

**Masinate ohutus. Masinate elektriseadmed. Osa 33:
Nõuded pooljuhtide tootmise seadmetele**

Safety of machinery - Electrical equipment of machines --
Part 33: Requirements for semiconductor fabrication
equipment

EESTI STANDARDI EESSÕNA

NATIONAL FOREWORD

Käesolev Eesti standard EVS-EN 60204-33:2011 sisaldab Euroopa standardi EN 60204-33:2011 ingliskeelset teksti.

Standard on kinnitatud Eesti Standardikeskuse 31.03.2011 käskkirjaga ja jõustub sellekohase teate avaldamisel EVS Teatajas.

Euroopa standardimisorganisatsioonide poolt rahvuslikele liikmetele Euroopa standardi teksti kättesaadavaks tegemise kuupäev on 04.03.2011.

Standard on kättesaadav Eesti standardiorganisatsioonist.

This Estonian standard EVS-EN 60204-33:2011 consists of the English text of the European standard EN 60204-33:2011.

This standard is ratified with the order of Estonian Centre for Standardisation dated 31.03.2011 and is endorsed with the notification published in the official bulletin of the Estonian national standardisation organisation.

Date of Availability of the European standard text 04.03.2011.

The standard is available from Estonian standardisation organisation.

ICS 13.110, 25.040.30, 29.020

Standardite reprodutseerimis- ja levitamiseõigus kuulub Eesti Standardikeskusele

Andmete paljundamine, taastekitamine, kopeerimine, salvestamine elektroonilisse süsteemi või edastamine ükskõik millises vormis või millisel teel on keelatud ilma Eesti Standardikeskuse poolt antud kirjaliku loata.

Kui Teil on küsimusi standardite autorikaitse kohta, palun võtke ühendust Eesti Standardikeskusega:
Aru 10 Tallinn 10317 Eesti; www.evs.ee; Telefon: 605 5050; E-post: info@evs.ee

Right to reproduce and distribute belongs to the Estonian Centre for Standardisation

No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying, without permission in writing from Estonian Centre for Standardisation.

If you have any questions about standards copyright, please contact Estonian Centre for Standardisation:
Aru str 10 Tallinn 10317 Estonia; www.evs.ee; Phone: 605 5050; E-mail: info@evs.ee

**Safety of machinery -
Electrical equipment of machines -
Part 33: Requirements for semiconductor fabrication equipment
(IEC 60204-33:2009, modified)**

Sécurité des machines -
Équipement électrique des machines -
Partie 33: Exigences pour les
équipements de fabrication des semi-
conducteurs
(CEI 60204-33:2009, modifiée)

Sicherheit von Maschinen -
Elektrische Ausrüstungen
von Maschinen -
Teil 33: Anforderungen an
Fertigungsausrüstungen für Halbleiter
(IEC 60204-33:2009, modifiziert)

This European Standard was approved by CENELEC on 2011-02-28. 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, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

CENELEC

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

Management Centre: Avenue Marnix 17, B - 1000 Brussels

Foreword

The text of the International Standard IEC 60204-33:2009, prepared by IEC TC 44, Safety of machinery - Electrotechnical aspects, together with common modifications prepared by the Technical Committee CENELEC TC 44X, Safety of machinery: electrotechnical aspects, was submitted to the formal vote and was approved by CENELEC as EN 60204-33 on 2011-02-28.

The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2012-02-28
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2014-02-28

This European Standard has been prepared under Mandate M/396 given to CENELEC by the European Commission and the European Free Trade Association and covers essential requirements of EC Directive 2006/42/EC. See Annex ZZ.

Annexes ZA and ZZ have been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 60204-33:2009 was approved by CENELEC as a European Standard with agreed common modifications as given below.

COMMON MODIFICATIONS

4 General requirements

4.2 Selection of electrical equipment

Replace with:

4.2 Selection of electrical equipment

Electrical components and devices that are used as part of a safety related system and those that handle hazardous voltage or hazardous electrical power shall be suitable for their intended use, be applied in accordance with their supplier's instructions and conform to relevant IEC standards where such exist.

11 Controlgear: location, mounting, and enclosures

11.2.1.1 General

Replace the 4th paragraph with:

All controlgear shall be mounted so as to facilitate its operation and maintenance from the front. Where a special tool is necessary to adjust, maintain, or remove a device, such a tool shall be supplied. Where access is required for regular maintenance or adjustment, the relevant devices shall be located between 0,4 m and 2,0 m above the servicing level. It is recommended that terminals be at least 0,2 m above the servicing level and be so placed that conductors and cables can be easily connected to them.

In the Bibliography, **add** the following notes for the standards indicated:

IEC 60034-1:2004	NOTE Harmonized as EN 60034-1:2004 (not modified).
IEC 60204-1	NOTE Harmonized as EN 60204-1 (not modified).
IEC 60204-32	NOTE Harmonized as EN 60204-32 (not modified).
IEC 60309-1:1999	NOTE Harmonized as EN 60309-1:1999 (not modified).
IEC 60364 series	NOTE Harmonized in HD 60364 series (not modified).
IEC 60364-5-54:2002	NOTE Harmonized as HD 60364-5-54:2007 (modified).
IEC 60439-1:1999	NOTE Harmonized as EN 60439-1:1999 (not modified).
IEC 60909 series	NOTE Harmonized in EN 60909 series (not modified).
IEC 60947-2:2006	NOTE Harmonized as EN 60947-2:2006 (not modified).
IEC 60947-3:2008	NOTE Harmonized as EN 60947-3:2009 (not modified).
IEC 60947-5-1	NOTE Harmonized as EN 60947-5-1 (not modified).
IEC 60947-5-2	NOTE Harmonized as EN 60947-5-2 (not modified).
IEC 61000-6-1	NOTE Harmonized as EN 61000-6-1 (not modified).
IEC 61000-6-2	NOTE Harmonized as EN 61000-6-2 (not modified).
IEC 61000-6-3	NOTE Harmonized as EN 61000-6-3 (not modified).
IEC 61000-6-4	NOTE Harmonized as EN 61000-6-4 (not modified).
IEC 61010-1:2001	NOTE Harmonized as EN 61010-1:2001 (not modified).
IEC 61082-1:2006	NOTE Harmonized as EN 61082-1:2006 (not modified).
IEC 61140:2001	NOTE Harmonized as EN 61140:2002 (not modified).
IEC 61310-3:2007	NOTE Harmonized as EN 61310-3:2008 (not modified).
IEC 61326 series	NOTE Harmonized in EN 61326 series (not modified).
IEC 61346 series	NOTE Harmonized in EN 61346 series (not modified).
IEC 61439-1:2009	NOTE Harmonized as EN 61439-1:2009 (modified).
IEC 61496-1	NOTE Harmonized as EN 61496-1 (not modified).
IEC 61558-2-16:2009	NOTE Harmonized as EN 61558-2-16:2009 (not modified).
IEC 61800-3	NOTE Harmonized as EN 61800-3 (not modified).
IEC 61984:2008	NOTE Harmonized as EN 61984:2009 (not modified).
IEC/TS 62046:2008	NOTE Harmonized as CLC/TS 62046:2008 (not modified).
ISO 13850:2006	NOTE Harmonized as EN ISO 13850:2008 (not modified).
ISO 14122 series	NOTE Harmonized in EN ISO 14122 series (not modified).

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60034-11	2004	Rotating electrical machines - Part 11: Thermal protection	EN 60034-11	2004
IEC 60038	-	IEC standard voltages	-	-
IEC 60073	2002	Basic and safety principles for man-machine interface, marking and identification - Coding principles for indicators and actuators	EN 60073	2002
IEC 60364-4-41 (mod)	2005	Low-voltage electrical installations - Part 4-41: Protection for safety - Protection against electric shock	HD 60364-4-41 + corr. July	2007 2007
IEC 60364-4-43 (mod)	2008	Low voltage electrical installations - Part 4-43: Protection for safety - Protection against overcurrent	HD 60364-4-43	2010
IEC 60364-6 (mod)	2006	Low voltage electrical installations - Part 6: Verification	HD 60364-6	2007
IEC 60417	Data-base	Graphical symbols for use on equipment	-	-
IEC 60445 (mod)	2006	Basic and safety principles for man-machine interface, marking and identification - Identification of equipment terminals and conductor terminations	EN 60445	2007
IEC 60446	2007	Basic and safety principles for man-machine interface, marking and identification - Identification of conductors by colours or alphanumerics	EN 60446	2007
IEC 60447	2004	Basic and safety principles for man-machine interface, marking and identification - Actuating principles	EN 60447	2004
IEC 60529	1989	Degrees of protection provided by enclosures (IP Code)	EN 60529 + corr. May	1991 1993
IEC 60617	Data-base	Graphical symbols for diagrams	-	-
IEC 60695-11-10	1999	Fire hazard testing - Part 11-10: Test flames - 50 W horizontal and vertical flame test methods	EN 60695-11-10	1999
IEC 60950-1 (mod)	2005	Information technology equipment - Safety - Part 1: General requirements	EN 60950-1 + A11	2006 2009

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 61010-1	2001	Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General requirements	EN 61010-1 + corr. June	2001 2002
IEC 61032	1997	Protection of persons and equipment by enclosures - Probes for verification	EN 61032	1998
IEC 61310	series	Safety of machinery - Indication, marking and actuation	EN 61310	series
IEC 61310-1	2007	Safety of machinery - Indication, marking and actuation - Part 1: Requirements for visual, acoustic and tactile signals	EN 61310-1	2008
IEC 61508	series	Functional safety of electrical/electronic/programmable electronic safety-related systems	EN 61508	series
IEC 61557-3	2007	Electrical safety in low voltage distribution systems up to 1 000 V a.c. and 1 500 V d.c. - Equipment for testing, measuring or monitoring of protective measures - Part 3: Loop impedance	EN 61557-3	2007
IEC 61558-1	2005	Safety of power transformers, power supplies, reactors and similar products - Part 1: General requirements and tests	EN 61558-1 + corr. August	2005 2006
IEC 61558-2-6	2009	Safety of transformers, reactors, power supply units and similar products for supply voltages up to 1 000 V - Part 2-6: Particular requirements and tests for safety isolating transformers and power supply units incorporating safety isolating transformers	EN 61558-2-6	2009
IEC 61800-5-1	2007	Adjustable speed electrical power drive systems - Part 5-1: Safety requirements - Electrical, thermal and energy	EN 61800-5-1	2007
IEC 62061	2005	Safety of machinery - Functional safety of safety-related electrical, electronic and programmable electronic control systems	EN 62061 + corr. February	2005 2010
ISO 12100-2	2003	Safety of machinery - Basic concepts, general principles for design - Part 2: Technical principles	EN ISO 12100-2	2003
ISO 13849	series	Safety of machinery - Safety-related parts of control systems	EN ISO 13849	series
ISO 13849-1 ¹⁾	1999	Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design	-	-

¹⁾ Superseded by ISO 13849-1:2006 "Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design".

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
ISO 13851	2002	Safety of machinery - Two-hand control devices - Functional aspects and design principles	-	-

This document is a preview generated by EVS

Annex ZZ (informative)

Coverage of Essential Requirements of EC Directives

This European Standard has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association and within its scope the standard covers only the following essential requirements out of those given in Annex I of EC Directive 2006/42/EC:

- 1.2.1
- 1.2.2
- 1.2.3
- 1.2.4.1
- 1.2.4.3
- 1.2.4.4
- 1.2.6
- 1.5.1
- 1.5.4
- 1.6.3 (for isolation of electrical supplies)
- 1.6.4 (for access to electrical equipment)
- 1.7.1.1
- 1.7.1.2
- 1.7.2 (for residual risks of an electrical nature)
- 1.7.4.2(e)

Compliance with this standard provides one means of conformity with the specified essential requirements of the Directive concerned.

WARNING: Other requirements and other EC Directives may be applicable to the products falling within the scope of this standard.

This document is a preview generated by EVS

CONTENTS

FOREWORD.....	10
INTRODUCTION.....	12
1 Scope.....	13
2 Normative references.....	14
3 Terms and definitions	15
4 General requirements	25
4.1 General considerations	25
4.2 Selection of electrical equipment.....	26
4.3 Electrical supply	26
4.3.1 General	26
4.4 Physical environment and operating conditions	26
4.4.1 General.....	26
4.4.2 Contaminants	27
4.4.3 Ionizing and non-ionizing radiation	27
4.4.4 Vibration, shock and bump.....	27
4.5 Transportation and storage.....	27
4.6 Provisions for handling	27
4.7 Installation.....	27
5 Incoming supply conductor terminations and devices for disconnecting and switching off	27
5.1 Incoming supply conductor terminations.....	27
5.1.1 General	27
5.1.2 Termination of the supply conductors.....	27
5.1.3 Neutral conductor	28
5.1.4 Terminal identification.....	28
5.2 Terminal for connection to the external protective earthing system	28
5.3 Supply disconnecting (isolating) device	28
5.3.1 General	28
5.3.2 Type	29
5.3.3 Requirements	29
5.3.4 Operating means	30
5.3.5 Supply disconnecting device mounting	30
5.3.6 Supply disconnecting device door interlock.....	30
5.3.7 UPS disconnection.....	30
5.4 Additional disconnecting devices.....	31
5.5 Protection against unauthorized, inadvertent and/or mistaken connection of plug/socket combination	31
6 Protection against electric shock.....	31
6.1 General	31
6.2 Protection against direct contact	31
6.2.1 General	31
6.2.2 Protection by enclosures.....	32
6.2.3 Protection by insulation of live parts	32
6.2.4 Protection against residual voltages	32
6.3 Protection against indirect contact	33
6.3.1 General	33
6.3.2 Prevention of the occurrence of a touch voltage	33

6.3.3	Protection by automatic disconnection of supply	34
6.4	Protection by the use of PELV	35
6.4.1	General requirements	35
6.4.2	Sources for PELV	35
6.4.3	Design to minimise risks of live working	36
6.5	Protection of skilled persons and instructed persons against inadvertent contact with hazardous-live-parts	36
6.5.1	General	36
6.5.2	Obstacles	36
6.5.3	Probe holes	36
7	Protection of equipment	36
7.1	General	36
7.2	Overcurrent protection	37
7.2.1	General	37
7.2.2	Supply conductors	37
7.2.3	Neutral conductor protection	37
7.2.4	Socket outlets and their associated conductors	37
7.2.5	Lighting circuits	37
7.2.6	Transformers	37
7.2.7	Location of overcurrent protective devices	37
7.2.8	Overcurrent protective devices	38
7.2.9	Rating and setting of overcurrent protective devices	38
7.3	Protection of motors against overheating	39
7.3.1	General	39
7.3.2	Overload protection	40
7.3.3	Over-temperature protection	40
7.4	Motor overspeed protection	40
7.5	Abnormal temperature detection	40
7.6	Protection against supply interruption or voltage reduction and subsequent restoration	41
7.7	Earth fault/residual current protection	41
7.8	Phase sequence protection	41
7.9	Protection against overvoltages due to lightning and to switching surges	41
7.10	Electrolytic capacitors	41
8	Equipotential bonding	42
8.1	General	42
8.2	Protective bonding circuit	44
8.2.1	General	44
8.2.2	Protective conductors	45
8.2.3	Continuity of the protective bonding circuit	45
8.2.4	Exclusion of switching devices from the protective bonding circuit	46
8.2.5	Protective conductor connecting points	46
8.2.6	Mobile machines	46
8.2.7	Limitation of touch current on cord and plug connected equipment	47
8.3	Functional bonding	47
8.4	Measures to limit the effects of high leakage current	47
9	Control circuits, emergency off (EMO), and protective interlock circuits	47
9.1	Control circuits	47
9.1.1	Control circuit supply	47

9.1.2	DC circuits derived from an a.c. supply	47
9.1.3	Start functions	47
9.1.4	Stop functions.....	48
9.1.5	Operating modes	48
9.1.6	Multiple control stations	48
9.2	Emergency Off (EMO)	48
9.2.1	General	48
9.2.2	Circuits to be de-energized	49
9.2.3	Requirements for EMO circuits.....	49
9.3	Operations other than emergency off	49
9.3.1	General	49
9.3.2	Start	49
9.3.3	Stop.....	50
9.3.4	Other control functions.....	50
9.3.5	Cableless control	51
9.4	Protective interlocks.....	51
9.4.1	General	51
9.4.2	Protective interlock circuit design	51
9.5	Suspension of safety functions and/or protective measures	53
10	Operator interfaces	53
10.1	General	53
10.1.1	General device requirements	53
10.1.2	Location and mounting.....	53
10.1.3	Degree of protection	53
10.1.4	Portable and pendant control stations	54
10.2	Push-buttons	54
10.2.1	Colours.....	54
10.2.2	Markings.....	55
10.3	Indicator lights	55
10.3.1	General	55
10.3.2	Colours.....	55
10.3.3	Flashing lights and displays	56
10.4	Illuminated push-buttons.....	56
10.5	Rotary control devices	56
10.6	Start devices	56
10.7	Emergency off devices.....	56
10.8	Emergency stop devices	57
10.9	Enabling control device.....	57
11	Controlgear: location, mounting, and enclosures	57
11.1	General requirements	57
11.2	Location and mounting.....	58
11.2.1	Accessibility and maintenance.....	58
11.2.2	Physical separation or grouping	59
11.2.3	Heating effects	59
11.3	Degrees of protection	59
11.4	Enclosures for electrical equipment.....	59
11.4.1	General	59
11.4.2	Fasteners	59
11.4.3	Windows.....	59

11.4.4	Doors	59
11.4.5	Openings	59
11.4.6	High surface temperatures	60
11.4.7	Containment of molten material or burning insulation	60
11.4.8	Enclosures that can be fully entered	60
11.4.9	Clearance for access to electrical equipment	60
12	Conductors and cables	62
12.1	General requirements	62
12.2	Insulation	62
12.2.1	General	62
12.2.2	Fire propagation and fume emissions	62
12.2.3	Printed circuit boards	62
12.3	Current-carrying capacity	63
12.4	Conductor and cable voltage drop	63
12.5	Flexible cables	63
12.5.1	General	63
12.5.2	Flexible cables inside enclosures or ducts	63
12.5.3	Mechanical ratings in cable handling systems	63
13	Wiring practices	64
13.1	Connections and routing	64
13.1.1	General requirements	64
13.1.2	Conductor and cable runs	65
13.1.3	Conductors of different circuits	65
13.1.4	Conductors smaller than 50 mm ²	65
13.1.5	Temperature exposure of conductors	65
13.1.6	Terminal temperatures	65
13.2	Multi-outlet assemblies	65
13.3	Plug/socket combinations	66
13.4	Identification of conductors	66
13.4.1	General requirements	66
13.4.2	Identification of the protective conductor	66
13.4.3	Identification of the neutral conductor by colour	67
13.4.4	Identification by colour	67
13.4.5	Wiring inside enclosures	67
13.5	Wiring outside enclosures	68
13.5.1	General requirements	68
13.5.2	Plug/socket combinations external to electrical enclosures	68
13.5.3	Cables and conductors external to the electrical enclosure	68
13.5.4	Ducts	69
13.5.5	Pendant control stations	69
13.5.6	Strain relief	69
13.5.7	Protection of flexible cables	69
13.5.8	Clearance between cables and moving parts	69
13.5.9	Clearance between flexible conduit and moving parts	69
13.5.10	Interconnection of electrical equipment	69
13.5.11	Dismantling for shipment	70
13.6	Ducts, connection boxes and other boxes	70
13.6.1	General	70
13.6.2	Cable trunking systems	70

13.6.3	Fabrication equipment compartments and cable trunking systems	71
13.6.4	Connection boxes and other boxes.....	71
14	Electric motors and associated equipment	71
14.1	General requirements	71
14.2	Remotely installed motors.....	71
14.3	Motor dimensions	71
14.4	Motor mounting and compartments	72
15	Accessories and lighting	72
15.1	Accessories.....	72
15.2	Local lighting of the fabrication equipment.....	72
15.2.1	General	72
15.2.2	Supply.....	72
15.2.3	Protection.....	73
15.2.4	Fittings.....	73
16	Marking, warning signs and reference designations.....	73
16.1	General.....	73
16.2	Electric shock hazard warning signs.....	73
16.3	Functional identification.....	73
16.4	Equipment nameplate	73
16.5	Reference designations	74
17	Technical documentation	74
17.1	General.....	74
17.2	Information to be provided	74
17.3	Requirements applicable to all documentation.....	75
17.4	Installation documents	75
17.4.1	General	75
17.4.2	Supply cables	75
17.4.3	Overcurrent protection devices.....	75
17.4.4	Ducts, cable trays, or cable supports.....	76
17.4.5	Diagrams.....	76
17.5	Overview diagrams and function diagrams	76
17.6	Circuit diagrams	76
17.7	Operating documentation.....	77
17.8	Maintenance documentation	77
17.8.1	General	77
17.8.2	Identification of replacement parts.....	77
18	Testing	77
18.1	General.....	77
18.1.1	Test schedule	77
18.1.2	Test conditions	77
18.2	Earthing continuity and continuity of the protective bonding circuit test	78
18.2.1	General	78
18.2.2	Test equipment.....	78
18.2.3	Procedure 1	78
18.2.4	Procedure 2.....	78
18.2.5	Acceptable results	79
18.3	Touch current test for cord and plug connected electrical equipment.....	79
18.3.1	Application.....	79
18.3.2	Test equipment.....	79

18.3.3	Procedure	79
18.3.4	Acceptable results	79
18.4	Dielectric test	79
18.4.1	Test equipment	79
18.4.2	Procedure	80
18.4.3	Acceptable results	80
18.5	Strain relief test	80
18.5.1	General	80
18.5.2	Test equipment	80
18.5.3	Procedure 1	80
18.5.4	Acceptable results for procedure 1	80
18.5.5	Procedure 2	81
18.5.6	Acceptable results for procedure 2	81
18.6	Power supply output short circuit test	81
18.6.1	Test equipment	81
18.6.2	Procedure	81
18.6.3	Acceptable results	81
18.7	Protective interlock circuit function test	81
18.7.1	Procedure	81
18.7.2	Acceptable results	81
18.8	Capacitor stored energy discharge test (see 6.2.4)	81
18.8.1	Test equipment	81
18.8.2	Procedure	82
18.8.3	Acceptable results	82
18.9	Temperature test	82
18.9.1	Test equipment	82
18.9.2	Procedure	82
18.9.3	Acceptable results	82
18.10	Strength of electrical enclosures test; 30 N steady force test	83
18.10.1	General	83
18.10.2	Test equipment	83
18.10.3	Procedure	83
18.10.4	Acceptable results	83
18.11	Strength of electrical enclosures test; 250N steady force test	83
18.11.1	General	83
18.11.2	Test equipment	83
18.11.3	Procedure	83
18.11.4	Acceptable results	83
18.12	Finger probe test	84
18.12.1	General	84
18.12.2	Test equipment	84
18.12.3	Procedure	84
18.12.4	Acceptable results	84
18.13	Wire flexing test	84
18.14	Insulation resistance tests	84
18.15	EMO functional test	84
18.15.1	General	84
18.15.2	Actuation	84
18.15.3	EMO button reset	85

18.15.4 EMO circuit reset.....	85
18.16 Input current test.....	85
18.16.1 Test equipment.....	85
18.16.2 Procedure	85
18.16.3 Acceptable results	85
18.17 Other safety circuit tests	85
18.18 Motor temperature test.....	85
18.18.1 Application	85
18.18.2 Test equipment.....	85
18.18.3 Procedure	85
18.18.4 Acceptable results	86
Annex A (normative) Basic protection (protection against indirect contact) in TN-systems	87
Annex B (normative) Protection against indirect contact in TT-systems (Derived from IEC 60364-4-41:2005 and IEC 60364-6:2006).....	91
Annex C (normative) Conductor ampacity, and creepage and clearance distances	93
Annex D (normative) Standard test fingers	102
Annex E (informative) Types of system earthing (Derived from IEC 60364-1: 2005)	104
Bibliography	120
Figure 1 – Example of equipotential bonding for electrical equipment.....	43
Figure 2 – Clearance in front of enclosures.....	61
Figure A.1 – Typical arrangement for fault loop impedance measurement.....	90
Figure D.1 – Rigid test finger	102
Figure D.2 – Jointed test finger	103
Figure E.1 – TN-S system with separate neutral conductor and protective conductor throughout the system	105
Figure E.2 – TN-S system with separate earthed line conductor and protective conductor throughout the system.....	106
Figure E.3 – TN-S system with earthed protective conductor and no distributed neutral conductor throughout the system.....	106
Figure E.4 – TN-C-S system 3-phase, 4-wire, where the PEN is separated into PE and N elsewhere in the installation	107
Figure E.5 – TN-C-S system 3-phase, 4-wire where the PEN is separated into PE and N at the origin of the installation	108
Figure E.6 – TN-C-S system – single-phase, 2-wire where the PEN is separated into PE and N at the origin of the installation.....	108
Figure E.7 – TN-C system with neutral and protective conductor functions combined in a single conductor throughout the system.....	109
Figure E.8 – TN-C-S multiple source system with separate protective conductor and neutral conductor to current-using equipment	110
Figure E.9 – TN multiple source system with protective conductor and no neutral conductor throughout the system for 2- or 3-phase load.....	111
Figure E.10 – TT system with separate neutral conductor and protective conductor throughout the installation	112
Figure E.11 – TT system with earthed protective conductor and no distributed neutral conductor throughout the installation	112
Figure E.12 – IT system with all exposed-conductive-parts interconnected by a protective conductor which is collectively earthed	113

Figure E.13 – IT system with exposed-conductive-parts earthed in groups or individually	114
Figure E.14 – TN-S d.c. system.....	115
Figure E.15 – TN-C d.c. system.....	116
Figure E.16 – TN-C-S d.c. system	117
Figure E.17 – TT d.c. system.....	118
Figure E.18 – IT d.c. system.....	119
Table 1 – Protection of transformers without thermal protection	39
Table 2 – Protection of transformers with thermal protection.....	39
Table 3 – Colour-coding for push-button actuators and their meanings	54
Table 4 – Symbols for push-buttons	55
Table 5 – Colours for indicator lights and their meanings with respect to the condition of the fabrication equipment.....	56
Table 6 – Acceptable temperature for parts of the electrical equipment.....	82
Table A.1 – Maximum disconnecting times for TN systems	87
Table B.1 – Maximum disconnecting times	92
Table C.1 – Conductor ampacity for AWG 30 to 4 conductors, ambient temperature 30 °C	94
Table C.2 – Conductor ampacity, for 25 mm ² to 600 kcmil conductors, ambient temperature 30 °C.....	95
Table C.3 – Derated ampacity (based on Table C.1 and Table C.2) for conductors 0,050 mm ² to 4,00 mm ²	96
Table C.4 – Ambient temperature correction factors	97
Table C.5 – Non-insulated bus bar sizes.....	98
Table C.6 – Creepage and clearance in Class 1 000 or less cleanroom.....	99
Table C.7 – Printed wiring board (PWB) creepage distances.....	100
Table C.8 – Creepage and clearance in greater than Class 1 000 cleanroom	101

INTRODUCTION

IEC 60204-33 has been created to reflect the unique needs of electrical safety within the semiconductor manufacturing environment. This includes the specialized clean room environment in which semiconductors are fabricated as well as the specialized nature of the semiconductor fabrication equipment itself. IEC 60204-33 ensures a level of safety consistent with IEC 60204-1 while still permitting the flexibility needed in the design and operation of semiconductor fabrication equipment. It has been drafted to satisfy the electrical safety needs of the semiconductor industry.

This standard is not intended to address those functional aspects of semiconductor fabrication equipment that do not relate directly to safety.

Note relating to SEMI: SEMI is the global industry association serving the manufacturing supply chains for the microelectronic, display and photovoltaic industries. SEMI maintains offices in Austin, Beijing, Brussels, Hsinchu, Moscow, San Jose, Seoul, Shanghai, Singapore, Tokyo, and Washington, D.C. The SEMI Standards Program, established in 1973, covers all aspects of semiconductor process equipment and materials, from wafer manufacturing to test, assembly and packaging, in addition to the manufacture of flat panel displays, photovoltaic systems and micro-electromechanical systems (MEMS). More than 2,100 volunteers worldwide participate in the program, which is made up of 19 global technical committees. Visit www.semi.org/standards for further details about SEMI Standards. Some information contained in this document was derived from SEMI S22 and S2. Republished with permission from Semiconductor Equipment and Materials International, Inc. (SEMI) © 2009

This document is a preview generated by EVS

SAFETY OF MACHINERY – ELECTRICAL EQUIPMENT OF MACHINES –

Part 33: Requirements for semiconductor fabrication equipment

1 Scope

This part of IEC 60204 applies to electrical and electronic equipment associated with semiconductor fabrication equipment for the manufacture, measurement, assembly, and test of semiconductors.

NOTE 1 In this standard, the term electrical includes electrical, electronic, and programmable electronic matters (i.e. electrical equipment means electrical, electronic, and programmable electronic equipment).

NOTE 2 In the context of this standard, 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 installation, use, and care of the fabrication equipment in question.

The electrical equipment covered by this standard commences at the point of connection of the supply to the electrical equipment (see 5.1), and includes proper instruction for its safe installation.

NOTE 3 For the requirements for the electrical supply installation in buildings, see IEC 60364 series.

This part 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 (a.c.) and not exceeding 1 500 V for direct current (d.c.), and with nominal supply frequencies not exceeding 200 Hz. For higher voltages or frequencies, special requirements may be needed.

NOTE 4 Electrical equipment within which derived voltages exceed these supply voltage limits is within the scope of this standard.

Included are requirements for protective measures against electrical safety hazards as well as electrical interlock circuits that protect against non-electrical hazards. However, it does not cover all the requirements that are needed or required by other standards or regulations in order to safeguard persons from hazards other than electrical hazards (e.g. chemical hazards, mechanical hazards, radiation hazards). Each type of machine has unique requirements to be accommodated to provide adequate safety.

Additional and special requirements can apply to the electrical equipment of fabrication equipment that:

- use, process, or produce potentially explosive material;
- are used in potentially explosive and/or flammable atmospheres;
- have special risks when producing or using certain materials;
- are hoisting machines (which are covered by IEC 60204-32).

This standard does not include specifications for performance or functional characteristics of the fabrication equipment.

This standard does not deal with the possible effects on human health that can result from emissions (for example EMFs, noise) from the fabrication equipment.

This standard does not specify requirements for electromagnetic compatibility (EMC).

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60034-11:2004, *Rotating electrical machines – Part 11: Thermal protection*

IEC 60038: *IEC standard voltages*

IEC 60073:2002, *Basic and safety principles for man-machine interface, marking and identification – Coding principles for indication devices and actuators*

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

IEC 60364-4-43:2008, *Low-voltage electrical installations – Part 4-43: Protection for safety – Protection against overcurrent*

IEC 60364-6:2006, *Low-voltage electrical installations – Part 6: Verification*

IEC 60417, *Graphical symbols for use on equipment*

IEC 60445:2006, *Basic and safety principles for man-machine interface, marking and identification – Identification of equipment terminals and conductor terminations*

IEC 60446:2007, *Basic and safety principles for man-machine interface, marking and identification – Identification of conductors by colours or alphanumerics*

IEC 60447:2004, *Basic and safety principles for man-machine interface, marking and identification – Actuating principles*

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

IEC 60617, *Graphical symbols for diagrams*

IEC 60695-11-10:1999, *Fire hazard testing – Part 11-10: Test flames – 50 W horizontal and vertical flame test methods*

IEC 60950-1:2005, *Information technology equipment – Safety – Part 1: General requirements*

IEC 61010-1:2001, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 1: General requirements*

IEC 61032:1997, *Protection of persons and equipment by enclosures – Probes for verification*

61310 (all parts): *Safety of machinery – Indication, marking and actuation*

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

IEC 61508 (all parts), *Functional safety of electrical/electronic/programmable electronic safety related systems*

IEC 61557-3:2007, *Electrical safety in low voltage distribution systems up to 1000 V a.c. and 1500 V d.c. – Equipment for testing, measuring or monitoring of protective measures – Part 3: Loop impedance*

IEC 61558-1:2005, *Safety of power transformers, power supplies, reactors and similar products – Part 1: General requirements and tests*

IEC 61558-2-6:2009, *Safety of transformers, reactors, power supply units and similar products for supply voltages up to 1 100 V – Part 2-6: Particular requirements and tests for safety isolating transformers and power supply units incorporating safety isolating transformers*

IEC 61800-5-1:2007, *Adjustable speed electrical power drive systems – Part 5-1: Safety requirements – Electrical, thermal and energy*

IEC 62061:2005, *Safety of machinery – Functional safety of safety-related electrical, electronic and programmable electronic control systems*

ISO 12100-2:2003, *Safety of machinery – Basic concepts, general principles for design – Part 2: Technical principles*

ISO 13849 (all parts): *Safety of machinery – Safety-related parts of control systems*

ISO 13849-1:1999, *Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design*

ISO 13851:2002, *Safety of machinery – Two hand control devices – Functional aspects and design principles*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1

actuator

part of a device to which an external manual action is to be applied

NOTE 1 The actuator may take the form of a handle, knob, push-button, roller, plunger, etc.

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

NOTE 3 See also 3.40.

3.2

ambient temperature

temperature of the air or other medium where the equipment is to be used

[IEV 826-01-04]

3.3

appliance coupler

means enabling the connection and disconnection at will, of a cord to an appliance or other equipment and consisting of a connector and an appliance inlet

NOTE 1 An appliance inlet integrated in an appliance or equipment is an appliance inlet the shroud and base of which is formed by the housing of the appliance or equipment.

NOTE 2 An appliance inlet incorporated in an appliance or an equipment is a separate appliance inlet built-in or fixed to an appliance or equipment.