

# PROTECTIVE GLOVES

## Electrostatic Properties



Personal protective equipment  
PROTECTIVE GLOVES COMMISSION



## The hazard ATEX - Explosive Atmospheres

Solvent or dust concentration in an area may create a risk of explosion; such an area is thus classified as an ATEX zone.

Example of activities presenting such a risk:

- Handling over compounding tanks (fine chemistry, pharmaceuticals...)
- Sampling from solvent tanks
- Transferring flammable substances from a tanker lorry
- Cleaning with solvents
- Packing, filling hoppers or weighing powders
- Manufacturing explosive products



In an ATEX zone, an explosion may result from objects that are charging static electricity and suddenly discharging thus creating a spark.

Therefore, any object entering an ATEX zone shall be designed and set up in order not to accumulate static electricity. It is thus called "static dissipative" or "conductive", often also wrongly called "antistatic".

Beware: PPE (an thus gloves) are excluded from the scope of the ATEX 94/9/EC Directive.

THEY ARE NOT MARKED  AND CANNOT BE CERTIFIED.

A person working in an ATEX zone must wear adequate clothing and shoes in order to be permanently earthed, thus not able to discharge static electricity that he/she produces through his/her own movements.

### The 1999/92/CE directive

The 1999/92/CE Directive defines the ATEX Zones and the obligations of the employer to protect the employees from potential explosion in these areas.

Zones	Definition	Criticality	Examples of application
Zone 0	Flammable substances, gas, vapour, aerosols mixtures	Permanent to frequent	Transfer of flammable products Solvent compounding Cleaning with solvent
Zone 1		Occasional	
Zone 2		Never or short duration	
Zone 20	Combustible dust	Permanent to frequent	Bulk filling station Weighing powders
Zone 21		Occasional	
Zone 22		Never or short duration	





## Clothing and Gloves in ATEX Zones

According to the guideline CEI 60079-32-1:2013 - Explosive Atmospheres - Electrostatic Hazards, this classification in Zones enables the employer to determine whether static dissipative gloves are necessary.

MIE (Minimum Ignition Energy) of gazes or dusts in the atmosphere.

Groups of gases IIA, IIB, IIC : propane, ethylene and hydrogen types.

Need to use static dissipative gloves				
ATEX Zone	Probability to charge	Low MIE $\leq 0,2$ mJ Gases groups IIB, IIC	High MIE $> 0,2$ mJ Gases groups IIA, IIB	
0	high	Necessary	Necessary	
	low		Recommended	
1	high		Recommended	Not necessary
	low			
2	high	Not necessary	Not necessary	
	low			Not necessary
20, 21, 22	high	Not necessary		
	low			

## Protective Gloves used in ATEX Zones

According to the PPE Directive 89/686/CE – Annex 2 – 2.6, if protective gloves are necessary in an ATEX Zone to protect against handled chemicals or mechanical risks, "they must be so designed and manufactured that they cannot be the source of an electric, electrostatic or impact-induced arc or spark likely to cause an explosive mixture to ignite".

ATEX 1999/92/EC Directive : workers must be provided with appropriate working clothes consisting of materials which do not give rise to electrostatic discharges that can ignite explosive atmospheres.

**Do not mix up! : a protective glove never protects against a risk of explosion!**  
 A regular glove is sometimes not good enough to dissipate charges and could be a risk in ATEX Zone if it can accumulate charges and create a spark. Therefore, in order to prevent this risk, acceptable electrostatic properties are required for the glove.

## Electrostatic Properties

The electrostatic properties of a glove shall be assessed through the vertical leakage resistance (in Ohm -  $\Omega$ ) according to EN 16350:2014 standard.

The CEI 60079-32-1:2013 (6.1 – Table 1) guideline provides the definition of electrostatic properties of various objects (below for clothing) at 25% relative humidity.

Object	Concerned measurement	Conductive	Dissipative <sup>(1)</sup>	Insulating <sup>(2)</sup>
Gloves	Leakage resistance ( $\Omega$ ) <sup>(3)</sup>	$<10^5\Omega$	$10^5\Omega$ to $<10^8\Omega$	$\geq 10^8\Omega$
Clothes	Surface resistance ( $\Omega$ )	No value	$< 2,5 \cdot 10^9\Omega$	$\geq 2,5 \cdot 10^9\Omega$
Shoes	Leakage resistance ( $\Omega$ ) <sup>(3)</sup>	$<10^5\Omega$	$10^5\Omega$ à $<10^8\Omega$	$\geq 10^8\Omega$

<sup>(1)</sup> Often wrongly called "antistatic".

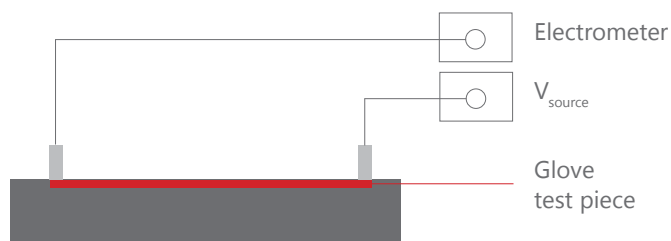
<sup>(2)</sup> For gloves made of insulative material to work on live electrical lines (EN 60903).

<sup>(3)</sup> Also called "vertical resistance".

## Measurement of electrostatic properties

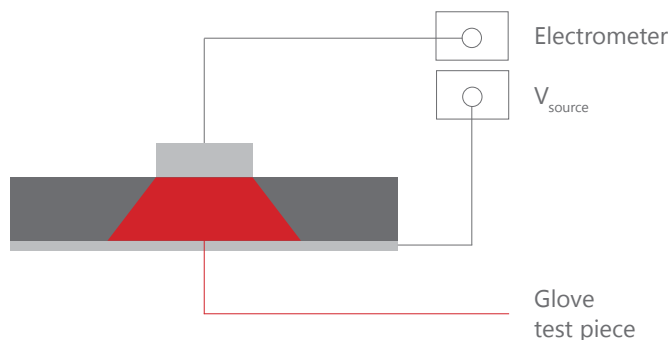
### Surface resistance

Resistance in Ohms ( $\Omega$ ) of the material's surface between two electrodes placed on its surface, under a voltage of 100V +/-5 V



### Vertical resistance

Resistance in Ohms ( $\Omega$ ) through the material between two electrodes placed over the opposite surfaces, under a voltage of 100 V +/- 5 V





## EN 16350:2014 - Protective Gloves Electrostatic Properties

This standard concerns requirements for gloves in ATEX Zones.

It does not concern:

- Gloves used to protect electronic devices against electrostatic risks, such as in the electronic industry (EN 61340-5-1 standard for example).
- Insulative gloves for live working (EN 60903).
- Gloves for welders (EN 12477).



The electrostatic properties alone are not sufficient to ensure safety. The gloves' wearer must be earthed through adequate dissipative shoes and a dissipative floor.

### Test Method

EN 1149-2 :1997 - vertical resistance.

Relative humidity: (25+/-5)%; Air temperature: (23 +/-1)°C <sup>(1)</sup>.

If the glove is too small to cut out the required test piece, the test device of the EN 61340-2-3 standard may be used, since it accepts a smaller test piece.

Measurement done on 5 test pieces, all must pass the vertical resistance limit.

### Requirements

Vertical resistance < 1,0 10<sup>8</sup> Ω <sup>(2)</sup>.

Design :

No conductive materials (eg. metal rivets).

Label or reflective strips shall be permanently attached around all edges.

No hook and loop tightening systems.

### Information from the manufacturer

No specific pictogramme, no specific marking on the glove.

The information for use must inform about the test results and the test conditions and have the following warnings:

- The person wearing static dissipative gloves shall be properly earthed eg. By wearing adequate footwear.
- Static dissipative gloves shall not be unpacked, opened, adjusted or removed whilst in flammable or explosive atmospheres or while handling flammable or explosive substances<sup>(3)</sup>.
- The electrostatic properties of the gloves might be adversely affected by ageing, wear, contamination and damage, and might not be sufficient for oxygen enriched flammable atmospheres where additional assessments are necessary.

<sup>(1)</sup> The lower the relative humidity, the less dissipative the glove. 25% relative humidity corresponds to a dry climate, thus severe conditions that is certainly not representative of all situations in the workplace.

<sup>(2)</sup> This value is severe, we can see that gloves measured at 1012 Ω are presently used in numerous ATEX Zones bringing a sufficient safety.

<sup>(3)</sup> Such handling may cause triboelectric frictions that may cause a spark to occur.

## History of requirements on electrostatic properties of gloves

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### At the beginning, from 1994 to 2003

The volume resistivity test is described in the EN 388 standard (protective gloves against mechanical risks) at a relative humidity of 50%.  
The requirement is:  $< 10^9$  Ohm.cm.

### From 2003 to 2013

The electrostatic properties are included in EN 420 standard (General requirements for protective gloves).

Tests according to EN 1149-1 (surface resistance), EN 1149-2 (vertical resistance) or EN 1149-3 (decay time), for clothes, may be used for gloves.

No requirements; the result must be included in the information for use without pictogram.

As a comparison, from 2006 (EN 1149-5 standard) the requirement for clothes is a surface resistance measured according to the EN 1149-1 of  $< 2,5 \cdot 10^9$  Ohm measured at low relative humidity (25%), and/or a decay time  $< 4$  seconds according to EN 1149-3.

### In 2013

Publication of the new specific standard on electrostatic properties of gloves EN 16350.

## Design and selection of gloves for ATEX Zones

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First of all the glove must be selected to cover the chemical or mechanical risks in the workplace, still preserving a good functionality (dexterity, comfort).

Most of the gloves presently used in ATEX Zones for chemical protection (in neoprene or nitrile) do not pass the requirement of the EN 16350 standard; only specially designed gloves with conductive yarns in the textile liner and conductive fillers in the elastomer compound would pass this requirement.

Special materials such as butyl or PVA usually pass the requirement, if the textile liner is adapted.

## SYNAMAP's guideline to the users

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It is certain that the test is severe and consider highly critical situations.

*A 25% relative humidity corresponds to the special case of cold, ventilated or dehydrated areas (case of preparations sensitive to humidity such as in pharmaceutical or cosmetics industries).*

*Note : Moreover, in most cases, the gloves are quickly wet inside, especially if liquidproof.*

For present or potential users of gloves in ATEX

- Check that the ATEX Zone effectively requires static dissipative gloves.
- Require the result of vertical resistance measured at the lowest relative humidity effectively found in the ATEX Zone.
- Make sure that the gloves are fulfilling the design requirements (no metal parts such as tightening loops, no free materials such as labels, no hook and loop devices...).
- Make sure that the instructions for a safe use are respected : the gloves must not be donned, tightened or taken out of their packaging in the ATEX Zone, they must not be washed, they must be often replaced...





## References

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EN 16350:2014 – Protective gloves – Electrostatic properties

ATEX 1999/92/EC Directive – Protection of workers exposed to risks in explosive atmospheres

ATEX 94/9/EC Directive – certification of materials in explosive atmospheres

89/686/EC Directive – Design of Personal Protective Equipment

CEI 60079-32-1:2013 : Explosive atmospheres – Electrostatic hazards

EN 61340-5-1 – Electrostatics – Protection of electronic devices against electrostatic phenomena – General requirements

EN 60903 – Live working – Gloves of insulating material

EN 12477 – Protective gloves for welders

EN 1149-1 – EN 1149-2 - EN 1149-3 - EN 1149-5 - Protective clothing – Electrostatic properties – Part 2 : test method for vertical resistance.

### For more information :

European regulations: [www.eurlex.eu/](http://www.eurlex.eu/)

French law: [www.legifrance.gouv.fr/](http://www.legifrance.gouv.fr/)

EN European standards: [www.afnor.org/](http://www.afnor.org/) (documents to be paid)

Vêtements de travail et équipements de protection individuelle - Propriétés antistatiques et critères d'acceptabilité en zone ATEX - F.Marc, B.Sallé (INRS), M.Boudalaa, Y.Ollier (INERIS) - ND 2358 - 2012 - 227/19. Can be seen on the INRS site : [www.inrs.fr](http://www.inrs.fr)

Vêtements et équipements de protection - L'antistatisme en zone ATEX - A. Bondéelle - Travail et Sécurité - mai 2012 - Can be seen on the INRS site : [www.inrs.fr](http://www.inrs.fr)

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## SYNAMAP

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