IEC 61340-4-4

Edition 2.0 2012-01

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

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

Électrostatique –
Partie 4-4: Méthodes d'essai normalisées pour des applications spécifiques – Classification électrostatique des grands récipients pour vrac souples (GRVS)

IEC 61340-4-4:2012

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
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

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It also gives information on projects, replaced and withdrawn publications.

Electropedia - 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.

IEC Just Published - 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.

Customer Service Centre - 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.

A propos de la CEI

La Commission Electrotechnique Internationale (CEI) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications CEI

Le contenu technique des publications de la CEI est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Liens utiles:

Recherche de publications CEI - www.iec.ch/searchpub

La recherche avancée vous permet de trouver des publications CEI en utilisant différents critères (numéro de référence, texte, comité d'études,…).
Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

Electropedia - www.electropedia.org

Le premier dictionnaire en ligne au monde de termes électroniques et électriques. Il contient plus de 30 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans les langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (VEI) en ligne.

Just Published CEI - webstore.iec.ch/justpublished

Restez informé sur les nouvelles publications de la CEI. Just Published détaille les nouvelles publications parues. Disponible en ligne et aussi une fois par mois par email.

Service Clients - webstore.iec.ch/csc

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: csc@iec.ch.

IEC 61340-4-4

Edition 2.0 2012-01

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

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

Électrostatique –
Partie 4-4: Méthodes d'essai normalisées pour des applications spécifiques – Classification électrostatique des grands récipients pour vrac souples (GRVS)

INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

PRICE CODE
CODE PRIX X

ICS 17.220.99; 29.020; 55.080

ISBN 978-2-88912-851-8

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTROSTATICS –

Part 4-4: Standard test methods for specific applications – Electrostatic classification of flexible intermediate bulk containers (FIBC)

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.

International Standard IEC 61340-4-4 has been prepared by IEC technical committee 101: Electrostatics, in cooperation with ISO subcommittee 3: Performance requirements and tests for means of packaging, packages and unit loads, of ISO technical committee 122: Packaging.

This second edition cancels and replaces the first edition, published in 2005, and constitutes a technical revision.

The main changes with respect to the first edition are listed below:

a) Adoption of a type classification system for FIBC based on four types: A, B, C and D.
b) Guidance for safe use of FIBC in relation to hazardous areas and hazardous zones defined in IEC 60079-10-1 and IEC 60079-10-2 is added.
c) Resistance to groundable points and electrical breakdown voltage measurements on FIBC shall be measured at low humidity only.

d) Requirements for labelling FIBC are changed to improve clarity and ease of recognition by end users.

e) Classification, performance requirements and guidance for safe use of inner liners in combination with FIBC are added.

f) An informative annex giving guidance on test methods for quality control and inspection testing is added.

The text of this standard is based on the following documents:

FDIS	Report on voting
101/346/FDIS	101/353/RVD

Full information on the voting for the approval of this standard 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 the parts in the IEC 61340 series, published under the general title *Electrostatics,* 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

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

Flexible intermediate bulk containers (FIBC) are widely used for the storage, transportation and handling of powdered, flaked or granular material. Typically, they are constructed from woven polypropylene fabric in the form of cubic bags of about 1 m^3 volume, although they can vary in shape and in size from 0,25 m^3 to 3 m^3. The fabric used may be a single layer, a multi-layer laminate, or a coated fabric. Untreated polypropylene is an electrical insulator, as is often the case with the products placed in FIBC. There is ample opportunity for the generation of electrostatic charge during filling and emptying operations and in unprotected FIBC high levels of charge can quickly build up. In such cases, electrostatic discharges are inevitable and can be a severe problem when FIBC are used in hazardous explosive atmospheres.

A hazardous explosive atmosphere can be generated when handling fine powders that create dust clouds or thin layers of powder, both of which can be ignited by electrostatic discharges. A hazardous explosive atmosphere can also be generated when using gases or volatile solvents. In these industrial situations there is clearly a need to eliminate incendive electrostatic discharges.

As with any industrial equipment, a thorough risk assessment should always be conducted before using FIBC in potentially hazardous situations. This part of IEC 61340 describes a system of classification, test methods, performance and design requirements and safe use procedures that can be used by manufacturers, specifiers and end-users as part of a risk assessment of any FIBC intended for use within a hazardous explosive atmosphere. However, it does not include procedures for evaluating the specific risks of electrostatic discharges arising from products within FIBC, e.g. cone discharges, from personnel or from equipment used near FIBC. Information on risks associated with cone discharges is given in Annex E.

CAUTION: The test methods specified in this standard involve the use of high voltage power supplies and flammable gases that may present hazards if handled incorrectly, particularly by unqualified or inexperienced personnel. Users of this standard are encouraged to carry out proper risk assessments and pay due regard to local regulations before undertaking any of the test procedures.

ELECTROSTATICS –

Part 4-4: Standard test methods for specific applications – Electrostatic classification of flexible intermediate bulk containers (FIBC)

1 Scope

This part of IEC 61340 specifies requirements for flexible intermediate bulk containers (FIBC) between 0,25 m^3 and 3 m^3 in volume, intended for use in hazardous explosive atmospheres. The explosive atmosphere may be created by the contents in the FIBC or may exist outside the FIBC.

The requirements include:

- classification and labelling of FIBC;
- classification of inner liners;
- specification of test methods for each type of FIBC and inner liner;
- design and performance requirements for FIBC and inner liners;
- safe use of FIBC (including those with inner liners) within different zones defined for explosion endangered environments, described for areas where combustible dusts are, or may be, present (IEC 60079-10-2), and for explosive gas atmospheres (IEC 60079-10-1);
- procedures for type qualification and certification of FIBC, including the safe use of inner liners.

NOTE 1 Guidance on test methods that may be used for manufacturing quality control is given in Annex C.

The requirements of this standard are applicable to all types of FIBC and inner liners, tested as manufactured, prior to use and intended for use in hazardous explosive atmospheres: Zones 1 and 2 (Groups IIA and IIB only) and Zones 21 and 22 (see Annex D for classification of hazardous areas and explosion groups). For some types of FIBC, the requirements of this standard apply only to use in hazardous explosive atmospheres with minimum ignition energy of 0,14 mJ or greater and where charging currents do not exceed 3,0 μA.

NOTE 2 0,14 mJ is the minimum ignition energy of a typical Group IIB gas or vapour. Although more sensitive materials exist, 0,14 mJ is the lowest minimum ignition energy of any material that is likely to be present when FIBC are emptied. 3,0 μA is the highest charging current likely to be found in common industrial processes. This combination of minimum ignition energy and charging current represents the most severe conditions that might be expected in practice.

Compliance with the requirements specified in this standard does not necessarily ensure that hazardous electrostatic discharges, e.g. cone discharges, will not be generated by the contents in FIBC. Information on the risks associated with cone discharges is given in Annex E.

Compliance with the requirements of this standard does not mitigate the need for full risk assessment. For example, metal and other conductive powders and toner powders may require additional precautions to prevent hazardous discharges from the powders.

NOTE 3 In the examples mentioned in the paragraph above, additional precautions may be necessary in the case of metal or other conductive powder because if the powder is isolated and becomes charged, incendiary sparks may occur, and in the case of toner powders, incendiary discharges may occur during rapid filling and emptying operations. Future IEC/TS 60079-32 [1][1] gives guidance on additional precautions that may be necessary.

---

1 Figures in square brackets refer to the bibliography.

Test methods included in this standard may be used in association with other performance requirements, for example when a risk assessment has shown the minimum ignition energy of concern is less than 0,14 mJ, charging currents are greater than 3,0 μA, or the ambient conditions are outside of the range specified in this standard.

Compliance with the requirements specified in this standard does not necessarily ensure that electric shocks to personnel will not occur from FIBC during normal use.

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.

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 60243-1:1998, *Electric strength of insulating materials – Test methods – Part 1: Tests at power frequencies*

IEC 60243-2, *Electric strength of insulating materials – Test methods – Part 2: Additional requirements for tests using direct voltage*

IEC 60417-5019:2006, *Graphical symbols for use on equipment*. Available at: <http://www.graphical-symbols.info/equipment>"

IEC 61241-2-3, *Electrical apparatus for use in the presence of combustible dust – Part 2: Test methods – Section 3: Method for determining minimum ignition energy of dust/air mixtures*

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*

ISO 7000:2004, *Graphical symbols for use on equipment – Index and synopsis*

ISO 21898, *Packaging – Flexible intermediate bulk containers (FIBCs) for non-dangerous goods*

ASTM E582, *Standard test method for minimum ignition energy and quenching distance in gaseous mixtures*

3 Terms and definitions

For the purposes of this document, the following terms and definitions, as well as those given in IEC 60079-10-1, IEC 60079-10-2 and ISO 21898, apply.

3.1
quenching
effect of solid objects acting as heat sinks in close proximity to gas

3.2
critical quenching distance
maximum separation distance between opposing electrodes below which quenching prevents ignition at a specified energy

NOTE For ignitions to take place, the gap between electrodes should be greater than the critical quenching distance.

3.3
flammable substance
substance in the form of gas, vapour, liquid, solid, or mixture of these, capable of propagating combustion when subjected to an ignition source

3.4
explosive atmosphere
mixture with air, under atmospheric conditions, of flammable substances in the form of gases, vapours, mists or dusts in which, after ignition has occurred, combustion spreads to the entire unburned mixture

3.5
hazardous explosive atmosphere
explosive atmosphere present in such quantities that precautions against ignition are required

3.6
minimum ignition energy
least electrical energy of a purely capacitive spark (i.e. no added inductance) required to ignite a dust, gas or vapour

3.7
charging current
quantity of charge per unit time flowing into FIBC

3.8
cone discharge
electrostatic discharge running outwards across the surface from the top of highly charged, insulating powder heaps in large containers

3.9
brush discharge
electrostatic discharge from a non-conductive, solid or liquid surface

3.10
spark
electrostatic discharge from an electrically isolated conductive object or surface

3.11
propagating brush discharge
highly energetic discharge from an insulating sheet, layer or coating on a conductive surface, or a material of high resistivity and high break down voltage with the two surfaces highly charged to opposite polarity

3.12
inner liner
integral or removable container which fits into the FIBC (synonymous with liner)

3.13
surface resistivity
equivalent to the surface resistance of a square area of material, having electrodes at two opposite sides

3.14
volume resistivity
equivalent to the volume resistance of a cube of material with unit length, having the electrodes at two opposite surfaces

3.15
type qualification testing
testing used to determine the type of FIBC as specified in 4.1 and to demonstrate that FIBC meet the requirements of Clause 7

3.16
quality control testing
testing designed to provide manufacturers and users with information that demonstrates all FIBC produced and delivered are substantially the same as the sample FIBC used to qualify the FIBC design

3.17
groundable point
point on FIBC designated by the manufacturer as a location to attach a grounding or earth bonding cable or other means of earthing FIBC

NOTE There may be one or more groundable points on each FIBC. Lift loops may also be designated as groundable points, but fortuitous earthing via lifting hooks should not be relied as these may be painted/coated, or covered with powder etc., and so may not guarantee an adequate earth path.

4 Classification

4.1 Principles of classification for FIBC

FIBC are classified according to one of four types: Type A, Type B, Type C and Type D. The types are defined by the construction of the FIBC, the nature of their intended operation and associated performance requirements.

An individual design of FIBC may only be classified as one single type; for example one FIBC cannot be simultaneously classified as both Type B and Type D, or as Type CD.

4.1.1 Type A

Type A FIBC are made from fabric or plastic sheet without any measures against the build up of static electricity. Any FIBC that does not meet the requirements specified in Clause 7, or which has not been tested against the requirements is classified as Type A.

4.1.2 Type B

Type B FIBC are made from fabric or plastic sheet designed to prevent the occurrence of sparks and propagating brush discharges.

4.1.3 Type C

Type C FIBC are made from conductive fabric or plastic sheet, or interwoven with conductive threads or filaments and designed to prevent the occurrence of incendiary sparks, brush discharges and propagating brush discharges. Type C FIBC are designed to be connected to earth during filling and emptying operations.

4.1.4 Type D

Type D FIBC are made from static protective fabric designed to prevent the occurrence of incendiary sparks, brush discharges and propagating brush discharges, without the need for a connection from the FIBC to earth.

4.2 Principles of classification and requirements for inner liners

4.2.1 Surface resistivity measurements for inner liners

Surface resistivity shall be measured according to IEC 61340-2-3. A minimum of ten measurements shall be made at points evenly distributed over the inner liner surface. All measurements shall be within the limits specified for the type of inner liner being tested.

4.2.2 Special cases

Inner liners made from materials that contain a conductive layer sandwiched between two insulating layers shall not be used in Type B or Type D FIBC. If such an inner liner is used in Type C FIBC, the conductive layer shall be securely bonded to earth. The thickness of the insulating layers shall be less than 700 μm, and the breakdown voltage measured between an electrode placed on each surface in turn and the conductive layer shall be less than 4 kV, measured according to 9.1 under the conditions specified in 8.2.

NOTE In order to avoid incendiary brush discharge, the thickness of any exposed insulating layers in contact with non-insulating layers is limited to a maximum of 700 μm.

4.2.3 Type L1

Type L1 inner liners are made from materials with surface resistivity on at least one surface less than or equal to $1{,}0 \times 10^7\ \Omega$ (see Annex F), measured under the conditions specified in 8.2. of this standard. Type L1 inner liners may be used in Type C FIBC.

If the material is multi-layered, or if the material has one surface with surface resistivity greater than $1{,}0 \times 10^{12}\ \Omega$, the breakdown voltage through the material shall be less than 4 kV, measured according to 9.1 under the conditions specified in 8.2.

The thickness of any layer with surface resistivity greater than $1{,}0 \times 10^{12}\ \Omega$ on the inside (product side) of the inner liner material shall be less than 700 μm.

Permissible configurations and requirements for type L1 inner liners are summarized in Table 1.

Table 1 – Permissible configurations and requirements for Type L1 inner liners

Configuration	Parameters			
	Resistivity of inside surface ρ_I	Resistivity of outside surface ρ_O	Breakdown voltage V_B	Thickness d
1	$\rho_I \leq 1{,}0 \times 10^7\ \Omega$	$\rho_O \leq 1{,}0 \times 10^7\ \Omega$	No measurement required	No limit
2A	$\rho_I \leq 1{,}0 \times 10^7\ \Omega$	$\rho_O \leq 1{,}0 \times 10^{12}\ \Omega$	No measurement required	No limit
2B	$\rho_I \leq 1{,}0 \times 10^{12}\ \Omega$	$\rho_O \leq 1{,}0 \times 10^7\ \Omega$	No measurement required	No limit
3	$\rho_I \leq 1{,}0 \times 10^7\ \Omega$	$\rho_O > 1{,}0 \times 10^{12}\ \Omega$	$V_B < 4$ kV	No limit
4	$\rho_I > 1{,}0 \times 10^{12}\ \Omega$	$\rho_O \leq 1{,}0 \times 10^7\ \Omega$	$V_B < 4$ kV	d <700 μm

4.2.4 Type L2

Type L2 inner liners are made from materials with surface resistivity on at least one surface between $1{,}0 \times 10^9\ \Omega$ and $1{,}0 \times 10^{12}\ \Omega$ (see Annex F), measured under the conditions specified in 8.3. Type L2 inner liners may be used in Type B, Type C and Type D FIBC.

If Type L2 inner liners are used in Type C FIBC, the charging current shall not exceed 3 μA.

If the material is multi-layered, or if the material has one surface with surface resistivity greater than $1{,}0 \times 10^{12}$ Ω, the breakdown voltage through the material shall be less than 4 kV, measured according to 9.1 under the conditions specified in 8.2.

The thickness of any layer with surface resistivity greater than $1{,}0 \times 10^{12}$ Ω on the inside (product side) of the inner liner material shall be less than 700 μm.

Permissible configurations and requirements for Type L2 inner liners are summarized in Table 2.

Table 2 – Permissible configurations and requirements for Type L2 inner liners

Configuration	Parameters			
	Resistivity of inside surface ρ_I	**Resistivity of outside surface** ρ_O	**Breakdown voltage** V_B	**Thickness** d
1	$1{,}0 \times 10^9\ \Omega \le \rho_I \le 1{,}0 \times 10^{12}\ \Omega$	$1{,}0 \times 10^9\ \Omega \le \rho_O \le 1{,}0 \times 10^{12}\ \Omega$	No measurement required	No limit
2	$1{,}0 \times 10^9\ \Omega \le \rho_I \le 1{,}0 \times 10^{12}\ \Omega$	$\rho_O > 1{,}0 \times 10^{12}\ \Omega$	V_B < 4 kV	No limit
3	$\rho_I > 1{,}0 \times 10^{12}\ \Omega$	$1{,}0 \times 10^9\ \Omega \le \rho_I \le 1{,}0 \times 10^{12}\ \Omega$	V_B < 4 kV	d <700 μm

4.2.5 Type L3

Type L3 inner liners are made from materials with surface resistivity of greater than $1{,}0 \times 10^{12}$ Ω, measured under the conditions specified in 8.2. Type L3 inner liners may be used in Type B FIBC.

The breakdown voltage through the material shall be less than 4 kV, measured according to 9.1 under the conditions specified in 8.2.

Permissible configurations and requirements for Type L3 inner liners are summarized in Table 3.

Table 3 – Permissible configurations and requirements for Type L3 inner liners

Configuration	Parameters			
	Resistivity of inside surface ρ_I	**Resistivity of outside surface** ρ_O	**Breakdown voltage** V_B	**Thickness** d
1	$\rho_I > 1{,}0 \times 10^{12}\ \Omega$	$\rho_O > 1{,}0 \times 10^{12}\ \Omega$	V_B < 4 kV	No limit

4.3 Combination of FIBC and inner liners

The inclusion of an inner liner in FIBC does not change the type classification of the FIBC. For example, Type A FIBC with Type L1 inner liners are still Type A FIBC and are subject to all the restrictions on use of Type A FIBC.

The requirements for breakdown voltage for FIBC and inner liners shall be applied separately. For Type B, Type C and Type D FIBC with inner liners for which there is a breakdown voltage requirement, two sets of breakdown voltage measurement shall be required: one set on the FIBC material and one set on the inner liner material. For example, if a Type B FIBC is fitted