

Types of Welding IV and Weld Defects

Thermit Welding (TW)

FW process in which heat for coalescence is produced by superheated molten metal from the chemical reaction of thermit

- Thermit = mixture of Al and Fe_3O_4 fine powders that produce an exothermic reaction when ignited
- Also used for incendiary bombs
- Filler metal obtained from liquid metal
- Process used for joining, but has more in common with casting than welding

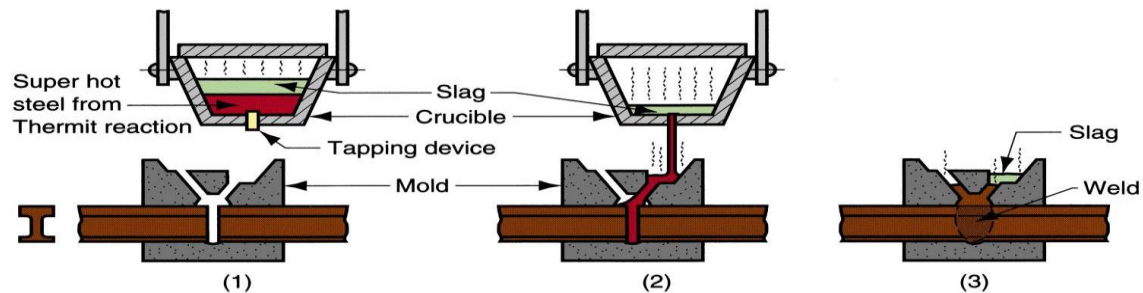


Fig: Thermit welding: (1) Thermit ignited; (2) crucible tapped, superheated metal flows into mold; (3) metal solidifies to produce weld joint.

Applications

- Joining of railroad rails
- Repair of cracks in large steel castings and forgings
- Weld surface is often smooth enough that no finishing is required

Diffusion Welding (DFW)

SSW process uses heat and pressure, usually in a controlled atmosphere, with sufficient time for diffusion and coalescence to occur

- Temperatures $\leq 0.5 T_m$
- Plastic deformation at surfaces is minimal
- Primary coalescence mechanism is solid state diffusion
- Limitation: time required for diffusion can range from seconds to hours

Applications

- Joining of high-strength and refractory metals in aerospace and nuclear industries
- Can be used to join either similar and dissimilar metals
- For joining dissimilar metals, a filler layer of different metal is often sandwiched between base metals to promote diffusion

Friction Welding (FRW)

SSW process in which coalescence is achieved by frictional heat combined with pressure

- When properly carried out, no melting occurs at faying surfaces
- No filler metal, flux, or shielding gases normally used
- Process yields a narrow HAZ
- Can be used to join dissimilar metals
- Widely used commercial process, amenable to automation and mass production

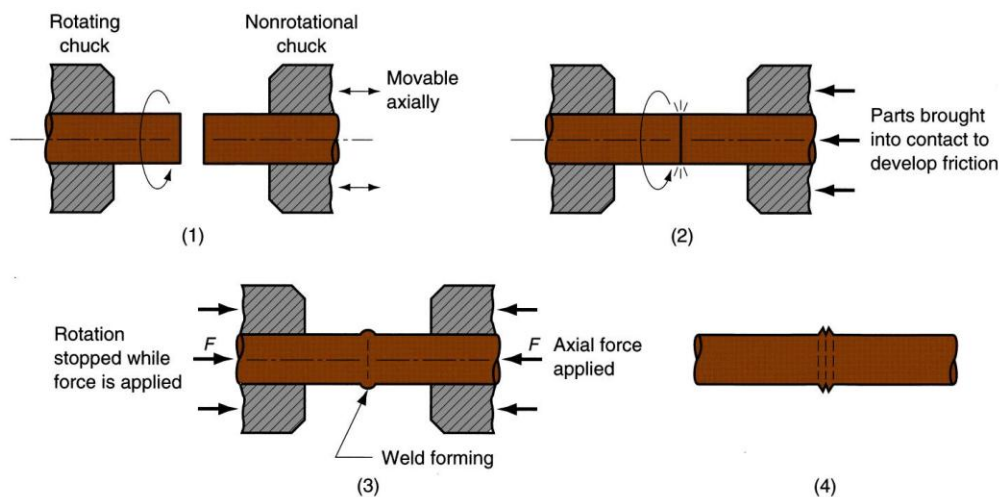


Fig: Friction welding (FRW): (1) rotating part, no contact; (2) parts brought into contact to generate friction heat; (3) rotation stopped and axial pressure applied; and (4) weld created.

Applications

- Shafts and tubular parts
- Industries: automotive, aircraft, farm equipment, petroleum and natural gas

Limitations

- At least one of the parts must be rotational
- Flash must usually be removed
- Upsetting reduces the part lengths (which must be taken into consideration in product design)

Weld Defects

- Undercuts/Overlaps
- Grain Growth

A wide ΔT will exist between base metal and HAZ. Preheating and cooling methods will affect the brittleness of the metal in this region

- Blowholes

Are cavities caused by gas entrapment during the solidification of the weld puddle. Prevented by proper weld technique (even temperature and speed)

- Inclusions

Impurities or foreign substances which are forced into the weld puddle during the welding process. Has the same effect as a crack. Prevented by proper technique/cleanliness.

- Segregation

Condition where some regions of the metal are enriched with an alloy ingredient and others aren't. Can be prevented by proper heat treatment and cooling.

- Porosity

The formation of tiny pinholes generated by atmospheric contamination. Prevented by keeping a protective shield over the molten weld puddle.

Source : <http://nprcet.org/e%20content/mech/MT.pdf>