

Oxyfuel Cutting (OFC)

1. Welding Terms

- a. **Oxyfuel Cutting:** A group of cutting process that uses _____ temperatures generated by burning a fuel gas in oxygen to accelerate the chemical reaction between oxygen and the base metal to sever and remove material.
- b. **Oxidation:** A _____ combination of oxygen with a substance.
- c. **Burning:** When oxygen _____ combines with a substance.
- d. **Kerf:** Space or _____ of the cut made by the oxygen stream during flame cutting.
- e. **Kindling Temperature:** The temperature at which a substance will catch fire and burn, also referred to as the “_____”.
- f. **Backfire:** Popping noise when the flame suddenly burns back into the tip but **goes out**. (explosion at the tip)
- g. **Flashback:** When the flame burns back **inside** the tip, torch, hose, or regulators. (pop - followed by a shrill squealing or hissing sound)

2. Personal Protection

- a. **Safety glasses;** ANSI Z87.1
- b. **Clothing;** Fire resistant materials, Leather, **cotton** – no synthetics like polyester. No turned up or frayed cuffs. Long sleeves and collars buttoned.
- c. **Boots;** Leather, steel toes, slip on best, no exposed **opening**.
- d. **Gloves;** Gauntlet, flexible but **heavy** enough for heat protection.
- e. **Goggles, Shield;** #3 – 5 shaded lens. (ultraviolet/ infrared light)
- f. **Ear protection;** muffs, plugs, (out of position welding/ cutting)
- g. **Never have a pressurized butane _____ on your person.**

3. Additional Fuel Types

- a. **MAPP:** Methylacetylene - Propadiene + Liquefied petroleum gas. Stable liquid, high flame temperature of acetylene but handles more like _____. (Neutral Flame _____° F)
- b. **Natural Gas:** Mixture of Methane, Ethane, and other hydrocarbons. Stable liquid, lower flame temperature than acetylene. (Neutral Flame _____° F)
- c. **Propane:** Known as Liquefied Petroleum Gas (LPG). Non-toxic, colorless, odorless gas. Mercaptan added for smell detection. (Neutral Flame _____° F)
- d. **Propylene & Propylene Based:** Found in coal gas or synthesized from petroleum. Colorless, highly flammable, garlic smell. (Neutral Flame _____° F)

4. Oxy-Acetylene Cutting Process

- a. Uses acetylene as the _____ combined with oxygen to produce heat source.
- b. _____ flames bring base metal to _____ temperature. (_____° F for steel)
- c. Rapid _____ or burn is caused by oxygen jet action which blows the oxides away from the cut.
- d. Cutting jet is feed through separate orifice in the _____ of the tip.
- e. Process can be applied to all carbon steels up to _____ % carbon.
- f. Process can be applied to _____ carbon steels but with more difficulty.
- g. Process _____ be used on copper, aluminum, or high-nickel alloys.

5. Oxy-Acetylene Cutting Equipment

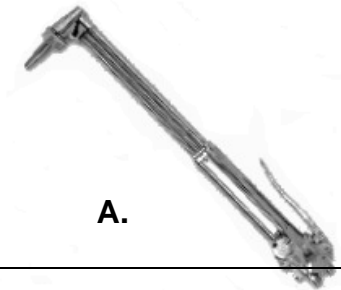
- a. Same basic oxyacetylene equipment as with welding except for the _____ attachment.

6. Torch Function

- a. Control and mix the oxygen and fuel gas within the _____ of the torch.
- b. Direct the pre-heat _____ and the cutting oxygen jet stream to the work area.

7. Cutting Torch Types

- a. **Straight Hand Cutting Torch:** used for cutting/_____.
- b. **Hand Cutting Torch Attachment:** used with _____ torch body.
- c. **Machine:** used with semi-automated equipment.



A.



B.



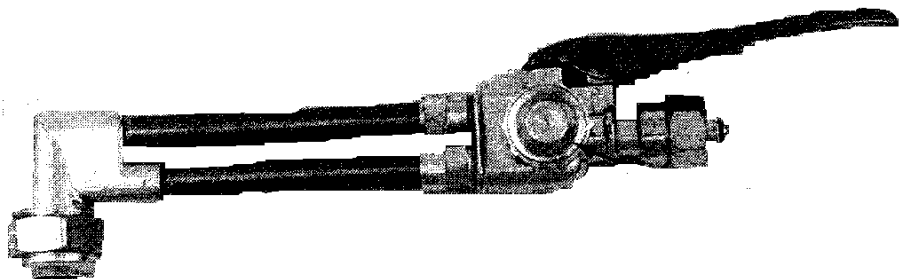
C.

8. Torch Styles

- a. 2 tube; Oxygen cutting tube & mixed pre-heat gas tube.
- b. 3 tube; Oxygen cutting tube. Separate oxygen and acetylene pre-heat gas tubes. Pre-heat gas mixed in tip mixing chamber.

9. 2 Tube Torch Parts

- Cutting Tip
- Cutting Oxygen Tube
- Preheat Oxygen & Acetylene Mixing Tube
- Cutting Oxygen Lever
- Torch Handle
- Preheat Acetylene Valve
- Preheat Oxygen Valve

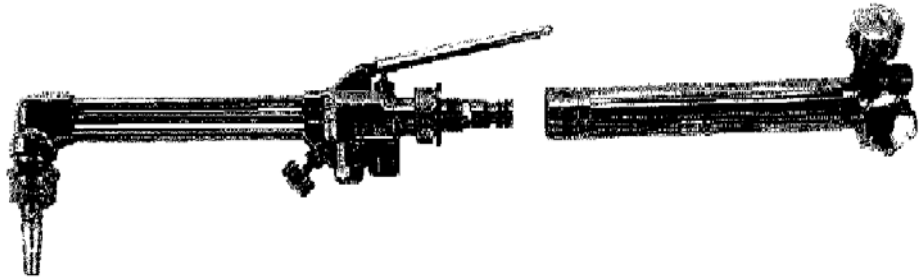


10. 3 Tube Torch Parts

- Cutting Tip
- In-tip Mixing Chamber
- Cutting Oxygen Tube
- Pre-heat Oxygen Tube
- Pre-heat Acetylene Tube
- Cutting Oxygen Lever
- Torch Handle
- Preheat Oxygen Valve
- Preheat Acetylene Valve



- Cutting Oxygen Valve



11. Cutting Tips



- a. Diameter of the tip end is much _____ than welding tips.
- b. Larger hole in the center for _____ pressure oxygen cutting stream.
- c. Four to eight smaller _____ holes surround center cutting orifice.
- d. Different tip types and styles for different fuel gasses and operations.

12. Cutting Tip Types



- a. **One piece:** Acetylene/ MAPP gas. _____ preheat holes, one cutting jet orifice.
- b. **Two Piece:** Used with other gas types. Multiple & _____ preheat holes to compensate for lower flame temperatures and BTU's.
- c. Premixed gas or _____ mixing.

13. Cutting Tip Styles



- a. **Straight cutting:** General cutting operations
- b. **Gouging:** Edge preparation, removing welds or cracked metals.
- c. **Rivet/Riser:** Rivets, bolt heads, bulk heads.
- d. **Rivet Blowing & Metal Washing:** Large quantities of metal.
- e. **Drag Tip:** Thin sheet metal.
- f. **Bent:** 180 cutting torch or tight places.
- g. **Heating:** Large volume of preheat. No cutting orifice. (not a Rosebud; designed for one-piece hand cutting torch)

14. Tip Sizes

- a. Measured by the diameter of the **orifice** at the end of the tip.
- b. Tip size affects the amount of **heat** – not temperature of the flame.
- c. Must select correct **tip** size for the job. (thickness & type of metal)
- d. No standard tip size measurement **system**.
- e. Use number system; 000 (smallest) to _____ (largest).
- f. Use manufactures number; Smith – _____ digit of part # equals tip size.

15. Tip Selection

- a. _____ and _____ of metal.
- b. Working pressures must match _____. Follow manufactures recommendation.



16. Tip Care

- a. Keep tip **clean**. (slag, carbon, molten metal distorts flame and can cause backfire or flashback and poor cut)
 - b. Use correct size tip **cleaner**. (don't enlarge or elongate orifice)
 - c. Do not **drop** the torch or the tip.
 - d. **Hang up** torch when not in use.
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17. Equipment Set-up Procedure

- a. Securely **chain** or fasten cylinders in vertical position.
 - b. Remove safety caps.
 - c. Quickly crack open cylinder **valve** to clear dirt. (stand to side)
 - d. Connect **regulator** by hand and tighten with a proper fitting wrench. (Attach Flashback arrester to regulator)
 - e. Attach **hoses** to respective regulators. (purge regulator & hose)
 - f. Attach check valve or **flashback** arrester to torch.
*In-tip mix type torches do not recommend using flashback or check valves as they will restrict the gas flow and are not susceptible to flashback.
 - g. Attach torch body & check valve/arrester to hoses by hand and **tighten** with proper fitting wrench.
 - h. Attach and **Hand-tighten** combination cutting attachment type.
 - i. Select and install correct **size tip**. Align w/ valves.
 - j. Tighten with a **wrench** in most cases. _____ styles are hand tightened only.
 - k. Pressurize system following proper procedures and check all connections and fittings for leaks using **soapy water** or commercial leak test solution. (check valve stem at the cylinder also)
 - l. Never test for leaks with **flame** or heat source.
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18. Pressurizing System & Lighting Torch

- a. Check that torch valves are **closed** and pressure adjustment screws on the regulators are backed **out**.
- b. **Slowly** crack open cylinder valves. Open Oxygen **completely** - Acetylene **1/4 – 1/2** turn. Always stand to the side of the gauges – never in front of them.
- c. Set working pressures separately.
Combination Torch; Open torch body valve completely. Open cutting oxygen valve. Adjust pressure adjustment screw at regulator to desired pressure. **Close** cutting oxygen torch valve only. Always purge gas lines – 3 to 4 seconds per 25' of hose before lighting torch. Repeat steps with acetylene.
- d. To light torch, open acetylene valve first, **1/8 to 1/2** turn. Light torch facing **downward** with sparklighter held approximately 1" from torch tip.
- e. Adjust acetylene flame until **smoke** almost disappears.
- f. Open torch **oxygen** _____ **valve** and adjust to neutral flame.
- g. Depress _____ oxygen lever and re-adjust flames to neutral if necessary.
- h. Oxygen pressures will be much higher for cutting than they are for welding. **(20 – 35 lbs.)**

19. Cutting Flame

- a. Preheat flames setting should stay _____ when cutting lever is pressed.
- b. Cutting jet stream will appear as two, _____, parallel streams.
- c. Improper flame settings or incorrect working pressures will cause defects in cut.

20. Holding the Torch

- a. **Hold Hand:** Over-Hand grip on _____ (handle).
Guide Hand: Underhand grip on _____ or cutting attachment.
- b. Hold hands back away from torch _____ as far as possible.
- c. Place hoses over shoulder to reduce weight. Do not wrap around _____.
- d. Support _____; get comfortable.

21. Torch Manipulation & Metal Placement

- a. **Perpendicular to cut line;** Hold torch 90° to cut line. Travel right to left or left to right. Used for cuts perpendicular to _____.
- b. **Push or Pull;** Hold torch parallel to cut line. Used with straight edge (angle iron) or cutting attachment, drag tip, and beveled cuts.
- c. Support metal off tables. Do not allow material to material contact _____ cut line.
- d. Do not cut too close to concrete or allow large amounts of _____ to pile on concrete.

22. Travel Angle

- a. Preheat cones are held _____ to surface for thick metal.
- b. Preheat cones are slightly angled _____ the travel direction for thin metal.

23. Travel Speed

- a. Speed at which torch moves in _____ direction.
- b. Correct and constant speed produces even width kerf and _____, parallel draglines.
- c. Too fast travel speed will create pronounced draglines that slant _____ from the travel direction with considerable slag on bottom edge.
- d. Inconsistent or excessive travel speed will result in the loss of kindling heat and _____ the cutting process.

24. Torch Height

- a. Distance from the tip of the neutral flame **cone** to the molten edge.
- b. Keep approximately ____” from molten edges. (changes w/ tip size)
- c. Improper cone to work height will cause defects in kerf.
Distance too _____; top edge appears to be blown away.
Distance too _____; top edge appears to be melted.
- d. Do not allow cone to _____ into molten edges. (Backfire, dirty tip, poor kerf quality)

25. Making a Straight Cut

- a. Set appropriate working pressures, light and adjust _____.
- b. Lower tip to the edge of the metal, align preheat cones slightly _____ the top edge. Bring metal to kindling temperature or cherry red appearance. (1500 F)
- c. Rotate tip to 90 angle. Bring tip 1/8” over edge. Slowly press oxygen _____ and slightly rotate tip away from travel direction.
- d. When cutting begins, rotate tip back to ____° travel angle and continue moving and a constant travel speed.
- e. Keep preheat cones approximately _____” off surface.

26. Piercing a Hole

- a. Start cut in the center of the hole.
- b. Holding the tip perpendicular to the surface, lower the preheat cones approximately _____” off the metal. Bring metal to kindling temperature or cherry red appearance. (1500 F)
- c. Raise tip approximately _____” and slightly angle the tip. Slowly press the oxygen _____.
- d. When metal is pierced, lower tip to cutting height and rotate tip back to **90°** travel angle. Spiral out to cut line and continue moving with a constant travel speed.
- e. Keep preheat cones approximately _____” off surface.

27. Making a Beveled Cut

- a. Clamp or place piece of angle Iron (with two edges facing down) or cutting jig on material.
- b. Preheat metals 3/8” or thicker. Use _____ or push technique.
- c. Bring metal to kindling temperature or cherry red appearance.
- d. Rotate tip to desired angle. Bring tip 1/8” over edge. Slowly press oxygen _____ and slightly rotate tip away from travel direction.
- e. When cutting begins, rotate tip back to ____° travel angle and continue moving and a constant travel speed.
- f. Keep preheat cones approximately _____” off surface.
- g. Keep torch angle consistent.

27. Backfire

- a. Popping noise when the flame suddenly burns back into the tip but **goes out**. (explosion at the tip)
- b. Can be caused by operating torch at too **low** pressure for tip.
- c. Touching the cutting **tip** to the work.
- d. **Overheating** the tip.
- e. **Obstruction** in the tip.
- f. After Backfire: Shut off **torch** valves – GAS IS STILL FLOWING, remedy the cause, relight torch

28. Flashback

- a. When the flame burns back inside the tip, torch, hose, or regulators and **does not** go out. (pop - followed by a shrill squealing or hissing sound)
- b. Generally indicates something is wrong with equipment or **set-up**.
- c. Touching tip to the work - **obstruction** in the tip.
- d. **Overheating** the tip.
- e. Wrong gas **working** pressure.
- f. After Flashback: Shut off valves **immediately** – GAS IS BURNING INSIDE THE TORCH AND WILL DAMAGE THE TORCH. Remedy the cause, inspect system, relight torch.
- g. Flash Arresters will **stop** flame at the torch if installed between the torch and the hoses.

29. Shutting Off Torch

- a. Turn off torch _____ valve first – Acetylene second.
- b. Close tank or manifold **valves**.
- c. Open torch **Acetylene** valve, bleed all gas from hose and regulator.
- d. Back out Acetylene pressure **adjusting screw** at regulator. **Close torch Acetylene valve**.
- e. Open torch preheat **Oxygen** valve, bleed all gas from hose and regulator.
- f. Back out Oxygen pressure **adjusting screw** at regulator. **Close torch Oxygen valve**.
- g. Place torch on **hanger**. Clean up work area. Cool metal **before** placing it in scrap bin.