



SLOVENSKI STANDARD
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Machine tools - Safety - Electro discharge machines

Machine tools - Safety - Electro Discharge Machines

Werkzeugmaschinen - Sicherheit - Funkenerodiermaschinen

Machines-outils - Sécurité - Machines d'électro-érosion

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English version

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This European Standard was approved by CEN on 9 May 2001.

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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 CEN member into its own language and notified to the Management Centre has the same status as the official versions.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
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Foreword

This European Standard has been prepared by Technical Committee CEN/TC 143 "Machine tools - Safety", the secretariat of which is held by SNV.

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of an identical text or by endorsement, at the latest by January 2002, and conflicting national standards shall be withdrawn at the latest by January 2002.

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).

Annexes A and ZA of this standard are informative, Annex B is normative.

For relationship with EC Directives, 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.

0 Introduction

This standard applies to equipment using the process of Electro Discharge Machining (EDM) as defined in clause 3. This European Standard is a type C Standard as stated in EN 1070.

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

Complementary guidance is given in type A and B Standards to which reference is made in the text.

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. It provides one means of conforming with the Essential Health and Safety Requirements (EHSR's) of the "Machinery Directive" (98/37/EC).

1 Scope

1.1 This standard specifies technical safety requirements and measures, applicable to EDM equipment and EDM system (e.g. for spark erosion-sinking, spark erosion-wire cutting), to be adopted by persons undertaking the design, construction, installation and/or supply of such equipment. This standard also includes information to be provided by the manufacturer to the user.

1.2 The design requirements of this standard shall not apply to arc eroding and electro chemical machining equipment.

1.3 This standard takes account of the intended use in normal workshop environment and non explosive atmospheres including installation, setting, maintenance, repair and dismantling for removal or disposal of EDM equipment.

1.4 This standard also applies to auxiliary devices essential for EDM processing.

1.5 This standard deals with specific hazards defined in clause 4, Table 1, and the measures of prevention in clause 5, Table 2.

1.6 This standard applies to machines built after its date of issue.

NOTE Directive 94/9/EC concerning equipment and protective systems intended for use in potentially explosive atmospheres can be applicable to the type of machine or equipment covered by this European Standard. The present standard is not intended to provide means of complying with the essential health and safety requirements of Directive 94/9/EC.

2 Normative references

This European Standard contains dated or not dated references on 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 (including amendments).

EN 2:1992	Classification of fires
EN 54-1:1996	Fire detection and fire alarm systems - Part 1: Introduction
EN 292-1:1991	Safety of machinery - Basic concepts, general principles for design - Part 1: Basic terminology, methodology
EN 292-2:1991	Safety of machinery - Basic concepts, general principles for design - Part 2: Technical principles and specifications
EN 292-2:1991/A1:1995	Safety of machinery - Basic concepts, general principles for design - Part 2: Technical principles and specifications, (Amendment A.1)

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EN 294:1992	Safety of machinery - Safety distances to prevent danger zones being reached by the upper limbs
EN 349:1993	Safety of machinery - Minimum gaps to avoid crushing of parts of the human body
EN 418:1992	Safety of machinery - Emergency stop equipment, functional aspects - Principles for design
EN 626-1:1994	Safety of machinery - Reduction of risks to health from hazardous substances emitted by machinery - Part 1: Principles and specifications for machinery manufacturers
EN 775:1992	Manipulating industrial robots - Safety (ISO 10218:1992 modified)
EN 811:1996	Safety of machinery - Safety distances to prevent danger zones being reached by the lower limbs
EN 953:1997	Safety of machinery - Guards - General requirements for the design and construction of fixed and movable guards
EN 954-1:1996	Safety of machinery - Safety related parts of control systems - Part 1: General principles for design
EN 982:1996	Safety of machinery - Safety requirements for fluid power systems and their components - Hydraulics
EN 983:1996	Safety of machinery - Safety requirements for fluid power systems and their components - Pneumatics
EN 999:1998	Safety of machinery - The positioning of protective equipment in respect of approach speeds of parts of the human body
EN 1037:1995	Safety of machinery - Prevention of unexpected start-up
EN 1050:1996	Safety of machinery - Principles for risk assessment
EN 1070:1998	Safety of machinery - Terminology
EN 1088:1995	Safety of machinery - Interlocking devices associated with guards - Principles for design and selection
prEN 12437-1:1996	Safety of machinery - Permanent means of access to machines and industrial plants - Part 1: Choice of a fixed means of access between two levels
prEN 12437-2:1996	Safety of machinery - Permanent means of access to machines and industrial plants - Part 2: Working platforms and gangways
prEN 12437-3:1996	Safety of machinery - Permanent means of access to machines and industrial plants - Part 3: Stairways, stepladders and guard-rails
prEN 12437-4:1996	Safety of machinery - Permanent means of access to machines and industrial plants - Part 4: Fixed ladders
EN 55011:1998	Industrial, scientific and medical (ISM) radio frequency equipment - Radio disturbance characteristics - Limits and methods of measurement (CISPR 11:1997, modified)
EN 60204-1:1997	Safety of machinery - Electrical equipment of machines - Part 1: General requirements (IEC 60204-1:1997)
EN 60529:1991	Degrees of protection provided by enclosures (IP code) (IEC 60529:1989)
EN 60742:1995	Isolating transformers and safety isolating transformers - Requirements (IEC 60742:1983 + A1:1992, modified)

EN 61000-6-2:1999	Electromagnetic compatibility (EMC) Part 6-2:Generic standards - Immunity for industrial environments (IEC 61000-6-2:1999)
EN 61310-1:1995	Safety of machinery - Indication, marking and actuation - Part 1: Requirements for visual, auditory and tactile signals (IEC 61310-1:1995)
EN 61310-2:1995	Safety of machinery - Indication, marking and actuation - Part 2: Requirements for marking (IEC 61310-2:1995)
EN ISO 3746: 1995	Acoustics – Determination of sound power levels of noise sources using sound pressure - Survey method using an enveloping measurement surface over a reflecting plane (ISO 3746:1995)
EN ISO 4871: 1996	Acoustics – Declaration and verification of noise emission values of machinery and equipment
EN ISO 11202:1995	Acoustics - Noise emitted by machinery and equipment - Measurement method of emission sound pressure levels at the workstation and at other specified positions - Survey method in situ
EN ISO 11688-1:1998	Acoustics – Recommended practice for the design of low noise machinery and equipment – Part 1 Planning

3 Terms and definitions

For the purposes of this standard, the definitions given in EN 1070:1998 apply together with definitions listed below.

Other general definitions (e.g. hazard, risk, safeguarding) are mentioned in corresponding type A and type B Standards and in the annex A of EN 292-2:1991.

3.1

arc erosion; arc eroding; arc machining
 the removal of material by constant (non-pulsed) electrodischarges, performed in a dielectric medium. The discharges are initiated by periodical contact of the electrode with the work piece interrupted by axial movement of the electrode

3.2

arc erosion equipment

all the necessary units for the process of arc machining

3.3

automatic mode

use of the machine under numerical control to achieve programmed sequential operation. This term is equivalent with machining mode

3.4

control circuit

circuit used for the operational control of the machine and for protection of the power circuits

3.5

control system for EDM equipment or EDM system

the system from the initial actuator or sensor to the point of input to the final actuator or element (e.g. motor, cylinders)

3.6

dielectric fluid (for EDM processes)

non-conductive medium to improve the discharge effect, evacuate debris and to cool the work piece/electrode

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3.7

dielectric fluid container

unit and/or systems used to keep the dielectric fluid in a condition suitable for EDM (e.g. filter unit/dielectric system)

3.8

EDM equipment

all the necessary units for the process of electro discharge machining which includes the machine tool, the generator, control circuits, the dielectric fluid container and integral devices

3.9

EDM system

an assembly of EDM equipment and other machines or devices which are arranged, linked and controlled to function as an integral whole

3.10

electro chemical equipment

all the necessary units for the process of electro chemical machining

3.11

electro chemical machining; ECM

any machining process based on electrolysis

3.12

electro discharge machining; EDM

any machining process based on spark erosion

3.13

electromagnetic compatibility; EMC

the ability of the EDM equipment/system to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment

3.14

flammable dielectric fluid

dielectric fluid used in EDM, characterised by its relative ease of ignition and relative ability to sustain combustion

3.15

flash point

minimum temperature at which, under specified test conditions, a liquid gives off sufficient combustible gas or vapour to ignite momentarily on application of an effective ignition source

3.16

generator (for EDM equipment)

device to convert electrical power supplied to the machine for the purpose of being used for spark erosion processing

3.17

operator of an EDM equipment and/or system

person or persons given the task of programming, setting, adjusting, operating, maintaining and cleaning the machinery

3.18

setting/manual mode

use of the machine for unprogrammed operations under the control of the operator

3.19

setting mode (simulation mode)

use of the machine under numerical control, without machining power, to check/optimise the NC-programme and allowing manual interventions

3.20**shielding of EDM equipment**

mechanical barrier or enclosure of conductive material intended to attenuate the emission/penetration of a varying electromagnetic field into an assigned region

3.21**spark erosion; spark eroding; spark machining; EDM process**

removal of material in a dielectric fluid by electro discharges, which are separated in time and randomly distributed in space, between two electrically conductive electrodes (the tool electrode and the work piece electrode), and where the energy in the discharge is controlled

3.22**spark erosion-sinking**

removal of material by spark erosion to produce various shapes in the work piece e.g. concave, convex and prismatic holes

3.23**spark erosion-wire cutting**

removal of material by spark erosion with a wire electrode to produce prismatic shapes in the work piece

3.24**tool changer (for EDM equipment); electrode changing device**

mechanism integrated with the machine to supply a previously loaded electrode in exchange for another electrode. The electrode changing device is expected to enable an operator to load/unload electrodes from outside the work area.

3.25**work area (on EDM equipment)**

space within the envelope of the machine where the EDM process can take place

3.26**work piece changing device (for EDM equipment)**

mechanism integrated with the machine to supply a previously loaded work piece in exchange for another work piece. The work piece changing device is designed to enable an operator to load/unload work pieces from outside the work area.

3.27**work tank (for EDM equipment)**

unit surrounding the work area to contain the dielectric fluid for EDM processes

4 List of hazards

The list of hazards contained in Table 1 is the result of a risk assessment, carried out as described by EN 1050:1996 for all EDM equipment covered by the scope of this standard. The technical measures and information for use contained in clause 5 and 7 are based on the risk assessment and deal with the identified hazards by either eliminating them or reducing the effects of the risks they generate.

The significant hazards covered by this standard are listed in Table 1.

Particular attention is given to hazards dealing with:

- Electrical hazards (electrode voltage).
- Flammable dielectric fluid (level, temperature, fire detection).
- Hazardous substances (waste disposal, filters, used dielectric fluid, fume extraction, electrodes and sludges).
- Electromagnetic emissions (radiated and conducted).

Note The designer's attention is focused on hazards which can occur during the life of the machine to both operator and other persons who have access to the danger zone/s for conditions of intended use including reasonably foreseeable misuse of the machine (see EN 292-1:1991, 3.12) for both spark erosion with automatic mode and operations requiring intervention (e.g. setting, maintenance, repair). Although acoustic noise is not considered to be a significant hazard for EDM equipment, the manufacturer of the equipment is

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not absolved from reducing noise and making noise declaration. The designer is cautioned to verify whether the list of hazards in Table 1 is exhaustive and applicable and, if there are other hazardous situations, not listed in Table 1, which are related to the specific equipment in question.

Table 1 - List of significant hazards and major sources of these hazards associated with Electro Discharge Machines

*	Description	Hazardous situation action	Activity	Danger zone	Reference to Table 2
1	Mechanical hazards due to:				
1d	Mass and velocity (kinetic energy of elements in controlled or uncontrolled motion)	movements of machine elements	setting, machining and maintenance	at and near the machine	A3 - A5
1.1 + 1.2	Crushing and shearing	work piece clamping automatic work piece/electrode changing moving parts (e.g. axes, rolling elements)	loading/unloading, reorienting power operated, work piece/ electrode change manual operation/work piece/electrode change	between clamps and work piece envelope of work piece/electrode motion between work piece/electrode and machine parts	A1, A2, A3 A1, A2, A3 A1, A2, A3
1.4	Entanglement	manual or automatic work piece/electrode changing, spindle rotation and wire rollers	manual or power operated work piece/electrode changing and spindle rotation	between work piece/electrode and machine parts	A1, A2, A3
1.9	High pressure fluid injection or ejection	hydraulic/pneumatic systems ejection, leakage and flushing	setting, machining and maintenance	at and near the machine	A4

(continued)

Table 1 (continued)

*	Description	Hazardous situation action	Activity	Danger zone	Reference to Table 2
2	Electrical hazards due to:				
2.1	Contact of persons with live parts (direct contact)	contact with work piece/electrode, wire/wire-path and contact with unprotected circuits	process control, setting and maintenance	work piece, electrode, tooling fixture, generator and electrical enclosure	B1, B2
2.2	Contact of persons with parts which have become live under faulty conditions (indirect contact)	contact with parts of the machine which are not live during normal operation	maintenance and service of the machine	at and near the machine, insulation of electrical cables and equipment	B1, B3
7	Hazards generated by materials and substances (and their constituent elements) processed or used by the machinery				
7.1	Contact with or inhalation of harmful fluids, gases, mists, fumes, and dust	conditions near the machine caused by ejection of dielectric fluid, droplets or evaporation, mists, fumes, etc.	during the EDM process, setting, maintenance and disposal of the machine	at and near the machine	D1 - D5
7.2	Fire or explosion	fire hazard originated by flammable mist generation, long lasting arcing condition, loss of dielectric fluid, fault of electrical or hydraulic power supply, etc.	during the EDM process	near the machine and the work tank	D5 - D12
10	Unexpected start-up, unexpected overrun/overspeed (or any similar malfunction) from:				
10.2	Restoration of the energy supply after an interruption	malfunction of the machine itself and/or electrical/pneumatic equipment due to restoration of the energy supply	after energy restoration	at the machine	E3
10.3	External influences on electrical equipment	malfunction of the machine itself or electrical equipment due to electromagnetic disturbances	machine in operation, setting and maintenance	at and in the vicinity of the machine	C1
13	Failure of the power supply	malfunction resulting from power loss, powered clamping failures and machine elements moving under residual forces (e.g. inertia, gravity)	all activities at the machine	at all moving elements of the machine	E1, E2

(continued)

Table 1 (concluded)

*	Description	Hazardous situation action	Activity	Danger zone	Reference to Table 2
14	Failure of the control circuit	mechanical hazards associated with machine movements, electrical hazard and/or fire	during operation, setting, cleaning, maintenance and repair activities	at the machine	F1
Other hazards					
19	Slip, trip and fall of persons (related to machinery)	ejection or spillage of fluids and lubricants; trailing floor-mounted or loose connection cables	during and after machining and maintenance	large work tanks, slippery floor and high working positions; area surrounding the machine	G1
20	Hearing loss or other physiological disturbances	emission of hazardous noise from the EDM equipment or its auxiliary devices	during operation, setting, cleaning, maintenance and repair activities	at and in the vicinity of the machine or the auxiliary devices	H1
* This list is derived from EN 1050:1996, annex A					

5 Safety requirements and/or measures

5.1 General requirements

Machinery shall comply with the safety requirements and/or protective measures as indicated in Table 2 of this clause. In addition the equipment shall be designed according to the principles of EN 292 for hazards relevant, but not significant, which are not dealt with by this standard (e.g. sharp edges).

5.2 Operating modes

5.2.1 Operating mode selection

Based on 1.2.5 of EN 292-2:1991/A1:1995 and 9.2.3 of EN 60204-1:1997, the selection of the mode shall be either a key operated switch, or equally lockable means. Mode selection shall be permitted only from outside the work area and shall not initiate start-up. The indication of the selected operating mode shall be provided (e.g. the position of the selector, the provision of an indicating light or visual display indication). Mode changes shall ensure, that only one mode is active at any one time.

Mode selection shall be category 1 according to EN 954-1:1996.

5.2.2 Protecting measures relating to operating modes