IEC 62135-2

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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Withdrawn

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

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

IEC 62135-2:2015-02(en-fr)

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

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

INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

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CONTENTS

FOREWORD 4
1 Scope 6
2 Normative references 6
3 Terms and definitions 8
4 General test requirements 9
4.1 Test conditions 9
4.2 Measuring instruments 9
4.3 Artificial mains network 9
4.4 Voltage probe 9
4.5 Antennas 9
5 Test set-up for emission and immunity 9
5.1 General requirements 9
5.2 Ancillary equipment 10
6 Emission tests 10
6.1 Classification of equipment 10
6.1.1 Class A equipment 10
6.1.2 Class B equipment 11
6.2 Test conditions 11
6.2.1 Test conditions for RF tests 11
6.2.2 Test conditions for low-frequency tests 11
6.3 Emission limits 12
6.3.1 Mains terminal disturbance voltage 12
6.3.2 Electromagnetic radiation disturbance 13
6.3.3 Low-frequency emission limits 13
7 Immunity tests 13
7.1 Tests applicability 13
7.2 Test conditions 14
7.3 Immunity performance criteria 14
7.3.1 Performance criteria A 14
7.3.2 Performance criteria B 14
7.3.3 Performance criteria C 14
7.4 Immunity levels 15
8 Documentation for the purchaser/user 16
Annex A (informative) Limits 18
A.1 General 18
A.2 Mains terminal disturbance voltage limits 18
A.3 Electromagnetic radiation disturbance limits 18
A.4 Harmonic current limits 20
A.5 Limits for voltage fluctuations and flicker 22
Annex B (informative) Symbols 24
Bibliography 25

Figure 1 – Test position for H field measurement 10

Withdrawn

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Table 1 – Immunity levels – Enclosure 15
Table 2 – Immunity levels – AC input power port 15
Table 3 – Immunity levels – Ports for measurement and control 16
Table A.1 – Mains terminal disturbance voltage limits, idle state 18
Table A.2 – Mains terminal disturbance voltage limits, load conditions 18
Table A.3 – Electromagnetic radiation disturbance limits, idle state 19
Table A.4 – Electromagnetic radiation disturbance limits, load conditions 19
Table A.5 – Magnetic field emission limits for Class B equipment 20
Table A.6 – Maximum permissible harmonic current for equipment with input current $I_{1cc} \leq 16$ A 20
Table A.7 – Current emission limits for equipment with 16 A $< I_{1cc} \leq 75$ A other than balanced three-phase equipment 21
Table A.8 – Current emission limits for balanced three-phase equipment with input current 16 A $< I_{1cc} \leq 75$ A 21
Table A.9 – Current emission limits for balanced three-phase equipment with input current 16 A $< I_{1cc} \leq 75$ A under specified conditions 21
Table A.10 – Current emission limits for balanced three-phase equipment with $I_{1cc} \leq$ 75 A under specified conditions (d, e, f) 22
Table A.11 – Limits for resistance welding equipment $I_{1cc} \leq 75$ A 23
Table B.1 – Symbols to describe EMC properties 24

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RESISTANCE WELDING EQUIPMENT –

Part 2: Electromagnetic compatibility (EMC) requirements

FOREWORD

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

This second edition cancels and replaces the first edition published in 2007 and constitutes a technical revision.

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

– update of the applicable limits related to the updated reference to CISPR 11;
– exclusion of the use of narrow band relaxations for RF emission limits;
– update of the applicable limits for harmonics and flicker related to the updated reference to IEC 61000-3-11 and IEC 61000-3-12;
– update of the requirements for voltage dips related to the updated reference to IEC 61000-4-11 and IEC 61000-4-34;

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– inclusion of symbols to indicate the RF equipment class and restrictions for use;
– inclusion of EM field immunity test for frequency from 1,4 GHz to 2,7 GHz;
– inclusion of emission limits for class B resistance welding equipment magnetic fields between 150 kHz and 30 MHz.

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

FDIS	Report on voting
26/555FDIS	26/557/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.

The list of all the 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.

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RESISTANCE WELDING EQUIPMENT –

Part 2: Electromagnetic compatibility (EMC) requirements

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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 a.c. r.m.s. This standard does not define safety requirements.

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

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

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 to determine radiofrequency (RF) emission;

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

NOTE 3 The limits in this standard 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.

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

NOTE 5 These requirements do not, however, cover extreme cases which are extremely rare.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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*

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IEC 61000-3-2:2014, *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: 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 61000-3-11:2000, *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, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test*

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

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

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

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

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

IEC 61000-4-34, *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 62135-1, *Resistance welding equipment – Part 1: Safety requirements for design, manufacture and installation*

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

CISPR 16-1-1, *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, *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 16-1-4, *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*

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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.

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.

3.4
enclosure port
physical boundary of the apparatus through which electro-magnetic fields may radiate or impinge

3.5
EUT
equipment under test

3.6
idle state
operating mode in which the power is switched on, but the welding circuit is not energized

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

3.8
small equipment
equipment, either positioned on a table top or standing on the floor which, including its cables fits in a cylindrical test volume of 1,2 m in diameter and 1,5 m above the ground plane

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

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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. 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 and the standards referred to in Tables 1, 2 and 3 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 V-network as specified in CISPR 16-1-2.

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 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 from 30 MHz to 1 GHz the antenna(s) used shall be as specified in CISPR 16-1-4. 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 standard.

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.

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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.

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 1, perpendicular to the plane x,y of the welding circuit.

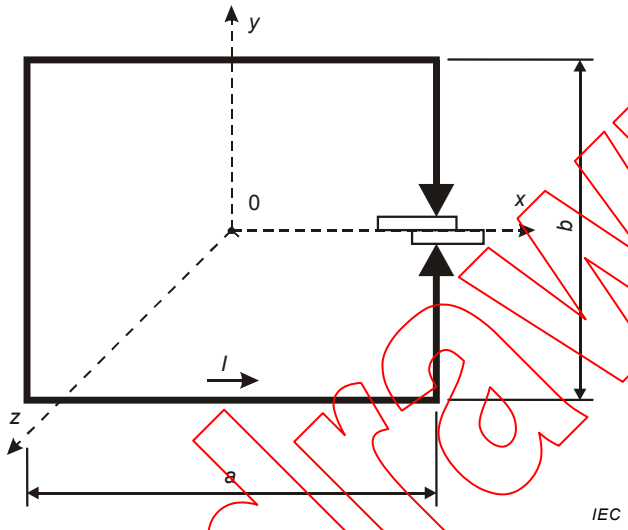

Figure 1 – Test position for H field measurement

Specific test set-up geometries for immunity tests are found in the basic standards referred to in Tables 1, 2 and 3.

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

NOTE 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.

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.

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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 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 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;
- adjust the current to obtain the highest emission, if means of adjustment is 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;
- adjust the current to obtain the highest emission, if means of adjustment is 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.

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The test parameters chosen shall be fully documented.

The arithmetic average value of 1,5 s smoothed r.m.s. supply current values (I_{ref} as per IEC 61000-3-12) 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 r.m.s. 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 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, 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 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 resistance welding equipment are the Group 2 limits given in Table 6 of CISPR 11:2009. 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.

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, 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.

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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.

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.

6.3.3 Low-frequency emission limits

The limits for

a) harmonic current emissions are given in IEC 61000-3-2 and IEC 61000-3-12;

b) voltage fluctuations and flicker are given in IEC 61000-3-3 and IEC 61000-3-11;

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, IEC TR 61000-3-6 and IEC TR 61000-3-7 are taken into consideration.

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, a.c. input power port and ports for process measurement and control lines are defined in Tables 1, 2 and 3.

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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 is provided and 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 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, interruption of the welding cycle shall be properly terminated;

f) in the "repeat", "seam" and "continuous" operating modes, 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 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, the welding cycle shall be properly terminated;

e) in the "repeat", "seam" and "continuous" operating modes, 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 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;

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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 1 for the enclosure, Table 2 for the a.c. input power port and Table 3 for ports for measurement and control lines.

Table 1 – Immunity levels – Enclosure

Phenomena		Units	Test specification	Basic standard	Remarks	Performance criteria
Radiofrequency EM field, amplitude modulated		MHz V/m (unmod. r.m.s.) % AM (1 kHz)	80 to 1 000 10 80	IEC 61000-4-3	The test level specified is prior to modulation	A
Radiofrequency EM field, amplitude modulated		GHz V/m (unmod. r.m.s.) % AM (1 kHz)	1,4 to 2,0 3 80	IEC 61000-4-3	The test level specified is prior to modulation	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	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 2 – 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 5/50	IEC 61000-4-4	Direct injection	B
Radio-frequency common mode	MHz V (unmod. r.m.s.) % AM (1 kHz)	0,15 to 80 10 80	IEC 61000-4-6	See note The test level specified is prior to modulation	A
Surges line-to-line line-to-earth	Tr/Th µs kV (open circuit voltage) kV (open circuit voltage)	1,2/50 (8/20) ±1 ±2	IEC 61000-4-5	This test is not required when normal functioning cannot be achieved because of the impact of the CDN on the EUT	B
Voltage dips	% residual voltage cycles at 50/60Hz	70 25/30	IEC 61000-4-11 IEC 61000-4-34	Voltage shift at zero crossing	B
	% residual voltage cycle	0 1			C
NOTE The test level can also be defined as the equivalent current into a 150 Ω load.					

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