IEC 61340-4-4

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INTERNATIONAL STANDARD

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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)

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

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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ELECTROSTATICS –

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

FOREWORD

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International Standard IEC 61340-4-4 has been prepared by IEC technical committee 101: Electrostatics.

This third edition cancels and replaces the second edition, published in 2012, and Amendment 1:2014. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) in light of experimental evidence, the maximum resistance to ground limit for Type C FIBC, and corresponding resistance limits for inner liners used in Type C FIBC has been increased from $1{,}0 \times 10^7\ \Omega$ to $1{,}0 \times 10^8\ \Omega$;
b) the classification of Type L1 inner liners has been revised and extended to include Type L1C inner liners made from multi-layer materials with a conductive internal layer;

c) a labelling requirement to include a reference to IEC TS 60079-32-1 for guidance on earthing has been added.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
101/546/FDIS	101/555/RVD

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

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

A list of all 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 document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

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- withdrawn,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

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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, for example 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 document 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 document 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 can be created by the contents in the FIBC or can 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, inner liner, labels and document pockets;

– design and performance requirements for FIBC, inner liners, labels and document pockets;

– 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 can 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 can be used for manufacturing quality control is given in Annex C.

The requirements of this document 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 document 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 represents a realistic minimum ignition energy for a Group IIB gas or vapour atmosphere. 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.

FIBC are not normally used in Zone 0 or Zone 20. If FIBC are used in Zone 0 or Zone 20, the requirements of this document are applicable, together with additional requirements that are beyond the scope of this document to define.

The volume contained within FIBC can be designated as Zone 20, in which case the requirements of this document are applicable.

Solids containing residual solvent can result in a hazardous explosive atmosphere within FIBC, possibly resulting in the volume being designated as Zone 1 or Zone 2; in which case the requirements of this document are applicable.

Compliance with the requirements specified in this document does not necessarily ensure that hazardous electrostatic discharges, for example 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 document does not mitigate the need for full risk assessment. For example, metal and other conductive powders and toner powders can require additional precautions to prevent hazardous discharges from the powders.

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

Test methods included in this document can 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 document.

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

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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 – Explosive dust atmospheres*

IEC 60243-1:2013, *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, *Graphical symbols for use on equipment* (available at: http://www.graphical-symbols.info/equipment)

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

ISO/IEC 80079-20-2, *Explosive atmospheres – Part 20-2: Material characteristics – Combustible dusts test methods*

ISO 7000, *Graphical symbols for use on equipment – Registered symbols* (available at: http://www.graphical-symbols.info/equipment)

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

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1 Numbers in square brackets refer to the Bibliography.

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 terms and definitions given in IEC 60079-10-1, IEC 60079-10-2 and ISO 21898 and the following apply.

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

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
multi-layer material
material comprised of more than one layer, the combination of which can be formed by coextrusion, coating, laminating or any other process that permanently bonds all layers together

3.2
quenching
effect of solid objects acting as heat sinks in close proximity to gas

3.3
critical quenching distance

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

Note 1 to entry: For ignitions to take place, the gap between electrodes is greater than the critical quenching distance.

3.4
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

3.5
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

3.6
hazardous explosive atmosphere
explosive atmosphere present in such quantities that precautions against ignition are required

3.7
minimum ignition energy
MIE
least electrical energy of a purely capacitive spark (i.e. no added inductance) required to ignite a dust, gas or vapour

3.8
charging current
quantity of charge per unit time flowing into FIBC

3.9
cone discharge
electrostatic discharge running outwards across the surface from the top of highly charged, insulating powder heaps in large containers

3.10
brush discharge
electrostatic discharge from a non-conductive, solid or liquid surface

3.11
spark
electrostatic discharge from an electrically isolated conductive object or surface

3.12
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 breakdown voltage with the two surfaces highly charged to opposite polarity

3.13
inner liner
liner
integral or removable container which fits into the FIBC

3.14
surface resistivity
resistivity equivalent to the surface resistance of a square area of material having electrodes at two opposite sides

3.15
volume resistivity
resistivity equivalent to the volume resistance of a cube of material with unit length, having the electrodes at two opposite surfaces

3.16
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

3.17
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

3.18
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

4 Classification

4.1 Classification for FIBC

4.1.1 Principles of classification

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 shall not be simultaneously classified as both Type B and Type D, or as both Type B and Type C, or as Type CD.

4.1.2 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.

4.1.3 Type B

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

Conductive materials, as used in the manufacture of Type C FIBC for example, shall not be used in the manufacture of Type B FIBC.

NOTE Type B FIBC are not normally connected to earth. Conductive material that is not connected to earth creates a risk of incendiary sparks.

4.1.4 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 before the commencement of filling and emptying operations and remain connected to earth during these operations.

4.1.5 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 Components of inner liners

Materials used for inner liners can be single layer, or multi-layered materials. In the latter case, the layers are typically permanently bonded together. Examples of FIBC with a single layer inner liner and with a multi-layer inner liner are shown in Figure 1.

For the purposes of this document, and for both single layer inner liners and multi-layer inner liners, the outside surface of the inner liner is the surface that physically contacts the FIBC, and the inside surface of the inner liner is the surface that physically contacts the product with which the FIBC is filled.

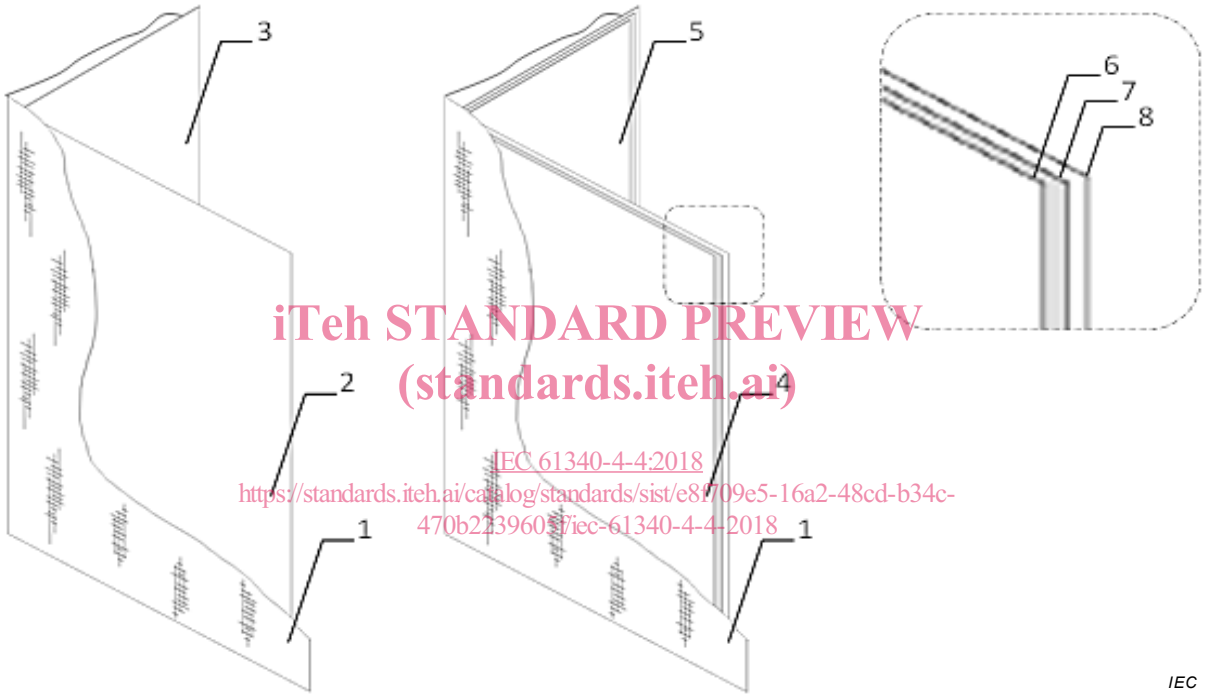
In Figure 1, the multi-layer inner liner is shown as comprising of three layers. In practice, more than three layers can be used. For the purposes of this document, an internal layer is

any layer of a multi-layer liner that does not physically contact either the FIBC or the product with which the FIBC is filled.

The electrical properties of the outside surface of a single layer or multi-layer inner liner can be the same as the inside surface, or they can be different. For example, one of the surfaces can be treated with a topical finish to reduce surface resistivity.

With multi-layer inner liners, there are many possible combinations of layers with similar or different electrical properties.

Notwithstanding the many possible combinations of materials for inner liners, for the purposes of this document it is the electrical properties of the outside surface and inside surface of inner liners that are of interest, together with the presence of any conductive internal layers.



Key

1 FIBC	5 inside surface of multi-layer inner liner
2 outside surface of single layer inner liner	6 external layer of multi-layer inner liner
3 inside surface of single layer inner liner	7 internal layer of multi-layer inner liner
4 outside surface of multi-layer inner liner	8 external layer of multi-layer inner liner

NOTE For illustrative purposes, the layers of the multi-layer inner liner are shown separated. In practice, they are typically permanently bonded together.

Figure 1 – Examples of inner liners in FIBC

4.2.2 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.

4.2.3 Breakdown voltage measurements for inner liners

Breakdown voltage shall be measured according to 9.2 under the conditions specified in 8.2. The measured breakdown voltage is highly dependent on the thickness of the insulating material and its electrical resistivity. As even minor changes can affect the breakdown voltage,