SLOVENSKI STANDARD
SIST EN 50059:2001

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Specifikacija za ročno opremo za elektrostatično brizganje z nevnetljivimi materiali za barvanje in končno obdelavo

Specification for electrostatic hand-held spraying equipment for non-flammable material for painting and finishing

Bestimmungen für elektrostatische Handsprüheinrichtungen für nichtbrennbare Sprühstoffe für Beschichtungen

Spécifications pour les équipements manuels de projection électrostatique de produits ininflammables pour peinture et finition

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English version

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CENELEC

European Committee for Electrotechnical Standardization
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Europäisches Komitee für Elektrotechnische Normung

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Contents

		Page
1	Scope	3
2	Definitions	3
3	Constructional requirements	3
4	Supply of spraying material	4
5	Type verifications and tests	5
6	Manufacturer's responsibility	6
7	Marking	6
8	Instruction manual	7
Annexes		
A	Terminals for external connections Internal connections	11
B	Test for resistance to impact	11

IEC Publications referred to in European Standard EN 50 059:

IEC 664 (1980) and 664A (1981) Insulation co-ordination within low-voltage systems including clearances and creepage distances for equipment.

European Standards referred to in European Standard EN 50 059:

EN 50 014 (1977) (1st edition)	Electrical apparatus for potentially explosive atmospheres — General requirements [including amendment 1 (July 1979), amendment 2 (June 1982), amendment 3 (December 1982), amendment 4 (December 1982) and amendment 5 (February 1986)].
EN 50 019 (1977) (1st edition)	Electrical apparatus for potentially explosive atmospheres — Increased safety "e" [including amendment 1 (July 1979), amendment 2 (September 1983) and amendment 3 (December 1985)].
EN 50 020 (1977) (1st edition)	Electrical apparatus for potentially explosive atmospheres — Intrinsic safety "i" [including amendment 1 (July 1979) and amendment 2 (December 1985)].
EN 50 050 (1986) (1st edition)	Electrical apparatus for potentially explosive atmospheres — Electrostatic hand-held spraying equipment.

CENELEC Harmonization document referred to in European Standard EN 50 059:

HD 365 S3 Classification of degrees of protection provided by enclosures [IEC 529 (1976) and amendments 1 and 2].

1 Scope

This European Standard specifies the constructional and test requirements for hand-held and hand-operated electrostatic spray guns and associated apparatus used to spray painting and finishing materials which are not flammable, with respect to the protection against high voltage electric shock.

NOTE:
The requirements for electrostatic hand-held spray guns and associated apparatus which are only to be used for flammable spraying materials are covered in European Standard EN 50 050.

2 Definitions

The following definitions, specific to electrostatic spray guns and associated apparatus, are applicable to this European Standard.

2.1 Hand-held electrostatic spraying equipment

Equipment for producing, charging and depositing suspended particles with the assistance of electric fields.
It consists in general of the following parts:

spray gun, high voltage generator, connecting cable and means of supplying spraying material.

2.1.1 Spray gun

The part of the electrostatic spraying equipment from which the charged spraying material emerges and which is held and operated by the hand.

2.1.2 High voltage electrode

A conducting part of the spray gun which is at high potential and which charges the spraying material.

2.1.3 High voltage generator

The part of the equipment for producing the high voltage and the current required.

NOTE:
The high voltage generator can be, in certain cases, incorporated in the spray gun.

2.1.4 Connecting cable

All cables to the spray gun, including any necessary high voltage supply cable.

2.1.5 Earth terminal

A terminal intended to provide means for reliable earthing for parts of an equipment.

2.1.6 Associated apparatus

All the electrical apparatus required to generate and control the electrostatic voltage of the spray gun.

2.1.7 Spraying material supply

That part of the equipment which supplies the spraying material at a convenient pressure to the spray gun.

2.2 Workpiece

The article on which the spraying material is to be deposited.

2.3 Non-flammable spraying material

The material which is applied by means of the electrostatic hand-held spraying equipment and which cannot be ignited, when in any mixture with air, by an energy source less than 500 mJ.

2.4 U_{max}

The maximum rated voltage of the high voltage generator.

2.5 Functional extra-low voltage without electrical separation

A voltage which does not exceed 50 V (r.m.s.) a.c. or 120 V d.c. with a maximum ripple of 10 %, between conductors or between any conductor and earth, and the source of which has one part of the circuit connected directly to earth.

2.6 Touchable parts in normal use

Those parts of the spray gun which are permissible to handle when the spray gun is in normal use.

3 Constructional requirements

3.1 General requirements

Electrical apparatus for spraying non-flammable material shall comply with the requirements of this European Standard.

3.2 Mechanical requirements

3.2.1 The spray gun shall withstand the impact and drop tests in **5.7** and **5.8** of this European Standard.

3.2.2 The spray gun handle shall have a total surface area of at least 20 cm^2, of metal or a material the maximum resistivity of which is 10 Ωm. This area shall be connected to the earth terminal (see **3.3.2**).

3.2.3 All cables shall be attached securely to the spray gun (see **5.9**).

3.3 Electrical requirements

3.3.1 Any cable to the spray gun, other than that carrying only functional extra-low voltage circuits without electrical separation shall include an earthed metallic screen protected by an insulating sheath. If this is not possible in the case of the high voltage cable due to design reasons, any other construction shall be tested in accordance with **5.6.2**.

3.3.2 All the non-current carrying conductive parts of the spray gun other than those designed to acquire a high potential shall be assembled so that they remain in electrical contact with each other. These conductive parts shall be connected to the earth terminal in the power supply of the high voltage generator by means of terminals of the type described in Annex A or other connections which are equally reliable.

NOTE 1:
A method of connection between the metal parts of the spray gun and the earth terminal in the power supply of the high voltage generator is via the metallic screen referred to in **3.3.1** above.

NOTE 2:
In the case where the generator is incorporated in the spray gun, the conductive parts of the spray gun must be efficiently connected to a good earth.

3.3.3 All the electrical components of a spray gun with the exception of the high voltage electrode shall comply with the degree of protection of IP 54 as defined in HD 365 S3.

3.3.4 The spray gun shall pass a voltage test of 1,2 U_{max} between the high voltage circuit and all parts of the spray gun which are touchable in normal operational use while spraying (this will require the suppression of corona current from the high voltage electrode, see **5.6.1**).

3.3.5 The high voltage cable shall be capable of withstanding a voltage test of 1,5 U_{max} (see **5.6.2**).

3.3.6 The operating trigger of the spray gun shall be biased towards the OFF position. The trigger, when released, shall switch off the high voltage supply and the spraying material supply to the spray gun within 2 s.

Multi outlet high voltage supplies shall not be used unless isolation for each high voltage outlet can be achieved by release of the operating switch of the spray gun connected to the outlet concerned.

3.3.7 Any current limiting resistor used in the spray gun or the associated apparatus shall be so mounted, insulated and protected that it is immune from short circuit and shall be so rated that it is undamaged when a short circuit occurs between the high voltage electrode of the spray gun and earth for 5 min.

3.3.8 Components on which safety in respect of high voltage electric shock depends and which are built into the high voltage supply shall be connected, assembled, etc., so that the safety of the device cannot be prejudiced.

3.3.9 If Zener diodes are used to limit the high voltage, they shall be duplicated (connected in parallel).

Zener diodes and components, except transformers, on which safety depends shall not be operated at more than 2/3 of their manufacturer's rating under a one fault condition (refer also to **4.2** and **7.6** of EN 50 020).

3.3.10 Potentiometers whose adjustment could increase the maximum tested high voltage output shall not be capable of re-adjustment. The locking of the adjustment shall be durable and permanent.

3.3.11 The maximum capacitance of the whole system, e.g. high voltage generator and its high voltage cable, spraying material container and its hoses insulated from earth, shall not exceed 2000 pF, see **5.5.4**.

3.3.12 The shock current to a human being from a touchable part in normal operational use of the system, shall be limited by a limiting resistance of not less than 10 kΩ per kilovolt of U_{max}

$$R_1 \geqslant \frac{U_{max}\ (\text{kV})}{1\ \text{kV}} \times 10\ \text{k}\Omega$$

Dependent on the design of the system this resistance can be the resistance of the spraying material in the hose, or a resistor in the high voltage supply lead in the spray gun or a combination of both, see fig. 1 to 9.

3.3.13 The maximum energy from the whole system available in the form of an electrical discharge to a human being from a touchable part shall not exceed 350 mJ, see also **5.5.4**.

3.3.14 The total direct current continuously available from a touchable part shall not exceed 2 mA.

4 Supply of spraying material

4.1 Spraying material container

4.1.1 If the container is made of conductive material it shall be provided with a means for connecting to earth (see 4.1 in figures 1, 3 and 5).

4.1.2 If the container is made of non-conducting material it shall be equipped with an earthed conductive connection. This connection shall be in contact with the spraying material (see 5.2 in figures 2 and 6 and 12.1 in figure 4).

4.1.3 If, for technical or other reasons, it is not possible to comply with **4.1.1** or **4.1.2** then precautions shall be taken so that the container or exposed parts at high voltage cannot be touched (see 14 in figures 7, 8 and 9).

These precautions shall take the form of either

4.1.3.1 an earthed metal enclosure around the container and the parts at high voltage

or

4.1.3.2 an insulating enclosure capable of withstanding a test voltage of 1,5 U_{max} incorporating, within the creepage paths from parts at high voltage to accessible parts, an earthed guard ring. There shall also be a minimum clearance distance of 100 mm from the container and any part at high voltage to the touchable parts of the enclosure.

4.1.3.3 Means of access to both types of enclosure shall be interlocked with an automatic earthing switch designed to lead to earth any charge that is on parts within the enclosure before access is possible (see 14.3 in figures 7, 8 and 9).

4.2 Spraying material supply hose

The hose intended for use with conductive spraying materials shall be made of insulating material which withstands a test voltage of 1,5 U_{max} according to **5.6.3**, if at least one end is in contact with the spraying material at high voltage (see 12 in figures 3, 4, 5, 6, 7, 8 and 9).

5 Type verifications and tests

Tests to this European Standard are made at an ambient temperature of (20 ± 5) °C.

5.1 General requirements

The type verifications and tests are intended to ensure that the requirements of this European Standard have been met on a prototype or sample of the electrical apparatus.

5.2 Verification of documents

The testing station shall verify that documents submitted by the manufacturer give a full and correct specification of the designed features satisfying the requirements of this European Standard.

5.3 Compliance of prototype or sample with documents

The testing station shall verify that the prototype or sample of the electrical apparatus submitted for the type test complies with the manufacturer's definitive documents referred to above.

5.4 Type tests

The prototype or sample shall be tested by the testing station in accordance with the requirements for type tests of this European Standard. However, the testing station may omit certain tests judged to be unnecessary.
The testing station shall keep a record of all tests carried out and the justification for those omitted. The tests are made either in the laboratory of the testing station or elsewhere under the supervision of that organization, for example at the manufacturer's works.

5.5 Tests of the discharge energy

WARNING NOTE: Attention is drawn to the fact that tests contained in this European Standard require precautions to ensure the safety of personnel carrying out such tests.

5.5.1 *Maximum output voltage U_{max}*

This test of maximum output voltage U_{max} shall be carried out after performing the manufacturer's cleaning procedure ten times. If the high voltage is adjustable it shall be increased uniformly from the minimum value up to the maximum value in 10 s and subsequently kept constant for 1 min in order to avoid the effects of impulses at the switching on of the equipment. The corona current from the high voltage electrode is to be suppressed during this procedure. The test shall be carried out at the value within the range 90 % to 110 % of rated supply voltage that gives the maximum output voltage.

The maximum possible output voltage available from the power supply shall be assessed. The effects of faults due to small creepage and clearance distances between parts of the circuit shall be taken into consideration (see IEC 664). Then the maximum output voltage U_{max} shall be determined.

5.5.2 *Capacitance of the high voltage electrode*

The capacitance C_o between the high voltage electrode and the earthed handle of the spray gun shall be measured directly if that electrode is accessible. Where there is more than one electrode the capacitance C_K, where K = 1, 2, ..., of each of them shall be measured and the sum $C_o = C_1 + C_2 + ...$ shall be calculated.

If the electrode is not accessible, e.g. if it is located inside the barrel, the spray gun shall be filled in the same manner as when in use with a column of conducting liquid with a conductivity at least as high as the highest value recommended by the manufacturer of the spray gun.
If the spray gun is completely filled the column will be accessible at the nozzle of the spray gun so that the capacitance C_o between liquid and earthed spray gun handle can be measured.

5.5.3 *Discharge energy of the spray gun*

The discharge energy E_g is calculated according to

$$E_g = \frac{1}{2} C_o U_{max}^2.$$

5.5.4 *Capacitance C_t of the total system*

In addition to C_o the capacitance C_s of the spraying material container and the hoses in a floating system (free of earth) is measured when filled with tap water. Then

$$C_t = C_o + C_s.$$

This shall not exceed 2000 pF.

5.6 Voltage tests

5.6.1 *Voltage test of the spray gun*

All parts of the spray gun made of non-conductive material, and which are touchable in normal operational use while spraying, shall be covered with earthed metal foil pressed against the non-conductive material with the aid of a sand bag with dimensions such that the pressure amounts to about 5 kPa. This foil shall be connected to earth, together with the parts of the spray gun and its connecting cable that are earthed in normal use. The spray gun shall be mounted so that the material supply hose and internal parts of the spray gun normally filled with a conductive paint, can be filled with tap water for the purpose of this test.

After filling with tap water the high voltage parts of the spray gun and its connecting cable shall be raised to a voltage of 1,2 U_{max}. This will require the suppression of corona current from the high voltage electrode. In order to avoid the effect of impulses at the switching on of the equipment the test voltage should be increased uniformly from the minimum value up to the final value in 10 s and subsequently kept constant for 1 min. There shall be no breakdown.

When the high voltage generator is part of the spray gun, it is permissible to use, for test purposes a dummy, which contains all conductive parts of the high voltage generator that operate at a voltage exceeding 0,5 U_{max} and is supplied with the test voltage from a separate generator.

5.6.2 *Voltage test for the high voltage cable*

If the cable has a metallic screen, a test voltage of 1,5 U_{max} shall be applied between core and screen for 20 min. There shall be no breakdown. If the cable does not have a metallic screen, the whole of a sample cable at least 2,5 m long shall be placed in a water bath containing ordinary tap water at ambient temperature, except for 75 cm at each end. Both ends are joined together and a test voltage of 1,5 U_{max} applied between core and water bath for 20 min, the water bath being earthed. There shall be no breakdown.

5.6.3 *Voltage test for the spraying material supply hose*

The spraying material supply hose capable of withstanding the high voltage of the high voltage generator has to be tested as follows. A sample hose at least 2,5 m long shall be placed in a water bath containing ordinary tap water at ambient temperature, except for 75 cm at each end. The hose shall be filled with ordinary tap water and a test voltage of 1,5 U_{max} applied between the water inside the hose and the water bath for 20 min, the water bath being earthed. There shall be no breakdown.

5.7 Impact test

The spray gun is to be submitted to tests according to annex B.

The test shall be performed on two samples of the spray gun. Both samples shall comply with all the requirements of this European Standard after the test, including retest according to **5.5** and **5.6** where applicable. It is not a requirement that the spray guns remain undamaged.

5.8 Drop test

The spray gun shall be dropped from a height of 1,25 m onto a concrete floor. The number of drops shall be four. The test shall be performed on two samples (not the same as those used in **5.7**), fully assembled and ready for use. The positions of the sample for the drop test shall be selected by the testing station. Both samples shall comply with all the requirements of this European Standard after the test, including retest according to **5.5** and **5.6** where applicable. It is not a requirement that the spray guns remain undamaged.

5.9 Cable pull test

Any cable to the spray gun including hoses intended for use as conductors, other than a cable containing only functional extra-low voltage circuits without electrical separation shall be subjected to a pull test of 150 N for 50 s.

This test shall be performed on two samples fully assembled. Both samples shall exhibit no movement visible by normal corrected vision of the cable or hose in its retaining device during the test.

6 Manufacturer's responsibility

By marking the electrical apparatus in accordance with clause **7** of this European Standard, the manufacturer attests on his own responsibility that the requirements of this European Standards have been complied with.

7 Marking

NOTE:
In the interest of safety, it is essential that the system of marking indicated below shall not be applied to apparatus which does not comply with this European Standard.

The following marking, and any additional marking required for the safe operation of the system, shall be clearly marked on the apparatus in a visible place. This marking shall be legible and durable taking into account possible chemical corrosion.

7.1 Associated apparatus

7.1.1 The name of the manufacturer or his registered trade mark.

7.1.2 The manufacturer's type identification, which shall be unique in order to ensure safe use of combinations of apparatus.

7.1.3 Range of input voltages and whether a.c. or d.c.

7.1.4 Rated frequency range of input.

7.1.5 Rated input power.

7.1.6 The number of this European Standard EN 50 059.

7.1.7 The indication of the testing station and the certificate number.

7.1.8 The rated output voltage.

7.1.9 The rated output current.

7.1.10 Where appropriate the maximum high voltage U_{max}.

7.1.11 Any marking normally required by the standards of construction of the electrical apparatus.

7.2 Spray gun

7.2.1 The name of the manufacturer or his registered trade mark.

7.2.2 The manufacturer's type identification, which shall be unique in order to ensure safe use of combinations of apparatus.

7.2.3 The maximum voltage and the maximum energy at this voltage.

7.2.3.1 Where the spraying material supply hose is earthed at the spray gun the maximum energy available at the maximum voltage shall be marked on the spray gun (e.g. ..... mJ).

7.2.3.2 When the spray gun has an integral insulated spraying material supply hose the maximum energy available at the maximum voltage of the spray gun and the supplied length of hose are to be marked on the spray gun (e.g. ..... mJ; ..... m).

7.2.4 The number of this European Standard EN 50 059.

7.2.5 The indication of the testing station and the certificate number.

8 Instruction manual

Each spray gun shall be supplied with an instruction manual in the appropriate language. In addition to the marking information above, the instruction manual shall contain the following information:

8.1 The rated output voltage of the high voltage generator.

8.2 The rated output current of the high voltage generator.

8.3 The upper and lower limit of the conductivity of the paint to be used, in particular if the spray gun needs a column of paint to conduct or produce the charging current.

8.4 The spray gun, power supply unit, material supply hose and material container shall be considered as a system. The stored energy of that system could be dangerously increased by any changes. The manufacturer shall be consulted before changes are made.

8.5 In the interest of safety it is essential that there is no joint in the hose intended for use with conductive spraying material and it is only replaced entirely with a hose of identical type and length.

8.6 This equipment can be dangerous unless it is used in accordance with the rules laid down in this manual and any relevant European Standards and national safety rules.