

# OPTIMIZATION OF CMT WELDING PROCESS PARAMETERS OF DISSIMILAR HOT ROLLED E250 AND POLYMER SANDWICH STEEL LAP JOINTS

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## Abstract

Lap joints of 1.5mm thin sheets of dissimilar hot rolled E250 with polymer sandwich steel (MPM) were produced by Cold metal transfer (CMT) process, closer to the real application. MPM sheets has wider application towards NVH as well as structure borne sound reductions, and light weighting solution in automotives. The MPM thin sheet structure is composed of 0.1mm polystyrene-butadiene-styrene polymer sandwiched between two 0.7 mm DC06 sheets. Polymer layer of the MPM on the welded blanks was found to be intact at significantly lower heat inputs (0.16-0.24 kJ/mm), which otherwise had been quite challenging during TIG welding leading to huge rejections. After several iterative trials for acceptable weld quality, experiments were conducted as per L<sub>9</sub> orthogonal array, Taguchi technique with welding speed (WS), wire feed rate (WFR) and welding torch orientation (TO) as the process parameters. The joints were investigated through optical macrograph, micrographs, hardness, tensile lap shear tests and SEM fractography. Optimum parameters were determined for maximizing shear strength. The sample with optimised parameters exhibited 6% improvement in shear strength achieving 152.09 MPa and polymer layer retention. ANOVA analysis suggested welding speed to be most significant parameter with 69.85% contribution affecting shear strength. Coefficient of determination (R<sup>2</sup>) for the shear strength was 87.26% derived from the linear regression model. Significantly lower error 0.96% computed from the confirmatory test concluded very effective optimization.

**Key Words:** Polymer sandwich Steel, CMT, Taguchi Technique, ANOVA, Regression Analysis, R<sup>2</sup>

## Highlights

- Thin Sheets of polymer sandwich steel (MPM) sheets were joined successfully with E250 sheet without thermal disengagement of the polymer layer in MPM by CMT welding.
- Under optimal parameters MPM/E250 joints exhibited excellent mechanical properties.
- Fractographic analysis revealed ductile failure mode.
- The error between experimental and predicted results by Taguchi was significantly lower and very well within the acceptable range.

## **Biography**

Bipin Sharan has professional career spanning more than 36 years with M/S Tata Motors and presently heading manufacturing operations of Defence Vehicles, TML Jamshedpur.

Currently Pursuing Doctoral Programme in Mechanical Engineering at NIT Jamshedpur.

He is highly competent professional and has hands on experience in the area of Manufacturing Operations, Quality Assurance, Process Enhancement, Project Management, EHS and Sustainability.

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Has pioneered and mentored Digitization initiatives in SHE & S space.

Certified Lead Assessor “ISO 45001” on OH&S Management System.

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## **Presentations in conference:**

1. "An Overview on Effect of CMT welding Process Parameters on Weld Quality and Properties in Dissimilar Welding of Metals " : AMPT Conference , NIT Jamshedpur October 31<sup>st</sup>-2<sup>nd</sup> November 2020
2. "Effect of Cold Metal Transfer Welding Process Parameters on Weld Quality and Properties during Welding of Dissimilar Welding of Thin Steel Sheets: Research Conclave, 25-27th Feb 2021, NIT Jamshedpur