Plasma Arc Welding (PAW)
Special form of GTAW in which a constricted plasma arc is directed at weld area
- Tungsten electrode is contained in a nozzle that focuses a high velocity stream of inert gas (argon) into arc region to form a high velocity, intensely hot plasma arc stream
- Temperatures in PAW reach 28,000°C (50,000°F), due to constriction of arc, producing a plasma jet of small diameter and very high energy density

Resistance Welding (RW)
A group of fusion welding processes that use a combination of heat and pressure to accomplish coalescence
- Heat generated by electrical resistance to current flow at junction to be welded
- Principal RW process is resistance spot welding (RSW)

Components in Resistance Spot Welding
- Parts to be welded (usually sheet metal)
- Two opposing electrodes
- Means of applying pressure to squeeze parts between electrodes
- Power supply from which a controlled current can be applied for a specified time duration

Advantages
- No filler metal required
- High production rates possible
- Lends itself to mechanization and automation
- Lower operator skill level than for arc welding
- Good repeatability and reliability

**Disadvantages**
- High initial equipment cost
- Limited to lap joints for most RW processes

**Resistance Seam Welding**

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**Electron Beam Welding (EBW)**

Fusion welding process in which heat for welding is provided by a highly-focused, high-intensity stream of electrons striking work surface
- Electron beam gun operates at:
  - High voltage (e.g., 10 to 150 kV typical) to accelerate electrons
  - Beam currents are low (measured in milliamps)
- Power in EBW not exceptional, but power density is

**Advantages**
- High-quality welds, deep and narrow profiles
- Limited heat affected zone, low thermal distortion
- High welding speeds
- No flux or shielding gases needed

**Disadvantages**
- High equipment cost
- Precise joint preparation & alignment required
- Vacuum chamber required
- Safety concern: EBW generates x-rays

**Laser Beam Welding (LBW)**

Fusion welding process in which coalescence is achieved by energy of a highly concentrated, coherent light beam focused on joint
- Laser = "light amplification by stimulated emission of radiation"
- LBW normally performed with shielding gases to prevent oxidation
- Filler metal not usually added
- High power density in small area, so LBW often used for small parts

**Comparison: LBW vs. EBW**

- No vacuum chamber required for LBW
- No x-rays emitted in LBW
- Laser beams can be focused and directed by optical lenses and mirrors
- LBW not capable of the deep welds and high depth-to-width ratios of EBW
  - Maximum LBW depth = ~ 19 mm (3/4 in), whereas EBW depths = 50 mm (2 in)

*Source: [http://nprcet.org/e%20content/mech/MT.pdf](http://nprcet.org/e%20content/mech/MT.pdf)*