

EXCESS AIR FLOW SAFETY VALVES

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1. SCOPE

This Standard covers the use, selection and location of excess air flow safety valves, intended to shut off air flow upon failure of a hose or fitting carrying compressed air.

2. GENERAL

• Note that:

- 1) Serious personal injury can result from compressed air hoses whipping, as might be caused by rupture, accidental cutting, or being suddenly disconnected.
 - 2) Federal Regulations require that compressed air hose greater than 1/2 inch I.D., be fitted with a safety device at the source of supply or branch line to reduce pressure in the event of hose failure. This includes placement at air line take offs used with air-operated hand tools and portable hoses, but not necessarily every column air drop or outlet and excludes lines piped directly to stationary equipment.
- Reference Figure 1, below, which shows a typical valve in cross section, noting that:
- 1) During normal operation, the poppet is held in position by the retaining ring and spring pressure, as shown in "A".
 - 2) Upon rupture or other failure, the surge of air causes the poppet to close, as shown in "B".
 - 3) The poppet will remain closed so long as upstream pressure exceeds downstream pressure.
 - 4) A small amount of air bleeds through the closed valve, to equalize pressure during repairs and facilitate the valve opening automatically.

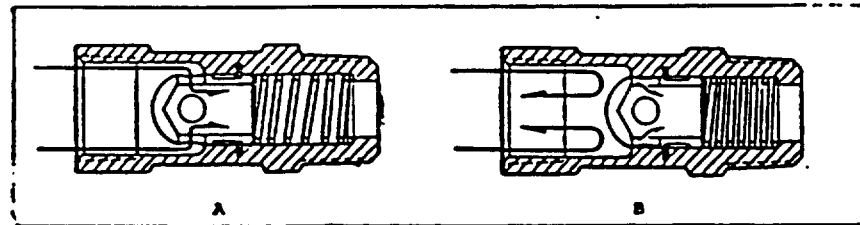


FIGURE 1

3. SELECTION

- Reference Appendix, Table 1, for a partial listing of acceptable valve manufacturers, valve sizes and ratings, noting that these are not intended as recommendations.
- Note that:
- 1) Flow rates in an air hose depend on compressor output (volume and pressure), line and hose diameter and length, pressure drop through the fittings and capacity of the pneumatic power tool.
 - 2) Shut-off flow rates for valves vary with manufacturer.

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- o Proper valve functioning depends on selecting a valve with a shut-off flow rate somewhat higher than the normal flow rate for the system.
- o Check flow rate using a flow meter or using the following procedure:
 - 1) Install an excess air flow safety valve based on estimated required flow, and
 - 2) Install the highest capacity air tool to be used on the line.
 - 3) Turn on the air supply and assure that the tool works properly. If not, install an excess flow rate valve with a higher shut-off flow rate.
 - 4) Substitute a high capacity shut-off valve for the air tool.
 - 5) Grasp the closed shut-off valve and open it fully. The safety valve must close. If not, an excess flow rate valve with a lower closing flow rate must be used.

NOTE: Installation of a safety flow valve without verification of its suitability for the system may not comply with the intent of OSHA regulations.

4. LOCATION

- o Locate safety valves as shown in Figure 2, below, noting that in the middle figure:
 - 1) A valve is required at the upstream end of each branch, as well as at the source.
 - 2) A valve at only the line source may not be sensitive enough to halt flow if a rupture occurs in a smaller branch, since it must have capacity to feed both branches.
 - 3) A valve is required at the source of a line feeding the branches, to prevent whipping should a rupture occur upstream from the "Y".

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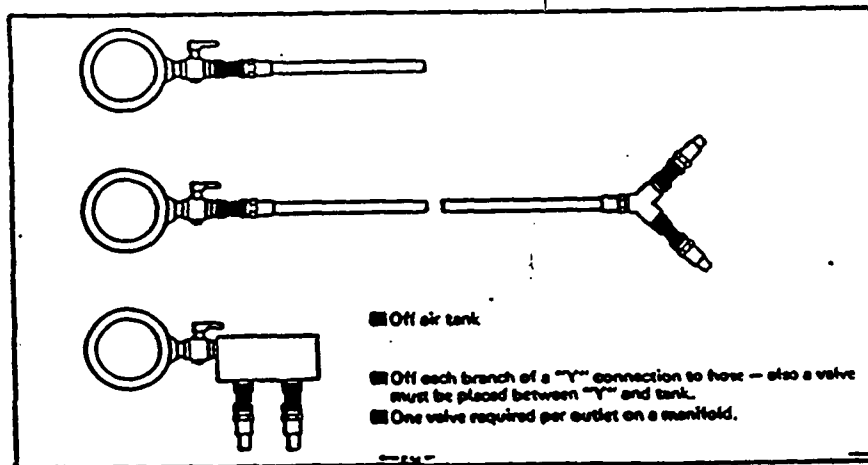


Figure 2. Location of valves in typical air lines.

5. REFERENCES

- o 29 Code of Federal Regulations, Part 1926, Section 1926.302, Paragraph 7 - "Power- Operated Hand Tools".



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6. APPENDIX

TABLE 1

EXCESS AIR FLOW SAFETY VALVES¹

Manufacturer	Valve Size (NPT)	Approximate Shut-Off Flow at 100 psig Inlet Pressure ² SCFM
Hansen 4050 W. 150 St. Cleveland, Ohio 44135	1/4	20
	3/8	50
	1/2	80
	3/4	130
	1	210
	1-1/2	450
	2	850
Le-Hi Valve and Coupling Parker-Hannifin 30240 Lakeland Wickliffe, Ohio 44092	3/4	130
	1	210
Perfecting Service Div. G. W. Murphy Industries P. O. Box 1949 Charlotte, N. C. 28201	1/4	26
	3/8	58
	1/2	92
	3/4	180
	1	300
	1-1/4	470
	1-1/2	710
	2	1050
	3	2700
Rego 4201 W. Peterson Ave. Chicago, Ill. 60646	3/8	51
	1/2	85
	3/4	130
		200
		350
	1	300
		400
		600
	1-1/2	272
		420
		693
Snap-tite Union City, Pa. 16438	2	453
		721
		1268
	3	906
		1690
		3171
	4	3150
	1/2	up to 70 ³
Thomas C. Wilson, Inc. 21-11 44th Avenue Long Island City, N.Y. 11101	3/4	up to 100
	1	up to 150
	1-1/2	up to 300
	2	up to 700
	1/4	15
	3/8	42
	1/2	68
		84
	3/4	120
		140
		190
	1	260
	1-1/4	470
	1-1/2	680
	2	840

¹ This is a partial list. These manufacturers are not recommended over others not listed.

² For shut-off flow rates at other inlet pressures, P.

$$\text{Shut-Off Flow} = (\text{SCFM at 100 psig}) \sqrt{\frac{P + 14.7}{104.7}}$$

³ P 85 to 130 psi working pressure.

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1. SCOPE

Use this Standard as the resource for the fundamentals to be employed in the development and application of a location confined space program. These procedures and practices shall be applied to protect Alcoa and Contractor's employees from the potential hazards that may be encountered in entering and working in confined spaces. Confined spaces may be described as, but not limited to, the following:

- o Large enough to permit an employee to enter and perform work,
- o Has limited or restricted means for entry or exit,
- o Is not equipped for routine employee occupancy, and may contain one or more of these characteristics:
 - Has potential to or contains a hazardous atmosphere,
 - Contains material with the potential to engulf the employee,
 - Is configured internally in a way that an employee may become trapped, disoriented, or asphyxiated by changing wall configurations or smaller cross sections,
 - Contains other established safety or health hazard(s) such as radioactive gauges, etc.

2. DEFINITIONS

Acceptable Environmental Conditions

Confined space workplace conditions with all uncontrolled hazardous atmospheres removed or controlled, and additional environmental criteria in place as required by the location's permit system for entry.

Observer

An employee stationed outside the confined space, trained as required by this Standard, assigned to monitor the employees inside this space, and other spaces within the limits as authorized by the location.

Entrant

An employee authorized to enter a confined space may serve as an observer if this is approved by the permit. May be a fully trained employee with authority to approve entry by others, and may enter the space covered by the permit provided the observer is informed.

Blanking or Blinding

The effective closure of a pipe, line, or duct by fastening a solid plate which covers the inside diameter, extends at least to the other edge of gasket on the flange to which it is fastened, and is capable of withstanding the maximum upstream pressure.

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Double Block and Bleed

The closure of a pipe, line, or duct by locking and/or tagging a drain or vent which is open to the atmosphere in the line between two locked-closed valves.

Emergency

Any occurrence or event(s) internal or external to the confined space that could endanger the entrants.

Engulfment

Surrounding and effective capture of an employee by a liquid or finely divided solid substance.

Entry

The act by which an employee intentionally passes through an opening into a confined space. Includes ensuing work activities in the space.

Entry Permit

Written or printed document, established by the location, containing the location's hazard identification and evaluation for that confined space. It may cover a class or family of confined spaces if they contain similar hazards, and is the method by which the location authorizes its employees to enter the permit confined space. It defines the conditions under which the permit confined space may be entered, states the reason(s) for entering the space, the anticipated hazards of the entry, identifies the individual authorizing the entry, lists the eligible entrants, observer's department, the personnel who may be in charge of the entry, and establishes the length of time for which the permit may remain valid, not to exceed one year.

Entry Permit System

The location's written procedures for preparing and issuing permits for entry and returning the permit space to service. Designates by name or job title, and the department who authorizes the entry.

Hazardous Atmosphere

Atmosphere which exposes an employee to a risk of death, incapacitation, injury, or acute illness.

Hot Work Permit

Location written authorization to perform operations which could provide a source of ignition such as riveting, welding, cutting, burning, heating, or grinding.

Immediately Dangerous to Life or Health(IDLH)

Any condition which poses an immediate threat or loss of life, may result in irreversible or immediate health effects, may result in eye damage, irritation, or other conditions which could impair escape from the permit space.

Immediate Severe Health Effects

Any acute clinical sign(s) of a serious, exposure related reaction - developing within 72 hours after exposure.

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- o Provide properly maintained equipment for safe entry and working conditions. This includes the monitoring and testing, as well as personal protective and communications equipment.
- o Provide complete training for all personnel in the proper application, use, and inspection of the equipment.
- o Conduct the necessary follow-up and inspection to insure that the application and use of all equipment is correctly applied.

The employee(s) is responsible for:

- o Evaluation of their work area for potential confined space entry situations as an integral part of their job before beginning work of any kind.
- o Consideration of potential hazards that may develop in the confined space associated with the task, and those associated with the entry into the space.
- o Consideration of the hazards surrounding the outside of the space that may affect the overall safety of the space, for example, activities or equipment overhead, fumes adjacent to the space, etc.
- o Using a questioning attitude and anticipating the unexpected during the evaluation phase of the job.
- o Discussing any potential hazards with the supervisor before action is underway.
- o Immediately evacuating the space at the first indication that something is wrong.
- o Avoiding the entrance to any confined space without following the procedures as defined by the location confined space entry program.

4. WRITTEN CONFINED SPACE ENTRY PROGRAM

As a general rule, these fundamentals shall apply to location programs:

- o Establish a written confined space entry program for the proper preparation, issuance, and implementation of confined space entry permits at the location containing the following:
 - An inventory of confined spaces by proprietor, department, area, etc.
 - Identification of the hazards by classifications of the individual confined spaces.
 - A written permit system for authorization of entry into a confined space.
 - Training for users, outside observers, and others.
 - Equipment for safe entry, monitoring and testing.
 - Rescue procedures and equipment needed to implement an effective response to any emergency.

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<u>Inverting</u>	Rendering the atmosphere of a permit space non-flammable, non-explosive, or otherwise chemically non-reactive by displacing or diluting the original atmosphere with steam or a gas that is non-reactive to that space.
<u>Isolation</u>	The separation of a permit space from unwanted forms of energy by tagout/lockout, double block and bleed, blanking or blinding, or the removal of spool pieces to disconnect for piping disconnects.
<u>Line Breaking</u>	The intentional opening of a pipe, line or duct that has the potential to deliver materials, gases, or fluids that are capable of causing injury.
<u>Low-Hazard Permit Space</u>	A permit space with an extremely low likelihood that an IDLH or engulfment hazard could be present, and where all serious hazards have been controlled.
<u>Non-Permitted Condition</u>	Any condition or set of conditions whose hazard potential exceeds the limits stated in the entry permit.
<u>Oxygen Deficient Atmosphere</u>	An atmosphere containing less than 19.5 percent oxygen by volume.
<u>Oxygen Enriched Atmosphere</u>	An atmosphere containing more than 22 percent oxygen by volume.
<u>Retrieval Line</u>	A line or rope secured at one end to the worker by a chest-waist or full-body harness, or wristlets with the other end secured to either a lifting (or other retrieval) device or to an anchor point located outside the entry portal.

3. RESPONSIBILITY

The supervisor(s) of the employees involved shall be responsible for:

- o Evaluating those areas of his/her proprietorship that could be expected to result in a confined space entry as defined above. The areas may include bins, hoppers, tanks, pits, process vessels, furnaces, machinery, railcars, ships, barges, trucks, and transportation equipment in general.
- o Develop a written program that identifies the means, procedures, and practices for entering the confined space safely.
- o Conduct training for personnel immediately supervised as well as any others who may support the effort on the proper practices, procedures, and equipment to be utilized.

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7. WORK PRACTICES - TESTING

- o Maintain and use the proper sampling equipment as indicated by the confined space entry procedures.
- o Document the inspection and calibration of this sampling equipment along with maintenance as specified by the manufacturer.
- o Train and certify those personnel who are selected to conduct tests on the confined space for the presence of hazardous atmospheres.

8. WORK PRACTICES - CLEANING

- o Identify the contents, and empty or drain or clear the confined space as completely as possible.
- o Use hot or cold water flush, steam, chemical neutralization, or purging.
- o Apply steam only above the liquid level in tanks and vessels and allow the confined space to cool properly for safe personnel access.
- o Bond low pressure steam lines to the space or enclosure to prevent auto-ignition and elimination of static spark potential. Prevent the use of free falling water unless the nozzles or hoses are bonded to the confined space.

9. WORK PRACTICES - VENTILATING AND PURGING

- o Purge gases lighter than air from the confined space by introducing an inert gas at the bottom of the space and discharging at the top.
- o Purge gases heavier than air from the confined space by introducing an inert gas at the top of the space and discharging at the bottom.
- o Conduct sampling of the atmosphere during the purge process. When this atmosphere reaches a point of stabilization, hold at this point for a period of time to ensure that a non-hazardous environment is maintained.
- o Introduce air with non-hazardous oxygen levels to displace any inert purge gas. Test for adequate oxygen (19.5% - 20.8%) before permitting entry.

10. WORK PRACTICES - OTHER PRECAUTIONS

- o Remove all burning and welding equipment from the confined space when not in use.
- o Store compressed gas cylinders outside the confined space. The only exception are cylinders used with self-contained breathing apparatus.

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- Protection from internally generated confined space hazards like welding, grinding, spray painting, and the use of any portable equipment.
- Information containing confined space hazard procedures and requirements associated with location equipment and facilities for use by Contractors.

5. WORK PRACTICES - ADMINISTRATIVE CONTROLS

As a general rule, apply these fundamentals to the administrative areas of each project:

- o Develop written procedures for permanent confined spaces or groups of confined isolation points, hazards, etc. Include specific items like tagout/lockout, and blinding that are fitted to the space; also general hazards, special safety precautions, and the equipment to be employed. (See Attachment 1).
- o Include schematic diagrams and/or checklists which indicate the specific valves, motors, piping disconnects, etc., which are part of the required sequence to be followed for each entry procedure. (See Attachments 2 and 3).
- o Attach the diagram and/or checklist to the copy of the entry permit posted at the confined space. Have copies available for personnel on all shifts, and retain a centralized copy with the central confined space program file.

6. WORK PRACTICES - ISOLATION

- o Use isolation procedures that are developed in accordance with location tagout/lockout procedures and Standard 18.3.
- o Assure that all radioactive gauges inside or in the proximity of the confined space are effectively isolated by closing, locking, and tagging the shutter. Verify this by using the appropriate Geiger-Mueller Counter.
- o Disconnect, bind, or drop feed and discharge lines to the confined space in such a way as to protect occupants of the space and personnel outside the space.
- o Attach personal danger tags to blinds used to achieve isolation.
- o Follow "Double Block and Bleed" or other location specific isolation procedures when alternate methods must be substituted for blinding. Obtain approval of location Engineering and Safety and Industrial Hygiene staff for this method.
- o Design blinds for the materials and pressures as required. Provide complete coverage for the flange and opening to eliminate the possibility of leakage.

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- o Follow the requirements of Standard 18.2 for properly securing ladders and scaffolds used inside confined spaces.
- o Follow Standard 33.053 and suppliers material safety data sheets for all painting required inside confined spaces.

11. OUTSIDE OBSERVER

Use an outside observer for personnel inside the confined space when:

- o Potential exposure is hazardous to life.
- o Rescue may be difficult.
- o The hazard warrants according to location assessment.

Use a retrieval line and body harness to provide safe emergency removal of the entrant by the outside observer when the size, shape, and location of the confined space specifies the use of this equipment in the permit.

Train outside observers for the duties as required by the permit as follows:

- o Maintain contact with entrants at all times.
- o Monitor conditions inside and outside the permit space to identify potential hazards and recall the entrant from the confined space when appropriate.
- o Order entrants to evacuate the permit space immediately when:
 - Conditions develop that are prohibited by the permit.
 - Detection of behavioral effects of the hazard develop.
 - Situations outside the space develop that could endanger the entrants.
 - An uncontrolled condition begins to develop within the confined space.
 - An observer is monitoring more than one space and must focus efforts on the rescue of entrants from another space.
- o Entry to or leaving the confined space entrance is not permitted until properly relieved.
- o Use a radio, alarm, whistle, or some appropriate means of communication to summon assistance in case of emergency.
- o Attempt to remove the entrant only by the use of a retrieval line.
- o Where additional adequate outside assistance is present, enter with all protective equipment and retrieval line as required by the permit.

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- o Turn off all cylinders stored outside the space immediately after use.
- o Use personal protective equipment specifically designed for the potential hazards normally encountered in a "worst case situation" as they apply to a given confined space.
- o Use respiratory protection according to Standard 18.1.1 with the assistance of the location industrial hygienist as required.
- o Use of canister type masks which operate on chemical absorption or mechanical filtration is not permitted where the potential for oxygen levels below 19.5 percent are possible.
- o Use supplied air respirators with emergency escape bottle or SCBA when there is a likely condition such as:
 - Reduced oxygen level below 19.5% or
 - Release of toxic contaminants from chemical sludge or deposits within the confined space or
 - Likelihood of toxic chemical concentrations exceeding the limits where other types of respiratory protection are permitted (See Standard 18.1.1, Table 1).

Last minute substitutions to facilitate the schedule without protection from the worst hazards shall be prohibited.

- o Secure confined spaces with rotational capability such as kilns and ball mills before entry.
- o Secure personnel lifelines to the proper structure as specified in Standard 18.2.
- o Use double insulated, GFCI protection, and low current - low voltage (24V max.) electrical systems when working in damp or metallic confined spaces.
- o Follow all grounding and isolation techniques before beginning electrical welding in the confined space.
- o Select electric and pneumatic tools according to the National Electric Code Classes I, II, or III as required by the conditions in the confined space.
- o Thoroughly clean all portable power tools and inspect for defects that may affect safe operation, and follow prescribed grounding techniques before use in any confined space.
- o Clean and inspect hand tools selected for use before entry. Use spark resistant tools as required.
- o Empty finely divided solids with engulfment potential from storage tanks or protect the entrant(s) with proper lifelines before entry is permitted.

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- o Provide additional rescue equipment outside the space and adequate fire fighting equipment appropriate for the potential hazards expected.
- o Limit the number of entrants in the confined space to an absolute minimum at all times.
- o Suspend activities, and recall entrants from the confined space when new or different hazards are detected. New procedures, equipment, and further training shall be developed and provided by the supervisor(s) before continuing.

12. RESCUE

Location choices for the use of an in-plant rescue team shall include:

- o Train all team members in the proper use of personal protective and rescue equipment that is required by the location's entire permit confined space program.
- o Train all team members in the proper rescue functions and the requirements for authorized entrants to the confined spaces.
- o Conduct simulated rescues at least every twelve months. Use a variety of dummies, mannequins, or personnel and openings and spaces to closely approximate the conditions under which the rescues at that location may be required.
- o Ensure that each rescue team has one member that maintains the current certification in first-aid and cardiopulmonary resuscitation (CPR) skills.

or.....

Choose an outside-the-plant rescue service that is completely qualified and trained to meet all hazards and has complete familiarity with the location confined space program.

13. REFERENCES

- Proposed OSHA Standard 1910.146, 1989 June 5.
- National Safety Council Accident Prevention Manual, Ninth Edition.
- Proposed OSHA Standard 1910.269, 1989 January 31.
- Standard 18.2 Fall Prevention.
- Standard 18.3 Tagout and Lockout Procedures.
- Standard 33.053 Safety in Painting.

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WORK PERMIT

REQUIRED FOR:

1. Welding or cutting in any location other than shops or auxiliary shops.
2. Hot work in hazardous and semi-hazardous areas.
3. Entering or working in confined spaces.

Date	From A.M. P.M.	To A.M. P.M.	Type of Work
Issued for work on/in			
Workman Assigned to Job		Department Assigned Job	
Outside Observer Assigned to Job		Authorizing Supervisor	

CHECK () ONLY IF ANSWER IS YES

1.	Is welding and cutting necessary?			
2.	Are lines carrying material to or from equipment blinded or removed?			
	Flammable	Corrosive	Steam	Toxic
3.	Are shut off valves tagged or locked in off position?			
	Flammable	Corrosive	Steam	Toxic
4.	Equipment Preparation			
	Steamed	Washed	Purged	
5.	Are sources of power for agitators and pumps locked in off position?			
	Electrical Switches		Belt Removed	
6.	Protective equipment needed			
	Respiratory Protection	Goggles	Air Mover	
	Hard Hat	Fire Protection	Clothing	
	Safety Belt	Safety Shoes		
7.	Will an Operating Representative be present?			
8.	Has the equipment been checked for residuals?			
9.	Have hazards of nearby areas been considered?			
	Other Floor Levels	Welding Machinery Properly Grounded		
	Severs	Other Machinery		

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VESSEL ENTRY PROCEDURE

Vessel: R-35L TANK
Date Approved: 1983SEPT09
Department: CLARIFICATION
Location: R-35L
Industrial Hygiene Test Required: Yes No X
Classification: Class C

Procedures

1. Empty tank. Look in top manhole to determine that it is completely empty.
2. Blind sump line.
3. Blind all thickener underflow lines to tank.
4. Blind second stage overflow line and causticizer discharge to tank.
5. Blind discharge line to pump suction header.
6. Roll off solid blind on bottom of cone.
7. Fill out and set entry permit at base of ladder leading to top of tank.
8. Each man to enter the tank is to affix his personal white tag to entry permit.

Superintendent John Ramon
Safety Manager J. R. Ramey

468346 1067

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ENTERING AND WORKING IN CONFINED SPACES

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VESSEL ENTRY PROCEDURE

Vessel: R-53 A AND B STORAGE TANKS
Date Approved: 1987 NOVEMBER
Department: RAW MATERIALS & MARINE
Location: R-53
Industrial Hygiene Test Required: Yes ___ No X
Classification: Class E

Procedures

Before entering these tanks the following must be observed:

1. Clearance must be obtained from the department supervisor in charge.
2. The unit supervisor in charge must open the switches, tag and lock out Conveyors #35, 36, 37, and 38 before entering the tank.
3. The supervisor in charge should check the level inside the storage tank before having the bottom entry door removed by Maintenance.
4. The supervisor should fill out Space Entry Permit Form #PC-1390-76 and place for display at entry of tank.
5. An outside observer must be present and in position to observe work inside the vessel at all times. The observer may assist the people inside as long as the observer does not enter the tank or leave the observation station.
6. A procedure must be established for the observer to signal or communicate with other employees for assistance in case of an emergency. Employees should be equipped with walkie-talkies.
7. All personnel entering tank must attach their white personal danger tag to the entry permit.
8. The supervisor in charge may use the group tag procedure.
9. All current tagging procedures are to be followed before entry.
10. If a dusty condition exists inside the storage tank, respiratory protection should be worn.
11. Do not attempt to walk on material if it is more than three (3) feet deep (danger of sinking).
12. A rescue harness, wrist straps, or other appropriate means of removing a disabled person must be adjacent to the point of entry.

08/11/20

Superintendent

Thomas E. Ryan

Safety & Ind. Hygiene Mgr.

J. L. Anderson

468346 1068

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1. SCOPE.

Falls in the construction and manufacturing environments can occur in a large variety of work situations. This standard establishes fall prevention/protection guidelines for Alcoa employees and outside contractors exposed to heights of eight (8) feet or more and at lower heights where especially hazardous circumstances such as over open vessels, machinery, or moving equipment; over water, in ship holds; or over objects which may impose impalement hazards exist. Lifelines and harness systems used solely for rescue operations in confined spaces, etc., are not covered by this standard.

The standard also covers access to portable and fixed ladders, cranes, girders, mobile equipment such as rail cars, roofs, tanks, pits, etc. Portions of this standard have been taken from the National Safety Council's Accident Prevention Manual, and Introduction to Fall Protection (J. Nigel Ellis, 1988), OSHA 29CFR 1910.66 Appendix C, and proposed OSHA 29CFR 1910.128 - .131.

2. DEFINITIONS.

Access Movement by physical or mechanical means to reach a workstation.

Aerial Lifts Mechanical devices such as manlifts, manbaskets, scissor lifts and bucket trucks used for access to heights. The term "skipbox" is reserved for materials use only on construction sites.

Anchorage A secure point of attachment for lifelines, lanyards, or deceleration devices.

Body Belt A strap that a worker can secure around his waist and to which he can attach a lanyard or device for fall arrest.

Deceleration Distance the vertical distance between the belt or harness attachment point at the activation of the fall arrest equipment and that attachment point once the individual comes to a complete stop.

D-Ring An attachment point(s) on the belt or harness for a device or lanyard. (Sometimes erroneously named for a carabiner snap hook).

Fall Arrest or Fall Protection System A lanyard or device along with other necessary components that are designed and tested to function together in preventing a fall from occurring or to minimize the potential for compounding injury.

Free Fall Distance The vertical distance between the belt or harness attachment point (at the time of an unrestrained fall) and any obstruction or grade level... or the activation of fall arrest equipment.

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Replaces 18.2
Safety Belt Tie-Off

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Full Body Harness The design of single or multiple straps that can be secured around the body to which a lanyard or device can be attached. The design distributes the arresting forces over the buttocks, thighs, chest, and shoulders.

Gate Snap hook closure which swings closed to secure.

Hardware Snap hooks, D-rings, buckles, carabiners, adjuster, and O-rings, that are used to attach the components of a fall protection system together.

Horizontal Lifeline A rail, rope, wire, or synthetic cable that is installed in a horizontal plane and used for attachment of a worker's lanyard or lifeline device while moving horizontally. Used to control dangerous pendulum-like swing falls.

Independent Anchorage A point of attachment that is not part of the working or walking surface or equipment rigging points.

Independent Lifeline A lifeline that is not attached to the work surface..one lifeline per person.

Lanyard A flexible line of webbing, rope, or cable that may be 2, 4, or 6 feet long, and used to secure a body belt or full body harness to a lifeline or an anchorage point.

Lifeline A vertical line from a fixed anchorage or between two horizontal anchorages, independent of walking or working surfaces, to which a lanyard or device is secured. Part of a fall protection system used as back-up safety for an elevated worker.

Locking Snap Hooks A connecting snap hook that requires two separate forces to open the gate; one to deactivate the gate keeper, and a second to depress and open the gate which automatically closes when released. Used to minimize roll-out or accidental disengagement.

Retracting Lifeline A fall arrestor whose integral line extends as a worker moves downward and automatically removes slack as the worker moves up towards the unit...Can have a centrifugal locking mechanism or alternatively centrifugal braking mechanism for controlled descent.

Roll Out Unintentional disengagement of a snap hook caused by the gate being depressed under torque or contact with single-action snap hooks that do not have a locking gate keeper.

Rope May be wire rope or synthetic rope used for lifelines.

Rope Grab A fall arrestor that is designed to move up and down a lifeline suspended from a fixed overhead anchorage point to which the belt or harness is attached. In the event of a fall, the rope grab locks onto the compatible rope through compression to arrest the fall.

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Safety Belt A generic term usually used for means of body support.

Shock Absorber A component of a fall protection system that dissipates energy by creating or extending the deceleration distance.

Shock Absorbing Lanyard A flexible line of webbing, cable, or rope used to secure a body belt or harness to a lifeline or anchorage point that has an integral shock absorber.

Single-action Snap hook A connecting snap hook that requires a single force to open the gate which automatically closes when released.

Snap Hook A self-closing connecting device with a gatekeeper latch or similar arrangement that will remain closed until manually released. This includes single action snap hooks that open when the gatekeeper is depressed and double action snap hooks that require a second action on a gate keeper before the gate can be opened.

Suspended Scaffold A single point or multiple point work platform used for powered or un-powered access up and/or down the side of a structure.

Synthetic Fibers A manufactured fiber such as nylon, polyester, or polypropylene.

Tie-off The act of a worker securing the end of a lanyard to an anchorage point. the terms tied off, and tying off, are related to tie-off. An anchorage point is sometimes referred to as a tie-off point.

3. RESPONSIBILITIES.

The supervisor(s) of the employees involved shall be responsible for:

- o Evaluating the need for personal fall prevention/protection equipment and systems as an integral part of pre-planning the job.
- o Supplying and maintaining the proper equipment for the job.
- o Thoroughly training the personnel in the proper application, use, and inspection of the equipment and systems.
- o Conducting the necessary follow-up and oversight to insure that the application and use is correctly applied to the situation.
- o Selecting either or both options below as a result of their evaluation of the potential hazards to personnel.

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Option 1....Fall Prevention.

Eliminate the fall hazard during all phases of the job. This includes traveling to and from elevated work areas as well as during the tasks. Temporary barricades and signs may be used to deny personnel access. The proper application of scaffolding or platforms with 42 inch minimum height guardrail and handrail systems, manlifts, secured ladders, etc., may also be used to reduce the risk of falls.

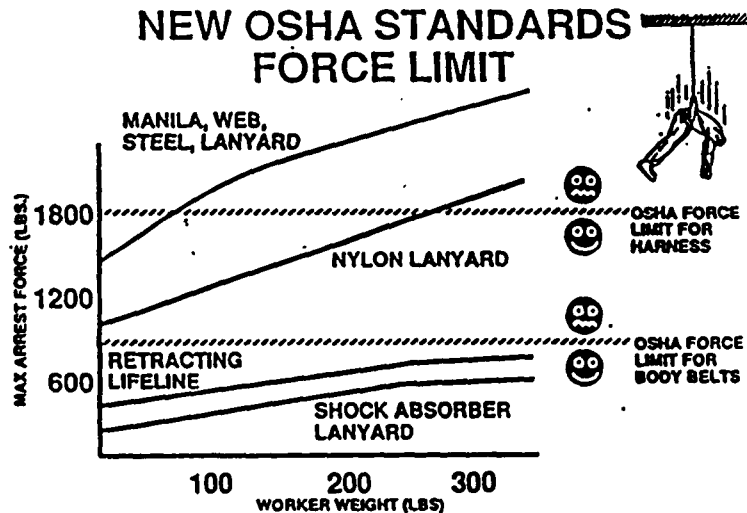
Option 2....Fall Protection System.

Select and install a fall protection system that eliminates the fall hazard during the performance of the task as well as travelling to and from the elevated work area. Personnel fall protection systems shall meet OSHA 1910.66 and 1910.129 criteria when stopping a fall:

- Limit maximum arresting force on an employee to 900 pounds (4kN) when used with a body belt; (reference Figure 1)
- Limit maximum arresting force on an employee to 1,800 pounds (8kN) when used with a body harness; (reference Figure 1)
- Bring an employee to a complete stop and limit maximum deceleration distance an employee travels to 3.5 feet (1.07m); and
- Shall have sufficient strength to withstand twice the potential impact energy of an employee free falling a distance of six feet (1.8m), or the free fall distance permitted by the system, whichever is less.

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CONCLUSION: SHOCK ABSORBING LIFELINES & LANYARDS MUST BE USED

FIGURE 1



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The employee is responsible for:

- o Evaluation of the need for fall prevention/protection as an integral part of their job before beginning work of any kind.
- o Consideration of hazards during the task as well as travelling to and from the elevated work area.
- o Considering the use of temporary scaffolding, handrails, aerial lifts, etc..
- o Using a questioning attitude and anticipating the unexpected during the evaluation phase.
- o Discussing any potential hazards that may develop during the job with the supervisor before continuing.

Work commences when the supervisor and the employee(s) are agreed that the job can begin and be completed safely.

4. WORK PRACTICES.

As a general rule, these fundamentals shall apply to all jobs as required.

- o Provide fixed platforms, ladders, and stairways 4 feet or more in height with the appropriate guardrails, handrails, midrails, toe boards, etc., according to Standard 33.013.
- o Use the parameters contained in Standard 33.013 for the design and arrangement of fixed ladders, platforms, and stairways.
- o Employees working on suspended staging or scaffolding either inside or outside of a building shall use a lifeline (with 5000# load capacity per person) that is independent of the other lines connected to the scaffold.
- o Employees working on tubular or other scaffolds shall utilize a fall protection system unless it meets the handrail and guardrail requirements of Standard 33.013.
- o Use personnel safety nets where appropriate. Install nets as close to the work as possible, not lower than 25 feet, and extend at least 8 feet outward from the structure. Use manufacturer's installation requirements and instructions.
- o Use a fall protection system if there are no fall prevention measures (temporary scaffold, aerial lift, etc.) when working on top of elevated equipment that exposes employees to hazardous situations as defined by the scope of this standard.

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- o Use fall protection systems where fall prevention equipment is not available or applicable when working on crane rail girders. See Figure 1.
- o Connect the fall protection system's lanyard in such a manner as to limit the potential free fall to less than 3 feet where practical, and no more than 6 feet in any case.
- o Wear safety belt securely fastened and tight enough to prevent slipping out of it. Fit should be snug between the chest and pelvic crest. The "D" ring should be positioned in the center of the back. This is especially true with tongue and buckle belts.
- o Punching extra holes to extend the use of the belt is prohibited.
- o Use a body harness instead of a body belt where the potential for a "severe free" fall exists, or where the harness would provide additional assistance for a difficult rescue. The harness lanyard positioning for a body harness should be at the shoulder level as a minimum attachment point.
- o Select anchorage points for fall protection systems carefully. Anchorage points to which personal fall protection equipment is attached shall be capable of supporting 5000 pounds (static load to failure) per person. In the case of descent devices, they shall at least equal the strength of the line. Anchorage points for engineered fall protection systems shall maintain a safety factor of at least two (2) times the manufacturers fall arrest peak dynamic load test data. Generally, fall protection anchorage points which are permanent should be designed by a competent engineer.
- o Equip portable extension ladders with shoes. Tie-off lines at the top of the ladder shall be used to anchor the ladder to an adequate support structure. Maintain lines in good condition. In busy work areas, protection at the bottom of the ladder may be required with someone holding it in place.
- o Use both hands while climbing. Sliding over the rails is preferred to grasping the rungs.
- o Use a fall protection system (provided a fall prevention system is not in place) secured to an appropriate anchor when both hands are required for the task, or the employee is working from planks supported on ladder jacks.
- o Use a fall protection system (provided a fall prevention system is not in place) when employees are working over concrete reinforcing bars, process tanks, vertical pipe, or conduit which constitutes a hazardous area.
- o Use a fall protection system or a fall prevention system in accordance with applicable sections of OSHA 1926.500 and the National Roofing Contractors Association publication "Passport to Safety" for employees assigned to roof work.

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- o Work from aerial lifts as covered by OSHA 1926.556 shall require the use of a body belt and lanyard attached to the boom or basket. Personnel shall not anchor to an adjacent pole, structure, or equipment when working from an aerial lift.

5. EQUIPMENT SELECTION.

Select and purchase fall protection systems and components that meet the capacity and performance requirements of this standard and the appropriate national standards for the task in question.

Snap Hooks Use locking snap hooks that require two separate forces to open the gate for disengagement. The use of single action snaps is not recommended.

Safety Belts Body Belts Material choices are cotton or nylon webbing in herringbone or basket weave construction. Avoid leather construction. The belt widths that normally bear on the employees body may range from 1 3/4 to 4 inches. Wider widths usually add support and comfort to the mid-section before and after a fall arrest. However, the benefits of the wider width are believed to be relatively small. Local choices for the task and employee preference should be made within the range of materials and capacity requirements to meet the current national standards.

Full Body Harness These are available from several nationally recognized suppliers. The advantage of a full body harness is the ability to distribute arresting forces over the seat as opposed to the soft, vulnerable mid-section of the body. The absence of a waist belt can help achieve unrestricted breathing.

Lanyards Select from a variety of materials such as spun nylon, filament nylon, polyethylene, and polypropylene. The use of steel cable is not permitted. Position the lanyard to limit the free fall to 3 feet (.9m), and not more than 6 feet (1.8m) with a shock absorber or full body harness. Shock absorbing lanyards reduce arresting forces, offer tell-tale indications that shock loading has occurred, are best choices with steel lifelines; all require replacement after being shock loaded and stressed. Final positioning and use of lanyards shall include the proximity of beams, rotating equipment, welding operations, electrical lines, and any obstruction which could add injury to the employee during a free fall. Careful consideration of all factors shall be thoroughly evaluated in the final selections among these choices.

Lifelines The material choices include nylon, polyester, polypropylene, other materials, or steel cable. Material choices should take into account the materials ability to resist rot, mildew, wet strength, and deterioration from sunlight and chemical exposure. For example, nylon may quickly deteriorate from exposure to strong mineral acids. Check with the supplier for details regarding material performance. Capacity shall be provided to support a 5000 pound (2220 kg) dead-weight load per person applied to the center of the lifeline between two fixed anchorages. Rope diameters selected for use with a rope grab type fall protection system must meet the

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grab manufacturers specifications. Steel lifelines are best suited for heat or spark protection, or at heights where lifeline elongation is limited. Steel lifelines are available with plastic coating for resistance to oxidation and certain chemicals. Steel cables should be preformed, and the use of either stainless steel or galvanized wire rope can be considered for corrosion resistance. Self-retracting lifelines which automatically limit free fall distances to two (2) feet or less shall have components capable of withstanding a minimum tensile load of 3000 pound (13.2kN) applied to the device with the lifeline in the fully extended position.

Personnel Safety Net Shall be manufactured and tested in accordance with ANSI A10.11, OSHA 1926.105, and OSHA 1910.128. Mesh openings are limited to 6 by 6 inches. Each net shall bear a label indicating the manufacturer's name, date of manufacture, and test data.

6. INSPECTION AND TESTING.

Safety belts, harnesses, lanyards, and similar fall protection devices shall bear permanent identification marks of the supplier, date of manufacture, and the identification of the Standard to which it was constructed. This information shall be indelible for the life of the equipment. The supplier shall certify that the presence of that standard number indicates that the minimum requirements have been met.

Belt, harness, and lanyard assemblies shall be inspected before each use, and receive a documented inspection at least twice per year while flexing the components as follows:

- o Visually examine for cuts, cracks, tears, enlarged eye holes, and other signs of wear that might effect strength.
- o Visually examine stitching for breaks, ragged strands, loose or rotted threads.
- o Visually examine metal hardware for breaks, cracks, fractures, loose anchorage, and corrosion.
- o Other requirements as specified by the manufacturer.

Cleaning shall be done according to the manufacturer's instructions where appropriate. Testing of fall protection equipment in service is not permitted. In the case of tests performed on an a sample belt, harness, or lanyard, they shall be destroyed to prevent any use. Belts, harnesses, or lanyards that are inspected and rejected for further use should also be destroyed to prevent further use and suitable disposition made of the inspection record.

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7. TRAINING

Many belt, harness, and fall protection equipment manufacturers have literature and video training programs on how to properly inspect and care for their products. It is recommended that each location work with their equipment manufacturers to develop specific programs based on their needs and suppliers recommendations.

Training shall be conducted in accordance with the applicable OSHA or MSHA regulations as a minimum.

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Engineering Standard



TAGOUT AND LOCKOUT PROCEDURES

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1. PURPOSE

Use this standard to develop the fundamental concepts to protect all employees from injury. A theoretical boundary line of protection exists for each machine, piece of equipment, or process that separates safety from hazard for the employee. No machine, piece of equipment, or process shall be operated when any danger tag, either personal or equipment, is attached to an associated isolation device. No supervisor, or employee, or contractor's employee shall cross the boundary of protection provided by these procedures while the equipment is still energized, or where the appropriate tagout/lockout procedure has not been fully implemented, for the purpose of facilitating continued operation. Any supervisor or employee who fails to follow these tagout/lockout procedures shall be guilty of a major rule infraction, and be subject to the appropriate disciplinary action.

Use those portions of these procedures to customize a program for control of hazardous energy sources. Comply with the appropriate OSHA, MSHA, or other applicable safety standards.

These are minimum safety requirements. More stringent procedures may be necessary. For example, complicated process systems with several departments involved employing multiple isolation devices and techniques.

Review periodically to confirm that procedures are current with changing processes, operating practices, and personnel. Verify the contents of this standard with the attachments to assure no conflicts exist. Use the most conservative alternative to resolve any conflict.

2. DEFINITIONS

Use these definitions:

Affected Employee - An employee whose job requires him/her to operate or use a machine or equipment on which servicing or maintenance is being performed under lockout or tagout; or whose job requires him/her to work in an area in which such servicing or maintenance is being performed.

Authorized Employee - A person who locks or implements a tagout system procedure on machines or equipment to perform the servicing or maintenance on that machine or equipment. An authorized employee and an affected employee may be the same person when the affected employee's duties also include performing maintenance or service on a machine or equipment which must be locked or a tagout system implemented.

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TAGOUT AND LOCKOUT PROCEDURES

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Capable of Being Locked Out - An energy isolating device will be considered to be capable of being locked out either if it is designed with a hasp or other attachment or integral part to which, or through which, a lock can be affixed, or if it has a locking mechanism built into it. Other energy isolating devices will also be considered to be capable, if lockout can be achieved without the need to dismantle, or rebuild, or replace the energy isolation device or permanently alter its energy control capability.

Energized - Connected to an energy source or containing residual or stored energy.

Energy Isolating Device - A mechanical device that physically prevents the transmission or release of energy, including but not limited to the following: a manually operated electrical circuit breaker, a disconnect switch, a manually operated switch by which the conductors or a circuit can be disconnected from all un-grounded supply conductors and in addition, no pole can be operated independently: a slide gage: a slip blind: a line valve: a block: and any similar device used to block or isolate energy. The term does not include a pushbutton, selector switch, and other control circuit type devices.

Energy Source - Any source of electrical, mechanical, hydraulic, pneumatic, chemical, thermal, or other energy.

Hot Tap - A procedure used in the repair, maintenance and services activities which involves welding on a piece of equipment (pipelines, vessels, or tanks) under pressure, in order to install connections or appurtenances. It is commonly used to replace or add sections of a pipeline without the interruption of service for air, gas, water, steam and petrochemical distribution systems.

Lockout - Is the act of padlocking, or padlocking and tagging a switch or other isolating device in the off or safe position. Isolation devices may have the lockout means built in or may require modification before locks can be used. In cases where more than one department (employee) is involved, provision shall be made for multiple use of padlocks with a white personal danger tag by each department/employee. Lockout is more positive than tagout particularly where the hazard potential is great and it can be properly implemented.

Lockout Device - A device that utilizes a positive means such as a lock, either key or combination type, to hold an energy isolating device in the safe position and prevent the energizing of a machine or equipment.

Normal Production Operation - The utilization of a machine or equipment to perform its intended production function.

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TAGOUT AND LOCKOUT PROCEDURES

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Servicing and/or Maintenance

- Workplace activities such as constructing, installing, setting up, adjusting, inspecting, modifying, and maintaining and/or servicing machines or equipment. These activities include lubrication, cleaning or unjamming, and making adjustments or tool changes, where the employee may be exposed to the unexpected energizing or start-up of equipment or release of hazardous energy.

Setting Up

- Any work performed to prepare a machine or equipment to perform its normal production operation.

Tagout

- Is the act of placing a switch, lever, valve, gate, or other isolating device in the off or safe position and tagging it to eliminate operation until the tag is removed. Personal identification is provided for by using the signature, date and department spaces.

Power System Distribution and Transmission Clearance

- A specific procedure or method used to assure that power transmission and distribution lines are de-energized for the purpose of protecting employees.

Try

- The act of testing start controls to determine that the appropriate disconnect or isolation device has been successfully de-energized.

3. RESPONSIBILITIES

The supervisor(s) of the employees involved shall:

- o Be knowledgeable in the potential energy hazards and personal protective equipment requirements; select energy isolation devices, work procedures to be used, and proper energy control plans as an integral part of the preplanning for the job.
- o Train personnel completely in the recognition of the obvious energy control hazards and the potential hazards that can develop within the scope of the job.
- o Develop complete energy control procedures governing the assignments on or near the obvious and potentially hazardous energy sources.
- o Assure that implementation of energy control procedures as defined by this standard are done only by authorized personnel properly trained for the job.
- o Furnish properly maintained equipment for the job, including but not limited to personal protective equipment, and hardware like tags, locks, chains, blinds, self-locking fasteners, test equipment, etc.

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TAGOUT AND LOCKOUT PROCEDURES

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- o Provide employees with a clear definition of the work area, type, magnitude, hazards, and methods to be used to control the hazardous energy.
- o Oversee the correct application of this standard to all aspects of the work.
- o Assign a competent lead person to be in charge of auditing the energy control plan where several personnel have been assigned to the job.
- o Coordinate plans for process and/or equipment shutdowns with the appropriate department representatives, communicate plans and schedules to all involved.

The employee(s) involved shall:

- o Evaluate the potential for hazardous energy contact, the need for additional personal protection, and other safety precautions before beginning work of any kind.
- o Unplug electrical devices fed by a cord, and develop exclusive control of the plug under conditions where unexpected energizing may occur.
- o Question all aspects of the job, expected or unexpected, during the evaluation phase of a job.
- o Stop work immediately and resolve unusual or unexpected situations at the moment they arise.
- o Inspect and test all safety equipment before use. Assure that any prescribed inspection by others is current, and inspect before use as required.
- o Participate in a group review of safety instructions for correct interpretation, on major jobs or jobs where specific concerns exist. Check with your supervisor if questions still exist.
- o Consult with the appropriate supervisor on any question of tagging an isolating device(s).

4. ENERGY CONTROL PROGRAM

Each location shall establish a program of energy control procedures and employee training consistent with the fundamentals of this standard, using one of the following options:

Option 1

- o Use a lockout program when the location energy isolation devices are capable of being locked out.
- o Use a tagout system for those devices at the location where the lockout of energy isolation devices is not possible. Where a lockout program is in effect, a job safety analysis, safety rule, or other written procedure should address the specific situations where tagout is acceptable.

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Option 2

- o Use a tagout program with the tag attached to the same device where a lock would normally be used.
- o Demonstrate that the location tagout program matches lockout safety provisions as follows:
 - Complete compliance with all tagout related provisions
 - Implementation measures which may include removal of valve handles, etc.

5. HARDWARE AND TAGS

Use the yellow equipment tag, SF-1500 or equivalent, as shown in Figure 1 (See Page 13) to prevent the operation of the following:

- o Unsafe equipment or machinery.
- o Machinery undergoing repairs that carry over into the next shift or for extended periods of time.
- o Machinery that would be damaged by operation.
- o New equipment or machinery that has been or is about to be connected to an energy source.

The yellow equipment warning tag does not provide personnel protection.

The yellow equipment warning tag can only be removed by the employee who attached the tag or by another authorized employee.

Identify local employees authorized to remove the yellow equipment warning tag. It is recommended that each location include the list of these employees as part of the written procedures and training. See Attachment 1 for an example.

Use the white personal danger tag, SF-7396 or equivalent, as shown in Figure 2, (See Page 14) to provide personal protection. Attach to isolation devices individually as in the case of the tagout program, or in conjunction with a lock as in the case of the lockout program.

The white personal danger tag can only be removed by the employee who attached the tag when:

- o The necessary work has been completed.
- o The work has been reassigned.

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- o At the end of the shift by the employee.
- o When the employee leaves the area prior to the end of the shift with the work incomplete.

Furnish locks, tags, chains, wedges, key blocks, adapter pins, etc., for the isolation, securing, blocking, and controlling of equipment and process energy release.

Readily identify lockout devices and tags exclusively for controlling energy from other devices and tags that may be similar for other purposes.

Standardize location tagout and/or lockout devices by color, shape, or size; tagout devices by print and format.

Furnish durable lockout and tagout devices that withstand the environmental conditions to which they are exposed.

Furnish tagout devices that will not deteriorate or become illegible as the result of weather or environmental conditions.

Furnish lockout devices that are constructed to prevent removal without excessive force or special tools.

Provide tagout devices and attachments that are substantial enough to prevent inadvertent or accidental removal.

Furnish tagout attachment devices that are non-reusable, self-locking and non-releasable, and attachable by hand. (Such as a one piece nylon cable).

Furnish lockout and tagout devices that identify the owner.

Use expressions such as "Do Not Operate", "Do Not Open", "Do Not Close", "Do Not Energize", on the tagout devices to warn against hazardous conditions.

6. COMPLIANCE AUDITS

Conduct an annual audit of the energy control procedures to assure that they are adequate and being applied in the field according to the program requirements. See Attachment 2 for a sample audit form.

Maintain documentation of the audits including the type of equipment or process audited, the employees participating in the job, the department, the date of the audit, and those persons conducting the audit protocol and checklist.

Correct deviations or inadequacies in procedures of work practices immediately.

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7. TRAINING

Use OSHA 1910.147.c.7 for mandatory training requirements if the location is under OSHA jurisdiction.

Use MSHA Subpart 48 for mandatory training requirements if the location is under MSHA jurisdiction.

All worldwide locations must, as a minimum, conduct initial orientation training for all employees (excluding clerical and administrative) on the location's tagout/lockout procedures. Production, craft, supervisory, and technical employees should be given a proficiency test following the orientation in the form of an oral quiz, written exam, hands on demonstration or a combination of these.

Conduct refresher training when the results of inspections, audits, observations, or accident experience indicates a lack of understanding or compliance.

Update energy control programs and refresher training when changes in the process, equipment, procedures, or audit results warrant a revision to the energy control program.

8. ENERGY CONTROL PROCEDURES

T0/LO Procedures for Electrical or Electrically Powered Equipment

Use the following sequence for implementing these procedures:

- o Review proposed work with the supervisor in charge of the equipment or facility. Reach agreement of potential operating interference and whether an immediate shutdown is required to protect employees and/or equipment.
- o Use normal stop procedures to shut down equipment (depress stop buttons, open toggle switches, etc.,.)
- o Stand to the side of the panel and open main disconnect switch(es) or circuit breaker(s).
- o Tagout (white personal danger tag) or lockout (white tag and padlock) the switch in the off or safe position. Each employee must perform their own tagout/lockout, even if another person has taken the equipment out of service. The supervisor or a member of the crew can be responsible for the crew with their approval. The individual must sign the tag, perform the tagout/lockout, and be responsible for every member of the crew on that job.
- o Provision must be made for anyone who desires to add their personal tagout/lockout, even if someone does this for the entire crew.

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- o Test the disconnect or switch handle after lockout to make certain it cannot be moved to the "on" position.
- o Try the machine "start" controls after tagout/lockout to make sure that the main isolation device is open or in the "safe" position. This shall be done before other employees who have tagged/locked out have begun work and while they are positioned safely.
- o Verify blade opening visually (when possible) when working on electrical conductors or energized parts.
- o Test for no voltage on phase-to-phase and phase-to-ground before beginning any work.

Only electrical or other authorized personnel shall open an enclosure to operate a disconnect device on the electrical system.

The use of pushbuttons, toggle switches, pressure switches, limit switches, and similar control circuit devices for isolation purposes is not permitted.

Pulling a fuse shall never be the sole substitute for lockout or tagout. One switch may feed several motors individually fused, and switch tagout may shut down equipment unnecessarily. In this case, disconnect, tape, and tagout the wires from the load side of the fuse clips.

CAUTION: If vessels and piping systems are involved, refer to the procedures for these facilities later in this section.

TAGOUT/LOCKOUT PROCEDURES FOR MECHANICALLY POWERED EQUIPMENT

Equipment powered by internal combustion engines, air, gas, water, steam, etc. are examples for this category. Use the following procedures:

- o Review proposed work with the supervisor in charge of the equipment or facility. Reach agreement on potential operating interference and whether an immediate shutdown is required to protect employees or equipment.
- o Use normal stop procedures to shut down equipment (depress stop button, shift lever, operate valve, etc.)
- o Operate mechanical isolating device such as a valve, or lever, to the safe position.
- o Tagout (white personal danger tag) or lockout (white tag and padlock) the mechanical isolating device in the safe or off position. Each person must perform their own tagout/lockout, even if another has taken the equipment out of service. The supervisor or a member of the crew can be responsible for the crew with their approval. The individual must sign the tag, perform the tagout/lockout, and be responsible for every member of the crew on that job.

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- o Provision must be made for anyone who desires to add their personal tagout/lockout to make sure that it cannot be operated or have its state changed.
- o Try the machine "start" controls after tagout/lockout to make sure that the isolation device has provided a complete shutdown. This shall be done before other employees who have tagged/locked out have begun work and while they are positioned safely.

Test and inspect for stored air, gas, steam, hydraulic fluid, etc., that remains under pressure in piping, accumulators, and cylinders. Operate enough combinations of controls to eliminate stored energy of this nature in the mechanical systems. Compare equipment component positions with those shown on equipment drawings to bring energy stored in springs or elevated devices latched into position to a zero state.

TAGOUT/LOCKOUT PROCEDURES FOR VESSELS AND PIPELINES

These systems require preplanning to identify all potential hazards before starting work. Include a review of Standard 18.1, Entering and Working in Confined Spaces. The supervisor and other employees shall be in complete agreement of the procedures to be followed. Of special interest are:

- o Closed valves may leak. Entrance or release of fluids may constitute a hazardous condition. Capping, blanking, blinding, or even disconnecting all service, process, vent, or overflow lines may be required. Bleeding or purging are other alternatives.
- o Upstream and downstream pressure may exist adjacent to a hydraulic or pneumatic control valve. Both pressures must be relieved by bleeding off, or disconnecting the proper piping connections. Tag open bleed valves. Consider tagging both sides of disconnected piping.

After these planning steps are complete, follow the appropriate steps as outlined in previous paragraphs.

9. RESTORATION OF EQUIPMENT/PROCESSES TO SERVICE

Each employee shall remove their lock and white personal danger tag when agreement has been reached that the work is complete.

When all locks and personal danger tags are removed, the yellow equipment tag shall be removed by its owner or another authorized employee.

Employees are prohibited from removing any personal danger tag or lock other than their own. If employees leave the job site before work is complete, and someone else is going to complete the repair, they should remove their lock and personal danger tag, leaving a properly completed yellow equipment warning tag in place to protect the equipment from operation.

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When an authorized employee(s) who applied the lockout or tagout device is not available to remove it, that device may be removed under the direction of a supervisor from the missing person's department having a thorough knowledge of the process and equipment involved. The supervisor shall investigate all circumstances related to the lockout/tagout with regard to personal safety and before reaching the conclusion that it is safe to remove the lockout/personal danger tag.

Following the removal of a personal danger tag and/or a lock, a complete written report shall be filed with the employee's supervisor and a copy sent to the Safety Department and the employee. (See Attachment 3)

Employee(s) that have had their lock(s) and/or personal danger tag(s) removed in this manner shall be informed by their immediate supervisor before returning to work.

10. SPECIAL TESTING OR POSITIONING OF MACHINES

Special testing or positioning of machines or equipment must, as a minimum, meet the procedures specified in OSHA 1910.147, f, 1.

11. GROUP LOCKOUT OR TAGOUT SITUATIONS

When servicing and/or maintenance is performed by a crew, craft, department or other group, they shall utilize a procedure which affords the employees a level of protection to that provided by the implementation of a personal lockout or tagout device.

General

Group lockout or tagout devices shall be used in accordance with but not necessarily limited to the following procedures:

- o Primary responsibility is vested in an authorized employee for a set number of employees working under the protection of a group lockout or tagout device.
- o Provision for the authorized employee to ascertain the exposure status of individual group members with regard to the lockout or tagout of the machine or equipment, and
- o When more than one crew, craft, department, etc., is involved, assignment of overall job-associated lockout or tagout control responsibility to an authorized employee designated to coordinate affected work forces and ensure continuity of protection: and
- o Each authorized employee shall affix a personal lockout or tagout device to the group lockout device, group lockbox, or comparable mechanism when he or she begins work, and shall remove those devices when he or she stops working on the machine or equipment being serviced or maintained.

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Power System Utilization, Distribution and Transmission Applications

- o When work requires employees and their equipment and/or materials to be within the clearances defined in Alcoa Engineering Standard 32.60 for energized, non-insulated conductors or their associated components, a power system clearance shall be implemented.
- o Procedures for location power system clearances shall meet the minimum standards as set forth in Alcoa Engineering Standard 32.60 and OSHA 1910.269, Sections (m) "Deenergizing Lines and Equipment for Employee Protection" and (n) "Grounding for Protection of Employees".

12. CONTRACTED SERVICES AND OTHER OUTSIDE PERSONNEL

Where outside personnel are engaged in activities at a location, the location and the contracted services employer must communicate their respective energy control procedures to each other.

Each party is responsible for ensuring that their respective employees who are likely to interface with each other, understand and honor the other's energy control procedures.

The word contractor may be stamped on both sides of a standard Alcoa tag as a method of distinguishing between the two separate work groups. Another method for a location where a lockout program is in effect would be using color coded locks for the two groups.

13. ENGINEERING AND MAINTENANCE PRACTICES

After 1989 October 31, energy equipment isolation devices shall be designed and installed to accept a lockout device on all major replacement, repair, renovation or modification of machines or equipment.

Main disconnect devices in the facility shall be clearly identified.

Control devices for field devices that are inputs or outputs for PLC control need to be clearly identified for maintenance personnel or they must be interrupted with auxiliary contacts on equipment main disconnects.

Complex equipment may have several devices located in remote locations or on master panels. Equipment records such as circuit or machine drawings shall be revised promptly to reflect changes in the operations of these devices.

Preplanning of the proper sequence and location identity of the devices must be provided to establish consistency on complex installations.

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For large shutdown, the following shall apply:

- o Procedures and practices for control of hazardous energy sources should be well established before the work begins. Last minute work decisions should be avoided.
- o Large shutdowns should be covered by specifically written shutdown procedures supplemented by specially marked-up electrical drawings which cover the scope of the work.
- o Where appropriate, operating employees should be involved in the preplanning of shutdown work.
- o Large scale shutdown jobs should be reviewed with the employees involved and should cover the following:
 - A description of the job to be done and its location.
 - Identification of the employee(s) in charge and other employee(s) who need to be informed throughout the job (production supervisors).
 - What communications have taken place and what will continue to take place to maintain safe working conditions.
 - The energy control plan for the job, a review of the tagging/locking methods, available prints for the job, and additional information as required.
 - Special safety procedures and practices that apply like the installation of grounding circuits, tests for voltage, tagout/lockout, etc.
 - Emergency procedures to be used and the location of equipment that has been provided for these procedures.
 - Time for additional questions from employees.

Shutdown notices which communicate starting times, temporary feeds, restricted areas and equipment to be affected shall be utilized for large shutdowns.

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WARNING

**DO NOT USE, MOVE OR OPERATE
WHILE THIS TAG IS ATTACHED**

**DO NOT DETACH UNTIL REPAIRS HAVE BEEN
COMPLETED.**

**This Equipment Ready for Service and Tag
Removed By**

Name	No.
Dept.	Date

PROTECT YOUR FELLOW WORKER

**USE THIS STUB IN
ACCORDANCE WITH SAFETY
RULES.**

SE-1500 Rev. 81-03

ALUMINUM
COMPANY OF
AMERICA

TAG NO. 161720 Date

WARNING

THIS TAG HAS BEEN ATTACHED BECAUSE:
(Write reason in space below)

**DO NOT USE, MOVE OR OPERATE WHILE
THIS TAG IS ATTACHED**

Tag Attached By

Name	No.
Dep't.	

TAG NO. 161720 Date

Has been attached to

Because

Signed	No.
--------	-----

FIGURE 1

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DO NOT OPERATE OR
REMOVE THIS TAG.
ANYONE DOING SO
WITHOUT AUTHORITY
IS SUBJECT TO
DISCIPLINARY
ACTION.

SEE OTHER SIDE.



**WORK
in progress**

**DO NOT
OPERATE**

SIGNED BY _____

DATE _____

DEPT. _____

SF-7396 REV. 80-04

FIGURE 2

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ATTACHMENT 1

III-2

TAGOUT/LOCKOUT AUTHORIZATION FORM

Department: CLARIFICATION

Persons or Classifications Authorized:

AREA II GENERAL MECHANIC

Tagout/lockout the following:

1. Pumps and valves on the R-35U caustic cleaning system.
2. Pumps and valves on the hose water, process water, and potable water systems.
3. Pumps and valves on the R-37 mud circulating system.
4. Pumps and valves on the press drain system.
5. Pumps and valves on the R-36C caustic cleaning system.
6. Pumps and valves on the filter-aid injection system.
7. Pumps and valves on the washer overflow system.
8. Washer underflow pumps and valves.
9. Pumps and valves on the R-35A filtrate system.
10. Thickener underflow pumps and valves.
11. Pumps and valves on the R-35L system.
12. Pumps and valves on the R-35D press feed system.
13. Pumps and valves on the R-35J causticizer system.
14. Sump pump motors and block valves.
15. Washer and thickener rake drives.

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16. Pumps and valves on the synthetic flocculent and starch system.
17. Pumps and valves on the R-35E-1 lime recovery system.
18. Pumps and valves on the R-38 Zimpro pump system.
19. Pumps and valves on the R-35 press dump system.
20. Pumps and valves on the R-35 caustic cleaning system.
21. Pumps and valves on the R-35 oxalate system.
22. Pumps and valves on the R-35 rake classifier overflow system.
23. Pumps and valves on the R-35 rake classifier sand transfer system.
24. Pumps and valves on the R-35 spiral classifier overflow and sand transfer system.
25. Sand line valves from the sand traps to the classifiers.
26. Press manifold valves (liquor, water, caustic, precoat, and acid).
27. Press header valves.
28. Pumps and valves on the hydraulic water system.
29. Pumps and valves on the #4 residue disposal lake system.
30. Pumps and valves on the storm lake system.
31. Pumps and valves on the process recycle lake system.
32. Pumps and valves on the clear lake system.

Date Approved: 88-12-27

R.E. Ustruck
Area Superintendent - Clarification

Date Approved: 89-01-03

John Palmer
Production Manager - Alumina

Date Approved: 89-01-04

G.D. Mlakar
Manager - Safety & Hygiene

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ATTACHMENT 2

Audit Protocol for Tagout/Lockout/Isolation Procedures

I. Probable Contacts:

- A. Safety Contact
- B. Maintenance Supervision
- C. Production Supervision
- D. Safety Committee Personnel
- E. Craft/Production Personnel
- F. Contractors
- G. Engineering Personnel

II. Assess Strengths/Weaknesses from Checklist:

- o Target on fair criteria - if they can't meet fair criteria rate as poor.
- o If it appears that elements of fair exist, quickly shift to good criteria.
- o If it appears that elements of good exist, evaluate for excellence.

III. Verification:

Inquiry (who do you want to talk to and what special questions do you want to ask?):

Safety Contact, Maintenance Supervision, Production Supervision

- o Describe the tagout/lockout procedures used at this location. Are they written?
- o What methods are used to communicate these procedures (posting, rule book, etc.?)
- o What type of training is provided on this procedure? Describe. Any practical application tests used?
- o Who is trained, how frequently, and by whom?
- o Is training documented? Please describe how.

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- o What hardware is available to employees for tagout/lockout? (Locks, tags, hasps, etc.)
- o How do employees access this hardware? (Individual locks/tags, central tool cribs, etc.)
- o How are violations handled? Any examples?

Craft Production Personnel

- o Are you aware of any recent incidents where tagout/lockout procedures were violated? If yes, please describe.
- o IS there hardware or protective equipment for tagout/lockout that is not available? If so, what is it?
- o What weaknesses, if any, currently exist in your department's tagout/lockout program?

Observations (Procedures, Practices and Facilities):

- o Obtain a copy of any written procedures or rules on tagout/lockout. Compare it with the requirements of Alcoa Engineering Standard 18.3.
- o Based on Alcoa Engineering Standard 18.3, assess the hardware available for tagout/lockout, such as tags, fasteners, locks, isolating devices, etc., during a facilities tour.
- o During a facilities tour, note any jobs not-protected by tagout/lockout that you want to question.
- o Review appropriate training records.

Testing (What Activities Do You Want To Employ To Increase Your Confidence?):

- o Through sampling, verify tagout/lockout procedures by checking tags, locks, isolating devices and by asking questions.
- o Through interviews in the field, verify tagout/lockout procedure knowledge among employees and contractors.

TAGOUT/LOCKOUT PROCEDURES

POOR

____ No formal procedure exists to render equipment and production systems/processes to a zero energy state before repair/maintenance, clearing jams, etc.

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PAIR

___ A formal procedure exists to render equipment and production systems/processes to a zero energy state before repair/maintenance, clearing jams, etc.

___ Copies of the procedure are available via wide spread posting, or distribution and have been reviewed with employees.

___ Maintenance employees have been adequately trained on the procedures and appear to have the best knowledge of them.

___ The procedure utilizes tags similar to those described in Alcoa Engineering Standard 18.3.

___ The procedure covers all energy sources mechanical, electrical, hydraulic, pneumatic, and stored potential.

___ Provisions exist for use of lockout in conjunction with tagout, but it is not mandatory.

___ Excluding group tagging provisions, each employee is required to place and remove their own tag/lock.

___ If written provisions exist to permit group tagging, a clearly identified person/persons is authorized to initiate the group tag.

___ If group tagging is permitted, a procedure exists (i.e. sign in, tag collection, individual tagging at a designated point, etc.,) to insure all employees protected by the tags are identified and accounted for by the group tagger.

All tagout/lockout procedures require a check of the tagout/lockout using the following methods as a minimum:

- Test the disconnect to be sure it cannot be moved to the "on" position.
- Try the machine start controls to verify that the right machine was tagged/locked or that the isolation was successful.
- For authorized personnel (as defined and trained by location policies, rules and procedures), verification of the blade openings and test for voltage phase to phase and phase to ground before work.

___ Pulling fuses is not allowed as a substitute for proper tagout/lockout.

___ Pushbuttons are not permitted for isolation.

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TAGOUT AND LOCKOUT PROCEDURES

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GOOD

___ All the above elements of FAIR are present.

___ The procedure is written and copies of the procedure are available via wide spread posting, and personal copy safety rules for each employee.

___ Production and staff employees (i.e. Engineering, etc.) as well as Maintenance employees have been adequately trained on the procedures, records of training are documented and examples can be verified.

___ Interviews with personnel confirm their knowledge of the procedures.

___ The procedure covers all energy sources such as mechanical, electrical, hydraulic, pneumatic, and stored potential.

___ Where hydraulic or pneumatic energy sources may exist, the procedures provide more detail and discuss points such as bleed-off, disconnecting and blinding lines, etc.

___ The applicability of tagout/lockout to contracted services is specifically addressed.

___ The use of a lockout in conjunction with tagout is mandatory, however, this may be one lock and not necessarily individual locks.

___ Written procedures clearly exist for defining the accepted method for removal of personal danger tags and/or locks when an employee fails to remove their tag/lock/lock at the end of a shift.

___ Observations during the plant tour confirm compliance with tagout/lockout procedures.

EXCELLENT

___ All the above elements of GOOD are present.

___ Individual locks are required with individual keys and a closely controlled master.

___ Complex production systems or processes, vessels and confined spaces, etc., have preplanned documented tagout/lockout procedures with identified isolation point references to assist in assuring that all isolation points are properly identified and isolated.

___ It is a model program in all facets.

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TAGOUT AND LOCKOUT PROCEDURES

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ATTACHMENT 3

WHITE PERSONAL DANGER TAG REMOVAL REPORT

1. Describe reason for removal of White Personal Danger Tag. _____

2. Name of Employee Who Left Tag _____
Department Employee Normally Assigned to _____
Date Noted on Tag _____
3. Supervisor or Specifically Authorized Person Who Removed Tag _____

Date Removed _____ Shift _____ Time _____
Location of Tag _____
4. Method Used to Verify Employee was not at Risk (Check All Applicable):
____ Called Employee's Home and Talked to Employee
____ Called Employee's Supervisor
____ Check Time Card at Clock
____ Reviewed With Other Employees to Determine Presence
____ Walked Equipment/Process
____ Paged Employee
____ Checked Security Sign-In

Comments _____

Date _____ Signature _____

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ASBESTOS REMOVAL STANDARD

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1. SCOPE

This standard covers the precautionary measures to follow when removing asbestos-containing materials as well as legal requirements as mandated by 29 CFR 1926.58, the standard which covers all construction work involving asbestos. The scope of this engineering standard is limited to those requirements and recommendations having to do with asbestos removal. Other requirements of 29 CFR 1926.58 such as the labeling of intact asbestos insulation and the general industry requirements from 29 CFR 1910.1001 will not be discussed here. More than half of the states have laws related to asbestos. Those unique state regulations are not covered in this standard, but whenever state or local requirements are more stringent, they should be followed over the Federal regulations.

Asbestos was used extensively in the past for insulating boilers, furnace linings, steam pipe covering, duct work, gaskets, brake linings, sound insulation, roofing, floor tiles, and for general fireproofing. When materials are suspected of containing asbestos, assume that they do unless current analytical testing confirms otherwise. Samples of bulk material can be analyzed by the Environmental Health Laboratory at Alcoa Technical Center. Additional discussion of sample analysis is included in Section 2.2 on sampling. For purposes of this engineering standard, materials will be classified as asbestos containing materials (ACM) if they contain greater than 0.1% asbestos.

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ASBESTOS REMOVAL CHECKLIST

1. Industrial hygienist and/or environmental engineer must be contacted prior to removal of any materials suspected of containing asbestos.
2. Obtain current, reliable analysis of materials suspected of containing asbestos.
3. Notification procedures consistent with Federal and local regulations must be followed.
4. Employees involved in asbestos removal operations must have had training or certification where required within the last 12 months.
5. Appropriate medical surveillance as well as employee fitness to wear a respirator must be addressed. Employee respirator fit tests must be current.
6. Appropriate protective clothing must be specified and worn for each job.
7. Regulated areas, with asbestos warning signs, must be established where air concentrations could exceed the PEL.

SUPERSEDES 1989-08

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8. Large Asbestos Demolition/Renovation Projects must be done in negative pressure enclosures whenever feasible.
9. Develop a written contingency plan for dealing with any asbestos release emergencies which might occur.
10. Competent persons must supervise activities within regulated areas of large scale jobs.
11. Initial personal exposure monitoring is required at the beginning of each job.
12. Daily exposure monitoring is required for large scale demolition renovation projects.
13. Work area must receive a thorough visual inspection after the clean-up phase to insure adequate clean-up. Air monitoring may also be warranted to document safe exposure levels.
14. All waste materials including used disposable protective clothing must be properly containerized and labeled as asbestos.
15. Placard vehicles carrying asbestos waste on public roadways per D.O.T. requirements.
16. Use Alcoa Form HS-8702 Non-Hazardous Waste Manifest except in states or municipalities where more stringent requirements are in effect.
17. All asbestos waste must be deposited in a permitted landfill with state approval for asbestos disposal. Notification of the disposal facility prior to asbestos waste shipment is recommended. All local regulations concerning asbestos waste disposal must be followed.

2. REQUIREMENTS

2.1 Notification Procedures. The plant industrial hygienist and/or environmental engineer must be contacted prior to removal of any materials suspected of containing asbestos to insure the implementation of adequate health protection measures and also to arrange for required notification and proper waste disposal. Federally mandated notification rules for asbestos Demolition/Renovation work are found in the USEPA National Emission Standards for Hazardous Air Pollutants (NESHAPs) Asbestos Regulations 40 CFR 61, Subpart M.

Some states, cities, and counties have notification rules in addition to the NESHAPs notification. All legally mandated notifications are to be made in conjunction with each asbestos job.

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NESHAP regulations require the owner/operator to notify the Program Administrator before beginning any renovation or demolition involving asbestos removal. Typically, State Pollution Control Agencies have authority for EPA Clean Air Programs including the NESHAPs Program. EP Regional office can be contacted to determine what agency has NESHAPs authority in your location.

Notification of Scheduled Renovation/Demolition

<u>Days</u> (prior to start of job)	<u>Quantity of Friable ACM Being Removed Advisory</u>
20	< 260 ft. or < 160 ft. ² or < 35 ft. ³
10	≥ 260 ft. or ≥ 160 ft. ² or ≥ 35 ft. ³

If there are no standard notification forms required by local regulations, the following form, designed by Pittsburgh Environmental Control, is recommended (Attachment 1). NESHAPs require the following information as a minimum.

- Company name and address, contact name and phone number.
- Contractor name and address, contact name and phone number.
- Location of renovation or demolition.
- Scheduled starting and completion dates of renovation or demolition.
- Description of facility to be renovated or demolished (including size, age, prior use, estimated of friable asbestos.)
- Nature of the renovation or demolition and method(s) to be used.
- Procedures to be used to insure compliance with Emission Standards (40 CFR 61.22d and Waste Disposal Standards 40 CFR 61.22j).
- Scheduled starting and completion dates.
- Name and address of waste disposal site.
- Name, title, and authority of government agent, if demolition is a result of government order.

2.2 Sampling. This section describes sampling to be conducted during all phases of asbestos jobs from planning, through removal as well as after cleanup. Some of this sampling is required by the OSHA Standard while other aspects of sampling are highly recommended as good practice during conduct of asbestos removal.

2.2.1 Bulk Sampling

During planning phases of asbestos removal jobs, it is essential that asbestos bulk sampling be conducted to determine the extent of asbestos containing materials (ACM). Bulk sampling conducted previously is sufficient to serve this purpose if the results of that previous sampling were conducted using methods sufficiently sensitive to detect the presence of asbestos at 0.1% and the results are considered by the location Industrial Hygienist to be reliable. Recommended test methods are polarized light microscopy (40 CFR Part 763, Appendix A, Subpart F), or other methods of equal or greater precision. Alcoa's

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Environmental Health Laboratory has the capability of conducting this analysis and is involved in an N.B.S. (National Bureau of Standards) quality assurance program to maintain analytical accuracy. Arrangements can be made with EHL to analyze rush samples by contacting them prior to sampling and by sending samples via overnight express mail. Any outside laboratory used for bulk asbestos sample analysis must use comparable analytical methods and maintain a quality assurance program.

2.2.2 Air Monitoring - Personal Exposures

Personal air samples are required by the construction standard. Appendix A, a mandatory appendix to the Asbestos Standard, describes NIOSH Method 7400 including both sampling and analytical procedures. NIOSH Method 7400 utilizes a 25 mm diameter open face cassette with a 50 mm extension cowl. Written justification must be made if another method is used. Additionally, the Asbestos Standard mandates a laboratory quality assurance program to be instituted by laboratories conducting analysis of samples required by this standard. ATC's EHL has instituted a quality assurance program to meet the specific requirements of 29 CFR 1926.58. If other laboratories are used, they must also have acceptable QA programs.

All personal air samples are required to be taken in the employees breathing zone. For comparison with the PEL and action level, sufficient samples should be taken to be representative of each employee's 8-hour (full shift) exposure.

Personal Exposure Sampling

Minimum Sample Volume

Action Level	0.1 f/cc	190 minutes	380 liters
Permissible Exposure Level	0.2 f/cc	90 minutes	180 liters
Short Term Exposure Limit	1 f/cc	20 minutes	40 liters
		(with 25 mm filter)	

Reference IH Technical Bulletin 89-03

Effectuated employees, or their designated representatives, have the right under the OSHA regulation to observe any monitoring of employee exposure to asbestos. Written results of personal asbestos monitoring are required to be made available to effected employees within 15 days of the receipt of such results. Just as with all personal sampling results, OSHA Record Retention Requirements, 29 CFR 1910.20, mandate that they be kept for the duration of the individual's employment plus 30 years.

Initial monitoring is required at the beginning of each asbestos job to determine the asbestos concentrations to which employees will be exposed. Exceptions to this requirement are when there is objective data to indicate that the ACM cannot release fibers in concentrations exceeding the action level or when there is historical data for closely resembling conditions.

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Daily monitoring is required for large scale demolition renovation projects. Large scale demolition renovation projects are defined by examples under Section 2.6 Work Practices. The definition of large scale demolition renovation projects pre-supposes that the employee exposures will exceed the action level of 0.1 fibers per cubic centimeter of air (0.1 f/cc). There must be sufficient samples to represent exposures of each employee assigned to work in the regulated work area. Regulated work areas are also explained further in Section 2.6.

2.2.3 Air Sampling - Area Sampling

While area sampling is not required by the asbestos regulations, it may be prudent in some circumstances. Area sampling is recommended in the non-mandatory Appendix E of the OSHA Construction Standard for Asbestos for large scale asbestos removal projects which utilize negative air pressure enclosures. Area samples are recommended in the work area, in the clean change room at the periphery of the restricted area, and in the area of the portable ventilation unit exhaust. Additional area samples are recommended in the asbestos removal area following cleanup. The enclosure should not be dismantled unless final clearance samples are below the OSHA action level of 0.1 f/cc. EPA recommends that these clearance samples be less than 0.01 f/cc for schools. Areas such as offices, lunchrooms, and control rooms should meet the EPA's recommended "clearance level" of 0.01 f/cc. Clearance sampling for the purpose of determining the adequacy of cleanup is done after surfaces in the work area have been allowed to dry thoroughly. Use of forced air equipment is sometimes used to conduct aggressive sampling in order to dislodge any stray fibers from surfaces and thereby represent worst case conditions.

Minimum Sample Times for Area Samples

<u>Clearance Level</u>	<u>Minimum Sample Volume</u>
0.1 f/cc	120 l
0.01 f/cc	270 l (540 l is preferable)

2.3 Employee Training Training shall be provided annually to all employees involved in asbestos removal operations. All Alcoa employees and outside contractors exposed to asbestos > 0.1 f/cc must have completed required training at some time within a 12 month period prior to assignment to any asbestos job. If asbestos work occurs infrequently during the year, JSAs and/or training materials should be available to employees for their review prior to the job.

The plant industrial hygienist can offer assistance in employee training programs. Attendance at these training sessions should be documented. OSHA requires that records of asbestos training be kept for a period of one year. This should be considered a minimum requirement. The training program should include the following:

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- (a) Recognition of asbestos.
- (b) Health effects associated with asbestos exposures including the relationship between asbestos and smoking.
- (c) Nature of job which could result in exposure.
- (d) Protective measures including engineering controls, work practices, housekeeping, and personal protective equipment used to reduce potential exposures.
- (e) Respirator fitting and use.
- (f) Medical surveillance requirements.

Some states have adopted additional regulations requiring standardized training and licensing of asbestos removal contractors. In locations where this additional requirement is in effect, appropriate licenses and certifications must be obtained.

2.4 Medical Surveillance. Employees wearing negative pressure respirators and employees exposed at or above the action level of 0.1 f/cc for 30 or more days a year are required to be in a medical surveillance program as outlined in 29 CFR 1926.58. For Alcoa employees, this periodic evaluation will be conducted according to Alcoa Medical Protocol B7, Occupational Medical Evaluation, Asbestos. Medical records made in accordance with the OSHA Asbestos Standard are subject to record keeping requirements as set forth in 29 CFR 1910.20. Medical records are required to be maintained for the duration of employment plus 30 years.

2.5 Personal Protective Equipment.

2.5.1 Respirators. Respiratory protection used for employees involved in asbestos jobs must be used in accordance with Alcoa Engineering Standard 18.1.1 as well as OSHA regulations (29 CFR 1910.134 (b), (d), (e), and (f)). This engineering standard describes minimal requirements of a Respiratory Protection Program including medical evaluation of respirator users, training, and fit testing. Fit testing under the Construction Standard is required prior to the initial job assignment and every six months thereafter. All respirator fit testing done in conjunction with this standard must be carried out according to the provisions of Appendix C to the OSHA asbestos standard for construction, which is mandatory.

The plant industrial hygienist can assist in the selection of appropriate respiratory protection. OSHA does not allow single use disposable respirators to be used to meet respiratory protection requirements of the asbestos standard. The selection of appropriate respiratory protection depends upon the concentration of asbestos in the work environment. An additional consideration in respirator selection is that the OSHA standard gives employees a choice of using a powered air purifying respirator (PAPR) rather than a negative pressure regulator so long as the PAPR provides adequate protection. Although OSHA would not require respiratory protection for employees exposed to less than the PEL, it is a good practice to use respiratory protection in any work situation where accidental exposure might occur due to some event such as rupturing of a glove bag or breakage of an asbestos waste container.

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<u>Exposure Level (X)</u> PEL = 0.2 f/cc	<u>Respirator Type</u>
$X \leq 10$ (PEL)	- 1/2 mask HEPA
10 (PEL) $< X \leq 50$ (PEL)	- Full facepiece HEPA
50 (PEL) $< X \leq 100$ (PEL)	- PAPR HEPA - 1/2 mask supplied air (positive pressure mode)
100 (PEL) $< X \leq 1000$ (PEL)	- Full face supplied air (positive pressure mode)
$X > 1000$ (PEL)	- Full face supplied air with auxiliary SCBA

HEPA - High efficiency particulate absolute
SCBA - Self contained breathing apparatus

Reusable respirators should be thoroughly washed to remove any asbestos contamination prior to sanitization and storage (refer to Engineering Standard 18.1.1).

2.5.2 Clothing Appropriate work clothing is required to be provided to employees when they are exposed to asbestos above the PEL and when the possibility of eye irritation exists. The purpose of special clothing for asbestos jobs is to prevent the contamination of street clothing that will be worn home by the employee. The type of work clothing which is necessary depends on the type of work that will be done.

For large removal operations, where there is a greater possibility of contamination, employees will need whole body coverings including:

Coveralls or Work Clothes - These can be either disposable garments or reusable garments which are dedicated to asbestos work.

Footwear - Molded rubber boots with safety toes can be washed or wiped clean of asbestos contamination following the job. Disposable rubber shoe coverings can be used to protect work shoes from contamination and they are available in styles of sufficient durability to withstand use in the work environment. Tyvek shoe covers would only be adequate under the most controlled conditions and they do present a greater slipping hazard than rubber shoe coverings. Pant legs should be worn outside any boots or shoe coverings and taped to them around the ankles.

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Work Gloves - Work gloves to be used should be selected on the basis of hand protection required. Inexpensive cotton work gloves are a good choice because they can be laundered during the job and disposed of at the job's completion. Sleeves of coveralls should be brought down over gloves and taped at the wrists.

Head Coverings - Disposable head coverings are recommended when jobs involve removal of overhead asbestos or are excessively dusty. Tyvek hoods are available attached to disposable coveralls or as a separate garment.

Eye Protection - Safety glasses, faceshields, vented goggles, or other appropriate eye protection must comply with the provisions of 29 CFR 1910.133.

Respiratory Protection - Refer to Section 2.5

Small asbestos jobs such as removal of pipe insulation in a glove bag or removal of an entire asbestos covered pipe or structure also requires some protective clothing. Due to the nature of these jobs, appropriate protective clothing may not need to be as extensive as that required for large scale asbestos jobs.

Coveralls - Even though exposures during these small jobs should not exceed the PEL, disposal coveralls are recommended as a precaution against contaminating work clothing with asbestos fibers.

Gloves - Disposable work gloves may be necessary for some small scale asbestos jobs depending on the need for hand protection from sharp or abrasive objects.

Shoe Coverings - The need for protecting work shoes from asbestos contamination will depend on the nature of the job. If there is a risk of contamination, disposable shoe coverings or cleanable work boots are recommended.

Eye Protection - Facility requirements for eye protection must be met.

Respiratory Protection - Half mask, negative pressure respirators should be used during glove bag jobs.

2.5.3 Disposal of Personal Protective Equipment. Before leaving the work area, specific procedures should be followed for removal of protective garments so as not to contaminate the employee or the surrounding areas. Section 2.7 of this standard discusses personal hygiene practices and hygiene facilities in more detail.

All disposal protective equipment (garments, gloves, etc.) is to be treated as asbestos-containing material and disposed of accordingly. (See Section 2.8).

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2.6 Work Practice and Engineering Controls. Work practices and engineering controls should be used to achieve compliance with the PEL of 0.2 f/cc.

2.6.1 Restricted Areas. OSHA regulations require the establishment of regulated areas whenever concentrations of airborne asbestos exceed or could reasonably be expected to exceed the PEL. The regulated area is meant to keep the number of employees in the work area to a minimum, to restrict access to authorized persons who are properly trained and outfitted in adequate personal protective equipment as well as to protect persons outside the work area from exposure to asbestos.

Warning signs are required to be posted around the perimeter of the regulated area so that employees have the opportunity to read them and take appropriate measures before entering the work area. Unless local regulations require more stringent measures, signs must conform to OSHA Regulation 29 CFR 1926.58 (k)(1), and read as follows:

DANGER

ASBESTOS

CANCER AND LUNG DISEASE HAZARD
AUTHORIZED PERSONNEL ONLY
RESPIRATORS AND PROTECTIVE CLOTHING
ARE REQUIRED IN THIS AREA

2.6.2 Large Asbestos Demolition/Renovation Projects. All requirements in 29 CFR 1926.58 (g) (1) apply to asbestos removal, renovation, and demolition projects. Exceptions to these requirements are made in the case of small scale short duration operations which are discussed in Section 2.6.3 of this standard. Engineering and work practice requirements for large scale asbestos demolition/renovation projects include the following:

- (a) Negative pressure enclosures must be constructed in the regulated area whenever feasible. Feasibility is not determined by cost, rather it relates to factors such as space limitations or greater hazards. It is recommended that this enclosure comply with guidelines in the Appendix F to the Asbestos Construction Standard. This non-mandatory Appendix is entitled "Work Practices and Engineering Controls for Major Asbestos Removal, Renovation, and Demolition Operations". Enclosures may be temporary structures lined with a double layer of 6 mil flame retardant polyethylene sealing all of the seams and penetrations through the plastic sheeting. A single means of access and egress should be provided with all other doors sealed. This doorway should be covered with a double flap of

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plastic sheeting to separate the work area from the hygiene facility which will be discussed further in Section 2.7. Ventilation is to be provided using a number of HEPA filter units sufficient to achieve three to four air changes per hour in the enclosure. OSHA also recommends a pressure of -0.02 inches of water within the enclosure. By definition, HEPA filters must be capable of removing 99.97% of the asbestos particles from the air. HEPA units are to be operated 24 hours a day during the entire project. Exhaust air must be adequately filtered for asbestos removal and should go, if possible, to the outside of the building where the asbestos project is being conducted.

- (b) Competent persons must supervise activities within regulated areas, including setting up negative pressure enclosures and ensuring its integrity, ensuring that engineering controls are functioning, controlling access to the regulated area, ensuring that employees entering regulated areas are properly outfitted with PPE, ensuring that employees are adequately trained, sampling exposures, inspecting employees work clothing for rips and tears, ensuring that employees follow decontamination procedures. Responsibilities of competent persons are described in 29 CFR 1916.58 (b),(e) (ii) (A)-(H), and (e) (6) (iii).
- (c) Only authorized persons are to be allowed within the restricted area. All such persons must comply with training requirements (Section 2.2), medical surveillance requirements (Section 2.4), and the personal protection requirements including respiratory protection (Section 2.5).

2.6.3 Small-Scale Short Duration Asbestos Jobs. Engineering controls and safe work practices are required to be used to control exposures during small scale asbestos jobs to levels below the action level of 0.1 f/cc. OSHA does not require negative pressure enclosures, supervision by a "competent person" or decontamination facilities for small-scale, short duration tasks. Examples of such tasks include pipe repair, valve replacement, installing electrical conduits, installing or removing drywall, roofing, and other general building maintenance or renovation involving only limited exposure to asbestos. Any asbestos removal which can be accomplished in a glove bag is considered to be a small-scale job. Controls and work practices which can be used to control exposures during small-scale jobs include:

- (a) Wet methods - Amended water or removal encapsulants.
- (b) Removal methods such as carefully cutting asbestos from pipes or other surfaces.
- (c) Glove bags.
- (d) Removal of entire asbestos insulated pipe or structure.
- (e) Mini-enclosures.

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2.6.4 Dust Suppression Techniques. Wherever feasible, wet removal methods are required to be utilized. In a very limited number of situations wet removal is not feasible such as:

1. Situations where electrical hazards exist such as removal of asbestos from a "live" electrical box.
2. Removing asbestos insulation from a live steam pipe.

Where it is not possible to disconnect electricity or to turnoff the steam, asbestos material can be removed in a dry state. Prior to removal, asbestos material should be sprayed with water containing a wetting agent to enhance penetration. Airless sprayers are recommended for application of wetting agents. The wetting agent should consist of 50% polyoxyethylene ester and 50% polyoxyethylene ether in a concentration of one ounce in five gallons of water. The material should be kept wet during all stages of work to minimize exposure to employees and emissions to outside air. Water should not be used if this would introduce other hazards (i.e., electrical, generation of toxic gases, etc.).

2.6.5 Work Practices. Written asbestos removal plan is recommended for large scale asbestos renovation/demolition work in Appendix F. Such a plan will describe the work practices as well as control methods. Such a plan would have information that is also required to be reported as part of the NESHAPS requirements (40 CFR 61, Subpart M).

Asbestos material should be removed in small sections and handled very carefully. While still wet, the pieces of material should be carried and lowered to ground level rather than dropped, and then placed into appropriate waste containers. Section 2.8 has more information on waste disposal.

If the work is regulated under U.S. EPA Clean Air Act regulations, and water cannot practically be used for dust control, a dust collection/exhaust system is required. Such a dust control system may be necessary even if not mandated by regulation, depending on the specifics of the job, and potential for airborne emissions and employee exposure.

2.6.6 Housekeeping and Clean-Up.

- (a) All surfaces in the work area must be cleaned using vacuum cleaners equipped with HEPA exhaust.
- (b) All waste materials should be placed promptly into labeled containers to reduce asbestos dust hazard in the work area.

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- (c) When asbestos removal job is complete, all surfaces should be cleaned with a HEPA-filtered vacuum or with damp rags. Do not dry sweep asbestos materials, as this will create airborne dust.

The asbestos work area must receive a thorough visual inspection after the clean-up phase to insure adequate clean-up. Industrial hygiene monitoring may also be warranted to document safe exposure levels. The EPA recommends that a "clearance level" of 0.01 f/cc be achieved for schools. Clean-up in areas which will be reoccupied by people for more than eight hours a day such as offices, lunchrooms, and control rooms should meet the EPA "clearance level". All plastic sheeting, cleaning materials, clothing, and all other disposable items used in the work area shall be packed into water impermeable containers and properly disposed of as described in Section 2.8.

2.6.7 Prohibitions. The following work practices are specifically prohibited during asbestos jobs.

- (a) Employee rotation is not considered by OSHA to be an acceptable way to reduce employee exposures to asbestos.
- (b) High speed abrasive disk saws are not permitted to be used for asbestos work unless they are equipped with HEPA exhaust.
- (c) Compressed air is not permitted to be used to remove asbestos unless it is used in conjunction with an enclosed ventilation system.

2.6.8 Contingency Plans. Written asbestos emergency plans are recommended for dealing with asbestos release emergencies and for unexpectedly encountering ACM during jobs, GERCLA RQ = 1 lb. (0.454 kg.)

2.7 Personal Hygiene Practices and Hygiene Facilities.

2.7.1 Smoking and eating are not permitted in the work area. Employees should thoroughly wash their hands, faces, and arms before smoking or eating during breaks and upon job completion. Lunchrooms with airborne concentrations less than the action level must be available to employees working in regulated areas.

2.7.2 Decontamination Facilities. Use of decontamination facilities for employees in jobs where they are exposed to concentrations of asbestos greater than the PEL is mandatory. These facilities are comprised of a clean room, a shower room, and an equipment room which is directly connected to the work area. The design of these hygiene facilities is described in non-mandatory Appendix F. to the Construction Standard.

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- (a) **Equipment Room** - The equipment room, also known as the dirty room, is the area connected directly to the work area with a double flap type doorway. This is the area in which the workers remove contaminated work clothing before proceeding to the shower room. It also serves as an equipment storage area. Asbestos waste containers may also be decontaminated and moved out of the work area via the equipment room. Separated from the equipment room by a double flap is the shower room.
- (b) **Shower Room** - Shower facilities should be contiguous with both the equipment room and the clean room. All workers leaving the work area are required to shower. Showers can also be used to clean contaminated equipment and materials such as respirators and work boots which are being taken out of the restricted area for further sanitization. Shower facilities could also be used to decontaminate the outside of asbestos waste containers. Separated from the shower room by a double flap is the clean room. The subject of contaminated shower water is addressed in Section 2.8.4.
- (c) **Clean Room** - Clean rooms or change rooms should provide for storage of workers' street clothes and personal belongings. They should also be equipped with towels (disposable towels are available) and Clean PPE needed for the job.

When it is not feasible to construct decontamination facilities adjoining the worksite because of space limitations or the lack of water, the Construction Standard allows for some alternative procedures to prevent spread of asbestos contamination between the job site and remote shower facilities.

- (a) HEPA vacuum protective clothing at the worksite, then proceed to showers or
- (b) Change into new disposable suits at the worksite before proceeding to the showers.
- (c) Exposed skin areas should be wiped clean with wet toweling or premoistened towelettes.

2.7.3 Exceptions. Small scale asbestos jobs do not require the use of decontamination facilities, however, practices must be adopted to prevent spread of asbestos away from the job site. HEPA vacuuming disposable clothing is strongly recommended as such a practice. Following this, disposable clothing can be removed and properly discarded with other asbestos waste.

2.7.4 Laundering. Reusable asbestos work clothing or other personal protective equipment (PPE) should be stored in containers labeled with asbestos warning labels. Any person who launders or cleans contaminated PPE or work clothing is required to be informed of the potential harmful effects of asbestos and protective measures that should be taken. Contaminated work clothing should not be shaken or handled in a way that is likely to create airborne fibers.

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2.8 Waste Disposal. Federal regulations which deal with asbestos waste are contained in the NESHAPS (40 CFR 61, Subpart M 61.145 - 61.147). As part of the notification procedure described in Section 2.1, generators of asbestos waste from renovation/demolition projects are asked to describe the method of containing asbestos waste as well as the name of the waste site to which waste will be taken for disposal.

2.8.1 Containers To reduce generation of airborne fibers, asbestos waste should be placed into disposal containers while wet. The type of container which is appropriate for asbestos waste is dependent upon the type of waste. All asbestos waste containers shall be free of asbestos dust before leaving the restricted area.

OSHA regulations require that asbestos waste containers be labeled with the following:

DANGER

CONTAINS ASBESTOS FIBERS
AVOID CREATING DUST
CANCER AND LUNG DISEASE HAZARD

- (a) Recommended containers are 6 mil thick polyethylene bags.
- (b) Asbestos waste containing metal or other sharp objects should be packaged in sturdier waste containers such as metal drums, fiber drums, or poly-lined plywood boxes.
- (c) Pipes and equipment insulated with asbestos being removed in large sections can be wrapped in 6 mil plastic to create leak-tight containers.

2.8.2 Transportation. In the United States, containers should be transported with proper D.O.T. shipping documents and identification. Shipping Name: Waste Asbestos RQ ORM-C. Pittsburgh Environmental Control recommends the use of Form HS-8702 Non-hazardous Waste Manifest except in states or municipalities where asbestos has been designated as a hazardous waste and manifests are required. There are no Federal regulations concerning the type of vehicles which should be used to transport asbestos waste, however, some state regulations specify that asbestos waste be transported in closed vehicles. As a minimum, the load must be well secured and transported in such a way to prevent damage to containers during transport.

2.8.3 Landfills. Waste asbestos is a "non-hazardous" solid waste under Subtitle D of the Resource Conservation and Recovery Act (RCRA). All asbestos waste must be deposited in a permitted landfill with state approval for asbestos disposal.

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- (a) Before using a landfill for asbestos disposal, it is recommended that the site be visited and investigated to confirm that it is permitted, operating in accordance with Part 61.25 of the Clean Air Act regulations, and is being operated by reputable management.
- (b) Notification of the disposal facility prior to asbestos waste shipment is recommended.
- (c) To minimize air emissions during disposal, the EPA recommends that the landfill designate a special area for asbestos waste which is separate and preferably isolated from other activities. It is also recommended that asbestos waste be deposited in trenches or at the "toe" of the slope and covered within 24 hours of disposal with at least six inches of material. Asbestos wastes should be compacted only after being covered.

2.8.4 Other Waste. Contaminated water from asbestos renovation demolition jobs may be regulated in some locations. It is recommended that asbestos levels in any water discharged from an asbestos renovation or demolition site be controlled to less than EPA's recommended Maximum Contaminant Level (MCL) of 7.1 million fibers per liter in drinking water. The generally recommended disposal procedure is to filter the contaminated water through a two stage disposable cartridge type filtering system (20 micron filter followed by a 5 micron filter).

3. OUTSIDE CONTRACTORS

All asbestos contracts for Alcoa facilities will be written by Pittsburgh Procurement in close cooperation with field procurement offices. Outside contractors shall be required to follow the provisions of this standard, as well as all Federal, state, and local regulations where applicable for the removal of asbestos-containing materials.

3.1 Contractor Requirements

- (a) The Construction Standard for Asbestos also requires that contractors/employers inform other employers on the worksite of the nature of asbestos work and the requirements pertaining to regulated areas.
- (b) Other Hazard Communication issues relevant to contractors working in Alcoa facilities are covered in Engineering Standard 33.052.4 "Application of the OSHA Hazard Communication Standard for Outside Contractors".
- (c) The contractor must supply Alcoa with copies of all documents (notifications, air monitoring results, landfill approvals, etc.) generated by the contractor in accordance with regulatory requirements.
- (d) It is recommended that the contractor afford Alcoa the opportunity to review the landfill to be used for disposal of the material.

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- (e) Some local asbestos regulations require third party oversight of contracted asbestos removal work. While asbestos contractors are responsible for conducting asbestos removal in compliance with all applicable regulations, Alcoa location Industrial Hygienist should be given the opportunity to evaluate asbestos control during removal work as deemed necessary by their professional judgement.

4. REFERENCES

For further information, you may find the following references helpful:

1. Bureau of National Affairs 49 BSP-57, "BNA Special Report, Asbestos Abatement: Risks and Responsibilities", 1987. (800)372-1033
2. EPA Report Number 530-SW-85-007 "Asbestos Waste Management Guidance: Generation, Transport, Disposal", 1985 May.
3. EPA Report Number 560/5-85-024, "Guidance for Controlling Asbestos-Containing Materials in Buildings", 1985 June. EPA publications are available by contacting EPA at following toll free number: (800)424-9065.
4. I.H. Technical Bulletin No. 86-4. Available through Pittsburgh Safety and Industrial Hygiene Division.
5. OSHA Safety & Health Standard 29 CFR 1926.58 - Asbestos for the Construction Industry.
6. U.S. EPA Regulations for Asbestos (CFR Title 40, Part 61, Subparts M.)

The following references are not an endorsement of vendors, but may be of assistance:

- ### 1. Vacuum Cleaners --

Euroclean
1186 Stratfield Road
Fairfield, CT 06432 (203)336-5432

Hako Minuteman, Inc.
111 South Route 53
Addison, IL 60101 (312)627-6900

Nilfisk of America, Inc.
300 Technology Drive
Malvern, PA 19355 (215)647-6420

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2. Dust Collection/Exhaust System --

Abatement Technologies
3305 Breckenridge Blvd. Suite 118
Duluth, GA 30136 (404)925-2761

Asbestos Control Technology, Inc.
P.O. Box 183
North Pine Avenue
Maple Shade, NJ 08052 (609)779-1300
(Micro-Trap Asbestos Filtration System -
2 models available. Capacity 600 - 1,700 CFM)

Global Consumer
1721 N. Highland
Los Angeles, CA 90028 (312)426-6980

GPAC Inc. (Owns patent for negative pressure enclosures)
P.O. Box 662
Maple Shade, NJ 08052 (609) 486-1555

Sentry Equipment
2676 Sunset Lane
Allison Park, PA 15101 (800)255-3362 (outside PA)

3. Wetting Agents --

Aquatrols Corporation of America
Pennsauken, NJ

BWE/Better Working Environment
380 Stevens Road, Suite 206
Solana Beach, CA 92075 1(800)654-6792
(Asbestos removal encapsulant BWE 5000
recommended for amosite)

EPA recommended wetting agent:
50% polyoxyethylene ester,
50% polyoxyethylene ether

Ethylene glycol is the wetting agent recommended for
amosite asbestos.

Liquid dishwashing detergents such as a liquid Joy make
effective and economical wetting agents.

Rohm & Haas
V. Philadelphia, PA

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4. Disposable Protective Garments --

Dupont Type 14 "Tyvek"; available through area distributors.

Kimberly Clark Corp.
1400 Holcomb Bridge Road
Roswell, GA 30076 (404)587-8114
(Disposable coveralls, hoods, towels and wipers)

MSA
P.O. Box 426
Pittsburgh, PA 15230 (412)273-5000
(Protective clothing, gloves and headwear)

5. Decontamination Units --

Aerospace America, Inc.
900 Truman Parkway
Bay City, MI 48706 (517)684-2121
(Showers and water filtration)

Creative Innovations
P.O. Box 3257
West Chester, PA 19381 (215)696-4952
(Decon Chamber, Spot Shot Shower, and Water Filtration)

Evergreen Safety Systems, Inc.
14045 W. 66th Ave.
P.O. Box 1207
Arvada, CO 80001 (303)422-2185
(Portable decontamination units)

Personal Protection, Inc.
P.O. Box 737
Crystal Lake, IL 60014 (312)658-2321
(Contaminant and decontamination systems)

Pezanni & Reid Equipment Co.
3960 West Ford Street
Detroit, MI 48216 (313)554-4000
(Decontamination trailers)

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