Under Raised Floor Wiring Requirements

National Fire Protection Association (NFPA) 70®, or the National Electrical Code® (NEC®) chapter, floor wiring in NEC Article 645.5 (E). Most recently updated in 2014, this set of regulations is references under adopted in all 50 states and is the benchmark for safe electrical design, installation, and inspection. This is the standard to which every data center in America with a raised floor needs to be complaint with.

**National Electrical Code Article 645.5**

(A) Branch-Circuit Conductors. The branch-circuit conductors supplying one or more units of information technology equipment shall have an ampacity not less than 125 percent of the total connected load.

(B) Power-Supply Cords. Information technology equipment shall be permitted to be connected to a branch circuit by a power-supply cord.

   (1) Power-supply cords shall not exceed 4.5 m (15 ft).
   
   (2) Power cords shall be listed and a type permitted for use on listed information technology equipment or shall be constructed of listed flexible cord and listed attachment plugs and cord connectors of a type permitted for information technology equipment.

Informational Note: One method of determining if cords are of a type permitted for the purpose is found in UL 60950-1-2007, Safety of Information Technology Equipment — Safety — Part 1: General Requirements; or UL 62368-1-2012, Audio/Video, Information and Communication Technology Equipment — Part 1: Safety Requirements.

(C) Interconnecting Cables. Separate information technology equipment units shall be permitted to be interconnected by means of listed cables and cable assemblies. The 4.5 m (15 ft) limitation in 645.5(B)(1) shall not apply to interconnecting cables.

(D) Physical Protection. Where exposed to physical damage, supply circuits and interconnecting cables shall be protected.

(E) Under Raised Floors. Power cables, communications cables, connecting cables, interconnecting cables, cord-andplug connections, and receptacles associated with the information technology equipment shall be permitted under a raised floor, provided the following conditions are met:

   (1) The raised floor is of approved construction, and the area under the floor is accessible.
   
   (2) The branch-circuit supply conductors to receptacles or field-wired equipment are in rigid metal conduit, rigid nonmetallic conduit, intermediate metal conduit, electrical metallic tubing, electrical nonmetallic tubing, metal wireway, nonmetallic wireway, surface metal raceway with metal cover, surface nonmetallic raceway, flexible metal conduit, liquidtight flexible metal conduit, or liquidtight flexible nonmetallic conduit, Type MI cable, Type MC cable, or Type AC cable and associated metallic and nonmetallic boxes.
or enclosures. These supply conductors shall be installed in accordance with the requirements of 300.11.

(3) Supply cords of listed information technology equipment are in accordance with 645.5(B).

(4) Ventilation in the underfloor area is used for the information technology equipment room only, except as provided in 645.4(2).

(5) Openings in raised floors for cords and cables protect cords and cables against abrasion and minimize the entrance of debris beneath the floor.

(6) Cables, other than those covered in 645.5(E)(2) and (E)(3), are one of the following:
   a. Listed Type DP cable having adequate fire-resistant characteristics suitable for use under raised floors of an information technology equipment room
   b. Interconnecting cables enclosed in a raceway
   c. Cable type designations shown in Table 645.5(E)(6)
   d. Equipment grounding conductors

Informational Note: One method of defining fire resistance is by establishing that the cables do not spread fire to the top of the tray in the “UL Flame Exposure, Vertical Tray Flame Test” in UL 1685-2011, Standard for Safety for Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables. The smoke measurements in the test method are not applicable. Another method of defining fire resistance is for the damage (char length) not to exceed 1.5 m (4 ft 11 in.) when performing the CSA “Vertical Flame Test — Cables in Cable Trays,” as described in CSA C22.2 No. 0.3-M-2001, Test Methods for Electrical Wires and Cables.

Table 645.5(E)(6) Cable Types Permitted Under Raised Floors

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(F) Securing in Place. Power cables; communications cables; connecting cables; interconnecting cables; and associated boxes, connectors, plugs, and receptacles that are listed as part of, or for, information technology equipment shall not be required to be secured in place.

(G) Abandoned Supply Circuits and Interconnecting Cables. The accessible portion of abandoned supply circuits and interconnecting cables shall be removed unless contained in a raceway.

(H) Installed Supply Circuits and Interconnecting Cables Identified for Future Use.
(1) Supply circuits and interconnecting cables identified for future use shall be marked with a tag of sufficient durability to withstand the environment involved.
(2) Supply circuit tags and interconnecting cable tags shall have the following information:
   a. Date identified for future use
   b. Date of intended use
   c. Information relating to the intended future use

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Allowed Branch Circuit Conductor Types

Before running information technology equipment cable under a raised floor, employees must have a comprehensive understanding of what type of cable is being run, the pros and cons of that type of cable verse other alternatives, and the NFPA. Understanding all three will help increase the safety of your data center for both personell and equipment.

Many different types of power, communications, connecting, and interconnecting cables, as well as cord-and-plug connections and receptacles exist for information technology equipment. Out of all, branch circuit conductors require the most attention because of the constant power they are supplying. NEC article 645.5 (E) only permits for branch circuit conductors that use Liquid-Tight Flexible Metallic Conduit, Flexible Metallic Conduit, or MC Cable installed under a raised floor.

Each type has benefits and disadvantages. The advantage to understanding the difference of the three is that decisions can be made that are best for your under floor environment. It will also help determine how much time and money is needed for installation of these cables and others after the fact. Not to mention the benefit of your underfloor environment adhering to the national fire code.

Liquid-Tight Flexible Metal Conduit

The most popular of the three options is Liquid-Tight Flexible Metallic Conduit, or Seal Tight. Seal Tight conduit is ideal for dual power feed environments or other environments that rely heavily on organization. While Seal Tight is a little larger and less flexible than it’s competitors, it makes up for in cost effectiveness and moisture resistant. Seal Tight is also label friendly and is available in different colors.
Flexible Metallic Conduit

Flexible Metallic Conduit has a smaller diameter and is lighter than Seal Tight. The metal jacket casing limits labeling options and they lack color options. The jacket also causes more dirt residue that the Seal Tight does not.

Metal Clad (MC) Cable

Metal Clad (MC) Cable has a smaller diameter and is lighter than Seal Tight, as well. Like Flexible Metallic Conduit, the metal jacket casing limits labeling options and lacks color options, as well as produce more dirt residue that the Seal Tight does not.

MC Cable and Flexible Metallic Conduit are almost identical with the exception being that MC Cable is factory assembled and has conductors already installed in it. Flexible Metallic Conduit does not come with the conductors in it. Due to risks in the manufacturing process, Johnston Technologies does not recommend MC Cable in under floor data center environments, even though it is NEC approved.

Branch Circuit Conductor Types Not Allowed

Along with every branch circuit conductor cords not listed in NEC Article 645.5, SO Cords are not allowed under raised floor in information technology environments. SO Cord Cables are a water-resistant conduit option that is flexible, light, and has a smaller outer diameter than the others.

A very common mistake is the use of SO Cord installed under raised floor, unfortunately, the use of SO Cord under a raised floor violates the NEC 645.5 (E). While SO Cords are commonplace in data centers, they is intended for use above the floor.