

STATIC ELECTRICITY AND FLOUROPLASTIC HOSE ASSEMBLIES

(PTFE, FEP, PFA AND HOSES OF TEFLON®)¹

Static electricity can be an ignition source for an ignitable mixture. Static charges can create malfunctions in calibrated electronic operating systems and other data sensitive components. Static charges can accumulate and discharge through the wall of flouroplastic hose and damage or puncture the innercore.

Purpose

The purpose of this document is to:

- 1) Explain the different levels of conductivity
 - a. Dissipate – to break up and scatter
 - b. Conductive – the process of conducting or transmitting electricity
- 2) Provide information documenting and testing hose assemblies for levels of conductivity
- 3) Assist in reducing fluoroplastic hose failures due to static electricity contamination

Scope

This document presents information to allow the user to **identify** and **substantiate** fluoroplastic hose assemblies (braided or unbraided) for **surface resistivity**, **volume resistivity** and **continuity** relative to the level of conductivity for which the assembly may be designed.

Introduction

The generation of static charge is more commonly observed during handling and processing of dusts and fibers in some industries. An area less familiar involves static electricity associated with various liquids especially petroleum based products and steam. Fluid movement can generate static charge build up on the inner surface of a fluoroplastic liner and extreme temperatures coupled with high pressure in steam applications could also create static electricity problems.

Static electrification and the various effects that result from positive and negative charges formed by fluid movement may constitute a fire or explosive hazard. The generation of static electricity by fluid movement and friction is always present. The elimination of static electricity is impossible, but redirection of positive and negative charges is feasible.

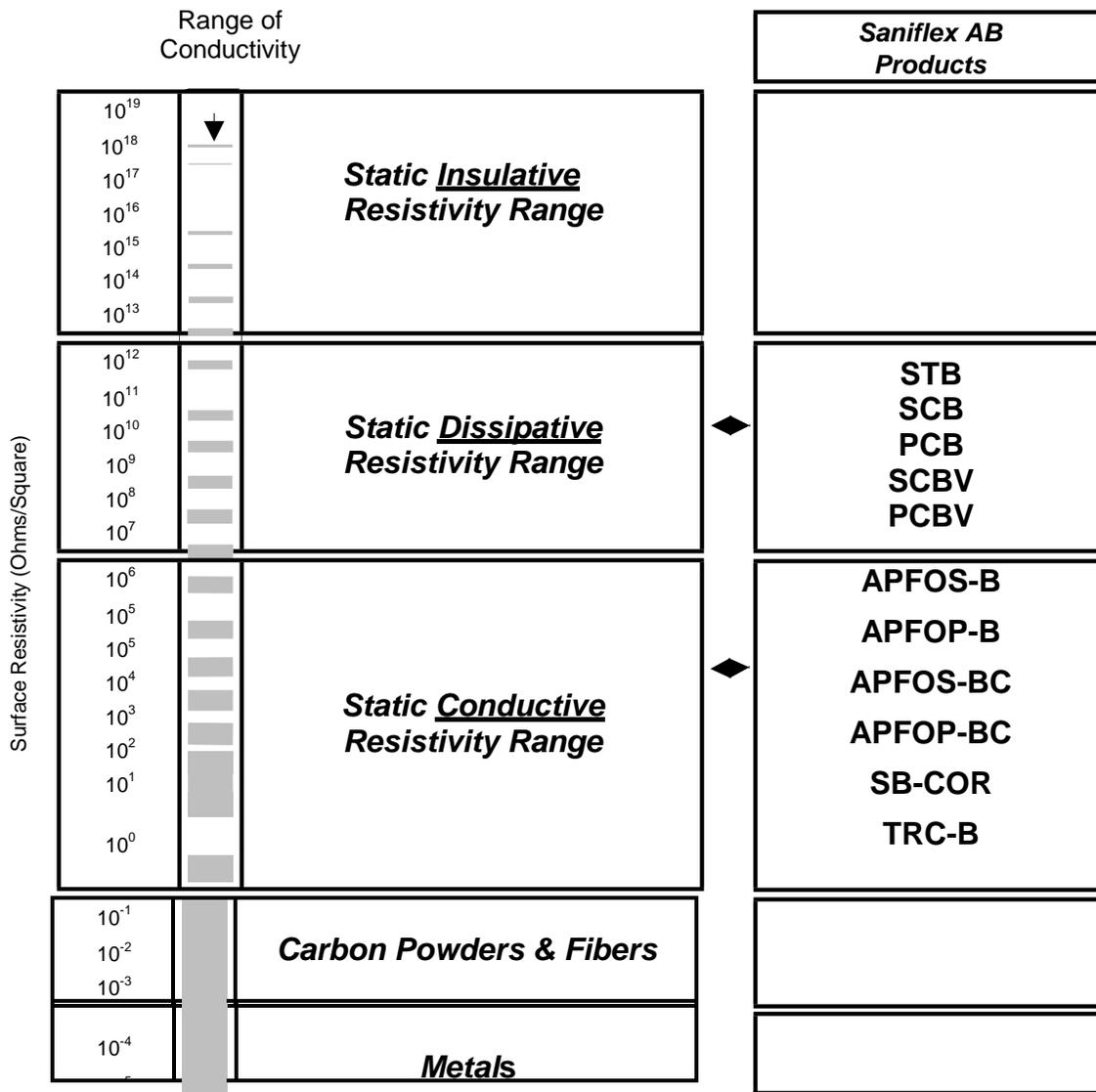
Normally, static electricity does not cause a hazard, but the discharge of static buildup can puncture the innercore of an assembly, or a sudden recombination of separated positive and negative charged particles may damage the assembly during use. Static electricity can create up to 20,000 volts of electricity in some instances.

Levels of Conductivity

The conductivity spectrum includes three different levels to measure surface resistance in ohms. See “Levels of Static Conductivity” chart:

¹ Teflon® is a registered product trademark of E.I. Dupont de Nemours Co.

Levels of Static Conductivity



- | | |
|-----------------|---|
| STB | Stainless braided, True smooth bore, Black (Dissipative lined) innercore |
| SCB | Stainless braided, Convoluted, Black (Dissipative lined) innercore PCB |
| | Polypropylene braided, Convoluted, Black (Dissipative lined) innercore |
| SCBV | Stainless braided, Convoluted, Black (Dissipative lined) innercore, Vacuum |
| PCBV | Polypropylene braided, Convoluted, Black (Dissipative lined) innercore, Vacuum |
| APFOS-B | Stainless braided, True smooth bore, Black (Conductive lined) innercore, Vacuum |
| APFOP-B | Polypropylene braided, True smooth bore, Black (Conductive lined) innercore, Vacuum |
| APFOS-BC | Stainless braided, Convoluted, Black (Conductive lined) innercore, Vacuum |
| APFOP-BC | Polypropylene braided, Convoluted, Black (Conductive lined) innercore, Vacuum |
| SB-COR | Stainless braided, Silicone Cover, True smooth bore, Black (Conductive lined) innercore, Vacuum |
| TRC-B | Rubber Covered, True smooth bore, Black (Conductive full wall) innercore |

Note: **Dissipative lined innercore**- A thin layer of static **dissipating** blended carbon Teflon® inside natural tube.
Conductive lined innercore- A thin layer of static **conductive** blended carbon Teflon® inside natural *tube*.
Conductive full wall innercore- Tubing has static **conductive** blended carbon Teflon® throughout entire innercore.

Electrical resistance testing

Testing Equipment

Determining the resistance of **conductive, anti-static and non-conductive hoses**, test with an instrument specifically designed for measuring insulation resistance. This requires a nominal open-circuit voltage of 500 V d.c., or another instrument giving comparable results. An instrument with sufficient accuracy to determine the resistance to within +/- 10% is required. During the test, dissipate no more than 3 watts of power into the specimen, in order to prevent erroneous results due to temperature effect. Determine dissipating power by the square of the open-circuit voltage in volts divided by the measured resistance in ohms.

For tests requiring measurement of **electrical continuity** between end fittings or through continuous internal or externally bonded wires, use an ohmmeter with sufficient accuracy to determine the resistance to within +/- 10%.

Tubing or Hose innercore

Before applying the pressure barrier or external braid, testing for conductivity or resistivity of the hose innercore is required. The reason is that the external braid may cause false readings of actual resistivity.

Procedure per ISO 8031

Hose Assembly with Attached Fittings

Bonding a continuous wire(s) between end fittings provides electrical continuity in certain types of hose construction. Establish electrical continuity, using a suitable ohmmeter as described above, for internal and external wires.

For hose assemblies without means of electrical continuity other than an innercore, bond an external attachment to the fitting to allow innercore and end connection contact. Establish electrical continuity using a suitable ohmmeter as described above.

Tagging of Assemblies

Tag each hose assembly with testing information as follows:

- 1) The ohmmeter reading of tubing innercore prior to the attachment of any external wire, braid or fittings.
- 2) The electrical continuity rating of pass or fail.

NOTE: Saniflex AB is providing this information as an assist to our customers for their use in understanding the phenomenon of static electricity associated with fluoroplastic tubing and hose. Under no circumstances is this information meant to be an all-inclusive dissertation on static electricity and many variables can always affect each individual circumstance. The information is for the exclusive use of Saniflex AB and its customers only.

DEFINITIONS

Ammeter	An instrument for measuring current in an electric circuit.
Capacitance	Capacitance is that property of a system of conductors and dielectrics which permits the storage of electrically separated charges when potential differences exist between the conductors. The capacitance of a body (C) is defined as the total electric charge (on the body) (q) divided by its electric potential (V) ($C=q/V$).
Charge	Quantity of unbalanced electricity on (or in) a body; i.e., an excess or deficiency of electrons, giving the body negative or positive electrification, respectively.
Charge Density	The net electric charge per unit volume.
Conductance	Reciprocal of resistance ($1/Q$). The unit of measure is the Siemens (S).
Conductivity	The reciprocal of electrical resistivity indicating the capability of a material to transmit electric charges; normally denoted by σ . The units of conductivity are P Siemens per meter (S/m).
Coulomb	The unit of electric charge in SI units (International System of Units). The coulomb is the quantity of electric charge that passes any cross section of a conductor in one second when the current is maintained constant at one (1) ampere.
Current	Rate of flow charged particles in a material. Unit of measure is the ampere (A).
Dielectric	A material with very few free charges throughout its bulk. Electrons are closely bound to atomic nuclei and cannot wander about the material as in a conductor. A perfect dielectric (an insulator) has no free charge and zero conductivity. Free charge can be placed on the surface of a dielectric where it remains trapped.
Dielectric Breakdown	Condition arising when a dielectric material is subjected to an electric field of sufficient strength that electrons are pulled out of molecular bonds and accelerated until colliding with other parts of the molecular lattice, causing damage to the material. After breakdown occurs, a dielectric material may become much more conductive and large currents may result.
Discharge	The reduction of an imbalanced charge at a given point (usually to zero), by sudden flow of current through a medium (usually to ground).
Dissipation	The process of reducing the amount of electrical charge on a body; also, the loss of electric energy as heat.
Electrostatic Charge	Electric charge on the surface of a body, causing a surrounding electrostatic field.
Electrostatic Force	The force that electrically charged bodies exert upon one another.

Electrostatic Potential	The electrostatic potential at any point is the energy required to move a charge from an agreed-upon reference point to that point, divided by the amount of charge moved. The reference point is usually called ground or zero potential.
Grounding	The intentional electrical connection of a component to earth, or to some other large conducting body (such as the body, frame, or the earth itself).
Ohm	The unit of electrical resistance; when 1 amp (A) of current flows through a 1-ohm resistance, producing 1-volt (V) of potential difference.
Resistance	Proportionality constant relating the voltage drop across a material to the amount of current flowing through the material, indicating the ease with which electric currents flow in the material causing dissipation of energy. The unit of measure for this material property is the ohm. When I ampere (A) of current flows through R ohms of resistance, $R=I^2$ of power (watts of power dissipated).
Static electricity	An electrical charge that is significant only for the effects of its electrical field component and that manifests no significant magnetic field component.
Static spark	An impulsive discharge of electricity across a gap between two points not in contact.
Streaming Current	The flow of an electrically charged fluid constitutes an electrical current. Unit of measure is the ampere (A).
Voltage	Amount of electric energy per coulomb of positive charge necessary to move a given charge from one point in space to another. The unit to express this electromotive force (or electric potential difference) is the volt (V).
Voltmeter	An instrument for measuring electric potential differences.