

# Welding Process

## Gas Tungsten-Arc Welding

The gas tungsten-arc welding process (GTAW) is recommended when the operator requires the utmost in deposit quality and precision control of the weld metal. The GTAW process is often employed to repair castings, construct or repair forming dies, fabricate copper alloy piping systems and for code work weldments. Direct current electrode negative (dcen) is preferred with this process although alternating current high frequency (achf) can be used. For most applications, 100% helium is recommended. A sharp pointed tungsten electrode is the preferred style.

Tungsten electrodes with 2% thorium are preferred to deposit copper and copper alloys since 2% thoriated tungsten electrodes have higher electron emissivity, longer life and are easier to start than pure tungsten electrodes.

To deposit AMPCO-TRODE<sup>®</sup> with GTAW, a dip technique is recommended similar to the technique used to deposit aluminum rod. Care must be exercised to avoid melting off the end of the filler rod with the arc, as this will result in an oxidized ball on the end of the filler rod and impair "wettability" of the filler rod.

The tungsten should extend from 1/4" to 3/8" (6.4 to 9.5 mm) beyond the cup of the welding torch. Maintain an arc length of 1/16" to 3/16" (1.6 to 4.8 mm).

### RECOMMENDED WELDING AMPERAGE

|                  | Filler   | Amperes* | Amperes* |
|------------------|----------|----------|----------|
|                  | Diameter | (dcen)   | (achf)   |
| Gas Tungsten-arc | 1/16"    | 70-120   | 70-150   |
|                  | 3/32"    | 120-160  | 140-230  |
|                  | 1/8"     | 170-230  | 175-300  |
|                  | 5/32"    | 220-280  | 225-320  |
|                  | 3/16"    | 280-330  | 250-330  |

\* Use low side of range for iron- or nickel-base alloys; middle of range for bronze alloys; high side for copper.

Helium has more current-carrying ability and provides a hot arc with greater speed and more penetration.

### GTAW

|             |           |                    |
|-------------|-----------|--------------------|
| 100% helium | 40-55 cfh | (19.0-26.0 L/min.) |
| 100% argon  | 40-55 cfh | (19.0-26.0 L/min.) |

### PREHEATING RECOMMENDATIONS

1. Low carbon and mild steels up to 0.29 C— none required.
2. Medium carbon steels 0.30 C to 0.59 C— 300°F to 600°F (149°C to 315°C), depending on carbon content.
3. Low alloy steels—same as low carbon and mild steel.
4. Gray cast iron 400°F to 600°F (204°C to 315°C), slow cool.
5. Nodular and malleable cast iron—300°F to 400°F (149°C to 204°C), post weld annealing is advisable.
6. Cupro-nickel and silicon bronze—no preheat, interpass temperature—200°F (93°C) maximum.
7. Aluminum bronze—alloys up to 10% aluminum—no preheat, 300°F (149°C) maximum interpass. Alloys exceeding 10% aluminum -300°F and 600°F (149°C and 315°C) maximum interpass.
8. Manganese bronze—300°F (149°C) for inert gas and 500°F (260°C) for shielded metal-arc.
9. Copper-1000°F (538°C).

