

From the builders of No. 60163 Tornado – the first new main line steam locomotive built in Britain since 1960

# Yes!

I would like to support the P2 Project and join The Cylinder Manufacturing Club

Our online donations system is live on [www.p2steam.com](http://www.p2steam.com) for signing up as a P2 Covenantor, joining P2 clubs, contributing to The P2 Support Coach Appeal or making one off donations.

Alternatively, please complete the form below and return to:  
P2 Construction Fund  
The A1 Steam Locomotive Trust  
Hopetown Lane  
Darlington DL3 6RQ

We will then send you the appropriate Standing Order and Donation Registration Forms so that we can set you up on our systems and reclaim UK income tax paid through Gift Aid where appropriate.

Why not visit Darlington Locomotive Works and see No 2007 Prince of Wales under construction for yourself? We are open 11:00hrs to 16:00hrs on the first and third Saturday each month - please check [www.p2steam.com](http://www.p2steam.com) for the current status due to COVID-19 restrictions.

## Please join The Cylinder Manufacturing Club and help us to fabricate the cylinder block for No. 2007 Prince of Wales:

We established The Cylinder Club in October 2017 to raise an initial £100,000 from 100 supporters each donating £1,000 plus Gift Aid towards the design and construction of the cylinder block for No. 2007 Prince of Wales. This initial target was reached in March 2018 and the club closed whilst design work was completed and manufacturing drawings produced.

In June 2021 the order to manufacture the cylinder block was placed with Howco Group Plc for delivery in 2022, with William Cook

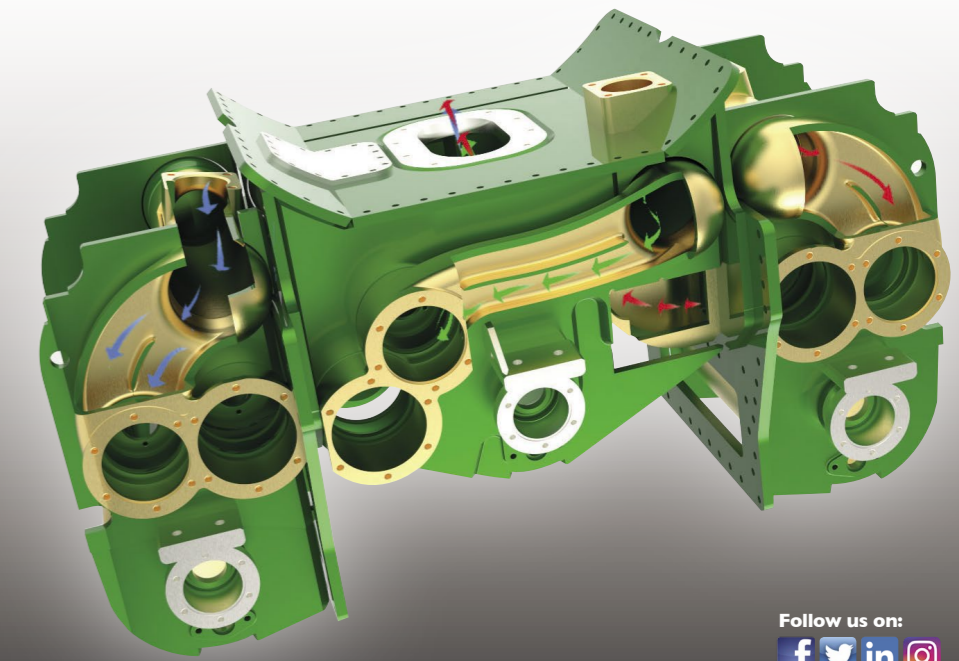
Cast Products Ltd providing a number of steel castings.

If we are to remain on schedule to complete No. 2007 Prince of Wales within three years we need to take delivery the cylinder block in spring 2022. We have therefore set ourselves the challenge of raising £250,000 through The Cylinder Manufacturing Club from 250 supporters each donating £1,000 (plus Gift Aid) to the project in up to eight payments of £125 by standing order.

## Putting the horsepower into Britain's most powerful steam locomotive

Almost £4m donated, wheels fitted, frames erected and boiler, motion, tender and cylinder block underway!

### Help us to manufacture the cylinder block for new Gresley class P2 2-8-2 No. 2007 Prince of Wales



Follow us on:  
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#### THE CYLINDER MANUFACTURING CLUB APPLICATION FORM

Name .....  
Address .....  
Post Code .....  
Email ..... Telephone .....

I have enclosed a cheque for £1,000 made payable to "A1SLT – P2 Construction Fund" or  
 I would like to make four (4) payments of £250 – please send me a Standing Order form or  
 I would like to make eight (8) payments of £125 – please send me a Standing Order form

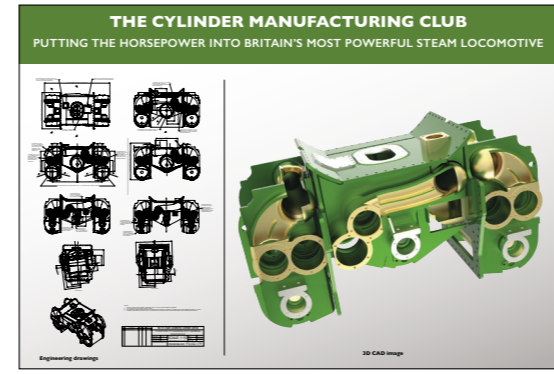
Are you a UK tax payer? Yes  No   
 Are you a P2 No. 2007 Prince of Wales covenantor? Yes  No   
 Are you a member of The Boiler Club for P2 No. 2007 Prince of Wales? Yes  No, please send details   
 Are you a member of The Tender Club for P2 No. 2007 Prince of Wales? Yes  No, please send details   
 Are you a subscriber to The P2 Support Coach Appeal? Yes  No, please send details   
 Are you a Peppercorn class A1 No. 60163 Tornado covenantor? Yes  No, please send details

To help our marketing efforts, could you please tell us where you picked up this leaflet?

JUNE 2021

#### Special benefits for members of The Cylinder Manufacturing Club

- Opportunity to buy ticket (seat already reserved) on one of the first trains hauled by No. 2007 Prince of Wales
- Reasonable access to No. 2007 at all times
- First choice of other components to sponsor
- Special supporters' day with Tornado
- An exclusive print of the engineering drawing and 3D CAD image of the redesigned cylinder block.



For further information on any aspect of the new Gresley class P2 please visit [www.p2steam.com](http://www.p2steam.com), email us on [enquiries@p2steam.com](mailto:enquiries@p2steam.com) or call 01325 460163. Together we can build this remarkable locomotive!



The Cylinder Manufacturing Club is raising funds for the manufacture of the cylinder block for the new Gresley class P2 No. 2007 Prince of Wales. If there are surplus funds left over following the manufacture of the cylinder block, we will use the money to purchase or manufacture other components for the Gresley class P2 that the charity would not otherwise have.





No. 2007 *Prince of Wales* outside Darlington Locomotive Works.

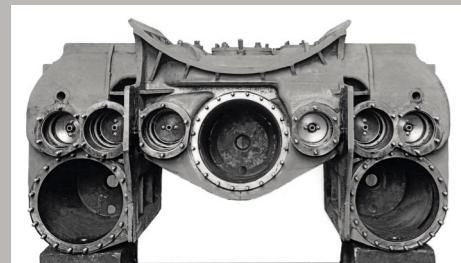
The Gresley class P2 2-8-2 'Mikados' were the most powerful express passenger locomotives to operate in the UK. They were designed by Sir Nigel Gresley to haul 600 ton trains on the arduous Edinburgh to Aberdeen route. Sadly the design was never fully developed and they were rebuilt by his successor Edward Thompson into ungainly class A2/2 4-6-2 'Pacifics' in 1943/4, and scrapped by 1961. As the builders of No. 60163 *Tornado*, we have set ourselves a new challenge: to develop, build and operate an improved Gresley class P2 'Mikado' steam locomotive for main line and preserved railway use. The project to build the 7<sup>th</sup> Gresley class P2 'Mikado' is using the latest computer design and modelling techniques to enable it to deliver its true potential.

#### The new locomotive will:

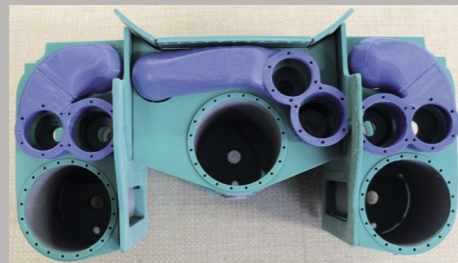
- Be aesthetically similar to pioneer class P2 No. 2001 *Cock o' the North* - it is a construction and development project not an opportunity for major redesign
- Make maximum use of systems, fittings and processes in use on No. 60163 *Tornado* - any changes to the original design will be either for operational, manufacturing or certification reasons
- Take into account the needs of the operator – all decisions will be judged for their value for money

- Meet current and foreseeable regulatory standards to allow the locomotive to operate as intended
- We estimate that No. 2007 *Prince of Wales* will cost over £5m to build over a ten year period. As with *Tornado*, funds will be raised through regular donations 'a P2 for the price of a pint of beer a week', donations dedicated to specific components and commercial sponsorship.

**We have the expertise, the track record and a plan... But this can't happen without you.**



The original monobloc (or one-piece) cast iron cylinder block for No. 2001 *Cock o' the North* (front view).



The assembled 1:8 scale 3D printed model of the cylinder block.

#### Progress to-date

- Frame: engine's frame & cab substantially complete; manufacture of pony truck frame complete; Finite Element Analysis (FEA) study being completed in collaboration with Ricardo Rail
- Cylinders & valves: 3D CAD design of the cylinder block & valve gear substantially complete and orders placed; detailed manufacturing drawings of cylinder block complete; Computational Fluid Dynamics (CFD) study of steam flow through cylinder block undertaken; updated poppet valve gear design almost complete; some components in manufacture
- Smokebox & fittings: smokebox assembled and chimney fitted; CFD study underway to check smoke lifting performance of front end
- Boiler: boiler design study completed & approved by TÜV Sud notified body; forged foundation ring corners manufactured; superheater header cast & machined; boiler cladding manufactured; boiler order placed with DB Meiningen (DBM) for delivery in 2021; minor re-design of the banjo dome completed by DBM; most components made & assembly of boilers underway
- Fittings: many non-ferrous fittings being cast & machined
- Brakes: manufacture of brake rigging well advanced and spring gear underway
- Wheelsets: crank axle re-designed to comply with modern standards & manufactured; all engine wheelsets complete & trial fitted to engine
- Motion: heavy motion ordered from Stephenson (Engineering) Ltd; six coupling rods, inside connecting rod and strap and outside connecting rods forged; six machined coupling rods and two outside connecting rods at DLW and machining of inside connecting rod & strap underway
- Pipework: design well advanced, pipe and fittings procured & installation underway
- Electricals: significant progress on electrical system; battery boxes built & fitted to frames; stainless steel conduit sections cut & bent as required; prototype of new axle driven alternator to be tested shortly
- Tender: frame being assembled by ID Howitt; tank constructed at NVES & painted to undercoat at DLW; wheelsets returned from South Devon Railway Engineering
- Finishing: nameplates and chime whistle delivered
- To-date, over £3.4m has been spent and almost £4m raised of the estimated £5m required.

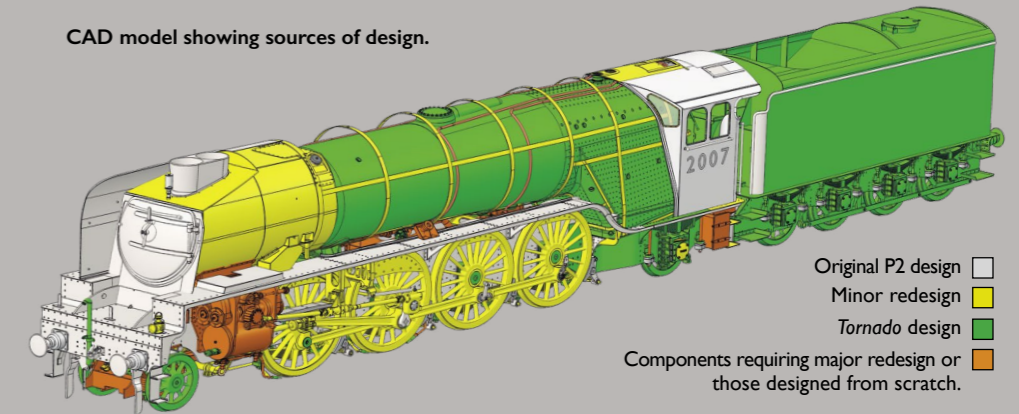
#### Why Lentz valve gear?

The first class P2 No. 2001 *Cock o' the North* was fitted with Lentz rotary cam poppet valves. Most modern steam locomotives used piston valves, where the entry of live steam to and the exit of exhaust steam from the cylinders was controlled by pistons which were driven backwards and forwards by the valve gear. Poppet valves are the type used in internal combustion engines and are activated by cams. Poppet valves can result in higher power, greater efficiency and reduced maintenance.

Dr Hugo Lenz developed a form of poppet valves where the cams of the oscillating type were driven by conventional valve gear. The original Lentz design was developed to be driven by rotary cams, which in turn take their drive through gear boxes and cardan shafts from the locomotive's wheels. This design was successfully applied to several hundred locomotives worldwide.

However, when proposed for No. 2001, Gresley requested that the Associated Locomotive Equipment Company provided continuously variable cams which provided an infinite number of settings between 10% and 75% cut-off. This fine adjustment was required with powerful locomotives to enable economical operation. However, on No. 2001 the continuous cams wore rapidly and required replacement after only 10,000 miles, so stepped cams were fitted adversely affecting its economy. Fortunately for No. 2007 *Prince of Wales*, the Lentz valve gear was further developed by the Franklin company of the USA during the 1940s which overcame the wear problems with the cams and other maintenance issues. We have been fortunate to obtain details of the Franklin developments and will be incorporating these into the valves and valve gear for No. 2007.

CAD model showing sources of design.



- Original P2 design
- Minor redesign
- Tornado design
- Components requiring major redesign or those designed from scratch.

#### Maintaining momentum

Since its launch in September 2013, the project to build new Gresley class P2 'Mikado' No. 2007 *Prince of Wales* has made remarkable progress. Over £3.4m has been spent on construction to-date and almost £4m of the estimated required £5m raised.

However, to maintain this rate of progress we need to raise in excess of £700,000 per year. This becomes more challenging as each year passes due to the nature of our 'P2 for the price of a pint of beer a week' covenant (regular donation) scheme.

#### Creating No. 2007's cylinder block

The work involved to redesign the cylinder block included:

- Converting the original class P2 one piece casting into a welded fabrication including Finite Element Analysis (FEA) to check for structural integrity
- Improving the layout of the valves to reduce the clearance volume (which affects cylinder efficiency)
- Re-routing the steam and exhaust passages to prevent incoming steam from heating the outgoing exhaust
- Increasing the size and improving internal streamlining of steam passages along Chapelon lines to increase maximum

power and improve economy, including Computational Fluid Dynamics analysis Frewer & Co Engineering Ltd

- Reducing the overall width of the cylinder block to provide No. 2007 with the widest possible route availability.

Manufacture of the cylinder block by Howco Group Plc includes:

- Producing the welded fabrication
- Stress relieving
- Grit blasting and painting with high temperature paint
- Machining
- Fitting cylinder liners and valve seats
- Manufacturing and fitting cylinder and valve covers
- Hydraulic testing the assembly.

The Cylinder Club was launched in October 2017 to raise an initial £100,000 towards the design and construction of No. 2007's new cylinder block. Having completed the redesign, produced the manufacturing drawings and commissioned Howco Group Plc to fabricate the new cylinder block using steel castings supplied by William Cook Cast Products Ltd, we have launched The Cylinder Manufacturing Club to raise the required £250,000.

**Help us to complete No. 2007's cylinder block by joining The Cylinder Manufacturing Club today.**

To become a member of The Cylinder Manufacturing Club, please complete the form overleaf or email [enquiries@p2steam.com](mailto:enquiries@p2steam.com), call 01325 460163 or visit [www.p2steam.com](http://www.p2steam.com) for more information.