



# HAZARD INFORMATION NEWSLETTER<sup>®</sup>

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## Focus . . . Equipment Powerline Contact

A detailed analysis and viewpoint on the hazard of powerline contact for those who plan to purchase, own, rent, or oversee the use of cranes, aerial lifts or other boomed/extendable equipment that can reach powerlines.

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### DEFINITION

Powerline contact occurs when any metal part of equipment touches a bare, uninsulated, high-voltage powerline.

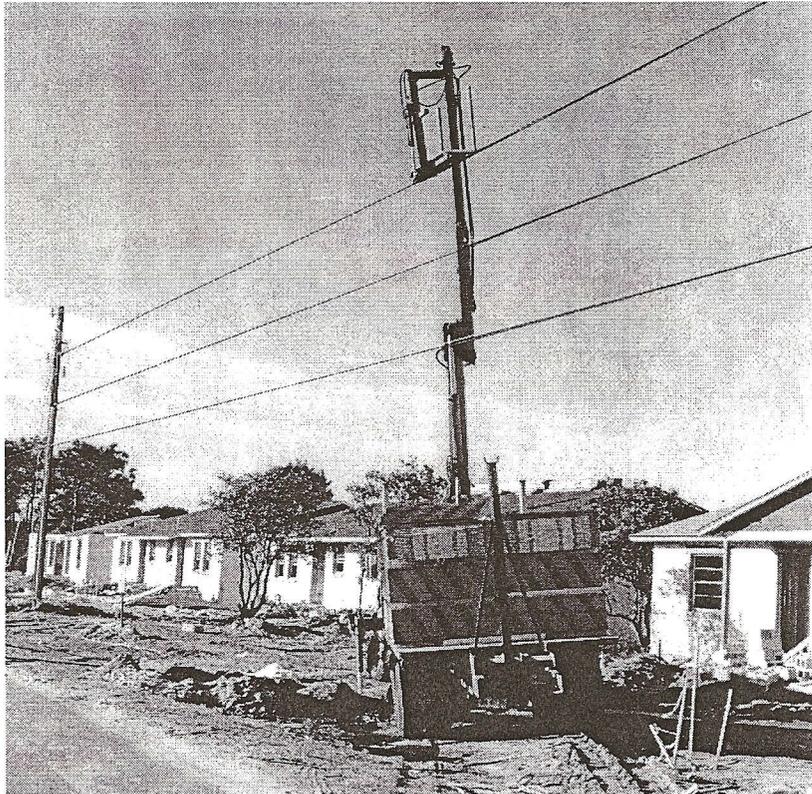


Figure 1 Powerline Contact

## TWO TYPICAL OCCURRENCES

In the previous issue of this newsletter, the focus was on anti-two-block devices for cranes. Let's examine a set of circumstances where lack of an anti-two-block device on a crane was a factor in the electrocution of one man and injury to another. This crane was mounted on a truck carrier frame that had a telescoping hydraulic boom and an auxiliary hoist. To avoid two-blocking the auxiliary hoist while extending the boom, the operator chose to have 10 to 15 feet of slack on the auxiliary hoist cable. The crane operator and signaler were watching the main hoist cable that was approximately 7-feet away from the powerline. While the crane was being rotated, the slack on the auxiliary hoist cable caused its hook to swing out and brush momentarily against the powerline, electrocuting one of the men guiding the load and stunning the other. Had anti-two-block devices been installed on **both** the main and auxiliary hoist cables, the operator would not have had to place slack on the auxiliary hoist cable, thus activating the hazard of powerline contact.

The second incident involved a young man who was instantly electrocuted while standing outside a mobile satellite TV van. While hurriedly covering a breaking news story, he touched a switch on the outside of his van to raise the pneumatic telescoping antenna mast in order to establish contact with his news desk. As the mast was raised, it contacted an overhead powerline that was completely hidden by trees. A proximity alarm on the mast could have warned this young man of the danger.

## WHAT ARE THE CHANCES OF INJURY OR DEATH?

Contact with powerlines with any type of equipment is disastrous. It is estimated that some 500 people a year are either permanently maimed or killed when the equipment they are using strikes a powerline.

It is estimated that **crane/powerline contact** kills a hundred people a year, and three times that number are seriously injured. Seven out of ten people are killed while guiding the load, when the crane boom or hoist cable strikes a bare-uninsulated high-voltage powerline. Moving cranes account for a significant number of powerline contacts, especially small mobile hydraulic cranes used with a raised boom for pick-and-carry operations and large latticework-boom cranes. It is all too common for people to be electrocuted while getting on or off a crane, or just touching it when the boom inadvertently contacts a powerline.

Aerial lifts with long all-metal booms also have a high incident of powerline contact. Even those with non-conductive booms used by electric utilities are vulnerable since not all sections or parts are insulated. If the lower arm or other uninsulated parts happen to strike a powerline, anyone who touches the equipment can be electrocuted. Also, phase-to-phase contact (touching two powerlines at the same time) is an ever present danger to linemen working from an insulated basket.

The reason equipment powerline contacts are so devastating is:

**F**irst, human flesh is an excellent conductor but can carry very little current. Therefore, when high-voltage contact is made and the most direct route is through a person, he/she then becomes a fuse that blows out. This is why arms, legs and other body parts suffer such horrible injury.

**S**econd, low amperage currents can upset the functioning of the nervous system so you can no longer "let go" of the conductor and fibrillation of the heart may occur.

### **Either way, you lose!**

Powerlines don't always stay de-energized after a contact. People are often re-shocked or endangered because they believe the powerline to be completely de-energized. When sufficient ground fault occurs, a remote re-closure system will automatically de-energize the electric distribution circuit to avoid blowing intervening fuses. The circuit is automatically re-energized several cycles later. Some systems have a manual override that allows someone at a remote control station to re-energize the system without knowledge of why the ground fault occurred. The electric utility should always be advised when cranes will be working near powerlines so automatic reclosures can be locked-out. Any remote manual override should be tagged so the powerlines **WILL NOT BE RE-ENERGIZED** until investigated.

Data from various sources provides some significant information so that high-loss equipment or activities can be targeted for the control of specific hazards. For instance, the following equipment is known to have been involved in repeated electrocution or serious injury:

### **CONSTRUCTION**

- Cranes
- Flatbed truck-mounted cranes with controls accessible from the ground, or with remote electrical controls containing a wire conduit tether
- Truck-mounted booms
- Excavators
- Power shovels
- Draglines
- Pumpcrete trucks with booms
- Truck-mounted conveyor booms
- Dump trucks (particularly the long bed 5th wheel models) that can reach powerlines when raised
- Delivery trucks (with elevating beds)
- Self-propelled and mobile scaffolds
- High-reach forklifts

### **UTILITY COMPANIES**

- Vehicle-mounted elevating & rotating aerial devices
- Side-boom crawler tractors used to place oil and gas pipelines

### **FIRE DEPARTMENTS**

- Snorkel units
- Water towers
- Aerial ladders

### **RAILROADS**

- Track-mounted cranes
- Cranes used to salvage train wrecks

### **GOVERNMENT**

- Construction equipment
- Utility maintenance equipment

### **OUTDOOR ADVERTISING**

- Sign installation and maintenance
- Flag pole erection or maintenance

### **TELEVISION BROADCASTING**

- Satellite-link vehicles with telescoping antennas
- Aerial lifts for filming
- Antenna installation

### **FARM EQUIPMENT**

- Portable grain elevators
- Irrigation pipe
- Mobile feed trucks with a boom

### **OTHER**

- Portable drilling rigs
- House-moving equipment
- Sailboats
- Kite/model plane flying
- Tree trimming equipment

A review of 381 crane powerline contacts reveals:

<b><u>Equipment involved:</u></b>	<b><u>%</u></b>
■ Truck Carrier, Latticework Boom:	26%
■ Truck Carrier, Hydraulic Boom:	24%
■ Mobile Hydraulic Boom,	
Rough-terrain:	19%
■ Flatbed, Hydraulic Boom:	16%
■ Flatbed, Trolley Boom,	
Remote Control:	11%
■ Crawler Carrier, Latticework Boom:	4%

**Personnel were injured or killed when:**

■ Guiding the load:	71%
■ Getting on or off the crane and/ or touching the crane:	21%
■ Other activity:	8%

**IT IS UNSAFE AND UNDEPENDABLE TO  
RELY SOLELY UPON VISUAL ESTIMATES  
TO DETERMINE "SAFE CLEARANCE"  
FROM POWERLINES**

### **WHY POWERLINE CONTACTS KEEP OCCURRING**

For years, human factor's specialists have said that it is beyond the range of normal human performance to:

- accurately and visually judge clearances between a crane boom or hoist cable and a powerline
- observe more than one visual target at a time
- overcome the camouflaging characteristics that trees, buildings, and other objects have upon powerlines
- see the powerlines when looking into a bright sky or sunlight.

In her article "Judging Clearance Distances Near Overhead Powerlines," *Human Factors Society*, October 1978, Human Factors psychologist Dr. Lorna Middendorf provided great insight into why people are unable to judge clearances accurately and to be unaware that a dangerous change of circumstance is arising. Twenty participants, one at a time, climbed into the operator's ground station on an aerial lift and "estimated" how far the basket was from the powerline. They also viewed the crane boom from a signaler's position in front of the crane to "estimate" clearance from the powerline. **Not one of the participants could correctly estimate such clearances.**

In 1985, Dr. Middendorf and Dr. Robert Cunitz made another field study that was published in *Hazard Prevention - Journal of the Systems Safety Society*, VOL 21, No. 2, entitled "Problems in the Perception of Overhead Power Lines;" (March/April 1985). Both of these studies show it is unsafe and undependable to rely solely upon visual estimates to determine "safe clearance" from powerlines.

Equipment powerline contacts also occur when: (1) building materials and supplies that may require lifting with a crane or other boomed equipment are unloaded and stored under powerlines, (2) supervisors require that work should proceed in spite of the danger, (3) workers who are confronted with an assignment near powerlines assume they can avoid them.

Electrical engineers will tell you that transmission and distribution systems are designed to protect the system from self-destruction and cannot respond quickly enough to protect people. The automatic disconnect and re-closure devices previously mentioned are designed to interrupt the power source

momentarily before the fuses are blown. Extended power outages are costly, as they reduce revenue, require expensive labor to replace fuses and inconvenience those who depend on electric power.

Rarely do injury reports indicate the type of equipment that was involved in the powerline contact so that hazard prevention awareness and appropriate safeguards can be targeted for high-risk machines. Today, no standard format for injury reporting exists that identifies the make and model of the equipment involved, making establishment of a much needed information clearinghouse very difficult. A standardized electronic data collection system should be set up among workers' compensation and personal injury liability insurers, the judicial system, Medicare, Social Security and other governmental bodies to gather information that includes identification of the hazard and the equipment involved in all injuries or death. Currently there seems to be an over-emphasis on reporting the type of injury without telling why it happened and with what. "It is hard to design a program to keep people from getting hurt if you don't know what's hurting them." *Safety & Health*, May 1996, page 33, "OSHA Proposes Changes to Record Keeping Rules" by Patrick R. Tyson.

### HOW POWERLINE CONTACT CAN BE PREVENTED

The key to avoiding equipment powerline contact is safety planning at time of project design, so drawings can show where adjacent powerlines are located in order that they can be removed, relocated or buried **before** work begins.

Because many parties and various employers may be involved in the construction worksite (the landowner,

construction management, prime contractor, subcontractors, crane rental firms, electric utilities, etc.), planning meetings are a necessity to bring these parties together to establish who is in charge and define how the work will be done in the safest possible manner.

**A** single individual should be responsible for overall safety supervision and coordination of the project, and this individual must initiate positive steps to ensure that safety planning has been completed before any cranes or heavy equipment arrive at the worksite. The objective of planning is to organize work so cranes or other equipment that can reach powerlines will not intrude in any areas where powerlines are located.

Phase plans must show the locations of existing or planned powerlines, so existing powerlines can be temporarily rerouted by the electric utility or the area fenced and declared off-limits to cranes or other high-profile equipment. Movement of cranes on a project should only be by permit to avoid having cranes work or pass near or under powerlines. Site plans should be available showing the location of powerlines and safe routes for pick-and-carry and other crane travel.

	750 volts to 22 k volts in feet	22 k volts to 50 k volts in feet
Roads, streets & alleys	20 feet	21 feet
Railways	28 feet	29 feet

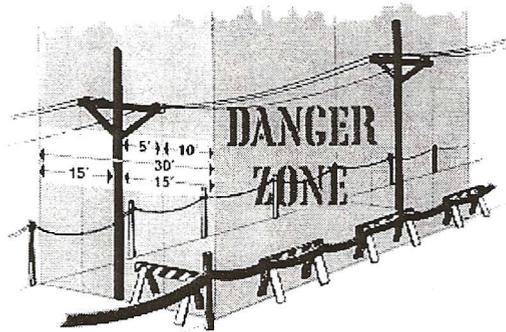
This excerpt is from the National Electrical Safety Code, Table 232-1

Table #1 Chart of basic clearances for powerlines

Construction planning must also recognize that clearances defined by the National Electrical Safety Code (See

Table #1), which are acceptable for normal roadway traffic, **do not apply for activities such as construction, mining and lumbering if industrial equipment capable of reaching into powerlines is to be used!**

On highway construction projects where cranes may pass under powerlines, signs should be erected to warn crane operators to lower their booms.



Map and Barricade the 30-foot wide Danger Zone (15 feet of each side of the powerline poles)

Figure 2 Mapping a Danger Zone

It is very important that all crane operators and jobsite workers be trained to map on the ground the **danger zone** surrounding powerlines; and supervisors must ensure that this procedure is accomplished. See figures #2, #3 and #4. The easiest way to do this is to step off 15 feet on each side of each power pole in the work area, draw a continuous line from pole to pole, and place banner tape, orange plastic netting or other visual barriers to fence the "off limits" area. Any encroachment of the hoist cable, boom tip, or load into the danger zone can be easily identified without looking up and guessing what the clearance may or may not be.

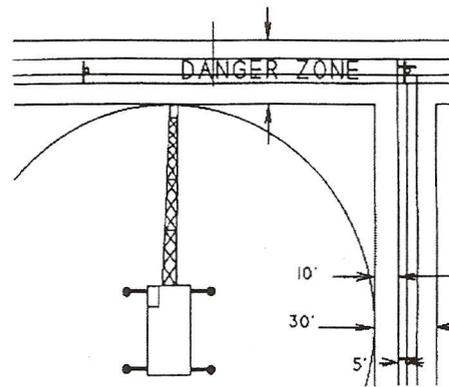


Figure 3: Plan View

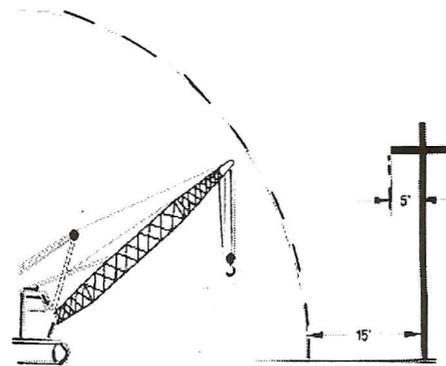


Figure 4: Plan View (Side View)

The reason for measuring 15 feet on each side of the powerpole is that the powerpole cross arm extends approximately 5 feet from the pole. By adding an additional 10 feet, you are outside of the **danger zone** (refer to Figures 2, 3 and 4). Since transmission towers vary in design, ask the utility company what the safe clearance should be on the ground. Once the **danger zone** has been mapped on the ground, cranes and other equipment must be placed so that any configuration of the boom or other extending parts cannot reach the powerlines.

**Never store materials inside the danger zone.** Suppliers and others must be made aware that the **danger zone** is off limits!

When circumstances arise that the **danger zone** has to be intruded, there needs to be a firm operating rule that the crane operator and crew must notify their superiors who must immediately notify the electric utility for assistance before the work can proceed! To avoid powerline contacts the electric utility can:

- ⌘ de-energize powerlines in the work area
- ⌘ relocate powerlines away from the work area
- ⌘ bury powerlines
- ⌘ place insulating barriers on the conductors to prevent contact
- ⌘ lock out the automatic re-closure circuit breakers so the powerline will not re-energize if contact is made
- ⌘ tag the remote manual re-closure so that power will not be restored until it is known to be safe.

It should be noted that the electric utility normally charges for these services.

Operator's manuals for cranes should contain detailed instructions on **how to map the danger zone**. It should be remembered - as stated in the first issue of this newsletter, *The Nature of Hazards*, (page 9) - "To err is human, to forgive, design." It is not uncommon for crane operators, riggers, foremen, or other workers to be focused on the load to be lifted and forget to look for powerlines.

### AVAILABLE SAFEGUARDS

In addition to the necessity for mapping, there are some physical safeguards that may assist:

- A **proximity alarm** is a device that can sense or detect powerlines. It is radio tuned to receive a signal created by a powerline that has alternating current that raises and collapses 60 times a second. This device is not intended to be used as a precise measuring system, but is designed only to alert personnel that

powerlines are present and a change of action, including mapping, is necessary. Contractors, fire departments, the Army, Navy, Immigration Service and other organizations have found the proximity alarm to be a valuable aid in identifying the presence of powerlines that would have gone unnoticed.

- **Non-conductive taglines (plastic rope attached to the load)** can be used to protect workers guiding a load lifted by a crane. It is interesting to note that Australia requires the use of these taglines when working near powerlines.

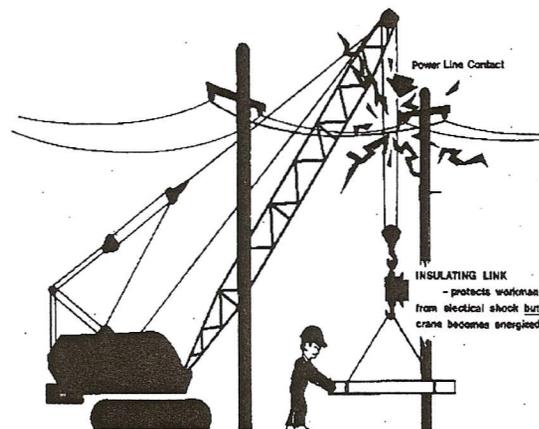


Figure 5 Insulated Link

- **Insulated Links** are back-up devices that prevent the flow of current down the hoist cable and protect the individual guiding the load if an unobserved powerline is struck. **The link will not protect anyone who touches the crane!** Eighty percent of the time, the voltage of the powerlines contacted is less than 16,000 volts and twenty percent of the time, the voltage is more than 16,000 volts. Based on this, it can be concluded that insulated links rated for 50,000 volts (a safety factor of 3) and tested for 100,000 volts (a safety factor of 6) could reduce the injury rate from powerline contact by at

least 64%! Recent tests of insulated links conducted under field conditions by Martin N. Kaplan, P.E., show that this device works even when it has been thoroughly covered in mud, oil, and other contaminants common to the work area. Kaplan's tests demonstrate that any leak in amperage was well below the paralysis threshold. Without an insulated link, riggers who are touching the load are in the ground fault circuit if powerline contact is made. Further, Kaplan's tests assume a lower threshold for "dangerous" current than that of OSHA's general requirements, which accept ground-fault interrupters that begin to kick-out at five milliamperes.

- **Non-conductive, pneumatic-powered or remote radio control systems.** These systems should be used rather than an electric tether. Many operators have been electrocuted using control systems with an electrical tether.
- **Truck-mounted boom controls inaccessible from the ground.** Operators are very vulnerable to electrocution when standing on the ground and operating truck-mounted controls. Just as birds are protected from electrical current when sitting on a wire, operators need to be protected from electrocution by having controls that are operable *only* while sitting or standing on the truck itself.
- **Insulated upper and lower elbow booms.** Uninsulated lower booms on aerial basket lifts are a trap because they can easily reach powerlines and electrocute anyone who inadvertently touches the truck. Retrofit kits for some older models are available to prevent this type of injury.

## HISTORY

### Who Did What and When?

In Medieval Times, thunderstorms were considered the work of demons, and church bells were frequently rung to ward off these evil spirits. Because wet bell ropes made perfect lightning rods, bell-ringing was a hazardous occupation, and many bell-ringers were electrocuted in the line of duty.

At the turn of this century, The National Electric Safety Code first published by the U.S. Department of Commerce, National Bureau of Standards, set safe clearances for powerlines above the ground and roadways (See Table #1). The early writers of this code placed high priority upon safety of workers and the public by requiring that any practicable measure to ensure their safety was to be provided.

Since World War II (WWII), a wide variety of mechanized equipment has been developed resulting in the steady rise of powerline contacts.

Starting in the 1950's, both insulating accessories and proximity warning systems became available, and as technology advanced, the usefulness of these safeguards has increased.

In the 1960's the Army and Air Force were buying cranes to more efficiently handle materials at depots that were built during WWI and WWII. These depots were criss-crossed with powerlines as thick as cobwebs, which were the cause of numerous powerline contacts. Boom cages, insulated links and proximity alarms were used until these powerlines could be buried or relocated.

The traditional concept of using airspace as a safeguard to avoid this hazard is slowly giving way to buried distribution systems. As long as there

are exposed bare, uninsulated, high-voltage distribution and transmission lines, just like Murphy's Law, the risk of powerline contact will always be with us unless stronger preventive measures are taken.

In 1969, the National Safety Council's Utility Section published a summary of powerline contact occurrences, and it would be useful if a current updated summary could be published.

In 1981, Sections 210 and 211 were deleted from the National Electric Safety Code, ANSI C2, which contained the following important safety philosophy:

- "210. Design and Construction. All electric supply and communication lines and equipment shall be of suitable design and construction for the service and conditions under which they are to be operated.
- "211. Installation and Maintenance. All electric supply and communication lines and equipment shall be installed and maintained so as to reduce the hazards to life as far as practicable."

## EXORCIZING DANGEROUS MYTHS!

### **M**yth...

Insulated links and proximity alarms are not reliable.

### **T**ruth...

There are no reported cases in which these devices failed and resulted in injury or death to a worker.

Ralph Armington, Ph.D., a consulting Electrical Engineer, has made some studies that discredit the negative evaluations of the proximity alarm. For

further information, contact him at: 6927 N. Kenton Avenue, Lincolnwood, IL 60646, Phone (847) 679-2732.

Dr. G.G. Karady has expertise concerning insulating materials and safe powerline configurations. He may be reached at: The Department of Electrical Engineering, Arizona State University, Tempe, AZ 85287-5706 Phone (602) 965-8569.

### **M**yth...

Insulated links are dangerous because they can leak several milliamps of current.

### **T**ruth...

There is considerable international debate concerning how much current flow the heart can tolerate without going into ventricular fibrillation. The International Electrotechnical Commission (IEC) report of 1984 and the book *Electric Shock Safety Criteria* by Bridges, Ford, Sherman and Vainburg, state for 60 cycles it is found that the "let go" range is 15 to 18 milliamps, extreme pain set in about 20 milliamps, and at about 50 milliamps irregular heart action occurs.

### **M**yth...

The use of an insulated link encourages people to bring equipment closer than the 10-foot clearance required by OSHA.

### **T**ruth...

This concept is completely without merit! If it were true, we could also say that drivers who consistently wear their seat belts in an automobile would deliberately drive faster, take greater risks and have a much greater collision rate than those who do not wear these belts, when in fact the opposite is true.

It is interesting to note that as public priorities for workplace safety increases, it has been found that workers' who use safeguards are more cautious and their safety awareness is greatly increased.

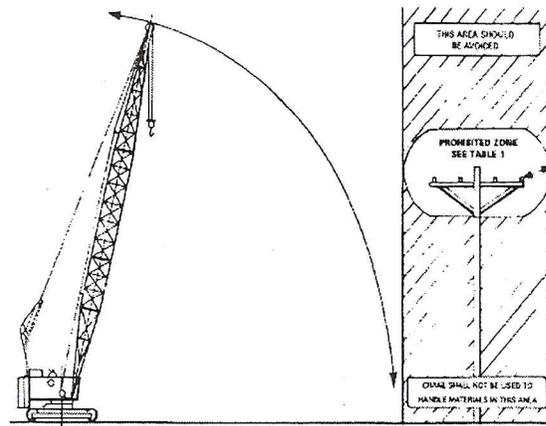
## WHO SAYS WHAT?

### OSHA & OTHER FEDERAL REQUIREMENTS

1. OSHA 1926.550(a)(15) and OSHA 1910.181(j)(5)(i). This is the 10-foot rule. Comment: Inclusion of a warning that visual estimates can be inaccurate and dangerous would be helpful, as well as instructions on how to map the danger zone on the ground.
2. OSHA 1926.955(e)(5) states: "The automatic re-closing feature of circuit interrupting devices shall be made inoperative where practical before working on any energized line or equipment." Comment: This safety requirement for linemen would also be a lifesaver for workers using a crane near powerlines.
3. Marine Terminal Standard 1917.45(i)(5).
4. MSHA Subpart K 56.12071 *Movement or operation of equipment near high-voltage powerlines*. "When equipment must be moved or operated near energized high-voltage powerlines (other than trolley lines) and the clearance is less than 10 feet, the lines shall be de-energized or other precautionary measures shall be taken."

### ANSI REQUIREMENTS

1. Mobile and Locomotive Cranes ASME B30.5a-1995 (paragraph 5-3.4.5.1 through 5). Comment: This illustrates the danger zone for cranes and lifted loads while operating near electrical transmission lines (see figure 6). A helpful addition would be a requirement to marking the danger zone on the ground.

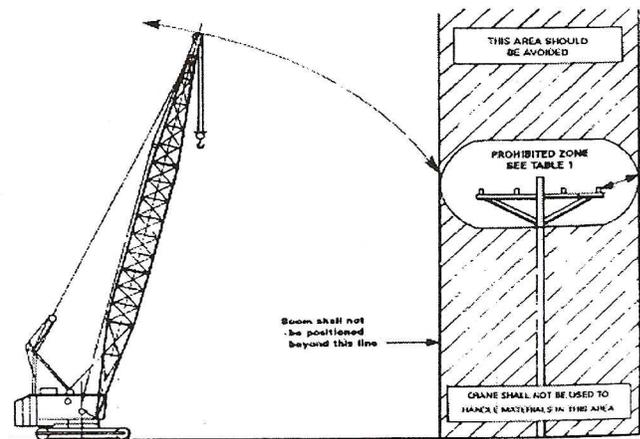


**Danger Zone for Cranes and Lifted Loads Operating near electrical transmission lines** (Fig. 17a ASME B30.5a-1995, page 43).

**Figure #6**

Paragraph 5-3.4.5.4 provides information on how to use the crane inside the danger zone. Comment: ***This is a very dangerous practice and should only be done if the lines are de-energized.***

This standard includes the general statement that cage-type boom guards, insulating links or proximity warning devices may be used on cranes, but not as a substitute for the ten-foot clearance.



**Danger Zone for Cranes and Lifted Loads Operating near Electrical Transmission Lines** (Fig. 17b from ASME B30.5a-1995, page 44).

**Figure #7**

2. *National Electrical Safety Code*, ANSI C2, Table 232 with Footnotes defines safe clearances for powerlines above the ground for:
- (A) Track rails of railroads
  - (B) Roads, streets, alleys, and residential driveways
  - (C) Other land traversed by vehicles
  - (D) Spaces accessible only to pedestrians
  - (E) Water areas not suitable for sailing
  - (F) Waterways suitable for sailboating

**Comment: It would be helpful to clearly state that the clearances defined above are not applicable for equipment used in construction, mining or other activities conducted adjacent to powerlines.**

## OTHER REFERENCES

1. "Numerical Analysis of Powerline Proximity Warning Device Using Electrofield Measurement" by Nguyen and Bourbonniere, *Hazard Prevention*, 1st Quarter 1996, published by the System Safety Society.
2. "Insulated links: The Next Generation" by Ted Petit, *Lift Equipment*, April - May, 1995.
3. *Construction Safety Planning* by David V. MacCollum, P.E., C.S.P., published by Van Nostrand Reinhold, 1995. Page 58(d) and Chapter 27.
4. *Crane Hazards and Their Prevention* by David V. MacCollum, P.E., C.S.P. published by ASSE 1993. Chapter 4.
5. *Safety and Health Requirements Manual*, EM385-1-1 (U.S. Army Corps of Engineers, October 1992), Section 11.E.01.b states: "All electric power or distribution lines shall be placed underground in areas where there is extensive use of equipment having the capability to encroach on the clear distances specified in 11.E.04."
6. "Data Sheet #I-743 New 90 (1990)." *Mobile Cranes and Powerlines*, National Safety Council.
7. National Safety Council's *Accident Prevention Manual for Industrial Operations for Engineering Technology*, 9th Edition 1988 on page 113 states:
 

"If cage-type boom guards, insulating links, or proximity warning devices are used on cranes, such devices must not be a substitute for the requirements of a specifically assigned signal person, even if such devices are required by law or regulation." Comment: It should be noted that ever since 1951 the National Safety Council's *Accident Prevention Manual* has included reference to commercial devices used on cranes that give warning of nearby powerlines.

"If the boom load line or cables accidentally come into contact with a wire, the operator should swing the crane to get clear. If the wire has been broken and the boom cannot be cleared from it, the operator shall stay on the crane and remain calm."

"If the boom of a wheel-mounted crane on rubber tires should become tangled with a "hot" electric wire, the entire crane may be energized because the rubber tires may or may not insulate the crane and chassis from the ground."

"Stepping from the crane to the ground is often fatal . . . if for any other reason it is impossible to remain on the crane, the operator should **JUMP**, making sure that all body parts are clear of the crane before touching the ground."
8. *Mobile Crane Manual* by D.E. Dickie of the Canadian Construction Safety Association of Ontario (1982), pp. 240-244, and Figure 10.15.
9. *Guidance Note General Series 6*, "Avoidance of Danger from Overhead Electric Lines," HM Factory Inspectorate of the Health and Safety Executive and the Electricity Boards of England, Wales and Scotland, April 1977.
10. 1035 MESA Information Report, "Field Evaluation of a Proximity Alarm Device." Mining Enforcement and Safety Administration, Richard L. Reynolds, 1976. "Field tests for a period of six months demonstrated that the device is rugged enough for mine use and that it does, indeed, operate with very good reliability."

11. *Crane Handbook* by D.E. Dickie of the Canadian Construction Safety Association of Ontario 1975, pp. 133-141, and Figures 4.66-477.
12. T.O. 36C-1-4, *Electrocution Protective and Proximity Warning Devices for Cranes, Crane Shovels, and Line Maintenance Derrick Trucks*, U.S. Air Force, January 1974.
13. Military Specification MIL-T-62089A (AT), "Truck, maintenance; with rotating hydraulic derricks, air transportable, 34,500 pounds GVW, 6x4," U.S. Army Tank-Automotive Command, Dec., 1973. 3.6.12: "Proximity warning device. When specified, an automatic electronic warning device should sound an audible alarm as the derrick approaches energized electrical powerlines, shall be furnished . . ."
14. Technical Bulletin #1, "Contacting Overhead Electrical Powerlines -- Mobile Cranes," May 20, 1968. A study for its policy holders by Liberty Mutual Insurance company discusses proximity indicators, boom enclosures, and insulated links as safety devices.
15. *A Safety Handbook for Mobile Cranes*, 1967. Royal Society for the Prevention on Accidents and Institute of Material Handling (the most respected and prestigious safety group in Great Britain). "There are available on the market, proprietary devices designed to give a warning when the crane jib comes within a predetermined distance of the power cables."
16. TB-385-101 *Safety, Use of Cranes, Crane Shovels, Draglines, and Similar Equipment Near Electric Powerlines*, January 1967. Department of the Army, by order Harold K. Johnson, General, USA, Chief of Staff. Provisions to equip crane booms with dielectric shields and install an insulated link.
17. *Handbook of Rigging for Construction & Industrial Operations*. W.E. Rossnagel, Third Edition, 1964. McGrawHill Publishers. Consulting Safety & Fire Protection Engineer, formerly Safety Engineer, Consolidated Edison Company of NY. Page 288 reads: "There are on the market several types of electronic devices intended to be mounted on the top of the boom. Such devices will sound an alarm or stall an engine if brought within a predetermined distance from an energized electrical conductor."
18. Cir. 285-1 *Safety, Use of Cranes, Crane Shovels, Draglines, and Similar Equipment Near Electric Powerlines*, February 1964. Department of the Army. Early G. Wheeler, General, USA, Chief of Staff, Headquarters, Department of Army. Provisions for a dielectric boom shield and insulated link on lifting the line above the hook.
19. T.O. 36C-1-4, *Electrocution Protective Devices for Cranes & Shovels*, March 1962. U.S. Air Force, Department of Defense, Secretary of the Air Force. Requires use of a dielectric boom shield and insulated link for all cranes dispatched for use near high-voltage lines.
20. United Kingdom Regulation 44 of the *Construction (General Provisions) Regulations* of the Factories Act of 1961 stipulates that powerlines left in the construction area be barricaded by providing a wooden goal post framework to prevent the crane from striking a powerline.
21. "Crane Booms v. Powerlines," Sam S. Elkins, September 1959. *National Safety News*, National Safety Council. Page 121 lists several types of electronic warning devices, crane boom guards, and insulated hooks.
22. "Crane Contacts Can Kill," Paul E. Sheppard, October 1958. *National Safety News*, National Safety Council. Page 130 states "musts" are: crane boom protectors, an insulated safety hook, and a powerline proximity warning device.
23. *Data Sheet #488*, 1957, National Safety Council. "An electronic safety device for warning crane operators of proximity to powerlines is commercially available. Also, commercially available are insulated-link load-line hooks and an insulated crane boom guard."

#### PATENTS

CHI is aware of at least 16 patents issued for proximity alarms and insulated links dating from 1952 through 1974.

## REPRESENTATIVE LITIGATION

Review of 381 summaries of personal injury lawsuits resulting from crane/powerline contacts during the last twenty-five years reveals the following:

- √ There were 179 fatalities, 35 loss of limb, and 167 other types of permanent disabilities
- √ Defense verdicts were only 5 percent of the total number examined
- √ Reported settlements averaged \$600,000
- √ Reported plaintiffs' verdicts averaged \$1.5 million
- √ Judgments and settlements for this hazard, in these 381 cases alone, are estimated to be greater than \$200 million. Such losses certainly suggest that hazard prevention should have a high priority.

These cases are only a sampling of the case data available involving powerline contact. As always in these newsletters, litigation data is provided to show the disastrous effects of the hazard and the available safeguards. Defendants are often crane manufacturers, crane rental firms and contractors. Thirty-six percent of the cases also involved electric utilities. Litigation data is overlooked as a source of hazard information. It could be very useful to show the benefits of expanding the responsibilities of safety departments to develop programs that target critical hazards. Review of depositions given by electric utility personnel shows that the safety personnel are assigned employee safety and are often not given the authority to coordinate powerline safety with contractors who will be working next to powerlines.

Another reason utilities are vulnerable to lawsuits is that the automatic recycling circuit breakers are not locked-out and the manual override is not put on hold when construction is known to be in progress, as is done for linemen. Thus, as previously discussed, construction workers assume the power is off and attempt to make a rescue, when the line is unexpectedly re-energized.

A real need exists for utility companies, crane manufacturers, rental companies and contractors to develop instructions for crane users on how to map the danger zone (discussed earlier). To avoid repeated litigation involving boomed equipment such as cranes, aerial baskets, high-reach lifts, and pumpcrete machines, utility companies should be involved with and promote construction planning to avoid use of boomed equipment adjacent to energized powerlines. Such planning would provide the opportunity to either relocate the equipment or powerlines to avoid violation of the National Electrical Safety Code.

**A**nother factor that becomes apparent when reviewing lawsuits is the absence of information in electric utility easements to warn the landowner:

- 1) that overhead powerlines limit the use of the land covered by the easement. Easements should also contain specific instructions on how to map and identify the **danger zone** and to notify the utility to de-energize the powerline before any project is undertaken that might encroach the **danger zone**
- 2) that the space under powerlines should never be used for storage of materials
- 3) that cranes and other boomed equipment should never be used adjacent to powerlines until after the utility company has been notified and

a safety plan has been agreed upon.

Here are some sample cases of litigation:

- √ Injured lost an arm while removing the hook when placing a four-foot concrete drainage culvert in a ditch. The boom popped up into a 7,200-volt powerline when the load was released.
- √ One worker was killed and one permanently disabled while they were guiding pipe, and the sluing boom hoist cable struck a 34,500-volt powerline.
- √ An oiler guiding a load sustained serious injury when a backhoe boom touched a 7,200-volt single-phase powerline while placing a drainage system in a housing development.
- √ A foreman lost both feet and hands while guiding materials being unloaded from a truck, when the hoist cable contacted a 13,800-volt powerline.
- √ The deceased was electrocuted while he was guiding forms being stacked, when the hoist cable contacted a 7,200-volt powerline.
- √ A female worker lost a leg and most of her other foot when the crane operator swung a mobile crane into a 115,000-volt powerline.

Because of the repeated occurrence of crane powerline contacts, the American Trial Lawyers Association (ATLA), formed a committee for the express purpose of exchanging and discussing information related to equipment powerline contacts.

It should be noted that in many personal injury cases, the reliability of the proximity alarm is challenged. Recently, a case was settled when it was recognized that it would be difficult to persuade the court into believing that the proximity alarm was unreliable because the contractor involved, immediately after the death of the

employee, installed 20 proximity alarms on its cranes. By the time the case came up for trial, the contractor's crane operators had used the proximity alarms for several years and were ready to testify that they were immensely pleased with them.

Additional information concerning litigated powerline contact cases can be obtained from CHI.

## WHAT'S NEW IN THE INDUSTRY!

- **PearlWeave Safety Netting** is ideal for marking off the danger zone. PearlWeave is manufactured by:

PearlWeave Safety Netting Corp.  
606 West 131 Street  
New York, NY 10027  
(800) 732-7566  
Fax (212) 862-8951

- **Sigalarm, Inc.** is a company that manufactures proximity alarms that visually and audibly alert equipment operators and crews to high-voltage danger.

Sigalarm, Inc.  
Frank Wood, President/Owner  
P.O. Box 571  
Cape Canaveral, FL 32920  
(800) 589-3769  
Fax (407) 783-9290

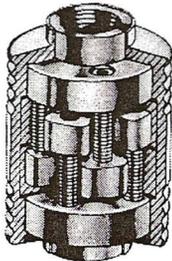


Arthur Gregr was also involved with Sigalarm in the 1960's. For information on early applications, he can be reached at:

125 Canyon Creek Drive  
Hamilton, MT 59840  
(406) 363-6510

✎✎ **Miller Products** recently introduced insulated links made with a polyurethane elastomer. The ISO/Link-AC series which they rate at 33,000 volts, but is individually tested to 50,000 volts. For further information, contact:

Ted Petit  
Director Sales & Marketing  
Miller Products  
41 Fremont Street  
Worcester, MA 01603  
(800) 733-7071  
Fax (508) 799-2707



✎✎ **H.J. Hirtzer & Associates** manufactures an insulated link that also protects against radio frequency (RF). RF waves are picked up by all antennas or metal objects and will cause continual electric discharge unless properly insulated. For further information, contact:

H.J. Hirtzer & Associates  
1308 Martino Road  
Lafayette, CA 95049  
(510) 682-8744  
Fax (510) 283-8561

✎✎ A **Range Limiting Device** has been developed, which can be programmed to restrict crane boom movement within a safe envelope of radius and length, by controlling boom length, angle and radius after the danger zone has been identified. Further information on the R520 Range Limiting Device, contact:

Wylie Systems Boom Buoy (U.S.)  
1-800-238-9492  
East Coast: Jacques Morin  
West Coast: David Smith  
or  
Canada Rayco Technology Group  
(418) 831-8973  
Fax (418) 831-0856

## LESSONS LEARNED



Safety planning to remove powerlines from the worksite is the best protection.



It is not enough to just look up because you may misjudge the clearance. What always needs to be done is to map the danger zone on the ground with marker tapes, cones or other visible barriers so that the lifting will be done outside of the danger zone.



Often, several hazards working together are the cause of a serious injury or death.

For additional information on safety planning, the book "Construction Safety Planning" can be purchased from Van Nostrand Reinhold. The 271 page hard-bound book covers the step-by-step construction planning process. Contact:

VNR Order Processing  
7625 Empire Drive  
Florence, KY 41042-2978  
(800) 842-3636  
Fax (606) 525-7778

### FUTURE ISSUES 1996/1997

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- Forklift Hazards
- Blind Zones on Moving Equipment
- Fall Prevention
- Inadvertent Control Activation
- Trucking Hazards
- Falling Objects
- Pinch Points
- Confined Spaces
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- Flying Objects
- Crane Upset
- Hazards and the Justice System
- Equipment Access
- Head Injuries (Helmets)
- Transportation of Machines

#### CENTER FOR HAZARD INFORMATION

Source data contained in this newsletter was made available through the resources of The Center for Hazard Information (CHI). CHI has an extensive library of hazard and safety information which can be made available to interested parties. Those desiring more detailed information or assistance in obtaining hazard data should contact CHI at:

P. O. Box 3962  
Sierra Vista, AZ 85636-3962  
(520) 458-4100  
Fax (520) 458-4093

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