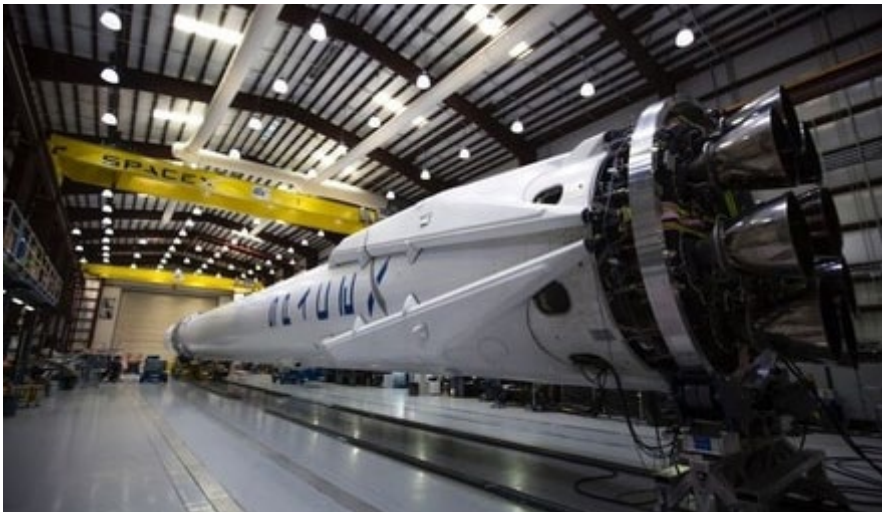
How does friction stir welding work?



Friction Stir Welding (FSW) is a welding technique developed by The Welding Institute Ltd. back in 1991. Although it was invented more than 25 years ago, it has seen a swift rise in demand in the last few years, particularly owing to the increased demand of higher strength and durability requirements in modern engineering applications.

It boasts a distinct method of fusing metals into each other which is significantly different from traditional techniques such as arc welding or gas welding. Its uniqueness lies in the fact that it is a solid-state welding method, which means that neither of the materials being joined together are melted.

Instead, they are merely softened to the point where they can penetrate each other's surfacewith a little assistance. This technique yields extraordinary mechanical properties like fatigue strength and stiffness, and minimal defects in the weld region.

Moreover, this welding method also involves less wastage of material and a better appearance, which means lower surface finishing requirements. Finally, one of the most praised advantages is that it has no adverse effects on the environment, as no toxic fumes are produced in the whole process.

How is friction stir welding performed?

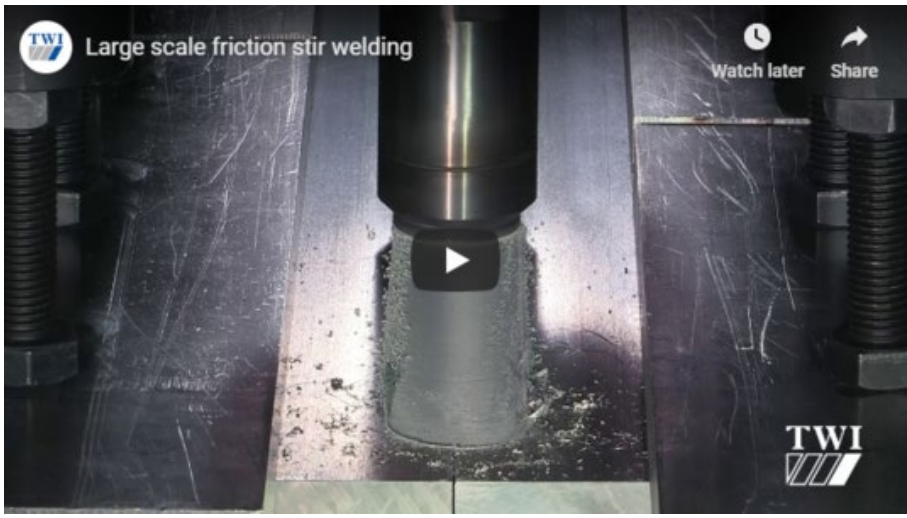
FSW is performed with the help of:

- a profiled welding tool
- a clamp to hold the workpieces together
- a mechanical setup to guide the tool along the joint line.

These components work in conjunction with each other to create the weld joint.

The tool is quite similar to a milling cutter in shape, which rotates throughout the machining process and is movable along the workpiece surface. The tool is practically pushed into the joint line surface initially and then traversed along the joint line periphery by the welding machine. The friction between this non-wear tool and the workpiece produces heat, raising the temperatures of the metals in the vicinity of the joint line.

A profiled probe placed at the very end of the tool is shaped in a way that it forces metals on both sides of the joint line into each other. Since they have been softened considerably due to the heat generated in the process at this point, they merge easily.



FSW is a solid-state process which produces welds of high quality in difficult-to-weld materials such as aluminium, and is fast becoming the process of choice for manufacturing lightweight transport structures such as boats, trains and aeroplanes.

Friction Stir Welding and SpaceX's Falcon Heavy

Owing to the superior qualities of this technique, it has particular relevance in applications requiring high strength properties and intense working conditions. The aerospace industry is one such example, with modern space vehicles being built to withstand unfathomable forces and temperatures.

SpaceX, the aerospace manufacturing company headed up by Elon Musk, has recently launched its Falcon Heavy rocket into space with a Tesla Roadster as the payload. This rocket is the fourth-highest of all rockets built up until now in terms of load-carrying capacity, and it featured the use of friction stir welding. This fact highlights FSW's importance in the aerospace industry and its possible usage in future engineering applications.

Design engineers at SpaceX used FSW to join the break-off fuel tanks of their rocket, which play a crucial role in the propelling of the spacecraft once it is in space and settled in its orbit. The reason for this application was obviously the need of exceptional strength in break-off fuel tanks of a rocket this powerful, which cannot be met by conventional means such as liquid-state welding or non-permanent joints like rivets.

Final Thoughts

Summing up everything discussed above, it is safe to say that the future of welding lies in the use of novel techniques like FSW that are more efficient, less costly, and environmentally friendly. It is a prime choice for design engineers who are looking for permanent joining techniques with results better than the ones being used currently.