BRITISH STANDARD

BS EN
1679-1:1998

Reciprocating internal combustion engines — Safety —

Part 1: Compression ignition engines

The European Standard EN 1679-1:1998 has the status of a British Standard

ICS 27.020

National foreword

This British Standard is the English language version of EN 1679-1:1998.

The UK participation in its preparation was entrusted to Technical Committee MCE/14, RIC engines, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

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

Cross-references

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Foreword

This European Standard 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of an identical text or by endorsement, at the latest by August 1998, and conflicting national standards shall be withdrawn at the latest by August 1998.

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, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

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0 Introduction

This European Standard has been prepared under a mandate given to CEN by the Commission of the European Communities and the European Free Trade Association, and supports essential requirements of the EC Machinery Directive (89/392/EEC) and the associated EFTA regulations.

The extent to which hazards are covered is indicated in the scope of this standard. In addition, machinery shall comply as appropriate with EN 292-1:1991 and EN 292-2:1991 for hazards which are not covered by this standard.

The requirements of this standard concern the designers, manufacturers, suppliers, importers and installers of reciprocating internal combustion engines.

This standard also gives the information which the manufacturer shall provide to the user.

1 Scope

This standard specifies the safety requirements for compression ignition engines and their essential auxiliaries used in all applications on land, underground and water, except engines used to propel road vehicles and aircraft. The special requirements needed to cover operation in potentially explosive atmospheres are not covered in this standard.

The engine, in terms of this standard, is understood as the prime mover up to its driving extremitie(s) for power take off(s).

The hazards relevant to compression ignition engines are identified in annex A.

This standard specifies the special safety requirements for compression ignition engines based on the general requirements laid down in EN 292-1:1991 and EN 292-2:1991.

This standard should be referred to in other standards wherever compression ignition engines are used.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN Standards

prEN 286-1:1995, *Simple unfired pressure vessels designed to contain air or nitrogen — Part 1: Design, manufacture and testing.*

EN 292-1:1991, *Safety of machinery — Basic concepts, general principles for design — Part 1: Basic technology, methodology.*

EN 292-2:1991, *Safety of machinery — Basic concepts, general principles for design — Part 2: Technical principles and specifications.*

EN 294:1992, *Safety of machinery — Safety distances to prevent danger zones being reached.*

EN 418:1992, *Safety of machinery — Emergency stop equipment.*

EN 547-2:1996, *Safety of machinery — Human body dimensions — Part 2: Principles for determining the dimensions required for access openings.*

EN 563:1994, *Safety of machinery — Temperatures of touchable surfaces — Ergonomics data to establish temperature limit values for hot surfaces.*

prEN 811:1992, *Safety of machinery — Safety distances to prevent danger zone being reached by the lower limbs.*

EN 953:1997, *Safety of machinery — General requirements for the design and construction of guards (fixed, movable).*

EN 983:1996, *Safety of machinery — Safety requirements for fluid power systems and componants — Pneumatics.*

prEN 1175-1:1993, *Safety of industrial trucks — Electrical equipment — Part 1: Battery powered trucks.*

prEN 1175-2:1993, *Safety of industrial trucks — Electrical equipment — Part 2: General requirements for IC engine powered trucks.*

prEN 1175-3:1993, *Safety of industrial trucks — Electrical equipment — Part 3: Specific requirements for the electric power transmission systems of IC engine powered trucks*

prEN 1834-1:1995, *Safety requirements for the design and construction of IC engines for use in potentially explosive atmospheres — Part 1: Group II engines for use in flammable gas and vapour atmospheres.*

prEN 1834-2:1996, *Safety requirements for the design and construction of IC engines for use in potentially explosive atmospheres — Part 2: Group I engines for use in underground workings including mines susceptible to firedamp and/or combustible dust.*

prEN 1834-3:1996, *Safety requirements for the design and construction of IC engines for use in potentially explosive atmospheres — Part 3: Group II engines for use in flammable dust atmospheres.*

EN ISO 8178-1:1996, *Reciprocating internal combustion engines — Exhaust emission measurement — Part 1: Test bed measurement of gaseous and particulate emissions*

EN ISO 8178-2:1996, *Reciprocating internal combustion engines — Exhaust emission measurement — Part 2: Measurement of gaseous and particulate emissions at site.*

EN ISO 8178-4:1996, *Reciprocating internal combustion engines — Exhaust emission measurement — Part 4: Test cycles for different engine applications.*

prEN ISO 8178-5:1995, *Reciprocating internal combustion engines — Exhaust emission measurement — Part 5: Specification of test fuels.*

prEN ISO 8178-6:1995, *Reciprocating internal combustion engines — Exhaust emission measurement — Part 6: Report on measurement results and test reports.*

EN ISO 11102-1:1997, *R.I.C. engines — Crank handle starting equipment — Part 1: Safety requirements.*

EN ISO 11102-2:1997, *R.I.C. engines — Crank handle starting equipment — Part 2: Method of testing the angle of disengagement.*

EN 23411:1988, *Earth-moving machinery — Human physical dimensions of operators and minimum operator space envelope.*

prEN 61310-1:1995, *Safety of machinery — Indicating, marking and actuating principles — Part 1: Visual, audible and tactile signals.*

prEN 61310-2:1994, *Safety of machinery — Indicating, marking and actuating principles — Part 2: Marking principles.*

ISO Standards

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

ISO 2710:1978, *Reciprocating internal combustion engines — Vocabulary.*

ISO 2867:1994, *Earth-moving machinery — Access systems.*

ISO 3046-1:1995, *Reciprocating internal combustion engines — Performance — Part 1: Standard reference conditions and declarations of power, fuel consumption and lubricating oil consumption and test methods.*

ISO 6798:1996, *Acoustics — Test code for the measurement of airborne noise emitted by reciprocating internal combustion engines — Engineering method and survey method*

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

ISO 7967-1:1987, *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 7967-3:1987, *Reciprocating internal combustion engines — Vocabulary of components and systems — Part 3: Valves, camshaft drive and actuating mechanisms.*

ISO 7967-4:1988, *Reciprocating internal combustion engines — Vocabulary of components and systems — Part 4: Pressure charging and air/exhaust gas ducting systems.*

ISO 7967-8:1994, *Reciprocating internal combustion engines — Vocabulary of components and systems — Part 8: Starting systems.*

ISO 7967-9:1996, *Reciprocating internal combustion engines — Vocabulary of components and systems — Part 9: Control and monitoring systems.*

ISO 8178-7:1996, *Reciprocating internal combustion engines — Exhaust emission measurement — Part 7: Engine family determination.*

ISO 8178-8:1996, *Reciprocating internal combustion engines — Exhaust emission measurement — Part 8: Engine group determination.*

ISO 8999:1993, *Reciprocating internal combustion engines — Graphic symbols.*

ISO/CD 14314:1996, *Internal combustion engines — Recoil starting equipment —Safety requirements and tests.*

IEC Standards

IEC 34-5:1983, *Rotating electrical machines — Part 5: Degrees of protection by enclosures for rotating machinery.*

IEC 73:1991, *Colours of indicator lights and push-buttons.*

IEC 331:1970, *Fire-resisting characteristics of electric cables.*

IEC 332-2:1989, *Tests on electric cables under fire condition — Part 2: Test on a single small vertical insulated copper wire or cable.*

3 Definitions

For the purposes of this Standard, definitions as specified in ISO 2710:1978, ISO 3046-1:1995, ISO 7967-1:1987, ISO 7967-2:1987, ISO 7967-3:1987, ISO 7967-4:1988, ISO 7967-8:1994 and ISO 7967-9:1996 and the following apply.

3.1

essential auxiliary

item of equipment which is essential for the continued or repeated operation of the engine (e.g. engine driven fuel-feed pump, engine driven water pump).

4 General

Since engines are only power sources and always part of a specific application, the desired degree of compliance with these safety requirements depends on the application and shall be subject to agreement between the engine manufacturer and the engine installer. In particular, when it is possible to deal with specific hazards either on the engine itself or on the complete application the installer shall be responsible for choosing the most appropriate solution.

The engine manufacturer shall ensure that the equipment he is supplying meets the requirements laid down in this standard. The extent of these requirements depends on the engine installation.

The safety requirements given in clause **6** apply to both, the engine manufacturer and the engine installer depending on the application.

5 List of hazards

The hazards relevant to compression ignition engines that have to be considered in order to prevent personal injury are listed in annex A.

6 Safety requirements and/or measures

6.1 Starting systems

Starting systems can be triggered manually or automatically.

Electrical starting systems normally operate at voltages of 24 V or below and therefore do not present a hazard. Electrical starting systems above 24 V are not dealt with in this standard and the installer of the engine has to ensure safe operation after connecting the engine to the driven machinery.

For engines with compressed air starting, the starting pneumatic system shall comply with the requirements of EN 983:1996.

Crank handle starting systems shall meet the requirements specified in EN ISO 11102-1:1997 and EN ISO 11102-2:1997. Additionally the following requirements apply.

— Starting handles shall have sufficient clearance from the mounting surfaces to ensure safe turning.

— Diesel engines with a manual starter shall have a decompression facility which does not require to be hand-held during cranking.

The only permissible hand starting systems are crank handle (as defined above) and recoil starting devices as described in ISO/CD 14314:1996.

6.2 Normal stopping

All engines shall have a normal stopping device which can be manually or automatically controlled. This shall operate by cutting off the fuel supply.

6.3 Emergency stopping

The installer and the engine manufacturer shall consider whether an emergency stopping system should be provided in order to avoid the engine getting into an unsafe mode of operation. Depending on the application, other means of stopping may be used such as a combustion air shut-off device. The emergency stopping system may be manually or automatically controlled.

6.3.1 *Manually controlled*

Manually controlled emergency stopping systems shall meet the requirements of EN 418:1992, category 0.

6.3.2 *Automatically controlled*

The engine installer shall consider whether an automatically controlled emergency stopping system shall be provided.

The main signals that might be used to trigger an automatically controlled stopping system are:

— overspeed;

— low lubricating oil pressure;

— high coolant temperature;

— low coolant level.

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

6.4 Controls

6.4.1 *General*

Hand controls shall be designed to withstand 1,2 times the maximum actuating forces given in Table 1.

Controls shall act positively and smoothly and without delay or unexpected action. ISO 2261:1994 should be used as a reference.

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 563:1994 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.

6.4.2 *Identification*

Controls shall be identified according to the function they perform or their function must be explained in the operating manual. They shall be identified according to prEN 61310-2:1994. Colour coding shall be according to IEC 73:1991.

The marking on the engine controls shall be legible throughout the engine life.

Identification should preferably be by symbols according to ISO 8999:1993 or, if there are no suitable symbols, by words placed on the control or adjacent to it. Design, location and marking principles of prEN 61310-1:1992 shall be followed.

Emergency shut-off control handles or buttons shall be prominently located and shaped as well as being coloured red, in order to be identified among the other controls.

6.4.3 *Accessibility*

Controls should preferably be grouped together.

Controls should be located within reach of the operator (see EN 23411:1988). Access shall be provided according to EN 547-2:1996.

The spacing between controls shall be sufficient to allow operation without unintentional actuation of adjacent controls. The following minimum clearances between controls are recommended for the given maximum actuating force.

Table 1 — Clearance between controls

Operation by	Spacing mm	Maximum actuating force N
Finger tip	10	10
Finger grasp		
– toggles	20	50
– knobs	20	50
Hand		
– upward	50	400
– fore-aft	50	300
Foot	50	700

6.5 Monitoring devices

6.5.1 *Instrument identification*

Monitoring instruments shall be identified on or adjacent to them, preferably by a symbol according to ISO 8999:1993 or a descriptive wording for the system being monitored.

6.5.2 *Instrument visibility*

Monitoring instruments should be visible to the operator (see EN 23411:1988). They shall be illuminated for night time or indoor operation so that they are legible from the operator's position where the application requires it.

6.5.3 *Instrument colour code*

Monitoring instruments and monitoring systems should preferably be colour coded according to IEC 73:1991. Red is recommended for a malfunction or unsafe situation; green for a satisfactory situation or to indicate a system is operating.

6.6 Warning devices

Warning devices, signs, markings and colours shall meet the requirements of prEN 61310-1:1995. A red light and/or an audible warning device that indicates the operation of an emergency system shall be provided if such a system is installed.

Warning devices shall have a check position to indicate that the device is functioning. They shall be so designed that the check can be carried out either with the engine running or with the engine shut-off.

6.7 Guarding

The operator shall be guarded against hazards within the safety distances specified by EN 294:1992 and prEN 811:1992. The safety distance depends on the engine installation. The party responsible for the engine installation is responsible for identifying the need for guarding.

6.7.1 *Guarding against mechanical hazards*

It shall be possible to install guards to avoid contact with moving components, such as shafts, fans, clutches, pulleys, belts, scissor action levers, etc. (see **6.8**).

Relief valves of pressure vessels (see **6.13**) shall either be guarded to prevent the discharge injuring the operator or the discharge should be directed away from the operator's position.

Loaded springs that may cause injury if accidently released, shall be guarded if the force exceeds 110 N.

Turbocharger casings should either contain the parts in case of an impeller or turbine wheel failure or should be guarded.

6.7.2 *Guarding against hot surfaces*

The hazard a hot surface presents depends on the surface temperature, its location, and if a person is likely to touch it. Depending on the location of the hot surface and its temperature, the engine installer needs to decide if a hazard exists that should be guarded. EN 563:1994 should be used as a design guide together with the relevant machinery standard. In absence of a specific indication the normal operating conditions, as in EN 563:1994, are at the declared speed and the ISO standard power according to ISO 3046-1:1995.

6.8 Guard design

Guards, when provided, shall prevent access to the danger zones and meet the requirements of EN 953:1997.

Guards, when provided, shall be securely fastened. Provision should be made for maintenance and adjustment of the guarded part.

Guards to contain failures such as broken belts or pulleys shall be designed so that space is provided between the moving part and the guard, e.g. a broken belt must be able to pass between guard and pulley.

Guards that someone can step or fall on shall support a vertical load of 1 200 N distributed over any 75 mm by 150 mm area without permanent deformation.

If someone can push or fall against a guard, it shall support a 500 N load over any 75 m by 150 mm area.

Guards may be constructed of either solid or open mesh material. The outside of the guard shall be free from burrs, sharp corners, or edges.

If the guard is constructed of open-mesh material the openings shall be sized as follows.

a) Guards that are less than 100 mm from a hazard shall meet the requirements of IEC 34-5:1983, with the 12 mm test probe.

b) Guards that are 100 mm or more from a hazard shall meet the opening requirements of Table 4 of EN 294:1992.

Guards designed to contain ejected parts should be non-perforate for the size of particle.

6.9 Lighting

If the engine manufacturer supplies a ready-to-use installation that includes lighting, the area around the control levers, monitoring devices and corresponding walkways shall be illuminated with an intensity of at least 20 lux.

6.10 Handling

Engines shall have provisions for lifting attachments to attach lifting devices to lift the whole engine or its components according to the manufacturer's instructions. The lifting attachments shall be designed to withstand at least 1,5 times the mass lifted divided by the number of lifting attachments.

The lifting attachments shall be located to allow at least 20 mm clearance between lifting rope or chain or belt and engine components, unless the components are designed to withstand the contact during a lifting operation without permanent deformation or damage to the rope, chain or belt.

The access to the lifting attachments shall allow an easy attachment of the lifting hook or shackle.

Lifting attachments shall be so located that the lifting ropes, chains or belts converge over the centre of gravity (if no cross beam is used) when the engine or its lifted component is in the normal position specified by the manufacturer.

6.11 Fire protection

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.

The engine basic requirements of ISO 6826:1997 shall be met. If the engine will be used in an application with an unusual risk of fire, stricter requirements, as laid down in ISO 6826:1997 shall be met according to the application.

Wiring for voltages in excess of 50 V shall meet the requirements laid down in IEC 331:1970, and IEC 332:1989.

6.12 Protection against explosion

If an engine works in areas where explosive conditions are or might be present, the engine shall, depending on the application, be designed according to prEN 1834-1:1995, prEN 1834-2:1996 or prEN 1834-3:1996.

6.13 Pressure vessels

Engine components containing pressurized air or fluids are not considered as pressure vessels. No part of the intake system shall be considered as pressure vessels.

6.14 Hoses, pipes and electric harnesses

Hoses, pipes and electric harnesses, as well as fittings and connectors, shall be designed and made of material to withstand expected pressure, voltage, temperature, abrasion, corrosion, etc. Excessive hose and electric cable length shall be avoided to prevent misuse and obstruction.

Hoses and electric harnesses shall be routed and retained so that it is unlikely they will be used as hand holds or footsteps.

Hoses and electric harnesses shall not interfere with the accessibility of service points.

Hoses and pipe assemblies that can leak flammable liquids or gases onto hot surfaces, shall either be guarded to prevent the liquid going onto the hot surface or be dimensioned to be able to contain twice the operating pressure. In the case of fuel pipes, 1,2 times the maximum operating pressure is sufficient.

6.15 Electrical equipment

Electrical equipment of a voltage of 24 V or below fitted to engines does not present a hazard. Electrical equipment above 24 V is not dealt with in this standard and the installer of the engine has to ensure safe operation after connection of the engine to the driven machinery.

Electrical equipment fitted to industrial truck engines shall meet the requirements of prEN 1175-1:1993, prEN 1175-2:1993 or prEN 1175-3:1993.

6.16 Operator platforms, walkways, and access systems

The surface of all walkways and platforms shall be slip resistant under the expected application conditions to minimize the possibility of foot slippage.

Platforms shall be level and free from obstructions and protrusions to prevent injury. Where this is not possible, the obstacles or protrusions shall be enclosed by toe plates and/or hand rails or be designed to prevent tripping.

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

Access systems, if required, shall be designed according to ISO 2867:1994.

6.17 Access to service points

If servicing has to be done with the engine running, hot surfaces and moving parts closer than 300 mm to the service point and/or operator access path shall be guarded.

Openings intended for service purposes shall comply with EN 547-2:1996.

6.18 Noise

If required, airborne noise shall be measured as specified in ISO 6798:1996.

Noise measurement required by **A.1.7.4**f) of EN 292-2:1991 shall be carried out on the complete machine.

The noise level produced by an engine and its auxiliaries shall be considered when the installation is designed. Noise insulation and/or enclosures as well as silencers may be necessary.

6.19 Exhaust emissions

6.19.1 *General*

The exhaust emissions shall be directed away from the engine operator work station.

If required, exhaust emissions shall be determined as specified in EN ISO 8178-1:1996, EN ISO 8178-2:1996, EN ISO 8178-4:1996, prEN ISO 8178-5:1995, prEN ISO 8178-6:1995, ISO 8178-7:1996 and ISO 8178-8:1996.

6.19.2 *Requirements for engines for underground use*

Reciprocating internal combustion engines to be installed in machines for underground use in the power range [P] of 37 kW to 560 kW shall meet the following emission limits which represent the state of the art. For engines below 37 kW there are no limit values given, as the hazards from them are regarded as negligible.

6.20 Drainage

Easy access shall be provided in order to be able to drain fuel, coolant and lubricating oil. It is the responsibility of the machine installer to adapt the draining devices to each individual application.

7 Operating and maintenance instructions

Operating and maintenance instructions shall comply with clause **5** of prEN 292-2:1991. They shall provide adequate information to enable the engine to be operated safely and give clear advice concerning its maintenance. This information shall be integrated in the instruction handbook of the complete machine.

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 engine nameplate, and explanation of the adjustment points that shall not be modified.

b) General information concerning the toxicity of exhaust gases, fuel, oil.

c) Information concerning the limitation of use in surroundings 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 eventually of their guards.

h) Routine maintenance instructions with particular notes on safety related aspects.

i) Correct disposal of residual fluids.

j) Indication that the engine installation and major repair work shall be carried out only by specifically trained personnel.

8 Special requirements

Some applications might require that the engine is designed to meet special requirements (e.g. health and safety regulations). The party responsible for the installation of the engine shall specify the requirements to be met.

9 Marking

Engines shall be marked legibly and indelibly with the following information.

— Name of manufacturer.

— Type of engine.

— Serial number of engine.

Other information can be added if desired, for example:

— declared power according to an appropriate standard. If no other standard is specified, ISO 3046-1:1995 and ISO 3046-7:1995, should be used;

— declared engine speed;

— year of manufacturing.

Table 2 — Emission limits

Power P kW	**Carbon monoxide CO** g/(kW·h)	**Hydrocarbons HC** g/(kW·h)	**Nitrogenoxide** $\mathbf{NO_X}$ g/(kW·h)	**Particulates PT** g/(kW·h)
$37 \leq P <$ 75 kW	6,5	1,3	9,2	0,85
$75 \leq P <$ 130 kW	5,0	1,3	9,2	0,7
$130 \leq P <$ 560 kW	5,0	1,3	9,2	0,54

Annex A (normative)
List of hazards

Table A.1 — List of hazards

Item No.	Hazards	Relevant Clauses EN 1679-1
1	**Mechanical hazards**	
1.1	Crushing hazards	**6.7.1**
1.2	Shearing hazard	**6.7.1**
1.3	Cutting or severing hazard	**6.7.1**
1.4	Entanglement hazard	**6.7.1**
1.5	Drawing-in or trapping hazard	**6.7.1**
1.6	Impact hazard	**6.7.1**
1.7	Stabbing and puncture hazard	**6.7.1**
1.8	Friction or abrasion hazard	**6.7.1**
1.9	High pressure fluid ejection hazard	**6.14**, **6.20**
1.10	Ejection of parts (of machinery and processed material/workpieces)	**6.3**, **6.7**
1.11	Loss of stability (of machinery and machine parts)	**6.10**
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)	**6.15**, **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.	N.A.
2.4	External influences on electrical equipment	N.A.
3	**Thermal hazards resulting in**:	
3.1	Burns and scalds, by a possible contact of persons, by flames or explosions and also by the radiation of heat sources	**6.4.1**, **6.7.2**
3.2	Health damaging effects by hot or cold work environment	**6.4.1**, **6.7.2**
4	**Hazards generated by noise**	
4.1	Hearing losses (deafness), other physiological disorders (e.g. loss of balance, loss of awareness)	**6.18**
4.2	Interferences with speech communication, acoustic signals, etc.	**6.18**
5	**Hazards generated by vibration (resulting in a variety of neurological and vascular disorders)**	N.A.
6	**Hazards generated by radiation**	
6.1	Electrical arcs	**6.15**
6.2	Lasers	N.A
6.3	Ionizing radiation sources	N.A.
6.4	Machines making use of high frequency electromagnetic fields	N.A
7	**Hazards generated by materials and substances processed, used or exhausted by machinery, for example:**	
7.1	Hazards resulting from contact with or inhalation of harmful fluids, gases, mists, fumes and dusts	**6.19**
7.2	Fire or explosion hazards	**6.11**, **6.12**

Table A.1 — List of hazards *(continued)*

Item No.	Hazards	Relevant Clauses EN 1679-1
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	**6.4.3**, **6.10**
8.2	Inadequate consideration of human hand-arm or foot-leg anatomy	**6.4.3**, **6.10**
8.3	Neglected use of protective equipment	**6.18**, **7**
8.4	Inadequate area lighting	**6.9**
8.5	Mental overload, stress, etc.	N.A.
8.6	Human error	**6.4.2**, **6.5**, **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, for example:**	
10.1	Failure of energy supply (of energy and/or control circuits)	**6.3**
10.2	Unexpected ejection of machine parts or fluids	**6.3**, **6.7.1**, **6.8**, **6.20**
10.3	Failure, malfunction of control systems (unexpected start up, unexpected overrun)	**6.3**
10.4	Errors of fitting	**7**
10.5	Overturn, unexpected loss of machine stability	**6.10**
11	**Hazards caused by (temporary) missing or incorrectly positioned safety related measures/means, for example:**	
11.1	All kinds of guards	**6.7**, **7**
11.2	All kinds of safety related protection devices	**6.7**, **7**
11.3	Starting and stopping devices	**6.1**, **6.2**, **6.3**
11.4	Safety signs and signals	**7**
11.5	All kinds of information or warning devices	**6.5**, **6.6**, **7**
11.6	Energy supply disconnecting devices	N. A.
11.7	Emergency devices	**6.3**
11.8	Feeding/removal of workpieces	N. A.
11.9	Essential equipment and accessories for safe adjusting and/or maintening	**7**
11.10	Equipment evacuating gases	**6.19**
N.A. Not applicable		

Annex B (informative)
Bibliography

ISO 3046-3:1989, *Reciprocating internal combustion engines — Performance — Part 3: Test measurements.*

ISO 3046-4:1997, *Reciprocating internal combustion engines — Performance — Part 4: Speed governing.*

ISO 3046-5:1978, *Reciprocating internal combustion engines — Performance — Part 5: Torsional vibrations.*

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

ISO 3046-7:1995, *Reciprocating internal combustion engines — Performance — Part 7: Codes for engine power.*

ISO/DIS 9611:1993, *Acoustics — Characterization of sources of structure borne sound measurement of translational and rotational velocity levels on the mounting feet of resiliently mounted machinery.*

Annex ZA (informative)
Relationship with EU Directives

Clauses of this European Standard addressing essential requirements or other provisions of EU Directives.

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 safety requirements of EU Directives 89/392/EEC as amended by 91/386/EEC and 93/68/EEC.

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

The clauses of this standard are likely to support requirements of the above referred Directive.

Compliance with this standard provides one means of conforming with the specific essential requirements of the Directive concerned and associated EFTA regulations.

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