KINGKRETE® We Create Future ACADEMY

CPD SEMINAR CPD-FL-SC-01

Static-Control Floors for Electronics and Data Centres

Designing, earthing and testing resin floors that control electrostatic discharge

0.75 LEU	AIA LU|HSW	45 MIN	ADVANCED

RIBA core curriculum · Design, construction and technology · Health, safety and wellbeing



BEFORE WE START

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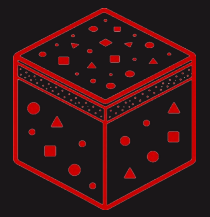
ABOUT THIS COURSE

Why this matters

Uncontrolled static can destroy electronic parts, corrupt data and, in hazardous areas, ignite vapours. The floor is the main path that drains it safely to earth.

This seminar explains how people and equipment become charged, how ESD control programmes use the floor, and how conductive and dissipative floors are classified. It then covers the build-up and earthing of resin static-control floors and the resistance and walking tests that prove them at handover and in service.

FOR Architects, MEP and electrical engineers, facility managers, specifiers and flooring contractors



CREDIT

0.75 LEU · AIA LU|HSW

RIBA TOPIC

Design, construction and technology; Health, safety and wellbeing

LEVEL

Advanced

FORMAT

Live, in-office or self-paced

ASSESSMENT

10 questions, 80% to pass

PREREQUISITE

CPD-FL-RF-01

LEARNING OBJECTIVES

By the end of this course you will be able to

01

Explain

how static electricity is generated on people and equipment and why the floor is part of an electrostatic discharge control programme

02

Distinguish

conductive, dissipative and antistatic floors and the resistance ranges set in IEC 61340 and ANSI/ESD standards

03

Design

the floor build-up and earthing, including conductive primers, copper tape and earth points

HSW

04

Specify

resistance testing on installation and in service, including system tests with people and footwear

HSW

HSW

AGENDA

How the next 45 minutes run

01	How static charge builds up	LO1	8 min
02	The floor in an ESD programme	LO1, LO2	8 min
03	Floor classes and resistance	LO2	8 min
04	Build-up and earthing	LO3	8 min
05	Testing, handover and service	LO4	8 min
Q	Knowledge check and summary	LO1–LO4	5 min

01

MODULE 01 · 8 MIN · LO1

How static charge builds up

Triboelectric charging, walking voltage, humidity and what discharges can do

WHY IT MATTERS

Every person in the room is a charged capacitor

People charge up simply by walking. Unless that charge has a controlled path to earth, it will find its own way out, through a component, a server or a vapour cloud. In most rooms, that controlled path is the floor.



How people and equipment become charged

01	**Contact and separation**	When two materials touch and part, electrons transfer, leaving one positive and one negative.
02	**Walking**	Each step lifts a sole off the floor, so charge accumulates on the body step by step.
03	**Rolling and sliding**	Trolleys, chairs, cable drums and packaging films charge the same way as they move.
04	**Induction**	A charged object nearby can induce charge on an isolated conductor without touching it.
05	**Insulators hold charge**	Insulating floors, soles and plastics cannot drain charge, so it stays until it discharges.

The voltages involved are larger than people expect

10 kV+

Typical possible body voltage walking on insulative floors in dry air

~3 kV

Approximate level at which a person starts to feel a discharge

<100 V

Discharge level that can damage many sensitive electronic devices

Most damaging discharges are never felt. A component can be harmed by a discharge far below the threshold of human perception.

Dry air makes charging worse

01	**Moisture films leak charge**	At higher humidity a thin moisture film on surfaces helps charge bleed away slowly.
02	**Low humidity removes it**	Below roughly 30% RH, charging rises markedly and charge persists for longer.
03	**Air conditioning dries air**	Cooling in hot, arid regions such as the Middle East often gives very dry indoor air.
04	**Data halls run dry**	Large cooling loads and wide humidity bands can leave data halls at low RH for long periods.

CONSEQUENCES

What an electrostatic discharge can do

01

Catastrophic failure

The device is destroyed outright and fails at test, which is costly but at least detected.

02

Latent defects

The device is weakened but still passes test, then fails early in service in the field.

03

Equipment upsets

Discharges near servers and controls can cause resets, data errors or unplanned shutdowns.

04

Ignition

In flammable atmospheres a spark from a person or trolley can ignite vapour, gas or dust.

05

Personnel startle

Shocks are not usually harmful but can cause falls or dropped items near machinery.

TWO DIFFERENT PROBLEMS

ESD protected areas versus explosive atmospheres

ESD protected area (EPA)

- Aim: protect sensitive electronic parts
- Governed by IEC 61340-5-1 or ANSI/ESD S20.20
- Body voltage limits as low as 100 V
- Floor works with footwear in a tested system

Explosive atmosphere

- Aim: prevent ignition of gas, vapour or dust
- Guidance in IEC 60079-32-1 on electrostatic hazards
- Driven by the hazardous-area classification
- Floor limits set by the risk assessment

Some spaces are both, such as battery or solvent rooms in electronics plants. Apply both sets of requirements.

Staff in a dry, air-conditioned electronics room report no shocks at all. Why does this not show that static is under control?

A Shocks only occur when relative humidity is high

B Devices can be damaged far below the voltage people can feel

C Static only builds up on trolleys, not on people

D Air conditioning removes all charge from the air

QUICK CHECK · LO1 · ANSWER

Staff in a dry, air-conditioned electronics room report no shocks at all. Why does this not show that static is under control?

A — Shocks only occur when relative humidity is high

B — Devices can be damaged far below the voltage people can feel

C — Static only builds up on trolleys, not on people

D — Air conditioning removes all charge from the air

WHY People typically feel discharges only from around 3 kV, yet sensitive devices can be damaged below 100 V, so damaging discharges usually go unnoticed.

02

MODULE 02 · 8 MIN · LO1, LO2

The floor in an ESD programme

How ESD control standards use the floor, footwear and grounding as one system

What an ESD control programme contains

IEC 61340-5-1 and ANSI/ESD S20.20 set out a managed programme, not a single product requirement.

01

Defined EPA

Marked boundaries where sensitive items are handled and every control applies.

02

Grounding and bonding

A common earth reference that all conductors, people and surfaces connect to.

03

Personnel grounding

Wrist straps for seated work; floor and footwear systems for mobile staff.

04

Surfaces and equipment

Worksurfaces, seating, trolleys and shelving with controlled resistance to ground.

05

Training

Everyone entering the EPA understands the controls and why they matter.

06

Compliance verification

A written plan for periodic testing of every control, with records kept.

What the floor actually does

01	**Grounds mobile people**	With suitable footwear, staff stay grounded as they walk, without wrist straps.
02	**Grounds mobile equipment**	Trolleys and chairs with conductive wheels or drag chains drain through the floor.
03	**Limits charge generation**	A suitable surface reduces how much charge each step creates.
04	**Backs up other controls**	Provides a second path to earth if a wrist strap or other control fails.

Typical floor and system limits in an EPA

Element	Typical limit	Test method
Floor, point to ground	Below 1×10^{9} Ω	IEC 61340-4-1 or ANSI/ESD STM7.1
Footwear	Below 1×10^{9} Ω, often much lower in practice	IEC 61340-4-3 or ANSI/ESD STM9.1
Person, footwear and floor	Below 3.5×10^{7} Ω system resistance	IEC 61340-4-5 or ANSI/ESD STM97.1
Alternative system route	Below 1×10^{9} Ω and body voltage below 100 V	IEC 61340-4-5 or ANSI/ESD STM97.2 walking test

Limits as typically set in IEC 61340-5-1 and ANSI/ESD S20.20. Confirm against the edition and programme the client follows.

KEY NUMBERS

Three numbers that define an EPA floor system

$<1\times10^{9}\ \Omega$

Typical maximum floor resistance to ground in an EPA

$3.5\times10^{7}\ \Omega$

Typical maximum for person, footwear and floor together

100 V

Typical maximum walking body voltage on the alternative route

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The floor limit is necessary but not sufficient. Qualification depends on the floor and footwear tested together with a person.

A floor measures 5×10^{8} Ω to ground, but operators' person-footwear-floor tests read 4×10^{8} Ω. What else is needed to qualify the system?

A Nothing, as the floor is below 1×10^{9} Ω

B A thicker topcoat to raise floor resistance

C Replacing the floor with a conductive type

D A walking test showing body voltage below 100 V

QUICK CHECK · LO2 · ANSWER

A floor measures 5×10^{8} Ω to ground, but operators' person-footwear-floor tests read 4×10^{8} Ω. What else is needed to qualify the system?

A Nothing, as the floor is below 1×10^{9} Ω

B A thicker topcoat to raise floor resistance

C Replacing the floor with a conductive type

D **A walking test showing body voltage below 100 V**

WHY The system exceeds 3.5×10^{7} Ω, so it can only qualify on the alternative route: below 1×10^{9} Ω and a walking body voltage below 100 V.

03

MODULE 03 · 8 MIN · LO2

Floor classes and resistance

Resistance classes, what the names really mean and how to choose between them

How floors are classified by resistance

Class	Typical resistance to ground	Main purpose
Conductive	Below 1×10^{6} Ω; older classes typically from 2.5×10^{4} Ω	Fast charge removal, often in hazardous or legacy areas
Dissipative	1×10^{6} to 1×10^{9} Ω	Controlled charge removal for most EPAs and data halls
Insulative	Above about 1×10^{9} Ω	No static control function
Antistatic	Not a resistance class; describes low charge generation	Reduces charging but does not ground people

Exact boundaries vary between standards and editions; the governing standard sets the limits used.

Conductive versus dissipative floors

Conductive

- Drains charge very quickly to earth
- Used where fast discharge is the priority
- Can let a fast, damaging discharge reach parts
- Lower limit needed where live equipment exists
- Resistance can be affected by fewer variables

Dissipative

- Drains charge in a slower, controlled way
- Default choice for most EPAs and data halls
- Limits peak current if a charged device grounds
- Higher resistance gives more margin on shock risk
- More sensitive to humidity, wear and cleaning

Specify the numerical range and test method, not just the class name.

Why antistatic is not enough on its own

01	**Describes charging**	Antistatic materials generate less charge on contact, but may not conduct it away.
02	**Higher voltage thresholds**	Some floor-covering standards call a floor antistatic at body voltages around 2 kV.
03	**Far above ESD limits**	An EPA typically needs body voltage below 100 V, so antistatic alone rarely qualifies.
04	**Specify numbers**	Replace descriptive words with resistance ranges, test methods and system limits.

Lower resistance is not automatically safer

A floor that drains static well can also complete a circuit from live equipment through a person to earth. Where mains-powered equipment is handled, set a lower resistance limit and coordinate with the electrical engineer.

Matching the floor class to the space

01

Electronics assembly

Dissipative floor qualified as a system with ESD footwear; body voltage below 100 V.

02

Data halls

Dissipative floor or raised access floor, bonded to earth, with controlled footwear policy.

03

Cleanrooms and labs

Dissipative, smooth and cleanable; check compatibility with cleaning agents.

04

Hazardous areas

Limits from the hazardous-area assessment and IEC 60079-32-1 guidance.

05

Live testing areas

Agree a lower resistance limit with the electrical engineer before choosing conductive.

A client brief asks for an antistatic floor in a new electronics assembly area. What is the best response?

A Convert it to a resistance range, test method and system limit

B Accept any floor described as antistatic by its supplier

C Specify the most conductive floor available

D Rely on humidification instead of a static-control floor

QUICK CHECK · LO2 · ANSWER

A client brief asks for an antistatic floor in a new electronics assembly area. What is the best response?

A **Convert it to a resistance range, test method and system limit**

B Accept any floor described as antistatic by its supplier

C Specify the most conductive floor available

D Rely on humidification instead of a static-control floor

WHY Antistatic describes low charging, not a resistance range. An EPA floor must be specified by resistance, test method and person-footwear-floor system limits.

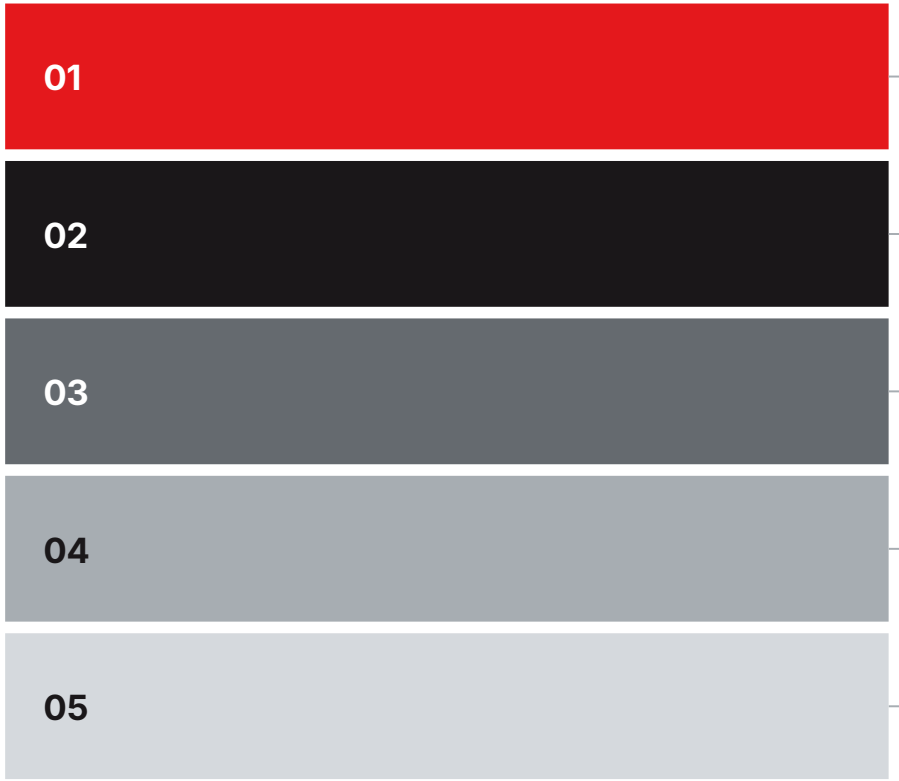
04

MODULE 04 · 8 MIN · LO3

Build-up and earthing

Conductive layers, copper tape, earth points and detailing

Typical dissipative resin floor build-up



Dissipative topcoat
Resin with conductive fillers or fibres; sets the surface resistance range

Conductive primer layer
Carbon-filled layer that spreads charge laterally to the copper tape

Copper tape network
Self-adhesive copper strips laid to the design and led to earth points

Sealing primer
Seals and bonds to the concrete; levels minor defects where needed

Prepared concrete
Sound, dry slab, mechanically prepared as for any resin floor

Layer order and materials vary by system; follow the system design for tape layout and earth points.

Installing the earthing network



Design earth points

Agree number and position of earth points with the electrical engineer at design stage.

Lay copper tape

Fix tape to the cured primer to the layout, running into each earth point.

Apply conductive layer

Roll the conductive primer evenly over the whole area, covering the tape fully.

Connect to earth

A qualified electrician bonds each tape end to the building earthing system.

Test before topcoat

Check continuity and resistance of the conductive layer before it is covered.

Apply topcoat

Apply the dissipative topcoat at the stated thickness, then test the finished floor.

Typically at least two earth points per area, with more on large floors, as the system design requires.

What changes the finished floor's resistance

01 **Topcoat thickness**

Thicker topcoat lengthens the path to the conductive layer and raises resistance.

02 **Filler dispersion**

Conductive fillers must be mixed fully; poor mixing leaves insulating patches.

03 **Added aggregate or pigment**

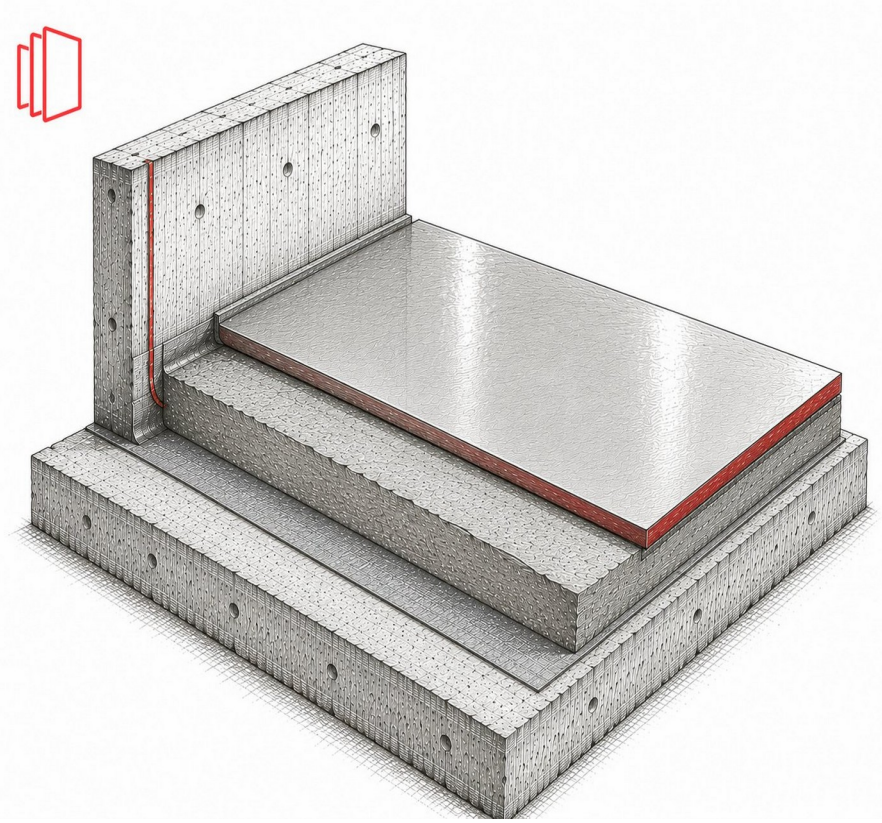
Unapproved broadcast, fillers or tints can disrupt the conductive network.

04 **Breaks in the network**

Gaps in the conductive layer or loose tape joints isolate parts of the floor.

05 **Site conditions**

Cure temperature and slab moisture can affect both cure and readings.



Details that keep the floor connected

01

Movement joints

Carry tape across or around joints so each bay keeps its own route to earth.

02

Day joints and phases

Overlap conductive layers or add tape so each phase is earthed independently.

03

Thresholds

Mark EPA boundaries clearly; keep insulating mats and carpets off the floor.

04

Plinths and fixed equipment

Bond racks, benches and plinths to the same earth reference as the floor.

05

Repairs and alterations

Restore the conductive layer and retest after any cutting, coring or patching.

Raised access floor or resin floor on slab

Raised access floor

- Dissipative panel finish on a pedestal system
- Pedestals and stringers bonded to earth
- Underfloor void used for air and cabling
- Check panel finish and bonding after works

Resin floor on slab

- Dissipative resin system on the structural slab
- Earthed via copper tape and wall earth points
- Cabling and cooling run overhead
- Seamless, cleanable and suits heavy racks

Cable rooms and plant spaces under or beside data halls often need their own static-control floor and earth points.

To improve slip resistance, a contractor proposes broadcasting quartz into the dissipative topcoat. What is the main concern?

A Quartz will make the floor too conductive

B Broadcast aggregate always reduces slip resistance

C It can disrupt the conductive network and change resistance

D The copper tape will corrode under the aggregate

QUICK CHECK · LO3 · ANSWER

To improve slip resistance, a contractor proposes broadcasting quartz into the dissipative topcoat. What is the main concern?

A Quartz will make the floor too conductive

B Broadcast aggregate always reduces slip resistance

C It can disrupt the conductive network and change resistance

D The copper tape will corrode under the aggregate

WHY Quartz is an insulator. Unless the textured finish is part of the tested system, it can break the conductive path and push resistance out of range.

05

MODULE 05 · 8 MIN · LO4

Testing, handover and service

Resistance and walking tests at installation, periodic verification and records

How static-control floors are tested

Test	Set-up	Result
Point to ground (RG)	One 2.27 kg (5 lb) electrode on floor, meter lead to earth point	Resistance of the floor's path to earth
Point to point (RTT)	Two 2.27 kg electrodes on the floor a set distance apart	Uniformity of the floor surface
System resistance	Person in footwear on floor holds electrode; meter to earth	Person, footwear and floor resistance
Walking test	Person walks a set pattern while body voltage is recorded	Peak body voltage, compared with 100 V

Floor tests to IEC 61340-4-1 or ANSI/ESD STM7.1; system tests to IEC 61340-4-5 or ANSI/ESD STM97.1 and STM97.2.

Testing a new floor before handover

01

Record conditions

Note temperature and relative humidity; test after the floor has fully cured.

02

Test conductive layer

Check resistance to earth before the topcoat is applied and record results.

03

Map the finished floor

Measure point to ground and point to point on a grid, near and far from earth points.

04

Test the system

Run system resistance and walking tests with the footwear the client will use.

05

Issue test report

Record locations, instruments, values and conditions as the baseline for service.

Write the test grid, acceptance values and who witnesses the tests into the specification.

What changes the readings over time

01	**Humidity**	Readings typically rise in dry conditions, so test in the driest expected conditions.
02	**Cleaning products**	Waxes, polishes and some detergents leave insulating films on the surface.
03	**Contamination and wear**	Dirt, residues and worn areas change surface resistance locally.
04	**Footwear condition**	Worn, dirty or wrong footwear can fail the system even on a good floor.
05	**Lost earth connections**	Alterations, damage or corrosion at earth points can isolate whole areas.

WORKED EXAMPLE

Specifying the floor for a new data hall

THE BRIEF

Space

Slab-on-grade data hall with overhead cabling, in a hot, arid region

Environment

Heavy air conditioning; indoor RH often low for long periods

Users

Technicians handling server components; frequent visitors

Loads

Heavy racks on castors, pallet trucks for deliveries

01 Set the regime

Treat the hall as an EPA to IEC 61340-5-1, agreed with the client's ESD coordinator.

02 Choose the class

Dissipative resin floor, RG below 1×10^9 Ω, with a lower limit agreed for safety.

03 Design the earthing

Copper tape, conductive primer and earth points bonded to the building earth.

04 Specify the tests

RG and RTT grid, system resistance and walking tests with issued footwear.

05 Plan for service

Approved cleaning products, annual retest in dry season, records kept.

Keeping the floor compliant in service

01

Verification plan

Frequency, locations and limits set in the client's ESD compliance verification plan.

02

Repeat test locations

Retest at the handover grid points so results can be compared over time.

03

Daily footwear checks

Staff check footwear at the EPA entrance before each shift or entry.

04

Calibrated instruments

Use calibrated meters and standard electrodes; record serial numbers.

05

Trigger events

Retest after refurbishment, cleaning product changes or electrical works.

KEY MESSAGE

Design it as a system, prove it as a system

A static-control floor only works with the right footwear, a sound earth connection and the right cleaning. Specify the resistance ranges, the build-up and the system tests, and keep testing for the life of the floor.



A floor that passed at handover now fails point-to-ground tests in several areas after a new cleaning contract. What should be checked first?

A Whether the copper tape has corroded in the slab

B Whether the new cleaning products leave an insulating film

C Whether the floor was laid too thin at installation

D Whether the walking test was done with the wrong footwear

A floor that passed at handover now fails point-to-ground tests in several areas after a new cleaning contract. What should be checked first?

A — Whether the copper tape has corroded in the slab

B — Whether the new cleaning products leave an insulating film

C — Whether the floor was laid too thin at installation

D — Whether the walking test was done with the wrong footwear

WHY The failure coincides with a change of cleaning contract. Waxes and polishes commonly leave insulating films, which is the likeliest and simplest cause to check.

SUMMARY

Four things to take away

LO1 Walking charges people to kilovolts in dry air; devices can fail below 100 V, so the floor must drain charge

LO2 Specify numbers: dissipative 1×10^{6}–1×10^{9} Ω; antistatic is not a resistance class; set lower limits for safety

LO3 Build primer, copper tape, conductive layer and dissipative topcoat; agree earth points with the electrician

LO4 Test RG, RTT and person-footwear-floor systems at handover, then reverify in service and keep records

EARN YOUR CREDIT

Complete the online assessment

10

questions drawn at random from the four objectives

80%

to pass; two attempts, reshuffled each time

0.75

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Sign in to SpecWorld, open the course and take the assessment. Your certificate is issued on passing and kept in your Workdesk under CPD & Certificates.

Standards and references

IEC 61340-5-1

Electrostatics. Protection of electronic devices from electrostatic phenomena. General requirements

ANSI/ESD S20.20

Protection of electrical and electronic parts, assemblies and equipment: ESD control programme

IEC 61340-4-1

Electrostatics. Test methods: electrical resistance of floor coverings and installed floors

IEC 61340-4-5

Electrostatics. Test methods: protection of footwear and flooring in combination with a person

ANSI/ESD STM7.1

Floor materials: resistive characterisation of materials

ANSI/ESD STM97.1 / 97.2

Floor materials and footwear: resistance and voltage measurement in combination with a person

IEC TS 60079-32-1

Explosive atmospheres. Electrostatic hazards, guidance

ASHRAE TC 9.9

Thermal guidelines for data processing environments

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THANK YOU FOR ATTENDING

Questions?

Kashif Aijaz
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This concludes The American Institute of Architects Continuing Education Systems course.

