

Electrical Safety

**AR Training
Updated 2012**

DMME

Division of Mineral Mining

Electrical Safety

- How many mineral miners died as a result of electrical accidents in the US last year and so far this year?
- How many people die as a result of electrical accidents in the US each year?

The Sad Facts

- 700 people are killed each year in electrical accidents.
- Electrical accidents are the third leading cause of all workplace deaths.
- 17 miners died in electrical accidents from 2002 through 2011.
- As of 11/1/12, none in 2012.

Electrical Safety

- How much electrical current can result in a fatal electric shock?

It Doesn't Take Much!

- At 30 – 75 mA your respiratory system shuts down
 - At 100 – 200 mA you experience heart fibrillation
 - at 200 – 500 mA the heart clamps tight
- * Key factors include; the path of the current through the body and the duration of exposure*

mA = milliampere, 1,000 milliamperes = 1 ampere!!

Electrical Safety

Six of the twenty most frequently cited MSHA standards are electrical standards.

The following slides will review these standards, other important standards and accidents at mineral mines related to electricity.

Electrical Conductors

- Power wires and cables shall have adequate current carrying capacity and shall be protected from mechanical injury (4VAC25-40-2050, MSHA 56.12004).



Inspection and Cover Plates

- Cover plates must be securely in place except during testing or repair (4VAC25-40-2290, MSHA 56.12032).



Insulation and Fittings for Power Wires and Cables

- Power wires & cables must be adequately insulated where they pass into/out of electrical compartments. For example, wire insulation must be secured in the insulated bushing (4VAC25-40-2090, MSHA 56.12008).



Testing of Grounding Systems

- Continuity and resistance of grounding systems shall be tested immediately after installation, repair, and modification. These tests shall be conducted annually thereafter with record kept 4VAC25-40-2250, MSHA 56.12028.



Dangerous Electrical Conditions

- Electrical equipment & wiring must be inspected periodically by a “competent person” to ensure safe operating conditions.
- Potentially dangerous conditions must be corrected prior to energizing. 4VAC25-40-2270, MSHA 56.12030.



Labeling of Switches



- Principal power switches shall be labeled to show which units they control.
- Where location of the switch makes its identification readily apparent, labeling is not required.

4VAC25-40-2160

MSHA 56.12018

Electrical Switches & Controls

4VAC25-40-2030

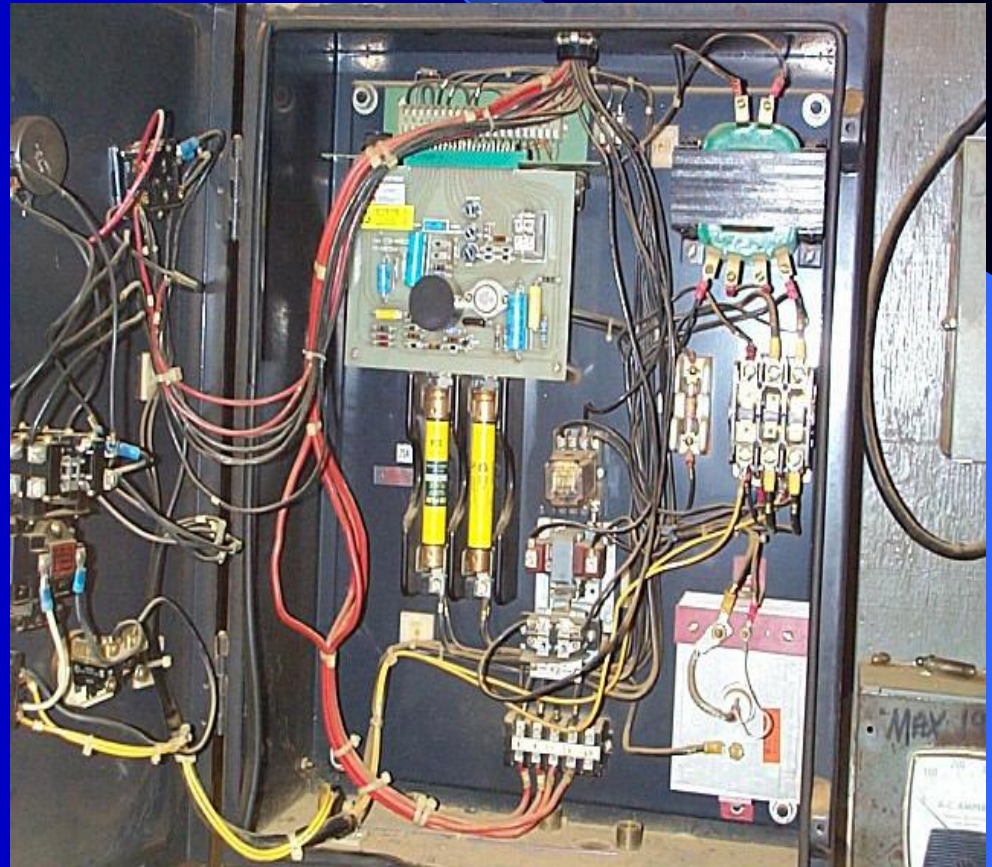
- Electrical circuits and equipment must be provided with acceptable and properly installed switches or controls.



Electrical Control Box

4VAC25-40-2370

- Operating controls must be installed so that they can be operated without danger of contact with energized conductors (e.g., behind access doors).



Nonconductive Electrical Safety Mats

4 VAC 25-40-2180



Conveyor belting is not acceptable!!

- Dry, wooden platforms, insulating mats, or other nonconductive material shall be kept in place at all switchboards and power control switches.
- Metal plates may be used where they are kept at the same potential as the grounded, metal non-current carrying parts of the power switch.

Power Line Clearance

4VAC25-40-2500

- If the clearance between mobile equipment and energized overhead power lines is less than 10-feet, the lines must be de-energized or a warning sign posted or other precautionary measures must be taken (e.g., lines marked, etc.).



Power Line Hazard For Truckers

- Failure to check for overhead lines has resulted in numerous fatal accidents in Virginia.



Fatal Trucker Accident

- Victim was electrocuted when he raised his truck bed without first checking for overhead power lines.



Overhead Line Incident

December 10, 2002

A quarry customer truck driver raised the bed of his truck into energized (240-volts) power lines located alongside a public road that fronts a portion of the mining operation. The driver was attempting to clear material from the bed of the moving truck prior to being loaded with a limestone product. The certified mine foreman on duty at the mine instructed the driver to remain in the truck until the power company de-energized the damaged lines.



Electrical Fatality

July 22, 2003



- Boom of crane struck energized 7200 volt overhead power line while moving a section of a conveyor at a sand and gravel operation. The victim was steadying the section as it was being lowered to the ground.

Electrical Fatal

October 15, 2004

- A 4 man crew was positioning a conveyor. The victim had both hands on the conveyor when the crane hoist cable contacted a high-voltage power line.



Electrical Fatal

April 3, 2006

- A metal pump control house was being set into position. The victim was standing on the ground touching the suspended control house when the crane boom contacted the energized overhead power line.



Open Transformers

4VAC25-40-2460

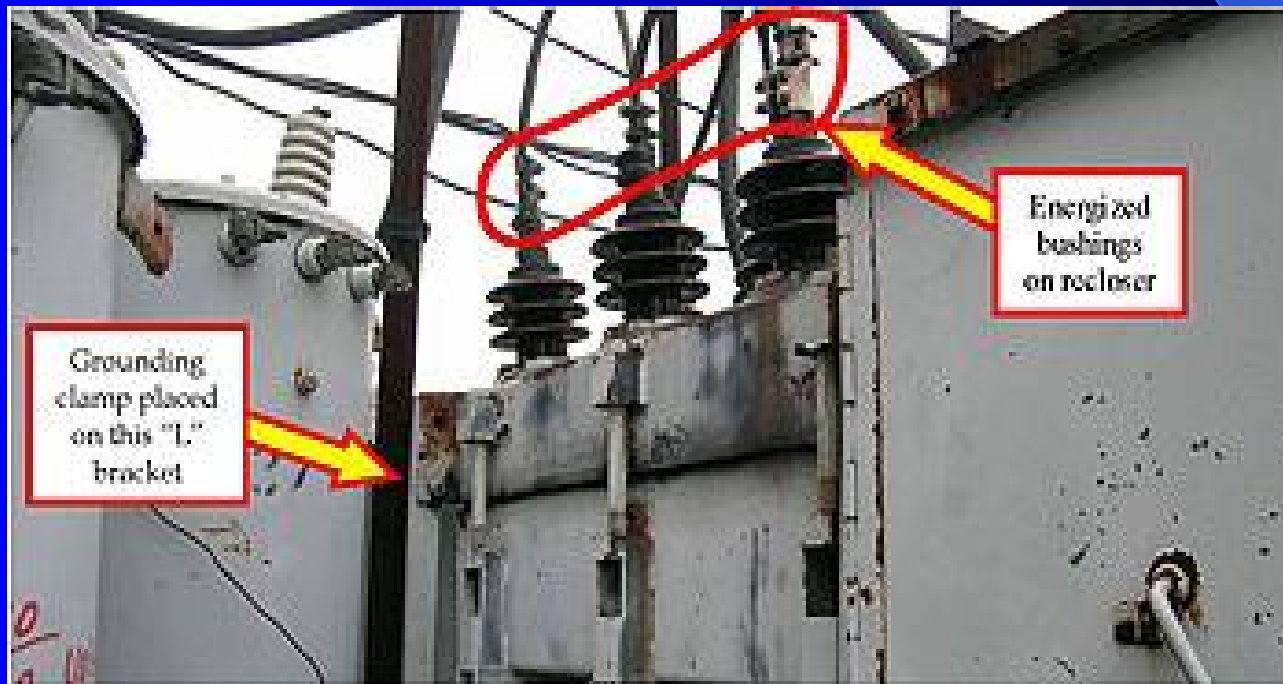
- Surrounded by a fence at least six feet (6-ft) high, with at least three feet (3-ft) of clearance between energized parts, casings, or wiring.
- Kept securely locked.
- Posted with warning/danger signs.



Fatality In Virginia

October 23, 2004

The victim and 2 helpers were installing transformers in a substation. The victim was severely burned, and later died, from a high energy arc that occurred while he was working on the transformer. The transformers were energized while grounding clamps were being connected.



Enclosed Transformers

4VAC25-40-2460

- Totally enclosed.
- Protected location.



Accident Investigation: Electrical Accident May 22, 2001

A mine worker operating a front-end loader struck and cut buried high voltage (34,000 volts) power lines feeding a totally enclosed transformer located on a concrete pad. The worker was attempting to remove accumulated sand around the barricaded transformer prior to thunderstorms forecast for the region. The bucket of the front-end loader struck & cut the buried wires which then tripped the breakers on a nearby power line pole. Luckily, the worker was not injured.



RECOMMENDATION: Always contact "Miss Utility" to identify and mark location of buried utility lines prior to digging by hand or use of mobile equipment; failure to locate & mark buried lines could result in personal injury, penalties, and disruption of plant production/operation.

Elevated Transformers

4VAC25-40-2460



Mounted at least 8 feet above the ground

De-energizing Electrical Equipment and Circuits

Why is it important to de-energize, lock-out/tag-out and test a circuit before performing work on a piece of equipment or a circuit?

Here is what can happen if you don't !!

Electrical Fatality

July 1, 1999

Victim came in contact with a 4160 volt electric circuit while replacing a transformer. Three leads supplying power to the transformer were disconnected, but, *still energized!*



Electrician Helper Burned

February 21, 2000

- Victim failed to de-energize, lock-out, and tag-out the circuit (4VAC25-40-2140).
- Victim not adequately supervised by a certified electrician (4VAC25-40-2015).
- Dangerous condition not corrected (4VAC25-40-2270).



Electrical Fatality

August 17, 2002

- Victim was electrocuted when he contacted a 480 volt cable and junction box in the process of moving them.
- Issues involved included using fuses and breakers of a proper type and size and ensuring proper grounding of metal enclosures.



Electrical Fatality

May 21, 2003

The victim was in the process of making a splice in a 480 volt power cable. While removing the insulation, he contacted a live conductor.



Electrical Fatality

February 5, 2004



- The victim was splicing a power cable during a mine-wide power outage. The power was restored to the cable before he finished, resulting in a fatal electrical shock.

Fatality In Virginia

September 24, 2004

- Victim suffered an electrical shock when he apparently contacted an energized receptacle.
- Proper identification of switches and use of proper testing equipment were factors as well as failure to lockout.



Electrical Fatality

March 28, 2005

- The victim was performing repairs inside an electrical box when he contacted an energized component.
- Proper identification of circuits and use of testing equipment were factors as well as poor lockout practices.



Electrical Fatality

May 23, 2005

- The victim was working near an energized high voltage conductor when apparently an arc flash occurred.
- Proper identification of circuits, use of testing equipment and use of proper PPE were factors as well as poor lockout procedures.



Electrical Fatality

May 19, 2006



- A 77 year old contract electrician with 50 years of experience was checking an electrical motor and contacted an energized conductor.

Electrical Fatality

June 21, 2006

- A 75 year old contractor electrician was fatally injured when he contacted energized conductors while installing an electrical circuit.
- The building where the electrician was working subsequently caught fire and burned down before the primary circuit could be de-energized.



Coal Fatality

October 23, 2006



An electrician was fatally injured while troubleshooting the trailing cable for an electrically powered dragline. The victim was working at a junction box that supplied power to the dragline when he contacted two 23,000 volt energized phases in the box. ***Incoming power to the box had been disconnected and locked out by the victim.*** A diesel powered generator on the dragline was started causing 480 volts to back feed, energizing the phases.

Electrical Fatality

Accident, Sept. 14, 2007

Victim Died, July 7, 2008

- With the switchgear in the “on” position, the victim opened an enclosure to make an adjustment.
- As he reached into the cabinet, his hand contacted the energized fuse block sending current through him and out his other hand, which was in contact with the cabinet door, to ground.



Electrical Fatality

August 15, 2008

- An apprentice electrician was fatally injured while working on a 480-volt floodlight.
- He came into contact with the energized wiring supplying power to the light.
- Failure to lock out/tag out and test were key factors.



Electrical Fatality

April 7, 2009

- A 36 - year old supervisor with 15 years of experience was fatally injured at a sand and gravel dredging operation. The victim was attempting to connect the 4160 volt cable for the dredge to load side terminals in the electrical panel when he came into contact with energized 4160 volt line side terminals.



Utility Power Lines

4VAC25-40-2450

- Where metallic tools or equipment can come in contact with bare power lines, the lines shall be guarded or de-energized.



Electrical Fatality

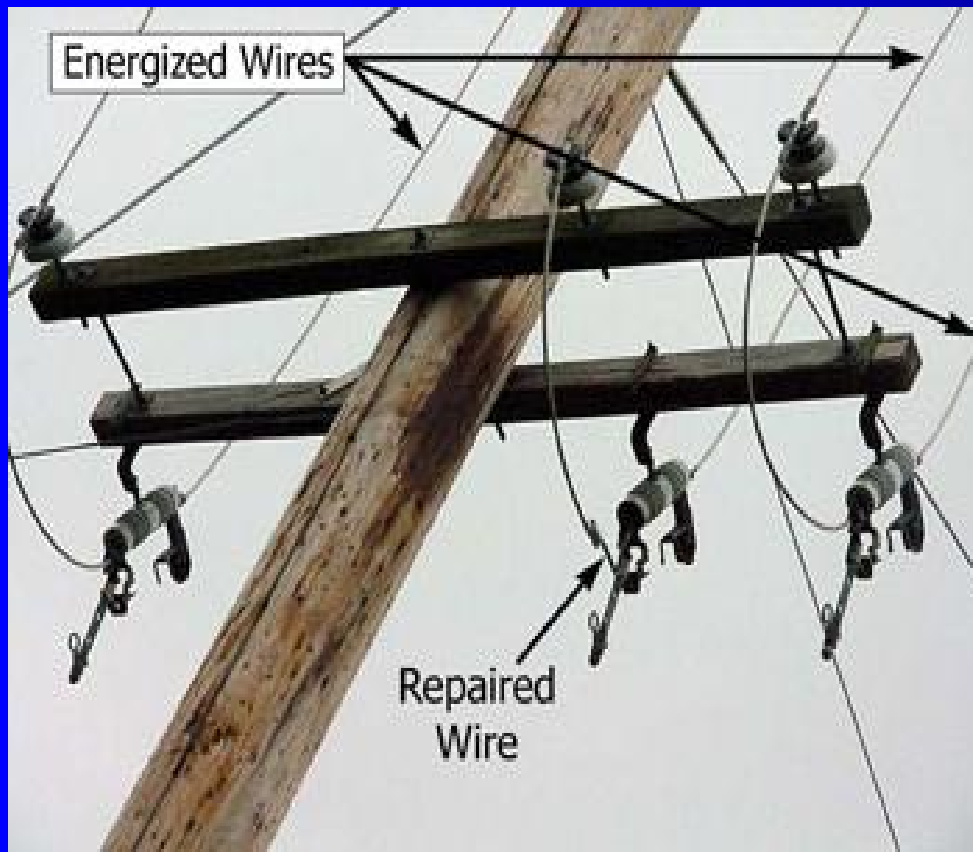
October 2, 2001

The victim was installing power lines to an electrical box on the side of a building. As he swung the man lift he was working from away from the building it contacted high voltage power lines that were located above his work area.



Electrical Fatality

August 29, 2004



- The victim contacted an energized power line while working on a power pole.

Electrical Fatality

July 27, 2006

- A contract laborer was using a weed eater with a steel blade to cut weeds and brush near a power pole. He severed the guy wire causing it to contact an energized supply conductor electrocuting him.



Coal Fatality - Buchanan County, Va.

May 4, 2006



- Contractor was clearing brush near a 12,470 VAC transmission line when he contacted an energized guy wire.
- There was no insulator, ground or proper anchor at ground level to prevent the guy wire from becoming energized.

Welding Safety

Are there any electrical hazards involved in welding operations?

Electrical Fatality

September 26, 2002

The victim was welding on a wet, metal screen deck in a confined area when he apparently touched the energized welding rod to his chest and received an electrical shock.



Proper protective matting and PPE are to be used when welding in confined spaces!

Safety in Electrical Storms



- What hazard does electrical storms pose to people who work outdoors?

A Huge Hazard!!

Did You Know:

- Outdoor workers face a high risk of a fatal strike
- Most lightning strikes occur between May and September
- One lightning strike can injure or kill several people
- 30% of those struck by lightning will die
- 74% of those who survive have permanent disabilities
- Death from a lightning strike usually occurs within 1 hour

Electrical Fatality

November 4, 2005

- A chief electrician was fatally injured while demonstrating the use of a high voltage cable fault locating device. The voltage selector was set on 10,000 volts at the time of the accident.
- Failure to follow the manufacturer's instructions, lack of specific task training and not using proper PPE were all factors in this accident.



Electrical Fatality

October 12, 2006



- A maintenance coordinator was troubleshooting an electrical fault in a high voltage motor control center when a sustained arc blast occurred.
- Calibration and maintenance of circuit protection devices and wearing proper PPE were factors in this accident.

Electrical Fatality

August 6, 2008

- A shift foreman with 15 years of mining experience was electrocuted when he contacted an energized steel water line.
- One conductor of a 480 volt circuit had short circuited to an abandoned heater tape.
- The heater tape, which was attached to the water line, overheated and energized the water line with 277 volts.



Electrical Fatality

October 10, 2010

- A 42 year- old contract electrician with 4 years of experience was seriously injured at a granite operation. The victim and two co-workers were installing ground fault indicator lights in a circuit breaker enclosure when an arc flash occurred. The circuit breaker enclosure contained a bottom feed circuit breaker. All three workers were hospitalized and the victim died on October 12, 2010.



Electrical Fatality

September 13, 2011



- A 38 year-old miner with 3 years of experience was killed at a portable sand and gravel operation. The victim opened the 480 volt feeder box at the motor control center and started to remove the leads when he received a fatal shock. One of two generator units was operating and supplying power to the control box.