New standards **EN 50678** and **EN 50699**

An overview of implementation

METREL®

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New standards **EN 50678** and **EN 50699**

New EN standards for periodic tests and tests after repair

CENELEC has published new standards EN 50678 and EN 50699 in March 2020 and November 2020 respectively. The aforementioned standards support the compliance with the European Directive for Occupational Safety 2009/104/EU on minimum safety and health requirements for the use of work equipment by qualified personnel.

- EN 50678: 2020 – General procedure for verifying the effectiveness of the protective measures of electrical equipment after repair
- EN 50699: 2020 – Recurrent Test of Electrical Equipment

CENELEC members (only European countries) are obliged to adopt these two new standards and withdraw conflicting national standards, although they can do so at their own pace (i.e., different transition periods). The aim of CENELEC is increasing uniformity regarding standards in Europe and consequently strengthening the European single market and reduce non-tariff barriers to trade.

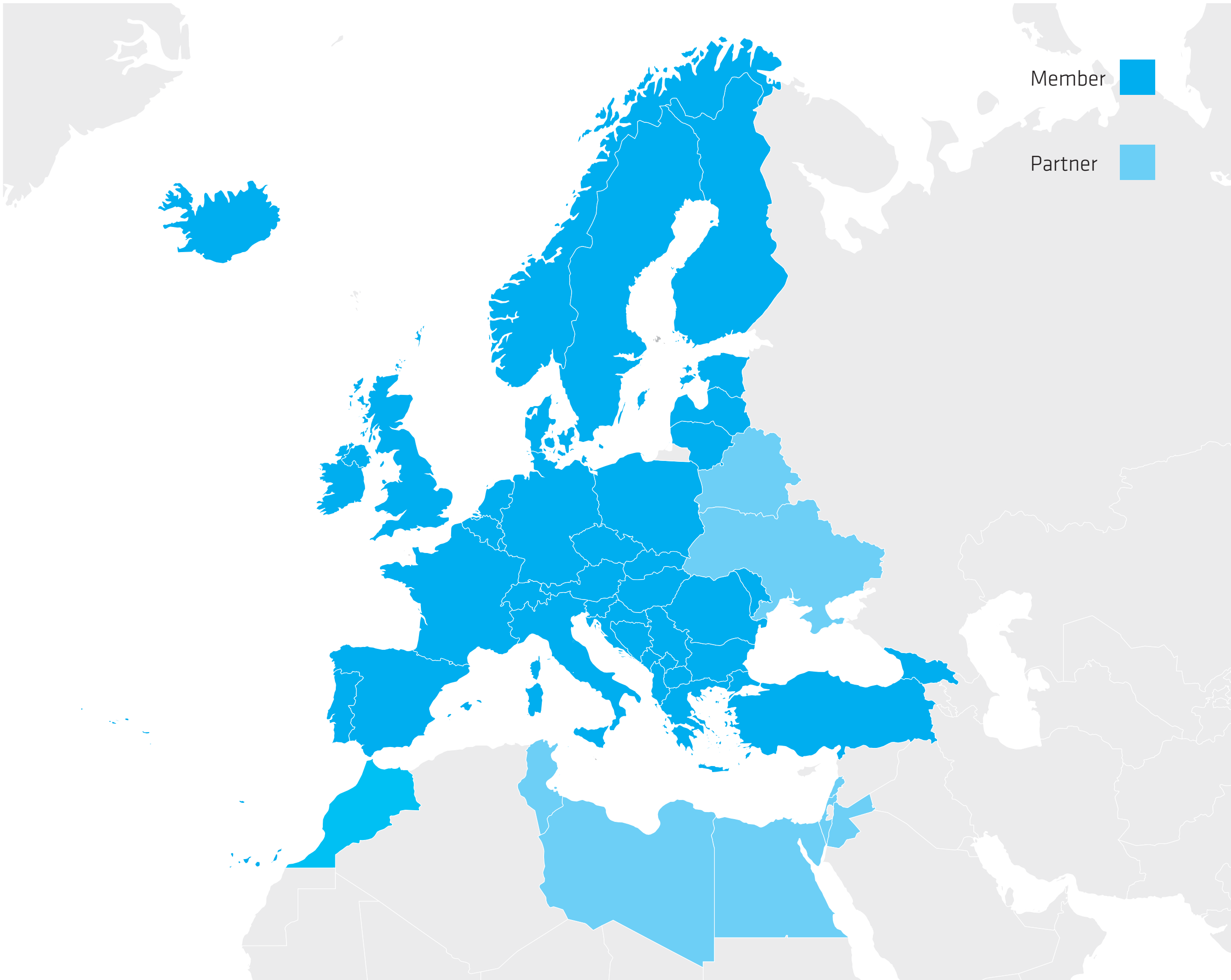
New standards **EN 50678** and **EN 50699**

Comité Européen de Normalisation Électrotechnique (CENELEC)

One of three major standardization organizations in Europe, the other two being CEN and ETSI, responsible for standardization in Europe. CENELEC specifically for standardization in the field of electrical engineering.

In general, the objective of CENELEC is harmonization of national standards in member countries through the introduction of uniform European standards. Additionally, CENELEC facilitates access at both the international and European level by adopting international standards, in close cooperation with the International Electrotechnical Commission or IEC (under the Frankfurt Agreement).

CENELEC members are Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Northern Macedonia, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, and the United Kingdom.



New standards **EN 50678** and **EN 50699**

Standard EN 50678: 2020

The new EN 50678: 2020 standard, titled General procedure for verifying the effectiveness of the protective measures of electrical equipment after repair, was published in March 2020. It applies to equipment that is connected via a plug or is permanently connected to final circuits with a rated voltage of more than 25 V AC and 60 V DC and up to 1000 V AC and 1500 V DC and with currents of up to 63 A.

The standard applies to all electrical equipment except for:
- Audio/video and IT equipment.
- Uninterruptible power supply (UPS) systems.
- Programmable logic controllers (PLCs).
- Charging stations for electric vehicles (EVs).
- Power drives.
- Power supplies.
- Equipment for explosive (EX) zones or for mining applications in general.
- Recurrent tests defined in EN 50699.
- Devices and equipment that are part of fixed electrical installations (covered by HD 60364-6 standard).
- Medical equipment covered by EN 60601-1 (tests for verification after repair are covered by EN 62353 standard).
- Arc welding equipment covered by EN IEC 60974-1 (tests for verification after repair are covered by EN 60974-4 standard).
- Machinery covered by EN 60204-1 (tests for verification after repair are covered by EN 60204-1).

	Country	National Organization	Website	National Reference
1	Austria	AS	https://www.austrian-standards.at	OVE EN 50678:2021
2	Czech Republic	ÚNMZ	https://www.unmz.cz	ČSN EN 50678:2021
3	Belgium	NBN	http://www.nbn.be	NBN EN 50678:2020
4	Bulgaria	BDS	https://bds-bg.org	EN 50699:2021
5	Croatia	HZN	http://www.hzn.hr	HRN EN 50678:2020
6	Cyprus	CYS	http://www.cys.org.cy	CYS EN 50678:2020
7	Denmark	DS	http://www.ds.dk	DS/EN 50678:2020
8	Estonia	EVS	http://www.evs.ee	EVS-EN 50678:2020
9	Finland	SESKO	http://www.sesko.fi	SFS-EN 50678:2020:en
10	France	AFNOR	https://www.afnor.org	NF EN 50678:2020
11	Island	IST	http://www.stadlar.is	ÍST EN 50678:2020
12	Ireland	NSAI	http://www.nsai.ie	I.S. EN 50678:2020
13	Italy	CEI	http://www.ceinorme.it	CEI EN 50678:2020
14	Latvia	LVS	http://www.lvs.lv	LVS EN 50678:2020
15	Lithuania	LSD	http://www.lsd.lt	LST EN 50678:2020
16	Luxembourg	ILNAS	https://portail-qualite.public.lu	ILNAS EN 50678:2020
17	Malta	MCCAA	https://www.mccaa.org.mt	SM EN 50678:2020
18	Netherlands	NEN	http://www.nen.nl	NEN-EN 50678:2020
19	Norway	NEK	http://www.nek.no	NEK EN 50678:2020
20	Serbia	ISS	https://iss.rs	SRPS EN 50678:2020
21	Slovakia	UNMS	https://normy.unms.sk	STN EN 50678
22	Slovenija	SIST	https://www.sist.si	SIST EN 50678:2020
23	Spain	CTN 82/SC 4	https://www.une.org	UNE-EN 50678:2020
24	Sweden	SIS	https://www.sis.se	SS-EN 50676:2020
25	Switzerland	Electrosuisse	http://www.electrosuisse.ch	SNEN 50678:2020
26	United Kingdom	BSI	http://bsigroup.com	BS EN 50678:2020

New standards **EN 50678** and **EN 50699**

Standard EN 50699: 2020

The new EN 50699: 2020 standard, titled Recurrent Test of Electrical Equipment, was published in November 2020. It applies to equipment that is connected via a plug or is permanently connected to final circuits with a rated voltage of more than 25 V AC and 60 V DC and up to 1000 V AC and 1500 V DC and with currents of up to 63 A.

The standard applies to all electrical equipment except for:

- Type, sample, routine, special, and acceptance tests for product safety and functional requirements.
- Tests covered by product standards.
- Uninterruptible power supply (UPS) systems.
- Photovoltaic inverters and power converters.
- Programmable logic controllers (PLCs).
- Charging stations for electric vehicles (EVs).
- Power drives.
- Power supplies.
- Equipment for explosive (EX) zones or for mining applications in general.
- Tests after repair defined in EN 50678.
- Devices and equipment that are part of fixed electrical installations (covered by HD 60364-6 standard).
- Medical equipment covered by EN 60601-1 (tests for verification after repair are covered by EN 62353 standard).
- Arc welding equipment covered by EN IEC 60974-1 (tests for verification after repair are covered by EN 60974-4 standard).
- Machinery covered by EN 60204-1 (tests for verification after repair are covered by EN 60204-1).

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3	Belgium	NBN	http://www.nbn.be	NBN EN 50699:2020
4	Bulgaria	BDS	https://bds-bg.org	EN 50699:2021
5	Croatia	HZN	http://www.hzn.hr	HRN EN 50699:2020
6	Cyprus	CYS	http://www.cys.org.cy	CYS EN 50699:2020
7	Denmark	DS	http://www.ds.dk	DS/EN 50699:2020
8	Estonia	EVS	http://www.evs.ee	EVS-EN 50699:2020
9	Finland	SESKO	http://www.sesko.fi	SFS-EN 50699:2020:en
10	France	AFNOR	https://www.afnor.org	NF EN 50699:2020
11	Island	IST	http://www.stadlar.is	ÍST EN 50699:2020
12	Ireland	NSAI	http://www.nsai.ie	I.S. EN 50699:2020
13	Italy	CEI	http://www.ceinorme.it	CEI - EN 50699:2021
14	Latvia	LVS	http://www.lvs.lv	LVS EN 50699:2021
15	Lithuania	LSD	http://www.lsd.lt	LST EN 50699:2020
16	Luxembourg	ILNAS	https://portail-qualite.public.lu	ILNAS-EN 50699:2020
17	Malta	MCCAA	https://www.mccaa.org.mt	SM EN 50699:2020
18	Netherlands	NEN	http://www.nen.nl	NEN-EN 50699:2020 en
19	Norway	NEK	http://www.nek.no	NEK EN 50699:2020
20	Serbia	ISS	https://iss.rs	SRPS EN 50699:2020
21	Slovakia	UNMS	https://normy.unms.sk	STN EN 50699:2021
22	Slovenija	SIST	https://www.sist.si	SIST EN 50699:2021
23	Spain	CTN 82/SC 4	https://www.une.org	UNE-EN 50699:2020
24	Sweden	SIS	https://www.sis.se	SS-EN 50699:2021
25	Switzerland	Electrosuisse	http://www.electrosuisse.ch	SNEN 50699:2020
26	United Kingdom	BSI	http://bsigroup.com	BS EN 50699:2020

New standards **EN 50678** and **EN 50699**

Implementation of new standards in Metrel instruments

What is new in EN 50678 and EN 50699 standards:

- Measuring instruments used for testing must comply with EN 61557-16 standard.
- Leakage current produced by a floating input must be verified.
- New calculation of limit value of protective bonding resistance for cross-section areas greater than 1.5 mm².

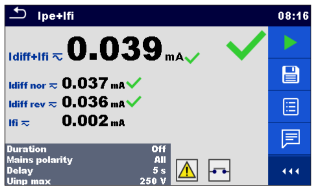
Metrel solution for specific testing equipment

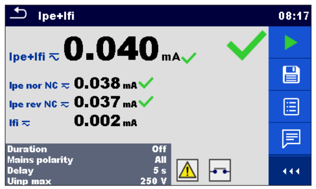
Examples of testing equipment complying with EN 61557-16 and having a leakage current produced by a floating input (with a rated input voltage above 50 V AC or 120 V DC) are for example power quality analysers (PQAs) and multimeters.

Standards require the evaluation of total touch-current/protective conductor current by the addition of the leakage current caused by the rated input voltage on the input terminals of such equipment. Consequently, Metrel developed two new measuring functions.

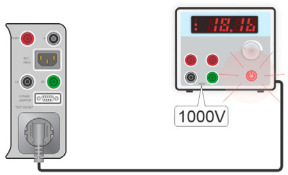
Ipe+Ifloating input

Total protective conductor current (direct/residual method) with addition of leakage current produced on floating inputs.

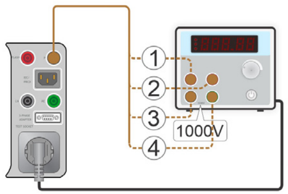




Test circuit



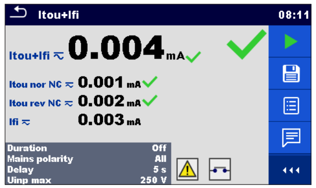
Step 1



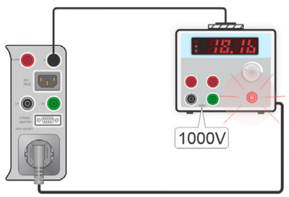
Step 2

Itouch+Ifloating input

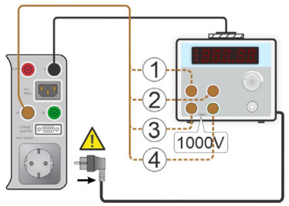
Total protective conductor current (direct/residual method) with addition of leakage current produced on floating inputs.



Test circuit

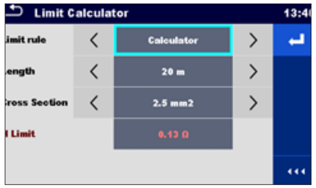


Step 1



Step 2

Limit calculator



Continuity and PE conductor resistance limit is calculated with the equation:

R=ρxL/A+0.1 Ω*

where:

- ρ - specific resistance of copper 1,68×10-8 Ωm
- L - wire length selected from a list (1 m, 2 m, 3 m, ... ,100 m) or a custom numeric entry
- A - wire cross section selected from a list (0.50 mm2, 0.75 mm², 1.00 mm², 1.50 mm², 2.5 mm², 4.0 mm², 6.0 mm², 10.0 mm², 16.0 mm²) or a custom numeric entry

*Note: The value of 0.1 Ω in the equation above considers the influence of the contact resistance.

Implementation of new standards in MI 3360

Metrel family of MI 3360 products now boasts:

- FW update in accordance with the requirements of the new EN standards.
- Updated AutoSequences covering both EN 50678 and EN 50699, plus additional test sequence for testing audio/video, information, and communication technology equipment after repair (in accordance with product standard IEC 62368-1).
- New optional accessory: A 1789 Single Fault Condition Adapter, which is designed to simulate abnormal operating conditions or single-fault conditions (SFC). Product standards such as EN 60601 and EN 62368 require testing leakage currents in single fault condition.

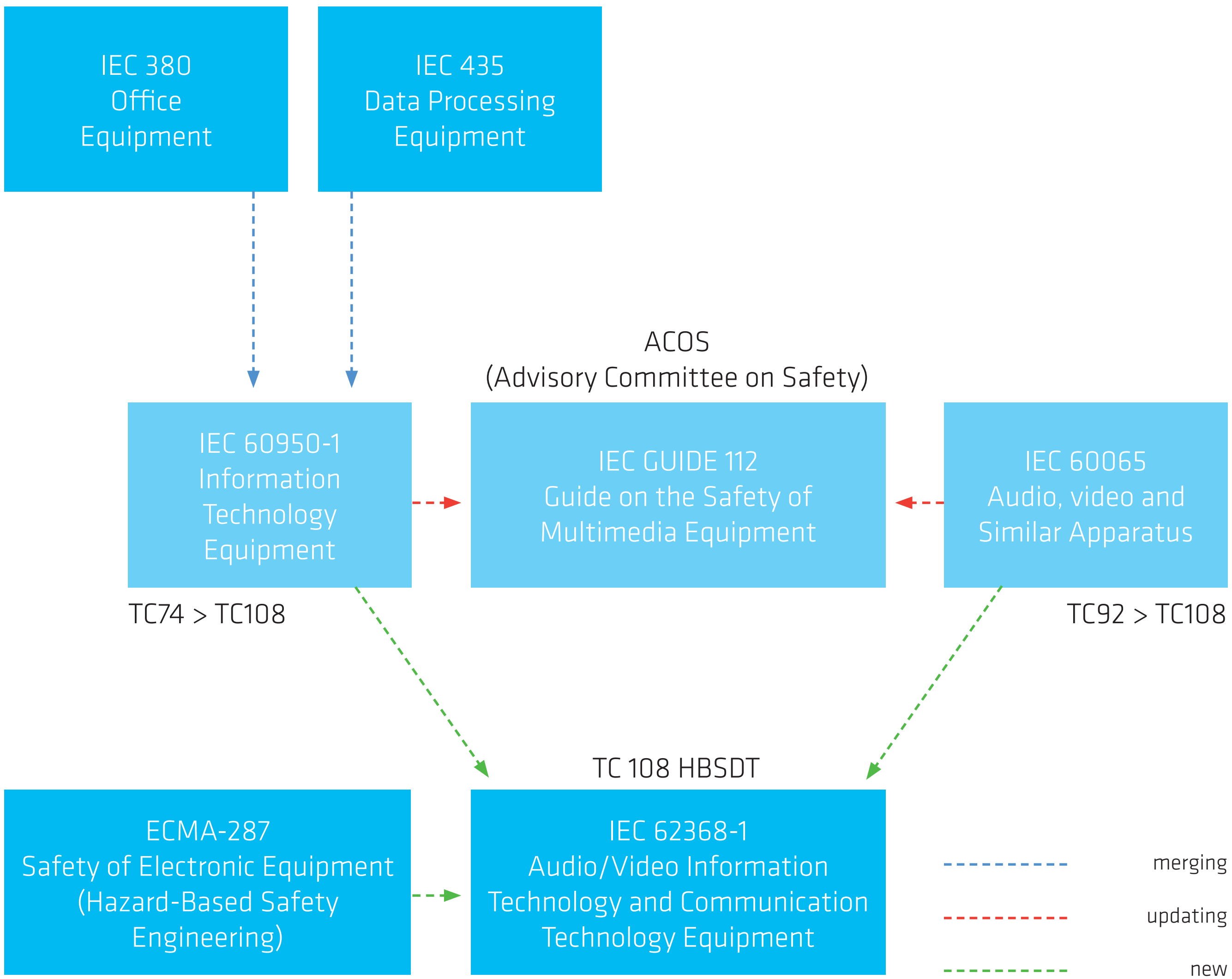

Single Fault Condition Adapter
normal
sf N
reversed
sf N
sf PE
S1
S2
S3
NC
NC
NC
sf = single fault
NC = normal condition
METREL
A 1789

Appendix: **IEC/EN 62368-1**

Overview

Like other exceptions listed on page 4 (EN 50678: 2020), testing of information technology after repair is not covered by EN 50678 standard, but by IEC/EN 62368-1. The latter specifically applies to audio, video, information, and telecommunication electrical and electronic equipment, and office machines and devices with a rated voltage not exceeding 600 V. Additionally, the standard also applies to assemblies and components that are integrated into such equipment.

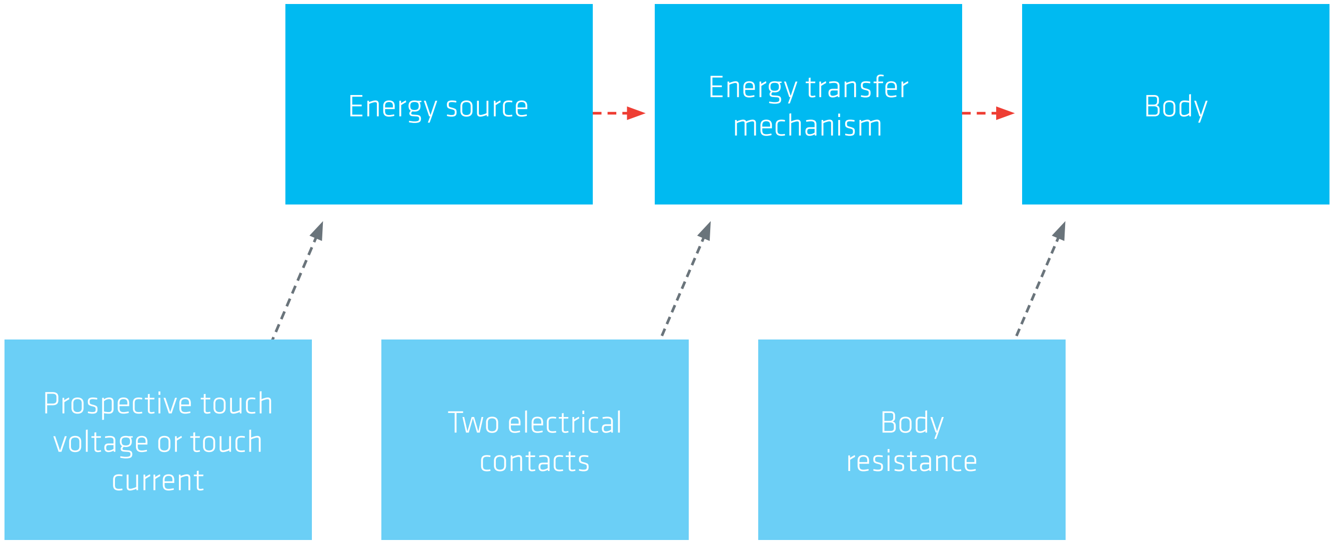
That said, it should be kept in mind that IEC/EN 62368-1 is not merely a merger of EN 50678 and other standards as one might think, but an entirely different, new standard. The schematic on the right explains how the new standard came to be much better and more clearly than words can. The history of creation of the standard aside, what's important is the safety model it uses to ascertain the degree of risk an energy source poses to a human body or property.



Model for pain and injury
An energy source causes pain or injury through (some form of) energy transfer to or from a body part (look at the schematic on the right). However, the energy threshold for pain or injury is not uniform throughout the population. The threshold may, for example (for some energy sources) be a function of a person's body mass; lower the mass, lower the threshold or vice versa.

Other notable variables include state of health, age, emotional state, presence of drugs or alcohol in the body, skin characteristics, etc. Lastly, pain perception varies greatly between individuals, meaning some are more affected than others despite all being subjected to an energy source of the same intensity or for the same time interval. In connection with the latter: the severity of harmful effects is a function of their magnitude and duration. Example: pain/injury by thermal energy can be caused by very high temperature for a very short time, or relatively moderate temperature for a long time.

Effects on the body per energy source class are also described in the table (somewhere on this page).



Model for pain and injury
In contrast to (highly variable) effects on the human body, effects on combustible materials are more precisely defined due to their (usually) uniform physical and chemical characteristics.

Effects on combustible materials per energy source class are also described in the table (somewhere on this page).

Energy sources	Effect on the human body	Effect on combustible materials
Class 1	Not painful, but may be detectable	Ignition not likely
Class 2	Painful, but not an injury	Ignition possible, but limited growth and spread of fire
Class 3	Injury	Ignition likely, rapid growth and spread of fire

Appendix: **IEC/EN 62368-1**

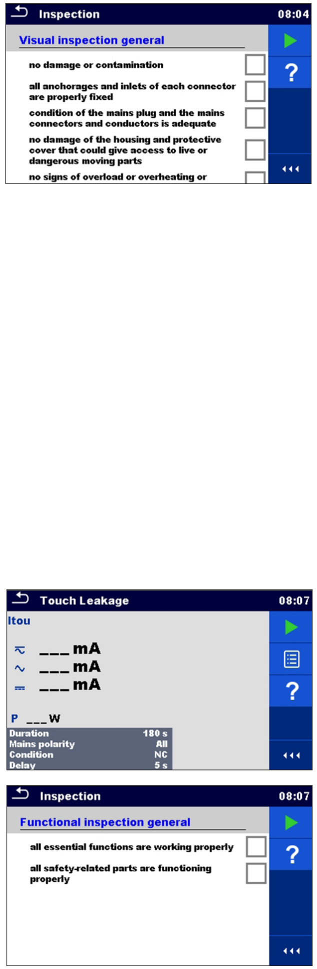
Overview

Energy sources in depth
There are (obviously) different types of energy sources that can cause different types of damage to the human body or combustible materials. More explicit examples are presented in the table below.

Forms of energy	Examples of effects on the body and combustible materials
Electrical energy (e.g., energized conductive parts)	Pain, fibrillation, cardiac arrest, respiratory arrest, skin burns, internal organ burns
Thermal energy (e.g., electrical ignition/fire)	Burn-related pain or injury or property damage
Chemical reaction (for example, electrolyte, poison)	Skin/organ damage
Kinetic energy (e.g., moving parts of equipment, or a moving body part against an equipment part)	Laceration, puncture, abrasion, contusion, crush, anputation, or loss of a limb, eye, ear, etc.
Thermal energy (e.g., hot accessible parts)	Skin burns
Radiated energy (e.g., electromagnetic energy, optical energy, acoustic energy, etc.)	Loss of sight, skin burns, or loss of hearing

Protection Class I

Protection Class II



ES3						> ES2
ES2	I	25 mA		5 mA RMS 7,07 mA peak		Figure 22, IEC 62368-1
	U	120 V	50 V RMS 70,7 V peak	50 V RMS + 0,9 f 70,7 V peak + 0,9 √2 f	140 V RMS 198 V peak	Figure 23, IEC 62368-1
ES1	I	2 mA		0,5 mA RMS 0,707 mA peak		(Idc(mA)/2)+(Iac RMS(mA)/0,5)≤1 (Idc(V)/2)+(Iac peak(mA)/0,707)≤1
	U	60 V	30 V RMS 42,4 V peak	30 V RMS + 0,4 f 42,4 V peak. + 0,4 √2 f	70 V RMS 99 V peak	(Udc(V)/60)+(Uac RMS(V)/(URMS limit))≤1 (Udc(V)/60)+(Uac peak(V)/(Upeak limit))≤1
Energy source		DC	AC to 1 kHz	AC > 1 kHz to 100 kHz	AC > 100 kHz	Combined AC & DC

As an alternative to the requirements above, the values below can be used for purely sinusoidal waveforms

ES3				> ES2
ES2	I RMS	5 mA	5 mA + 0,95 f	100 mA
ES1	I RMS	0,5 mA	0,5 mA × f	50 mA
Energy source		AC up to 1 kHz	AC > 1 kHz up to 100 kHz	AC above 100 kHz

Safeguards for protection of ordinary, instructed, and skilled persons

It should be noted that the requirements for the leakage current specified in the standard make a distinction with regard to which energy source (ESx) the user is exposed to. A layperson may only be exposed to an energy source 1, an instructed person to an energy source 2, and a qualified specialist to an energy source 3.

Energy source	Ordinary person	Instructed person	Skilled person
Class 1 ES	No safeguards	No safeguards	No safeguards
Class 2 ES	Basic safeguard	No safeguards	No safeguards
Class 3 ES	Basic safeguard reinforced safeguard	Basic safeguard reinforced safeguard	No safeguards

Equipment must be designed and constructed in such a manner that under normal, abnormal, and single fault operating conditions, integrated safety mechanisms reduce the likelihood of injury or property damage (fire).

The definition of a single fault condition (SFC)

A condition in which a single means for reducing a risk is defective, or a single abnormal condition is present. SFC is defined as a characteristic of electrical equipment, or its parts, whereby it remains free of unacceptable risk during its expected service life under single fault conditions.

For a device to remain single fault safe under the prescribed SFC, the following sequence of events must be considered:

- The first SFC can happen at any time.
- The device must remain single fault safe after the SFC.
- If the first SFC cannot be detected, then after some time a second SFC must be considered. This second SFC must be independent of the first SFC.
- The device must remain single fault safe after the occurrence of the first and the second SFC.

Therefore, it should be noted that the term single fault safe is misleading, because more than one SFC can occur, and the device can still be considered single fault safe.

WARNING!

According to EN 50678:2020 tests after repair must be performed only by an electrically skilled person.

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