Grounding Clamps and Cables – the fundamentals to getting it right.

30
Autumn
2014

Grounding clamps connected via cables to identified earthing points are the established and proven method of preventing electrostatic discharges from movable or fixed items of plant in flammable atmospheres.

With some operations requiring hundreds of connections to be made and broken every day it is essential that a good electrical connection is made each and every time. The effectiveness, reliability and durability of any static grounding clamp and associated cabling is fundamental to keeping process operations safe from the dangers of an incendive static spark discharge.

It is common for process plant, associated containers, drums and IBC's to 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 like alligator clips and other "in-house" methods of static grounding protection.

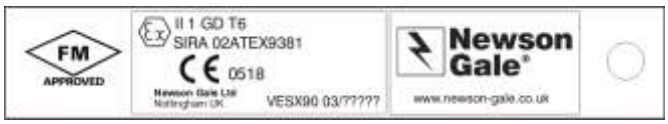
Clamp Approvals

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, static grounding clamps must meet specific criteria to be certified as suitable for use in hazardous areas. For example, grounding clamps made from aluminium must be anodized to prevent mechanical sparking under normal operating conditions if they are to be used in a Zone 0 or Zone 20 atmosphere. There are also limitations placed on the amount of plastic that may be used in the clamp body as this may enable the accumulation of static charge. Under an ATEX assessment grounding clamps are also assessed for sources of stored energy and their ability to cause a spark if the energy is released in the hazardous area. One potential source of energy in grounding clamps is the spring which has the potential to generate a mechanical spark through contact with other objects if its escapes the body of the clamp. Therefore clamps are assessed for their structural robustness to ensure any stored energy is reliably contained within the clamp.

US approval bodies such as FM Global assess several other design criteria regarded as critical for static grounding clamp performance.

For use in hazardous locations, the electrical resistance through the clamp, including through the contacts and the 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. To achieve FM approval grounding clamps must undergo, and pass, the criteria set by the following tests:

- **Separation force testing:** to ensure clamps are not easily or accidentally displaced during operations.
- **Clamp pressure testing:** to ensure the clamp contacts can penetrate connection inhibitors like rust, coatings and product deposits and make a positive connection to equipment requiring static grounding protection.
- **Vibration testing:** at varying frequencies to ensure that approved clamps guarantee positive and stable contact with vibrating and portable plant equipment.
- Have a **maximum resistance** through the clamp body of 1 ohm.



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

Newson Gale Studies

Lab tests, designed to reflect real world operating conditions, were 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 metal. Based on Factory Mutual static grounding 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 100 meg-ohm) were exhibited in clamps with varying combinations of high surface area contact and poor to good spring pressure – e.g. alligator clips.

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 teeth (typically manufactured from tungsten carbide or stainless steel) supported by good spring pressure, enabled penetration of the entire range of test coatings.

Tungsten Carbide Tips (Cen-Stat™ X45)

The '**Adhesives Test**' proved the most challenging for all the clamps tested. A 1 mm layer of adhesive was applied to metal strips and all clamps failed at initial connection. 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 demonstrated that protective coatings and product deposits can severely compromise clamps/clips that are regularly used for static grounding protection. Of particular note, welding clamps, alligator clips and copper cables wound around plant equipment showed values of electrical resistance that exceeded accepted safe test levels for static electricity.

Test Outcomes:

From the range of externally sourced clamps tested 64% failed the Coatings Test. There was a 100% failure rate for standard welding clips on the Adhesives Test.

Grounding and Bonding Cables

Effective grounding 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 over 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 should be used. In accordance with the BSI's **PD IEC/TS 60079-32-1 "Explosive Atmospheres: Electrostatic hazards, guidance"** the maximum benchmark resistance through such cables must 10 ohms or less. Hence the primary concern with such cables is their mechanical strength and robustness – not their current carrying capacity.

Trailing or taut static grounding wires and cables can be a major trip hazard in the work place. Use of brightly coloured high visibility cable coatings (in accordance with IEC 60446) clearly identifies the cable is for static grounding protection as opposed to electrical fault protection.

There are no mandated identifying colours for dedicated static grounding cables, however due attention should be paid to IEC60446, and the importance of selecting colours which cannot be confused with electrical fault and lightning protection circuits. In Europe '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.

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

Regulatory and approval bodies in Europe and North America emphasise the importance of using specially designed static grounding clamps that are fit for the purposes of dissipating electrostatic charges safely and are robust enough for use in industrial environments. FM approved clamps are especially significant as they have been subjected to mechanical and electrical tests that validate their use as a static grounding clamp. For ultra-critical applications with extremely sensitive flammable/explosive atmospheres, where a low resistance bond to earth is absolutely vital, self-testing clamps and inter-lockable grounding systems with visual indication are recommended.

ATHEX bvba
Industrial Suppliers
official distributor of
Newson Gale Ltd.

www.athex.eu/blog
www.athex.eu/twitter
www.athex.eu/newson-gale
info@athex.eu

Headquarters
Vierselbaan 40 unit 10
2240 Zandhoven
Belgium
Tel +32 (0)3 653 21 82
Fax +32 (0)3 653 21 61

Pilot Office
Rotterdam City Centre
Weena 290
3012 NJ Rotterdam
The Netherlands
Tel +31 (0)10 496 3614
Fax +31 (0)10 282 1222