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TECHNICAL REPORT

Audio/video, information and communication technology equipment – Part 2: Explanatory information related to IEC 62368-1

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colour inside

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AUDIO/VIDEO, INFORMATION AND COMMUNICATION TECHNOLOGY EQUIPMENT –

Part 2: Explanatory information related to IEC 62368-1

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IEC 62368-2, which is a technical report, has been prepared by subcommittee TC108: Safety of electronic equipment within the field of audio/video, information technology and communication technology.

The text of this technical report is based on the following documents:

Enquiry draft	Report on voting
108/439/DTR	108/452/RVC

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

In this standard, the following print types are used:

– notes/explanatory matter: in smaller roman type (also in green if colour is available);

– tables and figures that are included in the rationale have linked fields (shaded in grey if “field shading” is active).

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

A list of all parts of the IEC 62368 series can be found, under the general title *Audio/video, information and communication technology equipment*, on the IEC website.

In this document, only those subclauses considered to need further background reference information or explanation of their content to benefit the reader are included. Therefore, not all numbered subclauses are cited. Unless otherwise noted, all references are to clauses, subclauses, annexes, figures or tables are located in IEC 62368-1:2010.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site 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- withdrawn,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.

A bilingual version of this publication may be issued at a later date.

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AUDIO/VIDEO, INFORMATION AND COMMUNICATION TECHNOLOGY EQUIPMENT –

Part 2: Explanatory information related to IEC 62368-1

Clause 0 **Introduction – Principles of this product safety standard**

Clause 0 is informational and provides a rationale for the normative clauses of the standard.

0.5.7 **Equipment safeguards during skilled person service conditions**

Purpose: To explain the intent of requirements for providing safeguards against involuntary reaction.

Rationale: By definition, a skilled person has the education and experience to identify all class 3 energy sources to which he may be exposed. However, while servicing one class 3 energy source in one location, a skilled person may be exposed to another class 3 energy source in a different location.

In such a situation, either of two events is possible. First, something may cause an involuntary reaction of the skilled person with the consequences of contact with the class 3 energy source in the different location. Second, the space in which the skilled person is located may be small and cramped, and inadvertent contact with a class 3 energy source in the different location may be likely.

In such situations, this standard may require an equipment safeguard solely for the protection of a skilled person while performing servicing activity.

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Clause 1 **Scope**

Purpose: To identify the purpose and applicability of this standard and the exclusions from the scope.

Rationale: The scope excludes requirements for functional safety. Functional safety is addressed in IEC 61508-1. Because the scope includes computers that may control safety systems, functional safety requirements would necessarily include requirements for computer processes and software. The TC108 experts are experts in hardware safety, and have little or no expertise to properly address functional safety requirements.

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Clause 3 **Terms and definitions**

Rationale is provided for definitions that deviate from IEV definitions or from pilot standard definitions.

3.3.2.1 **electrical enclosure**

Source: IEV 195-06-13

Purpose: To support the concept of safeguards as used in this standard.

Rationale: The IEV definition is modified to use the term “safeguard” in place of the word “protection”. The word “safeguard” identifies a physical “thing” whereas the word “protection” identifies the act of protecting. This standard sets forth requirements for use of physical safeguards and requirements for those safeguards. The safeguards provide “protection” against injury from the equipment.

3.3.5.1 **basic insulation**

Source: IEV 195-06-06

Purpose: To support the concept of safeguards as used in this standard.

Rationale: The IEV definition is modified to use the term “safeguard” in place of the word “protection”. The word “safeguard” identifies a physical “thing” whereas the word “protection” identifies the act of protecting. This standard sets forth requirements for use of physical safeguards and requirements for those safeguards. The safeguards provide “protection” against injury from the equipment.

3.3.5.2 double insulation

Source: IEV 195-06-08

Purpose: To support the concept of safeguards as used in this standard.

Rationale: See 3.3.5.1, basic insulation.

3.3.5.5 solid insulation

Source: IEC 60664-1:2007, 3.4

Purpose: To support the concept that safeguards are interposed between an energy source and a body part.

Rationale: IEC 60664-1 defines insulation as material interposed between two conductive parts. The IEC 60664-1 definition is modified by adding that insulation is also “between a conductive part and a body part.” For safety purposes, solid insulation is not only used between conductors, but is also used between a conductor and a body part. For example, a Class II equipment employs solid insulation in this manner.

3.3.5.6 supplementary insulation

Source: IEV 195-06-07

Purpose: To support the concept of safeguards as used in this standard.

Rationale: See 3.3.5.1, basic insulation.

3.3.6.6 restricted access area

Source: IEV 195-04-04

Purpose: To use the concept of “instructed persons” and “skilled persons” as used in this standard.

Rationale: The IEV definition is modified to use the terms “instructed persons” and “skilled persons” rather than “electrically instructed persons” and “electrically skilled persons.”

3.3.7.8 reasonably foreseeable misuse

Source: ISO/IEC Guide 51:1999, definition 3.14

Purpose: To describe that the standard does not generally address foreseeable misuse.

Rationale: The scope excludes consideration of foreseeable misuse that might lead do an injury. Misuse depends on personal objectives, personal perception of the equipment, and the possible use of the equipment (in a manner not intended by the manufacturer) to accomplish those personal objectives. Equipment within the scope of this standard ranges from small handheld equipment to large, permanently installed equipment. There is no commonality among the equipment for readily predicting human behaviour leading to misuse of the equipment and resultant injury. Manufacturers are encouraged to consider reasonably foreseeable misuse of equipment and provide safeguards, as applicable, to prevent injury in the event of such misuse. (Not all reasonably foreseeable misuse of equipment results in injury or potential for injury.)

3.3.8.1 instructed person

Source: IEV 826-18-02

Purpose: To use the terms used in this standard.

Rationale: The IEV definition is modified to use the terms “energy sources”, “skilled person”, and “precautionary safeguard”. The definition is made stronger by using the term “instructed” rather than “advised”.

3.3.8.3 skilled person

Source: IEV 826-18-01

Purpose: To use the terms used in this standard.

Rationale: The IEV definition is modified to use the phrase “to reduce the likelihood of”. IEC 62368-1 does not use the word “hazard”.

3.3.14.5 prospective touch voltage

Source: IEV 195-05-09

Purpose: To properly identify electric shock energy source voltages.

Rationale: The IEV definition is modified to delete “animal”. The word “person” is also deleted as all of the requirements in the standard are with respect to persons.

3.3.14.10 working voltage

Source: IEC 60664-1:2007, definition 3.5

Purpose: To distinguish between r.m.s. working voltage and peak working voltage.

Rationale: The IEC 60664-1 definition is modified to delete “r.m.s”. IEC 62368-1 uses both r.m.s. working voltage and peak working voltage; each term is defined.

3.3.15.2 class II construction

Source: IEC 60335-1:2001, 3.3.11

Purpose: Although the term is not used in the standard, for completeness, it was decided to retain this definition.

Rationale: The word “appliance” is changed to “equipment”.

Clause 4 General requirements

Purpose: To explain how to investigate and determine whether or not safety is involved.

Rationale: In order to establish whether or not safety is involved, the circuits and construction are investigated to determine whether the consequences of possible fault conditions would lead to an injury. Safety is involved if, as a result of a single fault condition, the consequences of the fault lead to a risk of injury.

If a fault condition should lead to a risk of injury, the part, material, or device whose fault was simulated may comprise a safeguard.

Rationale is provided for questions regarding the omission of some traditional requirements appearing in other safety standards. Rationale is also provided for further explanation of new concepts and requirements in this standard.

functional insulation

Purpose: To explain why the standard has no requirements for functional insulation.

Rationale: This standard does not include requirements for functional insulation. By its nature, functional insulation does not provide a safeguard function against electric shock or electrically-caused fire and therefore may be faulted. Obviously, not all functional insulations are faulted as this would be prohibitively time-consuming. Sites for functional insulation faults must be based upon physical examination of the equipment, upon the electrical schematic.

Note that basic and reinforced insulation may also serve as functional insulation, in which case the insulation is not faulted.

functional components

Purpose: To identify the conditions for consideration of functional components as safeguards.

Rationale: This standard does not include requirements for functional components. By their nature, individual functional components do not provide a safeguard function against electric shock, electrically-caused fire, thermal injury, etc., and therefore may be candidates for fault testing. Obviously, not all functional components are faulted as this would be prohibitively time-consuming. Candidate components for fault testing must be based upon physical examination of the equipment, upon the electrical schematic diagrams, and whether a fault of that component might result in conditions for electric shock, conditions for ignition and propagation of fire, conditions for thermal injury, etc.

As with all fault-condition testing (Clause B.4), upon faulting of a functional component, there shall not be any safety consequence (for example, a benign consequence), or a basic, supplementary, or reinforced safeguard shall remain effective.

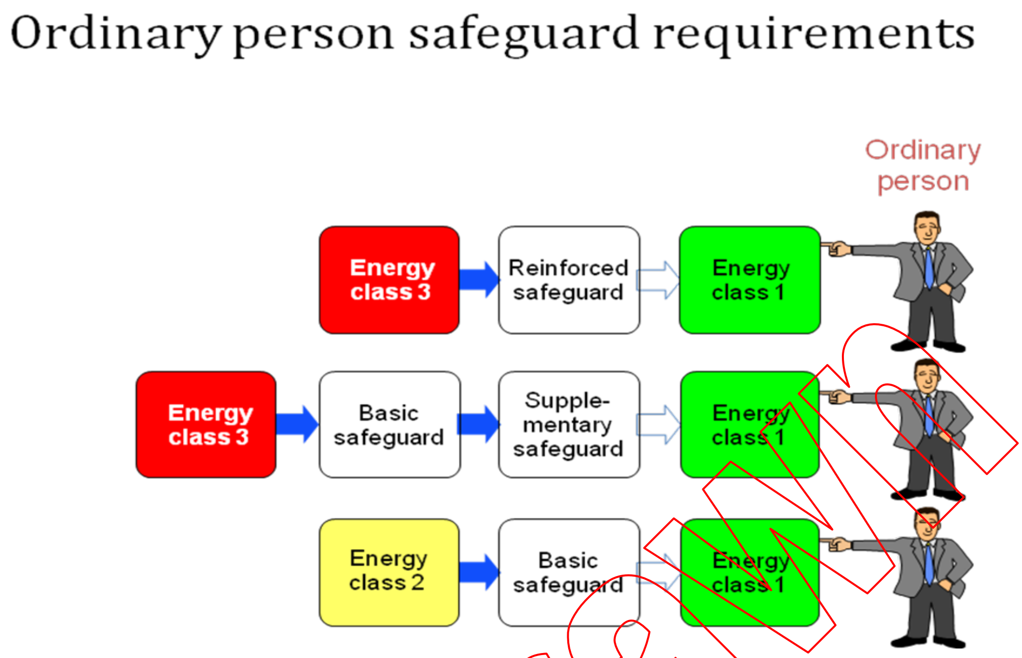
In some cases, a pair of functional components may comprise a safeguard. If the fault of one of the components in the pair is mitigated by the second component, then the pair must be designated as a double safeguard. For example, if two diodes are employed in series to protect a battery from reverse charge, then the pair must comprise a double safeguard and the components must be limited to the manufacturer and part number actually tested. A second example is that of an X-capacitor and discharge resistor. If the discharge resistor should fail open, then the X-capacitor will not be discharged. Therefore, the X-capacitor value must not exceed the ES2 limits specified for a charged capacitor. Again, the two components comprise a double safeguard and the values of each component must be limited to values for ES1 under normal operating conditions and the values for ES2 under single fault conditions.

4.1.1 Application of requirements and acceptance of materials, components and subassemblies

Purpose: To accept components as safeguards.

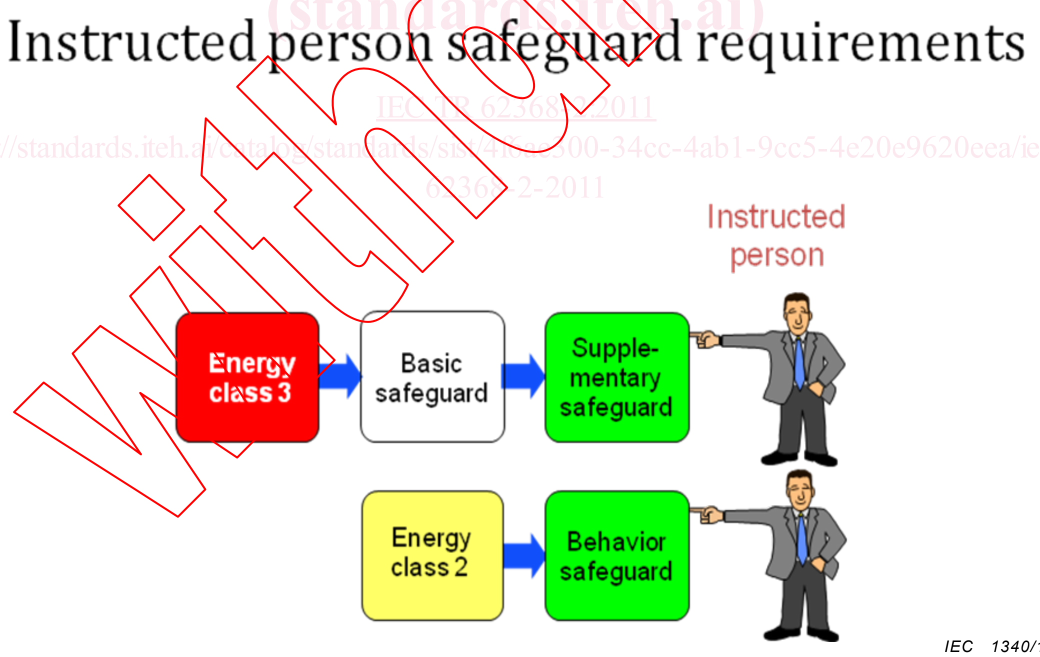
Rationale: This standard includes requirements for safeguard components. A safeguard component is a component specifically designed and manufactured for both functional and safeguard parameters. Examples of safeguard components are capacitors complying with IEC 60384-14 and other IEC component standards.

4.3.2 Safeguards for protection of an ordinary person



IEC 1339/11

4.3.3 Safeguards for protection of an instructed person



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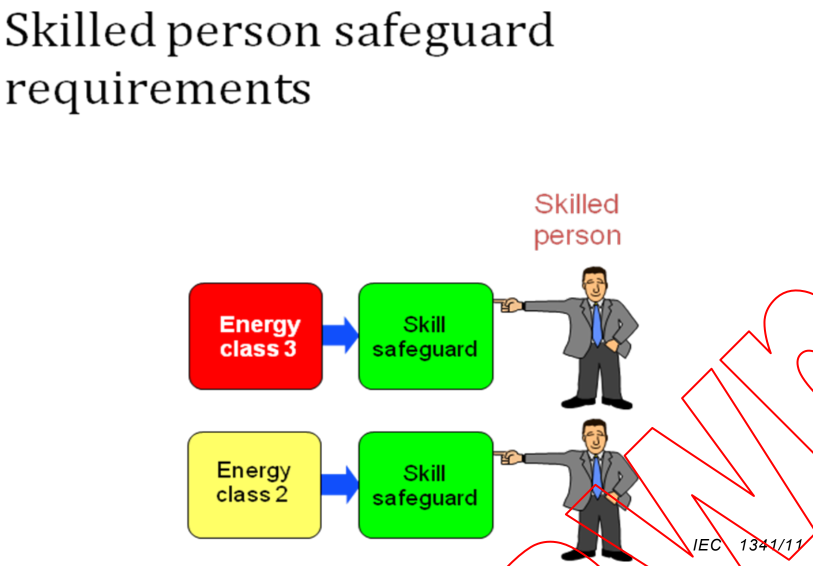
4.3.4 Safeguards for protection of a skilled person



4.4.3 Composition of a safeguard

Purpose: To specify design and construction criteria for a single safeguard (basic, supplementary, or reinforced) comprised of more than one element, for example, a component or a device.

Rationale: Safeguards need not be a single, homogeneous component. Indeed, some parts of this standard require a single safeguard be comprised of two or more elements. For example, for thin insulation, two or more layers are required to qualify as supplementary insulation. Another example is protective bonding and protective earthing, both of which are comprised of wires, terminals, screws, etc.

If a safeguard is comprised of two or more elements, then the function of the safeguard must not be compromised by a failure of any one element. For example, if a screw attaching a protective earthing wire should loosen, then the current-carrying capacity of the protective earthing circuit may be compromised, making its reliability uncertain.

4.4.5 Safeguard robustness

Purpose: To require safeguards to be robust.

Rationale: Safeguards must be sufficiently robust to withstand the rigors of expected use throughout the equipment lifetime. Robustness requirements are specified in the various clauses.

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Clause 5 Electrically-caused injury

Purpose: Clause 5 classifies electrical energy sources and provides criteria for determining the energy source class of each conductive part. The criteria for energy source class include the source current-voltage characteristics, duration, and capacitance. Each conductive part, whether current-carrying or not, or whether earthed or not, shall be classed ES1, ES2, or ES3 with respect to earth and with respect to any other simultaneously accessible conductive part.

5.2.1 Electrical energy source classifications

Source: IEC/TS 60479-1 and IEC 61201

Purpose: To define the line between hazardous and non-hazardous electrical energy sources for normal and abnormal operating conditions.

Rationale: The effect on persons from an electric source depends on the CURRENT through the human body. The effects are described in IEC/TS 60479-1.

Purpose: ES1 may be accessible to an ordinary person with no safeguards

Rationale: IEC/TS 60479-1:2005 (see Figures 20 and 22, Tables 11 and 13); zone AC-1 and zone DC-1; usually no reaction (Figure 1 and Figure 2, Table 1 and Table 2 in this standard).

Purpose: ES2 may be accessible to an instructed person with no safeguards and to an ordinary person under a fault condition of a basic safeguard.

Rationale: IEC/TS 60479-1:2005 (see Figures 20 and 22; Tables 11 and 13); zone AC-2 and zone DC-2; usually no harmful physiological effects (see Figure 1 and Figure 2, Table 1 in this standard).

Purpose: ES3 is not accessible to an ordinary person nor to an instructed person under normal conditions or under a fault condition of a safeguard. Parts and circuits classed ES3 may be accessible to a skilled person.

Rationale: IEC/TS 60479-1; zone AC-3 and zone DC-3; harmful physiological effects may occur (see Figure 1 and Figure 2, Table 1 and Table 2 in this standard).

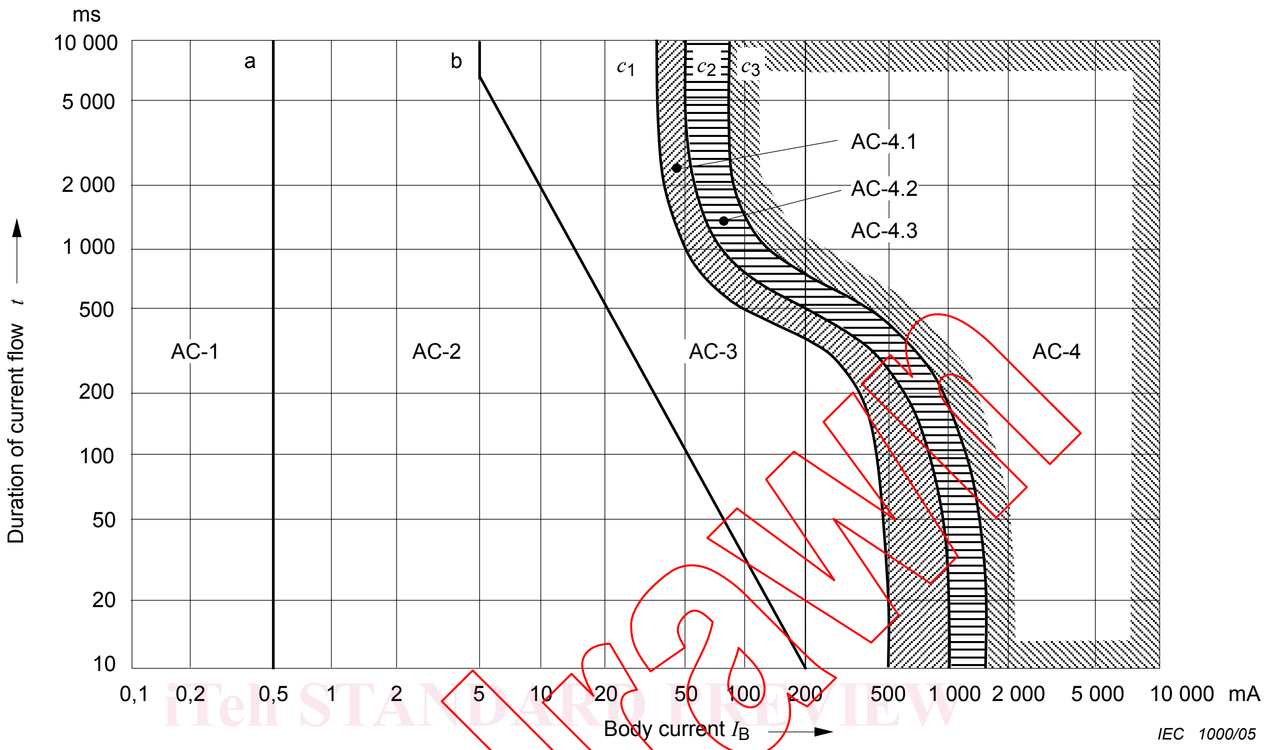

Figure 1 – Conventional time/current zones of effects of a.c. currents (15 Hz to 100 Hz) on persons for a current path corresponding to left hand to feet (see IEC/TS 60479-1:2005, Figure 20)

Table 1 – Time/current zones for a.c. 15 Hz to 100 Hz for hand to feet pathway (see IEC/TS 60479-1:2005, Table 11)

Zones	Boundaries	Physiological effects
AC-1	up to 0,5 mA curve a	Perception possible but usually no startle reaction
AC-2	0,5 mA up to curve b	Perception and involuntary muscular contractions likely but usually no harmful electrical physiological effects
AC-3	Curve b and above	Strong involuntary muscular contractions. Difficulty in breathing. Reversible disturbances of heart function. Immobilisation may occur. Effects increasing with current magnitude. Usually no organic damage to be expected.
AC-4[a]	Above curve c_1	Pathophysiological effects may occur such as cardiac arrest, breathing arrest, and burns or other cellular damage. Probability of ventricular fibrillation increasing with current magnitude and time.
	$c_1 - c_2$	AC-4.1 Probability of ventricular fibrillation increasing up to about 5 %.
	$c_2 - c_3$	AC-4.2 Probability of ventricular fibrillation up to about 50 %.
	Beyond curve c_3	AC-4.3 Probability of ventricular fibrillation above 50 %.

[a] For durations of current flow below 200 ms, ventricular fibrillation is only initiated within the vulnerable period if the relevant thresholds are surpassed. As regards ventricular fibrillation this figure relates to the effects of current which flows in the path left hand to feet. For other current paths the heart current factor has to be considered.

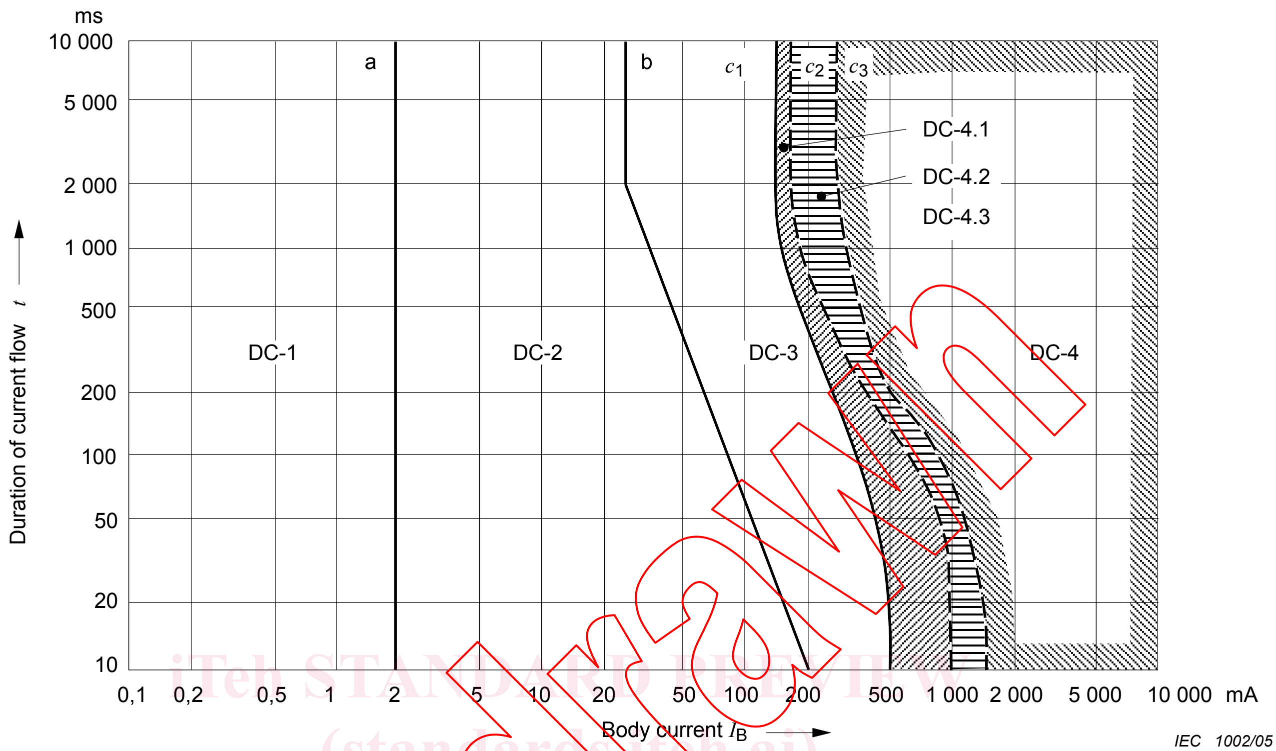

Figure 2 – Conventional time/current zones of effects of d.c. currents on persons for a longitudinal upward current path (see IEC/TS 60479-1:2005, Figure 22)

Table 2 – Time/current zones for d.c. for hand to feet pathway (see IEC/TS 60479-1:2005, Table 13)

Zones	Boundaries	Physiological effects
DC-1	Up to 2 mA curve a	Slight pricking sensation possible when making, breaking or rapidly altering current flow.
DC-2	2 mA up to curve b	Involuntary muscular contractions likely, especially when making, breaking or rapidly altering current flow, but usually no harmful electrical physiological effects
DC-3	curve b and above	Strong involuntary muscular reactions and reversible disturbances of formation and conduction of impulses in the heart may occur, increasing with current magnitude and time. Usually no organic damage to be expected.
DC-4[a]	Above curve c_1	Pathophysiological effects may occur such as cardiac arrest, breathing arrest, and burns or other cellular damage. Probability of ventricular fibrillation increasing with current magnitude and time.
	$c_1 - c_2$	DC-4.1 Probability of ventricular fibrillation increasing up to about 5 %.
	$c_2 - c_3$	DC-4.2 Probability of ventricular fibrillation up to about 50 %.
	Beyond curve c_3	DC-4.3 Probability of ventricular fibrillation above 50 %.

[a] For durations of current flow below 200 ms ventricular fibrillation is only initiated within the vulnerable period if the relevant thresholds are surpassed. As regards ventricular fibrillation this figure relates to the effects of current which flows in the path left hand to feet and for upward current. For other current paths the heart current factor has to be considered.

The effects for an injury increas continuously with the energy transferred to the body. To demonstrate this principle Figure 1 and Figure 2 in this standard (see IEC/TS 60479-1:2005, Figures 20 and 22) are transferred into a graph: effects = (f) energy (see Figure 3 in this standard).

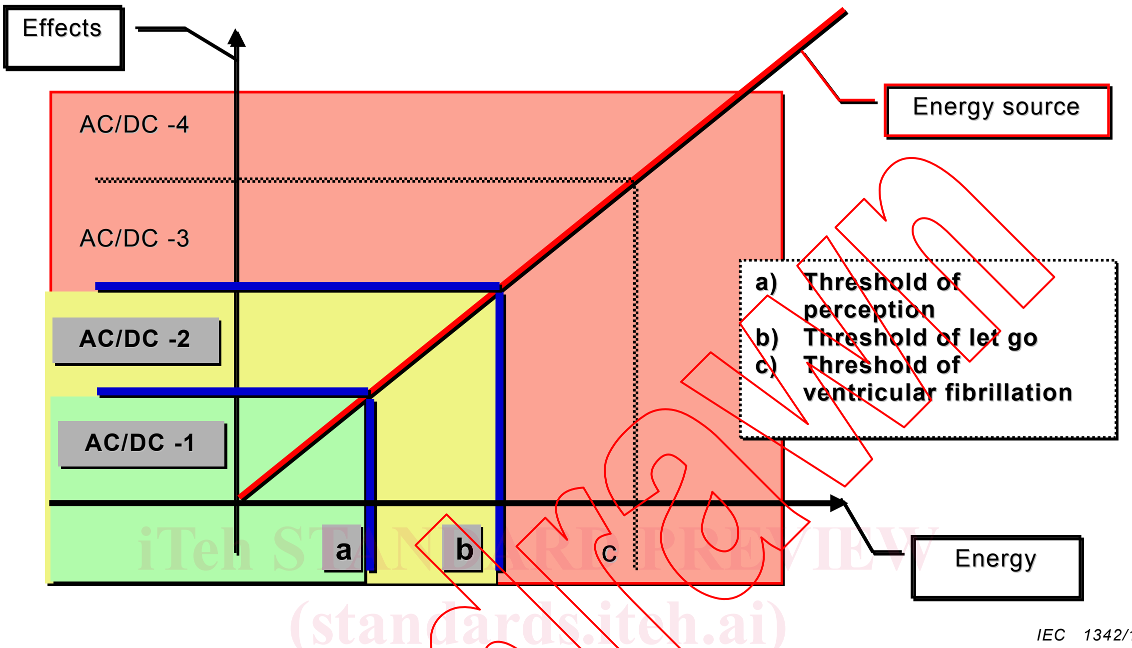

Figure 3 – Illustration that limits depend on both voltage and current

Within the standard only the limits for Zone 1 (green) and Zone 2 (yellow) will be specified.

Curve “a” (limit of Zone 1) will be the limit for parts accessible by an ordinary person during normal use.

Curve “b” (limit of Zone 2) will be the limit for parts accessible by an ordinary person during (or after) a single fault.

It was found to be not acceptable to go to the limits of either Zone 3 or 4.

In the standard three (3) zones are described as electrical energy sources.

This classification is as follows:

– electrical energy source 1 (ES1): levels are of such a value that they do not exceed curve “a” (threshold of perception) of Figure 1 and Figure 2 in this standard (see IEC/TS 60479-1:2005, Figures 20 and 22).
– electrical energy source 2 (ES2): levels are of such a value that they exceed curve “a”, but do not exceed curve “b” (threshold of let go) of Figure 1 and Figure 2 in this standard (see IEC/TS 60479-1:2005, Figures 20 and 22).
– electrical energy source 3 (ES3): levels are of such a value that they exceed curve “b” of Figure 1 and Figure 2 in this standard (see IEC/TS 60479-1:2005, Figures 20 and 22).