



Co-funded by the
Erasmus+ Programme
of the European Union



Erasmus+

MODULE 5

Special methods of fusion welding

Friction welding



Principle of friction welding

- The basic principle of the friction stir welding is based on the mutual movement of the two parts in the pressing force.
- Most often rotating parts are welded when a coaxially centered piece welded component rotates and the other stands, or performs the opposite movement.
- On one part of the pressing force, which gives rise to frictional forces.
- supplied mechanical energy is converted into heat at very high efficiency.
- high specific pressure of the two surfaces initially align, deform and eventually tearing occurs deep surface of the creation and termination micro-weldings, strong heating (up to 90% of all heat release) and a substantially longitudinal deformation.
- Together leads to formation of burr characteristic.



Principle of friction welding

- When welding. This so-mechanical-molecular friction phenomena, which simultaneously breaks the oxide layer and prevents their re-creation.
- In time phase of intense friction at the contact surfaces and in a narrow zone around a high temperature reaches about 80% - 85% of the melting temperatures (for the steel to 1200 ° C - 1300 ° C).
- Own joint is formed in a very short time for the final compaction, which is associated with a greater deformation.
- Condition obtaining high-quality joint is to maintain the maximum temperature on the contact surfaces below the melting point of metal, but the temperature in the middle cross-section is welded with respect to the minimum relative velocity is low and in certain welding parameters, there may arise a cold junction.
- Basic process variable - speed, friction pressure and time provide suitable temperature field and heat coupling.



Principle of friction welding

- ▶ Link quality significantly affect metallurgical condition at the interface, the upsetting pressure and size agglomerating.
- ▶ There are currently three known basic methods of friction welding linear oscillating motion, rotational motion of one or both usually rotating parts and welding rotating tool.
- ▶ Rotational welding divided into:
 - ▶ Welding direct drive - conventional,
 - ▶ Welding with stored energy - the flywheel.



The conventional method of friction welding

- ▶ In the conventional welding, spin welded components ensure direct drive from the motor via the gearbox and clutch.
- ▶ The main feature of the process speed is constant throughout the heating cycle, and two specific pressure levels.
- ▶ Number speed depends on the diameter, type and plasticity of the welded material, and their range is in the range of 500 min^{-1} to 5000 min^{-1} .
- ▶ Increasing relative speed leads to more rapid heating and thereby reduce the loss of material to the fin and reducing the heat affected zone.
- ▶ The relative speed of movement during friction welding is usually in the range of 0.6 ms^{-1} to 6 ms^{-1} .



Weldability of materials during friction stir welding

- Weldability of metals during the friction welding has a relatively low sensitivity to the chemical composition, allowing to weld a combination of metals by fusion nesvařitelných.
- rubbing can weld most types of steel, aluminum, copper, nickel, molybdenum, titanium, Monel, Stellite, Nimonic etc.
- Very time weldability of aluminum has a range of metals Zr, W, Ti, Ni, Mg, Cu, Brass and carbon steel.



The application and use of friction welding

- In addition to metal friction welding can also be used for joining ceramics and glass to metal.
- Engineering production constitutes the largest proportion of the rotating shaft components, pins, pipes, cylinders etc.
- Can connecting all profiles e.g. square or hexagonal shape, and components with a precisely defined shape, since microprocessor-controlled welding device controls and adjusts the angle of rotation.
- Because the short time at his own welding and high cost of the device must be ensured by mass or volume production parts.



The application and use of friction welding

- Applications, the friction welding is very much e.g. in the automotive industry - cardan shafts, control rods, gears, valves of internal combustion engines, drive shaft dampers, shafts of turbochargers, camshafts, sets of axles etc.
- In extractive industries welding drill rod, shutoff valves and pipe systems.



Safety in friction welding

- ▶ The safety of this type of welding process is characterized by quiet operation, there is no radiation, fumes and sparks are ejected or molten metal.
- ▶ Welding the device works without direct intervention worker, thereby reducing the risk of injury.