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Criteria you may want to consider when specifying an HAZLOC/EX static control solution

Experience of selecting solutions to mitigate against the ignition hazards of static electricity in HAZLOC/EX areas varies from those who are specifying static control solutions for the first time to those who specify solutions on a regular basis.

Although static electricity's role in igniting potentially combustible atmospheres is generally less well known than sources like electrical or mechanical sparks, there are dedicated International Standards and Recommended Practices that can provide a broad overview of the kinds of processes that can be susceptible to electrostatic discharges.

Recommended Practice

Two publications that provide a broad overview of static electricity and its role as an ignition source in operations carried in HAZLOC/EX areas are NFPA 77 "Recommended Practice on Static Electricity" and IEC 60079-32-1 "Explosive Atmospheres, Electrostatic Hazards, Guidance"*.

**This "Technical Specification" has been adopted by CENELEC and is referred to as CLC/TR 60079-32-1 "Explosive atmospheres. Electrostatic hazards, guidance".*

While not every process capable of generating static electricity can be addressed in a single publication, the more commonly used metal objects used in industry like road tankers, railcars, intermediate bulk containers (IBCs), drums or containers like FIBC are addressed.

3.3.22 of NFPA 77:

"3.3.22 Grounding. The process of connecting a conductive object to the ground, so that the object is at zero (0) electrical potential; also referred to as earthing."

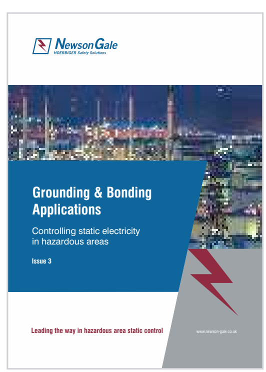
Generally speaking, grounding electrically conductive objects used in processes that are capable of generating electrostatic charge prevents the accumulation of electrostatic charge by equalizing the potential difference of the object with respect to earth.

13.1 of IEC 60079-32-1:
13.1 General

By far the most effective method of avoiding hazards due to static electricity is to connect all conductors to earth. This will avoid the most common problem which is the accumulation of charge on a conductor and the release of virtually all the stored energy as a single spark, to earth or to another conductor.

If static charge is permitted to accumulate on an object (e.g. filling an electrically isolated metal drum), then a voltage rise is likely to develop whereby the voltage of the object exceeds the breakdown voltage of the atmosphere surrounding the point at which a static discharge could occur. The primary hazard is that if the energy of the static discharge is higher than the minimum ignition energies (MIE) of a combustible atmosphere that happens to be present at the location of the discharge, ignition could occur.

Newson Gale's Grounding & Bonding Handbook identifies the processes at risk of discharging incendive electrostatic sparks into HAZLOC/EX atmospheres.



The handbook includes:

- Examples of the processes most commonly associated with electrostatic ignitions.
- Understanding static electricity and why it is a credible ignition source in HAZLOC/EX atmospheres.
- A wide range of solutions that enables HAZMAT engineers and QHSE professional demonstrate compliance with recommended practice.

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Benchmark values of electrical resistance

7.4.1.3.1 of NFPA 77:

7.4.1.3.1 Where the bonding/grounding system is all metal, resistance in continuous ground paths typically is less than 10 Ohms. Such systems include those having multiple components. Greater resistance usually indicates that the metal path is not continuous, usually because of loose connections or corrosion.

The electrical resistance between the object to be grounded and the general mass of earth is the critical benchmark for grounding equipment used in processes that could result in electrostatic charge accumulation. Although 1 Meg-Ohm resistance to earth is generally accepted as a resistance level that is adequate for dissipating static electricity, both NFPA 77 and IEC 60079-32-1, state that a resistance higher than 10 Ohms on a metal circuit (including the object to be grounded) can be indicative of loose, corroded or broken connections. Although many static grounding systems will monitor connection resistances that fall within a range of 1 Meg-Ohm, a valid benchmark to set for a permissive condition could be to follow the recommendations of NFPA 77 or IEC 60079-32-1 of 10 Ohms or less ($R \leq 10\ \Omega$).

13.2.2 "Practical Criteria" of IEC 60079-32-1:

Metallic items in good contact with earth should have a resistance to it of less than 10 Ω. Although a value of up to 1 MΩ is acceptable for static dissipation, values above 10 Ω may give an early indication of developing problems (e.g. corrosion or a loose connection) and should be investigated. It is important that all connections are reliable, permanent and not subject to deterioration.

Hence, the input criteria of a resistance of 10 Ohms or less ($R \leq 10\ \Omega$) can be defined as a primary condition for a grounding solution to indicate a positive connection between the object and the site's verified ground.

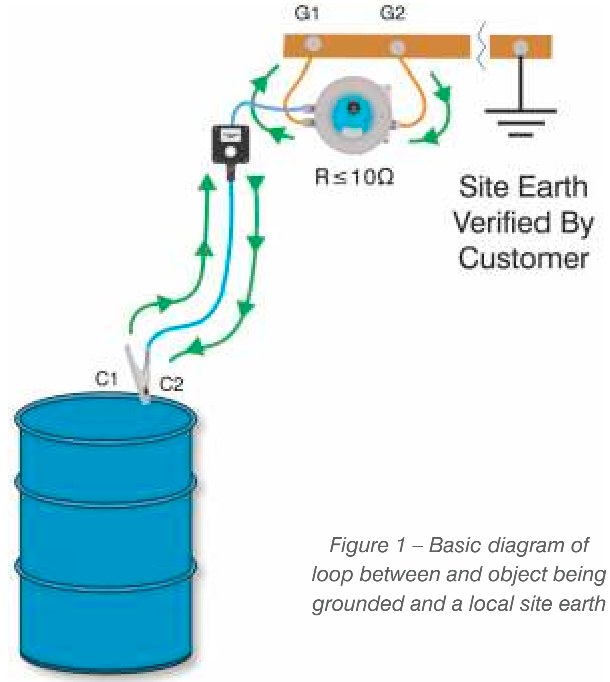

Figure 1 – Basic diagram of loop between and object being grounded and a local site earth

The connection to the general mass of earth can be achieved through the site's electrical grounding and lightning protection circuits. Many sites also use dedicated, permanently installed, ground rods to provide a static dissipation path to earth. Dedicated static grounding rods and electrical grounding and lightning protection circuits should be tested on a regular basis to ensure a low resistance connection to the general mass of the earth is maintained for the service life of such apparatus. Interconnecting conductors e.g. (busbars) should also be tested regularly to ensure a low resistance connection between the grounding point for process equipment and the verified ground.

7.4.1.3.1 of NFPA 77:

"A permanent or fixed grounding system that is acceptable for power circuits or for lightning protection is more than adequate for a static electricity grounding system."

13.4 IEC 60079-32-1
The establishment and monitoring of earthing systems

13.4.1 Design

"Where the bonding/earthing system is all metal, the resistance in continuous earth paths typically is less than 10 Ω. Such systems include those having multiple components. A greater resistance usually indicates that the metal path is not continuous, usually because of loose connections or corrosion. An earthing system that is acceptable for power circuits or for lightning protection is more than adequate for a static electricity earthing system."

Visual Indication of a ground connection

Day to day static grounding and bonding tasks are normally performed by process operators or vehicle drivers. In order to help operators and drivers follow static grounding standard operating procedures (SOPs), a visual reference of a ground connection can be a good reminder not to start the process until the grounding status of the equipment has been confirmed. This can support a "Clamp on First, Off Last" procedure by reminding operators that they should have a verifiable ground connection before they commence the process (e.g. filling an IBC) and not remove the ground connection until the process has been completed.

Green flashing LEDs are commonly used to convey a "good to go" situation. Flashing indicators can support the view that the grounding system is continuously monitoring the resistance of the connection to the equipment indicating that the overall resistance in the "ground loop" between the object and site's verified ground is 10 Ohms or less for the duration of the process. If the ground connection resistance is higher than 10 Ohms the indicator will not go green. This could be an indication of wire connections loosening or breaking or product deposits or paint coatings impeding a reliable electrical connection to the equipment.

Figure 2 – Tanker Truck being grounded to true earth via the bus bar and earth rod

Interlocks

In combination with visual indication, grounding systems with output contacts can be utilised to add an extra layer of control. Such systems, normally incorporating voltage free contacts (dry contacts) or intrinsically safe contacts, can be used to provide a permissive condition to equipment like pumps or PLCs when the grounding system input requirement (e.g. $R \leq 10$ Ohms resistance is established) is met. This helps site managers to promote a policy of "Clamp on First, Off Last" with respect to static grounding SOPs such that the process will not begin unless the grounding system has the necessary input(s) to provide a permissive output condition to the equipment controlling the movement of product.

Certification

It is essential that the hazardous area zoning classification (ATEX/IECEx), or Class and Division (North America), details of the location into which the equipment will be installed and operated is fully known prior to specifying static control equipment. This ensures that the equipment protection techniques designed into the grounding system are 3rd party certified for use in that area.

Installation

There is no point in specifying EX/HAZLOC certified systems only for them to not be installed in accordance with the manufacturer's instruction manual. Installations that do not reflect the manufacturer's instruction manual risk invalidating the system's certificate and use. It is essential that the site owner or electrical contractor ensure that the installer has the appropriate competency level to install equipment certified for installation and use in a hazardous area. From a certification standpoint, the instruction manual is a controlled document that will have been approved by the 3rd party certification body and should be reviewed before the installation begins. Under no circumstances should the installation be attempted without first consulting the manufacturer's instruction manual.

Operator Training

As operators will, for the majority of applications, be the people responsible for grounding or bonding equipment, it is essential that:

a) They are trained to understand why static electricity can pose an ignition risk for day-to-day operations.

b) They are trained on the correct use of static control equipment.

To do neither heightens the likelihood that they will not understand the inherent risks associated with electrostatic discharges. If the process characteristics permit it, the principle of "Clamp on First, Off Last" can be embedded in the static grounding SOP.

Applications

Although the range of processes at risk of charge generation are too numerous to discuss this Grounding & Bonding Handbook provides a general overview of some of the processes referred to in NFPA 77 and IEC 60079-32-1 and further information on static electricity as a potential ignition source.

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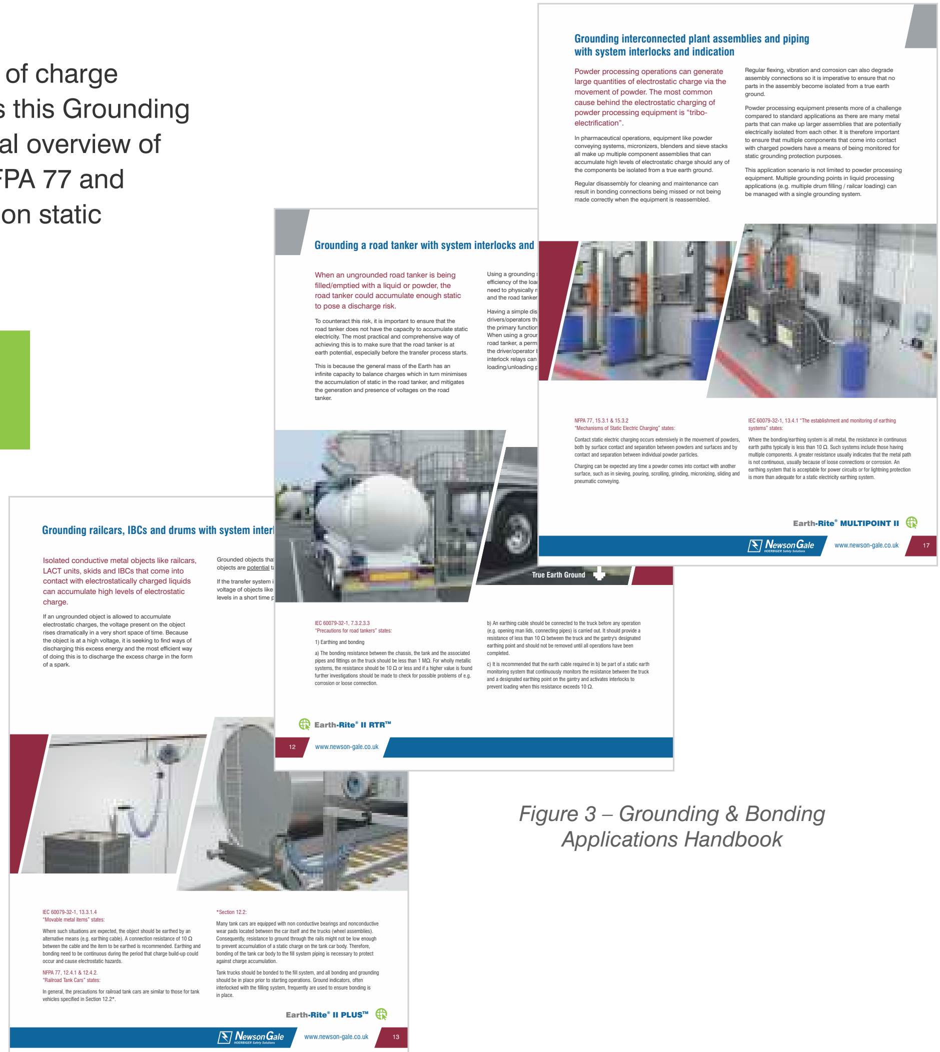

Figure 3 – Grounding & Bonding Applications Handbook

Leading the way in hazardous area static control

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