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Stationary electrostatic application equipment for non-ignitable liquid coating material — Safety requirements

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National foreword

This British Standard is the UK implementation of EN 50348:2010. It supersedes BS EN 50348:2002 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee GEL/31/-/18, Electrostatic spray guns.

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Stationary electrostatic application equipment for non-ignitable liquid coating material - Safety requirements

Matériel fixe de projection électrostatique de produit à projeter liquide inflammable - Exigences de sécurité

Stationäre Ausrüstung zum elektrostatischen Beschichten mit nichtentzündbaren flüssigen Beschichtungsstoffen - Sicherheitsanforderungen

This European Standard was approved by CENELEC on 2009-12-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

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CENELEC

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Foreword

This European Standard was prepared by the Technical Committee CENELEC TC 204, Safety of electrostatic painting and finishing equipment.

The text of the draft was submitted to the formal vote and was approved by CENELEC as EN 50348 on 2009-12-01.

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

This European Standard supersedes EN 50348:2001.

The following dates were fixed:

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2010-12-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2012-12-01

This European Standard has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association and covers essential requirements of EC Directive 2006/42/EC. See Annex ZZ.

The State of the Art is included in Annex ZY “Significant changes between this European Standard and EN 50348:2001”.

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0 Introduction

0.1 Process

During the electrostatic coating process the liquid coating material is transported to an electrostatic spraying device where it is converted to droplets by mechanical forces and by the influence of an electric field. During this atomising process the droplets are charged by high voltage of some 10 kV and a spray cloud is generated. The charged droplets are attracted by and applied to the grounded workpiece.

Droplets which are not applied to the workpiece (overspray) are removed by an extraction device or by another device.

The coated workpieces are transported to dryer, where the solvent is evaporated and a dry film of coating material is generated.

0.2 Fire hazards

0.2.1 Fire hazards can be caused by paint and varnish deposits inside the spray booth, exhaust air ducts and filters. During operation, malfunctions or electrical faults may cause ignition of these residues. This is especially true for spray booths where electrostatic coating takes place. The fast propagation of the fire leads to hazards also in adjacent areas.

0.2.2 Particular attention shall be paid to the prevention of electrostatic charges on different surfaces, which are in the vicinity of the spray cloud. This could apply to workpieces during the coating process or the reciprocating devices and the mounting parts of the spraying system, etc.

0.2.3 When spraying non-ignitable coating material, the formation of an explosive atmosphere is not likely to occur. Electrostatic application equipment for ignitable liquid coating materials and hard to ignite coating materials are covered by EN 50176.

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 under dangerous voltage during normal operation, but only in case of failure,
- insulated live parts whose insulation is insufficient or has been damaged due to mechanical influences.

0.3.2 Inadequate grounding may occur, for instance, due to

- faulty connections to the protective grounding system,
- a too high resistance to ground (requirement as in 5.6).

0.3.3 Hazards could occur, for instance, if hazardous malfunctions (e.g. shortcut of electronic safety circuits, of access guards to dangerous areas or of warning devices) 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-grounded 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 stationary electrostatic application equipment for non-ignitable liquid coating materials which do not generate an explosive atmosphere inside the spraying area. A distinction is made between spraying systems corresponding to EN 50050 and spraying systems designed for higher discharge energies and/or currents.

This European Standard also specifies the design-related requirements for a safe operation of the stationary equipment, including its electrical installations.

1.2 This European Standard considers two types of electrostatic spraying systems, see 5.1 for more details.

1.3 Noise has not been dealt with in this standard as it is not considered to be a significant hazard of stationary electrostatic application equipment for non-ignitable liquid coating material. For any other health protection, see EN 12215:2004, 5.5. For fire prevention and protection (e. g. fire hazards due to other sources), see also EN 12215:2004, 5.7.1.

This European Standard deals with all significant hazards, hazardous situations and events, which are relevant for stationary electrostatic application equipment for non-ignitable liquid coating and cleaning materials which do not generate an explosive atmosphere inside the spraying area, provided they are used as intended by the manufacturer.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 1081:1998, *Resilient floor coverings - Determination of the electrical resistance*

EN 1149-5, *Protective clothing - Electrostatic properties - Part 5: Material performance and design requirements*

EN 12215:2004, *Coating plants - Spray booths for application of organic liquid coating materials - Safety requirements*

EN 14462, *Surface treatment equipment - Noise test code for surface treatment equipment including its ancillary handling equipment - Accuracy grades 2 and 3*

EN 50059:1990, *Specification for electrostatic hand-held spraying equipment for non-flammable material for painting and finishing*

EN 50176, *Automatic electrostatic spraying installations for flammable liquid spraying material*

EN 60204-1:2006, *Safety of machinery - Electrical equipment of machines - Part 1: General requirements* (IEC 60204-1:2005, mod.)

EN 60529, *Degrees of protection provided by enclosures (IP Code)* (IEC 60529)

EN 61340-4-1:2004, *Electrostatics - Part 4-1: Standard test methods for specific applications - Electrical resistance of floor coverings and installed floors* (IEC 61340-4-1:2003)

EN 61508-3; *Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 3: Software requirements* (IEC 61508-3)

EN 62061:2005, *Safety of machinery - Functional safety of safety-related electrical, electronic and programmable electronic control systems* (IEC 62061:2005)

EN ISO 11688-1:1998, *Acoustics - Recommended practice for the design of low-noise machinery and equipment - Part 1: Planning* (ISO/TR 11688-1:1995)

EN ISO 12100-1:2003, *Safety of machinery - Basic concepts, general principles for design - Part 1: Basic terminology, methodology* (ISO 12100-1:2003)

EN ISO 12100-2:2003, *Safety of machinery - Basic concepts, general principles for design - Part 2: Technical principles* (ISO 12100-2:2003)

EN ISO 13849-1:2008, *Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design* (ISO 13849-1:2006)

EN ISO 20344:2004, *Personal protective equipment - Test methods for footwear* (ISO 20344:2004)

3 Definitions

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

3.1
stationary electrostatic application equipment for non-ignitable liquid coating material
equipment in which the electrostatic spraying system is either fixed stationary (e. g. on supports) and is operated automatically or is guided by reciprocators (e. g. robots).

In general, the equipment comprises the following:

– spray booth;

– spraying area;

– spraying system;

– fixtures for workpieces;

– conveyors;

– grounding system;

– forced ventilation

3.2
spraying system
devices for application of liquid coating material by means of electrostatic charge.

In general, the spraying system consists of the following components:

– device for the supply of coating material;

– high voltage electrode;

– high voltage supply system;

– spraying device

3.3
high voltage supply system
system consisting generally of the following components:

– low voltage section with devices for switching on and off the unit and for adjustment, control, regulation, limitation and monitoring of current and voltage, as well as the required connecting cables;

– high voltage generator;

– high voltage switching device;

– high voltage cable;

– high voltage plug-and-socket connector

3.4
spraying area
area, closed or not, in which the coating material is applied to the workpiece by the electrostatic spraying system

3.5
dangerous discharge
discharge which generates a fire hazard and/or a hazard of electric shock

3.6
workpiece
article to which the coating material is applied

3.7
ignitable liquid coating materials
sprayed materials, especially varnishes, which could be ignited by an effective ignition source and which continue to burn after the ignition source has been removed or may react in the form of an explosion

NOTE A formula for the estimation of the ignitability on the basis of the composition of the coating material is given in Annex A.

3.8
hard to ignite liquid coating materials
sprayed materials, especially varnishes, which could be ignited by an effective ignition source with an energy of 2 J or above and which continue to burn after the ignition source has been removed, or may react in the form of an explosion

NOTE A formula for the estimation of the ignitability on the basis of the composition of the coating material is given in Annex A.

3.9
non-ignitable liquid coating materials
sprayed materials, especially varnishes, which could not be ignited by an effective ignition source with an energy of 2 J or above

NOTE A formula for the estimation of the ignitability on the basis of the composition of the coating material is given in Annex A. Liquids whose composition is outside the range of the formula, e.g. chlorinated liquids, have to be tested experimentally.

3.10
discharge energy
energy discharged from a conductive part of the installation in the form of a spark which could cause an electric shock to a person

3.11
antistatic footwear
footwear that has a resistance to earth via the sole which is low enough to prevent the build-up of electrostatic charges capable to produce a hazardous discharge

See EN ISO 20344:2004.

NOTE A necessary electric insulating resistance to prevent electric shocks is not contradictory to this definition.

3.12
antistatic clothes
clothes that have a resistance which is low enough to prevent the build-up of electrostatic charges capable to produce a hazardous discharge

See EN 1149-5.

NOTE A necessary electric insulating resistance to prevent electric shocks is not contradictory to this definition.

3.13
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 hazardous discharge

3.14
accessories
assemblies and other equipment, except of the spraying system and the high voltage supply system

3.15
constant-voltage operation
closed control circuit system with direct feedback of the actual value of the output high voltage. During the constant-voltage operation, the adjusted output high voltage is maintained constant up to the capacity of the high voltage part via a control device, independent of the variable operational current

NOTE In this standard, the symbol for this mode of operation is U_{k}.

3.16
voltage-controlled operation
open control circuit system without feedback of the output high voltage. During the voltage-controlled operation the output high voltage is adjusted generally at a defined operational current. The output high voltage, however, is not maintained constant by a control device, it varies depending on the operational current and the on-load behavior of the high voltage device

NOTE In this standard, the symbol for this mode of operation is U_{v}.

3.17
constant-current operation
closed control circuit system with direct feedback of the actual value of the high voltage current to a control device. In doing so, the operational current is maintained constant and the output high voltage varies load-dependently between a minimum and a maximum value defined by the process

NOTE In this standard, the symbol for this mode of operation is I_{k}.

3.18
operational current
current that flows within the high voltage circuit during failure-free operation

NOTE In this standard, the symbol for the operational current is I_{b}.

3.19
overcurrent
current occurring during a malfunction, exceeding the operational current of the high voltage circuit and giving rise to expect that in voltage-controlled and constant-voltage operation hazardous discharges or arcs between high voltage parts and grounded parts of the plant can occur in case the safety distance drops below the permissible limit

NOTE In this standard, the symbol for overcurrent in the high voltage circuit is I_{u}.

3.20
minimum voltage
value of the voltage of the high voltage circuit giving rise to expect that in constant-current operation hazardous discharges or flashover by arcs can occur between high voltage parts and grounded parts of the plant in case the safety distance drops below the permissible limit

NOTE In this standard, the symbol for minimum voltage in the high voltage circuit is U_{min}.

3.21
disconnection threshold
disconnection threshold is either the overcurrent value I_u or the minimum voltage value U_{min}. When the value of I_u is exceeded or the value of U_{min} falls below, a cutting off of the high voltage supply is released

3.22
skilled person
person who due to technical training, experience and recent occupational activities has sufficient knowledge in the field of electrostatic coating with stationary equipment, is familiar with the relevant and generally accepted technical rules, and thus is able to test and evaluate the safe state of coating plants

3.23
repeated inspection
inspection of the entire electrical equipment, systems and plants to be carried out at regular intervals

4 General requirements

4.1 If spray booths are used, they shall comply with the requirements of EN 12215:2004, except for requirements related to explosion protection.

4.2 Special requirements for the spraying area are specified in 5.3.

4.3 An appropriate grounding of the different surfaces shall be provided. Special care shall be taken that sufficient grounding is maintained by the hangers. The hangers shall be designed in such a way that deposits of coating material are minimised.

4.4 Stationary equipment shall be designed and constructed to satisfy the intended function as given by the limitations of the manufacturer safely even in case of varying environmental conditions, influence of external voltages, exposure to humidity, vibrations, contaminations as well as other environmental influences. Stationary equipment shall be suitable for the intended mechanical and thermal demands and shall withstand the effects of present or predictable aggressive materials.

4.5 The spraying system, with exception of the spraying device, shall have at least IP-protection IP54 protection according to IEC 60529.

4.6 Safety devices shall function independently of the measuring, control and regulation devices required for operation. The failure of a safety device shall be detected, if possible, by appropriate technical measures within an adequate period, so that hazardous conditions are not likely to occur.

Fundamentally, the fail-safe principle shall be applied.

In case of failure of safety devices, the stationary equipment shall be led to a safe condition as far as possible.

4.7 The entire control system consisting of e.g. electrical control, monitoring and measurement systems, which are used in safety related functions, shall comply with the safety integrity level 2 according to EN 62061:2005 or fulfil the requirements of performance level (PL) d of EN ISO 13849-1:2008.

If safety functions of the control system according to Clause 5 and Table 2 depend on software, particular attention shall be paid to risks due to programme errors, see EN 61508-3 and EN 62061:2005, 6.10, 6.11 and Annex C.

4.8 The equipment shall comply with the safety requirements and/or protective measures of this clause. In addition, the equipment shall be designed according to the principles of EN ISO 12100 for relevant, but not significant hazards, which are not dealt with by this standard.

5 Requirements for the equipment

5.1 Electrostatic spraying systems

Depending on the discharge energy that can be transmitted, electrostatic spraying systems are categorised into two types according to Table 1.

Table 1 – Electrostatic spraying systems for non-ignitable coating material – Fields of application

Types ("NL" for liquid non-ignitable coating material)	Discharge energy	Hazard by electric shock
Type A-NL	< 350 mJ	No
Type B-NL	> 350 mJ	Yes

NOTE The discharge energy W can be calculated by the formula $W = ½ C U^2$. If resistors, semi-conductors or liquid conductors are present, the calculation of W results in too high values. Alternatively the discharge energy can be determined by measurement.

5.2 Requirements for spraying systems for non-ignitable liquid coating material

The requirements related to the different types are listed in Table 2.

Table 2 – Requirements for electrostatic spraying systems for non-ignitable liquid coating material

Subclause	Requirements	Type A-NL	Type B-NL
5.2.1	Design to EN 50059:1990	Yes	No
5.2.2	Disconnection of high voltage	No	Yes
5.2.3	Personal protection	No	Yes
5.4.2	Protection against contact	No	Yes

5.2.1 Design to EN 50059:1990

Spraying systems shall comply with the requirements of EN 50059:1990.

5.2.2 Safe disconnection of high voltage

A device shall be installed which prevents the occurrence of hazardous discharges between parts under high voltage and grounded parts in such a way that it disconnects the high voltage, discharges the spraying system and shuts down the supply of coating material. In this context, a difference shall be made between voltage controlled, constant-voltage and constant-current operating modes.

5.2.2.1 Voltage-controlled and constant-voltage operating mode

A device shall be installed, which is to disconnect the high voltage in case the safety distance between the parts under high voltage and grounded parts drops below the permissible limit.

For voltage-controlled and constant-voltage operating mode this is achieved by a disconnection in case of overcurrent I_u.

The disconnection threshold shall be defined with consideration of the operational and local conditions.

NOTE Typically an overcurrent I_{U}, for operational currents of less than 200 µA up to 200 % or for operational currents of more than 200 µA up to 50 % is permissible.

5.2.2.2 Constant-current operating mode

A device shall be installed which is to disconnect the high voltage in case the safety distance between parts under high voltage and grounded parts drops below the permissible limit.

For constant-current operating mode, this is achieved by disconnection, if a defined minimum output value of high voltage U_{min} is undercut.

The disconnection threshold shall be defined with consideration of the operational and local conditions.

NOTE Typically a value of the minimum voltage U_{min} of 20 % to 50 % below the value of the output high voltage for the failure-free normal operation is permitted.

5.2.3 Protection against too high discharge energy

After disconnection of the high voltage all live parts shall be discharged to a discharge energy of less than 350 mJ before these parts can be reached. The discharge time shall be defined considering the operational and local conditions.

5.3 Spraying area

5.3.1 The forced ventilation of the spraying area shall satisfy the requirements of EN 12215:2004.

5.3.2 When using walls, enclosures, signs and labels made of non-conductive material, the occurrence of propagating brush discharges shall be prevented. Thin sheets of plastic material less than 9 mm thick in contact with large areas of grounded metal (or other conductors) can give rise to propagating brush discharges. Where such thin sheets are used, the breakdown voltage through the sheet shall not exceed 4 kV to avoid the occurrence of propagating brush discharges.

NOTE The use of thin layers of non-conductive plastic material on conductive surfaces may cause hazards due to the formation of propagating brush discharges.

5.3.3 Inside spray booths and in a radius of 2,5 m around the openings of the booths an antistatic floor shall be installed. The resistance shall not exceed 10^8 Ω. Its resistance shall comply with the test conditions of EN 61340-4-1:2004. When using elastic floor the requirements of EN 1081:1998 shall be observed.

5.4 High voltage supply

5.4.1 The high voltage supply shall be safeguarded against unauthorized switching on. Switching-off shall be possible at any time.

NOTE Suitable safeguards against unauthorized switching on are e. g. key locks or hardware and software authorisations.

5.4.2 On all doors and openings of the spraying area where the hazard of contact with parts under high voltage exists the presence of the high voltage shall be indicated by an optical or acoustic signal. Every access to the spraying area provided for operators shall be safeguarded in such a way that the high voltage is disconnected when entrance is gained. The interlock shall satisfy the performance level d of EN ISO 13849-1:2008. Other openings of the spraying area through which parts under high voltage could be contacted shall be locked in such a way to be only opened by keys or tools. When using systems of type B-NL an interlock of the high voltage with all doors and openings shall be installed to prevent an electric shock of persons.

5.4.3 If exposed parts of the high voltage supply system are located outside the spraying area or outside a closed electrical operating area, complete protection against direct contact shall be provided. In addition, appropriate measures (e. g. closed, grounded housing) shall be taken to avoid persons or objects being charged by the influence of a present electrical field.

5.4.4 Components within the spraying area which are not at high voltage potential for operational reasons, shall be connected with the ground contact of the high-voltage supply system with a separate conductor of low impedance.

5.4.5 High voltage cables shall comply with the tests of 6.1.

5.4.6 Parts of the spraying system under high voltage located outside the spraying area shall be installed in such a way to prevent occurrence of discharges hazardous for persons.

5.4.7 The minimum distance in air between the parts under high voltage and the grounded parts shall not be less than 0,25 cm/kV. These minimum distances are not applicable both for the distance between the electrostatic spraying device and the workpiece, and the design-specific distances of the spraying devices.

NOTE Possible occurrence of surface discharges at the spraying device could have an influence on the minimum distances.

5.5 Electric requirements

The electric equipment shall comply with the requirements of EN 60204-1:2006.

5.6 Grounding measures

5.6.1 All conductive components of the equipment, like floors, walls, ceilings, fences, conveyors, workpieces, containers for coating material, reciprocators or elements of construction etc. within the spraying area, except for parts under high voltage for operational reasons, shall be connected to the grounding system. Parts of the booth shall be grounded in compliance with EN 12215:2004.

5.6.2 The resistance to earth from the suspending point of each workpiece shall not exceed 1 MΩ. The voltage during measurement shall be 500 V or 1 000 V. The design of hangers shall ensure that the workpieces remain grounded during the coating process.

NOTE Since workpieces are often grounded by metallic hooks, it is important to clean these hooks frequently or to design them in such a way that the build-up of insulating layers of coating material is prevented.

5.6.3 If an appropriate grounding of the workpiece according to 5.6.1 cannot be ensured, the dissipation of electrical charges at the workpiece by other devices, e. g. ionisers, is permitted. Such devices shall not exceed the permitted discharge energy of the spraying systems, for which they are used. Moreover, these devices shall be submitted to the same test for admissible discharge energy as the spraying system they are used with. The dissipation device shall be interlocked with the spraying system in such a way to disconnect the high voltage and stop coating in case of failure of the dissipation device.

5.7 Supply for coating material

5.7.1 Where conductive parts are used for the coating material supply system, these parts shall be either bonded to earth or connected with the high voltage supply system so that their potential level is invariably identical with that of the electrostatic spraying system.

5.7.2 Where a coating material container made of conductive material is connected to the high voltage supply system in normal operation, it shall be located in an electrical operating enclosure which is interlocked with the high voltage supply system and is grounded in accordance with the requirements as laid down in 5.2.3.

5.7.3 Where a coating material container made of non-conductive material is used, the coating material shall be in contact with a metallically conductive part so that the electrical charge of the coating material is diverted across this part in accordance with 5.2.3.

5.7.4 Where the requirements as laid down in 5.7.2 and 5.7.3 are not fulfilled, precautionary measures shall be taken in order to prevent any contact with the coating material container or any other exposed parts of the coating material supply under high voltage in normal operation.

5.7.5 Coating material supply hoses made of non-conductive material which are used for the supply of coating material under high voltage in normal operation, shall be laid in accordance with the requirements of 5.4.6 and 5.4.7 and withstand the high voltage test as specified in 6.2.

5.7.6 The requirements of 5.7.5 are also applicable for coating material containers made of non-conductive material; the high voltage test as specified in 6.2 shall be carried out.

6 Testing

6.1 Type tests of the high voltage cables

6.1.1 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 screen of the cable being grounded, except for 75 cm at each end. There shall be no breakdown.

6.1.2 If the cable does not have an electrically conductive screen, a sample cable, at least 2,5 m in length, is placed on an grounded metal plate. A test voltage of 1,2 U_{max} is applied for 24 h. There shall be no breakdown.

6.2 Type tests of the insulating spraying material supply hose

6.2.1 A sample of the insulating hose of at least 2,5 m filled with ordinary tap water at ambient temperature is placed on an grounded metal plate. The tap water inside the hose is raised to a voltage of 1,2 U_{max} for a period of 24 h. There shall be no breakdown.

6.2.2 If there is an electrically conductive screen, the sample hose of at least 2,5 m is filled with ordinary tap water at ambient temperature and raised to a voltage of 1,2 U_{max} for a period of 24 h. The electrically conductive screen of the hose will be grounded, except for 75 cm at each end. There shall be no breakdown.

6.3 Routine tests of the stationary equipment

The tests shall be carried out for each single spraying system. The tests shall be carried out by skilled persons and include the tests according to Table 3. For test intervals for repeated tests, see Table 4.

Table 3 – Survey of the tests

Subclause	Kind of test	Requirements
6.3.1	The stationary equipment for electrostatic coating with non-ignitable liquid coating materials shall be tested for occupationally safe state	In this context, especially the disconnection threshold, the overcurrent I_u and the minimum voltage U_{min} shall be defined and documented with respect to operational and local conditions (see also 5.2.2).
6.3.2	Effectivity of forced ventilation (exhaust air systems)	See 5.3.1.
6.3.3	Safe disconnection of high voltage shall be tested for voltage-controlled and constant voltage operation	See 5.2.2 and 5.2.2.1. The disconnection threshold I_u shall be defined and documented with respect to operational and local conditions. It shall be tested if the high voltage is disconnected in case of inadmissible increase of the operational current I_b and if the disconnection threshold I_u is reached. In this context, the disconnection threshold I_u defined during the initial test shall be tested. A disconnection threshold I_u, giving rise to expect an occurrence of hazardous discharges or flashover between parts under high voltage and grounded parts of the plant in case the safety distance drops below the permissible limit, is not permitted.
6.3.4	Safe disconnection of high voltage supply shall be tested for constant current operation	See 5.2.2 and 5.2.2.2. The disconnection threshold U_{min} shall be defined and documented with respect to operational and local conditions. It shall be tested if the high voltage is disconnected in case of inadmissible decrease of the high voltage below the disconnection threshold U_{min}. In this context, the disconnection threshold U_{min} defined during initial test shall be tested. A disconnection threshold U_{min}, giving rise to expect an occurrence of hazardous discharges or flashover between parts under high voltage and grounded parts of the plant in case the safety distance drops below the permissible limit, is not permitted.
6.3.5	Protection against too high discharge energy	See 5.2.3, 5.7.2 and 5.7.3
6.3.6	Effectivity of measures for protection against direct contact	See 5.4.2, 5.4.6 and 5.7.5
6.3.7	Effectivity of grounding measures	See 5.6.
6.3.8	Interlocks / protection against entrance	See 5.4.2.
6.3.9	Conductive parts of the spraying material supply system	See 5.7.1
6.3.10	Minimum clearance in air	See 5.4.7 and 5.7.5
6.3.11	Further tests	In compliance with EN 12215:2004

7 Information for use

7.1 General

The equipment shall be accompanied by instructions in the official Community language or languages of the Member State in which it is placed on the market and/or put into service.

The instructions accompanying the equipment shall be either ‘Original instructions’ or a ‘Translation of the original instructions’.

The translation shall be accompanied by the original instructions in a language of the EU to be chosen by the manufacturer or his authorized representative.

The original language version(s) of the instructions shall be marked with the words “Original instructions”.

7.2 Instruction manual

7.2.1 General

Every stationary equipment for electrostatic spraying of non-ignitable coating materials shall be accompanied by an instruction manual according to EN ISO 12100-1:2003 and EN ISO 12100-2:2003. It shall also contain the contents of Tables 3 and 4.

The instruction manual shall contain the warning, that if using protective gloves, these gloves shall comply with the requirements of 7.2.4.

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

The type plate shall include the reference "admissible combinations of devices, see information for use".

7.2.2 Cleaning, maintenance and corrective maintenance

The manufacturer shall provide comprehensive information on cleaning and maintenance. The stationary electrostatic spraying equipment shall be maintained regularly according to the instructions of the manufacturer. The instruction manual shall contain the following warning notices:

7.2.2.1 Before cleaning or any other manual work within the spraying area, the high voltage supply system shall be disconnected and secured against restart.

7.2.2.2 Use only electrically conductive containers for cleaning liquids; the containers shall be grounded.

7.2.2.3 Non-ignitable cleaning agents shall be preferred.

7.2.2.4 Appropriate measures shall ensure that the resistance to earth of the suspending point of the workpiece does not exceed 1 MΩ, measured at 500 V or 1 000 V.

7.2.3 Test intervals

The instruction manual shall contain information on safe operation of the stationary equipment for electrostatic spraying of non-ignitable liquid coating materials. Furthermore it shall include a reference, that the intervals for repeated tests shall be determined by the manufacturer. The intervals depend on the operational and local conditions. The following maximum intervals are recommended:

Table 4 – Test intervals

Subclause	Reference	Test interval
6.3.1	Occupationally safe state of the whole equipment	12 months
6.3.2	Effectivity of forced ventilation	Continuously
6.3.3	Overcurrent disconnection	Weekly
6.3.4	Low voltage disconnection	Weekly
6.3.5	Discharge energy	Weekly
6.3.6	Protection against contact	Weekly
6.3.7	Grounding measures	Weekly
6.3.8	Interlocks / Protection against entrance	Weekly
6.3.9	Conductive parts of the spraying material supply system	Weekly
6.3.10	Minimum clearance in air	Weekly
6.3.11	Further tests	In compliance with EN 12215:2004

NOTE An automatic monitoring of the stationary equipment for electrostatic coating with non-ignitable liquid coating materials is considered to be equivalent.

7.2.4 Additional information

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

- all references necessary for proper operation of the equipment;
- function of the safety devices;
- footwear to be used by the operators shall comply with EN ISO 20344:2004, the measured insulation resistance shall not exceed 100 MΩ;
- protective clothing, including gloves, should comply with EN 1149-5. The measured insulation resistance shall not exceed 100 MΩ;
- the capacitance of the high-voltage generator;
- reference: "This equipment could present hazards if it is not operated according to the information given in the instruction manual.

NOTE The capacitance of the whole system shall be measured after installation.

7.3 Marking

The following marking and any additional information required for safe operation of the stationary equipment for electrostatic coating with non-ignitable liquid coating material shall be placed clearly and visibly on the equipment. The marking shall be legible and durable taking into account possible chemical decomposition or corrosion.

7.3.1 High voltage supply

The high voltage supply shall be marked as follows:

- name of manufacturer or registered trademark;
- business name and full address of the authorised representative (where applicable);

- designation of the machinery;
- year of construction;
- manufacturer's type identification which shall be unique in order to ensure the safe use of combinations of the apparatus;
- range of input voltage and whether AC or DC;
- range of input frequency;
- power input;
- number of this European Standard EN 50348;
- rated output voltage;
- rated output current;
- any marking generally required by the standards of construction of the electrical equipment.

7.3.2 Spraying systems for non-ignitable liquid coating material

7.3.2.1 The marking of spraying systems of type A-NL according to Table 1 shall comply with EN 50059:1990.

7.3.2.2 The marking of spraying systems of type B-NL according to Table 1 shall be as follows:

- name of manufacturer or registered trade mark;
- business name and full address of the authorised representative (where applicable);
- designation of the machinery;
- year of construction;
- type of system;
- discharge energy.

7.3.3 Example for marking

Name of manufacturer, trademark	Admissible combination of devices, see information of use.		
Type designation	Production number	123456	2009
	Serial number	123456	
		EN 50348	
Discharge energy [mJ]	**IP54**		
Input voltage [V]	max. surface temperature "T" [°C]	output voltage [kV]	
Power input [W]	input frequency [Hz]	output current [µA]	

7.4 Warning sign

Needed warning signs shall be in a language understood by the operator, shall be delivered by the manufacturer and shall be placed at a noticeable place in the vicinity of the spraying area. This warning sign shall contain e .g. protective measures to be observed by the operators and maintenance personnel. Hazards generated by inappropriate cleaning shall be pointed out in a clear way (see 7.2.2).

Annex A
(informative)

Ignitability of water-based paints

This Annex A presents a summary of the publications of U. v. Pidoll and H. Krämer, PTB Braunschweig (see Bibliography).

At present the majority of the stationary electrostatic paint spraying equipment is adapted to water-based paints (so-called water paints). In this context, considerable facilitation of the fire and explosion protection may be benefited from, if the water paints used have proved to be non-ignitable. To clarify this question, the combustion behaviour of more than 200 electrostatically sprayed water paints, which are suspensions of ignitable or non-ignitable pigments and ignitable binders in mixtures of water-soluble ignitable solvents and water, was investigated. The investigations also included rinsing and cleaning liquids. The spraying of the paints was done with high rotation bell-shaped atomizers. While the large majority of the commercial water paints was found to be non-ignitable in the atomized state, ignitability could be verified for some of those paints. It makes sense to classify the investigated paints into three groups:

a) Non-ignitable:

Paints in this group have the following composition:

% by weight H_20 > 63/37 % by weight LM + 49/51 % % by weight ORG

Short forms used:

H_20: water

LM: liquid organic phase, mainly consisting of higher glycol esters in mixture with max. 1:1 propanol

ORG: solid organic phase, mainly consisting of binder and pigments

Paints of this type act like water in the liquid phase and in the atomized state. If also the rinsing and thinner liquids correspond to this category, e. g. contain no more than 35 % by weight of 1:1 butylglykol/N-propanol, rest water, no explosion protection is necessary. The requirements of EN 50348 (mainly protection against contact) shall be taken into account.

Paints of this group are classified as being non-ignitable liquid coating material.

b) Hard to ignite:

Paints in this group have the following composition:

% by weight H_20 > 60/40 % by weight LM + 33/67 % % by weight ORG

Spray clouds of these paints cannot be ignited by sparks having an energy < 4 J. Usually, explosion protection in the spraying area is not necessary, provided no ignition sources with energies of more than 2 J are present.

Paints of this group are classified as being hard to ignite liquid coating material.

c) Ignitable:

Paints in this group do not satisfy the criteria of non-ignitable or hard to ignite.

Paints of this group are classified as being ignitable liquid coating material.

For electrostatic spraying systems to process with all paints, which are classified as non-ignitable or hard to ignite, provided no ignition sources with energies of more than 2 J are present, a local fire prevention and protection device for the electrostatic spraying devices is not necessary. This does, however, not mean, that fire prevention and protection can be neglected as a whole. Even for paints classified in such a way it has to be expected that they will be flammable again as varnish layer following partial drying.

Furthermore, it has to be taken into account that, due to strong fire exposure, water paints may as well burn in the case of a fire started for other reasons and may thus present a certain fire load.

Annex ZY
(informative)

Significant changes between this European Standard and EN 50348:2001

Compared to EN 50348:2001 this European Standard includes the following changes:

- modification of the title of the standard
- adaptation of the safety requirements to the EU Directive Machinery 2006/42/EC
- enlargement of normative references
- enlargement of definitions
- rearrangement of the types of spraying systems
- determination of the requirements for safety devices and control systems
- enlargement of testing about the stationary equipment
- determination of the requirements for repeated tests
- enlargement of the information for use
- implementation of the informative Annex A “Ignitability of water-based paints”
- implementation of the informative Annex ZZ “Coverage of Essential Requirements of EC Directive 2006/42/EC”

Annex ZZ
(informative)

Coverage of Essential Requirements of EC Directive 2006/42/EC

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 all relevant essential requirements as given in EC Directive 2006/42/EC (Machinery Directive), except the following:

– Essential Requirement 2.2.1

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

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

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