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INTERNATIONAL STANDARD

colour inside

Resistance welding equipment –
Part 2: Electromagnetic compatibility (EMC) requirements

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

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

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RESISTANCE WELDING EQUIPMENT –

Part 2: Electromagnetic compatibility (EMC) requirements

FOREWORD

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This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

International Standard IEC 62135-2 has been prepared by IEC technical committee 26: Electric welding.

This third edition cancels and replaces the second edition published in 2015. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) update of the applicable limits related to the updated references;

b) implementation of radiated magnetic field requirements.

The text of this standard is based on the following documents:

FDIS	Report on voting
26/696/FDIS	26/698/RVD

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

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

A list of all parts of the IEC 62135 series, under the general title *Resistance welding equipment*, can be found on the IEC website.

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- withdrawn,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

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

RESISTANCE WELDING EQUIPMENT –

Part 2: Electromagnetic compatibility (EMC) requirements

1 Scope

This part of IEC 62135 is applicable to equipment for resistance welding and allied processes which are connected to mains supplies with rated voltages up to 1 000 V AC RMS. This document does not define safety requirements.

Resistance welding equipment type tested in accordance with, and which has met the requirements of, this document, is deemed to be in compliance for all applications.

The frequency range covered is from 0 Hz to 400 GHz.

Arc welding equipment containing a radio receiver or transmitter is within the scope of this document. Additional requirements for such equipment is specified in Annex D.

The radiated emission requirements in this document are not intended to be applicable to the intentional transmissions from a radio transmitter as defined by the ITU nor to any spurious emissions related to these intentional transmitters.

This product EMC standard for resistance welding equipment takes precedence over all aspects of the generic standards and no additional EMC tests are required or necessary.

NOTE 1 Typical allied processes are resistance hard and soft soldering or resistance heating achieved by means comparable to resistance welding equipment.

NOTE 2 Limit values are specified for only part of the frequency range.

Resistance welding equipment are classified as Class A and Class B equipment.

This part of IEC 62135 specifies

a) test methods to be used in conjunction with CISPR 11:2015, CISPR 11:2015/AMD1:2016 and CISPR 11:2015/AMD2:2019 to determine radio-frequency (RF) emission;

b) relevant standards and test methods for harmonic current emission, voltage fluctuation and flicker;

c) additional requirements for equipment powered by internal or external batteries (Annex C).

NOTE 3 The limits in this document cannot, however, provide full protection against interference to radio and television reception when the resistance welding equipment is used closer than 30 m to the receiving antenna(e).

NOTE 4 In special cases, when highly susceptible apparatus is being used in close proximity, additional mitigation measures are sometimes employed to further reduce the electromagnetic emissions.

NOTE 5 The origins of the limit values in this document are summarized in Annex A.

This part of IEC 62135 also defines immunity requirements and test methods for continuous and transient, conducted and radiated disturbances including electrostatic discharges.

NOTE 6 These requirements do not, however, cover extreme cases which are extremely rare.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

~~IEC 60050-161, *International Electrotechnical Vocabulary – Chapter 161: Electromagnetic compatibility*~~

~~IEC 60050-851, *International Electrotechnical Vocabulary – Part 851: Electric welding*~~

IEC 61000-3-2:~~2014~~2018, *Electromagnetic compatibility (EMC) – Part 3-2: Limits – Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)*

IEC 61000-3-3:2013, *Electromagnetic compatibility (EMC) – Part 3-3: Limits – Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current ≤ 16 A per phase and not subject to conditional connection*
IEC 61000-3-3:2013/AMD1:2017

IEC 61000-3-11:~~2000~~2017, *Electromagnetic compatibility (EMC) – Part 3-11: Limits – Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems – Equipment with rated current ≤ 75 A and subject to conditional connection*

IEC 61000-3-12:2011, *Electromagnetic compatibility (EMC) – Part 3-12: Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current > 16 A and ≤ 75 A per phase*

IEC 61000-4-2:2008, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test*

IEC 61000-4-3:2006, *Electromagnetic compatibility (EMC) – Part 4-3 : Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test*
IEC 61000-4-3:2006/AMD1:2007
IEC 61000-4-3:2006/AMD2:2010

IEC 61000-4-4:2012, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test*

IEC 61000-4-5:2014, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test*
IEC 61000-4-5:2014/AMD1:2017

IEC 61000-4-6:2013, *Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields*

IEC 61000-4-11:2004, *Electromagnetic compatibility (EMC) – Part 4-11: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests*
IEC 61000-4-11:2004/AMD1:2017

IEC 61000-4-34:2005, *Electromagnetic compatibility (EMC) – Part 4-34: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests for equipment with input current more than 16 A per phase*
IEC 61000-4-34:2005/AMD1:2009

IEC 61000-6-1:2016, *Electromagnetic compatibility (EMC) – Part 6-1: Generic standards – Immunity standard for residential, commercial and light-industrial environments*

IEC 61000-6-2:2016, *Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity standard for industrial environments*

IEC 61000-6-3:2006, *Electromagnetic compatibility (EMC) – Part 6-3: Generic standards – Emission standard for residential, commercial and light-industrial environments*
IEC 61000-6-3:2006/AMD1:2010

IEC 61000-6-4:2018, *Electromagnetic compatibility (EMC) – Part 6-4: Generic standards – Emission standard for industrial environments*

IEC 62135-1:2015, *Resistance welding equipment – Part 1: Safety requirements for design, manufacture and installation*

ISO 669:2016, *Resistance welding – Resistance welding equipment – Mechanical and electrical requirements*

CISPR 11:~~2009~~2015, *Industrial, scientific and medical equipment – Radio-frequency disturbance characteristics – Limits and methods of measurement*
~~CISPR 11:2009/AMD 1:2010~~
CISPR 11:2015/AMD1:2016
CISPR 11:2015/AMD2:2019

CISPR 16-1-1:2019, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-1: Radio disturbance and immunity measuring apparatus – Measuring apparatus*

CISPR 16-1-2:2014, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-2: Radio disturbance and immunity measuring apparatus – Coupling devices for conducted disturbance measurements*
CISPR 16-1-2:2014/AMD1:2017

CISPR 16-1-4:2019, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-4: Radio disturbance and immunity measuring apparatus – Antennas and test sites for radiated disturbance measurements*

~~ISO 669, *Resistance welding – Resistance welding equipment – Mechanical and electrical requirements*~~

3 Terms and definitions

~~For the purposes of this document, the terms and definitions given in IEC 60050-161 concerning EMC and the relevant phenomena, given IEC 60050-851, IEC 62135-1 and ISO 669 on resistance welding equipment, as well as the following, apply.~~

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
cable port
point at which a conductor or a cable is connected to the apparatus

Note 1 to entry: Examples are signal, control and power ports.

Note 2 to entry: The welding circuit of resistance welding equipment is not a cable port but is part of the enclosure port.

~~**3.2**~~
~~**conventional load**~~
~~load condition with the electrodes short-circuiting as defined in ISO 669~~

~~**3.3**~~
~~**conventional value**~~
~~standardized value that is used as a measure of a parameter for the purposes of comparison, calibration, testing, etc.~~

~~Note 1 to entry: Conventional values do not necessarily apply during the actual welding process.~~

3.2
click
disturbance which exceeds the limit of continuous disturbance no longer than 200 ms and which is separated from a subsequent disturbance by at least 200 ms

Note 1 to entry: Both intervals are related to the level of the limit of continuous disturbance.

Note 2 to entry: A click may contain a number of impulses, in which case the relevant time is that from the beginning of the first to the end of the last impulse.

[SOURCE: IEC 60050-851:2008, 851-15-13]

3.3
enclosure port
physical boundary of the apparatus through which electromagnetic fields may radiate or impinge

3.4
FAR
fully-anechoic chamber
shielded enclosure, the internal surfaces of which are lined with radio-frequency-energy absorbing material (i.e. RF absorber) that absorbs electromagnetic energy in the frequency range of interest

[SOURCE: CISPR 11:2015/AMD1:2016, 3.20]

~~**3.5**~~
~~**EUT**~~
~~equipment under test~~

3.5
idle state
operating ~~mode~~ state in which the power is switched on~~, but~~ and the welding circuit is not energized

Note 1 to entry: For some types of equipment there is no idle state.

Note 2 to entry: For a power source in a mechanized system, the configuration to achieve idle state is defined by the manufacturer.

Note 3 to entry: An idle state can include a low energy state in which a welding process cannot be started without automatic or manual reactivation.

3.6
OATS
open-area test site
facility used for measurements of electromagnetic fields the intention for which is to simulate a semi-free-space environment over a specified frequency range that is used for radiated emission testing of products

Note 1 to entry: An OATS typically is located outdoors in an open area, and has an electrically-conducting ground plane.

[SOURCE: CISPR 11:2015/AMD1:2016, 3.21]

3.7
port
~~particular interface of the specified apparatus with the external electro-magnetic environment~~

particular interface of an equipment which couples this equipment with the external electromagnetic environment (IEC 60050-161:2018, 161-01-01) and through which the equipment is influenced by this environment

EXAMPLE Examples of ports of interest are shown in Figure 1. The enclosure port is the physical boundary of the apparatus (e.g. enclosure). The enclosure port provides for radiated and electrostatic discharge (IEC 60050-161:2018, 161-01-22) energy transfer, whereas the other ports provide for conducted energy transfer.

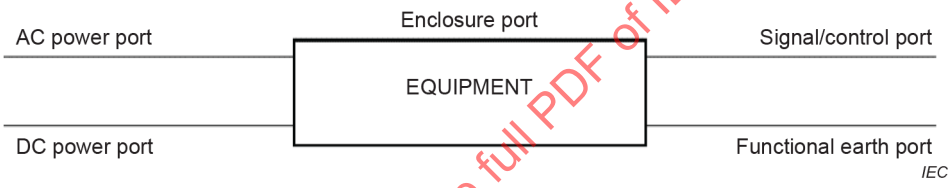


Figure 1 – Examples of ports

Note 1 to entry: Ports in the subject area of electromagnetic compatibility are specific cases of the port defined in IEC 60050-131:2002, 131-12-60.

[SOURCE: IEC Guide 107:2009, 3.1.12, modified – The presentation of the term and the wording of the definition have been revised for compatibility with IEC 60050 (all parts).]

3.8
SAC
semi-anechoic chamber
shielded enclosure, in which five of the six internal surfaces are lined with radio-frequency energy absorbing material (i.e. RF absorber) that absorbs electromagnetic energy in the frequency range of interest, and the bottom horizontal surface is a conducting ground plane for use with OATS test set-ups

[SOURCE: CISPR 11:2015/AMD1:2016, 3.22]

3.9
small equipment
equipment, either positioned on a table top or standing on the floor which, including its cables fits in an imaginary cylindrical test volume of 1,2 m in diameter and 1,5 m ~~above the~~ height (to ground plane)

~~[SOURCE: CISPR 11:2009/AMD1:2010, 3.10]~~

[SOURCE: CISPR 11:2015, 3.17, modified – Replacement of the term "small size equipment" by "small equipment".]

3.10
wired network port
port for the connection of voice, data and signalling transfers intended to interconnect widely-dispersed systems by direct connection to a single-user or multi-user communication network

Note 1 to entry: Examples of these include CATV, PSTN, ISDN, xDSL, LAN and similar networks.

Note 2 to entry: These ports may support screened or unscreened cables and may also carry AC or DC power where this is an integral part of the telecommunication specification.

[SOURCE: CISPR 32:2015, 3.1.32]

4 General test requirements

4.1 Test conditions

Tests shall be carried out on completely assembled equipment representative of the series production. Tests shall be performed within the specified operating conditions for the apparatus at its rated supply voltage and frequency as given in IEC 62135-1:2015. Results obtained for RF emission and immunity at 50 Hz are valid for the same model operating at 60 Hz and vice versa.

4.2 Measuring instruments

The measuring equipment shall comply with the requirements of CISPR 16-1-1:2019 and the standards referred to in Table 8, Table 9 and Table 10 as applicable.

4.3 Artificial mains network

Measurement of the mains terminal disturbance voltage shall be made using an artificial mains network, if commercially available, consisting of 50 Ω/50 μH or a 50 Ω/50 μH + 5 Ω V-network as specified in CISPR 16-1-2:2014 and CISPR 16-1-2:2014/AMD1:2017.

The artificial network is required to provide a defined impedance at RF across the mains supply at the point of measurement and also to provide for isolation of the equipment under test from ambient noise on the power lines.

4.4 Voltage probe

A voltage probe as specified in CISPR 16-1-2:2014 and CISPR 16-1-2:2014/AMD1:2017 shall be used when the artificial mains network cannot be used. The probe is connected sequentially between each line and the reference earth. The probe shall consist of a blocking capacitor and a resistor such that the total resistance between the line and earth is at least 1 500 Ω. The effect on the accuracy of measurement of the capacitor or any other device which may be used to protect the measuring receiver against dangerous currents shall be either less than 1 dB or allowed for in calibration.

4.5 Antennas

In the frequency range below 30 MHz the antenna shall be a loop as specified in CISPR 16-1-4:2019.

In the frequency range from 30 MHz to 1 GHz the antenna(s) used shall be as specified in CISPR 16-1-4:2019. Measurements shall be made for both horizontal and vertical polarization. The nearest point of the antenna(s) to the ground shall be not less than 0,2 m.

5 Test set-up for emission and immunity

5.1 General requirements

Emission and immunity testing shall be carried out on a representative resistance welding installation as described below. Resistance welding equipment tested in such an installation shall be considered to have met the necessary requirements of this document.

~~In any situation where it is necessary to re-test the equipment to show compliance with this standard the test setup originally chosen shall be used in order to guarantee consistency of the results, unless it is agreed by the manufacturer to do otherwise.~~

If the resistance welding equipment is part of an installation, or can be connected to auxiliary equipment, then the resistance welding equipment shall be tested whilst connected to the minimum configuration of auxiliary equipment necessary to exercise the ports. If the resistance welding equipment has a large number of similar ports or ports with many similar connections, then a sufficient number shall be selected to simulate actual operating conditions and to ensure that all the different types of termination are covered.

Measurements to determine compliance with the low-frequency emission limits shall be made in accordance with the test procedures of relevant basic and referenced standards.

For electromagnetic radiation disturbance tests the separation between the antenna and the equipment under test shall be as specified in Clause 6 of CISPR 11:~~2009~~2015, CISPR 11:2015/AMD1:2016 and CISPR 11:2015/AMD2:2019.

For radiated emission test in the frequency range between 150 kHz and 1 MHz, the antenna shall be positioned on the axis z, as given in Figure 2, perpendicular to the plane x, y of the welding circuit.

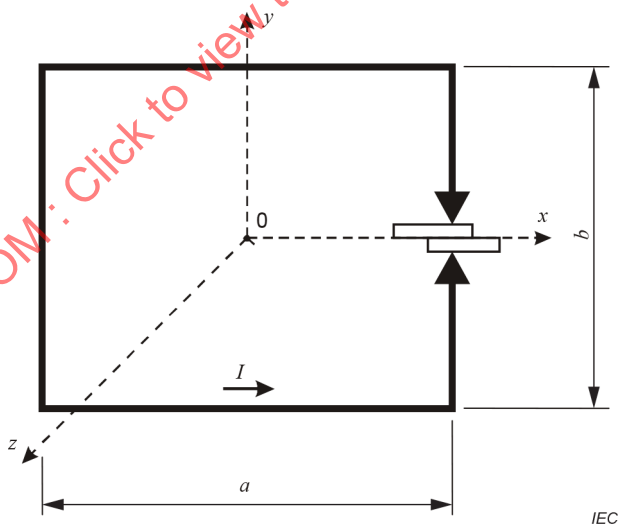


Figure 2 – Test position for H field measurement

Specific test set-up geometries for immunity tests are found in the basic standards referred to in Table 8, Table 9 and Table 10.

Class A resistance welding equipment may be measured either on a test site or *in situ* as preferred by the manufacturer.

NOTE 1 Due to size, complexity or operating conditions, some resistance welding equipment are sometimes measured *in situ* in order to show compliance with the radiation disturbance limits specified herein.

NOTE 2 By their nature, *in situ* tests are not adequate for type testing purposes.

Class B resistance welding equipment shall be measured on a test site.

The configuration of the resistance welding equipment under test shall be precisely noted in the test report.

5.2 Ancillary equipment

Ancillary equipment shall be tested in conjunction with the resistance welding equipment. It shall be connected, installed, configured and operated as recommended by the manufacturer.

6 Emission tests

6.1 Classification of equipment

6.1.1 Class A equipment

~~Class A equipment is intended for use in locations other than residential locations where the electrical power is provided by the public low-voltage supply system.~~

Class A equipment is equipment suitable for use in all locations other than those allocated in residential environments and those directly connected to a low voltage power supply network which supplies buildings used for domestic purposes.

NOTE This definition originates from CISPR 11:2015, 5.2.

Class A equipment shall meet class A limits in accordance with 6.3.

6.1.2 Class B equipment

~~Class B equipment is suitable for use in all locations, including residential locations where the electrical power is provided by the public low-voltage supply system.~~

Class B equipment is equipment suitable for use in residential environments and in establishments directly connected to a low voltage power supply network which supplies buildings used for domestic purposes.

NOTE This definition originates from CISPR 11:2015, 5.2.

Class B equipment shall meet Class B limits in accordance with 6.3.

6.2 Test conditions

6.2.1 Test conditions for RF tests

Measurements to determine compliance with the emission limits shall be made in accordance with the test procedures in CISPR 11:2015, CISPR 11:2015/AMD1:2016 and CISPR 11:2015/AMD2:2019 and as detailed below, using the test set-up given in Clause 5.

Resistance welding equipment is extremely diverse in its design and working conditions. It shall be tested under the following conditions:

a) idle state

b) loaded

- set up the welding circuit to minimize the impedance and to produce the highest flow of current (i.e., using minimum arms length and gap);
- set up the electrodes in short-circuit condition according to ISO 669:2016;
- adjust the current to obtain the highest emission, if means of adjustment are provided;

NOTE For thyristor-controlled equipment, an ignition delay angle of 90° typically gives the highest emission value.

– select a duty cycle and a welding heat time appropriate for the tested resistance welding equipment and the requirements of the measuring instrumentation.

The test parameters chosen shall be fully documented.

6.2.2 Test conditions for low-frequency tests

Resistance welding equipment is extremely diverse in its design and working conditions. It shall be tested under the following conditions:

– set up the welding circuit to minimize the impedance and to produce the highest flow of current;

– set up the electrodes in short-circuit condition according to ISO 669:2016;

– adjust the current to obtain the highest emission, if means of adjustment are provided;

– calculate the equipment duty cycle X at the maximum welding current based on Formula (1) and

$$X = \frac{(I_{2P})^2}{(I_{2cc})^2} \quad (1)$$

where

I_{2P} is the permanent output current;

I_{2cc} is the maximum short circuit welding current;

– select an observation period and a welding heat time appropriate for the calculated duty cycle, the tested resistance welding equipment and the requirements of the measuring instrumentation.

The test parameters chosen shall be fully documented.

The arithmetic average value of 1,5 s smoothed RMS supply current values (I_{ref} as per IEC 61000-3-12:2011) shall be measured when the welding equipment is delivering its maximum rated output current I_{2cc}.

For welding equipment with a rated maximum supply current I_{1cc} below 16 A, the reference current I_{ref} for the definition of limits shall be 16 A.

The maximum and arithmetic average values of 1,5 s smoothed RMS harmonic current values in each discrete Fourier transform (DFT) time window shall be determined over one or more full thermal cycle(s) including the idle state period.

The same welding heat time shall be used for the determination of I_{ref} and the harmonic component values.

NOTE An idle state period of more than 10 % is not a stand-by mode as defined in IEC 61000-3-12:2011, but an operational mode of the welding equipment within its full thermal cycle.

6.3 Emission limits

6.3.1 Mains terminal disturbance voltage

6.3.1.1 Idle state

~~The mains terminal disturbance voltage limits for class A resistance welding equipment in idle state, regardless of the rated input power, are given in Table 2 of CISPR 11:2009 in the column for a rated input power less than or equal to 20 kVA.~~

~~The mains terminal disturbance voltage limits for class B resistance welding equipment in idle state are given in Table 3 of CISPR 11:2009.~~

The mains terminal disturbance voltage limits for Class A and Class B resistance welding equipment in idle state are given in Table 1. The appropriate set of limits shall be selected in accordance with the maximum rated input power of the equipment, calculated using the rated maximum input current I_{1cc}.

Table 1 – Disturbance voltage limits – Idle state

Frequency range MHz	**Class B** dBµV		**Class A maximum rated input power ≤ 20 kVA** dBµV		**Class A maximum rated input power > 20 kVA**[a] **dBµV**		**Class A maximum rated input power > 75 kVA**[b] dBµV	
	Quasi-peak	Average	Quasi-peak	Average	Quasi-peak	Average	Quasi-peak	Average
0,15 to 0,50	66 Decreasing linearly with logarithm of frequency to 56	56 Decreasing linearly with logarithm of frequency to 46	79	66	100	90	130	120
0,50 to 5	56	46	73	60	86	76	125	115
5 to 30	60	50	73	60	90 Decreasing linearly with logarithm of frequency to 73	80 Decreasing linearly with logarithm of frequency to 60	115	105

At the transition frequency, the more stringent limit shall apply.

[a] These limits apply to equipment with a rated power > 20 kVA and intended to be connected to a dedicated power transformer or generator, and which is not connected to low voltage (LV) overhead power lines. For equipment not intended to be connected to a user specific power transformer the limits for ≤ 20 kV A apply. The manufacturer, and/or supplier shall provide information on installation measures that can be used to reduce emissions from the installed equipment. In particular it shall be indicated that this equipment is intended to be connected to a dedicated power transformer or generator and not to LV overhead power lines.

[b] These limits apply only to high power electronic systems and equipment with a rated power greater than 75 kVA when intended to be installed as follows:

- the installation is supplied from a dedicated power transformer or generator, and which is not connected to low voltage (LV) overhead power lines,
- the installation is physically separated from residential environments by a distance greater than 30 m or by a structure which acts as a barrier to radiated phenomena,
- the manufacturer and/or supplier shall indicate that this equipment meets the disturbance voltage limits for high power electronic systems and equipment of rated input power > 75 kVA and provide information on installation measures to be applied by the installer. In particular, it shall be indicated that this equipment is intended to be used in an installation which is powered by a dedicated power transformer or generator and not by LV overhead power lines.

NOTE Values are based on the limits for group 1 equipment in CISPR 11:2015, CISPR 11:2015/AMD1:2016 and CISPR 11:2015/AMD2:2019.

The equipment under test (EUT) shall meet either both average and quasi-peak limits using the corresponding detectors or the average limit when using the quasi-peak detector.

6.3.1.2 Loaded

The mains terminal disturbance voltage limits for Class A and Class B resistance welding equipment are the group 2 limits given in ~~Table 6 of CISPR 11:2009~~ Table 2. The appropriate set of limits shall be selected in accordance with the maximum rated input power of the equipment, calculated using the rated maximum input current I_{1cc}.

~~The mains terminal disturbance voltage limits for class B resistance welding equipment are the Group 2 limits given in Table 7 of CISPR 11:2009.~~

Table 2 – Disturbance voltage limits for Class A equipment – Loaded state

Frequency range MHz	Class B dBμV		Class A maximum rated input power ≤ 75 kVA[a] dBμV		Class A maximum rated input power > 75 kVA[a,b] dBμV	
	Quasi-peak	Average	Quasi-peak	Average	Quasi-peak	Average
0,15 to 0,50	66 Decreasing linearly with logarithm of frequency to 56	56 46	100	90	130	120
0,50 to 5	56	46	86	76	125	115
5 to 30	60	50	90 Decreasing linearly with logarithm of frequency to 73	80 60	115	105
At the transition frequency, the more stringent limit shall apply. [a] The maximum rated input power is calculated using the rated maximum supply current I_{1cc}. [b] The manufacturer and/or supplier shall provide information on installation measures that can be used to reduce emissions from the installed equipment..						

The EUT shall meet either both average and quasi-peak limits using the corresponding detectors or the average limit when using the quasi-peak detector.

For Class A equipment, impulse noise (clicks) which occurs less than 5 times per minute is not considered.

For Class B equipment, where impulse noise (clicks) ~~which~~ occurs less than 0,2 times per minute, a relaxation of the limits of 44 dB is allowed. For clicks appearing between 0,2 and 30 times per minute, a relaxation of the limits is allowed of 20 log (30/N) dB (where N is the number of clicks per minute). Criteria for separated clicks can be found in CISPR 14-1:2016.

6.3.2 Electromagnetic radiation disturbance

6.3.2.1 Idle state

~~The electromagnetic radiation disturbance limits for class A resistance welding equipment in idle state, regardless of the rated input power, are given in Table 4 of CISPR 11:2009 in the columns for a rated input power less than or equal to 20 kVA.~~

~~The electromagnetic radiation disturbance limits for class B resistance welding equipment are given in Table 5 of CISPR 11:2009/AMD1:2010.~~

The electromagnetic radiation disturbance limits for Class A and Class B resistance welding equipment in idle state are given in Table 3.

Table 3 – Electromagnetic radiation disturbance limits – Idle state

Frequency range MHz	Class B Quasi-peak dBμV/m			Class A Quasi-peak dBμV/m		
	OATS or SAC		FAR [a,b]	OATS or SAC		FAR [a,b]
	10 m measuring distance	3 m measuring distance [a]		10 m measuring distance	3 m measuring distance [a]	
30 to 230	30	40	42 to 35 Decreasing linearly with logarithm of frequency to 35	40	50	52 to 45 Decreasing linearly with logarithm of frequency to 45
230 to 1 000	37	47	42	47	57	52
On an OATS or in a SAC, Class A equipment can be measured at a nominal distance of 3 m, 10 m or 30 m. In case of measurements at a separation distance of 30 m, an inverse proportionality factor of 20 dB per decade shall be used to normalize the measured data to the specified distance for determining compliance. At the transition frequency, the more stringent limit shall apply.						
[a] The limits specified for the 3 m separation distance apply only to small equipment meeting the size criterion defined in 3.9. [b] The table-top equipment shall fit into the test volume of the FAR.						

6.3.2.2 Loaded

~~The electromagnetic radiation disturbance limits for class A resistance welding equipment in the frequency band 30 MHz to 1 000 MHz are the limits given in Tables 9 (test site) and 18 (in situ) of CISPR 11:2009/AMD1:2010.~~

~~The relaxations for class A limits in the frequency ranges 80,872 MHz to 81,848 MHz, 134,786 MHz to 136,414 MHz, 156 MHz to 174 MHz, 188,7 MHz to 190,979 MHz, 400 MHz to 470 MHz are not applicable to resistance welding equipment.~~

~~The electromagnetic radiation disturbance limits for class B resistance welding equipment are the Group 2 limits given in Table 11 of CISPR 11:2009/AMD1:2010.~~

~~The 20 dB relaxations for class B limits in the frequency ranges 80,872 MHz to 81,848 MHz and 134,786 MHz to 136,414 MHz are not applicable to resistance welding equipment.~~

The electromagnetic radiation disturbance limits for Class A resistance welding equipment in the frequency band 30 MHz to 1 000 MHz are the limits given in Table 4.

Table 4 – Electromagnetic radiation disturbance limits for Class A equipment – Loaded state

Frequency band	OATS or SAC			FAR
	On a test site at 30 m test distance	On a test site at 10 m test distance	On a test site at 3 m test distance[a]	On a test site at 3 m test distance[a,b]
MHz	dBμV/m	dBμV/m	dBμV/m	dBμV/m
30 to 47	58	68	78	80 to 78
47 to 54,56	40	50	60	60
54,56 to 68	40	50	60	60 to 59
68 to 81,848	53	63	73	72
81,848 to 87	53	63	73	72 to 71
87 to 134,786	50	60	70	68 to 67
134,786 to 136,414	50	60	70	67
136,414 to 156	50	60	70	67 to 66
156 to 174	50	60	70	66
174 to 188,7	40	50	60	56
188,7 to 190,979	40	50	60	66
190,979 to 230	40	50	60	56 to 55
230 to 1 000	50	60	70	65
At the transition frequency, the more stringent limit shall apply. The limit for measurements in the FAR decreases linearly with the logarithm of the frequency.				
[a] The limits specified for the 3 m separation distance apply only to small equipment meeting the size criterion defined in 3.9. [b] The table-top equipment shall fit into the test volume of the FAR.				

The electromagnetic radiation disturbance limits for class B resistance welding equipment are limits given in Table 5 and Table 6.

Table 5 – Electric field radiation disturbance limits for Class B equipment – Loaded state

Frequency band	OATS or SAC				FAR	
	On a test site at 10 m test distance		On a test site at 3 m test distance[a]		On a test site at 3 m test distance[a,b]	
	Quasi-peak	Average	Quasi-peak	Average	Quasi-peak	Average
MHz	dBμV/m		dBμV/m		dBμV/m	
30 to 230	30	25	40	35	42 to 35	37 to 30
230 to 1 000	37	32	47	42	42	37
At the transition frequency, the more stringent limit shall apply. The limit for measurements in the FAR decreases linearly with the logarithm of the frequency.						
[a] The limits specified for the 3 m separation distance apply only to small equipment meeting the size criterion defined in 3.9. [b] The table-top equipment shall fit into the test volume of the FAR.						

Table 6 – Magnetic field radiation disturbance limits for Class B equipment – Loaded state

Frequency band MHz	On a test site at 3 m test distance Quasi-peak dB(μA/m)
0,15 to 30	39 Decreasing linearly with the logarithm of frequency to 3
At the transition frequency, the more stringent limit shall apply.	

For equipment measured *in situ*, electromagnetic radiation disturbance limits in Table 7 apply.

Table 7 – In-situ electromagnetic radiation disturbance limits for Class A equipment – Loaded state

Frequency band MHz	At distance D from exterior wall of the building Quasi-peak dBμV/m
30 to 47	48
47 to 68	30
68 to 87	43
87 to 174	40
174 to 230	30
230 to 1 000	40
At the transition frequency, the more stringent limit shall apply.	

In Table 7, the measuring distance D from the exterior wall of the building in which the equipment is situated equals $(30 + x/a)$ m or 100 m whichever is smaller, provided that the measuring distance D is within the boundary of the premises. In the case where the calculated distance D is beyond the boundary of the premises, the measuring distance D equals x or 30 m, whichever is longer.

For the calculation of the above values:

x is the nearest distance between the outside wall of the building in which the equipment is situated and the boundary of the user's premises in each measuring direction;

a = 2,5 for frequencies lower than 1 MHz;

a = 4,5 for frequencies equal to, or higher than, 1 MHz.

6.3.3 Low-frequency emission limits

The limits for:

a) harmonic current emissions are given in IEC 61000-3-2:2018 and IEC 61000-3-12:2011,

b) voltage fluctuations and flicker are given in IEC 61000-3-3:2013 and IEC 61000-3-3:2013/AMD1:2017 and IEC 61000-3-11:2017,

and are applicable to resistance welding equipment, as far as covered by the scope of these standards. The applicable standard shall be selected based on the maximum short-circuit input current I_{1cc} value.

NOTE For other equipment, no requirements at manufacturing stage are specified. Connection conditions can apply depending on local power supply conditions. IEC TS 61000-3-4:1998, IEC TR 61000-3-6:2008 and IEC TR 61000-3-7:2008 are taken into consideration.

6.3.4 Conducted emissions at signal, control and measurement ports

Class A equipment shall comply with the limits in Table 5 of IEC 61000-6-4:2018.

Class B equipment shall comply with the limits for the telecommunications/network ports in Table 4 of IEC 61000-6-3:2006/AMD1:2010.

These requirements apply only to ports that connect the welding system to external equipment (e.g. wired network ports).

These requirements do not apply to ports designed exclusively for interconnection of equipment within the welding system (e.g. other power sources, remote controls).

7 Immunity tests

7.1 Tests applicability

Resistance welding equipment that does not contain electronic control circuitry is deemed to fulfil the necessary immunity requirements without testing.

Electric circuits consisting of passive components such as inductors, RF suppression networks, mains frequency transformers, rectifiers, diodes and resistors are not considered to be electronic control circuitry.

The tests for immunity levels for enclosure, AC input power port and ports for process measurement and control lines are defined in Table 8, Table 9 and Table 10.

7.2 Test conditions

The resistance welding equipment shall be tested, using the set-up as given in Clause 5. The resistance welding equipment shall be set up with a resistance of 1 kΩ between the electrodes. The output voltage shall be monitored to evaluate the compliance with performance criteria at an ignition delay angle of 90° electric if means of adjustment are provided and with the point with the duty cycle and the welding heat time typical of the resistance welding equipment on test or with a continuously flowing output current.

For equipment that cannot operate under the given test conditions, the manufacturers recommendations shall be followed.

Tests that cannot be performed on the complete resistance welding equipment can be performed on its electronic constituent parts.

7.3 Immunity performance criteria

7.3.1 Performance criteria A

The following ~~issues~~ criteria shall be met:

a) the resistance welding equipment shall continue to operate as intended;

b) variations of ±10 % of the output voltage are admissible;

c) the pre-set heat time shall not be exceeded;

d) no interruptions are permitted in the heat time;

e) in the "single" ~~operating mode,~~ welding state, an interruption of the welding cycle shall be properly terminated;

f) in the "repeat", "seam" and "continuous" ~~operating modes,~~ welding states, an interruption of the cycle by releasing the start switch provided shall be possible;

g) all controls shall continue to function;

h) malfunctioning of the semiconductor power switches is inadmissible;

i) loss of stored data is inadmissible.

7.3.2 Performance criteria B

The following ~~issues~~ criteria shall be met:

a) variations of $^{+50}_{-100}$ % of the output voltage are admissible;

b) in the case of a current interruption during the intended heat time, the welding cycle is terminated with "no current". Manual reset may be required;

c) the pre-set heat time shall not be exceeded;

d) in the "single" ~~operation mode,~~ welding state, an interruption of the welding cycle shall be properly terminated;

e) in the "repeat", "seam" and "continuous" ~~operating modes,~~ welding states, an interruption of the cycle by releasing the start switch provided shall be possible;

f) malfunctioning of the semiconductor power switches is inadmissible;

g) loss of stored data is inadmissible.

7.3.3 Performance criteria C

The following ~~issues~~ criteria shall be met:

a) temporary loss of function is allowed, provided that the loss of function is self-recoverable or can be restored by the operator of the controls. This may require the control voltage of the resistance welding equipment to be restored by means of an appropriate switch;

b) malfunctioning of the semiconductor power switches is inadmissible; temporary loss of function is allowed;

c) loss of stored programme data is inadmissible, unless it can be restored by the operation of the controls.

7.4 Immunity levels

Immunity levels are given in Table 8 for the enclosure, Table 9 for the AC input power port and Table 10 for ports for measurement and control lines.

Table 8 – Immunity levels – Enclosure

Phenomena		Units	Test specification	Basic standard	Remarks	Performance criteria
Radio-frequency EM field, amplitude modulated		MHz V/m (unmod. RMS) % AM (1 kHz)	80 to 1 000 10 80	IEC 61000-4-3:2006/AMD1:2007/AMD2:2010	The test level specified is prior to modulation	A
Radio-frequency EM field, amplitude modulated		GHz V/m (unmod. RMS) % AM (1 kHz)	1,4 to ~~2,0~~ 6,0 3 80	IEC 61000-4-3:2006/AMD1:2007/AMD2:2010	The test level specified is ~~prior to modulation~~ the RMS value of the unmodulated carrier	A
~~Radiofrequency EM field, amplitude modulated~~		~~GHz V/m (unmod. r.m.s.) % AM (1 kHz)~~	~~2,0 to 2,7 1 80~~	~~IEC 61000-4-3~~	~~The test level specified is prior to modulation~~	~~A~~
Electrostatic discharge	Contact discharge	kV (charge voltage)	±4 [a]	IEC 61000-4-2:2008	See basic standard for applicability of contact and/or air discharge test	B
	Air discharge	kV (charge voltage)	±8 [a]			B

[a] Testing is not required at lower levels than those specified.

Table 9 – Immunity levels – AC input power port

Phenomena	Units	Test specification	Basic standard	Remarks	Performance criteria
Fast transients	kV (peak) Repetition frequency kHz Tr/Th ns	±2 5 or 100 5/50	IEC 61000-4-4:2012	~~Direct injection~~ [f]	B
Radio-frequency common mode	MHz V (unmod. RMS) % AM (1 kHz)	0,15 to 80 10 80	IEC 61000-4-6:2013	~~See note~~ The test level specified is ~~prior to modulation~~ the RMS value of the unmodulated carrier [a]	A
Surges [d] line-to-line line-to-earth	T_r/T_h µs kV (open-circuit voltage) kV (open-circuit voltage)	1,2/50 (8/20) ±1 ±2	IEC 61000-4-5:2014/AMD1:2017	~~This test is not required when normal functioning cannot be achieved because of the impact of the CDN on the EUT~~ [g]	B
Voltage dips [c]	% residual voltage cycles at 50/60Hz	~~70~~ ~~25/30~~ 40 10/12	IEC 61000-4-11:2004/AMD1:2017 IEC 61000-4-34:2005/AMD1:2009	Voltage shift at zero crossings [b, e]	~~B~~ C
	% residual voltage cycles at 50/60Hz	70 25/30			C
	% residual voltage cycle	0 1			~~C~~ B

~~NOTE~~

[a] The test level can also be defined as the equivalent current into a 150 Ω load.

[b] Applicable only to input ports.

[c] For electronic power converters, the operation of protective devices (e.g. undervoltage protection) and the performance criterion C are allowed.

[d] For supply voltages where no test equipment is commercially available (e.g. CDNs), this test is not required.

[e] The test shall be carried out at the frequencies appropriate to the power supply frequency. Equipment intended to be used in regions where only one of these frequencies is applied needs to be tested at this specific frequency only.

[f] The test may be performed at one or at both repetition frequencies. The use of 5 kHz repetition frequency is traditional; however, 100 kHz is closer to reality.

[g] In cases where a manufacturer's specification requires external protection devices or measures which are clearly specified in the user's manual, the test requirements of this document shall be applied with the external protection devices or measures in place.

Table 10 – Immunity levels – Ports for measurement and control

Phenomena	Units	Test specification	Basic standard	Remarks	Performance criteria
Fast transients	kV (peak) T_r/T_h ns Repetition frequency kHz	±2 5/50 5	IEC 61000-4-4:2012	Capacitive clamp used [b, f]	B
Radio-frequency common mode	MHz V (unmod. RMS) % AM (1kHz)	0,15 to 80 10 80	IEC 61000-4-6:2013	~~See note~~ The test level specified is ~~prior to modulation~~ the RMS value of the unmodulated carrier [a, b]	A
Surge line-to-line line-to-earth	T_r/T_h µs kV (open-circuit voltage) kV (open-circuit voltage)	1,2/50 0,5[a] ±1	IEC 61000-4-5:2014/AMD1:2017	[c, d, e]	B

~~Applicable to measurement and control ports interfacing to cables unless the total length according to the manufacturer's specifications does not exceed 3 m.~~

~~NOTE~~

[a] The test level can also be defined as the equivalent current into a 150 Ω load.

[b] Applicable only to ports interfacing with cables whose total length according to the manufacturer's functional specification may exceed 3 m.

[c] Applicable only to ports interfacing with long distance lines. A long distance line is a line connected to a signal/control port and which inside a building is longer than 30 m, or which leaves the building (including a line installed outdoors).

[d] Where normal functioning cannot be achieved because of the impact of the coupling/decoupling network (CDN) on the EUT, the test shall be done with the reduced functionality. A rationale shall be given in the test report for doing so. After the test and the removal of the CDN, the normal function shall not be affected.

[e] Signal ports directly connected to AC power network shall be treated as AC power ports.

[f] The test may be performed at one or at both repetition frequencies. The use of 5 kHz repetition frequency is traditional; however, 100 kHz is closer to reality.

8 Documentation for the purchaser/user

The documentation made available to the purchaser/user prior to the purchase shall clearly indicate restrictions for use, due to:

a) the RF equipment class (Class A or Class B);

b) low-frequency (LF) requirements for the public low voltage supply network connection.

Symbol 1 given in Annex B is recommended to be used for Class A equipment to indicate the RF equipment class and restrictions for use.

Symbol 2 given in Annex B is recommended to be used to indicate restrictions for use due to LF requirements for the public low voltage supply network connection.

The user shall be made aware of the fact that proper installation and use of the resistance welding equipment is necessary to minimize possible interfering emissions. The manufacturer ~~or his authorized representative~~ shall ~~be responsible for including~~ include instructions and information with each equipment as follows:

a) For Class B equipment, a written statement that Class B equipment complies with electromagnetic compatibility requirements in industrial and residential environments, including residential locations where the electrical power is provided by the public low-voltage supply system;

b) ~~For class A equipment, the following warning or its equivalent shall be included in the instruction manual:~~

~~This class A equipment is not intended for use in residential locations where the electrical power is provided by the public low-voltage supply system. There can be potential difficulties in ensuring electromagnetic compatibility in those locations, due to conducted as well as radiated radio-frequency disturbances;~~

For Class A equipment, the instructions for use accompanying the product shall contain cautionary text such as:

Caution: This equipment is not intended for use in residential environments and may not provide adequate protection to radio reception in such environments.

c) If the equipment with an input current below 75 A per phase is intended to be connected to public low voltage systems, and it does comply with IEC 61000-3-11:2017 or IEC 61000-3-12:2011 based on system impedance restrictions, the information given in the next paragraph or its equivalent shall be included in the instruction manual. The restriction shall be given as the lower value of the permissible system impedances (in mΩ) or the higher value of the required short circuit power (in MVA) resulting from tests in accordance with these standards. The impedance value may be calculated from the short circuit power value and vice versa.

Provided that the public low voltage system impedance at the point of common coupling is lower than XX mΩ (or the short circuit power is higher than XX MVA), this equipment is compliant with IEC 61000-3-11:2017 and IEC 61000-3-12:2011 and can be connected to public low voltage systems. It is the responsibility of the installer or user of the equipment to ensure, by consultation with the distribution network operator if necessary, that the system impedance complies with the impedance restrictions.

d) If the equipment with an input current below 75 A per phase is intended to be connected to public low-voltage systems and does not comply with IEC 61000-3-12:2011, the following information or its equivalent shall be included in the instruction manual:

This equipment does not comply with IEC 61000-3-12:2011. If it is connected to a public low-voltage system, it is the responsibility of the installer or user of the equipment to ensure, by consultation with the distribution network operator, that the equipment may be connected.

e) Information on any special measures that have to be taken to achieve compliance, for example, the use of shielded cables.

f) Recommendations on the assessment of the surrounding area, to identify necessary precautions required for the installation and use, to minimize disturbances.

g) Recommendations on methods to minimize disturbances.

~~h) A statement drawing attention to the user's responsibility with respect to interference from welding.~~

Annex A
(informative)

Limits

A.1 General

The limits given in the standards referred to in the normative part of this standard are summarized in Tables A.1 to A.11 for information. As some of the references refer to specific parts of tables of limits given in the referenced documents, only the applicable parts of those tables are duplicated.

Annex A provides information on the origin of the limits given in the main part of this document.

A.2 Mains terminal disturbance voltage limits

Source: CISPR 11:2009/AMD1:2010

Table A.1 – Mains terminal disturbance voltage limits, idle state

Frequency range MHz	Class B dBμV		Class A dBμV	
	Quasi-peak	Average	Quasi-peak	Average
0,15 to 0,50	66 Decreasing linearly with logarithm of frequency to 56	56 Decreasing linearly with logarithm of frequency to 46	79	66
0,50 to 30	56	46	73	60

Table A.2 – Mains terminal disturbance voltage limits, load conditions

Frequency range MHz	Class B dBμV		Class A maximum rated input power ≤ 75 kVA [a] dBμV		Class A maximum rated input power > 75 kVA [a] dBμV	
	Quasi-peak	Average	Quasi-peak	Average	Quasi-peak	Average
0,15 to 0,50	66 Decreasing linearly with logarithm of frequency to 56	56 Decreasing linearly with logarithm of frequency to 46	100	90	130	120
0,50 to 5	56	46	86	76	125	115
5 to 30	60	50	90 Decreasing linearly with logarithm of frequency to 70	80 Decreasing linearly with logarithm of frequency to 60	115	105

[a] The maximum rated input power is calculated using the supply current I_{1ec}.

Limits given in the normative part of this document originate from the limits in CISPR 11:2015, CISPR 11:2015/AMD1:2016 and CISPR 11:2015/AMD2:2019.

For the idle state, group 1 limits were adopted. A relaxation of the limits based on the rated power of the equipment is not implemented in the idle-state.

The loaded-state limits are based on the limits for group 2 equipment in CISPR 11:2015, CISPR 11:2015/AMD1:2016 and CISPR 11:2015/AMD2:2019.

A.3 Electromagnetic radiation disturbance limits

~~Source: CISPR 11:2009/AMD1:2010~~

~~Table A.3 – Electromagnetic radiation disturbance limits, idle state~~

~~Frequency range~~ MHz	~~Class B~~ dBμV/m		~~Class A~~ dBμV/m	
	~~10 m measuring distance~~	~~3 m measuring distance [a]~~	~~10 m measuring distance~~	~~3 m measuring distance [a]~~
~~30 to 230~~	~~30~~	~~40~~	~~40~~	~~50~~
~~230 to 1 000~~	~~37~~	~~47~~	~~47~~	~~57~~

~~[a] The limits specified for the 3 m separation distance apply only to small equipment meeting the size criterion defined in 3.8.~~

~~Table A.4 – Electromagnetic radiation disturbance limits, load conditions~~

~~Frequency band~~ MHz	~~Class B~~		~~Class A~~		
	~~On a test site at 10 m test distance~~ dBμV/m	~~On a test site at 3 m test distance [a]~~ dBμV/m	~~On a test site at 10 m test distance~~ dBμV/m	~~On a test site at 3 m test distance [a]~~ dBμV/m	~~At distance *D* from exterior wall of the building~~ dBμV/m
~~30 to 47~~	~~30~~	~~40~~	~~68~~	~~78~~	~~48~~
~~47 to 53,91~~	~~30~~	~~40~~	~~50~~	~~60~~	~~30~~
~~53,91 to 54,56~~	~~30~~	~~40~~	~~50~~	~~60~~	~~30~~
~~54,56 to 68~~	~~30~~	~~40~~	~~50~~	~~60~~	~~30~~
~~68 to 80,872~~	~~30~~	~~40~~	~~63~~	~~73~~	~~43~~
~~80,872 to 81,848~~	~~30 [b]~~	~~40 [b]~~	~~63 [b]~~	~~73 [b]~~	~~43~~
~~81,848 to 87~~	~~30~~	~~40~~	~~63~~	~~73~~	~~43~~
~~87 to 134,786~~	~~30~~	~~40~~	~~60~~	~~70~~	~~40~~
~~134,786 to 136,414~~	~~30 [b]~~	~~40 [b]~~	~~60 [b]~~	~~70 [b]~~	~~40~~
~~136,414 to 156~~	~~30~~	~~40~~	~~60~~	~~70~~	~~40~~
~~156 to 174~~	~~30~~	~~40~~	~~60 [b]~~	~~70 [b]~~	~~40~~
~~174 to 188,7~~	~~30~~	~~40~~	~~50~~	~~60~~	~~30~~
~~188,7 to 190,979~~	~~30~~	~~40~~	~~50 [b]~~	~~60 [b]~~	~~30~~
~~190,979 to 230~~	~~30~~	~~40~~	~~50~~	~~60~~	~~30~~
~~230 to 400~~	~~37~~	~~47~~	~~60~~	~~70~~	~~40~~
~~400 to 470~~	~~37~~	~~47~~	~~60 [b]~~	~~70 [b]~~	~~40~~
~~470 to 1 000~~	~~37~~	~~47~~	~~60~~	~~70~~	~~40~~

[a] The limits specified for the 3 m separation distance apply only to small equipment meeting the size criterion defined in CISPR 11.

[b] 20 dB relaxation has been removed based on 6.3.2.2

Table A.5 – Magnetic field emission limits for Class B equipment

Frequency band MHz	Magnetic field D = 3 m
	Quasi-peak dB(μA/m)
0,15 to 30	39 Decreasing linearly with the logarithm of frequency to 3

For equipment measured *in situ*, the measuring distance D from the exterior wall of the building in which the equipment is situated equals $(30 + x/a)$ m or 100 m whichever is smaller, provided that the measuring distance D is within the boundary of the premises. In the case where the calculated distance D is beyond the boundary of the premises, the measuring distance D equals x or 30 m, whichever is longer.

For the calculation of the above values:

x is the nearest distance between the outside wall of the building in which the equipment is situated and the boundary of the user's premises in each measuring direction;

a = 2,5 for frequencies lower than 1 MHz;

a = 4,5 for frequencies equal to, or higher than, 1 MHz.

Limits given in the normative part of this document originate from the limits in CISPR 11:2015, CISPR 11:2015/AMD1:2016 and CISPR 11:2015/AMD2:2019.

For the idle-state, group 1 limits were adopted.

The loaded-state limits are based on the limits for group 2 equipment in CISPR 11:2015, CISPR 11:2015/AMD1:2016 and CISPR 11:2015/AMD2:2019.

CISPR 11:2015, CISPR 11:2015/AMD1:2016 and CISPR 11:2015/AMD2:2019 implements 20 dB relaxations in certain frequency ranges. These are not present in this document.

A.4 Harmonic current limits

Sources: IEC 61000-3-2:2014 and IEC 61000-3-12:2011

Table A.6 – Maximum permissible harmonic current for equipment with input current $I_{1cc} \leq 16$ A

Harmonic order n	Harmonic current A
Odd harmonics	
3	3,45
5	1,71
7	1,16
9	0,60

11	0,50
13	0,32
$15 \leq n \leq 39$	$0{,}23 \times 15/n$
Even harmonics	
2	1,62
4	0,65
6	0,45
$8 \leq n \leq 40$	$0{,}35 \times 8/n$

Table A.7 – Current emission limits for equipment with 16 A < I_{1cc} ≤ 75 A other than balanced three-phase equipment

Minimum R_{sce}	Admissible individual harmonic current I_h/I_{ref} [a] %						Admissible harmonic parameters %	
	I_3	I_5	I_7	I_9	I_{11}	I_{13}	THC/I_{ref}	$PWHC/I_{ref}$
33	21,6	10,7	7,2	3,8	3,1	2	23	23
66	24	13	8	5	4	3	26	26
120	27	15	10	6	5	4	30	30
250	35	20	13	9	8	6	40	40
≥ 350	41	24	15	12	10	8	47	47
The relative values of even harmonics up to order 12 shall not exceed 16/h %. Even harmonics above order 12 are taken into account in THC and $PWHC$ in the same way as odd order harmonics. Linear interpolation between successive R_{sce} values is permitted.								
[a] I_{ref} = reference current; I_h = harmonic current component.								

Table A.8 – Current emission limits for balanced three-phase equipment with input current 16 A < I_{1cc} ≤ 75 A

Minimum R_{sce}	Admissible individual harmonic current I_h/I_{ref} [a] %				Admissible harmonic parameters %	
	I_5	I_7	I_{11}	I_{13}	THC/I_{ref}	$PWHC/I_{ref}$
33	10,7	7,2	3,1	2	13	22
66	14	9	5	3	16	25
120	19	12	7	4	22	28
250	31	20	12	7	37	38
≥ 350	40	25	15	10	48	46
The relative values of even harmonics up to order 12 shall not exceed 16/h %. Even harmonics above order 12 are taken into account in THC and $PWHC$ in the same way as odd order harmonics. Linear interpolation between successive R_{sce} values is permitted.						
[a] I_{ref} = reference fundamental current; I_h = harmonic current component.						

Table A.9 – Current emission limits for balanced three-phase equipment with input current 16 A < I_{1cc} ≤ 75 A under specified conditions

Minimum R_{sce}	Admissible individual harmonic current I_h/I_{ref} [a] %				Admissible harmonic parameters %	
	I_5	I_7	I_{11}	I_{13}	THC/I_{ref}	$PWHC/I_{ref}$
33	10,7	7,2	3,1	2	13	22
≥ 120	40	25	15	10	48	46
The relative values of even harmonics up to order 12 shall not exceed 16/h %. Even harmonics above order 12 are taken into account in THC and $PWHC$ in the same way as odd order harmonics. Linear interpolation between successive R_{sce} values is permitted.						
[a] I_{ref} = reference fundamental current; I_h = harmonic current component.						

Table A.10 – Current emission limits for balanced three-phase equipment with I_{1cc} ≤ 75 A under specified conditions (d, e, f)

Minimum R_{sce}	Admissible individual harmonic current I_h/I_{ref} [a] %												Admissible harmonic parameters %	
	I_5	I_7	I_{11}	I_{13}	I_{17}	I_{19}	I_{23}	I_{25}	I_{29}	I_{31}	I_{35}	I_{37}	THC/I_{ref}	$PWHC/I_{ref}$
33	10,7	7,2	3,1	2	2	1,5	1,5	1,5	1	1	1	1	13	22
≥ 250	25	17,3	12,1	10,7	8,4	7,8	6,8	6,5	5,4	5,2	4,9	4,7	35	70
For R_{sce} equal to 33, the relative values of even harmonics up to order 12 shall not exceed 16/h %. The relative values of all harmonics from I_{14} to I_{40} not listed above shall not exceed 1 % of I_{ref}. For R_{sce} ≥ 250, the relative values of even harmonics up to order 12 shall not exceed 16/h %. The relative values of all harmonics from I_{14} to I_{40} not listed above shall not exceed 3 % of I_{ref}. Linear interpolation between both R_{sce} values is permitted.													
[a] I_{ref} = reference current; I_h = harmonic current component.														

Table A.6 is applied to equipment other than balanced three-phase equipment and Tables A.7, A.8 and A.9 are applied to balanced three-phase equipment.

Table A.7 may be used for any balanced three-phase piece of equipment.

Table A.9 may be used with balanced three-phase equipments if any one of the following conditions is met:

a) The phase angle of the 5th harmonic current related to the fundamental phase voltage is in the range of 90° to 150°.

NOTE 1 This condition is normally fulfilled by equipment with an uncontrolled rectifier bridge and capacitive filter, including a 3 % a.c. or 4 % d.c. reactor.

b) The design of the equipment is such that the phase angle of the 5th harmonic current has no preferential value over time and can take any value in the whole interval (0°, 360°).

NOTE 2 This condition is normally fulfilled by converters with fully controlled thyristor bridges.

c) The 5th and 7th harmonic currents are each less than 5 % of the reference fundamental current.

NOTE 3 This condition is normally fulfilled by "12-pulse" equipment.

Table A.10 may be used with balanced three-phase equipment if any one of these conditions is met:

d) The 5th and 7th harmonic currents are each less than 3 % of the reference current during the whole test observation period.

e) The design of the piece of equipment is such that the phase angle of the 5th harmonic current has no preferential value over time and can take any value in the whole interval [0°, 360°].

f) The phase angle of the 5th harmonic current related to the fundamental phase-to-neutral voltage is in the range of 150° to 210° during the whole test observation period.

NOTE 4 This condition is normally fulfilled by a 6 pulse converter with a small d.c. link capacitance, operating as a load.

A.5 Limits for voltage fluctuations and flicker

Sources: IEC 61000-3-3:2013 and IEC 61000-3-11:2000

Table A.11 – Limits for resistance welding equipment $I_{1cc} \leq 75$ A

Maximum relative voltage change d_{max} %	Relative steady-state voltage change d_c %	Short-term flicker indicator P_{st}
7	3,3	1,0

The P_{st} requirement is not applicable to voltage changes caused by manual switching.

Equipment which does not meet the limits given in Table A.10 when tested or evaluated with the reference impedance given in IEC 61000-3-3 is subject to conditional connection, and the manufacturer may either:

a) determine the maximum permissible system impedance Z_{max} at the interface point of the users supply in accordance with 6.3 of IEC 61000-3-11:2000, and declare Z_{max} in the instruction manual; or

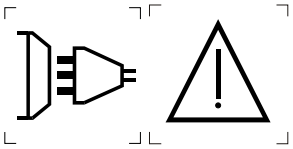
b) test the equipment in accordance with 6.2 of IEC 61000-3-11:2000, and declare in the instruction manual that the equipment is intended for use only in premises having a service current capacity ≥100 A per phase.

Annex B
(informative)

Symbols

Table B.1 provides symbols for the indication of the RF equipment class and restrictions for use.

Table B.1 – Symbols to describe EMC properties

N°	SOURCE	SYMBOL	FUNCTION, KEYWORD OR PHRASE	APPLICATION
1.	IEC 60417-5109 (2002-10)		Not to be used in residential locations where the electrical power is provided by the public low-voltage supply system	To identify class A equipment and restrictions for use NOTE Symbol can be used on packaging, equipment or documentation for purchaser or user available prior to purchase
2.	IEC 60417-5939 (2002-10) and ISO 7000- 0434A (2004-01) combined		Restrictions for the connection to public low voltage supply networks apply	To identify restrictions of use with regard to required supply network parameters NOTE Symbol can be used on packaging, equipment or documentation for purchaser or user available prior to purchase

Annex C
(normative)

Battery powered equipment

C.1 General

Annex C defines additional requirements for the welding equipment powered by internal or external batteries.

The equipment shall comply to the requirements in this document in all modes of operation.

C.2 Additional emission requirements

Any DC input power port of the welding equipment shall comply with the applicable conducted emissions requirements for DC power ports of:

- IEC 61000-6-4:2018 for Class A equipment,
- IEC 61000-6-3:2006 and IEC 61000-6-3:2006/AMD1:2010 for Class B equipment.

External chargers shall comply with:

- IEC 61000-6-4:2018 if used to charge Class A welding equipment,
- IEC 61000-6-3:2006 and IEC 61000-6-3:2006/AMD1:2010 if used to charge Class B welding equipment.

If a battery charger is intended to be used for both Class A and Class B welding equipment, the charger shall comply to the more stringent limits.

NOTE IEC 61000-6-3:2006 and IEC 61000-6-3:2006/AMD1:2010 and IEC 61000-6-4:2018 consider the highest internal frequency as well as the length of the connected cable to the DC power port.

C.3 Additional immunity requirements

Any DC input power port shall comply to the applicable immunity requirements for DC power ports of:

- IEC 61000-6-2:2016 for Class A equipment,
- IEC 61000-6-1:2016 for Class B equipment.

External chargers shall comply to:

- IEC 61000-6-2:2016 if used to charge Class A welding equipment,
- IEC 61000-6-1:2016 if used to charge Class B welding equipment.

If a battery charger is intended to be used for both Class A and Class B welding equipment, the charger shall be tested to the higher test levels.

NOTE IEC 61000-6-1:2016 and IEC 61000-6-2:2016 consider the highest internal frequency as well as the length of the connected cable to the DC power port.

Annex D
(normative)

Equipment containing radio devices

D.1 General

Annex D defines additional requirements for welding equipment containing radio devices.

The welding equipment shall comply with any additional requirement in the applicable radio standard not specified in this document.

NOTE Examples are requirements regarding the antenna port.

The radio device shall comply with the applicable radio standard.

Exclusion bands specified in the applicable radio standard only apply to the radio functionality.

D.2 Additional emission requirements

For frequency ranges not defined in this document, the welding equipment shall comply with the applicable radiated emissions limits for the enclosure port of

- Table 3 of IEC 61000-6-4:2018 for Class A equipment
- Table 1 of IEC 61000-6-3:2006/AMD1:2010 for Class B equipment

For the radiated emission the transmitter function of the radio device is turned off.

D.3 Additional immunity requirements

The performance criterion C shall be applied to the radio function.

If an immunity test would cause damage to a radio receiver, additional mitigation measures shall be applied. These measures shall be documented in the test report. The documentation to the user shall indicate ports sensitive to these phenomena.

Bibliography

IEC 60050-131:2002, *International Electrotechnical Vocabulary (IEV) – Part 131: Circuit theory*

IEC 60050-161:1990, *International Electrotechnical Vocabulary (IEV) – Part 161: Electromagnetic compatibility*

IEC 60050-851:2008, *International Electrotechnical Vocabulary (IEV) – Part 851: Electric welding*

IEC 60417~~-DB:2011~~ ~~[1]~~, *Graphical symbols for use on equipment* (available at http://www.graphical-symbols.info/equipment)

IEC TS 61000-3-4:1998, *Electromagnetic compatibility (EMC) – Part 3-4: Limits – Limitation of emission of harmonic currents in low-voltage power supply systems for equipment with rated current greater than 16 A*

IEC TR 61000-3-6:2008, *Electromagnetic compatibility (EMC) – Part 3-6: Limits – Assessment of emission limits for the connection of distorting installations to MV, HV and EHV power systems*

IEC TR 61000-3-7:2008, *Electromagnetic compatibility (EMC) – Part 3-7: Limits – Assessment of emission limits for the connection of fluctuating installations to MV, HV and EHV power systems*

~~CISPR 14-1, *Electromagnetic compatibility – Requirements for household appliances, electric tools and similar apparatus – Part 1: Emission*~~

IEC Guide 107:2014, *Electromagnetic compatibility – Guide to the drafting of electromagnetic compatibility publications*

ISO 7000:~~2014~~2019, *Graphical symbols for use on equipment – Registered symbols*

CISPR 14-1:2016, *Electromagnetic compatibility – Requirements for household appliances, electric tools and similar apparatus – Part 1: Emission*

CISPR 32:2015, *Electromagnetic compatibility of multimedia equipment – Emission requirements*
CISPR 32:2015/AMD1:*2019*

~~[1] DB refers to IEC online database.~~

IEC 62135-2

Edition 3.0 2020-03

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Resistance welding equipment –
Part 2: Electromagnetic compatibility (EMC) requirements

Matériels de soudage par résistance –
Partie 2: Exigences de compatibilité électromagnétique (CEM)

IEC 62135-2:2020-03(en-fr)

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

_____

RESISTANCE WELDING EQUIPMENT –

Part 2: Electromagnetic compatibility (EMC) requirements

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 62135-2 has been prepared by IEC technical committee 26: Electric welding.

This third edition cancels and replaces the second edition published in 2015. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) update of the applicable limits related to the updated references;
b) implementation of radiated magnetic field requirements.

The text of this standard is based on the following documents:

FDIS	Report on voting
26/696/FDIS	26/698/RVD

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

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

A list of all parts of the IEC 62135 series, under the general title *Resistance welding equipment*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website 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.

RESISTANCE WELDING EQUIPMENT –

Part 2: Electromagnetic compatibility (EMC) requirements

1 Scope

This part of IEC 62135 is applicable to equipment for resistance welding and allied processes which are connected to mains supplies with rated voltages up to 1 000 V AC RMS. This document does not define safety requirements.

Resistance welding equipment type tested in accordance with, and which has met the requirements of, this document, is deemed to be in compliance for all applications.

The frequency range covered is from 0 Hz to 400 GHz.

Arc welding equipment containing a radio receiver or transmitter is within the scope of this document. Additional requirements for such equipment is specified in Annex D.

The radiated emission requirements in this document are not intended to be applicable to the intentional transmissions from a radio transmitter as defined by the ITU nor to any spurious emissions related to these intentional transmitters.

This product EMC standard for resistance welding equipment takes precedence over all aspects of the generic standards and no additional EMC tests are required or necessary.

NOTE 1 Typical allied processes are resistance hard and soft soldering or resistance heating achieved by means comparable to resistance welding equipment.

NOTE 2 Limit values are specified for only part of the frequency range.

Resistance welding equipment are classified as Class A and Class B equipment.

This part of IEC 62135 specifies

a) test methods to be used in conjunction with CISPR 11:2015, CISPR 11:2015/AMD1:2016 and CISPR 11:2015/AMD2:2019 to determine radio-frequency (RF) emission;

b) relevant standards and test methods for harmonic current emission, voltage fluctuation and flicker;

c) additional requirements for equipment powered by internal or external batteries (Annex C).

NOTE 3 The limits in this document cannot, however, provide full protection against interference to radio and television reception when the resistance welding equipment is used closer than 30 m to the receiving antenna(e).

NOTE 4 In special cases, when highly susceptible apparatus is being used in close proximity, additional mitigation measures are sometimes employed to further reduce the electromagnetic emissions.

NOTE 5 The origins of the limit values in this document are summarized in Annex A.

This part of IEC 62135 also defines immunity requirements and test methods for continuous and transient, conducted and radiated disturbances including electrostatic discharges.

NOTE 6 These requirements do not, however, cover extreme cases which are extremely rare.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 61000-3-2:2018, *Electromagnetic compatibility (EMC) – Part 3-2: Limits – Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)*

IEC 61000-3-3:2013, *Electromagnetic compatibility (EMC) – Part 3-3: Limits – Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current ≤ 16 A per phase and not subject to conditional connection*
IEC 61000-3-3:2013/AMD1:2017

IEC 61000-3-11:2017, *Electromagnetic compatibility (EMC) – Part 3-11: Limits – Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems – Equipment with rated current ≤ 75 A and subject to conditional connection*

IEC 61000-3-12:2011, *Electromagnetic compatibility (EMC) – Part 3-12: Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current > 16 A and ≤ 75 A per phase*

IEC 61000-4-2:2008, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test*

IEC 61000-4-3:2006, *Electromagnetic compatibility (EMC) – Part 4-3 : Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test*
IEC 61000-4-3:2006/AMD1:2007
IEC 61000-4-3:2006/AMD2:2010

IEC 61000-4-4:2012, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test*

IEC 61000-4-5:2014, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test*
IEC 61000-4-5:2014/AMD1:2017

IEC 61000-4-6:2013, *Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields*

IEC 61000-4-11:2004, *Electromagnetic compatibility (EMC) – Part 4-11: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests*
IEC 61000-4-11:2004/AMD1:2017

IEC 61000-4-34:2005, *Electromagnetic compatibility (EMC) – Part 4-34: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests for equipment with input current more than 16 A per phase*
IEC 61000-4-34:2005/AMD1:2009

IEC 61000-6-1:2016, *Electromagnetic compatibility (EMC) – Part 6-1: Generic standards – Immunity standard for residential, commercial and light-industrial environments*

IEC 61000-6-2:2016, *Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity standard for industrial environments*

IEC 61000-6-3:2006, *Electromagnetic compatibility (EMC) – Part 6-3: Generic standards – Emission standard for residential, commercial and light-industrial environments*
IEC 61000-6-3:2006/AMD1:2010

IEC 61000-6-4:2018, *Electromagnetic compatibility (EMC) – Part 6-4: Generic standards – Emission standard for industrial environments*

IEC 62135-1:2015, *Resistance welding equipment – Part 1: Safety requirements for design, manufacture and installation*

ISO 669:2016, *Resistance welding – Resistance welding equipment – Mechanical and electrical requirements*

CISPR 11:2015, *Industrial, scientific and medical equipment – Radio-frequency disturbance characteristics – Limits and methods of measurement*
CISPR 11:2015/AMD1:2016
CISPR 11:2015/AMD2:2019

CISPR 16-1-1:2019, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-1: Radio disturbance and immunity measuring apparatus – Measuring apparatus*

CISPR 16-1-2:2014, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-2: Radio disturbance and immunity measuring apparatus – Coupling devices for conducted disturbance measurements*
CISPR 16-1-2:2014/AMD1:2017

CISPR 16-1-4:2019, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-4: Radio disturbance and immunity measuring apparatus – Antennas and test sites for radiated disturbance measurements*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
cable port
point at which a conductor or a cable is connected to the apparatus

Note 1 to entry: Examples are signal, control and power ports.

Note 2 to entry: The welding circuit of resistance welding equipment is not a cable port but is part of the enclosure port.

3.2
click
disturbance which exceeds the limit of continuous disturbance no longer than 200 ms and which is separated from a subsequent disturbance by at least 200 ms

Note 1 to entry: Both intervals are related to the level of the limit of continuous disturbance.

Note 2 to entry: A click may contain a number of impulses, in which case the relevant time is that from the beginning of the first to the end of the last impulse.

[SOURCE: IEC 60050-851:2008, 851-15-13]

3.3
enclosure port
physical boundary of the apparatus through which electromagnetic fields may radiate or impinge

3.4
FAR
fully-anechoic chamber
shielded enclosure, the internal surfaces of which are lined with radio-frequency-energy absorbing material (i.e. RF absorber) that absorbs electromagnetic energy in the frequency range of interest

[SOURCE: CISPR 11:2015/AMD1:2016, 3.20]

3.5
idle state
operating state in which the power is switched on and the welding circuit is not energized

Note 1 to entry: For some types of equipment there is no idle state.

Note 2 to entry: For a power source in a mechanized system, the configuration to achieve idle state is defined by the manufacturer.

Note 3 to entry: An idle state can include a low energy state in which a welding process cannot be started without automatic or manual reactivation.

3.6
OATS
open-area test site
facility used for measurements of electromagnetic fields the intention for which is to simulate a semi-free-space environment over a specified frequency range that is used for radiated emission testing of products

Note 1 to entry: An OATS typically is located outdoors in an open area, and has an electrically-conducting ground plane.

[SOURCE: CISPR 11:2015/AMD1:2016, 3.21]

3.7
port
particular interface of an equipment which couples this equipment with the external electromagnetic environment (IEC 60050-161:2018, 161-01-01) and through which the equipment is influenced by this environment

EXAMPLE Examples of ports of interest are shown in Figure 1. The enclosure port is the physical boundary of the apparatus (e.g. enclosure). The enclosure port provides for radiated and electrostatic discharge (IEC 60050-161:2018, 161-01-22) energy transfer, whereas the other ports provide for conducted energy transfer.

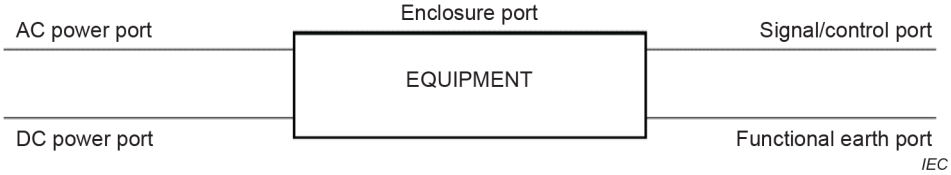


Figure 1 – Examples of ports

Note 1 to entry: Ports in the subject area of electromagnetic compatibility are specific cases of the port defined in IEC 60050-131:2002, 131-12-60.

[SOURCE: IEC Guide 107:2009, 3.1.12, modified – The presentation of the term and the wording of the definition have been revised for compatibility with IEC 60050 (all parts).]

3.8
SAC
semi-anechoic chamber
shielded enclosure, in which five of the six internal surfaces are lined with radio-frequency energy absorbing material (i.e. RF absorber) that absorbs electromagnetic energy in the frequency range of interest, and the bottom horizontal surface is a conducting ground plane for use with OATS test set-ups

[SOURCE: CISPR 11:2015/AMD1:2016, 3.22]

3.9
small equipment
equipment, either positioned on a table top or standing on the floor which, including its cables fits in an imaginary cylindrical test volume of 1,2 m in diameter and 1,5 m height (to ground plane)

[SOURCE: CISPR 11:2015, 3.17, modified – Replacement of the term "small size equipment" by "small equipment".]

3.10
wired network port
port for the connection of voice, data and signalling transfers intended to interconnect widely-dispersed systems by direct connection to a single-user or multi-user communication network

Note 1 to entry: Examples of these include CATV, PSTN, ISDN, xDSL, LAN and similar networks.

Note 2 to entry: These ports may support screened or unscreened cables and may also carry AC or DC power where this is an integral part of the telecommunication specification.

[SOURCE: CISPR 32:2015, 3.1.32]

4 General test requirements

4.1 Test conditions

Tests shall be carried out on completely assembled equipment representative of the series production. Tests shall be performed within the specified operating conditions for the apparatus at its rated supply voltage and frequency as given in IEC 62135-1:2015. Results obtained for RF emission and immunity at 50 Hz are valid for the same model operating at 60 Hz and vice versa.

4.2 Measuring instruments

The measuring equipment shall comply with the requirements of CISPR 16-1-1:2019 and the standards referred to in Table 8, Table 9 and Table 10 as applicable.

4.3 Artificial mains network

Measurement of the mains terminal disturbance voltage shall be made using an artificial mains network, if commercially available, consisting of 50 Ω/50 μH or a 50 Ω/50 μH + 5 Ω V-network as specified in CISPR 16-1-2:2014 and CISPR 16-1-2:2014/AMD1:2017.

The artificial network is required to provide a defined impedance at RF across the mains supply at the point of measurement and also to provide for isolation of the equipment under test from ambient noise on the power lines.

4.4 Voltage probe

A voltage probe as specified in CISPR 16-1-2:2014 and CISPR 16-1-2:2014/AMD1:2017 shall be used when the artificial mains network cannot be used. The probe is connected sequentially between each line and the reference earth. The probe shall consist of a blocking capacitor and a resistor such that the total resistance between the line and earth is at least 1 500 Ω. The effect on the accuracy of measurement of the capacitor or any other device which may be used to protect the measuring receiver against dangerous currents shall be either less than 1 dB or allowed for in calibration.

4.5 Antennas

In the frequency range below 30 MHz the antenna shall be a loop as specified in CISPR 16-1-4:2019.

In the frequency range from 30 MHz to 1 GHz the antenna(s) used shall be as specified in CISPR 16-1-4:2019. Measurements shall be made for both horizontal and vertical polarization. The nearest point of the antenna(s) to the ground shall be not less than 0,2 m.

5 Test set-up for emission and immunity

5.1 General requirements

Emission and immunity testing shall be carried out on a representative resistance welding installation as described below. Resistance welding equipment tested in such an installation shall be considered to have met the necessary requirements of this document.

If the resistance welding equipment is part of an installation, or can be connected to auxiliary equipment, then the resistance welding equipment shall be tested whilst connected to the minimum configuration of auxiliary equipment necessary to exercise the ports. If the resistance welding equipment has a large number of similar ports or ports with many similar connections, then a sufficient number shall be selected to simulate actual operating conditions and to ensure that all the different types of termination are covered.

Measurements to determine compliance with the low-frequency emission limits shall be made in accordance with the test procedures of relevant basic and referenced standards.

For electromagnetic radiation disturbance tests the separation between the antenna and the equipment under test shall be as specified in Clause 6 of CISPR 11:2015, CISPR 11:2015/AMD1:2016 and CISPR 11:2015/AMD2:2019.

For radiated emission test in the frequency range between 150 kHz and 1 MHz, the antenna shall be positioned on the axis z, as given in Figure 2, perpendicular to the plane x, y of the welding circuit.

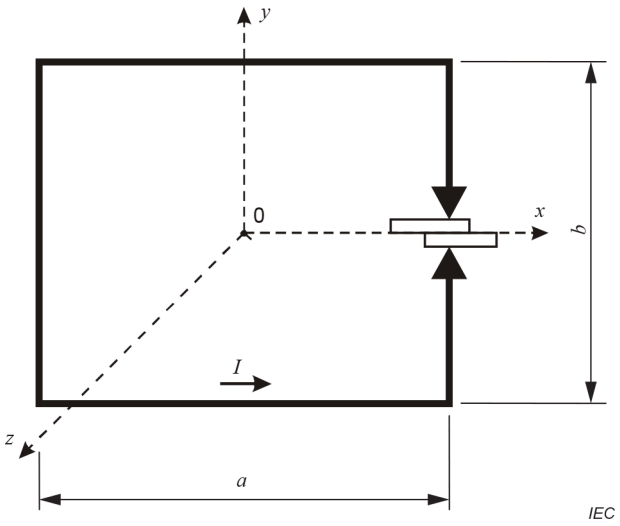


Figure 2 – Test position for H field measurement

Specific test set-up geometries for immunity tests are found in the basic standards referred to in Table 8, Table 9 and Table 10.

Class A resistance welding equipment may be measured either on a test site or *in situ* as preferred by the manufacturer.

NOTE 1 Due to size, complexity or operating conditions, some resistance welding equipment are sometimes measured *in situ* in order to show compliance with the radiation disturbance limits specified herein.

NOTE 2 By their nature, *in situ* tests are not adequate for type testing purposes.

Class B resistance welding equipment shall be measured on a test site.

The configuration of the resistance welding equipment under test shall be precisely noted in the test report.

5.2 Ancillary equipment

Ancillary equipment shall be tested in conjunction with the resistance welding equipment. It shall be connected, installed, configured and operated as recommended by the manufacturer.

6 Emission tests

6.1 Classification of equipment

6.1.1 Class A equipment

Class A equipment is equipment suitable for use in all locations other than those allocated in residential environments and those directly connected to a low voltage power supply network which supplies buildings used for domestic purposes.

NOTE This definition originates from CISPR 11:2015, 5.2.

Class A equipment shall meet Class A limits in accordance with 6.3.

6.1.2 Class B equipment

Class B equipment is equipment suitable for use in residential environments and in establishments directly connected to a low voltage power supply network which supplies buildings used for domestic purposes.

NOTE This definition originates from CISPR 11:2015, 5.2.

Class B equipment shall meet Class B limits in accordance with 6.3.

6.2 Test conditions

6.2.1 Test conditions for RF tests

Measurements to determine compliance with the emission limits shall be made in accordance with the test procedures in CISPR 11:2015, CISPR 11:2015/AMD1:2016 and CISPR 11:2015/AMD2:2019 and as detailed below, using the test set-up given in Clause 5.

Resistance welding equipment is extremely diverse in its design and working conditions. It shall be tested under the following conditions:

a) idle state

b) loaded

- set up the welding circuit to minimize the impedance and to produce the highest flow of current (i.e., using minimum arms length and gap);
- set up the electrodes in short-circuit condition according to ISO 669:2016;
- adjust the current to obtain the highest emission, if means of adjustment are provided;

  NOTE For thyristor-controlled equipment, an ignition delay angle of 90° typically gives the highest emission value.
- select a duty cycle and a welding heat time appropriate for the tested resistance welding equipment and the requirements of the measuring instrumentation.

The test parameters chosen shall be fully documented.

6.2.2 Test conditions for low-frequency tests

Resistance welding equipment is extremely diverse in its design and working conditions. It shall be tested under the following conditions:

- set up the welding circuit to minimize the impedance and to produce the highest flow of current;
- set up the electrodes in short-circuit condition according to ISO 669:2016;
- adjust the current to obtain the highest emission, if means of adjustment are provided;
- calculate the equipment duty cycle X at the maximum welding current based on Formula (1) and

$$X = \frac{(I_{2P})^2}{(I_{2cc})^2} \quad (1)$$

where

I_{2P} is the permanent output current;

I_{2cc} is the maximum short circuit welding current;

- select an observation period and a welding heat time appropriate for the calculated duty cycle, the tested resistance welding equipment and the requirements of the measuring instrumentation.

The test parameters chosen shall be fully documented.

The arithmetic average value of 1,5 s smoothed RMS supply current values (I_{ref} as per IEC 61000-3-12:2011) shall be measured when the welding equipment is delivering its maximum rated output current I_{2cc}.

For welding equipment with a rated maximum supply current I_{1cc} below 16 A, the reference current I_{ref} for the definition of limits shall be 16 A.

The maximum and arithmetic average values of 1,5 s smoothed RMS harmonic current values in each discrete Fourier transform (DFT) time window shall be determined over one or more full thermal cycle(s) including the idle state period.

The same welding heat time shall be used for the determination of I_{ref} and the harmonic component values.

NOTE An idle state period of more than 10 % is not a stand-by mode as defined in IEC 61000-3-12:2011, but an operational mode of the welding equipment within its full thermal cycle.

6.3 Emission limits

6.3.1 Mains terminal disturbance voltage

6.3.1.1 Idle state

The mains terminal disturbance voltage limits for Class A and Class B resistance welding equipment in idle state are given in Table 1. The appropriate set of limits shall be selected in accordance with the maximum rated input power of the equipment, calculated using the rated maximum input current I_{1cc}.

Table 1 – Disturbance voltage limits – Idle state

<table>
<tr><th rowspan="2">Frequency range
MHz</th><th colspan="2">Class B
dBμV</th><th colspan="2">Class A maximum rated input power ≤ 20 kVA
dBμV</th><th colspan="2">Class A maximum rated input power > 20 kVA[a]
dBμV</th><th colspan="2">Class A maximum rated input power > 75 kVA[b]
dBμV</th></tr>
<tr><th>Quasi-peak</th><th>Average</th><th>Quasi-peak</th><th>Average</th><th>Quasi-peak</th><th>Average</th><th>Quasi-peak</th><th>Average</th></tr>
<tr><td>0,15 to 0,50</td><td>66
Decreasing linearly with logarithm of frequency to
56</td><td>56
46</td><td>79</td><td>66</td><td>100</td><td>90</td><td>130</td><td>120</td></tr>
<tr><td>0,50 to 5</td><td>56</td><td>46</td><td>73</td><td>60</td><td>86</td><td>76</td><td>125</td><td>115</td></tr>
<tr><td>5 to 30</td><td>60</td><td>50</td><td>73</td><td>60</td><td>90
Decreasing linearly with logarithm of frequency to
73</td><td>80
60</td><td>115</td><td>105</td></tr>
<tr><td colspan="10">At the transition frequency, the more stringent limit shall apply.
[a] These limits apply to equipment with a rated power > 20 kVA and intended to be connected to a dedicated power transformer or generator, and which is not connected to low voltage (LV) overhead power lines. For equipment not intended to be connected to a user specific power transformer the limits for ≤ 20 kV A apply. The manufacturer, and/or supplier shall provide information on installation measures that can be used to reduce emissions from the installed equipment. In particular it shall be indicated that this equipment is intended to be connected to a dedicated power transformer or generator and not to LV overhead power lines.
[b] These limits apply only to high power electronic systems and equipment with a rated power greater than 75 kVA when intended to be installed as follows:
– the installation is supplied from a dedicated power transformer or generator, and which is not connected to low voltage (LV) overhead power lines,
– the installation is physically separated from residential environments by a distance greater than 30 m or by a structure which acts as a barrier to radiated phenomena,
– the manufacturer and/or supplier shall indicate that this equipment meets the disturbance voltage limits for high power electronic systems and equipment of rated input power > 75 kVA and provide information on installation measures to be applied by the installer. In particular, it shall be indicated that this equipment is intended to be used in an installation which is powered by a dedicated power transformer or generator and not by LV overhead power lines.</td></tr>
</table>

NOTE Values are based on the limits for group 1 equipment in CISPR 11:2015, CISPR 11:2015/AMD1:2016 and CISPR 11:2015/AMD2:2019.

The equipment under test (EUT) shall meet either both average and quasi-peak limits using the corresponding detectors or the average limit when using the quasi-peak detector.

6.3.1.2 Loaded

The mains terminal disturbance voltage limits for Class A and Class B resistance welding equipment are the group 2 limits given in Table 2. The appropriate set of limits shall be selected in accordance with the maximum rated input power of the equipment, calculated using the rated maximum input current I_{1cc}.

Table 2 – Disturbance voltage limits for Class A equipment – Loaded state

Frequency range MHz	Class B dBμV		Class A maximum rated input power ≤ 75 kVA[a] dBμV		Class A maximum rated input power > 75 kVA[a,b] dBμV	
	Quasi-peak	Average	Quasi-peak	Average	Quasi-peak	Average
0,15 to 0,50	66 Decreasing linearly with logarithm of frequency to 56	56 Decreasing linearly with logarithm of frequency to 46	100	90	130	120
0,50 to 5	56	46	86	76	125	115
5 to 30	60	50	90 Decreasing linearly with logarithm of frequency to 73	80 Decreasing linearly with logarithm of frequency to 60	115	105

At the transition frequency, the more stringent limit shall apply.

[a] The maximum rated input power is calculated using the rated maximum supply current I_{1cc}.

[b] The manufacturer and/or supplier shall provide information on installation measures that can be used to reduce emissions from the installed equipment..

The EUT shall meet either both average and quasi-peak limits using the corresponding detectors or the average limit when using the quasi-peak detector.

For Class A equipment, impulse noise (clicks) which occurs less than 5 times per minute is not considered.

For Class B equipment, where impulse noise (clicks) occurs less than 0,2 times per minute, a relaxation of the limits of 44 dB is allowed. For clicks appearing between 0,2 and 30 times per minute, a relaxation of the limits is allowed of 20 log (30/N) dB (where N is the number of clicks per minute). Criteria for separated clicks can be found in CISPR 14-1:2016.

6.3.2 Electromagnetic radiation disturbance

6.3.2.1 Idle state

The electromagnetic radiation disturbance limits for Class A and Class B resistance welding equipment in idle state are given in Table 3.

Table 3 – Electromagnetic radiation disturbance limits – Idle state

Frequency range MHz	Class B Quasi-peak dBμV/m			Class A Quasi-peak dBμV/m		
	OATS or SAC		FAR [a,b]	OATS or SAC		FAR [a,b]
	10 m measuring distance	3 m measuring distance [a]		10 m measuring distance	3 m measuring distance [a]	
30 to 230	30	40	42 to 35 Decreasing linearly with logarithm of frequency to 35	40	50	52 to 45 Decreasing linearly with logarithm of frequency to 45
230 to 1 000	37	47	42	47	57	52
On an OATS or in a SAC, Class A equipment can be measured at a nominal distance of 3 m, 10 m or 30 m. In case of measurements at a separation distance of 30 m, an inverse proportionality factor of 20 dB per decade shall be used to normalize the measured data to the specified distance for determining compliance. At the transition frequency, the more stringent limit shall apply.						
[a] The limits specified for the 3 m separation distance apply only to small equipment meeting the size criterion defined in 3.9. [b] The table-top equipment shall fit into the test volume of the FAR.						

6.3.2.2 Loaded

The electromagnetic radiation disturbance limits for Class A resistance welding equipment in the frequency band 30 MHz to 1 000 MHz are the limits given in Table 4.

Table 4 – Electromagnetic radiation disturbance limits for Class A equipment – Loaded state

Frequency band MHz	OATS or SAC			FAR
	On a test site at 30 m test distance dBμV/m	On a test site at 10 m test distance dBμV/m	On a test site at 3 m test distance[a] dBμV/m	On a test site at 3 m test distance[a,b] dBμV/m
30 to 47	58	68	78	80 to 78
47 to 54,56	40	50	60	60
54,56 to 68	40	50	60	60 to 59
68 to 81,848	53	63	73	72
81,848 to 87	53	63	73	72 to 71
87 to 134,786	50	60	70	68 to 67
134,786 to 136,414	50	60	70	67
136,414 to 156	50	60	70	67 to 66
156 to 174	50	60	70	66
174 to 188,7	40	50	60	56
188,7 to 190,979	40	50	60	66

Frequency band	OATS or SAC			FAR
	On a test site at 30 m test distance	On a test site at 10 m test distance	On a test site at 3 m test distance[a]	On a test site at 3 m test distance[a,b]
MHz	dBμV/m	dBμV/m	dBμV/m	dBμV/m
190,979 to 230	40	50	60	56 to 55
230 to 1 000	50	60	70	65
At the transition frequency, the more stringent limit shall apply. The limit for measurements in the FAR decreases linearly with the logarithm of the frequency.				
[a] The limits specified for the 3 m separation distance apply only to small equipment meeting the size criterion defined in 3.9. [b] The table-top equipment shall fit into the test volume of the FAR.				

The electromagnetic radiation disturbance limits for class B resistance welding equipment are limits given in Table 5 and Table 6.

Table 5 – Electric field radiation disturbance limits for Class B equipment – Loaded state

Frequency band	OATS or SAC				FAR	
	On a test site at 10 m test distance		On a test site at 3 m test distance[a]		On a test site at 3 m test distance[a,b]	
	Quasi-peak	Average	Quasi-peak	Average	Quasi-peak	Average
MHz	dBμV/m		dBμV/m		dBμV/m	
30 to 230	30	25	40	35	42 to 35	37 to 30
230 to 1 000	37	32	47	42	42	37
At the transition frequency, the more stringent limit shall apply. The limit for measurements in the FAR decreases linearly with the logarithm of the frequency.						
[a] The limits specified for the 3 m separation distance apply only to small equipment meeting the size criterion defined in 3.9. [b] The table-top equipment shall fit into the test volume of the FAR.						

Table 6 – Magnetic field radiation disturbance limits for Class B equipment – Loaded state

Frequency band	On a test site at 3 m test distance
MHz	Quasi-peak dB(μA/m)
0,15 to 30	39 Decreasing linearly with the logarithm of frequency to 3
At the transition frequency, the more stringent limit shall apply.	

For equipment measured *in situ*, electromagnetic radiation disturbance limits in Table 7 apply.

Table 7 – In-situ electromagnetic radiation disturbance limits for Class A equipment – Loaded state

Frequency band	At distance D from exterior wall of the building
MHz	**Quasi-peak** dBμV/m
30 to 47	48
47 to 68	30
68 to 87	43
87 to 174	40
174 to 230	30
230 to 1 000	40
At the transition frequency, the more stringent limit shall apply.	

In Table 7, the measuring distance D from the exterior wall of the building in which the equipment is situated equals (30 + x/a) m or 100 m whichever is smaller, provided that the measuring distance D is within the boundary of the premises. In the case where the calculated distance D is beyond the boundary of the premises, the measuring distance D equals x or 30 m, whichever is longer.

For the calculation of the above values:

x is the nearest distance between the outside wall of the building in which the equipment is situated and the boundary of the user's premises in each measuring direction;

a = 2,5 for frequencies lower than 1 MHz;

a = 4,5 for frequencies equal to, or higher than, 1 MHz.

6.3.3 Low-frequency emission limits

The limits for:

a) harmonic current emissions are given in IEC 61000-3-2:2018 and IEC 61000-3-12:2011,

b) voltage fluctuations and flicker are given in IEC 61000-3-3:2013 and IEC 61000-3-3:2013/AMD1:2017 and IEC 61000-3-11:2017,

and are applicable to resistance welding equipment, as far as covered by the scope of these standards. The applicable standard shall be selected based on the maximum short-circuit input current I_{1cc} value.

NOTE For other equipment, no requirements at manufacturing stage are specified. Connection conditions can apply depending on local power supply conditions. IEC TS 61000-3-4:1998, IEC TR 61000-3-6:2008 and IEC TR 61000-3-7:2008 are taken into consideration.

6.3.4 Conducted emissions at signal, control and measurement ports

Class A equipment shall comply with the limits in Table 5 of IEC 61000-6-4:2018.

Class B equipment shall comply with the limits for the telecommunications/network ports in Table 4 of IEC 61000-6-3:2006/AMD1:2010.

These requirements apply only to ports that connect the welding system to external equipment (e.g. wired network ports).

These requirements do not apply to ports designed exclusively for interconnection of equipment within the welding system (e.g. other power sources, remote controls).

7 Immunity tests

7.1 Tests applicability

Resistance welding equipment that does not contain electronic control circuitry is deemed to fulfil the necessary immunity requirements without testing.

Electric circuits consisting of passive components such as inductors, RF suppression networks, mains frequency transformers, rectifiers, diodes and resistors are not considered to be electronic control circuitry.

The tests for immunity levels for enclosure, AC input power port and ports for process measurement and control lines are defined in Table 8, Table 9 and Table 10.

7.2 Test conditions

The resistance welding equipment shall be tested, using the set-up as given in Clause 5. The resistance welding equipment shall be set up with a resistance of 1 kΩ between the electrodes. The output voltage shall be monitored to evaluate the compliance with performance criteria at an ignition delay angle of 90° electric if means of adjustment are provided and with the point with the duty cycle and the welding heat time typical of the resistance welding equipment on test or with a continuously flowing output current.

For equipment that cannot operate under the given test conditions, the manufacturers recommendations shall be followed.

Tests that cannot be performed on the complete resistance welding equipment can be performed on its electronic constituent parts.

7.3 Immunity performance criteria

7.3.1 Performance criteria A

The following criteria shall be met:

a) the resistance welding equipment shall continue to operate as intended;

b) variations of ±10 % of the output voltage are admissible;

c) the pre-set heat time shall not be exceeded;

d) no interruptions are permitted in the heat time;

e) in the "single" welding state, an interruption of the welding cycle shall be properly terminated;

f) in the "repeat", "seam" and "continuous" welding states, an interruption of the cycle by releasing the start switch provided shall be possible;

g) all controls shall continue to function;

h) malfunctioning of the semiconductor power switches is inadmissible;

i) loss of stored data is inadmissible.

7.3.2 Performance criteria B

The following criteria shall be met:

a) variations of $^{+50}_{-100}$ % of the output voltage are admissible;

b) in the case of a current interruption during the intended heat time, the welding cycle is terminated with "no current". Manual reset may be required;

c) the pre-set heat time shall not be exceeded;

d) in the "single" welding state, an interruption of the welding cycle shall be properly terminated;

e) in the "repeat", "seam" and "continuous" welding states, an interruption of the cycle by releasing the start switch provided shall be possible;

f) malfunctioning of the semiconductor power switches is inadmissible;

g) loss of stored data is inadmissible.

7.3.3 Performance criteria C

The following criteria shall be met:

a) temporary loss of function is allowed, provided that the loss of function is self-recoverable or can be restored by the operator of the controls. This may require the control voltage of the resistance welding equipment to be restored by means of an appropriate switch;

b) malfunctioning of the semiconductor power switches is inadmissible; temporary loss of function is allowed;

c) loss of stored programme data is inadmissible, unless it can be restored by the operation of the controls.

7.4 Immunity levels

Immunity levels are given in Table 8 for the enclosure, Table 9 for the AC input power port and Table 10 for ports for measurement and control lines.

Table 8 – Immunity levels – Enclosure

Phenomena		Units	Test specification	Basic standard	Remarks	Performance criteria
Radio-frequency EM field, amplitude modulated		MHz V/m (unmod. RMS) % AM (1 kHz)	80 to 1 000 10 80	IEC 61000-4-3:2006/AMD1:2007/AMD2:2010	The test level specified is prior to modulation	A
Radio-frequency EM field, amplitude modulated		GHz V/m (unmod. RMS) % AM (1 kHz)	1,4 to 6,0 3 80	IEC 61000-4-3:2006/AMD1:2007/AMD2:2010	The test level specified is the RMS value of the unmodulated carrier	A
Electrostatic discharge	Contact discharge	kV (charge voltage)	±4 [a]	IEC 61000-4-2:2008	See basic standard for applicability of contact and/or air discharge test	B
	Air discharge	kV (charge voltage)	±8 [a]			B
[a] Testing is not required at lower levels than those specified.						

Table 9 – Immunity levels – AC input power port

Phenomena	Units	Test specification	Basic standard	Remarks	Performance criteria
Fast transients	kV (peak) Repetition frequency kHz Tr/Th ns	±2 5 or 100 5/50	IEC 61000-4-4:2012	[f]	B
Radio-frequency common mode	MHz V (unmod. RMS) % AM (1 kHz)	0,15 to 80 10 80	IEC 61000-4-6:2013	The test level specified is the RMS value of the unmodulated carrier [a]	A
Surges[d] line-to-line line-to-earth	T_r/T_h µs kV (open-circuit voltage) kV (open-circuit voltage)	1,2/50 (8/20) ±1 ±2	IEC 61000-4-5:2014/AMD1:2017	[g]	B
Voltage dips[c]	% residual voltage cycles at 50/60Hz	40 10/12	IEC 61000-4-11:2004/AMD1:2017 IEC 61000-4-34:2005/AMD1:2009	Voltage shift at zero crossings [b, e]	C
	% residual voltage cycles at 50/60Hz	70 25/30			C
	% residual voltage cycle	0 1			B

[a] The test level can also be defined as the equivalent current into a 150 Ω load.

[b] Applicable only to input ports.

[c] For electronic power converters, the operation of protective devices (e.g. undervoltage protection) and the performance criterion C are allowed.

[d] For supply voltages where no test equipment is commercially available (e.g. CDNs), this test is not required.

[e] The test shall be carried out at the frequencies appropriate to the power supply frequency. Equipment intended to be used in regions where only one of these frequencies is applied needs to be tested at this specific frequency only.

[f] The test may be performed at one or at both repetition frequencies. The use of 5 kHz repetition frequency is traditional; however, 100 kHz is closer to reality.

[g] In cases where a manufacturer's specification requires external protection devices or measures which are clearly specified in the user's manual, the test requirements of this document shall be applied with the external protection devices or measures in place.

Table 10 – Immunity levels – Ports for measurement and control

Phenomena	Units	Test specification	Basic standard	Remarks	Performance criteria
Fast transients	kV (peak) T_r/T_h ns Repetition frequency kHz	±2 5/50 5	IEC 61000-4-4:2012	Capacitive clamp used [b, f]	B
Radio-frequency common mode	MHz V (unmod. RMS) % AM (1kHz)	0,15 to 80 10 80	IEC 61000-4-6:2013	The test level specified is the RMS value of the unmodulated carrier [a, b]	A
Surge line-to-line line-to-earth	T_r/T_h µs kV (open-circuit voltage) kV (open-circuit voltage)	1,2/50 0,5[a] ±1	IEC 61000-4-5:2014/AMD1:2017	[c, d, e]	B

[a] The test level can also be defined as the equivalent current into a 150 Ω load.

[b] Applicable only to ports interfacing with cables whose total length according to the manufacturer's functional specification may exceed 3 m.

[c] Applicable only to ports interfacing with long distance lines. A long distance line is a line connected to a signal/control port and which inside a building is longer than 30 m, or which leaves the building (including a line installed outdoors).

[d] Where normal functioning cannot be achieved because of the impact of the coupling/decoupling network (CDN) on the EUT, the test shall be done with the reduced functionality. A rationale shall be given in the test report for doing so. After the test and the removal of the CDN, the normal function shall not be affected.

[e] Signal ports directly connected to AC power network shall be treated as AC power ports.

[f] The test may be performed at one or at both repetition frequencies. The use of 5 kHz repetition frequency is traditional; however, 100 kHz is closer to reality.

8 Documentation for the purchaser/user

The documentation made available to the purchaser/user prior to the purchase shall clearly indicate restrictions for use, due to:

a) the RF equipment class (Class A or Class B);

b) low-frequency (LF) requirements for the public low voltage supply network connection.

Symbol 1 given in Annex B is recommended to be used for Class A equipment to indicate the RF equipment class and restrictions for use.

Symbol 2 given in Annex B is recommended to be used to indicate restrictions for use due to LF requirements for the public low voltage supply network connection.

The user shall be made aware of the fact that proper installation and use of the resistance welding equipment is necessary to minimize possible interfering emissions. The manufacturer shall include instructions and information with each equipment as follows:

a) For Class B equipment, a written statement that Class B equipment complies with electromagnetic compatibility requirements in industrial and residential environments, including residential locations where the electrical power is provided by the public low-voltage supply system;

b) For Class A equipment, the instructions for use accompanying the product shall contain cautionary text such as:

Caution: This equipment is not intended for use in residential environments and may not provide adequate protection to radio reception in such environments.

c) If the equipment with an input current below 75 A per phase is intended to be connected to public low voltage systems, and it does comply with IEC 61000-3-11:2017 or IEC 61000-3-12:2011 based on system impedance restrictions, the information given in the next paragraph or its equivalent shall be included in the instruction manual. The restriction shall be given as the lower value of the permissible system impedances (in mΩ) or the higher value of the required short circuit power (in MVA) resulting from tests in accordance with these standards. The impedance value may be calculated from the short circuit power value and vice versa.

   Provided that the public low voltage system impedance at the point of common coupling is lower than XX mΩ (or the short circuit power is higher than XX MVA), this equipment is compliant with IEC 61000-3-11:2017 and IEC 61000-3-12:2011 and can be connected to public low voltage systems. It is the responsibility of the installer or user of the equipment to ensure, by consultation with the distribution network operator if necessary, that the system impedance complies with the impedance restrictions.

d) If the equipment with an input current below 75 A per phase is intended to be connected to public low-voltage systems and does not comply with IEC 61000-3-12:2011, the following information or its equivalent shall be included in the instruction manual:

   This equipment does not comply with IEC 61000-3-12:2011. If it is connected to a public low-voltage system, it is the responsibility of the installer or user of the equipment to ensure, by consultation with the distribution network operator, that the equipment may be connected.

e) Information on any special measures that have to be taken to achieve compliance, for example, the use of shielded cables.

f) Recommendations on the assessment of the surrounding area, to identify necessary precautions required for the installation and use, to minimize disturbances.

g) Recommendations on methods to minimize disturbances.

Annex A
(informative)

Limits

A.1 General

Annex A provides information on the origin of the limits given in the main part of this document.

A.2 Mains terminal disturbance voltage limits

Limits given in the normative part of this document originate from the limits in CISPR 11:2015, CISPR 11:2015/AMD1:2016 and CISPR 11:2015/AMD2:2019.

For the idle state, group 1 limits were adopted. A relaxation of the limits based on the rated power of the equipment is not implemented in the idle-state.

The loaded-state limits are based on the limits for group 2 equipment in CISPR 11:2015, CISPR 11:2015/AMD1:2016 and CISPR 11:2015/AMD2:2019.

A.3 Electromagnetic radiation disturbance limits

Limits given in the normative part of this document originate from the limits in CISPR 11:2015, CISPR 11:2015/AMD1:2016 and CISPR 11:2015/AMD2:2019.

For the idle-state, group 1 limits were adopted.

The loaded-state limits are based on the limits for group 2 equipment in CISPR 11:2015, CISPR 11:2015/AMD1:2016 and CISPR 11:2015/AMD2:2019.

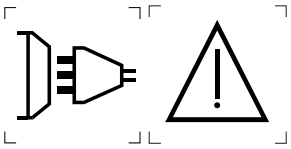
CISPR 11:2015, CISPR 11:2015/AMD1:2016 and CISPR 11:2015/AMD2:2019 implements 20 dB relaxations in certain frequency ranges. These are not present in this document.

Annex B
(informative)

Symbols

Table B.1 provides symbols for the indication of the RF equipment class and restrictions for use.

Table B.1 – Symbols to describe EMC properties

N°	SOURCE	SYMBOL	FUNCTION, KEYWORD OR PHRASE	APPLICATION
1.	IEC 60417-5109 (2002-10)		Not to be used in residential locations where the electrical power is provided by the public low-voltage supply system	To identify class A equipment and restrictions for use NOTE Symbol can be used on packaging, equipment or documentation for purchaser or user available prior to purchase
2.	IEC 60417-5939 (2002-10) and ISO 7000-0434A (2004-01) combined		Restrictions for the connection to public low voltage supply networks apply	To identify restrictions of use with regard to required supply network parameters NOTE Symbol can be used on packaging, equipment or documentation for purchaser or user available prior to purchase

Annex C
(normative)

Battery powered equipment

C.1 General

Annex C defines additional requirements for the welding equipment powered by internal or external batteries.

The equipment shall comply to the requirements in this document in all modes of operation.

C.2 Additional emission requirements

Any DC input power port of the welding equipment shall comply with the applicable conducted emissions requirements for DC power ports of:

- IEC 61000-6-4:2018 for Class A equipment,
- IEC 61000-6-3:2006 and IEC 61000-6-3:2006/AMD1:2010 for Class B equipment.

External chargers shall comply with:

- IEC 61000-6-4:2018 if used to charge Class A welding equipment,
- IEC 61000-6-3:2006 and IEC 61000-6-3:2006/AMD1:2010 if used to charge Class B welding equipment.

If a battery charger is intended to be used for both Class A and Class B welding equipment, the charger shall comply to the more stringent limits.

NOTE IEC 61000-6-3:2006 and IEC 61000-6-3:2006/AMD1:2010 and IEC 61000-6-4:2018 consider the highest internal frequency as well as the length of the connected cable to the DC power port.

C.3 Additional immunity requirements

Any DC input power port shall comply to the applicable immunity requirements for DC power ports of:

- IEC 61000-6-2:2016 for Class A equipment,
- IEC 61000-6-1:2016 for Class B equipment.

External chargers shall comply to:

- IEC 61000-6-2:2016 if used to charge Class A welding equipment,
- IEC 61000-6-1:2016 if used to charge Class B welding equipment.

If a battery charger is intended to be used for both Class A and Class B welding equipment, the charger shall be tested to the higher test levels.

NOTE IEC 61000-6-1:2016 and IEC 61000-6-2:2016 consider the highest internal frequency as well as the length of the connected cable to the DC power port.

Annex D
(normative)

Equipment containing radio devices

D.1 General

Annex D defines additional requirements for welding equipment containing radio devices.

The welding equipment shall comply with any additional requirement in the applicable radio standard not specified in this document.

NOTE Examples are requirements regarding the antenna port.

The radio device shall comply with the applicable radio standard.

Exclusion bands specified in the applicable radio standard only apply to the radio functionality.

D.2 Additional emission requirements

For frequency ranges not defined in this document, the welding equipment shall comply with the applicable radiated emissions limits for the enclosure port of

- Table 3 of IEC 61000-6-4:2018 for Class A equipment
- Table 1 of IEC 61000-6-3:2006/AMD1:2010 for Class B equipment

For the radiated emission the transmitter function of the radio device is turned off.

D.3 Additional immunity requirements

The performance criterion C shall be applied to the radio function.

If an immunity test would cause damage to a radio receiver, additional mitigation measures shall be applied. These measures shall be documented in the test report. The documentation to the user shall indicate ports sensitive to these phenomena.

Bibliography

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IEC 60050-161:1990, *International Electrotechnical Vocabulary (IEV) – Part 161: Electromagnetic compatibility*

IEC 60050-851:2008, *International Electrotechnical Vocabulary (IEV) – Part 851: Electric welding*

IEC 60417, *Graphical symbols for use on equipment* (available at http://www.graphical-symbols.info/equipment)

IEC TS 61000-3-4:1998, *Electromagnetic compatibility (EMC) – Part 3-4: Limits – Limitation of emission of harmonic currents in low-voltage power supply systems for equipment with rated current greater than 16 A*

IEC TR 61000-3-6:2008, *Electromagnetic compatibility (EMC) – Part 3-6: Limits – Assessment of emission limits for the connection of distorting installations to MV, HV and EHV power systems*

IEC TR 61000-3-7:2008, *Electromagnetic compatibility (EMC) – Part 3-7: Limits – Assessment of emission limits for the connection of fluctuating installations to MV, HV and EHV power systems*

IEC Guide 107:2014, *Electromagnetic compatibility – Guide to the drafting of electromagnetic compatibility publications*

ISO 7000:2019, *Graphical symbols for use on equipment – Registered symbols*

CISPR 14-1:2016, *Electromagnetic compatibility – Requirements for household appliances, electric tools and similar apparatus – Part 1: Emission*

CISPR 32:2015, *Electromagnetic compatibility of multimedia equipment – Emission requirements*
CISPR 32:2015/AMD1:2019

SOMMAIRE

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

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MATÉRIELS DE SOUDAGE PAR RÉSISTANCE –

Partie 2: Exigences de compatibilité électromagnétique (CEM)

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La Norme internationale IEC 62135-2 a été établie par le comité d'études 26 de l'IEC: Soudage électrique.

Cette troisième édition annule et remplace la deuxième édition parue en 2015. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

a) mise à jour des limites applicables conformément aux références mises à jour;
b) mise en œuvre des exigences du champ magnétique rayonné.

Le texte de cette norme est issu des documents suivants:

FDIS	Rapport de vote
26/696/FDIS	26/698/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à l'approbation de cette norme.

Cette publication a été rédigée selon les Directives ISO/IEC, Partie 2.

Une liste de toutes les parties de la série IEC 62135, publiées sous le titre général *Matériels de soudage par résistance*, peut être consultée sur le site web de l'IEC.

Le comité a décidé que le contenu de cette publication ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous " http://webstore.iec.ch " dans les données relatives à la publication recherchée. À cette date, la publication sera

- reconduite,
- supprimée,
- remplacée par une édition révisée, ou
- amendée.

MATÉRIELS DE SOUDAGE PAR RÉSISTANCE –

Partie 2: Exigences de compatibilité électromagnétique (CEM)

1 Domaine d'application

La présente partie de l'IEC 62135 est applicable aux matériels de soudage par résistance et procédés connexes qui sont connectés aux réseaux d'alimentation avec des tensions assignées jusqu'à 1 000 V efficace en courant alternatif. Le présent document ne définit pas d'exigences de sécurité.

Les matériels de soudage par résistance ayant fait l'objet d'un essai de type conforme au présent document et qui en ont rempli les exigences sont considérés comme étant conformes pour toutes les applications.

La plage de fréquences couverte est de 0 Hz à 400 GHz.

Les matériels de soudage à l'arc contenant un récepteur ou un émetteur radio relèvent du domaine d'application du présent document. Des exigences supplémentaires applicables à de tels matériels sont spécifiées dans l'Annexe D.

Les exigences en matière d'émissions rayonnées contenues dans le présent document ne sont pas destinées à s'appliquer aux transmissions intentionnelles d'un émetteur radio telles que définies par l'UIT ni aux émissions parasites associées à ces émetteurs intentionnels.

La présente norme de produit CEM pour les matériels de soudage par résistance prévaut sur tous les aspects des normes génériques et aucun essai additionnel CEM n'est exigé ou nécessaire.

NOTE 1 Le brasage tendre et fort par résistance ou le chauffage par résistance par des moyens comparables au matériel de soudage par résistance sont des procédés connexes typiques.

NOTE 2 Les valeurs limites ne sont spécifiées que pour une partie de la plage de fréquences.

Les matériels de soudage par résistance sont classés en matériels de Classe A et de Classe B.

La présente partie de l'IEC 62135 spécifie

a) les méthodes d'essai à utiliser conjointement à la CISPR 11:2015, CISPR 11:2015/AMD1:2016 et CISPR 11:2015/AMD2:2019 pour déterminer l'émission radiofréquence (RF);

b) les normes pertinentes et les méthodes d'essai pour l'émission de courant harmonique, la fluctuation de tension et le papillotement;

c) les exigences supplémentaires pour les matériels alimentés par des batteries internes ou externes (Annexe C).

NOTE 3 Les limites du présent document ne peuvent pas, toutefois, fournir une pleine protection contre les interférences à la réception de la radio et de la télévision quand le matériel de soudage par résistance est utilisé à moins de 30 m d'une ou de plusieurs antennes réceptrices.

NOTE 4 Dans des cas spéciaux, quand un appareil de grande sensibilité est utilisé dans un voisinage proche, des mesures d'atténuation additionnelles sont parfois utilisées pour réduire davantage les émissions électromagnétiques.

NOTE 5 Les origines des valeurs limites dans le présent document sont résumées dans l'Annexe A.

La présente partie de l'IEC 62135 définit les exigences d'immunité et les méthodes d'essai pour les perturbations continues et transitoires, conduites et rayonnées, y compris les décharges électrostatiques.

NOTE 6 Ces exigences ne couvrent pas, toutefois, les cas extrêmes qui sont particulièrement rares.

2 Références normatives

Les documents suivants cités dans le texte constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 61000-3-2:2018, *Compatibilité électromagnétique (CEM) – Partie 3-2: Limites – Limites pour les émissions de courant harmonique (courant appelé par les appareils ≤ 16 A par phase)*

IEC 61000-3-3:2013, *Compatibilité électromagnétique (CEM) – Partie 3-3: Limites – Limitation des variations de tension, des fluctuations de tension et du papillotement dans les réseaux publics d'alimentation basse tension, pour les matériels ayant un courant assigné ≤ 16 A par phase et non soumis à un raccordement conditionnel*
IEC 61000-3-3:2013/AMD1:2017

IEC 61000-3-11:2017,*Compatibilité électromagnétique (CEM) – Partie 3-11: Limites – Limitation des variations de tension, des fluctuations de tension et du papillotement dans les réseaux publics d'alimentation basse tension – Équipements ayant un courant assigné ≤ 75 A et soumis à un raccordement conditionnel*

IEC 61000-3-12:2011, *Compatibilité électromagnétique (CEM) – Partie 3-12: Limites – Limites pour les courants harmoniques produits par les appareils connectés aux réseaux publics basse tension ayant un courant appelé > 16 A et ≤ 75 A par phase*

IEC 61000-4-2:2008, *Compatibilité électromagnétique (CEM) – Partie 4-2: Techniques d'essai et de mesure – Essai d'immunité aux décharges électrostatiques*

IEC 61000-4-3:2006, *Compatibilité électromagnétique (CEM) – Partie 4-3: Techniques d'essai et de mesure – Essai d'immunité aux champs électromagnétiques rayonnés aux fréquences radioélectriques*
IEC 61000-4-3:2006/AMD1:2007
IEC 61000-4-3:2006/AMD2:2010

IEC 61000-4-4:2012, *Compatibilité électromagnétique (CEM) – Partie 4-4: Techniques d'essai et de mesure – Essais d'immunité aux transitoires électriques rapides en salves*

IEC 61000-4-5:2014, *Compatibilité électromagnétique (CEM) – Partie 4-5: Techniques d'essai et de mesure – Essai d'immunité aux ondes de choc*
IEC 61000-4-5:2014/AMD1:2017

IEC 61000-4-6:2013, *Compatibilité électromagnétique (CEM) – Partie 4-6: Techniques d'essai et de mesure – Immunité aux perturbations conduites, induites par les champs radioélectriques*

IEC 61000-4-11:2004, *Compatibilité électromagnétique (CEM) – Partie 4-11: Techniques d'essai et de mesure – Essais d'immunité aux creux de tension, coupures brèves et variations de tension*
IEC 61000-4-11:2004/AMD1:2017

IEC 61000-4-34:2005, *Compatibilité électromagnétique (CEM) – Partie 4-34: Techniques d'essai et de mesure – Essais d'immunité aux creux de tension, coupures brèves et variations de tension pour matériel ayant un courant appelé de plus de 16 A par phase*
IEC 61000-4-34:2005/AMD1:2009

IEC 61000-6-1:2016, *Compatibilité électromagnétique (CEM) – Partie 6-1: Normes génériques – Norme d'immunité pour les environnements résidentiels, commerciaux et de l'industrie légère*

IEC 61000-6-2:2016, *Compatibilité électromagnétique (CEM) – Partie 6-2: Normes génériques – Norme d'immunité pour les environnements industriels*

IEC 61000-6-3:2006, *Compatibilité électromagnétique (CEM) – Partie 6-3: Normes génériques – Norme sur l'émission pour les environnements résidentiels, commerciaux et de l'industrie légère*
IEC 61000-6-3:2006/AMD1:2010

IEC 61000-6-4:2018, *Compatibilité électromagnétique (CEM) – Partie 6-4: Normes génériques – Norme sur l'émission pour les environnements industriels*

IEC 62135-1:2015, *Matériels de soudage par résistance – Partie 1: Exigences de sécurité pour la conception, la fabrication et l'installation*

ISO 669:2016, *Soudage par résistance – Matériel de soudage par résistance – Exigences mécaniques et électriques*

CISPR 11:2015, *Appareils industriels, scientifiques et médicaux – Caractéristiques de perturbations radioélectriques – Limites et méthodes de mesure*
CISPR 11:2015/AMD1:2016
CISPR 11:2015/AMD2:2019

CISPR 16-1-1:2019, *Spécifications des méthodes et des appareils de mesure des perturbations radioélectriques et de l'immunité aux perturbations radioélectriques – Partie 1-1: Appareils de mesure des perturbations radioélectriques et de l'immunité aux perturbations radioélectriques – Appareils de mesure*

CISPR 16-1-2:2014, *Spécifications des méthodes et des appareils de mesure des perturbations radioélectriques et de l'immunité aux perturbations radioélectriques – Partie 1-2: Appareils de mesure des perturbations radioélectriques et de l'immunité aux perturbations radioélectriques – Dispositifs de couplage pour la mesure des perturbations conduites*
CISPR 16-1-2:2014/AMD1:2017

CISPR 16-1-4:2019, *Spécifications des méthodes et des appareils de mesure des perturbations radioélectriques et de l'immunité aux perturbations radioélectriques – Partie 1-4: Appareils de mesure des perturbations radioélectriques et de l'immunité aux perturbations radioélectriques – Antennes et emplacements d'essai pour les mesures des perturbations rayonnées*

3 Termes et définitions

Pour les besoins du présent document, les termes et définitions suivants s'appliquent.

L'ISO et l'IEC tiennent à jour des bases de données terminologiques destinées à être utilisées en normalisation, consultables aux adresses suivantes:

- IEC Electropedia: disponible à l'adresse http://www.electropedia.org/
- ISO Online browsing platform: disponible à l'adresse http://www.iso.org/obp

3.1
borne pour câble
borne d'interface au niveau de laquelle un conducteur ou un câble est connecté à l'appareil

Note 1 à l'article: Les exemples sont les bornes pour câble de signal, de commande et de puissance.

Note 2 à l'article: Le circuit secondaire du matériel de soudage par résistance n'est pas une borne pour câble mais un accès par l'enveloppe.

3.2
claquement
perturbation qui dépasse la limite d'une perturbation continue qui n'est pas plus longue que 200 ms et qui est séparée d'une perturbation subséquente par au moins 200 ms

Note 1 à l'article: Les deux intervalles sont reliés au niveau de la limite de la perturbation continue.

Note 2 à l'article: Un claquement peut contenir un nombre d'impulsions, dans ce cas le temps en question est celui à partir du début de la première jusqu'à la fin de la dernière impulsion.

[SOURCE: IEC 60050-851:2008, 851-15-13]

3.3
accès par l'enveloppe
frontière physique de l'appareil à travers laquelle les champs électromagnétiques peuvent rayonner ou à laquelle ils peuvent se heurter

3.4
FAR
chambre totalement anéchoïque
enceinte protégée dont les surfaces intérieures sont garnies d'un matériau absorbant l'énergie aux fréquences radioélectriques (c'est-à-dire un absorbant RF) qui absorbe l'énergie électromagnétique dans la plage de fréquences concernée

Note 1 à l'article: L'abréviation "FAR" est dérivée du terme anglais développé correspondant " fully-anechoic room ".

[SOURCE: CISPR 11:2015/AMD1:2016, 3.20]

3.5
état de repos
état de fonctionnement dans lequel l'alimentation est activée, mais où le circuit de soudage n'est pas sous tension

Note 1 à l'article: Il n'existe pas d'état de repos pour certains types de matériel.

Note 2 à l'article: Pour une source de courant dans un système mécanisé, la configuration réalisant l'état de repos est définie par le fabricant.

Note 3 à l'article: Un état de repos peut inclure un faible niveau d'énergie à partir duquel le procédé de soudage ne peut pas démarrer sans une réactivation automatique ou manuelle.

3.6
OATS
site d'essai en champ libre
installation utilisée pour les mesures des champs électromagnétiques, dont l'intention est de simuler un environnement semi-libre sur une plage de fréquences spécifiée utilisée pour les essais d'émissions rayonnées des produits

Note 1 à l'article: Un site OATS type se situe à l'extérieur dans un champ libre, son plan de masse étant conducteur.

Note 2 à l'article: L'abréviation "OATS" est dérivée du terme anglais développé correspondant " open-area test site ".

[SOURCE: CISPR 11:2015/AMD1:2016, 3.21]

3.7
accès
interface particulière d'un matériel qui associe ce matériel avec l'environnement électromagnétique (IEC 60050-161:2018, 161-01-01) externe et par laquelle le matériel est influencé par cet environnement

EXEMPLE Les exemples d'accès présentant un intérêt sont indiqués à la Figure 1. L'accès par l'enveloppe est la frontière physique de l'appareil (par exemple l'enveloppe). L'accès par l'enveloppe concerne la transmission d'énergie rayonnée et les décharges électrostatiques (IEC 60050-161:2018, 161-01-22), alors que les autres accès concernent la transmission d'énergie conduite.

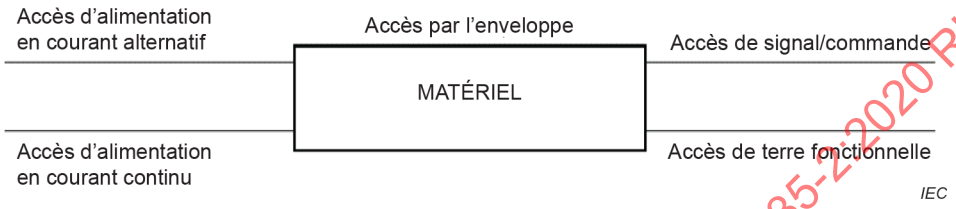

Figure 1 – Exemples d'accès

Note 1 à l'article: Les accès relevant de la compatibilité électromagnétique sont des cas spécifiques de l'accès défini dans l'IEC 60050-131:2002, 131-12-60.

[SOURCE: Guide IEC 107:2009, 3.1.12, modifiée – La présentation et le libellé de la définition ont été révisés pour l'aligner sur l'IEC 60050 (toutes les parties).]

3.8
SAC
chambre semi-anéchoïque
enceinte protégée dans laquelle cinq des six surfaces intérieures sont garnies d'un matériau absorbant l'énergie aux fréquences radioélectriques (c'est-à-dire un absorbeur RF) qui absorbe l'énergie électromagnétique dans la plage de fréquences concernée et dont la surface horizontale inférieure est un plan de masse conducteur destiné à être utilisé avec un équipage d'essai OATS

Note 1 à l'article: L'abréviation "SAC" est dérivée du terme anglais développé correspondant " semi-anechoic chamber ".

[SOURCE: CISPR 11:2015/AMD1:2016, 3.22]

3.9
petit matériel
matériel qui est, soit placé sur une table, soit posé sur le sol, et qui tient à l'intérieur d'un volume d'essai cylindrique imaginaire dont le diamètre ne dépasse pas 1,2 m et dont la hauteur au-dessus du plan au sol ne dépasse pas 1,5 m, y compris ses câbles

[SOURCE: CISPR 11:2015, 3.17, modifiée – Ne s'applique qu'à la version anglaise.]

3.10
accès de réseau câblé
accès pour le raccordement de la voix, de données et des transferts de signaux destinés à relier entre eux des systèmes largement répandus à une connexion directe à un réseau de communication unique ou multiutilisateur

Note 1 à l'article: Les exemples incluent CATV, PSTN, ISDN, xDSL, LAN et les réseaux similaires.

Note 2 à l'article: Ces accès peuvent prendre en charge des câbles blindés ou non blindés et peuvent également transporter l'alimentation courant alternatif ou courant continu, ce qui constitue une partie intégrale de la spécification relative aux télécommunications.

[SOURCE: CISPR 32:2015, 3.1.32]

4 Exigences générales d'essai

4.1 Conditions d'essai

Les essais doivent être effectués sur un matériel entièrement assemblé, représentatif de la production en série. Les essais doivent être réalisés dans les conditions de fonctionnement spécifiées pour l'appareil, à sa tension d'alimentation et fréquence assignées, comme cela est indiqué dans l'IEC 62135-1:2015. Les résultats obtenus pour l'émission RF et l'immunité à 50 Hz sont valables pour le même appareil utilisé à 60 Hz et inversement.

4.2 Instruments de mesure

Les instruments de mesure doivent satisfaire aux exigences de la CISPR 16-1-1:2019 et aux normes indiquées dans le Tableau 8, le Tableau 9 et le Tableau 10, le cas échéant.

4.3 Réseau artificiel d'alimentation

La tension perturbatrice aux bornes du réseau doit être mesurée en utilisant un réseau d'alimentation artificiel (si un tel réseau est disponible sur le marché) consistant en un réseau V de 50 Ω/50 µH ou de 50 Ω/50 µH + 5 Ω comme cela est spécifié dans la CISPR 16-1-2:2014 et CISPR 16-1-2:2014/AMD1:2017.

Le réseau artificiel doit fournir une impédance d'alimentation réseau définie à la RF au point de mesure et aussi pour isoler le matériel en essai du bruit ambiant sur les lignes d'alimentation.

4.4 Sonde de tension

Une sonde de tension telle que spécifiée dans la CISPR 16-1-2:2014 et CISPR 16-1-2:2014/AMD1:2017 doit être utilisée quand le réseau artificiel d'alimentation ne peut être utilisé. La sonde est connectée successivement entre chaque phase et la terre de référence. La sonde doit comprendre un condensateur de blocage et une résistance de sorte que la résistance totale entre la phase et la terre soit au moins de 1 500 Ω. L'effet sur l'exactitude de mesure du condensateur ou de n'importe quel autre dispositif qui peut être utilisé pour protéger le récepteur de mesure contre les courants dangereux, doit être soit inférieur à 1 dB, soit admis pour l'étalonnage.

4.5 Antennes

Dans la plage de fréquences inférieures à 30 MHz, l'antenne doit être une boucle comme cela est spécifié dans la CISPR 16-1-4:2019.

Dans la plage de fréquences comprises entre 30 MHz et 1 GHz l'antenne ou les antennes utilisées doivent être telles que spécifiées dans la CISPR 16-1-4:2019. Les mesurages doivent être effectués pour les deux polarisations horizontale et verticale. Le point le plus proche de la ou des antenne(s) à la terre ne doit pas être inférieur à 0,2 m.

5 Montage pour essai d'émission et d'immunité

5.1 Exigences générales

Les essais d'émission et d'immunité doivent être réalisés sur une installation représentative de soudage par résistance telle que décrite ci-dessous. Les matériels de soudage par résistance soumis à l'essai dans ces conditions doivent être reconnus comme ayant satisfait aux exigences du présent document.

Si le matériel de soudage par résistance fait partie d'une installation, ou peut être connecté à un matériel auxiliaire, alors le matériel de soudage par résistance doit être soumis à l'essai quand il est connecté à la configuration minimale de matériel auxiliaire nécessaire pour faire travailler tous les accès. Si le matériel de soudage par résistance a un grand nombre d'accès similaires ou des accès ayant de nombreuses connexions similaires, un nombre suffisant doit être choisi pour simuler les conditions de fonctionnement réelles et pour assurer que tous les types de terminaisons différents soient couverts.

Les mesurages permettant de déterminer la conformité aux limites d'émission basse fréquence doivent être effectués selon les procédures d'essai des normes de base et des normes référencées pertinentes.

Pour les essais de rayonnement électromagnétique perturbateur, la séparation entre l'antenne et le matériel en essai doit être telle que spécifiée à l'Article 6 de la CISPR 11:2015, CISPR 11:2015/AMD1:2016 et CISPR 11:2015/AMD2:2019.

Pour l'essai d'émission rayonnée, dans la plage de fréquences comprises entre 150 kHz et 1 MHz, l'antenne doit être placée sur l'axe z, comme cela est indiqué à la Figure 2, perpendiculairement au plan x, y du circuit de soudage.

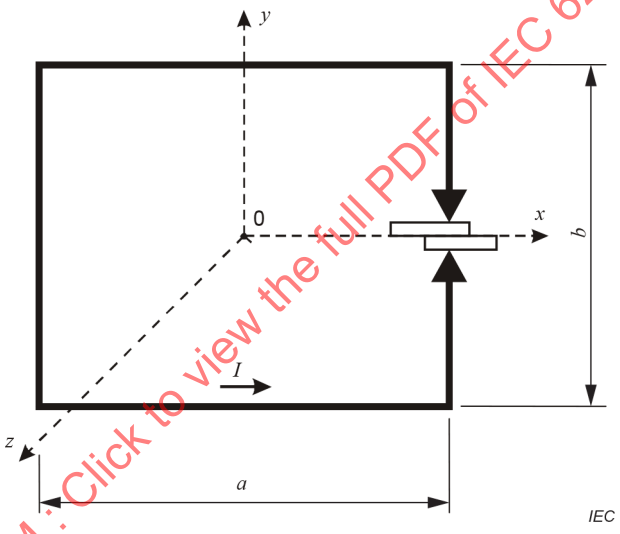

Figure 2 – Position d'essai pour le mesurage du champ H

Les montages d'essai spécifiques pour les essais d'immunité sont présentés dans les normes de base référencées dans les Tableau 8, Tableau 9 et Tableau 10.

Les mesurages sur le matériel de soudage par résistance de Classe A peuvent être réalisés soit sur un site d'essai, soit *in situ* selon la préférence du fabricant.

NOTE 1 En raison de la dimension, de la complexité ou des conditions de fonctionnement, les mesurages de certains matériels de soudage par résistance sont parfois réalisés *in situ* pour prouver la conformité aux limites de rayonnement électromagnétique perturbateur, spécifiées dans le présent document.

NOTE 2 Les essais *in situ*, en raison de leur nature, ne sont pas appropriés pour les essais de type.

Les mesurages sur le matériel de soudage par résistance de Classe B doivent être réalisés sur un site d'essai.

La configuration du matériel de soudage par résistance en essai doit être consignée avec précision dans le rapport d'essai.