

H. FLOYD

MR. N. E. MYERS

MECHANICAL ENGINEERING &
MAINTENANCE SUPERINTENDENT

MECHANICAL SUPERVISOR

cc: Mr. R. M. Rose

March 15, 1976

RE: RULES SUB COMMITTEE MEETING - MARCH 17, 1976

Norman, there will be a meeting Wednesday, March 17, 1976, at 1:00 p.m. in the upstairs Conference Room, Building 1, of the Rules Sub Committee. Please attend in my place. I believe the attached is self-explanatory.

In regard to discussion on Engineering Standard 18.1, I have marked some comments which should be considered.

H. FLOYD

HF:mm
Attachment



ALCOA

Engineering Standard

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ENTERING AND WORKING IN TANKS, CASTING PITS,
MANHOLES AND OTHER CONFINED SPACES

NOVEMBER, 1974

1. SCOPE

This standard outlines the essential precautionary measures necessary when personnel must enter confined spaces to clean, inspect, repair, paint, or perform other duties. Examples of the confined spaces covered by this standard are tanks, casting pits, tubs, vaults, sewers, and process vessels. In this standard, such confined spaces will hereafter be called tanks.

Much of the information in this standard was taken from the Recommended Safe Practices and Procedures Safety Guide adopted by the Manufacturing Chemist's Association, Inc., entitled, "Entering Tanks and Other Enclosed Spaces."

This standard is compatible with OSHA safety requirements contained in 1910.252, Welding, cutting and brazing, and 1926.253, Ventilation and protection in welding, cutting and heating.

Unusual and frequently unexpected acute hazards may be encountered when personnel enter a tank or other confined space for any purpose and for any length of time. Typical of such hazards are: accidental activation of powerful agitating equipment; release of dangerous gases or liquids into the space; exposure to paint volatiles; unexpected exposure to asphyxiating, toxic, corrosive, flammable, or radioactive chemicals; or insufficient oxygen for life.

Although the character and degree of each specific hazard or combination of hazards will usually be different, the fundamental precautions and procedures outlined in this standard must be applied to all cases to insure positive accident prevention.

Confined spaces (tanks) which are potentially hazardous include:

1. Enclosures with limited access openings for personnel, such as closed storage tanks, tank cars, process vessels (usually with only a manhole for entering).
2. Tanks, casting pits, tubs, vaults, vessels, furnaces or other confined spaces with one side open to the air but so deep as to require entrance and aid of an assistant in case of emergency.
3. Ventilation or exhaust ducts, sewers, underground utility tunnels or pipe lines.
4. Small offices, cupboards or closets being painted.

2. RESPONSIBILITY *WHAT SUPPLY MAINT. OR PAINT.*

Responsibility for safe procedure both at the time of entry and during the entire operation rests with the Supervisor. This responsibility covers conditions of work for contractors' employees and workmen from other departments as well as for his own personnel. He must make sure that adequate steps have been taken to eliminate or control the hazards. He must also make sure that everyone understands the nature of such hazards which remain and the precautions that must be followed. Advice on the nature and type of tests to be made to insure safe entry and the equipment to be used can be obtained through the Works Industrial Hygiene Committee.

3. HAZARDS

The hazards commonly encountered are:

1. Toxic vapors in harmful concentrations - may result from material in the tank, by gradual release from sludge or scale, or be introduced by painting or leakage from interconnected systems due to failure to blank off or disconnect pipelines or ducts. Painting or repairing of the protecting coating of casting pits also releases toxic and explosive vapors.
2. Flammable gases, with potential of fire or explosion.
3. Lack of oxygen, causing asphyxiation - may result from chemicals absorbing or replacing oxygen in the air, or from inert gas often used to exclude oxygen to reduce the possibility of explosions. Air in clean tanks closed for an extended period may become deficient in oxygen for various reasons including oxidation of the metal. Improper or inadequate ventilation during work such as welding, gas cutting or arc cutting may also result in a lack of oxygen.
4. Electric shock from portable lights, tools, or associated electrical equipment.
5. Injury from mechanical equipment such as mixers, conveyors, etc, inadvertently activated.
6. Bodily injury from direct contact with corrosives of dermatitis-producing chemicals.
7. Physical hazards such as slipping, falling, and falling objects
8. Burn hazards resulting from accidental opening of a steam valve in a line which has not been blanked off or disconnected.



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4. PROCEDURES

The hazards inherent in tank entry can be avoided or overcome if the following principles are applied properly each and every time a tank is entered.

4.1 Establish a definite system of pre-planning for entry and a worker instruction program.

4.1.1 Pre-Planning. Survey the various tanks requiring entry and evaluate the hazard potential. All concerned shall agree to the detailed standards and procedures established. There shall be no doubt as to exactly what is meant. Worker and supervisor alike, shall be fully informed both as to fundamentals and specific requirements. Close liaison and job planning between various groups such as production and maintenance are essential.

4.2 Prepare the area or vessel for entry by physically isolating it, cleaning it to remove contaminants, and testing it to insure absence of such contaminants.

4.2.1 Preparation of Tank.

4.2.1.1 Cleaning. According to the nature of the product, the tank shall be cleaned and emptied of residual product by hot or cold water flush, by steaming, by chemical neutralization or by air purge, with harmful vapors vented safely to the outdoors.

If the tank is steamed, it shall be allowed to cool before entry. Steam shall not be introduced below liquid surfaces in tanks being cleaned. Non-miscible solvents sometimes will stratify and burst out at almost explosive pressures due to the difference in boiling point temperatures between the water layer and the solvents.

After the material has been drained, sludge or incrustation shall be removed, to the greatest possible degree, by operation from outside the tank if possible. Protective clothing and respiratory protection shall not be used as a substitute for cleaning and ventilating, except in extreme emergency -- for example, saving a life or making emergency surveys or repairs. For the same reasons no one shall enter a tank containing a flammable atmosphere or one which because of oxygen deficiency or contamination may be so immediately harmful as to prevent escape from the tank in case of failure of the respiratory equipment.

4.2.1.2 Ventilation. The tank shall be thoroughly ventilated by some positive method of mechanical ventilation so arranged as to avoid recirculating contaminated air or

contaminating adjacent areas. After the tank is cleaned and ventilated, the mechanical ventilation equipment shall be kept operating to provide secondary protection in case of accidental introduction of harmful chemicals; to remove contamination that may be produced by residues of the tank's contents or by work in the tank such as welding and cutting, painting, coating; to cool the tank; or to otherwise improve working conditions.

Should decontamination involve flammable liquids, vapors, gases or ducts, all sources of ignition shall be eliminated. For example, to eliminate any accumulation of static electricity and prevent autogenous ignition of flammables which may be in the tank, steam should be introduced at relatively low pressure and velocity. Steam lines shall be electrically bonded to the tank if the tank contains any flammable material. If the percentage of combustible vapors is greater than 20% of the lower explosive limit, no work shall be permitted where a source of ignition is in contact with the enclosed space.

4.2.1.3 Isolation. The tank shall be completely isolated from all other systems and equipment by taking positive and adequate measures to prevent harmful material (solid, liquid or vapor) from entering the tank while workmen are inside or after cleaning. The isolation procedures given below should be coordinated with cleaning operations to prevent recontamination.

All supply lines connected to the tanks shall either be physically disconnected and capped or a "Figure 8" blind or a slip blind shown in Figure 1 inserted between the pipe flanges. The disconnection shall be made or the blind installed as close to the tank as practicable to prevent drainage from trapped sections.

It is not permissible to close and tag out valves to achieve isolation. Sad experience shows that even when closed, a valve may leak dangerous liquids or gas and even when tagged out, a valve can be accidentally opened.

The open ends of disconnected lines shall be capped to prevent any flow from hitting personnel outside the tank or possibly entering a tank opening.

The above procedures apply also to the steam connections of a tank jacket, and, in the case of welding on the wall between the inner tank and the jacket shall apply to water, brine or air lines to the jacket.

Drain or overflow lines shall also be disconnected or blinded if they extend into a sewer from which steam or fumes could be conducted back to the tank or if they connect to other equipment or extend to a remote location.

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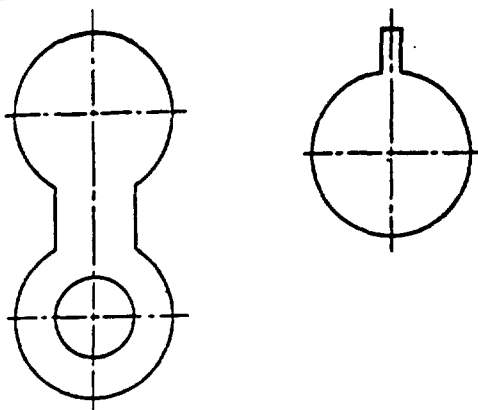


Figure 1. The "Figure 8" blind is a two-position device which is obviously open or closed. With single blinds, a removable annular spacer is often placed in the line to provide space for the blind. Some plants drill a small hole in the handle of the spacer to distinguish it from a blind which, therefore, must have no hole in the handle. With this identification, blinds must be ordered with care since some are commercially available with holes in the handle for hanging.

Exceptions to normal blanking procedure, such as bleeder valves tagged in the open position, shall be approved only by qualified supervision. Exceptions should be made only when thoroughly justified and not as a matter of expediency. Approval of exceptions requires that adequate alternative measures be taken to protect the worker.

Caps and blinds must be of a material and design to withstand the chemicals and pressures to which they are subjected and identified accordingly.

4.2.1.4 Lock Out. Line-disconnect switches supplying power to any mechanical apparatus in the tank such as mixers, conveyors, etc., shall be tagged and locked in the "off" position. It is not adequate to lock a push button station as it still may be possible to energize the circuit. The key should be kept by the man in the tank, and he alone shall be authorized to unlock the switch and remove the tag on completion of the job. Where more than one man is exposed, each shall place his own lock on the switch. In certain cases, it may be advisable, as further protection, to have a plant electrician pull the line fuses in the electrical circuit involved to take other positive steps to guard against accidental energization. Where there is a line shaft, the belt or chain drive shall be removed or similar positive measures provided such as mechanical latches.

See Alcoa Standard 18.3, Tagout and Lockout Procedures.

THIS STANDARD ALSO CALLS FOR INDIVIDUAL LOCKS & KEYS

4.2.1.5 Testing. If the tank has held any flammable or toxic material before flushing; if it contains any residue or sludge which may release flammable or toxic gases or vapors; or if oxygen deficiency or excess is suspected or even possible, tests of atmosphere in the tank at critical points shall be made immediately before entering and before performing any hot work such as the lighting of torches. Presence of flammable or toxic vapors, excess oxygen or oxygen deficiency should be determined by direct reading instruments or chemical analysis. Single-fluid instruments which absorb both oxygen and carbon dioxide should not be used for oxygen determination. Interim tests of the atmosphere in the tank should be made as often as may be necessary while the work is in progress. Continuous sampling and analysis with automatic alarm may be indicated.

4.3 Use a formal permit system requiring written authorization for entry to be issued only (after the supervisor in charge) is satisfied personally with tank preparation, precautions to be taken, personal protective equipment to be used and procedures to be followed.

4.3.1 Issuance of Permit for Entry. The tank entry permit is authorization and approval in writing. It serves as a check list to insure that all existing hazards are considered and evaluated, and that the correct protective measures are taken.

No employee shall enter any tank without reporting to and securing approval from his immediate supervisor who in turn secures entry approval from the supervisor to whom the tank is assigned. The supervisor to whom the tank is assigned shall discuss the project in detail with those entering the tank. He shall review the hazards of the product or other materials to which they may be exposed. He shall furnish all the safety information he is able to provide. Then supervisors of various men to be involved shall review and complete the permit form jointly. Appropriate supervisors must be certain by personal investigation, immediately before entry and before signing the permit, that the entry and its incidental work will be safe. To insure continuation of safe conditions, if a pause of appreciable duration occurs during the carrying out of a job, the site must be re-investigated by the authorized signer before the job can be resumed. Commencement of a new shift shall always require re-investigation and a new permit. No permit shall be valid except for the job, location, persons and time specified. A sample of a work permit form is shown on the last page of this standard.

4.4 There shall be appropriate follow-up to insure that the system is being followed exactly.

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THIS IS CONTRARY TO OUR DANGER TAG LOCK OUT PROCEDURE

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THIS WORK
OF REPAIR

MAINT. & PRODUCTION

IN "NOT"



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5. PRECAUTIONS

5.1 Painting. Read carefully Alcoa Construction Department Standard 33.1.10, Construction and Maintenance Painting - Safety in Painting. In addition, rules have been developed which must be observed in the handling of synthetic resin coatings in enclosed areas. These rules are good practice for the application of any coating in enclosed areas where flammable solvents are a factor.

The first and most important point is ventilation. It must be stressed that adequate ventilation, wherever solvents are found, is the key to their safe use. This is true whether they are aliphatic hydrocarbons with low toxicity, or aromatic hydrocarbons with more dangerous physiological properties. It cannot be overemphasized that adequate ventilation, from either a fire, explosion or health hazard standpoint, is the key to good coating practice wherever these materials are used in enclosed areas.

Ordinarily, no fire hazard will exist if the solvent vapor concentration in air is kept below 1%.

Since the solvent vapors are heavier than air, they have a tendency to concentrate in the lower portions of a tank or closed structure. Therefore, the ventilation system should be operated in such a way as to prevent pockets of solvent vapor being concentrated in the lower portions of enclosed spaces. This can ordinarily be accomplished by sucking the air from the bottom of the tank, so that the circulation is from the top manholes or openings down through the tank and up through the blowers. In this way the solvents are swept down and immediately sucked away from the bottom portion of the tank, eliminating any pockets of solvent vapor which might be above the explosion limit. An alternate procedure is to blow ventilation air into the tank.

Maintain ventilation in the coated tank until the coating is sufficiently dry so that any remaining solvents cannot release solvent vapors to the extent that they exceed the lower explosive limit.

The next precaution to be observed is the use of spark-proof and explosion-proof equipment. Electrical equipment and lights shall be explosion proof; tools and shoes shall be spark proof. The use of such equipment has been common practice in the application of synthetic coatings for a number of years.

All smoking, matches, fire, flames or torches shall be prohibited within fifty feet of the area where coatings are being applied.

If the integrity of the atmosphere cannot be guaranteed, all men working in enclosed areas shall wear self-contained, continuous-flow or pressure-demand supplied-air respirators to supply them with a flow of clean air at all times.

Where epoxies, epoxy coal tar, coal tar, phenolic resins or other skin irritants are applied, protective clothing shall be worn to eliminate contact with the liquid coating.

If these rules are followed during the application of any coating in enclosed spaces, the hazard from fire, inhalation of fumes or contact with the liquid should remain at a level which will provide maximum safety to the individual workman.

5.2 Welding. Employees performing electrical welding in tanks shall be provided with and required to use rubber blankets and such other personal protective equipment as may be required. Welding and cutting torches must not be taken into the tank until ready to be used and must be removed from the tank immediately after use. Cylinders of oxygen or other gas shall never be taken into tanks, and shall be turned off at the cylinder valve when not in use.

5.3 Tools. Hand tools shall be clean, in good condition, and shall be selected carefully according to the uses intended. Spark-resistant hand tools are usually preferred where a possibility of flammable vapors or gases exists unless the area is well wetted down with water.

Portable power tools and equipment shall be clean and in good condition. Electrical tools and equipment such as hand lamps and extension cords shall be grounded. If the tank is a "Hazardous Location" under the definitions of the National Electrical Code, the tools and equipment shall also be of the explosion-proof type. In any Class I exposure (also Class II in dangerous flammable dust concentrations) it may be preferable to use air-operated power tools. Even in these circumstances, however, careful thought must be given to the possibility of fire or explosion from struck sparks, overheating of the tool (as in drilling), electrostatic generation from discharge of compressed air, or other mechanical sources.

5.4 Ladders. Ladders used in tanks shall be lashed at the top, and if possible, at the bottom.

6. PERSONAL PROTECTIVE EQUIPMENT

Proper protection may range from especially designed complete coverage suits for protection against highly toxic chemicals harmful by absorption through the skin, to chemical goggles, hard hats, gloves, and safety shoes normally worn to protect against routine hazards.

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Employees should never unduly expose the skin when working in tanks, and should wear full coverage of clothing at all times. When burning or welding is done inside a tank, supervision should consider the use of flame-proofed clothing by the employees involved.

Self-contained, continuous-flow or pressure-demand supplied-air respirators shall be used if the integrity of the atmosphere cannot be guaranteed and if there is any possibility of air contamination of a harmful nature or of oxygen deficiency while employees are within an enclosed vessel. The air supplied shall be of respirable quality. The use of canister-type masks, which operate on the principle of chemical absorption or mechanical filtration, may not afford adequate protection and shall, therefore, not be used.

Equipment shall bear the NIOSH or Bureau of Mines approval, shall be suited specifically to the type of exposure and shall protect against the worst condition that might be encountered. As part of pre-planning, information as to the best type of respiratory protection should be ascertained in advance according to the specified exposure involved.

7. OUTSIDE OBSERVER

Employees in a tank where the potential exposure is hazardous to life must wear a body harness with a life line attached and an outside observer must be in close attendance at all times. Such an arrangement must be in effect during any painting, welding, other operations where respiratory protection is required or where rescue may be difficult. It is good practice, however, to use a body harness for any vessel entry work.

A body harness and life line or safety coveralls with a built-in harness and life line shall be used when the shape, size and location of the tank space permits the safe emergency removal of personnel by standby personnel without requiring entry of the tank. When the shape, size and location of the tank does not meet this requirement, a specific procedure for the rescue of personnel must be developed in the pre-planning stage of the tank entry work and made a specific part of the tank entry permit. In some cases it is advisable to have a block and tackle positioned on a

tripod or otherwise fastened above the manhole. For obvious reasons, manholes large enough to accommodate the man and his safety gear should be provided, such as a 24" diameter for circular ones. Where existing manholes are smaller than 20" in the largest dimension, wrist harnesses often are practical.

The free end of the life line shall be secured to a fixed object and shall be attended by an observer who will keep the man in the tank always within his vision. The observer may pass tools, but he must have no other job which will take his attention away from the man in the tank, which will interfere with his attempts to withdraw the victim by use of the life line, or which will require his leaving the vicinity of the tank for any time whatever.

In case of emergency, the outside observer must never enter the tank until he is relieved at his post. It is his job to summon aid immediately (various alarms, such as a whistle, may be used), to attempt to remove the victim by use of the life line, and to perform all other necessary rescue functions from outside. Upon the arrival of help, he may enter the tank for rescue work only when he is assured that his outside assistance is adequate. Such safety observers shall be well trained in basic First Aid principles, such as rescue breathing techniques. Rescuers entering the tank must be protected with the safety facilities required by the situation, i.e., life lines and harness, and proper personal protective equipment. For rescue purposes at least one unit of self-contained breathing equipment shall be located outside and convenient to the tank together with harness, rope and such other emergency equipment as may be indicated. It is better to have too much equipment at job site than too little -- too late! Where the possibility of fire is involved, fire extinguishing equipment adequate to cope with the fire that may be encountered shall be provided. The number of men in a tank, particularly at the time of burning or welding, must be reduced to the absolute minimum necessary for the work itself.

The supervisors concerned must be trained to be on the alert, before and during the job to detect and correct immediately new and different hazards or to stop the work until the new hazards are corrected.

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WORK PERMITREQUIRED 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
☐ Sewers ☐ Other Machinery

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