

2011-01-07

Stærkstrømsinstallationer med vekselspændinger over 1 kV – Del 1: Generelle regler

Power installations exceeding 1 kV a.c. –
Part 1: Common rules

DANSK STANDARD
Danish Standards

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DS projekt: M254919
ICS: 29.240.01

Første del af denne publikations betegnelse er:

DS/EN, hvilket betyder, at det er en europæisk standard, der har status som dansk standard.

Denne publikations overensstemmelse er:

MOD i forhold til: IEC 61936-1 ED 2.0:2010.

IDT med: EN 61936-1:2010.

DS-publikationen er på engelsk.

Denne publikation erstatter: DS/HD 637 S1:1999.

DS-publikationstyper

Dansk Standard udgiver forskellige publikationstyper. Typen på denne publikation fremgår af forsiden.

Der kan være tale om:

Dansk standard

- standard, der er udarbejdet på nationalt niveau, eller som er baseret på et andet lands nationale standard, eller
- standard, der er udarbejdet på internationalt og/eller europæisk niveau, og som har fået status som dansk standard

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- europæisk præstandard

DS-håndbog

- samling af standarder, eventuelt suppleret med informativt materiale

DS-hæfte

- publikation med informativt materiale

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- **EQV:** Når publikationen teknisk er i overensstemmelse med en given publikation, men præsentationen er ændret.
- **NEQ:** Når publikationen teknisk eller præsentationsmæssigt ikke er i overensstemmelse med en given standard, men udarbejdet på baggrund af denne.
- **MOD:** Når publikationen er modificeret i forhold til en given publikation.

English version

**Power installations exceeding 1 kV a.c. -
Part 1: Common rules
(IEC 61936-1:2010, modified)**

Installations électriques en courant
alternatif de puissance supérieure à 1 kV -
Partie 1: Règles communes
(CEI 61936-1:2010, modifiée)

Starkstromanlagen mit
Nennwechselfspannungen über 1 kV -
Teil 1: Allgemeine Bestimmungen
(IEC 61936-1:2010, modifiziert)

This European Standard was approved by CENELEC on 2010-11-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Management Centre: Avenue Marnix 17, B - 1000 Brussels

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Foreword

The text of document 99/95/FDIS, future edition 2 of IEC 61936-1, prepared by IEC TC 99, System engineering and erection of electrical power installations in systems with nominal voltages above 1 kV a.c. and 1,5 kV d.c., particularly concerning safety aspects, was submitted to the IEC-CENELEC parallel vote.

A draft amendment was prepared by the Technical Committee CENELEC TC 99X, Power installations exceeding 1 kV a.c. (1,5 kV d.c.) and was submitted to formal vote.

The combined texts were approved by CENELEC as EN 61936-1 on 201X-(dor).

This European Standard partially supersedes HD 637 S1:1999.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN and CENELEC shall not be held responsible for identifying any or all such patent rights.

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) dor + 12 months
- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) dor + 36 months

Annexes ZA, ZB and ZC have been added by CENELEC.

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Endorsement notice

The text of the International Standard IEC 61936-1:2010 was approved by CENELEC as a European Standard without with agreed common modifications as given below.

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

[5] IEC 60044-6	NOTE	Harmonized as EN 60044-6.
[16] IEC 60068 series	NOTE	Harmonized in EN 60068 series (not modified).
[17] IEC 60364-4-41	NOTE	Harmonized as EN 60364-4-41.
[18] IEC 60480	NOTE	Harmonized as EN 60480.
[19] IEC 60664-1	NOTE	Harmonized as EN 60664-1.
[23] IEC 62271-100	NOTE	Harmonized as EN 62271-100.
[24] IEC 62271-102	NOTE	Harmonized as EN 62271-102.
[25] IEC 62271-103	NOTE	Harmonized as EN 62271-103.
[26] IEC 62271-104	NOTE	Harmonized as EN 62271-104.
[27] IEC 62271-105	NOTE	Harmonized as EN 62271-105.

COMMON MODIFICATIONS

2 Normative references

Delete and **shift** to Bibliography:

IEEE 80, *The IEEE guide for safety in AC substation grounding*

IEEE 980, *Guide for containment and control of oil spills in substations*

3 Terms and definitions

3.5.5 Add:

NOTE Additional definition of danger zone (D_L) is given in EN 50110-1 and EN 50110-2.

3.5.6 Add:

NOTE 3 Additional definition of vicinity zone (D_V) is given in EN 50110-1 and EN 50110-2.

4 Fundamental requirements

4.2.9 Add:

NOTE For more information consult EN 50160.

4.3.10 Add:

NOTE For more information consult EN 50341 and EN 50423.

7 Installations

Figure 3 Add:

NOTE Deviant regulations for danger zone (D_L) and vicinity zone (D_V) are given in EN 50110-1 and EN 50110-2.

Figure 4 Add:

NOTE 2 Deviant regulations for vicinity zone (D_V) are given in EN 50110-1 and EN 50110-2.

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~~Re-number the NOTE into NOTE 1.~~

10 Earthing systems

10.2.1 Add after the third last paragraph:

Annexes C and D are only informative for CENELEC. Details for permissible touch voltages are given in EN 50522.

Annex C Permissible touch voltage according IEEE 80

Change title "normative" by "informative"

Annex D Earthing system design flow chart

Change title "normative" by "informative"

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ANNEX ZA
(normative)

Special national conditions

Special national condition: National characteristic or practice that cannot be changed even over a long period, e.g. climatic conditions, electrical earthing conditions.

NOTE If it affects harmonization, it forms part of the European Standard.

For the countries in which the relevant special national conditions apply these provisions are normative, for other countries they are informative.

Clause **Special national condition**

4.3.2 **Finland**

The combinations used in Finland are for example:

- – 40 °C without ice and without wind;
- – 0 °C with ice and without wind;
- – 20 °C with wind.

For special projects even value – 50 °C without ice and without wind could be needed.

4.3.4 **France**

In France, ice load is not considered; only heavy snow is taken into account on the basis of 600 kg/m³ density.

4.4.2.2 **Finland**

In Finland even class – 50 °C could be needed.

4.4.2.2 **France**

In metropolitan France solar radiation limit is 900 W/m².

7.2.1 **Finland**

Barriers for outdoor installations shall have a minimum height of 2,0 m. They shall fulfil the same requirements as the external fence. The minimum height of live parts behind a barrier shall be $N + 300$ mm with a minimum of 800 mm.

7.2.2 **Sweden**

The height H for outdoor installations shall be at least $H = N + 2\,500$ mm, with a minimum of 3 000 mm.

7.2.4 **Finland**

The height H for outdoor installations shall be at least $H = N + 2\,600$ mm with a minimum of 2 800 mm.

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7.2.4 Sweden

The height H for outdoor installations shall be at least $H = N + 2\,500$ mm, with a minimum of 3 000 mm.

7.2.6 Finland

The height of the external fence shall be at least 2 000 mm. The local conditions of snow shall be taken into account.

7.7 Finland

The minimum height H' of live parts above surfaces accessible to the general public shall be:

- $H' = 5\,500$ mm for rated voltages U_m up to 24 kV;
- $H' = N + 5\,300$ mm for rated voltages U_m above 24 kV.

12 Finland

In Finland only emergency phone number is required.

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ANNEX ZB (informative)

A-deviations

A-deviation: National deviation due to regulations, the alteration of which is for the time being outside the competence of the CENELEC national member.

This European Standard does not fall under any Directive of the EC.

In the relevant CENELEC countries these A-deviations are valid instead of the provisions of the European Standard until they have been removed.

<u>Clause</u>	<u>Deviation</u>
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General	France
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In France many laws and decrees are mandatory for the design, the construction, the verification and the control of HV installations. All the French safety and legal requirements, mainly driven by the ministry of industry (arrêté du 17 mai 2001), the ministry of labour (décret du 14 novembre 1988) and the grid codes for HV and MV public networks are incorporated in two national standards; NFC 13-100 and NFC 13-200. Both NFC 13-100 and NFC 13-200 are globally in line with EN 61936-1. Their application is mandatory in France and they cannot be superseded by the European Standard, which provide only general rules.

EN 61936-1 does not cover a large part of the field of the French regulation. It cannot be used in France as a contracting basis between various players involved in HV installation business, since it may create difficulties, interpretation problems, and confused situations.

The main additional rules and deviations from EN 61936-1 are covered by NFC 13-100 and NFC 13-200.

Additional rules:

- limits of private installations and interfaces with the HV public grid;
- mandatory requirements for private installations including power generation;
- mandatory requirements for HV substations interfacing private installation to public grid;
- rules for architecture design of HV private installations;
- detailed rules concerning neutral systems;
- detailed rules concerning design and construction of a global earthing system;
- additional rules concerning the protection against direct and indirect contact;
- additional rules concerning the protection against fire and explosion;
- rules dedicated to the protection against over voltages, under voltages, temporary loss of supply, harmonics;
- protection against the noise including French directives;
- detailed rules dedicated to HV cables sizing;
- additional rules for selection, installation and protection of generators, motors and transformers;
- dedicated rules for metering according to utility requirements;
- dedicated rules to the data to be exchanged with the grid operator system and associated communication equipment;
- design and construction of buildings according French directives;
- verification and control of HV installations according to French legislation;
- detailed information concerning the classification of environmental conditions.

Main A-deviations: see appropriate (sub)clause number.

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4.2.7 Norway

(Regulation on electrical network and with guide to the regulation. FEF 2006 § 4-3)

One phase to earth shall be disconnected as fast as possible and within:

Directly earthed net:	8 s
Resistance earthed net:	30 s

Insulated and coil earthed net:

Aerial network and mixed cable/aerial network with distribution transformer:	10 s
Aerial network and mixed cable/aerial network without distribution transformer:	120 min
Cable grid (without aerial conductor) with global earthing:	240 min

Net shall be monitored continuously, and clearance for disconnection of earth fault is activated immediately.

4.2.7 Norway

(Regulation on electrical network and with guide to the regulation. FEF 2006 § 2-9)

In private houses, kindergartens and schools maximum 0,4 μ T.

4.3.7 France

Short-circuit mechanical stresses are not taken into account for the design of foundations in France. They are considered to be second order effects and covered by other stress limit.

4.5.2 France

According to the French regulation (arrêté technique – Article 12), in France the noise level is defined and measured in conformity with the French national standard NF S31 010.

5 Norway

(Regulation on electrical network and with guide to the regulation. FEF 2006 § 4-2)

Insulated and coil earthed cable and aerial network with voltage less or equal to 24 kV shall have a minimum transition resistance towards earth. If the resistance is less than this value, operator shall be warned automatically, alternatively the installation can be disconnected.

The value are:

- Cable grid	minimum 1 000 Ω ;
- Aerial network and mixed network	minimum 3 000 Ω .

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6.2.1 France

According to French regulation, the minimum clearances distances in air of Tables 1 and 2 are replaced by Table 32B of the NFC 13-200 for industrial installations and by the following table for public network substations:

Nominal voltage (kV)	Highest voltage (kV)	Rated switching impulse voltage (kV)	Rated lightning impulse (kV)	Minimum phase to earth distance (mm)	Minimum phase to phase distance (mm)
63	72,5		325	660	760
90	100		450	920	1 060
225	245		1 050	2 140	2 470
400	420	1 050/1 575 ⁽⁵⁾	1 425	2 900 ⁽¹⁾ 3 500 ⁽²⁾	4 000 ⁽³⁾ 4 200 ⁽⁴⁾
⁽¹⁾ Between conductors and metal frames. ⁽²⁾ In rod-rod configuration. ⁽³⁾ Between parallel conductors. ⁽⁴⁾ In rod-conductor configuration. ⁽⁵⁾ Phase-earth and phase-phase.					

6.2.1 France

According to French regulation, the design and operation of switching devices shall respect the requirements of the document UTE-C 18510.

6.2.4.1 Norway

(Regulation on electrical network and with guide to the regulation. FEF 2006 § 4-4)

There shall not be fuses in conductors from current transformers.

6.2.9.5 Norway

(Regulation on electrical network and with guide to the regulation. FEF 2006 § 4-4)

Laying of cables in earth minimum depth 0,4 m. Cables shall be protected minimum 1,5 m above (the ground) where they emerge from water or soil.

Where cables emerge from water it shall be a warning sign.

Cables shall have clear identification and marking e.g. imprinting on the cable protector every 1,0 m.

6.2.15 and

7.7 Norway

(Regulation on electrical network and with guide to the regulation. FEF 2006 § 4-6)

All electrical installations on mast, pole and tower shall be arranged so that operation and switching operations can be carried out from the ground. Installations with fuses shall have multipolar switch, so that the fuses can be operated in dead (without voltage) condition.

7.2.1 Norway

(Regulation on electrical network and with guide to the regulation. FEF 2006 § 4-5)

Height of protection in front of cubicle shall be a minimum of 2 200 mm.

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- 7.2.2 Finland**
(Decision of the Ministry of trade and industry on safety of electrical installations (1193/1999))
The use of protective method obstacles is not allowed.
- 7.2.2 Sweden**
(ELSÄK-FS 2008:1, kap 5, § 2)
Rails, chains and ropes are not allowed as obstacles.
- 7.2.3 Norway**
(Regulation on electrical network and with guide to the regulation. FEF 2006 § 4-5)
Minimum boundary clearance wire mesh/screens $E = N + 2\ 500$ mm.
- 7.2.6 Norway**
(Regulation on electrical network and with guide to the regulation. FEF 2006 § 4-5)
The height of fence/wall including barbed wire shall be at least 2 500 mm high.
- 7.3 Finland**
(Decision of Ministry of trade and industry on safety of electrical installations (1193/1999))
Use of indoor installations of open design is not allowed in Finland.
- 7.3 Norway**
(Regulation on electrical network and with guide to the regulation. FEF 2006 § 4-5)
Behind (cell) doors and openings wider than 0,5 m it shall be a rail in a not conductive material in the colours yellow/black.
- 7.3 Sweden**
(ELSÄK-FS 2008:1, kap 5, § 2)
Rails, chains and ropes are not allowed as obstacles.
- 7.4.1 Sweden**
(ELSÄK-FS 2008:1, kap 5, § 1)
Outside closed electrical operation areas equipment and cables shall either be constructed with an earthed intermediate shield or be protected against unintentional contact by placing out of reach. With an earthed intermediate shield, a metal enclosure for equipment or a screen for cables are understood.
- 7.5.4 Norway**
(Regulation on electrical network and with guide to the regulation. FEF 2006 § 4-5)
Aisles shall be at least 1 000 mm wide.

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7.5.4 Sweden
(ELSÄK-FS 2008:1, kap 3, § 9)

Gangways longer than 10 m shall be accessible from both ends. Indoor closed restricted access areas with length exceeding 20 m shall be accessible by doors from both ends. (See IEC 60364-7-729.)

7.5.5 Norway
(Regulation on electrical network and with guide to the regulation. FEF 2006 § 4-7)

It shall be possible to open emergency doors from the inside without a key by using a latch or other simple means also when crawling, even when they are locked from the outside.

7.7 Norway
(Regulation on electrical network and with guide to the regulation. FEF 2006 § 4-5)

The minimum height of live parts above area accessible to the general public $H' = N + 5\ 000$ mm.

The minimum effect of snow in Norway is 700 mm.

Figure 1 Sweden
(ELSÄK-FS 2008:1, kap 5, § 2)

Rails, chains and ropes are not allowed as obstacles.

8.2 Sweden
(ELSÄK-FS 2008:1, kap 5, § 1)

Exposed conductive parts shall be earthed. Also extraneous conductive parts which by faults, induction, or influence could become live and be a hazard to persons or damage to property shall be earthed.

8.2.1.2 Norway
(Regulation on electrical network and with guide to the regulation. FEF 2006 § 4-5)

Protection by obstacle is only acceptable in Norway in front of a distribution transformer and in front of a generator unit. Rail in a non conductive material in the colours yellow/black must be used.

8.2.2.1 Sweden
(ELSÄK-FS 2008:1, kap 5, § 1)

Outside closed electrical operation areas equipment and cables shall either be constructed with an earthed intermediate shield or be protected against unintentional contact by placing out of reach. With an earthed intermediate shield, a metal enclosure for equipment or a screen for cables are understood.

8.2.2.2 Finland
(Decision of Ministry of trade and industry on safety of electrical installations (1193/1999))

The use of protective method obstacles is not allowed in electrical installations of buildings. The use of protective method placing out of reach is restricted only to situations where the use of insulation or enclosures or barriers is not practicable.

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8.2.2.2 Sweden

(ELSÄK-FS 2008:1, kap 5, § 2)

Rails, chains and ropes are not allowed as obstacles.

8.2.2.3 Finland

(Decision of the Ministry of trade and industry on safety of electrical installations (1193/1999))

In installations with $U_m \leq 52$ kV, where doors or covers have to be opened in order to carry out normal operation or maintenance, a rigid non-conductive rail shall be used as an additional protective measure.

8.4.2 Norway

(Regulation on electrical network and with guide to the regulation. FEF 2006 § 4-4)

Breakers and earth breakers shall be referred inoperative by suitable locking facilities.

8.7 Finland

(Land Use and Building Act (132/1999))

Regulations of fire safety are given in National Building Code part E1 Structural safety of buildings.

8.7.2.1 Norway

(Regulation on electrical network and with guide to the regulation. FEF 2006 § 4-9)

For transformers with below 1 000 l special conditions for Norway are listed in FEF 2006 § 4-9.

8.7.3 Norway

(Regulation on electrical network and with guide to the regulation. FEF 2006 § 4-5)

In installations where it is difficult to evacuate or the voltage is above 30 kV, cables for emergency power, control and communication shall be separated from other cables and protected against fire.

8.8.1.3 France

Figures 8, 9 and 10 are not authorised in France since the use of gravels layer may maintain high temperature in case of fire hazard (see NFC 13-200).

8.9.1 Norway

(Regulation on electrical network and with guide to the regulation. FEF 2006 § 2-12)

Warning signs, markings and identifications in Norway shall be in Norwegian and special cases additional marking in other language.

9.1 Norway

(Regulation on electrical network and with guide to the regulation. FEF 2006 § 4-10)

Blocking of remote operations should be possible locally. The blocking shall be indicated in the control centre.

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10.2.1 France

In France protection against electric shock, including global earthing system and disconnection on first faults, is provided according to:

- arrêté technique du 17 mai 2001 for public network substations;
- NFC 13-200 for industrial installations.

10.2.1 UK

(Health & Safety Executive (HSE))

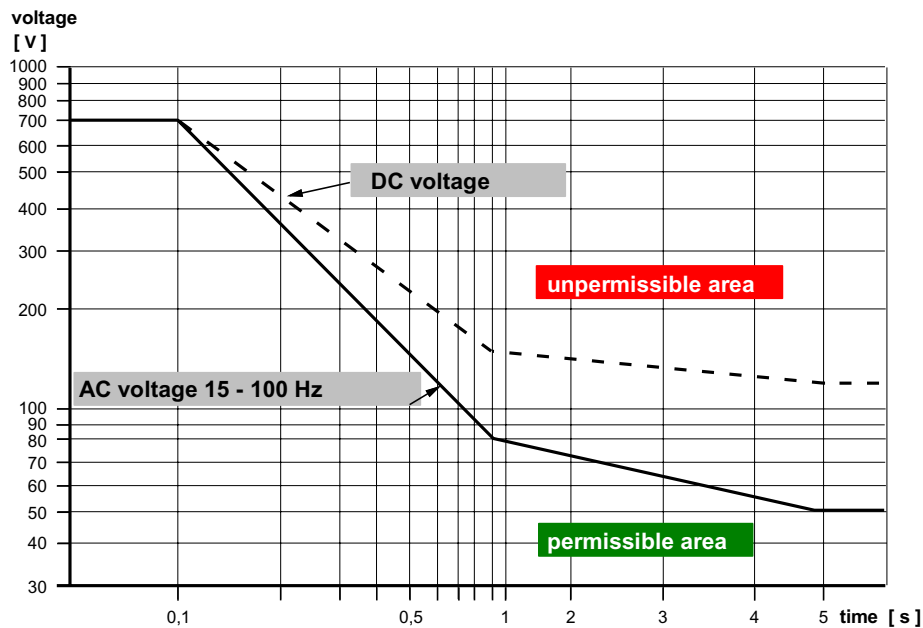
HV earthing systems should be designed according to tolerable voltages based on body impedances not exceeded by 5 % of the population, as given in Table 1 of IEC 60479-1.

10.2.1 Switzerland

(Federal law concerning electrical installations (High and low voltage) (SR 734.0), Regulation for electrical power installations (SR 734.2))

Dimensioning with regard to touch and step voltages permissible values, SR 734.2: Art. 54 (Permissible touch and step voltages in power installations), Art. 55 (Permissible touch voltages in low voltage installations) and Art. 57 (Earthing in high voltage installations).

(Appendix 4 (Art. 54, 55 and 57) Permissible touch voltages.)



Permissible touch voltages and step voltages

10.2.3.3 France

According to the French regulation (arrêté technique du 17 mai 2001 – Article 45), in case of a single phase HV faults, the overvoltage induced in reference to local earth of a BT installation, shall not exceed 1 500 V rms.

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11 Norway

(Regulation on electrical network and with guide to the regulation. FEF 2006 § 3-1)

Inspection, testing and final test of the installation shall be carried out to verify compliance with national legislation.

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Annex ZC (normative)

Normative references to international publications with their corresponding European publications

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.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60034-1 (mod)	-	Rotating electrical machines - Part 1: Rating and performance	EN 60034-1	-
IEC 60034-3	-	Rotating electrical machines - Part 3: Specific requirements for synchronous generators driven by steam turbines or combustion gas turbines	EN 60034-3	-
IEC 60060-1	-	High-voltage test techniques - Part 1: General definitions and test requirements	EN 60060-1	-
IEC 60071-1	-	Insulation co-ordination - Part 1: Definitions, principles and rules	EN 60071-1	-
IEC 60071-2	1996	Insulation co-ordination - Part 2: Application guide	EN 60071-2	1997
IEC 60076-2 (mod)	1993	Power transformers - Part 2: Temperature rise	EN 60076-2	1997
IEC 60076-11	-	Power transformers - Part 11: Dry-type transformers	EN 60076-11	-
IEC 60079-0	-	Explosive atmospheres - Part 0: Equipment - General requirements	EN 60079-0	-
IEC 60079-10-1	-	Explosive atmospheres - Part 10-1: Classification of areas - Explosive gas atmospheres	EN 60079-10-1	-
IEC 60255	Series	Measuring relays and protection equipment	EN 60255	Series
IEC 60331-21	-	Tests for electric cables under fire conditions - Circuit integrity - Part 21: Procedures and requirements - Cables of rated voltage up to and including 0,6/1,0 kV	-	-
IEC 60331-1	-	Tests for electric cables under fire conditions - - Circuit integrity - Part 1: Test method for fire with shock at a temperature of at least 830 °C for cables of rated voltage up to and including 0,6/1,0 kV and with an overall diameter exceeding 20 mm	-	-
IEC 60332	Series	Tests on electric and optical fibre cables under fire conditions	-	-

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Publication	Year	Title	EN/IEC	Year
IEC 60364	Series	Low-voltage electrical installations	HD 60364	Series
IEC/TS 60479-1	2005	Effects of current on human beings and livestock - Part 1: General aspects	-	-
IEC 60529	-	Degrees of protection provided by enclosures - (IP Code)	-	-
IEC 60617	-	Graphical symbols for diagrams	-	-
IEC 60721-2-6	-	Classification of environmental conditions - Part 2-6: Environmental conditions appearing in nature - Earthquake vibration and shock	HD 478.2.6 S1	-
IEC 60721-2-7	-	Classification of environmental conditions - Part 2-7: Environmental conditions appearing in nature - Fauna and flora	HD 478.2.7 S1	-
IEC 60754-1	-	Test on gases evolved during combustion of materials from cables - Part 1: Determination of the amount of halogen acid gas	-	-
IEC 60754-2 (mod)	-	Test on gases evolved during combustion of electric cables - Part 2: Determination of degree of acidity of gases evolved during the combustion of materials taken from electric cables by measuring pH and conductivity	HD 602 S1 ¹⁾	-
IEC/TS 60815-1	-	Selection and dimensioning of high-voltage insulators intended for use in polluted conditions - Part 1: Definitions, information and general principles	-	-
IEC 60826	-	Design criteria of overhead transmission lines -	-	-
IEC 60865-1	-	Short-circuit currents - Calculation of effects - Part 1: Definitions and calculation methods	EN 60865-1	-
IEC 60909	Series	Short-circuit currents in three-phase a.c. systems	EN 60909	Series
IEC 60949	-	Calculation of thermally permissible short- circuit currents, taking into account non- adiabatic heating effects	-	-
IEC/TR 61000-5-2	-	Electromagnetic compatibility (EMC) - Part 5: Installation and mitigation guidelines - Section 2: Earthing and cabling	-	-
IEC 61034-1	-	Measurement of smoke density of cables burning under defined conditions - Part 1: Test apparatus	EN 61034-1	-
IEC 61082-1	-	Preparation of documents used in electrotechnology - Part 1: Rules	EN 61082-1	-
IEC 61100	-	Classification of insulating liquids according to fire point and net calorific value	EN 61100	-
IEC 61140	-	Protection against electric shock - Common aspects for installation and equipment	EN 61140	-

¹⁾ HD 602 S1 is superseded by EN 50267-2-3:1998.

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Publication	Year	Title	EN/IEC	Year
IEC 61219	-	Live working - Earthing or earthing and short-circuiting equipment using lances as short-circuiting device - Lance earthing	EN 61219	-
IEC 61230	-	Live working - Portable equipment for earthing or earthing and short-circuiting	EN 61230	-
IEC 60079-10-2	-	Explosive atmospheres - Part 10-2: Classification of areas - Combustible dust atmospheres	EN 60079-10-2	-
IEC 61243	Series	Live working - Voltage detectors	EN 61243	Series
IEC 62271-1	2007	High-voltage switchgear and controlgear - Part 1: Common specifications	EN 62271-1	2008
IEC 62271-200	-	High-voltage switchgear and controlgear - Part 200: AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV	EN 62271-200	-
IEC 62271-201	-	High-voltage switchgear and controlgear - Part 201: AC insulation-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV	EN 62271-201	-
IEC 62271-202	-	High-voltage switchgear and controlgear - Part 202: High voltage/low voltage prefabricated substation	EN 62271-202	-
IEC 62271-203	-	High-voltage switchgear and controlgear - Part 203: Gas-insulated metal-enclosed switchgear for rated voltages above 52 kV	EN 62271-203	-
IEC/TR 62271-303	-	High-voltage switchgear and controlgear - Part 303: Use and handling of sulphur hexafluoride (SF6)	CLC/TR 62271-303	-
IEC 62305	Series	Protection against lightning	EN 62305	Series
IEC 62305-4	-	Protection against lightning - Part 4: Electrical and electronic systems within structures	EN 62305-4	-
IEC Guide 107	-	Electromagnetic compatibility - Guide to the drafting of electromagnetic compatibility publications	-	-
ISO/IEC Guide 51	-	Safety aspects - Guidelines for their inclusion in standards	-	-
ISO 1996-1	-	Acoustics - Description, measurement and assessment of environmental noise - Part 1: Basic quantities and assessment procedures	-	-
IEEE 80	-	Guide for safety in AC substation grounding	-	-
IEEE 980	-	Guide for containment and control of oil spills in substations	-	-

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INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Power installations exceeding 1 kV a.c. –
Part 1: Common rules**

**Installations électriques en courant alternatif de puissance supérieure à 1 kV –
Partie 1: Règles communes**



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

POWER INSTALLATIONS EXCEEDING 1 kV AC –

Part 1: Common rules

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 61936-1 has been prepared by IEC technical committee 99: System engineering and erection of electrical power installations in systems with nominal voltages above 1 kV a.c. and 1,5 kV d.c., particularly concerning safety aspects.

This second edition cancels and replaces the first edition, published in 2002. It constitutes a technical revision.

The main changes with respect to the previous edition are listed below:

- new table of references for additional agreements between manufacturer/contractor/planer and user/orderer/owner (4.1.2)
- addition of minimum clearances in air not standardized by IEC but based on current practice in some countries (Annex A)
- deletion of nominal voltages (Table 1, Table 2, Clause 5)
- addition of regulations for fuses (6.2.15)
- simplification of regulations for escape routes (7.5.4)

- deletion of special regulations for operating aisles (7.5.4)
- modification of clearances for fire protection (Table 3)
- modification of safety criteria for earthing systems (10.2.1)
- modified curves of permissibly touch voltages (Figure 12, Annex B)
- deletion of numbering of subclauses without headlines
- change of "should" to "shall" in many cases or change of subclauses with "should" to a note

The text of this standard is based on the following documents:

FDIS	Report on voting
99/95/FDIS	99/96/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 the parts¹ in the IEC 61936 series, under the general title *Power installations exceeding 1 kV a.c.*, can be found 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.

The following differences exist in the countries indicated below.

- 4.3.2: The combinations are for example: $-40\text{ }^{\circ}\text{C}$ without ice and without wind; $-0\text{ }^{\circ}\text{C}$ with ice and without wind; $-20\text{ }^{\circ}\text{C}$ with wind. For special projects even value $-50\text{ }^{\circ}\text{C}$ without ice and without wind could be needed (Finland)
- 4.4.2.2a: Even class $-50\text{ }^{\circ}\text{C}$ could be needed (Finland)
- 6.2.4.1: It shall not be fuses in conductors from current transformers (Norway)
- 7.2.1: Barriers for outdoor installations shall have a minimum height of 2,0 m. They shall fulfil the same requirements as the external fence. The minimum height of live parts behind a barrier shall be $N + 300\text{ mm}$ with a minimum of 800 mm (Finland)
- 7.2.2: The use of protective method obstacles is not allowed in electrical installations outside of buildings (Finland)
- 7.2.2: Rails, chains and ropes are not allowed as obstacles (Sweden)
- 7.2.2: The height H for outdoor installations shall be at least $H = N + 2\ 500\text{ mm}$, with a minimum of 3 000 mm (Sweden)
- 7.2.4: The height H for outdoor installations shall be at least $H = N + 2\ 500\text{ mm}$, with a minimum of 3 000 mm (Sweden)
- 7.2.4: The height H for outdoor installations shall be at least $H = N + 2\ 600\text{ mm}$, with a minimum of 2 800 mm (Finland)
- 7.2.6: The height of the external fence shall be at least 2 000 mm. The local conditions of snow shall be taken into account (Finland)
- 7.2.6: The height of the external fence shall be at least 2 500 mm (Australia)
- 7.3: The use of indoor installations of open design is not allowed (Finland)
- 7.3: A rail shall be of not conductive material in the colours yellow/black behind (cell) doors and openings wider than 0,5 m (Norway)

¹ At the time of writing, future parts are still under consideration.

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- 7.3: Rails, chains and ropes are not allowed as obstacle (Sweden)
- 7.4.1: Outside closed electrical operation areas equipment and cables shall either be constructed with an earthed intermediate shield or be protected against unintentional contact by placing out of reach. With an earthed intermediate shield, a metal enclosure for equipment or a screen for cables are understood (Sweden)
- 7.5.4: Gangways longer than 10 m shall be accessible from both ends. Indoor closed restricted access areas with length exceeding 20 m shall be accessible by doors from both ends (See IEC 60364-7-729) (Sweden)
- 7.5.8: Installations that are difficult to evacuate like Installations in underground, in mountains, wind-power stations e.g. special conditions shall be imposed to secure safe evacuation in case of fire or accident (Norway)
- 7.7: The minimum height H' of live parts above surfaces accessible to the general public shall be:
 - $H' = 5\ 500$ mm for rated voltages U_m up to 24 kV
 - $H' = N + 5\ 300$ mm for rated voltages U_m above 24 kV (Finland)
- 8.2: Exposed conductive parts shall be earthed. Also extraneous conductive parts which by faults, induction, or influence could become live and be a hazard to persons or damage to property shall be earthed (Sweden)
- 8.2.1.2: The minimum height of protective barriers is 2 300 mm (Finland)
- 8.2.1.2: Rails, chains and ropes are not allowed as obstacles (Sweden)
- 8.2.2.1: Outside closed electrical operation areas equipment and cables shall either be constructed with an earthed intermediate shield or be protected against unintentional contact by placing out of reach. With an earthed intermediate shield, a metal enclosure for equipment or a screen for cables are understood (Sweden)
- 8.2.2.2: Rails, chains and ropes are not allowed as obstacles (Sweden)
- 8.2.2.2: The use of protective method obstacles is not allowed in electrical installations of buildings. The use of protective method placing out of reach is restricted only to situations where the use of insulation or enclosures or barriers is not practicable (Finland)
- 8.7.2.1: For transformers with below 1000 l special conditions are listed in FEF 2006 §4-9 (Norway)
- 8.9.1: Warning signs, markings and identifications shall be in Norwegian and special cases additional marking in other language (Norway)
- 10.2.1 and Annex B: Health & Safety Executive (HSE) has advised that HV earthing systems should be designed according to tolerable voltages based on body impedances not exceeded by 5% of the population, as given in Table 1 of IEC60479-1:2005 (UK)
- 10.2.1: Permissible touch and step voltages in power installations shall be in accordance with the Federal law concerning electrical installations (High and low voltage) (SR 734.0) and the Regulations for electrical power installations (SR 743.2 StV) (Switzerland)
- Figure 1: Rails, chains and ropes are not allowed as obstacles (Sweden)

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

There are many national laws, standards and internal rules dealing with the matter coming within the scope of this standard and these practices have been taken as a basis for this work.

This part of IEC 61936 contains the minimum requirements valid for IEC countries and some additional information which ensures an acceptable reliability of an installation and its safe operation.

The publication of this standard is believed to be a decisive step towards the gradual alignment all over the world of the practices concerning the design and erection of high voltage power installations.

Particular requirements for transmission and distribution installations as well as particular requirements for power generation and industrial installations are included in this standard.

The relevant laws or regulations of an authority having jurisdiction takes precedence.

POWER INSTALLATIONS EXCEEDING 1 kV AC –

Part 1: Common rules

1 Scope

This part of IEC 61936 provides common rules for the design and the erection of electrical power installations in systems with nominal voltages above 1 kV a.c. and nominal frequency up to and including 60 Hz, so as to provide safety and proper functioning for the use intended.

For the purpose of interpreting this standard, an electrical power installation is considered to be one of the following:

- a) Substation, including substation for railway power supply
- b) Electrical installations on mast, pole and tower
Switchgear and/or transformers located outside a closed electrical operating area
- c) One (or more) power station(s) located on a single site
The installation includes generators and transformers with all associated switchgear and all electrical auxiliary systems. Connections between generating stations located on different sites are excluded.
- d) The electrical system of a factory, industrial plant or other industrial, agricultural, commercial or public premises

The electrical power installation includes, among others, the following equipment:

- rotating electrical machines;
- switchgear;
- transformers and reactors;
- converters;
- cables;
- wiring systems;
- batteries;
- capacitors;
- earthing systems;
- buildings and fences which are part of a closed electrical operating area;
- associated protection, control and auxiliary systems;
- large air core reactor.

NOTE In general, a standard for an item of equipment takes precedence over this standard.

This standard does not apply to the design and erection of any of the following:

- overhead and underground lines between separate installations;
- electric railways;
- mining equipment and installations;
- fluorescent lamp installations;
- installations on ships and off-shore installations;
- electrostatic equipment (e.g. electrostatic precipitators, spray-painting units);

- test sites;
- medical equipment, e.g. medical X-ray equipment.

This standard does not apply to the design of factory-built, type-tested switchgear for which separate IEC standards exist.

This standard does not apply to the requirements for carrying out live working on electrical installations.

If not otherwise required in this standard, for low-voltage electrical installations the standard series IEC 60364 applies.

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

IEC 60034-3, *Rotating electrical machines – Part 3: Specific requirements for synchronous generators driven by steam turbines or combustion gas turbines*

IEC 60060-1, *High-voltage test techniques – Part 1: General definitions and test requirements*

IEC 60071-1, *Insulation co-ordination – Part 1: Definitions, principles and rules*

IEC 60071-2:1996, *Insulation co-ordination – Part 2: Application guide*

IEC 60076-2:1993, *Power transformers – Part 2: Temperature rise*

IEC 60076-11, *Power transformers – Part 11: Dry-type transformers*

IEC 60079-0, *Explosive atmospheres – Part 0: Equipment – General requirements*

IEC 60079-10-1, *Explosive atmospheres – Part 10-1: Classification of areas – Explosive gas atmospheres*

IEC 60255 (all parts), *Measuring relays and protection equipment*

IEC 60331-21, *Tests for electric cables under fire conditions – Circuit integrity – Part 21: Procedures and requirements – Cables of rated voltage up to and including 0,6/1,0 kV*

IEC 60331-1, *Tests for electric cables under fire conditions – Circuit integrity – Part 1: Test method for fire with shock at a temperature of at least 830 °C for cables of rated voltage up to and including 0,6/1,0 kV and with an overall diameter exceeding 20 mm*

IEC 60332 (all parts), *Tests on electric and optical fibre cables under fire conditions*

IEC 60364 (all parts), *Low-voltage electrical installations*

IEC/TS 60479-1:2005, *Effects of current on human beings and livestock – Part 1: General aspects*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

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IEC 60617, *Graphical symbols for diagrams*

IEC 60721-2-6, *Classification of environmental conditions – Part 2-6: Environmental conditions appearing in nature – Earthquake vibration and shock*

IEC 60721-2-7, *Classification of environmental conditions – Part 2-7: Environmental conditions appearing in nature. Fauna and flora*

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IEC 60865-1, *Short-circuit currents – Calculation of effects – Part 1: Definitions and calculation methods*

IEC 60909 (all parts), *Short-circuit currents in three-phase a.c. systems*

IEC 60949, *Calculation of thermally permissible short-circuit currents, taking into account non-adiabatic heating effects*

IEC/TR 61000-5-2, *Electromagnetic compatibility (EMC) – Part 5: Installation and mitigation guidelines – Section 2: Earthing and cabling*

IEC 61034-1, *Measurement of smoke density of cables burning under defined conditions – Part 1: Test apparatus*

IEC 61082-1, *Preparation of documents used in electrotechnology – Part 1: Rules*

IEC 61100, *Classification of insulating liquids according of fire-point and net calorific value*

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

IEC 61219, *Live working – Earthing or earthing and short-circuiting equipment using lances as a short-circuiting device – Lance earthing*

IEC 61230, *Live working – Portable equipment for earthing or earthing and short-circuiting*

IEC 60079-10-2, *Explosives atmospheres – Part 10-2: Classification of areas – Combustible dust atmospheres*

IEC 61243 (all parts), *Live working – Voltage detectors*

IEC 62271-1:2007, *High-voltage switchgear and controlgear – Part 1: Common specifications*

IEC 62271-200, *High-voltage switchgear and controlgear – Part 200: AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV*

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IEC 62271-202, *High-voltage switchgear and controlgear – Part 202: High-voltage/low-voltage prefabricated substation*

IEC 62271-203, *High-voltage switchgear and controlgear – Part 203: Gas-insulated metal-enclosed switchgear for rated voltages above 52 kV*

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IEC 62305-4, *Protection against lightning – Part 4: Electrical and electronic systems within structures*

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IEEE 80, *Guide for safety in AC substation grounding*

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3 Terms and definitions

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

3.1 General definitions

3.1.1

electrical equipment

item used for such purposes as generation, conversion, transmission, distribution or utilization of electric energy, such as electric machines, transformers, switchgear and controlgear, measuring instruments, protective devices, wiring systems, current-using equipment

[IEC 60050-826:2004, 826-16-01]

3.1.2

nominal value

value of a quantity used to designate and identify a component, device, equipment or system

[IEC 60050-151:2001, 151-16-09]

3.1.3

nominal voltage of a system

suitable approximate value of voltage used to designate or identify a system

[IEC 60050-601:1985, 601-01-21]