The University of Michigan
Hot Work Safety Program

Prepared by:
The Department of Occupational Safety & Environmental Health
and
The Plant Work Safe Be Well Safety Committee
# PLANT HOT WORK SAFETY PROGRAM

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University of Michigan Plant Hot Work Safety Program

I. PURPOSE AND SCOPE

A. Purpose: When performing hot work, appropriate planning and precautions must be in place in order to eliminate or reduce the risks of fire, explosion, property damage, or worker exposure to health and safety concerns. This program is designed to help provide a safe work environment for employees performing hot work and employees working in and around hot work areas.

B. Scope

This program applies to all hot work conducted by Plant Division employees. Hot work includes cutting, welding, brazing, torch soldering, high speed metal grinding, or use of an open flame.

II. DEFINITIONS

A. **Fire Watch (observer)** - a person stationed in the hot work area who monitors the work area for the beginnings of potential unwanted fires. The fire watch may be assigned other work duties while in the hot work area.

B. **Hot Work** - cutting, welding, brazing, torch soldering, high speed metal grinding, or use of an open flame.

C. **Hot Work Safety Permit** - a written document that functions as a procedure guide and warning tag in prepping and performing hot work.

III. RESPONSIBILITIES

A. Plant Operations

1. Supervisors will:
   a. instruct their employees regarding the requirements of this program and keep records according to the Plant Safety Training Program.
   b. effectively enforce compliance of this program’s procedures, including the use of disciplinary action, for any violations or deviations from the procedures outlined in this program.
   c. assure that the equipment required for compliance with this program is in proper working order and made available for use by their employees.
   d. promptly investigate and report all on-the-job accidents or job related health problems relating to hot work.
   e. after the completion of work, collect the Hot Work Safety Permits and keep copies for at least two years.
2. Employees will:
   a. comply with the procedures of this program.
   b.consult with their supervisor, OSEH, or other knowledgeable personnel, when they have questions regarding their safety.
   c. report any accidents or job related injuries or illnesses to their supervisor and seek prompt medical treatment, if necessary.

B. Occupational Safety and Environmental Health (OSEH)
   1. The Plant OSEH Rep. will provide technical assistance, approve plans and set-ups for hot work as requested, and inspect job sites and permits.
   2. Provide training to Plant hot work employees, as necessary.

C. Construction Management
   Inspectors responsible for contract work performed by Plant will inspect hot work job sites and inspect permits.

D. Risk Management
   Risk Management, through the University’s property insurance carrier, Factory Mutual, will inspect hot work job sites and inspect permits.

E. Department of Public Safety
   Upon request, provide fire extinguisher training. May inspect hot work areas and permits.

IV. PROCEDURE - ALL HOT WORK
A. General Requirements.
   1. Hot work should only be done when there are no other means of accomplishing the work. If other methods cannot be used, then the issues of fire, worker, occupant, and property protection must be addressed when hot work is planned.
   2. To the extent feasible, hot work should be performed in shop areas specifically designed for such work (welding or machine shops). When this is not possible, a hot work permit will be used to manage the process and assure adequate precautions have been taken.
   3. When conducting hot work in a confined space, a Hot Work Safety permit and a Confined Space Entry Permit must both be used. See the Plant Confined Space Program for details on confined space entry.
   4. During welding or cutting, general ventilation may be required to keep the amount of metal fumes at acceptable levels. The ventilation must insure that workers and building occupants are not exposed to harmful levels of
gases, vapors or fumes from the hot work. As a general guideline, a ventilation rate of 2,000 cfm may be used for each welding/cutting operation in the area.

5. Local exhaust ventilation may be needed when working on materials containing or coated with zinc, lead, cadmium, beryllium, or mercury, especially when performed indoors or in confined spaces. Local ventilation may also be needed when using fluorine containing fluxes or filler materials. Contact the Plant OSEH Rep. for assistance in assessing these situations.

6. Chlorinated solvents should never be used on materials just prior to welding. If chlorinated solvents have been used, the material surface must be fully dried before welding can begin.

B. Fire Prevention Rules.

1. Work Area Preparation.
   a. Hot work is not permitted:
      i. within 50 feet of explosives, stored cylinders, or stored fuel.
      ii. unless authorized by a supervisor.
      iii. in the presence of a potentially explosive atmosphere.
   b. Combustible and flammable materials will be moved a minimum of 35 feet from the hot work area or covered with fire resistant material. Moving material owned by building occupants will be coordinated by the occupant/customer.
   c. Wet down wooden floors or cover them with a fire resistant material (such as fire resistant sheets), except when laid over concrete. NOTE: Arc welders must be protected from electric hazards. See Arc Welding section below.
   d. Use fire resistance material to cover cracks or openings in walls and floors (including ductwork) that are within 35 feet and through which sparks could pass.
   e. Have an “ABC” rated or other appropriate fire extinguisher immediately available to the work area during the hot work.
   f. Hot work shall not be performed on drums, barrels, tanks, etc., until they have been cleaned and purged of all flammable, combustible, or hazardous materials, gases or vapors. An opening in the tank shall be maintained during welding or cutting to vent gases or vapors.
   g. Smoke and fire detectors/alarms, in the immediate area of the hot work, must be temporarily disabled. This is coordinated through the Plant Electric Shop (647-2059) and DPS (763-3434).
h. Inform the building facility manager, or other contact person, of the location and estimated duration of the hot work job.

2. Hot Work Safety Permits: The permit tracks each step of the job, and functions as a procedure guide and warning tag. The permit must be used for hot work jobs done outside of permanent work areas specifically intended for hot work (such as the welding and machine shops). The worker will complete the permit, sign it, and conspicuously display it where the hot work is performed.

3. Fire Watch: A fire watch (observer) is needed during the following types of hot work:
   a. In a sprinklered building while the sprinkler system is impaired.
   b. When there are combustible materials within 35 feet of the hot work area.
   c. When there are large amounts of combustible and flammable materials present, even if located more than 35 feet from the area, but close enough to be easily ignited by a spark.
   d. Any time there is a high risk that a fire could start.

   However, a Fire Watch is not necessary if the fire detection system remains activated.

   The Fire Watch must have fire extinguishing equipment readily available and be trained in its use. He or she must also be familiar with the procedures for sounding an alarm in the event of a fire.

   The Fire Watch will watch for fires in all exposed areas and try to extinguish them first only when obviously within the capacity of the equipment available, or otherwise sound the alarm immediately.

4. Permit Close Out: At the completion of the hot work, the employee will inspect the work and surrounding areas for the possibility of smoldering or fire, assure that all hot work equipment has been removed from the area and if appropriate, re-activate the fire detection system. The building facility manager/contact person should be notified of completion of the work. The employee will then sign the permit, indicating appropriate close out procedures were completed.

5. Monitoring: If there is a possibility that a smoldering fire may start, someone will stay in the hot work area for 30 minutes after the hot work is completed, unless the fire detection system has been re-activated and it is in an occupied building or the alarm goes to DPS dispatch. The employee can conduct clean up and close out procedures during the 30-minute period.

C. Personal Protective Equipment (PPE).

1. Use PPE in accordance with the hazard assessment completed in compliance with the Plant PPE Program (see Appendix B).
2. Respiratory protection will be worn if the levels of gases, vapors or fumes are excessive and these levels cannot be controlled through adequate general or local exhaust ventilation. Air filtering, negative pressure respirators with filters or cartridges rated for dusts, mists and fumes are appropriate. Workers required to wear a respirator must be participating in the University’s Respiratory Protection Program. OSEH is the sole source for acquiring respirators.

3. Any employees working directly with the employee doing the hot work will wear the same PPE as the hot work employee.

D. Protection of Occupants.

1. Occupants not directly involved with the hot work must be protected from the hazards in the hot work area using one or more of the following techniques:
   a. Restricting access to the work area by using existing walls or partitions;
   b. Providing general or local exhaust ventilation to the hot work area;
   c. Keeping occupants a safe distance from the work area; or
   d. By erecting temporary screens.

2. Gases, vapors and fumes from the hot work must be prevented from entering the building’s ventilation system. Ventilation intakes in the area of the hot work will be sealed or shut off, and the hot work fumes vented to the outside of the building to the extent feasible.

E. Training:

The Plant OSEH Rep. can provide training to Plant hot work employees. Other training resources include the University Fire Marshal’s office and the University’s property insurance carrier, Factory Mutual. All employees should be trained in the following topics:

- hot work safety permit procedure
- general fire prevention rules
- use of fire extinguishers
- safe work practices for welding and cutting
- use of personal protective equipment

V. CAMPUS UTILITY TUNNELS - SPECIFIC WORK PRACTICES

The procedures described here apply to hot work performed in the utility tunnels, except those portions of the tunnels considered confined spaces. These procedures are in addition to those established in the Plant Tunnel Safety Program.

A. Ventilation is required. Fans/ventilators shall be used at the point of entrance and adjacent to the work area. If the exhaust is not through an alternate access, necessary precautions will be taken so the exhaust is not affecting another work
party that may be in the area. Note: Pressurized sources of oxygen shall never be used for ventilating purposes.

B. Conduct continuous air monitoring for carbon monoxide, oxygen and flammable gases throughout the project.

C. Leak test gas cylinders or welding machines and place them as far away as practical from the work site.

D. Extra care must be exercised in placing cylinders or welding machines in hot environments. Cylinders must be kept at 125°F or cooler and most welding machines are designed to operate in temperature of 104°F or less.

E. All work performed in tunnels will be conducted by a minimum of two workers together. If at any time a worker experiences headaches, dizziness, or any other signs or symptoms that they did not have prior to beginning work within the tunnel, they are to leave the tunnel immediately and contact their supervisor. If necessary, contact OSEH to assess the work area before work re-commences.

VII. WELDING & CUTTING - SAFE WORK PRACTICES

A. Cylinder Use.

1. Don’t use oxygen as a substitute for compressed air or any other use, except for hot work or life support procedures. Do not use liquid acetylene.

2. Only mix, pipe or manifold together fuel gas and air or oxygen at a burner or torch designed to burn the mixture.

3. Don’t move cylinders with attached regulators unless secured to a hand truck or powered truck designed or equipped for this purpose. Cylinders, full or empty, will not be used as a roller or support.

4. Close cylinder valves in the following circumstances: when moving a cylinder; when work is finished; during a prolonged break; when the cylinder is empty; and when the regulator is removed.

5. Hammers will not be used to open or loosen cylinder valves or caps. Thaw frozen or ice clogged valves with warm air or warm water and dry before using. Don’t use boiling water, flame, or force to loosen a frozen cylinder valve.

6. Protect cylinders from molten or hot metal, slag and sparks, electrical currents and accidental grounding.

7. Clear all valves of dirt by opening them slightly to release some gas and then re-closing them before making connections to other equipment. Open cylinders slowly to protect regulators from strong bursts of pressure.

8. Leaking cylinders, or a cylinder with the valve stuck open or a valve in need of repair, will be taken outdoors away from sources of ignition, slowly emptied, and tagged with warning sign. Do not remove the valve stem and contact the distributor.
9. Don’t block cylinder valves or place cylinders where the valves cannot be closed quickly.

B. Cylinder Storage.

1. Secure cylinders in the upright position, and so they don’t fall. Post cylinder storage areas with the names of the gases stocked. Cylinder storage areas will be located so cylinders will not be knocked over or struck by a passing or falling objects.

2. Store oxygen cylinders at least 25 feet from fuel gas cylinders or other highly combustible materials, such as oil, grease, flammable gases, or ignition sources, or separate them from these materials with a non-combustible wall, at least 5 feet high with a fire resistance rating of one hour. Store cylinders in a well ventilated area away from heat above 125°F.

3. A first in, first out system will be used to store cylinders. All cylinders, including empty cylinders, will have protective caps on when stored or shipped.

4. All cylinders, cylinder valves, couplings, regulator hoses and equipment must be kept clean of oily or greasy substances and not handled with oily hands or gloves. Keep oxygen jets from striking oily surfaces, greasy clothes or from entering a fuel, oil, or other storage tank.

5. Don’t drop, drag, strike, or roll cylinders on their side. Lift cylinders by crane or hoisting device only in cradles or enclosed in platforms. Don’t use electromagnetic hooks, slings or ropes.

6. Mark cylinders as “empty” or “MT” when depleted.

C. Hoses and Regulators.

1. Color code parallel hoses as follows: red - fuel gases; green - oxygen; and black - inert gas or air.

2. Burned, leaking, worn, or other wise defective hoses will be repaired or replaced.

3. Regulators shall be inspected for faulty seats, and tagged and taken out of service when damaged.

4. Close the cylinder valve and drain the regulator before removing it from the cylinder.

5. Mark regulators "Use No Oil" when used for oxygen.

D. Arc Welding and Cutting.

1. Insulation, or other protection, will be used when welding or cutting processes require open circuit voltages higher than 100 volts to prevent the operator from making accidental contact with the high voltage.
2. When electrodes are not in use place them so they cannot make electrical contact with an employee, fuel or gas tanks or conductive objects. Retract or remove electrodes when the machine is not in use. Do not use cylinders to strike an arc.

3. In damp conditions, or areas with a high relative humidity, workers will be protected from possible electrical shock hazards.

4. Do not cool electrodes by immersion in water.

5. Do not curl or loop welding cable around your body.
APPENDIX A
UNIVERSITY OF MICHIGAN HOT WORK SAFETY PERMIT

**NOTE:** All hot work done at the University Hospitals must have prior approval from Hospital Security (936-7890). Notify Hospital Security when hot work is completed.

Name of Employee: ___________________________ Employee No.: __________________

Work to be Performed: ____________________________

Location of Work Area: ____________________________

Is a Fire Watch Required? YES ____ NO ____ Name: ____________________________

Hosp. Sec. Approval (hospitals only): ____________________________ Date: ________ Time ________

**Required Equipment:** (inspected and operational) (check all that apply)
- Glasses/Goggles
- Shield/Helmet
- Body Protection
- Gloves
- Hard Hat
- Respirator
- Ventilation
- Communication
- Air Monitoring (tunnels only)
- Special Protection/Tools

**Hot Work Precautions Checklist:** Complete prior to starting hot work in areas not designed for hot work. Check each box where the statement is true. If any statements are not true, then hot work should not begin until that issue has been safely resolved.

**Before work begins:**
- Fire suppression sprinklers, fire hoses, or fire extinguishers are available and operable.
- Flammable or ignitable materials and debris have been moved at least 35 feet from the hot work area, or covered and protected with fire resistant material, or a fire watch provided.
- Smoke/fire detectors/alarms in the immediate area of the hot work have been temporarily disabled until the hot work is completed.
- Adequate ventilation is being used.
- Building occupants have been protected or isolated from the hot work area.
- Cracks or holes in floors, walls and ceilings (including ductwork) are covered or plugged.
- Welders have been protected from electrical hazards. Metal equipment and materials have been adequately grounded.
- Hot work equipment is operable and in good repair. Gas cylinders have been leak tested.
- Welding machines have been inspected.
- Drums, barrels and tanks have been cleaned and purged of flammables and toxics. All tank feed lines are closed and tank is vented.
- Workers and Fire Watch have been trained in the use of equipment and how to sound alarm.

I verify the precautions checked on this permit have been taken and that the work has been authorized. The creation or discovery of any work induced hazards or other unforeseen, actual, apparent or potential hazards will be assessed, and additional precautions taken, if necessary.

**Employee Signature (Issued):** ____________________________ Date: ________ Time ________

**When work is completed:**
- Inspected work area, and any potentially affected surrounding areas, for fire, fire damage, or potential for delayed or smoldering fire.
- Reactivated smoke/fire detectors/alarms that were disabled because of the hot work.
- Notified Hospital Security and/or building contact person that work is completed.

**Employee Signature (Closed):** ____________________________ Date: ________ Time ________

**Instructions:** Complete the heading portion of the permit and get prior approval, as necessary. Check that all safety equipment is available and serviceable. Complete the top portion of the precautions checklist and sign. Post the permit in the hot work area until the hot work is finished. When work is finished, inspect the work area and surrounding areas for possible smoldering fires, re-activate the fire detection system, complete the bottom portion of the precautions checklist and sign. If appropriate, notify Hospital Security, or other building contact person, that work has been completed. Give closed permits to your supervisor.

**Hot Work:** includes cutting, welding, brazing, torch soldering, high speed metal grinding, or use of an open flame.

Hot work is not permitted:
- * within 50 feet of explosives, stored cylinders, or stored fuel.
- * unless authorized by a supervisor.
- * in the presence of a potentially explosive atmosphere.

Fire extinguishing equipment will be readily available near all hot work areas. Workers and fire watch personnel will be trained in fire extinguishing equipment use, and be familiar with the procedures for sounding an alarm in the event of a fire.

**Fire Watch:** is a person stationed in the hot work area that monitors the work area for the beginnings of potential, unwanted fires. The fire watch may be assigned other work duties while in the hot work area, as long as they remain in the hot work area.

A fire watch is needed during the following types of hot work:
- * In a sprinklered building while the sprinkler system is impaired.
- * When there are combustible materials within 35 feet of the hot work area that cannot be covered or otherwise protected.
- * When there are large amounts of combustible materials present, even if located more than 35 feet from the hot work area, but close enough to be ignited by a spark.
- * Anytime there is a high risk that a fire could start.

However, a Fire Watch is not necessary if the fire detection system remains activated.

The Fire Watch must have fire extinguishing equipment readily available and be trained in its use. They must also be familiar with the procedures for sounding an alarm in the event of a fire.

The Fire Watch will watch for fires in all exposed areas and try to extinguish them, only when obviously within the capacity of the equipment available. Otherwise, sound the alarm immediately.

**Monitoring:** If there is a possibility that a smoldering fire may start, someone will stay in the hot work area for 30 minutes after the hot work is completed, unless the fire detection system has been re-activated and it is in an occupied building, or the alarm goes directly to DPS dispatch. Workers can conduct clean up and close out procedures during the 30-minute monitoring period.

**Smoke and Fire Detectors/Alarms:** Shut-offs and restarts are coordinated through the Plant Electric Shop (647-2046), DPS (763-3434), and Hospital Security (936-7890). Disabling of individual detectors/alarms should only be done with prior approval of these departments.

**Hospitals:** All hot work done at the University Hospitals must have prior approval from Hospital Security (936-7890). Notify Hospital Security when hot work is completed.
APPENDIX B
**UNIVERSITY OF MICHIGAN**
**PERSONAL PROTECTIVE EQUIPMENT GUIDELINE**
**CERTIFICATION OF HAZARD ASSESSMENT**

Department: **Plant Division**
Date: **8 SEP 97**
Analysis by: **Keith Trombley**

<table>
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<tr>
<th>Tasks</th>
<th>Potential Hazard</th>
<th>PPE Recommended</th>
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<tr>
<td>Arc Welding or Cutting</td>
<td>Electric shock, metal sparks, molten and hot metal, UV, IR and visible light, falling, dropping, rolling and sharp objects.</td>
<td>Insulating mats or blankets, insulated/heat and puncture/cut resistant gloves, safety shoes, hard hat, safety glasses, welding shield or helmet with appropriate eye shade*.</td>
</tr>
<tr>
<td>Oxy-fuel Welding or Cutting</td>
<td>Metal sparks, molten and hot metal, UV, IR and visible light, falling, dropping, rolling and sharp objects.</td>
<td>Heat and puncture/cut resistant gloves, safety shoes, hard hat, safety glasses, welding shield or helmet with appropriate eye shade*.</td>
</tr>
<tr>
<td>Torch Brazing</td>
<td>Metal sparks, molten and hot metal, UV, IR and visible light.</td>
<td>Heat and puncture/cut resistant gloves, filter lens spectacles or goggles, or safety glasses and hand held face shield, with appropriate eye shade*.</td>
</tr>
<tr>
<td>Torch Soldering</td>
<td>Molten and hot metal, UV, IR and visible light.</td>
<td>Heat and puncture/cut resistant gloves, filter lens spectacles or goggles, or safety glasses and hand held face shield, with appropriate eye shade*.</td>
</tr>
<tr>
<td>Metal Grinding or Chipping</td>
<td>Metal sparks and chips.</td>
<td>Heat and puncture/cut resistant gloves, safety glasses, full face shield.</td>
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* See Hot Work Eye and Face Protection Table (next page)

**NOTES:**
Use of specific PPE is only required when workers are exposed to the hazard. Workers in areas that cannot be adequately ventilated must be provided respiratory protection. All workers required to wear respiratory protection must participate in the Respiratory Protection Program. Insulated blankets or mats are only required when workers have an increase electrical shock hazard exposure. Additional head and face protection may be required when conducting overhead work. Eye protection should be increased as the type of hot work hazard increases. All workers exposed to noise levels above the OSHA action limit must participate in the Hearing Conservation Program. Workers working at elevations or on scaffolding must have adequate fall protection and conform to the Fall Protection Program. Workers working in areas with falling object hazards must have adequate protection from falling objects. Hard hats are only required where there is a falling object or head hazard.
### Hot Work Eye and Face Protection Table

Eye/Face Protection Against Radiant Energy and Metal for Arc Welding and Cutting.

<table>
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<tr>
<th>Operations</th>
<th>Electrode Size 1/32 in.</th>
<th>Arc Current</th>
<th>Minimum* Eye Protective Shade</th>
<th>Type of Eye/Face Protection</th>
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<td>Shielded metal arc welding</td>
<td>Less than 3, 3 - 5, 5 - 8</td>
<td>Less than 60, 60 - 160, 160 - 250, 250 - 550</td>
<td>7, 8, 10, 11</td>
<td>Welding Helmet or Shield</td>
</tr>
<tr>
<td>Gas metal arc welding and flux cored arc welding</td>
<td>Less than 60, 60 - 160, 160 - 250, 250 - 500</td>
<td>7, 10, 10, 10</td>
<td>Welding Helmet or Shield</td>
<td></td>
</tr>
<tr>
<td>Gas Tungsten arc welding</td>
<td>Less than 50, 50 - 150, 150 - 500</td>
<td>8, 8, 10</td>
<td>Welding Helmet or Shield</td>
<td></td>
</tr>
<tr>
<td>Air carbon Arc cutting</td>
<td>Light, Heavy</td>
<td>Less than 500, 500 - 1000</td>
<td>10, 11</td>
<td>Welding Helmet or Shield</td>
</tr>
<tr>
<td>Carbon arc welding</td>
<td>All</td>
<td></td>
<td>14</td>
<td>Welding Helmet or Shield</td>
</tr>
<tr>
<td>Plasma arc welding</td>
<td>Less than 20, 20 - 100, 100 - 400, 400 - 800</td>
<td>6, 8, 10, 11</td>
<td>Welding Helmet or Shield</td>
<td></td>
</tr>
<tr>
<td>Plasma arc cutting</td>
<td>Light**, Medium**, Heavy**</td>
<td>Less than 300, 300 - 400, 400 - 800</td>
<td>8, 9, 10</td>
<td>Welding Helmet or Shield</td>
</tr>
</tbody>
</table>

* As a rule of thumb, start with a shade that is too dark to see the weld zone. Then go to a lighter shade which gives sufficient view of the weld zone without going below the minimum. In oxy-fuel gas welding or cutting, use a filter lens that absorbs the yellow visible light of the operation.

** These values apply where the actual arc is clearly seen. Experience has shown that lighter filters may be used when the arc is hidden from the worker by the workpiece.

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### Eye/Face Protection Against Radiant Energy from Oxy-fuel Welding, Cutting, Brazing, Torch Soldering, & Grinding

<table>
<thead>
<tr>
<th>Operations</th>
<th>Metal Plate Thickness - in.</th>
<th>Metal Plate Thickness - mm</th>
<th>Minimum* Eye Protective Shade</th>
<th>Type of Eye/Face Protection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas Welding:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light</td>
<td>Under 1/8</td>
<td>Under 3.2</td>
<td>4</td>
<td>Welding Goggles or Hand Shield (Full Welding Helmet or Shield Recommended)</td>
</tr>
<tr>
<td>Medium</td>
<td>1/8 to 1/2</td>
<td>3.2 to 12.7</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Heavy</td>
<td>Over 1/2</td>
<td>Over 12.7</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Oxygen Cutting:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light</td>
<td>Under 1</td>
<td>Under 25</td>
<td>3</td>
<td>Welding Goggles or Hand Shield (Full Welding Helmet or Shield Recommended)</td>
</tr>
<tr>
<td>Medium</td>
<td>1 to 6</td>
<td>25 to 150</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Heavy</td>
<td>Over 6</td>
<td>Over 150</td>
<td>5</td>
<td></td>
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<tr>
<td>Torch soldering</td>
<td></td>
<td></td>
<td>2</td>
<td>Filter Lens Spectacles, Goggles, or Hand shield</td>
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<tr>
<td>Torch brazing</td>
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<td>3</td>
<td></td>
</tr>
<tr>
<td>Metal Grinding or Chipping</td>
<td></td>
<td></td>
<td>2</td>
<td>Safety Glasses with Side Shields or Safety Goggles, (plus face shield recommended)</td>
</tr>
</tbody>
</table>

* As a rule of thumb, start with a shade that is too dark to see the weld zone. Then go to a lighter shade which gives sufficient view of the weld zone without going below the minimum. In oxy-fuel gas welding or cutting, where the torch produces a high yellow light, use a filter lens that absorbs the yellow visible light of the operation.

** These values apply where the actual arc is clearly seen. Experience has shown that lighter filters may be used when the arc is hidden from the worker by the workpiece.