28.12 Discharging electrostatic charges on Masterflex hoses

28.12.1 General

Hose lines can be a potential source of danger on pneumatic suction and conveying plants due to the build-up of electrostatic charges. The capacity to discharge such charges is therefore mandatory in many areas of application to ensure safe operation. Hoses are used to transport solids (e.g. in the form of granular material, chips, dust, sand, cement etc.) and also liquid and gaseous media. Electrostatic charges arise wherever solids which are non-conductive or of poor conductivity are brought into contact with other materials and separated again. As a result of the separation process, one material has fewer electrons than the other which leads to one being positively and the other negatively charged. In the area of the common boundary surface, the so-termed "interfacial potential" is formed which makes spark discharge possible. There are many ways of avoiding such discharges and these are described in more detail below.

28.12.2 Regulations

There is a series of directives and regulations on evaluating and avoiding the risk of ignition and deciding on the safety precautions to be taken. At this point we refer primarily to the directives of the main federation of commercial employers' liability insurance associations: BGR 132.

28.12.3 Why electrostatic charge occurs

During the transportation of solid, liquid or gaseous media, the "interfacial potential" described above is built up due to the friction on the inside of the hose lines. Depending on the degree of charge, this leads to sparking, electric breakdown or sometimes the ignition of flammable materials. In addition to the intensity of the contact (friction) between the medium and the inner sides of the hose, the "permittivity" of the hose and of the medium flowing through it is decisive for the extent to which charging is possible. This is considered to be a measure of the polarisability. Even conductive materials can become charged if not earthed.

28.12.4 Ways of preventing electrostatic charges

The surface resistance of the materials of the hose sides can be reduced to values of between 10^3 - 10^4 ohms by incorporating conductive additives. These conductive additives form a network of conductive particles (volume conductivity) in contact with each other in the plastic. Another possibility is incorporating antistatic agents. Their effect results from the absorption of water from the atmospheric humidity at the surface of the sides of the hose. Surface resistance values of 108 ohms can be attained (surface conductivity). According to BGR 132 (Elimination of fire hazards caused by static charges) fire hazrds can be avoided by using hoses that feature an earthed metal helix. Its spacing must noch exceed 3cm and its overlap must be less than 2mm.

28.12.5 Limit determination and definition

In general the following can become electrostatically charged:

- hose lines with a wire spiral
- solids with a surface resistance > 10^9 ohms
- all objects of conductive materials which are not earthed

In general the following cannot become electrostatically charged:

- all solid and liquid matter which falls short of the above critical resistance values
- all conductive materials which are earthed.

In practice, when using hose lines with a wire spiral, this means the following:

1. When using chargeable standard hoses with a surface resistance > 10^9 ohms it is generally sufficient to expose both the ends of the spiral and to earth them to the conductive connecting element to discharge electrostatic charges. The spiral distance may not exceed 30 mm in accordance with BGR 132.
2. Increased protection can be obtained by using a non-chargeable hose, antistatic ≤ 10^9 ohms, on which the exposed ends of the spiral must have an earthed connection.
3. Electrically conductive hoses with a surface resistance ≤ 10^6 ohms offer optimum safety. Even on these hoses there should be an earthed connection between the exposed ends of the wire and the connection struts for safety reasons. Tested Masterflex-PU hoses with the addition "EL" comply fully with these requirements and are electrically conductive ≤ 10^4 Ohm.
4. Also available on request: additional grounding possibilities, e.g. ground wire

28.12.6 Measuring method

The determination of the surface resistance depends on the relevant method of measuring and is determined for non-conductive solids in accordance with DIN iEC 60093 / VDE 0303, section 3 (Test method for electrically insulating materials, volume resistivity and specific surface resistance of solid, electrically insulating materials).
For rubber and plastic hoses and hose lines DIN EN iso 8031 - Rubber and plastic hoses and hose lines, describes the determination of the electrical resistance. This standard describes:

- procedures for hoses with conductive inner layers (e.g. the method of measuring Masterflex hose types):Master-CLIP TEFLON® H-EL Master-CLIP TEFLON® S-EL
- procedures for hoses with a conductive outer layer
- procedures for hoses made of mixtures of materials which are conductive throughout (e.g. the measuring method for the Masterflex hose type: Master-PUR H-EL)

28.12.7 Note

The addition of conductive additives or antistatic agents reduces the mechanical properties of the material (e.g. resistance to abrasion and tearing) and thus reduces service life. The information summarised under points 1 to 6 is based on internal and external field research and on the currently applicable regulations. It serves as a guideline for using Masterflex hose types in areas of potential

danger but no guarantee is given that it is complete.
The catalogue details relating to surface resistance are based to some extent on official test results, details supplied by our raw material suppliers and internal measurements. In case of doubt, we recommend that users test the hoses under operating conditions or similar circumstances before final installation.