Bowling Green State University

Hot Work Program

Purpose:

These procedures have been developed to comply with Ohio's Public Employee Risk Reduction Act, the Occupational Safety and Health Administration (OSHA) Welding, Cutting and Brazing Standards (29 CFR 1910 Subpart Q, 29 CFR 1926 Subpart J), Ohio Fire Code Rule 35, National Fire Protection Association (NFPA) Standard 51B, NFPA Standard 70, and American National Standards Institute (ANSI) Z49.1. The purpose of this program is to establish requirements for work involving burning, welding, or similar operations that are capable of initiating fires or explosions to minimize the probability of personal injury and property loss.

Definitions:

Brazing – A process of joining materials together by melting only a filler material.

Cutting – A process of melting and separating material using combustion of fuel gas or an electric arc.

Designated Hot Work Area – Preapproved location designed or constructed using fire resistant or noncombustible materials safe for performing hot work without a permit. (See page 2 for designated hot work locations on campus)

Fire Watch – Temporary measure of continuous and systematic surveillance of a building or portion thereof by one or more qualified individuals for detecting, identifying, controlling and alerting occupants and/or the fire department of an unwanted fire or fire hazard during hot work operations and the established period of time after hot work has been completed.

Hot work – Any work involving burning, welding, or similar operations that are capable of initiating fires or explosions. This program shall cover, at a minimum, the following hot work processes:

- Welding and Allied Processes
- Heat Treating
- Grinding
- Thawing Pipe
- Powder-Driven Fasteners
- Hot Riveting
- Soldering (electric soldering irons exempt)
- Similar Application Producing a Spark, Flame or Heat

Permit Authorizing Individual (PAI) – A person authorized to approve hot work in permit-required locations, such as a Campus Operations Supervisor as designated by the Director of Energy Management or the Director of Budget and Operations (Firelands).

Qualified Person – A person who, by possession of a recognized degree, certificate, or professional standing, or by extensive knowledge, training, and experience has successfully demonstrated the ability to solve or resolve problems related to the subject matter, work, or project.

Welding – A process of joining materials together by melting metal and filler material to form a joint using heat and/or pressure.

Responsibility:

All individuals conducting hot work are responsible for the initiation and execution of approved hot work procedures as defined by this program. Contractors are required to follow Bowling Green State University's hot work program. Before any hot work is to be conducted, Campus Operations Supervisor(s) or other qualified personnel must advise contractors about flammable materials or hazardous conditions of which they may not be aware.

General Requirements:

1. Hot Work Areas

The PAI or other qualified personnel (as determined by Environmental Health and Safety) shall determine the suitability of designated areas for hot work. Hot work can be performed in two types of areas, designated areas and permit-required areas. Designated areas are locations that have been approved for hot work and do not require a permit. These areas must be made of fire resistant or noncombustible construction. The second type is a permit-required area. These locations require a permit and shall be made safe by removing or protecting combustibles from ignition sources.

List of Designated, Non-permit Required Hot Work Locations at Bowling Green State University:

- Bowen-Thompson Student Union – 122C (bench grinder only)
- Campus Operations – Grounds Maintenance and Mechanic Shops
- Campus Operations – Plumbing Shop
- Campus Operations – BMO Shop (bench grinder only)
- Campus Operations – Paint Shop (heat gun only)
- Fine Arts – Sculpture Room
- Fine Arts – Glass Room
- Fine Arts – Metals Shop
- Fine Arts – Ceramics Room (handheld torch only)
- Fine Arts – Print Shop (heat gun only)
- Firelands – Maintenance Building
- Firelands – Manufacturing Lab in North Building
- Ice Arena – Zamboni Shop and Skate Sharpening Areas Only
- Kuhlin Center – SMC 118 Engineering Shop (heat gun only)
- Life Science – 149A (bench grinder only)
- Life Science – 230C (bench grinder only)
- Moore Musical Arts – Piano Shop (bench grinder only)
- Student Rec Center – BMO Shop (bench grinder and heat gun only)
- Technology – Workshop
- Tucker Center – Campus Operations Weld Shop
- Tucker Center – Room 109A (bench grinder)
- Wolfe Center – Designated Area in Scene Shop Room 115

The following is a list of non-permissible hot work areas:

- Areas not authorized by the PAI.
- Sprinklered buildings while such protection is impaired.
- In the presence of an explosive atmosphere including improperly stored drums that once contained flammable materials.
- Areas near storage of large quantities of exposed, readily ignitable materials.

2. Hot Work Permit

The hot work permit identifies the risk of the potential for fire and is a tool used by Campus Operations personnel, contractors, and by all other persons that perform hot work on any Bowling Green State University Campus to reduce the inherent risks involved in performing hot work. If hot work is to occur in a location other than that of a designated area, a written hot work permit is to be obtained from the PAI. The hot work permit must be displayed at the job site during the hot work and shall be returned to Campus Operations at the conclusion of the shift. Cutting, welding, or other hot work shall be permitted only in areas that are or have been made fire safe. The hot work permit is only good for one shift and the following requirements must be completed by the permit holder and verified by the PAI. A permit for hot work operations shall not be issued unless the individuals in charge of performing such operations are capable of doing so safely. See Hot Work Permit in Appendix A.

3. Hot Work Operations

Hot work equipment:

- Must be maintained in satisfactory operating condition and good repair.

Hot work shall NOT be attempted on:

- A partition, wall, ceiling or roof that has a combustible covering or insulation, or on walls or partitions of combustible sandwich-type panel construction.
- Pipes or other metal that are in contact with combustible walls, partitions, ceilings or roofs if the work is close enough to cause ignition by conduction.

Requirements within 35 ft (11m) of hot work operations:

- The area is free from flammable liquids and combustible material, or the work must be moved to an area free from combustibles.
- Combustibles that cannot be moved are shielded or protected against ignition.
- Combustible materials on the floor have been swept for a radius of 35 ft (11 m).
- Combustible floors have been kept wet down, covered with damp sand, or protected by shielding; personnel operating arc welding or cutting are protected from possible shock.
- Openings or cracks in floors, walls, and ducts must be covered or sealed with listed fire-rated or noncombustible material to prevent passage of sparks to adjacent areas.
- Edges of covers at the floor are tight, including the point of overlap to prevent sparks from entering.
- Ducts and conveyor systems that are capable of carrying sparks to distant combustibles are shut down or properly protected.

Work on walls or ceilings/enclosed equipment:

- Where hot work is done near combustible walls, partitions, ceilings or roofs, protection shall be provided using listed welding blankets, curtains, pads or equivalent.
- On the opposite side of noncombustible walls, partitions and ceilings, combustibles must be relocated when practical or a fire watch shall be provided.
- If hot work takes place in close proximity to a sprinkler head, a wet rag is placed over the head and then removed at the conclusion of the welding or cutting operation. Special precaution should be taken to prevent accidental operation of the automatic fire detection or suppression system.

Fire watch/hot work area monitoring personnel:

- A trained and equipped fire watch individual is provided for the duration of work and at least 30-60 minutes after completion of work, including breaks.
- Fully charged and operable fire extinguishers are in the immediate work area.
- Nearby personnel are suitably protected against heat, sparks, slag, radiation, etc.
- After welding is complete, some means of warning that the metal is hot must be provided.

Hot work in confined spaces:

- The requirements of BGSU's Permit-Required Confined Space Program must be followed when entering and working inside a permit-required confined space. Please consult EHS for assistance if any clarifications are needed on how to conduct confined space hot work tasks.
- Additional precautions must be taken when welding, cutting, and brazing in confined spaces as outlined in section 5 of this program.

Personal Protective Equipment (PPE):

- Clothing, health protection and ventilation requirements, such as gloves, welding curtains and eye protection, must be identified prior to work. If unsure of what PPE is required, please consult with a supervisor or EHS. For welding, cutting, and brazing PPE recommendations, please refer to section 5 of this program - Welding, Cutting, and Brazing. In addition, the OSHA guide for proper shade selection can be found in appendix B.

4. Responsibilities During Hot Work Operations

PAIs are responsible for**:**

- Issuing hot work permits and the time allotted for each permit, not to exceed 24 hours;
- The safe operation of hot work activities;
- Ensuring the protection of combustibles from ignition sources;
- Determining that fire protection and extinguishing equipment is properly located at the site; and
- Where a fire watch is not required, making sure a final check is completed 30 minutes after the completion of hot work to detect and extinguish possible smoldering fires.

Before hot work is permitted and at least once per day while the permit is active, the hot work area shall be inspected by the PAI to ensure the location is fire safe. A pre-hot work check must be completed to verify that all equipment is safe and recognized hazards are properly addressed. All applicable sections of the BGSU hot work permit must be filled out and maintained on file for one full calendar year following the completion of the hot work. Completed hot work permits are stored at the following locations:

Main Campus – Campus Operations
Firelands – Budget and Operations office

Fire Watch Personnel

A fire watch is required when hot work is performed in a location where fires might develop or when any of the following conditions exist:

- Combustible materials in building construction or contents are closer than 35 ft (11m) to the point of operation.
- Combustible materials are more than 35 ft (11m) away but easily ignited by sparks.
- Wall or floor openings within a 35 ft (11 m) radius expose combustible materials in adjacent areas, including concealed spaces in walls or floors.
- Combustible materials are adjacent to the opposite side of partitions, walls, ceilings, or roofs and are likely to be ignited.

Fire watch personnel are responsible for:

- Being aware of the inherent hazards of the work site and of the hot work;
- Ensuring that safe conditions are maintained;
- Authorized to stop the hot work if unsafe conditions develop;
- Having fire extinguishing equipment available and being knowledgeable of its use;
- Knowing alarm procedures and activating alarms in the facilities during an uncontrolled fire;
- Watching for fires in all exposed areas, during hot work operations and for at least 30 minutes after completion; and
- Attempting to extinguish fires only when they are within the scope of their training and equipment.

More than one fire watch shall be required if combustible materials that could be ignited by the hot work cannot be directly observed by only one fire watch.

Appropriate Campus Operations Supervisors, Contractor Supervisors, or other qualified personnel:

- Ensure hot work is not scheduled to be performed during operations that might expose combustibles to ignition;
- Tag out-of-service and immediately repair equipment if it is found to be incapable of reliable safe operation, including torches, manifolds, regulators or pressure-reducing valves and acetylene generators;
- Ensure that fire protection and extinguishing equipment is properly located at the site and employees are trained in their use; and
- Make a fire watch available if needed.

Hot Work Operators

- Obtain a hot work permit from the PAI and ensure conditions are safe before performing any hot work;
- Inspect the area at least once per day while the hot work permit is in effect to ensure the area is fire safe;
- Inspect the area before cutting or welding is permitted, determining site-specific hazards, and issuing hot work permits;
- Protect combustibles from ignition by having the work moved to a location free from combustibles, moving combustibles to a safe distance, or properly shielding against ignition;
- Safe handling and use of equipment, as well as determining any combustible or hazardous areas that are present in the work area;
- Understand emergency procedures in the event of a fire and have an awareness of the inherent risks involved;
- Stop hot work operations and notify the PAI, appropriate Campus Operations Supervisor, or other qualified personnel if an unsafe condition occurs; and
- Deliver completed hot work permits to the Help Desk or Campus Operations Supervisor (If completed after hours, permit can be dropped off at Campus Operations via key drop-off box inside the East entrance corridor).

5. Welding, Cutting, and Brazing

General Requirements

- All moveable fire hazards in the vicinity of an object to be welded or cut must be relocated to a safe place. If the object or nearby fire hazards cannot be removed, guards shall be used to control sparks, heat, and slag. Hot work shall not be performed if these conditions are not met.
- Fire extinguishers or other suitable extinguishing equipment must be properly maintained and ready for use.
- No welding, cutting, or other hot work shall be performed on used tanks, barrels, or drums unless thoroughly cleaned and absolutely certain that no flammable materials or other substances are present that could produce toxic or flammable vapors when exposed to heat.
- A welder working on platforms, scaffolds, or runways shall be protected against falling by the use of railings, life lines, or other equally effective means.
- Welding cables and other equipment shall be placed clear of passageways, ladders and stairways.

Personal Protective Equipment

- Employees exposed to hazards created by welding, cutting, or brazing operations shall be protected by PPE that is maintained in good repair. The selection of appropriate PPE will vary with the nature, size and location of the work to be performed.
- Clothing should be selected to minimize the potential for ignition, burning, trapping hot sparks, or electric shock.
- It is recommended that all welders and cutters wear protective flame-resistant gloves maintained in good repair, dry and capable of providing protection from electric shock.
- Durable flame-resistant aprons or welding jackets should be worn to protect the front of the body.
- Helmets or hand shields shall be used during all arc welding and arc cutting operations. Helpers or attendants shall be provided with proper eye protection.
- Goggles or other suitable eye protection shall be used during all gas welding and oxygen cutting operations. Spectacles without side shields that have suitable filter lenses are permitted for use during gas welding operations on light work, torch brazing, or for inspection.
- All operators or attendants of resistance welding or resistance brazing equipment shall use transparent face shields or goggles to protect their eyes and faces as required.
- Helmets and hand shields shall be made of a material which is an insulator for heat and electricity.
- Helmets, goggles, and shields shall not be readily flammable and capable of withstanding sterilization.

- Helmets and hand shields shall be positioned to protect the face, neck and ears from direct radiant energy from the arc.
- Helmets shall be provided with easily removable filter plates and cover plates. All components shall be constructed of a material that will not readily corrode or discolor the skin.
- Goggles shall be ventilated to prevent fogging of lenses as much as practical.
- All glass lenses shall be tempered, free from imperfections, and have smooth and parallel front and rear surfaces unless ground for proper optical correction. Lenses must have a permanent distinctive marking which readily identifies the source and shade.
- The proper shade must be selected and worn based on the welding operation being performed. Please see Appendix B for the OSHA guide on shade selection.
- Flame-resistant capes, sleeves and/or caps should be worn for added protection during overhead work. If a hazard exists for the ear canals, proper flame-resistant plugs or equivalent protection should be worn.

Ventilation

- Mechanical ventilation shall be provided:
    - In a space of less than 10,000 cubic feet (284 m^3) per welder;
    - In a room having a ceiling height less than 16 feet (5 m);
    - In confined spaces or where partitions, balconies, or other structural barriers significantly obstruct cross ventilation.
- When controls such as ventilation fail to reduce air contaminants to allowable levels or when the implementation of controls are not feasible, respiratory protective equipment shall be used to protect personnel from hazardous concentrations of airborne contaminants. This cannot occur without following the provisions set forth in BGSU's Respiratory Protection Program.

  See Appendix C for additional mechanical ventilation specifications.

Compressed Gas Cylinders

- Compressed gas cylinders shall be legibly marked with the chemical or trade name of the gas by stamping, labeling or stenciling that is not readily removable.
- Cylinders shall be stored in well-protected and well-ventilated, dry location away from elevators, stairs, combustibles, radiators and other sources of heat.
- Cylinders shall be kept far enough away from actual welding or cutting operations so that sparks, hot slag, or flame will not reach them, or fire-resistant shields must be provided.
- Oxygen cylinders in storage shall be separated from fuel gas cylinders and combustible materials by a minimum of 20 feet (6.1 m) or by a non-combustible barrier at least 5 feet (1.5 m) high having a ½ hour fire-resistance rating.
- Compressed gas cylinders, tanks and systems shall be protected against accidental dislodgement, physical damage, and access by unauthorized personnel.
- Compressed gas containers, cylinders and tanks shall be secured to prevent falling caused by contact, vibration or seismic activity by one of the following methods:
    - Securing to a fixed object with one or more restraint;
    - Securing on a cart or mobile device designed for movement of compressed gas containers, cylinders, and tanks;
    - Nesting, if dislodgment does not obstruct the path of egress;
    - Securing within a rack, framework, cabinet or similar assembly designed for such use.

Welding Equipment

- The operator should report any equipment defect or safety hazard to their supervisor and the equipment shall be removed from service until repaired by qualified personnel.
- Hoses showing leaks, burns, worn places, or other defects rendering unfit for service shall be repaired or replaced.
- Cables with damaged insulation or exposed bare conductors shall be replaced.

- Resistance (spot) welders shall be inspected annually by qualified personnel and have a certification record maintained on file, which includes the date of inspection, signature, equipment serial number or other identifier.
- A nameplate shall be provided for each resistance welder containing the following information:
    - Name of manufacturer
    - Frequency
    - Primary voltage
    - Rated kilovolt-amperes (kVA) at 50 percent duty cycle
    - Maximum and minimum open-circuit secondary voltage
    - Short-circuit secondary current at maximum secondary voltage
    - Specified throat and gap setting
- Arc welders shall have electrodes removed from the holder when welding and cutting is discontinued for a period of 1 hour or more. The holders shall be positioned to prevent accidental contact and the machines shall be disconnected from the power source.
- Fuel-gas and oxygen piping systems must have backflow and flashback arrestors in place. Best practice is to install backflow preventers (check valves) at the torch inlets and flashback arrestors at the regulator outlets. Additional approved fuel-gas and oxygen piping protective equipment configurations can be found in Appendix D.

Confined Spaces

- When welding or cutting inside a confined space, the compressed gas cylinders and welding machine shall be left outside. Before operations are started, heavy portable equipment mounted on wheels shall securely blocked to prevent accidental movement.
- If a welder must enter a confined space through a manhole or other small opening, means shall be provided for quick removal in case of emergency. An attendant with a preplanned rescue procedure capable of initiating rescue operations shall be stationed outside to observe the welder at all times.
- When welding operations are suspended for any substantial period of time, such as during lunch or overnight, the welder must be disconnected from the power source and all electrodes shall be removed from the holders and the holders positioned so accidental contact cannot occur. Torch valves shall be closed and the fuel-gas and oxygen supply positively shut off. If practical, the torch and hose shall be removed from the confined space.
- Oxygen shall never be used for ventilation.

6. Training

Training must be provided to all responsible parties on:

- The inherent risks involved;
- The emergency procedures in the event of a fire;
- Instructions on all equipment and processes;
- The use of a portable fire extinguisher if performing hot work or providing a fire watch; and
- The provisions of this program.

Hot Work Permit

Before completing this form, review planned hot work operations for less hazardous alternatives such as moving to exterior location or using non-sparking/non-flame mechanical methods for repair. **Page 1**

Part 1 Instructions:

1. Verify all applicable work area safety precautions have been reviewed and completed per this form as applicable.
2. Complete Page 1 & retain for records.
3. Complete Page 2 and issue to individual(s) conducting hot work with direct review of instructions and precautions for compliance.
4. Always follow jurisdictional requirements when more stringent.
5. Only issue one permit per operation/area and per shift.

Work Details:

Work Performed by: ☐ Employee ☐ Contractor
Name(s): _____
Work Location (Building/Floor):

Hot Work Type:

☐ Brazing ☐ Thawing Pipe
☐ Cutting ☐ Welding Torch
☐ Grinding ☐ Applied Roofing
☐ Soldering ☐ Burning
☐ Other _____

Approval & Tracking:

Work area has been fully inspected, necessary precautions have been taken, and permission is granted for this work: ☐ Yes ☐ No

Permit Issuer Name:
_____
Signature:
_____
Permit Issue Date: _____
Permit Expiration:
Date: _____ Time: _____

Job/Task/PO Number: _____
Hot Work Permit Number: _____

Completion Signatures:

Person Conducting Work: _____
Date/Time: _____
Fire Watch: _____
Date/Time: _____
Final Completion: _____
Date/Time: _____

Required Precautions Checklist

General Precautions:

☐ Planned task and permit information reviewed with precautions taken as necessary.
☐ Work confined to area/equipment specified in permit only.
☐ Sprinkler protection, hose streams & fire extinguishers in-service, unobstructed and fully operational.
☐ Operational fire extinguishers (or charged fire hose lines) within reach of each fire watch.
☐ Hot work equipment is approved and in good condition.

Area Within 35 ft. (11 m) of Hot Work:

☐ Noncombustible construction confirmed with no combustible coverings, insulation, or core material.
☐ Combustible roof and floor construction protected by fire resistive tarpaulins or curtains, metal shields or other noncombustible shields/barriers.
☐ No work is being done on walls, roofs, or floors with combustible sandwich-type panel construction.
☐ All wall, floor, and duct openings have been covered.
☐ Combustibles have been removed from opposite sides of walls, ceilings, roofs, and floor or additional fire watch has been added where applicable.
☐ Fire resistive tarpaulins have been suspended beneath work area to collect sparks where applicable.

Hot Work With Enclosed Equipment:

☐ Equipment has been cleaned of all combustibles.
☐ Containers have been purged of flammable/combustible liquids, vapors and gases.
☐ Pressurized vessels & piping have been removed from service, isolated & vented.
☐ Stored and electrical energy equipment has been removed from service and isolated.
☐ Work area atmosphere LEL reading, if required: _____

Fire Watch & Monitoring:

☐ Fire watch continuous during entire hot work task and for one hour after completion.
☐ Fire watch trained in use of fire extinguishers and/or charged fire hose line(s).
☐ Fire watch trained on inherent area and hot work hazards.
☐ Fire watch trained on proper fire reporting, notification to those conducting hot work and with authority to take necessary actions including stopping work if required.
☐ Additional fire watch posted on lower floors and adjacent areas subject to spark or heat source spread or drop below.
☐ Area monitoring for three hours after fire watch conclusion by approved method.

Hot Work Permit

Before completing this form, review planned hot work operations for less hazardous alternatives such as moving to exterior location or using non-sparking/non-flame mechanical methods for repair. **Page 2**

Part 2 Instructions:

1. Person Conducting Work: Post issued permit in visible location near work area. Upon completion, record date/time and notify the permit issuer or fire watch.
2. Fire Watch: After conducting required fire watch, sign permit and record the date/time of fire watch completion. Notify the permit issuer fire watch has ended.
3. Final Work Area Reviewer: Conduct final area review, sign and date time of final completion, and remove permit from area for records retention.

Work Details:

Work Performed by: ☐ Employee ☐ Contractor

Name(s): _____

Work Location (Building/Floor):

Hot Work Type:

☐ Brazing ☐ Thawing Pipe
☐ Cutting ☐ Welding Torch
☐ Grinding ☐ Applied Roofing
☐ Soldering ☐ Burning
☐ Other_____

Approval & Tracking:

Work area has been fully inspected, necessary precautions have been taken, and permission is granted for this work: ☐ Yes ☐ No

Permit Issuer Name:

_____

Signature:

_____

Permit Issue Date: _____

Permit Expiration:

Date:_____ Time:_____

Job/Task/PO Number:_____

Hot Work Permit Number:_____

Completion Signatures:

Person Conducting Work:_____

Date/Time: _____

Fire Watch:_____

Date/Time:_____

Final Completion:_____

Date/Time: _____

Required Precautions Checklist

General Precautions:

☐ Planned task and permit information reviewed with precautions taken as necessary.
☐ Work confined to area/equipment specified in permit only.
☐ Sprinkler protection, hose streams & fire extinguishers in-service, unobstructed and fully operational.
☐ Operational fire extinguishers (or charged fire hose lines) within reach of each fire watch.
☐ Hot work equipment is approved and in good condition.

Area Within 35 ft. (11 m) of Hot Work:

☐ Noncombustible construction confirmed with no combustible coverings, insulation, or core material.
☐ Combustible roof and floor construction protected by fire resistive tarpaulins or curtains, metal shields or other noncombustible shields/barriers.
☐ No work is being done on walls, roofs, or floors with combustible sandwich-type panel construction.
☐ All wall, floor, and duct openings have been covered.
☐ Combustibles have been removed from opposite sides of walls, ceilings, roofs, and floor or additional fire watch has been added where applicable.
☐ Fire resistive tarpaulins have been suspended beneath work area to collect sparks where applicable.

Hot Work With Enclosed Equipment:

☐ Equipment has been cleaned of all combustibles.
☐ Containers have been purged of flammable/combustible liquids, vapors and gases.
☐ Pressurized vessels & piping have been removed from service, isolated & vented.
☐ Stored and electrical energy equipment has been removed from service and isolated.
☐ Work area atmosphere LEL reading, if required:_____

Fire Watch & Monitoring:

☐ Fire watch continuous during entire hot work task and for one hour after completion.
☐ Fire watch trained in use of fire extinguishers and/or charged fire hose line(s).
☐ Fire watch trained on inherent area and hot work hazards.
☐ Fire watch trained on proper fire reporting, notification to those conducting hot work and with authority to take necessary actions including stopping work if required.
☐ Additional fire watch posted on lower floors and adjacent areas subject to spark or heat source spread or drop below.
☐ Area monitoring for three hours after fire watch conclusion by approved method.

AIG

Hot Work Permit

Appendix B: OSHA 1910.252(b)(2)(ii)(H) Guide for Proper Selection of Shade Numbers

The following is a guide for the selection of the proper shade numbers. These recommendations may be varied to suit the individual's needs.

Welding operation	Shade No.
Shielded metal-arc welding - 1/16-, 3/32-, 1/8-, 5/32-inch electrodes	10
Gas-shielded arc welding (nonferrous) - 1/16-, 3/32-, 1/8-, 5/32-inch electrodes	11
Gas-shielded arc welding (ferrous) - 1/16-, 3/32-, 1/8-, 5/32-inch electrodes	12
Shielded metal-arc welding:	
3/16-, 7/32-, 1/4-inch electrodes	12
5/16-, 3/8-inch electrodes	14
Atomic hydrogen welding	10-14
Carbon arc welding	14
Soldering	2
Torch brazing	3 or 4
Light cutting, up to 1 inch	3 or 4
Medium cutting, 1 inch to 6 inches	4 or 5
Heavy cutting, 6 inches and over	5 or 6
Gas welding (light) up to 1/8 inch	4 or 5
Gas welding (medium) 1/8 inch to 1/2 inch	5 or 6
Gas welding (heavy) 1/2 inch and over	6 or 8

Note: In gas welding or oxygen cutting where the torch produces a high yellow light, it is desirable to use a filter or lens that absorbs the yellow or sodium line in the visible light of the operation.

Appendix C: OSHA 1910.252(C)(3) Mechanical Ventilation Requirements

- Ventilation shall be at the minimum rate of 2,000 cubic feet (57 m^3) per minute per welder except where local exhaust is provided.
- Mechanical local exhaust ventilation may be provided by means of:
    - Freely movable hoods placed near as practicable to the work being performed with a minimum air-flow velocity toward the hood of 100 linear feet (30 m) per minute in the welding zone at its most remote distance from the point of welding. The rate of ventilation required using a 3-inch (7.6 cm) wide flanged suction opening are as follows:

Welding zone	**Minimum air flow[1] cubic feet/minute**	**Duct diameter, inches[2]**
4 to 6 inches from arc or torch	150	3
6 to 8 inches from arc or torch	275	3½
8 to 10 inches from arc or torch	425	4½
10 to 12 inches from arc or torch	600	5½

[1] When brazing with cadmium bearing materials or when cutting on such materials increased rates of ventilation may be required.

[2] Nearest half-inch duct diameter based on 4,000 feet per minute velocity in pipe.

- A fixed enclosure with a top and no less than two sides which surrounds the welding and cutting operations with a rate of airflow sufficient to maintain a minimum velocity of 100 linear feet (30 m) per minute away from the welder.

Appendix D: OSHA 1910.253(e)(3)(i) Diagram for Fuel-Gas and Oxygen Piping System Protective Equipment

The fuel-gas and oxygen piping systems, including portable outlet headers shall incorporate the protective equipment shown in Figures Q-1, Q-2, and Q-3. When only a portion of a fuel-gas system is to be used with oxygen, only that portion need comply with this paragraph (e)(3)(i).

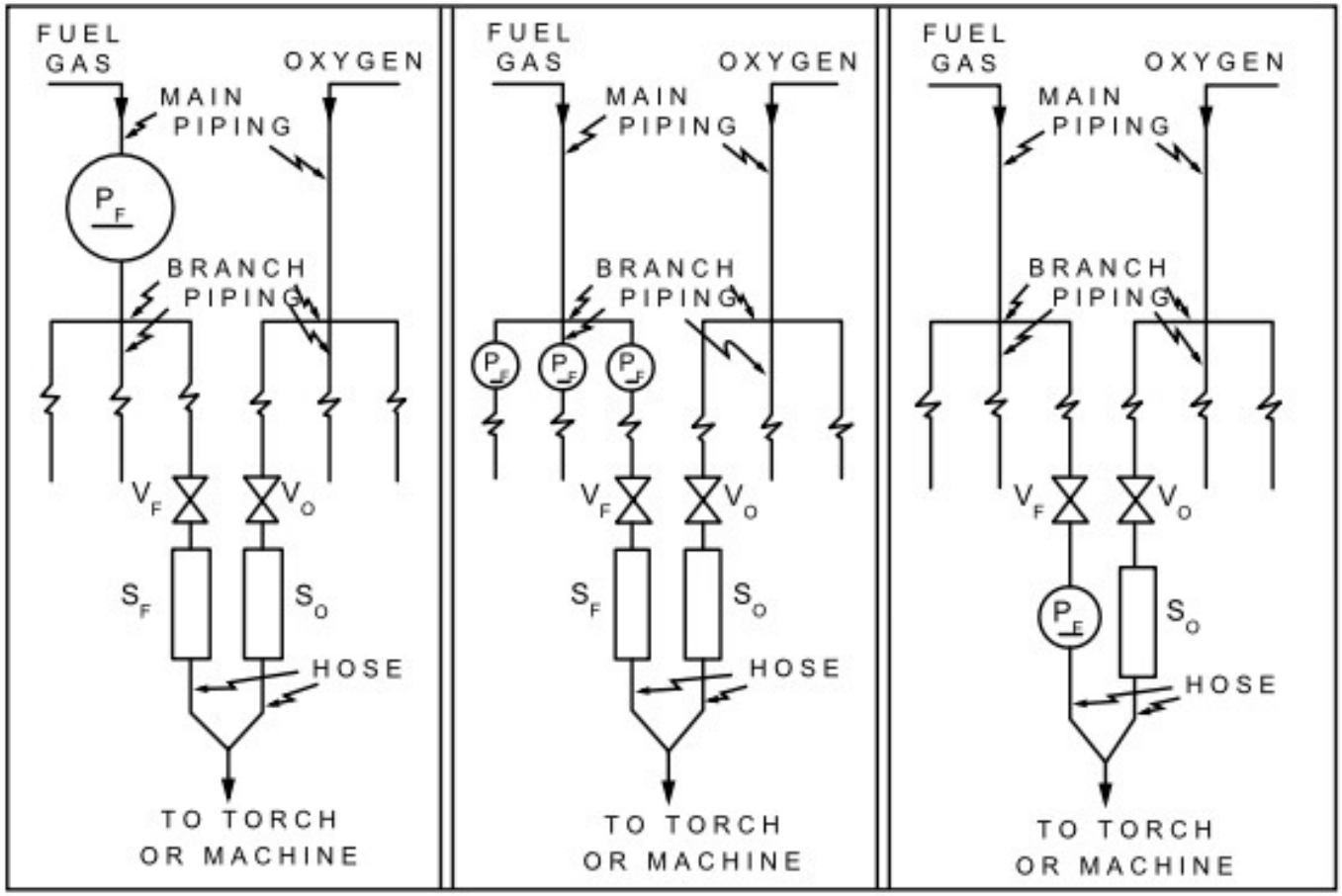

Fig. Q-1 Fig. Q-2 Fig. Q-3

LEGEND

P_F--Protective equipment in fuel gas piping
V_F--Fuel gas station outlet valve
V_O--Oxygen station outlet valve
S_F--Backflow prevention device(s) at fuel gas station outlet
S_O--Backflow prevention device(s) at oxygen station outlet