

## Application Spotlight

### 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 the USA and Canada, guidance for safe use of FIBCs in regards to hazardous areas and hazardous zones is defined in NFPA® 77 (Edition: 2019) and IEC 61340-4-4 (Current Edition: 2018).

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 a 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 NFPA 77 2019 'Recommended Practice on Static Electricity' and IEC 61340-4-4:2018, 'Electrostatics – Part 4-4: Standard test methods for specific applications –

Electrostatic classification of Flexible Intermediate Bulk Containers (FIBC)'. The important Recommended Code of Practice and International Standard specifies procedures for FIBC that must be grounded, promoting a maximum resistance of  $1.0 \times 10^7$  ohms (10 meg ohms) for Type C FIBC bags. This provides EX/HAZLOC industry participants with a clear benchmark to target as a safety function when grounding protection against the accumulation of static electricity is a critical fire and explosion prevention measure.

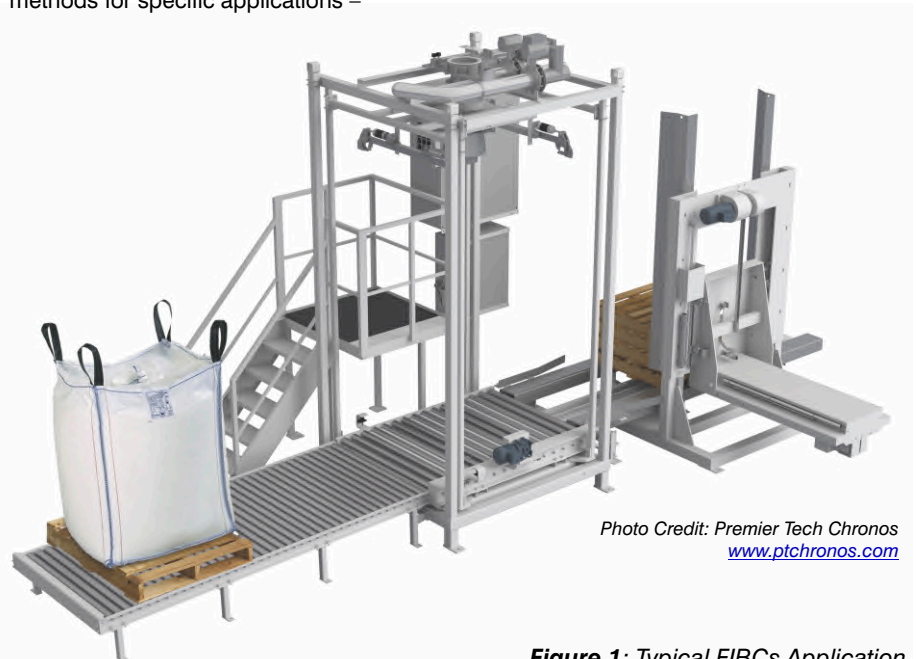


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**Figure 1:** Typical FIBCs Application

**Types of FIBCs**

IEC 61340-4-4: 2018, describes four 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.

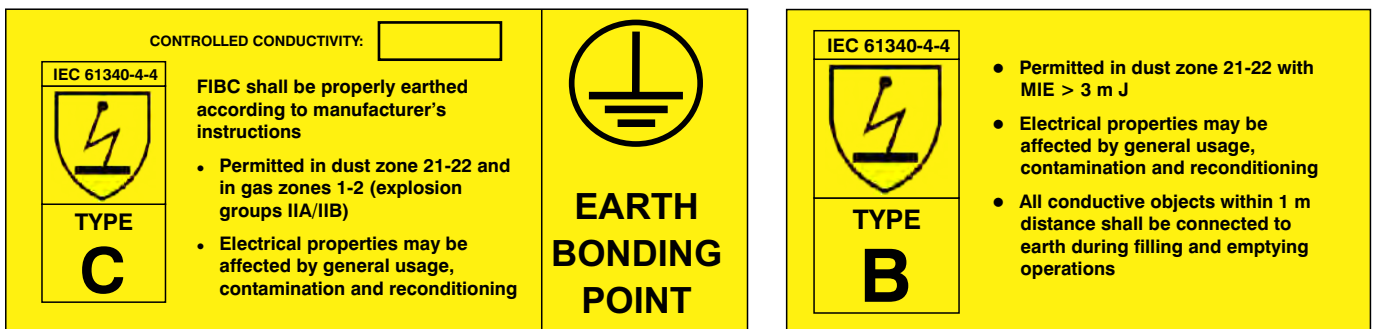
Certified IEC bags carry identification tags which specify bag type along with any other relevant information specific to that bag. Only FIBC bags that have been qualified exactly in accordance with the procedures specified in IEC 61340-4-4:2018 can legitimately be labelled as such.

**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 prevent 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 prevent the occurrence of propagating brush discharges. Although Type B FIBC can prevent 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 meter area surrounding Type B bags (in use) must be grounded to prevent 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 prevent 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 61340-4-4:2018 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 one meter (1m) area surrounding Type D bags (in use) must be grounded to prevent inductive charging of isolated conductors.



**Figure 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  $1.0 \times 10^7$  ohms, in compliance with the NFPA 77 and IEC.

The standard 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 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 NFPA 77 and IEC 61340-4-4:2018.



**Figure 3:** Type C FIBC bag

Bulk Product in FIBC	Surroundings		
	Nonflammable Atmosphere	Class II, Divisions 1 and 2 (1000 mJ $\geq$ MIE > 3 mJ)*	Class I, Divisions 1 and 2 (Gas Groups C and D) or Class II, Divisions 1 and 2 (MIE $\leq$ 3 mJ)*
MIE > 1000 mJ	A, B, C, D	B, C, D	C, D†
1000 mJ $\geq$ MIE > 3 mJ	B, C, D	B, C, D	C, D†
MIE $\leq$ 3 mJ	C, D	C, D	C, D†

Notes:

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

(2) Nonflammable atmosphere includes dusts having an MIE > 1000 mJ.

\* Measured in accordance with IEC 61241-2-3, *Electrical apparatus for use in the presence of combustible dust - Part 2: Test methods - Section 3: method of determining minimum ignition energy of dust/air mixtures*; capacitive discharge circuit (no added inductance).

† Use of Type D limited to gas groups C and D with MIE  $\geq$  0.14 mJ.

**Table 1:** Use of Different Types of FIBCs, according to the NFPA 77 2019 Edition

## Specifying a Static Grounding System for Type C FIBC bags

What is clear from the recommendations of NFPA 77 2019 and the standard IEC 61340-4-4: 2018 is that  $1.0 \times 10^7$  ohms 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 NFPA 77 2019 and IEC 61340-4-4:2018. 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, Quincy, MA. All rights reserved.
- (2) NFPA77: 'Recommended Practice on Static Electricity', NFPA 2019.
- (3) IEC 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/>

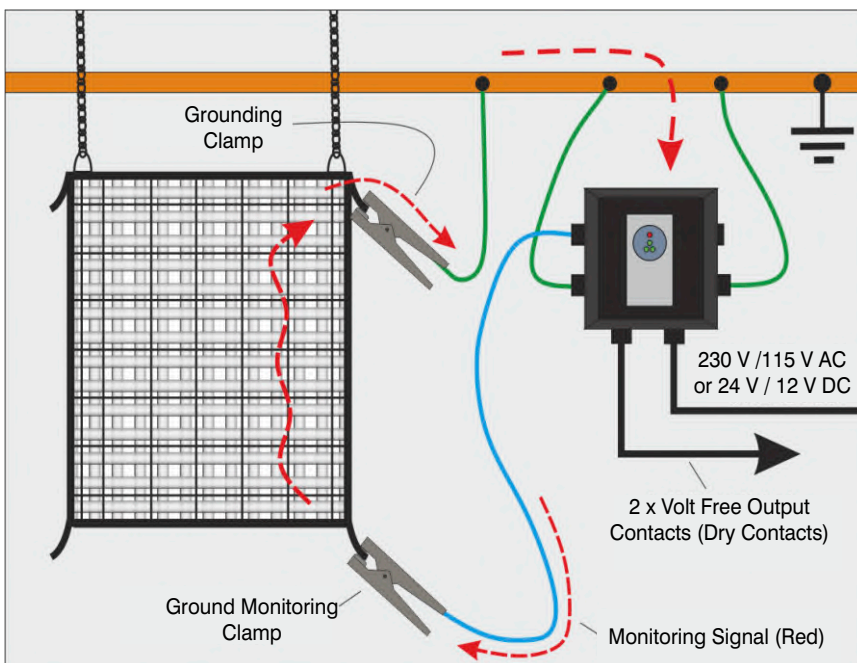


Figure 4: Earth-Rite® FIBC for Type C bags