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Reciprocating internal combustion engine driven generating sets — Safety

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National foreword

This British Standard is the UK implementation of EN 12601:2010. It supersedes BS EN 12601:2001 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee MCE/14, RIC engines.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Stromerzeugungsaggregate mit Hubkolben-Verbrennungsmotoren - Sicherheit

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Foreword

This document (EN 12601:2010) has been prepared by Technical Committee CEN/TC 270 “Internal Combustion Engines”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2011 and conflicting national standards shall be withdrawn at the latest by June 2011.

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This document supersedes EN 12601:2001.

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative Annex ZA , which is an integral part of this standard.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

This document is a type C standard as stated in EN ISO 12100 (all parts).

The machinery concerned and the extent to which hazards, hazardous situations and hazardous events are covered are indicated in the scope of this document.

When provisions of this type C standard are different from those which are stated in type A or B standards, the provisions of this type C standard take precedence over the provisions of the other standards, for machines that have been designed and built according to the provisions of this type C standard.

1 Scope

This European Standard specifies the safety requirements for reciprocating internal combustion (RIC) engine driven generating sets up to 1 000 V consisting of a RIC engine, an alternating current (a.c.) generator including the additional equipment required for operating, e.g. controlgear, switchgear, auxiliary equipment.

This European Standard is not applicable for generating sets which are manufactured before the date of its publication as a national EN standard.

It applies to generating sets for land and marine use, excluding generating sets used on board of seagoing vessels and mobile offshore units as well as on aircraft or to propel road vehicles and locomotives. The special requirements needed to cover operation in potentially explosive atmospheres are not covered in this standard.

The hazards relevant to RIC engine driven generating sets are identified in Annex A.

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.

EN 547-2, *Safety of machinery — Human body measurements — Part 2: Principles for determining the dimensions required for access openings*

EN 953, *Safety of machinery — Guards — General requirements for the design and construction of fixed and movable guards*

EN 981, *Safety of machinery — System of auditory and visual danger and information signals*

EN 1679-1:1998, *Reciprocating internal combustion engines — Safety — Part 1: Compression ignition engines*

EN 60034-5:2001, *Rotating electrical machines — Part 5: Degrees of protection provided by the integral design of rotating electrical machines (IP code) — Classification (IEC 60034-5:2000)*

EN 60204-1:2006, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements (IEC 60204-1:2005, modified)*

EN 60335-1:2002, *Household and similar electrical appliances — Safety — Part 1: General requirements (IEC 60335-1:2001, modified)*

EN 60529:1991, *Degrees of protection provided by enclosures (IP Code) (IEC 60529:1989)*

EN 61310-1, *Safety of machinery — Indication, marking and actuation — Part 1: Requirements for visual, acoustic and tactile signals (IEC 61310-1:2007)*

EN ISO 4871:2009, *Acoustics — Declaration and verification of noise emission values of machinery and equipment (ISO 4871:1996)*

EN ISO 12100-1:2003, *Safety of machinery — Basic concepts, general principles for design — Part 1: Basic terminology, methodology (ISO 12100-1:2003)*

EN ISO 12100-2:2003, *Safety of machinery — Basic concepts, general principles for design — Part 2: Technical principles (ISO 12100-2:2003)*

EN ISO 13732-1, *Ergonomics of the thermal environment — Methods for the assessment of human responses to contact with surfaces — Part 1: Hot surfaces (ISO 13732-1:2006)*

EN ISO 13850:2008, *Safety of machinery — Emergency stop — Principles for design (ISO 13850:2006)*

EN ISO 13857:2008, *Safety of machinery — Safety distances to prevent hazard zones being reached by upper and lower limbs (ISO 13857:2008)*

EN ISO 14122-2, *Safety of machinery — Permanent means of access to machinery — Part 2: Working platforms and walkways (ISO 14122-2:2001)*

ISO 2261:1994, *Reciprocating internal combustion engines — Hand-operated control devices — Standard direction of motion*

ISO 2710-1:2000, *Reciprocating internal combustion engines — Vocabulary — Part 1: Terms for engine design and operation*

ISO 2710-2:1999, *Reciprocating internal combustion engines — Vocabulary — Part 2: Terms for engine maintenance*

ISO 3046-1:2002, *Reciprocating internal combustion engines — Performance — Part 1: Declarations of power, fuel and lubricating oil consumptions, and test methods — Additional requirements for engines for general use*

ISO 3046-6:1990*, Reciprocating internal combustion engines — Performance — Part 6: Overspeed protection*

ISO 6826:1997, *Reciprocating internal combustion engines — Fire protection*

ISO 7000, *Graphical symbols for use on equipment — Index and synopsis*

ISO 7967-1:2005, *Reciprocating internal combustion engines — Vocabulary of components and systems — Part 1: Structure and external covers*

ISO 7967-2:1987, *Reciprocating internal combustion engines — Vocabulary of components and systems — Part 2: Main running gear*

ISO 7967-3:2010, *Reciprocating internal combustion engines — Vocabulary of components and systems — Part 3: Valves, camshaft drive and actuating mechanisms*

ISO 7967-4:2005, *Reciprocating internal combustion engines — Vocabulary of components and systems — Part 4: Pressure charging and air/exhaust gas ducting systems*

ISO 7967-8:2005, *Reciprocating internal combustion engines — Vocabulary of components and systems — Part 8: Starting systems*

ISO 7967-9:2010, *Reciprocating internal combustion engines — Vocabulary of components and systems — Part 9: Control and monitoring systems*

ISO 8528-1:2005, *Reciprocating internal combustion engine driven alternating current generating sets — Part 1: Application, ratings and performance*

ISO 8528-2:2005, *Reciprocating internal combustion engine driven alternating current generating sets — Part 2: Engines*

ISO 8528-3:2005, *Reciprocating internal combustion engine driven alternating current generating sets — Part 3: Alternating current generators for generating sets*

ISO 8528-4:2005, *Reciprocating internal combustion engine driven alternating current generating sets — Part 4: Controlgear and switchgear*

ISO 8528-5:2005, *Reciprocating internal combustion engine driven alternating current generating sets — Part 5: Generating sets*

ISO 8528-6:2005, *Reciprocating internal combustion engine driven alternating current generating sets — Part 6: Test methods*

ISO 8528-7:1994, *Reciprocating internal combustion engine driven alternating current generating sets — Part 7: Technical declarations for specification and design*

ISO 8528-8:1995, *Reciprocating internal combustion engine driven alternating current generating sets — Part 8: Requirements and tests for low-power generating sets*

ISO 8528-9:1995, *Reciprocating internal combustion engine driven alternating current generating sets — Part 9: Measurement and evaluation of mechanical vibrations*

ISO 8528-10:1998, *Reciprocating internal combustion engine driven alternating current generating sets — Part 10: Measurement of airborne noise by the enveloping surface method*

IEC 60364-4-41:2005, *Low-voltage electrical installations — Part 4-41: Protection for safety — Protection against electric shock*

IEC 60417-DB-12M:2002, *Graphical symbols for use on equipment — 12-month subscription to online database comprising all graphical symbols published in IEC 60417*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 8528-1:2005, ISO 8528-2:2005, ISO 8528-3:2005, ISO 8528-4:2005, ISO 8528-5:2005, ISO 8528-6:2005, ISO 8528-7:1994, ISO 8528-8:1995, ISO 8528-9:1995, ISO 8528-10:1998, ISO 2710-1:2000, ISO 2710-2:1999, ISO 3046-1:2002, ISO 3046-6:1990, ISO 7967-1:2005, ISO 7967-2:1987, ISO 7967-3:2010, ISO 7967-4:2005, ISO 7967-8:2005, ISO 7967-9:2010, and EN ISO 12100-1:2003 and the following apply.

3.1
low power generating sets
power generating sets for the purpose of this standard which are determined by the following special features:

- low power is taken to mean power of a magnitude up to approximately 10 kW;
- users normally are laymen;
- complete generating set is usually transportable, or mobile;
- electrical output is connected by plugs and sockets;
- generating set is ready for use without any additional installation work by the user

3.2
close proximity
30-mm space immediately around the operating and adjusting controls and carrying handles, including their whole movement range

4 General

If the installation of a generating set can create hazards in addition to those covered by this European Standard, the safety requirements and/or protective measures related to these additional hazards are the responsibility of the installer, if necessary with the agreement of the manufacturer of the generating set. The

installer will be responsible for ensuring compliance for the additional hazards arising because of the installation.

5 Hazards

The hazards relevant to RIC engine driven generating sets that have to be considered in order to prevent personal injury are listed in Annex A.

6 Safety Requirements

6.1 General

Machinery shall comply with the safety requirements and/or protective measures of this clause. In addition, the machine shall be designed according to the principles of EN ISO 12100 (all parts) for relevant but not significant hazards, which are not dealt with by this document.

6.2 Starting system

6.2.1 Requirements

Starting systems shall meet the requirements of Clause 6, Subclause "Starting system" of EN 1679-1:1998.

6.2.2 Verification

Compliance with the requirements shall be verified by inspection and testing of the starting systems.

6.3 Stopping

6.3.1 Requirements

6.3.1.1 Normal stopping

All generating sets shall have a normal stopping device which can be manually or automatically actuated. Stopping controls shall remain in the stop position when operated. This shall operate by a device ensuring the cutting off of the fuel or the ignition (for spark ignition engines) supply. This device may include an air supply cut-off.

6.3.1.2 Stopping in case of failure

Generating sets except low power generating sets shall be provided with an automatically actuated stopping device in case of failure.

This device shall monitor one or more signals of the generating set and if these signals are out of the allowable range it triggers the automatic stop.

The main signals that might be used to actuate automatic stopping are e.g.

a) for the RIC engine:

   1) overspeed (see ISO 3046-6);

   2) low lubricating oil pressure;

3) high coolant temperature;

4) low coolant level;

b) for the generator:

1) excessive overvoltage;

2) overload.

Which of these or other measures should be specified depends on the application.

6.3.2 Verification

Normal stopping shall be verified by inspection and testing of the stopping device in manual and in automatic modes (if provided in the application).

Automatic stopping in case of failure shall be verified by testing the action of typical failure modes in operating conditions (an appropriate method shall be used to create typical failure conditions, e.g. manual triggering, short-circuiting of contacts).

6.4 Emergency stopping

6.4.1 Requirement

Emergency stopping devices are required for remote controlled generating sets and generating sets with an enclosure or container accessible by persons. An emergency stopping device is not required for low power generating sets.

Emergency stopping devices shall be actuated manually. As for normal stopping, emergency stopping shall operate by a device ensuring the cutting off of the fuel supply or ignition (for spark ignition engines). This device may include an air supply cut-off.

Emergency stopping devices shall also meet the requirements of EN ISO 13850:2008, category 0, and the reset shall not initiate a restart or any hazardous conditions.

Manually actuated emergency stopping devices shall be located inside and outside the enclosure or container in which a generating set is located and which is accessible for personnel to carry out maintenance or control operations when generating sets are in operation.

6.4.2 Verification

Emergency stopping devices shall be verified by inspection and testing in operating conditions.

6.5 Control devices

6.5.1 Design, safety and mechanical strength

6.5.1.1 Requirement

Control devices for the RIC engine of the generating set shall meet the following requirements:

— hand controls shall be designed to withstand 1,2 times the maximum actuating forces given in Table 1 of EN 1679-1:1998;

— controls shall act positively and *smoothly* and without *delay or* unexpected action and be in accordance with ISO 2261:1994;

— the surface temperature of the controls that have to be manually actuated while the engine is running shall be within the limits specified in EN ISO 13732-1 for a contact time of 10 s;

— sharp edges or corners on, or adjacent to manual controls shall be removed; edges shall have a chamfer of at least 0,5 mm.

Control devices on electrical equipment of the generating set shall comply with EN 60204-1:2006, 10.1 and 10.2 with the exception as given in Annex B, 10.

— The surface temperature of the controls that have to be manually actuated while the generating set is running shall be within the limits specified in EN ISO 13732-1 for a contact time of 10 s.

6.5.1.2 Verification

Control devices of the RIC engine shall be verified by inspection and testing.

Control devices of the generating sets shall be verified in accordance with EN 60204-1:2006, 10.1 and 10.2.

For surface temperature measurement of the control devices (RIC engines and generating sets), the following method shall be conducted:

a) the generating set shall be operated at its rated power until the surface temperatures stabilize;

b) the test shall be conducted in well-ventilated place not directly exposed to sunshine;

c) if the test is conducted at an ambient temperature outside of the nominal (20 ± 3) ^{o}C the reported temperatures shall be corrected by the following formula:

   1) corrected temperature (°C) = observed temperature (°C) – ambient temperature (°C) + 20°C.

6.5.2 Identification

6.5.2.1 Requirements

The control devices of RIC engines shall comply with the requirements of Clause 6, Subclause “Identification” of EN 1679-1:1998 that shall apply.

The control devices on electrical equipment shall comply with the requirements of EN 60204-1:2006, 10.1 and 10.2 with the exception as given in Annex B, 10.

6.5.2.2 Verification

Compliance with the requirements shall be verified by inspection.

6.5.3 Accessibility

6.5.3.1 Requirements

The requirements of EN 1679-1:1998, 6.4.3 shall apply.

6.5.3.2 Verification

Compliance with the requirements shall be verified by inspection and measurement.

6.6 Monitoring devices

6.6.1 Requirements

The instruments for the monitoring of the RIC engine shall comply with the requirements in Clause 6, Subclause “Monitoring devices" of EN 1679-1:1998.

The instruments for the monitoring of the electrical equipment shall comply with EN 60204-1:2006, 10.3.

6.6.2 Verification

Compliance with the requirements shall be verified by inspection.

6.7 Warning devices

6.7.1 Requirements

Warning devices, signs, markings and colours shall meet the requirements of EN 61310-1 and EN 981.

6.7.2 Verification

Compliance with the requirements shall be verified by inspection.

6.8 Guarding

6.8.1 General

6.8.1.1 Requirements

The following clauses give the requirements for the common hazards related to guarding and these principles shall be followed for any generating set or installation.

Guards shall be designed in accordance with EN 953.

Fixing systems of fixed guards shall remain attached to the guards or to the generating set when the guards are removed. This requirement is limited to fixed guards that need to be removed during normal maintenance operations as described in instructions of use.

For fixed installed generating sets the need of guarding shall be agreed between generating set manufacturer and installer considering that the persons shall be protected during operating and routine servicing.

Because it is not possible to envisage the layout of fixed installation, the overall requirements for this situation are not dealt with in this standard. Therefore, for fixed installations, the need for additional guarding to protect persons during operation and routine servicing shall be established after discussion between the generating set manufacturer, user and installer.

NOTE The provider of additional guarding for fixed installations that is outside the scope of this standard is responsible for ensuring its suitability.

6.8.1.2 Verification

Compliance with the requirements shall be verified by inspection.

6.8.2 Guarding against mechanical hazards

6.8.2.1 Requirements

Moving parts of generating sets e.g. fan, belt, chains, etc. shall be so arranged or enclosed as to prevent direct involuntary access during normal use i.e. during maintenance, monitoring or control operations described in the manual of use. Safety distance shall comply with EN ISO 13857:2008, Table 4.

6.8.2.2 Verification

Compliance with the requirements shall be verified by measurements.

6.8.3 Guarding against hot surfaces

6.8.3.1 General

The necessity to guard hot surfaces depends on its surface temperature, its location and if a person is likely to touch it.

A guard shall be provided to prevent accidental contact with any engine exhaust component during normal operation; any hot surface below 10 cm^2 does not require guarding.

The temperature of the guards shall not exceed the threshold temperature. If this cannot be avoided, then display a warning.

6.8.3.2 Requirements for generating sets except low power generating sets

A risk assessment shall be carried out by the generating sets manufacturer to determine the surfaces with a burn hazard and identify appropriate protective measures in order to prevent accidental contact in normal conditions of use, i.e. during control, monitoring and maintenance operations described in the manual of use. At least the following areas shall be considered.

a) The surfaces which can be reached when probed by the cones in accordance with Figure 1 and Figure 2 shall not have a temperature higher than:

   1) 80 °C for metallic surfaces;

   2) 94 °C for non metallic surfaces.

b) The surfaces, except exhaust engine parts, which may cause burns shall be protected. When a guard does not permit the reduction of the temperature below the limits threshold, a warning marking shall be fixed on or near this guard to warn the generating sets user of the presence of a burn danger.

c) The engine exhaust, with very important burn hazards during the operating, but also during cooling period following a generating sets stopping, shall be equipped with a guard to limit the most severe burn risks by direct contact. Any exhaust surface less than 10 cm^2 or out of reach of operator does not need to be equipped with a protection. Engine exhaust components and their guards shall not have surface temperatures higher than 94 °C for non metallic surfaces materials or 80 °C for metallic surfaces. When a guard does not permit to reduce the temperature below the limits threshold, a warning marking shall be fixed on or near this guard to warn the generating sets user of the presence of a burn danger.

d) An enclosure with access doors for maintenance or control operations shall not be considered as protection against contact with an engine exhaust.

6.8.3.3 Verification for generating sets except low power generating sets

a) The accessibility of the identified hot surfaces during control and monitoring operations shall be verified by applying the test cones in accordance with Figure1 and Figure 2:

   1) When the distance between the identified hot area and the nearest control is in excess of 100 mm, cone A as shown in Figure 1 shall be used;

   2) For distances less than 100 mm between the identified hot area and the nearest control, cone B as shown in Figure 2 shall be used;

   3) For cone A with the axis of the cone anywhere 0^{o} and 180^{o} to the horizontal and with the point of the cone in a downward to horizontal direction, move the cone towards the hot surface. The cone shall not be moved in an upwards direction. When moving the cone, determine if contact is made with the hot surface area(s) with the cone tip or conical surface of the cone;

   4) Cone B shall be moved in any direction.

b) For maintenance operations, the hot surfaces to be considered are those more than 10 cm^2 located at less than 300 mm of a maintenance or control point and/or of access path for operators.

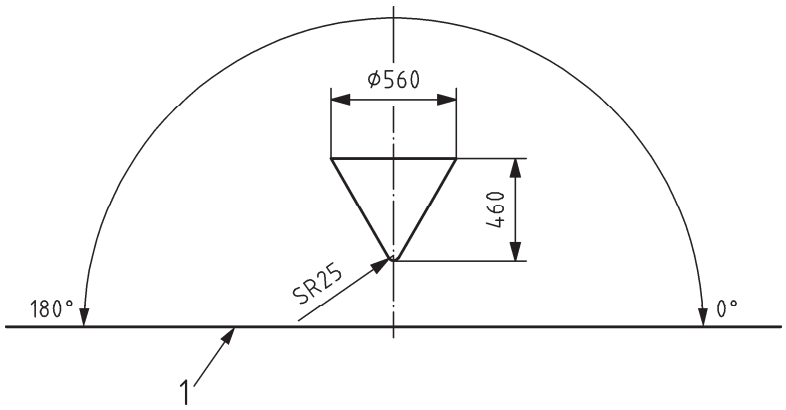
c) The generating set shall be operated at its rated power until the surface temperatures stabilize.

d) The test shall be conducted in well-ventilated place not directly exposed to sunshine.

e) If the test is conducted at an ambient temperature outside of the nominal (20 ± 3) ^{o}C the reported temperatures shall be corrected by the following formula:

   1) corrected temperature (°C) = observed temperature (°C) – ambient temperature (°C) + 20°C

Dimensions in millimetres

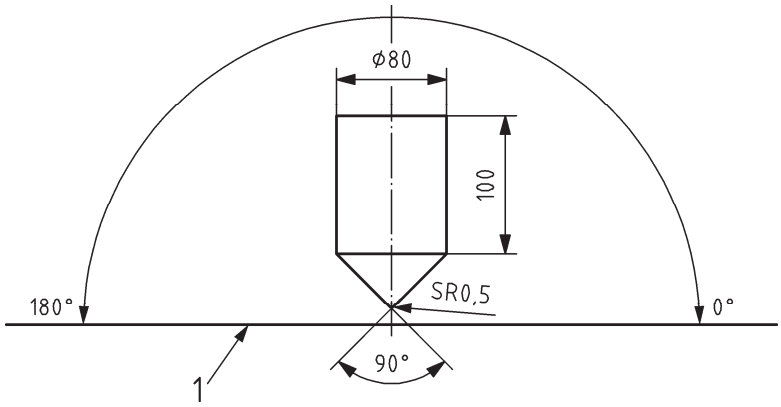


Key

1 horizontal plane

Figure 1 — Cone A

Dimensions in millimetres



Key

1 horizontal plane

Figure 2 — Cone B

6.8.3.4 Requirements for low power generating sets

a) The surfaces in the close proximity of controls shall not have a temperature higher than:

   1) 80 °C for metallic surfaces;

   2) 94 °C for non metallic surfaces.

b) Carrying handles of generating sets and the surfaces in their close proximity shall not have a temperature higher than:

   1) 50 °C for metallic surfaces;

   2) 70 °C for non metallic surfaces.

c) The engine exhaust, with very important burn hazards during the operating, but also during cooling period following a generating sets stopping, shall be equipped with a guard to limit the most severe burn risks by accidental contact. Any exhaust surface less than 10 cm^2 does not need to be equipped with protection.

   1) Engine exhaust components and their guards shall not have surface temperatures higher than 94 °C for non metallic surfaces materials or 80 °C for metallic surfaces.

d) An enclosure with access doors for maintenance or control operations shall not be considered as protection against contact with an engine exhaust.

6.8.3.5 Verification for low power generating sets

a) The surfaces temperatures shall be verified by measurement.

b) The generating set shall be operated at its rated power until the surface temperatures stabilize.

c) The test shall be conducted in well-ventilated place not directly exposed to sunshine.

d) If the test is conducted at an ambient temperature outside of the nominal (20 ± 3) °C the reported temperatures shall be corrected by the following formula:

1) corrected temperature (°C) = observed temperature (°C) – ambient temperature (°C) + 20°C

6.8.4 Guarding against electrical shock by enclosures

6.8.4.1 Requirement

The requirements of EN 60204-1:2006, 6.2.2 shall be met.

6.8.4.2 Verification

Compliance with the requirements shall be verified by inspection and testing.

The degree of protection shall be verified in accordance with the test method and acceptance criteria of EN 60529:1991.

6.9 Stability for low power generating sets

6.9.1 Requirements

The mechanical stability to prevent tip-over shall comply with ISO 8528-8:1995, 6.2.

6.9.2 Verification

The mechanical stability shall be verified by applying the method and criteria of ISO 8528-8:1995, 6.2.

6.10 Lighting

6.10.1 Requirement

If installed, the lighting of a generating set shall illuminate the control levers, monitoring devices and corresponding walkways with an intensity of at least 20 lux.

6.10.2 Verification

Compliance with the requirements shall be verified by measurement or technical documentation.

6.11 Handling

6.11.1 Requirements

Generating sets above 140 kg shall have provisions for lifting attachments to attach lifting devices to lift the generating set or parts of it according to the manufacturers' instructions.

The lifting attachments shall be designed to withstand at least 1,5 times the mass lifted by lifting attachments.

The lifting attachments and their location shall comply with the requirements of Clause 6, Subclause "Handling" of EN 1679-1:1998.

Generating sets below 140 kg intended for transportation by persons shall have carrying handles or an adequate frame design to transport it according to the manufacturers' manual.

The handles shall be designed to withstand at least 2,5 times the mass lifted divided by the number of carrying handles.

NOTE Typically, generating sets are either designed with handles or use the frame for carrying purposes. Therefore, it is not possible to prescribe the exact number or layout of handles. As a basis for providing means of carrying the generating set it is considered that a 140 kg set should be provided with the means of carrying by 4 persons.

6.11.2 Verification

Compliance with the requirements of 6.10.1 regarding the number and the location of the lifting attachments shall be verified by inspection.

The strength of the lifting attachments to withstand the mass to be lifted shall be verified by testing or calculation.

6.12 Fire protection

6.12.1 General

The design has to consider hazards from flammable liquids or gases with regard to routing of pipes, location of reservoir, leakage, filling and draining. The possibility of contact with energy sources that could result in a hazard should be minimized.

6.12.2 Requirements

For the RIC engine, the basic requirements of ISO 6826:1997 shall be met.

The orifices and the filling devices of the generating set shall meet the requirements of ISO 6826:1997, 6.2.

The piping for flammable liquids shall meet the requirements of ISO 6826:1997, 7.3 and the draining valves the requirements of ISO 6826:1997, 7.6.

For fuel tanks the following additional requirements apply.

Design requirements:

— Fuel tanks shall be designed as to ensure that no leaks develop under normal operating conditions.

— Leaking fuel from the vent holes of the tanks of reciprocating internal combustion engines during start-up and operation is permissible as long as it has been ensured that there is no subsequent danger of fire.

— Filler necks in fuel tanks shall be arranged and designed in such a way as to ensure that fuel cans or other devices with spouts can be directly inserted and no fuel can come into contact with hot parts.

Strength requirements:

— The tank shall be secured to withstand normal handling.

— The tank shall be strong enough to withstand impact during normal handling or be protected from impact.

For low power generating sets the following additional temperature requirement applies.

— Any parts of the generating set which are in direct contact with its supporting surface shall not exceed a temperature of 90 °C.

6.12.3 Verification

Compliance with the requirements shall be verified by inspection and examination of the engine manufacturer documentation.

For low power generating sets, compliance with the fuel tank strength requirements shall be satisfied by testing in accordance with ISO 8528-8:1995, 6.1.1.

For low power generating sets, the temperature measurement shall be done in the same operating conditions as specified in 6.8.3.5.

6.13 Hoses, pipes and electrical harnesses of the RIC engine

6.13.1 Requirements

Hoses, pipes and electrical harnesses of the RIC engine shall comply with the requirements of Clause 6, Subclause “Hoses, pipes and electric harnesses” of EN 1679-1:1998.

6.13.2 Verification

Compliance with requirements shall be verified by inspection and examination of the documentation provided by component manufacturers.

6.14 Electrical equipment

6.14.1 Generators

6.14.1.1 General

6.14.1.1.1 Requirements

— Generators shall meet the requirements of ISO 8528-3.

— Generators for low power generating sets shall meet the requirement of ISO 8528-8:1995, 6.6.2.

6.14.1.1.2 Verification

The requirements shall be verified by testing and inspection.

6.14.1.2 Degree of protection

6.14.1.2.1 Requirements

The IP degree of protection of the generator shall correspond to the requirements of the operational conditions and shall comply at least with IP21M for generating sets except low power generating sets and IP23M for low power generating sets.

6.14.1.2.2 Verification

a) For low power generating sets the degree of protection shall be verified in accordance with the test method and acceptance criteria of EN 60529:1991.

After the test of protection against ingress of water, inspection and dielectric test have to be performed in accordance with EN 60034-5:2001, 9.2.

b) For generating sets except for low power generating sets the IP degree indicated by the generator manufacturer shall be in accordance with the requirements of the operational conditions.

6.14.2 Other electrical equipment

6.14.2.1 General

6.14.2.1.1 Requirements

Electrical equipment used to operate the generating set shall meet the requirements of Annex B.

6.14.2.1.2 Verification

The electrical equipment shall be verified by testing and inspection.

6.14.2.2 Degree of protection

6.14.2.2.1 Requirement

The electrical equipment for low power generator sets except for the safety extra low voltage circuits shall at least comply with IP33M in operating conditions.

6.14.2.2.2 Verification

The degree of protection shall be verified in accordance with the test method and acceptance criteria of EN 60529:1991.

For low power generating sets, after the test of protection against ingress of water, the following inspection and test have to be performed:

— If any water has entered, the creepage distance shall comply with Table 17 of EN 60335-1:2002, 29.2;

— A dielectric test has to be performed in accordance with Table 7 of EN 60335-1:2002, 16.3.

6.14.2.3 Insulation

6.14.2.3.1 Requirements

The insulation shall comply with EN 60204-1:2006.

6.14.2.3.2 Verification

Insulation resistance shall be verified according to EN 60204-1:2006, 18.3, insulation resistance test, or 18.4, voltage test.

6.14.2.4 Protective bonding circuit

6.14.2.4.1 Requirements

The protective bonding circuit shall comply with EN 60204-1.

6.14.2.4.2 Verification

The function of the protective bonding circuit shall be verified according to EN 60204-1:2006, 18.2.

6.15 Noise

6.15.1 Requirements

When designing the generating set the available information and technical measures to control noise at source shall be taken into account, see for example EN ISO 11688-1. The main sources of airborne noise on generating sets include:

— the engine;

— the cooling system fan if provided;

— the exhaust system.

6.15.2 Verification

Airborne noise shall be measured as specified in ISO 8528-10:1998, Clause 9 at 75 % of rated power (PRP) and determined according to ISO 8528-10:1998, Clause 13 for the sound power level and according to ISO 8528-10:1998, Clause 14 for the emission sound pressure level.

6.16 Access systems

6.16.1 Requirements

Surfaces of all access system (e.g. walkways and platforms, etc.), if required, shall be slip resistant under the expected use to minimise the possibility of foot slippage.

Access systems shall be level and free from obstructions and protrusions to prevent injury.

The structure shall be sufficiently sturdy and stable to support any expected load without undue deformation or loss of integrity.

Access systems shall be designed according to EN ISO 14122-2.

6.16.2 Verification

Compliance with the requirements shall be verified by test or calculation.

6.17 Access to service points

6.17.1 Requirement

Openings intended for maintenance purposes shall comply with EN 547-2.

6.17.2 Verification

Compliance with the requirements shall be verified by inspection and measurement.

6.18 Gaseous and particulate exhaust emissions

6.18.1 Requirement

The exhaust shall be directed away from the generating set control panel.

For generating sets intended to be used indoors, the exhaust shall be directed outside.

NOTE This may be the responsibility of the installer, see 7.1.

6.18.2 Verification

Compliance with the requirement shall be verified by inspection.

6.19 Drainage

6.19.1 Requirements

Provisions shall be made to allow drainage of fuel, coolant and lubrication oil without any spillage.

This can be achieved by:

— permanently installed pipework to a collection point

or

— providing access for collection containers to allow direct drainage

or

— access to drain plugs without the need to remove guards.

6.19.2 Verification

Compliance with the requirements shall be verified by inspection.

7 Operating and maintenance instructions

7.1 Requirements

Operating and maintenance instruction shall comply with EN ISO 12100-2:2003, 6.5 and shall provide adequate information to enable the generating set to be operated safely and give clear advice concerning its installation, use and maintenance.

Extensive use should be made of photographs and/or diagrams.

The operating and maintenance instructions shall include, but not be limited to the following:

a) general description, in particular description of the generating set nameplate, and explanation of the adjustment points that shall not be modified;

b) general information concerning the toxicity of exhaust gases, fuel and oil;

c) information concerning the limitation of use at locations where the risk of fire may be high;

d) filling with fuel and oil;

e) starting and stopping;

f) correct use of batteries;

g) indications about the hot surfaces and their guards when provided;

h) routine maintenance instructions;

i) correct disposal of residual fluids;

j) indication that the installation and major repair work shall be carried out only by specifically trained personnel;

k) information on installation precautions e.g. exhaust system, intake system, cooling system, drainage, fuelling, electrical connection, noise and access;

l) if necessary advice on the need of personal protection equipment;

m) in the case of generating sets provided for use by laymen the supplied instructions shall meet the requirements as defined in ISO 8528-8:1995, Clause 9;

n) the operation manual shall contain information on sound power level from the generator set and the emission sound pressure level at the operator's position(s) as follows:

1) A-weighted sound power level emitted by the machine together with uncertainty of stated values, where the equivalent continuous A-weighted emission sound pressure level at the operator's station(s) exceeds 80 dB. The declaration of this value shall have the format of a single number declaration as defined in EN ISO 4871:2009.

NOTE For generator sets covered by Directive 2000/14/EC, this value is the guaranteed value indicated on the marking of the machine.

2) A-weighted emission sound pressure level at the operator's station where this exceeds 70 dB, together with uncertainty of stated values; where this level does not exceed 70 dB, this fact shall be indicated. The declaration of this value shall have the format of a dual-number declaration as defined in EN ISO 4871:2009.

3) For indoor generating sets for which the ambient noise levels depend on the conditions of installation, it is not possible to specify these ambient noise levels in the operating and maintenance instructions. In this case, the operating and maintenance instructions shall include a warning about the dangers of airborne noise and on the need for performing, after the installation, acoustic measurements to determine the sound pressure level in the conditions specified in 6.15.2 and for implementing appropriate protective measures if necessary.

7.2 Verification

Compliance with the requirements shall be verified by examination of the operating and maintenance instructions and then by inspection of the generating set.

8 Safety labels

8.1 Requirement

The symbols shall be labelled according to ISO 7000.

The labels shall be clearly visible, legible and indelible.

Low power generator sets shall be labelled with at least the following safety labels:

— A) read the operator's instruction manual

— B) exhaust gas is poisonous; do not operate in an unventilated area;

— C) not to refuel when operating.

8.2 Verification

The conformity of the safety labels shall be verified by inspection.

9 Marking

9.1 Requirements

Generating sets shall be marked legibly and indelibly with the following minimum information:

— name and address of the manufacturer and where applicable his authorised representative;

— designation “Generating set” or “Low power generator set”;

— designation of series or type[1)];

— serial Number;

— year of construction, that is the year in which the manufacturing process is completed;

— mass, in kilograms;

— rated power, in kilowatts, with the prefixes COP, PRP or LTP or ESP in accordance with ISO 8528-1:2005, Clause 13;

— performance class in accordance with ISO 8528-1;

— for low power generating sets: quality class in accordance with ISO 8528-8:1995 7.3;

— rated power factor;

— maximum site altitude above sea-level, in metres;

— maximum ambient temperature, in degrees Celsius;

— rated frequency, in hertz;

— rated voltage, in volts;

— rated current, in amperes;

— mandatory Marking[2)].

NOTE For low power generating sets, maximum site altitude and temperature markings are not compulsory.

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1) The designation of the series or type is to allow the technical identification of the product and this can be achieved by a combination of letters and/or numbers and can be combined with the designation of the machinery.

2) For machines and their related products intended to be put on the market in the EEA, CE marking as defined in the applicable European directive(s), e.g. Machinery.

9.2 Verification

The conformity of the markings shall be verified by inspection.

Annex A
(normative)

List of hazards

Table A.1 — List of hazards

Hazards		Relevant subclauses in EN 12601
1	Mechanical hazards	
1.1	Crushing hazards	6.8.2
1.2	Shearing hazard	6.8.2
1.3	Cutting or severing hazard	6.8.2
1.4	Entanglement hazard	6.8.2
1.5	Drawing-in or trapping hazard	6.8.2
1.6	Impact hazard	6.8.2
1.7	Stabbing and puncture hazard	6.8.2
1.8	Friction or abrasion hazard	6.8.2
1.9	High pressure fluid ejection hazard	6.13, 6.19
1.10	Ejection of parts (e. g. broken belt)	6.4, 6.8
1.11	Loss of stability (of machinery and machine parts)	6.11
1.12	Slip, trip and fall hazards in relationship with machinery (because of their mechanical nature)	6.16
2	Electrical hazards	
2.1	Electrical contact (direct or indirect)	6.14
2.2	Electrostatic phenomena	N. A.
2.3	Thermal radiation or other phenomena, such as ejection of molten particles, and chemical effects from short circuits, overloads, etc.	6.14
2.4	External influences on electrical equipment e.g. starter battery overcharge	6.14
2.5	Alternator automatic voltage regulator failure	6.3.1.2
3	Thermal hazards resulting in:	
3.1	Burns and scalds, by a possible contact of persons, by flames and also by the radiation of heat sources	6.8.3
3.2	Health damaging effects by hot or cold work environment	N. A.
4	Hazards generated by noise, resulting in:	
4.1	Hearing losses (deafness), other physiological disorders (e.g. loss of balance, loss of awareness)	6.15
4.2	Interferences with speech communication, acoustic signals, etc.	6.15
5	Hazards generated by vibration (resulting in a variety of neurological and vascular disorders)	N.A.
6	Hazards generated by radiation, especially by:	
6.1	Electrical arcs	6.14
6.2	Lasers	N.A.
6.3	Ionizing radiation sources	N.A.
6.4	Machines making use of high frequency electromagnetic fields	N.A.

Table A.1 *(continued)*

Hazards		Relevant subclauses in EN 12601
7	Hazards generated by materials and substances processed, used or exhausted by machinery	
7.1	Hazards resulting from contact with or inhalation of harmful fluids, gases, mists, fumes and dusts	6.13, 6.18, 7
7.2	Fire hazards	6.12
7.3	Biological and microbiological (viral or bacterial) hazards	N.A
8	Hazards generated by neglecting ergonomic principles in machine design (mismatch of machinery with human characteristics and abilities)	
8.1	Unhealthy postures or excessive efforts	6.5.3, 6.11
8.2	Inadequate consideration of human hand-arm or foot-leg anatomy	6.5.3, 6.11
8.3	Neglected use of personal protective equipment	6.15, 7
8.4	Inadequate area lighting	6.10
8.5	Mental overload, stress, etc.	N. A.
8.6	Human error	6.5.2, 6.6, 6.7
9	Hazard combinations	N.A.
10	Hazards caused by failure of energy supply, breaking down of machinery parts or other functional disorders	
10.1	Failure of energy supply (of energy and/or control circuits)	6.4
10.2	Unexpected ejection of machine parts or fluids	6.4, 6.8, 6.13, 6.19
10.3	Failure, malfunction of control systems (unexpected start up, unexpected overrun)	6.4
10.4	Errors of fitting	7
10.5	Overturn, unexpected loss of machine stability	6.11
11	Hazards caused by (temporary) missing or incorrectly positioned safety related measures/means	
11.1	All kinds of guards	6.8, 7
11.2	All kinds of safety related protection devices	6.8, 7
11.3	Starting and stopping devices	6.2, 6.3.1.1, 6.4
11.4	Safety signs and signals	7
11.5	All kinds of information or warning devices	6.6, 6.7, 7
11.6	Energy supply disconnecting devices	N. A.
11.7	Emergency devices	6.4.
11.8	Feeding/removal of workpieces	N. A.
11.9	Essential equipment and accessories for safe adjustment and/or maintenance	7
11.10	Equipment evacuating gases	6.18

Annex B
(normative)

Application of EN 60204-1 for generating sets

Generating sets are considered as machines as defined in the machinery directive. For this reason, the basic standard EN 60204-1 shall be used with respect to the electric equipment of the generating sets.

In accordance with Annex F of the standard EN 60204-1:2006 (Guide for using the present part of IEC 60204), EN 12601:2010, Annex B specifies and completes the general requirements of EN 60204-1:2006 which are applicable to the electric equipment of the generating sets.

Table B.1 shall indicate:

— the articles or subclauses of EN 60204-1:2006 applicable to generating sets;

— the articles or subclauses of EN 60204-1:2006 for which a modification is necessary so that these apply to generating sets;

— the articles or subclauses of EN 60204-1:2006 for which a supplement is necessary so that these apply to generating sets.

The modifications or supplements of these clauses or subclauses are given in the continuation of this annex.

Table B.1 — Table on the application of EN 60204-1:2006

NOTE Clauses applicable in totality are not detailed by subclauses.

EN 60204-1:2006			**EN 12601 Annex B - Application for generating sets** A : applicable S : supplement M : modification		
Clause	**Subclause**	**Title**	**A**	**S**	**M**
1		Scope			X
2		Normative references	X		
3		Definitions	X		
4		General requirements			
	4.1	General considerations	X		
	4.2	Selection of equipment	X		
	4.3	Electrical supply			X
	4.4	Physical environment and operating conditions			
	4.4.4	Humidity			X
	4.5	Transportation and storage	X		
	4.6	Provisions for handling	X		
	4.7	Installation	X		

Table B.1 *(continued)*

EN 60204-1:2006			EN 12601 Annex B - Application for generating sets		
			A : applicable S : supplement M : modification		
Clause	**Subclause**	**Title**	**A**	**S**	**M**
5		Incoming supply conductor terminations and devices for disconnecting and switching off			
	5.1	Incoming supply conductor terminations			X
	5.2	Terminal for connection to the external protective earthing system			X
	5.3	Supply disconnecting (isolating) device			X
	5.4	Devices for switching off for prevention of unexpected start-up			X
	5.5	Devices for disconnecting electrical equipment	X		
	5.6	Protection against unauthorized, inadvertent and/or mistaken connection	X		
6		Protection against electric shock			
	6.1	General	X		
	6.2	Protection against direct contact	X		
	6.3	Protection against indirect contact		X	
	6.3.3	Protection by automatic disconnection of supply		X	
7		Protection of equipment			
	7.1	General	X		
	7.3	Protection of motors against overheating	X		
	7.4	Abnormal temperature protection	X		
	7.7	Earth fault/residual current protection	X		
	7.8	Phase sequence protection	X		
	7.9	Protection against overvoltages due to lightning and to switching surges	X		
8		Equipotential bonding	X		
10		Operator interface and machine-mounted control devices			
	10.1	General	X		
	10.1.3	Protection			X
	10.2	Push-buttons	X		
	10.3	Indicators lights and displays	X		
	10.4	Illuminated push-buttons	X		
	10.5	Rotary control devices	X		
	10.7	Emergency stop devices			X

Table B.1 *(continued)*

EN 60204-1:2006			EN 12601 Annex B - Application for generating sets A : applicable S : supplement M : modification		
Clause	**Subclause**	**Title**	**A**	**S**	**M**
	10.9	Enabling control devices	X		
11		Controlgear: location, mounting and enclosures			
	11.1	General requirements	X		
	11.2	Location and mounting	X		
	11.3	Degrees of protection			X
	11.4	Enclosures, doors and openings	X		
	11.5	Access to control gear	X		
12		Conductors and cables	X		
13		Wiring practices			
	13.1	Connection and routing	X		
	13.2	Identification of conductors	X		
	13.3	Wiring inside enclosures			X
	13.4	Wiring outside enclosures	X		
	13.5	Ducts, connection boxes and other boxes	X		
	13.5.1	General requirements			X
14		Electric motors and associated equipment	X		

1 Scope

The equipment, which is covered by the following requirements as well as the requirements of EN 60204-1:2006, commences for generating sets at the output terminals of the generator.

If generating sets, operating standby-to mains or parallel to mains, and the equipment of generating sets is supplied with power supply from the main supply net, those requirements commences at the point of connection of the supply.

4 General Requirements

4.3 Electrical Supply

Contrary to EN 60204-1:2006 the following requirements apply to generating sets:

Electrical equipment of generating sets, which is supplied by the generator of the generating sets itself, shall work without any failure under the rated conditions of the generating sets according to ISO 8528-1:2005, Clause 7 and ISO 8528-5:2005, Clause 16. For low power generating sets ISO 8528-8:1995, Clause 7 applies.

If not otherwise agreed the electrical equipment which is not supplied by the generator of the generating set has to meet the requirements according EN 60204-1:2006, 4.3

In case the generator supplies electrical equipment of machinery the supply requirements according to EN 60204-1:2006, 4.3.1 apply. The requirements have to be agreed between user and manufacturer especially in view of the transient behaviour during load changes.

4.4.4 Humidity

Instead of the values given in EN 60204-1:2006 generating sets shall meet the limit values according to ISO 8528-1:2005, Clauses 10 and 11.

Low power generating sets shall meet the limit values according ISO 8528-8:1995, Clause 7.

Deviations from those values shall be agreed between manufacturer and user.

5 Incoming supply conductor terminations and devices for disconnecting and switching off

5.1 Incoming supply conductor terminations

Contrary to EN 60204-1:2006 for generating sets, dependent from the demanded protection measure, a connection between neutral conductor and protective bonding circuit may be required.

If generating sets are used as standby-to-mains-units an electrical and/or mechanical interlocking system is necessary to avoid parallel operation (see ISO 8528-4). If generating sets are operating parallel to the mains or other generating sets additional equipment for synchronising and protection is needed (see ISO 8528-4).

5.2 Terminal for connection to the external protective earthing system

The generating sets shall have a terminal for the connection of an external protective conductor and/or a functional grounding near the associated phase conductor terminal, or on a suitable place at the generating set frame. The requirements for this terminal shall be according to EN 60204-1:2006, 5.2. If the use of this terminal at delivery of the generating sets is unknown, it has to be delivered and marked with the symbol 5019 of IEC 60417-DB-12M:2002.

5.3 Supply disconnecting (isolating) device

For generating sets in single operation, which provide power supply to various electrical equipment through a plug-type device, the electrical disconnection through the plug-type device up to 32 A or a protection switch above 32 A at the generating sets with manual operation is permitted. For generating sets in single operation, standby-to mains operation or parallel-to mains operation, which provides power to a consumer net, ISO 8528-4:2005, 5.2 applies.

Electrical equipment which is necessary for the operation of the generating set and which is not only supplied by the generator has to be equipped with a separate disconnecting device.

NOTE For generating sets used for stand-by operation a separate disconnecting device for secondary machines may be necessary.

5.4 Devices for switching off for prevention of unexpected start-up

Such devices are only necessary for generating sets with a remote starting device or an automatic starting device if there is any danger of an unexpected start. An emergency stop button may be used as such a device.

6 Protection against electric shock

6.3 Protection against indirect contact

For low-power generating sets exclusively the following requirements shall be met:

The low-power generating sets shall be designed in a manner to ensure according to IEC 60364-4-41 a protection against the indirect contacts with following particularities:

The choice of protection arrangement to be carried out depending on characteristic of generator, running conditions and scheme of grounded liaisons determined by the user, the instructions and operation and instructions manual shall contain all information needed to the user to carry out

correctly these protective measures according to the user (information for grounded, allowable lengths of connection cables, devices of complementary protection, etc.).

Furthermore it shall contain:

— A warning reminding the user that he shall conform to regulations of electrical safety applicable to the place where the generating sets are used;

— A warning on the requirements and the precautions to be respected by the user in the case of re-supply by generating sets of an installation, depending on existing protective measures in this installation and applicable regulations.

These requirements shall be verified by examination of using and instructions manual.

For generating sets intended to supply temporarily one or more apparatus by means of plug-in connectors, the following requirements shall be met by the manufacturer for a possible operation by electrical separation:

— All exposed conductive parts of the generating set and the earth terminal of plug-in connectors shall be interconnected to a protective bonding circuit.

— This protective bonding circuit shall be connected to an earth terminal and shall be marked by symbol 5019 of IEC 60417-DB-12M:2002, permitting the connection to ground by the user.

— If a neutral conductor is installed, it shall not be connected to the earth terminal.

— If several apparatus are connected to the generating set in case of insulation double default between lived parts and the protective bonding circuit, a reduction of tension shall be occurred to a value lower or equal to 50 V, in a time complying with values of Table 41.1 of IEC 60364-4-41:2005, or a disconnection of supply. The protection circuit-breaker against over-current used for disconnection of supply shall be adapted to short circuit current of the generator; the fuses are not allowed.

These requirements shall be verified by a visual checking and by a test of a short-circuiting with a resistance of 1,5 Ω behind the sockets of the generating set. For polyphase generators, this requirement shall be verified in case of short-circuit between two phase conductors and between a phase conductor and an eventual neutral conductor.

For generating sets intended to be able to supply an installation in TT scheme, or when a protection by differential current is needed in TN scheme, or if this device is imposed as complementary protection by use conditions or regulations, only residual differential devices of 30 mA shall be used as protection devices.

When these devices are not integrated by the manufacturer in generating sets, information on characteristics of these devices and their installation by the user (grounding of neutral, connection distance to the generating set) shall be included in the use and instructions manual.

These requirements shall be verified by visual checking, operation test and control of use and instructions manual.

6.3.3 Protection by automatic disconnection of supply

If the automatic disconnection shall be done by over-current release then a correctly sized over-current protection device shall be fitted taking into account the impedance of the generator and the short circuit behaviour of the generating sets.

Earth fault protection devices shall correspond to ISO 8528-4:2005, 7.3.7.

10 Operator interface and machine mounted control devices

10.1.3 Protection

Operator interface and machine mounted control devices shall withstand the stresses of the expected use declared by the manufacturer. A minimum degree of protection of IP 33 according to EN 60529:1991 is sufficient.

10.7 Emergency stop devices

Only applicable if an emergency stopping is provided.

11 Control gear: Location, mounting and enclosures

11.3 Degrees of protection

Control- and switchgear shall withstand the stresses of the expected use declared by the manufacturer. For control- and switchgear in electrical operating areas the degree of protection IP 41 is sufficient.

13 Wiring practices

13.3 Wiring inside enclosures

Flame-retardant cable ducts are not required.

Annex ZA
(informative)

Relationship between this European Standard and the Essential Requirements of EU Directive 2006/42/EC

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association to provide a means of conforming to Essential Requirements of the New Approach Directive 2006/42/EC on machinery.

Once this standard is cited in the Official Journal of the European Union under that Directive and has been implemented as a national standard in at least one Member State, compliance with the normative clauses of this standard confers, within the limits of the scope of this standard, a presumption of conformity with the relevant Essential Requirements of that Directive and associated EFTA regulations.

WARNING — Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard."

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