# CODE-440

# Trade - Welder [Gas and Electric]

## Unit III: Set the Oxygen - Acetylene Gas Cutting Plant (Oagc) and Oxygen - Acetylene Welding (OAW)

# 1. Oxy–Acetylene

## Gases Used:

- Oxygen ($O_2$) – supports combustion
- Acetylene ($C_2H_2$) – fuel gas

  Flame Temperature: ~ 3,200˚C to 3,500˚C (highest among commercial fuel gases)

## Flame Types:

1. Neutral Flame – Equal oxygen & acetylene, for welding steels, cast iron, copper, aluminum.
2. Carburizing (Reducing) Flame – Excess acetylene, for welding high-carbon steels, surface hardening.
3. Oxidizing Flame – Excess oxygen, for welding brass, bronze, cutting operations.

## Uses:

- Gas welding of ferrous and non-ferrous metals
- Oxy-fuel cutting of steel
- Brazing & soldering
- Heat treatment (flame hardening, tempering)

# 2. Oxy–Hydrogen

## Gases Used:

- Oxygen ($O_2$)
- Hydrogen ($H_2$)

**Flame Temperature: ~ 2,800°C to 2,850°C**

## Characteristics:

- Softer flame, less intense than oxy-acetylene
- Clean, no carbon soot

## Uses:

- Welding of low-melting-point metals (aluminum, lead)
- Glass working and quartz welding
- Cutting special metals in explosive environments (less risk of backfire)
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## 3. Air–Acetylene

### Gases Used:

- Air (instead of pure oxygen)
- Acetylene ($C_2H_2$)

### Flame Temperature: ~ 2,300°C

### Uses:

- Soft soldering & brazing
- Plumbing work (copper pipes)
- Low-temperature heating applications

# 4. LPG / Propane / Butane with Oxygen

## Gases Used:

- Oxygen ($O_2$)
- Propane ($C_3H_8$) or Butane ($C_4H_{10}$) or LPG mixture

**Flame Temperature: ~ 2,820°C (oxy–propane)**

## Characteristics:

- Cheaper & safer than acetylene
- Slightly lower flame temp, but high heat content in outer flame

## Uses:

- Cutting, heating, bending metals
- Preheating before welding
- Foundry work
- Not preferred for fusion welding (lower inner cone temp)

## 5. MAPP Gas (Methylacetylene–Propadiene–Propane mixture)

**Gases Used:**

- MAPP gas + Oxygen

**Flame Temperature: ~ 2,925°C (oxy–MAPP)**

**Advantages:**

- Safer than acetylene (stable under higher pressures)
- Portable

**Uses:**

- Heavy-duty cutting, brazing
- Underwater welding & cutting
- Industrial maintenance

# Common Gases Used in Welding & Cutting

| Gas | Chemical Formula | Type of Flame Produced | Max Flame Temp (in $O_2$) | Common Uses |
|---|---|---|---|---|
| **Acetylene** | $C_2H_2$ | Neutral / Carburizing / Oxidizing | **~3,200°C** | Gas welding (Oxy-acetylene), cutting, brazing, heating. |
| **Hydrogen** | $H_2$ | Clean, non-carbon flame | **~2,800°C** | Welding of aluminium & lead, underwater welding. |
| **Propane** | $C_3H_8$ | Slightly lower heat intensity than acetylene | **~2,820°C** | Cutting, heating, soldering (not recommended for fusion welding). |
| **Natural Gas** | $CH_4$ (Methane) | Softer flame | **~2,770°C** | Cutting & heating in industries where gas is cheap. |
| **Butane** | $C_4H_{10}$ | Similar to propane | **~2,800°C** | Soldering, brazing, small-scale cutting. |
| **MAPP Gas** *(Methylacetylene-Propadiene Propane)* | $C_3H_4$ + $C_3H_6$ mixture | Hotter than propane | **~2,925°C** | High-performance cutting, heating, brazing. |

# 1. Neutral Flame

**Proportion: Equal volume of Oxygen ($O_2$) and Acetylene ($C_2H_2$).**

**Appearance:**

- **Bright white inner cone with sharp outline.**
- **Light blue outer envelope.**

**Flame Temperature: ~ 3,200°C (maximum heat at the tip of inner cone).**

**Characteristics:**

- **No excess oxygen or carbon.**
- **Does not alter chemical composition of metal much.**

**Uses:**

- **General welding of mild steel, stainless steel, aluminum, copper, cast iron.**
- **Cutting (when used with oxygen jet).**
- **Brazing and silver soldering.**

## 2. Carburizing Flame (Reducing Flame)

**Proportion: Excess Acetylene ($O_2 < C_2H_2$).**

**Appearance:**

- Inner cone + acetylene feather (second cone) around it.
- Outer envelope longer than in neutral flame.

**Flame Temperature: Slightly lower than neutral (~ 3,150°C).**

**Characteristics:**

- Rich in carbon (reducing atmosphere).
- Prevents oxidation of certain metals.
- Can add carbon to steel surface (case hardening).

**Uses:**

- Welding high-carbon steels and alloy steels.
- Hard-facing.
- Surface hardening.
- Welding lead, aluminum, and some non-ferrous metals.

# 3. Oxidizing Flame

**Proportion: Excess Oxygen ($O_2$ > $C_2H_2$).**

**Appearance:**

- **Short, pointed inner cone.**
- **Outer flame envelope shorter and noisier.**

**Flame Temperature: Slightly higher than neutral (~ 3,300˚C).**

**Characteristics:**

- **Oxygen-rich (oxidizing atmosphere).**
- **Can oxidize and burn steel if not used properly.**

**Uses:**

- **Welding brass, bronze, manganese steel.**
- **Flame cutting of ferrous metals.**
- **Brazing certain metals where oxide layer is beneficial.**

# Oxy–Acetylene Flames

| Flame Type | Gas Ratio ($O_2$:$C_2H_2$) | Temp (°C) | Appearance | Main Uses |
|---|---|---|---|---|
| Neutral | 1 : 1 | ~3200 | Sharp inner cone, blue outer envelope | General welding (steel, copper, aluminum), brazing |
| Carburizing | < 1 : 1 | ~3150 | Inner cone + acetylene feather | High-carbon steel, alloy steel, lead, aluminum welding, hard-facing |
| Oxidizing | > 1 : 1 | ~3300 | Short pointed cone, noisy | Brass, bronze, manganese steel welding, cutting |

# 1. Principle of Oxy–Acetylene Cutting

Oxy–acetylene cutting (also called oxy–fuel gas cutting) is based on the oxidation of metal at high temperature.

Key points in principle:

1. Heating flame – The metal is first preheated to its kindling temperature (lower than melting point for ferrous metals; ~ 800–900°C for mild steel) using an oxy–acetylene flame.
2. Oxygen jet – A stream of pure oxygen is directed at the heated area.
3. Rapid oxidation – The oxygen reacts with the metal to form metal oxides (e.g., $Fe \rightarrow FeO/Fe_2O_3$).
4. Oxide removal – The heat of the reaction melts the oxide, which is blown away by the oxygen jet, creating a cut.

⚠️ Note: Works well for ferrous metals with an oxidation temperature lower than melting temperature (e.g., mild steel).

# 2. Equipment Components

## Cylinders:

- Oxygen cylinder (black body, white top in India) – ~150–200 bar pressure.
- Acetylene cylinder (maroon body) – dissolved acetylene in acetone, ~15 bar max.

Regulators/Pressure gauges: Reduce and control gas pressure.

## Hoses:

- Oxygen hose – blue.
- Acetylene hose – red.

## Cutting torch:

- Mixing chamber (mixes $O_2$ & $C_2H_2$).
- Preheat flame nozzles.
- Central cutting oxygen jet.

Nozzles/Tips: Different sizes for various plate thicknesses.

Flashback arrestors: Prevent flame from travelling back into the hose/cylinder.

# 3. Important Cutting Parameters

1. Preheat flame type – Usually oxidizing flame for cutting.
2. Oxygen purity – Should be ≥ 99.5% for efficient cutting.
3. Oxygen pressure – Depends on plate thickness:
   - Thin plates: ~2–3 bar
   - Thick plates: up to 6 bar
4. 4.Acetylene pressure – ~0.2–0.4 bar (always below 1 bar for safety).
5. Nozzle size – Larger nozzles for thicker plates.
6. Cutting speed – Too fast → incomplete cut; too slow → excess metal burn & rough edges.
7. Torch angle – Vertical or slightly inclined depending on job.
8. Stand-off distance – Distance between nozzle and workpiece ~3–6 mm.

# 4. Applications

1. Metal plate cutting – Mild steel, low-carbon steel plates up to several hundred mm thick.
2. Scrap cutting – Dismantling old structures, scrap yards.
3. Edge preparation – Bevel cutting for welding joints.
4. Piercing – Starting holes in thick plates.
5. Gouging – Removing defective welds or metal.
6. Profile cutting – Using templates or CNC oxy–fuel cutting machines.

1. The principle of oxy–acetylene cutting is based on:

A) Melting of metal

B) Oxidation of metal at high temperature

C) Evaporation of metal

D) Sublimation of metal

2. The usual flame type used for oxy–acetylene cutting is:

A) Neutral flame

B) Carburizing flame

C) Oxidizing flame

D) Cold flame

3. The kindling temperature of mild steel is approximately:

A) 500°C

B) 800–900°C

C) 1,500°C

D) 2,000°C

4. Oxy–acetylene cutting is not suitable for:

A) Mild steel

B) Low-carbon steel

C) Stainless steel

D) Scrap steel

5. The purity of oxygen for efficient cutting should be at least:

A) 90%

B) 95%

C) 99.5%

D) 80%

6. Which flame is generally noisy and has a short pointed inner cone?

A) Carburizing

B) Oxidizing

C) Neutral

D) Diffusion flame

7. Which flame is best suited for welding high-carbon steels?

A) Neutral

B) Carburizing

C) Oxidizing

D) Cold flame

8. The carburizing flame is not recommended for:

A) High-carbon steels

B) Aluminum welding

C) Lead welding

D) Surface hardening

9. Which fuel gas has the highest heat release in the outer flame rather than in the inner cone?

A) Acetylene

B) Propane

C) MAPP Gas

D) Hydrogen

10.Which of the following is NOT a fuel gas for welding or cutting?

A) Propane

B) Acetylene

C) Nitrogen

D) MAPP Gas

# THANK YOU