

FESHM 9130: MANAGEMENT AND USE OF CABLE TRAY SYSTEMS

Revision History

Author	Description of Change	Revision Date
David E. Mertz	Editorial changes to clarify that this chapter applies to Fermilab leased spaces as well as the Fermilab site	January 2018
Michael J. Utes	Added Technical Appendix with IT Equipment Grounding Guidelines	June 2013
Michael J. Utes	1. Revised the definition of Cable Tray System 2. Revised the first sentence in the definition of Signal 3. Added NFPA reference to Requirements item 1a 4. Reworded requirement 2b	December 2010

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1.0 INTRODUCTION

This chapter describes general installation requirements and uses permitted for various types of cable tray systems for electrical conductors not generally covered by Article 392 of the National Electrical Code (NFPA 70). Hazards associated with the use of cable tray include overloading which may lead to mechanical failure and overheating which may lead to insulation failure and the possibility of fire. This chapter applies to Fermilab's site in Batavia, Illinois as well as any leased spaces.

This chapter does not apply to mechanical tray systems used to support piping, tubing, or other non-electrical loadings.

2.0 DEFINITIONS

Cable Tray System: A unit or assembly of units or sections and associated fittings forming a rigid structural system used to support, securely fasten, and protect electrical cables.

Power Cable Tray: A cable tray containing DC cables supplying magnet loads and or AC cables for utilization equipment.

Premises Wiring Cable Tray: A cable tray containing conductors associated with the premises wiring system.

Signal: A voltage or current of low energy carried on a conductor for the purpose of monitoring or controlling equipment. Such signals are typically associated with, but not limited to, accelerator and experimental control and data acquisition systems and their connective networks. This definition must not be confused with the NEC definition for a signaling circuit which refers to alarm (fire alarm) or security (burglar alarm) systems or with controllers that deliver electric power to equipment such as motors.

Utility Cable Tray: A cable tray containing signal cables. See definition of "Signal" above.

Definitions of other applicable terms of AC Electrical Power Distribution System, Electrical Utilization Equipment, Point of Outlet, and Premises Wiring are found in Fermilab FESHM Chapter 9120.

3.0 RESPONSIBILITIES

3.1 Electrical Safety Subcommittee

The Electrical Safety Subcommittee (ESS) of the Fermilab Environment, Safety, & Health Committee (FESHCom), in conjunction with the Laboratory Director and Chief Safety Officer, has oversight responsibility for the on-going direction and content of the Laboratory's Electrical Safety Program and for providing guidance, interpretation, approval, and recommendations related to cable tray installation and use.

3.2 Electrical Authority Having Jurisdiction (AHJ)

Provide day-to-day guidance and decisions on the implementation of the requirements in this Chapter and relevant portions of the National Electrical Code.

3.3 ESH&Q Section Division Safety Officers (DSOs)

Provide guidance and correction regarding electrical installations and operations to personnel in their areas of responsibility and direct inquiries and concerns about electrical installation and operation to the Electrical AHJ.

3.4 Facilities Engineering Services Section

Provide documents and inspection services for facility construction, renovation, and demolition in compliance with the requirements in this Chapter and relevant portions of the National Electrical Code.

3.5 Project Electrical Managers and Engineers

Provide documents and inspection services for experimental equipment construction, renovation, and demolition in compliance with the requirements in this Chapter and relevant portions of the National Electrical Code.

4.0 PROGRAM DESCRIPTION

4.1 General Requirements For All Cable Tray Installations

The following requirements and recommendations relate to all installations and uses of cable trays, of any type.

- a. Cable tray systems shall be grounded. Reference NFPA 70 articles 392.7 and 250.
- b. Cable tray systems shall be engineered and properly installed to preclude mechanical failure under anticipated load conditions.
- c. Cable tray systems shall present a minimum of sharp edges to installed cables.
- d. Caution must be exercised when adding cables or other services to existing trays to ensure that installed cables are not crushed, abraded, or otherwise damaged.
- e. Mechanical fastening of cables to the cable tray structure or to other cables in the cable tray system should be minimized. Excessive fastening unnecessarily constrains the addition or removal of cables at future times. It is recognized, however, that mechanical fastening of certain cable installations is necessary to limit movements associated with electromagnetic forces.
- f. It is strongly recommended that all unused cables be removed from existing cable tray systems. It is recognized, however, that such removal may be precluded if existing operational cables would be adversely affected by the removal process.

- g. Cable trays should not be utilized for storage of excessive lengths of installed cables. Cables should be dressed to suitable lengths upon installation.
- h. It is recognized that in many locations, due to limited space, the cable tray system offers the best means of bringing services to support experimental devices. In all cases, neither the mechanical loading nor the ventilating capability of the installed cable tray system shall be significantly compromised by addition of such services.
- i. Flammable gas lines are generally not permitted to be located in cable trays. Refer to Fermilab FESHM Chapter 6020.3 for specific details relative to flammable gas line installation and routing.
- j. Utilization equipment shall not be located in cable tray.

4.2 Special Cable Tray Installation Requirements

The following requirements and recommendations relate to installations and uses of specific types of cable trays. Refer to “Power,” “Premises Wiring,” and “Utility” cable trays in the Definitions section above.

- a. For instances of where premise wiring is to be installed in a cable tray, such wiring shall be installed in accordance with the National Electrical Code. For those cases where premise wiring is installed in existing cable trays, it is suggested that the wiring be removed or be segregated through the use of tray dividers. The fill factor should be adjusted to meet the requirements of the National Electrical Code.
- b. For installations of cable into a power cable tray, the responsible engineer shall consider the thermal and electrical properties of the cable with regard to that specific installation and the structural load capability of the cable tray system. All installations should reference the NEC NFPA 70 Article 392 guidelines for cable tray fill and other considerations specified.
- c. For installations of cable into a utility cable tray, the responsible engineer shall take into account the structural load capability of the cable tray system and the durability of the existing cables. 100% cable fill of the tray is permitted. The nature of signal circuits is such that the energy carried by the cables is relatively low. Accordingly, the resultant losses in signal cables are of a sufficiently low level that heat dissipation is not a problem.
- d. While subject to the general requirements of this chapter, non-flammable gas lines which are neatly bundled and secured may be installed in utility cable tray or attached to the utility cable tray supports (not attached to the tray itself).

5.0 TECHNICAL APPENDIX TO MANAGEMENT AND USE OF CABLE TRAY SYSTEMS:

GROUNDING STANDARDS FOR INFORMATION TECHNOLOGY EQUIPMENT

Information Technology Equipment is significant at Fermilab with facilities designed and dedicated to and for that purpose. Particular attention is being given to this area as more facilities are constructed with specific purpose to large scale computing. This memo addresses the subject of grounding information technology equipment for proper operation and safety.

BACKGROUND:

The National Electrical Code (NEC), 2005 Edition, addresses the standards for grounding of information technology systems in NEC article 645. The code generally applies the requirement that “All exposed non-current-carrying metal parts of an information technology system shall be bonded to the equipment grounding conductor in accordance with Article 250 or shall be double insulated.” The purpose for this requirement is to ensure personnel safety, such that conductive parts of the equipment that become energized, quickly cause overcurrent protective devices to operate and clear the hazard. This requirement is typical in other code sections of any conductive structure or equipment that may become energized.

SCOPE:

The following construction standards apply to the information technology equipment in designated special purpose facilities. The standards developed are based on the National Electrical Code and intended to complement and clarify the code for specific installations. Also, additional information is available and is incorporated from the Department of Energy Handbook, Electrical Safety, DOE-HDBK-1092-2013.

Equipment:

- 1.) All equipment shall be listed or approved for the intended purpose.

Grounding and Bonding:

Enclosures

All metal parts of electrical equipment and chassis shall be bonded and grounded per the NEC. The use of the single point grounding method is preferred. Multiple ground paths should be avoided.

- 1.) Each enclosure containing power shall be bonded to the grounded equipment conductor supplying power to the enclosure.
- 2.) The bonding conductor shall be the same gauge or larger in size and in accordance with the NEC.
- 3.) The equipment grounding conductor and the grounded conductor, also known as the supply neutral, shall not be connected together at any point.

- 4.) Each cabinet mounting rail shall be bonded to the equipment grounding conductor in accordance with manufacturer's instructions.
- 5.) If the enclosure contains a power distribution unit, the enclosure shall be bonded through the power distribution unit in accordance with manufacturer's instructions.
- 6.) If the enclosure contains a power strip, the metallic case of the power strip shall be bonded to the grounding conductor through the mounting screw in accordance with manufacturer's instructions.

Equipment

- 1.) Each chassis receiving power shall be bonded/grounded internally through the equipment ground conductor contained in the power cord or feed wires.
- 2.) Each chassis not receiving power shall be bonded/grounded to the rails with a bond conductor in accordance with the manufacturer's instructions.

Cable Trays

- 1.) Cable trays shall be grounded per NEC 250.
- 2.) Cable tray systems shall not be used as the equipment grounding conductor.
- 3.) Cable tray systems do not need to be mechanically continuous but must be electrically continuous.
- 4.) The cable tray system shall be bonded to the source panel ground system at one point.
- 5.) An individual equipment grounding conductor should be routed with each branch circuit supply conductor to the enclosure point of connection.

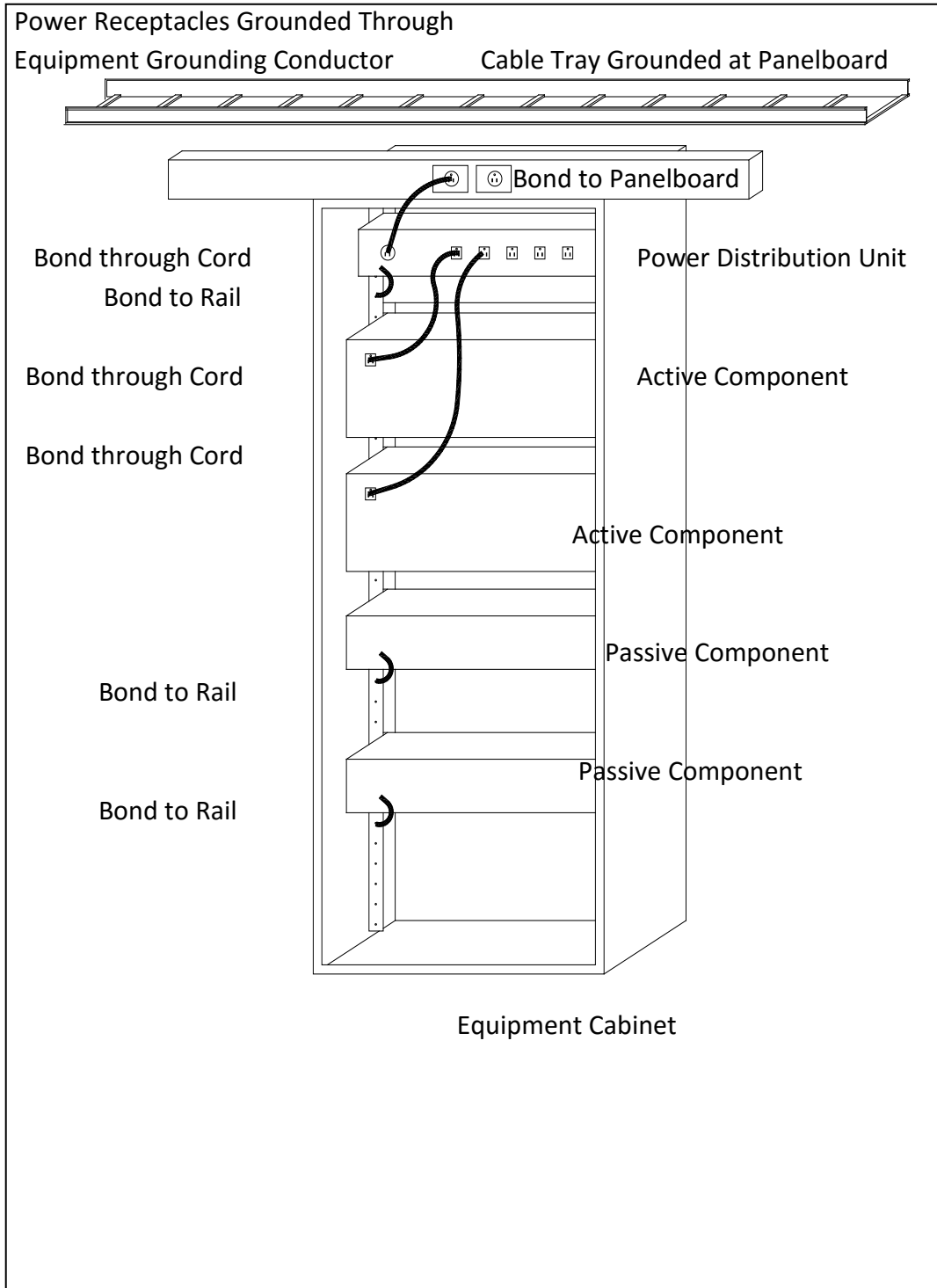


Figure 1. - Information Technology Equipment Rack Grounding