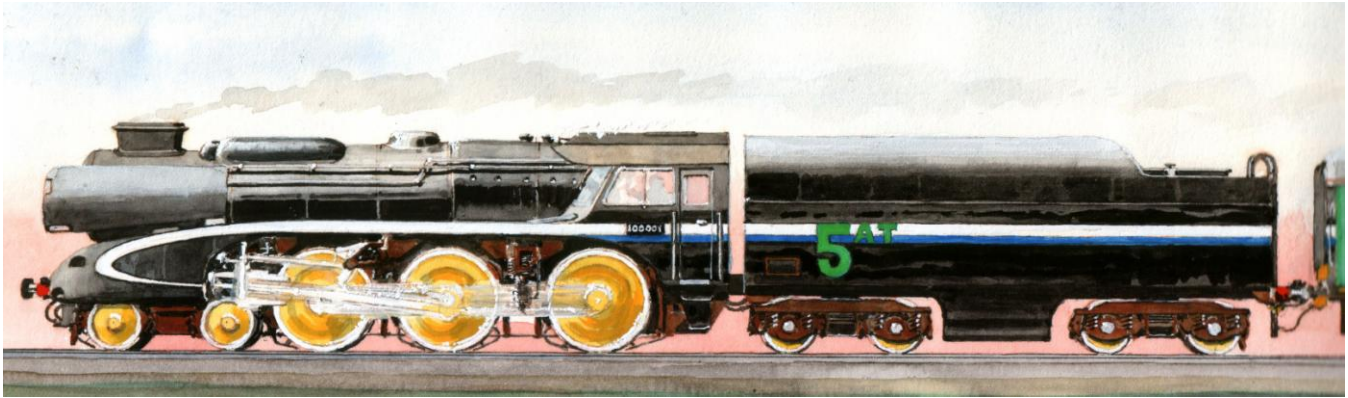


The 5AT locomotive – an overview



The 5AT “Class 5 Advanced Technology” locomotive is being designed to haul cruise and charter trains on modern main line networks in the UK and Europe and to demonstrate the capabilities and advantages of SGS locomotives to the railway industry worldwide.

It will be the world's first SGS (Second Generation Steam) locomotive for operation on the main line. It will incorporate the latest design practices and engineering techniques and will deliver a 21st century performance consistent with today's fast and intensively trafficked railway networks. With a maximum design speed of 125mph (200 km/hr), a practical operating range of around 310 miles (500 kilometers) under average service conditions and a thermal efficiency approximately 80% higher than the most advanced British designs of the 1950s, the 5AT will meet the demands of today's railway systems and ensure a future for steam traction within the modern-day railway framework.

Design of the 5AT is based on the size and format of the British Railways Standard Class 5MT 4-6-0 of 1951 with a new high capacity tender, although it is important to realise that the 5AT engine will be a totally new design from the ground up. The reasons for adopting this format are as follows:

- Given the power-to-weight ratio now available from steam traction, it is an appropriate size of locomotive for the intended duty of main line charter train service in the UK. Its performance will eclipse that of older designs of UK express steam locomotives even though it is of smaller size.
- The deep firebox of a 4-6-0 has, size for size, a higher evaporative capacity than a shallow firebox boiler, and is ideally suited to burning oil or coal (using the Gas Producer Combustion System).
- Basing the design on an existing one is intended to simplify the design process and the acceptance procedure, as all overall dimensions constrained by the moving structure gauge will be kept within those of the BR Class 5MT.
- A modest size locomotive allows a large tender without exceeding the permissible length for turning facilities, this in turn maximising the very important parameter of operating range between supplies replenishment.

- The route availability is high – it is a ‘go-anywhere’ type.
- The relatively small taper boiler gives good forward visibility from the cab, a factor of paramount importance to safe operation at high speed.

The 5AT has a maximum design speed of 125mph (200km/hr) and a normal maximum operational speed of 112.5mph (180 km/hr) although derogations from Railway Group Standards will be needed to operate at speeds above 75mph (120 km/hr).

The high capacity tender of the 5AT will hold up to 10,200 gallons (46 tonnes) of water giving a potential range (based on 100% of tender water) of some 380 miles (610 km) under average operating conditions. The demonstrator locomotive will be oil fired and have a fuel capacity of 7 tonnes of diesel fuel/gas oil giving a fuel range of up to 590 miles (940 km)

A maximum cylinder horsepower of 3460 hp/2580 kW (more than the iconic Deltic diesel locomotives which used to haul the major East Coast expresses) will give the locomotive an outstanding performance and excellent acceleration at medium to high speeds compared to existing steam locomotive designs.

Other relevant 5AT criteria:

Reliability: In its truest sense this means that locomotives will achieve the necessary reliability “on the road” with very little maintenance effort. Good reliability is of major importance because (i) in-service failures which disrupt other services will be increasingly unacceptable, and (ii) the intensive servicing and maintenance which steam received in the past (and which is still required on today’s heritage locomotives) will become too costly. Even at the present state of the art, reliability and simplicity do go together, and the format of the Class 5AT – a 2-cylinder single expansion 4-6-0 – is about as simple as a main line locomotive can be. Reliability is also very much a question of good detail design, and every attention will be given to this point at the detail design stage. Naturally features of proven high reliability, such as roller bearings, will be incorporated wherever possible. The level of reliability will be such that it is expected that major overhauls will only be required at approximately 250 000 mile (400 000 km) intervals, with intermediate overhauls (dictated only by tyre wear) at some 125 000 mile (200 000 km) intervals, and major servicing (e.g. boiler washouts) at a minimum of 12 500 miles (20 000 km).

Low operating cost will be a consequence of the locomotive’s high thermal efficiency, giving low fuel and water consumption; high reliability, giving low maintenance expense; low daily servicing requirements minimizing servicing man-hours; and low lubricating oil consumption due to the extensive use of sealed roller bearings.

High route availability of a locomotive conforming to the size of the BR Class 5MT will not be confined to Britain alone. Due to the tight British moving structure gauge such a locomotive could run virtually anywhere in the world on standard gauge tracks taking 20-ton axle load, thus giving it a truly ‘universal’ route availability. This gives the potential advantage that the same design is suitable for service in many countries where steam charters are run. It will, of course, be possible to modify the locomotive’s external outline as required to appeal to overseas users, e.g. made to look more Germanic or French.

Adhesion: The relationship between maximum wheel rim tractive effort and adhesive weight is generally well-balanced throughout the Class 5AT's speed range, and especially at high speeds. Although it will be a modest-size locomotive, it is worth noting that the 4-6-0 type has the same level of adhesion as much larger 4-6-2's and 4-6-4's. Therefore the proposed 4-6-0 has the same tractive capacity as that generally found on the last of the steam-era express passenger locomotives running on standard gauge European railways, an era when train weights were generally heavier than they are now.

However, whilst being new and innovative, the 5AT design deliberately adheres to the traditional Stephensonian format of earlier generations of steam locomotive. This adherence to past practice is for strictly pragmatic reasons - namely:

- The 5AT will be immediately recognizable as a steam locomotive and will thus exploit the intrinsic and undiminished appeal of the genre that was so strongly evident at the unveiling of the LNER A1 Class "Tornado" (the first new build of an existing express locomotive design since the 1950s) in 2008;
- The 5AT's design philosophy is founded on tried-and-proven principles to ensure "out-of-the-box" performance with minimal teething troubles.
- Rail authority approvals will be facilitated if the locomotive retains the form of a design that has been approved for main line operation and which the authorities are familiar with.

The project's Feasibility Study recognizes that designing a new locomotive from scratch will present many challenges, not least because so much of the knowledge that was prevalent in the "age of steam" has been lost. However the biggest difficulty to be faced will be raising the finance needed to design and develop the demonstrator locomotive. The £10.5 million required is considered to be too much to raise through public appeals of the sort that funded the building of Tornado. Yet such a figure is a relatively trivial amount in the world of finance, and is small even when compared to the preservation of some art forms that have far less public appeal.

It is now over 180 years since Stephenson built his "Rocket". The 5AT project aims to spark a renewal of interest in steam locomotive technology, to inspire and train a new generation of steam locomotive designers and to form the foundation for its ongoing development.