3. Neutralizing the charges, the primary methods of which are grounding isolated conductors and air ionization:
   - To prevent the accumulation of static electricity in conductive equipment, the total resistance-to-ground should be sufficient to dissipate charges that are otherwise likely to be present. A resistance of 1 megohm (10^6 ohms) or less generally is considered adequate.
   - Where the bonding/grounding system is all metal, resistance in continuous ground paths typically is less than 10 ohms.
   - Annex G contains diagrams of various grounding devices, connections, and equipment.
4. Operating outside the flammable range

Chapters 9 through 18 of the 2014 Edition of NFPA 77 focus on the assessment and control of static electricity hazards that are associated with some more specific industrial applications including:
- Fluid flow in piping, hose, tubing, and filters
- Static electricity hazards of liquids in bulk storage tanks, vehicles, containers, and intermediate bulk containers, process vessels
- Static electricity hazards of powders and dusts, including mechanisms of static electric charge generation, retention, and discharges, pneumatic transport systems, and bulk storage
- Intermediate Bulk Containers (IBCs) for powders, including Flexible Intermediate Bulk Containers (FIBCs)
- Web and sheet processes
- Miscellaneous applications such as spray applications, belts and conveyors, explosives, and plastic sheets and wraps

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Vahid Ebadat Ph.D.

Vahid Ebadat Ph.D., M.Inst.P, M.IEE, C.Eng., C.Phys. is the CEO of Chilworth North America. He has worked extensively as a process and operational hazards consultant for the chemical, pharmaceutical and food industries. Dr. Ebadat is a regular speaker at training courses on gas and vapor flammability, dust explosions, and controlling electrostatic hazards. He is a member of NFPA 77 Technical Committee on Static Electricity. NFPA 654 Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids and ASTM E27 Committee on Hazard Potential of Chemicals. Dr. Ebadat’s research has culminated in the publication of numerous technical articles and papers.

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Scope and Purpose
This recommended practice applies to the identification, assessment, and control of static electricity for purposes of preventing fires and explosions.

The purpose of this recommended practice is to assist the user in controlling the hazards associated with the generation, accumulation, and discharge of static electricity by providing the following:
1. Basic understanding of the nature of static electricity
2. Guidelines for identifying and assessing the hazards of static electricity
3. Techniques for controlling the hazards of static electricity
4. Guidelines for controlling static electricity in selected industrial applications

Equivalency
Nothing in this NFPA 77 recommended practice is intended to prevent the use of systems, methods, or devices of equivalent or superior quality, strength, fire resistance, effectiveness, durability, and safety over those prescribed by this recommended practice.

Technical documentation should be submitted to the authority having jurisdiction to demonstrate equivalency. The system, method, or device should be approved for the intended purpose by the authority having jurisdiction.

Definitions
Chapter 3 defines the terms that are used throughout the NFPA 77 document. Compared to the 2007 Edition, this section of the 2014 Edition of NFPA 77 is quite extensive. The terms defined in this section include:

- **Antistatic** - Capable of dissipating a static electric charge at an acceptable rate for the intended purpose
- **Bonding** - For the purpose of controlling static electric hazards, the process of connecting two or more conductive objects together by means of a conductor so that they are at the same electrical potential, but not necessarily at the same potential as the earth
- **Charging**
  - **Induction Charging** - The act of charging an object by bringing it near another charged object, then touching the first object to ground; also known as induction. Charge polarization is induced on a grounded object in the vicinity of a charged surface due to the electric field existing between the object and the surface. If the ground connection is removed from the object during this period, the induced charge remains on the object. Induction charging occurs when a person walks from a conductive floor covering onto an insulating floor in the presence of an electric field.
  - **Triboelectric Charging** - Static electric charging that results from contact or friction between two dissimilar materials; also known as frictional charging and contact/separation charging.
- **Conductive** - Possessing the ability to allow the flow of an electric charge; typically, liquids possessing a conductivity greater than 10⁻⁴ picosiemens per meter (pS/m) or solids having a resistivity less than 10⁹ ohmeters (Ω-m).
- **Discharge**
  - **Brush Discharge** - A higher energy form of corona discharge characterized by low-frequency bursts or by streamers, which can form between charged nonconductive surfaces and grounded conductors.
  - **Bulkling Brush Discharge** - A partial surface discharge over the top of solid piles that is created during bulkling of powder in containers and that appears as a luminous, branched channel flashing radially from the wall toward the center of the pile.
  - **Corona Discharge** - A low energy electrical discharge that results from a localized electrical breakdown of gases near sharp conductive edges, needle points, and wires.
  - **Propagating Brush Discharge** - An energetic discharge caused by electrical breakdown across a dielectric layer having equal and opposite charges on the opposite sides of the layer.
- **Dissipative** - A material or a construction that will reduce static charge to acceptable levels.
- **Grounding** - The process of bonding one or more conductive objects to the ground, so that all objects are at zero electrical potential; also referred to as earthing.
- **Minimum Ignition Energy (MIE)** - The energy, usually expressed in millijoules, stored in a capacitor that, upon discharge, is just sufficient to effect ignition of the most ignitable mixture of a given fuel mixture under specified test conditions.
- **Nonconductor (Insulator)** - A material that has the ability to accumulate charge, even when in contact with ground.
- **Resistance (R)** - The opposition that a material offers to the flow of current, expressed in ohms, and which is equal to the voltage (V, in volts) between two points divided by the current (I, amperes) that flows between those points.

Fundamentals of Static Electricity
Chapter 5 provides some useful background information on the fundamentals of static electricity. It discusses how static electric charge is generated and retained (accumulated). If the rate of electrostatic charge separation (generation) is greater than the rate that the charges recombine (relax to ground), electrostatic charge accumulation will occur, and, under certain conditions, the accumulated charge on an object which is in contact with ground will dissipate (relax) to ground at a rate which is dependent on the surface and volume conductivity (resistivity) of the object. According to NFPA 77, “conductive” materials have a “resistivity less than 10⁹Ω-m.” “Semiconductive materials” have a “resistivity between 10⁵Ω-m and 10⁹Ω-m.” If the resistivity is much greater than 10⁴Ω-m, the relaxation time may be a few hours or even longer. Electrostatic discharges resulting from the accumulation of charge can only cause a flash fire or explosion, if the energy of the discharge is greater than the Minimum Ignition Energy (MIE) of the gas, vapor, liquid mist, dust cloud, or the hybrid mixture that may be present.

A person can accumulate a significant electrostatic charge by walking on an insulating surface, by coming into contact with an already charged object, by brushing against other surfaces, or by approaching places where there is already some significant electrostatic charge. During routine activities, the voltage on a human body can be expected to reach 10KV to 15KV. Since the capacitance of a human body is about 200pF, the available stored energy for a spark can reach 10 to 22.5mJ.

Evaluating Static Electricity Hazards
The primary concern posed by static electricity in industry is the risk of a fire and explosion due to the ignition of flammable atmospheres. In order to assess the risk one needs to ask the following questions:

- Could electrostatic charge be generated?
- Could charge accumulate?
- Could the accumulated charge cause a discharge?
- Could the discharge have sufficient energy to ignite the flammable atmosphere?

If the answer to these questions is yes, there will be a risk of an electrostatically initiated fire or explosion and steps should be taken to minimize the risk.

Chapter 6 of NFPA 77 provides information on the evaluation of the hazards of static electricity. Measurement of the accumulation and relaxation of charge, resistivity of materials, spark energy, Minimum Ignition Energy (MIE), as well as the assessment of bonding and grounding (conduction path) are discussed in this chapter.

There are two basic steps in evaluating static electricity hazards:
1. Identification of locations where electrostatic charge separates and accumulates
2. Assessment of the ignition hazards at the locations where charge separates and accumulates

It is recommended that an on-site evaluation or survey of the process is made to identify any ungrounded conductive objects, including personnel, and any materials that could serve as electrical insulators and interfere with proper bonding and grounding or dissipation of charge to ground. The survey should identify those locations that might pose a static electricity hazard, even if there is no evidence of accumulation of charge at the time of the evaluation.

- Special attention should be given to insulating materials (including liquids and powders) that are handled or processed.
- Each process operation should be considered separately, and attention should be given to the likely range of exposure of the materials. For example, changes in temperature and relative humidity can significantly influence the bulk (volume) conductivity and surface conductivity of materials.
- It is often helpful to first complete a design review of the operation, process, or machine and a visual survey of the area. An on-site instrumented evaluation should then be conducted during actual operating conditions to determine the nature and magnitude of any static electricity hazards present.

Control of Static Electricity and Its Hazards by Process Modification and Grounding
The objective of controlling a static electricity hazard is to provide a means whereby charges, separated by whatever cause, can recombine harmlessly before discharges can occur.

Chapters 7 and 8 discuss some practical measures for controlling the ignition hazards from static electricity by the following methods:

1. Removing the ignitible mixture from the area where static electricity could cause an ignition-capable discharge
2. Reducing charge generation, charge accumulation, or both by means of process or product modifications