

Safety of machinery — Electrical equipment of machines —

Part 1: Specification for general requirements

The European Standard EN 60204-1:1992 has the status of a
British Standard

UDC 621.3.005:621.38:621.9-83:614.825.001.25

NO COPYING WITHOUT BSI PERMISSION EXCEPT AS PERMITTED BY COPYRIGHT LAW



Document Sharing Hub

Cooperating organizations

The European Committee for Electrotechnical Standardization (CENELEC), under whose supervision this European Standard was prepared, comprises the national committees of the following countries:

Austria	Italy
Belgium	Luxembourg
Denmark	Netherlands
Finland	Norway
France	Portugal
Germany	Spain
Greece	Sweden
Iceland	Switzerland
Ireland	United Kingdom

This British Standard, having been prepared under the direction of the Power Electrical Engineering Standards Policy Committee, was published under the authority of the Standards Board and comes into effect on 15 March 1993

© BSI 10-1998

The following BSI references relate to the work on this standard:
Committee reference PEL/84
Draft for comment 90/25823 DC

ISBN 0 580 21551 2

Amendments issued since publication

Amd. No.	Date	Comments
8436	March 1995	Indicated by a sideline in the margin

Contents

	Page
Cooperating organizations	Inside front cover
National foreword	ii
Foreword of EN 60204-1	2
Text of EN 60204-1	5
National annex NA (informative) Original IEC text amended by CENELEC common modifications	62
National annex NB (informative) Committees responsible	65
National annex NC (informative) Cross-references	65

National foreword

This British Standard has been prepared under the direction of the Power Electrical Engineering Standards Policy Committee and is the English language version of EN 60204-1 *Safety of machinery — Electrical equipment of machines: Part 1: General requirements*, including Corrigendum: 1993, published by the European Committee for Electrotechnical Standardization (CENELEC). It was derived by that organization from IEC Publication 204-1 (1992) third edition the title of which has been modified in the European Standard. The new edition of EN 60204-1 differs from the previous edition in that the scope is not limited to industrial machines but includes those machines covered by the EEC Directives relating to the safety of machinery. This British Standard supersedes BS 2771-1:1986, identical to EN 60204-1:1985, which however remains applicable for use as a reference standard with BS EN 60204-3-1:1992.

The CENELEC common modifications have been implemented at the appropriate places in the text and are indicated by a side line in the margin. Parts of the original IEC text that have been modified by CENELEC have been quoted in national annex NA.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the EN title page, pages 2 to 66, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

English version

Safety of machinery — Electrical equipment of machines Part 1: General requirements

(IEC 204-1:1992, modified)

Sécurité des machines — Equipement
électrique des machines
Partie 1: Règles générales
(CEI 204-1:1992, modifiée)

Sicherheit von Maschinen — Elektrische
Ausrüstung von Maschinen
Teil 1: Allgemeine Anforderungen
(IEC 204-1:1992, modifiziert)

This European Standard was approved by CENELEC on 24 March 1992. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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

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

CENELEC members are the national electrotechnical committees of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CENELEC

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

Central Secretariat: rue de Stassart 35, B-1050 Brussels

Foreword

This Part of European Standard EN 60204 was developed by CENELEC Technical Committee 44X from IEC 204-1: Electrical equipment of industrial machines – *Part 1: General requirements, third edition*. The text of IEC 204-1, third edition was prepared by IEC Technical Committee 44 with the collaboration of CENELEC Technical Committee 44X taking into account the common work of CEN/TC 114 and CENELEC/TC 44X in preparing group safety standards (Type B in CEN), as defined in EN 414.

This Part of EN 60204 is the first part of a series of standards relating to the electrical equipment of machines, and specifies general requirements for the electrical equipment of an individual machine as well as a group of machines operating in a coordinated manner. It supersedes EN 60204-1:1985 which however remains applicable for use as a reference standard with EN 60204-3-1:1990.

This new edition of EN 60204-1 differs from the previous edition in that the scope is not limited to industrial machines but includes those machines covered by the EEC Directives relating to the safety of machinery.

This Part of EN 60204 has the status of an application standard (group safety standard, Type B1 in CEN) and is intended to be used by Technical Committees in CEN and CENELEC preparing product family and/or dedicated product standards (machine safety standards or Type C in CEN) which are presumed to comply with the Essential Safety Requirements in annex 1 of Council Directive 89/392/EEC on machines. This Part of EN 60204 also fulfils the requirements of the Low Voltage Directive 73/23/EEC. Electromagnetic compatibility has also been considered. Annexes A, B and C are informative.

Technical committees preparing Type C European Standards should use this standard by applying one of the three options described below:

Option 1 This Part of EN 60204 applies in full (no additional electrical equipment requirement needed).

Action: Refer directly to this Part of EN 60204.

Option 2 This Part of EN 60204 applies in full and there are additional electrical equipment requirements.

Actions:

- 1) Refer directly to this Part of EN 60204; and
- 2) Specify the additional requirements referring to the clause or subclause affected in this Part of EN 60204.

Option 3 This Part of EN 60204 applies in part because:

- a) certain requirements are adequately covered in another manner;
- b) certain requirements are outside the scope of this Part of EN 60204; and
- c) it is necessary to modify certain clauses but these modifications do not adversely affect the level of safety required for that machine.

Actions:

- 1) Refer directly to
 - those relevant clauses of this Part of EN 60204 that are to be complied with; and
 - those replaced by machine specific requirements or those otherwise adequately covered; and
- 2) Add those very specific requirements for the machine stating variations from this Part of EN 60204 for those clauses quoted as being relevant.

This Part of EN 60204 should be applied to machines for which no Type C European Standard exists to comply with the Essential Safety Requirements in annex 1 of Council Directive 89/392/EEC on machines.

The following dates are applicable:

- latest date of publication (dop) 1993-06-15 of an identical national standard
- latest date of withdrawal (dow) 1993-12-01 of conflicting national standards

NOTE EN 60204-1:1985 remains applicable for use with EN 60204-3-1:1990.

For products which have complied before 1993-12-01 either with EN 60204-1:1985 and its amendment A1:1988 or with a relevant national standard, as shown by the manufacturer or by a certification body, that previous standard may continue to apply for production until 1998-12-01.

Endorsement notice

The text of the International Standard IEC 204-1:1992 was approved by CENELEC as a European Standard with agreed common modifications as indicated by a vertical line in the left margin of the text.

Contents

	Page		Page
Foreword	2	8.5 Bonding to a common reference potential	28
Introduction	5	8.6 Electrical interference	28
1 Scope	8	9 Control circuits and control functions	29
2 Normative references	8	9.1 Control circuits	29
3 Definitions	13	9.2 Control functions	29
4 General requirements	16	9.3 Protective interlocks	31
4.1 General considerations	16	9.4 Control functions in case of failure	31
4.2 Selection of equipment	17	10 Operator interface and machine mounted control devices	32
4.3 Electrical supply	17	10.1 General	32
4.4 Physical environment and operating conditions	18	10.2 Push-buttons	33
4.5 Transportation and storage	19	10.3 Indicator lights and displays	35
4.6 Provisions for handling	19	10.4 Illuminated push-buttons	35
4.7 Installation and operation	19	10.5 Rotary control devices	35
5 Incoming supply conductor terminations and devices for disconnecting and switching off	19	10.6 Start devices	36
5.1 Incoming supply conductor terminations	19	10.7 Emergency stop devices	36
5.2 External protective conductor terminal	19	10.8 Displays	36
5.3 Supply disconnecting (isolating) device	20	11 Control interfaces	36
5.4 Devices for switching off for prevention of unexpected start-up	21	11.1 General	36
6 Protection against electric shock	21	11.2 Digital input/output interfaces	36
6.1 General	21	11.3 Drive interfaces with analogue inputs	37
6.2 Protection against direct contact	21	11.4 Peripherals	37
6.3 Protection against indirect contact	23	11.5 Communications	37
6.4 Protection by the use of PELV (Protective Extra Low Voltage)	23	12 Electronic equipment	37
7 Protection of equipment	23	12.1 General	37
7.1 General	23	12.2 Basic requirements	37
7.2 Overcurrent protection	24	12.3 Programmable equipment	37
7.3 Overload protection of motors	25	13 Controlgear: location, mounting and enclosures	38
7.4 Abnormal temperature protection	25	13.1 General requirements	38
7.5 Protection against supply interruption or voltage reduction and subsequent restoration	25	13.2 Location and mounting	38
7.6 Motor overspeed protection	26	13.3 Degrees of protection	39
8 Equipotential bonding	26	13.4 Enclosures, doors and openings	39
8.1 General	26	14 Conductors and cables	40
8.2 Protective bonding circuit	26	14.1 General requirements	40
8.3 Bonding to the protective bonding circuit for operational purposes	28	14.2 Conductors	40
8.4 Insulation failures	28	14.3 Insulation	40
		14.4 Current-carrying capacity in normal service	40
		14.5 Voltage drop	41
		14.6 Minimum cross-sectional area	41
		15 Wiring practices	42
		15.1 Connections and routing	42

	Page		Page
15.2 Identification of conductors	43	Annex A (informative) Examples of machines covered by this standard	53
15.3 Wiring inside enclosures	44	Annex B (informative) Inquiry form for the electrical equipment of machines	55
15.4 Wiring outside enclosures	44	Annex C (informative) Current-carrying capacity and overcurrent protection of conductors and cables in the electrical equipment of machines	58
15.5 Ducts, connection and junction boxes	45	Annex D Not used	
16 Electric motors and associated equipment	46	Index Not used	
16.1 General requirements	46	Figure 1 — Block diagram of a typical manufacturing system	6
16.2 Motor enclosures	46	Figure 2 — Block diagram of a typical machine and its associated equipment	7
16.3 Motor dimensions	47	Figure 3 — Example of equipotential bonding for electrical equipment of a machine	27
16.4 Motor mounting and compartments	47	Figure C.1 — Methods of conductor and cable installation	59
16.5 Motor nameplates	47	Table 1 — Minimum cross-sectional area of the external protective copper conductor	20
16.6 Criteria for selection	47	Table 2 — Colour-coding for push-button actuators and their meanings	34
17 Accessories and lighting	47	Table 3 — Colours for indicator lights and their meanings with respect to the condition of the machine	35
17.1 Accessories	47	Table 4 — Maximum allowable conductor temperatures under normal and short-circuit conditions	40
17.2 Local lighting of the machine and equipment	48	Table 5 — Current-carrying capacity (I_z) of PVC insulated copper conductors or cables under steady state conditions in an ambient air temperature of + 40 °C for different methods of installation	41
18 Warning signs and item designations	48	Table 6 — Minimum cross-sectional area of copper conductors	42
18.1 Nameplates, markings and identification plates	48	Table 7 — Verification of the continuity of the protective bonding circuit	51
18.2 Warning signs	48	Table C.1 — Correction factors	58
18.3 Functional identification	49	Table C.2 — Derating factors for grouping	59
18.4 Marking of control equipment	49	Table C.3 — Derating factors for multicore cables up to 10 mm ²	60
18.5 Item designations	49	Table C.4 — Correction factors for insulation materials	60
19 Technical documentation	49	Table C.5 — Classification of conductors	60
19.1 General	49		
19.2 Information to be provided	49		
19.3 Requirements applicable to all documentation	50		
19.4 Basic information	50		
19.5 Installation diagram	50		
19.6 System (block) diagram	50		
19.7 Circuit diagrams	50		
19.8 Operating manual	51		
19.9 Maintenance manual	51		
19.10 Parts lists	51		
20 Testing	51		
20.1 General	51		
20.2 Continuity of the protective bonding circuit	51		
20.3 Insulation resistance tests	51		
20.4 Voltage tests	52		
20.5 Protection against residual voltages	52		
20.6 Electromagnetic compatibility tests	52		
20.7 Functional tests	52		
20.8 Retesting	52		

Introduction

This Part of European Standard EN 60204 provides requirements and recommendations relating to the electrical equipment of machines so as to promote:

- safety of persons and property;
- consistency of control response; and
- ease of maintenance.

High performance should not be obtained at the expense of the essential factors mentioned above.

An example of a possible application of these requirements is a group of machines used in the production of discrete parts where a failure in such mass production machines or manufacturing systems or cells can have serious economic consequences.

Figure 1 and Figure 2 have been provided as an aid to the understanding of the interrelationship of the various elements of a machine and its associated equipment. Figure 1 is an overall block diagram of a typical manufacturing system (a group of machines working together in a coordinated manner) and Figure 2 is a block diagram of a typical machine and associated equipment showing the various elements of the electrical equipment addressed in this Part of EN 60204. Numbers in parentheses () refer to clauses and subclauses in this Part of EN 60204. It is understood in Figure 1 and Figure 2 that all of the elements taken together including the safeguards, tooling/fixtures, software, and the documentation constitute the machine and that one or more machines working together with usually at least one level of supervisory control constitute a manufacturing system or cell.

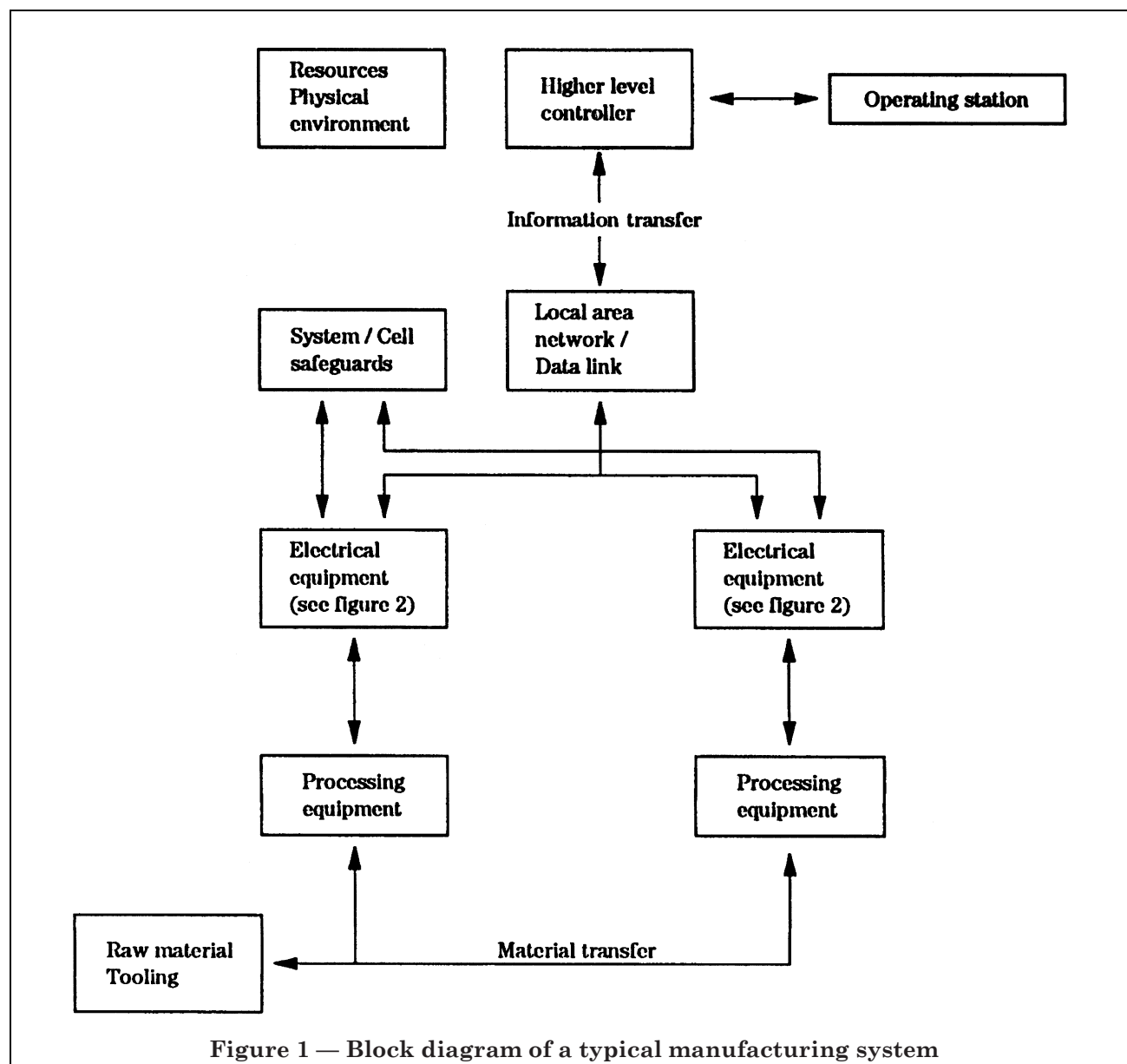


Figure 1 — Block diagram of a typical manufacturing system

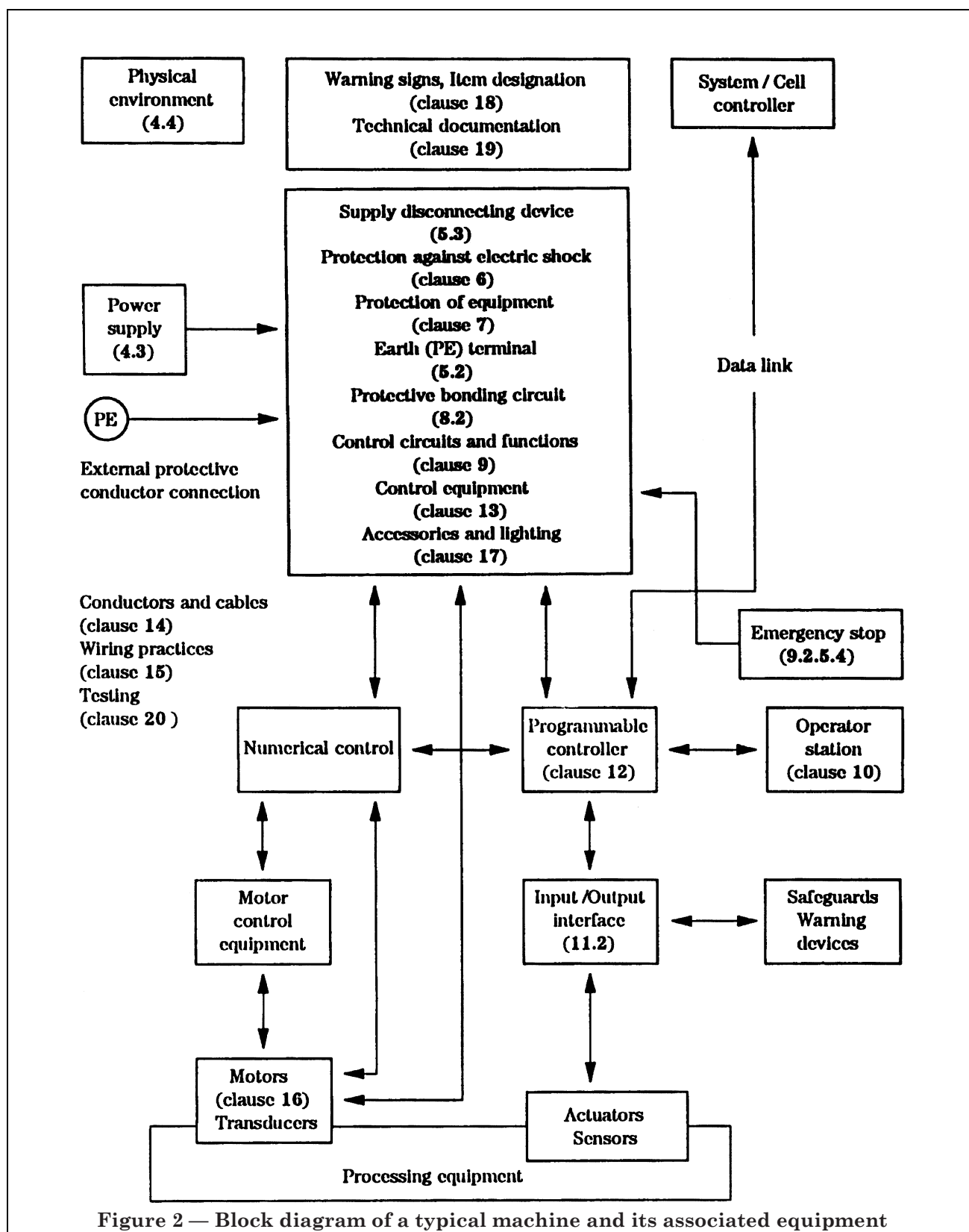


Figure 2 — Block diagram of a typical machine and its associated equipment

1 Scope

This Part of EN 60204 applies to the application of electrical and electronic equipment and systems to machines including a group of machines working together in a coordinated manner but excluding higher level systems aspects (i.e. communications between systems).

NOTE 1 In this Part, the term *electrical* includes both electrical and electronic matters (e.g. *electrical equipment* means both the electrical and electronic equipment).

NOTE 2 Not used.

NOTE 3 In the context of this Part, the term *person* refers to any individual; *personnel* are those persons who are assigned and instructed by the user or his agent(s) in the use and care of the integrated manufacturing system in question.

The equipment covered by this Part commences at the point of connection of the supply to the electrical equipment of the machine (see 5.1). This Part is applicable to equipment or parts of equipment which operate with nominal supply voltages not exceeding 1000 V a.c. or 1500 V d.c. between lines and nominal frequencies not exceeding 200 Hz. For higher voltages or frequencies, special requirements may be needed.

NOTE 4 These special requirements are under consideration for a further Part of EN 60204.

This Part is a basic standard and is not intended to limit or inhibit technological advancement. It does not cover all the requirements (e.g. guarding, interlocking, or control) which are needed or required by other standards or regulations in order to safeguard persons from hazards other than electrical. Each type of machine has unique requirements which shall be accommodated to provide adequate safety.

This Part specifically includes, but is not limited to, the electrical equipment of industrial machines as defined in 3.28 (annex A lists examples of machines whose electrical equipment may be covered by this standard).

Also applicable is electrical equipment of machines for assembling, material handling (e.g. conveyors) and inspection, where associated with machines referred to above.

Additional and special requirements can apply to the electrical equipment of machines which:

- are used in open air (i.e. outside buildings or other protective structures);
- use, process or produce explosive material (e.g. paint or sawdust);
- are used in explosive and/or flammable atmospheres;
- give rise to special risks when producing certain materials;
- are used in mines;
- are sewing machines, units and systems (see EN 60204-3-1).

Excluded from this Part are:

- power circuits where electrical energy is directly used as a working tool.

2 Normative references

This Part of EN 60204 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 Part of EN 60204 only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

European Standards

EN 292-1:1991	<i>Safety of machinery – Basic concepts – General principles for design — Part 1: Basic terminology, methodology</i>
EN 292-2:1991	<i>Safety of machinery – Basic concepts – General principles for design — Part 2: Technical principles and specifications</i>
EN 414:1992	<i>Safety of machinery: Rules for the drafting and presentation of safety standards</i>
EN 418:1992	<i>Safety of machinery: Emergency stop equipment: Functional aspects – Principles for design</i>

International publications with references to the corresponding European publications.

When the international publication has been modified by CENELEC common modifications (mod = modified by CENELEC common modifications) the relevant EN/HD applies.

IEC Publications	EN/HD
34-1:1983 + A1:1987 + A2:1989 (mod) Rotating electrical machines Part 1: Rating and performance	HD 53.1 S2:1985 + A1:1986 + A2:1989 + A3:1992
34-5:1981 (mod) Rotating electrical machines Part 5: Classification of degrees of protection provided by enclosures for rotating electrical machines (IP code)	EN 60034-5:1986
34-11:1978 Rotating electrical machines Part 11: Built-in thermal protection Chapter 1: Rules for protection of rotating electrical machines	—
50 (191):1990 International Electrotechnical Vocabulary (IEV) Chapter 191: Dependability and quality of service	—
50 (441):1984 International Electrotechnical Vocabulary (IEV) Chapter 441: Switchgear, controlgear and fuses	—
50 (826):1982 International Electrotechnical Vocabulary (IEV) Chapter 826: Electrical installations of buildings	HD 384.2 S1:1986
72-1:1991 Dimensions and output series for rotating electrical machines. Part 1: Frame numbers 56 to 400 and flange numbers 55 to 1080	—
72-2:1990 Dimensions and output series for rotating electrical machines. Part 2: Frame numbers 355 to 1000 and flange numbers 1180 to 2360	—
73:1984 Colours of indicator lights and push-buttons	HD 354 S2:1987
76-5:1976 + A1:1979 (mod) Power transformers Part 5: Ability to withstand short circuit	HD 398.5 S1:1983 + A1:1988
146:1973 Semiconductor convertors	—
204-3-1:1988 Electrical equipment of industrial machines Part 3: Particular requirements for sewing machines, units and systems	EN 60204-3-1:1990

309-1:1988 (mod) Plugs, socket-outlets and couplers for industrial purposes Part 1: General requirements	EN 60309-1:1992
332-1:1979 Tests on electric cables under fire conditions Part 1: Test on a single vertical insulated wire or cable	HD 405.1 S1:1983
364-4-41:1982 Electrical installations of buildings Part 4: Protection for safety Chapter 41: Protection against electric shock	—
364-4-46:1981 (mod) Electrical installations of buildings Part 4: Protection for safety Chapter 46: Isolation and switching	HD 384.4.46 S1:1987
364-4-47:1981 (mod) Electrical installations of buildings Part 4: Protection for safety Chapter 47: Application of protective measures for safety Section 470: General Section 471: Measures of protection against electric shock	HD 384.4.47 S1:1988
364-4-473:1977 (mod) Electrical installations of buildings Part 4: Protection for safety Chapter 47: Application of protective measures for safety Section 473: Measures of protection against overcurrent	HD 384.4.473 S1:1980
364-5-54:1980 (mod) Electrical installations of buildings Part 5: Selection and erection of electrical equipment Chapter 54: Earthing arrangements and protective conductors	HD 384.5.54 S1:1988
417:1973 + suppl up to J:1990 Graphical symbols for use on equipment. Index, survey and compilation of the single sheets	HD 243 S9:1991
439-1:1985 (mod) Low-voltage switchgear and controlgear assemblies Part 1: Requirements for type-tested and partially type-tested assemblies	EN 60439-1:1990
445:1988 Identification of equipment terminals and of terminations of certain designated conductors, including general rules of an alphanumeric system	EN 60445:1990
446:1989 Identification of conductors by colours or numerals	—

447:1974 Standard directions of movement for actuators which control the operation of electrical apparatus	HD 331 S1:1977
529:1989 Degrees of protection provided by enclosures (IP code)	EN 60529:1991
536:1976 Classification of electrical and electronic equipment with regard to protection against electric shock	HD 366 S1:1977
742:1983 (mod) Isolating transformers and safety isolating transformers – Requirements	EN 60742:1989
750:1983 Item designation in electrotechnology	—
757:1983 Code for designation of colours	HD 457 S1:1985
801-1:1984 Electromagnetic compatibility for industrial-process measurement and control equipment Part 1: General introduction	HD 481.1 S1:1987
801-2:1984 Electromagnetic compatibility for industrial-process measurement and control equipment Part 2: Electrostatic discharge requirements	HD 481.2 S1:1987
801-3:1984 Electromagnetic compatibility for industrial-process measurement and control equipment Part 3: Radiated electromagnetic field requirements	HD 481.3 S1:1987
801-4:1988 Electromagnetic compatibility for industrial-process measurement and control equipment Part 4: Electrical fast transient/burst requirements	—
947-2:1989 Low-voltage switchgear and controlgear Part 2: Circuit-breakers	EN 60947-2:1991
947-3:1990 (mod) Low-voltage switchgear and controlgear Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units	EN 60947-3:1992
947-5-1:1990 Low-voltage switchgear and controlgear Part 5: Control circuit devices and switching elements Section one: Electromechanical control circuit devices	EN 60947-5-1:1991

947-7-1:1989 Low-voltage switchgear and controlgear Part 7: Ancillary equipment Section one: Terminal Blocks for copper conductors	EN 60947-7-1:1991
1082-1:1991 Preparation of documents used in electrotechnology Part 1: General requirements	—
1131-1:1992 Programmable controllers Part 1: General information	—
1131-2:1992 Programmable controllers Part 2: Equipment requirements and tests	—
CISPR 11:1990 (mod) Limits and methods of measurement of electromagnetic disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment	EN 55011:1991
CISPR 14:1985 (mod) Limits and methods of measurement of radio interference characteristics of household electrical appliances, portable tools and similar electrical apparatus	EN 55014:1987 + A2:1990
CISPR 22:1985 (mod) Limits and methods of measurement of radio interference characteristics of information technology equipment	EN 55022:1987
IEC Guide 106:1989 Guide for specifying environmental conditions for equipment performance rating	—
ISO Publications	
3864:1984 Safety colours and safety signs	—
7000:1989 Graphical symbols for use on equipment Index and synopsis	—

3 Definitions

For the purposes of this Part of EN 60204, the following definitions apply:

3.1

actuator

the part of the actuating system to which an external actuating force is applied

NOTE 1 The actuator may take the form of a handle, knob, push-button, roller, plunger, etc. (IEV 441-15-22)

NOTE 2 There are some actuating means that do not require an external actuating force, but only an action.

NOTE 3 See also 3.36: machine actuator.

3.2

ambient temperature

the temperature of the air or other medium where the equipment is to be used (IEV 826-01-04)

3.3

barrier

a part providing protection against direct contact from any usual direction of access (IEV 826-03-13)

3.4

cable tray

a cable support consisting of a continuous base with raised edges and no covering

3.5

cable trunking system

a system of closed enclosures comprising a base with a removable cover intended for the complete surrounding of insulated cables, cords, and/or for the accommodation of other electrical equipment

3.6

component

constituent part of the electrical equipment, usually specified by function, but used in various applications

3.7

concurrent

acting in conjunction; used to describe a situation wherein two or more controls exist in an operated condition at the same time (but not necessarily synchronously)

3.8

conduit

a part of a closed wiring system of circular cross-section for insulated conductors or cables in electrical installations allowing them to be drawn in and replaced

3.9

control circuit (of a machine)

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

3.10

control device

device connected into the control circuit and used for controlling the operation of the machine (e.g. position sensors, manual control switches, relays, magnetically operated valves)

3.11

controlgear

a general term covering switching devices and their combination with associated control, measuring, protective and regulating equipment, also assemblies of such devices and equipment with associated interconnections, accessories, enclosures and supporting structures, intended in principle for the control of electrical energy consuming equipment (IEV 441-11-03)

3.12

controlled stop

the stopping of machine motion by reducing the command signal to 0 once the stop signal has been recognized by the control but retaining power to the machine actuators during the stopping process

3.13

device

a unit of the electrical system which is intended to carry but not utilize electric energy

3.14

digital

operated by the use of discrete signals to represent data in the form of numbers or other characters

3.15

direct contact

contact of persons or livestock with live parts (IEV 826-03-05)

3.16

duct

an enclosed channel of either metal or insulating material designed expressly for holding and protecting electrical conductors, cables, and busbars

NOTE The term includes rigid metal conduit, rigid non-metallic conduit, intermediate metal conduit, liquidtight flexible conduit, flexible metallic tubing, flexible metal conduit, electrical non-metallic tubing, underfloor ducts, cellular concrete floor ducts, cellular metal floor ducts, surface ducts and cable trunking systems.

3.17

not used

3.18

electronic equipment

that part of the electrical equipment containing circuitry mainly based on electronic devices and components

3.19 enclosure

a part providing protection of equipment against certain external influences and, in any direction, protection against direct contact (IEV 826-03-12)

NOTE The definition taken from the existing IEV needs the following explanations under the scope of this standard:

- 1) enclosures provide protection of persons or livestock against access to hazardous parts;
- 2) barriers, shapes of openings, or any other means – whether attached to the enclosure or formed by the enclosed equipment – suitable to prevent or limit the penetration of the specified test probes are considered as part of the enclosure, except where they can be removed without the use of a key or tool (EN 60529, 3.1).

an enclosure may be:

- a cabinet or box, either mounted on the machine or separate from the machine;
- a compartment consisting of an enclosed space within the machine structure;
- an enclosed room.

3.20 equipment

a general term including material, fittings, devices, appliances, fixtures, apparatus, and the like used as part of, or in connection with, an electrical installation

3.21 equipotential bonding

electrical connection putting various exposed conductive parts and extraneous conductive parts at a substantially equal potential (IEV 826-04-09)

3.22 exposed conductive part

a conductive part of electrical equipment, which can be touched and which is not normally live, but which may become live under fault conditions (IEV 826-03-02)

3.23 failure

the termination of the ability of an item to perform a required function

NOTE 1 After failure the item has a fault.

NOTE 2 “Failure” is an event, as distinguished from “fault”, which is a state.

NOTE 3 This concept as defined does not apply to items consisting of software only.

(IEV 191-04-01)

3.24 fault

the state of an item characterized by inability to perform a required function, excluding the inability during preventive maintenance or other planned actions, or due to lack of external resources

NOTE A fault is often the result of a failure of the item itself, but may exist without prior failure.

(IEV 191-05-01)

3.25 guard

part of a machine specifically used to provide protection by means of a physical barrier. Depending on its construction, a guard may be called casing, cover, screen, door, enclosing guard, etc. (See 3.22 of EN 292-1)

3.26 hazard

a source of possible injury or damage to health. (See 3.5 of EN 292-1)

3.27 indirect contact

contact of persons or livestock with exposed conductive parts which have become live under fault conditions. (IEV 826-03-06)

3.28 industrial machine

a power-driven machine used to shape or form material by cutting, impact, pressure, electrical, thermal or optical techniques, lamination, or a combination of these processes, or associated machines or equipment used in conjunction with these machines to transfer raw material, work in progress, or tooling (including fixtures); assemble/disassemble; spray or coat; inspect or test; or package. (See annex A for examples of industrial machines.) The associated electrical equipment including the logic controller(s) and associated software or logic together with the machine actuators and sensors are considered as part of the machine. (See 3.61 machinery)

3.29 input

- 1) The terminals where current, voltage, power, or driving force may be applied to a circuit or device.
- 2) The state or sequence of states occurring on a specific input channel.
- 3) The device or collective set of devices used to bring data into another device.

3.30 instructed person

an individual adequately advised or supervised by a skilled person to enable that individual to avoid hazards which electricity can create (e.g. operating and maintenance staff)

3.31 interlock (for safeguarding)

an arrangement that interconnects the guard(s) or device(s) with the control system and/or all or part of the electrical energy distributed to the machine

3.32 interlocking device

a device which makes the operation of a switching device dependent upon the position or operation of one or more other pieces of equipment (IEV 441-16-49)

3.33 item designation

a distinctive code, which serves to identify an item in a diagram, list, chart, and on the equipment. (See IEC 750, 2.9)

3.34 limiting device

a device which prevents a machine or machine elements from exceeding a designed limit (e.g. space limit, pressure limit)

3.35 live part

a conductor or conductive part intended to be energized in normal use, including a neutral conductor, but, by convention, not a PEN conductor

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

(IEV 826-03-01)

3.36 machine actuator

a power mechanism used to effect motion of the machine

3.37 marking

signs or inscriptions for the identification of the type of a component or device attached by the manufacturer of the component or device

3.38 neutral conductor (symbol N)

a conductor connected to the neutral point of a system and capable of contributing to the transmission of electrical energy (IEV 826-01-03)

3.39 obstacle

a part preventing unintentional direct contact, but not preventing direct contact by deliberate action (IEV 826-03-14)

3.40 output

1) The terminals where current, voltage, power or driving force may be delivered by a circuit or device.

2) The state or sequence of states occurring on a specific output channel.

3) The device or collective set of devices used for taking data out of another device.

3.41 overcurrent

any current exceeding the rated value. For conductors, the rated value is the current-carrying capacity (IEV 826-05-06)

3.42 overload (of a circuit)

the time/current relationship in a circuit which is in excess of the rated full load of the circuit when the circuit is not under a fault condition

NOTE *Overload* should not be used as a synonym for *overcurrent*.

3.43 positive opening operation (of a contact element)

the achievement of contact separation as a direct result of a specified movement of the switch actuator through non-resilient members (e.g. not dependent upon springs) (IEC 947-5-1, Chapter 3, 2.2)

3.44 power circuit

a circuit used for supplying power from the supply network to units of equipment used for productive operation, and to transformers supplying control circuits

3.45 protective bonding circuit

the whole of the protective conductors and conductive parts participating in protection against the consequences of earth faults

3.46 protective conductor

a conductor required by some measures for protection against electric shock for electrically connecting any of the following parts:

- exposed conductive parts;
- extraneous conductive parts;
- main earthing terminal.

(in accordance with IEV 826-04-05)

**3.47
redundancy**

the application of more than one device or system, or part of a device or a system, with the objective of ensuring that in the event of one failing to perform its function another is available to perform that function

**3.48
risk**

a combination of the probability and the degree of the possible injury or damage to health in a hazardous situation. (See 3.7 of EN 292-1)

**3.49
safe working procedure**

a method of working that reduces risk

**3.50
safeguard**

a guard or protective device used in a safety function to protect persons from a present or impending hazard

**3.51
safeguarding**

safety measures consisting of the use of specific technical means called safeguards (guards, safety devices) to protect persons from the hazards which cannot reasonably be removed or sufficiently limited by design. (See 3.19 of EN 292-1)

**3.52
safety measure (safety function)**

a means that eliminates or reduces a hazard

**3.53
servicing level**

level on which persons normally stand when operating or maintaining the electrical equipment

**3.54
short-circuit current**

an overcurrent resulting from a short circuit due to a fault or an incorrect connection in an electric circuit (IEV 441-11-07)

**3.55
skilled person**

an individual with technical knowledge or sufficient experience to enable that individual to avoid hazards which electricity can create

**3.56
supplier**

an entity (e.g. manufacturer, contractor, installer, integrator) that provides equipment or services associated with the machine

NOTE The user may also act in the capacity of a supplier to himself.

**3.57
switching device**

a device designed to make or break the current in one or more electric circuits (IEV 441-14-01)

**3.58
terminal**

a conductive part of a device provided for electrical connection to external circuits

**3.59
uncontrolled stop**

the stopping of machine motion by removing power to the machine actuators, all brakes or other mechanical stopping devices being activated

**3.60
user**

an entity that utilizes the machine and its associated electrical equipment

**3.61
machinery (machine)**

an assembly of linked parts or components, at least one of which moves, with the appropriate machine actuators, control and power circuits, etc., joined together for a specific application, in particular for the processing, treatment, moving or packaging of a material

the term machinery also covers an assembly of machines which, in order to achieve one and the same end, are arranged and controlled so that they function as an integral whole. (See 3.1 of EN 292-1)

machinery also means interchangeable equipment modifying the function of a machine, which is placed on the market for the purpose of being assembled with a machine or a series of different machines, or with a tractor by the operator himself insofar as this equipment is not a spare part or tool

4 General requirements**4.1 General considerations**

This Part of EN 60204 is intended to apply to electrical equipment used with a wide variety of machines and a group of machines working together in a coordinated manner.

The risks associated with the hazards relevant to the electrical equipment shall be assessed as part of the overall requirements for risk assessment of the machine. This will determine the acceptable level of risk and the necessary protective measures for persons who can be exposed to these hazards while still maintaining an acceptable level of performance of the machine and its equipment. (A European Standard for Risk Assessment is under consideration by CEN/TC 114).

Hazards can include but are not limited to the following:

- failures or faults in the electrical equipment resulting in the possibility of electrical shock or electrical fire;
- failures or faults in control circuits (or components and devices associated with these circuits) resulting in malfunctioning of the machine;
- disturbances or disruptions in external power sources as well as failures or faults in the power circuits resulting in the malfunctioning of the machine;
- electrical interferences (e.g. electromagnetic, electrostatic, radio interference) either from outside the electrical equipment or internally generated;
- stored energy (either electrical or mechanical);
- audible noise at levels that cause health problems to persons.

Safety measures are a combination of the measures incorporated at the design stage and those measures required to be implemented by the user.

Design and development shall be the first consideration in the reduction of risks. Where this is not possible, safeguarding shall be considered.

NOTE Clause 4 of EN 292-2 deals with **safeguarding**.

The use of the inquiry form as shown in annex B of this Part of EN 60204 is intended to facilitate an appropriate agreement between the user and the supplier(s) on basic conditions and additional user requirements related to the electrical equipment. These additional requirements are to:

- provide additional safety features which are dependent on the type of machine (or group of machines) and the application;
- facilitate maintenance and repair; and
- advance the reliability and ease of operation.

4.2 Selection of equipment

Electrical components and devices shall be suitable for their intended use e.g. industrial (heavy, light), commercial, leisure, domestic, and shall comply with the relevant European Standards where such exist. In the absence of European Standards, compliance shall be to available International Standards.

4.3 Electrical supply

The electrical equipment shall be designed to operate correctly under full load as well as no load with the conditions of the nominal supply as specified below unless otherwise specified by the user (see annex B).

4.3.1 a.c. supplies

Voltage	Steady state voltage 0,9 ... 1,1 of nominal voltage.
Frequency	0,99 ... 1,01 of nominal frequency continuously, 0,98 ... 1,02 short-time. NOTE The short time value may be specified by the user (see annex B).
Harmonics	Harmonic distortion not to exceed 10 % of the total r.m.s. voltage between the live conductors for the sum of the 2nd through 5th harmonic. An additional 2 % max. of the total r.m.s. voltage between the live conductors for the sum of the 6th through 30th harmonic is permissible.
Voltage unbalance in 3-phase supplies	Neither the voltage of the negative sequence component nor the voltage of the zero sequence component shall exceed 2 % of the positive sequence component.
Voltage impulses	Not to exceed 1,5 ms in duration with a rise/fall time between 500 ns and 500 μ s and a peak value not more than 200 % of the rated r.m.s. supply voltage.
Voltage interruption	Supply interrupted or at zero voltage for not more than 3 ms at any random time in the supply cycle. There shall be more than 1 s between successive interruptions.
Voltage dips	Voltage dips shall not exceed 20 % of the peak voltage of the supply for more than one cycle. There shall be more than 1 s between successive dips.

4.3.2 d.c. supplies

From batteries

Voltage	0,85 ... 1,15 of nominal voltage 0,7 ... 1,2 of nominal voltage in the case of battery-operated vehicles.
---------	--

Voltage interruption	note exceeding 5 ms.
----------------------	----------------------

From converting equipment

Voltage	0,9 ... 1,1 of nominal voltage.
---------	---------------------------------

Voltage interruption	not exceeding 20 ms. There shall be more than 1 s between successive interruptions. (See Note.)
----------------------	---

Ripple (peak-to-peak) does not exceed 0,05 of nominal voltage. (See Note.)

NOTE This is a variation to IEC Guide 106 to ensure proper operation of electronic equipment.

4.4 Physical environment and operating conditions

The electrical equipment shall be suitable for use in the physical environment and operating conditions as specified below.

When the physical environment and/or operating conditions are outside those specified below, an agreement may be needed between the supplier and the user (see annex B).

4.4.1 Electromagnetic compatibility

The electrical interferences generated by the equipment itself shall not exceed levels specified in the relevant equipment standards and other documents dealing with electromagnetic compatibility (EMC) levels. The levels allowed shall be determined for the specific application. Where electronic equipment is used, it shall be designed to withstand at least the tests as specified by IEC 801 level 3. For permissible limits and methods of measurement of radio interference characteristics see EN 55011, EN 55014 and EN 55022.

Generated interference signals can be kept to a minimum by:

- suppression at the source by using capacitors, inductors, diodes, Zener diodes, varistors or active devices, or a combination of these; or
- screening of the equipment in a bonded electrically conductive enclosure to provide segregation from other equipment.

Undesirable effects of electrostatic discharge, radiated electromagnetic energy and mains borne interference shall be avoided (e.g. use of appropriate filters and time delays, choice of certain power levels, suitable wiring types and practices).

The effects of interference on equipment can be reduced by:

— **Reference potential circuit or common connections:** each common connection is treated as a single circuit and connected to one of several central reference points which are wired to earth by insulated conductors of large cross-sectional area (e.g. a minimum of 6 mm² of type class 6 (see Table C.5));

— **Frame connections:** in each piece of equipment all frame connections are to be taken to a common point and large section braided conductors used between slides and enclosures; the connections to the frame shall be as short as possible;

— **Transmission of signals:** using electrostatic screens, electromagnetic shields, twisted conductors and orientation (i.e. crossing cable runs at as near to 90 degrees as is practicable) as necessary to ensure that low level signal wiring is not affected by interference from control or power cables, or running the connections parallel to the ground plane as necessary; and

— **Separation of equipment:** separating and/or shielding sensitive equipment (e.g. units working with pulses and/or at low signal levels) from switching equipment (e.g. electromagnetic relays, thyristors); separating low level signal wiring from control and power cables.

NOTE see 20.6 on electromagnetic compatibility tests.

4.4.2 Ambient air temperature

Enclosed electrical equipment shall be capable of operating correctly in an ambient air temperature between +5 °C and +40 °C and the average ambient air temperature over a period of 24 h shall not exceed +35 °C.

Electrical equipment in free air shall be capable of operating correctly in an ambient air temperature of +5 °C to +55 °C and the average ambient air temperature over a period of 24 h shall not exceed +50 °C.

4.4.3 Humidity

The electrical equipment shall be capable of operating correctly within a relative humidity range of 30 % to 95 % (non-condensing).

Harmful effects of occasional condensation shall be avoided by proper design of the equipment or, where necessary, by proper additional measures (e.g. built-in heaters, air conditioners, drain holes).