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)

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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 25.160.30

ISBN 978-2-8322-8028-7

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FOREWORD

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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- withdrawn,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.

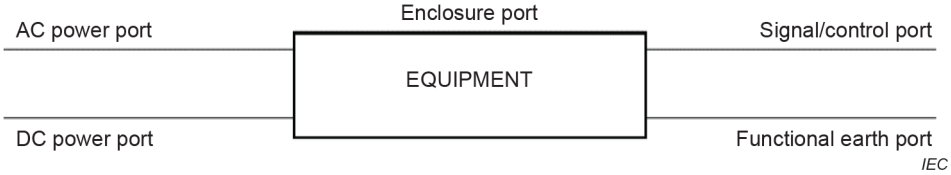

Figure 1 – Examples of ports

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.

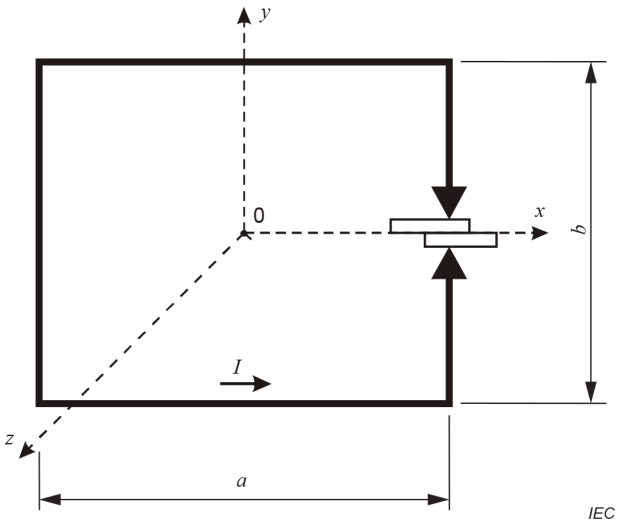

Figure 2 – Test position for H field measurement

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.