



# Monitoring of earthing when loading and unloading explosion hazardous goods

## Safe prevention of an ignition due to electrostatic discharges

by Stephan Schultz



Figure 1: Explosion protected earth monitoring device in a tank filling plant

All of us are aware of the phenomena of electrostatic charging and their associated discharge in our daily routines. Who has not experienced the painful effects of electrostatic discharge just as they were about to press a switch.

If industrial processes are closely examined we find that there are countless sources for electrostatic charges. However, many of these sources are difficult to recognise and easy to overlook. As a result there are very often serious consequences for both people and machinery in explosion hazardous areas.

The ›Electrostatic charge causes ignition‹ article in the last issue of the Ex-Magazine

impressively described the case of the ignition of an explosive mixture during the loading of a mixer. Examination of the accident showed that the remnants of a cleaning agent formed an explosive atmosphere in the mixer. Filling of the mixer with a powdered plastic substances led to the electrostatic charging. The subsequent discharge caused ignition of the vapour atmosphere.

However, the planners and user of industrial plants are provided with measures to permanently avert these dangers. It is important to know the causes of electrostatic charge in order to properly apply these measures. When substances touch and then sepa-

rate the charge is separated. An electrically neutral object transfers a part of its charge when the substances contact the second object. As a result when the objects separate, one of them is charged positively and the other is charged negatively. This process occurs as described above in the following examples: when a mixer is being filled with a powder, when a liquid is being pumped through a pipe, when a person moves across a floor covering, or during spray painting.

The charge which is created always wants to equalize itself. On conductive materials the result is a very small current. On poorly conductive materials or isolated conductors, this compensation is not possible, and the charge accumulates as a result. An electrical field is built up between the different charges. If a breakdown field strength

### Two solutions with the new monitoring devices for monitored earthing of mobile fuel tank trucks

is achieved due to the physical proximity or the level of the charge, a discharge occurs. The energy of this discharge can achieve magnitudes which exceed the minimum ignition energies of a whole series of potentially explosive gas atmospheres (Table 1).

A discharge in hazardous areas should be avoided at all costs due to the potential risk of ignition. The most important countermeasure is safe leakage of the charge by potential equalization or earthing. For example, no materials that are poor electrical conductivity, should be used in explosion hazardous areas. The avoidance of potential sources of ignition by electrostatic charge is described in many international rules. In Europe, the CENELEC/TR 50404 ›Electrostatic code of practice for the avoidance of hazards due to static electricity‹ has existed since 2003, and has largely been incorporated into the German ›Berufsgenossenschaftliche Regel‹ 132 (rules of the German employer's liability insurance association). In the USA, the NFPA 77 (National Fire Protection Association) is applicable.

Transport and logistics involved with chemical and petrochemical products are by definition disproportionately affected by electrostatic charge phenomena. Every transport operation and stock relocation is inevitably

associated with friction, which is one of the main causes of electrostatic charge. This is particularly the case when a large quantity has to be moved in a very short period of time, as, for example, is the case when large tanks have to be filled and emptied. Permanently installed tanks do not present a particular challenge as regards to the safe leakage of charge via a connection to earth. This is, however, not the case with mobile containers such as barrels, tank containers, tank cars and tank wagons. A permanent connection to earth is not possible in such cases. Safe earthing must therefore be provided at the loading and unloading stations by suitable devices. In the simplest case this is performed using a flexible cable with a robust set of clamps. The clamps are simply applied to the most suitable part of the tank or barrel. It is essential to ensure that a conductive connection between the material of the tank and the earth is guaranteed. This initially sounds like a simple measure, but corrosion or paint on the surface can present high resistance, which prevents sufficient earthing. The way a tank container has been constructed can also present a further barrier, if, for example, the external metal frame is insulated from the actual tank using rubber buffers. If the personnel fail to notice this, the connection of the clamps to the frame is frequently faulty. The ›human‹ factor plays a decisive roll regarding safety in this case. Therefore, extensive training of the personnel and the use of safe earthing devices that feature a monitoring function is of large benefit.

#### Solutions for monitored earthing

R. STAHL provides solutions which ensure monitored earthing of mobile tank and container units. The new earth monitoring device type 8146/5075 assures on the one hand, the safe earthing of barrels, tank containers, tank cars and tank wagons, while on the other hand, permanently monitoring the connection to earth. If a sufficiently good contact is established to the tank unit to be earthed, a green light signals this state. Poor earthing is



Figure 2: Earth monitoring device 8146/5075

indicated when the red lights up. Furthermore, the user is provided with a contact that can be used for an additional signalling device, e.g. a horn, a indicator light or to control a safety valve. A safety valve can interrupt the filling process to a tank wagon if a poor earth is detected and ensures that the electrostatic charging does not reach a critical value. The technical codes of practice CENELEC/TR 50404 and NFPA 77 prescribe an interruption of the tank filling process with poor earthing.

The area in the direct vicinity of a tank normally is classified as to Zone 1. Therefore, both the device and the monitoring circuit must be suitable for use in Zone 1. The earth monitoring device 8146/5075 complies with the requirements of Equipment Category 2 in accordance with Directive 94/9/EC and is designed on the basis of Standard IEC 60079 for Zones 1 and 2. The full marking is therefore  $\text{Ex}$  II 2G EEx de [EEx ia] IIC T6. As a result, the earth monitoring device can be used universally. →

Object	Stored energy at 10 kV	Stored energy at 30 kV	Minimum ignition energy of		
			Propanol	Methane	Hexane
Fuel truck	250 mJ	2,250 mJ	0.65 mJ	0.28 mJ	0.24 mJ

Table 1: Comparison of electrostatic energy and minimum ignition energy

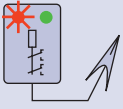
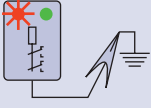
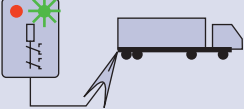
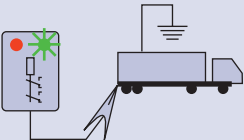
Method of operation: State of earthing	Reaction of earth monitoring device
 <p>Clamp is not connected, device in idle state</p>	<p>Earthing defective</p> <ul style="list-style-type: none"> <li>› Red indicator light ON</li> <li>› Green indicator light OFF</li> <li>› Switching contacts OPEN</li> </ul>
 <p>Clamp directly connected with earth, e.g. via the offloading platform</p>	<p>Earthing defective</p> <ul style="list-style-type: none"> <li>› Red indicator light ON</li> <li>› Green indicator light OFF</li> <li>› Switching contacts OPEN</li> </ul>
 <p>Clamp connected to the fuel tank truck</p>	<p>Earthing OK</p> <ul style="list-style-type: none"> <li>› Red indicator light OFF</li> <li>› Green indicator light ON</li> <li>› Switching contacts CLOSED</li> </ul>
 <p>Clamp connected to the fuel tank truck which is subsequently earthed, e.g. via the offloading arm</p>	<p>Earthing OK</p> <ul style="list-style-type: none"> <li>› Red indicator light OFF</li> <li>› Green indicator light ON</li> <li>› Switching contacts CLOSED</li> </ul>

Figure 3: Function for earthing with object recognition

### Earthing cable

Three different types of cable combined with rugged earthing clamps are available. The earthing clamps feature two hard tips, which establish a secure contact even on painted or corroded surfaces.

The earthing cables are generally subject to large mechanical strain in day-to-day use. Therefore, it is necessary to exchange them regularly. In order to facilitate a quick and simple exchange, the earth monitoring device 8146/5075 is provided with an Ex e connection chamber. The maintenance costs are thus reduced to a minimum.

### Summary and outlook

With earth monitoring devices 8146/5075 and UZCL3.d, the users and planners of plants in explosion hazardous areas are provided with two new solutions for monitoring the earthing of barrels, tank containers, tank cars and fuel tank trucks. They both feature safe functionality, simple handling and low maintenance costs.

### Monitoring earthing of fuel tank trucks

Rounding off its range for earthing mobile tank and container units, R. STAHL provides a further earthing system. The device with the designation UZCL3.d can detect if it is correctly connected to a fuel tank truck. A direct connection to a tank platform, a connection resistance that is too high or even the interruption of the connection is detected as faulty and indicated by a red indicator light. As with the 8146/5075, relay contacts are provided for valve actuation. The UZCL3.d is marked as follows:  $\text{Ex} \text{ II } 2\text{G EEx d [ia] IIB T4}$ .