Ansell

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Antistatic Overview:
EN 1149 vs EN 16350

Guidelines for PPE worn by workers who require protection in explosive (ATEX) environments or settings that increase the risk of electrostatic charges.

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***Antistatic Overview* | EN 1149 vs EN 16350**

Antistatic and gloves – a history

1994 to 2003

Antistatic properties for gloves formed part of the EN 388 standard. This included a volume resistivity test in which the gloves were tested and needed to achieve a resistance of <1 x 10^9 Ohms per cm in order to pass.

From 2003 to 2013

Once EN 420 was brought into effect in 2003 describing the general requirements for gloves, it stipulated that the electrostatic property test should no longer sit within EN 388 and in fact testing under the clothing standard EN 1149 should be used. No set requirements were stipulated for a "pass" or a "fail" and EN 420 states that no icon should be present on the gloves, irrelevant of the score. As the clothing tests were used, the clothing requirement for a "pass" or "fail" were frequently used to determine the gloves' electrostatic properties.

From 2014 to 2020

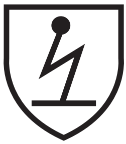
EN 16350 is introduced which uses the Vertical resistance test of EN 1149-2 but unlike EN 1149-2, EN 16350 sets requirements to define the gloves' electrostatic properties. Even with a score of below 1 x 10^8 Ohms (100 MegaOhms), which is considered a pass to be used to mark the product.

From 2020 onwards

With the EN ISO 21420:2020 revision, should a glove pass the EN 16350 test, gloves can be stamped with the icon in the following page.

Antistatic Overview | EN 1149 vs EN 16350

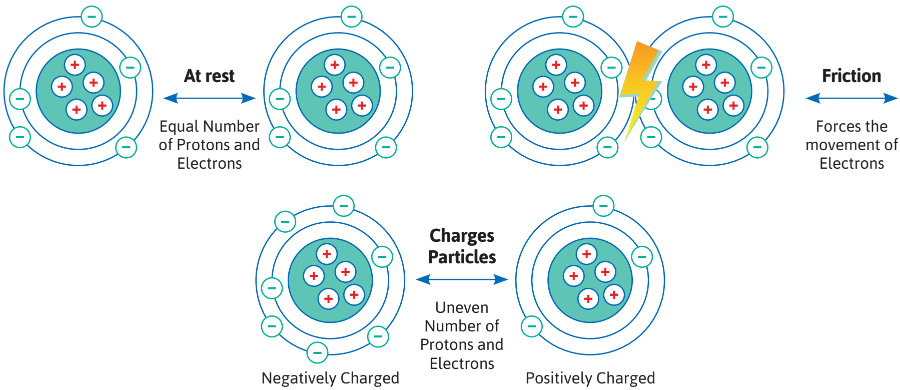
What is static electricity and why is it important to manage?



There are numerous causes of static electricity, however at its core static electricity is a naturally occurring process **caused by the transfer of electrons from one material to another,** disrupting electrical neutrality and giving a material a positive or negative charge. This charge can then be transferred onto another material through a static discharge.

The most basic explanation of static electricity is a buildup/store of energy, on the surface or within an object which needs to be either released **through** the object or be **transferred** to another object.

Example of Friction causing charged particles:

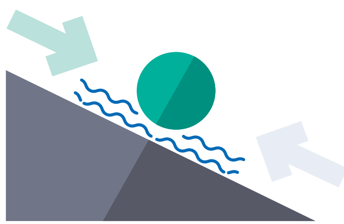


The level of static energy produced depends **on how the static electricity is generated and the type of materials generating the movement of electrons.** There are various ways in which static electricity can be generated:

Contact induced, i.e. friction *(Triboelectric effect)*

How is the most common type of static electricity created? **When physical contact between materials causes friction** - often due to the contact and separation of the materials. This contact and separation transfer the electrons from one surface to another. Real world examples include:

- Running a brush through hair
- Socks rubbing on a carpet
- Rubbing a balloon on your hair
- Lightning (due to friction of ice particles in clouds)



Antistatic Overview | EN 1149 vs EN 16350

Pressure-induced *(Piezoelectric effect)*

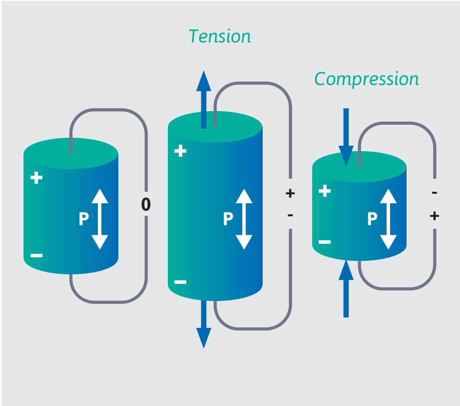
Caused when **mechanical stress,** such as being exposed to high pressure environments, causes the electrons to separate and transfer. This is mainly caused in crystal and ceramic molecules

Heat-induced *(Pyroelectric effect)*

When **heating the material causes the electrons to separate and transfer.** This is closely linked to pressure-induced and is mostly found in crystals.

Charge-induced

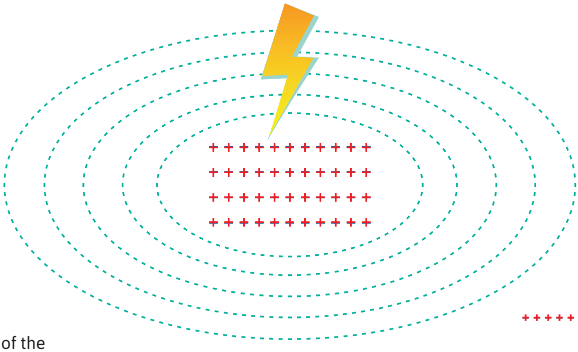
Caused when an **electrically charged object is brought close to a neutral object** causing electrons to move.



Static electricity, in contrast to current electricity, **stays on the surface of a material until it is able to move through contact with another material.** It is this holding and generation of a static charge which **is the risk to be managed when it comes to PPE.** Testing of PPE is carried out to assess its electrostatic properties and how little charge build up there is on/within a material. **Static discharges can destroy assembly components and at worst cause explosions on site.**

Examples of how the charge is distributed:

A static discharge is generated when a sufficiently high electric field creates an ionized, electrically conductive channel through a normally insulating medium such as air or other gases



The distance the static charge can travel is directly linked to the size of the electric field generated

++++++ Electric field with charged object

------- Electric field

Many common solutions to managing environmental static build-up, such as opening a window or using a humidifier are simply not possible within many manufacturing environments, so **it's down to the PPE to help manage static build up and protect employees and products.**

Antistatic Overview | EN 1149 vs EN 16350

Where is it most important to manage static?

It is most important to use antistatic PPE to manage static discharge in flammable atmospheres in a variety of work environments.

Flammable Atmospheres:	***Examples:***
Vapour-Dust	Styrene, heptane, alcohols, and ketones when mixed in containers which aren't cleaned properly leaving dusts such as polypropylene, polyethylene, polyvinyl alcohol, maleic anhydride, aluminum isopropoxide, rubber powders
Dusts	Aluminum / polyethylene / bisphenol / sulphur
Gases	Hydrogen - either directly or through reaction (hydrochloric acid / hydrogen peroxide / hydrogen sulphide)
Gas-Dust	Ethylene-polyethylene / propylene-polypropylene
Vapours	Toluene / gasoline / hexane / benzene / ethyl acetate / ethanol / xylene / methanol / acetone / naphtha / styrene

Working in these environments requires workers to be properly protected **using the correct PPE and be properly earthed via dissipative footwear / earthing straps / clothing with the correct level of electrostatic properties.**

Most common causes of static charging:

Causes of charging


Discharge by leakages


Peeling


Spraying


Liquid flow


Friction

There are multiple types of static discharge within applications, however, over **70% of accidents are caused by a static spark.** These sparks can form from handling various items such as:

Metal parts of cleaning tools, spatulas, small containers, hoppers, funnels, metal parts of bag filters, sieves, rods, scoops, shovels, metal parts on insulating pipes/hoses, hose nozzles, platform trucks and human interaction with machinery/products.

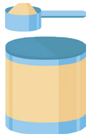
Antistatic Overview | EN 1149 vs EN 16350

Applications where workers are involved and cause static:

Over 90% of all accidents which involve static occur during operations in which **human workers are involved.** Some key examples include:

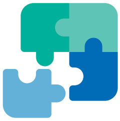
Operations

Maintenance
Most susceptible to accidents in normal manufacturing operations due to human interaction



Powder filling/emptying
Flammable hybrid mixtures created due to insufficient degassing, in which cone discharges cause ignitions.

Liquid leakages
Liquid causes friction and reacts with the atmosphere



Assembly
Mainly product protection as opposed to accident mitigation

Gas filling
This is linked to the leakages of the gases due to improper connections

Tank cleaning
Insufficient removal of hydrogen before cleaning creating flammable vapours

Adding powder to liquids
Powder poured into containers with air bubbles potentially forms a hybrid flammable vapour-dust mixture which is an ideal source for static

Antistatic Overview | EN 1149 vs EN 16350

What is EN 1149?

EN 1149 is a suite of clothing standards which has been in place for a number of years and most recently **updated in 2018,** however the testing methods of the individual parts of **this standard have been widely adopted for gloves to determine their electrostatic properties.**

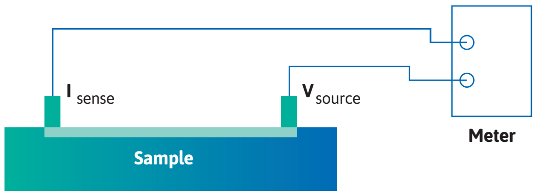
The test methods measure in different ways the electrical resistance of materials which corresponds to how resistant the materials are to the accumulation of charge. This resistance is measured in "Ohms". Ohms are defined as an electrical resistance between two points of a conductor and the higher the resistance, the more likely charge will begin to build up on the surface or within the material and pose a risk within the working environment.

EN 1149 is broken down into the following parts:

EN 1149-1

Test methods for the measurement of surface resistance

- This is a test to identify how good the material is at allowing charge to move across its surface. Resistance in Ohms is measured across the surface of the material, between two specified electrodes (resting on the test specimen) with a potential of 100±5 V. The pass limit for this test is a surface resistance of <2.5 x 10^9 Ohms



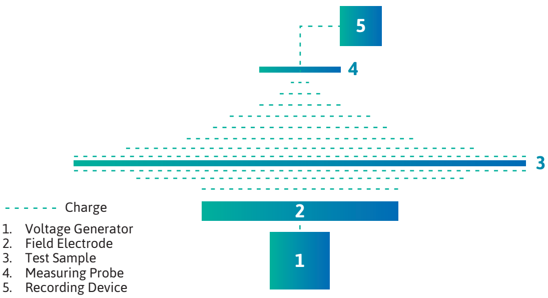
EN 1149-2

This is the vertical (aka volume) resistance test and is incorporated in EN 16350 covered later in this document

EN 1149-3

Test method for the measurement of charge decay

- Charge decay is the speed at which the material loses the charge it builds up into the air. To pass this part of the standard the material needs to lose at least 50% of its charge within 4 seconds over a set distance.



Antistatic Overview | EN 1149 vs EN 16350

EN 1149-5

Performance requirements

- This part of the standard simply sets out the performance requirements of parts 1 & 3 as well as design requirements for clothing

EN 1149-5

For antistatic clothing, EN 1149's pictogram is a lightning bolt inside a shield. Product marking shall also include the text EN 1149-5. This standard specifies requirements for electrostatic dissipative clothing i.e. clothing that conducts electricity sufficiently to avoid static charges. This clothing (combined with shoes that effectively dissipate) forms part of a completely earthed system. For such clothing the antistatic symbol can be used to show the material passes at least one of these tests.

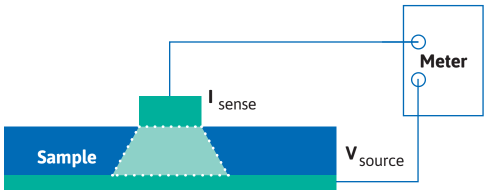
EN 16350

EN 16350 has been created to **define and govern the electrostatic properties of gloves** to ensure they are suitable within environments susceptible to static risk. EN 16350 is identical to the EN 1149-2 vertical (or volume) resistance test for protective clothing.

This test defines how well an electric charge moves through the glove and how much charge build-up is held in the glove material which could then be released upon contact with another material. This test is set up in a similar fashion to EN 1149-1 however the electrode is placed on the underside of the test sample **to be able to measure the build up of charge over time.**

The only difference to EN 1149-2 is that EN 16350 now sets a specific target which is required to be met in order to pass: **Less than 1 x 10^8 Ohms vertical resistance is required to be able to claim compliance to this standard.**

Understanding vertical (or volume) resistance of a glove is an important factor as a glove could easily pass EN 1149-1 which is the surface resistance test, however whilst the charge can move across the glove surface easily, it could potentially not be able to move through the glove allowing for a charge to build up and create a static risk.



Why are gloves with electrostatic properties not enough?

Gloves are an important part of managing static electricity as they are more often the discharge point as the hands encounter other materials. However, to rely on gloves alone will not effectively manage the risk, **they need to be used as part of a wider program which includes earthing straps, appropriate clothing and footwear.**

How are glove able to pass EN 16350?

Standard mechanical or chemical gloves are unlikely to pass the requirement of EN 16350 as they tend not to be dissipative enough and there is **too much resistance for the charge to flow sufficiently.**

Only gloves which incorporate special conductive fibers into the textile yarns and special conductive active fillers inside the gloves' polymer layers would tend to pass this standard.

Antistatic Overview | EN 1149 vs EN 16350

When to use EN 16350 vs EN 1149?

The vast majority of Ansell's chemical glove portfolio has in the past been tested to EN 1149 to determine their electrostatic properties. These results were then used by employers to assess if this met their requirements specified within their risk assessment.

PPE Regulation:

The PPE regulation stipulates protective properties at an extremely high level with Annex II section 2.6 stipulating:

"PPE intended for use in potentially explosive atmospheres must be designed and manufactured in such a way that it cannot be the source of an electric, electrostatic or impact-induced arc or spark likely to cause an explosive mixture to ignite"

This is intended to represent all PPE so is kept as a very broad statement of fact, without calling up any specific requirements. With end users of gloves only having EN 1149 to test against and as standards evolve and move to become more inherently safe and relevant, it's now critical to understand when a user should look to incorporate gloves certified to EN 16350 within their requirements or if remaining with EN 1149 is sufficient.

Surface resistance vs. vertical resistance vs. charge decay:

First let's look at the how electrostatic properties of materials fall into separate categories which are tested by EN 1149 & EN 16350:

- ***Surface resistance: Forms part of EN 1149-1***
- ***Vertical resistance: Forms part of EN 1149-2 & EN 16350***
- ***Charge Decay: Forms part of EN 1149-3***

Each of these tests have set requirements to be able to meet the standard:

- ***Surface resistance: <2.5 X 10^9 Ohms***
- ***Vertical resistance: No requirements under EN 1149-2 and <1 x 10^8 Ohms under EN 16350***
- ***Charge decay: t_{50} <4 s or S (shielding) >0.2***

EN 1149-1 is a clothing standard and is designed to reflect how static is managed by the garment and its likelihood to be a point of static ignition. Surface resistance is used as the garment itself is, more often than not, not in direct contact with the skin and therefore understanding how the material holds static charge on the surface of the material is of key importance.

EN 16350 however **measures the vertical resistance, which is a property which denotes how easily the charge can move through the material.** As the glove is in constant contact with the skin, the gloves ability to allow the static charge to move through the glove and onto the body which can then be earthed is crucial.

EN 1149-3 charge decay references how long it takes the material to reduce its static charge over time and by what percentage. This test can be carried out in isolation or alongside EN 1149-1 / EN 16350.

Antistatic Overview | EN 1149 vs EN 16350

Static Dissipative vs Antistatic

The nature of EN 16350 is to represent how a charge can flow through a glove. A glove's electrostatic properties are often, mistakenly, applied to determining if the glove is "antistatic" or not.

What is represented when testing gloves is how well they perform in dissipating this static charge either on the surface or through the material.

"Antistatic" is perceived as a material not allowing any static build up whatsoever however this is simply not the case when it comes to hand or body protection. Antistatic is also not as beneficial as it may appear to sound.

Static build up is a natural process and it's how the glove materials aid in managing it which makes it key. Enabling charge to be dissipated effectively, and in accordance with site safety regulations is key to keeping users safe.

What should be referenced instead of "Antistatic" is how "Static dissipative" the gloves are in terms of each of the standards. This will enable end users to determine if the glove is fit for purpose for the environment or application.

Hand tools?

Many hand tools, such as spanners, are good conductors of electrostatic charge when in use and this needs to be managed accordingly to ensure this risk is mitigated. Ensuring that the gloves used when handling such tools pass the requirements of EN 16350 will ensure resistance through the gloves is sufficiently low to minimize the risk of any electrostatic charge.

ATEX zones

ATEX (ATmosphères EXplosives) consists of 2 EU directives which describe what is allowed in terms of equipment and working space within a potentially explosive environment.

As static discharge is the primary cause of incidents within explosive environments, the directives aim to guide employers by splitting workplaces up into ZONES. These zones are split up by type of explosive risk within the environment and the rate/frequency that this risk is likely to be encountered.

Zone Classification	*Risk Definition*	*Likelihood & Frequency*
Zone 0	Gases, vapours, mists	Continuously, frequently or for long periods
Zone 1		Occasionally
Zone 2		Not likely, short periods
Zone 20	Dusts	Continuously, frequently or for long periods
Zone 21		Occasionally
Zone 22		Not likely, short periods

Antistatic Overview | EN 1149 vs EN 16350

Technical Specification IEC TS 60079-32-1:2013+AMD1:2017, which is published by the International Electrotechnical Commission, looks **to give guidance around products and processes required to avoid ignition events.** When taking this into account with hand protection, this is split into the following sections to determine whether static dissipative gloves (gloves certified to EN 16350) are required:

<table>
<tr><th>Zone Classification</th><th>Probability of ignition</th><th>Low MIE <0.2 mJ - Gases Groups IIB, IIC</th><th>High MIE <0.2 mJ - Gases Groups IIA, IIB</th></tr>
<tr><td rowspan="2">Zone 0</td><td>High</td><td rowspan="2">Necessary</td><td>Necessary</td></tr>
<tr><td>Low</td><td rowspan="2">Recommended</td></tr>
<tr><td rowspan="2">Zone 1</td><td>High</td><td rowspan="2">Necessary</td></tr>
<tr><td>Low</td><td rowspan="3">Not Necessary</td></tr>
<tr><td rowspan="2">Zone 2</td><td>High</td><td>Recommended</td></tr>
<tr><td>Low</td><td>Not Necessary</td></tr>
<tr><td rowspan="2">Zone 20, 21, 22</td><td>High</td><td rowspan="2" colspan="2">Not Necessary</td></tr>
<tr><td>Low</td></tr>
</table>

MIE refers to the Minimum Ignition Energy which is required to cause an ignition event. Where the group of gas ignites at very low energy it is imperative that static dissipative gloves are worn as part of the wider PPE ensemble.

Gas groups are denoted **A**, **B** and **C** depending on their MIE.

A ***Less easily ignited gases e.g. Propane***

B ***Easily ignited gases e.g. ethylene***

C ***Very easily ignited gases e.g. Hydrogen***

Antistatic Overview | EN 1149 vs EN 16350

Recommendation:

In addition to the measurements set forth under the ATEX directives, the rationale behind EN 16350, and thus the requirements set in place, is that the main electrostatic risk associated with gloves is from conductors held in the gloved hand, such as hand tools. It is essential that such conductors are earthed when used in the presence of explosive atmospheres, and therefore, it is essential that there is a sufficiently low resistance through the gloves to ensure they are earthed via the body of the wearer. By ensuring a low resistance through the gloves, the risk of any electrostatic discharge from the gloves themselves would also be minimised.

If the applications in which gloves are worn do not involve using hand tools or other such conductors, then compliance with the requirements stated within EN 1149 may be sufficient, subject to risk assessment.

Meeting the requirements associated with EN 1149-1 and/or EN 1149-3 may demonstrate acceptably low risk of hazardous discharges from gloves, but does not necessarily ensure that handheld conductors can be earthed via the gloves.

Find out more

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