Leading the way in hazardous area static control

Application Spotlight



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Earth-Rite® FIBC

Controlling Static Hazards when Handling FIBCs in Potentially Hazardous Atmospheres

The movement of product during filling or emptying of FIBC bags can generate a large amount of electrostatic charge. The Flexible Intermediate Bulk Container (FIBC) causes an electrostatic charge of equal intensity, on the inner surface, but with an opposite polarity on the outer surface. This accumulated electrostatic charge always seeks a conductive path to ground. The quantity of the electrostatic charge depends on the characteristics of the product, filling or emptying rate. In Europe/ROW, guidance for safe use of FIBCs in regards to hazardous zones/locations is defined in IEC TS 61340-4-4 and NFPA® 77 in USA and Canada.

Earth-Rite® FIBC Controlling Static Hazards when Handling FIBCs in Potentially Hazardous Atmospheres

FIBCs are very large fabric bags supported in a frame. They are more convenient than rigid IBCs (Intermediate Bulk Containers) for powder transfers because they can be fully collapsed after use, taking up little storage space. The fabric used is usually polypropylene and is sewn to form a three-dimensional cube or rectangle with lifting straps. An FIBC can be filled with a powder or granular material and moved about with conventional handling equipment (forklifts, etc.)

An advantage of FIBCs is that they can be unloaded quickly, typically 300kg to 500kg in 30 seconds or less. It is common under these circumstances for the rates at which static electric charges are generated to exceed the rates at which the charges can relax, accumulation of a static electric charge is developed during the process. If the accumulated charge is strong enough and is released in the presence of an combustible atmosphere, ignition can occur. Static charges can be generated both during the filling and emptying of FIBCs. These discharges exhibit effective energies of as much as several joules.

Where a static electric charge accumulates on FIBCs or associated process equipment, the following four types of discharges can occur:

(1) Spark Discharge

(2) Brush Discharge

(3) Propagating Brush Discharge

(4) Bulking Brush Discharge

The risk of electrostatic discharges in FIBCs in potentially flammable atmospheres is well documented in best practice standards / recommended codes of practice such as IEC TS 61340-4-4, 'Electrostatics – Part 4-4: Standard test methods for specific applications – Electrostatic classification of Flexible Intermediate Bulk Containers (FIBC)' and NFPA 77 'Recommended Practice on Static Electricity'.

These standards specify that FIBC Type C bags must be grounded to the following maximum resistance levels: -

1×10^8 Ohms (100 Meg-Ohms) for IEC TS 61340-4-4 and 1×10^7 Ohms (10 Meg-Ohms) for NFPA 77.

This provides Ex/HAZLOC engineers clear targets to aim for when protecting FIBC Type C bags against the accumulation of static electricity and is a critical fire and explosion prevention measure.



Photo Credit: Premier Tech Chronos
www.ptchronos.com

Fig. 1 - Typical FIBCs Application

Types of FIBCs

IEC TS 61340-4-4, 'Electrostatics – Part 4-4: Standard test methods for specific applications – Electrostatic classification of Flexible Intermediate Bulk Containers (FIBC)', describes four (04) types of FIBCs, defined by the construction of the FIBCs, the nature of their intended operation and associated performance requirements: Type A, Type B, Type C and Type D.

Certified IEC bags carry identification tags which specify bag type along with any other relevant information specific to that bag. Only FIBC bags that have been qualified exactly in accordance with the procedures specified in IEC TS 61340-4-4 can legitimately be labelled as such.

Type A FIBC bags are generally made from plain polypropylene or other non-conductive material. Static electricity is generated as product moves over the inside surface of bulk bags when being filled or emptied. Electrostatic hazards arise with Type A FIBC bags as they do not have any mechanisms for dissipating static electricity and will not mitigate the occurrence of highly energetic and dangerous propagating brush discharges. As there is no static protection provided by Type A FIBC, it is essential that they are not used to store or transport combustible materials or used in flammable or combustible environments.

Type B FIBC bags, similar to Type A, are made from plain polypropylene or other non-conductive material and do not have a mechanism for dissipating static electricity. Type B FIBC bags are made from materials that have a low breakdown voltage, which helps mitigate the occurrence of propagating brush discharges. Although Type B FIBC can mitigate propagating brush discharges, they cannot be considered static dissipative FIBC because they do not dissipate electrostatic charge and so normal brush discharges can still occur with enough energy to ignite flammable solvent vapours. Type B FIBCs are only used when transporting 'dry' flammable powders in the absence of a flammable atmosphere around the bag. All conductive objects within a 1 metre area surrounding Type B bags (in use) must be grounded to mitigate inductive charging of isolated conductors.

Type C FIBC bags we will get to in a moment.

Type D FIBC bags are made from static protective fabric designed to mitigate the occurrence of incendiary sparks, brush discharges and propagating brush discharges without the need for a connection from the FIBC to the ground. This static protective fabric is called CROHMIQ® FIBC and each design is tested according to IEC TS 61340-4-4 prior to despatch of the first shipment to the user. At a regular basis agreed with the user, e.g. every six months, the user sends one sample of each Type D FIBC bag for re-qualification. Type D FIBC bags with surface contamination of conductive material, such as water or oil, should not be used. All conductive objects within a 1 metre area surrounding Type D bags (in use) must be grounded to mitigate inductive charging of isolated conductors.

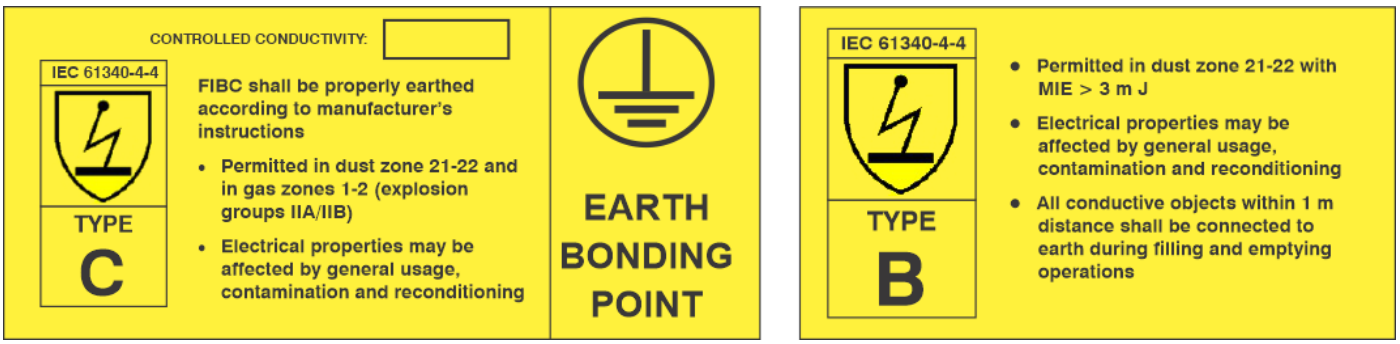


Fig. 2 - Examples of FIBCs bags standard labelling

Type C FIBC bags are designed to dissipate static electricity through static dissipative or conductive threads that are interwoven through the bag's material. The Type C FIBC bags usually have conductive grounding tags located on both the top section and bottom section of the bag. The size, shape and number of tags vary through different bag manufacturers.

Grounding tabs located on the bags are points where grounding systems can be connected to ensure static electricity does not accumulate on the bag. To ensure bags destined for use in hazardous areas will not accumulate static to hazardous levels, the resistance between the inside or outside surface of the FIBC and the grounding tabs should be less than 1 x 10^8 Ohms, in compliance with IEC TS 61340-4-4 and 1 x 10^7 Ohms and in compliance with the NFPA 77.

The standard/s requires that these bags be built entirely from conductive materials; low quality and cheaper FIBC bags have been known to enter the supply chain, however there are cases where the clamp's connection point is not connected to the SD (static dissipative) grid of the bag, therefore making the bag completely ineffective in conducting electrostatic charges from the surface of the bag to ground. It is imperative that a Type C FIBC bag complies with the requirements from IEC TS 61340-4-4 and NFPA 77.



Fig. 3 - Type C FIBC bag

Bulk Product in FIBC	Surroundings		
MIE of dust[a]	Nonflammable Atmosphere	Dust Zones 21-22 (1000 mJ ≥ MIE > 3 mJ)	Gas Zones 1-2 (Explosion Groups IIA/IIB)
MIE > 1000 mJ	A, B, C, D	B, C, D	C, D[b]
3 mJ < MIE ≤ 1 000 mJ	B, C, D	B, C, D	C, D[b]
MIE ≤ 3 mJ	C, D	C, D	C, D[b]

Notes:

[a] Measured in accordance with IEC 61241-2-3, ASTM E2019 and EN 13821 with a capacitive discharge circuit (no added inductance).

[b] Use of Type D limited to Explosion Groups IIA/IIB with MIE ≥ 0.14 mJ.

NOTE 1 Additional precautions are usually necessary when a flammable gas or vapour atmosphere is present inside the FIBC, e.g. in the case of solvent wet powders.

NOTE 2 Non-flammable atmosphere includes dusts having an MIE >1000 mJ.

NOTE 3 The MIE limit of 3 mJ is based on the incendivity of cone discharges. Cone discharges might have a much higher energy in a Type B FIBC than in a Type C or D FIBC because the wall of a Type C or D FIBC will be at close to zero potential. Based on this fact the internal field distribution will be such that in Type C or D FIBC cone discharges will at most only jump across half the diameter of the FIBC. A calculation with the formula given in A.3.7 for the largest FIBC commonly used (diameter of 1,5 m) yields 3 mJ for powder with a median size of only 0,055 mm in a Type B FIBC, whereas in a Type C or D FIBC the 3 mJ limit is only reached with a coarse powder having a median size of 0,27 mm or higher. However, such coarse powders usually have a MIE higher than 3 mJ.

Table 1 - Use of the different types of FIBCs

Specifying a Static Grounding System for Type C FIBC bags

What is clear from the standard IEC TS 61340-4-4 and the recommendations of NFPA 77 is that 1 x 10^8 Ohms (IEC TS 61340-4-4) and 1 x 10^7 Ohms (NFPA 77) in the grounding circuit is the maximum resistance recommended for Type C FIBC bags.

A grounding system that combines a simple visual 'GO / NO GO' communication via a traffic light model of indication, with interlock control capability, is the most effective means of mitigating the risk of ignitions caused by static electricity in Type C FIBC bags. Interlocking the transfer system with the grounding system is probably the ultimate layer of protection equipment specifiers and designers can take to ensure the Type C bag is grounded.

The Earth-Rite® FIBC can be specified to monitor the resistance in accordance with IEC TS 61340-4-4 and NFPA 77. This is achieved by sending an Intrinsically Safe signal (red line in the illustration) through the bag. If the green ground status indicators pulse continuously, the operator knows the bag is grounded. The system verifies the grounding of the bag by ensuring the signal returns via a verified true earth ground.

Earth-Rite FIBC is hazardous area certified

The monitoring control unit and power supply unit are ATEX / IECEx / cCSAus approved. The Earth-Rite FIBC has been given a SIL (Safety Integrity Level) of rating 2.

Reference List :

(1) NFPA® and National Fire Protection Association® are registered trademarks of the National Fire Protection Association, Qunicy, MA.
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(2) NFPA77: 'Recommended Practice on Static Electricity', NFPA 2019.

(3) IEC TS 61340-4-4, 'Electrostatics – Part 4-4: Standard test methods for specific applications – Electrostatic classification of Flexible Intermediate Bulk Containers (FIBC)', 2018.

(4) Holdstock, P. (2012). Testing & Certifying the Safety of Static Protective FIBC.

(5) Chilworth Technology, Inc. (2010). Electrostatic Testing of Type C FIBC, 13-14.

(6) Midwestern Bag & Supply. (2019). 'Type C Groundable Bulk Bags'. Retrieve from https://midwesternbag.com/fibc-bulk-bag/type-c-groundable-bulk-bags/

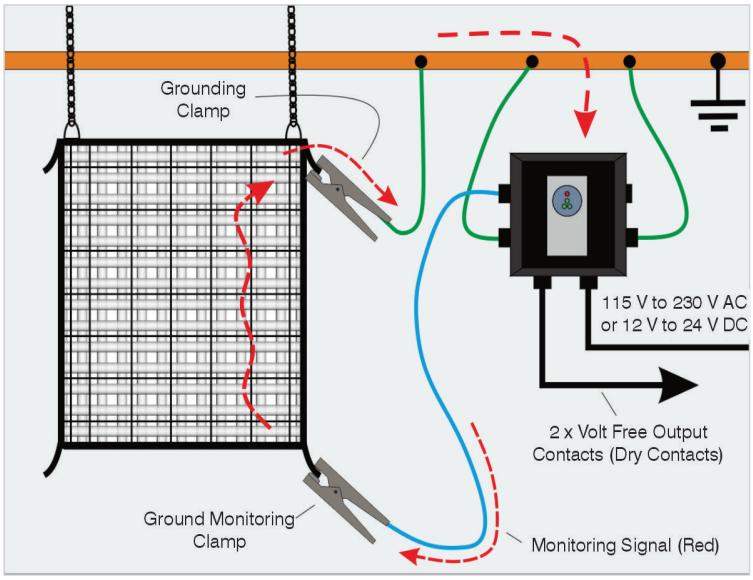


Fig. 4 - Earth-Rite® FIBC for Type C bags

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