

FLEXIBLE INTERMEDIATE BULK CONTAINERS

ALLIANZ RISK CONSULTING



FIBCs in storage rack. (Source: unknown)

This Tech Talk discusses the use of FIBCs, potential ignition hazards from electrostatic discharge and Allianz Risk Consulting (ARC) loss prevention recommendations.

AT-A-GLANCE

- The use of flexible intermediate bulk containers (FIBCs) continues to grow since they reduce transportation and storage costs
- An electrostatic discharge is possible during the filling and emptying process, creating a very real ignition source
- FIBCs that have not been tested and verified for type should not be used for combustible dusts or in areas where flammable vapors are present

INTRODUCTION

The use of flexible intermediate bulk containers (**FIBCs**) aka "**supersacks**" continues to grow with the worldwide transportation of a variety of chemicals, minerals, food products, agricultural products, fertilizers, plastics, etc. These materials can be in fine dust, powder, granular, or flake form. FIBCs are generally made from woven polypropylene fabric in the form of a cube, with typical volumes of 0.25 m³, 1 m³, and 3 m³. The fabric can be single or multi-layer, and depending upon the material being transported, a plastic liner may also be used. FIBCs are generally preferred over rigid intermediate bulk containers (IBCs) since they can be fully collapsed after use. This reduces both the space needed for storage and the transfer/transportation costs when emptied.

POTENTIAL IGNITION SOURCE FROM ELECTROSTATIC DISCHARGE

These woven fabric materials and plastic liners used in the construction of FIBCs are generally untreated and act as an electrical insulator. During the filling and emptying process, the development of an electrical charge to the contents as well as the fabric is possible since dissimilar materials pass over each other repeatedly. This charge results from the transfer of electrons between the materials. The material gaining electrons acquires a negative charge, while the material losing electrons acquires a positive charge. An electrostatic discharge is possible when the two electrically charged materials are brought near to, or come into contact with, each other. This presents a very real ignition source when used where explosive atmospheres or combustible dusts are present.



FIBC being filled. (Source: unknown)

There are four types of electrostatic discharge:

Brush Discharge – A higher energy form of corona discharge characterized by low-frequency bursts or by streamers, which can form between charged nonconductive surfaces and grounded conductors. For positive discharges, pre-onset or breakdown streamers are observed, and the maximum effective energy is a few millijoules (mJ). For negative discharges, the maximum effective energy is a few tenths of a millijoule. Brush discharges can ignite flammable gas and hybrid mixtures, but not combustible dust in air.

Bulking Brush Discharge – A partial surface discharge over the top of solid piles that is created during bulking of powder in containers and appears as a luminous,

branched channel flashing radially from the wall toward the center of the pile. The maximum effective energy of a bulking brush discharge is believed to be 10 mJ to 25 mJ. Bulking brush discharges can ignite flammable gas, hybrid mixtures, and some fine combustible dusts in air. Bulking brush discharge is also known as **cone discharge**.

Corona Discharge – A low energy electrical discharge that results from a localized electrical breakdown of gases near sharp conductive edges, needle points, and wires. Corona discharges can also result from similar sharp points on conductors at high voltage. Corona discharge might be a hazard with ignition-sensitive flammable gases such as acetylene, hydrogen, and carbon disulfide or other flammable gases in oxygen-enriched atmospheres

Propagating Brush Discharge – An energetic discharge caused by electrical breakdown across a dielectric layer having equal and opposite charges on the opposite sides of the layer. The two-sided charge is typically formed by charged plastic coating on a metal substrate, although plastic pipe and plastic intermediate bulk containers can also form the required charged double layer. The effective energy can exceed 1000 mJ, causing both shock to personnel and ignition hazards for a wide variety of materials, including dusts in air.

When it comes to the selection and use of the proper FIBC, **bulking brush** and **propagating brush discharge** are the two primary electrostatic discharges of concern.

A more detailed description of ignition hazards associated with the use of FIBCs can be found in the International Electrotechnical Commission (IEC) 61340-4-4, *Electrostatics – Part 4-4: Standard test methods for specific applications – Electrostatic classification of flexible intermediate bulk containers (FIBC)*.

TYPES OF FIBCS

There are four types of FIBCs defined by construction materials, performance requirements, as well as areas of intended use:

Type A – Constructed of nonconductive materials (e.g., polypropylene fabric with polyester stitching) and has no special features incorporated in their design to control static electric discharge hazards. Type A FIBCs should be limited to use with noncombustible particulate solids, or combustible particulate solids having a minimum ignition energy (MIE) >1,000 mJ and in areas where flammable vapors/gases are not present.

Type B – Like Type A FIBCs, are constructed of nonconductive materials, however, the material of construction of Type B FIBCs is designed to have a breakdown voltage less than 6 kilovolts (kV) and hence control static electric discharge hazards. Since Type B FIBCs have no mechanism for dissipating electrostatic charge, brush discharges might occur that can ignite flammable gases and vapors. Type B FIBCs are not to be used in locations where flammable vapors are present and are not to be used for conductive particulate solids.

Type C – Constructed entirely from conductive or insulating material that contains fully interconnected conductive threads or tapes with specific spacing. It is essential that Type C FIBCs be grounded during filling and emptying operations. A grounding tab that is electrically connected to the conductive material or threads is provided and is intended to be connected to a ground point when the FIBC is filled or emptied. The resistance between the conductive elements in the FIBC and the grounding tabs should be less than 1.0×10^7 ohms. Type C FIBCs provide protection from propagating brush discharges and brush discharges.

Type D – Constructed from fabrics and/or threads with special electrostatic properties to control discharge incendivity. They are intended for use without grounding in the presence of flammable vapors or gases with a MIE of 0.14 mJ or greater and with combustible powders, including those with ignition energies of 3 mJ or less. Before being used in hazardous environments, Type D FIBCs should be qualified as safe. In other words, it should be demonstrated that no incendiary discharge can occur under normal operating conditions. Type D FIBCs do not require grounding and provide protection from propagating brush discharges and brush discharges.

FIBCs should be tested in accordance with the requirements and test procedures as specified in IEC 61340-4-4 and in accordance with their intended use before being used in hazardous environments.

The National Fire Protection Association’s (NFPA) *Recommended Practice on Static Electricity (NFPA 77)* summarizes the use of different types of FIBCs:

BULK PRODUCT IN FIBC	SURROUNDINGS		
	NONFLAMMABLE ATMOSPHERE	CLASS II, DIVISIONS 1 AND 2 (1000 MJ \geq MIE > 3MJ)*	CLASS I, DIVISIONS 1 AND 2 (GAS GROUPS C AND D) OR CLASS II, DIVISIONS 1 AND 2 (MIE \leq 3MJ)*
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+

Table 16.6.3 Use of Different Types of FIBCs

Notes:

(1) Additional precautions usually 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.

*MIE – 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 for 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.

ARC RECOMMENDATIONS

While not all inclusive, the following basic loss prevention guidelines can greatly reduce the potential for property damage and resulting business interruption caused by the improper selection of a flexible intermediate bulk container.

1. Contract with a qualified fire protection engineer to **perform a process hazard analysis** for the area(s) in which FIBCs will be used. The analysis should be related to the processes involved and their associated fire and/or explosion hazards. This should include the electrostatic ignition hazards associated with the particulate and objects surrounding or inside the FIBC. As with any process hazard analysis, it is essential to have the results of any combustible dust/flammability testing in order to know the MIE of the material(s) being handled. If no such data exists, samples of the materials should be submitted to a qualified laboratory to determine the MIE in accordance with the American Society for Testing and Materials’ (ASTM) *Standard Test Method for Minimum Ignition Energy of a Dust Cloud in Air (ASTM E 2019)* and the standard test procedure for MIE of flammable vapors is *ASTM E 582, Standard Test Method for Minimum Ignition Energy and Quenching Distance in Gaseous Mixtures*.
2. **Use only FIBCs that have been tested and verified for type** in accordance with IEC 61340-4-4. FIBCs that have not been tested and verified for type should not be used for combustible dusts or in areas where flammable vapors are present.
3. Develop and implement written procedures to **manage change** to process materials, technology, equipment, procedures and facilities (see *ARC Tech Talk Vol 14, Managing Change*). Even if properly designed and installed initially, many materials, processes and equipment change over time.
4. **Provide proper labeling**, clearly identify the type of FIBC in accordance with IEC 61340-4-4.

REFERENCES

NFPA 77, *Recommended Practice on Static Electricity*
NFPA 654, *Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids*
IEC 61340-4-4, *Electrostatics - Part 4-4: Standard Test Methods for Specific Applications – Electrostatic Classification of Flexible Intermediate Bulk Containers (FIBC)*
Hearn, Graham, *Static Electricity – Guidance for Plant Engineers*, Wolfson Electrostatics Limited
ARC Tech Talk Volume 10, *Combustible Dusts*
ARC Tech Talk Volume 14, *Managing Change*

QUESTIONS OR COMMENTS?

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Tech Talk is a technical document developed by ARC to assist our clients in property loss prevention. ARC has an extensive global network of more than 100 property risk engineers that offers tailor made, customer focused risk engineering solutions.

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