Welding for Dummies: Issues and Hazards from a Safety Perspective

ASSE Bakersfield Chapter

4/6/16
Learning Objectives:

- Recognize common welding processes
- Recognize health effects of welding
- Anticipate potential atmospheric hazards
- Recognize effective/ineffective control strategies with special emphasis relating to confined spaces
Shielded Metal Arc Welding (Stick)

<table>
<thead>
<tr>
<th>Process</th>
<th>Base Metal</th>
<th>Contaminant</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMAW</td>
<td>Mild Steel</td>
<td>Iron Oxide, Manganese</td>
</tr>
<tr>
<td>SMAW</td>
<td>Stainless Steel</td>
<td>Chromium, Nickel, Manganese, NOx, Ozone</td>
</tr>
<tr>
<td>SMAW</td>
<td>Galvanized</td>
<td>Zinc</td>
</tr>
</tbody>
</table>

**Diagram:**
- Shielding atmosphere
- Core wire
- Electrode covering
- Molten weld pool
- Solidified slag
- Metal and slag droplets
- Weld
- Base metal
- Penetration depth
- Ground earth cable
- Electrode lead
- Welding machine
What causes weld failure?

Porosity:

Hydrogen Embrittlement:

Heat Affected Zone Cracking:
Shield gas or flux serves a valuable purpose:

- Mechanical/chemical cloud to displaces atmosphere
- Slag protects weld while it cools (remove impurities)
- Flux health implications:
  - Manganese, Fluoride
  - Stabilizes Cr VI long enough to permit exposure
- Flux & shielding gas vs ventilation
Gas Tungsten Arc Welding (TIG)

Common Inert Gases:
- Helium
- Argon
- Carbon Dioxide
Gas Metal Arc Welding (MIG)

**Common Inert Gases:**
- Argon
- Helium
- Carbon Dioxide
Flux Core Arc Welding (FCAW)

- Flux is similar in composition
- Flux internal to wire
- Advantages of wire feed (4x)
- Dual Shield
- “Dirty”
- Significant generator of manganese and CrVI
How can I get hurt?

- Burns from fire
- Injury from falls
- MSDs
- Eye abrasion/laceration
- Electrocution
- Heat illness
- Hearing loss from noise
- Arc Eye (UV)
- Fumes/Gases?
Exposure Depends On:

- Welding Process
- Filler Rod
- Dispersion Factors
- Base Metal
- Task Information
- Presence of coatings
- Presence of chlorinated HC

Photo of arc gouging (Can you see the worker?)
Health Effects:

- Pulmonary disease
- Small airway disease
- Chronic Bronchitis
- Pulmonary edema
- Reduced sperm quality
- Metal fume fever (Zn, Cu)
- Cancer (Cr VI)
- Nasal Perforations
- Acute/Chronic Beryllium disease
- Manganism
### A few evaluation considerations:

<table>
<thead>
<tr>
<th>Process</th>
<th>Consideration</th>
<th>Contaminant</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>Stainless Steel</td>
<td>Chromium, Nickle,</td>
</tr>
<tr>
<td>All</td>
<td>Galvanized</td>
<td>Zinc Oxide</td>
</tr>
<tr>
<td>All</td>
<td>Chemical Asphyxiation in Enclosed Space</td>
<td>Carbon Monoxide</td>
</tr>
<tr>
<td>SMAW</td>
<td>Process with flux electrode</td>
<td>Metal Fumes, Manganese, UV</td>
</tr>
<tr>
<td>TIG/MIG</td>
<td>Aluminum especially in confined space</td>
<td>UV, Ozone (5-10X SS) NOx</td>
</tr>
<tr>
<td>TIG/MIG</td>
<td>Chlorinated Degreasers</td>
<td>Phosgene, Chlorine</td>
</tr>
<tr>
<td>TIG/MIG</td>
<td>Simple Asphyxiation in Enclosed Space</td>
<td>Inert Shielding Gas</td>
</tr>
<tr>
<td>FCAW</td>
<td>SMAW on steroids</td>
<td>Metal Fume, Manganese, Fluoride</td>
</tr>
<tr>
<td>All</td>
<td>Sulfide Residue Paint Coating</td>
<td>Sulfur Dioxide Lead, Cadmium</td>
</tr>
</tbody>
</table>
What Respiratory Should I Wear?

- Develop a sample plan
- Use a competent IH
- Impact of the welding helmet
Control:

- Select less hazardous welding process
- Ventilation
  - Local Exhaust
  - Dilution
- Respiratory Protection
Can you find your exposure group?
8 CCR 1536 gives us direction for Ventilation:

• Indoor: Local Exhaust Ventilation
  – Capture Velocity = 100 fpm (1.1 mph)
  – 1.5 to 2 duct diameters from arc
  – Verify effectiveness

• Dilution Ventilation:
  – 2000 cfm per welder

• Toxic Substances:
  – Enclosed Space: LEV and/or SAR
  – Open Air: Natural or mechanical ventilation
Ventilation Strategies Vary In Effectiveness

Where is the make-up air coming from?
Where is the short circuit?
Where is the exhaust going? Exhaust entrainment? Where should we place our 4 gas monitor?

Locate gas cylinders outside CS
Shut off fuel gas supply when not in use outside of confined space?
Respirator Selection and Assigned Protection Factors

- ½ Faced Air Purifying Respirator: 10 X PEL
- Full Faced Air Purifying Respirator: 50 X PEL
- Helmet/Hood Powered Air Purifying Respirator: 25/1000 X PEL
- Helmet/Hood Supplied Air Respirator: 25/1000 X PEL

The employer must have evidence provided by the respirator manufacturer that testing of these respirators demonstrates performance at a level of protection of 1,000 or greater to receive an APF of 1,000. This level of performance can best be demonstrated by performing a Workplace Protection Factor (WPF) or simulated WPF study or equivalent testing. Absent such testing, all other PAPRs and SARs with helmets/hoods are to be treated as loose-fitting facepiece respirators, and receive an APF of 25.
PPE
Additional Resources

- Recognition of Health Hazards In industry, 2nd Edition, William Burgess
- Field Guidelines for Temporary Ventilation of Confined Spaces With an Emphasis on Hot Work, AIHA
- Welding Health And Safety: A Field Guide For OEHS Professionals, AIHA
- Welding: An Exercise in Applied Industrial Hygiene, AIHA
Questions?