



Review of Insulated Rail Joints: Literature Review

In this report, the state-of-the-art in research reported on bonded insulated rail joints (IRJs) is summarised. The following conclusions can be drawn based on the review:

- Under heavy-haul railway traffic load, bonded IRJs fail at a greater rate when compared to any other railway track component.
- Design and manufacture of IRJs to date are controlled by fewer technologies. IRJs are usually factory-manufactured under high quality control as evidenced by testing to standards and codes of practice. New technologies that do not require factory manufacturing are emerging in the market.
- Recent Australian research (Rail CRC Project 75) has advocated reducing the thickness of endposts from 8.5mm to 5mm. The industry has adopted this recommendation.
- Design solutions for increasing the service life of IRJs vary between countries. For instance, the United States' design is mainly focused on increasing the stiffness of the IRJs assemblies by increasing the dimensions of joint bars, whilst other nations are primarily focused on material innovation (e.g. steel with a higher yield point, or composites) without modifying the conventional IRJ design parameters.
- There is no agreement on best practice when installing, maintaining, and repairing IRJs. The US practice advocates directly supporting the joint section of the IRJ on a sleeper, whilst the Australian and other comparable heavy-haul national systems recommend that the joint sections be suspended symmetric to two sleeper supports.
- Although the US practice is to embed geogrid within the ballast layer in the vicinity of IRJs to improve lateral stiffness, little research has been conducted into the effect of ballast and subgrade stiffness on the impact loading of IRJs and how these variables might correlate with IRJ service life. This PhD study is the first of its kind to examine the effect of variation in ballast stiffness on the performance of IRJs.
- There is no universal agreement regarding the common modes of failure of bonded IRJs. For instance, the North American heavy-haul railway tracks report adhesive debonding followed

by joint bar cracking, whilst the Australian heavy-haul railway tracks report railhead metal flow in the vicinity of the endposts as the most frequent mode of IRJ failure.

- Field visit visual observation reports indicate that there is significant statistical variability and deficiency with regard to IRJ installation, maintenance, and repair practices.
- There is a paucity of literature regarding the availability of efficient numerical modelling tools for IRJs that can be used for accurate prediction of railhead material accumulated plastic deformation failure and subsequent fatigue fracture problems under cyclic wheel loads.
- There is a renewed interest in IRJ research around the world, especially in regard to their service in heavy-haul applications.