STATIC CONTROLLED FLOORING

FeRFA Guidance Note No. 4

THE NEED FOR STATIC CONTROLLED FLOORING

We will all be familiar with the effects of the build up of static electricity. Taking off a sweater made from synthetic fibre will often be accompanied with 'crackling' sounds as sparks jump across. On some days we can experience unpleasant shocks from touching car door handles particularly when wearing shoes with synthetic soles. The same effects are responsible for the adhesion of dust on still surfaces. Under normal conditions these effects are, at the most, merely unpleasant but not particularly dangerous. However in the industrial environment such electrostatic build-up can cause lasting effects which may inhibit production or at worst endanger life.

Concrete floors are normally sufficiently conductive due to their pore water to dissipate any electrostatic charges on the surface. However resin flooring, often used to provide a more hard wearing or chemically resistant surface, is an effective natural insulator and should be selected with caution in some circumstances. In certain cases a static controlled grade of Resin flooring should be selected. Static controlled grades are generally derived from normal Resin flooring grades by incorporating a small proportion of carbon powder or fibres, and other more sophisticated solutions may also be used by the manufacturer.

TYPICAL APPLICATIONS FOR STATIC CONTROLLED FLOORING

In certain industrial environments the attraction or adhesion of dust may present a problem. In areas where volatile substances, gases, powders or liquids are processed, stray electric currents are undesirable and potentially dangerous. Each of these areas will have requirements for static controlled floors.

Typical examples are: Semi-conductor and electronic assembly, computers, Pyrotechnics, Munitions, ejector seat mechanisms, Micromechanics, Gyroscopes, Miniature bearings, Optical lenses, Photographic film, Lasers, Biotechnology, Pharmaceutical production, Clean rooms, surgical implant manufacture and medical environment, even some Food & Drink production environments.

CAUSE OF ELECTROSTATIC BUILD-UP

When the creation of a charge takes place faster than the redistribution of that charge, static charge accumulates. Additionally the movement, spraying or dispersal of powders, gasses or liquids will also result in an electro-static charge, as will wheeled traffic or sliding one thing over another.

The uncontrolled, spontaneous discharge of accumulated electrostatic charge can lead to damage of sensitive devices, or a spark may occur as bodies at different electrostatic potential approach one another and this can ignite volatile materials leading to fire or explosion.

Less obvious consequences of static charge build up on floors are cleaning problems arising where materials might adhere to the floor surface, for example, any powders.

Such situations may be created when old concrete floors, re-furbished with resin flooring, which do not take into account the reduction of the excellent but unpredictable static controlled properties of ground floor concrete.

Certain environments may call for the control of electrostatic build up to be achieved by a number of measures which support the use of a static controlled floor finish, such as the use of wrist straps and selection of static controlled chairs, tables and workwear.

SELECTION OF FLOORING MATERIAL

Static controlled grades of resin flooring are available in Types 3 to 8 (coatings, self-smoothing and trowel applied screeds). It is important for the specifier to understand that there is a wide range of products and properties available and to select the system that best meets the requirements for the working environment as a whole and to not treat the individual elements in isolation. Colour should be discussed with the flooring manufacturer, as there may be certain colour limitations on static controlled flooring due to the darkening effect of carbon or other conducting additives.

SPECIFICATION AND STANDARDS

The rate at which electrostatic charge is dispersed within and through the floor finish is controlled by the resistance, measured in the unit Ohms (Ω), usually expressed in thousands (Kilo-ohms or KΩ) or millions (Mega-ohms MΩ) and denoted by units expressed as a figure of ten with indices, i.e.10^3 for 1KΩ 10^6 for 1MΩ. Greater values of resistance suggest a slower passage of electrostatic charge and the decay of voltage measured.

Resistance may be measured in one or more of three ways, (a) between two points at a pre-defined distance on the surface of the cured resin floor finish, (b) between the surface and the underside of the resin finish (the substrate), (c) earth leakage of the whole system, between the surface of the resin finish and via the substrate to a point defined as electrical earth. It is not uncommon for those operating facilities which demand an anti-static floor finish to be unsure of their exact numerical requirements, expressed in these terms and (d) a combined body voltage test where the charge level generated and its decay rate on a person walking the floor is measured using specialist equipment to identify the interaction between floor and specialist footwear

The terms 'conductive' and 'dissipative' are widely used although they may mean slightly different things to different people. In general terms 'conductive' floors are produced with resistive values in the region of

$10^4\Omega$ to $10^6\Omega$($10K\Omega$ to $1M\Omega$) and 'dissipative' floors generally offer $10^7\Omega$ to $10^9\Omega$ ($10M\Omega$ to $100M\Omega$)..These values are usually quoted when measured through the system to the substrate, the Earth Leakage Resistance.

Dissipative floors are those most frequently specified for areas where damage to equipment might result from electrostatic accumulation or to prevent accumulation generated by the movement or processing of powders and liquids. Conductive floors might be selected for areas of intrinsic safety where spontaneous release of static charge might cause an explosion, such as with gasses, flammable liquids, munitions or pyrotechnics.

Where possible, the exact range of acceptable resistance, test method (including test voltage) and any specific charge decay requirements should be specified by the end user before selection of resin flooring. Where a resistance value is quoted (in Ohms) it should be specified whether this refers to surface resistivity (the resistance measured between two electrodes placed on the surface of a material after a given time of electrification) or resistance to ground (the resistance measured between a single electrode placed on the surface of a material and a groundable point). In this case it should be specified whether 'ground' refers to the protective earth of the power distribution system (resistance to earth) or, for example, the steel frame of a building used as a return path for electric currents and as an arbitrary zero reference point. The test voltage must be specified as the measured resistance will depend upon the applied voltage.

Different industries have varying requirements and standards vary from country to country. Many industries or organisations have their own internal standards for static controlled flooring. Requirements may relate to the static controlled or conductive nature of the flooring material to be used or to the static controlled characteristics of the finished floor.

In the UK the standard frequently specified has been BS 2050 (now withdrawn), but this merely determined the electrical resistance across the surface (between 25 mm square electrodes placed 50 mm apart) and did not consider either the resistance through the thickness of the flooring onto the concrete base, or the resistance from the surface to ground, both of which are important factors.

Other standards have since come into force that are more comprehensive in their approach. The standard now specified for testing flooring materials is EN 1081. This uses a tripod electrode with conductive rubber feet and provides procedures for determining surface resistance, through resistance and resistance to ground. However it does not give any guidance as to what levels of conductivity are appropriate in different industrial situations. This is where the designer needs to refer to industry-based specifications.

For the protection of Electrostatic Sensitive Devices BS IEC 61340-5-1 (superseding BS EN 100 015-1) Basic Specifications: Protection is the current standard for the electronics industry in 22 European countries. This gives general requirements for surface resistivity, volume resistivity, resistance to ground and charge decay for flooring. However, requirements may be different for the munitions industry, explosive handling areas, hospitals, solvent stores etc.

There is currently no single British Standard that is universally applicable to all industries and all requirements for static controlled flooring. Therefore, the electrical properties, test method and test agency (contractor, client or third party) should be agreed with the end user and discussed with the product manufacturer at the tendering stage. The document entitled 'Conductive Coatings For Industrial Floors' published by Deutsche Bauchemie is highly recommended to assist in establishing project specific standards and test methods. The Health & Safety Executive may also be able to offer advice on specific issues (08701 545500).

APPLICATION OF STATIC CONTROLLED FLOORING

General

If the programme allows, it is recommended to lay a trial area of the static controlled flooring, preferably 4 to 10 m^2, at the beginning of the contract. This will enable parties involved to agree on the appearance and testing of the floor before the work progresses too far.

Surface Preparation

It is recommended that mechanical preparation be undertaken to prepare the surface of concrete substrates. Cutting of rebates and structural repairs such as making good of cracks, day joints and other defects should be undertaken prior to application of the primer.

Earthing

Where a static controlled floor is laid directly onto ground floor concrete there may be enough electrical dissipation to ground. However, where doubt exists, or if an anti-static floor is laid on an insulating sub-floor, it is far better to include copper earth strips.

This will ensure electrical continuity between the substrate and the electrical earth or grounding point. This is normally achieved by the use of adhesive copper tape, laid below the first conductive layer and connected to earthing points installed in a suitable location by the end user's electrical contractor.

Care should be taken to ensure that all sections of the floor are linked together i.e. expansion joints bridged with copper tape to provide electrical conductivity. The application of a surface damp proof membrane will render any floor insulative whether on ground floor concrete or not and additional earthing methods should then be employed.

These strips, are used more frequently where the risks during normal operation are greater. For simpler installations they may be laid simply as a number of tails connecting to specified points, or as a perimeter ring with earthing tails. In more complex situations they are typically applied in a grid pattern or in a herringbone pattern before application of the first conductive layer. The electrical continuity of the copper tape network should be verified before application of the primer. Copper tape is also used to bridge gaps such as expansion joints, beam joints, repairs or where any feature breaks up the continuity of the floor.

In some cases an unmodified non-conducting primer is laid first in order to maximise adhesion to the concrete surface. Such a primer will act as an insulating layer and additional steps as outlined above will be needed to ensure adequate earthing.

It is essential that sufficient earthing points are provided and these should be agreed with the building owner's electricians and sited in discrete locations away from trafficked areas

Priming

In addition to the usual purpose of improving the bond between sub-floor and resin flooring, in some anti-static systems the primer forms the main conductive layer and is critical to the electrical performance of the floor.

Application

The application of static controlled flooring (including earthing and priming) is a specialised process. It is essential that the materials are mixed and applied according to the manufacturer's instructions to the correct thickness onto suitable surfaces and properly tested for continuity and resistance at the various stages.

Testing should always be carried out in conjunction with a qualified electrician to assess the quality of the connection to earth.

In some cases, the film thickness can affect the electrical properties therefore it is important to make suitable allowances for the profile (roughness) of the floor to ensure sufficient material is applied. The application should be made in a continuous process to ensure that continuity is achieved in each area and that electrical bridges are installed between areas. The applicator may be required within the specification to provide evidence that the system meets the specified requirements on completion. It may be required that initial trafficking is necessary before any testing by the manufacturer, or independent testing which will usually attract a fee.

Post Installation

Routine cleaning and wear may alter the electrical properties of flooring. Therefore, in the most stringent circumstances, routine test methods and frequency of tests should be agreed before completion, as should the agency responsible for these tests. The manufacturer should be contacted for their recommendations regarding cleaning methods, materials, polishes etc. some polishes may act as insulators.

Repair and maintenance of the floor should be carried out in such a way as to preserve the electrical properties. If parts of the floor become worn it needs to be borne in mind that a simple overcoating or patching with a conductive system may not be effective because of the need to ensure electrical continuity between the new and old layers.

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