

# London Tram CR4000 Tram - Power Bogie and Gearbox 1.2km Overhaul Program

## Overview

It may be the only tram network in London, but with **27 million passengers every year**, London Trams' service linking Wimbledon with Beckenham has become a vital part of the capital's vast transport network.

London Trams is part of Transport for London and uses a combination of on-street and segregated running along its 28km route, which also covers Croydon, Elmers End and New Addington.

In total it consists of 39 stops, including seven National Rail stations and more than 50 bus routes – figures which mean that the network's fleet of 24 CR4000 trams and 12 Stadler Variobahn trams have to endure a heavy workload, with little maintenance downtime.

In 2017, Wabtec Rail secured a contract with TFL for the overhaul of 48 Bombardier-built CR4000 power bogies, plus traction motors and gearboxes.

This was the first contract ever undertaken on behalf of London Trams – and, indeed on any tram bogie - and was predominantly carried out at Wabtec Rail's Doncaster facility. The traction motor overhaul was carried out by sister company Brush Traction at our Loughborough site, while Wabtec appointed Siemens Flender, as the gearbox OEM, to overhaul the gearboxes on its behalf in Leeds.

Wabtec Rail worked collaboratively with both Siemens and London Trams throughout the process, from the initial contract award stage and project mobilisation right through to project completion.





## The Deliverables

The core scope of work required a number of different aspects, including:

- Power bogie overhaul
- Gearbox overhaul
- Traction motor overhaul
- Wheelset bearing overhaul and UAT
- Development of all Component overhaul instructions and other technical documentation

With the bogies previously being overhauled by tram builder and OEM Bombardier, none of the technical documentation was available to Wabtec Rail, so all of this

## Challenges

As with many contracts, one of the main challenges was managing the customers' initial expectations with regards to the condition of the bogies, as well as identifying any potential delivery risks and working collaboratively with the customer to develop risk mitigation plans.

Initially, London Trams expected to be delivering complete dirty bogies for standard overhaul that Wabtec Rail's team would be able to return 10 days later, without any issues.

However, this plan did not factor in the many unplanned issues that arose from one bogie to another, through wear and tear or damage beyond the expected condition for the age of the bogies. At the start of the tender process, the customer envisaged the biggest technical issues to be associated with the gearboxes due to the mileage – in fact,

information had to be produced before any of the work could be undertaken.

Wabtec Engineering Services, meanwhile, created the Component Overhaul Instructions for the bogie and motor overhaul, working in conjunction with London Trams, which delivered a first-in-class bogie to Wabtec's Doncaster facility.

There, a controlled strip, condition assessment and controlled rebuild was undertaken to develop the COI and other drawings and technical documents, as well as to identify OEM suppliers in order that Wabtec Rail could source materials from OEMs rather than via Bombardier.

the bogies and wheelsets needed more attention than first expected.

Another challenge concerned lack of float bogies and sub-components and communicating the difficulties and consequences of embarking on such an overhaul programme without float bogies to the customer, which is what was originally suggested.

In addition, due to the size and beat rate, tram bogies do not fit easily into Wabtec Rail's main bogie production line, where staff can output one bogie every four hours. Therefore, this contract would need its own dedicated production line creating.



## The Solutions:

Wabtec Rail convinced London Trams to supply one float bogie at the outset of the work. This enabled the company to take delivery of a bogie every two weeks so, if a bogie needed further work, the float bogie could be utilised (for parts) to ensure the two-week plan was kept intact.

No trams were ever out of service during the bogie overhaul work – when a bogie was returned, London Trams would swap it with the next one to be overhauled and put the renovated bogie straight into service.

The tram bogies' unfamiliar size and beat rate was addressed by creating a dedicated tram production cell with its own team and Project Manager, rather than drawing from a staff resource pool based on the competency database as would be our usual practice. This ensured the tacit knowledge of staff and lessons learned were easily transferred from one bogie to another, helping to reduce beat rate, implement continuous improvement and reduce the number of quality snags found on inspection.

Wabtec Rail also devised new repair procedures for certain items, affording London Trams big savings. The Technical Query (TQ) procedure was very beneficial in informing London Trams of issues and demonstrating how it was being dealt with.

Wabtec Rail always proposed solutions to any issues encountered, including:

- **Track Brake Hanger Bracket** – It was discovered very early during the overhaul process that the holes were worn to such an extent that they were unusable. An external supplier quoted a high cost for a new bracket, along with a minimum order quantity. In response, the bogie engineering team and weld engineer drew up a repair procedure which resulted in a considerable cost saving for London Trams.
- **Coupling Forks** - The coupling forks had sustained damaged bores and, with new forks on a nine-month lead time, Wabtec Rail worked with Siemens to develop a procedure where the bores were bushed, resulting in additional significant cost savings.
- **Wiring Harness** – Unexpected damage and a lack of documentation made dealing with these components problematic, while the high cost of replacing the harnesses meant that a decision to repair them was taken instead. Each part was identified, and five bogies' worth were purchased and topped up if used, while a wiring diagram was produced by the engineering team to ensure each bogie was built the same.

Wabtec Rail already had a strong project governance and reporting process in place, but this was further enhanced to manage the stringent reporting expectations of TFL / London Trams, which required daily project status reports, including early warning of potential risks. Wabtec Rail has now implemented some of this enhanced reporting for other bogie projects, which is further supported using Excel Wraps with live on-line project status visible to customers.

Strong communication and project governance were essential throughout this project, along with collaborative working and teamwork between London Tram, Wabtec Rail and Siemens Flender. The respective engineering teams worked closely together to propose and agree solutions to any technical issues as they arose, while project managers worked closely throughout to keep the program running and tram availability high.

**“Wabtec Rail worked closely with London Trams on this project and collaboration was the best it could have been.”**

**Ian Buck**  
*Fleet Project Engineering Manager*  
*London Trams*

## Outcome and Customer Reference:

Not only did the strategically important CR4000 contract represent the first work Wabtec Rail had undertaken for London Trams, it also represented the company's first step into light rail bogie overhaul – and happily the programme was declared a success.

Ian Buck, Fleet Project Engineering Manager, London Trams, reported that the overhaul was completed within time and to a satisfactory standard, adding:

“Wabtec Rail worked closely with London Trams on this project and collaboration was the best it could have been. The overhaul specification was written by Wabtec Rail on behalf of London Trams as part of the contract. Where engineering issues arose, they were dealt with swiftly and to mutual satisfaction. The engineering support provided by Wabtec Rail was professional and pragmatic, where problems were encountered solutions were freely proffered.

“In the few instances where quality issues were raised, they were speedily managed by Wabtec Rail with minimal input required from ourselves. London Trams is very happy the way that the contract was pursued by Wabtec Rail.”

Through the tender evaluation process, Wabtec Rail worked closely with London Trams to finalise the contract agreement and mobilisation plan which helped to develop an open and collaborative working relationship from the start. Both parties felt like the project was delivered as a combined team and not just a more distant Customer/Supplier relationship.

Wabtec Rail looks forward to further strengthening this partnership and, since this contract, it has gained further light rail bogie experience on other projects including overhauling five Stadler tram bogies for London Trams.

