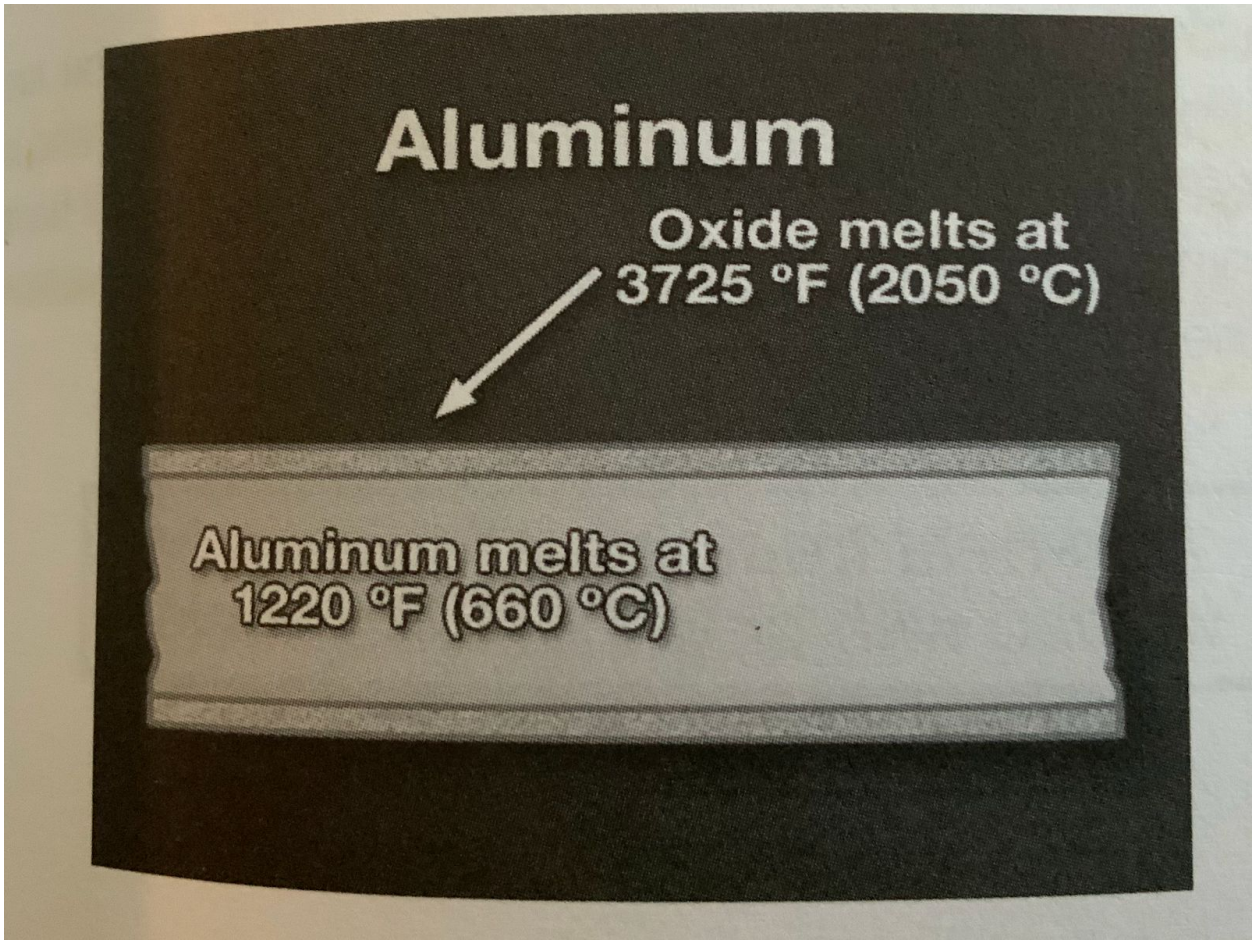
● GMAW Aluminum Welding #2

● Aluminum Weldability

- Aluminum is much lighter than steel, has excellent corrosion resistance and good strength depending on the alloying content
    - Aluminum is increasingly used in applications for **transportation, marine, aerospace, electrical, communication, etc.**
    - It is highly reactive and forms a protective oxide coating the moment it is exposed to oxygen

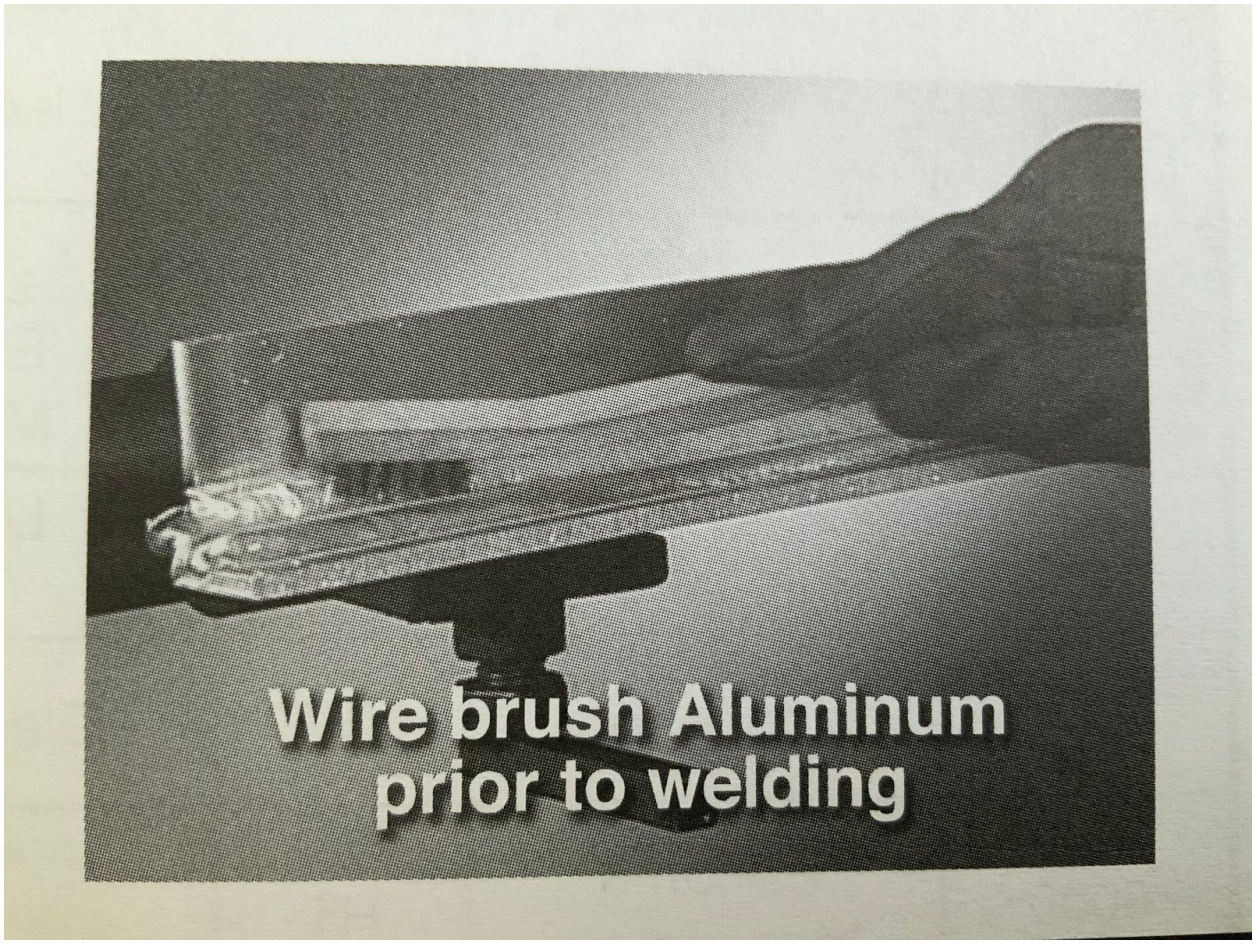
        -this **aluminum oxide** coating gives aluminum its' corrosion resistance but also makes it challenging to weld because the oxide melts at **3700 F** while aluminum itself melts at about **1220 F**



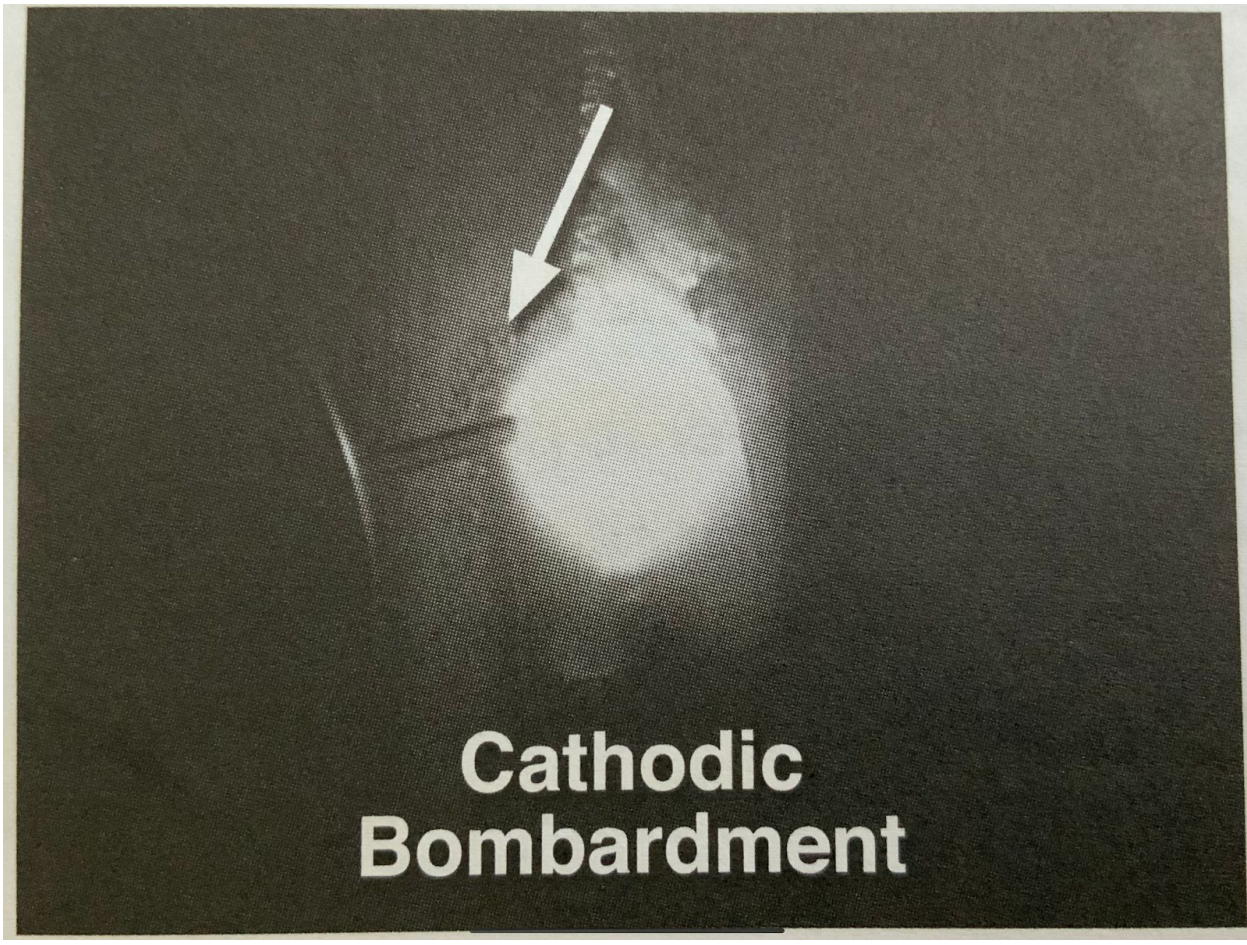
-if you try to weld aluminum without removing the oxide, the coating will prevent the molten aluminum from fusing into a quality weld

-although aluminum oxide is next in hardness to diamond, it is very porous and can retain moisture and other contaminants which break down in the heat of the arc to form hydrogen gas. Hydrogen is extremely soluble in molten aluminum and may cause porosity in the weld

-the aluminum surface must be free of moisture, oil, and grease. Break up the oxide coating just prior to welding with a stainless steel wire brush

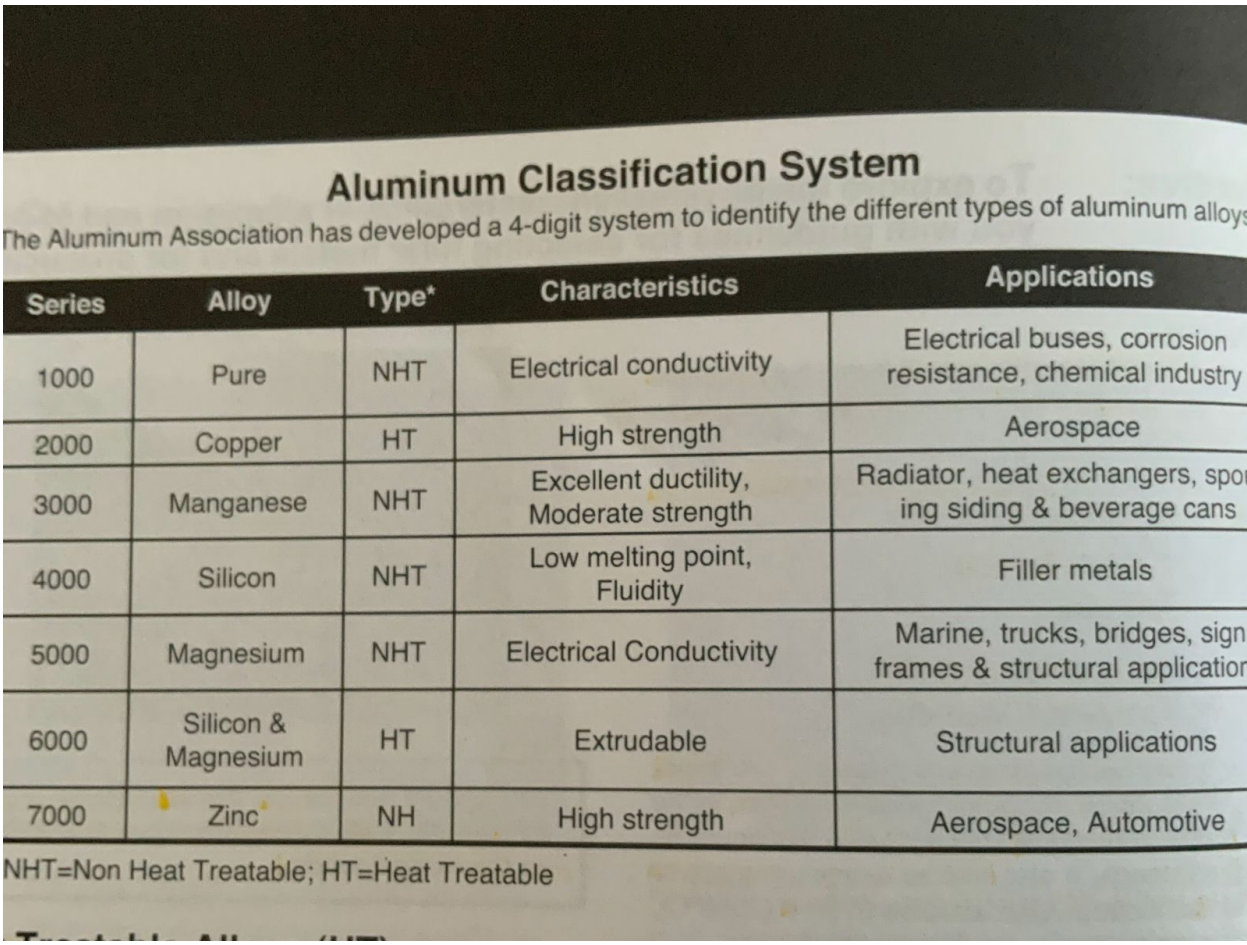


- Using **DCEP**, while current flows in the direction of the electrode, ions bombard the negatively charged aluminum, blasting the oxide coating away (called **cathodic bombardment** or cleaning action). This will leave a white line on both sides of the weld.



- Because aluminum conducts heat **6x** faster than steel, you must weld at higher amperages to compensate for the heat conducted away from the weld

- Additionally, the rate of thermal expansion is about **2x** that of steel so you must be careful of distortion



Aluminum Classification System

The Aluminum Association has developed a 4-digit system to identify the different types of aluminum alloys

Series	Alloy	Type*	Characteristics	Applications
1000	Pure	NHT	Electrical conductivity	Electrical buses, corrosion resistance, chemical industry
2000	Copper	HT	High strength	Aerospace
3000	Manganese	NHT	Excellent ductility, Moderate strength	Radiator, heat exchangers, spo ing siding & beverage cans
4000	Silicon	NHT	Low melting point, Fluidity	Filler metals
5000	Magnesium	NHT	Electrical Conductivity	Marine, trucks, bridges, sign frames & structural applicatio
6000	Silicon & Magnesium	HT	Extrudable	Structural applications
7000	Zinc	NH	High strength	Aerospace, Automotive

NHT=Non Heat Treatable; HT=Heat Treatable

<u>Heat Treatable Alloys (HT)</u>

- 2000, 6000, and 7000 series alloys get their strength from heat treatment and will crack if welded without filler metal
  - -must use filler metal
  - -use lower amperages and faster travel speeds to minimize heat input
  - -maintain interpass temperatures on multi-pass welds to prevent overheating
- You are creating a partially annealed condition in the weld and in the heat affected zone, giving the

welds excellent ductility but they will be weaker than the unheated metal

Non-heat Treatable Alloys (NHT)

- 1000, 3000, 4000, and 5000 series alloys get their strength from **strain hardening (cold working).** The strength of these alloys depend on the alloying element (silicon, manganese, or magnesium)
- These can be welded with or without filler metal

Unlike filler metal for carbon steels that are usually selected based on tensile strength, aluminum filler metals are selected based on the **application** and **service conditions** of the weldment