Rolls-Royce Merlin Engine Development – 1933-1945
Peter Maynard

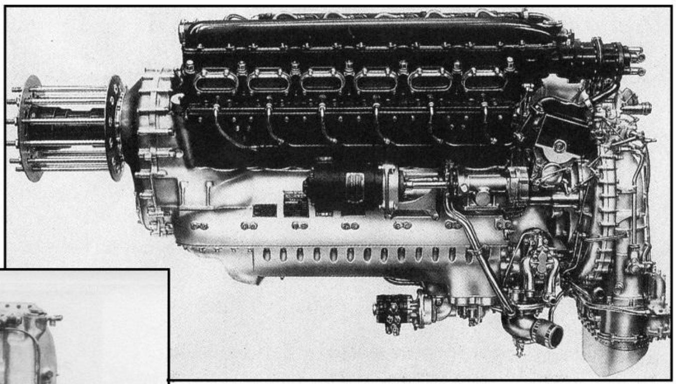
The speaker serviced Griffon-powered Avro Shackletons during his period of RAF service. Subsequently with British Airways he spent the majority of his career maintaining gas-turbine engines. He retained interest in high-performance piston engines, and from his wide knowledge of the Rolls-Royce Merlin he presented an illuminating in-depth description of this iconic British aero-engine. His perspectives were manifold, embracing operational needs, performance and design features, and interspersing them with cameos of the leading individuals whose influence on the Merlin engine programme was crucial to its success.

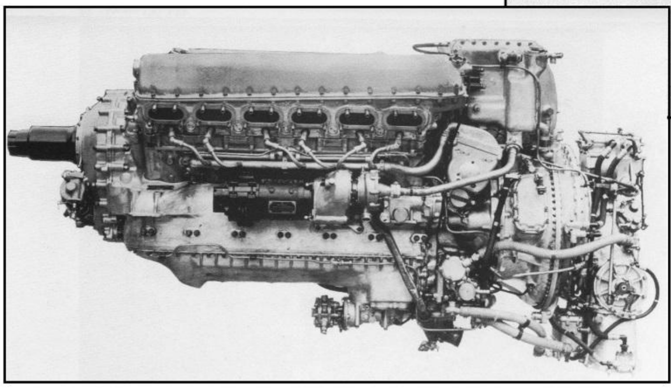
The Schneider Trophy races (1929 and 1931) were experiences that provided a backdrop to the Merlin, as it was when Supermarine aircraft designer R.J.Mitchell and Rolls-Royce Chief Engineer Ernest Hives (later Lord Hives) forged a partnership. Hives recognised that the Rolls-Royce 'R' Series in the racers was not suited to even higher power development. He remained committed to the liquid-cooled V-12 configuration and proposed a new engine with an integrally cast crankcase and cylinder blocks, 'wedge' shape combustion chambers, helical gears and a supercharger. He envisaged an engine providing at least 1,000HP, which was both lightweight and reasonably fuel-efficient, and to suit anticipated fighter aircraft requirements. Development was funded by Rolls-Royce. Supermarine and Hawker designed the Spitfire and Hurricane respectively around the new engine. Initial in-service experience was achieved in the Fairey Battle light bomber, but the engine was not reliable. The presenter then detailed its shortcomings and their remedies which resulted in a considerably re-designed Merlin which had a more conventional cylinder-head valve configuration, and sub-divided the crankcase and cylinder block castings. The much improved Merlin III entered service with the RAF in Spitfires and Hurricanes in early 1940.

The next significant development was the use of higher octane fuel (up from 87 to 100 octane) which allowed the supercharger boost pressure to be doubled from 6 to 12 inches, and provided 1,300HP at up to 18,000ft altitude. This was a 5 minute 'emergency' setting, but the likelihood this was adhered to at all times is a matter that the speaker questioned. By this stage Rolls-Royce production delivered 9,000 aero-engines overall throughout 1940.

Two significant events soon followed. These were the recruitment of a new engineer, and a licence-build agreement in the USA. The new engineer was Stanley Hooker, a mathematician whose insights led to supercharger diffuser changes that increased available power to 1,475HP on the Merlin 45 (used in the Spitfire V). The license-build arrangement with Packard (in the USA) was responsible for creating a 400 engine per week production source. Hooker went on to be one of Britain's most notable jet-engine designers, and the very reliable Packard-Merlin engine was to be used by the RAF Bomber command fleet. Meanwhile, Hooker developed the 2-stage supercharger, necessitated by the superior combat performance of the German Focke-Wulf FW190. This attained 18-inch boost that took total power output to 1700HP. Supermarine test pilot Jeffery Quill was quoted as saying this improved the top speed of Spitfire Mk5 and Mk9 at 30,000ft by 70mph. The speaker commented on how a liquid-cooled (and lower capacity) engine could so outperform a larger air-cooled (radial) such as the DB601.

The early production Merlin, based on the original casting and cylinder head layout, delivered 1,030HP and was available from 1937.





The Merlin 66, was widely used by the RAF from 1942, especially in Spitfire IIX and IX, and provided 1,720HP

His presentation of what was essentially a technical story of the engine also introduced some operational related issues. These included the poorly thought-through installation of the Merlin in place of the Bristol Hercules on the Halifax 2 bomber, where engine failures were commonplace, and were always on the outboard engines. This was due to the longer engine nacelles influencing propeller-wake interaction and the solution was to fit 4-bladed propellers to the outboard engines whilst retaining 3-bladed propellers on the inboard engines. He also described the well-recorded work of RAE scientist Beatrice Shilling, whose investigation into the reasons that the Merlin's float-chamber carburettor caused the engine to stall when under negative-G led her to believe that a constriction – provided by inserting a drilled washer in the fuel delivery – would allow power to be maintained for the period necessary for the fuel pumps to restore normal delivery without temporary loss of power.

In this roughly chronological journey thought the engine's development and service life the final models of the Merlins were described. In the twin-engine DH Hornet counter-rotating propellers were used, and 150 octane fuel, and with up to 25 inches boost pressure they delivered 2,000HP each, enabling a level speed of 475mph. Not shy of nostalgia he included in his concluding stages a brief video of Spitfires on fly past and approach which reminded everyone of the engines distinctive and memorable signature. He quoted finally that some 160,000 examples of the Merlin were built during World War 2.

Question and answers were numerous, and were often stimulated by reminiscences amongst the 200 or so attendees, who seconded the appreciative vote of thanks given by Loughborough Branch committee member Ivor Amos with long-standing applause.

Mike Hirst