Road Tanker Transfers - **Our Safety Philosophy**

Static electricity is a phenomenon many of us are well aware of! As early as the 1960's petrochemical companies were so concerned with the hidden dangers of static electricity they conducted scientific research into understanding its physical nature and behaviour. The outcomes of this research proved that the transfer of charged flammable products into road tankers was one of many hazardous risks related to uncontrolled discharges of static electricity. An electrostatic discharge from a road tanker can contain upwards of 1000mJ of energy far exceeding the minimum ignition energy of a broad range of flammable vapours, liquids and dusts. To illustrate, **Table 1** shows the amount of energy required to ignite many hazardous substances that are transported on a regular basis, whereas **Table 2** shows how much charge potential can accumulate on a road tanker.

In Europe alone there is, on average, one major fire or explosion every week, which is linked to uncontrolled discharges of static electricity in hazardous areas. In the USA NFPA statistics show that on average there are 280 static-related fires and explosions reported to Fire Services annually, not to mention the number that go unreported, or do not have conclusive proof of static-caused ignition.

Electrostatic safety protocols developed by industry experts have been channelled into modern national and international standards ensuring best practise across a range of sectors integrated into petrochemical, pharmaceutical and food and beverage supply chains. Standards like Cenelec 50404 and NFPA 77 recommend the earthing of road tankers engaged in the loading or unloading of hazardous cargo. Today, road tanker earthing is standard practise for companies engaged in hazardous material transportation.

In the early days of road tanker earthing there were few cost-effective and time-efficient methods of ensuring that drivers were following road tanker earthing safety procedures. Allied to this risk was the fact that the majority of systems were made up of basic mechanical devices and cables, which were connected to items assumed to have a low impedance path to earth. However, mechanical and environmental wear and tear can easily inhibit the dissipative capacity of static earthing devices and cables. This situation can be particularly dangerous, as a hazardous incident may be the only indicator that an earthing device or cable was not doing its job effectively. Adding to this complexity, road tanker drivers in the modern era are assessed against metrics which are often linked to bonus incentives like on time delivery. As plant asset utilisation is a key accounting metric, production managers and engineers are increasingly working to tighter schedules in order to get work in progress to the next level of production. These time pressures translate back along the supply chain to product delivery schedules. Given these pressures it is easy to see why drivers can forget to earth their road tanker, or worse still, underestimate the importance of earthing road tankers.

In response to market demands to challenge this lack of visibility and accountability Newson Gale developed the Earth-Rite PLUS road tanker earthing system leading to the creation of Dual Mode technology. The guiding principle of the development project was that the road tanker body had to be continuously connected to earth before, during and after the transfer process.

To achieve this; two key conditions needed to be satisfied to ensure that personnel and assets were protected from static related hazard:

A: how could human decision making be controlled such that the driver had no choice but to follow a set protocol of earthing the road tanker?

B: how could personnel be confident the road tanker always had a reliable earth connection and would not be impeded from dissipating static over an infinite number of loading cycles?

contd.

Minimum Ignition Energies (MIE) of regularly transported gases, vapours and dusts in milli-joules (mJ).

	Material	MIE (mJ)
Liquid Vapour Gas	Gasoline	0.80
	Ethanol	0.65
	Propanol	0.65
	Ethyl acetate	0.46
	Methane	0.28
	Propane	0.25
	Ethane	0.24
	Hexane	0.24
	Methanol	0.14
	Acetylene	0.017
	Hydrogen	0.011
	Carbon disulphide	0.009
Powder	Zinc	200
	Wheat flour	50
	Polyethylene	30
	Sugar	30
	Magnesium	20
	Sulphur	15
	Aluminium	10
	Epoxy resin	9
	Zirconium	5

Table 1: Minimum Ignition Energy of explosive / flammable materials (Source: IChemE)

Stored Energy on Common Objects

Object	Capacitance (Pico Farads)	Stored energy @ 10kV (mJ)	Stored energy @ 30kV (mJ)
Road tanker	5000	250	2250
Person	200	10	90
Bucket	20	1	9
100mm flange	10	0.5	4.5
1/2" bolt	3	0.15	1.5

Table 2: Electrical energy stored on a range of common objects (Source: IChemE)

To ensure optimum product performance and reliability Newson Gale policy advocates the inclusion of international standards and best practice guidelines into product solutions.

For this project the challenge for the development team was to identify which parameters, supported by international standards, would indicate that personnel were working in known safe conditions.

Early in the development project it was clear that to control the risk of static ignition, the most effective and relevant output of the system would be its capability to control the flow of hazardous material. Cenelec 50404 (5.4.4.1.2) supports this theory by recommending the use of interlocks to prevent loading of hazardous material when an earthing cable is not connected to the object that requires earthing. In line with best practise the development team incorporated interlocking capability into the product solution.

To satisfy condition B, the engineers designed the system to monitor resistance in the circuit between the road tanker and the high integrity earth connection. This functionality enabled the system to continuously monitor the integrity of the circuit so that it engaged a fail-safe output when a specified threshold resistance was exceeded. Although different standards advocate a variety of resistance values as being adequate for dissipating static, NFPA 77 (6.4.1.3) was adopted as the target parameter for circuit monitoring. NFPA states that electrical resistance in a continuous circuit is normally less than 10 ohms. Levels of resistance higher than this indicates a potential fault with the circuit. This principle fits perfectly with the idea of monitoring the integrity of the circuit. If the system detects a spike above this threshold it can engage the interlock indicating a potential fault with the circuit. The key value proposition of this solution is the capability of the system to monitor resistance in real time ensuring static is dissipated effectively and offsetting the expenses associated with routine maintenance checks or the risk of them not being carried out on a regular basis.

As continuous monitoring of the circuit requires constant contact with the road tanker body, this method was expanded to satisfy condition A by making the road tanker body an identifiable circuit component. For this to work the road tanker needed to possess electrical properties that provided a means of isolating and measuring a unique, identifiable parameter. Research into the capacity of road tankers to generate and store charge had shown that the majority of road tankers shared a similar band of electrical capacitance (ref: Table 2). Given that this electrical property is measurable and likely to be a consistent parameter across industrial road tankers, the engineers developed the theory of identifying road tankers based on their values of electrical capacitance. The early phases of the R+D process established 2 key parameters that could satisfy the technical challenge of ensuring that:

(a): the road tanker body would have a parameter uniquely identifiable for confirmation based on capacitance (Farad).

(b): the circuit would have a benchmark parameter of resistance such that a rise above 10 ohms could be instantaneously measured and detected by the system.

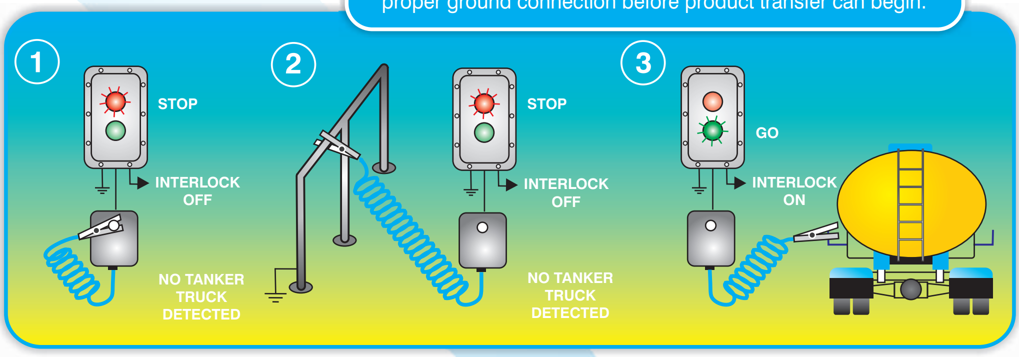
In the hardware development phase of the project the engineers investigated the opportunity of measuring and verifying both these parameters via one mode of measured impedance. To provide some background, electrical impedance in a circuit is made up of varying values of resistance, capacitance and inductance. Inductance was discounted, as no significant sources of inductance would be present in the circuit or local area of a road tanker.

Testing of the first prototype highlighted concerns about the reliability of this method. It was possible to enable the system go permissive when the values of capacitance and resistance were outside their safety critical limits. In the interests of developing a reliable solution, Newson Gale discarded the idea of using one mode of measurement for road tanker earthing.

In order to ensure that only a road tanker specifically and a resistance value of ≤10 ohms could enable material transfer to take place, the development team decided to measure the capacitance of the road tanker and the resistance in the circuit independently of each other. This operating principle ensured there could be no interference between both modes of measurement, thus eliminating spurious and inaccurate data that implied satisfactory earthing conditions.

This would require the system to perform two modes of measurement. One mode that exclusively sought the presence of a road tanker and the other mode that independently ensured electrical resistance levels in the static dissipative circuit were continuously monitored to a level of ≤10 ohms. If neither of these dual conditions was satisfied then material transfer could not commence or continue if initial conditions were satisfactory. The Dual Mode principle provided the optimum level of product performance and reliability, by measuring both parameters independently and by ensuring the system only went permissive if (a) and (b) were verified.

Tanker truck recognition and continuous monitoring of a proper ground connection before product transfer can begin.



Testing of the Dual Mode concept proved that the road tanker recognition component of the technology was capable of isolating and recognising the presence of road tankers. This combined well with the circuit-monitoring component, which verified if the circuit was in a good enough condition to dissipate static. This proved the road tanker recognition mode, combined with the resistance monitoring mode, would only engage an interlock provided the narrow band of road tanker capacitance and circuit resistance of ≤10 ohms were independently measured and verified. To summarise if the system is connected to objects other than a road tanker, the road tanker recognition component of Dual Mode technology will not permit the transfer of hazardous material. If the resistance in the static dissipative circuit rises above 10 ohms, the circuit-monitoring component will not permit the transfer of hazardous material.

In summary unless both conditions are satisfied, Dual Mode technology will ensure that personnel and company assets are not put at risk.

contd.

Over the past ten years Dual Mode technology has proven extremely reliable in real world operating conditions. To illustrate, other earthing systems that use road tanker recognition can suffer from parallel resistance shorting out the capacitance of road tankers present in wet conditions especially in coastal areas where the atmosphere has higher concentrations of salt. Combined values of road tanker capacitance and resistance can affect the lower threshold value of capacitive reactance, meaning the road tanker identification part of many systems need to be shutdown or overridden. The most suitable alternative to this scenario is to have a supervisor present at each loading point to ensure drivers are earthing their road tanker. Unfortunately this is not a cost-effective nor a 100% foolproof substitute for ensuring road tankers are correctly earthed. With the Earth-Rite PLUS system, the road tanker recognition check is not as sensitive to damp or salty conditions meaning road tanker recognition overrides are less commonplace. This level of reliability provides equipment owners and end-users with a unique competitive advantage maintaining continuous material transfer without sacrificing the safety of personnel and company assets.

Now in its 10th year on the market, Newson-Gale's Earth-Rite PLUS is synonymous with high quality product performance and reliability and has become the benchmark technology for road tanker earthing. In line with the company's policy of continuous product development and improvement, Newson Gale will continue to provide new and existing customers with solutions to static earthing problems packaged in value propositions that are second to none.

The Earth-Rite PLUS is ATEX approved for use in Zone 1 hazardous areas and forms part of Newson-Gale's comprehensive range of Cenelectrex earth monitoring and indicating systems designed for the safe control of static in hazardous areas.

For further information with regards to this article or any of our Cenelectrex® range of products or services, please do not hesitate to contact us.

This issue of Ear to the Ground was compiled by the Editorial Team at Newson Gale.
Newson Gale Ltd, Unit 6,Churchill Park,Colwick, Nottingham NG4 2HF,UK Tel:+44 (0)115 940 7500 Fax:+44 (0)115 940 750 e-mail: earthit@newson-gale.co.uk Web: www.newson-gale.co.uk
Newson Gale Inc, 1072 Madison Avenue, Lakewood, NJ 08701, USA. Tel: +1 732 987 7715 Fax:+1 732 791 2182 e-mail: groundit@newson-gale.com Web: www.newson-gale.com