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BROOKHAVEN NATIONAL LABORATORY

Memo

date: *April 19, 2000*

to: *ES&H Coordinators and Building Managers*

from: *J.A. Curtiss, Laboratory Electrical Safety Officer*

subject: *Electrical Connections to Vacuum System Bake-out Heaters*

Heaters used for bake-out of vacuum systems are generally not in enclosures which would provide one barrier layer preventing contact with an energized conductor. Accordingly, it is necessary to exercise additional care when wiring vacuum system heaters.

Such heaters are generally provided with welded-on lead wires for room-temperature connection to electrical power. The lead wires may be terminated directly in a plug which is inserted into a conventional receptacle. In this case, the plug must be two-prong so there is no assumption that a ground connection is provided through the heater wiring.

It is not permissible to extend the lead wires as individual wires. Two barrier layers to prevent contact with an energized conductor are generally required for electrical installations and the insulation over a wire provides one of the barriers. For enclosed equipment the enclosure provides the second barrier. For cables, the cable jacket provides the second layer. The above arrangement, with individual wires directly terminating in a plug, is acceptable only due to the limited length of the lead wires.

When bake-out heaters and the power source are separated, it is preferable to extend power to the vicinity of the heater. When it is necessary to do the reverse, to extend electrical connections of a bake-out heater to the source of power, then the extension must provide a double barrier. The connections between the lead wires and the cable can be made in an electrical enclosure, or with crimp-connected insulated "barrel" splices between the heater extension wires and the wires in the extension cable. Make the splices by covering each individual splice with shrink tubing, and covering the assembly of the two connections with a single piece of shrink tubing. This arrangement provides multiple layers of insulation over the energized conductors and adds mechanical strength.

There are two options for the extension cable. Option A is use of a three-wire "S-cord" and plug, with the green grounding conductor connected to the vacuum system at the heater location. Option B is extending only two wires using any "S-Cord" cable (zip-cord is not cable!) and terminating the cable in a two-prong plug. In addition, for this option, the object on which the valve is mounted must be adequately (and obviously) grounded to protect personnel in the event that a malfunction should cause a short of the energized wire to the equipment.

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