Static Ignition Hazards in Packaging

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Static charging is often unavoidable when handling non-conductive solids & liquids; the key question is…

Can it cause a fire or explosion by igniting flammable vapors or combustible dusts either inside or outside the container?

Incorrect container design or misuse of an acceptable package can cause a problem; proper use of the correct type of package can eliminate the threat

Scope

- We’ll only cover packaging & associated items used in solids and liquid handling operations
- Primary emphasis is on how to avoid introducing an ignition hazard into the workplace

Types of Packaging

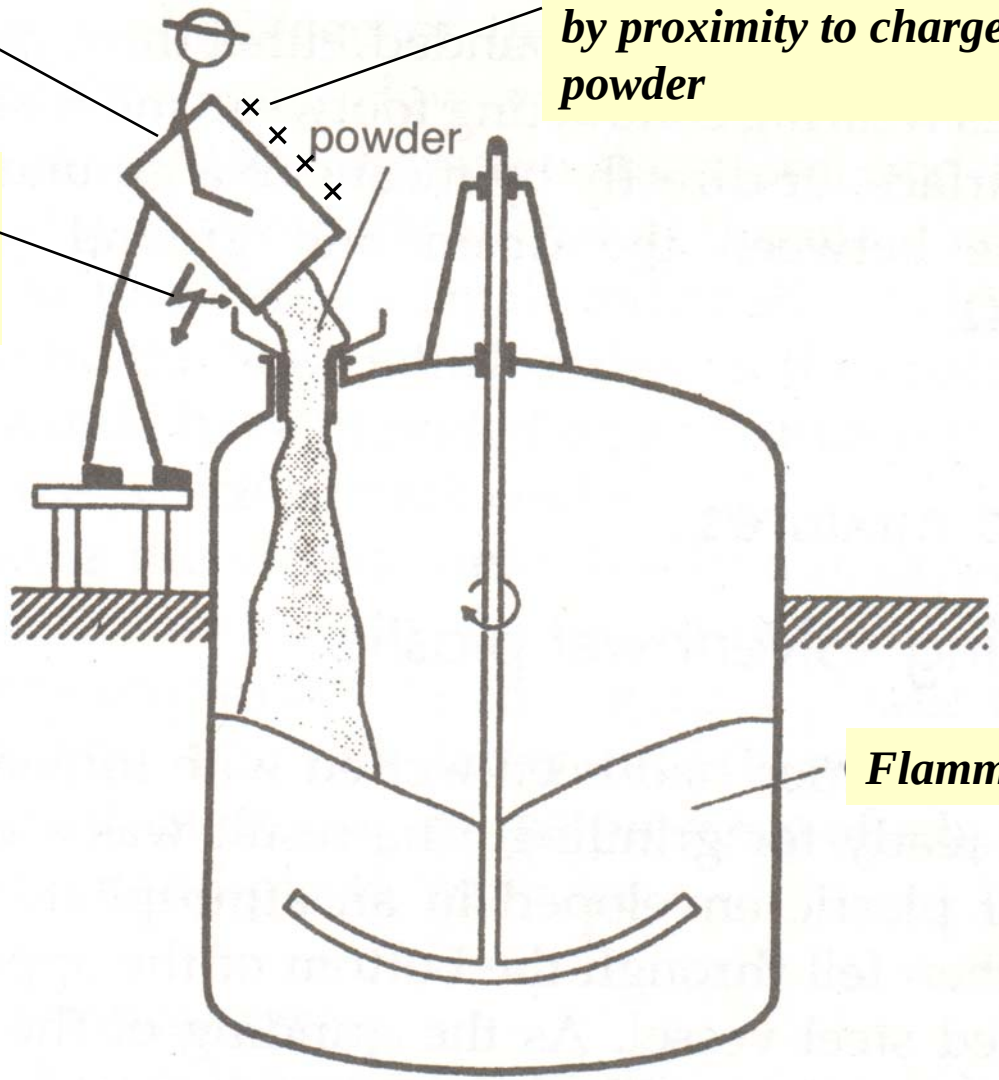
- Containers
  - Drums: Metal, Fiberboard, Plastic
  - Bags: Paper, Plastic, Composite
  - IBCs: Flexible & Rigid
- Associated Items
  - Liners
  - Shrink & Stretch Wrap

Conductive vs. Non-Conductive Containers

How Do Conductive Containers Become Charged?

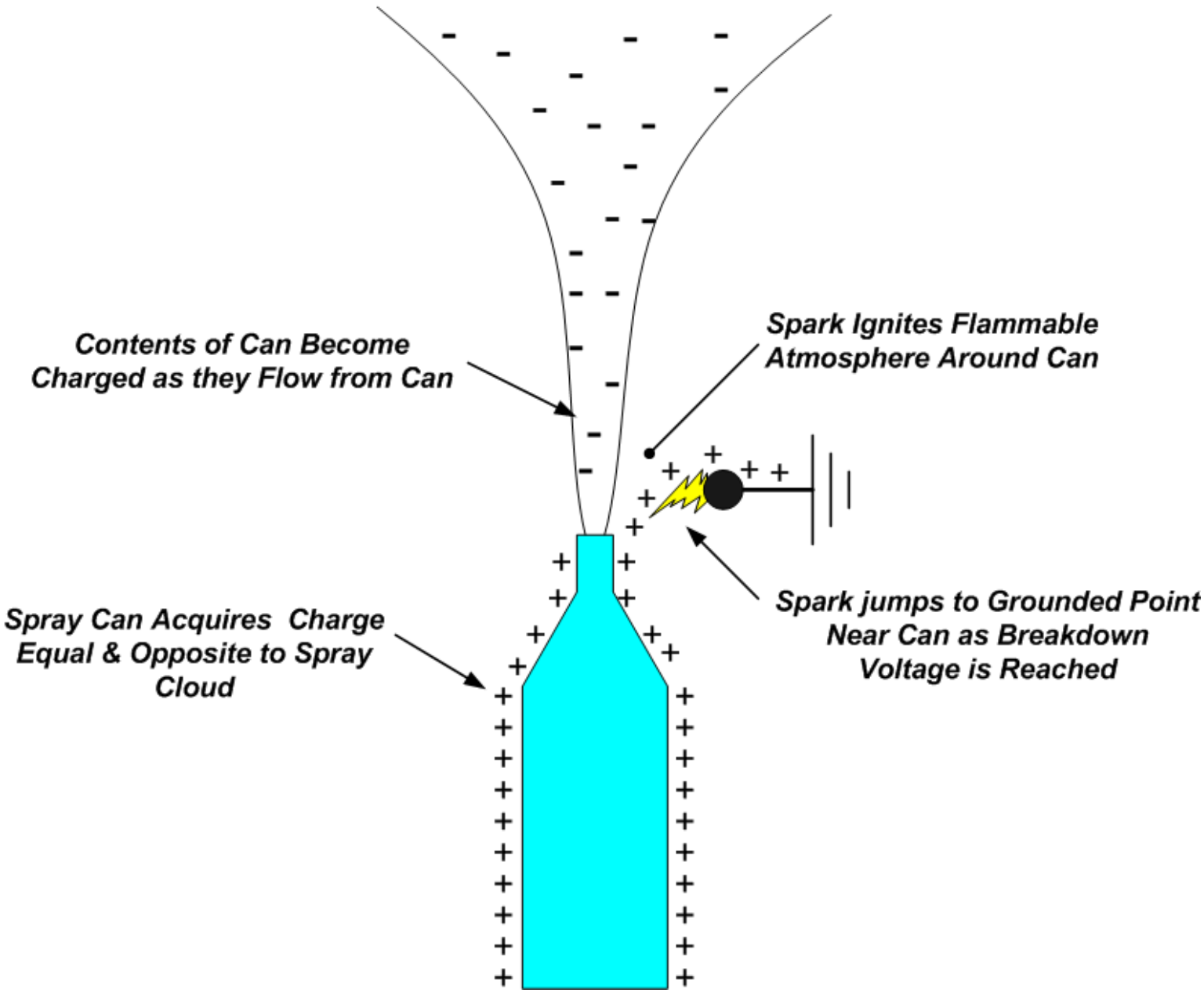
- They’re ungrounded and are in proximity to a charged object (e.g., charged solids or liquid in them, charged non-conductor nearby)

Hazard Posed by Ungrounded Container



Ref. Luttgens, Electrostatic Hazards

Spray Can Ignition Incident

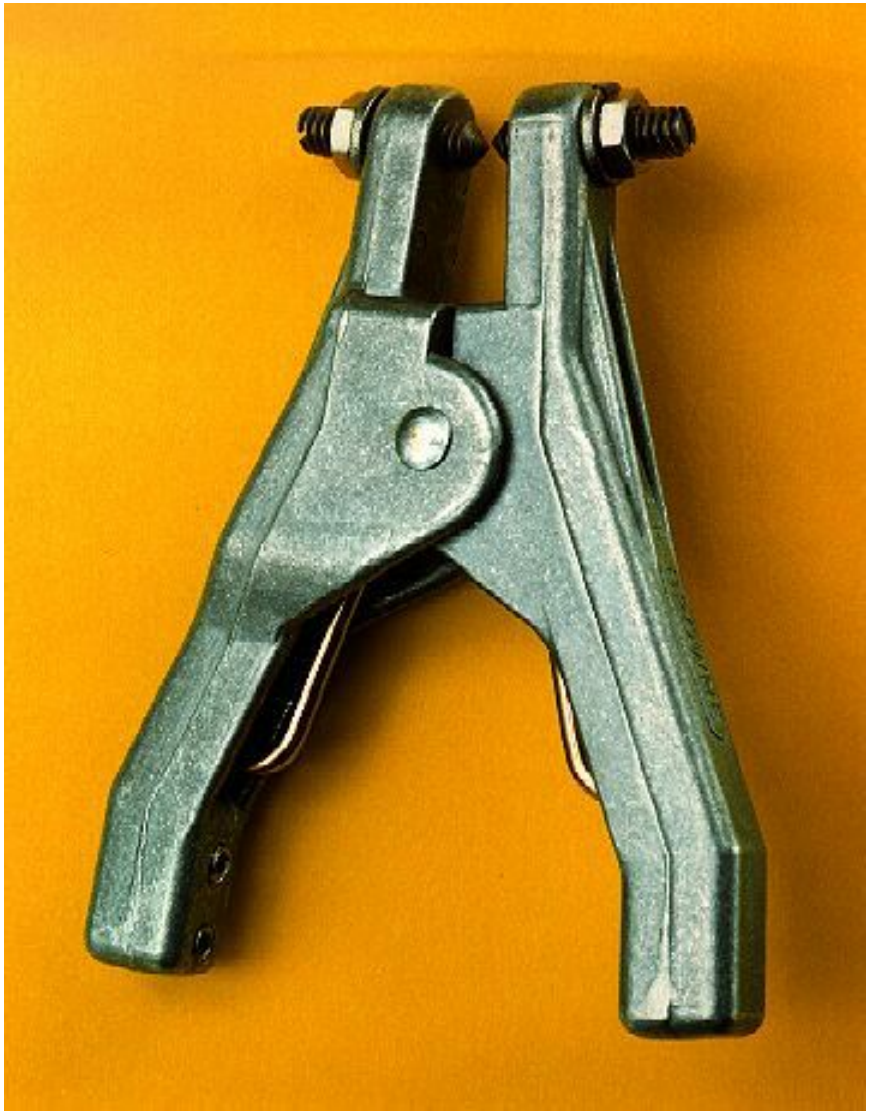


Safety with Conductive Containers

- Conductive containers are almost always inherently safe ***provided that they are properly grounded***
- Sparks from ungrounded conductive containers are probably responsible for the majority of incidents caused by electrostatics and packaging

Proper Grounding via Cable & Clamp

Use of spring-loaded pin-type clamp to ground painted drums is HIGHLY recommended!



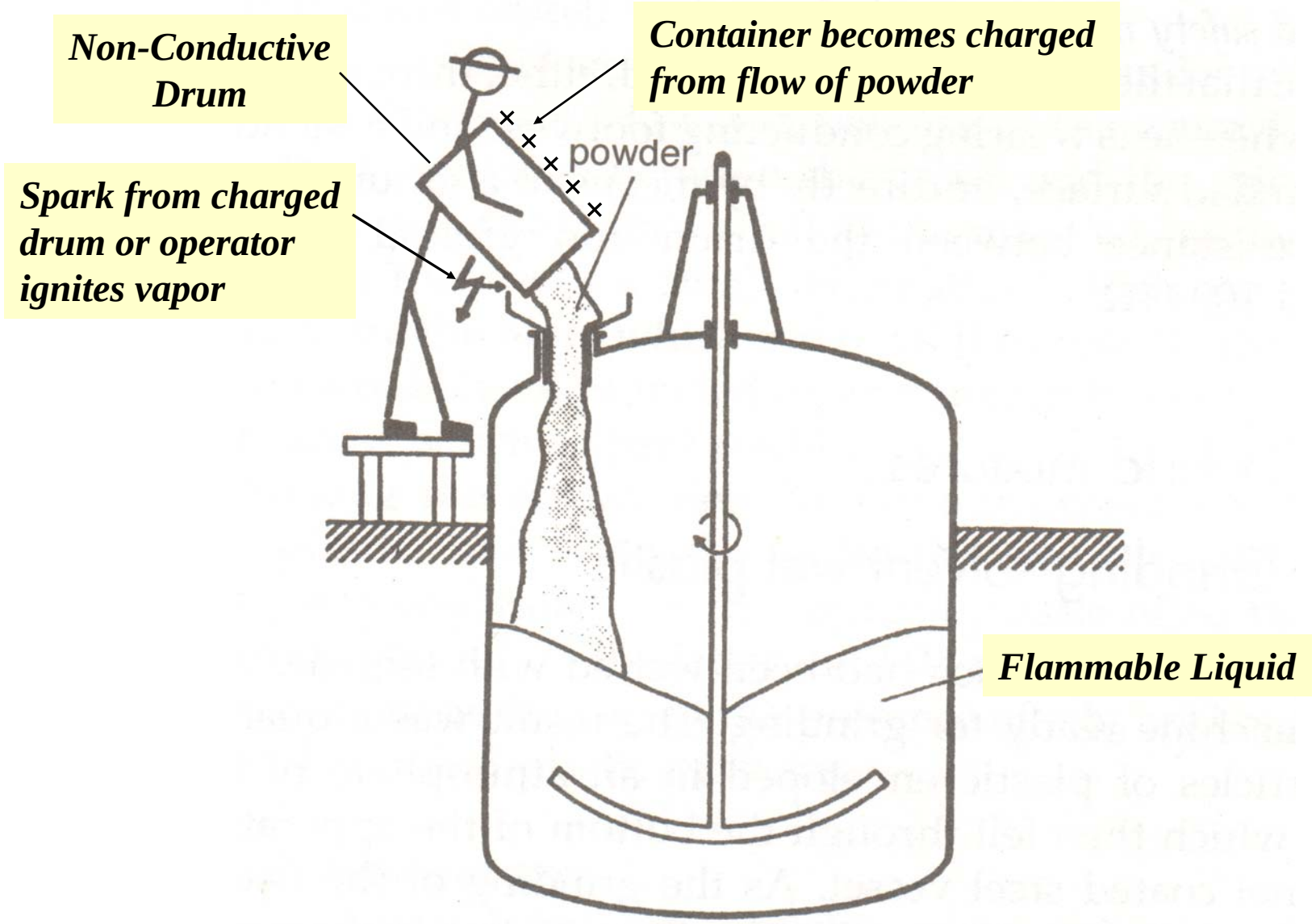
How Do Non-Conductive Packages Become Charged?

- Flow of solids/liquids into or out of them (tribocharging)
- Rubbing motion or flow of liquid/solids on outside surface (e.g., wiping with dry paper towels)

Hazards from Non-Conductive Containers may result from the Container, nearby ungrounded Objects, or Solids/Liquids in the Container

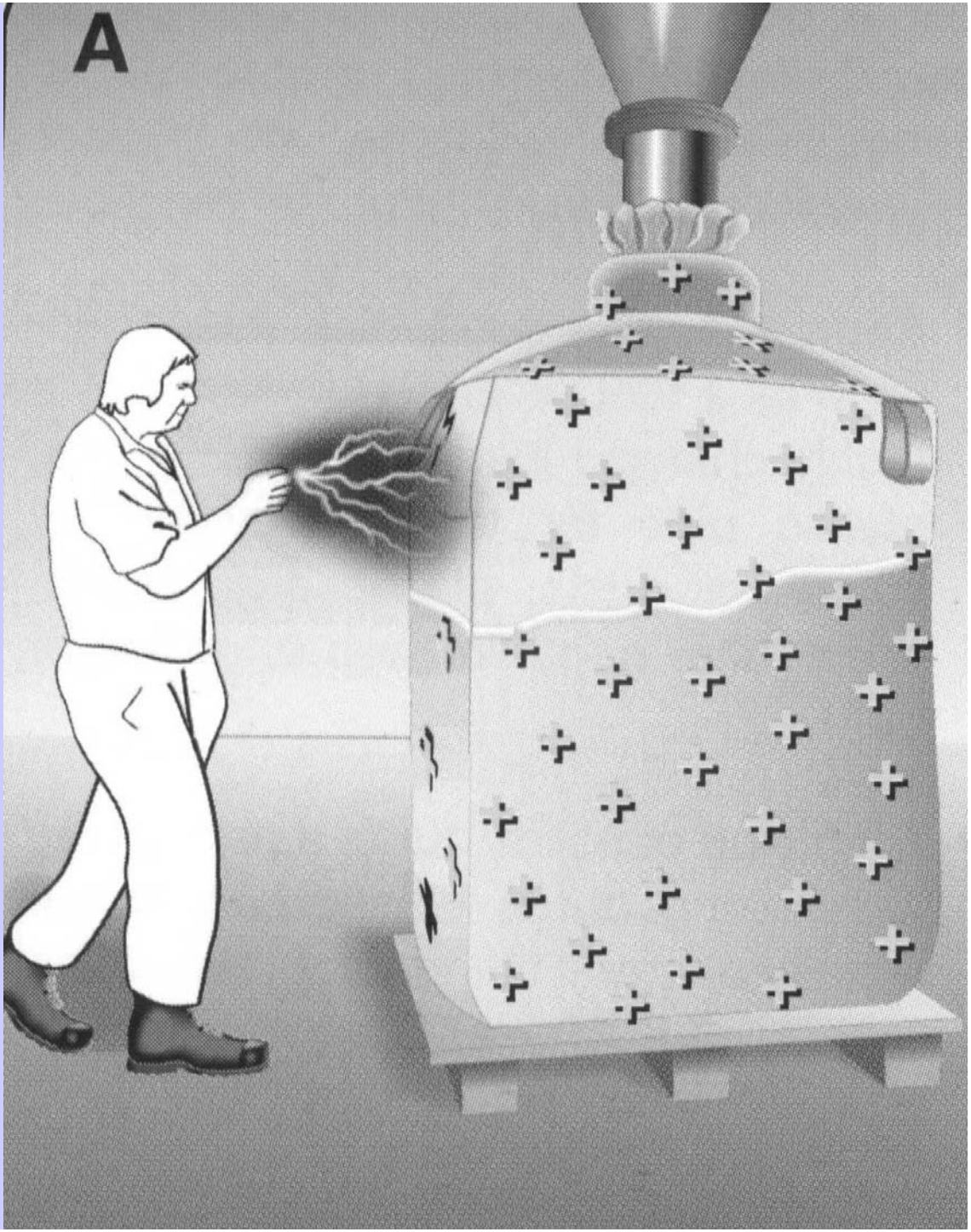
Some Examples …

Ignition Hazards from Non-Conductive Container



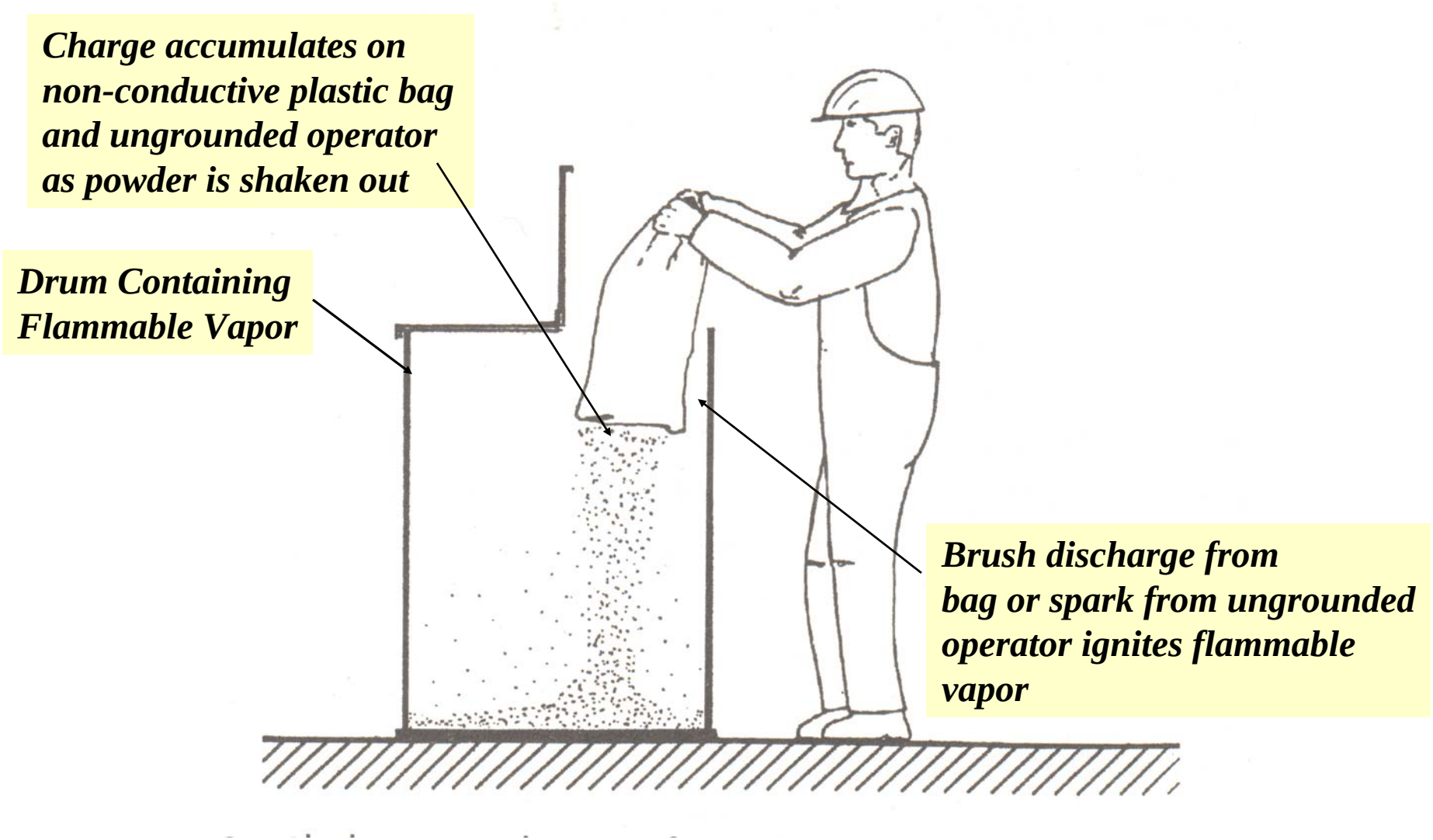
Ref. Luttgens, Electrostatic Hazards

Brush discharge from a non-conductive container can ignite flammable vapors outside the bag



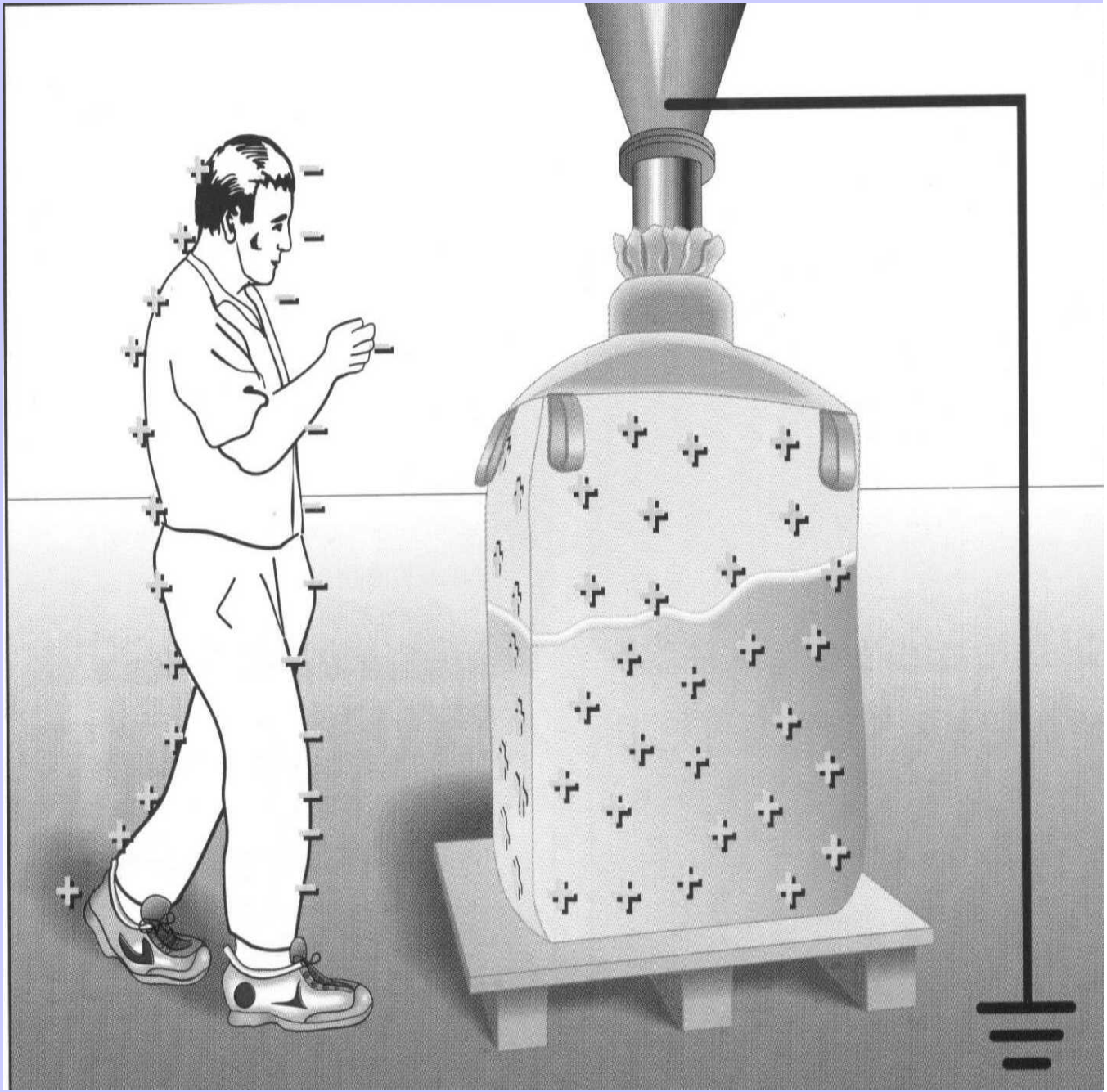
(ref. ISSA Prevention Series No. 2017)

Spark from Plastic Container



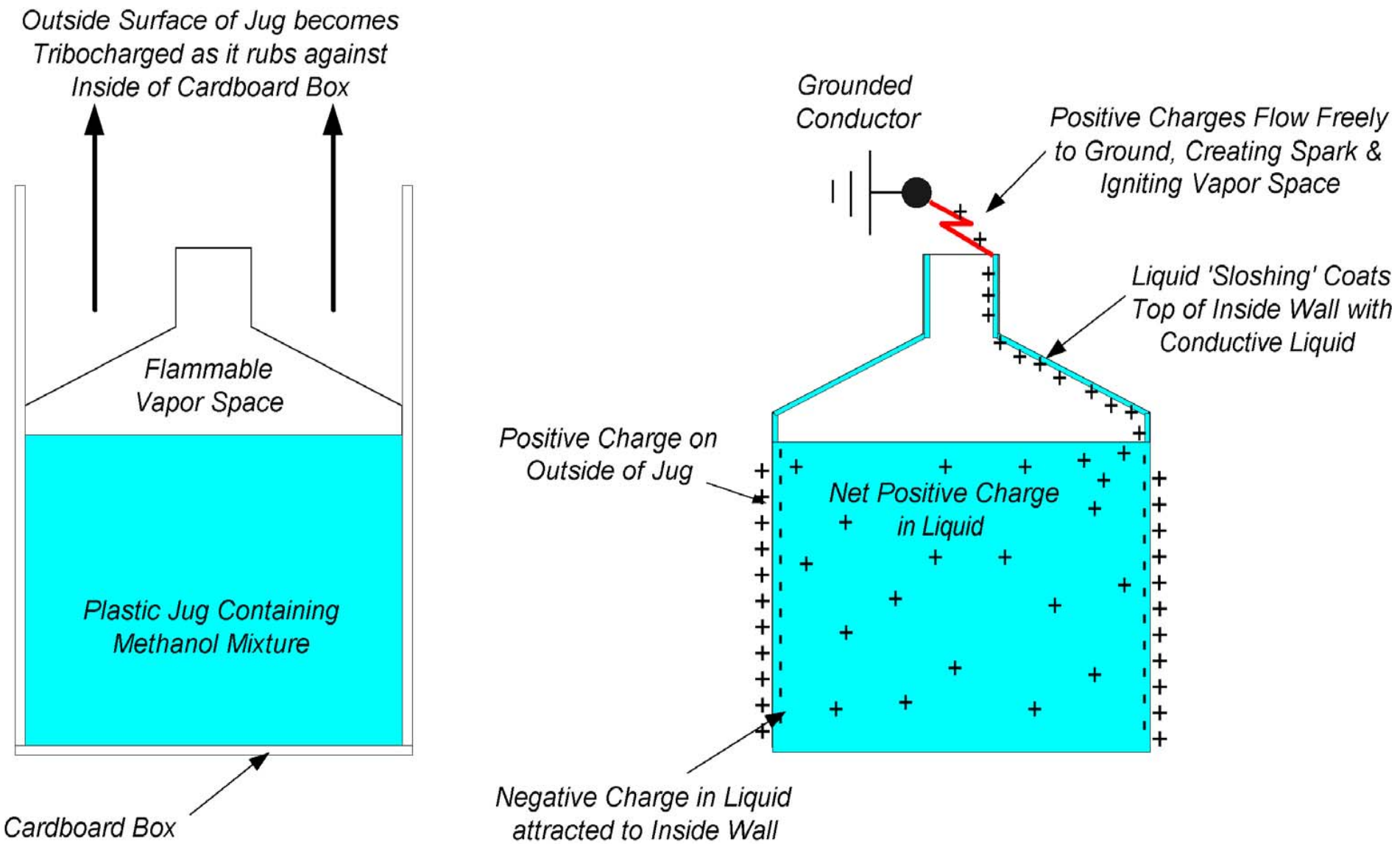
Ref. Luttgens, Electrostatic Hazards

Ungrounded person can become charged as they approach a charged container; this may result in a spark which ignites flammable vapor outside the bag

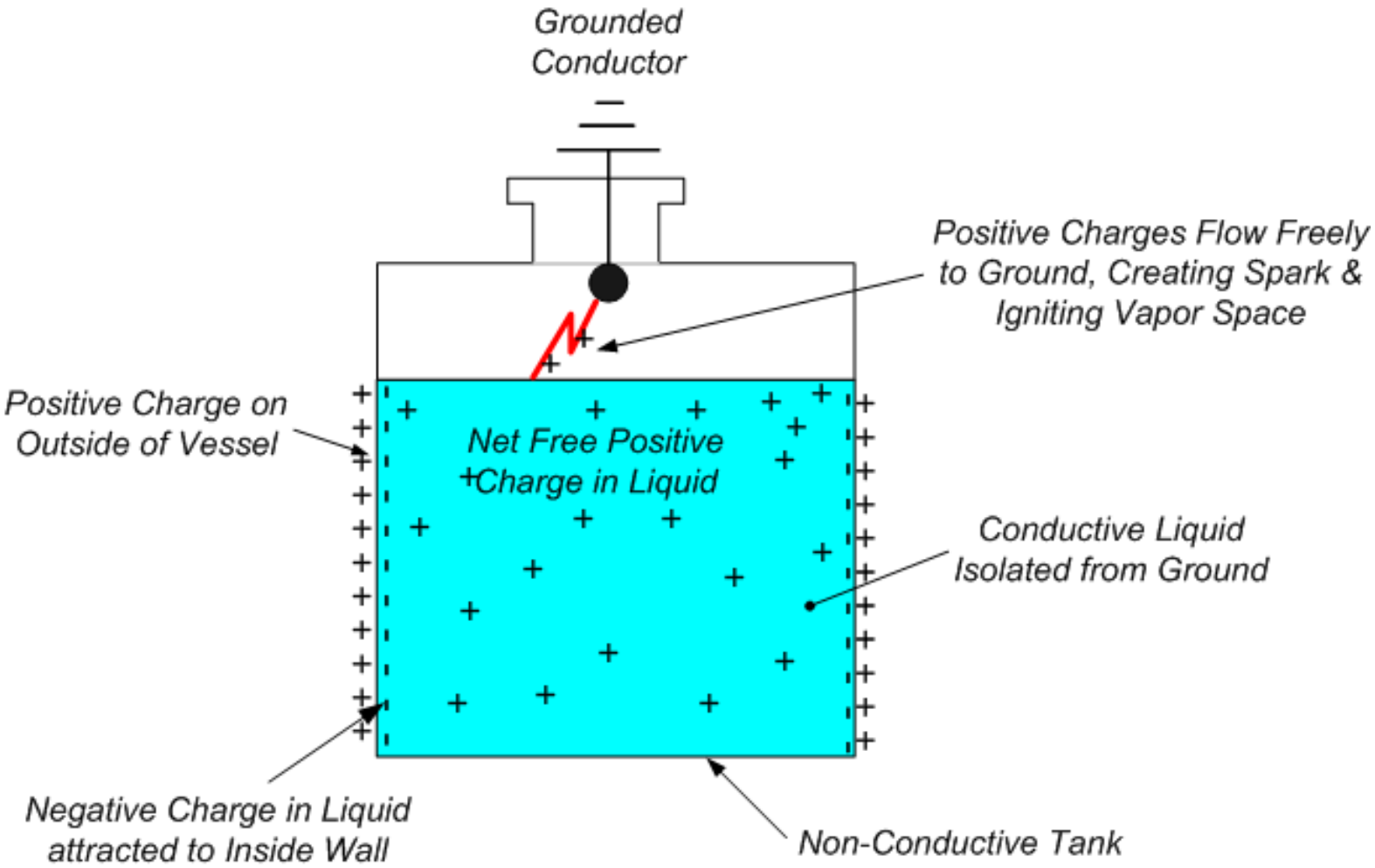


(ref. ISSA Prevention Series No. 2017)

Static Ignition of Methanol/Air Mixture in Plastic Jug



Electrostatic Ignition of Flammable Conductive Liquid in Non-Conductive Tank



Hazards of Non-Conductive Plastics…

- *They can't be grounded!*
- They can produce brush discharges which can ignite flammable vapors
- They can charge nearby ungrounded conductors which can produce sparks that can ignite flammable vapors or combustible dusts

A Solution: Antistat Plastics

- Antistatic plastics eliminate hazard by safely dissipating charge if grounded
- Generally work by allowing moisture layer to form on surface of plastic

Antistatic Plastics (cont'd)

- Ways to make plastic antistatic:
  - Conductive fillers
  - Antistat additives in polymer melt
  - Topical antistats
  - Inherently dissipative polymers (IDPs)

Potential Antistat Pitfalls...

- May not work if humidity is too low
- May have finite shelf life
- May be incompatible with product
  - Contaminant
  - Antistat adsorption in product

Other 'Safe' Containers

- Non-conductive liners less than 2 mm thick in metal drums are considered safe if the drum is grounded
- Fiberboard drums are generally considered static dissipative except under very low humidity conditions; chimes should be grounded

'Safe' Containers (cont'd)

- Paper bags, including bags with non-conductive liners or bags of composite ply construction, are considered safe if the liners are kept inside the bag

Other Considerations...

- NFPA-30, *"Flammable and Combustible Liquids Code,"* restricts the use of plastic containers for flammable liquid storage

Intermediate Bulk Containers

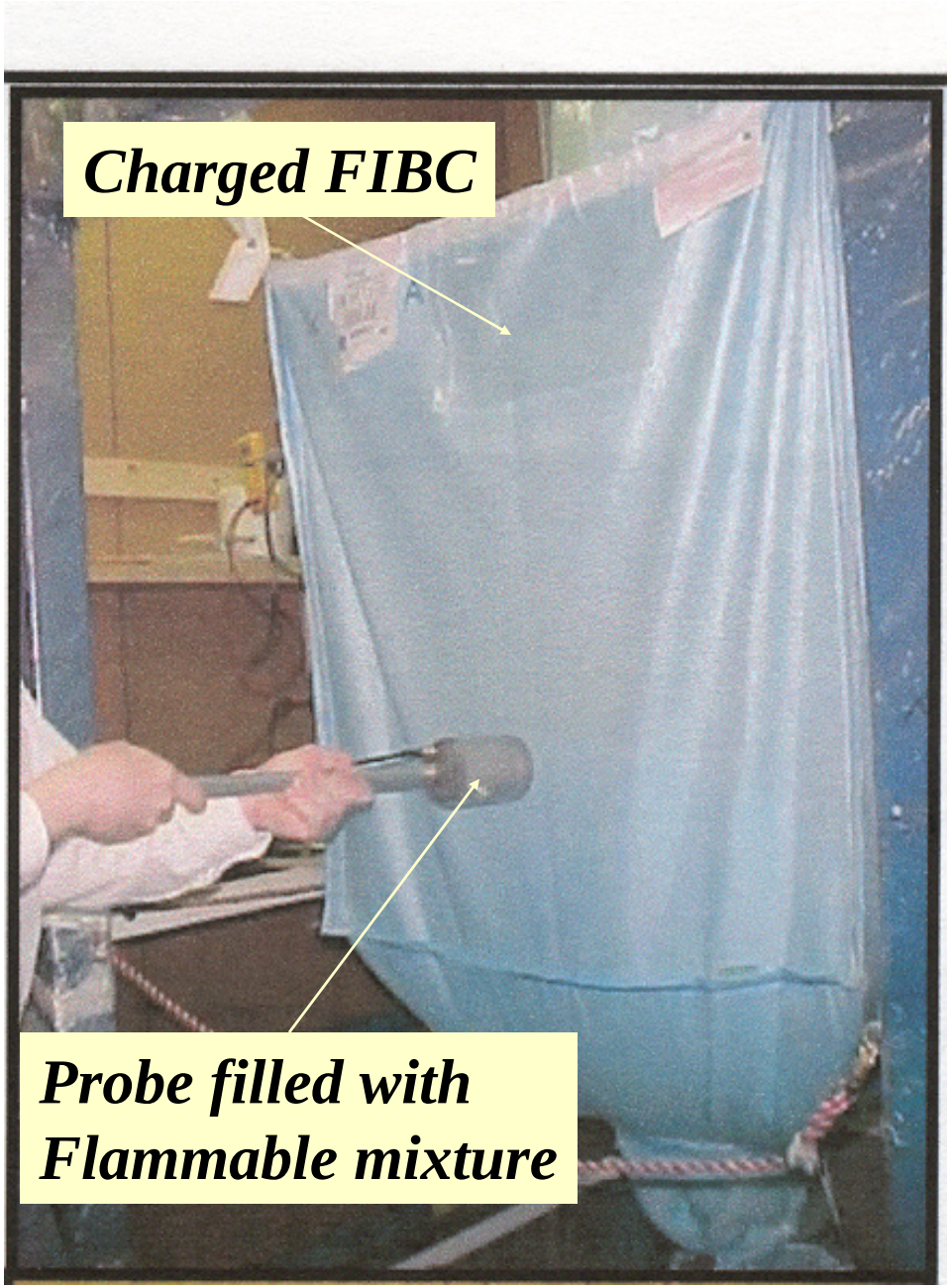
Flexible Intermediate Bulk Containers (FIBCs)

- Type ‘A’: Non-conductive; may produce sparks which ignite vapors & combustible dusts
- Type ‘B’: Designed for use with combustible dusts; may ignite flammable vapors
- Type ‘C’: Conductive; for use with combustible dusts and flammable vapors; must be grounded!

FIBCs (cont'd)

- Type 'D': Static Dissipative; for use with combustible dusts and flammable vapors
- New IEC standard 61340-4-4 for specification & qualification of FIBCs issued in 2005

Testing of Type 'D' FIBC with special probe per new IEC standard



Courtesy of Linq Industrial Fabrics

'Standard' Intermediate Bulk Container

Static Ignition Hazards:

- ***Possible Brush Discharges from Plastic Shell***
- ***Charged surface may result in charging of ungrounded Conductors outside IBC***
- ***'All plastic' Design means that there is no way to ground Liquid in IBC***

Courtesy of Schutz Werke GmbH

IBC for use in Hazardous Area or with Flammables

Protective Features:

- ***Grounded metal cage prevents charging of objects around IBC and eliminates discharges from IBC surface***

- ***Groundable drain valve allows liquid inside IBC to be grounded***

For Use with Flammable Or where Vapors Present Outside Container

Courtesy of Schutz Werke GmbH

New IEC Standard being developed for qualification of rigid IBCs

Shrink & Stretch Wrap

- Will often become highly charged as it is removed from pallets
- Potential spark from film can ignite flammable vapors if present; for this reason it must be removed in a safe area
- Anti-stat shrink/stretch wrap: myth or reality?

References

- Avoiding Electrostatic Ignition Hazards in Chemical Operations, L.G. Britton, 1999
- CENELEC TR50404, “Electrostatics—Code of Practice for the Avoidance of Hazards Due to Static Electricity
- Electrostatic Hazards, Luttgens & Wilson, 1997

References (cont'd)

- NFPA -77, *"Recommended Practice on Static Electricity,"* 2000 edition

- Generation and Control of Static Electricity in Coatings Operations, NPCA Bulletin 803, Reppermund & Christopher, National Paint & Coatings Assn., 2002