

CODE-436

Trade - Fitter

Unit IV: Welding

CLASS-1



Safety in Welding Shop

1. Personal Protective Equipment (PPE):

Welders must always wear the correct PPE, including:

- **Welding Helmet:** Protects eyes and face from harmful UV rays, sparks, and debris.
- **Welding Gloves:** Heat-resistant gloves to protect hands.
- **Apron or Leather Jacket:** To protect the body from sparks and molten metal.
- **Safety Glasses or Goggles:** Worn under the helmet for extra protection.
- **Safety Shoes:** Steel-toed shoes to protect feet from falling objects and hot materials.
- **Hearing Protection:** In high-noise environments.

2. Ventilation and Fume Control:

- **Ensure proper ventilation in the workshop.**
- **Use fume extractors to remove harmful gases and smoke produced during welding.**
- **Avoid inhaling welding fumes directly — some metals produce toxic fumes.**

3. Fire Safety:

- **Keep a fire extinguisher nearby (Class D for metal fires).**
- **Remove flammable materials from the welding area.**
- **Use fire-resistant blankets or curtains to contain sparks.**
- **Have a fire watch person during and after welding for hot work safety.**

4. Electrical Safety:

- **Inspect welding equipment and cables for damage before use.**
- **Ensure proper grounding of welding machines.**
- **Avoid working in wet or damp conditions to reduce electrical shock risk.**
- **Disconnect power when not in use or when changing electrodes.**

5. Safe Work Practices:

- **Never look at the arc with the naked eye — it causes arc eye (welder's flash).**
- **Do not touch hot workpieces immediately after welding — allow cooling time.**
- **Use clamps or pliers to handle hot metal.**
- **Follow proper storage of gas cylinders and keep them upright and chained.**

6. First Aid Readiness:

- **Keep first aid kits accessible.**
- **Train staff in basic first aid and CPR.**
- **Know how to treat burns and electric shocks promptly.**

7. Training and Supervision:

- **Only trained personnel should operate welding equipment.**
- **Regular safety training and drills should be conducted.**
- **Supervisors must enforce safety protocols strictly.**

1. Chipping Hammer

- **Purpose:** Used to remove slag from weld beads in arc welding.
- **Design:** Pointed at one end and flat or cross-peen at the other.
- **Material:** Made of hardened steel.

2. Wire Brush

- **Purpose:** Used to clean the weld surface and remove slag or rust.
- **Material:** Steel bristles (mild steel or stainless steel).

3. Welding Pliers (Multi-purpose)

Uses:

- **Removing hot nozzles**
- **Cutting wire**
- **Hammering**
- **Nozzle cleaning**
- **Benefit:** One tool serves multiple purposes in MIG welding especially.

4. Electrode Holder (Stinger)

- **Purpose:** Holds the welding electrode during arc welding.
- **Features:** Insulated handle to protect against electric shock.

5. Ground Clamp (Earth Clamp)

- **Purpose:** Completes the electrical circuit by grounding the metal workpiece.
- **Use:** Connected to the workpiece in arc welding processes.

6. Welding C-Clamps / Locking Pliers

- **Purpose:** Holds metal parts tightly in position during welding.
- **Types:** C-clamps, F-clamps, vice-grip clamps.

7. Soapstone (Welding Marker)

- **Purpose:** For marking metals before cutting or welding.
- **Advantage:** Can withstand high heat and remains visible on metal.

8. Measuring Tools (Tape, Steel Ruler, Square)

- **Purpose:** Accurate measurement and layout marking of welding jobs.

- **Types:**

1. Steel rule

2. Tape measure

3. Try square or combination square



9. File

- **Purpose:** Smoothens the sharp edges of metal or removes small burrs after welding.

10. Tongs

- **Purpose:** For holding or carrying hot metal pieces safely.

11. Slag Removal Tools (Needle Scaler / Pneumatic Tools)

- **Purpose: Mechanically remove slag and scale from welds in heavy-duty jobs.**

12. Helmet with Hand Shield (Sometimes counted as tool)

- **Purpose: Protect eyes and face while welding.**

- **Types:**

1. Fixed-shade helmet

2. Auto-darkening helmet



Conclusion

Using the right hand tools in welding ensures:

- **Safety of the welder**
- **Clean and accurate welds**
- **Increased productivity**

Gas Welding

Gas welding is a process of joining two metals by melting the base metal using a gas flame, usually produced by burning oxygen (O_2) and acetylene (C_2H_2). It is also known as oxy-acetylene welding (OAW).

I. Gas Welding Equipment

1. Gas Cylinders

- **Oxygen Cylinder: Usually painted black or green, contains compressed oxygen at high pressure (~2000 psi).**
- **Acetylene Cylinder: Usually painted maroon/red, contains acetylene dissolved in acetone.**

2. Pressure Regulators

- Attached to both oxygen and acetylene cylinders.
- Controls and reduces the high pressure of gases from the cylinders to the required working pressure.
- Has two gauges:
 1. Cylinder pressure gauge
 2. Working pressure gauge

3. Welding Torch (Blowpipe)

- Main tool that mixes oxygen and acetylene in required proportions.
- Has two valves to control flow of each gas.
- Types:
 1. Equal pressure type (most common)
 2. Injector type

4. Hoses and Hose Fittings

- **Flexible rubber tubes for supplying gas from cylinder to torch.**
- **Color coded:**
 - 1. Red for acetylene**
 - 2. Blue/green for oxygen**
- **Fitted with non-return valves and flashback arrestors.**

5. Flashback Arrestor

- **A safety device that stops flames from traveling back into hoses or cylinders.**
- **Prevents explosions.**

6. Filler Rods

- **Filler material that melts and fills the gap between the base metals.**
- **Material should match or be compatible with base metal.**

7. Goggles and Protective Equipment

- **Goggles: To protect eyes from bright flame and UV radiation.**
- **Gloves, apron, shoes: For safety from heat and sparks.**

II. Gas Welding Process

1. Preparation

- **Clean the metal surfaces.**
- **Select appropriate torch tip, gas pressure, and filler rod.**

2. Flame Adjustment

Open acetylene and oxygen valves to get proper flame:

- **Carburizing flame (Excess acetylene)**
- **Neutral flame (Equal oxygen and acetylene) ✓ (most commonly used)**
- **Oxidizing flame (Excess oxygen)**

3. Heating the Base Metal

- **Use the flame to melt the edges of the metal pieces.**

4. Adding Filler Rod

- **Insert the filler rod into the molten pool to create a joint.**
- **Move the torch along the joint to continue welding.**

5. Cooling

- **After welding, let the joint cool naturally.**
- **Clean the weld using wire brush if required.**

Flame Type	Oxygen:Acetylene Ratio	Appearance	Use
Neutral Flame	1:1	Light blue, short inner cone ✓	General welding (steel, aluminum)
Carburizing Flame	<1 (Excess C ₂ H ₂)	Longer inner cone, yellowish	Used for lead, low-carbon steel
Oxidizing Flame	>1 (Excess O ₂)	Small inner cone, harsh sound	Brass, bronze, copper

Safety Tips in Gas Welding

- **Check hoses and valves for leaks before use.**
- **Never use oil or grease on oxygen fittings.**
- **Use flashback arrestors and fire-resistant gear.**
- **Store cylinders upright and away from heat.**

Advantages of Gas Welding

- **Simple and portable setup**
- **Good for thin metal sheets**
- **Low-cost equipment**



Limitations

- **Not suitable for thick materials**
- **Slower than arc welding**
- **Flame temperature is lower (~3200°C)**

Welding Parameters

Welding parameters are the controllable inputs in arc welding that influence:

- **Heat input**
- **Penetration**
- **Weld bead appearance**
- **Spatter level**

Key Parameters in Arc Welding Machine Setup

1. Welding Current (Amperage)

- **Definition:** Amount of electric current flowing through the electrode.
- **Unit:** Amperes (A)
- **Function:** Controls heat.

1. Too low: Poor fusion

2. Too high: Excessive spatter, burn-through

Amperage Selection Depends On:

- **Electrode size (e.g., 2.5 mm, 3.15 mm, 4 mm)**
- **Base metal thickness**
- **Welding position (flat, vertical, overhead)**

Electrode Size	Current Range
2.5 mm	60–90 A
3.15 mm	90–130 A
4.0 mm	130–180 A

2. Voltage (Arc Voltage)

- **Definition:** The electrical potential across the arc.
 - **Unit:** Volts (V)
 - **Function:** Controls arc length and stability.
1. **Low voltage:** Short arc, unstable
 2. **High voltage:** Long arc, excessive spatter

3. Polarity Setting (DCEN / DCEP)

Polarity in DC welding:

DCEN (Direct Current Electrode Negative): More heat on workpiece

DCEP (Direct Current Electrode Positive): More heat on electrode (deeper penetration)

AC Welding: Alternating polarity, commonly used for general-purpose welding

4. Electrode Type and Size

Match electrode with:

- **Material (Mild Steel, Stainless Steel, etc.)**
- **Current type (AC or DC)**

Examples:

- **E6013: General purpose**
- **E7018: Low hydrogen, strong welds**

5. Arc Length

- **Controlled manually by welder**
- **Ideal arc length = Diameter of the electrode core**

- **Too short: Sticking**

- **Too long: Spatter, poor bead**

6. Travel Speed

Speed at which electrode moves over the workpiece

- **Too fast: Narrow bead, poor fusion**
- **Too slow: Wide bead, excess heat input**

7. Duty Cycle

- **Duty Cycle: Percentage of 10 minutes the machine can weld continuously without overheating.**
- **Example: 60% duty cycle at 150 A → weld for 6 minutes, rest for 4**

8. Machine Type

- **Transformer Type (AC): Cost-effective, heavy**
- **Rectifier Type (DC): Stable arc, smoother welds**
- **Inverter Type: Compact, efficient, adjustable settings**

Steps to Set Arc Welding Machine

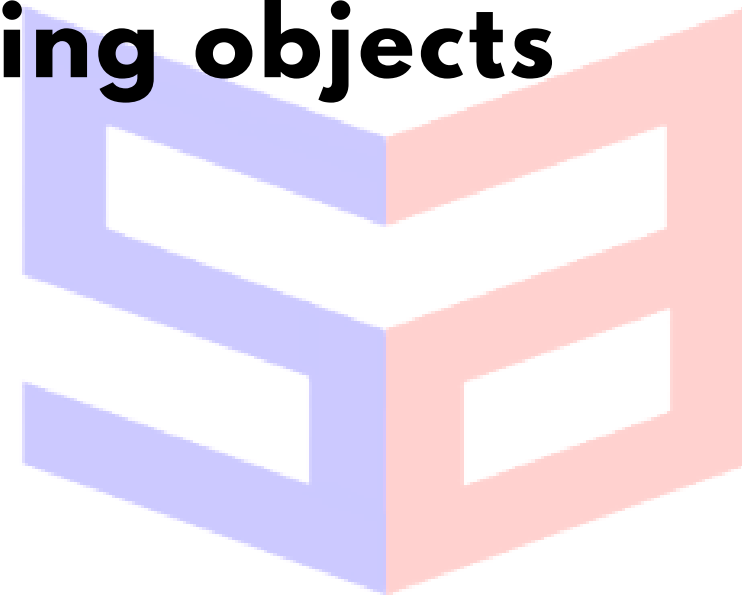
- 1. Select electrode type and size**
- 2. Set current (amperage) according to electrode**
- 3. Check polarity (for DC machines)**
- 4. Adjust arc voltage (if available)**
- 5. Connect ground clamp to workpiece**
- 6. Ensure safety gear is worn**
- 7. Test arc on scrap piece before actual welding**

Safety Precautions

- Always check for loose connections.**
- Wear gloves, helmet, apron, and leather shoes.**
- Use proper ventilation to avoid fume inhalation.**
- Never change settings while welding is active.**

1.The primary cause of eye injury in welding is:

- A) Dust**
- B) Arc flash**
- C) Noise**
- D) Flying objects**



2. Why is it important to keep gas cylinders upright and chained?

- A) For easy identification**
- B) For safety and stability**
- C) To prevent leakage**
- D) For quick access**



3. The proper way to handle hot welded materials is:

A) With hands

B) With pliers or clamps

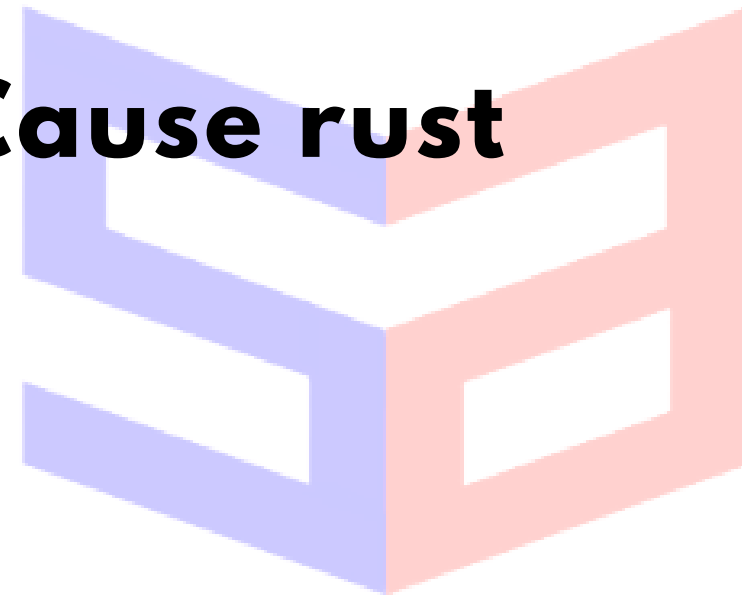
C) With paper

D) With cloth gloves



4. Welding fumes are dangerous because they:

- A) Smell bad**
- B) Contain harmful gases**
- C) Are cold**
- D) Cause rust**



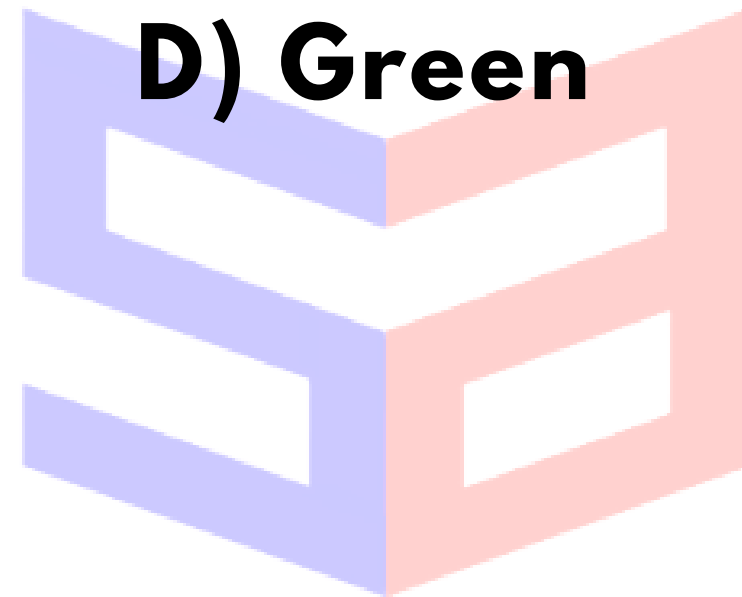
5.What is the color of an oxygen cylinder used in welding?

A) Red

B) Black

C) Blue

D) Green



6. Welding pliers are NOT used for:

- A) Cutting wire**
- B) Removing nozzle**
- C) Drilling holes**
- D) Cleaning spatter**

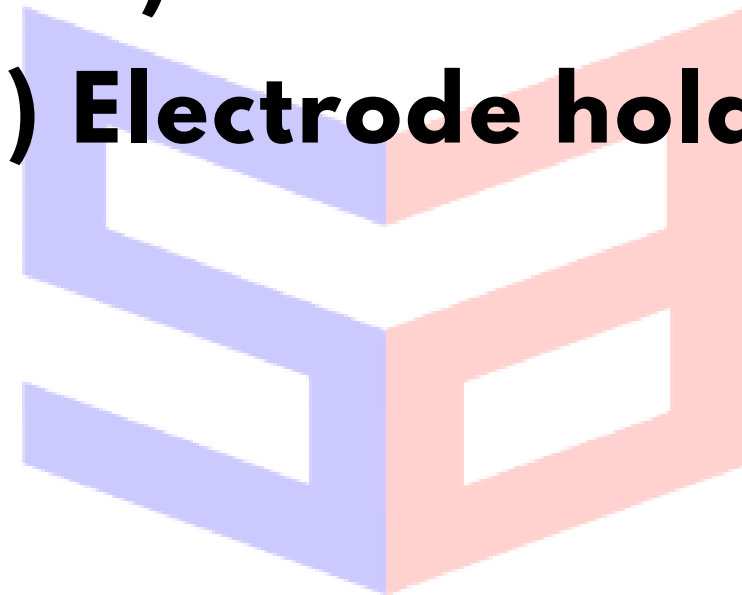
7. Which of the following is NOT a welding hand tool?

A) Chipping hammer

B) Welding helmet

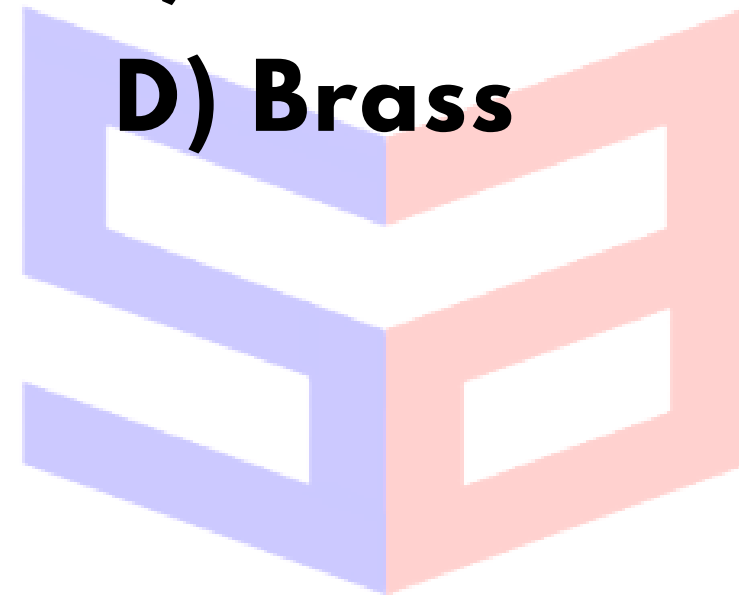
C) Wire brush

D) Electrode holder



8.What is the material used for a chipping hammer head?

- A) Aluminium**
- B) Hardened steel**
- C) Plastic**
- D) Brass**



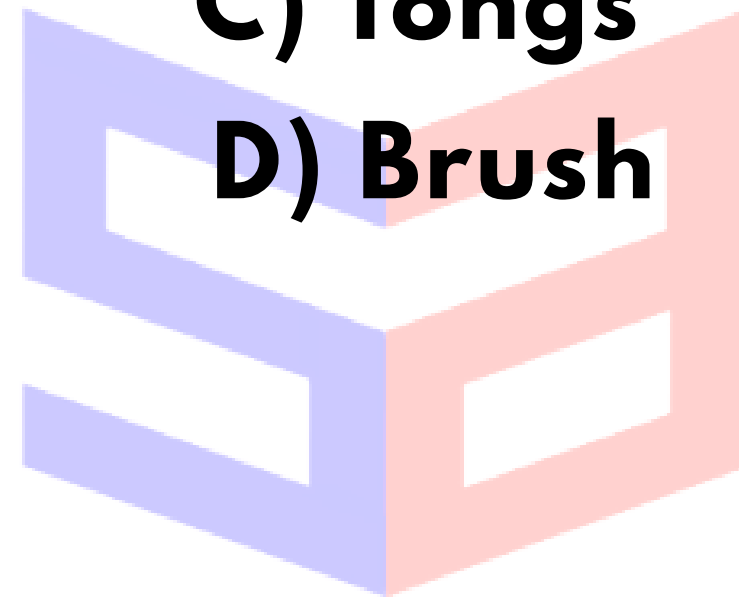
9. Which of the following tools is used to hold hot metal pieces?

A) Pliers

B) Clamp

C) Tongs

D) Brush



10. Which tool is used for precise length measurements?

A) Chipping hammer

B) Tape measure

C) File

D) Soapstone



11.The pressure regulator in gas welding is used to:

A) Heat the metal

B) Adjust the flame color

C) Reduce cylinder pressure to working pressure

D) Increase gas temperature



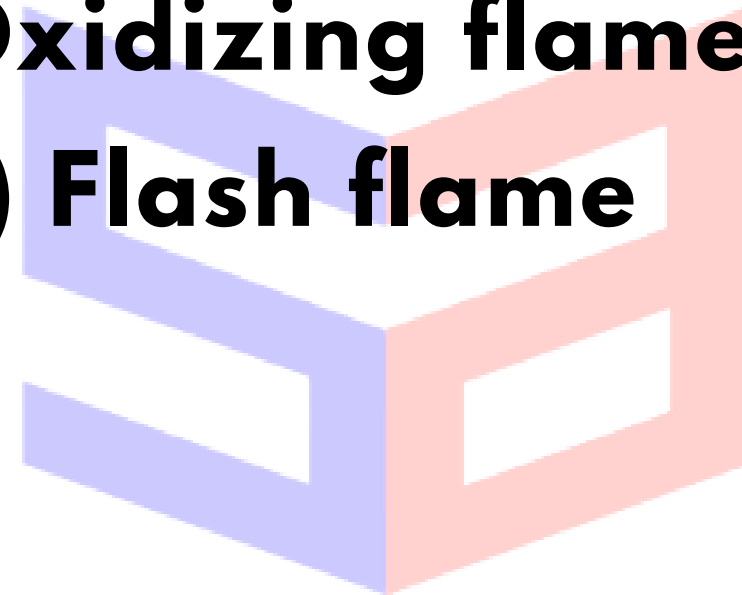
12. The flame commonly used for general gas welding is:

A) Carburizing flame

B) Neutral flame

C) Oxidizing flame

D) Flash flame



13.The welding torch is also called:

A) Spark lighter

B) Filler rod

C) Blowpipe

D) Tongs



14. A flashback arrestor is used to:

- A) Control pressure**
- B) Prevent flame from entering hose**
- C) Mix gases**
- D) Increase gas flow**



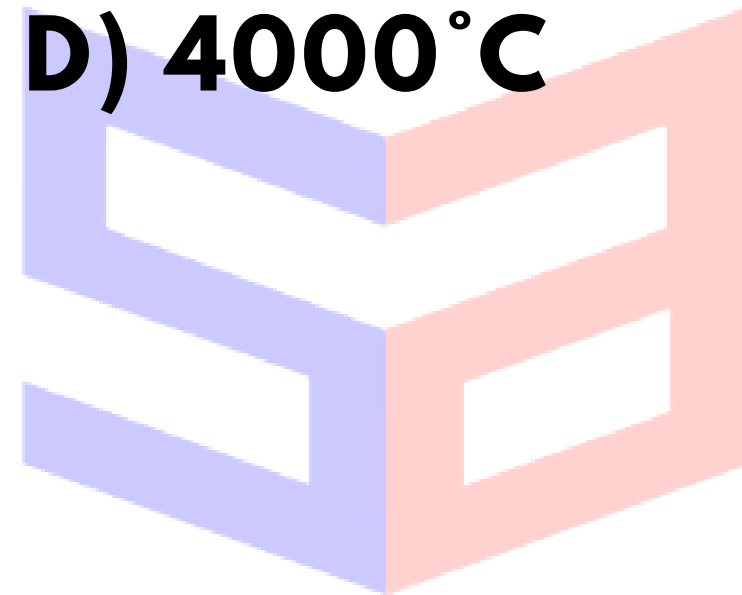
15. The temperature of the neutral flame is approximately:

A) 2000°C

B) 3000°C

C) 3200°C

D) 4000°C



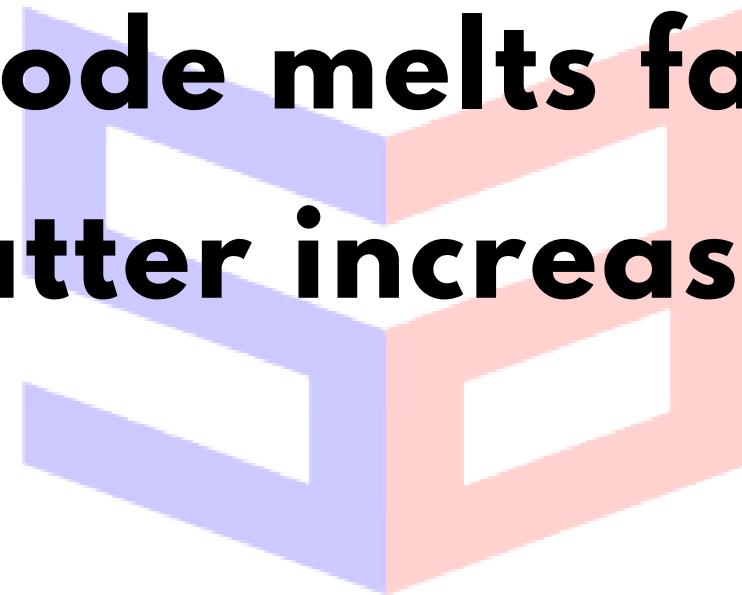
16. What is the effect of too long an arc?

- A) Bead will be smooth**
- B) Arc will extinguish**
- C) Spatter increases**
- D) Penetration increases**



17. What happens if arc voltage is too low?

- A) Arc becomes too long**
- B) Arc becomes unstable and short**
- C) Electrode melts faster**
- D) Spatter increases**



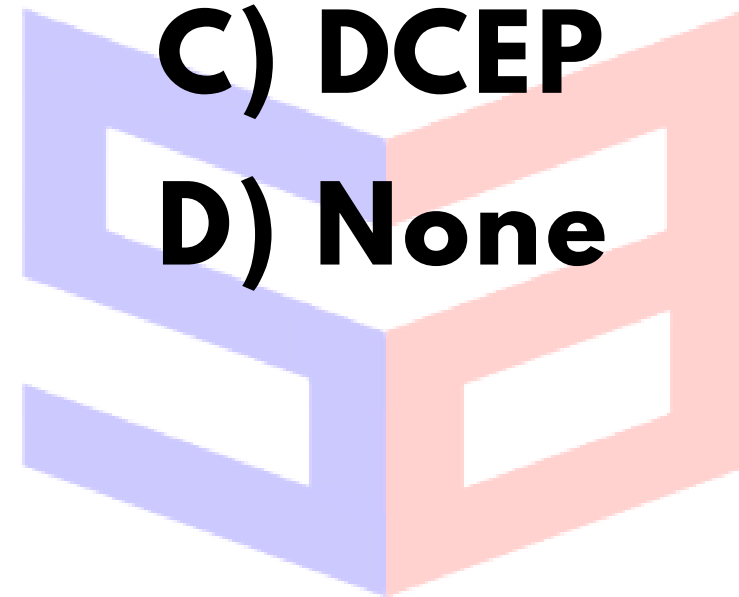
18. Which welding polarity gives deeper penetration?

A) AC

B) DCEN

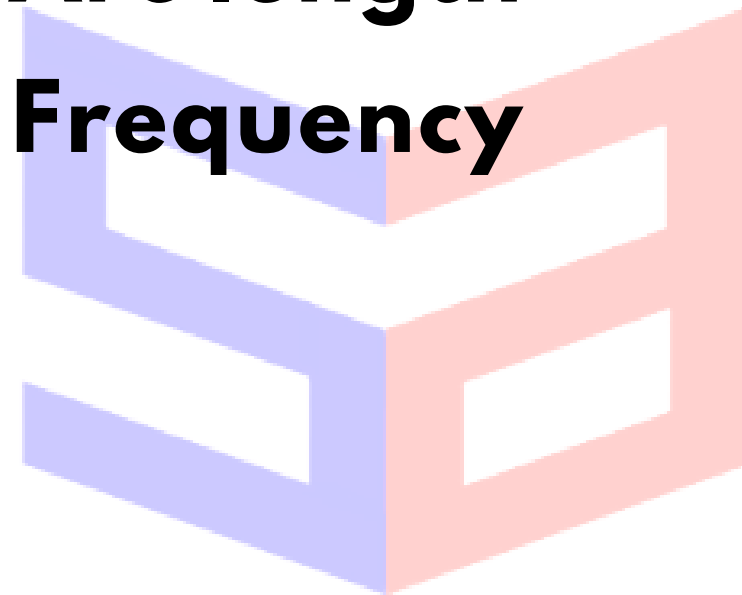
C) DCEP

D) None



18. Which parameter is manually controlled by the welder during arc welding?

- A) Current**
- B) Voltage**
- C) Arc length**
- D) Frequency**



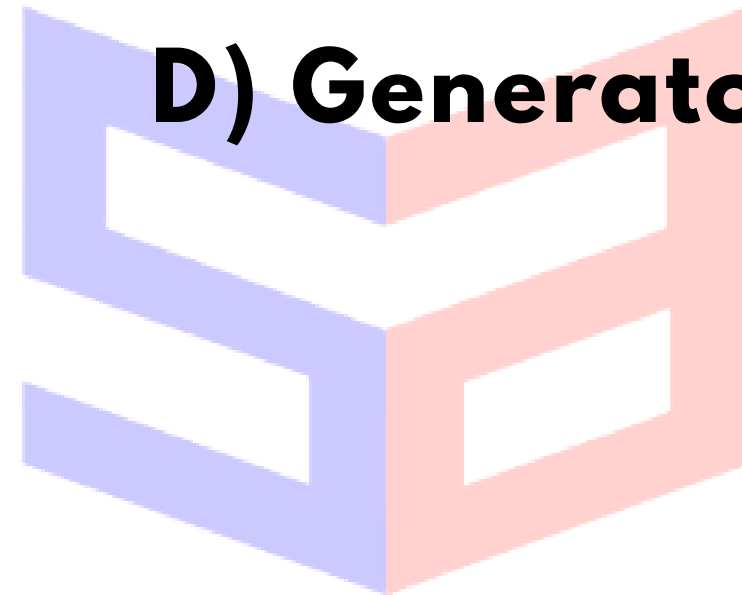
20. Which type of machine gives smooth arc and better control?

A) Transformer

B) Inverter

C) Rectifier

D) Generator



Thank
*You*

