

Edition 1.0 2010-01

# INTERNATIONAL STANDARD



Audio/video, information and communication technology equipment – Part 1: Safety requirements





### THIS PUBLICATION IS COPYRIGHT PROTECTED

### Copyright © 2010 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester.

If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

IEC Central Office 3, rue de Varembé CH-1211 Geneva 20 Switzerland

Email: inmail@iec.ch Web: www.iec.ch

#### About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

#### **About IEC publications**

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

- Catalogue of IEC publications: www.iec.ch/searchpub
- The IEC on-line Catalogue enables you to search by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, withdrawn and replaced publications.
- IEC Just Published: www.iec.ch/online news/justpub
- Stay up to date on all new IEC publications. Just Published details twice a month all new publications released. Available on-line and also by email.
- Electropedia: <u>www.electropedia.org</u>
- The world's leading online dictionary of electronic and electrical terms containing more than 20 000 terms and definitions in English and French, with equivalent terms in additional languages. Also known as the International Electrotechnical Vocabulary online.
- Customer Service Centre: <u>www.iec.ch/webstore/custserv</u>

If you wish to give us your feedback on this publication or need further assistance, please visit the Customer Service Centre FAQ or contact us:

Email: csc@iec.ch Tel.: +41 22 919 02 11 Fax: +41 22 919 03 00



Edition 1.0 2010-01

# INTERNATIONAL STANDARD



Audio/video, information and communication technology equipment – Part 1: Safety requirements

INTERNATIONAL ELECTROTECHNICAL COMMISSION

PRICE CODE X

ICS 33.160.01; 35.020 ISBN 2-8318-1073-8

## **CONTENTS**

FO	FOREWORD13					
INTRODUCTION						
0	Princ	Principles of this product safety standard				
	0.1	Objecti	ive	15		
	0.2	•	ıs			
		0.2.1	General	15		
		0.2.2	Ordinary person	15		
		0.2.3	Instructed person			
		0.2.4	Skilled person			
	0.3		for pain and injury			
	0.4	0.4 Energy sources				
	0.5	Safegu	ards	17		
		0.5.1	General	17		
		0.5.2	Equipment safeguard	. 18		
		0.5.3	Installation safeguard	18		
		0.5.4	Instructional safeguard	18		
		0.5.5	Personal safeguard	19		
		0.5.6	Safeguards during ordinary or instructed person service conditions	.19		
		0.5.7	Equipment safeguards during skilled person service conditions	. 19		
		0.5.8	Precautionary safeguard	.19		
		0.5.9	Skill safeguard	19		
		0.5.10	Examples of safeguard characteristics	.20		
	0.6	Electric	cally-caused pain or injury (electric shock)	.21		
		0.6.1	General	21		
		0.6.2	Models for electrically-caused pain or injury	21		
		0.6.3	Models for protection against electrically-caused pain or injury	. 21		
	0.7	Electric	cally-caused fire	22		
		0.7.1	General			
		0.7.2	Models for electrically-caused fire			
		0.7.3	Models for protection against electrically-caused fire			
	8.0		cally-caused injury			
	0.9		nically-caused injury			
	0.10		ally-caused injury (skin burn)			
			General			
			Models for thermally-caused injury			
			Models for protection against thermally-caused pain or injury			
			on-caused injury			
1	•					
2			ferences			
3	Term	s, defini	itions and abbreviations	. 35		
	3.1	Genera	al	35		
	3.2	Terms	and abbreviations			
		3.2.1	Terms in alphabetical order			
		3.2.2	Abbreviations in alphabetical order			
	3.3		and definitions			
		3.3.1	Circuit terms	.38		

		3.3.2	Enclosure terms	38
		3.3.3	Equipment terms	39
		3.3.4	Flammability terms	40
		3.3.5	Insulation	41
		3.3.6	Miscellaneous	42
		3.3.7	Operating and fault conditions	43
		3.3.8	Persons	44
		3.3.9	Potential ignition sources	44
		3.3.10	Ratings	45
		3.3.11	Safeguards	45
		3.3.12	Spacings	47
		3.3.13	Temperatures and controls	47
		3.3.14	Voltages and currents	48
		3.3.15	Classes of equipment with respect to protection from electric shock	49
		3.3.16	Chemical terms	49
4	Gene	eral requ	irements	50
	4.1	Genera	al	50
		4.1.1	Application of requirements and acceptance of materials,	
			components and subassemblies	
		4.1.2	Use of components	
		4.1.3	Equipment design and construction	
		4.1.4	Equipment installation	
		4.1.5	Constructions not specifically covered	
		4.1.6	Orientation during transport and use	
		4.1.7	Choice of criteria	
		4.1.8	Conductive liquids	
		4.1.9	Electrical measuring instruments	
		4.1.10	Temperature measurements	
			Steady state conditions	
			Hierarchy of safeguards	
			Examples mentioned in the standard	
			Tests on parts or samples separate from the end-product	
			Markings and instructions	
	4.2	٠.	source classifications	
		4.2.1	Class 1 energy source	
		4.2.2	Class 2 energy source	
		4.2.3	Class 3 energy source	
		4.2.4	Energy source classification by declaration	
	4.3		tion against energy sources	
		4.3.1	General	
		4.3.2	Safeguards for protection of an ordinary person	
		4.3.3	Protection of an instructed person	
		4.3.4	Protection of a skilled person	
		4.3.5	Safeguards in a restricted access area	
	4.4	•	ards	
		4.4.1	General	
		4.4.2	Equivalent materials or components	
		4.4.3	Composition of a safeguard	
		4.4.4	Accessible parts of a safeguard	57

		4.4.5	Safeguard robustness	59
		4.4.6	Air comprising a safeguard	59
	4.5	Explos	ion	59
		4.5.1	General	59
		4.5.2	Requirements	59
		4.5.3	Compliance	59
5	Elect	trically-c	caused injury	60
	5.1	Genera	al	60
	5.2		fication and limits of electrical energy sources	
		5.2.1	Electrical energy source classifications	
		5.2.2	ES1, ES2 and ES3 limits	
	5.3	Protec	tion against electrical energy sources	
		5.3.1	General	
		5.3.2	Protection of an ordinary person	
		5.3.3	Protection of an instructed person	
		5.3.4	Protection of a skilled person	
		5.3.5	Safeguards between energy sources	
		5.3.6	Accessibility to electrical energy sources and safeguards	
	5.4		ion materials and requirements	
		5.4.1	General	
		5.4.2	Clearances	
		5.4.3	Creepage distances	
		5.4.4	Solid insulation	
		5.4.5	Antenna terminal insulation	
		5.4.6	Insulation of internal wire as a part of a supplementary safeguard	
		5.4.7	Thermal cycling test procedure	
		5.4.8	Test for pollution degree 1 environment and for an insulating compound	
		5.4.9	Tests for semiconductor components and for cemented joints	
		5.4.10	Humidity conditioning	103
			Electric strength test	
			Protection of ordinary and instructed persons against transient	
		<b>5</b> 4 40	voltages from external circuits	
			Separation between external circuits and earth	
	5.5	•	onents as safeguards	
		5.5.1	General	
		5.5.2	Components as basic safeguard and supplementary safeguard	
		5.5.3	Components as a reinforced safeguard	112
		5.5.4	Insulation between the mains and an external circuit consisting of a coaxial cable	113
		5.5.5	Components and parts that may bridge insulation	113
	5.6	Protec	tive conductor	114
		5.6.1	General requirements	114
		5.6.2	Corrosion	
		5.6.3	Colour of insulation	114
		5.6.4	Test for low current carrying protective conductors	115
		5.6.5	Protective conductors used as basic a safeguard between ES1 and ES2	115
		5.6.6	Protective conductors used as a supplementary safeguard	115

		5.6.7	Protective earthing conductors serving as a double or reinforced safeguard	120
		5.6.8	Reliable earthing	
	5.7		ective touch voltage, touch current and protective conductor current	
	0	5.7.1	General	
		5.7.2	Measuring devices and networks	
		5.7.3	Equipment set-up, supply connections and earth connections	
		5.7.4	Unearthed conductive accessible parts	
		5.7.5	Earthed accessible conductive parts	
		5.7.6	Protective conductor current	
		5.7.7	Prospective touch voltage and touch current due to external circuits	
		5.7.8	Summation of touch currents from external circuits	
6	Elec	trically-	caused fire	125
	6.1	Gener	ral	125
	6.2		ification of power sources (PS) and potential ignition sources (PIS)	
		6.2.1	General	
		6.2.2	Power source circuit classifications	
		6.2.3	Classification of potential ignition sources	
	6.3	Safeg	uards against fire under normal operating conditions and abnormal	
			ting conditions	130
		6.3.1	Requirements	130
		6.3.2	Compliance	131
	6.4	Safeg	uards against fire under single fault conditions	131
		6.4.1	General	131
		6.4.2	Reduction of the likelihood of ignition under single fault conditions in PS1 circuits	131
		6.4.3	Reduction of the likelihood of ignition under single fault conditions in PS2 circuits and PS3 circuits	131
		6.4.4	Control of fire spread in PS1 circuits	133
		6.4.5	Control of fire spread in PS2 circuits	133
		6.4.6	Control of fire spread in a PS3 circuit	134
		6.4.7	Separation of combustible materials from a PIS	135
		6.4.8	Fire enclosures and fire barriers	138
	6.5	Intern	al and external wiring	142
		6.5.1	General	142
		6.5.2	Requirements	142
		6.5.3	Compliance	142
		6.5.4	Requirements for interconnection to building wiring.	142
		6.5.5	Compliance	
	6.6		nood of fire due to entry of foreign objects	
	6.7		uards against fire due to the connection of secondary equipment	
7	Cher	mically-	caused injury	144
	7.1	Gener	al	144
	7.2	Reduc	ction of exposure to hazardous chemicals	144
	7.3	Ozone	e exposure	144
	7.4		f PPE	
	7.5		f instructional safeguards and instructions	
	7.6		ies	
Ω	1//00	hanicall	v caused injury	115

8.1	Genera	al	145
8.2	Mecha	nical energy source classifications	145
	8.2.1	General classification	145
	8.2.2	MS1	146
	8.2.3	MS2	146
	8.2.4	MS3	146
8.3	Protec	tion against mechanical energy sources	146
	8.3.1	General	
	8.3.2	Protection of ordinary persons	147
	8.3.3	Protection of instructed person	
	8.3.4	Protection of skilled persons	
8.4		uards against parts with sharp edges and corners	
•	8.4.1	Requirements	
	8.4.2	Instructional safeguard	
	8.4.3	Compliance	
8.5		uards against moving parts	
0.5	8.5.1	Requirements	
	8.5.2	MS2 or MS3 part required to be accessible for the function of the	140
	0.5.2	equipment	149
	8.5.3	Compliance	
	8.5.4	Special categories of equipment comprising moving parts	
	8.5.5	Protection of persons against loosening, exploding or imploding parts	
8.6		ty of equipmentguines is a second grant of the second grant	
0.0	8.6.1	Requirements	
	8.6.2	Static stability for floor standing equipment	
	8.6.3	Non-floor standing equipment having controls that are accessed	100
	0.0.0	during normal use or having displays with moving images	157
8.7	Equipn	nent mounted to a wall or ceiling	157
	8.7.1	General	157
	8.7.2	Test method	157
	8.7.3	Compliance	
8.8	Handle	strength test method	
	8.8.1	General	
	8.8.2	Compliance and test method	
8.9	Wheels	s or casters attachment requirements	
	8.9.1	General	
	8.9.2	Test method	
8.10	Carts.	stands, and similar carriers	
		General	
		Marking and instructions	
		Cart, stand or carrier loading test and compliance	
		Cart, stand or carrier impact test	
		Mechanical stability	
		Thermoplastic temperature stability	
8 11		ng means for rack mounted equipment	
0.11		Requirements	
		Mechanical strength test, variable N	
		Mechanical strength test, 250 N, including end stops	
		Compliance	162

	8.12	Telesc	oping or rod antennas	162
9	Therr	nal burr	n injury	163
	9.1	General		
	9.2	Therma	al energy source classifications	163
		9.2.1	General	163
		9.2.2	TS1	163
		9.2.3	TS2	163
		9.2.4	TS3	163
		9.2.5	Touch temperature levels	164
	9.3	Protect	tion against thermal energy sources	
		9.3.1	General	
		9.3.2	Protection of an ordinary person	
		9.3.3	Protection of an instructed person	
		9.3.4	Protection of a skilled person	
	9.4		ements for safeguards	
		9.4.1	Equipment safeguard	
		9.4.2	Instructional safeguard	
10				
			al	
	10.2		on energy source classifications	
			RS1	
			RS2	
	40.0		RS3	
	10.3		ements for electromagnetic radiation	
			Protection of persons from non-ionising radiation	167
		10.3.2	Non-ionizing radiation from radio frequencies in the range 0 Hz to 300 GHz	170
		10.3.3	Protection of persons from ionizing radiation (X-radiation)	
			Protection of materials from lamps that produce UV radiation	
	10.4		tion against acoustic energy sources	
			General	
			Requirements	
		10.4.3	Protection of ordinary persons	172
Ann	ex A		ative) Examples of equipment within the scope of this standard	
Anr	ex B	(normat	ive) Normal operating condition tests, abnormal operating condition	
			fault condition tests	175
Anr	ex C	(normat	ive) UV radiation	184
Ann	ex D	(normat	ive) Test generators	186
		•	ive) Test conditions for equipment containing audio amplifiers	
			ive) Equipment markings, instructions, and instructional safeguards	
		•	tive) Components	
		•	ive) Criteria for telephone ringing signals	
		•	tive) Overvoltage categories (see IEC 60364-4-44)	
			ve) Insulated winding wires for use without interleaved insulation	
			ive) Safety interlocks	
			ive) Disconnect devices	
	•		tive) Ratteries and fuel cells	253

Annex N (normative) Electrochemical potentials	263
Annex O (normative) Measurement of creepage distances and clearances	264
Annex P (normative) Safeguards against entry of foreign objects, foreign liquids, and spillage of internal liquids	272
Annex Q (normative) Interconnection with building wiring	277
Annex R (normative) Limited short-circuit test	279
Annex S (normative) Tests for resistance to heat and fire	281
Annex T (normative) Mechanical strength tests	286
Annex U (normative) Mechanical strength of CRTs and protection against the effects of implosion	291
Annex V (normative) Determination of accessible parts	293
Annex W (informative) Comparison of terms introduced in this standard	299
Bibliography	310
Figure 1 – Three block model for pain and injury	
Figure 2 – Three block model for safety	17
Figure 3 – Schematic and model for electrically-caused pain or injury	21
Figure 4 – Model for protection against electrically-caused pain or injury	
Figure 5 – Model for electrically-caused fire	23
Figure 6 – Models for protection against fire	23
Figure 7 – Schematic and model for thermally-caused injury	26
Figure 8 – Model for protection against thermally-caused injury	26
Figure 9 – Model for protection of an ordinary person against a class 1 energy source	54
Figure 10 – Model for protection of an ordinary person against a class 2 energy source	54
Figure 11 – Model for protection of an ordinary person against a class 2 energy source during ordinary person servicing conditions	55
Figure 12 – Model for protection of an ordinary person against a class 3 energy source	55
Figure 13 – Model for protection of an instructed person against a class 1 energy source	55
Figure 14 – Model for protection of an instructed person against a class 2 energy source	55
Figure 15 – Model for protection of an instructed person against a class 3 energy source	56
Figure 16 – Model for protection of a skilled person against a class 1 energy source	56
Figure 17 – Model for protection of a skilled person against a class 2 energy source	56
Figure 18 – Model for protection of a skilled person against a class 3 energy source	56
Figure 19 – Model for protection of a skilled person against class 3 energy sources during equipment servicing conditions	57
Figure 20 – Illustration of accessible and inaccessible parts of a basic safeguard	58
Figure 21 – Illustration of accessible and inaccessible parts of a supplementary safeguard	58
Figure 22 – Illustration of accessible and inaccessible parts of a reinforced safeguard	58
Figure 23 – Illustration that shows that ES limits depend on both voltage and current	61
Figure 24 – Maximum values for combined a.c. current and d.c. current	62
Figure 25 – Maximum values for combined a.c. voltage and d.c. voltage	63
Figure 26 – Model for protection of ES1 against ES2	68

Figure 27 – Model for protection of ES1 against ES3	68
Figure 28 – Model for protection of ES1 against ES3	68
Figure 29 – Model for protection of ES2 against ES3	68
Figure 30 – Model for protection of ES2 against ES3	68
Figure 31 – Contact requirements to bare internal conductive parts	69
Figure 32 – Mandrel	96
Figure 33 – Initial position of mandrel	
Figure 34 – Final position of mandrel	97
Figure 35 – Position of metal foil on insulating material	97
Figure 36 – Example of electric strength test instrument for solid insulation	106
Figure 37 – Test for separation between a telecommunication network and earth	109
Figure 38 – Power measurement for worst-case load fault	127
Figure 39 – Power measurement for worst-case power source fault	128
Figure 40 – Illustration of power source classification	129
Figure 41 – Minimum separation requirements from an arcing PIS	135
Figure 42 – Extended separation requirements from a PIS	136
Figure 43 – Rotated separation requirements due to forced air flow	136
Figure 44 – Deflected separation requirements from a PIS when a fire barrier is used	137
Figure 45 – Top openings	
Figure 46 – Bottom openings	140
Figure 47 – Illustration showing MS limits for moving fan blades	146
Figure 48 – Example for determining opening 'X' without a deflector	153
Figure 49 – Example for determining opening 'X' with a deflector	153
Figure D.1 – 1,2/50 $\mu s$ and 10/700 $\mu s$ voltage surge generator	187
Figure D.2 – Antenna interface test generator circuit	187
Figure D.3 – Example of an electronic pulse generator	188
Figure E.1 – Band-pass filter for wide-band noise measurement	190
Figure F.1 – Example of an instructional safeguard	199
Figure G.1 – Determination of arithmetic average temperature	207
Figure G.2 – Thermal ageing time	233
Figure G.3 – Abrasion resistance test for coating layers	234
Figure H.1 – Definition of ringing period and cadence cycle	239
Figure H.2 – $I_{TS1}$ limit curve for cadenced ringing signal	240
Figure H.3 – Peak and peak-to-peak currents	240
Figure H.4 – Ringing voltage trip criteria	242
Figure M.1 – Distance d as a function of the rated capacity for various charge currents <i>I</i> (mA/Ah)	261
Figure O.1 – Narrow groove	264
Figure O.2 – Wide groove	264
Figure O.3 – V-shaped groove	265
Figure O.4 – Intervening unconnected conductive part	265
Figure O.5 – Rib	265
Figure O.6 – Uncemented joint with narrow groove	265