The Static Statistics | On a reported annual basis, the US accounts for an average of 280* reported industrial static related incidents while the UK and Europe account for an average of 50 and 350 incidents** respectively. Datasource * NFPA (USA), ** HSE (UK).

Grounding Clamps and Cables – Essentials for safety and reliability

Grounding (also known as Earthing) clamps connected via cables to identified ground points are the established and proven method of preventing electrostatic charge accumulating on movable or fixed items of plant in flammable and explosive atmospheres.

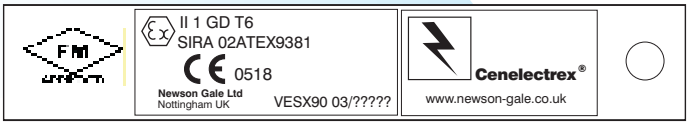
With batch processes often operations requiring many hundreds or even thousands of earth connections to be made and broken every day it is essential good earth contact is made each and every time. The effectiveness, reliability and durability of any earthing clamp and associated cabling is therefore key to keeping process operations safe from the dangers of a static discharge.

In the coatings, resins, adhesives, paints, solvents, explosive or combustible powders and related industries, it is common that process plant, associated containers, drums and IBC's can build up layers of product or rust, or have surface coatings present. These layers can form an unpredictable insulating barrier that can easily defeat certain designs of clamps and other "in-house" methods of making earth connections.

Clamp Approvals

The importance of effective clamp design and its suitability for use in flammable atmospheres has not gone unnoticed by regulatory and approval bodies around the globe. Under ATEX, earthing clamps must meet specific criteria to be certified as suitable for use in hazardous areas. For example, an earthing clamp made from aluminium must be coated with material that will not contribute to mechanical sparking under normal operating conditions if it is to be used in a Zone 0 or 20. There are also limitations placed on the amount of plastic that may be used in the clamp body as this may enable surface accumulation of static charge, as well as the obvious problems of durability, resistance to chemical attack, and thermal stability. Clamps are also assessed for sources of potentially stored energy and their ability to cause a spark if the energy is released in the hazardous area. One major energy source in earthing clamps is the spring. This has the potential to generate a mechanical spark through contact with other objects if its escapes the body of the clamp. Therefore clamps are tested for their structural robustness to ensure any stored energy is reliably contained within the clamp.

Combined with structural robustness testing, US approval bodies such as FM Global assess several other design criteria regarded as being essential for static earthing clamps. For use in hazardous locations, the electrical resistance across the clamp, including contacts and clamp body must not exceed 1 Ohm when attached to plant equipment. Additional tests ensure the clamp must be suitable for use in normal industrial conditions. The clamp must pass separation force testing, minimum-clamping force testing and vibration testing at varying frequencies to ensure that approved clamps guarantee positive and stable contact with mobile or portable plant equipment.



Typical markings to be found on an ATEX and/or FM approved clamps

Newson Gale Studies

Engineers at Newson Gale have studied the effect of product accumulation, rust build up and protective coatings on the ability of earthing clamps to dissipate static effectively. Lab tests, designed to reflect real world operating conditions, have been conducted to investigate the impact layers of protective coatings and adhesives can have on the ability of clamps to establish positive contact with strips of conductive metal. Based on earthing clamp approval requirements, the benchmark clamp resistance test was set at 1 Ohm.

The tests showed some surprising results. Most notably, in the 'Coatings Test' even the thinnest layers (400 µm) provided a wide range of clamp resistance readings that varied based on clamp design. The test indicated the highest levels of clamp resistance (upwards of $1x10^6$ Ohm) were exhibited in clamps with varying combinations of high surface area contact with poor to good spring pressure. The clamps that exhibited consistent positive values (less than 1 Ohm) combined low surface area contact with good spring pressure. Low surface area contact, achieved via sharpened tips (typically manufactured from Tungsten Carbide or Stainless Steel) supported by good spring pressure, enabled penetration of the entire range of test coatings.

Test Data

- Paint coating thickness 300µm - 675µm
- Ohm meter range 0 - 1000 Ohms
- From the range of purpose designed static grounding clamps tested 64% failed
- 100% failure rate for standard welding clips

The 'Adhesive Test' proved the most challenging for all the clamps tested. A 1mm layer of adhesive was applied to metal conductive strips and all clamps failed at initial clamping. When the clamps were then permitted some "jigging" by hand to dislodge the adhesive, the clamps that passed the coatings test, subsequently passed the adhesive test. Rusted and corroded clamps were also tested for values of resistance. These test results were alarmingly high, even on clean surface tests.

The tests effectively demonstrate that product deposits can severely compromise accepted good earthing methods. Of particular note, welding clamps, alligator clips and copper cables wound around plant equipment showed values of electrical resistance that exceeded generally accepted safe test levels for static electricity.

Grounding and Bonding Cables

Effective Clamps need cables and connections that can stand up to the rigours of industrial use. Due to their mechanical strength multi-stranded steel cables provide much longer lifetime use than copper braids or cables which can easily work harden with constant movement. In manufacturing areas where corrosion is a problem multi-stranded stainless steel cabling is available.

Trailing or taut earthing wires and cables can be a major trip hazard in the work place. Use of brightly coloured highly visible sheathed cable (in accordance with IEC 60446) clearly identifies the cable is for static earthing as opposed to electrical earth use. Hytrel covered cable with proven resistance to abrasion, mechanical wear and most types of chemical corrosion when used in a retractable spiral, keeps earth cable handling simple, and options are available with a special anti-static treatment to even prevent a surface charge accumulating on the cable coating.

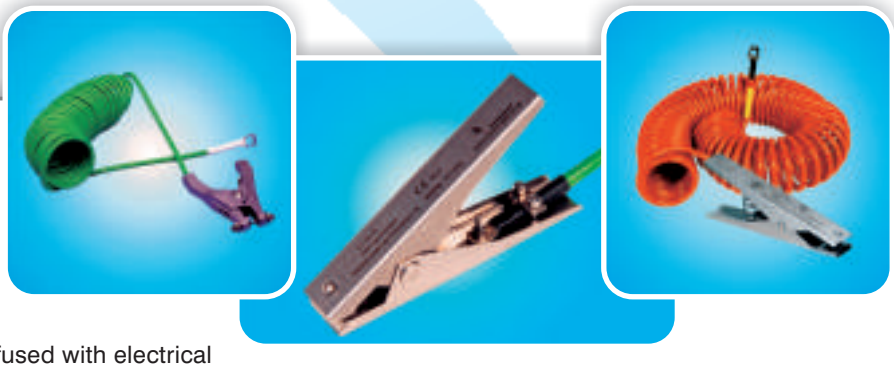
Maintenance

Regularly inspecting and recording the integrity of bonds to designated earth points is essential. The integrity of bonds can be tested in hazardous areas with Intrinsically Safe portable instruments, which provide a simple reading to ensure the clamp is making effective and positive contact with the plant equipment, and that the bonding cable is properly attached to the local earth point.

Conclusion

It is easy to assume that the use of simple clamps will automatically eliminate the risk posed by static electricity. However, the complexity of dissipating static effectively requires careful planning and a sound approach to risk management.

Regulatory & Approval bodies in Europe and in North America emphasise the importance of using specially designed earthing clamps that are both fit for the purposes of dissipating static safely and for use in industrial environments. For ultra-critical applications with extremely sensitive flammable/explosive atmospheres, where a low resistance bond to earth is absolutely vital, self-testing clamps and indicating/interlock systems are recommended. Working to these standards and guidelines is the way to ensure plant and personnel are protected from the ever-present and hidden dangers of static electricity.



Cable Colours

There are no mandated identifying colours for sheathed static earthing cables, however due attention should be paid to IEC60446, and the importance of selecting colours which cannot be confused with electrical "fault current" or circuit protective conductors. In Europe Cenelectrex 'Cen-Stat" single core cable is GREEN to distinguish it from the green/yellow used for electrical earthing. Cen-Stat ORANGE cable is used to denote single core static grounding cables in North America.

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.
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