Technical Article 4

Flooring Resistance Measurements : Instrumentation, Correct Specification & Test Procedure

Abstract

There is currently a lot of confusion on the point to point and point to ground resistance testing methodology for *installed* flooring materials including the application voltage (10V, 100V or 500V), the type of instrument to use and the specifications itself – what is conductive and what static dissipative . This technical bulletin will attempt to highlight these points and establish the proper selection of instrumentation, application voltage, specifications and testing / sampling procedures .

Instrumentation & Specifications

For the purpose of standardization, we will make reference to the ESDA standard ANSI ESD S7.1-2000 : Floor Materials – all other available standards are similar or make reference to this particular document . This standard clearly establishes the type of instrument to use, the application voltage and defines the conductive and static dissipative range of the flooring materials .

a. Instrumentation

There are 3 levels or types of instruments that can be used

i. Laboratory Grade Instruments

An instrument that meets the criteria of a standard or standard test method that provides a measurement that is accurate & repeatable . This equipment is typically used to qualify materials, devices, or procedures prior to acceptance and under controlled conditions . The meter must be capable of making measurements from 2.0E03 to 1.0E10 ohms (Accuracy ±10%) .

ii. Acceptance Level Instruments

An instrument that meets the criteria of a standard or standard test method that provides a measurement that is repeatable . This equipment is typically used to verify materials, devices or procedures under in-use (installed) conditions – it is used for acceptance testing of installed materials . The meter must be capable of making measurements from 2.0E03 to 1.0E10 ohms (Accuracy ±20%) .

iii. Compliance Verification (Periodic Testing) Instrument

An instrument that provides an indication or measurement . It may or may not be repeatable or accurate . This instrument is typically used for indications of pass or fail and might not give actual readings – just an indication per coloured resistance ranges on the instrument's indication panel . This meter must be capable of making measurement one order of magnitude below the lowest expected resistance measurement and one order of magnitude above the highest expected resistance measurement .

b. Application Voltage

Battery powered instruments are recommended as AC line powered instruments might give erroneous readings due to undefined ground paths . For acceptance testing of floors, the acceptance level instrument needs to be used with an open circuit voltage of 10V (±10%) for measurements < 1.0E06 ohms (conductive floor) and

100V ((±10%) for measurements ≥ 1.0E06 ohms (static dissipative floor) . Although an open circuit type resistance meter is acceptable – take note that the open circuit voltage will vary with the load . *As such a constant-voltage type instrument is recommended as the voltage will remain constant even with load* . For such instruments – these have been designed according to the ANSI ESD S7.1-2000 : Floor Materials standard such that the application voltage will automatically change to 100V once the resistance ≥ 1.0E06 ohms and remain at 10V for resistance < 1.0E06ohms .

c. Flooring Specifications

First of all the type of flooring needs to be defined – ie, conductive or static dissipative . The definition as per the ANSI ESD S7.1-2000 : Floor Materials standard is as follows :

i. Conductive Flooring Material

A floor material that has a resistance to ground of less than (<) 1.0E06 ohms

ii. Dissipative Flooring Material

A floor material that has a resistance to ground of between 1.0E06 ohms and 1.0E09 ohms (*1.0E06 ≤ R ≤1.0E09)*

Take note that the conductive floor has to be tested at an application voltage of 10V and the static dissipative floor at an application voltage of 100V . *It is common for floor manufacturers or even end users to define a resistance range that goes from the conductive range to the dissipative range and even specify this to be acceptance tested at an application voltage of 100V when the standard clearly states that conductive floor needs to be tested at 10V . Eg – it is common to come across resistance specs of 1.0E04 to 1.0E07 @ application voltage of 100V – obviously this is a common misconception when defining the specifications of floor materials or flooring . The correct specifications should be :*

a. 1.0E04 ≤ RTG < 1.0E06 @ application voltage of 10V and
b. 1.0E06 ≤ RTG ≤1.0E07 @ application voltage of 100V

Therefore by using the correct acceptance level meter with the automatic switching application voltage, the flooring can then be acceptance tested correctly as per the standard . It is wrong to apply an application voltage of 100V for floor materials with specifications of less than 1.0E06 ohms and most instruments will not be able to do this as the high current in the instrument as a result of the lower resistance might damage the instrument . Most good acceptance levels instruments will not permit this damaging situation .

Actual Measurement / Sampling

a. Measurement

Actual acceptance testing will entail PTP or RTT (Point to Point) and RTG (Resistance to Ground) measurements as follows :

a. PTP measurements should be made with the 5 lbs electrodes spaced 915mm (3ft) apart . Should make at least 3 measurements at each location and report the average .
b. RTG measurements should be made by connecting one end of the instrument to a known flooring groundable point (auxillary ground) or electrical ground . It is recommended that 5 points be sampled at each location based on an imaginary 610 by 610mm square grid – refer to Fig 1 .

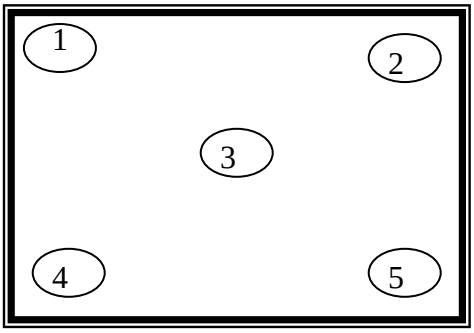

Fig 1 : Plan View of the 5 sampling locations for RTG test (per location)

This methodology can be applied to access (raised) floor or any other type of applied flooring material . Record all the 5 readings per location and report the average .

In addition to the individual readings, report the following :
a. average at each location
b. room average
c. standard deviation (optional)

b. Cleaning

As part of acceptance testing of new floors or floor finishes, these should be cleaned per manufacturer's recommendation before testing . Prior to measurement of the flooring resistance at each location, the electrodes can be cleaned using a minimum of 70% IPA with a clean, low linting cloth (or alternatively, dry cleaned) . When testing existing floors or floor finishes as part of an on going compliance verification plan, the materials shall not be cleaned prior to testing (However, if the resistance readings obtained are out of specification, it is then permissible to clean the floor material to determine the cause of the out of specification condition – but this is only a troubleshooting condition to ascertain that the readings are out of specification because the floor is dirty) .

Technical Article 4
Flooring Resistance Measurements : Instrumentation, Correct Specification & Test Procedure

c. Sampling

As per the ANSI ESD S7.1-2000 : Floor Materials standard, it is recommended that a minimum of 5 tests (5 sampling locations) per 500 sq m (5000 sq ft) be performed . However, in most instances this sampling size is too small and not reflective of the actual resistance uniformity of the floor material in bigger rooms . When establishing the actual number of sampling locations, the following criteria need to be considered :

a. the size of the room
b. whether the sampling size is statistically reflective of the room condition
c. whether there is a need to sample more points at areas of high wear and tear, if these can be established

d. Compliance Verification

As part of the compliance verification plan, it is recommended that the flooring be tested on a quarterly basis (perhaps more frequently at high wear and tear areas) with a compliance verification type instrument and at least on an annual basis using a acceptance level type instrument . The sampling plan for compliance verification does not have to be similar to the initial acceptance testing plan in terms of number of sampling locations . As long as the sampling plan considers the critical areas as part of their bigger overall ESD Management Program then this should be reasonably acceptable. *Prior to using the compliance verification instruments it is important to correlate these to the acceptance level meters to ensure consistency in measurements* .

Conclusion

It is therefore important to establish correct specifications, select the right instrument, define a sampling plan and use the correct testing procedure to make right and acceptable flooring resistance (RTT/RTG) measurements . The floor manufacturer, the installer, the main contractor, the tester (or certifier) and the end user should be simultaneously engaged to establish the correct methodology before the measurements are made . Any disputes in the selection of instrumentation, specifications or testing procedures should be highlighted and trashed out before commencement of the acceptance testing and not after. This will ensure a smooth and quick acceptance testing of the floor material / finishes with little or no impact to the end user .

Prepared By :
Inderjit Singh
NARTE Certified ESD Engineer (#328)
NEBB CPT Supervisor
Cesstech (S) Pte Ltd

25 Sep 2006