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Unpleasant electrical shock due to static electricity

Examples:

1. Flooring
2. Handling of plastic waste
3. ESD hazard in a margarine factory
4. ESD hazard in a noodle factory
5. Unpleasant ESD in packaging

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References

IEC TR 600079-32 Explosive atmospheres – Part 32-1
Electrostatic hazards, guidance

Pt. 12.4.1 – **Reported shocks from equipment or processes**
“Reports by operatives that they are receiving shocks should always be investigated. It is likely that they are harmless, but this is not always the case, it can indicate that equipment is faulty and hazardous.”

BG RCI TRGS 727 8/2016
Technical Guidance Dangerous Goods
Vermeidung von Zündgefahren infolge elektrostatischer Aufladung
Preventing risk of ignition due to electrostatic charges

Günter Lüttgens, Wolfgang Schubert et al
Static Electricity
Wiley-VCH Verlag, Weinheim 2018 ISBN 978-3-527-24128-3

1. ESD because of flooring

The walkway of a historical bridge was refurnished with plastic timbers instead of the original oak timber.

At the ribbon cut party the participants received unpleasant electrical shocks.

EPA Design & Control 2.6.2009

GDEBURGER LOKALANZEIGER Donnerstag, 28. Mai 2009

Hersteller war vor Ort / Steht er in der Pflicht? / Heute Vormittag Messungen an der Brücke

Hubbrücken-„Anomalie“: Amt rüstet Erdung gegen Spannungsschlag nach

Die elektrostatischen Anomalien an der Hafen-Hubbrücke haben ein Nachspiel: Durch die Nachrüstung von zusätzlichen Erdverbindungen an den Plastebohlen sollen den unerklärlich starken elektrischen Entladungen ein Ende bereitet werden. Ob es klappt, steht nicht hundertprozentig fest. Tiefbauamtschef Gebhardt ist zuversichtlich und verärgert: Das Herstellerunternehmen der Plastebohlen soll nicht ausreichend auf die „Nebenwirkungen“ hingewiesen haben.

Von Karl-Heinz Kaiser

Bothensee. Noch in dieser Wo-

Radler stürmen die Hafenhubbrücke. Noch bekommt man hier am Geländer schnell „eine gewischt“. Foto: Viktoria Kühne

Magdeburger Lokalanzeiger 28. Mai 2009

ESD measurement on site

I was called to analyze the situation.

Results & solution

Findings: At a nice dry day in spring
Voltage on a person with ESD shoes U_s **> 15.000 V**
Interesting: With Street shoes *Us* ≈ 10.000 V

Sensing strong ESD at the rails, also sensing ESD through the soles of my shoes.

calculation: energy
capacitance 200 pF – 18 kV = **33 mJ**
10 % of what is considered a direct hazard
to health 350 mJ. Certainly unpleasant !!

Solution:
Metal strips between the plastic timbers to discharge pedestrians and to limit the accumulation of static.
At the stairs, the plastic timbers have been replaced by grounded metal grids.

2. ESD hazard in plastic waste handling

- In a plant large amounts of plastic waste was collected in metal containers.
- To improve the material flow, the metal container was placed on a trolley.
- The container app. 10 m^3, was on a trolley with plastic wheels, unfortunately fully insulated.
- Workers reported severe ESD shocks when they came close to the container.

Inspection on site

I received a ***nice*** **ESD** over app. 20 cm!

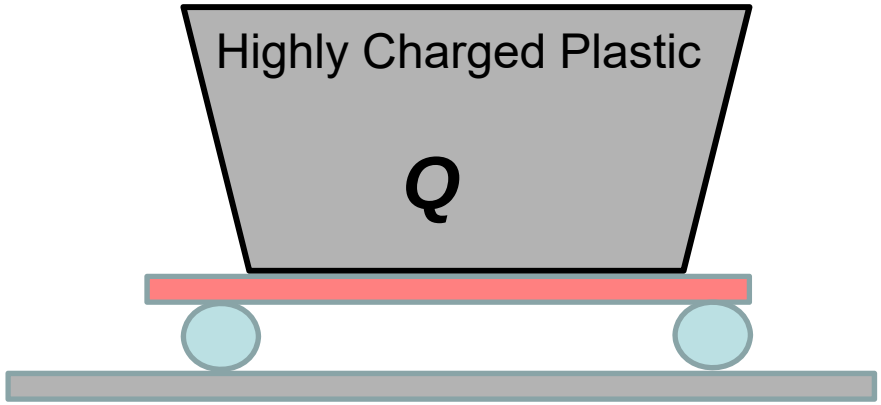
The very basics are applicable:

All Charge on the plastic waste is also on the surface of the container!

Analyzing

This is a Faraday Pail !

$$\oint_A \vec{D} \cdot d\vec{A} = \int_V \rho \cdot dV = Q,$$



All Charge (Q) on the Volume of Material (V) is reflected on the Surface (A)

Calculation: **Capacitance 350 pF**
Voltage 100 kV
W = 170 mJ

This is 50% of what is considered as a direct hazard to health! (350 mJ IEC 60079 – 32- 2 Pt. 12) This confirmed the reported nuisance and sometimes unbearable ESD shocks.

Solution

Solution: Ref. TRGS 727 Pt. 4.5.1
Conductive containers must be grounded during loading and unloading.

Visual inspection on site identified installed grounding points and cables, but not used.

Solution: Training and instructions must be provided Ref. TRGS 727 Pt. 8.6

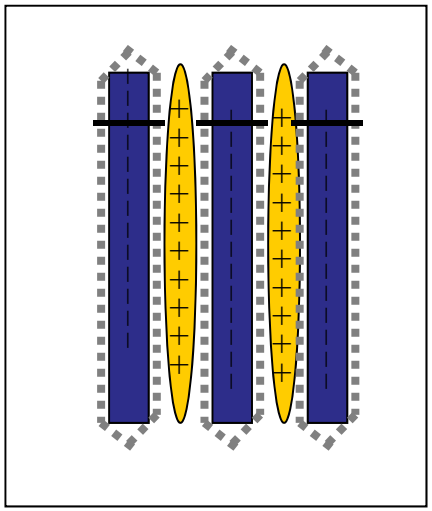
Objective: Operators must know the grounding facilities and must be trained to use grounding correctly.

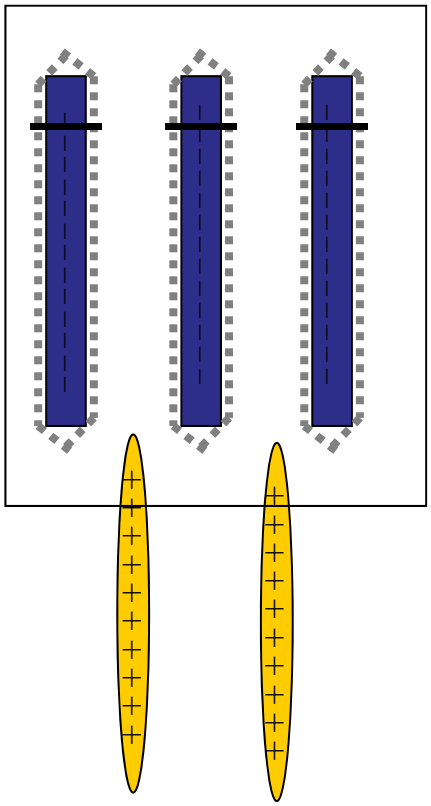
3. ESD hazard in a margarine factory

- At the nut oil press workers complained about ESD during cleaning the filter mats after releasing the filter cake.
- The filter cake is highly charged. Workers observed sparks during falling down into a bunker.
- This situation was reported after the introduction of new “antistatic” filters, actual filter mats with stainless steel fibers for better reliability.

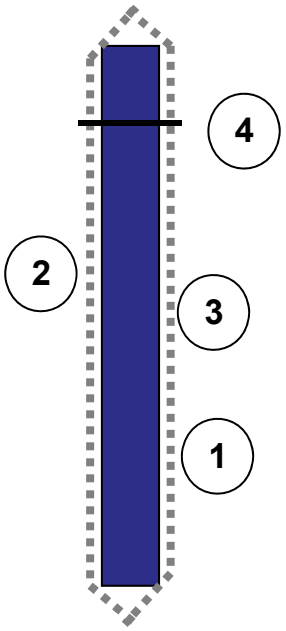
Process description

Left:
During the press cycle, several hours, the charge in the filter cake is compensated.





Right:
After opening the filter cake drops into a bunker. A net charge is left at the press plates.



Press Plate:

1 Press plate
2 Filter mat frontside
3 Filter mat backside
4 Electrical bonding

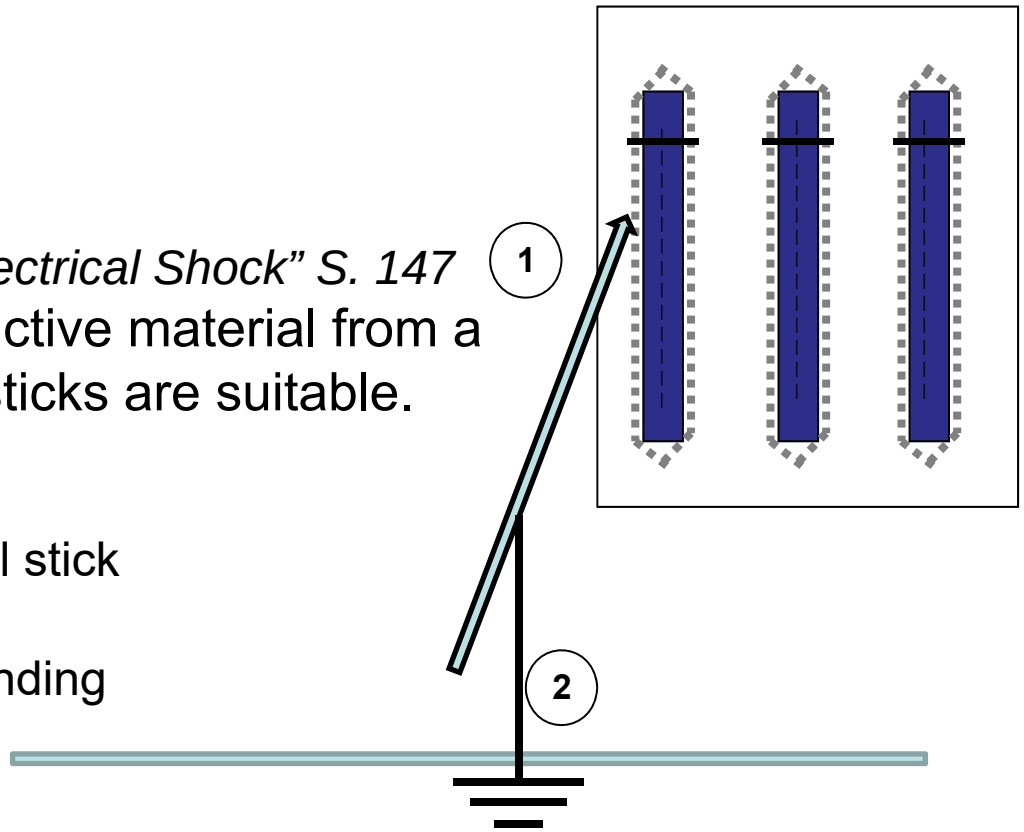
However the press plate is not grounded.

Solution

The filter mats are large, app. 8 m², conductive but not grounded. The charged large capacitance can present an ESD hazard.

Solution 1:
Ground the filter mat!

Solution 2:
TRGS 727 Attachment D "Electrical Shock" S. 147
To remove charged conductive material from a surface, grounded metal sticks are suitable.



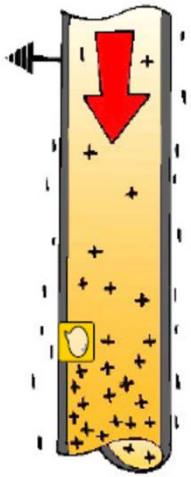
1 metal stick

2 grounding

4. ESD hazard in a noodle factory

- In a noodle factory workers complained about ESD during cleaning pipes.
- These pipes are a combination of transparent polycarbonate and stainless steel tubes.
- Granulates travelling in a pipe (gravity) can charge up due to friction and charge the pipe and equipment by induction

Demonstration



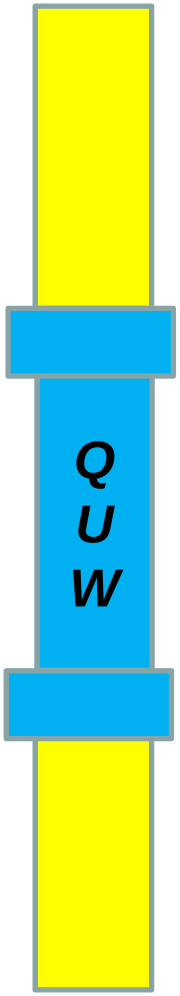
Demonstration:

Dry rice, charged by friction, can charge the conductive pipe and charge up a conductive tote box.

References

ESD hazard in a noodle factory
"For granulates with MIE > 1 J (Ws) measures to avoid ignition hazards due to static electricity are usually not necessary. ***Precautions to minimize electrostatic shock risks could be necessary.***"
IEC 60079- 32-2 Pt. 9.1 / TRGS 727 Pt. 6 (3)

Conductive parts in a pipe system, not grounded, can accumulate a high charge ***Q,*** have a static potential ***U*** and the Energy ***W*** can present a ESD shock risk!
Static Electricity, P 206

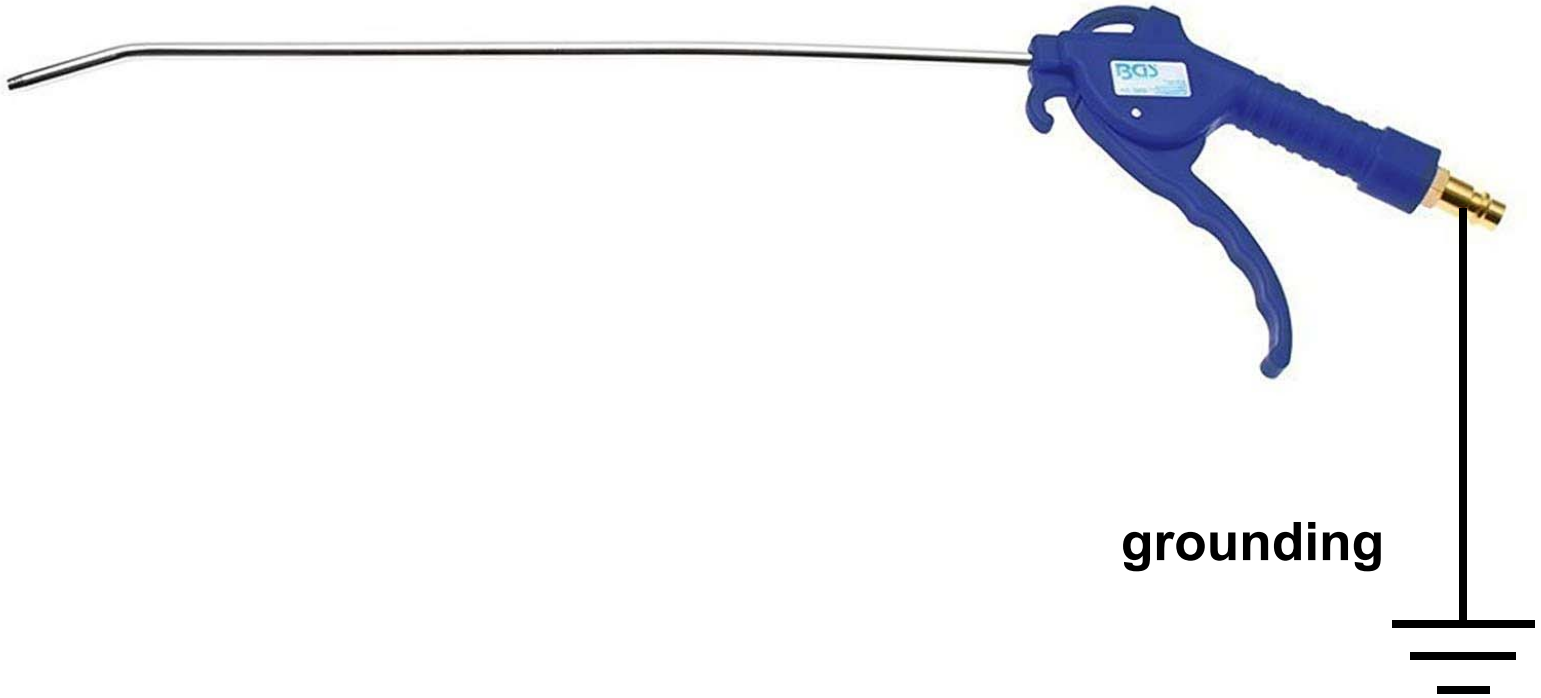


MIE Minimum ignition energy

Solution

Solution:

For cleaning with an air gun, the tool should be grounded by means of conductive air hoses or a by a ground wire.



5. ESD hazard in packaging

To protect goods from contamination, the items in large plastic boxes have been wrapped in aluminum foil.
During the handling of the boxes workers reported ESD shocks.

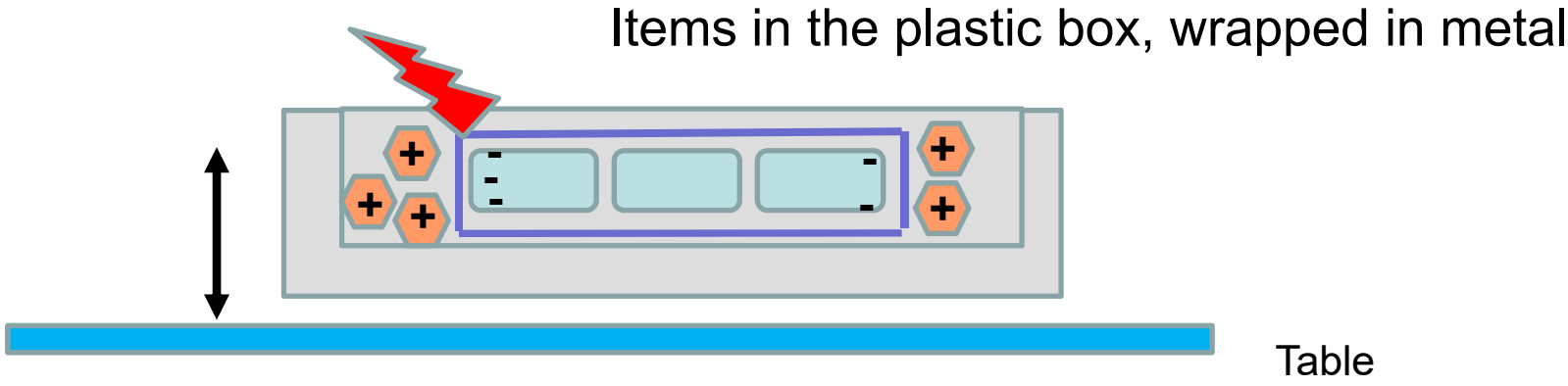
Step 1 If there are ESD shocks, the worker must wear ESD shoes!
Result: No improvement.

Step 2: ESD shoes can not work on normal flooring!
2500 m² ESD flooring was installed!
Result: No improvement.

Step 3: I had to check the performance of the ESD flooring!
Result: High quality ESD flooring!
But I also had a glance to the packaging process.

The style of packaging caused the ESD problem!!

Analyzing the packaging



Cushioning material, highly charged, induces a net charge into the insulated wrap of metal foil.

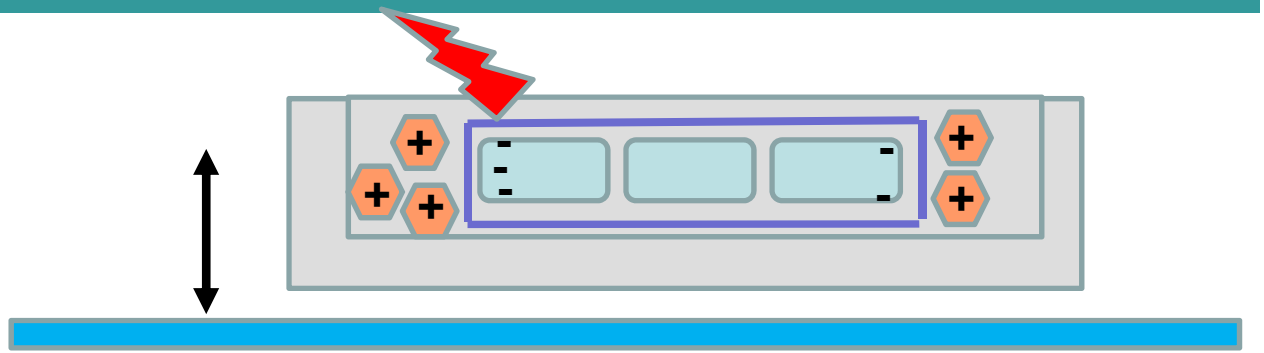
+++

By lifting off the box the voltage of the wrap increases $U = Q / C$.

By contact to the metal wrap ESD is likely.

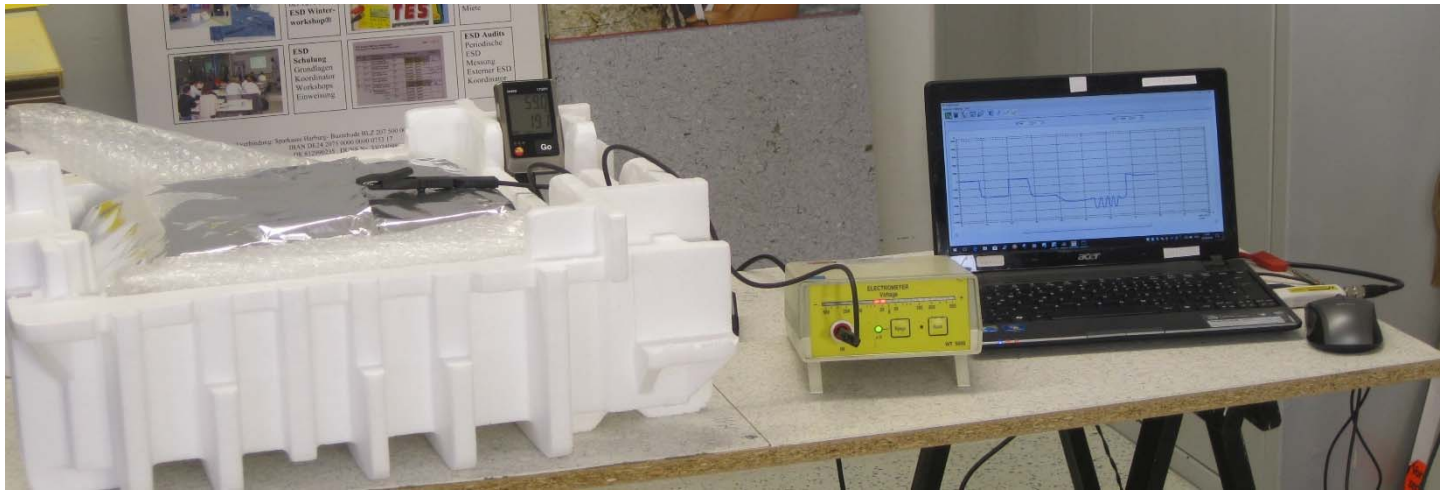
Demonstration

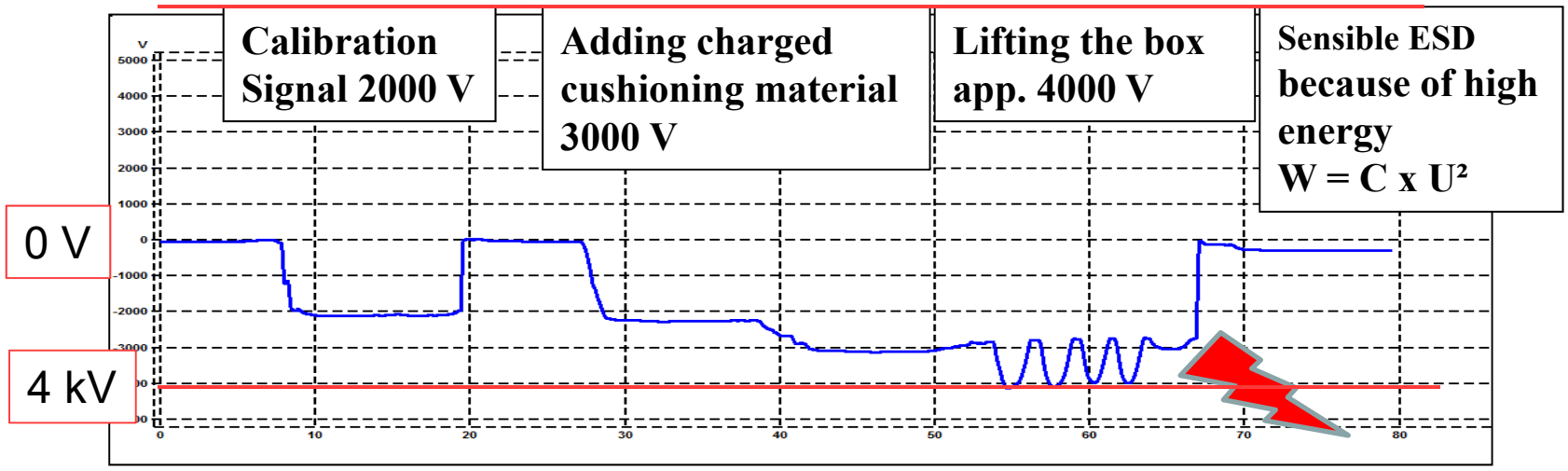
Demonstration
at 20 °C / 60 % rF



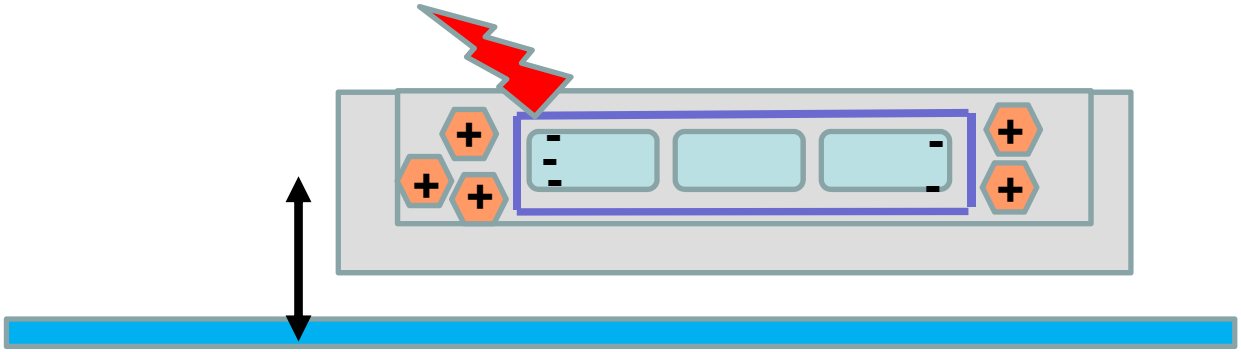
Items in the box wrapped in metal foil. The voltage of the wrap was recorded.

Measurements





Solution



Because of induction unpleasant electrical shock due to static electricity are likely.

Solutions:

Use dissipative packaging material!
Discharge the metal!
Do not touch the metal or use gloves!

Conclusion

Unpleasant ESD Shocks can happen.

Investigation and Training is essential!

IEC TR 600079-32
Explosive Atmospheres – Part 32-1
Electrostatic hazards, Guidance

Reported Shocks must be investigated

“Reports by operatives that they are receiving shocks should always be investigated. … It is likely that they are harmless, but this is not always the case, it can indicate that equipment is faulty and hazardous.” *Pt. 12.4.1*

ESD Risks are not obvious.

TRGS 727 Pt. 8.6 – **Instruction and Training**

Workers must know the grounding facilities and must be trained to use grounding correctly to avoid failures.