

Australian/New Zealand Standard™

**Safety of machinery — Electrical
equipment of machines**

**Part 1204: General requirements (IEC
60204-1:2016 (ED. 6.0) MOD)**



AS/NZS 4024.1204:2019

This Joint Australian/New Zealand Standard™ was prepared by Joint Technical Committee SF-041, Safety of Machinery. It was approved on behalf of the Council of Standards Australia on 11 June 2019 and by the New Zealand Standards Approval Board on 3 July 2019.

This Standard was published on 31 July 2019.

The following are represented on Committee SF-041:

- Austmine
- Australian Industry Group
- Australian Institute for Health and Safety
- Australian Manufacturing Technology Institute
- Australian Manufacturing Workers' Union
- Australian Packaging and Processing Machinery Association
- Engineers Australia
- Human Factors and Ergonomics Society of Australia
- New Zealand Safety Council
- NSCA Foundation
- NSW Department of Planning and Environment
- Safety Institute of Australia
- SafeWork NSW
- SafeWork SA
- Swinburne University of Technology
- University of Melbourne
- Winery Engineering Association (Australia)
- Workplace Health and Safety Queensland
- WorkSafe New Zealand
- WorkSafe Victoria

This Standard was issued in draft form for comment as DR AS 4024.1204:2019.

Keeping Standards up-to-date

Ensure you have the latest versions of our publications and keep up-to-date about Amendments, Rulings, Withdrawals, and new projects by visiting:

www.standards.org.au

www.standards.govt.nz

ISBN 978 1 76072 538 9

Australian/New Zealand Standard™

**Safety of machinery — Electrical
equipment of machines**

**Part 1204: General requirements (IEC
60204-1:2016 (ED. 6.0) MOD)**

Originated as AS 1543—1985.
Revised and redesignated AS 60204.1—2005.
Jointly revised and redesignated as AS/NZS 4024.1204:2019.

COPYRIGHT

© IEC 2019 — All rights reserved
© Standards Australia Limited/the Crown in right of New Zealand, administered by the New Zealand Standards Executive 2019

All rights are reserved. No part of this work may be reproduced or copied in any form or by any means, electronic or mechanical, including photocopying, without the written permission of the publisher, unless otherwise permitted under the Copyright Act 1968 (Cth) or the Copyright Act 1994 (New Zealand).

Preface

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee SF-041, Safety of Machinery, to supersede AS 60204.1—2005, *Safety of machinery — Electrical equipment of machines, Part 1: General requirements (IEC 60204-1, Ed. 5 (FDIS) MOD)*.

After consultation with stakeholders in both countries, Standards Australia and Standards New Zealand decided to adopt this Standard as an Australian/New Zealand Standard.

The objective of this Standard is to provide requirements and recommendations relating to the safety of electrical, electronic and programmable electronic equipment and systems to machines not portable by hand while working, including a group of machines working together in a coordinated manner. The equipment covered by this part of AS/NZS 4024 commences at the point of connection of the supply to the electrical equipment of the machine.

This part of AS/NZS 4024 does not cover all the requirements (for example, guarding, interlocking and control) that are needed or required by other parts of AS/NZS 4024 and regulations in order to protect persons from hazards other than electrical hazards. Each type of machine has unique requirements to be accommodated to provide adequate safety.

This Standard is an adoption with national modifications, and has been reproduced from, IEC 60204-1:2016, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements*. The modifications are additional requirements and are set out in Appendix ZZ, which has been added at the end of the source text.

Appendix ZZ lists the variations to IEC 60204-1:2016 for the application of this Standard in Australia and New Zealand.

As this document has been reproduced from an International Standard, the following applies:

- (a) In the source text “this part of IEC 60204” should read “this Australian/New Zealand Standard”;
- (b) A full point substitutes for a comma when referring to a decimal marker.

Australian or Australian/New Zealand Standards that are identical adoptions of international normative references may be used interchangeably. Refer to the online catalogue for information on specific.

The terms “normative” and “informative” are used in Standards to define the application of the appendices or annexes to which they apply. A “normative” appendix or annex is an integral part of a Standard, whereas an “informative” appendix or annex is only for information and guidance.

NOTES

CONTENTS

FOREWORD.....	10
INTRODUCTION.....	13
1 Scope.....	15
2 Normative references.....	16
3 Terms, definitions and abbreviated terms	17
3.1 Terms and definitions	17
3.2 Abbreviated terms	26
4 General requirements	26
4.1 General.....	26
4.2 Selection of equipment.....	27
4.2.1 General	27
4.2.2 Switchgear.....	27
4.3 Electrical supply.....	28
4.3.1 General	28
4.3.2 AC supplies	28
4.3.3 DC supplies	28
4.3.4 Special supply systems	28
4.4 Physical environment and operating conditions	28
4.4.1 General	28
4.4.2 Electromagnetic compatibility (EMC)	29
4.4.3 Ambient air temperature	29
4.4.4 Humidity	29
4.4.5 Altitude	29
4.4.6 Contaminants.....	29
4.4.7 Ionizing and non-ionizing radiation	30
4.4.8 Vibration, shock, and bump	30
4.5 Transportation and storage.....	30
4.6 Provisions for handling.....	30
5 Incoming supply conductor terminations and devices for disconnecting and switching off	30
5.1 Incoming supply conductor terminations	30
5.2 Terminal for connection of the external protective conductor	31
5.3 Supply disconnecting (isolating) device.....	31
5.3.1 General	31
5.3.2 Type	31
5.3.3 Requirements	32
5.3.4 Operating means of the supply disconnecting device	32
5.3.5 Excepted circuits.....	33
5.4 Devices for removal of power for prevention of unexpected start-up	34
5.5 Devices for isolating electrical equipment	34
5.6 Protection against unauthorized, inadvertent and/or mistaken connection.....	35
6 Protection against electric shock.....	35
6.1 General.....	35
6.2 Basic protection	35
6.2.1 General	35
6.2.2 Protection by enclosures	36

6.2.3	Protection by insulation of live parts	37
6.2.4	Protection against residual voltages	37
6.2.5	Protection by barriers	37
6.2.6	Protection by placing out of reach or protection by obstacles	37
6.3	Fault protection	37
6.3.1	General	37
6.3.2	Prevention of the occurrence of a touch voltage	38
6.3.3	Protection by automatic disconnection of supply	38
6.4	Protection by the use of PELV	39
6.4.1	General requirements	39
6.4.2	Sources for PELV	40
7	Protection of equipment	40
7.1	General	40
7.2	Overcurrent protection	40
7.2.1	General	40
7.2.2	Supply conductors	40
7.2.3	Power circuits	41
7.2.4	Control circuits	41
7.2.5	Socket outlets and their associated conductors	41
7.2.6	Lighting circuits	41
7.2.7	Transformers	42
7.2.8	Location of overcurrent protective devices	42
7.2.9	Overcurrent protective devices	42
7.2.10	Rating and setting of overcurrent protective devices	42
7.3	Protection of motors against overheating	42
7.3.1	General	42
7.3.2	Overload protection	43
7.3.3	Over-temperature protection	43
7.4	Protection against abnormal temperature	43
7.5	Protection against the effects of supply interruption or voltage reduction and subsequent restoration	44
7.6	Motor overspeed protection	44
7.7	Additional earth fault/residual current protection	44
7.8	Phase sequence protection	44
7.9	Protection against overvoltages due to lightning and to switching surges	44
7.10	Short-circuit current rating	45
8	Equipotential bonding	45
8.1	General	45
8.2	Protective bonding circuit	47
8.2.1	General	47
8.2.2	Protective conductors	47
8.2.3	Continuity of the protective bonding circuit	48
8.2.4	Protective conductor connecting points	49
8.2.5	Mobile machines	49
8.2.6	Additional requirements for electrical equipment having earth leakage currents higher than 10 mA	49
8.3	Measures to restrict the effects of high leakage current	50
8.4	Functional bonding	50
9	Control circuits and control functions	50

9.1	Control circuits	50
9.1.1	Control circuit supply.....	50
9.1.2	Control circuit voltages.....	51
9.1.3	Protection	51
9.2	Control functions	51
9.2.1	General	51
9.2.2	Categories of stop functions	51
9.2.3	Operation.....	51
9.2.4	Cableless control system (CCS)	55
9.3	Protective interlocks	57
9.3.1	Reclosing or resetting of an interlocking safeguard	57
9.3.2	Exceeding operating limits.....	57
9.3.3	Operation of auxiliary functions	57
9.3.4	Interlocks between different operations and for contrary motions	57
9.3.5	Reverse current braking	57
9.3.6	Suspension of safety functions and/or protective measures.....	58
9.4	Control functions in the event of failure	58
9.4.1	General requirements.....	58
9.4.2	Measures to minimize risk in the event of failure	59
9.4.3	Protection against malfunction of control circuits.....	60
10	Operator interface and machine-mounted control devices	66
10.1	General.....	66
10.1.1	General requirements.....	66
10.1.2	Location and mounting	66
10.1.3	Protection	66
10.1.4	Position sensors	66
10.1.5	Portable and pendant control stations.....	67
10.2	Actuators	67
10.2.1	Colours.....	67
10.2.2	Markings.....	67
10.3	Indicator lights and displays	68
10.3.1	General	68
10.3.2	Colours.....	68
10.3.3	Flashing lights and displays.....	69
10.4	Illuminated push-buttons	69
10.5	Rotary control devices.....	69
10.6	Start devices	69
10.7	Emergency stop devices.....	70
10.7.1	Location of emergency stop devices	70
10.7.2	Types of emergency stop device	70
10.7.3	Operation of the supply disconnecting device to effect emergency stop.....	70
10.8	Emergency switching off devices	70
10.8.1	Location of emergency switching off devices.....	70
10.8.2	Types of emergency switching off device	70
10.8.3	Local operation of the supply disconnecting device to effect emergency switching off.....	71
10.9	Enabling control device	71
11	Controlgear: location, mounting, and enclosures	71
11.1	General requirements.....	71

11.2	Location and mounting	71
11.2.1	Accessibility and maintenance	71
11.2.2	Physical separation or grouping	72
11.2.3	Heating effects	72
11.3	Degrees of protection	73
11.4	Enclosures, doors and openings	73
11.5	Access to electrical equipment	74
12	Conductors and cables	74
12.1	General requirements	74
12.2	Conductors	74
12.3	Insulation	75
12.4	Current-carrying capacity in normal service	75
12.5	Conductor and cable voltage drop	76
12.6	Flexible cables	77
12.6.1	General	77
12.6.2	Mechanical rating	77
12.6.3	Current-carrying capacity of cables wound on drums	77
12.7	Conductor wires, conductor bars and slip-ring assemblies	78
12.7.1	Basic protection	78
12.7.2	Protective conductors	78
12.7.3	Protective conductor current collectors	78
12.7.4	Removable current collectors with a disconnecter function	79
12.7.5	Clearances in air	79
12.7.6	Creepage distances	79
12.7.7	Conductor system sectioning	79
12.7.8	Construction and installation of conductor wire, conductor bar systems and slip-ring assemblies	79
13	Wiring practices	80
13.1	Connections and routing	80
13.1.1	General requirements	80
13.1.2	Conductor and cable runs	80
13.1.3	Conductors of different circuits	81
13.1.4	AC circuits – Electromagnetic effects (prevention of eddy currents)	81
13.1.5	Connection between pick-up and pick-up converter of an inductive power supply system	81
13.2	Identification of conductors	81
13.2.1	General requirements	81
13.2.2	Identification of the protective conductor / protective bonding conductor	82
13.2.3	Identification of the neutral conductor	82
13.2.4	Identification by colour	83
13.3	Wiring inside enclosures	83
13.4	Wiring outside enclosures	84
13.4.1	General requirements	84
13.4.2	External ducts	84
13.4.3	Connection to moving elements of the machine	84
13.4.4	Interconnection of devices on the machine	85
13.4.5	Plug/socket combinations	85
13.4.6	Dismantling for shipment	86
13.4.7	Additional conductors	86

13.5	Ducts, connection boxes and other boxes	86
13.5.1	General requirements.....	86
13.5.2	Rigid metal conduit and fittings.....	87
13.5.3	Flexible metal conduit and fittings.....	87
13.5.4	Flexible non-metallic conduit and fittings	87
13.5.5	Cable trunking systems	87
13.5.6	Machine compartments and cable trunking systems	88
13.5.7	Connection boxes and other boxes	88
13.5.8	Motor connection boxes	88
14	Electric motors and associated equipment.....	88
14.1	General requirements.....	88
14.2	Motor enclosures	88
14.3	Motor dimensions.....	89
14.4	Motor mounting and compartments	89
14.5	Criteria for motor selection	89
14.6	Protective devices for mechanical brakes	89
15	Socket-outlets and lighting.....	90
15.1	Socket-outlets for accessories	90
15.2	Local lighting of the machine and of the equipment	90
15.2.1	General	90
15.2.2	Supply	90
15.2.3	Protection	91
15.2.4	Fittings	91
16	Marking, warning signs and reference designations	91
16.1	General.....	91
16.2	Warning signs	91
16.2.1	Electric shock hazard	91
16.2.2	Hot surfaces hazard	92
16.3	Functional identification.....	92
16.4	Marking of enclosures of electrical equipment.....	92
16.5	Reference designations	92
17	Technical documentation	92
17.1	General.....	92
17.2	Information related to the electrical equipment.....	93
18	Verification	94
18.1	General.....	94
18.2	Verification of conditions for protection by automatic disconnection of supply	94
18.2.1	General	94
18.2.2	Test 1 – Verification of the continuity of the protective bonding circuit	95
18.2.3	Test 2 – Fault loop impedance verification and suitability of the associated overcurrent protective device	95
18.2.4	Application of the test methods for TN-systems.....	95
18.3	Insulation resistance tests	97
18.4	Voltage tests	98
18.5	Protection against residual voltages	98
18.6	Functional tests.....	98
18.7	Retesting	98
Annex A (normative)	Fault protection by automatic disconnection of supply.....	99

A.1	Fault protection for machines supplied from TN-systems	99
A.1.1	General	99
A.1.2	Conditions for protection by automatic disconnection of the supply by overcurrent protective devices.....	99
A.1.3	Condition for protection by reducing the touch voltage below 50 V	100
A.1.4	Verification of conditions for protection by automatic disconnection of the supply	101
A.2	Fault protection for machines supplied from TT-systems	103
A.2.1	Connection to earth.....	103
A.2.2	Fault protection for TT systems	103
A.2.3	Verification of protection by automatic disconnection of supply using a residual current protective device	104
A.2.4	Measurement of the fault loop impedance (Z_S).....	105
Annex B (informative)	Enquiry form for the electrical equipment of machines	107
Annex C (informative)	Examples of machines covered by this part of IEC 60204	111
Annex D (informative)	Current-carrying capacity and overcurrent protection of conductors and cables in the electrical equipment of machines	113
D.1	General.....	113
D.2	General operating conditions	113
D.2.1	Ambient air temperature	113
D.2.2	Methods of installation	113
D.2.3	Grouping.....	115
D.2.4	Classification of conductors.....	116
D.3	Co-ordination between conductors and protective devices providing overload protection.....	116
D.4	Overcurrent protection of conductors	117
D.5	Effect of harmonic currents on balanced three-phase systems.....	118
Annex E (informative)	Explanation of emergency operation functions	119
Annex F (informative)	Guide for the use of this part of IEC 60204	120
Annex G (informative)	Comparison of typical conductor cross-sectional areas	122
Annex H (informative)	Measures to reduce the effects of electromagnetic influences	124
H.1	Definitions.....	124
H.1.1	apparatus	124
H.1.2	fixed installation	124
H.2	General.....	124
H.3	Mitigation of electromagnetic interference (EMI).....	124
H.3.1	General	124
H.3.2	Measures to reduce EMI	125
H.4	Separation and segregation of cables	125
H.5	Power supply of a machine by parallel sources	129
H.6	Supply impedance where a Power Drive System (PDS) is used	129
Annex I (informative)	Documentation / Information	130
Bibliography	132
Figure 1	– Block diagram of a typical machine	14
Figure 2	– Disconnecter isolator	33
Figure 3	– Disconnecting circuit breaker	33
Figure 4	– Example of equipotential bonding for electrical equipment of a machine	46

Figure 5 – Symbol IEC 60417-5019: Protective earth	49
Figure 6 – Symbol IEC 60417-5020: Frame or chassis	50
Figure 7 – Method a) Earthed control circuit fed by a transformer	60
Figure 8 – Method b1) Non-earthed control circuit fed by transformer	61
Figure 9 – Method b2) Non-earthed control circuit fed by transformer	62
Figure 10 – Method b3) Non-earthed control circuit fed by transformer	62
Figure 11 – Method c) Control circuits fed by transformer with an earthed centre-tap winding	63
Figure 12 – Method d1a) Control circuit without transformer connected between a phase and the neutral of an earthed supply system	64
Figure 13 – Method d1b) Control circuit without transformer connected between two phases of an earthed supply system	64
Figure 14 – Method d2a) Control circuit without transformer connected between phase and neutral of a non-earthed supply system	65
Figure 15 – Method d2b) control circuit without transformer connected between two phases of a non-earthed supply system	65
Figure 16 – Symbol IEC 60417-5019	82
Figure 17 – Symbol IEC 60417-5021	82
Figure 18 – Symbol ISO 7010-W012	91
Figure 19 – Symbol ISO 7010-W017	92
Figure A.1 – Typical arrangement for fault loop impedance (Z_S) measurement in TN systems	102
Figure A.2 – Typical arrangement for fault loop impedance (Z_S) measurement for power drive system circuits in TN systems	102
Figure A.3 – Typical arrangement for fault loop impedance (Z_S) measurement in TT systems	105
Figure A.4 – Typical arrangement for fault loop impedance (Z_S) measurement for power drive system circuits in TT systems	106
Figure D.1 – Methods of conductor and cable installation independent of number of conductors/cables	114
Figure D.2 – Parameters of conductors and protective devices	116
Figure H.1 – By-pass conductor for screen reinforcement	125
Figure H.2 – Examples of vertical separation and segregation	127
Figure H.3 – Examples of horizontal separation and segregation	127
Figure H.4 – Cable arrangements in metal cable trays	128
Figure H.5 – Connections between metal cable trays or cable trunking systems	128
Figure H.6 – Interruption of metal cable trays at fire barriers	129
Table 1 – Minimum cross-sectional area of copper protective conductors	31
Table 2 – Symbols for actuators (Power)	68
Table 3 – Symbols for actuators (Machine operation)	68
Table 4 – Colours for indicator lights and their meanings with respect to the condition of the machine	69
Table 5 – Minimum cross-sectional areas of copper conductors	75

Table 6 – Examples of 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	76
Table 7 – Derating factors for cables wound on drums	78
Table 8 – Minimum permitted bending radii for the forced guiding of flexible cables.....	85
Table 9 – Application of the test methods for TN-systems	96
Table 10 – Examples of maximum cable lengths from protective devices to their loads for TN-systems	97
Table A.1 – Maximum disconnecting times for TN systems	99
Table A.2 – Maximum disconnecting time for TT-systems	104
Table D.1 – Correction factors.....	113
Table D.2 – Derating factors for I_Z for grouping	115
Table D.3 – Derating factors for I_Z for multicore cables up to 10 mm ²	115
Table D.4 – Classification of conductors	116
Table D.5 – Maximum allowable conductor temperatures under normal and short-circuit conditions.....	117
Table F.1 – Application options	121
Table G.1 – Comparison of conductor sizes.....	122
Table H.1 – Minimum separation distances using metallic containment as illustrated in Figure H.2	126
Table I.1 – Documentation / Information that can be applicable.....	130

INTERNATIONAL ELECTROTECHNICAL COMMISSION

SAFETY OF MACHINERY – ELECTRICAL EQUIPMENT OF MACHINES –

Part 1: General requirements

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as “IEC Publication(s)”). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 60204-1 has been prepared by IEC technical committee 44: Safety of machinery – Electrotechnical aspects.

This sixth edition cancels and replaces the fifth edition published in 2005. It constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) added requirements to address applications involving power drive systems (PDS);
- b) revised electromagnetic compatibility (EMC) requirements;
- c) clarified overcurrent protection requirements;
- d) requirements for determination of the short circuit current rating of the electrical equipment;

- e) revised protective bonding requirements and terminology;
- f) reorganization and revision to Clause 9, including requirements pertaining to safe torque off of PDS, emergency stop, and control circuit protection;
- g) revised symbols for actuators of control devices;
- h) revised technical documentation requirements;
- i) general updating to current special national conditions, normative standards, and bibliographical references.

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

FDIS	Report on voting
44/765/FDIS	44/771/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 60204 series, published under the general title *Safety of machinery – Electrical equipment of machines*, can be found on the IEC website.

The following differing practices of a less permanent nature exist in the countries indicated below.

- 4.3.1: The voltage characteristics of electricity supplied by public distribution systems in Europe are given in EN 50160:2010.
- 5.1: Exception is not allowed (USA).
- 5.1: TN-C systems are not permitted in low-voltage installations in buildings (Norway).
- 5.2: Terminals for the connection of the protective earthing conductors may be identified by the colour green, the letters “G” or “GR” or “GRD” or “GND”, or the word “ground” or “grounding”, or with the graphical symbol IEC 60417-5019:2006-08 or any combination (USA).
- 6.3.3 b), 13.4.5 b), 18.2.1: TT power systems are not allowed (USA).
- 6.3.3, 18.2, Annex A: TN systems are not used. TT systems are the national standard (Japan).
- 6.3.3 b): The use of residual current protective devices with a rated residual operating current not exceeding 1 A is mandatory in TT systems as a means for fault protection by automatic disconnection of supply (Italy).
- 7.2.3: Disconnection of the neutral conductor is mandatory in a TN-S system (France and Norway).
- 7.2.3: Third paragraph: distribution of a neutral conductor with an IT system is not allowed (USA and Norway).
- 7.10: For evaluation of short circuit ratings the requirements of UL 508A Supplement SB, may be used (USA).
- 8.2.2: See IEC 60364-5-54:2011, Annex E List of notes concerning certain countries.
- 9.1.2: Maximum nominal AC control circuit voltage is 120 V (USA).
- 12.2: Only stranded conductors are allowed on machines, except for 0,2 mm² solid conductors within enclosures (USA).
- 12.2: The smallest power circuit conductor allowed on machines is 0,82 mm² (AWG 18) in multiconductor cables or in enclosures (USA).
- Table 5: Cross-sectional area is specified in NFPA 79 using American Wire Gauge (AWG) (USA). See Annex G.

- 13.2.2: For the protective conductor, the colour identification GREEN (with or without YELLOW stripes) is used as equivalent to the bicolour combination GREEN-AND-YELLOW (USA and Canada).
- 13.2.3: The colour identification WHITE or GREY is used for earthed neutral conductors instead of the colour identification BLUE (USA and Canada).
- 15.2.2: First paragraph: Maximum value between conductors 150 V (USA).
- 15.2.2: Second paragraph, 5th bullet: The full load current rating of lighting circuits does not exceed 15 A (USA).
- 16.4: Nameplate marking requirements (USA).
- A.2.2.2: The permissible maximum value of R_A is regulated (e.g. when $U_o \geq 300V$, R_A shall be less than 10Ω , when $U_o < 300 V$, R_A shall be less than 100Ω , U_o is the nominal AC line to earth voltage in volts (V) (Japan).
- A.2.2.2: The maximum permissible value of R_A is 83Ω (Netherlands).

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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

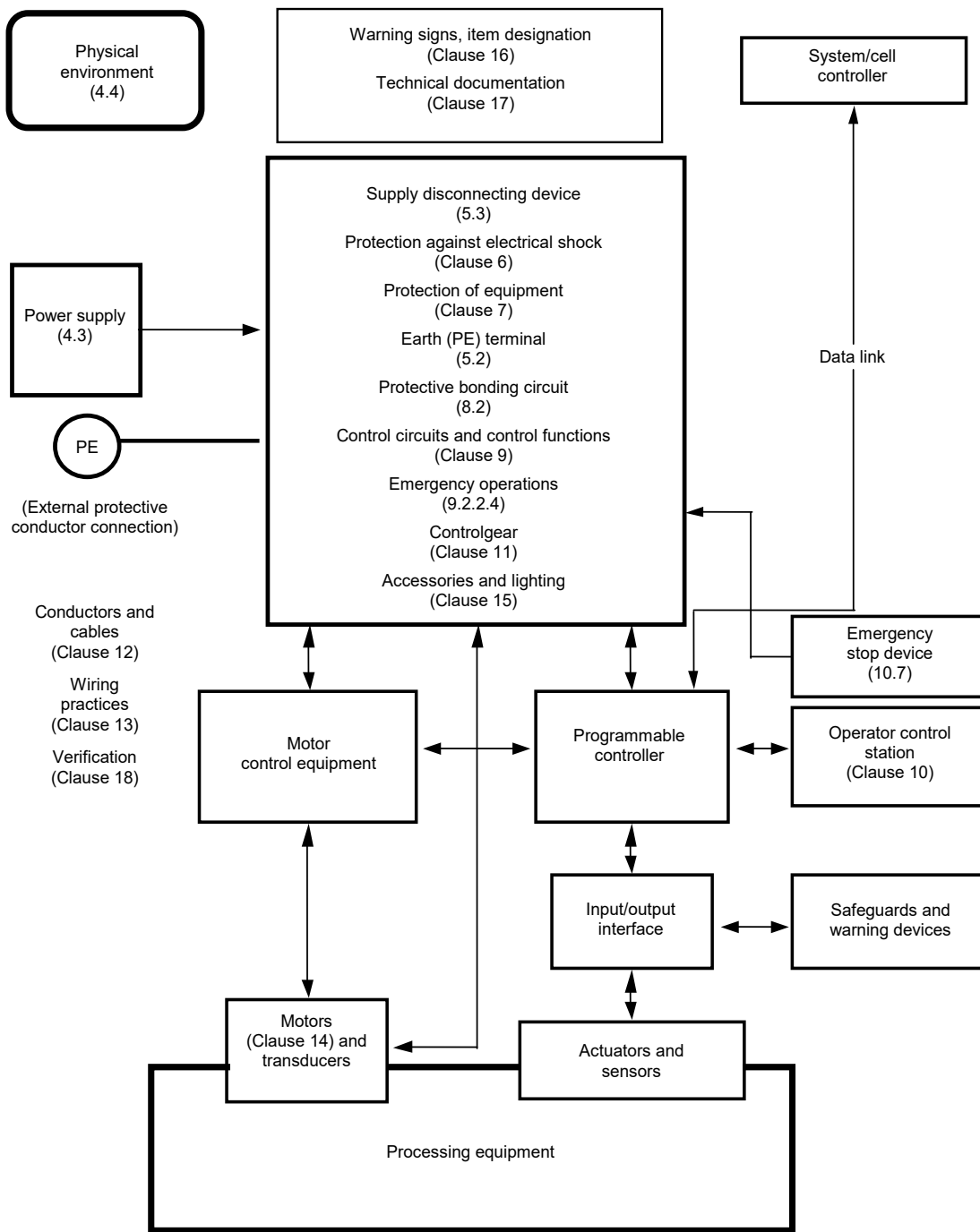
INTRODUCTION

This part of IEC 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;
- ease of operation and maintenance.

More guidance on the use of this part of IEC 60204 is given in Annex F.

Figure 1 has been provided as an aid to the understanding of the inter-relationship of the various elements of a machine and its associated equipment. Figure 1 is a block diagram of a typical machine and associated equipment showing the various elements of the electrical equipment addressed in this part of IEC 60204. Numbers in parentheses () refer to Clauses and Subclauses in this part of IEC 60204. It is understood in Figure 1 that all of the elements taken together including the safeguards, tooling/fixturing, 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 cell or system.



IEC

Figure 1 – Block diagram of a typical machine

SAFETY OF MACHINERY – ELECTRICAL EQUIPMENT OF MACHINES –

Part 1: General requirements

1 Scope

This part of IEC 60204 applies to electrical, electronic and programmable electronic equipment and systems to machines not portable by hand while working, including a group of machines working together in a co-ordinated manner.

NOTE 1 This part of IEC 60204 is an application standard and is not intended to limit or inhibit technological advancement.

NOTE 2 In this part of IEC 60204, the term “electrical” includes electrical, electronic and programmable electronic matters (i.e. “electrical equipment” means electrical, electronic and programmable electronic equipment).

NOTE 3 In the context of this part of IEC 60204, the term “person” refers to any individual and includes those persons who are assigned and instructed by the user or his agent(s) in the use and care of the machine in question.

The equipment covered by this part of IEC 60204 commences at the point of connection of the supply to the electrical equipment of the machine (see 5.1).

NOTE 4 The requirements for the electrical supply installation are given in the IEC 60364 series.

This part of IEC 60204 is applicable to the electrical equipment or parts of the electrical equipment that operate with nominal supply voltages not exceeding 1 000 V for alternating current (AC) and not exceeding 1 500 V for direct current (DC), and with nominal supply frequencies not exceeding 200 Hz.

NOTE 5 Information on electrical equipment or parts of the electrical equipment that operate with higher nominal supply voltages can be found in IEC 60204-11.

This part of IEC 60204 does not cover all the requirements (for example guarding, interlocking, or control) that are needed or required by other standards or regulations in order to protect persons from hazards other than electrical hazards. Each type of machine has unique requirements to be accommodated to provide adequate safety.

This part of IEC 60204 specifically includes, but is not limited to, the electrical equipment of machines as defined in 3.1.40.

NOTE 6 Annex C lists examples of machines whose electrical equipment can be covered by this part of IEC 60204.

This part of IEC 60204 does not specify additional and special requirements that can apply to the electrical equipment of machines that, for example:

- are intended for use in open air (i.e. outside buildings or other protective structures);
- use, process, or produce potentially explosive material (for example paint or sawdust);
- are intended for use in potentially explosive and/or flammable atmospheres;
- have special risks when producing or using certain materials;
- are intended for use in mines;
- are sewing machines, units, and systems (which are covered by IEC 60204-31);
- are hoisting machines (which are covered by IEC 60204-32);
- are semiconductor fabrication equipment (which are covered by IEC 60204-33).