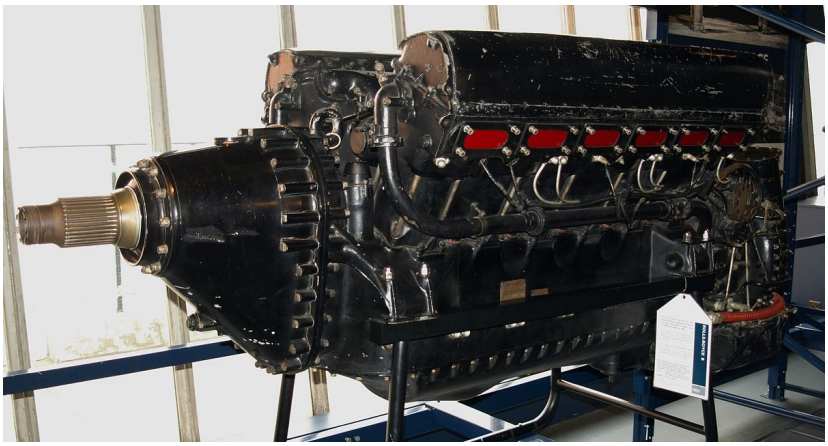
Rolls-Royce R



Type	Piston V-12 aero engine
Manufacturer	Rolls-Royce Limited
Designed by	Arthur Rowledge
First run	7 April 1929
Major applications	Supermarine S.6 Supermarine S.6B Blue Bird K4
Number built	19
Developed from	Rolls-Royce Buzzard

Pictured Rolls-Royce R (R27) on display at the London Science Museum. The rectangular red objects are the exhaust ports blanking plates which would be replaced by the exhaust stubs/pipes when fitted to an aircraft or other vehicle

Information Sourced from Wikipedia – a condensed version

The Rolls-Royce R was a British aero engine designed and built specifically for air racing purposes by Rolls-Royce Limited. Nineteen R engines were assembled in a limited production run between 1929 and 1931. Developed from the Rolls-Royce Buzzard, it was a 37-litre (2,240 cu in) capacity, supercharged V-12 capable of producing just under 2,800 horsepower (2,090 kW) and weighed 1,640 pounds (770 kg). Intensive factory testing revealed mechanical failures which were remedied by redesigning the components, greatly improving reliability.

The R was used with great success in the Schneider Trophy seaplane competitions held in England in 1929 and 1931. Shortly after the 1931 competition, an R engine using a special fuel blend powered the winning Supermarine S.6B aircraft to a new airspeed record of over 400 miles per hour (640 km/h). Continuing through the 1930s, both new and used R engines were used to achieve various land and water speed records by such racing personalities as Sir Henry Segrave, Sir Malcolm Campbell and his son Donald, the last record being set in 1939. A final R-powered water speed record attempt by Donald Campbell in 1951 was unsuccessful.

The experience gained by Rolls-Royce and Supermarine designers from the R engine was invaluable in the subsequent development of the Rolls-Royce Merlin engine and the Spitfire. A de-rated R engine, known as the Griffon, was tested in 1933, but it was not related to the production Rolls-Royce Griffon of 1939, of the same exact bore/stroke and resultant displacement figures as the "R" design. Three examples of the R engine are on public display in British museums as of 2014.

Origin

Rolls-Royce realised that the Napier Lion engine used in the 1927 Supermarine S.5 Schneider Trophy winner had reached the peak of its development, and that for Britain's entrant in the next race to be competitive a new, more powerful engine design was required. The first configuration drawing of the "Racing H" engine, based on the Buzzard, was sent to R. J. Mitchell of Supermarine on 3 July 1928, allowing Mitchell to start design of the new S.6 Schneider Trophy seaplane. Shortly after this the engine's name was changed to R for "Racing". An official British Government contract to proceed with the project was not awarded until February 1929, leaving Rolls-Royce six months to develop the engine before the planned Schneider Trophy competition of that year.

Description

The R was a physically imposing engine designed by a team led by Ernest Hives and including Cyril Lovesey, Arthur Rowledge and Henry Royce. The R shared the Buzzard's bore, stroke, and capacity, and used the same 60-degree V-12 layout. A new single-stage, double-sided supercharger impeller was designed along with revised cylinders and strengthened connecting rods. The wet-liner cylinder blocks, crankcase and propeller reduction gear castings were produced from "R.R 50" aluminum alloy; and because of the short life expectancy of these engines, forged aluminum was used to replace bronze and steel in many parts.

To make the R as compact as possible, several design modifications were made in comparison to the Buzzard: the propeller reduction gear housing was reshaped, and the camshaft and rocker covers were modified to fair into the shape of the aircraft's nose, the air intake was positioned in the vee of the engine (which also helped to avoid the ingress of spray), and beneath the engine the auxiliaries were raised a little to reduce the depth of the fuselage. The engine's length was minimised by not staggering its cylinder banks fore and aft, which meant that the connecting rods from opposing cylinders had to share a short crankshaft bearing journal known as the "big end". This was initially achieved by fitting one connecting rod inside the other at the lower end in a blade and fork arrangement; however, after cracking of the connecting rods was found during testing in 1931, the rod design was changed to an articulated type.

The introduction of articulated connecting rods was regarded as a "nuisance" by Arthur Rubbra, a Rolls-Royce engine designer, as there were inherent problems with the arrangement. The complicated geometry meant that a pair of rods had different effective lengths, giving a longer stroke on the articulated side; consequently, the cylinder liners on that side had to be lengthened to prevent the lower piston ring from running out of the cylinder skirt. Articulated rods were used in the Goshawk engine, but were not embodied in the later Rolls-Royce Merlin, for which Arthur Rowledge had designed a revised blade and fork system.

Later production R engines featured sodium-filled exhaust valve stems for improved cooling, while additional modifications included a redesigned lower crankcase casting and the introduction of an oil scraper ring below the piston gudgeon pin; a measure that was carried over to the Merlin engine. A balanced crankshaft was introduced in May 1931, and the compression ratio on the "sprint" engines prepared for that year was raised from 6:1 to 7:1.

The ignition system consisted of two rear-mounted, crankshaft-driven magnetos, each supplying one of a pair of spark plugs fitted to each cylinder. This is common practice for aero engines, as it ensures continued operation in the case of a single magneto failure and has the advantage of more efficient combustion over a single spark plug application.

Relationship to the Griffon and Merlin

A front right view of a black-painted aero engine, the words 'Rolls-Royce' appear in red. The engine has yellow electrical wiring and is sitting on a wooden pallet.

According to Arthur Rubbra's memoirs, a de-rated version of the R engine, known by the name Griffon at that time, was tested in 1933. This engine, R11, was used for "Moderately Supercharged Buzzard development" (which was not proceeded with until much later) and bore no direct relationship to the volume-produced Griffon of the 1940s.

The pre-production Griffon I shared the R engine's bore and stroke but was otherwise a completely new design that first ran in the Experimental Department in November 1939. Although this single engine was never flown, the production version, the Griffon II, first flew in 1941 installed in the Fairey Firefly. A significant difference between the R and the production Griffon was the re-location of the camshaft and supercharger drives to the front of the engine to reduce overall length. Another length-reducing measure was the use of a single magneto (the R had two, mounted at the rear), this again was moved to the front of the engine.

Further possible development work on the R engine was discussed in The National Archives' file AVIA 13/122, which contains a proposal from the Royal Aircraft Establishment dated October and November 1932, to test four engines to destruction. This document states that there were five engines available for test purposes, the fifth to be used for a standard Type Test at high revolutions.

Although not related to the Spitfire, the Supermarine engineers gained valuable experience of high-speed flight with the S.5 and S.6 aircraft, their next project being the Rolls-Royce Goshawk-powered Supermarine Type 224 prototype fighter aircraft. Technological advances used in the R engine, such as sodium-cooled valves and spark plugs able to operate under high boost pressures, were incorporated into the Rolls-Royce Merlin design. The author Steve Holter sums up the design of the Rolls-Royce R with these words:

> *Quite simply the R-type engine was far ahead of its time, a marvel of British skill and ability.*
>
> — Steve Holter, Leap into Legend

Schneider Trophy

The Schneider Trophy was a prestigious annual prize competition for seaplanes that was first held in 1913. The 1926 race was the first where all the teams fielded pilots from their armed forces, the Air Ministry financing a British team known as the High-Speed Flight drawn from the Royal Air Force. Sometimes known simply as The Flight, the team was formed at the Marine Aircraft Experimental Establishment, Felixstowe, in preparation for the 1927 race in which Supermarine's Mitchell-designed, Napier Lion-powered Supermarine S.5s placed first and second. 1927 was the last annual competition, the event then moving onto a biannual schedule to allow more development time between races.

A trophy with a bronze coloured base, above the base is a wave of silver coloured metal. Atop the wave is a silver winged figurine kissing another figurine partly submerged in the wave.

The Schneider Trophy (right) on display at the London Science Museum along with the S.6B that secured it, as well as the R engine that powered this aircraft for the subsequent airspeed record flight.

During the 1929 race at Cowes between Great Britain and Italy, Richard Waghorn flying the Supermarine S.6 with the new Rolls-Royce R engine retained the Schneider Trophy for Great Britain with an average speed of 328.63 mph (529 km/h) and gained the 50 km and 100 km (31 mi and 62 mi) world speed records. The records were subsequently beaten when Richard Atcherley later registered higher speeds when he completed his laps of the circuit. The Italian team placed second and fourth using Fiat AS.3 V-12-powered Macchi M.52 aircraft. Another racing seaplane, the Fiat C.29 powered by the AS.5 engine attended the contest but did not compete.

More comparable to the R engine was the Fiat AS.6 engine developed for the 1931 contest; effectively a coupled, double AS.5 that suffered from technical problems. With the assistance of Rod Banks, the AS.6 powered the Macchi M.C.72 to a new speed record for piston-powered seaplanes in 1934 of 440.6 mph (709.2 km/h), a record that still stands as of 2009.

In 1931 the British Government withdrew financial support, but a private donation of £100,000 from Lucy, Lady Houston allowed Supermarine to compete on 13 September using the R-powered Supermarine S.6B. For this race, the engine's rating was increased by 400 hp (300 kW) to 2,300 hp (1,700 kW). The Italian and French entrants however, failed to ready their aircraft and crews in time for the competition, and the remaining British team set both a new world speed record at 379 mph (610 km/h) and, unopposed, won the trophy outright with a third consecutive victory. "The Flight" was wound up within weeks of the 1931 win as there were to be no more Schneider Trophy contests.