

**Idaho National Laboratory**

<b>WELDING, CUTTING AND OTHER HOT WORK</b>	Identifier: RD-2010
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Subcontractors	Program Requirements Document	eCR Number: 618906
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Manual: INL Subcontractor Requirements

**1. PURPOSE**

This document provides requirements for INL subcontractors to protect the workplace, environment, and safety and health of personnel involved in welding, cutting, and other hot work. This document highlights requirements referenced in the “Source Documents” section, as well as Contractor requirements. Any applicable regulatory or Contractor requirements must be followed, with the most stringent requirement being met.

**2. APPLICABILITY**

This document applies to all subcontractors performing welding, cutting, and other hot work for Contractor facilities at the Idaho National Laboratory (INL). Stricter requirements may be imposed by subcontractors upon their employees or subtier contractors. The requirements of this document must be followed by subcontractors; however, the means of implementation may vary as determined by the subcontractor.

**3. REQUIREMENTS**

**3.1** Welding, cutting, and other hot work shall meet the requirements of the 29 CFR 1926 Subpart J - Welding and Cutting, NFPA 51B, and ANSI Z49.1 – 1999. Additional requirements specific to welding, cutting, and other hot work are specified below.

**3.2 Training**

- 3.2.1 All persons performing welding, cutting, and other hot work shall be trained to perform their specific work tasks safely.
- 3.2.2 All persons performing welding and brazing activities shall be trained according to the approved INL Welding Manual (latest version) at the INL Welder Test Facility (CPP-698).
- 3.2.3 All persons performing fire watch activities shall be trained to perform their assigned duties and on the proper use of the fire extinguishing equipment available for their use.
- 3.2.4 All training shall be documented in accordance with RD-1008, Training and Indoctrination.

**3.3 General Requirements**

- 3.3.1 Signs shall be posted to designate welding, cutting, and other hot work areas, and to indicate that eye protection shall be worn.

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- 3.3.2 A Non-Designated Area Hot Work Permit (Form 442.36) shall be used to authorize welding and cutting operations that take place outside of areas covered by a Designated Area Hot Work Permit (Form 442.35). (See RD-2000, Work Coordination and Hazard Control.)
- A. For areas/buildings controlled by INL organizations, the Permit Authorizing Individual (PAI) shall be the person(s) designated by the INL facility management.
  - B. For areas/buildings that entirely controlled by the subcontractor organization, INL Construction Management shall designate Permit Authorizing Individuals (PAI) for the subcontractor activities.
  - C. Any required subcontractor approval of hot work permits shall also be present on the permit.
  - D. The Facility Fire Protection Engineer or other persons qualified to approve hot work permits (as determined by the INL Fire Marshal) shall also approve hot work permits.
  - E. Management, subcontractors, PAI(s), the fire watch, and the operators shall recognize their mutual responsibility for safety in hot work operations.
- 3.3.3 During the hazard evaluation process, consider the amount of contamination to which workers will be exposed, based on the following three factors:
- A. size of the area in which welding/cutting is to be done, with special regard to ceiling height
  - B. number of welders or cutters
  - C. possible evolution of hazardous fumes, gases, or dust according to the materials involved.
- 3.3.4 Where arc welding is regularly carried out, adjacent walls and other surfaces shall have low reflectivity to ultraviolet radiation.
- 3.3.5 Shields or non-combustible screens shall be installed to protect employees in adjacent areas.

**NOTE:** When it has been determined that a welder's helper is needed to complete a task, special attention must be given to the type of

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welding being performed, the length of time the welder's helper will be exposed to the flash, and the distance the welder's helper will be from the flash when determining the level of protection required. In most cases, shaded safety glasses (ANSI Z87.1), along with proper skin protection will be sufficient when used in combination with an aversion of the head to prevent direct observation of the welding arch. It is recognized that in some situations an increased or equivalent level of Personal Protective Equipment to that being used by the welder may be required due to the type of welding, exposure duration of the arch flash, or need to directly observe the welding arch. This determination should be made through consultation with the welder, welder helper and the job Safety Representative.

- 3.3.6 Welding blankets, welding pads, welding curtains or similar *fire-resistant* protective covers shall be *listed* (see definition) or approved by the INL Fire Marshal.
- A. Welding blankets, welding pads, welding curtains or other fire-resistant protective covers shall be used in a manner consistent with the manufacturer's requirements.

### 3.4 Hazard Prevention

- 3.4.1 Combustibles shall be protected from ignition by one or more of the following:
- A. moving work to a location free from combustibles
- B. moving combustibles at least 35 feet from the work site
- C. protecting all combustibles with listed or approved fire-resistant welding curtain, welding blankets or equivalent.
- D. scheduling work so that plant operations that might expose combustibles to ignition are not started during welding, cutting, and other hot work.
- E. keeping combustible floors clean, protecting them by wetting with water or covering with damp sand, or protected by a listed or approved welding blanket, welding pad, sheet metal, or the equivalent.

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**NOTE:** *Although wetting floors is appropriate when cutting with a torch, water should not be used around arc-welding equipment or other electrical equipment.*

3.4.2 Listed or approved welding blankets, welding pads, welding curtain, or similar fire-resistant protective covers shall be used to tightly cover or seal combustibles that cannot be relocated, considering the following:

- A. floor openings or cracks in the flooring that cannot be closed
- B. cracks, holes, open doorways, open or broken windows
- C. combustible walls, partitions, ceilings, or roofs
- D. metal walls, partitions, ceilings, or roofs that have immovable combustibles on the opposite side
- E. ducts and conveyors that might carry sparks to distant combustibles.

**NOTE:** *Ducts or conveyors may be guarded or shielded, or they may be shut down to eliminate the hazard.*

3.4.3 In instances where the scope of work and the tools used to conduct hot work are known to be capable of generating slag, sparks, spatter, or similar mobile sources of ignition farther than 35 feet then the combustibles shall be protected at the greater distance and the fire watch shall be adjusted to meet the new conditions as directed in the Hot Work permit.

3.4.4 In instances where the scope of work and the tools used to conduct hot work are known to be incapable of generating slag, sparks, spatter, or similar mobile sources of ignition capable of leaving the immediate area of the applied hot work then reduce the distance to protect combustibles and fire watch to that distance he or she considers fire safe for the intended operation as directed in the Hot Work Permit.

3.4.5 Fully charged and operable fire extinguishers that are appropriate for the type of possible fire shall be readily available.

3.4.6 The proper PPE that will be required for workers and other persons adjacent to the work area shall be recorded in the JSA or other hazard evaluation (See Appendices A, B, and C of this document).

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- 3.4.7 No welding, cutting, or other hot work shall be performed on used drums, barrels, tanks, or other containers until they have been cleaned so that there are no flammable materials present or any substances such as greases, tars, acids, or other materials which when subject to heat, might produce flammable or toxic vapors.
- 3.4.8 When working on drums, barrels, tanks, or other containers, any pipe lines or connections to the vessel shall be disconnected or blanked.
- 3.4.9 All hollow spaces, cavities, or containers shall be vented to permit the escape of air or gases before preheating, welding, or cutting.

**NOTE:** *Purging with inert gas is recommended.*

- 3.4.10 Welding, cutting, and other hot work shall **NOT** be performed in the following situations:
- A. in areas not authorized by management.
  - B. in sprinklered buildings while such protection is impaired, unless compensatory measures are in place and approved by the INL Fire Marshal or designee.
  - C. in the presence of explosive atmospheres, explosive atmospheres that may develop inside uncleaned or improperly prepared tanks or equipment which have previously contained such materials, or that may develop in areas with an accumulation of combustible dust.
  - D. in areas near the storage of large quantities of exposed, readily ignitable materials.
  - E. on a metal wall, partition, ceiling, or roof having a combustible cover nor on walls or partitions of combustible sandwich type panel construction.
  - F. on pipes or other metal in contact with combustible walls, partitions, ceilings, or roofs if the work is close enough to cause ignition by conduction.
- 3.4.11 Welding equipment, machines, cables and other equipment shall be placed so that it does not place a hazard to personnel in stairs, ladders, or passageways.

### 3.5 Fire Watch

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- 3.5.1 Fire watchers shall be present whenever welding, cutting, or other hot work is performed in locations outside designated areas or where any of the following conditions exist:
- A. When special hazards exist that may affect the safety of the welder due to the nature of the work activity or the work area.
  - B. combustible materials, in building construction or contents, are closer than 35 feet to the point of operation.
  - C. combustible materials are more than 35 feet away but are easily ignited by sparks.
  - D. wall or floor openings within a 35-foot radius expose combustibile material in adjacent areas, including concealed spaces in walls and floors.
  - E. combustibile materials are adjacent to the opposite side of metal partitions, walls, ceilings, or roofs and are likely to be ignited by conduction or radiation.

**NOTE:** *More than one fire watcher may be required.*

- 3.5.2 Fire watches shall be staged to watch for fires in all areas where byproducts of hot operations could be distributed. More than one fire watch shall be required if combustibile materials could be ignited by the hot work operation can't be directly observed by the initial fire watch.
- 3.5.3 Persons performing fire watch work shall have the following responsibilities:
- A. Be familiar with the area or facility emergency plan, the fire alarm activation system, and the fire extinguishing equipment present.
  - B. Maintain a clear line of sight with persons performing hot work at all times.
  - C. Watch for fires, try to extinguish fires without incurring personal danger, and activate the nearest fire alarm if necessary.
  - D. Maintain a fire watch for at least 30 minutes after completion of welding, cutting, and other hot work

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operations, or as directed by the Hot Work Permit when the fire hazard warrants the extension.

- E. Fire watches shall be permitted to perform additional tasks provided those tasks do not distract them from fire watch responsibilities.

**NOTE:** *The fire watch shall immediately notify the INL fire department (Idaho Falls Fire Department for Science and Technology Campus facilities) of any fire, regardless of size and regardless of whether or not it has been extinguished (See RD-2202, Fire Protection).*

**3.6 Welding Practices**

- 3.6.1 Welders, who wear a pacemaker or other electronic equipment vital to life, should check with the equipment manufacturer or their doctor to determine whether arc welding will create a hazard.
- 3.6.2 Welding, cutting, or other hot work operations shall be stopped immediately if any conditions arise that pose a risk to personnel or equipment or that has not been adequately addressed in the Hot Work Permit or other hazards evaluation.

**4. DEFINITIONS**

*Approved.* Acceptable to the Authority Having Jurisdiction (i.e., INL Fire Marshal).

*Listed.* Equipment, materials or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintain periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets appropriate designated standards or has been tested and found suitable for a specified purpose. This would typically include, but not to, Underwriter Laboratories (UL) listed and Factory Mutual (FM) approved equipment.

For definitions of terms used throughout the INL Subcontractor Requirements Manual, refer to LST-359.

**5. REFERENCES**

**5.1 Source Documents**

- 29 CFR 1926, Subpart E, Personal Protective and Life-Saving Equipment
- 29 CFR 1926, Subpart J, Welding and Cutting

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ANSI Z49.1, “Safety in Welding and Cutting” American National Standards Institute.

NFPA 51B, Standard for Fire Prevention During Welding, Cutting, and Other Hot Work

**5.2 Related Requirements**

The following documents may also contain requirements that apply to this activity:

RD-2001, Personal Protective Equipment

RD-2009, Compressed Gases

RD-1008, Training and Indoctrination

**6. APPENDICES**

Appendix A, Personal Protective Equipment: Minimum Requirements

Appendix B, Personal Protective Equipment: Eye and Face Protection Selection Chart

Appendix C, Personal Protective Equipment: Filter Lenses for Protection Against Radiant Energy

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## Appendix A

### Personal Protective Equipment Minimum Requirements

During the performance of oxygen/acetylene cutting, brazing, soldering, welding, or arc cutting, personnel shall be required to use at least the following minimum personal protective equipment. Job specifics may require additional protection.

1. **BODY:** 100% cotton or heavy wool pants, long sleeve shirts, aprons, leggings, and/or capes and sleeves.
  - Clothing shall be selected to minimize the potential for ignition, burning, trapping hot sparks, or electrical shock.
  - Sleeves and collars shall be kept buttoned and pockets be eliminated from the front of clothing.
  - Frayed clothing shall not be worn.
  - Durable flame-resistant aprons made of leather or other suitable materials shall be used to protect the front of the body when additional protection against sparks and radiant energy is needed.
  - For heavy work, flame-resistive leggings or other equivalent means shall be used to give added protection to the legs, when necessary.
  - During overhead work, cape sleeves or shoulder covers with bibs made of leather or other flame-resistant material shall be worn.
  - Materials in contact with the body shall not readily irritate or discolor the skin.

(See Notes a, b, c)

2. **FOOT:** Leather boots, above the ankle, laced properly.

(See Note d)

3. **HEAD:** Caps made from flame resistant material shall be worn, when necessary.

Properly fitted plugs in the ear canals, or equivalent protection, shall be used where hazards to the ear canals exist.

- Noise shall be controlled at the source when feasible. When control methods fail to bring noise exposure within allowable limits, PPE such as ear muffs or ear plugs shall be used.

4. **FACE:** Safety glasses with side shields with the appropriate shade of lens, full-face shield/welding hood.

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- Helmets or hand shields with filter lenses and cover lenses shall be used by operators and nearby personnel when viewing the arc while performing arc welding and arc cutting with open arcs. Protective spectacles with side shields, arc goggles, or other approved eye protection shall also be worn.
- Filter lenses shall bear some permanent distinctive marking by which the manufacturer may be readily identified. In addition, all filter lenses shall be marked with their shade number and "Z87."
- Goggles or other approved eye protection shall be worn during all oxyfuel gas welding and cutting, and submerged arc welding operations.
- Operators of resistance welding or brazing equipment and their helpers shall use spectacles, goggles, or face shields, depending upon the particular job.
- For large area viewing, such as training, demonstrations, shows, and certain automatic welding operations, a large filter window or curtain may be used, rather than individual helmets, hand shields, or goggles. Additionally, suitable arrangements shall be provided to prevent direct viewing of the arc without filter protection and to protect viewers from sparks and chipped slag.
- Helmet and hand shield bodies shall be made of material that is thermally and electrically insulating, noncombustible or self-extinguishing, and opaque to visible, ultraviolet, and infrared radiation.
- Helmets and hand shields shall protect the face, forehead, neck, and ears to a vertical line in back of the ears, from direct radiant energy from the arc and from direct weld spatter.
- Goggles shall be vented to deter fogging of the lenses.
- Outer lenses shall be provided to protect the filter lens or filter lens in goggles, helmets, or hand shields from welding spatter, pitting, or scratching. Outer cover lenses shall be of clear glass or self-extinguishing plastic, but need not be impact resistant.
- When the "lift front" type of welder's helmet is used, there shall be a fixed impact-resistant safety lens or plate on the inside of the frame, next to the eyes, to protect the welder against flying particles when the front is lifted.
- All filter lenses shall meet the "Ultraviolet, Luminous, and Infrared Transmittance" requirements.

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- Helmets, hand shields, and goggles shall be well maintained.

(See Notes e, f)

**5. HANDS: FIRE RESISTANT GLOVES ABOVE THE WRIST.**

(See Note g)

**Notes**

- a. Cotton clothing should be chemically treated to reduce its combustibility.
- b. When pockets are present, they should be emptied of flammable or readily combustible materials.
- c. Trousers or overalls should not have cuffs and not be turned up on the outside. Trousers should overlap shoe tops.
- d. Shoe covers as directed by the Safety Professional.
- e. Helmets, hand shields, and goggles should not be transferred from one employee to another without being cleaned.
- f. See Appendix C for additional eye protection.
- g. Gloves made of leather, rubber, or other suitable materials are recommended. Insulating linings should be used to protect areas exposed to high radiant energy.

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**Appendix B**

**Personal Protective Equipment  
Eye and Face Protection Selection Chart**

Source	Assessment of Hazard	Protection
<b><u>Impact</u></b> Chipping, grinding, machining	Flying fragments, objects, large chips, particles of dirt, etc.	Safety glasses with side protection, goggles, face shields. For severe exposure, use a face shield.
<b><u>Heat</u></b> Welding	Hot sparks	See notes a,, b, c, d, and e. Face shields, goggles, safety glasses with side protection. For severe exposure, use a face shield.
	Splash from molten metals	See notes a, b, and f Face shields worn over goggles. See notes a, b, and f.
	High temperature exposure	Screen face shields, reflective face shields. See notes a, b, and f.
<b><u>Light and/or radiation</u></b> Electric arc welding	Optical radiation	Welding helmets or welding shields. Typical shades: 10 & 14. See note g.
Gas welding	Optical radiation	Welding goggles or welding face shield. Typical shades: gas welding 4 & 8, cutting 3 & 6, brazing 3 & 4. See note g.
Cutting, torch brazing, torch soldering.	Optical radiation	Safety glasses or welding face shield. Typical shades: 1.5 & 3.
Glare	Poor vision	See notes b and g. Safety glasses with shaded or special purpose lenses, as suitable. See notes e and g.

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**Notes**

- a. Care should be taken to recognize the possibility of multiple and simultaneous exposure to a variety of hazards. Adequate protection against the highest level of each of the hazards should be provided. Protective devices do not provide unlimited protection.
- b. Face shields should only be worn over primary eye protection (spectacles or goggles).
- c. As required by the standard, persons whose vision requires the use of prescription lenses must wear either protective devices fitted with prescription lenses or protective devices designed to be worn over regular prescription eyewear.
- d. Wearers of contact lenses must also wear appropriate eye and face protection devices in a hazardous environment. It should be recognized that dusty and/or chemical environments may represent an additional hazard to contact lens wearers.
- e. Non-side shield spectacles are available for frontal protection only, but are not acceptable eye protection from the sources and operations listed for impact.
- f. Operations involving heat may also involve light radiation. As required by the standard, protection from both hazards must be provided.
- g. Welding helmets or face shields should be used only over primary eye protection (spectacles or goggles).
- h. Protection from light radiation is directly related to filter lens density. Select the darkest shade that allows task performance. Tinted and shaded lenses are not filter lenses unless they are marked or identified as such.

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### Appendix C

#### Personal Protective Equipment Filter Lenses for Protection Against Radiant Energy

Operations	Electrode Size (in 1/32 inch)	Minimum protective shade <sup>a</sup>	Suggested shade number (comfort)
Shielded metal arc welding	Less than 3	7	
	3 & 5	8	10
	5 & 8	10	12
	More than 8	14	14
Gas metal arc welding and flux-cored arc welding		7 & 10	11 & 14
Gas tungsten arc welding		8 & 10	10 & 14
Arc carbon arc cutting (ACC)	Light	10	12
	Heavy	11	14
Plasma arc welding		6 & 11	6 & 14
Plasma arc cutting	Light <sup>b</sup>	8	9
	Medium <sup>b</sup>	9	12
	Heavy <sup>b</sup>	10	14
Torch brazing			3 & 4
Torch soldering			2
Carbon arc welding			14

		Plate Thickness (inches)	Plate Thickness (mm)	Suggested shade number <sup>a</sup> (comfort)
Gas welding	Light	Under 1/8	Under 3.2	4 & 5
	Medium	1/8 to 2	3.2 to 12.7	5 & 6
	Heavy	over 2	Over 12.7	6 & 8
Oxygen cutting	Light	Under 1	Under 25	3 & 4
	Medium	1 to 6	25 to 150	4 & 5
	Heavy	Over 6	Over 150	5 & 6

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**Notes**

- a. As a rule of thumb, start with a shade that is too dark to see the weld zone. Then go to a lighter shade that gives a sufficient view of the weld zone without going below the minimum. In oxyfuel gas welding or cutting where the torch produces a high yellow light, it is desirable to use a filter lens that absorbs the yellow or sodium line in the visible light of the (spectrum) operation.
- b. These values apply where the actual arc is clearly seen. Experience has shown that lighter filters may be used when the arc is hidden by the workpiece.