

# Effect of Intermetallic Compounds and Inclusions in Normalizing Rolled C–Mn Steel Plate Butt Joint Failure

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**Abstract** Production weld tests were usually conducted in steel fabrication industries to ascertain the process reliability and product quality. Plate groove butt joint test specimens, prepared from production weld test coupon, were failed during the mechanical test. To analyse the root cause for joint failure, a series of tests were conducted on prepared samples from production weld test. The macro-examination was conducted at the failed region, and microstructure analysis was carried out by optical microscopy and scanning electron microscopy on the banded structure of the base metal and at heat-affected zone. The purpose of this investigation is to identify the effect of the non-metallic inclusions in the segregated banded zone during welding of plate butt joint and to identify the impurity elements responsible for the weld failure. From this investigation, it was found that the presence of manganese sulphide, lead sulphide and aluminium oxides in the segregated zone decreased the mechanical properties of the plate groove butt joint weld in terms of failure.

**Keywords** Segregation · Impurity elements · Plate butt joint · Mechanical properties · Weld failure

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## List of Symbols

ASTM	American Society for Testing Materials
%	Per cent by weight
HAZ	Heat-affected zone
Al <sub>2</sub> O <sub>3</sub>	Aluminium oxide
Mn <sub>3</sub> C	Manganese carbide
MnS	Manganese sulphide
SiO <sub>2</sub>	Silicon oxide
FeC	Iron carbide
MgO	Magnesium oxide
PbS	Lead sulphide
Si	Silicon
Mn	Manganese
mm	Millimetre
C	Carbon
S	Sulphur

## 1 Introduction

Advances in the plate manufacturing process have enhanced the low level of impurities. In recent years, “clean steel” has been developed and commercialized by plate mill, thereby meeting the demand for steel. The structural steel plates are manufactured with the condition of either normalizing rolled or As rolled. The modern steel plate manufacturer prefers the normalized rolling for its optimum strength, energy savings and pollution-free environment. Normalized rolling steel plates are widely used for non-alloyed structural steel construction industries such as pressure vessel, boilers, bridges and shipbuilding. Hot-rolled medium- and high-tensile structural (C–Mn) steel with normalizing rolled plate Specification: IS 2062 E