



**NSAI**  
Standards

Irish Standard Recommendation  
S.R. CLC/TR 60079-32-1:2015

# Explosive atmospheres - Part 32-1: Electrostatic Hazards - Guidance

**S.R. CLC/TR 60079-32-1:2015**

*Incorporating amendments/corrigenda/National Annexes issued since publication:*

The National Standards Authority of Ireland (NSAI) produces the following categories of formal documents:

I.S. xxx: Irish Standard — national specification based on the consensus of an expert panel and subject to public consultation.

S.R. xxx: Standard Recommendation — recommendation based on the consensus of an expert panel and subject to public consultation.

SWiFT xxx: A rapidly developed recommendatory document based on the consensus of the participants of an NSAI workshop.

*This document replaces/revises/consolidates the NSAI adoption of the document(s) indicated on the CEN/CENELEC cover/Foreword and the following National document(s):*

*NOTE: The date of any NSAI previous adoption may not match the date of its original CEN/CENELEC document.*

*This document is based on:*

CLC/TR 60079-32-1:2015

*Published:*

2015-04-24

*This document was published under the authority of the NSAI and comes into effect on:*

2015-05-19

*ICS number:*

29.260.20

*NOTE: If blank see CEN/CENELEC cover page*

NSAI  
1 Swift Square,  
Northwood, Santry  
Dublin 9

T +353 1 807 3800  
F +353 1 807 3838  
E standards@nsai.ie  
W NSAI.ie

Sales:  
T +353 1 857 6730  
F +353 1 857 6729  
W standards.ie

Údarás um Chaighdeáin Náisiúnta na hÉireann

TECHNICAL REPORT

**CLC/TR 60079-32-1**

RAPPORT TECHNIQUE

TECHNISCHER BERICHT

April 2015

ICS 29.260.20

Supersedes CLC/TR 50404:2003

English Version

**Explosive atmospheres - Part 32-1: Electrostatic Hazards -  
Guidance  
(IEC/TS 60079-32-1:2013)**

Atmosphères explosives - Partie 32-1: Risques  
électrostatiques - Guide  
(IEC/TS 60079-32-1:2013)

Explosionsgefährdete Bereiche - Teil 32-1: Elektrostatische  
Gefährdungen, Leitfaden  
(IEC/TS 60079-32-1:2013)

This Technical Report was approved by CENELEC on 2014-06-02.

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



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

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

## Foreword

This document (CLC/TR 60079-32-1:2015) consists of the text of IEC/TS 60079-32-1:2013 prepared by IEC/TC 31 "Equipment for explosive atmospheres".

This document supersedes CLC/TR 50404:2003

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

## Endorsement notice

The text of the International Standard IEC/TS 60079-32-1:2013 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 60243-1	NOTE	Harmonized as EN 60243-1.
IEC 60243-2	NOTE	Harmonized as EN 60243-2.
IEC 60247	NOTE	Harmonized as EN 60247.
IEC 61340-2-1	NOTE	Harmonized as EN 61340-2-1.
IEC 61340-4-5	NOTE	Harmonized as EN 61340-4-5.
IEC 61340-4-7	NOTE	Harmonized as EN 61340-4-7.
ISO 8028	NOTE	Harmonized as EN ISO 8028.
ISO 8330	NOTE	Harmonized as EN ISO 8330.
ISO 13688	NOTE	Harmonized as EN ISO 13688.
ISO 20344	NOTE	Harmonized as EN ISO 20344.
ISO 20345	NOTE	Harmonized as EN ISO 20345.

## **Annex ZA** (normative)

### **Normative references to international publications with their corresponding European publications**

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

NOTE 1 When an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: [www.cenelec.eu](http://www.cenelec.eu).

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60079-0	-	Explosive atmospheres -- Part 0: Equipment - General requirements	EN 60079-0	-
-	-		+A11	-
IEC 60079-10-1	-	Explosive atmospheres -- Part 10-1: Classification of areas - Explosive gas atmospheres	EN 60079-10-1	-
IEC 60079-10-2	-	Explosive atmospheres -- Part 10-2: Classification of areas - Combustible dust atmospheres	EN 60079-10-2	-
IEC 60079-14	-	Explosive atmospheres -- Part 14: Electrical installations design, selection and erection	EN 60079-14	-
IEC 60079-20-1	-	Explosive atmospheres - Part 20-1: Material characteristics for gas and vapour classification - Test methods and data	EN 60079-20-1	-
IEC 60079-32-2	-	Explosive atmospheres -- Part 32-1: Electrostatics hazards - Tests	-	-
IEC 60093	-	Methods of test for volume resistivity and surface resistivity of solid electrical insulating materials	HD 429 S1	-
IEC 60167	-	Methods of test for the determination of the HD 568 S1 insulation resistance of solid insulating materials		-
IEC 61340-2-3	-	Electrostatics -- Part 2-3: Methods of test for determining the resistance and resistivity of solid planar materials used to avoid electrostatic charge accumulation	EN 61340-2-3	-
IEC 61340-4-1	-	Electrostatics -- Part 4-1: Standard test methods for specific applications - Electrical resistance of floor coverings and installed floors	EN 61340-4-1	-
IEC 61340-4-3	-	Electrostatics -- Part 4-3: Standard test methods for specific applications - Footwear	EN 61340-4-3	-
IEC 61340-4-4	2012	Electrostatics - Part 4-4: Standard test methods for specific applications - Electrostatic classification of flexible intermediate bulk containers (FIBC)	EN 61340-4-4	2012
ISO 284	-	Conveyor belts - Electrical conductivity - Specification and test method	EN ISO 284	-

ISO 6297	-	Petroleum products - Aviation and distillate - fuels - Determination of electrical conductivity	-
ISO 8031	-	Rubber and plastics hoses and hose assemblies - Determination of electrical resistance and conductivity	EN ISO 8031
ISO 9563	-	Belt drives; electrical conductivity of antistatic endless synchronous belts; characteristics and test method	-
ISO 12100-1	-	Safety of machinery - Basic concepts, general principles for design - Part 1: Basic terminology, methodology	EN ISO 12100-1
ISO 16392	-	Tyres - Electrical resistance - Test method for measuring electrical resistance of tyres on a test rig	-
ISO 21178	-	Light conveyor belts - Determination of electrical resistances	EN ISO 21178
ISO 21179	-	Light conveyor belts - Determination of the electrostatic field generated by a running light conveyor belt	EN ISO 21179
ISO 21183-1	-	Light conveyor belts - Part 1: Principal characteristics and applications	EN ISO 21183-1
ASTM D257	-	Standard Test Methods for DC Resistance or Conductance of Insulating Materials	-
ASTM D2624-07a	-	Standard Test Methods for Electrical Conductivity of Aviation and Distillate Fuels	-
ASTM D4308-95	-	Standard Test Method for Electrical Conductivity of Liquid Hydrocarbons by Precision Meter	-
ASTM E2019-03	-	Standard test method for minimum ignition energy of a dust cloud in air	-
ASTM E582-88	-	Standard test method for minimum ignition energy and quenching distance in gaseous mixtures	-
ASTM F150	-	Standard Test Method for Electrical Resistance of Conductive and Static Dissipative Resilient Flooring	-
ASTM F1971	-	Standard Test Method for Electrical Resistance of Tires Under Load On the Test Bench	-
BS 5958-1	-	Code of practice for control of undesirable static electricity - Part 1: General considerations	-
BS 5958-2	-	Code of practice for control of undesirable static electricity - Part 2: Recommendations for particular industrial situations	-
BS 7506-2	-	Methods for measurements in electrostatics - Part 2 Test methods	-
DIN 51412-1	-	Testing of petroleum products; determination of the electrical conductivity - Part 1: laboratory method	-
DIN 51412-2	-	Testing of petroleum products; determination of the electrical conductivity - Part 2: field method	-
EN 1081	-	Resilient floor coverings - Determination of the electrical resistance	-
EN 1149-3	-	Protective clothing - Electrostatic properties - Part 3: Test methods for measurement of charge decay	-

EN 1149-5	-	Protective clothing - Electrostatic properties - Part 5: Material performance and design requirements	-	-
EN 13463-1	-	Non-electrical equipment for use in potentially explosive atmospheres - Part 1: Basic method and requirements	-	-
EN 1360	-	Rubber and plastic hoses and hose assemblies for measured fuel dispensing systems - Specification	-	-
EN 1361	-	Rubber hoses and hose assemblies for aviation fuel handling - Specification	-	-
EN 14125	-	Thermoplastic and flexible metal pipework for underground installation at petrol filling stations	-	-
EN 14973	-	Conveyor belts for use in underground installations - Electrical and flammability safety requirements	-	-
ISGOTT	-	International Safety Guide for Oil Tankers and Terminals (ISGOTT), fifth edition, International chamber of shipping, 2006	-	-
JNIOSH TR 42	-	Recommendations for Requirements for Avoiding Electrostatic Hazards in Industry	-	-
NFPA 77	-	Recommended practice on static electricity	-	-
SAE J1645	-	Surface vehicle recommended practice - Fuel systems and Components - Electrostatic Charge Mitigation	-	-

This page is intentionally left blank



**IEC/TS 60079-32-1**

Edition 1.0 2013-08

# **TECHNICAL SPECIFICATION**

---

**Explosive atmospheres –  
Part 32-1: Electrostatic hazards, guidance**





**THIS PUBLICATION IS COPYRIGHT PROTECTED**  
**Copyright © 2013 IEC, Geneva, Switzerland**

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester.

If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

IEC Central Office  
3, rue de Varembé  
CH-1211 Geneva 20  
Switzerland

Tel.: +41 22 919 02 11  
Fax: +41 22 919 03 00  
[info@iec.ch](mailto:info@iec.ch)  
[www.iec.ch](http://www.iec.ch)

## About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

## About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

### Useful links:

IEC publications search - [www.iec.ch/searchpub](http://www.iec.ch/searchpub)

The advanced search enables you to find IEC publications by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - [webstore.iec.ch/justpublished](http://webstore.iec.ch/justpublished)

Stay up to date on all new IEC publications. Just Published details all new publications released. Available on-line and also once a month by email.

Electropedia - [www.electropedia.org](http://www.electropedia.org)

The world's leading online dictionary of electronic and electrical terms containing more than 30 000 terms and definitions in English and French, with equivalent terms in additional languages. Also known as the International Electrotechnical Vocabulary (IEV) on-line.

Customer Service Centre - [webstore.iec.ch/csc](http://webstore.iec.ch/csc)

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: [csc@iec.ch](mailto:csc@iec.ch).



**IEC/TS 60079-32-1**

Edition 1.0 2013-08

# **TECHNICAL SPECIFICATION**

---

**Explosive atmospheres –  
Part 32-1: Electrostatic hazards, guidance**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

PRICE CODE **XH**

---

ICS 29.260.20

ISBN 978-2-8322-1055-0

**Warning! Make sure that you obtained this publication from an authorized distributor.**

## CONTENTS

FOREWORD.....	10
INTRODUCTION.....	12
1 Scope .....	13
2 Normative references .....	13
3 Terms and definitions .....	16
4 Nomenclature .....	19
5 General .....	20
6 Static electricity in solid materials .....	21
6.1 General considerations .....	21
6.2 The use of conductive or dissipative materials in place of insulating ones .....	23
6.2.1 General considerations .....	23
6.2.2 Dissipative solid materials .....	23
6.2.3 Earthing of conductive and dissipative items.....	24
6.3 Precautions required when using insulating solid materials .....	25
6.3.1 General .....	25
6.3.2 Restrictions on the size of chargeable insulating surfaces .....	26
6.3.3 Earthed metal meshes .....	27
6.3.4 Insulating coatings on earthed conductive surfaces .....	27
6.3.5 Conductive or dissipative coatings on insulating materials .....	28
6.3.6 Static dissipative agents .....	29
6.3.7 Humidification.....	29
6.3.8 Ionisation / Charge Neutralisation.....	29
6.3.9 Methods to determine the incendivity of discharges .....	30
6.4 Conveyor belts and transmission belts .....	31
6.4.1 General .....	31
6.4.2 Conveyor belts .....	31
6.4.3 Transmission belts.....	32
7 Static electricity in liquids .....	33
7.1 General considerations .....	33
7.1.1 Occurrence of flammable atmospheres .....	33
7.1.2 Ignition sensitivity and limitations to the scope of advice.....	34
7.1.3 Charging mechanisms .....	35
7.1.4 Charge accumulation and conductivity classifications .....	35
7.1.5 Incendive discharges produced during liquid handling operations .....	36
7.2 Summary of precautions against ignition hazards during liquid handling operations.....	37
7.2.1 Earthing and avoidance of isolated conductors .....	37
7.2.2 Restricting charge generation .....	37
7.2.3 Avoidance of a flammable atmosphere .....	38
7.2.4 Promoting charge dissipation.....	38
7.3 Tanks and Containers .....	38
7.3.1 General .....	38
7.3.2 Conductive tanks and containers .....	39
7.3.3 Tanks and containers made entirely of dissipative material.....	52

7.3.4	Tanks and containers with insulating surfaces .....	52
7.3.5	Use of liners in containers .....	56
7.4	High viscosity liquids.....	57
7.5	High charging equipment .....	57
7.5.1	Filters, water separators and strainers .....	57
7.5.2	Pumps and other equipment .....	58
7.6	Gauging and sampling in tanks .....	59
7.6.1	General .....	59
7.6.2	Precautions during gauging and sampling.....	59
7.7	Pipes and hose assemblies for liquids.....	60
7.7.1	General .....	60
7.7.2	Pipes .....	60
7.7.3	Hoses and hose assemblies .....	63
7.8	Special filling procedures .....	69
7.8.1	Aircraft fuelling .....	69
7.8.2	Road tanker deliveries .....	70
7.8.3	Retail filling stations .....	71
7.8.4	Mobile or temporary liquid handling equipment .....	75
7.9	Plant processes (blending, stirring, mixing, crystallisation and stirred reactors) .....	75
7.9.1	General .....	75
7.9.2	Earthing.....	75
7.9.3	In-line blending .....	75
7.9.4	Blending in vessels or tanks .....	76
7.9.5	Jet mixing .....	76
7.9.6	High speed mixing .....	77
7.10	Spraying liquids and tank cleaning .....	77
7.10.1	General .....	77
7.10.2	Tank cleaning with low or medium pressure water jets (up to about 12 bar) .....	77
7.10.3	Tank cleaning with low conductivity liquids .....	78
7.10.4	Tank cleaning with high pressure water or solvent jets (above 12 bar).....	78
7.10.5	Steam cleaning tanks .....	78
7.10.6	Water deluge systems .....	79
7.11	Glass systems .....	79
7.11.1	General .....	79
7.11.2	Precautions to be taken for low conductivity liquids .....	79
8	Static electricity in gases .....	80
8.1	General.....	80
8.2	Grit blasting .....	80
8.3	Fire extinguishers .....	81
8.4	Inerting .....	81
8.5	Steam cleaning .....	81
8.6	Accidental leakage of compressed gas .....	81
8.7	Spraying of flammable paints and powders .....	82
8.7.1	General .....	82
8.7.2	Earthing.....	82
8.7.3	Plastic spray cabinets .....	82

8.8	Vacuum cleaners, fixed and mobile .....	82
8.8.1	General .....	82
8.8.2	Fixed systems.....	82
8.8.3	Portable systems .....	83
8.8.4	Vacuum trucks.....	83
9	Static electricity in powders .....	83
9.1	General.....	83
9.2	Discharges, occurrence and incendivity .....	84
9.3	Procedural measures .....	85
9.3.1	General .....	85
9.3.2	Humidification.....	85
9.3.3	Hoses for pneumatic transfer.....	85
9.3.4	Ionisation.....	85
9.4	Bulk materials in the absence of flammable gases and vapours .....	86
9.4.1	General .....	86
9.4.2	Equipment and objects made of conductive or dissipative materials.....	86
9.4.3	Equipment and objects made of insulating materials .....	86
9.4.4	Dust separators .....	87
9.4.5	Silos and Containers.....	87
9.5	Additional requirements for bulk material in the presence of flammable gases and vapours.....	93
9.5.1	General .....	93
9.5.2	Measures for resistivity greater equal 100 MΩ m .....	93
9.5.3	Measures for resistivity less than 100 MΩ m .....	93
9.5.4	Filling of bulk material into a container.....	94
9.6	Flexible intermediate bulk containers (FIBC) .....	95
9.6.1	General .....	95
9.6.2	Additional precautions when using FIBC .....	97
10	Static electricity when handling explosives and electro-explosive devices.....	98
10.1	Explosives manufacture, handling and storage.....	98
10.1.1	General .....	98
10.1.2	First degree protection.....	98
10.1.3	Intermediate protection .....	98
10.1.4	Second degree protection .....	98
10.2	Handling of electro-explosive devices .....	99
10.2.1	General .....	99
10.2.2	Earthing .....	99
10.2.3	Precautions during storage and issue .....	100
10.2.4	Precautions during preparation for use .....	100
11	Static electricity on people.....	100
11.1	General considerations .....	100
11.2	Static dissipative floors .....	101
11.3	Dissipative and conductive footwear .....	101
11.4	Supplementary devices for earthing of people .....	102
11.5	Clothing .....	102
11.6	Gloves .....	104
11.7	Other Items.....	104
12	Electrostatic shock .....	104

12.1	Introduction.....	104
12.2	Discharges relevant to electrostatic shocks.....	105
12.3	Sources of electrostatic shock.....	105
12.4	Precautions to avoid electrostatic shocks.....	106
12.4.1	Sources of electrostatic shocks.....	106
12.4.2	Reported shocks from equipment or processes.....	106
12.4.3	Shocks as a result of people being charged.....	106
12.5	Precautions in special cases .....	107
12.5.1	Pneumatic conveying.....	107
12.5.2	Vacuum cleaners .....	107
12.5.3	Reels of charged film or sheet .....	107
12.5.4	Fire extinguishers .....	108
13	Earthing and bonding.....	108
13.1	General.....	108
13.2	Criteria for the dissipation of static electricity from a conductor.....	109
13.2.1	Basic considerations.....	109
13.2.2	Practical criteria.....	109
13.3	Earthing requirements in practical systems .....	111
13.3.1	All-metal systems .....	111
13.3.2	Metal plant with insulating parts .....	112
13.3.3	Insulating materials .....	113
13.3.4	Conductive and dissipative materials .....	114
13.3.5	Earthing via intrinsic safety circuits .....	114
13.3.6	Earthing of ships.....	114
13.4	The establishment and monitoring of earthing systems .....	114
13.4.1	Design .....	114
13.4.2	Monitoring .....	115
Annex A (informative)	Fundamentals of static electricity .....	116
A.1	Electrostatic charging .....	116
A.1.1	Introduction .....	116
A.1.2	Contact charging .....	116
A.1.3	Contact charging of liquids .....	116
A.1.4	Charge generation on liquids flowing in pipes .....	117
A.1.5	Charge generation in filters.....	120
A.1.6	Charge generation during stirring and mixing of liquids.....	120
A.1.7	Settling potentials .....	120
A.1.8	Breakup of liquid jets .....	120
A.1.9	Contact charging of powders .....	120
A.1.10	Charging by induction .....	121
A.1.11	Charge transfer by conduction .....	121
A.1.12	Charging by corona discharge .....	121
A.2	Accumulation of electrostatic charge .....	121
A.2.1	General .....	121
A.2.2	Charge accumulation on liquids .....	122
A.2.3	Charge accumulation on powders .....	123
A.3	Electrostatic discharges .....	124
A.3.1	Introduction .....	124
A.3.2	Sparks .....	124
A.3.3	Corona .....	125

A.3.4	Brush discharges .....	125
A.3.5	Propagating brush discharges.....	126
A.3.6	Lightning like discharges .....	126
A.3.7	Cone discharges .....	127
A.4	Measurements for risk assessment .....	127
Annex B (informative)	Electrostatic discharges in specific situations .....	129
B.1	Incendive discharges involving insulating solid materials .....	129
B.1.1	General .....	129
B.1.2	Sparks from isolated conductors .....	129
B.1.3	Brush discharges from insulating solid materials.....	129
B.1.4	Propagating brush discharges from insulating solid materials .....	129
B.2	Incendive discharges produced during liquid handling.....	130
B.2.1	General .....	130
B.2.2	Calculated maximum safe flow velocities for filling medium-sized vertical axis storage tanks .....	130
B.3	Incendive discharges produced during powder handling and storage .....	132
B.3.1	General .....	132
B.3.2	Discharges from bulk powder.....	132
B.3.3	Discharges from powder clouds .....	132
B.3.4	Discharges involving insulating containers and people.....	132
B.3.5	The use of liners in powder processes .....	132
B.3.6	Spark discharges in powder processes .....	133
B.3.7	Brush discharges in powder processes .....	133
B.3.8	Corona discharges in powder processes .....	133
B.3.9	Propagating brush discharges in powder processes.....	133
Annex C (informative)	Flammability properties of substances.....	135
C.1	General.....	135
C.2	Effect of oxygen concentration and ambient conditions .....	135
C.3	Explosive limits for gases and liquids .....	135
C.4	Inerting .....	135
C.5	Flash point.....	136
C.6	Minimum ignition energies.....	136
C.7	Combustible powders.....	139
C.8	Biofuels.....	139
Annex D (informative)	Classification of hazardous areas .....	140
D.1	Concept of zoning .....	140
D.2	Classification .....	140
D.3	Explosion groups .....	140
D.3.1	General .....	140
D.3.2	Group I .....	140
D.3.3	Group II .....	141
D.3.4	Group III .....	141
Annex E (informative)	Classification of equipment protection level .....	142
Annex F (informative)	Flow chart for a systematic electrostatic evaluation .....	143
Annex G (informative)	Tests .....	145
G.1	General.....	145
G.2	Surface resistance .....	145
G.2.1	General .....	145

G.2.2	Principle .....	145
G.2.3	Apparatus .....	145
G.2.4	Test sample .....	146
G.2.5	Procedure .....	147
G.2.6	Acceptance criteria .....	147
G.2.7	Test report .....	147
G.3	Surface resistivity .....	147
G.4	Leakage resistance .....	148
G.4.1	General .....	148
G.4.2	Principle .....	148
G.4.3	Apparatus .....	148
G.4.4	Test sample .....	148
G.4.5	Procedure .....	149
G.4.6	Acceptance criteria .....	149
G.4.7	Test report .....	149
G.5	In-use testing of footwear .....	149
G.5.1	General .....	149
G.5.2	Principle .....	149
G.5.3	Apparatus .....	149
G.5.4	Procedure .....	150
G.5.5	Acceptance criteria .....	150
G.5.6	Test report .....	150
G.6	In-use testing of gloves .....	150
G.6.1	General .....	150
G.6.2	Principle .....	150
G.6.3	Apparatus .....	151
G.6.4	Procedure .....	151
G.6.5	Acceptance criteria .....	151
G.6.6	Test report .....	151
G.7	Powder resistivity .....	151
G.7.1	General .....	151
G.7.2	Principle .....	151
G.7.3	Apparatus .....	152
G.7.4	Procedure .....	152
G.7.5	Acceptance criteria .....	153
G.7.6	Test report .....	153
G.8	Liquid conductivity .....	153
G.8.1	General .....	153
G.8.2	Principle .....	153
G.8.3	Apparatus .....	153
G.8.4	Procedure .....	154
G.8.5	Acceptance criteria .....	154
G.8.6	Test report .....	154
G.9	Capacitance .....	155
G.9.1	General .....	155
G.9.2	Principle .....	155
G.9.3	Apparatus .....	155
G.9.4	Test sample .....	155
G.9.5	Procedure for moveable items .....	155

G.9.6	Procedure for installed items .....	156
G.9.7	Acceptance criteria .....	156
G.9.8	Test report.....	156
G.10	Transferred charge .....	157
G.10.1	General .....	157
G.10.2	Principle .....	157
G.10.3	Apparatus .....	157
G.10.4	Test sample .....	158
G.10.5	Procedure.....	158
G.10.6	Acceptance criteria .....	159
G.10.7	Test report.....	159
G.11	Ignition test.....	160
G.11.1	General .....	160
G.11.2	Apparatus .....	160
G.11.3	Procedure.....	163
G.11.4	Acceptance criteria .....	163
G.11.5	Test report.....	163
G.12	Measuring of charge decay .....	164
G.12.1	General .....	164
G.12.2	Principle .....	164
G.12.3	Apparatus .....	164
G.12.4	Test sample .....	165
G.12.5	Procedure.....	165
G.12.6	Acceptance criteria .....	166
G.12.7	Test report.....	166
G.13	Breakthrough voltage .....	166
G.13.1	General .....	166
G.13.2	Principle .....	166
G.13.3	Apparatus .....	166
G.13.4	Test procedure .....	167
G.13.5	Acceptance criteria .....	167
G.13.6	Test report.....	167
Bibliography.....		169
Figure 1 – Flow diagram: Assessment of bulk material with $\rho \leq 1 \text{ M}\Omega \text{ m}$ .....		89
Figure 2 – Flow diagram: Assessment of bulk material with $1 \text{ M}\Omega \text{ m} < \rho \leq 10 \text{ G}\Omega \text{ m}$ .....		90
Figure 3 – Flow diagram: Assessment of bulk material with $\rho > 10 \text{ G}\Omega \text{ m}$ .....		91
Figure 4 – Difference between earthing and bonding .....		108
Figure 5 – Hazardous earthed conductor in contact with a flowing insulator .....		113
Figure A.1 – Equivalent electrical circuit for an electrostatically charged conductor.....		122
Figure B.1 – Calculated maximum safe filling velocities for medium sized tanks (see 7.3.2.2.5.2) .....		131
Figure F.1 – Flowchart for a systematic electrostatic evaluation.....		144
Figure G.1 – Test sample with applied electrodes .....		146
Figure G.2 – Measuring cell for powder resistivity .....		152
Figure G.3 – Measuring cell for liquid conductivity .....		154
Figure G.4 – Ignition probe .....		162

Figure G.5 – Perforated plate of ignition probe.....	163
Figure G.6 – Example of an arrangement for measurement of charge decay.....	165
Figure G.7 – Electrodes for measuring breakthrough voltage of sheets.....	167
Table 1 – Boundary limits at $(23 \pm 2)^\circ\text{C}$ and $(25 \pm 5)\%$ RH for the characterisation of solid materials and examples for the classification of objects .....	22
Table 2 – Maximum allowed isolated capacitance in Zones with explosive atmosphere.....	25
Table 3 – Restriction on size of insulating solid materials in hazardous areas.....	27
Table 4 – Maximum acceptable transferred charge .....	31
Table 5 – Requirements for conveyor belts .....	32
Table 6 – Requirements for transmission belts.....	33
Table 7 – Conductivities and relaxation times of some liquids .....	36
Table 8 – Precautions for filling large conductive tanks with low conductivity liquids .....	41
Table 9 – Filling rate limits for filling medium-sized vertical-axis tanks through schedule 40 pipes.....	47
Table 10 – Velocity and filling rate limits for loading low conductivity liquids into short ( $N=1$ ), fixed horizontal axis tanks via schedule 40 pipes .....	48
Table 11 – Vehicles and compartments suitable for high-speed loading for ADR compliant vehicles .....	49
Table 12 – Influence of the sulphur content on middle distillate vd limits for road tankers .....	50
Table 13 – Velocity and filling rate limits for road tankers based on schedule 40 pipes; rates for hoses will be similar.....	50
Table 14 – Velocity and filling rate limits for loading rail tankers .....	51
Table 15 – Classification of end-to-end hose resistances for control of hazards from static electricity and stray current.....	64
Table 16 – ISO 8031 classification of hose grades .....	66
Table 17 – Hybrid grades of hoses and hose assemblies .....	67
Table 18 – Hose selection Table for flammable liquid service .....	68
Table 19 – Use of the different types of FIBC.....	96
Table 20 – Inner liners and FIBC: combinations that are permissible and not permissible in hazardous atmospheres .....	97
Table 21 – Determination of requirement for electrostatic dissipative protective clothing and other items of personal protective equipment .....	103
Table 22 – Summary of maximum earthing resistances for the control of static electricity in hazardous areas .....	110
Table A.1 – Charge build up on powders.....	121
Table A.2 – Values of capacitances for typical conductors .....	125
Table C.1 – Typical MIE intervals with examples.....	137
Table C.2 – Minimum ignition energy MIE and minimum ignition charge MIQ .....	138
Table G.1 – Volume concentrations of flammable gas mixtures.....	161

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

### **EXPLOSIVE ATMOSPHERES –**

#### **Part 32-1: Electrostatic hazards, guidance**

#### **FOREWORD**

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

The main task of IEC technical committees is to prepare International Standards. In exceptional circumstances, a technical committee may propose the publication of a technical specification when

- the required support cannot be obtained for the publication of an International Standard, despite repeated efforts, or
- the subject is still under technical development or where, for any other reason, there is the future but no immediate possibility of an agreement on an International Standard.

Technical specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

IEC/TS 60079-32-1, which is a technical specification, has been prepared by IEC Technical Committee 31: Equipment for explosive atmospheres, and IEC Technical Committee 101: Electrostatics.

The text of this technical specification is based on the following documents:

Enquiry draft	Report on voting
31/1033/DTS	31/1076/RVC

Full information on the voting for the approval of this technical specification can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of the IEC 60079 series, under the general title *Explosive atmospheres*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

transformed into an International standard,  
reconfirmed,  
withdrawn,  
replaced by a revised edition, or  
amended.

A bilingual version of this publication may be issued at a later date.

## INTRODUCTION

This IEC Technical Specification is based on CENELEC TR 50404:2003, *Code of practice for the avoidance of hazards due to static electricity* and a number of other documents:

- from the UK: BS 5958, Parts 1 & 2:1991, *Control of undesirable static electricity*,
- from Germany: TRBS 2153:2009, *Preventing risks of ignition due to electrostatic charges*,
- from Shell International Petroleum: *Static electricity – Technical and safety aspects*,
- from the US: NFPA 77, *Recommended Practice on Static Electricity* (2007),
- from Japan: JNOSH TR42, *Recommendations for Requirements for Avoiding Electrostatic Hazards in Industry* (2007),
- from ASTM, EUROPIA, IEC, International chamber of shipping, ISO etc.

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 and users of processes and equipment, manufacturers and test houses. It can also be used by suppliers of equipment (e.g. machines) and flooring or apparel when no product family or dedicated product standard exists or where the existing standard does not deal with electrostatic hazards.

A second part, IEC 60079-32-2, *Electrostatic Hazards, Tests*, is under development.

## EXPLOSIVE ATMOSPHERES –

### Part 32-1: Electrostatic hazards, guidance

#### 1 Scope

This part of IEC 60079 gives guidance about the equipment, product and process properties necessary to avoid ignition and electrostatic shock hazards arising from static electricity as well as the operational requirements needed to ensure safe use of the equipment, 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 electrical or non-electrical machines or equipment.

The hazards associated with static electricity in industrial processes and environments that most commonly give problems are considered. These processes include the handling of solids, liquids, powders, gases, sprays and explosives. In each case, the source and nature of the electrostatic hazard are identified and specific recommendations are given for dealing with them.

The purpose of this document is to provide standard recommendations for the control of static electricity, such as earthing of conductors, reduction of charging and restriction of chargeable areas of insulators. In some cases static electricity plays an integral part of a process, e.g. electrostatic coating, but often it is an unwelcome side effect and it is with the latter that this guidance is concerned. If the standard recommendations given in this document are fulfilled it can be expected that the risk of hazardous electrostatic discharges in an explosive atmosphere is at an acceptably low level.

If the requirements of this document cannot be fulfilled, alternative approaches can be applied under the condition that at least the same level of safety is achieved.

Basic information about the generation of undesirable static electricity in solids, liquids, gases, explosives, and also on people, together with descriptions of how the charges generated cause ignitions or electrostatic shocks, is given in the annexes and in IEC/TR 61340-1.

This Technical Specification is not applicable to the hazards of static electricity relating to lightning or to damage to electronic components.

This Technical Specification is not intended to supersede standards that cover specific products and industrial situations.

#### 2 Normative references

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

IEC 60079-0, *Explosive atmospheres – Part 0: Equipment – General requirements*

IEC 60079-10-1, *Explosive atmospheres – Part 10-1: Classification of areas – Explosive gas atmospheres*

IEC 60079-10-2, *Explosive atmospheres – Part 10-2: Classification of areas – Combustible dust atmospheres*

IEC 60079-14, *Explosive atmospheres – Part 14: Electrical installations design, selection and erection*

IEC 60079-20-1, *Explosive atmospheres – Part 20-1: Material characteristics for gas and vapour classification – Test methods and data*

IEC 60079-32-2<sup>1</sup>, *Explosive atmospheres – Part 32-2: Electrostatic hazards – Tests*

IEC 60093, *Methods of test for volume resistivity and surface resistivity of solid electrical insulating materials*

IEC 60167, *Methods of test for the determination of the insulation resistance of solid insulating materials*

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

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

IEC 61340-4-3, *Electrostatics – Part 4-3: Standard test methods for specific applications – Footwear*

IEC 61340-4-4:2012, *Electrostatics – Part 4-4: Standard test methods for specific applications – Electrostatic classification of flexible intermediate bulk containers (FIBC)*

ISO 284, *Conveyor belts – Electrical conductivity – Specification and test method*

ISO 6297, *Petroleum products – Aviation and distillate fuels – Determination of electrical conductivity*

ISO 8031, *Rubber and plastics hoses and hose assemblies – Determination of electrical resistance*

ISO 9563, *Belt drives; electrical conductivity of antistatic endless synchronous belts; characteristics and test method*

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

ISO 16392, *Tyres – Electrical resistance – Test method for measuring electrical resistance of tyres on a test rig*

ISO 21178, *Light conveyor belts – Determination of electrical resistances*

ISO 21179, *Light conveyor belts – Determination of the electrostatic field generated by a running light conveyor belt*

ISO 21183-1, *Light conveyor belts – Part 1: Principal characteristics and applications*

---

<sup>1</sup> To be published.



This is a free preview. Purchase the entire publication at the link below:

[Product Page](#)

- Looking for additional Standards? Visit Intertek Inform Infostore
- Learn about LexConnect, All Jurisdictions, Standards referenced in Australian legislation