

BS EN 50050-2:2013



BSI Standards Publication

Electrostatic hand-held spraying equipment — Safety requirements -

Part 2: Hand-held spraying equipment for ignitable coating powder

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National foreword

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 Together with BS EN 50050-1:2013 and BS EN 50050-3:2013 it supersedes BS EN 50050:2006 which is withdrawn.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

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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English version

**Electrostatic hand-held spraying equipment -
Safety requirements -
Part 2: Hand-held spraying equipment for ignitable coating powder**

Équipement manuel de projection
électrostatique -
Exigences de sécurité -
Partie 2: Équipement manuel de
projection de poudre de revêtement
inflammable

Elektrostatische Handsprüheinrichtungen -
Sicherheitsanforderungen -
Teil 2: Handsprüheinrichtungen für
entzündbares Beschichtungspulver

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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Foreword

This document (EN 50050-2:2013) 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- latest date by which the national standards conflicting with this document have to be withdrawn (dow) 2016-10-14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 50050-3:2013, this document supersedes EN 50050:2006.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

This document has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

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

0 Introduction

0.1 Process

During the electrostatic coating process the coating powder is transported in an air stream, or by air, from a powder hopper or other container, up to an applicator. As the powder particles are passing the applicator they are electrostatically charged by means of a high voltage in the range of some tens of kilovolts or triboelectrically and ejected in the form of a cloud which is directed towards the workpiece. The charged powder particles of the cloud are attracted by and applied to the earthed workpiece.

Powder, that is not applied to the workpiece (overspray) is removed by a exhaust ventilation system or other means and transported into the powder recovery unit.

After the coating process the workpieces are introduced into an oven where the powder is melted and cured into a coherent coating.

0.2 Explosion hazards

0.2.1 An explosion can occur, if

- the concentration of coating powder in air is above the lower explosion limit,
- an ignition source of appropriate energy for this coating powder cloud 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 coating powder in air.

0.2.2 Deflagration of explosive atmospheres is only possible within a given range of concentration above the lower explosion limit.

NOTE 1 If an explosive cloud of coating powder and air is trapped into a closed room, an explosion can lead to a fatal increase of pressure.

NOTE 2 The particle size distribution of coating powder is usually in the range of 5 μm to 120 μm .

NOTE 3 Coating powder in air is not evenly distributed inside a given volume, therefore it is possible that a part of the mixture is within the ignitable concentration range. An upper limit is safety-related not applicable.

0.2.3 It is important that deposits of powder 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 coating powder in hoppers where filters and hoppers are integrated in the spraying area and are designed to collect the coating powder. See 4.6 of EN 12981:2005.

0.2.4 Particular attention should be paid to the prevention of electrostatic charges on different surfaces located in the vicinity of the powder cloud. This could apply to e.g. workpieces during the coating process. Grounding is very critical to the prevention of electrostatic charge to any conductive objects in the spray area.

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 coating powder).

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 coating powders 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 coating powders, 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-P according to Table 1 of EN 50177:2009.

1.2 With regard to explosion protection and prevention measures, this standard also applies to ionisators with corona charging. Ionisators used together with or under similar conditions as electrostatic spraying equipment for ignitable coating powders are considered to be equipment of group II, category 2D for use in potentially explosive areas of zone 21 or 22. All other parts of ionisators are considered to be equipment of category 3D if they are installed or used in potentially explosive areas of zone 22, see Annex D.

1.3 Electrostatic applicators are considered to be equipment of group II, category 2D for use in potentially explosive areas of zone 21 or 22, which have been generated by the equipment itself. 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.

1.4 All other significant hazards relevant for applicators (e.g. ejection of powder, mechanical strength, electrical hazards (apart from the electrostatic hazards)), noise, explosion, contact with or inhalation of dangerous substances, ergonomics) are covered by EN 1953.

1.5 This European Standard also gives details regarding quality assurance systems for electrostatic spraying equipment, see Annex C.

1.6 Additional requirements may be applicable to equipment designed for use in food and pharmaceutical industry.

1.7 This European Standard does not apply to

- zone classification of the areas in and around spray booths [see EN 12981],
- 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 12981],
- 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 12981],
- dust hazards [see EN 12981].

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 1149-5	<i>Protective clothing – Electrostatic properties – Part 5: Performance requirements</i>
EN 1953	<i>Atomising and spraying equipment for coating materials – Safety requirements</i>
EN 12981:2005	<i>Coating plants – Spray booths for application of organic powder coating material – Safety requirements</i>
EN 50177:2009	<i>Stationary electrostatic application equipment for ignitable coating powders – Safety requirements</i>
EN 60079-0	<i>Explosive atmospheres - Electrical apparatus for explosive gas atmospheres – Part 0: General requirements (IEC 60079-0)</i>
EN 60079-7:2007	<i>Explosive atmospheres – Part 7: Equipment protection by increased safety "e" (IEC 60079-7:2006)</i>
EN 60204-1	<i>Safety of machinery – Electrical equipment of machines – Part 1: General requirements (IEC 60204-1)</i>
EN 60529	<i>Degrees of protection provided by enclosures (IP code) (IEC 60529)</i>
EN 61340-4-1	<i>Electrostatics – Part 4-1: Standard test methods for specific applications – Electrical resistance of floor coverings and installed floors (IEC 61340-4-1)</i>
EN 62061	<i>Safety of machinery – Functional safety of safety-related electrical, electronic and programmable electronic control systems (IEC 62061)</i>
EN ISO 12100	<i>Safety of machinery - General principles for design - Risk assessment and risk reduction (ISO 12100)</i>
EN ISO 13849-1	<i>Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design (ISO 13849-1)</i>
EN ISO 20344	<i>Personal protective equipment – Test methods for footwear (ISO 20344)</i>

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 coating powders, generally comprising the following parts:

- applicator (with corona charging or triboelectric charging);
- coating powder supply system;
- control device;
- high voltage supply system for corona charging (can be integral to the applicator);
- connecting cable

3.2

connecting cable

electric cable to the applicator

3.3

earthing device

device for earthing the hand-held spraying equipment permanently

Note 1 to entry Triboelectric applicators (see 3.8) are generally earthed by the recirculation of the tribo-current.

3.4

spraying device

outlet opening for the coating powder

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 coating powder supply system, the control air, the purge air;
- measurement of recirculated tribo-current at triboelectrical equipment

Note 1 to entry A combination of the control device and the high voltage supply according to 3.9 is possible.

3.7

applicator with corona charging

equipment for application of coating powder with corona charging

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

triboelectric applicator

equipment for application of coating powder with triboelectric charging (tribo-charge)

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

- charging system;
- housing;
- powder feed line;
- spraying device;
- device for recirculation of tribo-current (earthing);
- exchangeable attachment parts (e.g. nozzles, extensions, angular pieces, etc.).

3.9

high voltage supply for applicators with corona charging

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

3.10

spraying area

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

3.11

dangerous discharge

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

3.12

coating powder supply system

in general, coating powder supply system comprising the following:

- powder hopper, or supply container;
- dosing devices for coating powder;
- supply lines for coating powder;
- devices for drive, control and monitoring powder delivery

3.13

workpiece

article to which the coating powder is applied

3.14

ignitable coating powder

coating powder 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

3.15

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

Note 1 to entry See EN 1127-1.

3.16

Lower Explosion Limit

LEL

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

3.17

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

3.18

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 an incendive 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.

3.19

antistatic clothes

clothes that have a resistance to earth, which is low enough to prevent the build-up of electrostatic charges capable of an incendive 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.

3.20

antistatic floor

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

3.21

accessories

accessories are all devices, components and other equipment, except for 3.7 and 3.8 of this standard

3.22

U_{\max}

maximum output voltage of the high-voltage generator

3.23

I_{\max}

maximum output current of the high-voltage generator

3.24

repeated test

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

3.25

ionisator

an ionisator is a device to discharge electrostatic charge e.g. from workpieces

3.26

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 coating powders

4.1 General requirements

4.1.1 Hand-held spraying equipment shall be designed and constructed to prevent exceeding the maximum transferred charge of single sparks of 200 nC, or the maximum discharge energy of 2 mJ.

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 $\leq 100 \text{ M}\Omega$. 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 cm^2 . This contact surface area shall be earthed, and the resistance to earth shall not exceed $1 \text{ M}\Omega$.

4.1.6 Operating triggers of the applicators shall be biased to the off position. In this position, the coating material 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 $1 \text{ M}\Omega$. 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, resistors 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 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 1 (e.g. according to EN 62061) or PL c (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 Special requirements for hand-held spraying equipment with corona charging

4.2.1 All components shall withstand a short circuit between the high voltage electrode and earth for 5 min. The degree of protection shall remain unchanged.

4.2.2 All electrical components of the applicator, other than the spraying device shall be constructed at least comparable with IP64 of EN 60529. As an alternative, the applicator, except for the spraying device, can be designed according to IP64 according to EN 60529.

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

4.3 Requirements for the accessories

4.3.1 Accessories that are used in hazardous areas, as applicable, shall be submitted to a cable pull test according to 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 200 nC, or the maximum discharge energy of 2 mJ.

4.3.2 Control devices and the coating powder supply system shall have an earth connection. The resistance to earth shall not exceed 1 M Ω . The connection shall be designed in accordance with 4.2.1 of EN 60079-7:2007.

4.3.3 It shall not be possible to modify the safety-relevant operating parameters maximum output high voltage, maximum spraying current and maximum short circuit current from the checked limit values according to 5.4.1.1, 5.4.1.2 and 5.4.1.3.

4.3.4 Detachable earth connections shall be marked clearly.

4.3.5 Hoses for supply of coating powder shall be dissipative or conductive and earthed with a resistance of ≤ 100 M Ω . The size of the hoses shall be observed.

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 5.3 and 5.4 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 unfavorable for passing the test.

5.2 General tests

5.2.1 Test of earth connections

It shall be tested that hand-held spraying equipment has an earth connection complying with 4.1.7, 4.1.9 and 4.3.2.

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, 4.3.2 and 4.3.5.

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 4.1.6.

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 (not applicable to triboelectrical applicators)

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 5.5.1).

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

5.3.3 Drop test (not applicable to triboelectrical applicators)

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 5.5.1).

5.4 Tests for electrical safety (not applicable to triboelectrical applicators)

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 4.2.1.

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 64 shall be tested according to EN 60529.

5.5 Ignition test

5.5.1 Ignition test of applicators with high voltage supply

Either the test according to 5.5.1.1 or 5.5.1.2 shall be carried out.

5.5.1.1 Test using a shunt and an oscilloscope

Test for observance of the limit value for maximum transferred charge of single sparks (200 nC) by measurement according to Annex A.

5.5.1.2 Test within the gas mixture

Test for observance of the limit value for maximum discharge energy of single sparks (2 mJ) according to Annex B.

5.5.2 Ignition test for triboelectrical applicators

Test for observance of the limit value for maximum transferred charge of single sparks (200 nC) by measurement 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 of equipment category 3D.

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 coating powder 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 coating powders to a maximum of 50 % of LEL of the coating powders 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, powder hoppers, 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. This can also be fulfilled by a system approval drawing identifying the equipment and options of the system.

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.

- 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, low voltage and compressed air.

6.2.2.2 Earthing of containers for cleaning liquids

Only electrically conducting containers shall be used for cleaning liquids; the containers shall be earthed.

6.2.2.3 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.

6.2.2.4 Earthing of the jigs for workpieces

Appropriate measures shall ensure that the resistance to earth of the jig shall not exceed 1 M Ω , measured with a measurement voltage from 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
5.2	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:

- if necessary, description of the operational restrictions for equipment marked with "X";
- all references required for a correct operation of the equipment;
- mode of functioning of the safety devices;
- 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 M Ω ;
- protective clothing to be worn, including gloves, shall comply with EN 1149-5. The measured insulation resistance shall not exceed 100 M Ω ;
- 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 the applicator

The following markings are required in addition to the legal marking and of EN 1953:

- the number of this European Standard EN 50050-2;
- the kept limit value of the discharge energy in mJ.

Example 1 (informative):

[Name of the manufacturer or registered trademark]

[Series/Type] [serial number]



NB YY ATEX XXXX

EN 50050-2:2013

NOTE 1 "0000" is number of the notified body involved in production control system.

NOTE 2 "NB" is short form of the notified body of type examination.

NOTE 3 "YY" last two digits of the year of certification.

NOTE 4 "XXXX" number of certificate.

6.3.2 Marking of the associated control devices

The following markings are required in addition to the legal marking requirements, if applicable::

- "Admissible combinations of devices, see instruction manual";
- the number of this European Standard EN 50050-2;
- range of input voltages and whether AC or DC;
- input power;
- degree of protection;
- range of input frequency;
- output voltage;
- output current.

Example 2 (informative):

<p>Name of the manufacturer, registered trademark</p> <p>NBYY ATEX XXXX</p> <p>Discharge energy [mJ]</p> <p>Input voltage [V]</p> <p>Input power [W]</p>	<p>"Admissible combinations of devices, see information for use"</p> <p>Series/type</p> <p>Serial number</p> <p>EN 50050-2</p> <p>IP54</p> <p>Max. surface temperature "T" [°C]</p> <p>Input frequency [Hz]</p>	<p>Output voltage [V/kV]</p> <p>Output current [µA]</p>
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NOTE 1 "0000" is number of the notified body involved in production control system.

NOTE 2 "NB" is short form of the notified body of type examination.

NOTE 3 “YY” last two digits of the year of certification.

NOTE 4 “XXXX” number of certificate.

NOTE 5 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.

6.3.3 Marking of other accessories

All other accessories shall be marked with the label of the notified body and the number of the EC type examination certificate. Very small parts are excluded from this requirement. Very small parts shall be identified by e.g. the part number.

Example 3 (informative):

NBYY ATEX XXXX

NOTE 1 “NB” is short form of the notified body of type examination.

NOTE 2 “YY” last two digits of the year of certification.

NOTE 3 “XXXX” number of certificate.

Annex A (normative)

Test for ignition protection using a shunt and an oscilloscope

Measurement shall be carried out at a relative humidity of $\leq 50\%$ and at a temperature of $(22 \pm 5)^\circ\text{C}$. 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 $\leq 2,5\%$ and shall be indicated to the third decimal place. The system consisting of shunt and coaxial cable shall ensure a limit frequency of $\geq 500\text{ MHz}$.

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

The oscilloscope used for measurement shall record the measurements with $\geq 1\text{ GS/s}$ (gigasamples per second) and with a bandwidth of $\geq 300\text{ MHz}$. The DC amplification of the oscilloscope shall have an uncertainty of $\leq 2\%$. The stability of the time base shall be $\leq 20\text{ ppm}$ 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 $\int U dt$ forms a value of $< 1,5\text{ nVs}$ 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 $\pm 100\text{ pVs}$ 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 $\int U dt$. 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 200 nC .

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 200 nC for the transferred charge.

Annex B (normative)

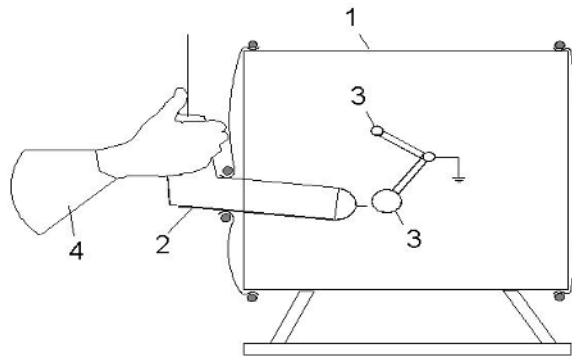
Ignition test within the gas mixture

B.1 General

A test gas mixture having a minimum ignition energy of 2 mJ shall be used for the ignition test of electrostatic applicators for ignitable coating powders. This requirement is satisfied, for instance, by a mixture of methane of at least 99 % purity and air having a concentration by volume of $(12,0 \pm 0,1)$ % methane.

The ignition test shall be performed inside a test chamber consisting of non-conductive and transparent materials (see Figure B.1).

The test shall be performed without escape of coating powders and without pressurised air.



Key

- 1 ignition test chamber
- 2 applicator with accessories
- 3 electrode
- 4 hand protected by fire resistant glove

Figure B.1 — Example of a test arrangement

B.2 Preparations

Prior to the test, the applicator shall be cleaned.

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

B.3 Preliminary test

The preliminary test can be performed inside or outside the test chamber. The preliminary test inside the test chamber is carried out without test gas mixture.

All parts of the applicator and of the accessories belonging to the applicator, as well as the connection cable, shall be approached to a earthing electrode for several times. In doing so, those areas where the most visible and/or hearable energy-rich discharges can be observed shall be determined.

B.4 Test

The test is performed within the test chamber filled with the test gas mixture. Diluting of the gas mixture during the test shall be prevented. The test person shall be in a secured position during testing

The areas determined during the preliminary test shall be approached repeatedly and quickly by two earthed metal spheres (electrodes) of 10 mm and 25 mm in diameter. The test is carried out for a period of 5 min and is performed four times using a fresh test gas mixture each time. If the explosive mixture is passed continuously through the chamber, the test is carried out for one period of 20 min. In the latter case, the test is performed without interruption.

B.5 Result

The test will be considered to be passed, if the explosive mixture is not ignited.

Annex C **(informative)**

Quality assurance systems for electrostatic spraying equipment

C.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.

C.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.

C.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 (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.

C.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 D (normative)

Requirements for explosion protection and prevention for ionisators

In addition to the requirements of IEC 61340-4-7, this European standard defines the requirements for explosion protection and prevention for ionisators with high voltage corona ionisation which are used together with or under similar conditions as spraying equipment for ignitable coating powders.

Ionisators shall comply with the clauses of this standard listed in Table D.1:

Table D.1 — Requirements for ionisators

Requirement	Subclauses
General requirements	4.1.1, 4.1.2, 4.1.4, 4.1.7, 4.1.8, 4.1.9, 4.1.10
Specific requirements	4.2.1, 4.2.2
Requirements for accessories	4.3.1, 4.3.3
General tests	5.2.1, 5.2.2
Conditioning tests	5.3.1, 5.3.2
Test of electrical safety	5.4
Ignition test	5.5.1
Test of IP degree of protection	5.6.1

The information for use for and the marking of ionisators shall comply with the requirements of EN 60079-0.

Annex ZY
(informative)

**Significant changes between this European Standard and
EN 50050:2006**

In combination with EN 50050-1:2013 and EN 50050-3:2013, this European Standard 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	
Extension of the scope with regard to explosion prevention and protection measures for ionisators with high voltage corona ionisation		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 coating powders		X	
Definition of requirements for safety functions		X	
New arrangement and extension of tests for hand-held spraying equipment for ignitable coating powders		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 the normative Annex B "Ignition test within the gas mixture"		X	
Introduction of informative Annex C "Quality assurance systems for electrostatic spraying equipment"		X	
Introduction of the informative Annex D "Explosion protection and prevention measures for ionisators"		X	

	Type		
	Minor and editorial changes	Extension	Substantial change regarding ESR's ^a
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 2.3.2

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.

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- EN 1127-1 *Explosive atmospheres – Explosion prevention and protection – Part 1: Basic concepts and methodology*
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- EN 13463-1 *Non-electrical equipment for use in potentially explosive atmospheres – Part 1: Basic method and requirements*
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- EN 50050-3:2013 *Electrostatic hand-held spraying equipment – Safety requirements - Part 3: Hand-held spraying equipment for ignitable flock*
- prEN 50059:2011 *Electrostatic hand-held spraying equipment – Safety requirements – Hand-held spraying equipment for non-ignitable coating materials*
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