SLOVENSKI STANDARD
SIST EN 50176:2010

01-januar-2010

Nadomešča:
SIST EN 50176:1998

Vgrajena oprema za elektrostatični nanos vnetljivih tekočin za prevleke - Varnostne zahteve

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

Stationäre Ausrüstung zum elektrostatischen Beschichten mit entzündbaren flüssigen Beschichtungsstoffen - Sicherheitsanforderungen

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

Ta slovenski standard je istoveten z: **EN 50176:2009**

ICS:

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

SIST EN 50176:2010 **en,fr,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 50176

October 2009

ICS 87.100

Supersedes EN 50176:1996

English version

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

Matériels stationnaires de projection électrostatique de produit liquide de revêtement inflammable - Exigences de sécurité

Stationäre Ausrüstung zum elektrostatischen Beschichten mit entzündbaren flüssigen Beschichtungsstoffen - Sicherheitsanforderungen

This European Standard was approved by CENELEC on 2009-09-01. 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.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

CENELEC

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

Central Secretariat: Avenue Marnix 17, B - 1000 Brussels

Ref. No. EN 50176:2009 E

Foreword

This European Standard was prepared by SC 31-8, Electrostatic painting and finishing equipment, of Technical Committee CENELEC TC 31, Electrical apparatus for potentially explosive atmospheres.

The text of the draft was submitted to the formal vote and was approved by CENELEC as EN 50176 on 2009-09-01.

This European Standard supersedes EN 50176:1996.

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)	2010-09-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2012-09-01

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 94/9/EC. See Annex ZZ.

CENELEC/TC 31 as the responsible committee has concluded that this new edition of EN 50176 does not contain substantial changes regarding the ESRs.

The State of the Art is included in Annex ZY "*Significant changes between this European Standard and EN 50176:1996*".

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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 earthed workpiece.

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

After the coating process the coated workpieces are introduced into a dryer where the solvent is evaporated and a dry film of coating material is generated.

0.2 Explosion hazards

An explosion could occur, if

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

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

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

An explosion could be prevented, if one – or better both – conditions are 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.

0.2.1 Mixtures of ignitable coating materials and air could only explode within a given range of concentration, but not, if the concentration is above or below this range.

NOTE If an explosive mixture of coating materials and air is trapped in a closed room, an explosion could lead to a fatal increase of pressure.

0.2.2 Particular attention should 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.

0.3 Electric hazards

0.3.1 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 dangerous voltage during normal operation, but in case of failure,

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

0.3.2 Inadequate grounding could occur, for instance, due to

– faulty connections to the protective grounding system,

– a too high resistance to ground.

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 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 stationary electrostatic application equipment for ignitable liquid coating materials and for hard to ignite liquid coating materials to be used in explosive atmospheres generated by their own spray cloud. 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 installation.

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

1.3 This European Standard deals with all hazards significant for the electrostatic spraying of coating materials, 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, and the protection of persons from electric shocks.

1.4 This stationary equipment is classified as equipment of group II, category 2G or category 3G for use in potentially explosive areas of zone 1 or 2, respectively.

NOTE For other safety aspects like

- zone classification of the areas in and around spray booths, see EN 12215:2004, 5.7.2.3;
- zone classification of other areas with explosive atmosphere, see EN 60079-10-1;
- selection, installation and application of other electrical and non electrical equipment in areas with explosion hazard, see EN 60079-14 and EN 12215:2004, 5.7.2.5;
- health protection (for instance, noise), see also EN 12215:2004, 5.5 and EN 14462;
- cleaning of spraying areas, see instruction manual of the spraying equipment;
- fire prevention and protection (for instance fire hazards due to other sources) see also EN 12215:2004, 5.7.1.

Design-related measures for reducing the generation of noise of the stationary equipment for electrostatic coating are given in EN ISO 11688-1. See also EN 14462.

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, *Resilient floor coverings – Determination of the electrical resistance*

EN 1127-1, *Explosive atmospheres – Explosion prevention and protection – Part 1: Basic concepts and methodology*

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 13463-1, *Non-electrical equipment for use in potentially explosive atmospheres - Part 1: Basic method and requirements*

EN 13478, *Safety of machinery – Fire prevention and protection*

EN 50050, *Electrical apparatus for potentially explosive atmospheres – Electrostatic hand-held spraying equipment*

EN 60079-0, *Electrical apparatus for explosive gas atmospheres – Part 0: General requirements* (IEC 60079-0)

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

EN 60529:1991, *Degrees of protection provided by enclosures (IP code)* (IEC 60529:1989)

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

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

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

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

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

EN ISO 20344, *Personal protective equipment – Test method for footwear* (ISO 20344)

3 Definitions

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

3.1
stationary electrostatic application equipment for ignitable liquid coating material
equipment in which the electrostatic spraying equipment 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;
– fire prevention and protection equipment

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 compounds:

– device for the supply of coating material;
– high voltage electrode;
– high voltage supply system;
– spraying device

3.3
high voltage supply system
system consisting in general 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 the hazard of ignition of explosive mixtures or 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 ignitability on the basis of the composition of the coating material is given in Annex B.

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 ignitability on the basis of the composition of the coating material is given in Annex B.

3.9
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 [see EN 1127-1]

3.10
lower explosion limit (LEL)
concentration of ignitable gas, vapour, mist, powder or flock in air below which an explosive atmosphere will not be formed

3.11
average concentration of ignitable coating materials in air
mass of the ignitable coating material applied in the spraying area divided by the volume of air exchanged during the same period of time in the spraying area

3.12
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

3.13
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 [see EN ISO 20344]

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

3.14
antistatic clothes
clothes that have a resistance to earth, which is low enough to prevent the build-up of electrostatic charges capable to produce an incendive discharge [see EN 1149-5]

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

3.15
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

3.16
minimum air volume flow
air volume flow of the forced ventilation which shall be ensured in case of worst operational conditions as described in 5.4.1 and 5.4.4

3.17
accessories
accessories are all devices, components and other equipment, except for 3.2 of this standard

3.18
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 capacitance of the high voltage part via a control device, independent of the variable operational current

NOTE In general the symbol for this type of operation is U_k.

3.19
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 behaviour of the high voltage device

NOTE In general the symbol for this type of operation is U_v.

3.20
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 general the symbol for this type of operation is I_k.

3.21
operational current
current which flows within the high voltage circuit during failure-free operation

NOTE In general the symbol for the operational current is I_b.

3.22
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 In general the symbol for overcurrent in the high voltage circuit is $I_ü$.

3.23
minimum voltage
voltage of the high voltage circuit giving rise to expect that in constant current operation 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 In general the symbol for minimum voltage in the high voltage circuit is U_{min}.

3.24
disconnection threshold
limit value for current $I_ü$ or voltage U_{min}. In case of any deviation of the actual value from the threshold value, disconnection of the high voltage supply is activated

3.25
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. It shall meet the special requirements of electrostatic coating

3.26
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 check and evaluate the occupationally safe state of coating plants

3.27
repeated inspection
inspection of the entire electrical equipment, systems and plants to be carried out at regular intervals

4 General requirements

4.1 All equipment and components shall be designed and constructed according to good engineering practice and comply with the required categories for group II devices to ensure avoidance of any ignition source.

4.2 All accessories shall be, if possible, outside the areas with explosion hazards.

4.3 All accessories used in areas with explosion hazards shall comply with the requirements of EN 60079-0 and/or EN 13463-1.

4.4 An appropriate grounding of the different surfaces shall be provided. Special care shall be taken that sufficient grounding is maintained by the hangers. These hangers shall be designed in such a way that deposits of coating materials are minimized.