SLOVENSKI STANDARD
oSIST prEN 50176:2021

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Avtomatska oprema za elektrostatični nanos vnetljivih premazov - Varnostne zahteve

Automatic electrostatic application systems for ignitable coating materials - Safety requirements

Automatische elektrostatische Beschichtungssysteme für entzündbare Beschichtungsstoffe - Sicherheitsanforderungen

Systèmes automatiques de projection électrostatique de produit liquide de revêtement inflammable - Exigences de sécurité

Ta slovenski standard je istoveten z: **prEN 50176**

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29.260.20	Električni aparati za eksplozivna ozračja	Electrical apparatus for explosive atmospheres
87.100	Oprema za nanašanje premazov	Paint coating equipment

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Will supersede EN 50176:2009 and all of its amendments and corrigenda (if any)

English Version

Automatic electrostatic application systems for ignitable coating materials - Safety requirements

Systèmes automatiques de projection électrostatique de produit liquide de revêtement inflammable - Exigences de sécurité

Automatische elektrostatische Beschichtungssysteme für entzündbare Beschichtungsstoffe - Sicherheitsanforderungen

This draft European Standard is submitted to CENELEC members for enquiry.
Deadline for CENELEC: 2021-06-04.

It has been drawn up by CLC/SC 31-8.

If this draft becomes a European Standard, 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.

This draft European Standard was established by CENELEC 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 CEN-CENELEC Management Centre has the same status as the official versions.

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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
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European foreword

This document (prEN 50176:2021) has been prepared by CLC/TC 31/SC 31-8 “Electrostatic painting and finishing equipment” of CLC/TC 31 “Electrical apparatus for potentially explosive atmospheres”.

This document is currently submitted to the Enquiry.

The following dates are proposed:

• latest date by which the existence of this document has to be announced at national level	(doa)	dor + 6 months
• latest date by which this document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	dor + 12 months
• latest date by which the national standards conflicting with this document have to be withdrawn	(dow)	dor + 36 months (to be confirmed or modified when voting)

This document will supersede EN 50176:2009 and all of its amendments and corrigenda (if any).

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) 2006/42/EC and 2014/34/EU.

For the relationship with EU Directive(s) see informative Annexes ZZA and ZZB, which are an integral part of this document.

prEN 50176:2021 includes the following significant technical changes with respect to EN 50176:2009:

— modification of the title of the document;

— new arrangement and new designation of the types of spray systems;

— new arrangement and amendments of the requirements for automatic spraying equipment for ignitable liquid coating materials;

— introduction of requirements about non-electric ignition sources of spraying systems

— definition of requirements for safety functions;

— new arrangement and amendment of tests for automatic spraying equipment for ignitable liquid coating materials;

— new arrangement and extension of the information for use;

— definition of requirements for repeated tests;

— introduction of the normative Annex A “Test for ignition protection using shunt and oscilloscope for L-1 spraying systems including parts of the coating material supply system”;

— introduction of the normative Annex B “Ignition test within the gas mixture for L-1 spraying systems including parts of the coating material supply system”;

— introduction of the normative Annex C “Compliance with area I for L-2 spraying systems including parts of the coating material supply system”;

— introduction of the informative Annex D “Example for discharge measurement”;

— introduction of the normative Annex E “Test procedure for the prevention of hazardous discharges of spraying systems including parts of coating material supply system (routine test)”;

— introduction of the revised informative Annex F “Ignitability of coating materials”.

Introduction

During the electrostatic coating process, the ignitable liquid coating material is transported to a spraying device where it is atomised by mechanical forces and/or by the influence of an electric field. The generated spray cloud is charged by high voltage of some 10 kV, is attracted by and is applied to the earthed workpiece.

Spray clouds which are not applied to the workpiece (overspray) are removed by a suction device or by other means.

The coating material is cured at room temperature or by heating.

1 Scope

1.1 This document specifies the electrical requirements for the design of automatic electrostatic application systems for liquid coating materials which can be ignited in an atomised state, used within a temperature range from 5 °C to 40 °C.

This document considers automatic electrostatic application systems for processing ignitable liquid coating materials, where the conductivity of the complete system is limited up to 50 nS/cm. Together with additional measures like e.g. potential separation systems, these requirements can also be applied to ignitable liquid coating materials, where the conductivity of the complete system is limited up to 2 000 µS/cm.

Ignition hazards related to the generated explosive atmosphere and the protection of persons against electric shock are considered.

1.2 This document specifies requirements for interfaces to and additional requirements for machinery according to EN 16985:2018, prEN 12621:2020 and prEN 1953:2020.

1.3 This document also specifies requirements for a safe operation of electrostatic application systems, including the electrical installation. The requirements consider both the processing of coating materials and the cleaning and purge processes.

1.4 This document considers three types of spraying systems; see 5.1.

Spraying systems are classified as equipment of group II, category 2G or category 3G.

Only electrostatic spraying systems operating with a d.c. sinusoidal ripple of not more than 10 % of the r.m.s. value are considered.

1.5 For electrostatic spraying equipment used in food and pharmaceutical industry, additional requirements could apply.

1.6 This document is not applicable to:

— liquid electrostatic application equipment for non ignitable liquid coating material, see EN 50348:2010[1];

— electrostatic hand-held spraying equipment, see EN 50050-1:2013, EN 50050-2:2013 and EN 50050-3:2013 as well as prEN 50059:2021;

— potential separation systems;

— cleaning systems for spraying devices;

— selection, installation and application of other electrical and non-electrical equipment in areas with explosion hazard, see EN 60079-14:2014 and EN 16985:2018;

— quality assurance systems for electrostatic spraying equipment (see EN ISO/IEC 80079-34:2020, ZB.11).

1.7 This document is not applicable to equipment manufactured before the date of its publication as a European Standard.

[1] As impacted by EN 50348:2010/COR1:2010.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

prEN 1953:2020, *Application equipment for coating materials - Safety requirements*

prEN 12621:2020, *Machinery for supply and circulation of liquid coating materials - Safety requirements*

EN 16985:2018, *Spray booths for organic coating material - Safety requirements*

EN 50050-1:2013, *Electrostatic hand-held spraying equipment - Safety requirements - Part 1: Hand-held spraying equipment for ignitable liquid coating materials*

EN 50050-2:2013, *Electrostatic hand-held spraying equipment - Safety requirements - Part 2: Hand-held spraying equipment for ignitable coating powder*

EN 50050-3:2013, *Electrostatic hand-held spraying equipment - Safety requirements - Part 3: Hand-held spraying equipment for ignitable flock*

prEN 50059:2021, *Electrostatic hand-held spraying equipment - Safety requirements - Hand-held spraying equipment for non-ignitable coating materials*

prEN 50176:2021, *Automatic electrostatic application systems for ignitable coating materials - Safety requirements*

EN 50177:2009,[2] *Stationary electrostatic application equipment for ignitable coating powders - Safety requirements*

EN 50223:2010, *Stationary electrostatic application equipment for non-ignitable liquid coating material - Safety requirements*

EN 50348:2010, *Stationary electrostatic application equipment for non-ignitable liquid coating material - Safety requirements*

EN 60204-1:2018, *Safety of machinery - Electrical equipment of machines - Part 1: General requirements (IEC 60204 1:2016, modified)*

EN 60529:1991,[3] *Degrees of protection provided by enclosures (IP Code) (IEC 60529:1989)*

EN ISO 12100:2010, *Safety of machinery - General principles for design - Risk assessment and risk reduction (ISO 12100:2010)*

EN ISO 12100 (series), *Safety of machinery - Basic concepts, general principles for design (ISO 12100 series)*

EN ISO 20344:2011, *Personal protective equipment - Test methods for footwear (ISO 20344:2011)*

[2] As impacted by EN 50177:2009/A1:2012.
[3] As impacted by EN 60529:1991/A1:2000 and EN 60529:1991/A2:2013.

3 Terms, definitions and abbreviations

3.1 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1.1
application system
automatic electrostatic application system in which the spraying device is either fixed stationary (e.g. on supports) and is operated automatically or is guided by reciprocators (e.g. robots) and generally comprises the following:

— spraying system;

— fire prevention and protection equipment;

— coating material supply system

3.1.2
spraying system
devices for application of liquid coating material by means of electrostatic charge and generally comprises the following:

— spraying device;

— high-voltage supply system;

— control system

Note 1 to entry: The term 'spraying system' is a synonym to the terms 'applicator' of EN 50050-1:2013 and 'automatic electrostatic application equipment' of prEN 1953:2020.

Note 2 to entry: The high-voltage supply system may be an integral part of the control system.

3.1.3
spraying device
device with high-voltage electrode for atomising and charging the coating material and, if applicable, supplying atomising air and shaping air

Note 1 to entry: Typical designs are nozzles or rotating discs, or bell-shaped devices.

Note 2 to entry: the high-voltage electrode may be a needle or a solid part which is on high-voltage potential.

3.1.4
high-voltage supply system
In general, the system comprises the following:

— 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

3.1.5
coating material supply system
system, comprising components for supplying the spraying system with coating material, like e.g:

— pressurized or depressurised containers,

— pumps,

— controllers and valves,

— ducts and hoses

3.1.6
hazardous discharge
discharge which generates the hazard of ignition of explosive mixtures or of electric shock

3.1.7
workpiece
article to which the coating material is applied

3.1.8
non-ignitable coating materials
substances, especially varnishes which cannot be ignited in sprayed state

Note 1 to entry: A formula for the estimation of ignitability on the basis of the composition of the coating material is given in Annex F.

3.1.9
ignitable coating materials
sprayed materials, especially varnishes which can be ignited in sprayed state and react in the form of an explosion

Note 1 to entry: A formula for the estimation of ignitability on the basis of the composition of the coating material is given in Annex F.

3.1.10
explosive atmosphere
mixture of air, under atmospheric conditions, and 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 1127-1:2019.

3.1.11
discharge energy
energy, transferred charge, body current and pulse duration that become free from a part of the installation in form of a spark which could cause both electric shock to a person and/or an ignition of an explosive atmosphere

3.1.12
dissipative 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 20344:2011.

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

3.1.13
dissipative floor
floor that has a resistance to earth which is low enough to prevent the build-up of electrostatic charges capable of producing an incendive discharge

3.1.14
constant-voltage mode
closed control circuit system with direct feedback of the actual value of the high voltage to a control device, and during the mode of which the adjusted high voltage is maintained constant up to the performance limit of the high-voltage part, independent of the variable operational current

Note 1 to entry: The symbol for this mode is U_k.

3.1.15
voltage-controlled mode
open control circuit system without feedback of the high voltage, and during the mode of which the high voltage is adjusted generally at a defined operational current; the high voltage is not maintained constant by a control device, but it varies depending on the operational current and the on-load behaviour of the high-voltage device

Note 1 to entry: The symbol for of mode is U_V.

3.1.16
constant-current mode
closed control circuit system with direct feedback of the actual value of the operating current to a control device; the operational current is maintained constant, and the high voltage varies load-dependently between a minimum and a maximum value defined by the process

Note 1 to entry: The symbol for this mode is I_k.

3.1.17
current-controlled mode
closed control circuit system with direct feedback of the actual value of the operating current and the actual value of the high voltage to a control device; the operating current is controlled, the high voltage varies load-dependently between a minimum and a maximum value defined by the process

Note 1 to entry: The symbol for this mode is I_V.

3.1.18
operational current
current which flows within the high-voltage circuit during failure-free operation

Note 1 to entry: The symbol for the operational current is I_b.

3.1.19
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 earthed parts of the plant could occur in case the safety distance drops below the permissible limit

Note 1 to entry: The symbol for overcurrent in the high-voltage circuit is $I_{ü}$.

3.1.20
maximum admissible operating voltage
voltage of the high-voltage circuit giving rise to expect that hazardous discharges or arcs could occur between high-voltage parts and earthed parts of the plant

Note 1 to entry: The symbol for the maximum admissible operating voltage is U_{app}.

3.1.21
minimum voltage
voltage of the high-voltage circuit giving rise to expect that in constant-current mode hazardous discharges or arcs could occur between high-voltage parts and earthed parts of the plant, in case the safety distance drops below the permissible limit

Note 1 to entry: The symbol for minimum voltage in the high-voltage circuit is U_{min}.

3.1.22
lowering or shut off threshold
limit value for current $I_{ü}$ or voltage U_{min}; in case of any deviation of the actual value from the threshold value, lowering or shut off of the high-voltage supply is activated

3.1.23
locally acting fire extinguishing system
device which protects the highly hazardous area between spraying system and workpiece and is actuated immediately in case of fire

Note 1 to entry: It shall meet the special requirements of electrostatic coating.

3.1.24
cleaning device
equipment for outside cleaning of the spraying device

3.2 List of abbreviations

U_{max}	Maximum output voltage of the high-voltage generator
I_{max}	Maximum output current of the high-voltage generator
$I_{B\ rms}$	Body current (r.m.s.) flowing from the hand to both feet
$I_{C\ (p)}$	Peak-current value generated by a discharge provoked by the spraying device
t_i	Period in which the peak-current value *IC (p)* is reduced to 5 % of its value
$U_{C\ (p)}$	Peak-voltage value recorded from the oscilloscope
R_{Shunt}	Resistance of the shunt in Ω
F_{CT}	Factor of the current transformer in V/A
F_{AT}	Factor of the attenuator e.g. 10:1

U_k	Constant-voltage mode
U_v	Voltage-controlled mode
I_k	Constant-current mode
I_v	Current-controlled mode
I_b	Operating current
$I_ü$	Overcurrent
U_{app}	Maximum admissible operating voltage
U_{min}	Minimum voltage
Q	Transferred charge
W	Energy

4 Hazards

4.1 Explosion hazards

An explosion hazard is present, if

— the concentration of sprayed ignitable liquid coating materials in air is within the explosion limits,

— an ignition source of appropriate energy for this explosive atmosphere is present.

An explosion can be prevented, if 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 explosive atmosphere.

NOTE If an explosive mixture of coating materials and air is trapped in a closed room, the damaging effects of an explosion could be increased due to the increase in pressure.

Electric ignition sources are an electric arc or a spark.

4.2 Electric hazards

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

— live parts, which are not insulated for operational reasons,

— conductive parts, which are not under hazardous voltage during normal operation, but in case of failure,

— insulated live parts whose insulation is insufficient or has been damaged due to mechanical influences

Inadequate earthing could occur, for instance, due to

— faulty connections to the protective earthing system,

— a too high resistance to earth (e.g. due to contamination by coating materials).

Electrical hazards could occur, for instance, if hazardous malfunctions (e.g. shortcut of electronic safety circuits, of access guards to hazardous areas or of warning devices) occur due to interferences of the high-voltage equipment and the components of control and safety systems.

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.