

Mark 4 Bogie Overhaul Case Study

Overview

Mark 4 coach rolling stock has transported millions of people since it was introduced as part of the InterCity 225 trainsets in 1989. Purpose-built for longer-distance services on the then newly-electrified East Coast Main Line, 302 Mark 4 coaches – there were 314 built in total - are still in service some 31 years later. They are under the ownership of Eversholt UK Rails Group, which leases them to London North Eastern Railway, Transport for Wales and Grand Central. The Mark 4 passenger fleet, which has seven different vehicle types, mainly operates with the 125mph Class 91 electric locomotive and Mark 4 Driving Van Trailer.

In 2006, Eversholt (HSBC Rail at the time) awarded Wabtec Rail a long-term contract worth \$140m to overhaul all bogies for Eversholt fleets, including the Mark 4 bogies. The initial contract term was for 10 years, which was unheard of at the time in the UK rail industry after-market but Eversholt wanted to commit to a long-term partnership with a bogie overhauler to build collaboration. The 10-year bogie contract was initially for circa 6,000 bogies for 11 different fleet types and was later extended for the majority of Eversholt fleets.

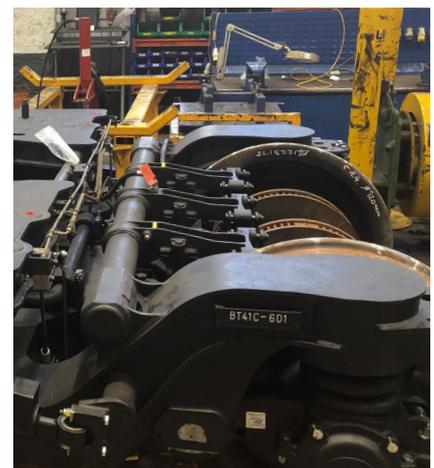
In 2006, Eversholt also awarded Wabtec Rail a Class 91 locomotive overhaul contract and in 2009 they awarded Wabtec Rail the IC225 fleet heavy maintenance contract for both vehicles and bogies, which comprised of OH1 and OH2 exam cycles. This further developed the collaborative partnership that the companies had established.

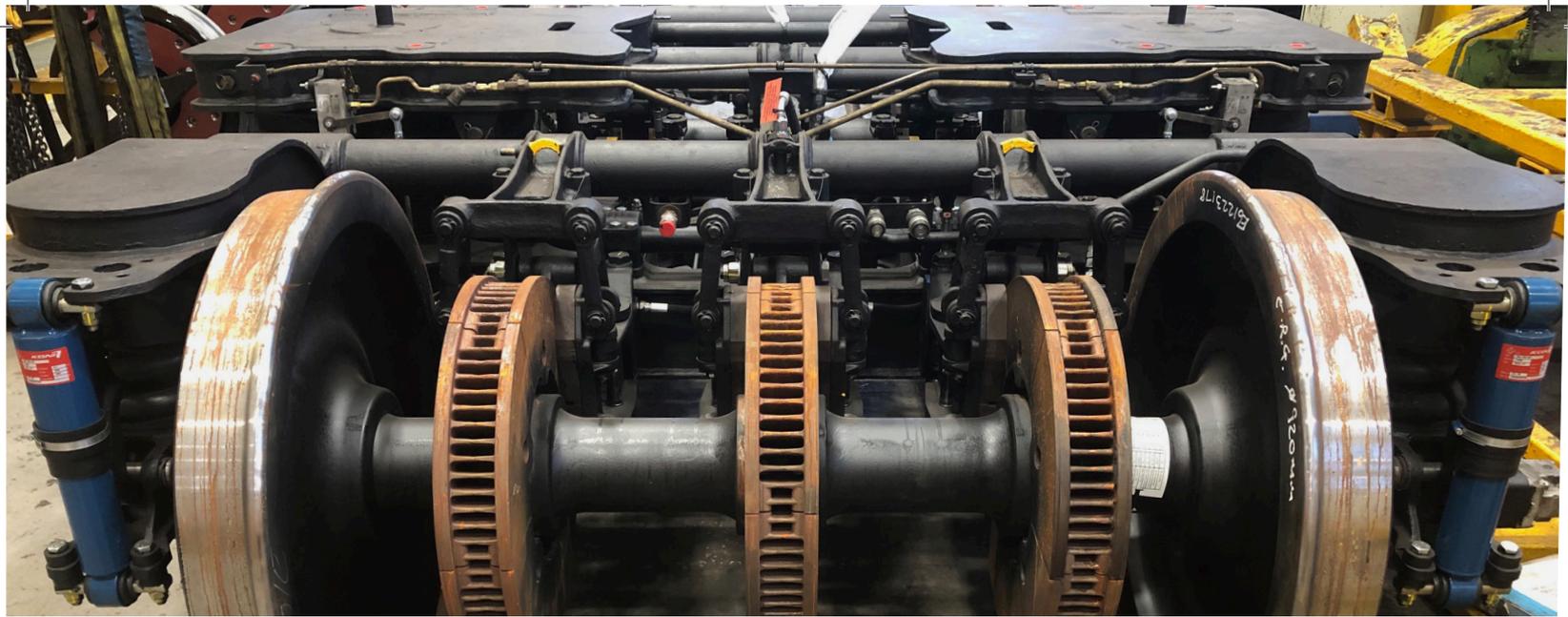
The Deliverables

IC225 Vehicle maintenance was carried out in Doncaster and the beat rate was consistent with around 20 bogies completed per month throughout.

The component and wheelshop areas of the business supported the contract by overhauling the bogies' subcomponents, while the component and HVAC departments were also involved undertaking work on battery boxes, brake frames and air conditioning units.

To date, Wabtec Rail has overhauled nearly 2,500 Mark 4 bogies, 5,000 Mk4 wheelsets and 15,000 brake callipers and actuators.





Challenges

Through the years that Mark 4 bogies were overhauled, several engineering solutions and modifications were implemented by Wabtec Rail in collaboration with Eversholt, in response to a series of challenges.

One of these concerned the need to reduce track access charges levied by Network Rail due to the extra wear and tear on curved sections of track caused by the effect of the yaw stiffness of the wheels over time. This was alleviated by adding HALL variable rate radial arm bushes to the bogies which was proposed by the client and implemented by Wabtec Rail.

Another challenge concerned the brake disc performance, which was inadequate, causing high operating temperatures and, in some cases, catastrophic failures. To solve this problem, Wabtec Rail proposed and then implemented Poli brake discs, using a SISCO OEM component.

Engineers also discovered inherent design issues with the AWS head stock beam, resulting in joint fretting and, in some cases, the beams coming loose in-service. This was resolved by developing a detailed inspection and repair process, including new fixings, resulting in a complete interface re-design.

An increase in axle failure over time was leading to increased overhaul costs, so Wabtec Rail developed a reclamation procedure which safely removed material from the axle without affecting the other critical dimensions. Time was also taken on other components, adding more cost to the overhaul cycle, but by developing the repair process to include new technologies, such as metal spray to reclaim axle boxes, costs were minimised.

Finally, after the bogies' hydraulic parking brakes experienced intermittent faults, Wabtec Rail designed and developed a new bleeding process and valve system to control it.

Outcome

The long-term nature of the contract meant that many changes to Wabtec Rail's production line took place over the years. This generated working practices and knowledge that have helped with other contracts for other clients and demonstrate the company's ability and willingness to build flexibility into its production processes.

In particular, the design, size and shape of the BT41A (Mark 4) bogie led to the creation of a bogie production line that was independent to the main bogie facility. This included its own dedicated bogie turn-over rig and load simulator, as well as a full suite of tooling jigs and fixtures.

The Mark 4 cell, commonly known as "6 bay" due to its location on Wabtec Rail's Doncaster site, boasted a Mark 4-specific resource and a small group of operatives who, predominantly, specialised in the Mark 4 bogie and subcomponents. This allowed for the more challenging processes, such as height-setting, to be carried out in a controlled and repeatable manner. A similar approach has since been used by Wabtec Rail on other more bespoke bogie overhaul projects such as CR4000 tram bogies but, arguably, the key outcome from the Mark 4 bogie overhaul contract was the long and fruitful collaborative approach involving both the customer and supplier working in partnership, which contributed to the overwhelming success of this contract.

With each of the 622 bogies having been subject to a heavy maintenance cycle every three to four years, Wabtec Rail overhauled them four times over the 13-year lifespan of the contract. It also overcame engineering challenges that arose as the units and their components endured the wear and tear associated with a long service.