

# The Dangers of Earthing an **Already-Charged** object

This article sets out to dispel the myths surrounding “safe” ways to earth an object after it has become inadvertently charged with static electricity in a potentially flammable atmosphere. It draws from a paper given at Explorisk 2002 by M. Glor and K. Schwenzfeuer of the Swiss Institute for the Promotion of Safety and Security ([www.swissi.ch](http://www.swissi.ch)), along with research carried out at Newson Gale Ltd.

It is generally understood that if a conductive object, such as a drum, is earthed with a suitable clamp and cable, before it is used in an operation, then it can never become charged with static electricity. However if the earth connection was forgotten and the object was allowed to become electro-statically charged, then approaching it with an earthed item, such as a grounding clamp, will cause a spark to be drawn from it, just before the earth contact is made. This spark discharge may cause the ignition of flammable gases, vapours or even some dusts, if they are present in optimum concentrations in the surrounding atmosphere.

The above is true, but it is not the full picture. A number of devices or methods are in use which rely on the fact that the grounding clamp is not directly in contact with earth, in order to prevent discharges. The two most common types are:

## The Open Earth Cable

Here the earth connection is broken by an isolation switch, usually in a flameproof enclosure built into the clamp or situated on the wall close by. The concept is that the clamp will not draw a spark from an object that may have become charged, as the clamp is not earthed until after it has been applied and the isolation switch has been turned to make the earth connection. It is said that any sparking will occur in the Exd enclosure.

This is a myth! A spark will not only occur between a charged object and an earthed clamp, but between a charged object and anything with enough electrical capacitance and at a lower electrical potential. Research has proved that, in practice, the clamp and cable length back to the switch has as much capacitance as a typical object to be earthed - possibly as much as a road tanker!

Hence, when the clamp comes close to the charged object, the capacitance of the clamp and cable will allow a spark to jump from the object, regardless of whether the isolation switch has broken the earth

connection or not. In practice, an even greater problem can occur with such a device: after connecting the clamp, the operator may forget to turn the switch, leaving the drum unearthed as the operation is commenced. This would allow the drum to become charged when, ordinarily, it would not have.

## Earth Cable with High Resistance

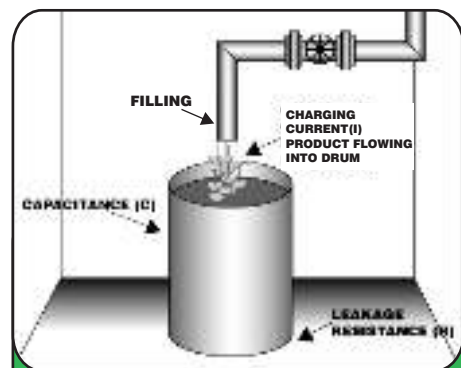
Here the earthing clamp contains a resistor, typically of around 1 megohm. The belief is that the clamp will not draw a spark from an object that may have become charged, as the resistance will impede the connection to earth and prevent it.

This is another false assumption! Experimentation has clearly shown that a 1 megohm resistance is not able to prevent incendive sparks. Even raising the resistance to 100 megohm or above will not do this and as the resistance is increased, the clamp and cable's ability to carry out its intended function of providing a good earth connection, is diminished. Moreover, an incendive spark is just as likely to jump across to the conductive body of a clamp, owing to the fact that it has its own electrical capacitance, when the clamp is brought into close proximity with the charged plant item.

## Safe Practice

Both of these methods lead the user into a false sense of security. In truth, it is essential to ensure that objects are earthed prior to being used in a static-generating operation. However, if an object has inadvertently been allowed to become charged in a potentially flammable area, the only safe ways to proceed are as follows:

1. Test the area with a gas detector (without getting too close to the drum) and if no flammable atmosphere is present, attach the clamp.
2. Leave the object for some considerable length of time, so that the charge can relax naturally. In practice, this could be several hours, depending on the situation.

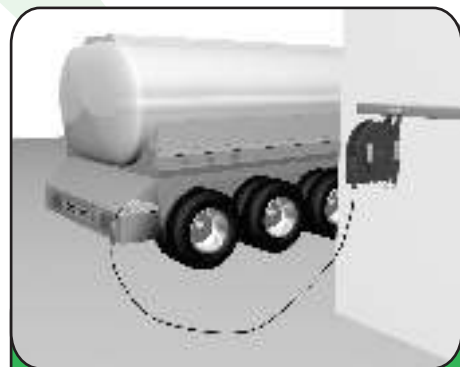


An example of how an object could become charged accidentally would be if the filling of a drum was to occur, thus providing relative movement between the product and the drum (and hence, a charging mechanism) when the drum had not been correctly earthed.

## Static Charge on Road Tankers

Finally, there is the widely held myth that a tanker earthing clamp must have some mechanism to prevent it drawing a spark from a charged object, since the tanker will arrive holding charge which it picked up on its journey.

In reality, road vehicles have slightly static-dissipative tyres that help to prevent the build up of charge by allowing the low levels of static electricity generated during motion to flow to earth via the road surface. The American Institute of Chemical Engineers publication “Avoiding Static Hazards in Chemical Operations” states that “there is negligible practical hazard from charging via road tyres”. In fact, if this were not the case, simply a person approaching a “charged” tanker would be in danger of drawing a considerable spark. As we have seen, it is not only an earthed clamp, but anything with sufficient capacitance and at a lower electrical potential that can cause this to occur.



Note: whilst the tanker tyres are capable of dissipating the relatively low levels of static electricity generated during travelling, they should not be relied upon to cope with the high charging mechanism of prolonged product transfer (often at speed) to or from the tanker. In order to control this level of static charging, a low resistance earth connection should always be used.

**Conclusion** To quote Messrs. Glor and Schwenzfeuer “An incendive spark discharge cannot be prevented by including a high resistance into the earth circuit. Experiments have shown that the resulting spark discharges are still able to ignite solvent vapours.... Even if the earth cable is first disconnected from earth, an incendive discharge will appear.”

Hence it can be seen that the best method of earthing moveable objects is to use regular ATEX approved clamps with continuous cables back to the earthing point. In order to prevent a static-generating operation from starting before the earthing clamp has been correctly attached, Earth Monitoring systems with interlocks to pumps, valves or mixers may be used, as recommended in the latest CENELEC “Code of Practice for the avoidance of hazards due to static electricity” (50404).