



Collaborative Bachelor's Degree Program of Fire Protection and Safety Engineering Technology between Southwest Jiaotong University and Oklahoma State University, U.S.A.




FPST 2023 Industrial and Occupational Safety

Welding and Cutting


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What is Welding?




- A fusion process for joining metals.
- The application of intense heat, at the joint where metals intermix (often with a filler material) create a metallurgical bond as strong as the original two metals.







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History of Welding




- Bronze age (2600 – 800 BC)
 - Gold boxes were made by pressure welding lap joints together
- Iron age (1200-1000 BC)
 - Egyptians, Greeks, Romans forged weld to make tools and weapons
 - Forge Welding – joining two pieces of metal by heating them to a high temperature and then hammering them together
- Middle Ages (500 – 1500 AD)
 - Blacksmithing
- 19th Century
 - Modern welding was developed

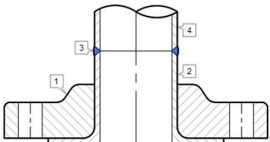



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Lap Joint Flange



1. Lap joint flange 2. Stub End
3. Butt weld 4. Pipe or Fitting

800.580.4195 - bmssi.ca


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Types of Welding & Cutting

- Stick Welding
 - Shielded Metal Arc Welding (SMAW)
- MIG Welding
 - Metal Inert Gas welding
 - Gas Metal Arc Welding (GMAW)
- TIG Welding
 - Tungsten Inert Gas Welding
 - Gas Tungsten Arc Welding (GTAW)
- Flux Cored Arc Welding
 - FCAW
 - Self Shielding/Dual Shielding
- Oxy-Acetylene welding
 - Mostly used for cutting
- Resistance Welding
- Plasma cutting
- Brazing
- Heating
- Watch Canvas video
 - welding

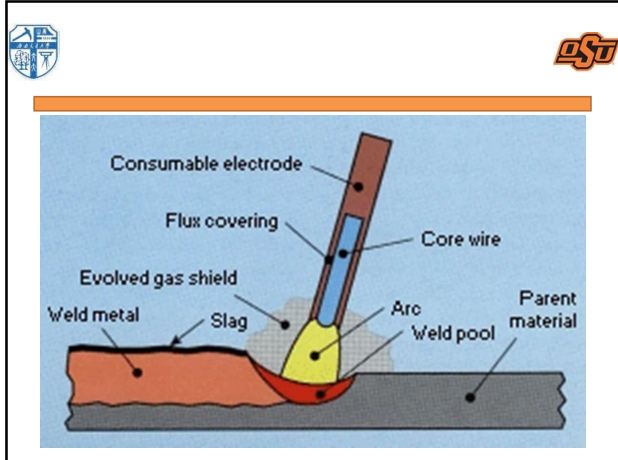
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Definitions

- Flux
 - A chemical compound that combines with impurities and with oxygen to prevent harmful oxidation of the hot metal
- Slag
 - After combining with impurities the flux is in the molten state called slag
 - Slag solidifies and must be removed from when finished
- Inert gas
 - Argon or Helium
 - Displaces the air ambient to the weld and thus keeps harmful oxygen away from the hot metals


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Oxygen Acetylene Welding/Cutting

- Oxy-acetylene torch process, with temperature around 3300°C (6000°F)
- Watch Canvas videos
 - Torch cutting 1
 - Torch cutting 2
 - Torch cutting 3



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Oxy-Acetylene Equipment



- Cylinders
- Labeled with contents
- Double seated valves – open or closed
- Secured in storage
- Oxygen and fuel gas must be stored 20 feet apart OR with a ½ hour fire wall between them
- Never rolled or hand carried
- Cart for “in use” applications within 24 hours
- Hydro-tested every 10 years



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Torch Cutting Carts



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Oxy-Acetylene Equipment



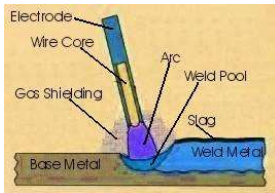
- Gauges
 - Brass construction
 - Never use Oil
 - Should be removed when not in use
- Hoses
 - Oxygen (green)
 - Acetylene (red)
 - Should not be repaired or taped
- Torches
 - Never use thread tape or “dope”



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Electric-arc Welding



- Use an inert gas to facilitate the process
- Requires a small gap between electrodes
- Electric arc formed between electrodes provides the intense heat
- Shielded Metal Arc Welding (SMAW)
 - The flux covering the electrode melts during welding. This forms the gas and slag to shield the arc and molten weld pool.

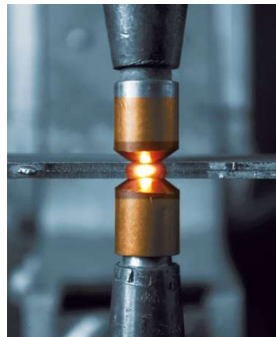
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Resistance Welding



- Seam Weld
- Resistance is restricted to relatively thin sheets of material
- Electrical current is applied through the material to generate the heat and physical pressure
- The melting only occurs where the mating surfaces meet and the damage to the material is minimal due to the oxidation at high temperature



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Welder Injuries – 2018
BLS.gov
Videos

WELDING, CUTTING, AND HOT WORK HAZARDS

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Safety Hazards



- Fire and Explosion
 - Near combustible materials, prevent sparks or hot slag from reaching such material and starting fire.
 - Drums, tanks, closed containers
- Electric Shock
 - From the Arc welding machine
- Flash Burns
 - Eyes
 - Skin
- Slag Burns
- Strains/Sprains from welding in awkward postures
- Falls from heights

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Health Hazards



- The most significant health hazard in the welding process is the generation of toxic metal fumes, vapors, and gases.

- Ozone (formed by electrical arcs)
- Phosgene
- CO/CO₂
- Particulate matter
- Metals (Cr₆, Zn, Ti, Ni...)



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Fires & Explosions



- Welding is one of the principal causes of industrial fires
- Welding on old oil drums or pipes that have contained asphalt or other petroleum products has resulted in a large number of explosions and fatalities
- Welding and confined spaces, flammable and combustible materials, and lack of ventilation

Safe Welding, Cutting, and Hot
Work Practices in the Petroleum
and Petrochemical Industries

API RECOMMENDED PRACTICE 2009
SEVENTH EDITION, FEBRUARY 2012




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HOTWORK PERMITS
29 CFR 1910.252(A)(2)(IV)

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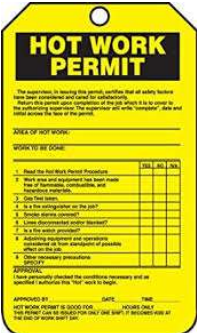





Hot Work Permits




- Approval and written permits to do hot work operations, even for quick repairs, are required
 - Welding
 - Cutting
 - Brazing
 - Heating
- Hazard identification surveys and advance planning for exactly when and where the permit system is really need are necessary.





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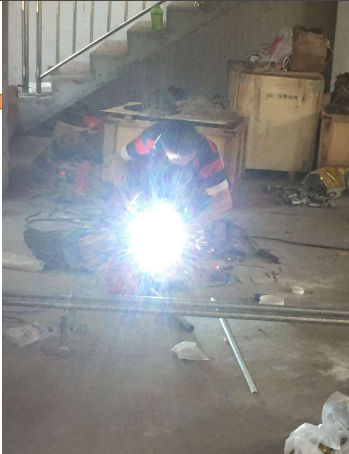

Hot Work Procedure



- Site Preparation
 - LOTO
 - Ventilation/Washdown
- Gas Detection
- Fire Watch
 - 30 minutes after work completes
- Fire extinguishers
- Limiting Exposures



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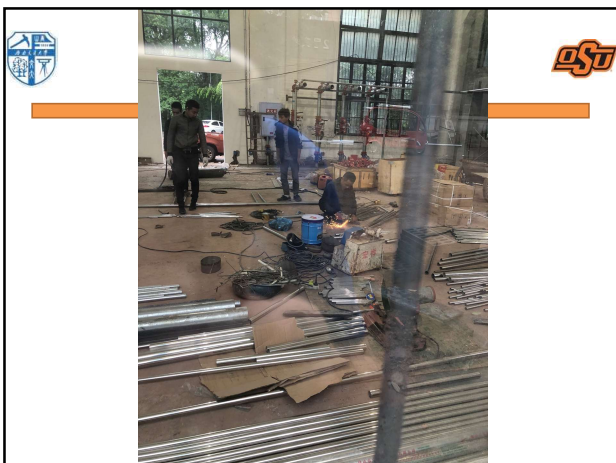
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Personal Protective Equipment for Welding




- Protective Outerwear
- FR or Leather
- Jacket
- Sleeves
- Pants
- Coveralls
- Bibs or aprons
- Hoods
- Gloves
- Caps
- Respiratory Protection
 - Supplied Air
 - Purifying
- Eye protection



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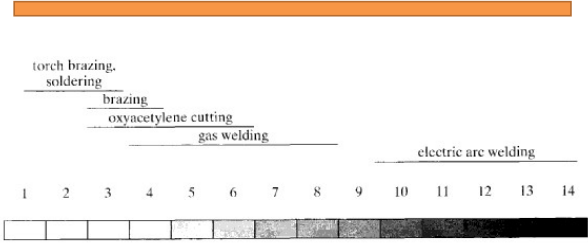
Eye Protection



- Eye protection is needed for people in the welding area, including the welders, helpers and others
- Minimum appropriate eye protection
 - The darker shades provide more protection, but less visibility
 - A helmet to protect the entire face area from painful burns can prevent radiation

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Summary



- Hotwork
 - Welding
 - Torch Cutting
 - Grinding
- Hazards
 - Fire/Explosion
 - Burns
 - Thermal and light
- Hotwork Permit
- PPE

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