Guide to the electrical parameter classifications of IEC 60950 and IEC 62368 safety standards

Abstract

This Guide is an informative listing of selected terms and definitions found in IEC Glossary entry for IEC TC108: Safety of electronic equipment within the field of audio/video, information technology and communication technology. Ultimately IEC 60950 series of safety documents should be replaced by the IEC 62368 series of hazard-based safety standards making it important to understand the relationships between the established and hazard-based terminology.

Warning

Standards term definitions can change and the IEC Glossary should always be consulted to verify the current term and its definition. This Guide is of a general nature only and is not intended to address the specific circumstances of any particular individual or entity; nor be necessarily comprehensive, complete, accurate or up to date; nor represent professional or legal advice.

M J Maytum, 2015-09-16
Guide to the electrical parameter classifications of IEC 60950 and IEC 62368 safety standards

Introduction
This document compares the terms, definitions and parameters of the IEC 60950-1 and IEC 62368-1. Ultimately IEC 60950-1 should be replaced by the IEC 62368-1 hazard-based safety standard and so it is important to understand the relationships between the established and hazard-based terminology.

In IEC 62368-1, the electrical environment conditions are often not defined in the terms clause but are given in the body text. Electrical environment classification is by means of the available electrical Energy Source, ES, and Power Source, PS. There are three classes of each, for energy they are ES1, ES2 and ES3 and for power PS1, PS2 and PS3. The energy sources are not directly classified in J but are classified for a range of parameters. Annex W (informative) does supply a comparison of IEC 60950-1 and IEC 62368-1 terms. The definitions of ES and PS classes have been extracted from the body text and are shown in red to indicate that these don’t exist in the IEC 62368-1 terms clause.

IEC 62368-1 defines PE wiring current capability, but general wiring isn’t covered much apart from the statement

“PS2 circuits or PS3 circuits that provide power and that are intended to be compatible with LPS to external circuits (see Annex Q) shall have their output power limited to values that reduce the likelihood of ignition within building wiring. External paired conductor cable circuits, such as those described in Table 14, ID numbers 1 and 2 having a minimum wire diameter of 0,4 mm, shall have the current limited to 1,3 A”.

The contents of this contribution are grouped by root term; Access, Cable, Circuit, Conditions, Enclosure, Insulation, Network, Persons, Remote, Safeguard, Sources, Touch and Voltage & current. Each root term is subdivided into IEC 60950 terms and IEC 62368-1 terms. The three Appendixes cover IEC 60950-1 voltages, IEC 62368-1 electrical source parameters and Safety equivalence of IEC 60950-1 and IEC 62368-1 terms.
Access

**IEC 60950-1, ed. 2.0 (2005-12)**

**operator access area** [b-IEC 60950-1]: part of the equipment to which, under normal operating conditions, one of the following applies:
- access can be gained without the use of a tool;
- the means of access is deliberately provided to the operator;
- the operator is instructed to enter regardless of whether or not a tool is needed to gain access

The terms "access" and "accessible", unless qualified, relate to an operator access area as defined above.

**restricted access location** [b-IEC 60950-1]: location for equipment where both of the following apply:
- access can only be gained by service persons or by users who have been instructed about the reasons for the restrictions applied to the location and about any precautions that shall be taken; and
- access is through the use of a tool or lock and key, or other means of security, and is controlled by the authority responsible for the location

NOTE The requirements for equipment intended for installation in restricted access locations are the same as for operator access areas, except as given in 1.7.14, 2.1.3, 4.5.4, 4.6.2 and 5.1.7.

**service access area** [b-IEC 60950-1]: part of the equipment, other than an operator access area, where it is necessary for service persons to have access even with the equipment switched on

**IEC 62368-1, ed. 2.0 (2014-02)**

**restricted access area** [b-IEC 62368-1]: area accessible only to skilled persons and instructed persons with the proper authorization

**accessible** [b-IEC 62368-1]: touchable by a body part

Note 1 to entry: A body part is represented by one or more of the probes specified in Annex V, as applicable.

Cable

**IEC 60950-1, ed. 2.0 (2005-12)**

**interconnecting cable** [b-IEC 60950-1]: cable used to
- electrically connect an accessory to a unit of information technology equipment,
- interconnect units in a system, or
- connect a unit to a telecommunication network or to a cable distribution system

Such a cable may carry any type of circuit from one unit to another.

NOTE A power supply cord for connection to the mains supply is not an interconnecting cable.

**IEC 62368-1, ed. 2.0 (2014-02)**

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Circuit

IEC 60950-1, ed. 2.0 (2005-12)

ELV circuit [b-IEC 60950-1]: secondary circuit with voltages between any two conductors of the circuit, and between any one such conductor and earth (see 1.4.9), not exceeding 42.4 V peak, or 60 V d.c., under normal operating conditions, which is separated from hazardous voltage by basic insulation, and which neither meets all of the requirements for an SELV circuit nor meets all of the requirements for a limited current circuit

limited current circuit [b-IEC 60950-1]: circuit that is so designed and protected that, under both normal operating conditions and single fault conditions, the current that can be drawn is not hazardous

NOTE The limit values of currents under normal operating conditions and single fault conditions (see 1.4.14) are specified in 2.4.

primary circuit [b-IEC 60950-1]: circuit that is directly connected to the AC mains supply
It includes, for example, the means for connection to the AC mains supply, the primary windings of transformers, motors and other loading devices.

NOTE Conductive parts of an interconnecting cable may be part of a primary circuit as stated in 1.2.11.6.

SELV circuit [b-IEC 60950-1]: secondary circuit that is so designed and protected that under normal operating conditions and single fault conditions, its voltages do not exceed a safe value

NOTE 1 The limit values of voltages under normal operating conditions and single fault conditions (see 1.4.14) are specified in 2.2. See also Table 1A.

NOTE 2 This definition of an SELV circuit differs from the term "SELV system" as used in IEC 61140

TNV-1 circuit [b-IEC 60950-1]: TNV circuit
- whose normal operating voltages do not exceed the limits for an SELV circuit under normal operating conditions and
- on which overvoltages from telecommunication networks and cable distribution systems are possible

TNV-2 circuit [b-IEC 60950-1]: TNV circuit
- whose normal operating voltages exceed the limits for an SELV circuit under normal operating conditions and
- which is not subject to overvoltages from telecommunication networks

TNV-3 circuit [b-IEC 60950-1]: TNV circuit
- whose normal operating voltages exceed the limits for an SELV circuit under normal operating conditions and
- on which overvoltages from telecommunication networks and cable distribution systems are possible

TNV circuit [b-IEC 60950-1]: circuit that is in the equipment and to which the accessible area of contact is limited and that is so designed and protected that, under normal operating conditions and single fault conditions (see 1.4.14), the voltages do not exceed specified limit values
A TNV circuit is considered to be a secondary circuit in the meaning of this standard.

NOTE 1 The specified limit values of voltages under normal operating conditions and single fault conditions (see 1.4.14) are given in 2.3.1. Requirements regarding accessibility of TNV circuits are given in 2.1.1.1.

NOTE 2 Conductive parts of an interconnecting cable may be part of a circuit as stated in 1.2.11.6.

TNV circuits are classified as TNV-1 circuits, TNV-2 circuits and TNV-3 circuits as defined in 1.2.8.12, 1.2.8.13 and 1.2.8.14.

NOTE 3 The voltage relationships between SELV and TNV circuits are shown in Table 1A.

IEC 62368-1, ed. 2.0 (2014-02)

**external circuit [b-IEC 62368-1]:** electrical circuit that is external to the equipment and is not mains

Note 1 to entry: An external circuit is classified as ES1, ES2 or ES3, and PS1, PS2, or PS3.

**Conditions**

IEC 60950-1, ed. 2.0 (2005-12)

IEC 62368-1, ed. 2.0 (2014-02)

**abnormal operating condition [b-IEC 62368-1]:** temporary operating condition that is not a normal operating condition and is not a single fault condition of the equipment itself

Note 1 to entry: Abnormal operating conditions are specified in Clause B.3.

Note 2 to entry: An abnormal operating condition may be introduced by the equipment or by a person.

Note 3 to entry: An abnormal operating condition may result in a failure of a component, a device or a safeguard.

**normal operating condition [b-IEC 62368-1]:** mode of operation that represents as closely as possible the range of normal use that can reasonably be expected

Note 1 to entry: Unless otherwise stated, the most severe conditions of normal use are the most unfavourable default values as specified in Clause B.2.

Note 2 to entry: Misuse is not covered by normal operating conditions. Instead, it is covered by abnormal operating conditions.

**overload condition [b-IEC 62368-1]:** abnormal operating condition or single fault condition where the load stresses the equipment or circuit beyond normal operating conditions, but does not, immediately, result in a non-operating state

**single fault condition [b-IEC 62368-1]:** condition of equipment with a fault under normal operating condition of a single safeguard (but not a reinforced safeguard) or of a single component or a device

Note 1 to entry: Single fault conditions are specified in Clause B.4.

**Enclosure**

IEC 60950-1, ed. 2.0 (2005-12)

**electrical enclosure :** part of the equipment intended to limit access to parts that may be at hazardous voltages or hazardous energy levels or are in TNV circuits
**fire enclosure** : part of the equipment intended to minimize the spread of fire or flames from within

**IEC 62368-1, ed. 2.0 (2014-02)**

**electrical enclosure [b-IEC 62368-1]**: enclosure intended as a safeguard against electrically-caused injury

[SOURCE: IEC 60050-195:1998, 195-06-13, modified – the term safeguard has been used]

**fire enclosure [b-IEC 62368-1]**: enclosure intended as a safeguard against the spread of fire from within the enclosure to outside the enclosure

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**Insulation**

**IEC 60950-1, ed. 2.0 (2005-12)**

**basic insulation [b-IEC 60950-1]**: insulation to provide basic protection against electric shock

**double insulation [b-IEC 60950-1]**: insulation comprising both basic insulation and supplementary insulation

**functional insulation [b-IEC 60950-1]**: insulation that is necessary only for the correct functioning of the equipment

NOTE functional insulation by definition does not protect against electric shock. It may, however, reduce the likelihood of ignition and fire.

**reinforced insulation [b-IEC 60950-1]**: single insulation system that provides a degree of protection against electric shock equivalent to double insulation under the conditions specified in this standard

NOTE The term "insulation system" does not imply that the insulation has to be in one homogeneous piece. It may comprise several layers that cannot be tested as basic insulation and supplementary insulation.

**solid insulation [b-IEC 60950-1]**: material that provides electrical insulation between two opposite surfaces, not along an outer surface

NOTE The required properties of solid insulation are specified either as
- the actual minimum distance through the insulation (see 2.10.5.2), or by
- other requirements and tests in this standard instead of a minimum distance.

**supplementary insulation [b-IEC 60950-1]**: independent insulation applied in addition to basic insulation in order to reduce the risk of electric shock in the event of a failure of the basic insulation

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**IEC 62368-1, ed. 2.0 (2014-02)**

**basic insulation [b-IEC 62368-1]**: insulation to provide a basic safeguard against electric shock

Note 1 to entry: This concept does not apply to insulation used exclusively for functional purposes.

**double insulation [b-IEC 62368-1]**: insulation comprising both basic insulation and supplementary insulation


**functional insulation [b-IEC 62368-1]**: insulation between conductive parts which is necessary only for the proper functioning of the equipment
reinforced insulation [b-IEC 62368-1]: single insulation system that provides a degree of protection against electric shock equivalent to double insulation

solid insulation [b-IEC 62368-1]: solid insulating material placed between two conductive parts or between a conductive part and a body part

supplementary insulation [b-IEC 62368-1]: independent insulation applied in addition to basic insulation to provide a supplementary safeguard for fault protection against electric shock

Network

IEC 60950-1, ed. 2.0 (2005-12)

telecommunication network [b-IEC 60950-1]: metallically terminated transmission medium intended for communication between equipment that may be located in separate buildings, excluding:
- the mains system for supply, transmission and distribution of electrical power, if used as a telecommunication transmission medium;
- cable distribution systems;
- SELV circuits connecting units of information technology equipment

NOTE 1 The term telecommunication network is defined in terms of its functionality, not its electrical characteristics. A telecommunication network is not itself defined as being either an SELV circuit or a TNV circuit. Only the circuits in the equipment are so classified.

NOTE 2 A telecommunication network may be:
– publicly or privately owned;
– subject to transient overvoltages due to atmospheric discharges and faults in power distribution systems;
– subject to longitudinal (common mode) voltages induced from nearby power lines or electric traction lines.

NOTE 3 Examples of telecommunication networks are:
– a public switched telephone network;
– a public data network;
– an Integrated Services Digital Network (ISDN);
– a private network with electrical interface characteristics similar to the above.

telecommunication network transient voltage [b-IEC 60950-1]: highest peak voltage expected at the telecommunication network connection point of the equipment, arising from external transients on the network

NOTE The effect of transients from cable distribution systems is not taken into account.

IEC 62368-3 Draft

information and communication technology (ICT) network [b-IEC 62368-3]: metallically terminated transmission medium consisting of two conductors intended for communication between equipment that may be located in separate buildings, excluding:
- the mains system for supply, transmission and distribution of electrical power, if used as a communication transmission medium;
- dedicated HBES/BACS networks;
- external circuits using ES1 connecting units of audio/video, information and communication technology equipment
NOTE 1 to entry: This may include twisted pairs, and may include circuits, which are subjected to transients as indicated in table 14 of IEC 62368-1 ID1 (assumed to be 1,5kV),

NOTE 2 to entry: An ICT network may be:
- publicly or privately owned;
- subject to longitudinal (common mode) voltages induced from nearby power lines or electric traction lines,

NOTE 3 to entry: Examples of ICT networks are:
- a public switched telephone network;
- a public data network;
- an Integrated Services Digital Network (ISDN);
- a private network with electrical interface characteristics similar to the above.

NOTE 4 to entry: For information about circuit voltages and signals, which may be present, see Annex B of IEC 62949 (currently at CD stage).

Persons

IEC 60950-1, ed. 2.0 (2005-12)

service person [b-IEC 60950-1]: person having appropriate technical training and experience necessary to be aware of hazards to which that person may be exposed in performing a task and of measures to minimize the risks to that person or other persons

user [b-IEC 60950-1]: any person, other than a service person.

NOTE: The term user in this standard is the same as the term operator and the two terms can be interchanged

IEC 62368-1, ed. 2.0 (2014-02)

instructed person [b-IEC 62368-1]: person instructed or supervised by a skilled person as to energy sources and who can responsibly use equipment safeguards and precautionary safeguards with respect to those energy sources

Note 1 to entry: Supervised, as used in the definition, means having the direction and oversight of the performance of others.

ordinary person [b-IEC 62368-1]: person who is neither a skilled person nor an instructed person

skilled person [b-IEC 62368-1]: person with relevant education or experience to enable him or her to identify hazards and to take appropriate actions to reduce the risks of injury to themselves and others

Remote

IEC 60065, ed. 8.0 (2014-06)

remote power feeding [b-IEC 60065]: supply of power to apparatus via a cable network, for example a telecommunication network or a cable distribution network for antenna signals

IEC 60950-21, ed. 1.0 (2002-12)

RFT circuit; remote feeding telecommunication circuit [b-IEC 60950-21]: a secondary circuit within the equipment, intended to supply or receive d.c. power via a telecommunication network at voltages exceeding the limits for tnv circuits, and on which overvoltages from telecommunication networks are possible
RFT-C circuit [b-IEC 60950-21]: an rft circuit which is so designed and protected that under normal operating conditions and single fault conditions, the currents in the circuit do not exceed defined values

NOTE The limit values of current under normal operating and single fault conditions are specified in 6.1

RFT-V circuit [b-IEC 60950-21]: an rft circuit which is so designed and protected that under normal operating conditions and single fault conditions, the voltages are limited and the accessible area of contact is limited

NOTE The limit values of voltage under normal operating and single fault conditions are specified in 6.2

IEC 62368-3 Draft
RFT circuit, remote feeding (tele)communication circuit [b-IEC 62368-3]: circuit within the equipment not connected to an a.c. mains, intended to supply or receive d.c. power via an ICT network at voltages exceeding the limits of ES2, and on which overvoltages from ICT networks are possible

NOTE1 to entry: Communication signalling is not required to be present on an RFT circuit.

RFT-C circuit [b-IEC 62368-3]: RFT circuit which is so designed and protected that under normal operating conditions and single fault conditions, the currents in the circuit do not exceed defined values

NOTE 1 to entry: The limit values of current under normal operating conditions and single fault conditions are specified in 6.3.1.1.

RFT-V circuit [b-IEC 62368-3]: RFT circuit which is so designed and protected that under normal operating conditions and single fault conditions, the voltages are limited and the accessible area of contact is limited

NOTE 1 to entry: The limit values of voltage under normal operating conditions and single fault conditions are specified in 6.3.1.2.

Safeguard

IEC 60950-1, ed. 2.0 (2005-12)
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IEC 62368-1, ed. 2.0 (2014-02)
basic safeguard [b-IEC 62368-1]: safeguard that provides protection under normal operating conditions and under abnormal operating conditions whenever an energy source capable of causing pain or injury is present in the equipment

double safeguard [b-IEC 62368-1]: safeguard comprising both a basic safeguard and a supplementary safeguard

equipment safeguard [b-IEC 62368-1]: safeguard that is a physical part of the equipment

installation safeguard [b-IEC 62368-1]: safeguard that is a physical part of a man-made installation
instructional safeguard [b-IEC 62368-1]: instruction invoking specified behaviour

personal safeguard [b-IEC 62368-1]: personal protective equipment that is worn on the body and that reduces exposure to an energy source

Note 1 to entry: Personal protective equipment (PPE) is a form of a personal safeguard. Examples are shields, goggles, gloves, aprons, face masks or breathing apparatus.

precautionary safeguard [b-IEC 62368-1]: instructed person behaviour to avoid contact with or exposure to a class 2 energy source based on supervision or instructions given by a skilled person

reinforced safeguard [b-IEC 62368-1]: single safeguard that is operational under:
- normal operating conditions;
- abnormal operating conditions; and
- single fault conditions

safeguard [b-IEC 62368-1]: physical part or system or instruction specifically provided to reduce the likelihood of pain or injury, or, for fire, to reduce the likelihood of ignition or spread of fire

Note 1 to entry: See 0.5 for further explanation of a safeguard.

skill safeguard [b-IEC 62368-1]: skilled person behaviour to avoid contact with or exposure to a class 2 or class 3 energy source based on education and experience

supplementary safeguard [b-IEC 62368-1]: safeguard applied in addition to the basic safeguard that is or becomes operational in the event of failure of the basic safeguard

Sources

IEC 60950-1, ed. 2.0 (2005-12)
hazardous energy level [b-IEC 60950-1]: available power level of 240 VA or more, having a duration of 60 s or more, or a stored energy level of 20 J or more (for example, from one or more capacitors), at a potential of 2 V or more

IEC 62368-1, ed. 2.0 (2014-02)
electrical energy source (ES) class[b-IEC 62368-1]: prospective touch voltage and the touch current under normal operating conditions, abnormal operating conditions, and single fault conditions determined the class of energy source.

electrical energy source class 1, ES1 [b-IEC 62368-1]: class 1 electrical energy source with levels not exceeding ES1 limits under normal operating conditions and abnormal operating conditions that do not lead to a single fault conditions and not exceeding ES2 limits under single fault conditions of a basic safeguard.

NOTE ES1 may be accessible to an ordinary person (user in IEC 60950-1 terms). ES1 effects are; not painful on the body, but may be detectable and ignition of combustible materials not likely

electrical energy source class 2, ES2 [b-IEC 62368-1]: class 2 electrical energy source with levels not exceeding ES2 limits under normal operating conditions, abnormal operating conditions, and single fault conditions, but is not ES1.
NOTE ES2 may be accessible to an instructed person (no IEC 60950-1 equivalent to someone under supervision). ES2 effects are; painful on the body, but not an injury ignition of combustible materials possible, but limited growth and spread of fire

**electrical energy source class 3, ES3 [b-IEC 62368-1]:** class 3 electrical energy source with one or more parameters exceeding ES2 limits

NOTE ES3 may be accessible to a skilled person (service person in IEC 60950-1 terms). ES3 effects are; injury to the body and ignition of combustible materials likely with rapid growth and spread of fire

**electrical power source (PS) class[b-IEC 62368-1]:** electrical sources of heating classified by the maximum available power under the following conditions:
- for load circuits: a power source under normal operating conditions as specified by the manufacturer into a worst-case fault (see 6.2.2.2);
- for power source circuits: a worst-case power source fault into the specified normal load circuit (see 6.2.2.3).

**electrical power source class 1 (PS1) [b-IEC 62368-1]:** circuit where the power source, measured according to 6.2.2, does not exceed 15 W measured after 3 s.

NOTE The power available from external circuits described in Table 14, ID numbers 1 and 2, are considered to be PS1.

**electrical power source class 2 (PS2) [b-IEC 62368-1]:** circuit where the power source, measured according to 6.2.2:
- exceeds PS1 limits; and
- does not exceed 100 W measured after 5 s.

**electrical power source class 3 (PS3) [b-IEC 62368-1]:** circuit whose power source exceeds PS2 limits, or any circuit whose power source has not been classified.

**IEC 60065:2014**

**hazardous live [b-IEC 60065]:** electrical condition of an object from which a hazardous touch current (electric shock) could be drawn

Note 1 to entry: See 9.1.1.

**Touch**

**IEC 60950-1, ed. 2.0 (2005-12)**

**touch current [b-IEC 60950-1]:** electric current through a human body when it touches one or more accessible parts

NOTE touch current was previously included in the term "leakage current"

**IEC 62368-1, ed. 2.0 (2014-02)**

**prospective touch voltage [b-IEC 62368-1]:** voltage between simultaneously accessible conductive parts when those conductive parts are not being touched

**touch current [b-IEC 62368-1]:** electric current through a human body when body parts touch two or more accessible parts or one accessible part and earth
Voltage and current

IEC 60950-1, ed. 2.0 (2005-12)

**hazardous voltage [b-IEC 60950-1]:** voltage exceeding 42,4 V peak, or 60 V d.c., existing in a circuit that does not meet the requirements for either a limited current circuit or a TNV circuit

**limited current circuit [b-IEC 60950-1]:** circuit that is so designed and protected that, under both normal operating conditions and single fault conditions, the current that can be drawn is not hazardous

NOTE The limit values of currents under normal operating conditions and single fault conditions (see 1.4.14) are specified in 2.4.

**protective current rating [b-IEC 60950-1]:** rating of an overcurrent protective device that is known or assumed to be in place to protect a circuit

NOTE Rules to determine the value of the protective current rating are in 2.6.3.3.

**rated current [b-IEC 60950-1]:** input current of the equipment as declared by the manufacturer

**required withstand voltage [b-IEC 60950-1]:** peak voltage that the insulation under consideration is required to withstand

**telecommunication network transient voltage [b-IEC 60950-1]:** highest peak voltage expected at the telecommunication network connection point of the equipment, arising from external transients on the network

NOTE The effect of transients from cable distribution systems is not taken into account.

IEC 62368-1, ed. 2.0 (2014-02)

**mains transient voltage :** highest peak voltage expected at the mains input to the equipment arising from external transients

**protective current rating [b-IEC 62368-1]:** current rating of an overcurrent protective device that is in the building installation or in the equipment to protect a circuit

**rated current [b-IEC 62368-1]:** input current of the equipment as declared by the manufacturer at normal operating conditions

**required withstand voltage [b-IEC 62368-1]:** peak voltage that the insulation under consideration is required to withstand
### Appendix I
IEC 60950-1 voltages

**Introduction**
In the body of the standard defines the voltage limits for the various circuits.

**Parameters**
In an SELV circuit the voltages between any two conductors of the SELV circuit or circuits and between any one such conductor and earth shall not exceed 42.4 V rms maximum, or 60 V d.c..
Under a single fault condition and for periods of less than 200 ms the voltage shall not exceed 71 V rms maximum or 120 V d.c..

In a telecommunication network the transient overvoltage is assumed to be 1.5 kV peak in TNV-1 circuit and a TNV-3 circuit. IEC 60950 in clause G.3 specifies an 800 V peak transient overvoltage for an SELV circuit and a TNV-2 circuit if they are connected to a telecommunication network, yet the SELV and TNV-2 definitions say they are not subject to overvoltages!

From the conditions and values provided Table I.1 can be made to summarize the environments.

#### Table I.1 IEC 60950-1 voltage environments

<table>
<thead>
<tr>
<th>Condition</th>
<th>Voltage environment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SELV</td>
</tr>
<tr>
<td>d.c. supply voltage and signal (V)</td>
<td>&lt; 60</td>
</tr>
<tr>
<td>Single fault supply voltage &lt; 0.2 s (V)</td>
<td>&lt; 120</td>
</tr>
<tr>
<td>Telecommunications overvoltage (V)</td>
<td>NA see NOTE 2</td>
</tr>
</tbody>
</table>

**NOTE 1:** See IEC 60950-1 Figure 2F for other voltage-time values.
**NOTE 2:** IEC 60950-1 clause G.3 states an 800 V peak transient overvoltage for an SELV circuit and a TNV-2 circuit if they are connected to a telecommunication network.
Appendix II
IEC 62368-1 electrical source parameters

Introduction
Compared to a voltage source an energy source has additional attributes and some parameters may
have a range of values e.g. capacitance value with voltage in a given class. To fully understand the
energy source class requirements clause 5, Electrically-caused injury, must be read.

Power sources, which can be loads or sources, are classified by their steady state power after a
defined time period. There is no power limitation defined for the initial start-up time of 3 s to 5 s.

Parameters
From the clause 5 conditions and values Table II.1 summarizes spot parameter values for comparison
with Table I.1. For ES1 and ES2 energy sources all the parameters must conform to the class
requirements. An ES3 energy source has one or more parameters that exceed ES2 limit values.

Table II.1 IEC 62368-1 energy source parameters

<table>
<thead>
<tr>
<th>Condition</th>
<th>Energy source parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ES1</td>
</tr>
<tr>
<td>Steady state (&gt; 2 s) d.c. supply touch voltage (V)</td>
<td>see NOTE 1</td>
</tr>
<tr>
<td>Single fault supply touch voltage 0.2 s to 2 s (V)</td>
<td>see NOTE 5</td>
</tr>
<tr>
<td>Single fault supply touch voltage for &lt; 0.2 s (V)</td>
<td>see NOTE 5</td>
</tr>
<tr>
<td>DC touch current (mA)</td>
<td>see NOTE 6</td>
</tr>
<tr>
<td>Single fault supply touch current 0.2 s (mA)</td>
<td>see NOTE 6</td>
</tr>
<tr>
<td>Capacitance of charged capacitor (nF)</td>
<td>see NOTE 3</td>
</tr>
<tr>
<td>External paired conductor circuit overvoltage (V)</td>
<td>see NOTE 4</td>
</tr>
</tbody>
</table>

NOTE 1 Applies to normal operating conditions, abnormal operating conditions, and single fault conditions for periods greater than 2 s.
NOTE 2 Other time values of voltage are given in IEC 62368-1 Table 6
NOTE 3 Value given is for the steady state supply voltage.
Other capacitance values for different voltages are given in IEC 62368-1 Table 5
NOTE 4 Only differential if one conductor is earthed in the equipment.
NOTE 5 ES1 values from IEC 62368 Table 6 quoted. However, under single fault conditions of a basic safeguard the single fault ES2 limits
Power source classifications and measurements are described in the 6.2.2 Power source circuit classifications clause. Table II.2 reports the levels defined in clause 6.2.2.

### Table II.2 IEC 62368-1 power source parameters

<table>
<thead>
<tr>
<th>Condition</th>
<th>Power source parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PS1</td>
</tr>
<tr>
<td>Maximum steady state power (W)</td>
<td>15, &gt;3 s</td>
</tr>
<tr>
<td>see NOTE</td>
<td></td>
</tr>
<tr>
<td>Short term power (W)</td>
<td>Undefined, &lt; 3 s, see NOTE 5</td>
</tr>
</tbody>
</table>

**NOTE** The electrical power source classification shall be determined by measuring the maximum power under each of the following conditions:
- for load circuits: a power source under normal operating conditions as specified by the manufacturer into a worst-case fault (see 6.2.2.2);
- for power source circuits: a worst-case power source fault into the specified normal load circuit (see 6.2.2.3).
Appendix III
Safety equivalence of IEC 60950-1 and IEC 62368-1

Introduction
This data is from IEC 62368-1 Annex W (informative) Comparison of terms introduced in this standard. People miss the important Annex statement of “The (sic electrical energy source) electrical characteristics are not identical to TNV circuits but will give equivalent level of safety”. Thus it is wrong to say a circuit containing an ES2 on which transients occur is equivalent to a TNV-3 circuit. But one can say that the same safety rules apply.

Safety equivalence
From a safety perspective the following approximations can be made according to IEC 62368-1 Annex W.

Table III.1 SAFETY equivalence of IEC 60950-1 and IEC 62368-1

<table>
<thead>
<tr>
<th>IEC 60950-1</th>
<th>IEC 62368-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>SELV</td>
<td>ES1</td>
</tr>
<tr>
<td>TNV-1</td>
<td>ES1</td>
</tr>
<tr>
<td></td>
<td>External circuits have impulse testing see NOTES 1 through 3</td>
</tr>
<tr>
<td>TNV-2</td>
<td>ES2</td>
</tr>
<tr>
<td>TNV-3</td>
<td>ES2</td>
</tr>
<tr>
<td></td>
<td>External circuits have impulse testing see NOTES 1 through 3</td>
</tr>
</tbody>
</table>

NOTE 1 Paired conductor (shielded or unshielded) - tested with 1500 V, 10/700. Only differential if one conductor is earthed in the equipment.
NOTE 2 Any other conductors – tested with mains transient or known external circuit overvoltage impulse whichever is higher. The external circuit is not earthed at either end, but there is an earth reference.
NOTE 3 Cable distribution network coaxial cable – tested with 4000 V, 10/700 centre conductor to shield cable (shield is earthed at the equipment). Not applicable to power-fed coaxial repeaters.

Bibliography
[b-IEC 62368-3] IEC 62368-3:Draft CD 2015, Part 3: DC power transfer through information technology communication cabling