

Welding Fixture Design for T-Joint Fabrication

1. Introduction

Welding fixtures ensure accuracy, repeatability, and productivity during fabrication. This project involves designing a fixture to hold two square hollow section (SHS) tubes in a precise 90-degree T-joint configuration. The tubes used are 50×50×150 mm and 50×50×200 mm. The goal is to eliminate alignment errors, simplify clamping, and handle thermal effects during welding. The fixture was modeled in SolidWorks.

2. Problem Statement

The fixture must hold SHS tubes in a perpendicular T-joint while ensuring: correct 90° orientation, repeatability, minimal heat transfer to clamps, easy loading/unloading, and clear welding access. It must be stable, modular, and easy to fabricate using standard materials.

3. Design Requirements

The design requirements include: rigid holding of both tubes, quick clamping using toggle clamps, thermal protection for clamps, wear blocks and air gaps under tubes, free welding access, modularity for adjustments, and use of commonly available materials.

4. Fixture Concept and Description

The fixture includes a base plate, vertical support frame, wear blocks, toggle clamps, thermal pads, and an air gap region. The base plate provides rigidity; the vertical frame aligns the vertical tube; wear blocks elevate and protect components; toggle clamps allow fast locking; thermal pads reduce heat transfer; and the air gap protects the fixture during welding.

5. Working Principle and Clamping Sequence

The vertical tube is placed on wear blocks and held by a toggle clamp. The horizontal tube is placed on its respective support blocks and locked by two toggle clamps. This positions the T-joint accurately and provides clear access for welding. The setup ensures repeatability and minimizes distortion.

6. Thermal Stability and Heat Management

Thermal insulating pads protect clamps, air gaps reduce heat conduction, wear blocks absorb spatter, and dowel pins ensure accurate repositioning after maintenance or replacement.

7. Material Selection

Base Plate: Mild Steel — strong and economical.

Support Blocks: EN24 / Brass — wear and heat resistant.

Angle Supports: Mild Steel — good machinability.

Toggle Clamps: Carbon Steel — strong holding force.

Dowel Pins: SS304 — corrosion resistant.

Thermal Pads: Ceramic fiber — excellent insulation.

8. CAD Modelling (SolidWorks)

The complete 3D assembly—including base plate, supports, clamps, wear blocks, and pads—was modeled in SolidWorks. The model ensures correct dimensions, alignment, manufacturability, and assembly feasibility.

9. Advantages of the Fixture

Accurate and repeatable T-joint fabrication, reduced dependency on operator skill, fast clamping, thermal resistance, modular design, and easy fabrication using standard parts.

10. Applications

Suitable for fabrication shops, welding industries, automotive component welding, educational workshops, and batch production of welded SHS frames.

11. Conclusion

The designed fixture provides a stable, heat-resistant, efficient system for producing accurate T-joints. It meets all functional requirements and improves welding accuracy and productivity while being easy to manufacture and maintain.