

## Crain Rail Welding by MMAW process replacing Thermit Welding

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Crain Rail is nothing but Manganese Steel having 0.4 – 0.6% Carbon and 0.9 – 1.25% Manganese. Due to this high percentage of Carbon as well as Manganese, Carbon equivalent is quite high which indicates poor weldable material.

So far Mechanical property is concern, minimum tensile strength should be 710 MPa and minimum elongation percentage should be 14% as per IS: 3443 – 1980.

The conventional joining technique is Thermit welding. It is specialized process and lot of safety hazards are involved in this process. The weldment property is normally not equivalent or homogeneous due to slag inclusion. The process is costly also.

As a substitute of Thermit welding, MMAW process with Low Hydrogen electrode (E7018) with Hard facing can be used. By using E7018 material homogeneity cannot be achieved as the strength of parent material is quite high. It used to fail during tensile testing to validate the process.

After several trial and discussing with different electrode manufacturer, E12018M is identified. It is micro alloyed Low Hydrogen electrode with low Carbon but high Manganese (1.3-1.4%), 2% Nickel and 0.5% Chromium. Its UTS value is also around 860 MPa and elongation 20%.

As a pre-requisite of Low Hydrogen electrode, it has to be baked @200°C for two hours and carry-over oven has to be set at 80-100°C during welding.

Because of high Carbon equivalent and higher section thickness, preheating @200°C is recommended at the length of 200 mm for both sides of the joint. Inter pass temperature also have to be maintained around 200°C. But it should not exceed 300°C.

After completion of welding, the joint and adjacent area should be covered with Lime dust for slow cooling as well as to avoid oxidation. After proper cooling, surface to be cleaned by grinding.

Test coupon with CR 100 Rail section is prepared to validate the process or to establish the PQR (Procedure Qualification Record) as per following photograph:



Tensile test sample prepared from the head section and UTS value found more than 760 MPa, which is accepted as per ASME Sec-XI Clause QW 153.1(a).



Bend test sample prepared from web portion of the Rail section. Test conducted as per ASME Sec-XI Clause QW 160 guideline but no crack observed in weld zone, hence accepted.

The welding as well as testing conducted at Tata Steel plant, Jamshedpur.

Following advantages are there in MMAW process over Thermit Welding process:

- ◆ No specialized agency are required. 3G qualified welder are

sufficient to do the job.

- ◆ Weldment can be porous in Thermit welding resulting weaker strength than traditional (MMAW) welding.
- ◆ Safety hazard is very less as persons are conversant with the MMAW process.
- ◆ It is very much cost effective. Per joint is around 6 times less costly.