

Manufacturing Processes– UTA026

Welding – GTAW or TIG Process



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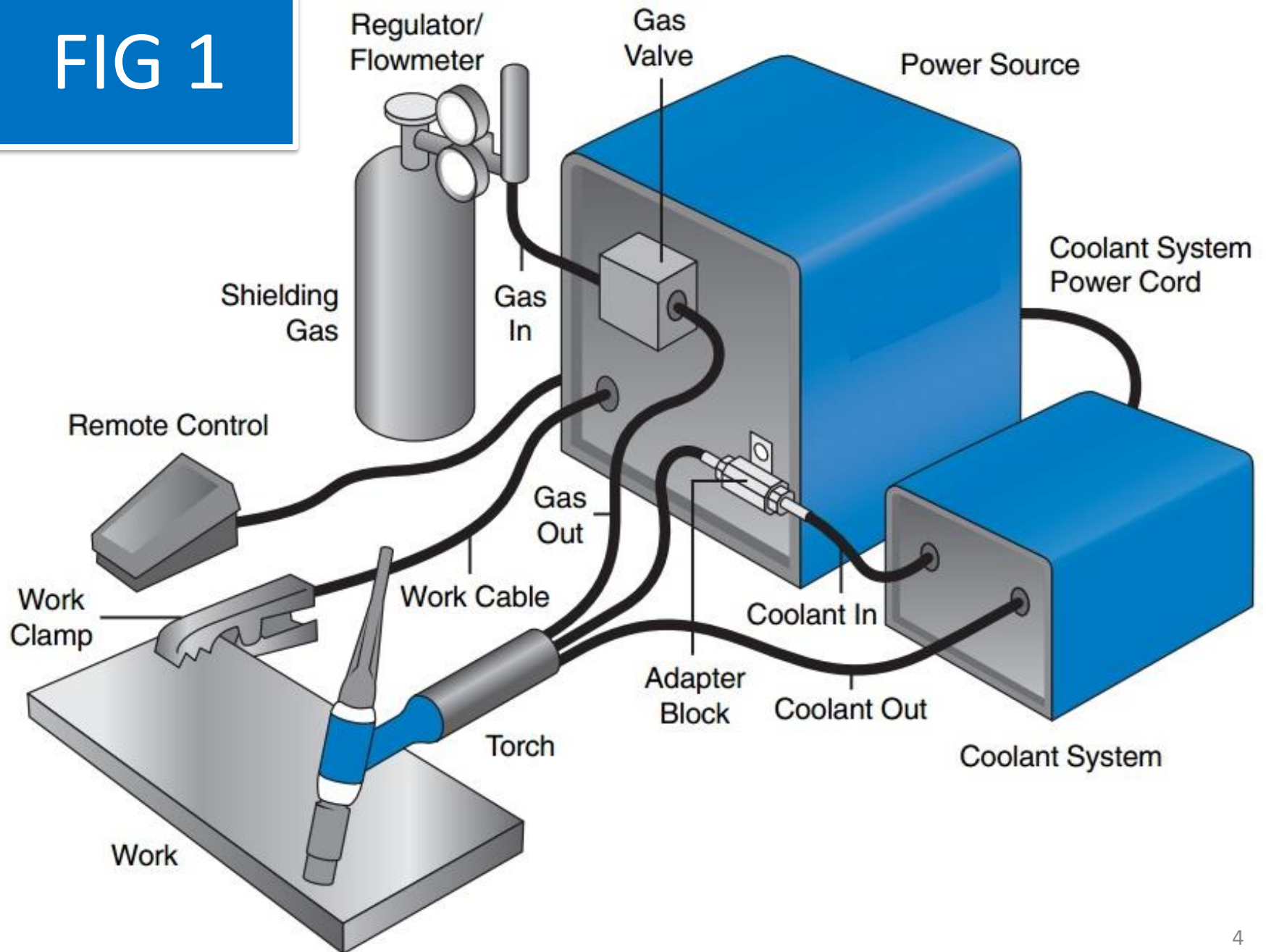


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WELDING PROCESSES

TIG or GTAW

FIG 1



Gas Tungsten Arc Welding (GTAW)

- The *heat* for *Gas Tungsten Arc Welding* (GTAW) is produced by an electric arc maintained between a *non-consumable tungsten electrode* and the *part to be welded*.
- The heat-affected zone, the molten metal, and the tungsten electrode are all shielded from the atmosphere by a *blanket of inert gas* fed through the *GTAW torch*.

Gas Tungsten Arc Welding (GTAW)

- ***Inert gas*** is that which is ***inactive***, or deficient in active chemical properties.
- It ***does not burn***, and ***adds nothing*** to or ***takes anything*** from the metal.
- Inert gases such as ***argon and helium*** do not chemically react or combine with other gases.

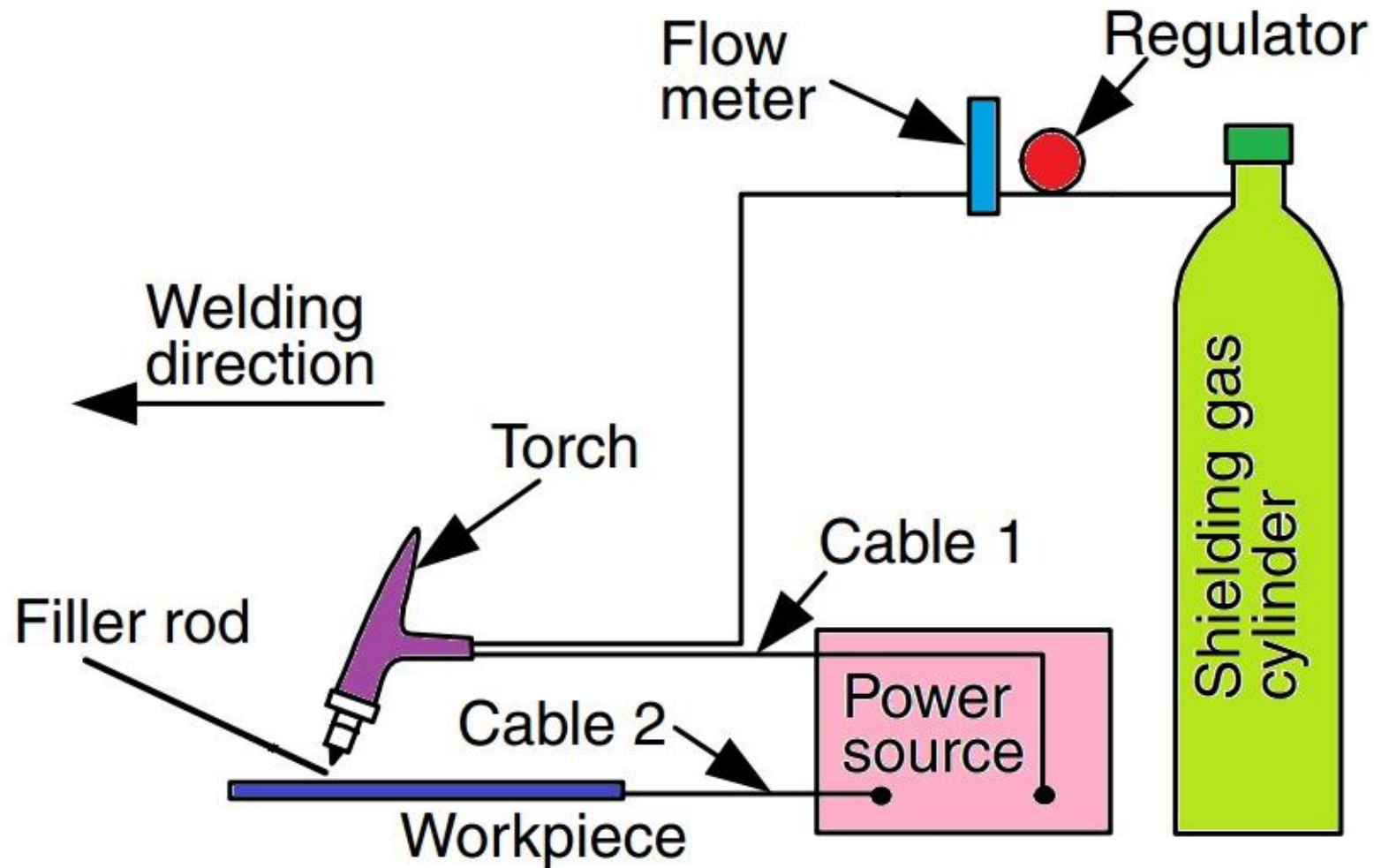
Gas Tungsten Arc Welding (GTAW)

- They possess *no odour* and are *transparent*, permitting the welder *maximum visibility* of the *arc*.
- *In some instances a small amount of reactive gas such as hydrogen can be added to enhance travel speeds.*

Gas Tungsten Arc Welding (GTAW)

- The torch holding the tungsten electrode is connected to a shielding gas cylinder as well as one terminal of the power source, as shown in Figure 2.

FIG 2



Gas Tungsten Arc Welding (GTAW)

- The tungsten *electrode* is usually in contact with a *water-cooled copper tube*, called the *contact tube*, which is connected to the welding cable (*cable 1*) from the terminal.
- The *workpiece* is connected to the other terminal of the power source through a different cable (*cable 2*).

Gas Tungsten Arc Welding (GTAW)

- The shielding gas goes through the torch body and is directed by a nozzle toward the weld pool to protect it from the air.
- ***Protection*** from the air is ***much better*** in ***GTAW*** ***than in SMAW.***

Gas Tungsten Arc Welding (GTAW)

- **Autogenous** GTAW welding (**without filler metal**) is used in **thin square edged sections** (2mm), while **V** and **X** type edge preparations are needed in **thicker sections**.
- A **filler rod** is needed for joining thicker materials.
- The autogeneous process is readily used in robotics and automation techniques.

Gas Tungsten Arc Welding (GTAW)

- This process is extensively used for welding thin components of *stainless steel*, *aluminum*, *magnesium* or *titanium alloys* as well pieces of *carbon* and *low alloy steels*.

ELECTRODE

- ***Tungsten*** is preferred for this process because it has the ***highest melting point of all metals***.
- The tungsten electrode establishes and maintains the arc.
- It is said to be a “***nonconsumable***” in that the electrode is not melted and included in the weld pool.
- In fact, great care must be taken so that the tungsten does not contact the weld pool in any way, thereby causing a ***contaminated***, faulty weld.

SHIELDING GAS

- Primarily two inert gases are used for shielding purposes for TIG.
- They are *argon and helium*.
- *Argon*, with an atomic *weight of 40*, is about *one and a half* times *heavier than air* and *ten times heavier than helium* which has an atomic weight of 4.

AR & HELIUM

- Argon and helium are the major shielding gases used in gas tungsten arc welding.
- In some applications, mixtures of the two gases prove advantageous.
- To a lesser extent, hydrogen is mixed with argon or helium for special applications.
- **Note:** CO₂ cannot be used in this process since it provides inadequate protection for the hot tungsten electrode as it tends to oxidize the electrode.

Advantages of the GTAW Process

1. Wide range of metal can be welded.
2. Dissimilar metals can also be joined such as copper to brass and stainless to mild steel.
3. Narrow heat-affected zone (compared to other processes like SMAW, GMAW and SAW)
4. Less distortion
5. No Slag: There is no requirement for flux with this process; therefore, there is no slag to obscure the welder's vision of the molten weld pool.

Advantages of the GTAW Process

- 6. *No Sparks or Spatter, No Smoke or Fumes:*
- 7. *Improved metallurgical properties* stronger, more ductile and more corrosion resistant joints.
- 8. *Very thin metals can be welded* due to the ease of controlling the current.

GTAW Disadvantages

- The main disadvantage of the GTAW process is the *low filler metal deposition rate*.
- Another disadvantage is that the *hand-eye coordination* necessary to accomplish the weld is *difficult to learn*, and requires a great deal of practice to become proficient.
- The *arc rays* produced by the process tend to be *brighter* than those produced by SMAW and GMAW. This is primarily due to the absence of visible fumes and smoke.

GTAW Disadvantages

- The *increased* amounts of *ultraviolet rays* from the arc also cause the *formation* of *ozone and nitrous oxides*.
- Therefore, care should be taken to protect *skin* with the proper clothing and protect *eyes* with the correct shade lens in the welding hood.
- Metal thickness of upto 7 mm can be welded only.
- Contamination of tungsten can cause discontinuities in welding.

(Ozone is formed by the irradiation of the oxygen in the air surrounding and in the immediate vicinity of the arc with ultraviolet light. Ozone results from the action of ultraviolet radiation, which “breaks” the surrounding oxygen molecules. The single oxygen atoms thus formed (O) will be able to react with other oxygen molecules O_2 and form ozone molecules O_3)

APPLICATIONS

- Aerospace application.
- Welding of aluminium alloys, steel, copper, nickel, tin & Zr.
- Aircraft frames, Jet engine castings, Rocket motor cases etc.
- Precision welding of parts in atomic industry.
- Pipe works required for high pressure steam lines, chemical and petroleum industries.

APPLICATIONS

- Stainless steel, nickel and its alloys – Ar + 5% H(increase the arc heating efficiency)
- Aluminium alloys –Ar and He

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