

English version

**Electrostatics -  
Code of practice for the avoidance of hazards  
due to static electricity**

This Technical Report was approved by CENELEC on 2003-04-19.

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

**CENELEC**

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

**Central Secretariat: rue de Stassart 35, B - 1050 Brussels**

## Foreword

This CENELEC code of practice gives information about the product and process properties necessary to avoid electrostatic hazards as well as operational requirements to be written in the users manual to ensure safe use of the product or process. It can be used in a risk assessment of electrostatic hazards or for the preparation of product family or dedicated product standards for machines (i.e. type C standards in CEN, as defined in EN 414:1992, 3.1).

This CENELEC document is based on a number of documents including two national Codes of Practice: from the UK, BS 5958: Parts 1 & 2:1991, *Control of undesirable static electricity*; and from Germany, ZH 1/200: October 1989, *Code of Practice for preventing risks of ignition due to electrostatic charges: Guidelines in static electricity*, and a document published by Shell International Petroleum: *Static electricity - Technical and safety aspects*. It gives the best available accepted state of the art guidance for the avoidance of hazards due to static electricity.

This document is mainly written for designers of processes, manufacturers and test houses. Appropriate information about the procedures necessary to avoid electrostatic hazards shall be written in the users manual or on the product to ensure safety. This document can also be used by suppliers of equipment (e.g. machines) when no product family or dedicated product standard exists or where the existing standard does not deal with electrostatic hazards.

This CENELEC document was originally prepared by the Technical Committee CENELEC TC 44X, Safety of machinery: electrotechnical aspects. The text of the first edition approved by CLC/TC 44X on 1997-11-07 and its publication was authorised by the CENELEC Technical Board on 1999-01-01.

Following a decision by CENELEC BT, the maintenance of the document was undertaken by the Technical Committee CENELEC TC 31, Electrical apparatus for explosive atmospheres - General requirements, which has delegated the revision to its Working Group 20 dealing with electrostatic hazards.

The text of the draft was submitted to the National Committees for approval by correspondence and was approved by CENELEC as CLC/TR 50404 on 2003-04-10.

This Technical Report supersedes R044-001:1999.

---

This document is under review generated by EVS

## Contents

Clause		Page
<b>1</b>	<b>Scope</b> .....	<b>5</b>
<b>2</b>	<b>Definitions</b> .....	<b>5</b>
<b>3</b>	<b>General</b> .....	<b>7</b>
	3.1 Standard approaches.....	7
	3.2 Alternative approaches.....	8
<b>4</b>	<b>Static electricity in non-conductive solid materials</b> .....	<b>8</b>
	4.1 General considerations.....	8
	4.2 Dissipative solid materials.....	8
	4.3 The use of conductive or dissipative materials in place of non-conductive ones.....	9
	4.4 Precautions required when using non-conductive solid materials.....	9
	4.5 Conveyor belts and transmission belts.....	12
<b>5</b>	<b>Static electricity in liquids</b> .....	<b>13</b>
	5.1 General considerations.....	13
	5.2 Ignition hazard.....	14
	5.3 Precautions against ignition hazards during liquid handling operations.....	15
	5.4 Tanks and Containers.....	16
	5.5 Pipes and hoses for liquids.....	31
	5.6 Special filling procedures.....	34
	5.7 Plant processes (blending, stirring, mixing and crystallisation).....	36
	5.8 Spraying liquids and tank cleaning.....	38
	5.9 Glass systems.....	39
<b>6</b>	<b>Static electricity in gases</b> .....	<b>40</b>
	6.1 General.....	40
	6.2 Grit blasting.....	41
	6.3 Fire extinguishers.....	41
	6.4 Inerting.....	41
	6.5 Steam cleaning.....	41
	6.6 Accidental leakage of compressed gas.....	41
	6.7 Spraying of flammable paints and powders.....	42
	6.8 Extraction systems.....	42
	6.9 Vacuum cleaners, fixed and mobile.....	42
<b>7</b>	<b>Static electricity in powders</b> .....	<b>43</b>
	7.1 General.....	43
	7.2 Powders in the absence of flammable gases and vapours.....	43
	7.3 Powders in the presence of flammable gases or vapours.....	50
<b>8</b>	<b>Static electricity when handling explosives and electro-explosive devices</b> .....	<b>52</b>
	8.1 Explosives manufacture, handling and storage.....	52
	8.2 Handling of electro-explosive devices.....	54
<b>9</b>	<b>Static electricity on persons</b> .....	<b>55</b>
	9.1 General considerations.....	55
	9.2 Conducting floor.....	55
	9.3 Dissipative and conductive footwear.....	55
	9.4 Clothing.....	55
	9.5 Protective gloves.....	56
	9.6 Other items.....	56

<b>10</b>	<b>Electric shock</b> .....	<b>56</b>
10.1	Introduction .....	56
10.2	Discharges relevant to electric shock .....	56
10.3	Sources of electric shock .....	57
10.4	Precautions to avoid electric shocks .....	57
10.5	Precautions in special cases.....	57
<b>11</b>	<b>Earthing and bonding</b> .....	<b>58</b>
11.1	General .....	58
11.2	Criteria for the dissipation of static electricity from a conductor.....	59
11.3	Earthing requirements in practical systems .....	60
11.4	The establishment and monitoring of earthing systems.....	62
<b>Annexes</b>		
<b>Annex A</b>	<b>(informative) Fundamentals of static electricity</b> .....	<b>64</b>
<b>Annex B</b>	<b>(informative) Electrostatic discharges in specific situations</b> .....	<b>73</b>
<b>Annex C</b>	<b>(informative) Igniteability properties of substances</b> .....	<b>77</b>
<b>Annex D</b>	<b>(informative) Classification of hazardous areas</b> .....	<b>79</b>
	<b>Bibliography</b> .....	<b>80</b>
<b>Figures</b>		
	Figure A.1 - Equivalent electrical circuit for an electrostatically charged conductor .....	67
<b>Tables</b>		
	Table 1 - Restriction on area or width values of non-conductive solid materials in hazardous areas containing potentially explosive atmospheres of groups IIA, IIB and IIC .....	10
	Table 2 - Conductivities and relaxation times of some liquids .....	14
	Table 3 - Precautions for filling large metal tanks with low conductivity liquids .....	18
	Table 4 - Maximum filling velocities for loading low conductivity liquids other than petroleum products into road tankers .....	22
	Table 5 - Vehicles and compartments suitable for high-speed loading for ADR compliant vehicles.....	22
	Table 6 - Influence of the sulphur content on vd limits for road tankers.....	23
	Table 7 - Flow rate limits for road tankers .....	23
	Table 8 - vd and flow rate limits for loading rail tankers with non-petroleum liquids.....	24
	Table 9 - Flow rate limits for loading rail tankers with petroleum fuels .....	25
	Table 10 - Use of different types of FIBC .....	49
	Table 11 - Summary of maximum earthing resistances for the control of static electricity .....	62
	Table A.1 - Charge build up on medium resistivity powders.....	66
	Table A.2 - Values of capacitances for typical conductors .....	70

## 1 Scope

This document is a code of practice for avoiding ignition and electric shock hazards arising from static electricity. The processes that most commonly give rise to problems of static electricity are described in detail. They include the handling of solids, liquids, powders, gases, sprays and explosives. In each case, the source and nature of the electrostatic hazard is identified and specific recommendations are given for dealing with them.

Basic information about the generation of undesirable static electricity in solids, liquids, gases, explosives, and also on persons, together with descriptions of how the charges generated cause ignitions or electric shocks, is given in the annexes.

This document is not applicable to the hazards of static electricity relating to lightning, to damage to electronic components, nor to medical hazards.

## 2 Definitions

Regulations relating to safety and electrostatics make use of many adjectives in order to quantify the conducting ability of materials. Different regulations and different industries use different adjectives; even when the same adjectives are used their definitions can vary. In order to avoid confusion, and to assist with translation, the adjectives normally used to quantify the resistance of a material in this document are conductive, dissipative and non-conductive (see 2.6, 2.8 and 2.9). However, in parts of the document liquids are also described according to their conductivities (see 5.1) and powders according to their resistivities (see 7.2.1).

NOTE 1 More details about electrostatic properties, concepts and terms are given in the annexes

NOTE 2 The values given in the following definitions are the generally accepted ones. However, in parts of the document the values quoted in the text differ from those in the definitions. This is because the process, the method of handling or the material being handled is sufficiently unusual that a different (higher or lower value) is required.

For the purpose of this document the following definitions apply:

### 2.1

#### **volume resistivity**

the resistance of a body of unit length and unit cross-sectional area

### 2.2

#### **surface resistivity**

the resistance across opposite sides of a surface of unit length and unit width commonly expressed in ohms (or ohms/square)

### 2.3

#### **surface resistance**

the resistance expressed in ohms between two electrodes in contact with the surface to be measured (usually parallel electrodes, each 100 mm long and 10 mm apart)

### 2.4

#### **leakage resistance**

the resistance expressed in ohms between an electrode in contact with the surface to be measured and earth (usually a circular electrode, 20 cm<sup>2</sup> in area)

NOTE The resistance depends upon the volume or surface resistivity of the materials and the distance between the chosen point of measurement and earth.

### 2.5

#### **conductivity**

the reciprocal of volume resistivity

EN 50223: 2001, *Automatic electrostatic spraying installations for flammable flock material*

prEN 50281-3:2000, *Equipment for use in the presence of combustible dusts Part 3: Classification of areas where combustible dusts are or may be present*

EN 60079-10:1996, *Electrical apparatus for potentially explosive gas atmospheres Part 10: Classification of areas*

IEC 61340-2-3:2000, *Methods of test for determining the resistance and resistivity of solid planar materials used to avoid electrostatic charge*

IEC 61340-4-1:1995, *Electrostatic behaviour of floor coverings and installed floors*

International Safety Guide for Oil Tankers and Terminals (ISGOTT).

This document is a preview generated by EVS