White Paper

An Industrial Buyer's Guide to Protecting against the Ignition Hazards of Static Electricity.

Author Details:

Mike O'Brien, Managing Director for Newson Gale

If you have any questions relating to the topics discussed in this article, please contact Newson Gale.

Enquiry > Click here to submit a product related query or a request for quotation.

Hazop assessments, and the reports that follow on from them, are a great way of capturing and identifying processes and practices that could lead to the ignition of flammable atmospheres through discharges of static electricity. What Hazop reports are not so great at doing is identifying what the grounding solution to eliminate the risk should look like.

The task of identifying the right grounding solution falls to people like you and members of your team and it's not likely to be something you deal with on a day to day basis. For most people, identifying and specifying the right static grounding solution is probably the kind of project they'll handle once or twice in their career. But get it right first time and it quickly becomes an area where you can bring value to the table throughout your career. This guide is about helping you get started on the right path and can be best described as a door opener to the subject of hazardous area static control.

The guide is broken down into three distinct sections. The first section deals with industry guidelines that provide guidance on controlling static electricity in hazardous areas The second section helps you work out the "best-fit" for controlling electrostatic hazards at your site and the third section touches on hazardous area equipment approvals, specifically what you should be looking for when selecting an EX Certified approved static grounding solution.

1. Static Grounding Benchmarks.

Before embarking on this guide to specifying and sourcing static grounding solutions it should be asserted from the jump-off point that hazardous area certified equipment that carries the mark of a Notified Body like SIRA or BASEEFA is not a validation of a grounding system's performance characteristics when it relates to providing static grounding protection. Although a lot of time and effort can be put into sourcing grounding solutions that match or exceed your EX zoning requirements, the first recommendation this buyer's guide will make is to take account of hazardous process industry associations that provide guidance on preventing ignitions caused by static electricity. There are several documents published by highly authoritative and respected associations around the world that identify the industrial processes that can be the source of electrostatic ignitions.

The committees that are assigned the task of developing and updating these guidance documents in line with the latest state of the art techniques are employees of companies and consultancies active in the hazardous process industries.

Demonstrating compliance with the recommendations outlined in these guidance documents will virtually ensure all of the electrostatic hazards presented by your company's operations are under your control. If you can specify grounding solutions that display compliance with the publications listed in Table 1, you will be ensuring your static grounding protection methods display the latest state of the art in preventing fires and explosions caused by static electricity.

The guidelines in Table 1 describe how and why certain operations, whether it involves liquids, gases or powders, can generate static electricity and result in the static electricity accumulating on the equipment being used in the process. The primary means of preventing ignitions caused by static electricity is to ensure all conductive and semi-conductive equipment, including people, are bonded and grounded to a verified "true earth" grounding point. This ensures electrostatic charges cannot accumulate on equipment and discharge a spark into an ignitable atmosphere.

Association	Publication Title	Year of Publication
National Fire Protection Association	NFPA 77: Recommended Practice on Static Electricity	2014
International Electrotechnical Commission	IEC 60079-32-1: Explosive Atmospheres Part 32-1: Electrostatic Hazards - Guidance.	2013
American Petroleum Institute	API RP 2003: Protection Against Ignitions Arising out of Static, Lightning, and Stray Currents, Seventh Edition.	2008
CENELEC	CLC/TR 50404: Electrostatics - Code of Practice for the Avoidance of Hazards due to Static Electricity. Superceded by: CLC/TR 60079-32-1: Explosive atmospheres - Part 32-1: Electrostatic hazards, guidance.	2003 2015

Table 1: Hazardous process industry guidelines for preventing fires and explosion caused by static electricity.

Because the Earth has an infinite capacity to balance positive and negative charge, if equipment is connected to it, that equipment is at "earth potential" meaning it can't charge up in response to static generated by the movement of material.

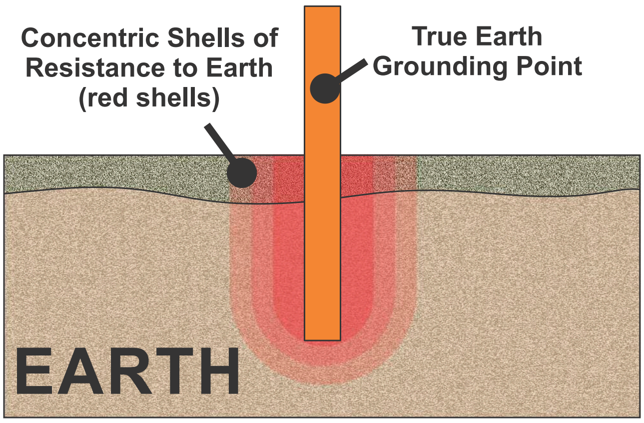

Fig. 1: To ensure equipment cannot accumulate electrostatic charge, the equipment should be connected to the general mass of the earth by means of a true earth grounding point. The resistance between the grounding point and true earth must be low enough to allow the electrostatic charge generated by the process flow to earth.

Just as many other safety related functions have benchmarks designed with factors of safety in mind, grounding and bonding circuits can, and should, work to benchmarks that exceed the minimum safety requirements. The minimum theoretical requirement for grounding electrostatic charges is usually described in academic circles as having an electrical resistance not exceeding 1 meg-ohm (1 million ohms) between the object at risk of charge accumulation and the general mass of earth.

However, it is well recognised that metal objects at risk of charge accumulation, e.g. road tankers, and the grounding and bonding circuits providing grounding protection, should never display an electrical resistance of more than 10 ohms if they are in good condition. This value of 10 ohms is the one value of resistance that is consistently recommended across all of the publications listed in Table 1. So wherever a grounding solution is being sourced for operations that involve metal objects like road tankers, railcars, totes, barrels and containers, grounding systems that display ground monitoring values of 10 ohms or less should be specified.

Another reason why the theoretical value of 1 meg-ohm does not have a role in real world applications is the requirements related to grounding Type C FIBCs. Although CLC/TR: 50404 (2003) states that the resistance through a Type C FIBC bag should not exceed 100 meg-ohm, the latest state of the art guidance published in IEC 60079-32-1 (2013) and NFPA 77 (2014) states that resistance through the bag should not exceed 10 meg-ohm. So clearly, a "theoretically acceptable" value of 1 meg-ohm is impractical when discussed in the context of metal objects that should display a benchmark resistance of 0 to 10 ohms or less, and Type C FIBCs that should display benchmarks of either 0 to 10 meg-ohm or 0 to 100 meg-ohms (depending on what standard the bag is manufactured to).

NOTE: If you are engaged in sourcing a grounding solution for Type C FIBC bags you must ensure you know what standard the bags are manufactured to. If you don't know what standard your bags are manufactured to the bag supplier should be consulted. Once you know what standard your bag is manufactured to you should source a Type C FIBC grounding system that monitors the grounding circuit from 0 ohms up to 10 meg-ohms (NFPA 77 / IEC 60079-32 compliant) or from 0 ohms up to 100 meg-ohms (CLC/TR: 50404 compliant).

Avoid grounding systems that do not monitor the full range of resistance as they are likely to fail bags that are designed to work up to 100 meg-ohms and pass bags that should only work up to 10 meg-ohms.

2. Source a grounding solution that provides the "Best Fit" with your objectives.

Your company's Hazop report will normally identify the risk of static sparks from specific equipment like road tankers, drums, IBCs, etc., and provide an assessment of what impact a fire or explosion caused by an electrostatic ignition could have on the area. It will be your task to determine what the grounding solution needs to look like. Before fully embarking on the search for a static grounding solution, determine the layers of protection you want from an electrostatic ignition hazard. The more layers deployed to protect against an ignition source, the more likely static will controlled in a safe, repeatable and reliable way.

Producing answers to the following questions will help you identify the layers of protection you require from your static grounding solution.

A. Who will be responsible for ensuring the equipment is grounded prior to, and during, the operation and how do we alert them to a situation where there could be an electrostatic discharge risk?

B. If, for whatever reason, the equipment loses its grounding protection during the operation, do I want that process to continue building up electrostatic charge on the equipment?

C. What type of equipment requires static grounding protection and does the application have unique characteristics that require a particular type of grounding solution?

2.1 Assessing the required Layers of Protection in the context of Question A:

With the exception of locations like laboratories that handle small quantities of flammable products, the act of grounding a piece of equipment identified as being a static discharge risk will be the responsibility of equipment operators, or in the case of road tanker and vacuum truck operations, the driver of the vehicle. Because static electricity is a complex technical subject *(some would even say akin to witchcraft!)* it can be hard for people who don't deal with it on a day-to-day basis to grasp the fundamentals of why it is a serious risk when assessed in the context of operations conducted in flammable atmospheres. An unhealthy paradigm of it ***"can't happen to me"*** can follow on from this lack of awareness especially when the hazard is neither a tangible nor visual risk that would trigger a natural safety related response from an individual.

As static electricity is neither a visible nor tangible hazard the main challenge is to get your company's operators to take responsibility for their own safety and the safety of their colleagues.

The most effective way of getting operators into the habit of grounding equipment on a routine basis is to deploy a grounding solution that requires a visual confirmation of a verified ground before the operation can start. If the operator has a visual reference point for knowing when the operation can begin, they can be trained to take responsibility for the action of grounding the equipment they are operating. The most effective method of indication is to use green indicators to communicate a **"GO"** situation and red indicators to communicate a **"NO GO"** situation. To really get their attention, pulsing LEDs can prove very effective at telling the operator that the resistance in the grounding circuit is being monitored on a continuous basis and that he/she needs to see a pulsing green light before, and throughout, the operation.

Fig. 2: Pulsing green ground status indicators provide operators with a visual reference point to ensure the equipment they are operating is grounded prior to, and during, the operation.

Some grounding solutions have in-built buzzers that can alert operators to a lost grounding connection, however, you do need to be careful when evaluating such equipment, as the audibility of the buzzers frequently become redundant when they are competing against the ambient noise levels of the immediate working environment, if the operator is out of the buzzer's effective audible range or if the operator must wear ear mufflers or protective ear plugs.

The benchmarks that should be in place to monitor grounding and bonding circuits should be based on the guidance outlined in the publications listed in Table 1. This will ensure your grounding solutions, hence your company, displays compliance with the leading authorities and latest state of the art in static grounding protection. Just to recap, any equipment of metallic construction like road tankers, railcars, IBCs, drums and powder processing systems should be monitored with a resistance not exceeding 10 ohms back to a verified earth grounding point. Type C bags manufactured in line with IEC and NFPA requirements should be monitored with 10 meg-ohm grounding systems and Type C bags manufactured to CENELEC requirements should be monitored with 100 meg-ohm grounding systems.

2.2 Assessing the required Layers of Protection in the context of Question B:

Visual indication and continuous ground circuit monitoring are two fundamental layers of protection that tend to go hand in hand. However, when there is no active grounding of the equipment and the operation is still running (thereby rapidly accumulating hazardous static charges) there must be additional controls in place that will prevent the equipment from rapidly accumulating hazardous electrostatic charges. Shutting down the movement of the material being processed will stop the generation of static electricity.

A common action is for the equipment operator to hit an emergency shutdown button to prevent further generation and accumulation of static electricity on the equipment he/she is operating. Depending on the nature of the operation, and with the best will in the world, people's attention can, and will, be diverted to other activities while the operation is running so in the event that grounding or bonding is lost an additional layer of protection that can be deployed is to shut down the operation automatically. Automatic shutdown can be achieved with grounding systems that carry output contacts which can be interlocked with a range of devices (switches, valves, PLCs) that can execute a shutdown in response to the monitoring circuit identifying a lost ground connection.

Visual indication is an effective layer of protection to get grounding in place before the process is started by the operator and interlocks are an additional layer of protection that ensure that an automatic shutdown, as opposed to a manual shutdown, prevents the rapid build-up of static electricity.

2.3 Assessing the required Layers of Protection in the context of Question C:

As highlighted already, there are many operations carried out in the hazardous process industries that require static grounding protection but the nature of the operation and the environments they are conducted in can vary greatly. Different zoning requirements coupled with the characteristics of the operation and the scale of the hazard, particularly the amount of flammable or combustible material at risk of ignition, can influence the kind of solution specified. This generally means that a "one-size-fits-all" off-the shelf grounding solution will not provide you with the layers of protection and installation flexibility you may require. The following examples help illustrate how different processes can have unique characteristics that can influence the type of grounding solution employed by your company.

2.3.1 Drumming operations require the repeated filling of drums on a continuous basis where the drums can be filled with fixed pumps that can fill four drums to a pallet, can be filled with fixed pumps on a rolling conveyor system or can be filled with portable pumps. Because such operations are typically carried out indoors, a number of Ex locations ranging from Zone 0 right through to Non-Hazardous areas could reflect a matrix of installation options and required layers of protection that provide the best fit for your static grounding application.

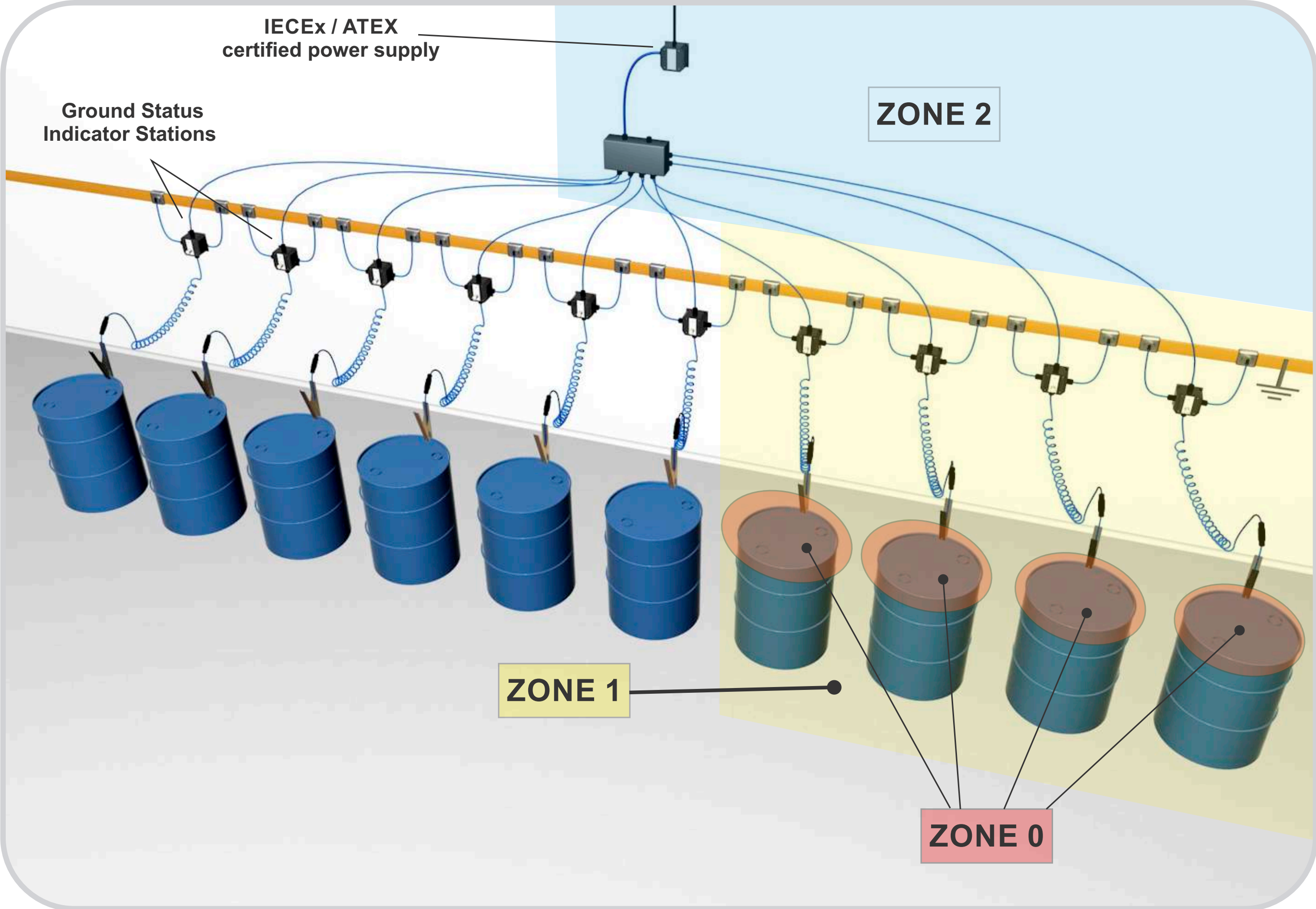

Fig. 3: Pulsing green ground status indicators provide operators with a visual reference point to ensure the equipment they are operating is grounded prior to, and during, the operation.

Imagine a scenario where up to 10 drums can be filled with portable pumps at a dedicated solvent filling location at any one time. Because the pumps are held by the operators and require the operators to continuously "eyeball" the liquid level in the drum, when management analyse the trade-off between interlocking the pumps with that of a manual shutdown by the worker operating the pump, they deem it OK for the operator to both start and stop the pump in response to a visual indication of each drum's ground connection. An ancillary benefit of determining this operation's required layers of protection, which is ground circuit monitoring in combination with a visual I.D. of the ground status of the drum, is that a solution like the **Bond-Rite® REMOTE** can be specified to monitor multiple drums off a single power supply on a 24/7 basis.

The benefit of this type of solution is that it closes the gap between no visual indication via "passive" grounding clamps and "off-the-shelf" grounding solutions with interlocks that require a 230 V AC mains supply or 24 V DC supply delivered to 10 separate grounding systems operating in the hazardous location. A solution like the **Bond-Rite® REMOTE**, which only requires a single 230 V AC or 24 V DC feed to its Zone 2/21 mounted power supply, can deliver Intrinsically Safe power to the 10 Zone 0 / 20 ground status indicators, which can then independently monitor the grounding status of each individual drum. If filling is carried out on a less routine basis, installation time can be reduced by specifying ground status indicators that are powered by their own internal battery.

2.3.2 Vacuum trucks provide a multitude of services to the hazardous process industries, with the primary role of cleaning out storage tanks and sucking up spills from loss of containment incidents. They also present one of the most complex problems in terms of assigning layers of protection that can control an electrostatic hazard in a safe and repeatable way. They process and transport large quantities of volatile flammable liquids and powders, often in less than perfect circumstances when it comes to controlling the presence of flammable atmospheres. They operate in many different locations, often in a remote setting, where there will be no ground monitoring systems in place for them to connect to and the speed at which material is transferred, which increases the rate of charge generation, can be very high. In short, the risk profile is pretty high and until recently all drivers could do was connect a passive grounding clamp to a metal object, like a tank shell, or piping, in the hope that he/she could ground the truck safely and reliably, without monitoring the grounding circuit or even knowing if the object he/she connected the clamp to had a verified true earth ground connection (see Fig. 1).

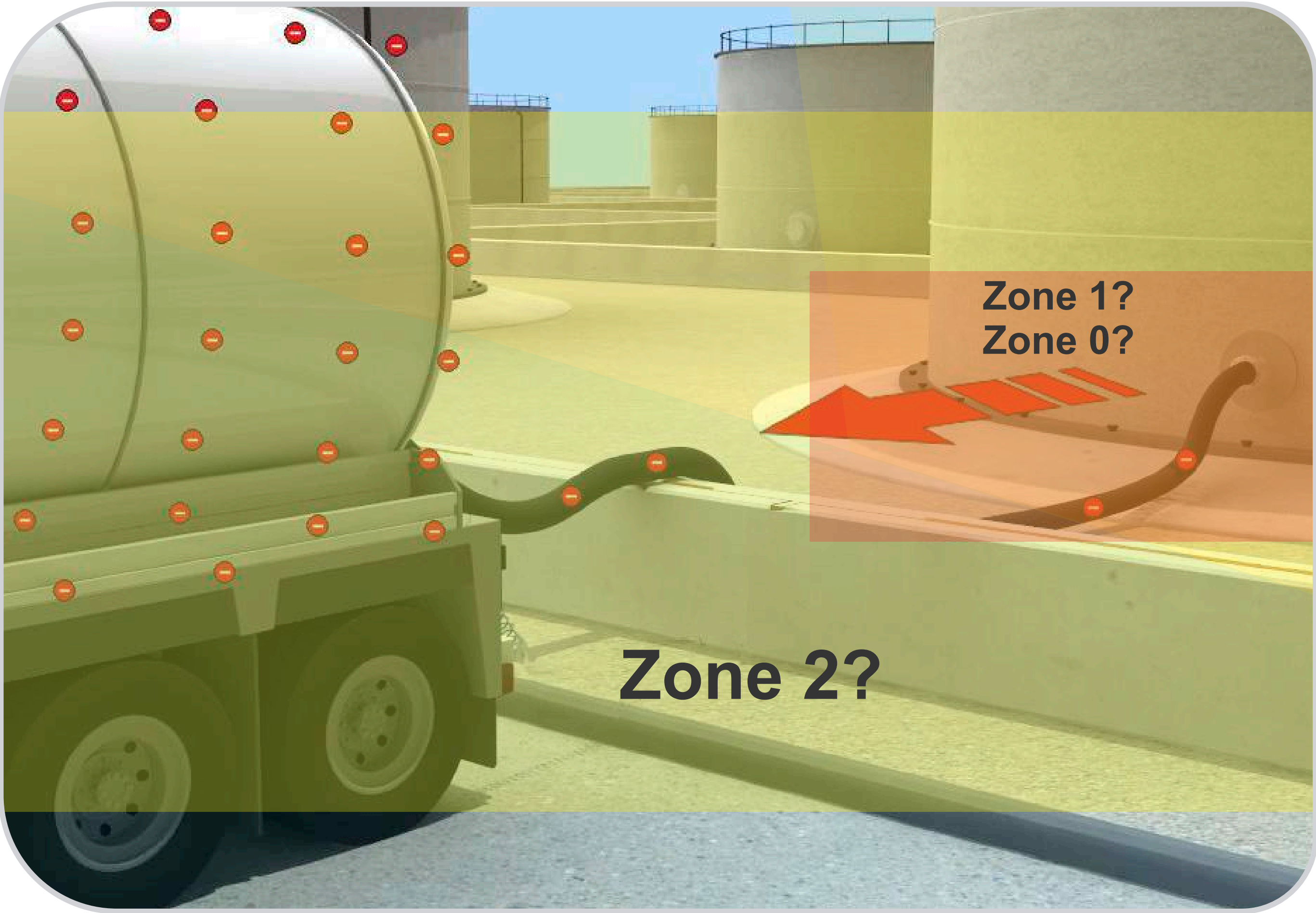

Fig. 4: Vacuum trucks operate in a multitude of environments ranging from Zone 0 areas right through to non-hazardous areas. Providing the right layers of protection from an electrostatic spark can be a significant challenge.

Nowadays, vacuum truck service providers and their clients can specify truck mounted grounding systems that will verify a connection to true earth; monitor the connection constantly, provide a visual indication of a verified ground to the driver and automatically shut down the operation if the ground connection is lost during the transfer. Due to the risk profile of this type of operation a solution like the **Earth-Rite® MGV** can provide the maximum layers of protection by ensuring:

1) The grounding point the truck is connected to IS connected to the general mass of the earth.
2) The driver has a visual indication of a good static ground connection so he can carry on with the job at hand.
3) The ground path between the truck and the verified grounding point is continuously monitored to 10 ohms.
4) A pair of output contacts can shut down the transfer operation if the ground connection is lost especially when the driver does not have a consistent view of the ground status indicators.

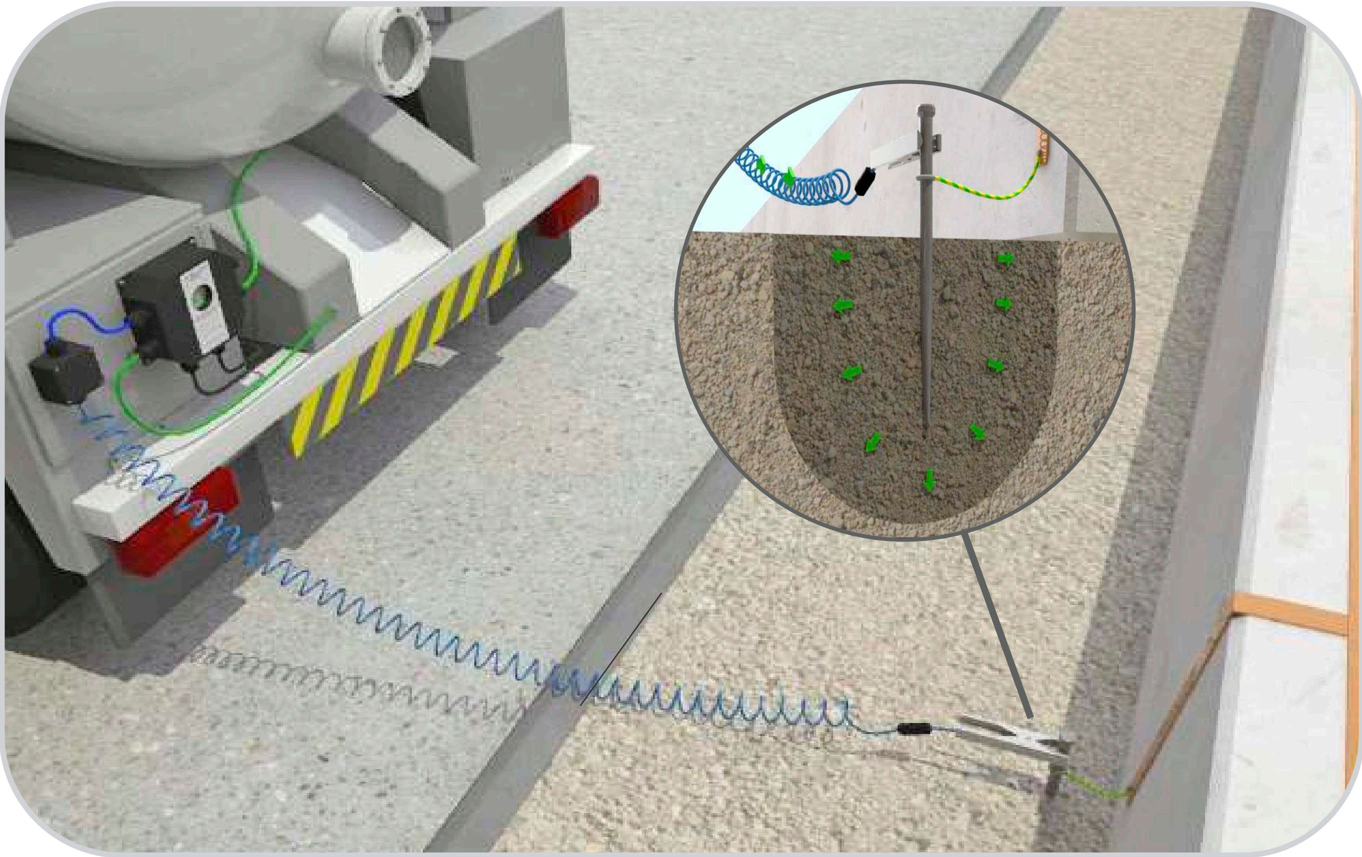

Fig. 5: A truck mounted static ground verification system with interlock control of the vacuuming operation reduces the electrostatic ignition risk profile of vacuum truck operations by a significant margin.

To select the solution that provides the best-fit, source solutions that can combine the features outlined in the columns of Fig. 6. Starting at the most basic level, you should avoid using devices like welding clamps and alligator clips as these devices are not designed with static grounding in mind, especially for the kinds of processes that require the penetration of an insulating layer like a paint coating or rust. Static grounding clamps should be subjected to FM testing to ensure they are suitable to use in hazardous areas. Following on from this, the grounding solution specified should combine the features outlined in Fig. 6.

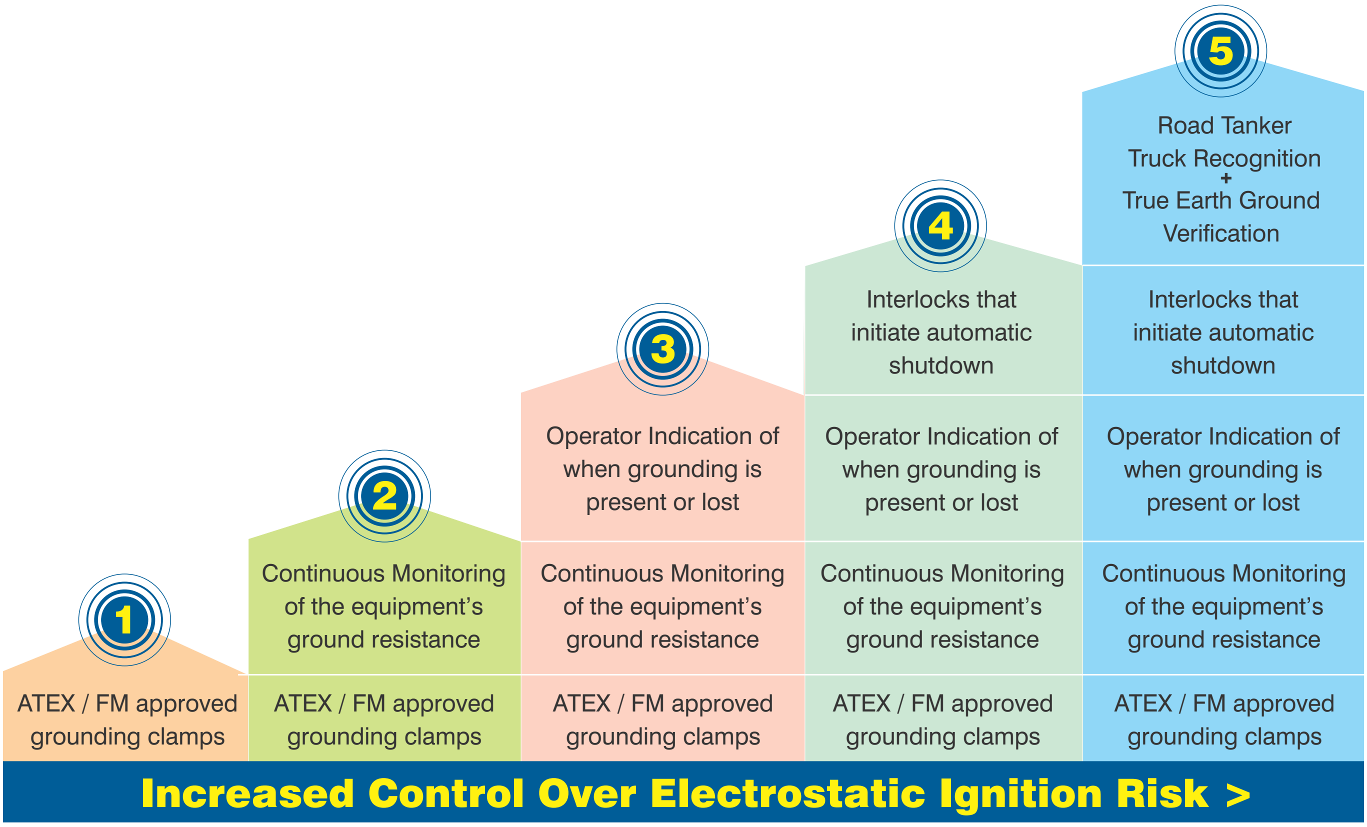

Fig. 6: grounding solutions can be selected based the layers of protection you require from the risk of an electrostatic ignition.

3. Selecting Hazardous Area Certified equipment:

Try to source grounding equipment that has been approved to standards that reflect the latest state of the art in respect of hazardous area "equipment protection techniques" in accordance with IECEx and EN standards. It's worth noting that all of the standards (the IEC 60079 family of standards for explosive atmospheres) that are utilised in terms of assessing equipment for ATEX are produced by the International Electrotechnical Commission on behalf of CENELEC. There are many ATEX certified devices, not just grounding devices, on the market today that have been approved to standards that have gone through several revisions, or are no longer in existence, since the devices were first approved. For example, the current standard for intrinsic safety, EN 60079-11 (2012), has been through two revisions since 2002, both of the superseding revisions being released in 2007 and in 2012 respectively. If grounding systems approved prior to 2007 were assessed by a Notified Body today, it is very probable that the device would need to be redesigned to match the requirements of EN 60079-11 today.

Summary

This guide will hopefully have provided you with enough information to get you started on the right path to buying static grounding solutions that best fits your company's operations and their risk profile. The foundations of your buying specification should be built on:

- Sourcing static grounding equipment that can demonstrate compliance with the latest state of art in static control, namely, IEC 60079-32-1, CLC/TR: 60079-32-1, NFPA 77 and API RP 2003.

- Determining the layers of protection you think will control the risk of an electrostatic ignition – this will help you identify a grounding solution that will provide the "best-fit" for your operations and your operators.

A company that truly specialise in static grounding protection should be contacted to help guide you through this process. Newson Gale has offices in the U.S., Europe and South East Asia with teams that are on hand to help you navigate your way to the right static grounding solution. Contact one of our offices today to get you started on the right path.

Examples of how different operations can result in discharges of static electricity:

It's worth noting that the common denominator in these incidents was that the operator(s) did not have a visual reference point for a verified ground connection.

news.bbc.co.uk/1/hi/england/nottinghamshire/8506055.stm

www.csb.gov/barton-solvents-flammable-liquid-explosion-and-fire/

United Kingdom
Newson Gale Ltd
Omega House
Private Road 8
Colwick, Nottingham
NG4 2JX, UK
+44 (0)115 940 7500
groundit@newson-gale.co.uk

Deutschland
IEP Technologies GmbH
Kaiserswerther Str. 85C
40878 Ratingen
Germany

+49 (0)2102 5889 0
erdung@newson-gale.de

United States
IEP Technologies, LLC
417-1 South Street
Marlborough, MA 01752
USA

+1 732 961 7610
groundit@newson-gale.com

South East Asia
Newson Gale S.E.A. Pte Ltd
136 Joo Seng Road, #03-01
Singapore
368360

+65 6704 9461
ngsea@newson-gale.com

www.newson-gale.co.uk

NG UK White Paper 29 260918