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# INSAFE

**SAFETY AND HEALTH CONSULTATION**

**Tony Kuritz & Curtis Taylor**  
INSafe Health & Safety Consultants

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## A Safer Look at Welding



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## Objectives Safety and Health Hazards

- Burns/Fires
- Explosions
- Electrical Shock/Electrocutions
- Air Contaminates
- Radiation
- Confined Space



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## Significant Hot Work Incidents (NFPA 51B)

- **Warehouse in Wisconsin**
  - Arc welding on second floor
  - No fire watch on first floor
  - Boxes caught fire
  - \$1.6 million



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## Significant Hot Work Incidents (NFPA 51B)

- **Wire and Nail Mill in Georgia**

Acetylene torch welding

Initial fire was thought to be out

Hours later, fire restarted

\$2.3 million



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## Significant Hot Work Incidents (NFPA 51B)

- **Demolition in Tennessee**

Acetylene torch pipe cutting

No flame-retardant clothing

No fire watch

Inadequate hot work procedure

Fatally burned

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## Processes

- Arc welding (MIG, TIG, Plasma)
- Gas welding (Oxy-acetylene)
- Electrical resistance welding
- Brazing
- Solid state welding (Friction, Ultrasonic, Explosive)
- Laser and Electron Beam

MIG

TIG

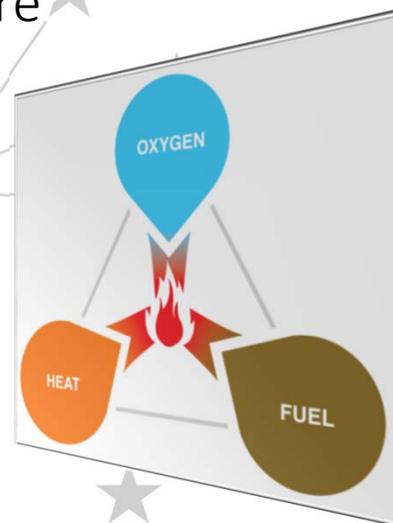
Oxy-Ace

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## General Requirements - Fire

**Remove  
or  
Guard the "Fuel"**



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## Safety Concerns -

### Authorized and Trained personnel

- General Requirements
- Safety and Health Concerns
- Procedures
- PPE and Clothing



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## Awareness

- Fire Extinguishers (charged and operable)
- Authorization (Hot work Permit)
  - Checklist or written document authorized by Management or Supervisors
    - Contains the details of the work and the potential hazards.
- Fire watch (trained, to foresee and prevent fires) (not be distracted from duties)



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## General Requirements - Personnel Protection

- Follow all other safety and health programs as necessary
  - (i.e., Confined Space, Fall Protection, LOTO, gas cylinder storage, etc...)

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## General Requirements - Personnel Protection

- Eye protection; [29 CFR 1910.252\(b\)\(2\)](#) – Guide based on welding process and material
  - Radiant Energy
    - (Don't look at the blue light with your one good eye)

Welding operation	Shade No.
Shielded metal-arc welding— $\frac{1}{16}$ - $\frac{3}{32}$ - $\frac{1}{8}$ - $\frac{5}{32}$ -inch electrodes	10
Gas-shielded arc welding (nonferrous)— $\frac{1}{16}$ - $\frac{3}{32}$ - $\frac{1}{8}$ - $\frac{5}{32}$ -inch electrodes	11
Gas-shielded arc welding (ferrous)— $\frac{1}{16}$ - $\frac{3}{32}$ - $\frac{1}{8}$ - $\frac{5}{32}$ -inch electrodes	12
Shielded metal-arc welding:	
$\frac{3}{16}$ - $\frac{7}{32}$ - $\frac{1}{4}$ -inch electrodes	12
$\frac{3}{16}$ - $\frac{3}{8}$ -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 $\frac{1}{2}$ inch	4 or 5
Gas welding (medium) $\frac{1}{2}$ inch to $\frac{3}{4}$ inch	5 or 6
Gas welding (heavy) $\frac{3}{4}$ inch and over	6 or 8

proper shade number, visit [OSHA.gov](#)

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## General Requirements - Personnel Protection

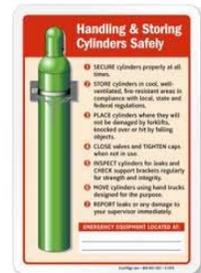
- Protective clothing; [29 CFR 1910.132](#)
  - Hazard assessment conducted by the employer\*
  - Examples: flame-retardant chemical treated or leather
    - Jackets
    - Sleeves
    - Aprons & Bibs
    - Chaps
    - Gloves

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## Personnel Protection continued...

- When completed, on break, or lunch
  - Removed electrode from the holders
  - Shutoff gas cylinder
  - Warning sign



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## Safety Concerns – Oxygen-fuel gas

- Use approved burners, torches, attachments, regulators, and manifolds.
- Pressure less than 15 psig (103 kPa gauge)
- Don't repair or tamper with valves



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## Safety Concerns – Oxygen-fuel gas

### Cylinders and containers

- Approved containers and connections
- Labeled or Marked (LEGIBLY)
- Storage
  - sources of heat
  - electric circuit
  - location
  - Hand-tight valve caps, valve end up

**20 feet**

**or**

**5 ft “wall” with  
half hour fire-rating**



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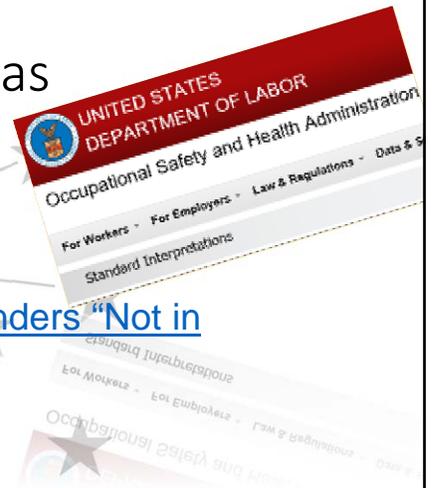
## Safety Concerns – Oxygen-fuel gas

- Storage

- [Standard Interpretations](#)

[Single acetylene and single oxygen](#) and [Cylinders](#) “Not in storage”

“in use or attached ready for use”



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## Safety Concerns – Oxygen-fuel gas

- Open valves by hand
- Close valves before moving cylinder
- Secured cylinder while moving or
- Remove regulators + put on valve
- Valve end up while in use

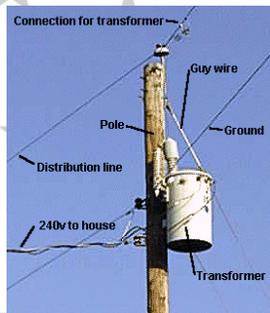


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## Safety Concerns – Arc

- Check all connections before starting (c)
  - Work lead firmly attached to the work
- Coiled welding cable shall be spread out



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## Safety Concerns – Arc

- Check for leaks in shielding gas, etc...
- Electrical Shock
  - Don't use or repair cables with splices within 10 ft of the holder
  - Don't coil or loop electrode cable around **body**
  - Report defective equipment or safety hazard
    - Discontinue use



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## Welding Health Hazards and Illnesses

- Metal fumes – allergic reactions/systemic/skin
- Particulates – lung disorders
- Gases – systemic/irritation and ulceration (phosgene gas)
- Ultra violet (UV) light – eyes and skin
- Ionizing radiation from X-ray inspection and gauging sources – cancer/body organ damage

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## Welding or Cutting Containers

- Thoroughly cleaned before hot work
- Prevent toxic or flammable vapors
  - Flammables
  - Acids and caustics
  - Greases and tars
- Pipelines and connections – disconnected or blanked
- Vent before preheating
  - Spaces, cavities or containers
  - Inert gas purging recommended



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## Work in Confined Spaces

- Ventilation is required
- Gas cylinders outside of space in case of leak
- Lifelines for outside rescue by attendant
  - Rescue plan
- Shut off gas cylinders when not in use



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## Health Protection and Ventilation

- Contamination factors
  - Space dimensions, especially height of ceiling
  - Number of welders
  - Fumes, gases or dust generation
- Welding screens > two feet above floor for ventilation
- Exposures below OSHA Permissible Exposure Limits
- Hazard communication – 1910.1200
  - Fluxes
  - Coatings / coverings
  - Filler material



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# Health Protection and Ventilation

- Hazard communication (cont.)
  - Special labels for welding
    - Filler metals and granular materials
  - Cadmium
    - Cancer, lung and kidney effects
    - Acute toxicity effects
  - Fluorine in brazing and gas welding fluxes
    - Eye and respiratory tract effects

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# Ventilation for General Welding and Cutting

- Mechanical ventilation for:
  - Fluorine
  - Zinc
  - Lead
  - Beryllium
  - Cadmium
  - Mercury
  - Cleaning compounds on metal
  - Stainless steel



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## Special Chemicals Specified in .252(c)(5)-(12)

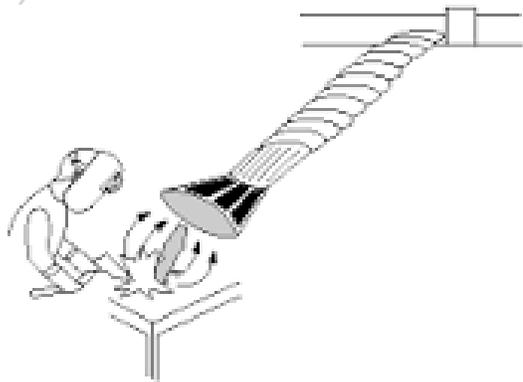
- Mechanical ventilation
  - Confined spaces
  - Hoods or booths for general welding
  - Below Permissible Exposure Limit
  - Cleaning compounds
    - Manufacturers instructions
    - No UV radiation from gas-shielded welding around degreasing tanks with halogenated hydrocarbons
      - Can generate phosgene – WWI chemical weapon
        - Trichloroethylene
        - Perchloroethylene
  - Stainless steel welding – hexavalent chromium (Cr6)

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## Ventilation for General Welding and Cutting

- Space < 10,000 square feet per welder
- Ceiling height < 16 feet
- Confined spaces or obstructed ventilation
- Minimum flow rate of 2,000 cubic feet per minute
- Local exhaust hoods and booths
  - Free moving hoods – 100 linear feet per minute
    - Table at 1910.252(c)(3)(i)
  - Fixed enclosure with top and at least two sides
    - 100 linear feet per minute



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## Ventilation in Confined Spaces

- Prevent oxygen deficiency or toxic contaminants
- For welders and helpers
- Clean replacement air, but not oxygen
- Respirators if ventilation doesn't work
  - Airline – 42 CFR Part 84
  - Self-contained for immediately dangerous to life or health
    - Full facepiece, pressure demand (SCBA) or
    - Full facepiece, pressure demand supplied air with auxiliary self-contained air supply



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## Ventilation in Confined Spaces (cont.)

- Outside helper if respirators worn
- Oxygen must never be used for ventilation
- Respirator program – 1910.134



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## Miscellaneous Health Hazards in Welding

- X-rays and radioactive isotopes
  - Ionizing radiation hazards – human cells altered
  - Pipeline and mechanical piping systems inspection
- ANSI Z54.1-1963 American National Standard Safety Standard for Non-medical and Sealed Gamma Ray Sources
- Resistance welding – “spot welding” usually not a health problem

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## Air Sampling for Welding Contaminants

- Pump/filter sampling common
  - Metals - oxides
  - Particulates
  - Ozone/phosgene/carbon monoxide (special sampling methods)
- Sample filter usually placed inside of hood to determine need for respirator
- Sample filter usually placed outside of hood for engineering determination

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## Summary

### Safety Hazards

- Burns
- Fire
- Explosion
- Electrical shock/electrocution

### Health Hazards

- Air Contaminants
  - Fumes, particulate, gases
- Radiation
- Confined Spaces

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- **Indiana Safety and Health Achievement Recognition Program**
- Federally recognized program
- Similar to Voluntary Protection Program (VPP)
- Certification = Exemption from random IOSHA inspections
- To learn more:

[www.in.gov/dol/insharp](http://www.in.gov/dol/insharp)



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## Social Media



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## SAFETY AND HEALTH CONSULTATION

- (317) 232-2688
- [insafe@dol.in.gov](mailto:insafe@dol.in.gov)
- [www.in.gov/dol/insafe.htm](http://www.in.gov/dol/insafe.htm)

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