BS EN 50050-3:2013

BSI Standards Publication

Electrostatic hand-held spraying equipment — Safety requirements -

Part 3: Hand-held spraying equipment for ignitable flock

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National foreword

This British Standard is the UK implementation of EN 50050-3:2013. Together with BS EN 50050-1:2013 and BS EN 50050-2:2013 it supersedes BS EN 50050:2006 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee EXL/31/-/1, Electrostatic spray guns.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Contents

Foreword

This document (EN 50050-3:2013) has been prepared by SC 31-8, "Electrostatic painting and finishing equipment", of CLC/TC 31, "Electrical apparatus for potentially explosive atmospheres".

The following dates are fixed:

- latest date by which this document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2014-10-14
- latest date by which the national standards conflicting with this document have to be withdrawn (dow) 2016-10-14

In combination with EN 50050-1:2013 and EN 50050-2:2013, this document supersedes EN 50050:2006.

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For the relationship with EU Directive(s) see informative Annex ZZ, which is an integral part of this document.

0 Introduction

0.1 Process

In the process of electrostatic flock application, flock particles are transported from a reservoir to an applicator either by gravitational forces or within an air stream. As the flock particles are passing the applicator, they are electrostatically charged and developed by means of a high voltage of some tens of kilovolts and ejected in the form of a cloud which is directed towards the workpiece. The flock particles of the cloud are attracted by the earthed workpiece and enclosed from a before served adhesive layer. They stick in this adhesive layer until the adhesive is set at room temperature or by heating.

Flock particles not deposited on the workpiece (overspray) are removed by the exhaust ventilation system, by brushes or other devices into the flock recovery system.

0.2 Explosion hazards

0.2.1 An explosion can occur, if

— the concentration of flock particles in air is within the explosion limits,

— contamination by adhesives (in a cured condition most of the adhesives are insulating), and

— an ignition source of appropriate energy for this explosive atmosphere

is present.

Ignition sources could be, for instance, a hot surface, a naked flame, an electric arc or a spark.

An explosion could be prevented, if at least one condition is avoided. Because it is very difficult to exclude the possibility of ignitable discharges completely, the main focus should be the prevention of ignitable concentrations of flock in air.

0.2.2 Deflagration of explosive atmospheres is only possible within a given range of concentration, but not, if the concentration is above or below this range.

NOTE If an explosive cloud of flock and air is trapped into a closed room, an explosion can lead to a fatal increase of pressure.

0.2.3 It is important that deposits of flock are not allowed to accumulate within the spraying areas for they may be whirled up and give rise to an explosive atmosphere. This does not apply to deposits on filter devices and accumulations of flock in reservoirs where filters and reservoirs are integrated in the spraying area and are designed to collect the flock.

0.2.4 Particular attention should be paid to the prevention of electrostatic charges on different surfaces located in the vicinity of the flock cloud. This could apply to e.g. workpieces during the coating process.

0.3 Electric hazards

0.3.1 Electric shock (by direct or indirect contact) can be generated, for instance, by contact with

- live parts, which are not insulated for operational reasons,
- conductive parts, which are not connected to dangerous voltage during normal operation, but only in case of failure,
- insulated live parts with insufficient or damaged insulation due to external impact.

0.3.2 Inadequate earthing may occur, for instance, due to

- faulty connections to the protective earthing system,
- a too high resistance to earth (e. g. contamination by flock).

0.3.3 Hazards could occur, for instance, if hazardous malfunctions (e.g. shortcut of electronic safety circuits) occur due to interferences of the high voltage equipment and the components of the control and safety systems.

0.3.4 Hazardous electrostatic discharges could be generated, for instance, by non-earthed conductive components or by large insulating surfaces, especially if they are backed with conductive material.

1 Scope

1.1 This European Standard specifies the requirements for hand-held or hand-operated electrostatic spraying equipment for ignitable flock within a temperature range from 5 °C to 40 °C to be used in explosive atmospheres generated by their own spray cloud.

This European Standard deals with all electrical hazards significant for the electrostatic spraying of flock, which could also contain small quantities of added metal particles, if the work is carried out under conditions recommended by the manufacturer. In particular, this includes ignition hazards resulting from the generated explosive atmosphere. This European Standard specifies the design-related and test requirements for electrostatic spraying equipment of type A-F and type B-F according to Table 1 of EN 50223:2010.

1.2 Electrostatic applicators are considered to be equipment of group II, category 3D for use in potentially explosive areas of zone 22. All other parts of hand-held electrostatic spraying equipment are considered to be equipment of category 3D if they are installed or used in potentially explosive areas of zone 22.

NOTE 1 Solvent vapours which could be evaporated by workpieces coated with adhesives do not lead to a zone 2 in the flocking area.

1.3 In addition to the requirements above, the requirements of EN 1953 applies with regard to all other significant hazards relevant for applicators (e.g. health hazards, inadequate ergonomics).

1.4 This European Standard does not apply to

— zone classification of the areas in and around spray booths [see EN 50223],

— zone classification of other areas with potentially explosive atmosphere [see EN 60079-10-2],

— selection, erection and application of other electrical and non-electrical equipment in areas with explosion hazard [see EN 60079-14 and EN 50223],

— cleaning of spraying areas, see instruction manual of the spray booth,

— fire prevention and protection, for instance fire hazards due to other sources [see EN 50223],

— explosion protection systems [see EN 50223],

— dust hazards [see EN 12981].

NOTE 2 Noise is not considered to be a significant hazard for hand-held spraying equipment for ignitable flock.

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.

EN 1953	*Atomising and spraying equipment for coating materials – Safety requirements*
EN 1149-5	*Protective clothing – Electrostatic properties – Part 5: Performance requirements*
EN 12981	*Coating plants – Spray booths for application of organic powder coating material – Safety requirements*
EN 50223:2010	*Stationary electrostatic application equipment for ignitable flock material – Safety requirements*
EN 60079-7:2007	*Explosive atmospheres – Part 7: Equipment protection by increased safety "e" (IEC 60079-7:2006)*
EN 60204-1	*Safety of machinery – Electrical equipment of machines – Part 1: General requirements (IEC 60204-1)*
EN 60529	*Degrees of protection provided by enclosures (IP code) (IEC 60529)*
EN 61340-4-1	*Electrostatics – Part 4-1: Standard test methods for specific applications – Electrical resistance of floor coverings and installed floors (IEC 61340-4-1)*
EN 62061	*Safety of machinery – Functional safety of safety-related electrical, electronic and programmable electronic control systems (IEC 62061)*
EN ISO 12100	*Safety of machinery - General principles for design - Risk assessment and risk reduction (ISO 12100)*
EN ISO 13849-1	*Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design (ISO 13849-1)*
EN ISO 20344	*Personal protective equipment – Test methods for footwear (ISO 20344)*

3 Terms and definitions

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

3.1
hand-held spraying equipment
hand-held or hand-operated equipment for electrostatic coating using ignitable flock, generally comprising the following parts:

— applicator;

— flock supply system;

— control device;

— high voltage supply system;

— connecting cable

3.2
connecting cable
electric cable to the applicator

3.3
earthing device
device for earthing the hand-held spraying equipment permanently

3.4
spraying device
outlet opening for the flock

3.5
high voltage electrode
conductive part of the applicator which is at high voltage and serves to charge the coating material directly or indirectly

3.6
control device
device generally having the following functions:

— control of, for instance, the flock supply system, the control air, the purge air

Note 1 to entry A combination of the control device and the high voltage supply according to 3.8 is possible.

3.7
applicator
equipment for application of flock

Note 1 to entry In general, the applicator comprises the following parts:

- high voltage electrode;
- high voltage supply (as far as integrated into the applicator);
- housing;
- spraying device;
- exchangeable attachment parts (e.g. nozzles, extensions, angular pieces, etc.);
- if applicable, battery unit (integrated fixedly, or attached).

3.8
high voltage supply for applicators
in general, high voltage supply comprising the following parts:

— low voltage section with devices for switching on and off the hand-held spraying equipment and for adjustment, control, regulation, limitation and monitoring of current and voltage, as well as the required connecting cables;

— high voltage generator

3.9
spraying area
area, closed or not, in which the flock is applied to the workpiece by the hand-held spraying equipment

3.10
dangerous discharge
discharge which generates the hazard of ignition of explosive mixtures or of electric shock

3.11
flock supply system
in general, flock supply system comprising the following:

— flock reservoir;

— dosing devices for flock;

— supply lines for flock;

— devices for drive, control and monitoring flock supply system

3.12
workpiece
article to which the flock is applied

3.13
ignitable flock
flock which, in a whirled-up state, could be ignited by an effective ignition source and which continues to burn after the ignition source has been removed or may react in the form of an explosion

3.14
explosive atmosphere
mixture of air, under atmospheric conditions, and of ignitable substances in the form of gas, vapour, mist, powder or flock, in such proportions that it can be ignited by effective ignition sources, such as excessive temperature, arcs or sparks [EN 1127-1]

3.15
Lower Explosion Limit
LEL
concentration of ignitable gas, vapour, mist, powder or flock in air below which an explosive atmosphere will not be formed

3.16
discharge energy
energy discharged from a conductive part of the installation in form of a spark which could cause both electric shock to a person and an ignition of an explosive atmosphere

3.17
antistatic footwear
footwear that has a resistance to earth via its sole, which is low enough to prevent the build-up of electrostatic charges capable to produce a dangerous discharge

Note 1 to entry See EN ISO 20344.

Note 2 to entry A required electric insulating resistance to prevent electric shocks is not contradictory to this definition.

3.18
antistatic clothes
clothes that have a resistance to earth, which is low enough to prevent the build-up of electrostatic charges capable of a dangerous discharge

Note 1 to entry See EN 1149-5.

Note 2 to entry A required electric insulating resistance to prevent electric shocks is not contradictory to this definition.

3.19
antistatic floor
floor that has a resistance to earth, which is low enough to prevent the build-up of electrostatic charges capable to produce a dangerous discharge

3.20
accessories
devices, components and other equipment, except for 3.7 of this standard

3.21
U_{max}
maximum output voltage of the high-voltage generator

3.22
I_{max}
maximum output current of the high-voltage generator

3.23
repeated test
test of the hand-held spraying equipment, including all accessories, to be carried out at regular intervals

3.24
contact surface area
part of the handle connected to earth to discharge the charge of a person

4 Requirements for hand-held spraying equipment for ignitable flock

4.1 General requirements

4.1.1 Hand-held spraying equipment shall be designed and constructed to prevent exceeding of a maximum discharge energy of 350 mJ for electrical systems (live conductive components, e.g. cables, high voltage electrode) and exceeding of a maximum transferred charge of individual sparks of 50 µC for electrostatic systems (charged plastic surfaces, e.g. insulating hoses, insulating enclosures).

4.1.2 All conductive parts of the hand-held spraying equipment which are not at high voltage potential shall be earthed. Earthing of conductive parts inside the hand-held spraying equipment can be neglected if hazardous discharges have been prevented by design. Conductive parts connected to measuring and control circuits shall be earthed with a resistance of ≤ 100 MΩ. Parts which are at high voltage for operational reasons shall be bonded to each other in a conductive way.

4.1.3 Applicators shall meet the applicable requirements of EN 1953.

4.1.4 Electrical connecting cables shall be connected to the applicator or associated equipment in a secured way. Requirements of 5.3.1 shall be fulfilled.

4.1.5 The handle of the applicator shall have a contact surface area of conductive material of at least 20 cm². This contact surface area shall be earthed, and the resistance to earth shall not exceed 1 MΩ.

4.1.6 Operating triggers of applicators shall be dissipative and shall automatically take the OFF-position. In this position, the flock supply system shall be cut-off immediately, and the high voltage supply shall be cut-off within 2 s. For high voltage supplies having several outputs, the cut-off function shall be ensured for each output/applicator individually.

4.1.7 Applicators shall have an earth connection. The resistance to earth shall not exceed 1 MΩ. The connection shall be designed in accordance with 4.2.1 of EN 60079-7:2007.

4.1.8 Components on which ignition safety depends shall be designed, arranged and built in to not impair the safety of the electrostatic hand-held spraying equipment. Examples of components on which ignition safety depends are spray nozzles, cables of the earthing system, resistances and other electronic components.

Insulating materials of parts under high-voltage shall be constructed according to the operation, transport and storage conditions.

4.1.9 The electric equipment not connected to the high voltage system shall comply with EN 60204-1.

4.1.10 If energy limiting electric components (e.g. resistors) are used, they shall be designed in such a way that they are protected against damage. All components shall withstand a short circuit between the high voltage electrode and earth for 5 min. The degree of protection shall remain unchanged.

4.1.11 All electrical components of the applicator, other than the spraying device shall be constructed at least comparable with IP54 of EN 60529. As an alternative, the applicator, except for the spraying device, can be designed according to IP54 according to EN 60529.

4.1.12 Electrical cables connected to the applicator shall have an earthed shielding which is protected against mechanical damage (e.g. by insulation).

4.1.13 It shall be ensured that the limit values for maximum discharge energy and maximum transferred charge defined in 4.1.1 are observed under any operating conditions. Faults of the high voltage supply for applicators shall be considered. This safety function (monitoring function) shall meet the requirements of SIL 2 (e.g. according to EN 62061) or PL d (e.g. according to EN ISO 13849-1). Alternatively, this safety level will be reached if the values for outlet current and outlet voltage according to 5.4.1 will be limited by two Zener diodes or equivalent parts (e.g. power semiconductors) loaded up to two-thirds in the case of failure.

In general, the fail-safe principle shall be applied.

In case of failure of the safety functions the hand-held spraying equipment shall be led in a safe state.

If the safety related functions of the hand-held spraying equipment depend on software, hazards due to program errors shall be considered in particular.

4.2 Requirements for the accessories

4.2.1 Accessories that are used in hazardous areas, as applicable, shall be submitted to a cable pull test according 5.3.1. Non-metallic accessory that is used in hazardous areas shall be submitted to an impact resistance test according to 5.3.2. Accessories that are used in hazardous areas shall comply with the minimum degree of protection IP54 according to EN 60529 and may not exceed the maximum allowed surface temperature. Accessories that are used in hazardous areas shall be designed and constructed to prevent exceeding the maximum transferred charge of single sparks of 50 µC, or the maximum discharge energy of 350 mJ.

4.2.2 Control devices and the flock supply system shall have an earth connection. The resistance to earth shall not exceed 1 MΩ. The connection shall be designed in accordance with 4.2.1 of EN 60079-7:2007.

4.2.3 The operating parameters relevant for safety, operational voltage, operational current and short circuit current, shall not be set to values deviating from the checked limit values defined in 5.3.1.1 to 5.3.1.3.

4.2.4 Detachable earth connections shall be marked clearly.

4.2.5 All parts of the flock material supply system in particular hoses made of non-conducting material shall be designed and constructed in such a way that they cannot be the source of discharges having a transferred charge of more than 50 µC.

5 Tests

5.1 General

All tests described in 5.2, 5.3, 5.4 and 5.5 shall be carried out with two applicators according to the following order: cable pull test, impact test, drop test, test of electrical safety and ignition tests.

All tests described in 5.2, 5.3, 5.4 and 5.5 shall be carried out with cleaned applicators.

The value of the output high voltage and output current shall be set to the maximum value during the tests according to 5.4.1.1 to 5.4.1.3 and 5.5. The manufacturer shall indicate the required relevant operational parameters (e.g. supply voltage).

Tests described in 5.4 and 5.5 shall be carried out by a temperature of (22 ± 5) °C, except for those in which the upper or lower limit value of the operating temperature is assumed to be the more unfavourable for passing the test.

5.2 General tests

5.2.1 Test of earth connections

It shall be tested that the hand-held spraying equipment has an earth connection complying with 4.1.5, 4.1.7 and 4.2.2.

5.2.2 Resistance to earth test

The resistance shall be measured using a measuring device at a measurement voltage from 500 V to 1 000 V, see 4.1.2, 4.1.5, 4.1.7 and 4.2.2.

5.2.3 Test of contact surface area

The size of the contact surface area shall be proven by measurement (e. g. tape measure), see 4.1.5.

5.2.4 Test of OFF-position

The function of the OFF-position shall be proven by measurement, see 4.1.5.

5.3 Conditioning test

5.3.1 Cable pull test

Each cable of the applicator, except for cables connecting intrinsically safe circuits among each other, shall be submitted to a cable pull test with 150 N for 60 s.

During the test, the test sample shall not show visible movements of the cable in its fixture.

5.3.2 Impact test

The test shall be carried out on two applicators which are ready for operation, one test without and one with attachment parts (e.g. extensions, angular pieces, battery unit, etc.), as well as on the accessories which has to be located within the potentially hazardous area. The test shall be carried out once at four different positions. The impact points shall be those points which are considered to be the weakest ones, and they shall be located on the outer side of those parts which may be exposed to impacts.

The test samples shall be exposed to a test mass of 1 kg falling perpendicularly from a height of 0,7 m. The test mass shall be equipped with a hemispherical impact load of at least 25 mm in

diameter made of hardened steel. The samples shall be positioned on a steel plate in such way that the direction of impact is perpendicular to the surface to be tested. The steel plate shall have a minimum mass of 20 kg, or shall be fixed rigidly, or shall be embedded into the floor, e.g. in concrete.

After this test, the samples of the applicators shall pass the ignition test (see 5.4.2).

The degree of protection IP54 of the accessories shall not be impaired by the impact test.

5.3.3 Drop test

The test shall be carried out on two applicators which are ready for operation, one test without and one with attachment parts (e.g. extensions, angular pieces, battery unit, etc.). The applicators are dropped four times from a height of 1 m on to a horizontal concrete surface. The position considered to be the most unfavourable one shall be selected for the sample during the drop test.

After this test, the samples shall pass the ignition test (see 5.4.2).

5.4 Tests for electrical safety

5.4.1 Measurement of the parameters high voltage, spraying current, short-circuit current

5.4.1.1 Measurement of maximum output high voltage

The measurement of maximum output high voltage shall be carried out without load at the end of the high voltage electrode at the spraying device of the applicator.

5.4.1.2 Measurement of maximum spraying current

The measurement of the maximum spraying current shall be carried out with a μ-ampere meter connected between a metal plate and earth potential. The switched-on applicator is approached at several velocities to the metal plate and the maximum spraying current shall be recorded.

5.4.1.3 Measurement of maximum short-circuit current

The measurement of the maximum short-circuit current shall be carried out with a μ-ampere meter, from the end of the high voltage electrode at the spraying device of the applicator against earth potential. The duration of the test shall be at least 5 min, see 4.1.10.

5.4.1.4 Measurement of the capacitance of the high-voltage electrode and the high-voltage cable

The capacitance of the high voltage electrode and the high voltage cable (if applicable) of the applicator shall be measured against earth. To avoid earth loops battery driven capacitance measuring devices (e.g. LCR-Meter) are required. The measurement frequency shall be at 120 Hz and 1 kHz. The highest measured capacitance is valid.

5.4.2 Voltage test

5.4.2.1 Test of parts at high voltage

The parts at high voltage of the applicator, which produce hazard of incendive discharges inside the applicator, shall be tested at U_{max} for 90 min. There shall be no incendive discharges. After the test, the degree of protection of the hand-held spraying equipment shall be retained.

All parts of the applicator which are at earth potential for operational reasons shall be earthed during the test.

NOTE The voltage of U_{max} implies the suppression of the corona current at the high-voltage electrode e.g. by an insulating moulding.

5.4.2.2 Test of the high voltage cable

A sample of the high voltage cable of at least 2,5 m is raised to a voltage of 1,2 U_{max} for a period of 24 h, the electrically conductive shielding of the cable being earthed. The shielding shall be removed min. 75 cm at each end. There shall be no breakdown.

5.4.3 Test of the degree of protection of applicators

Compliance with degree of protection IP 54 shall be tested according to EN 60529.

5.5 Test of the maximum discharge energy and the maximum transferred charge

5.5.1 Test of the maximum discharge energy

Test of electric systems for the threshold value of the maximum discharge energy of 350 mJ by measuring the output high-voltage U (see 5.4.1.1) and the capacitance C (see 5.4.1.4) and calculation of the energy according the formula $W = ½ \times C \times U^2$

5.5.2 Test of the maximum transferred charge

Test of electrostatic systems for the threshold value of the maximum transferred charge of individual sparks (50 µC) by measuring according to Annex A

5.6 Tests of the accessories

5.6.1 Test of the degree of protection

Compliance with degree of protection IP54 according to EN 60529 shall be tested on samples to be used in spraying areas.

5.6.2 Test of the flock supply system

The measurement of the ability of the flock material supply system in particular hoses for flock to be charged (50 µC) shall be carried out according to Annex A.

6 Information for use

6.1 General

The information for use with all information relevant for safety of normal operation and maintenance shall be written in the language of the user. Furthermore, it shall be accompanied by a version preferably in the language of the manufacturer.

6.2 Instruction manual

6.2.1 General

Each electrostatic hand-held spraying equipment shall be accompanied by an instruction manual according to EN ISO 12100. It shall also contain the contents of Table 1.

NOTE 1 The instruction manual can be written in a general comprehensive, illustrated or symbolic language.

The instruction manual shall contain the following references:

1) electrostatic hand-held spraying equipment shall only be operated by competent persons;

2) all protective gloves used shall comply with the requirements of 6.2.4;

3) electrostatic hand-held spraying equipment shall be used only in spraying areas according to EN 12981, or under equivalent ventilation conditions;

4) electrostatic hand-held spraying equipment shall be interlocked with the forced ventilation in such a way, that the flock supply system and the high voltage shall only be effective, if the forced ventilation is operated at the minimum exhaust volume flow or at a higher exhaust volume flow;

NOTE 2 The minimum exhaust volume flow is the minimum air volume flow which dilutes the concentration of ignitable flock to a maximum of 50 % of LEL of the flock in air and to a maximum of 20 % of LEL of solvent vapour in air. Here, all air performance losses have to be considered.

5) all conductive components of the system, like for instance floors, walls, ceilings, protective gratings, transport devices, workpieces, flock reservoirs, reciprocators or constructional parts, etc. within the spraying area, except for parts which are at high voltage for operational reasons, shall be connected to the earthing system. Parts of the booth shall be earthed in accordance with EN 12981;

6) details of transportation limitations, storage life and storage limitations for the electrostatic hand-held spraying equipment and accessories, including, where applicable, the following:

    a) temperature range,

    b) humidity range,

    c) pressure range,

    d) time.

The instruction manual shall contain a list of safety relevant spare and wear parts.

The instruction manual shall contain the admissible combinations of devices, including the indication of the admissible accessories.

6.2.2 Cleaning, maintenance and repair

6.2.2.1 General

The manufacturer shall supply comprehensive information on cleaning and maintenance. The electrostatic hand-held spraying equipment shall be cleaned and maintained regularly according to the instructions of the manufacturer. The instruction manual shall contain the following warning references:

— electrostatic hand-held spraying equipment shall only be operated in a safe and sound state. Damaged equipment shall be put out of operation immediately and shall be repaired;

— spare parts can have safety relevant properties;

— list of relevant Directives

— all obligations laid down in the relevant Directives have to be fulfilled also by spare parts;

NOTE Obligations are e. g. type examination, quality assessment, etc..

— worn parts shall be replaced immediately.

Before starting cleaning or maintenance works:

— the high voltage supply shall be cut off and safeguarded against restart;

— the applicator shall be disconnected from energy sources like high voltage and low voltage.

6.2.2.2 Characteristics of the cleaning liquid

The flash point of the cleaning liquids used shall at least be 15 K above the ambient temperature. Otherwise, the cleaning works shall be carried out at forced ventilated cleaning places.

Non-ignitable cleaning agents shall be preferred.

6.2.2.3 Earthing of the jigs for workpieces

Appropriate measures shall ensure that the resistance to earth of the jig shall not exceed 1 MΩ, measured with a voltage of 500 V to 1000 V.

6.2.3 Test intervals of repeated tests

For a safe operation of electrostatic hand-held spraying equipment the intervals for repeated tests shall be determined by the manufacturer. The intervals depend on the operational and local conditions. The following maximum test intervals listed in Table 1 are recommended:

Table 1 — Test intervals

Subclause	Reference	Test interval
5.1	Earthing measures	Weekly
6.2.1	Interlocking of forced ventilation and electrostatic hand-held spraying equipment	Yearly
6.2.2	Check of electrostatic hand-held spraying equipment for damage	Weekly

6.2.4 Additional information

The instruction manual shall contain at least the following additional information:

— all references required for a correct operation of the equipment;

— measures in case of disturbances and repairs;

— reference: "This electrostatic hand-held spraying equipment could present hazards if it is not operated according to the information given in the instruction manual";

— footwear to be worn by the operator shall comply with EN ISO 20344. The measured insulation resistance shall not exceed 100 MΩ;

— protective clothing to be worn, including gloves, shall comply with EN 1149-5. The measured insulation resistance shall not exceed 100 MΩ;

— floor assemblies in potentially explosive areas shall be dissipative according to EN 61340-4-1;

— in potentially explosive areas, only approved explosion-protected equipment shall be used;

— it shall be ensured that excess of coating material (overspray) will be collected reliably;

— specification of the operational temperature range.

Any other information required for correct use of the equipment, see EN 1953.

6.3 Marking of electrostatic hand-held spraying equipment and associated control devices

6.3.1 Marking of applicators

The following markings are required in addition to the legal marking:

— the number of this European Standard EN 50050-3;

— the kept limit value of the discharge energy in mJ.

Example 1 (informative):

[Name of the manufacturer or registered trademark]

[Series/Type] [serial number]

 **II 3D 350 mJ**

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6.3.2 Marking of the associated control devices

The following markings are required in addition to the legal marking:

— "admissible combinations of devices, see instruction manual";

— the number of this European Standard EN 50050-3;

— range of input voltages and whether AC or DC;

— input power;

— IP degree of protection;

— range of input frequency;

— output voltage;

— output current.

Example 2 (informative):

Name of the manufacturer, registered trademark	**"Admissible combinations of devices, see information for use"**	
 **II (3) D**	Series/type Serial number **EN 50050-3:2013**	
Discharge energy [mJ]	**IP54**	
Input voltage [V]	Max. surface Temperature "T“ [°C]	Output voltage [V/kV]
Input power [W]	Input frequency [Hz]	Output current [µA]

Example 3 (informative):

Name of the manufacturer, registered trademark	**"Admissible combinations of devices, see information for use"**	
	Series/type	
CE Ex **II 3(3)D**	Serial number	
	EN 50050-3:2013	
Discharge energy [mJ]	**IP54**	
Input voltage [V]	Max. surface Temperature "T“ [°C]	Output voltage [V/kV]
Input power [W]	Input frequency [Hz]	Output current [µA]

NOTE The examples also consider marking requirements according to EN 1953.

If it is not possible to fit the complete marking at small parts, the reduced marking shall contain at least:

— name of the manufacturer or registered trademark;

— series, type.

Annex A
(normative)

Test for ignition protection using a shunt and an oscilloscope

Measurement shall be carried out at a relative humidity of ≤ 50 % and at a temperature of (22 ± 5) °C. The influence of the air pressure on the measurements can be neglected.

The test for ignition protection is carried out with a shunt and an oscilloscope. The transferred charges resulting from the provoked discharges from the applicator to the shunt will be measured with an oscilloscope.

The shunt used for measurement shall be designed coaxially and shall be equipped with a ball electrode having 25 mm in diameter. The resistances of the shunt with the connected coaxial cable shall be determined with an uncertainty of ≤ 2,5 % and shall be indicated to the third decimal place. The system consisting of shunt and coaxial cable shall ensure a limit frequency of ≥ 500 MHz.

NOTE 1 In general, the shunt with connected BNC cable has a resistance between 0,100 Ω and 0,500 Ω.

The oscilloscope used for measurement shall record the measurements with ≥ 1 GS/s (gigasamples per second) and with a bandwidth of ≥ 300 MHz. The DC amplification of the oscilloscope shall have an uncertainty of ≤ 2 %. The stability of the time base shall be ≤ 20 ppm related to a time interval of 1 ms. Prior to the measurements the base line of the oscilloscope shall be set in such a way that the zero integral U dt forms a value of < 1,5 nVs and the total discharge will be recorded on the screen of the oscilloscope.

NOTE 2 Standard values for adjustment of the oscilloscope are in a range of 20 mV/div to 1 V/div, between 20 ns/div and 100 ns/div; for the zero integral at ± 100 pVs or less.

The tests will be carried out with operative applicators, both with and without attachment parts (e.g. extensions, angular pieces, etc.). For tests with attachment parts, the smallest and largest parts (e.g. extensions, angular pieces, etc.) shall be used.

The maximum values shall be set in case of adjustable output high voltage and adjustable output current.

During the test the applicator will be moved towards the ball electrode. The periodic discharges provoked by this process will be measured by the oscilloscope as integral U dt. Over 5 min the discharges will be provoked quickly in a consecutive way for each configuration of the applicator and the integral is recorded in nVs. The maximum transferred charge Q of the applicator results from the absolute maximum value of the integral divided by the resistance of the shunt (in Ω) according to the following relationship: $Q = |\int i(t)dt| = 1/R\ |\int u(t)dt|$.

The test will be considered to be successful, if the absolute value of the maximum transferred charge Q will not exceed the limit value of 50 µC.

NOTE 3 Further information about the safety relevant limits are given e.g. in EN 60079-0.

The uncertainties for this measurement method are considered appropriately by a limit value of 60 nC and 50 000 nC for the transferred charge.

Annex B
(informative)

Quality assurance systems for electrostatic spraying equipment

B.1 General

The following safety aspects as specified in the technical file should be realised by systematic production techniques and/or verifications and tests on the basis of written procedures.

B.2 Electrical assembly

The characteristics of the following parts including control devices and accessories should be tested with respect to the application in electrostatic spraying equipment. This means normally that the marking on the component parts or the packaging is verified, where appropriate statistical methods may be applied as necessary:

— selection of the high voltage transformer (type, manufacturer, insulation, voltage);

— equipotential bonding and earthing system for the spraying equipment and control device;

— number of stages of the cascade and turn ratio of the high-voltage transformer and the capacity of the cascade;

— assembling, type and value of each current limiting resistor, diode, Zener diode, capacitor or any other safety-relevant component (e.g. hardware-watch-dog);

— manual or automatic assembly of printed circuit boards;

— fixing and soldering of transformer, diodes, capacitors of the cascades;

— date of expiry and storage of adhesives and casting compounds;

— mixing procedures (e.g. pressure, temperature, time characteristics);

— surface treatment (degreasing or equivalent measures are usually required immediately before the potting process to ensure proper adhesion);

— processing, e.g. filling instructions, void-free potting, temperature conditions;

— curing process including: curing time, all relevant environmental factors, provisions made to ensure that the curing process will proceed without disturbance (e.g. mains power failure detection);

— selection of cable (high voltage, low voltage);

— length, type and electric strength of the cable including earthing and screening if applicable;

— connection technique and fixing method of cables between controlling device and spraying equipment.

For printed circuit boards the manufacturer should provide a list of safety-relevant electronic components (e.g. resistors, Zener diodes) used. 100 % of the listed components should be tested. This can be done by visual inspection or for SMD-components by assuring correct charging of the component insertion automat and by visual inspection of correct positioning or by automated test equipment (ATE) provided that each individual safety-relevant electronic component is considered and that a visual inspection is performed to check the type code and direction of components used in assemblies.

If the SMD-insertion automat selects the correct component carrier on the basis of a value measurement of the component, this measuring function should be calibrated.

B.3 Mechanical assembly

— materials of spraying equipment and control devices should be inspected for cracks, inclusions, bubbling and porosity;

— dimensional accuracy, evenness, surface roughness, fitting accuracy, depth of bushings, flanges and threads of the nozzles of spraying equipment and accessories (extensions, angles, etc.);

— dimensional accuracy and position accuracy of the electrode(s) in relation to the nozzle;

— torque of the screwed connections if safety relevant;

— ingress protection (IP degree of protection)

— weld continuity;

— fitting of gaskets and seals;

— continuity of moulded grooves and tongues;

— application of cements;

— continuous weld seams;

— mounting of annular and flat gaskets;

— continuity of moulded tongues and grooves;

— application of adhesives.

B.4 Tests

— I_{max} of the spraying equipment with associated accessories;

— U_{max} of the spraying equipment with associated accessories;

— open-circuit monitoring between spraying equipment and control device, if applicable;

— response of the safety facilities in case of simulated malfunction, if applicable.

Where spraying equipment and associated accessories are intended to be combined user-defined, criteria of acceptance for the tests should consider the worst case.

Annex ZY
(informative)

Significant changes between this European Standard and EN 50050:2006

In combination with EN 50050-1:2013 and EN 50050-2:2013, this document supersedes EN 50050:2006.

The significant changes with respect to EN 50050:2006 are as listed below.

	Type		
	Minor and editorial changes	**Extension**	**Substantial change regarding ESR's[a]**
Modification of the title of the standard	X		
Extension of introduction		X	
Separation in three scopes / parts		X	
Complete adaption of the safety technical requirements to the EU Directive 94/9/EC (ATEX)		X	
Extension of normative references		X	
Extension of terms and definitions		X	
New arrangement and extension of the requirements for hand-held spraying equipment for ignitable flock		X	
Definition of requirements for safety functions		X	
New arrangement and extension of tests for hand-held spraying equipment for ignitable flock		X	
New arrangement and extension of the information for use		X	
Definition of requirements for repeated tests		X	
Introduction of the normative Annex A "Test of ignition protection using a shunt and an oscilloscope“		X	
Introduction of informative Annex B "Quality assurance systems for electrostatic spraying equipment“		X	
Introduction of the informative Annex ZY "Significant changes between this European Standard and EN 50050:2006“		X	
Introduction of the informative Annex ZZ "Coverage of essential requirements of EU directive 94/9/EC“		X	
a Essential health and safety requirements (Annex II of Directive 94/9/EC).			

General conclusion on the change of the State of the Art by this standard

CENELEC/TC 31 as the responsible committee has concluded that this new edition does not contain substantial changes regarding the ESRs.

Annex ZZ
(informative)

Coverage of Essential Requirements of EU Directives

This European Standard has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association and within its scope the standard covers only the following essential requirements out of those given in Annex II of the EU Directive 94/9/EC:

– ER 1.0.1 to ER 1.0.6

– ER 1.1.1

– ER 1.2.4, ER 1.2.5, ER 1.2.7 a) and b), ER 1.2.8

– ER 1.3.2 to ER 1.3.4

– ER 1.4.2

– ER 1.6.4

– ER 2.2.2

– ER 2.3

Compliance with this standard provides one means of conformity with the specified essential requirements of the Directive concerned.

WARNING: Other requirements and other EU Directives may be applicable to the products falling within the scope of this standard.

Bibliography

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EN 1127-1	*Explosive atmospheres – Explosion prevention and protection – Part 1: Basic concepts and methodology*
EN 13463-1	*Non-electrical equipment for use in potentially explosive atmospheres – Part 1: Basic method and requirements*
EN 14462	*Surface treatment equipment – Noise test code for surface treatment equipment including its ancillary handling equipment – Accuracy grades 2 and 3*
EN 50050-1:2013	*Electrostatic hand-held spraying equipment – Safety requirements – Part 1: Hand-held spraying equipment for ignitable liquid coating materials*
EN 50050-2:2013	*Electrostatic hand-held spraying equipment – Safety requirements – Part 2: Hand-held spraying equipment for ignitable coating powder*
prEN 50059:2011	*Electrostatic hand-held spraying equipment – Safety requirements – Hand-held spraying equipment for non-ignitable coating materials*
EN 50176	*Stationary electrostatic application equipment for ignitable liquid coating material – Safety requirements*
EN 50177	*Stationary electrostatic application equipment for ignitable coating powders – Safety requirements*
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