

***Lessons Learned***  
***Loose Ground Pin Suspected of Causing Internal Fault of***  
***250 vac 30 amp 3 phase Connector***  
***October 30, 2006***

***Event***

On Monday October 30th, an electrical technician was preparing to continue work on some equipment inside the MW9 Building electrical shop area. The employee had plugged the electrical connector for the equipment into a 30 amp 3 phase 208 VAC receptacle and was in the process of turning the plug slightly clockwise to lock it into place when the plug electrically faulted internally. The technician, although not required by any of the electrical safe work practices, always wore voltage rated gloves, leather hand protectors and an arc rated face shield when plugging in the equipment. Due to the use of the PPE, the employee was uninjured from the fault arc. The employee reported the incident to his supervisor and an investigation into the cause of the fault was initiated.



Faulted Plug

The plug being used on the equipment was a Hubbell Model 45815 four-pin-plus-ground twist-lock plug. This is an older style plug characterized by an irregular shaped ground pin. The cable grounding conductor is terminated at the external cable end of the plug body. The plug is rated for 30 amps 250 VAC 3 phase circuits. The failed plug was examined by the AD ESH Department Head and two members of the Electrical Safety Subcommittee (ESS), including the Subcommittee Chair. When the faulted plug was first recovered, the ground pin was observed to be missing and was later discovered on the floor by the receptacle. There was no evidence of arcing at the conductor blades. The flexible SO cord wired to the connector was fully intact. The insulation covering the individual conductors of the SO cord was in place and not brittle. Conductor arcing was limited completely to the interior of the plug body. The severe damage to the internals of the plug makes a positive fault diagnosis impossible. One of the most plausible causes is a failure of the ground pin connection on the inside of the plug. The ground pin is inserted through a phenolic shell and



Hubbell Model 45815 plug.  
External Plug Face (top)  
Internal pin configuration  
(bottom)

held in place by penning the end of the ground pin over a brass washer on the inside of the plug, much like a rivet. If the end of the ground pin were to break off, a small piece of the ground pin and the washer could move inside the plug, shorting out one or more of the phase pins inside of the plug.

A web search to identify similar plug failures was conducted as part of the investigation but no information on similar failures was found. While there are undoubtedly more than several hundred instances of this older style Hubbell connector and the associated mating receptacle at the Laboratory, wholesale replacement of this style of plug and its receptacles is not considered to be warranted by the Electrical Safety Subcommittee, given only this single instance of plug failure.

The subject connector is no longer supplied through Fermilab stores. The more standard NEMA Style L21 series plugs and receptacles are currently utilized in new and retrofitted installations for 30 Amp 208 VAC 5 wire service.

### ***Lessons Learned***

Before plugging in any electrical connector into a receptacle, a close examination of the plug connector should be made. The inspection should look for loose or damaged plug pins, damaged plug housing, or damaged or frayed cord. In installations where the older style Hubbell 45815 connector is used, the plug's ground pin should specifically be examined to insure the pin is tightly connected to the plug housing.

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