

Ferryhill Turntable Load Test Completed Successfully

Summary

We have completed major repair and refurbishment work to the structure of the turntable. As a prudent precaution we decided to perform a series of load tests to simulate turning a variety of locomotives. The most severe load case required over 190 tonnes of steel test weights.



Proof Load Volunteers



Proof load of 190.5t. E-Group's crane and weights from Sparrows and EMM.



How the turntable works

The turntable balances on a central ball pivot and has two wheels at each end which run on a circular track. At each end there are also two 'blocking pads' which lock the turntable into position and take the weight off the wheels as the locomotive is driven on and off the turntable. The wheels are only under load when the turntable is rotated.

As a locomotive is driven onto the turntable its weight is shared by two 'blocking pads' and the centre bearing. There is a gap under the blocking pads and the wheels at the other end until the locomotive's centre of mass passes over the centre bearing when the turntable tips or rocks onto the blocking pads at the other end. To rotate the turntable the 'blocking pads' are withdrawn and the wheels take any un-balanced load.

As a locomotive is driven onto the turntable, which is over 21m long, the main beams bend very slightly. The gap under the 'blocking' pads and wheels will reduce by about 40mm for a 170t locomotive. As soon as the locomotive is driven off the gap returns to its original size.

If the locomotive is perfectly balanced there is very little weight on any of the wheels as most of it is on the centre bearing. Taking the weight off the wheels or balancing makes it possible for people to rotate the turntable by pushing at the ends. If the turntable is 'un-balanced' much more effort is required to rotate it.



If Tornado's tender was completely empty there could be up to 15t on the wheels at one end which makes pushing very hard work.

The height of the centre bearing must be set very precisely to achieve the required clearances for the rocking motion and operation of the blocking pads. We are very grateful for the support from Whittaker Engineering who made a special shear stop spacer to set the bearing height and a special socket for torqueing the hanger rods in record time.





The shear stop spacer made by Whittaker Engineering in record time.



Whittaker Engineering also made a very special socket so we could torque the hanger rods



Load Test

We based our load tests on turning Tornado as it weighs about 170t with coal and water.

We tested five different load cases for locomotives plus a static 'proof' load test with 190.5t.

- 1. Loco entry onto the turntable, load on one half on the turntable (static).
- 2. Locomotive balanced and rotated
- 3. Locomotive and full tender balanced and rotated
- 4. Locomotive and empty tender unbalanced and rotated
- 5. Loco exit from the turntable
- 6. Static proof load no rotation.



A 'balanced' load case

Test method

The turntable is about 21m long so the test weights must be arranged to apply about 9t per metre to achieve a uniformly distributed load. As we also required to apply a non-uniform weight distribution we had to use steel test weights which were stacked over 1m high. Concrete weights would have been 2.5 times higher and were impractical. Some of the test weights weighed 10t.

The test took two only days rather than the three we had planned. We recorded the exact position of each weight and used several spreadsheets to calculate the load on the wheels for each load case. We also measured the gaps under the wheels and the blocking pads which lock the turntable into position. The predicted and actual deflection correlated very well with both the hand calculations and finite element modelling predictions done by our volunteers.



Our Sponsors

We were very fortunate to be supported by several local companies.

- EMM and Sparrows allowed us to use their weights
- **Dyce Carriers** HIAB unloaded the weights from eight of their fully loaded articulated lorries. Eight more loads are required to return them.
- **E-Group,** who performed the fabrication repairs, blasting and painting kindly made their 130t crane available.
- Lifting Equipment Rental lent us some compact 30t load indicating jacks so we could measure the loads on the wheels.
- Whittaker Engineering made the shear stop spacer and special socket in record time.



Dyce Carriers' HIAB unloading a 10t weight.





Measuring the clearances

Conclusion

With the load test successfully completed, we will align and re-lay the track ready for Tornado on 14th March.

Tornado's visit will be the first operational use of the turntable since it was restored. As we need to focus our efforts on ensuring a very smooth turnaround for Tornado **access to the site will be strictly by invitation only** and restricted to existing volunteers and observers from the companies who have given us such excellent support.

Our footpath access from Duthie Park is currently under construction. Once it is complete, we should be able to allow a limited number of visitors to view locomotives being turned. We currently expect six locomotives to visit this year.





Weights removed – rails lifted on to turntable ready for fitting – re-laid track in the foreground lifted prior to alignment.



Track laying in progress





Before work started!