PURPOSE

The purpose of this program is to set forth procedures for the safe use of electrical equipment, tools, and to comply with NFPA 70E requirements. These practices and procedures are intended to provide employee safety relative to electrical hazards in the workplace.

SCOPE

This program covers electrical safety-related work practices and procedures for Midland Engineering Co., Inc. employees who are exposed to an electrical hazard in work places covered in the scope of the NFPA 70E. When work is performed on a non-owned or operated site, the operator's program shall take precedence, however, this document covers Midland Engineering Co., Inc. employees and shall be used on owned premises, or when an operator's program doesn't exist or is less stringent.

REFERENCES

NFPA 70E.

Responsibility

Midland Engineering Co., Inc. shall provide the safety related work practice and shall train the employee, who shall then implement them.

Midland Engineering Co., Inc. will notify any host employers or other subcontractors of any unique hazards in the workplace presented by the contractor's work and this shall include unanticipated hazards and measures taken to correct hazards reported.

Managers/Supervisor

The HSE Manager will develop electrical safety programs and procedures in accordance with OSHA requirements and/or as indicated by events and circumstances.

Operations Managers and Supervisors are responsible for ensuring that only qualified employees perform electrical repairs or installations. Unqualified persons shall not be permitted to enter spaces that are required to be accessible to qualified employees only, unless the electric conductors and equipment involved are in an electrically safe work condition.

Operations Managers and Supervisors shall ensure a documented job briefing is held before starting each job and will include all employees involved. The briefing will cover hazards associated with the job, work procedures involved, special precautions, energy source controls and PPE requirements.

Operations Managers are also responsible for ensuring all applicable electrical safety programs are implemented and maintained at their locations.

Employees are responsible to use electrical equipment, tools, and appliances according to this program, for attending required training sessions when directed to do so and to report unsafe conditions to their supervisor immediately.

Only qualified employees may work on electric circuit parts or equipment that has not been de-energized and this includes performing tasks such as testing, troubleshooting, and voltage measuring within the limited approach boundary of energized electrical conductors or circuit parts operating at 50 volts or more or where an electrical hazard exists. Such employees shall be made familiar with the use of special precautionary techniques, PPE, insulating and shielding materials and insulated tools.

DEFINITIONS

Arc Flash Hazard – A dangerous condition associated with the possible release of energy caused by an electric arc.

Arc Flash Hazard Analysis – A study investigating a worker's potential exposure to arc flash energy, conducted for the purpose of injury prevention and the determination of safe work practices, arc flash boundary, and the appropriate levels of personal protective equipment (PPE).

Arc Flash Suit – A complete arc-rated clothing and equipment system that covers the entire body, except for the hands and feet.

Arc Flash Boundary – When an arc flash hazard exists, an approach limit at a distance from a prospective arc source within which a person could receive a second degree burn if an electrical arc flash were to occur.

Electrical Hazard – A dangerous condition such that contact or equipment failure can result in electric shock, arc flash burn, thermal burn, or blast.

Electrical Safety – Recognizing hazards associated with the use of electrical energy and taking precautions so that hazards do not cause injury or death.

Electrically Safe Work Condition – A state in which an electrical conductor or circuit part has been disconnected from energized parts, locked/tagged in accordance with established standards, tested to ensure the absence of voltage, and grounded if determined necessary.

Incident Energy – The amount of energy impressed on a surface, a certain distance from the source, generated during an electrical arc event. One of the units used to measure incident energy is calories per centimeter squared (cal/cm2).

Incident Energy Analysis – A component of an arc flash hazard analysis used to predict the incident energy of an arc flash for a specified set of conditions.

Shock Hazard – A dangerous condition associated with the possible release of energy caused by contact or approach to energized electrical conductors or circuit parts.

Safe Work Practices

Prior to any work being done within the Limited Approach Boundary a hazard risk analysis shall be performed. The analysis shall contain event severity, frequency, probability and avoidance to determine the level of safe practices employed.

Safe work practices shall be employed to prevent electric shock or other injuries resulting for either direct or indirect electrical contacts when work is performed near or on equipment or circuits which are or may be energized.

Safe Work Practices for Working within the Limited Approach Boundary

The limited approach boundary is the distance from an exposed live part within which a shock hazard exists.

The restricted approach boundary is the closest distance to exposed live parts a qualified person can approach with without proper PPE and tools. Inside this boundary, accidental movement can put a part of the body or conductive tools in contact with live parts or inside the prohibited approach boundary. To cross the restricted approach boundary, the qualified person must:

- Have an energized work permit that is approved by the supervisor or manager responsible or the safety plan.
- Use PPE suitable for working near exposed lived parts and rated for the voltage and energy level involved.
- Be certain that no part of the body enters the prohibited space.
- Minimize the risk from unintended movement, by keeping as much of the body as possible out of the restricted space; body parts in the restricted space should be protected.

The prohibited approach boundary is the minimum approach distance to exposed live parts to prevent flashover or arcing. Approaching any closer is comparable to making direct contact with a live part. To cross the prohibited approach boundary, the qualified person must:

- Have specified training to work on exposed live parts.
- Have a permit with proper written work procedures and justifying the need to work that close.
- Do a risk analysis.
- Have (2) and (3) approved by the appropriate supervisor.
- Use PPE appropriate for working near exposed live parts and rated for the voltage and energy level involved.

The Flash Protection Boundary is the approach limit at a distance from exposed live parts within which a person could receive a second degree burn if an electrical arc flash were to occur.

- Use PPE appropriate for working near exposed live parts and rated for the voltage and energy level involved.
- For systems of 600 volts and less, the flash protection boundary is 4 feet, based on an available bolted fault current of 50 kA and a clearing time of 6 cycles for the circuit breaker to act, or any combination of fault currents and clearing times not exceeding 300 kA cycles.
- When working on de-energized parts and inside the flash protection boundary for nearby live exposed parts - If the parts cannot be de-energized, use barriers such as insulted blankets to protect against accidental contact or wear proper PPE.

Arc Flash Hazard Analysis
An arc flash hazard analysis includes the following:

- Collect data on the facility's power distribution system.
    - Arrangement of components on a one-line drawing with nameplate specifications of every device.
    - Lengths and cross-section area of all cables.
- Contact the electric utility for information including the minimum and maximum fault currents that can be expected at the entrance to the facility.

- Conduct a short circuit analysis followed by a coordination study is performed.
- Feed the resultant data into the NFPA 70E equations.
    - These equations produce the necessary flash protection boundary distances and incident energy to determine the minimum PPE requirement.
    - The flash protection boundary is the distance at which PPE is needed to prevent incurable burns (2nd degree or worse) if an arc flash occurs. (It is still possible to suffer 1st or 2nd degree burns.)
- For systems of 600 volts and less, the flash protection boundary is 4 feet, based on an available bolted fault current of 50 kA (kiloamps) and a clearing time of 6 cycles (0.1 seconds) for the circuit breaker to act, or any combination of fault currents and clearing times not exceeding 300 kA cycles (5000 ampere seconds).

When working on de-energized the parts, but still inside the flash protection boundary for nearby live exposed parts:

- If the parts cannot be de-energized, barriers such as insulated blankets must be used to protect against accidental contact or PPE must be worn.
- Employees shall not reach blindly into areas that might contain exposed live parts.
- Employees shall not enter spaces containing live parts unless illumination is provided that allows the work to be performed safely.

- Conductive articles of jewelry and clothing (such as watchbands, bracelets, rings, key chains, necklaces, metalized aprons, cloth with conductive thread, metal headgear, or metal frame glasses) shall not be worn where they present an electrical contact hazard with exposed live parts.
- Conductive materials, tools, and equipment that are in contact with any part of an employee's body shall be handled in a manner that prevents accidental contact with live parts. Such materials and equipment include, but are not limited to long conductive objects such as ducts, pipes, tubes, conductive hose and rope, metal-lined rules and scales, steel tapes, pulling lines, metal scaffold parts, structural members, and chains.
- When an employee works in a confined space or enclosed spaces (such as a manhole or vault) that contains exposed live parts, the employee shall use protective shields, barriers or insulating materials as necessary to avoid contact with these parts. Doors, hinged panels, and the like shall be secured to prevent them from swinging into employees. Refer to the confined space entry program.

Training

Employees shall be trained in safety-related work practices and procedural requirements as necessary to provide protection from the electrical hazards associated with their respective jobs. Employees shall be trained to identify and understand the relationship between electrical hazards and possible injury. Documentation shall be made when the employee demonstrates proficiency, be maintained for the duration of the employee's employment, and contain each employee's name and date of training.

Employees shall be trained in safety related work practices that pertain to their respective job assignments. Additional training requirements for qualified persons allowed to work within the Limited Approach Boundary are:

- Distinguish exposed energized electrical conductors and circuit parts from other parts of electrical equipment
- Determine the nominal voltage of exposed energized electrical conductors and circuit parts
- The approach distances specified in Tables 130.4(C)(a) and 130.4(C)(b)
- Decision making process necessary to determine the degree and extent of the hazard and the personal protective equipment and job planning necessary to perform the task safely.

Retraining will be performed as needed and must occur before three years from the date of most recent employee's training. Retraining will occur if an employee is not complying with safe work practices or when there is a change in the work environment that necessitates the use of safe work practices that are different from the current standard.

Inspections

- Electrical equipment, tools, and appliances must be inspected prior to each use.
- The use of a hard fixed GFCI or a portable GFCI adapter shall be used with all portable hand tools, electric extension cords, drop lights and all 110 volt equipment.
- Faulty equipment, tools, or appliances shall be removed from service immediately and tagged "Out of Service", dated and signed by the employee applying the tag.

Equipment

Test instruments, equipment, and their accessories shall meet the requirements of ANSI/ISA-61010-1-Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use Part 1 General Requirements, for rating and design requirements for voltage measurement and test instruments intended for use on electrical systems 1000 Volts and below.

When test instruments are used for the testing for the absence of voltage on conductors or circuit parts operating at 50 volts or more, the operation of the test instrument shall be verified to be in proper working order before and after an absence of voltage test is performed.

Personal Protective Equipment

All insulating PPE must be inspected before each day's use and immediately following any incident that can reasonably be suspected of having caused damage. Insulating gloves shall be given an air test, along with the inspection.

Maximum test intervals for rubber insulating personal protective equipment shall include:

- Blankets-before first issue/every 12 months thereafter
- Gloves-before first issue and every 6 months
- Sleeves before first issue and every 12 months
- Covers and line hose shall be testing if insulating value is suspect.

Energized Electrical Work Permit

Work on energized electrical conductors or circuit parts that are not placed in an electrically safe work condition will be considered energized electrical work and will be performed by written permit only.

Lighting

Employees shall not enter spaces containing electrical hazards unless illumination is provided that enables the employees to perform the work safely. Where lack of illumination or an obstruction precludes observation of the work to be performed employees shall not perform any task within the Limited Approach Boundary of energized electrical conductors or circuit parts operating at 50 volts or more or where an electrical hazard exists.

Extension Cords

- Use only three-wire, grounded, extension cords and cables that conform to a hard service rating of 14 amperes or higher, and grounding of the tools or equipment being supplied.
- Only commercial or industrial rated-grounded extension cords may be used in shops and outdoors.
- Cords for use other than indoor appliances must have a rating of at least 14 amps.
- Cords must have suitable strain relief provisions at both the plug the receptacle ends.
- Work lamps (drop light) used to power electrical tools must have a 3 wire, grounded outlet, unless powering insulated tools.
- Adapters that allow three wire, grounded prongs, connected to two wire non-grounded outlets are strictly prohibited.
- Cords must have a service rating for hard or extra-hard service and have S, AJ, ST, SO, SJO, SJT, STO, or SJTO printed on the cord.
- Cords may not be run through doorways, under mats or carpets, across walkways or aisles, concealed behind walls, ceilings or floors, or run through holes in walls, or anywhere where they can become a tripping hazard.
- High current equipment or appliances should be plugged directly into a wall outlet whenever possible.

    - All extension cords shall be plugged into one of the following:
    - A GFCI outlet;
    - A GFCI built into the cord;
    - A GFCI adapter used between the wall outlet and cord plug.

- All extension cords and or electrical cords shall be inspected daily or before each use, for breaks, plug condition and ground lugs, possible internal breaks, and any other damage. If damage is found, the extension cord or electrical cord shall be remove from service and repaired or replaced.
- Extension cords shall not be used on compressor skid to operated heat tapes or any other type of equipment on a temporary basis. Heat tapes or other equipment shall be hard wired per applicable electrical codes.

Outlets

- Outlets connected to circuits with different voltages must use a design such that the attachment plugs on the circuits are not interchangeable.

Multiple Outlet Boxes

- Multiple outlet boxes must be plugged into a wall receptacle.
- Multiple outlet boxes must not be used to provide power to microwave ovens, toasters, space heaters, hot plates, coffeepots, or other high-current loads.

Double Insulated Tools

- Double insulated tools must have the factory label intact indicating the tool has been approved to be used without a three wire grounded supply cord connection.
- Double insulated tools must not be altered in any way, which would negate the factory rating.

Switches, circuit breakers, and disconnects

- All electrical equipment and tools must have an on and off switch and may not be turned on or off by plugging or unplugging the supply cord at the power outlet.
- Circuit breaker panel boxes and disconnects must be labelled with the voltage rating.
- Each breaker within a breaker panel must be labelled for the service it provides.
- Disconnect switches providing power for individual equipment must be labelled accordingly.

Ladders

- Only approved, non-conductive ladders, may be used when working near or with electrical equipment, which includes changing light bulbs.
- Ladders must be either constructed of wood, fiberglass, or have non-conductive side rails.
- Wood ladders should not be painted, which can hide defects, except with clear lacquer.
- When using ladders they shall be free from any moisture, oils, and greases.

Confined or Enclosed Work Spaces

- When an employee works in a confined or enclosed space that contains exposed energized parts, the employee shall isolate the energy source and turn off the source and lock and tag out the energy source (Only qualified electricians can work on an exposed energy source).
- Protective shields, protective barriers or insulating materials as necessary shall be provided.

Enclosures, Breaker Panels, and Distribution Rooms

- A clear working space must be maintained in the front, back and on each side of all electrical enclosures and around electrical equipment for a safe operation and to permit access for maintenance and alteration.
- A minimum two-foot working floor space in front of panels and enclosures shall be painted yellow.
- Employees may not enter spaces containing exposed energized parts unless illumination is provided that enables the employees to work safely.
- Housekeeping in distribution rooms must receive high priority to provide a safe working and walking area in front of panels and to keep combustible materials to the minimum required to perform maintenance operations.
- All enclosures and distribution rooms must have "Danger: High Voltage – Authorized Personnel Only" posted on the front panel and on entrance doors.
- Flammable materials are strictly prohibited inside distribution rooms (Boxes, rags, cleaning fluids, etc.)

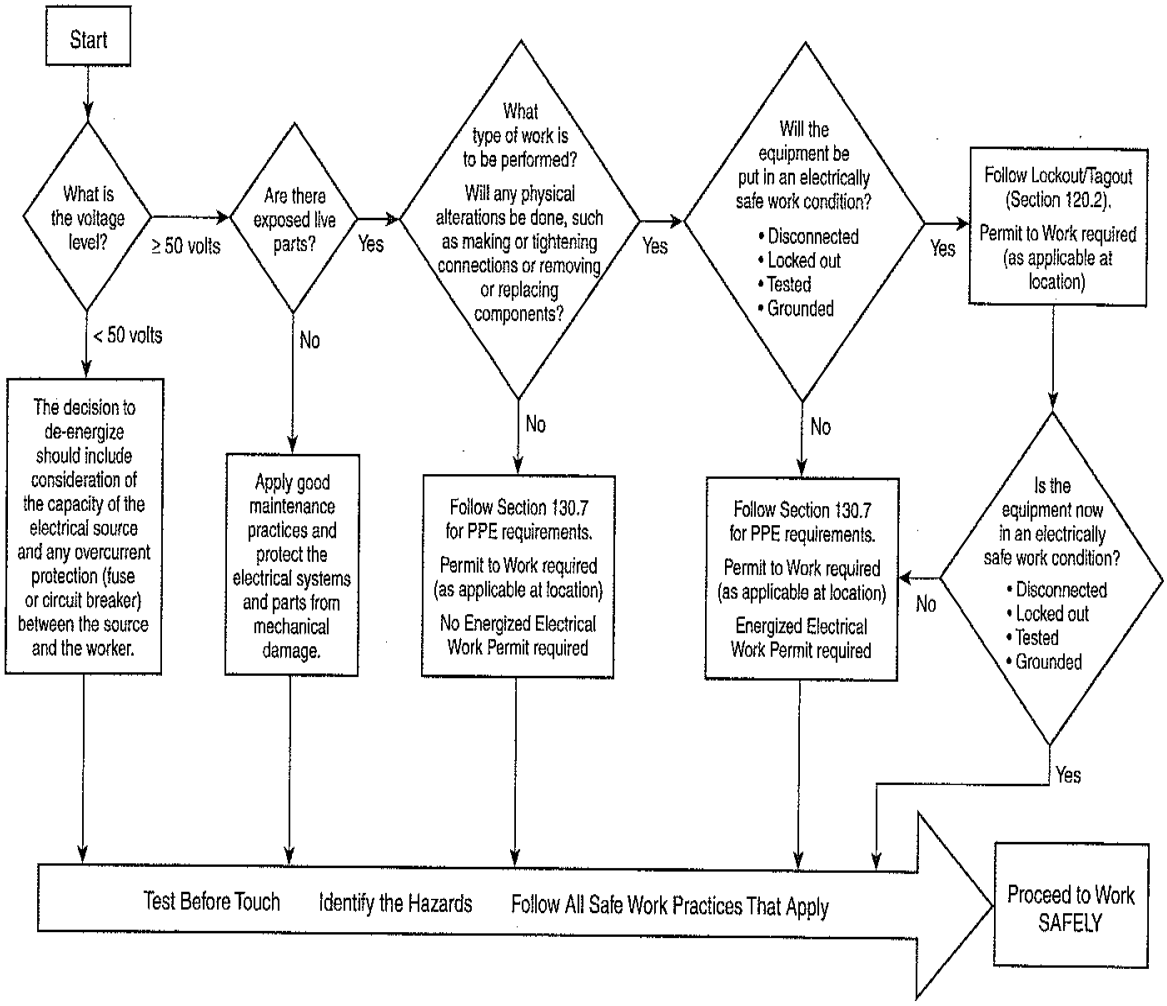
Lock Out/Tag Out

- No work shall be performed on (or near enough to them for employees to be exposed due to the dangers of tools or other equipment coming into contact with the live parts) live parts and the hazards they present.
- If any employee is exposed to contact with parts of fixed electric equipment or circuits which have been deenergized, the circuits energizing the parts shall be locked out or tagged or both.
- Conductors and parts of electrical equipment that have been de-energized but not been locked or tagged out shall be treated as live parts.
- Only authorized personnel may perform lock out/tag out work on electrical equipment and will follow Midland Engineering Co., Inc. Control of Hazardous Energy – Lock out/Tag Out Program.
- Authorized personnel will be trained in lock out/tag out procedures.
- Affected personnel will be notified when lock out/tag out activities are being performed in their work area.

Electric Shock-CPR:

- If someone is discovered that has received an electric shock and is unconscious, first check to see if their body is in contact with an electrical circuit. Do not touch a person until you are sure there is no contact with an electrical circuit.
- When it is safe to make contact with the victim, begin CPR if the person's heart has stopped or they are not breathing.
- Call for help immediately.

Energized Electrical Work Permit Flow Chart



Approach Boundaries

Employees shall be trained in the skills and techniques to distinguish exposed energized electrical conductors and circuit parts from other parts of electrical equipment, to determine the nominal voltage of exposed energized electrical conductors and circuit parts, the approach distances (below), and the decision making process necessary to determine the degree and extent of the hazard and the personal protective equipment and job planning necessary to perform the task safely.

Alternating Current Systems - Approach Boundaries				
Nominal system voltage range, phase to phase	Exposed movable conductor	Exposed fixed- circuit part	Restricted approach boundary (allowing for accidental movement)	Prohibited approach boundary
0 to 50 volts	Not specified	Not specified	Not specified	Not specified
51 to 300 volts	10 ft. 0 in.	3 ft. 6 in.	Avoid contact	Avoid contact
301 to 750 volts	10 ft. 0 in.	3 ft. 6 in.	1 ft. 0 in.	0 ft. 1 in.
751 to 15 KV KV	10 ft. 0 in.	5 ft. 0 in.	2 ft. 2 in.	0 ft. 7 in.
15.1 kV to 36 KV	10 ft. 0 in.	6 ft. 0 in	2 ft. 7 in.	0 ft. 10 in.
36.1 KV to 46 kV	10 ft. 0 in.	8 ft. 0 in	2 ft 9 in.	1 ft. 5 in.
46.1 KV to 72.5 KV	10 ft. 0 in.	8 ft. 0 in.	3 ft 2 in.	2 ft. 1 in.
72.6 KV to 121 KV	10 ft. 8 in.	8 ft. 0 in.	3 ft. 3 in.	2 ft. 8 in.
138 to 145	11 ft 0 in	10 ft. 0 in.	3 ft. 7 in	3 ft. 1 in.
161 KV to 169 KV	11 ft 8 in.	11 ft. 8 in.	4 ft. 0 in.	3 ft. 6 in.
230 KV to 242 KV	13 ft. 0 in.	13 ft. 0 in.	5 ft. 3 in.	4 ft. 9 in.
345 KV to 362 KV	15 ft. 4 in	15 ft. 4 in.	8ft. 6 in.	8 ft. 0 in.

Energized Electrical Work Permit

ENERGIZED ELECTRICAL WORK PERMIT

PART I: TO BE COMPLETED BY THE REQUESTER:

Job/Work Order Number _____

(1) Description of circuit/equipment/job location: _____

(2) Description of work to be done: _____

(3) Justification of why the circuit/equipment cannot be de-energized or the work deferred until the next scheduled outage:

_____ _____

Requester/Title Date

PART II: TO BE COMPLETED BY THE ELECTRICALLY QUALIFIED PERSONS *DOING* THE WORK:

	Check when complete
(1) Detailed job description procedure to be used in performing the above detailed work:	☐
(2) Description of the safe work practices to be employed:	☐
(3) Results of the shock hazard analysis:	
(a) Limited approach boundary	☐
(b) Restricted approach boundary	☐
(c) Prohibited approach boundary	☐
(d) Necessary shock personal and other protective equipment to safely perform assigned task	☐
(4) Results of the arc flash hazard analysis:	
(a) Available incident energy or hazard/risk category	☐
(b) Necessary arc flash personal and other protective equipment to safely perform the assigned task	☐
(c) Arc flash boundary	☐
(5) Means employed to restrict the access of unqualified persons from the work area:	☐
(6) Evidence of completion of a job briefing, including discussion of any job-related hazards:	☐

(7) Do you agree the above-described work can be done safely? ❑ Yes ❑ No (If *no*, return to requester.)

_____ _____

Electrically Qualified Person(s) Date

_____ _____

Electrically Qualified Person(s) Date

PART III: APPROVAL(S) TO PERFORM THE WORK WHILE ELECTRICALLY ENERGIZED:

_____ _____

Manufacturing Manager Maintenance/Engineering Manager

_____ _____

Safety Manager Electrically Knowledgeable Person

_____ _____

General Manager Date

Note: Once the work is complete, forward this form to the site Safety Department for review and retention.

 NFPA 70E

Job Briefing and Planning Checklist

Identify

- ❑ Hazards
- ❑ Voltage levels involved
- ❑ Skills required
- ❑ Any "foreign" (secondary source) voltage source
- ❑ Any unusual work conditions
- ❑ Number of people needed to do the job
- ❑ Shock protection boundaries
- ❑ Available incident energy
- ❑ Potential for arc flash (Conduct an arc flash hazard analysis.)
- ❑ Arc flash boundary

Ask

- ❑ Can the equipment be de-energized?
- ❑ Are backfeeds of the circuits to be worked on possible?
- ❑ Is a standby person required?

Check

- ❑ Job plans
- ❑ Single-line diagrams and vendor prints
- ❑ Status board
- ❑ Information on plant and vendor resources is up to date
- ❑ Safety procedures
- ❑ Vendor information
- ❑ Individuals are familiar with the facility

Know

- ❑ What the job is
- ❑ Who else needs to know — Communicate!
- ❑ Who is in charge

Think

- ❑ About the unexpected event . . . What if?
- ❑ Lock — Tag — Test — Try
- ❑ Test for voltage — FIRST
- ❑ Use the right tools and equipment, including PPE
- ❑ Install and remove temporary protective grounding equipment
- ❑ Install barriers and barricades
- ❑ What else . . . ?

Prepare for an emergency

- ❑ Is the standby person CPR trained?
- ❑ Is the required emergency equipment available? Where is it?
- ❑ Where is the nearest telephone?
- ❑ Where is the fire alarm?
- ❑ Is confined space rescue available?
- ❑ What is the exact work location?
- ❑ How is the equipment shut off in an emergency?
- ❑ Are the emergency telephone numbers known?
- ❑ Where is the fire extinguisher?
- ❑ Are radio communications available?