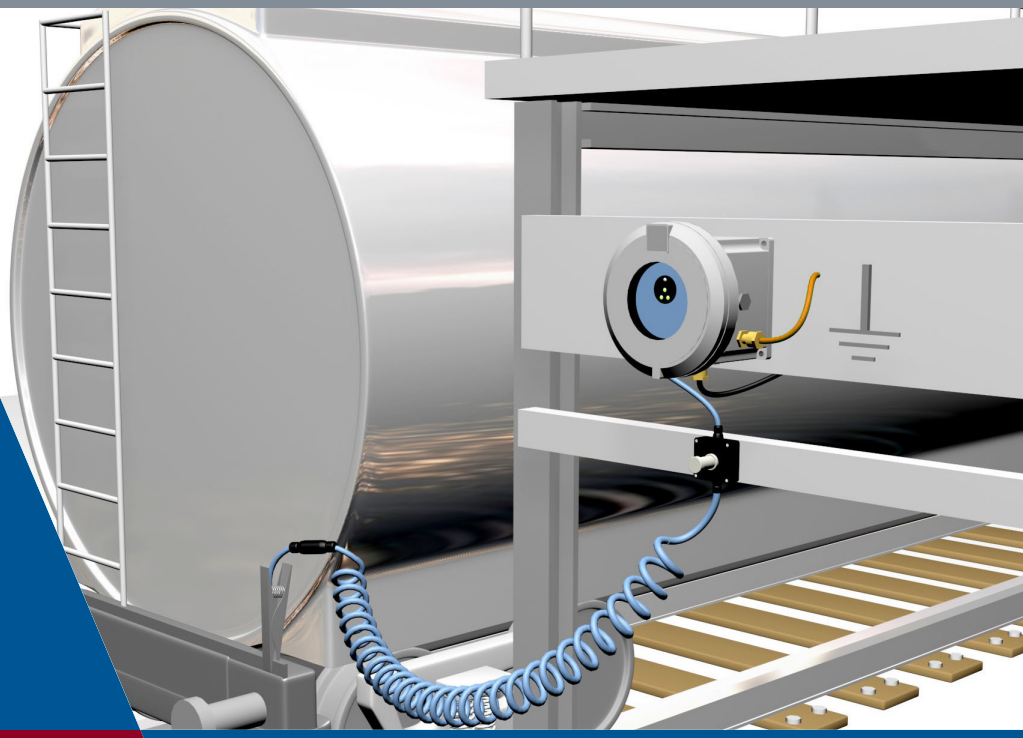
Leading the way in hazardous area static control

Application Spotlight



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HOERBIGER Safety Solutions

Earth-Rite® PLUS

Static Grounding Protection for Rail Tankers (Rail Cars or Railroad Tank Cars)

In the hazardous process industries, more commonly referred to as the Ex/Hazloc industries, static electricity is generated virtually all of the time. Various grades of crude oil, refined petroleum products like LPG, and a host of chemicals fall into a category of materials that are often referred to as "static accumulators". Materials in this category are known to be powerful attractors of electrons from other materials and resist "letting go" of electrons they come into contact with. In other words they "accumulate" static charge.

In a typical LACT unit or rack loading operation, the static accumulating product is transferred from, say, a truck, via the LACT unit or from a storage tank via a rack loading system into a receiving rail car. We can refer to the equipment involved in the transfer of product collectively as the product "transfer system".

> ***"As the product makes its way through the transfer system to the rail tanker, the molecules in the product become electrostatically charged."***

If the rail car does not have a direct connection to earth it will accumulate electrostatic charges on its surface, which will result in the voltage of the rail car rising dramatically in a very short space of time.

Because the rail car is at a high voltage, it will find ways of discharging this excess potential energy and the most efficient way of doing this is to discharge the excess electrons in the form of a spark.

Energy discharged in static sparks

Grounded objects that are in close proximity to charged objects are good targets for electrostatic sparks and permitting the uncontrolled accumulation of static electricity in an Ex/Hazloc atmosphere is no different to having an engine's spark plug exposed to a potentially flammable atmosphere.

If the transfer system is not grounded, the electrostatic voltage of the rail car can build up to hazardous levels in less than 20 seconds. Table 1 illustrates how much energy can be discharged by a spark from a rail car charged to 20,000 volts.

When the energy of the sparks discharged by static electricity is compared with the minimum ignition energies of a wide range of petroleum products and flammable chemicals, it's easy to see why the rail car and any equipment connected to it, like flexible hoses and piping, should be bonded and grounded to mitigate accidents.

As can be seen in Table 1, isolated rail cars can discharge sparks with a huge amount of energy. At these static spark energy levels the prevention of electrostatic shocks to workers is an important safety consideration. Involuntary physiological reactions caused by electrostatic shocks could lead to trips and falls and could be particularly hazardous when personnel are working above ground level.

Of the several factors that contribute to static charging, the one variable that must definitely be controlled is the grounding of the rail car. Grounding the rail car ensures that the rail car's resistance to the general mass of the earth is maintained at a level that does not impede the safe transfer of static charges from the rail car to ground.

Rail Car charged to 20,000 volts	Potential Spark Energy (mJ)
Rail Tanker	1,000

Table 1 - Potential energy of sparks from various objects

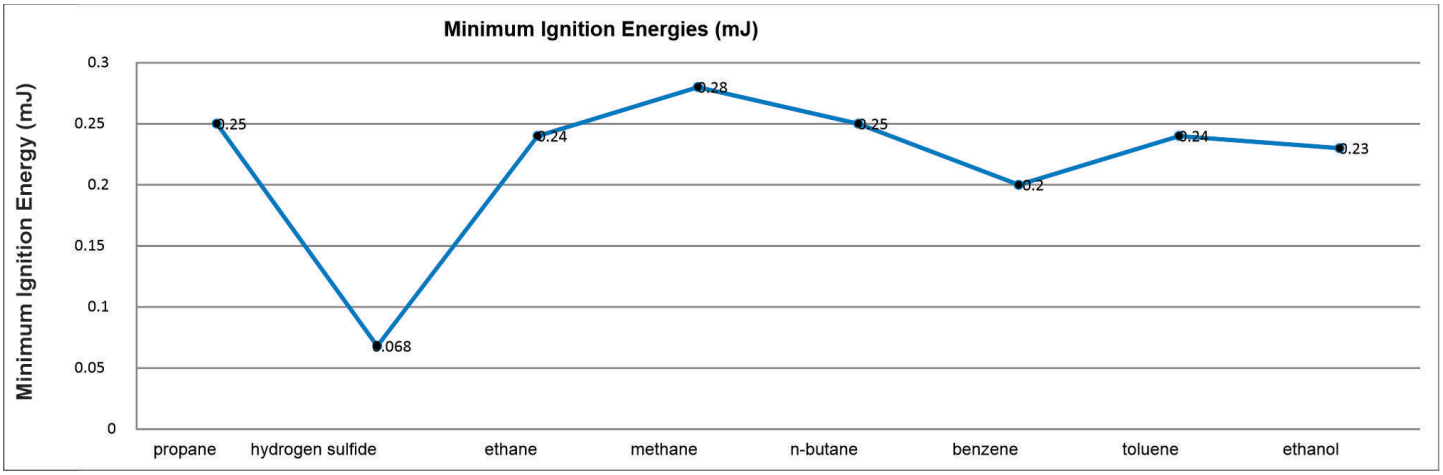

Fig. 1 - The MIEs of common petroleum products

In North America the grounding of rail cars with dedicated static grounding systems is common practice. In Europe, the practice of rail car grounding is mixed. Some sites do it, some don't. For sites that do not actively ground rail cars there is an assumption made that the tank of the rail car is well bonded to the chassis and that static charges generated by the product transfer operation can pass from the chassis through the rail cars wheels to earth or back to the loading gantry via bonding connections.

This is very rarely the case and it is better to fit a grounding system to ensure the safety of the product transfer and also provides compliance with International Standards, Guidance and/or Recommended Practices.

Relevant International Standards, Guidance and/or Recommended Practices related to the static grounding of rail cars in Ex/Hazloc atmospheres:

NFPA77 Section 12 – Railroad Tank Cars

API RP 2003 Section 4.3 – Tank Car Loading

IEC TS 60079-32 Section 7.3.2.3.4 - Precautions for Rail Tankers

What is clear from the recommendations of NFPA 77, API RP 2003 and IEC TS 60079-32-1 is that 10 Ohms in the grounding and bonding circuit is the maximum resistance recommended for equipment at risk of electrostatic charging in Ex/Hazloc atmospheres. While API RP 2003 goes one step further in recommending 1 Ohm or less, if a grounding system with signal lights is in use, 10 Ohms is satisfactory. This is because the grounding system is continuously monitoring the resistance in the grounding circuit, so that if it rises above 10 Ohms, the grounding system can signal this potential hazard to the operator of the loading rack or LACT unit. Another important recommendation is to use interlocks wherever possible, to ensure the transfer does not take place if grounding is not present. By halting the movement of product, the charge generation source is mitigated thus preventing additional charging of the rail car.

Specifying a Static Grounding System for rail car loading/unloading operations

One of the main problems with static electricity is that it is not something the operators can see, smell or hear. This characteristic of static electricity can, unfortunately, promote an attitude of "it can't happen to me" or "it doesn't exist" amongst personnel operating LACT units and loading rack systems. A grounding system that combines a simple visual "GO / NO GO" communication via a traffic light model of indication with interlock control capability is the most effective means of controlling the risk of ignitions caused by static electricity during rail car product transfer operations. Interlocking the transfer system with the grounding system is probably the ultimate layer of protection equipment specifiers and designers can take to ensure the rail car is grounded.

Earth-Rite® PLUS Static Grounding Protection for Rail Tankers (Rail Cars or Railroad Tank Cars)

Newson Gale recommends the Earth-Rite® PLUS for bonding rail cars to LACT units and loading rack superstructures. Along with demonstrating the full range of cCSAus, ATEX and IECEx certification for all gas and liquid vapor groups, it also ensures there is a 10 Ohm, or less, connection between the rail car and the product transfer system. This provides equipment specifiers with the ability to demonstrate full compliance with the recommendations of NFPA 77 and API RP 2003.

By simply connecting the grounding clamp to the tank car the Earth-Rite PLUS automatically verifies if the rail car is connected to the LACT unit or loading rack by delivering an Intrinsically Safe monitoring circuit to the system's Factory Mutual approved grounding clamp. The Factory Mutual approved stainless steel heavy duty grounding clamp ensures that a strong initial connection, via a pair of tungsten carbide teeth, is made to the rail car, and is then maintained for the duration of the product transfer operation, resisting movement caused by vibration or accidental dislodging.

Unlike standard grounding systems that rely on their non-monitored electrical ground connection to dissipate the static charges generated by the transfer, the Earth-Rite PLUS ensures that its dedicated static grounding connection to the LACT unit or loading rack is always monitored, via the static ground connections G1 and G2 (ref. Fig. 2). This ensures there is a monitored connection directly between the rail car and the LACT unit or loading rack.

> ***"This is an important feature as we are depending on the LACT unit / loading rack's verified ground connection to dissipate static charges from the rail car to the general mass of earth."***

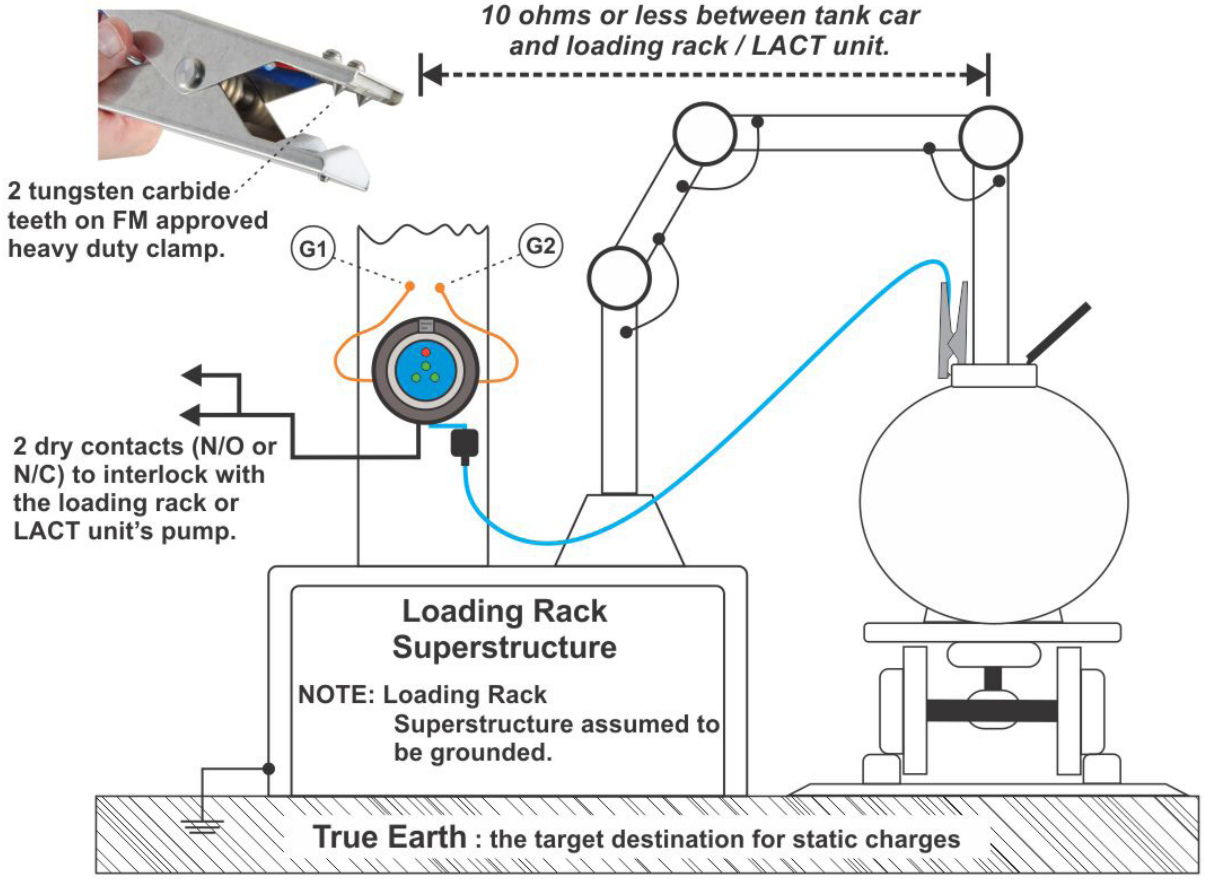

Fig. 2 - Typical Earth-Rite® PLUS rail car loading rack installation. The tungsten carbide teeth on the grounding clamp are the contact points for the intrinsically safe signal that verifies if the rail car is grounded to the loading rack (or LACT unit) through connections G1 & G2 with a resistance of 10 Ohms or less

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When the Earth-Rite PLUS verifies the rail car is bonded to the LACT unit or loading rack superstructure, a cluster of attention grabbing green high intensity LEDs pulse continuously to inform the operator that the system is actively monitoring the integrity of the ground loop.

A pair of dry contacts can be interlocked with the power delivered to the pump or PLCs to halt the product transfer operation if the Earth-Rite PLUS detects a resistance of more than 10 Ohms in the ground loop between the rail car and the product transfer system.

Shutting down the transfer operation ensures the generation of static electricity is stopped thereby mitigating the risk of the rail car accumulating a voltage and discharging a static spark which could ignite combustible flammable or dust atmospheres present in the spark discharge gap.

Some customers like to have 2 off grounding systems per rail car. One attached to the bogie and the other attached to the man way close to the loading arm.

Sometimes even sections of the loading arm itself are monitored to ensure that these sections do not become isolated from each other and ground.

The Earth-Rite PLUS can be powered off a 115 or 230 V AC source or 12/24 V DC source and is cCSAus approved Class I, Div.1 for gas groups A, B, C, D and all combustible dust and fibre groups E, F & G installations.

For more information on static grounding protection in Ex/Hazloc atmospheres, visit www.newson-gale.com

Fig. 3 - Earth-Rite® PLUS ground status indicators pulse continuously when grounding is in place

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