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University employees should observe the following general safety guidelines when performing hot work operations. Also see the Hot Work Guidelines EH&S 02-008. Hot work is defined as: brazing, cutting, grinding, soldering, torch-applied roofing, pipe thawing and welding.

- Areas with hot work need to be kept clean and free of any excess materials, especially combustible material.
- Do not perform hot work operations in a building when sprinkler protection is inoperable or off-line for repairs, except with specific permission from the Department of Environmental Health and Safety (EH&S). Phone 412-624-9505 or 412-298-7998.
- Only authorized employees with proper training are permitted to perform hot work.
- Employees performing hot work must wear the personal protective equipment required for the job. Clothing shall be free of excessive grease and oil. Fire extinguishers shall be readily available. DO NOT wear clothing that can potentially increase the extent of injury, if the clothing would ignite and continue to burn, or if it melts on the skin. Thus, workers are prohibited from wearing clothing materials made entirely of, or blended with, synthetic materials such as acetate, nylon, polyester or rayon.
- Only perform hot work in an area that has restricted entry by unauthorized personnel.

WELDING AND CUTTING GUIDELINES

1. Cylinders

- 1.1. Oily or greasy substances shall be kept away from cylinders, cylinder valves, couplings, regulators, hose and other equipment. Any equipment that has been subject to oil and grease shall be thoroughly cleaned before being placed back into service.
- 1.2. Fittings shall never be lubricated. Only approved materials shall be used on oxygen equipment.
- 1.3. Contents of cylinders shall be identified by commonly accepted names legibly marked on the cylinder. Do not rely on color codes because there are no standard color codes for cylinders. Report any unlabeled cylinder to your foreman or supervisor.
- 1.4. All cylinders shall be provided with approved pressure relief devices. No repairs of any kind are to be attempted on any cylinder. Safety devices on cylinders or apparatus shall not be tampered with or removed.
- 1.5. Oxygen cylinders shall not be stored in the same compartment with cylinders of acetylene or other fuel gas, unless separated by a minimum of twenty (20) feet or a fire-resistant partition.

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- 1.6. Cylinders shall always be stored in an upright position. Provisions should be made to prevent their falling over or being struck by other objects.
- 1.7. Cylinders shall not be stored in locations where they might be exposed to excessive heat.
- 1.8. All empty cylinders shall be marked ('MT') and returned to their proper storage compartments with valves tightly closed and caps replaced.
- 1.9. During transportation, cylinders shall be secured in an upright position.
- 1.10. When an oxygen and an acetylene cylinder are mounted together on a cart, a partition of steel or other non-combustible material shall be installed between the cylinders.
- 1.11. Do not place cylinders where they might become part of an electric circuit. When cylinders are used in proximity to electric welding, precautions must be taken to protect the cylinders against accidental grounding.
- 1.12. A cap shall protect cylinder valves when the cylinders are not in use or are being transported. If the valve cannot be opened by hand, the cylinder shall be tagged and exchanged for a new one.
- 1.13. Cylinder valves shall not be tampered with nor should any attempt be made to repair them.
- 1.14. Fuel gas leaks can generally be identified by odor and the location determined by applying soapy water. If a leak is discovered in a cylinder, it shall immediately be moved to fresh air and away from any source or ignition, the valve opened slightly, and the contents allowed to escape to a safe location.

2. Pressure Reducing Equipment and Torches

- 2.1. Oxygen, acetylene and other compressed gases shall never be used from a cylinder without reducing the pressure through a pressure-reducing regulator bearing an Underwriter Laboratory (UL) or Factory Mutual (FM) approval.
- 2.2. Oxygen regulators shall be used only on oxygen cylinders and fuel gas regulators only on fuel gas cylinders. Oxygen regulators are provided with national standard right-hand threads and fuel gas regulators with left-hand threads.
- 2.3. Handle all pressure regulating equipment with care to avoid damage to the mechanism.
- 2.4. Never use oil or grease on cutting or welding equipment for any purpose.

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- 2.5. Regulators in need of repair shall be returned to the supplier or a vendor authorized to make repairs. Inspect regulating equipment and torch prior to every use. Remove unsafe equipment from service.
 - 2.6. Always stand to the side of regulators when opening or closing valves and making adjustments.
 - 2.7. When a regulator is not in use, the pressure adjusting screw shall be released and the cylinder valve closed. A cylinder valve shall never be opened until the pressure adjustment screw on the regulator is fully released.
 - 2.8. When burning or welding overhead, the regulators on the cylinders shall be properly protected to prevent sparks and objects from falling on them.
 - 2.9. Regulators shall be removed from cylinders before cylinders are moved from one location to another, unless they are in a carrier specifically designed for transporting.
3. **Hose**
- 3.1. All units should be equipped with back-flow prevention and flash back arrestors.
 - 3.2. New hose should be tested for leaks before use.
 - 3.3. Oxygen and acetylene hose shall be fastened together with tape or approved clamps at intervals of three to four feet along the hose. Care must be exercised to prevent hose from being damaged.
 - 3.4. Hose shall be fastened to the regulators and torches by approved fittings only. It is important that all connections be kept tight.
 - 3.5. Use hose and connections made especially for gas welding and cutting. Red colored hose shall be used for acetylene or other fuel gas and green colored hose for oxygen.
 - 3.6. Care shall be taken that the hose does not become kinked or tangled. Place the hose so that it will not be trampled on, run over or present a tripping hazard.
 - 3.7. Examine hoses for defects before every use. Defective hose shall not be used.
4. **Operation**
- 4.1. Hot work is prohibited:
 - 4.1.1. On partitions, walls, ceilings or roofs with combustible coverings or cores (e.g., expanded plastic insulation, sandwich panels).
 - 4.1.2. In areas containing unprotected flammable liquids, vapors or gases, combustible dusts or combustible metals.

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- 4.1.3. On or in rubber lined equipment.
- 4.1.4. In an oxygen-enriched atmosphere.
- 4.1.5. In storage and handling areas for oxidizing materials or explosives.
- 4.1.6. In other areas where hot work cannot be performed safely.

4.2. University personnel may only conduct welding and cutting outside of designated hot work areas when specifically authorized by the foreman or sub-foreman and the following conditions are verified:

- 4.2.1. No other suitable non-hot work means can be found to produce the desired result;
- 4.2.2. No other safe location can be found to do the hot work; and
- 4.2.3. The designated person(s) involved with authorizing and conducting the hot work have complied with all hot work permitting process requirements, including all precautions and required follow-up actions. Contractors hired to do work potentially involving hot work must comply with all requirements of the hot work permitting process and will be overseen by a designated University employee.

4.3. Do not perform any welding or cutting operations in any area where there is danger of fire unless you have received permission to do so from your foreman or sub-foreman. Provisions for hot work authorization shall be made and a fire watch provided to properly safeguard the area.

5. Attaching Regulator to Cylinder

- 5.1. Keep hands and gloves free of oil and grease.
- 5.2. Stand to one side when opening valve.
- 5.3. Open discharge valves slowly.
- 5.4. With the cylinder secured in place upright, and the outlet valve pointed away from the operator, the valve shall then be opened sufficiently to blow any dirt out before attaching the regulator.
- 5.5. Close the valve and tightly attach the regulator to prevent leaks. The pressure adjusting screw shall be fully released before slowly opening the cylinder valve. Do not stand in front of the outlet.

6. Procedure for Use of Cylinder Valves, Regulators and Torch Valves

After equipment has been assembled and connected for use, the following procedure shall be employed before putting the equipment in service.

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- 6.1. Oxygen cylinder valve shall be opened slowly so that the needle on the high-pressure gauge rises slowly. The valve shall then be opened as far as possible. Regulate desired oxygen pressure. Wrenches shall not be used on oxygen valves.
- 6.2. Acetylene cylinder valve shall be opened one and one quarter turns with the "T" handle wrench, which is supplied for the cylinder. This wrench shall be kept on the valve while equipment is in use. Regulate desired gas pressure, which shall never exceed 15 pounds per square inch.
- 6.3. Purge each hose before lighting the torch.
- 6.4. Use only a friction lighter to ignite torch. Matches or other flames are prohibited.
- 6.5. Always stand to the side of regulators when opening valves.
- 6.6. Light acetylene, adjust flame, and then adjust oxygen.
- 6.7. In the case of a "backfire", (which is the flame going out with a loud snap) the torch may relight itself. If the torch does not relight itself, the oxygen valve must be shut off quickly; then close the gas valve. After a moment relight in the regular manner. If a "flash-back" (which is the flame flashing back inside the torch, and which may extend to the hose and regulators) occurs, the torch oxygen valve shall be closed quickly, then the acetylene valve and the valves of both cylinders shall be closed. All torches and regulators must be provided with reverse flow check valves and flashback arrestors on both oxygen and fuel gas connections to reduce the possibility of "backfires".
- 6.8. When finished with the torch, the fuel gas shall be turned off at the torch and then the oxygen. Gas shall not be kept burning on the end of the tip as a pilot. This practice will apply excess carbon on the torch and render it dangerous. Keep torch tips clear of all foreign material.
- 6.9. When finished using or moving the equipment, employees must ensure that cylinder valves are closed and the pressure on regulators relieved.
- 6.10. The regulator thumbscrews shall be backed off and the pressure released from the low-pressure gauges, unless the operator will be using the equipment again within a few minutes.
- 6.11. Do not shut off cylinder valves or leave equipment with regulator thumb screws turned in.
- 6.12. If creeping is noted on the working pressure gauge hands, this is an indication that the regulator is faulty and must be repaired.

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6.13. The valves on the torch and all connections shall be examined daily for leaks before lighting the torch. If leakage is noted around the valve stems, tighten the packing nuts and if this does not correct the situation, have proper repairs made by an authorized person.

6.14. Use great care not to allow the oxygen pressure to fall below the working pressure of the acetylene regulator. Fuel gas may flow back into the oxygen cylinder, forming an explosive mixture, which is highly dangerous.

7. Arc welding and cutting

7.1. Electrical Connections

Before starting operations:

- 7.1.1. Make certain all electric lead welding connections are secure.
- 7.1.2. Firmly attach the ground connection as close to the work as possible.
- 7.1.3. Work leads shall be as short as possible.
- 7.1.4. The welding machine frame shall be grounded.

7.2. Electric Shock

It is important to take precautions to avoid electric shock. The following are especially important precautions to be taken:

- 7.2.1. Clothing, shoes, gloves and other protective equipment shall be kept as dry as possible.
- 7.2.2. Always wear approved hand protection and never permit the metal part of an electrode or holder to touch your body.
- 7.2.3. Electrodes shall be removed from the holder when not in use. Electrode holders, when not in use, shall be placed so they cannot make electrical contact with persons or conductive objects. Be careful to avoid shock when changing electrodes.
- 7.2.4. Check equipment regularly to see that electrical connections and cable are in good condition. Be particularly alert that the electrode holder cable connection is in good condition and secure. Only approved ground connecting devices and rod holders shall be used.
- 7.2.5. All welding lines and connections shall be insulated.
- 7.2.6. Welding machines shall be shut off when work is stopped.
- 7.2.7. Only authorized employees shall make repairs on welding machines.

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8. Welding or cutting in confined spaces

- 8.1. When welding or cutting in any confined space, such as a tank, boiler, pipeline or compartment, the space shall be cleaned, tested and ventilated during the welding operation. All requirements outlined in the University Confined Space Program must be followed. Permission must be received from the Department of Environmental Health and Safety prior to any hot work in a confined space.
- 8.2. When entering a confined space through a manhole or other small opening, means shall be provided for quickly removing employee in case of an emergency.
- 8.3. When arc welding in a confined space is to be suspended for any substantial period of time, all electrodes shall be removed from the holders and the machine shut off.
- 8.4. When gas welding or cutting in a confined space is to be stopped for any substantial period of time, the torch valves shall be closed and the gas and oxygen supply to the torch positively shut off at a point outside the confined area. The torch and hose shall be removed from the confined space or disconnected from the gas supply during such times. Atmospheric tests shall be made before re-entering.
- 8.5. Do not allow unlighted gas or oxygen to escape, and exercise extreme care that hoses and connections are free from leaks. The torch shall be lighted outside and passed with care to the employee inside.
- 8.6. Ventilation shall be provided to keep the space purged of any possible accumulation of flammable gas or vapors. If welding or burning is done on the outside of the structure and there is any possibility of flammable gases accumulating, the interior shall be properly purged to prevent any fire or explosion.
- 8.7. Welding or cutting is not to be done on or in any tank, pipe line, compartment or container which has contained flammable material until it has been thoroughly purged, cleaned and proved to be free from explosive vapors or any danger of explosion, by means of gas detector.

9. Protective Equipment and Clothing

- 9.1. Use of commercially available flameproof gloves, aprons, capes, hardhats or shoulder covers, skull caps, spats, leggings, and high boots follows as required:
 - 9.1.1. Aprons for protection against radiated sparks.
 - 9.1.2. Capes, shoulder covers, skull caps, and if required, ear protection for overhead welding.
 - 9.1.3. Fire resistant leggings and high boots for heavy work.

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- 9.2. Woolen clothing is preferable to cotton and protects against temperature change. Polyester, nylon, and other similar synthetic clothing shall be avoided. Fire resistant clothing, such as FR cotton or Dupont Nomex, is highly recommended.
- 9.3. Long sleeves are required and shall be buttoned. Cuffs and top pockets shall be avoided.
- 9.4. Pants shall not be tucked into boots while performing hot work.
- 9.5. Hard hat hoods are required while working in areas where there are overhead hazards, construction areas or where required by management.

10. Miscellaneous

- 10.1. Under ordinary conditions no artificial ventilation is necessary when welding in large or well-ventilated areas. However, special materials such as brass, galvanized or stainless materials may necessitate the use of portable exhaust fans or respiratory protection. Consult with EH&S.
- 10.2. When welding is done in a space screened off on all sides, the screens shall be so arranged that no serious restriction of ventilation exists. Screens should be mounted approximately one foot above the floor.
- 10.3. Where, because of the nature of the work or other reasons, it is not possible to sufficiently ventilate an area, welders shall wear approved respiratory protective equipment.
- 10.4. Electric/gas welding or cutting shall not be permitted over or in close proximity to a manhole without first testing with a gas-detecting instrument.
- 10.5. If the object to be welded or cut cannot be moved, combustible materials in the vicinity shall be removed to a safe place. If the object to be welded or burned cannot be moved and if the combustible materials near that object cannot be removed, then the combustible materials must be protected from heat, sparks and slag. A fire watch shall be provided and maintained.
- 10.6. Flammable materials in the area where burning and welding operations are to be performed shall be removed or protected from heat, sparks and molten metal.
- 10.7. Plasma torch cutting or inert gas shielded arc welding are specialized processes requiring that the manufacturer's recommendations with regard to safety procedures and personal protective equipment be followed.
- 10.8. Do not perform any welding or cutting operations on a concrete floor. Keep the work at least 12" above the floor.