be secured against becoming loose due to vibration.

NOTE For guidance regarding shock testing, see IEC 60068-2-27.

4.15 Location of electrical equipment in units

Major electrical equipment, such as

- electrical switchgears and distribution boards/panels;
- motor starters and feeders including contactors and breakers;
- power transformers;
- battery chargers;
- frequency converters;

shall, wherever possible, be installed in rooms with a controlled atmosphere.

NOTE Regarding installations in hazardous areas, reference is made to IEC 61892-7.

4.16 Mechanical protection

Electrical equipment shall be placed so that, as far as practicable, it is not exposed to risk of mechanical damage.

NOTE Special attention to protection of electrical equipment against mechanical damage should be given in storage, loading and other exposed areas.

4.17 Protection from heat, water, steam and oil

Electrical equipment shall be so selected and located or protected from the effects of exposure to saliferous atmosphere, water, steam, oil or oil fumes, spray, ice formation, etc., that the effects are minimised. It should be located well clear of boilers, steam, oil or water pipes, and engine exhaust pipes and manifolds, unless specifically designed for such locations. If pipes must be run adjacent to electrical equipment, there shall be no joints in the immediate vicinity of the electrical equipment.

NOTE Where sprinkler heads or water spraying devices are fitted for fire-fighting, due consideration should be given to the siting of electrical equipment which would be seriously affected by the inadvertent operation of the extinguishing arrangement. This is particularly applicable to switchgear and switch rooms, where a suitable alternative method of extinguishing should be used.

4.18 Protection against electrical shock

All electrical equipment shall be provided with an enclosure complying with a degree of protection of at least IP2X or shall be provided with at least provisions for basic protection in accordance with IEC 61140.

NOTE 1 Where an item of equipment or enclosure contains live parts that are not capable of being isolated by a single device, a warning notice should be placed in such a position that any person gaining access to live parts will be warned of the need to use appropriate isolating devices, unless an interlocking arrangement is provided so that all the circuits are isolated.

NOTE 2 For information regarding IP codes, see Annex A.

4.19 Enclosures

Enclosures shall comply with the degrees of protection as required in Table 7 of IEC 61892-2. Enclosing cases for electrical equipment shall be of adequate mechanical strength and rigidity and mounted so that their enclosing arrangements and the functioning of the built-in equipment will not be affected by distortions, vibrations and movements of the unit's construction, or by risk of damage.

NOTE For additional requirements to mobile units, see IEC 61892-5.

4.20 Environmental impact

The design, construction and maintenance shall, wherever possible, consider:

- the impact on the environment;
- the efficient use of generated power;
- the actual environmental values, e.g. temperature variations, over the year and operational area;
- the use of high efficient motors and high frequency drives to optimize power consumption, e.g. motors;
- the use of low-loss transformers, generators and other high power equipment;
- the re-use of waste energy in HVAC installations;
- the use of low energy luminaires and efficient switching arrangements.

NOTE 1 Consideration should be given to establishing an energy management system.

NOTE 2 Energy optimization by use of i.e. brake energy or waste heat recovery should be evaluated.

Annex A
(informative)

Degree of protection

The following gives information regarding the IP code, as found in IEC 60529.

Table A.1 – Degrees of protection against foreign objects indicated by the first characteristic numeral

First characteristic numeral	Degree of protection	
	Short description	Definition
0	Non-protected	–
1	Protected against solid objects of 50 mm Ø and greater	The object probe, sphere of 50 mm Ø, shall not fully penetrate [a]
2	Protected against solid foreign objects of 12,5 mm Ø and greater	The object probe, sphere of 12,5 mm Ø, shall not fully penetrate [a]
3	Protected against solid objects of 2,5 mm Ø and greater	The object probe, sphere of 2,5 mm Ø, shall not penetrate at all [a]
4	Protected against solid objects of 1 mm Ø and greater	The object probe, sphere of 1,0 mm Ø, shall not penetrate at all [a]
5	Dust-protected	Ingress of dust is not totally prevented, but dust shall not penetrate in a quantity to interfere with satisfactory operation of the apparatus to impair safety
6	Dust-tight	No ingress of dust

[a] The full diameter of the object probe shall not pass through an opening of the enclosure.