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3018 Eastpoint Parkway
Louisville, KY 40223

502-716-7073
http://www.e-Hazard.com

Using Dielectric and Electrical Hazard (EH) Shoes

Hugh Hoagland, Sr. Managing Partner, e-Hazard.com
President, ArcWear.com

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What Shoes do I Wear?

There are two basic names for shoes which have some protection from electrical shock: Dielectric and Electrical Hazard rated. The differences between the standards even by electrical specialists are not usually understood. Few guidelines exist on when and where to use the shoes in either standard. This paper offers some assistance on which standards relate to which shoes.

Hazard Assessment Guides

OSHA PPE General Guide

According to 1910.136(a): "Each affected employee shall wear protective footwear when working in areas where there is a danger of foot injuries due to falling or rolling objects, or objects piercing the sole, and where such employee's feet are exposed to electrical hazards." Appendix B of Subpart I identifies the following occupations for which foot protection should be routinely considered: shipping and receiving clerks, stock clerks, carpenters, electricians, machinists, mechanics and repairers, plumbers, assemblers, drywall installers and lathers, packers, wrappers, craters, punch and stamping press operators, sawyers, welders, laborers, freight handlers, gardeners and grounds keepers, timber cutting and logging workers, stock handlers and warehouse laborers. (http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10120)

OSHA 29 CFR 1910.269 which applies to transmission, distribution and generation of electricity, cites ASTM F1117 shoes in the standards document but gives no guidelines as to when they are needed.

http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_id=9873&p_table=STANDARDS

An OSHA interpretation letter from March 17, 1993 basically does not "require" electrical trades to wear "safety toed shoes." The letter states, "One option you and your employer may wish to consider is the purchase of non-metallic safety footwear that provides both foot protection and is non-conductive." No later opinions have been offered.

OSHA gives little guidance and really only mentions the EH shoes in the general PPE guide for small businesses. OSHA states, "Electrical hazard, safety-toe shoes are nonconductive and will prevent the wearers' feet from completing an electrical circuit to the ground. These shoes can protect against open circuits of up to 600 volts in dry conditions and should be used in conjunction with other insulating equipment and additional precautions to reduce the risk of a worker becoming a path for hazardous electrical energy. The insulating protection of electrical hazard, safety-toe shoes may be compromised if the shoes become wet, the soles are worn through, metal particles become embedded in the sole or heel, or workers touch conductive, grounded items. Note: Nonconductive footwear must not be used in explosive or hazardous locations."
http://www.osha.gov/Publications/osha3151.pdf

NFPA 70E Guidelines

NFPA 70E attempts to give guidelines for using DI or EH shoes but it suffers from some of the same issues as the OSHA guides. It is better in the sense that it does make use mandatory in a few cases but it is still unclear about the role, if any for EH shoes.

Electrical Hazard (EH) Shoes

Table 130.7(C)(8) Standards on Protective Equipment lists both ASTM F1117 and F2413 under the footwear section but does not mention EH shoes. The ASTM F1117 standard is cited by the F2413 standard as the standard specification for DI shoes so the citation of F2413 does not imply that EH shoes are required by NFPA 70E.

Table **130.7(C)(10)** Protective Clothing and Personal Protective Equipment (PPE) calls for all Hazard/Risk Categories (HRC) to include "leather shoes" which in no case can be dielectric shoes but "leather shoes" are not equivalent to "EH" shoes.

130.7(C)(13)(d) "Foot Protection. Heavy-duty leather work shoes provide some arc flash protection to the feet and shall be used in all tasks in Hazard/Risk Category (HRC) 2 and higher and in all exposures greater than 4 cal/cm^2." This would imply that DI shoes alone are not acceptable but does not exclude EH shoes.

Dielectric (DI) Shoes

"130.7(C)(7) Foot Protection. Where insulated footwear is used as protection against step and touch potential, dielectric overshoes shall be required. Insulated soles shall not be used as primary electrical protection."

130.5(E)(3) Dielectric overshoes are required when performing "equipment grounding near power lines."

Only dielectric footwear is listed in 250.1 Maintenance Requirements for Personal Safety and Protective Equipment.

320.8 Personal Protective Equipment for Battery Rooms requires protective overshoes but doesn't indicate why they are used. If they are for acid protection then they would need to meet an applicable part of F2413 but if for electrical hazards, they would need to meet ASTM F1117.

In **310.5 (D)(2)(*1*)** for protecting employees working around electrolytic cells like in smelting operations, shoes are listed for "wet service and if 130.7(C)(7) is understood, the use of dielectric shoes/overshoes or boots is required.

NFPA 70E Guideline Summary

Dielectric shoes are required for wet service and step potential hazards in any application and EH shoes are optional, but leather is mandatory in HRC 2-4.

OSHA Guideline Summary

OSHA letters of interpretation present EH shoes positively but do not require them. In higher voltages or higher risks (1910.269), OSHA cites ASTM F1117 for dielectric shoes NOT ANSI Z41 or ASTM F2413.

Shoe Standards

ANSI Z41

This was the old general safety shoe standard and used to include EH shoes but now shoes must meet ASTM 2413-2005

ASTM F2413-2005

(http://www.astm.org/Standards/F2413.htm).

The ASTM F2413-05 standard covers minimum requirements for the design, performance, testing and classification of protective footwear. Footwear certified as meeting ASTM F2413-05 must meet the minimum requirements of Section 5.1 "Impact Resistant Footwear" and Section 5.2 "Compression Resistant Footwear." Additional sections have requirements of specialty shoes such as metatarsal protection, conductive protection, electric shock protection, static dissipative protection and protection against punctures.

ASTM specification must be marked with the specific portion of the standard with which it complies. One shoe of each pair must be clearly and legibly marked (stitched in, stamped on, pressure sensitive label, etc.) on either the surface of the tongue, gusset, shaft or quarter lining.

An example of ASTM style markings for protective footwear is:

ASTM F2413-05
M I/75/C/75/Mt75
PR
EH

First Line: ASTM F2413-05:
This means the protective footwear meets the performance requirements of ASTM F2413 issued in 2005.

Second Line : M I/75 C/75 Mt75:
M in this case means the footwear is designed for a Male (F would be Female). (I) denotes impact resistance followed by the

impact resistance rating (75 or 50 in foot-pounds), (C) denotes compression resistance and the compression resistance rating (75 or 50 which correlates to 2500 pounds. and 1750 pounds of compression respectively). (Mt) designates that this shoe has metatarsal protection and rating (75 or 50 foot-pounds).

Third and Optional Fourth Line: PR EH.

The last two lines are used to identify footwear made to offer protection from other specific types of hazards referenced in the standard. They designate conductive (Cd) properties, electrical insulation properties (EH), static electricity dissipative (SD), puncture resistance (PR), chainsaw cut resistance (CS) and dielectric insulation (DI), if applicable. The last line is only used when more than three sections apply.

Electrical Hazard (EH) footwear is manufactured with non-conductive electrical shock resistant soles and heels. The outsole can provide a secondary electrical shock resistance protection to the wearer against the hazards from an incidental contact with energized electrical circuits or parts. Testing ensures the materials are capable of withstanding 14,000 v at 60 Hz for one minute with no current flow or leakage current in excess of 3.0 mA, under dry conditions. (This is NOT usually acceptable for wet service or higher voltages.). ASTM 2413 cites ASTM F1117 for dielectric shoes.

CAN/CSA-Zl95-M92 Section 4.3 (http://www.csa.ca)
CAN/CSA-Zl95-M92 Section 4.3 is similar to the ASTM 2413 standard only more stringent in its leakage and voltage requirements. The CSA standard is also a "wet sole test."

ASTM F1116-03 (Reapproved 2008) is the ASTM *test* method for dielectric shoes. It has three different procedures which differ according to the section of the footwear tested. (To purchase ASTM standards see http://www.astm.org/.)

ASTM F1117-03 (Reapproved 2008) is the *specification* for dielectric footwear and is a quite stringent standard. Only one boot and overshoe currently meets the F1117-08 specification.

The most important thing to be aware of is that ASTM F2413 is a standard designed primarily for impact and compression protection. Some dielectric shoes cannot pass the compression portion of that standard because many are designed as overshoes and don't have a steel toe, but the overshoes can be worn with compression resistant shoes if needed.

Note: Steel toes have never been shown to conduct electricity as long as the toe is still covered with the shoe material.

ASTM F-1117 refers to the boots and overshoes as "supplementary protection" since the shoes have no "in-use" standard. In-use standards normally require re-testing so shoes should never be relied on as primary protection. An in-use standard is not planned at the current time by the ASTM F18 committee.

Which Standard Do I Choose?

First, choose the protection level or specific standard you need: Dielectric or Electrical

Hazard levels. Second, choose the standard ASTM F1117, ASTM F2413 or CSA Z41,

PVC boots weigh up to 50 percent less than the rubber version, but do not currently meet the ASTM standard.

Third, look into the unique hazards of the work environment. The higher the overshoe, the less likely there will be water or grass or other energized materials contacting the worker. Also, look closely at the heel and sole design. This is especially true for climbing poles, ladders and stairs. A deep heel is needed to safely climb while the normal shallow heel works well for walking. Fit and the ease of donning and doffing the footwear warrants consideration especially on overshoes.

Problems to Consider

Most testing applies only to the sole of the footwear, which usually begins degrading quickly. Minute holes in the soles of the footwear are the biggest area of concern in the protection scenarios. The footwear, unlike the rubber gloves used for primary protection in utilities, has nothing to protect them from the effects of walking and from the effects of ozone and UV light. The makers and users of dielectric shoes point out this fact. They also note that some utilities attempt to lessen the chances of sole degradation by stamping a date on the footwear and replacing them after one year or less depending on the frequency of use. All the manufacturers and users recommend regular visual inspections and replacement when any sign of excessive wear exists.

Summary

With OSHA early documents falling on the side of EH shoes for electrical work, companies would do well to consider them for all electrical workers and other workers exposed to electrical hazards or damp locations. These shoes rarely add more than five USD to the cost of the shoe and they have been known to save lives. They should be considered for low voltage (<750V) and low risk tasks.

High risk tasks, environments and medium and high voltages require more and more stable protection. ASTM F1117 shoes provide this type of protection and are the preferred step potential PPE option in both OSHA 1910.269 and NFPA 70E.

Hugh Hoagland owns two companies which focus on arc flash testing and electrical safety and arc flash training. He may be reached at hugh@e-hazard.com or 502-314-7158.