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WARNING!

Persons using electrical equipment are cautioned that the use of damaged receptacles and connectors can be extremely dangerous.

Summary

The National Institute for Occupational Safety and Health (NIOSH) is requesting assistance in preventing the electrocution of workers due to the use of damaged electrical receptacles and connectors. Two recent incidents are described. Results of the investigations indicate that *periodic inspection, recognition of hazards, and proper use of receptacles and connectors*, and *prompt repair of damaged connectors and receptacles*, could prevent such incidents. Editors of appropriate trade journals, safety and health officials, and especially those who work with electrical equipment, are requested to bring these recommendations to the attention of owners, managers, and workers.

Background

Occupational electrocutions continue to be a serious problem throughout the United States. Data obtained from the Bureau of Labor Statistics' Annual Survey indicate that approximately 10% of all occupational fatalities are due to electrocutions. Those data, as well as other information collected by the National Institute for Occupational Safety and Health (NIOSH), demonstrate that fatalities due to electrocutions occur in a variety of ways. For example, previous NIOSH Alerts have described cases in which workers have been electrocuted as a result of contacting improperly grounded equipment, or when cranes or grain augers have contacted overhead power lines [1,2]. This Alert presents information on two fatal electrocutions that occurred as a result of using damaged receptacles and connectors.

Two investigations by NIOSH found evidence to suggest that the victims were unaware of hazards associated with the use of damaged connectors.

In both cases, it was assumed that because a connector fit into a receptacle, the connection was proper and no hazard existed. The prevalence of this particular hazard is not clear. However, the cases described below point out the insidious nature of this hazard. The presence of receptacles and connectors in all workplaces, and the repetitive nature of their use (which in certain workplaces increases the possibility of damage) suggests that the potential hazard is widespread. These investigations also demonstrate that careful routine inspection and aggressive maintenance might well prevent such fatalities.



Case Reports of Fatal Injuries

Case #1--One Fatality

On July 23, 1985, a 24-year-old employee of a textile mill was electrocuted when he *touched a loom frame* while performing his routine duties at the loom. The loom had become energized when an electrical, three-prong connector from a thread feeder machine was inserted into a damaged receptacle mounted on the loom. The damage to the receptacle permitted the ground prong of the plug to be improperly inserted into one of the phase terminals (90 degrees clockwise away from the appropriate ground terminal). This resulted in energizing the ground prong and the frame of the loom. When the worker touched the energized loom, he was electrocuted. It appeared, upon subsequent inspection, that the receptacle had been damaged because of a lack of adequate strain relief for the electrical cord from the thread feeder.

Case #2--One Fatality

On July 29, 1985, a 29-year-old welder was electrocuted when he inserted the "male" end of an electrical plug on a portable arc welder into a broken "female" connector of an extension cord. As in the previous case, the victim inserted the ground prong of the welder cord 90 degrees clockwise away from the appropriate ground terminal of the extension cord, and the metal casing of the welder connector became energized. It appeared that the connector on the extension cord had been damaged by everyday use or abuse (being thrown down on and dragged across concrete floors, being run over by industrial equipment, etc.).



Regulatory Status

Although, in these investigations the receptacles and connectors in these investigations were listed by a nationally recognized testing laboratory, the damaged state of the receptacles negated their conformance to these listings,* to the manufacturers' specifications, and to the safety features inherent in their design. NIOSH strongly urges periodic inspection and maintenance of electrical systems to assure compliance with applicable sections of the National Electric Code, OSHA standards, and other listing requirements. Electrical components should be used only in accordance with the manufacturers' specifications, and should be tested and approved by a nationally recognized laboratory (such as Underwriters Laboratory, Factory Mutual, etc.).

Conclusion

The investigations by NIOSH indicate that damaged receptacles may physically permit improper electrical connections to be made, negating the intended safeguards designed into them. Furthermore, workers may not recognize a hazard of electrocution associated with the use of worn or damaged receptacles and connectors. Electrical hazards of this sort are of particular concern because of the large number of users of electrical equipment in all kinds of workplaces. Investigations of such incidents suggest failures in the areas of **PROPER UTILIZATION OF ELECTRICAL COMPONENTS, HAZARD RECOGNITION, and PERIODIC INSPECTION AND MAINTENANCE OF ELECTRICAL SYSTEMS**. These basic safety activities are potentially lifesaving in preventing such incidents.

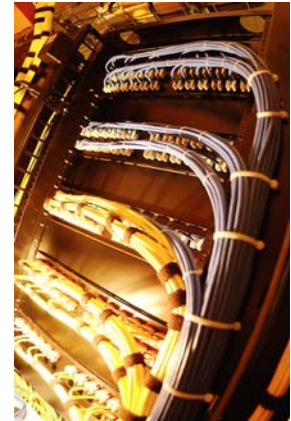
Caution should be used around **ALL** electrical circuits and equipment. The potential for electric shock should never be underestimated. Employers and other groups should regularly emphasize the safe use of electricity in the workplace. Continuous efforts must be made to prevent electrical injuries and deaths due to damaged receptacles and connectors.

Recommendations

NIOSH makes the following recommendations in these areas:

1. Proper Utilization of Electrical Systems

All receptacles and connectors should be used only in accordance with the manufacturers' specifications, and the specific listing for the item as set forth by nationally recognized testing laboratories. Users should be advised of the importance of using receptacles and connectors only for applications for which they have been designed. When a component is selected for use, it should be evaluated to determine if it can tolerate the environment to which it will be exposed. Physical abuse and stress on these components should be minimized by the selection of a safe location and by the use of stress/strain relief devices.



2. Awareness and Recognition Of Hazards

Policies that address the proper use of receptacles and connectors should be developed and implemented by qualified safety personnel. Safety training should emphasize awareness and recognition of electrical hazards associated with receptacles and connectors (i.e., broken receptacles and connectors, improper electrical connections, damaged cords, the importance of grounding, etc.). Immediate corrective action should be taken when damaged components or safety hazards are encountered. When safety policies and procedures are developed, they should be enforced.

3. Periodic Inspection And Maintenance Of Electrical Systems

Periodic inspections should be conducted for all electrical system equipment and components in order to identify all electrical hazards present. Records should be kept of any electrical hazards identified, and appropriate corrective action should be taken immediately. These periodic inspections should be supplemented with daily inspections by the personnel using this equipment.

References

1. *NIOSH Alert: Request for Assistance in Preventing Electrocution from Contact between Cranes and Power Lines.* DHHS (NIOSH) Publication No. 85-111, National Institute for Occupational Safety and Health, 6 pages (1985).
2. *NIOSH Alert: Request for Assistance in Preventing Grain Auger Electrocutions.* DHHS (NIOSH) Publication No. 86-119, National Institute for Occupational Safety and Health, 4 pages (1986).

