AustralAsia Railway Fact Sheet

CONTINUOUS RAIL WELDING

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WHAT ARE THE WELDING PROCESSES USED ON THIS PROJECT?

There are two welding processes used;

- Flash Butt Welding – this method is used to weld 13 short welded rail sections (27.5 metres) together into long welded rail sections (LWR) of 357.5 metres, which are then used in the tracklaying process; and
- Aluminothermic (Thermit) Welding – this method is used on site to weld LWR sections together.

WHAT IS FLASH BUTT WELDING?

Flash Butt Welding aligns the rail, charges rails electrically and hydraulically forges the ends together. The welderhead automatically shears upset metal to within 1/8" of the rail profile. A base grinder removes the 1/8" flashing material from the rail, which leaves a smooth base and greatly reduces the likelihood of stress risers, which shorten the life of the rail. The sides and head of the rail are also ground to the profile of the parent rail. As a final step in the welding process, a mag particle test is performed. These quality checks, plus two separate checks with a straightedge and taper gauge, contribute to the complete job that makes a quality weld.

WHAT IS ALUMINOTHERMIC (THERMIT) WELDING?

Thermit welding is a welding process, which produces coalescence of metals by heating them with superheated liquid metal from a chemical reaction between metal oxide and aluminium with or without the application of pressure.

Filler metal is obtained from an exothermic reaction between iron oxide and aluminium. The temperature resulting from this reaction is approximately 2500° C. The superheated steel is contained in a crucible located immediately above the weld joint. The superheated steel runs into a mould, which is built around the parts to be welded. Since it is almost twice as hot as the melting temperature of the base metal, melting occurs at the edges of the joint and alloys with the molten steel from the crucible. Normal heat losses cause the mass of molten metal to solidify, coalescence occurs, and the weld is completed.

WHY IS THE ALICE SPRINGS TO DARWIN RAILWAY CONSTRUCTED WITH CONTINUOUS WELD LINE?

To provide a low maintenance cost railway. The development of Continuously Welded rail was undertaken in Europe during the 1950's and 1960's and has been progressively introduced into Australia since that time until now it is the standard practice. Most of the rail tracks in Australia are constructed using this technique.

WHY IS CONTINUOUS WELD LINE LOW MAINTENANCE?

There are no joints to be maintained. In the early history of railways the rails were joined by mechanical joints, which were designed to allow the rail to expand and contract as the temperature rose and fell. These joints were a significant source of maintenance as the bolts and plates that joined the rails often broke, the rails were damaged by the bolts and plates and could crack, the track was harder to keep level and the sleepers would be damaged.

HOW STRONG ARE THE WELDS?

When the rail is trying to contract, the rails are trying to pull themselves apart. The point where this is most likely to occur is at the welds. The strength and the quality of the welds are sufficient to prevent this happening. An ongoing program of ultrasonic rail flaw inspections will be carried out to check the integrity of both the welds and the rails.

OLDER GENERATION RAILWAY WORKERS ARE ADAMANT THAT YOU MUST HAVE EXPANSION JOINTS OTHERWISE THE RAIL WILL BUCKLE. HOW DOES THE CONTINUOUS RAIL OVERCOME THERMAL EXPANSION AND CONTRACTION IN THE TEMPERATURES BETWEEN DARWIN AND ALICE SPRINGS?

In order to balance the forces between those which want to buckle the track during high temperatures and those which want to pull the rails apart during cold temperatures the rail is laid at what is called the neutral temperature of 40 degrees Celsius. The range of rail temperature expected throughout the course of the year is approximately -10°C to +65°C.

On a railway the length of the Alice Springs to Darwin railway (1420km) this movement would be 16.3 metres for every degree of temperature change. It has been calculated that the rails are subjected to a temperature range of 45 degrees in Darwin and 74 degrees in Alice Springs. This would mean that the rails would expand and contract up to 1.2 km between the coldest night and hottest day during the year.

If the rail were free to move when heated or cooled it would expand or contract like all other steel. A small amount of the stress developed along the rail can be taken up with expansion across the rail. Its height and width expand due to their own dimension as well as some distributed stress from the longer length. The rail bulges slightly. As long as the column is prevented from moving sideways along its length it is very stable.

HOW IS THE RAIL CONSTRAINED?

The rails are held to the sleepers by strong spring clips and prevent the rail moving along the track. The sleepers are very heavy concrete. Their weight and the friction of the ballast stop any movement. There are 2 clips for each rail at each sleeper. Each clip exerts a load of about 2 tonnes onto the foot of the rail.

When the rail is constrained from moving along the track the only potential expansion the rail experiences at any single point, is the expansion that could occur between two sleepers. Over 700mm, between the sleepers, the rail will try to expand 0.0077mm, about 8 thousandths of one mm.