

Precautions for Cleaning Water-tube Boilers

NOTE: The following is adapted from a report based on work by the Yale Occupational Health Program with CEUI/SEIU Local 511, a state employees union in Connecticut, in 1990 and 1992.

I. Preparation for cleaning

A. Shut-down and cooling. Boilers must be shut down several days prior to cleaning to allow cooling. Fireboxes of water-tube boilers should be cooled to essentially ambient temperature prior to entry. They must be left open to the room with the draft open to assure adequate ventilation before entry.

B. Lockout/Tagout. In accordance with the OSHA Lockout-Tagout standard, 1910.147, a program and procedures must be established for affixing appropriate lockout devices and tagout devices to energy isolating mechanisms, and to otherwise disable machines or equipment to prevent unexpected energization, start-up, or release of stored energy in order to prevent injury to employees. The standard specifies that the employer must train employees in the safe application of these procedures. If outside contractors are employed, the two employers must inform each other of their respective lockout and tagout procedures and ensure mutual understanding and compliance.

! Electrical load centers to all motor-driven auxiliary equipment (including fuel pumps and flame failure devices) should be de-energized and locked out. Where fuses are provided and accessible they must be removed while the boiler is out of service.

! Valves and/or piping to interconnected systems (such as steam, blow-off, and feedwater) should be fully closed and locked, and common piping connections (with no stop valves) should be blanked off.

! The safety procedures must specify who is responsible for each phase of the isolation of the boiler and its return to service. Where more than one person is involved, the person with prior authority must determine that all safety measures are in effect before allowing anyone to enter a boiler.

C. Working in Confined Spaces. The OSHA Confined Space standard, 1910.146, requires the establishment by the employer of restricting conditions based on the hazard(s) identified within the confined space and a written entry permit. It sets forth the conditions which must be met before authorized people would be allowed to enter the space. Training requirements for authorized entrants and for attendants who must be stationed outside the permitted space are also specified.

The need for an entry permit is based on the presence of a hazardous atmosphere within the confined space. The original report noted:

"On the basis of sampling, done in the course of this project, entry to the firebox of a boiler for cleaning would be considered a permit-requiring confined space, due to the potential exceedences of the OSHA PEL for vanadium pentoxide, nickel, arsenic, lead, and cobalt." (Emphasis added.)

"Total dust levels can also be quite high and may constitute a condition of obscured vision at a distance of 5 feet, fulfilling another definition of hazardous atmospheres and triggering the need for a permit. Exceedence of the PEL for vanadium is almost a certainty if any welding or cutting for tube repair or replacement is to be done. If any cutting of welding is done inside the fireboxes a permit would certainly be required."

Permits for entry in confined spaces should include:

- (1) the hazards of the permit space
- (2) specific measures to be taken to ensure isolation of the space
- (3) lockout/tagout procedures as required to satisfy the lockout/tagout standard
- (4) measures for purging, ventilating and flushing the space
- (5) communication equipment or method
- (6) rescue procedures
- (7) requirements for personal protective equipment (see below)
- (8) other information, such as times, dates, purpose of entry, authorized entrants and attendants, and person in charge

II. Facilities and Equipment

Showers must be available so that workers may clean up as soon as they have finished a cleaning operation. Soot may contain skin sensitizing agents and polynuclear aromatic hydrocarbons (PAHS) which should be removed from skin surfaces as soon as possible.

A vacuum cleaner with an effective dust containment bag must be available. Brushes and brooms which can cause dust to become airborne must not be used for removal of loose dust or soot. Shovels may be used to pick up wet material but vacuums should be used for dry dust and debris.

All electrical circuits should be provided with ground fault circuit interrupters (GFCIs). Where electrical convenience outlets are subject to damp environments or water exposure, they must be of waterproof design.

A. Water-tube boilers — Fireside

Air lance. If an air lance is used it must be equipped with dead man controls, i.e. it must have an on/off switch such that the flow of compressed air ceases when the pressure on the control is released.

Scaffolding. If the firebox is of a size that the tubes cannot be reached from the ground, proper scaffolding must be brought in and erected.

B. Water-tube boilers— Waterside

A portable blower must be available so that the steam drum and mud drums can be ventilated prior to entry to assure sufficient oxygen.

III. Personal Protective Equipment

A. Waterside

As long as only water is used for cleaning, eye protection (goggles) should be used but no other PPE is required unless there is contact with corrosive chemicals. In these cases acid and alkali resistant disposable clothing should be used. The inside of goggles can be coated with a fog-proof material or a layer of water to prevent fogging. In those instances where mechanical means is used to brush scale from the tubes, coveralls and gloves must be worn. Eye protection should also be worn,

and if dust is generated, a respirator should be used. If the cutting tool is noisy, hearing protection should be used.

Removal of scale through handholes after waterside cleaning has caused serious skin irritation in some plants. The use of long rubber gloves would prevent irritation. If gloves are not feasible, a barrier cream could be used to protect the skin.

B. Fireside

Water-tube boilers requiring entry into a confined space:

Respirators. A supplied air respirator must be used to enter compartments. This shall be supplied by a breathing air compressor and shall meet the OSHA requirements for supplied air. An oil lubricated compressor must not be used. Air should be cooled if necessary for comfort. If neither tube cleaning nor tube replacement is required and only a vacuum cleaner will be used to perform the entire job, then a supplied air respirator need not be worn. An air purifying full-face respirator is recommended in such a case.

Clothing. Coveralls, either disposable or washable, must be provided and worn for fireside cleaning. The soot contains polynuclear aromatic hydrocarbons (PAHs) which can cause cancer. Immediate washing of the skin is essential after contact with soot. These coveralls should be removed after cleaning and should not be worn home or taken home for laundering. If the head is not covered by the supplied air equipment, a disposable hood or head covering should also be worn to prevent soot from collecting in the hair. Work gloves must be provided and worn. Hard hats must be worn if there is the possibility of chunks of slag falling.

Eye protection. Eye protection to prevent dust from getting into the eyes must be provided. This may best be accomplished by the use of either a full face mask as receiver of the supplied air, by the use of a hood as receiver of supplied air, or by the use of a hood worn over a half-face mask receiver of the air supply.

Hearing protection. Hearing protection must be worn if any powered cleaning equipment is in use. This includes vacuums, powered tube brushes, air lances and pressure hose.

IV. Procedures

Soot blowers, if available, should be blown before the boiler is removed from service.

Valves to interconnecting systems (such as steam, blow-off and feedwater) should be fully closed, locked, tagged and common piping connections blanked. If the boiler is in battery with operating boilers, the blow-off valves on the operating boilers and pipes to a common discharge must be secured. The blow-off valves on the operating boiler shall not be opened until the blow-off valves on the unit being removed from service are closed and locked. All lockout/tagout procedures should be in place.

Water-tube Boilers:

If compatible with cleaning, boilers should be cooled to room temperature.

A confined space entry permit should be filled out specifying hazardous atmospheres as described above and PPE provided according to above guidelines. Training must be provided as spelled out in the OSHA standard for both authorized entrants and attendants.

Someone must be designated and trained to stand at the entry to monitor and assist those working in the confined space.

Fireside: The draft must be opened to allow as much air to pass through the firebox as the people working inside find tolerable. Air should be entering the firebox through the man-hole and air entry ports and should exit out the flue. The firebox should have a good breeze passing in through these ports and out the flue at all times. It must be well-ventilated before entry.

Waterside: Mud and steam drums must be ventilated prior to entry to ensure sufficient oxygen. Waterside confined spaces may not require permitting as the atmosphere inside is not likely to violate a PEL, be excessively dusty or flammable, or, if ventilated prior to entry, be oxygen deficient. Appropriate entry procedures must be in effect and checked prior to entry. An attendant must be stationed outside to help and keep an eye on the person working in the drum. Both must be trained in the hazards and what to do in an emergency.

Workers must scrupulously adhere to all lockout/tagout procedures. Low voltage (12 volts) extension lights should be used inside steam/water drums. No one should enter a steam/water drum or a mud drum until it has been determined that there is no leakage into these areas.

V. Medical Surveillance

A. With proper protective equipment and procedures for cleaning, no routine medical surveillance should be required beyond that to determine eligibility for the respirator program per OSHA Respiratory Protection standard, 1910.134.

B. Anyone doing fireside cleaning is potentially exposed to significant amounts of vanadium-containing ash and should receive routine annual spirometry to monitor chronic changes in lung function.

C. Audiograms should be provided to everyone working in the heating plants at hire and annually unless noise at the workplace can be documented to be too low to be causing hearing loss.