SAND2011-0785C

Chemical

SAFETY AND SECURITY TRAINING

Safe Work Practices

February 2011

SAND No. xxxx
Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

Sandia National Laboratories

Safe Work Practices are a Subset of Process Safety Management

- Material hazard
- Energy hazard
- Chemical interaction hazard

Hazards

- Safe operating procedures (SOPs)
- Safety Audits
- Training
- Job Hazard Analysis
- Safe Work Practices

Job Hazard Analysis

Job Hazard Analysis is a technique that focuses on job tasks as a way to identify hazards before they occur. It focuses on the relationship between the worker, the task, the tools, and the work environment.

Essential Steps in Job Hazard Analysis

1. Involve your employees.
2. Review your accident history.
3. Conduct a preliminary job review.
4. List, rank, and set priorities for hazardous jobs.
5. Outline the steps or tasks.

What Jobs Need a Hazard Analysis ?

- Jobs with the highest injury or illness rates
- Jobs with the potential to cause severe or disabling injuries or illness, even if there is no history of previous accidents;
- Jobs in which one simple human error could lead to a severe accident or injury;
- Jobs that are new to your operation or have undergone changes in processes and procedures; and
- Jobs complex enough to require written instructions.

The Job Hazard Analysis asks Several Questions

- What can go wrong?
- What are the consequences?
- How could it happen?
- What are other contributing factors?
- How likely is it that the hazard will occur?

Job Hazard Analysis Template

Job Hazard Analysis		
Date: _____	JHA Number: _____	Steps: 1 through 5
Location of Task:	_____	
Task Description:	_____	
Step 1 Description	Hazards	Preventive Measure(s)
Step 2 Description	Hazards	Preventive Measure(s)
Step 3 Description	Hazards	Preventive Measure(s)
Step 4 Description	Hazards	Preventive Measure(s)
Step 5 Description	Hazards	Preventive Measure(s)
Safe Job Procedures		

Safe Work Practices Apply to a Variety of Jobs/ Hazards

Hazards

- Elevated work
- Hoisting, rigging
- Cranes- forklifts
- Heavy equipment
- Trenches, excavation
- Pressurized vessels
- Energized equipment
- Chemical reactivity

Specialty PPE

- Safety Vests
- Face Shields/ goggles
- Gloves
- Respiratory Protection
- Safety Harnesses
- Hearing Protection

Definition of Safe Work Practices

Safe Work Practices provide for the control of hazards during work activities such as:

- Lockout - Tagout
- Confined space entry
- Opening process equipment or piping
- Hot work
- Control over entrance by support personnel.

They are generally written methods outlining how to perform a task with minimum risk to people, equipment, materials, environment, and processes.

They are issued
- to specific persons
- for a specific time period
- for a specific job

Safe Work Practices Go Beyond SOPs

OSHA PSM Standard- Nonroutine Work Authorizations

- **Lockout - Tagout (energy control)**
- **Confined Space Entry**
- **Initial Opening of Process Lines and Vessels**
- **Hot Work**

Some procedures require permits for more than one of the above categories

Lockout-Tagout Addresses all Forms of Hazardous Energy

- **Kinetic (mechanical) energy** - *in the* moving parts of mechanical systems
- **Potential energy** -*stored in pressure* vessels, gas tanks, hydraulic or pneumatic systems, and springs (potential energy can be released as hazardous kinetic energy)
- **Electrical energy** *from generated elec*trical power, static sources, or electrical storage devices (such as batteries or capacitors)
- **Thermal energy** *(high or low temperature)* resulting from mechanical work, radiation, chemical reaction, or electrical resistance

Lockout-Tagout Definition

Lockout-Tagout (LOTO) or lock and tag is a safety procedure which is used in industry and research settings to ensure that dangerous machines are properly shut off and not started up again prior to the completion of maintenance or servicing work.

OSHA 1910.147

Hazardous Energy Management Involves the Following Steps

- Identify tasks that may expose workers to hazardous energy.
- Identify and de-energize *all hazardous* energy sources, including those in adjacent equipment.
- Lockout and tagout *all energy-isolating* devices to prevent in advertent or unauthorized reactivation or startup.
- Isolate, block, and/or dissipate *all haz*ardous sources of stored or residual energy, including those in adjacent equipment.
- Before beginning to work, verify energy isolation and de-energization, including that in adjacent equipment or energy sources.
- After work is complete, verify that all personnel are clear of danger points

Steps to Safe LOTO

1. Prepare for shutdown
2. Shutdown machine or piece of equipment
3. Isolate or block all hazardous energy sources for the equipment
4. Apply lockout or tagout devices
5. Release all stored energy
6. Verify energy isolation
7. Perform work

Steps to Release from LOTO

1. Make the work area safe
2. Check the work area to ensure individuals are clear of the hazard area
3. Remove locks, tags, and devices
4. Notify affected workers
5. Re-energize

Isolation of Energy is the key Principle

LOTO Practices-

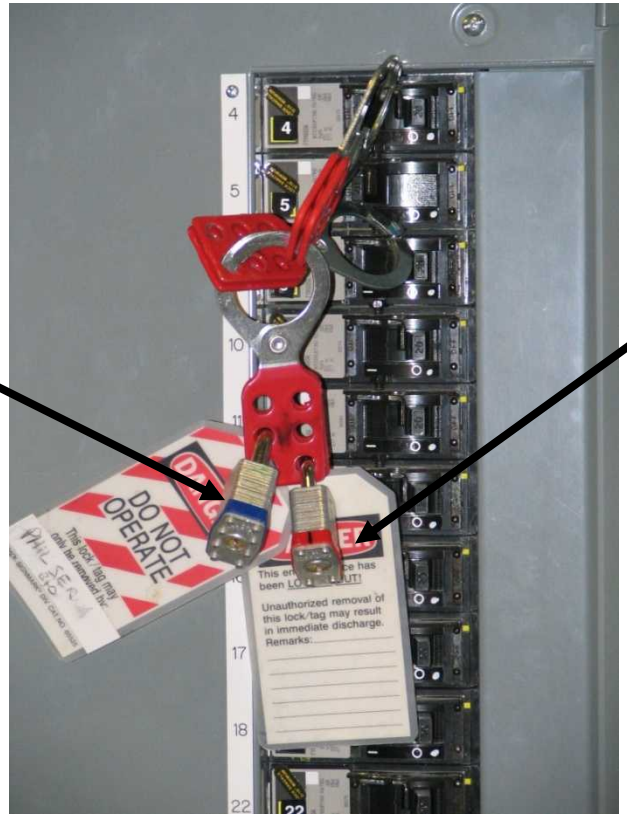
•LOTO is not just closing valves or unplugging machinery
•Only one key for each lock the worker controls
•Each lock labeled with durable tag
•Only worker who installs lock can remove
•Shift change- New lock added before old one removed
•Key control for group lockout device
•Procedures must be specific not generic
•Periodic inspections
•LOTO alternatives- machine guarding, cord and plug, control circuitry

Examples of LOTO-

•Blanking: installing flange with blank
•Line breaking - misalignment
•Remove stored energy-springs, hydraulic, pneumatic, counterweighted flywheel,
•Install chocks, cribbing
•Remove belt and chains
•Clamping

Lock Self Adhesive Band , IDEAL Part Number 34-003

Company Assigns Unique Lock to LOTO

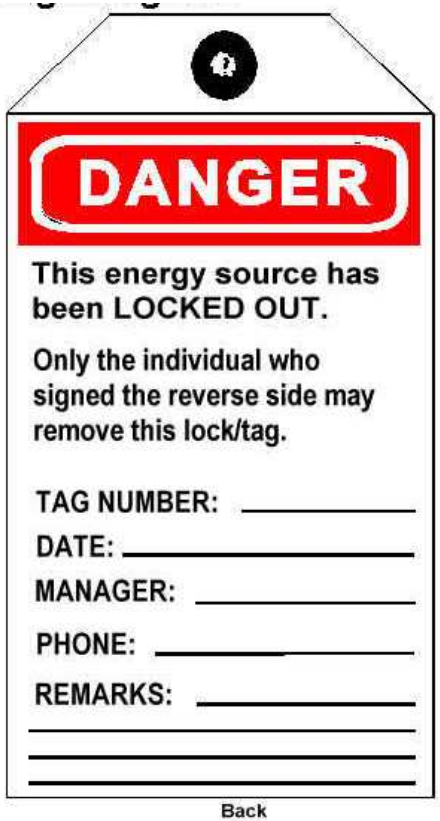


Which of these locks is an administrative lock?

General LOTO Devices and Tags

Lock Self Adhesive Band , IDEAL Part Number 34-003

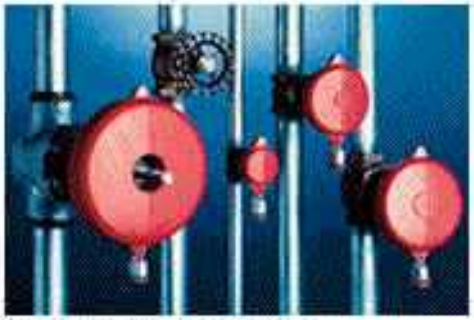
Front



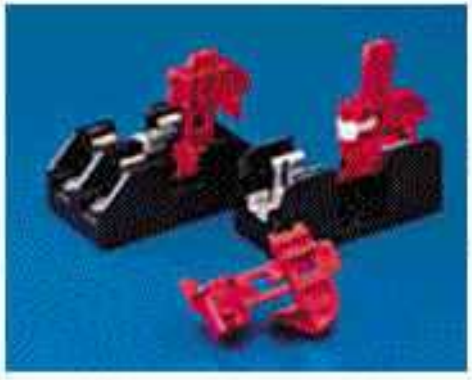
Back

Other LOTO Devices

BALL VALVE LOCKOUTS -
Brady Catalog #65666 & #65669
Panduit Catalog #PSL-BV1 &
#PSL-BV2 (Similar)



GATE VALVE LOCKOUT -
Brady Catalog #65560 to 65564

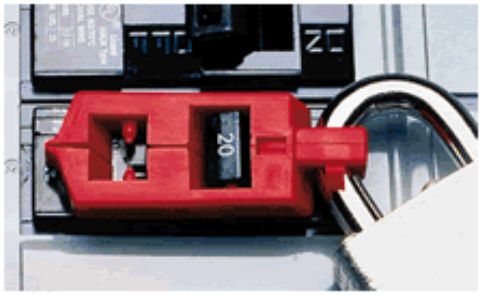


Circuit Breaker LOCKOUT...OPEN

Circuit Breaker LOCKOUT...LOCKED

Other LOTO Devices

120 VOLT PLUG EXCLOSURE -
Brady Catalog #65674



SINGLE-POLE CIRCUIT BREAKER LOCKOUT -
Brady Catalog #65688

WALL STATION LOCKOUT
Brady Catalog #65696

MULTI-POLE BREAKER LOCKOUT
Brady Catalog #65694

Confined Space Definition

Confined space is any space that has:

- Limited or restricted means of entry or exit;
- Is large enough for a person to enter to perform tasks and
- Is not designed or configured for continuous occupancy

OSHA 1910.146

Confined Space Entry Permit

Entry Date: _____ Start Time: _____ Completion Time: _____

Description of Work to be Performed: _____

Description of Space

Confined Space ID Number: Type: Classification

Building Name

Location of Confined Space:

Entry Checklist

Potential Hazards Identified?	☐ YES	☐ NO
Communications Established with Operations Center	☐ YES	☐ NO
Emergency Procedures Reviewed ?	☐ YES	☐ NO
Entrants and Attendants Trained?	☐ YES	☐ NO
Isolation of Energy Completed?	☐ YES	☐ NO
Area Secured?	☐ YES	☐ NO
Emergency Escape Retrieval Equipment Available	☐ YES	☐ NO
Personal Protective Equipment Used?	☐ YES	☐ NO

Confined Space Equipment and PPE Used During Entry:

☐ Tripod with Mechanical Winch
☐ Rescue Tripod with Lifeline
☐ Harness
☐ Two-Way Communications
☐ General / Local Exhaust Ventilation
☐ Air Purifying Respirator
☐ Self Contained Breathing Apparatus
☐ Steel Toe Boots
☐ Hard Hat
☐ Safety Glasses / Goggles / Face Shield
☐ Gloves
☐ Chemical Resistant Clothing
☐ Hearing Protection

Other PPE or Equipment Used:

Air Monitoring Results Prior to Entry

Monitor Type: _____ Serial Number: _____

Oxygen _____ % LEL _____ % CO _____ % H2S _____ %

Calibration Performed ? ☐ YES ☐ NO Initials _____

Alarm Conditions ? ☐ YES ☐ NO

Monitoring Performed by (sign): _____ Date: _____ Time: _____

Continuous Air Monitoring Results

Time _____ Oxygen _____ % LEL _____ % CO _____ % H2S _____ %

Time _____ Oxygen _____ % LEL _____ % CO _____ % H2S _____ %

Time _____ Oxygen _____ % LEL _____ % CO _____ % H2S _____ %

Time _____ Oxygen _____ % LEL _____ % CO _____ % H2S _____ %

Authorization

We have reviewed the work authorized by this permit and the information contained here-in. Written instructions and safety procedures hav been received and are understood. Entry cannot be approved if any squared are marked in the "NO" column. This permit is not valid unless all appropriate items are completed. This permit is to be kept at the job site. Return site copy to supervisor.

Entrants Name _____ Signature: _____ Date: _____

Attendants Name _____ Signature: _____ Date: _____

Supervisors Name: _____ Signature: _____ Date: _____

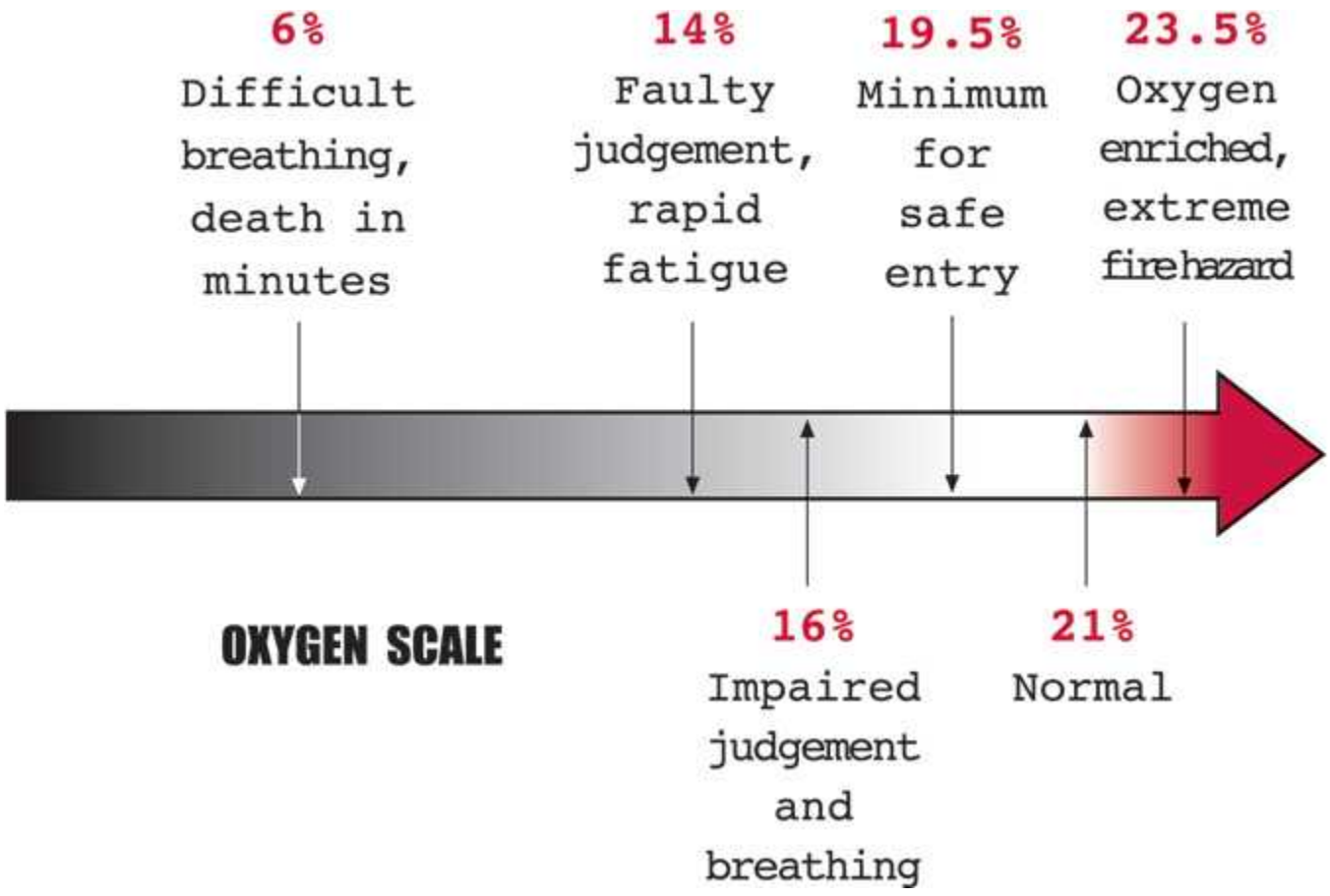
Confined Space Definition (cont)- plus One of These

- Contains or has the potential to contain a hazardous atmosphere
- Contains a material that has the potential for engulfing the entrant
- Has an internal configuration that might cause an entrant to be trapped or asphyxiated by inwardly converging walls or by a floor that slopes downward and tapers to a smaller cross section
- Contains any other recognized serious safety or health hazards.
- In addition to the hazards posed by the design of the space, work activities can also pose serious safety hazards (heat, noise, vapors, etc.)

Hazards in Confined Space

- Atmospheric Hazards
- Oxygen Deficiency/Enrichment; Combustible/Flammable/Explosive Gases and Vapors;
- Combustible Dust; Toxics; Safety Data Sheets (SDS); Monitoring-Air
- Physical Hazards- Collapse, Thermal
- Mechanical; Entrapment; Engulfment; Other Types of Hazards

Oxygen Concentration is a Fundamental Aspect of Confined Space Work



Confined Space Controls

- Controls for Atmospheric Hazards
  - Ventilation; Respiratory Protection; Other Control Measures
- Controls for Physical Hazards
  - Isolation
    - Mechanical, Electrical, Pressurized Lines, Ducts, or Pipes
    - Other Control Measures
- Personal Protective Equipment and Tools
- Communication System

Testing the Confined Space

1.Oxygen is tested first because most combustible gas and toxic atmosphere meters are oxygen-dependent and will not provide reliable readings when used in oxygen-deficient atmospheres. In addition, both oxygen-deficient and oxygen enriched atmospheres are *extremely hazardous to workers' health and safety.*

2. Combustible gases and vapors are tested next because the threat of fire and explosion is both more immediate and more life-threatening, in most cases, than exposure to toxic gases and vapors.

3. Toxic atmospheres are tested last.

Many modern direct-reading instruments provide simultaneous readings of multiple gases.

Confined Space Entry Process

Administrative

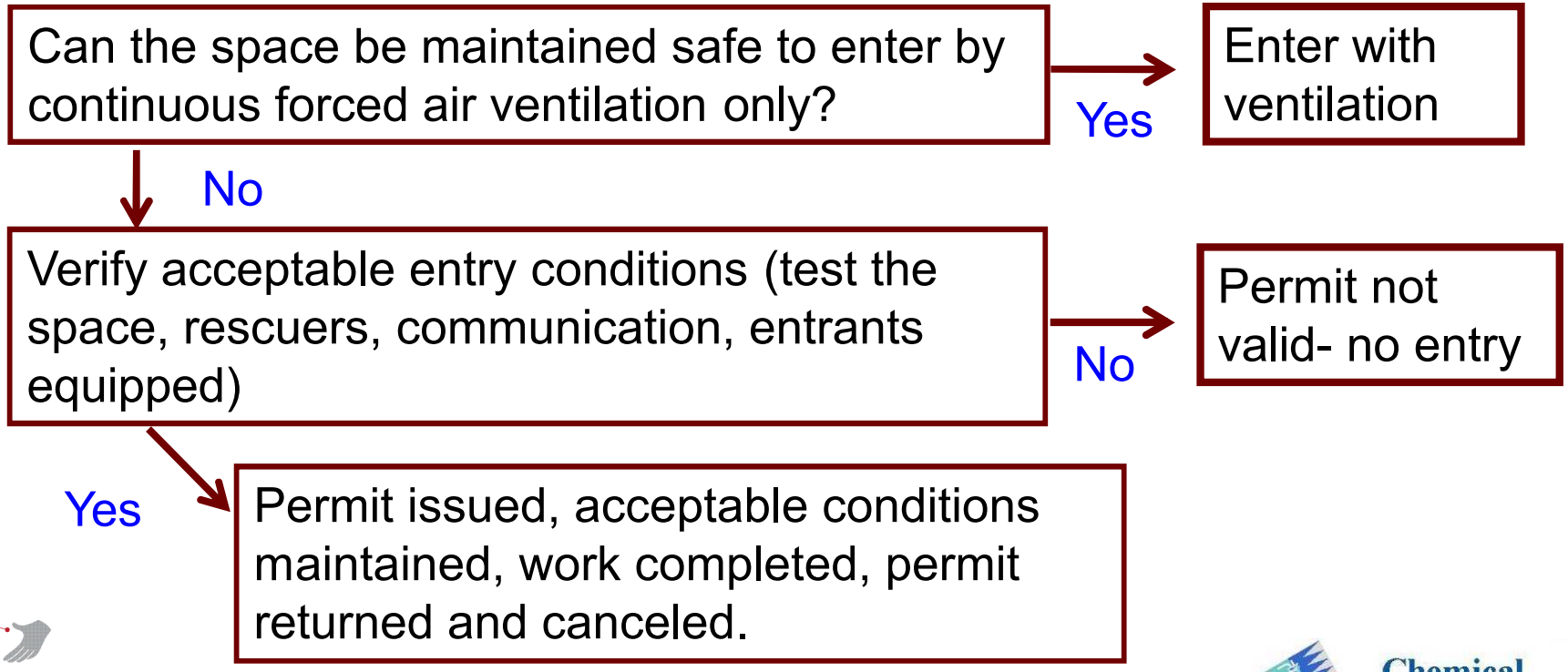
- Space to be entered
- Purpose of entry
- Date and duration
- Authorized entrants
- Personnel attendants
- Entry supervisor

Work Procedures

- Hazards of permit space
- Measures used to isolate the space
- Acceptable entry conditions
- Safety retrieval line
- Periodic rests during entry
- On-site rescue team
- Communication procedures
- Certified and calibrated equipment
- Permits for other hazardous procedures in area

Confined Spaces Decision (OSHA)

Does the work contain permit-required confined space ?
Will the permit space be entered?
Does the space have known or potential hazards?
Can the hazards be eliminated?



Emergency During Entry

- If emergency exists (prohibited condition).
- Entrants evacuated-entry aborts. (Call rescuers if needed).
- Permit is void.
- Reevaluate program to correct/prevent prohibited condition.
- Occurrence of emergency (usually) is proof of deficient program.
- No re-entry until program (and permit) is emended. (May require new program.)

Opening Lines and Vessels
”Line Breaking” Definition

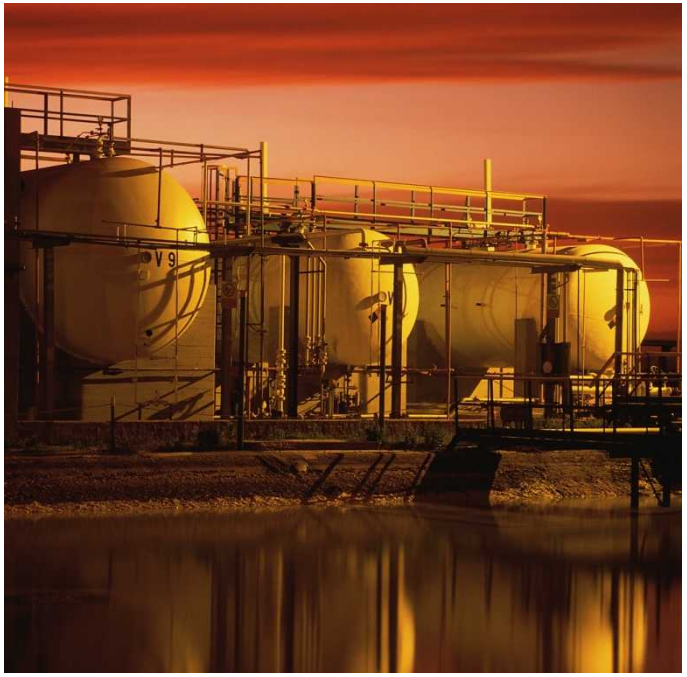
Line breaking means the intentional opening of a pipe, line, or duct that is or has been carrying flammable, corrosive, or toxic material, an inert gas, or any fluid at a volume, pressure, or temperature capable of causing injury.

Hazards of Opening Lines and Vessels

Toxic release and exposure
- Ammonia
- Hydrogen Sulfide

Fire and explosion
- Hydrocarbons
- Pyrophoric materials
- Moisture sensitive materials

Pressure release
- Pipeline pigging



Consideration for Line Breaking/Line Opening Procedures

Identify the Hazard
Develop Permit
Appropriate PPE
Barricades
Isolating system
Cooling system
Depressurizing system
Flushing system
LOTO of electrical / valving

Step by step procedure
Emergency equipment
Emergency plan
Testing

Line Breaking Procedure Example:
Ammonia Refrigeration

A line break permit shall be obtained.

Only qualified Refrigeration personnel shall perform the work

The line to be opened shall be isolated, and isolation valves secured with locking devices appropriate to type shall be applied. Isolation valves must be logged by number, and a *copy* of this log kept in the maintenance office to preclude loss.

The portion of the line to be opened shall be evacuated (pumped down, into a vacuum). Operators shall test that the vacuum condition is holding, and hold the level of vacuum for a minimum of 30 minutes.

Prior to the opening of the line, operators shall don appropriate PPE, (APR), and wear the PPE until it is evident to the senior operator that no danger of ammonia flow exists.

Line Breaking Procedure Example:
Ammonia Refrigeration

Mechanical integrity of all lines, valves, and other component parts affected by the line break related work shall be maintained.

At the conclusion of the work process, the assembled line, valves, or other constituent parts shall be first vacuum tested, then pressure tested.

When such testing is successfully completed, all valves shall be restored to the original alignment conditions. The original log shall be consulted to ensure that all valves originally listed have been returned to original alignments, and all tags and biscuits have been removed, and the work area restored to previous conditions.

The area of the line break shall be observed periodically to ensure leakage-free operation, and proper refrigeration function.

LINE BREAK PERMIT

☐ Contractor Name: _____ Plant Location: _____

☐ Sub-Tier Contractor Name: _____

Project Name: _____ Contract/PO No.: _____

Date of Line Break: _____ Time: _____

Service Being Broken: _____ Line Number: _____

Location (i.e., building, area, etc.): _____

Hazards (list all types of potential hazardous energy; also list all hazardous chemicals/material thought to ever have been in the line)

Special Instructions:

PROTECTIVE MEASURES

Personal Protective Equipment (PPE) Required	Yes	No	Date Complete	Other Protection Methods	Yes	No	Date Complete
Boots – Rubber	☐	☐		Barricade – ft. Radius (above/below)	☐	☐	
Coveralls – Cloth	☐	☐		Blanks to be Installed	☐	☐	
Coveralls – Tyvek	☐	☐		Block Valve Shut	☐	☐	
Dosimetry – Chemical (specify)	☐	☐		Fire Extinguisher	☐	☐	
Gloves – Leather	☐	☐		Grating, Floor Opening Covered	☐	☐	
Gloves – Long	☐	☐		Lock/Tag/Verify Plan Required	☐	☐	
Gloves – Rubber	☐	☐		Monitoring (specify)	☐	☐	
Goggles	☐	☐		Nonsparking Tools	☐	☐	
Hood – Acid	☐	☐		Piping Support Needed	☐	☐	
Respirator – Full Face	☐	☐		Pump Locked Out	☐	☐	
Respirator – Half Face	☐	☐		Spark Proof Tiles	☐	☐	
Respirator – Air Supplied	☐	☐		Standby Person (required for first time breaks)	☐	☐	
Respirator – SCBA	☐	☐		System Flushed	☐	☐	
Shield – Face	☐	☐		System Less than 100 °C	☐	☐	
Shield – Special Shielding	☐	☐		System Vented	☐	☐	
Suit – Acid	☐	☐		Valve Locked Out	☐	☐	
Suit – Hot	☐	☐		Ventilation – Exhaust	☐	☐	
Suit – Rain	☐	☐		Ventilation – Dilution	☐	☐	
Spill Containment	☐	☐		Water Hose	☐	☐	

PLANNING ITEMS FOR LINE BREAKS

Items	Description
1. Depressurizing, Cleaning, and Venting Check	
2. Nearest Safety Shower Location (if greater than 50 feet, water hose must be provided)	
3. Nearest Eyewash Location	
4. Cold Pak Location	
5. Emergency Respirator Location	
6. Fire Extinguisher Location	
7. Fire Alarm Location	
8. Stretcher Location	
9. Planned Escape Route	

Hot Work Definition

Hot work is work involving electric or gas welding, torch cutting, grinding, brazing, or similar flame or spark-producing operations.

OSHA 1910.252

Hot Work Permit

- Fire prevention and protection requirements
- Implemented prior to beginning the hot work operations
- Date(s) authorized for hot work
- Identify the object on which hot work is to be performed
- Permit shall be kept on file until completion of the hot work operations.

WARNING!

HOT WORK IN PROGRESS
WATCH FOR FIRE!

PART 2

INSTRUCTIONS

1. **Person doing Hot Work: Indicate time started and post permit at Hot Work location. After Hot Work, indicate time completed and leave permit posted for Fire Watch.**
2. **Fire watch: Prior to leaving area, do final inspection, sign, leave permit posted and notify Firesafety Officer.**
3. **Monitor: After 4 hours, do final inspection, sign and return to Firesafety Officer.**

HOT WORK BEING DONE BY:

☐ EMPLOYEE _____ LIFE NO. _____

☐ CONTRACTOR _____ CO. _____

DATE | JOB NO.

LOCATION/BUILDING & FLOOR

NATURE OF JOB

NAME OF PERSON DOING FIRE WATCH

I verify the above location has been examined, and permission is authorized for this work.

SIGNED: (FIRE/SAFETY OFFICER)

DATE:

PERMIT EXPIRES	DATE	TIME AM PM

I verify that the List of Precautions is Understood and work will proceed only if precautions are followed:

Signed: (Supervisor)

FIRE WATCH SIGNOFF

Work area and all adjacent areas to which sparks and heat might have spread were inspected during the fire watch period and were found fire safe.

Signed:

FINAL CHECKUP

Work area was monitored following Hot Work and found fire safe.

Signed:

Required Precautions Checklist

MAY BE RETAINED AS RECORD OF HOT WORK ACTIVITY

☐ Available sprinklers, hose streams and extinguishers are in service/operable.

☐ Hot Work equipment in good repair.

Requirements within 35 ft (10m) of work

☐ Flammable liquids, dust, lint and oil deposits removed.

☐ Explosive atmosphere in area eliminated.

☐ Floors swept clean.

☐ Combustible floors wet down, covered with damp sand or fire-resistive sheets.

☐ Remove other combustibles where possible. Otherwise protect with fire-resistive tarpaulins or metal shields.

☐ All wall and floor openings covered.

☐ Fire-resistive tarpaulins suspended beneath work.

Work on walls or ceilings

☐ Construction is noncombustible and without combustible covering or insulation.

☐ Combustibles on other side of walls moved away.

Work on enclosed equipment

☐ Enclosed equipment cleaned of all combustibles.

☐ Containers purged of flammable liquids/vapors and monitored for vapor buildup.

Fire watch/Hot Work area monitoring

☐ Fire watch conractor/department will supply during and for 60 minutes after work, including any coffee or lunch breaks.

☐ Fire watch is supplied with suitable extinguishers, charged small hose.

☐ Fire watch is trained in use of this equipment and in sounding alarm (telephone, alarm box, radio).

☐ Fire watch may be required for adjoining areas, above, and below (see other precautions).

☐ Monitor Hot Work area for 4 hours after job is completed.

Other Precautions Taken

☐ False alarm with detection systems considered.

☐ _____

3195

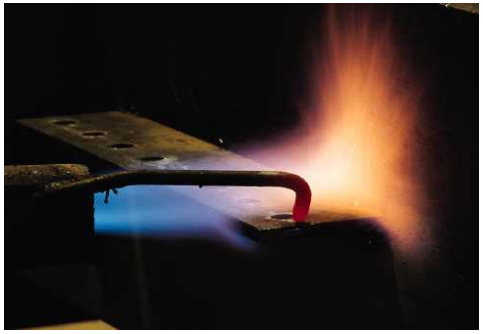
Responsibility for Hot Work is Clearly Outlined

Permit Authorizing Individual – Inspects hot work site before starting

Hot Work Operators – Perform hot work operations

Fire Watch – is posted to monitor safe operations

Designated Area – Location approved for hot work operations.



Fire Protection during Hot Work

- Keep all entrances and exits clear of obstructions such as vehicles, equipment and general clutter at all times.
- Correct poor housekeeping practices.
- Use appropriate shielding of flammable surfaces when performing hot work.
- Remember that grinders are capable of throwing red hot particles approximately 30 feet.
- Keep your work area free of unnecessary combustible materials.
- Use proper degreasing agents. Never use gasoline or other "flammable liquids" for degreasing or cleaning.

Fire Fighting Equipment and Procedures

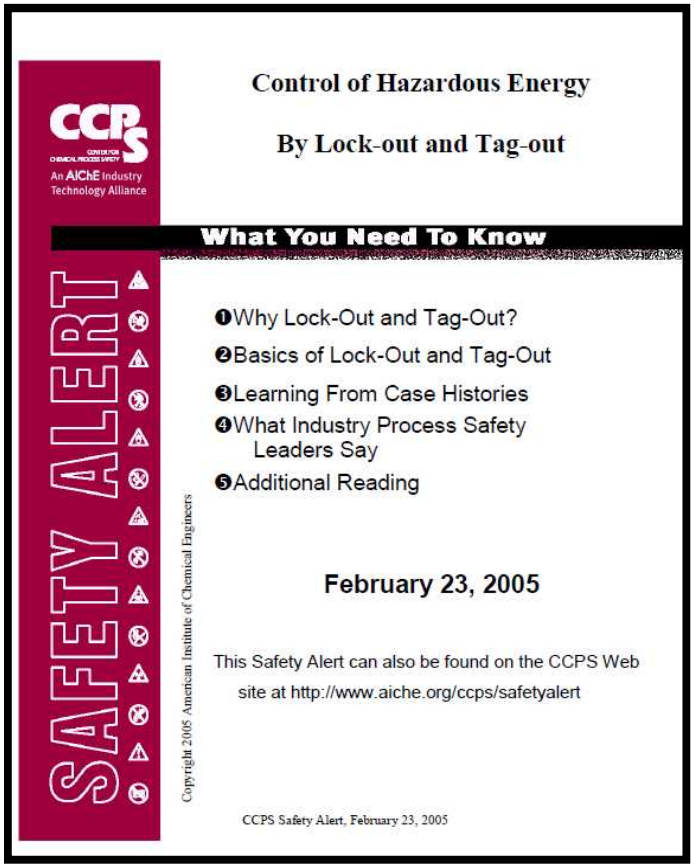
- All workers should know the location of the fire fighting equipment in their area.
- Fire extinguishers are to be checked monthly.
- Never return an empty extinguisher to its fire station. Clearly mark it “MT” with chalk and exchange it for a charged unit.
- All fire extinguishers will be inspected on an annual basis by a certified company.
- All workers must receive training before using fire extinguishing equipment.
- If Fire Watch determines fire may grow beyond control- emergency services must be contacted

Hot Work Area is Controlled by Zoning

- Hot zone- inside permit space
- Warm zone – outside occupied by attendant personnel
- Cold or support zone – equipment and supplies

- Barricades and barriers
- Shields and railings

Resources for Control of Hazardous Energy



CCPS
An AIChE Industry Technology Alliance

SAFETY ALERT

Control of Hazardous Energy

By Lock-out and Tag-out

What You Need To Know

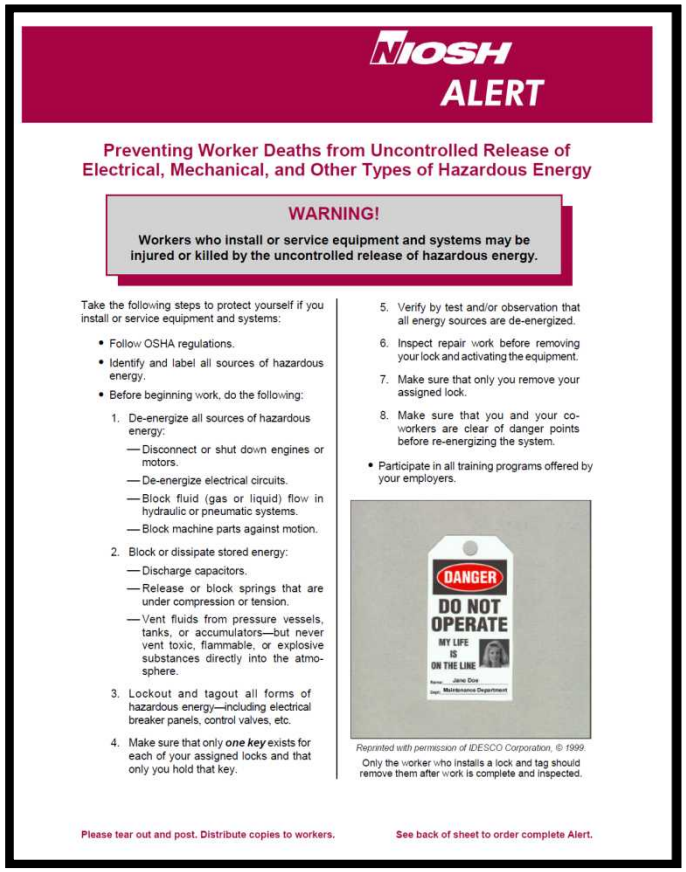
❶Why Lock-Out and Tag-Out?
❷Basics of Lock-Out and Tag-Out
❸Learning From Case Histories
❹What Industry Process Safety Leaders Say
❺Additional Reading

February 23, 2005

This Safety Alert can also be found on the CCPS Web site at http://www.aiche.org/ccps/safetyalert

CCPS Safety Alert, February 23, 2005

http://www.osha.gov/SLTC/controlhazardousenergy/index.html



NIOSH ALERT

Preventing Worker Deaths from Uncontrolled Release of Electrical, Mechanical, and Other Types of Hazardous Energy

WARNING!

Workers who install or service equipment and systems may be injured or killed by the uncontrolled release of hazardous energy.

Take the following steps to protect yourself if you install or service equipment and systems:

- Follow OSHA regulations.
- Identify and label all sources of hazardous energy.
- Before beginning work, do the following:

1. De-energize all sources of hazardous energy:
   - —Disconnect or shut down engines or motors.
   - —De-energize electrical circuits.
   - —Block fluid (gas or liquid) flow in hydraulic or pneumatic systems.
   - —Block machine parts against motion.
2. Block or dissipate stored energy:
   - —Discharge capacitors.
   - —Release or block springs that are under compression or tension.
   - —Vent fluids from pressure vessels, tanks, or accumulators—but never vent toxic, flammable, or explosive substances directly into the atmosphere.
3. Lockout and tagout all forms of hazardous energy—including electrical breaker panels, control valves, etc.
4. Make sure that only ***one key*** exists for each of your assigned locks and that only you hold that key.
5. Verify by test and/or observation that all energy sources are de-energized.
6. Inspect repair work before removing your lock and activating the equipment.
7. Make sure that only you remove your assigned lock.
8. Make sure that you and your co-workers are clear of danger points before re-energizing the system.

- Participate in all training programs offered by your employers.

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Only the worker who installs a lock and tag should remove them after work is complete and inspected.

Please tear out and post. Distribute copies to workers.

See back of sheet to order complete Alert.

http://www.cdc.gov/niosh/docs/99-110/pdfs/99-110sum.pdf