

= Rolls @-@ Royce R =

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 directly 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 .

= = Design and development = =

= = = 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 " aluminium alloy ; and because of the short life expectancy of these engines , forged aluminium 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 practise 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 .

== = Cooling == =

Cooling this large engine whilst minimising aerodynamic drag posed new challenges for both the Rolls @-@ Royce and Supermarine design teams . Traditional cooling methods using honeycomb @-@ type radiators were known to cause high drag in flight ; consequently it was decided to use the surface skins of the S.6 wings and floats as heat exchangers , employing a double @-@ skinned structure through which the coolant could circulate . Engine oil was cooled in a similar manner using channels in the fuselage and empennage skins . The S.6 was described at the time as a " flying radiator " , and it had been estimated that this coolant system dissipated the equivalent of 1 @,@ 000 hp (745 kW) of heat in flight . However , even with this system in use , engine overheating was noted during the race flights , requiring the pilots to reduce the throttle setting to maintain a safe operating temperature .

A not @-@ so @-@ obvious cooling measure was the deliberate use of a rich fuel mixture , which accounts for the frequent reports of black smoke seen issuing from the engine exhaust stubs . Although this robbed the engine of some power , it increased reliability and reduced the possibility of detonation in the cylinders .

== = Supercharger and fuel == =

The keys to the R engine 's high power @-@ to @-@ weight ratio were its supercharger design , ability to run at high revolutions due to its structural strength , and the special blends of fuel used . The double @-@ sided supercharger impeller was a new development for Rolls @-@ Royce : running at a ratio of almost 8 : 1 , it could supply intake air at up to 18 pounds per square inch (psi) (1 @.@ 24 bar) above atmospheric pressure , a figure known as " boost " and commonly abbreviated as " + x lb " . By comparison the maximum boost of the earlier Rolls @-@ Royce Kestrel design was + 6 lb (0 @.@ 4 bar) , this figure not being achieved until 1934 . The high boost pressures initially caused the spark plugs to fail on test , and eventually the Lodge type X170 plug was chosen as it proved to be extremely reliable .

The development of special fuel was attributed to the work of " Rod " Banks , an engineer who specialised in fuels and engine development . After using neat benzole for early ground test runs ; a mixture of 11 % aviation petrol and 89 % benzole , plus 5 cubic centimetres (cc) of tetra @-@ ethyl lead per Imperial gallon (4 @.@ 5 L) was tried . This blend of fuel was used to win the 1929

Schneider Trophy race , and continued to be used until June 1931 . It was discovered that adding 10 % methanol to this mixture resulted in a 20 hp (15 kW) increase , with the further advantage of reduced fuel weight ? particularly important for aircraft use ? due to its lowered specific gravity . For the 1931 airspeed record attempt acetone was added to prevent intermittent misfiring , the composition of this final blend was 30 % benzole , 60 % methanol , and 10 % acetone , plus 4 @. @ 2 cc of tetra @-@ ethyl lead per gallon .

On an early test run the R engine produced 1 @, @ 400 hp (1 @, @ 040 kW) and was noted to idle happily at 450 revolutions per minute (rpm) . With increased boost ratings and fuel developed by Banks , the R engine ultimately developed 2 @, @ 530 hp (1 @, @ 890 kW) at 3 @, @ 200 rpm ; well over double the maximum power output of the Buzzard . The engine was further tested and cleared for limited sprint racing at 2 @, @ 783 hp (2 @, @ 075 kW) at 3 @, @ 400 rpm and + 21 lb (1 @. @ 45 bar) of boost , but this capability was not used due to concerns with the S.6B 's airframe not being able to withstand the power , and the inability of the aircraft to lift the extra fuel required to meet the increased consumption .

= = = Testing = = =

= = = = Ground testing = = = =

The first run of engine R1 took place at Rolls @-@ Royce 's Derby factory on 7 April 1929 with R7 running the next day . Many mechanical failures were experienced during bench testing including burnt valves , connecting rod breakages and main bearing seizures , while considerably more trouble than expected occurred with valve springs ; at one time two or three would be found broken after a 10 @-@ minute run , but the continual redesigning and testing of components reduced all these problems . Unknown to Royce himself , the engineers had also fitted " Wellworthy " pistons that were better able to withstand the 13 tons " pressure " of each firing stroke .

Ground testing of the R involved the use of three Kestrel engines : one to simulate a headwind or airspeed , one to provide ventilation of the test area , and another to cool the crankcase . Superchargers could be tested on a separate rig that was driven by another Kestrel engine . Eight men were required to run a test cell , led by the " Chief Tester " who had the tasks of logging the figures and directing the other operators . One of these chief testers was Victor Halliwell who later lost his life whilst on board the water speed record contender Miss England II . The conditions in the test cell were particularly unpleasant ; deafness and tinnitus lasting up to two days were experienced by test personnel even after plugging their ears with cotton wool . Development time was short and the deafening sound of three Kestrels and an R engine running at high power for 24 hours a day took its toll on the local population . The Mayor of Derby stepped in and asked that the people endure the noise for the sake of British prestige ; subsequently testing continued for seven months .

In the course of a 25 @-@ minute test an early R engine would consume 60 Imperial gallons (gal) (270 L) of pre @-@ heated castor oil . The majority of this was spat out of the exhaust ports and smothered the test cell walls , milk being given to staff to minimise the effects of this well @-@ known laxative . Up to 200 gal (900 L) of the special fuel blend had to be mixed for each test , 80 gal (360 L) of which were used just to warm the engine to operating temperature . The same coarse @-@ pitch propeller used for flight trials was fitted throughout these tests .

= = = = Flight testing = = = =

Overseen by Cyril Lovesey , flight testing commenced on 4 August 1929 in the new Supermarine S.6 at RAF Calshot , a seaplane and flying boat station on Southampton Water in Hampshire . During pre @-@ race scrutineering tests , metal particles were found on two of the engine 's 24 spark plugs indicating a piston failure which would require an engine re @-@ build or replacement . The competition rules did not allow an engine change , but due to the foresight of Ernest Hives ,

several Rolls @-@ Royce engineers and mechanics that were familiar with the R had travelled down to Southampton to witness the trials , and with their assistance one cylinder bank was removed , the damaged piston replaced and the cylinder refurbished . This work was completed overnight and allowed the team to continue in the competition .

Engine starting was achieved by a combination of compressed air and a hand @-@ turned magneto ; however , starting problems were encountered during pre @-@ race testing at Calshot due to moisture in the air and water contamination of the fuel . A complicated test procedure was devised to ensure clean fuel for competition flights since more than 0 @-@ 3 % water content made it unusable . As expected , minor engine failures continued to be experienced , and to counter this engines and parts were transported at high speed between Derby and Calshot using an adapted Rolls @-@ Royce Phantom I motor car . Travelling mostly after dark , this vehicle became known as the Phantom of The Night .

= = Relationship to the Griffon and Merlin = = =

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 directly 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 .

= = Schneider Trophy use = =

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 .

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 also 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 . The original Trophy is on display in 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 .

= = World speed record use = =

New airspeed records were set after the 1929 and 1931 Schneider Trophy contests , both achieved using the R engine . In the two decades before World War II , the quest to break the land speed record was hotly contested , particularly so in the early 1930s . Aero engines were often used to power wheeled vehicles to ever @-@ higher speeds , chosen because of their high power @-@ to @-@ weight ratios : the Liberty engine , Napier Lion and the Sunbeam Matabele were among the engine types used in the 1920s . The Rolls @-@ Royce R was the latest development in high @-@ powered aero engine design at the time , and was chosen by several makers of land speed record @-@ contending cars ; the engine was also chosen for powerboats attempting the water speed record . One car and two boats successfully used the combined power of two R engines .

= = = Airspeed record = = =

Supermarine S.6

Immediately after the 1929 Schneider Trophy contest Squadron Leader Augustus Orlebar , commanding officer of the High Speed Flight , set a new airspeed record of 355 @. @ 8 mph (572 @. @ 6 km / h) using Supermarine S.6 , N247 .

Supermarine S.6B

On 29 September 1931 , barely two weeks after the British team had secured the Schneider Trophy outright , Flight Lieutenant George Stainforth broke the world airspeed record in a Rolls @-@ Royce R @-@ powered Supermarine S.6B , serial S1595 , reaching an average speed of 407 @. @ 5 mph (655 @. @ 67 km / h) . It had been intended to also use the identical sister aircraft , S1596 , for the attempt but Stainforth had capsized it on 16 September whilst testing a propeller .

= = = Land speed record = = =

Campbell @-@ Railton Blue Bird

Sir Malcolm Campbell , and later his son Donald , used R engines from 1931 to 1951 . At Sir Malcolm 's knighthood ceremony in February 1931 , King George V expressed great interest in the R and asked many questions about its fuel consumption and performance .

In 1932 , Campbell stated that he " ... was fortunate in procuring a special R.R. Schneider Trophy engine " for his land speed record car to replace its Napier Lion . Lent to him by Rolls @-@ Royce , this engine was either R25 or R31 . By February 1933 the car , named Blue Bird had been rebuilt to

accommodate the larger engine and was running at Daytona .

In late 1933 Campbell bought engine R37 from Rolls @-@ Royce ; and had also been lent R17 and R19 by Lord Wakefield , and R39 by Rolls @-@ Royce . He then lent R17 to George Eyston . Once he had achieved the 300 mph (480 km / h) record on 3 September 1935 at the Bonneville Speedway , Campbell retired from further land speed endeavours .

Lord Wakefield arranged for a replica of the Rolls @-@ Royce R to be exhibited at the 1933 Motor Show , held at Olympia , London . A press report from the event provides an insight into the public perception of the engine :

Of the size only of an office desk ... this 12 @-@ cylinder supercharged racing engine is more powerful than an express locomotive . Its design is stated to be so valuable that it is still on the Government 's secret list .

Blue Bird is now on display at the Daytona International Speedway .

Thunderbolt

During the mid @-@ 1930s , George Eyston set many speed records with his Speed of the Wind car , powered by an unsupercharged Rolls @-@ Royce Kestrel . In 1937 he built a massive new car , Thunderbolt , powered by two R engines to attempt the absolute land speed record . At first Eyston experienced clutch failure due to the combined power of the engines . Nevertheless , he took the record in November 1937 , reaching 312 mph (502 km / h) , and in 1938 when Thunderbolt reached 357 @.@ 5 mph (575 km / h) . When first built at Bean Industries in Tipton , the nearside engine fitted to Thunderbolt was R27 which had powered S1595 when it set the air speed record in 1931 . The other was R25 , used by the same aircraft to win the Schneider Trophy two weeks earlier . Eyston had also borrowed R17 from Sir Malcolm Campbell and , with the continuing support that Rolls @-@ Royce extended to both Campbell and Eyston , he also had the option of using R39 .

= = = Water speed record = = =

Miss England II and III

Two R engines , R17 and R19 , were built for Sir Henry Segrave 's twin @-@ engined water speed record boat Miss England II , this craft being ready for trials on Windermere by June 1930 . On Friday 13 June , Segrave was fatally injured and a Rolls @-@ Royce technical advisor , Victor Halliwell , was killed when Miss England II capsized at high speed after possibly hitting a log . Shortly before his death Segrave learnt that he had set a new water speed record of just under 100 mph (160 km / h) . On 18 July 1932 , Kaye Don set a new world water speed record of 119 @.@ 81 mph (192 @.@ 82 km / h) on Loch Lomond in a new boat , Miss England III , which also used engines R17 and R19 .

Blue Bird K3

In late 1935 , Sir Malcolm Campbell decided to challenge the water speed record . At that point he had two Napier Lions and one Rolls @-@ Royce R engine , R37 at his disposal , and it was decided to install the R engine in Blue Bird K3 . During trials on Loch Lomond in June 1937 the engine was " slightly damaged ... because of trouble with the circulating water system " . In August 1937 Blue Bird K3 was taken to Lake Maggiore in Italy where " the modified [circulation] system worked perfectly with a second engine " , R39 .

Blue Bird K4 and the work of Leo Villa

R39 was again used in 1939 in Blue Bird K4 . In 1947 Campbell unsuccessfully converted K4 to jet power using a de Havilland Goblin engine . After Campbell 's death from natural causes in 1948 , Donald Campbell bought K4 for a nominal sum as well as the 1935 record car when his father 's effects were auctioned . He also purchased R37 back from a car dealer and reinstalled it in K4 . Attempts on the record were made in 1949 , and again in 1951 when R37 was " damaged beyond any immediate repair " by overheating . Another attempt was made later in the year using R39 , but K4 suffered a structural failure and sank in Coniston Water . It was recovered and broken up on the shore .

The care and maintenance of the Campbell 's R engines was entrusted to Leo Villa , a Cockney born to a Swiss father , who was described as " the man behind the Campbells " and a central figure

who " fitted the first nut to the first bolt " . Villa learnt his trade of " aircraft mechanic " in the Royal Flying Corps ; his first job was fitting Beardmore 160 hp engines to airframes . After World War I he worked for a motor racing company and participated as co @-@ driver and mechanic in several races .

Villa was first employed by Malcolm Campbell in 1922 , and continued in the service of Donald Campbell until 1967 , when Campbell was killed during a record attempt on Coniston Water . He was the chief caretaker of their R engines until the last R @-@ powered record attempt in 1951 , after which his responsibilities centred on Campbell 's jet engines . Villa 's many responsibilities included installing and removing the engines , repairing and tuning them , and operating the compressed air and magneto for starting them . During the World War II years , he was responsible for the upkeep of Blue Bird K4 and the spare R engines , but unknown to him they had been sold along with K3 . Villa eventually took the three R engines to Thomson & Taylor at Brooklands for long @-@ term storage .

His relationship with Malcolm Campbell was strained at times : Campbell , with no engineering background , would often question Villa 's intimate knowledge of the R engine , but his relations with Donald Campbell were much better , as they were of a similar age . At Lake Garda in 1951 Villa noted the willingness of " Don " to help with engineering tasks , and the difficulties of working on the R engine :

I was in the workshop stitching the old R37 back together and had the long job of lapping in all 48 valves . It was a terrible job because the engine was two monoblocs , which meant that you couldn 't just lift off the heads , you had to lift what amounted to two separate engines and even then getting the valves in was no easy task . But old Don just rolled up his sleeves and mucked in .

= = = World speed record summary = = =

Note :

Air speed record

Supermarine S.6 : 8 September 1929 ? 355 @.@ 8 mph (572 @.@ 6 km / h)

Supermarine S.6B : 29 September 1931 ? 407 @.@ 5 mph (656 km / h)

Land speed record

Blue Bird : 3 September 1935 ? 301 mph (484 km / h)

Thunderbolt : 16 September 1938 ? 357 @.@ 5 mph (575 km / h)

Water speed record

Miss England II : 9 July 1931 ? 110 @.@ 28 mph (177 @.@ 48 km / h)

Miss England III : 18 July 1932 ? 119 @.@ 81 mph (192 @.@ 82 km / h)

Blue Bird K3 : 17 August 1938 ? 130 @.@ 91 mph (210 @.@ 67 km / h)

Blue Bird K4 : 19 August 1939 ? 141 @.@ 74 mph (228 @.@ 11 km / h)

= = Production and individual engine history = =

= = = Production summary = = =

Nineteen R engines were produced at Derby between 1929 and 1931 , all given odd serial numbers . This was a Rolls @-@ Royce convention when the propeller rotated anticlockwise when viewed from the front , but an exception was made for R17 , the sole clockwise @-@ rotation R engine . There is some confusion as to whether 19 or 20 R engines were produced . In his notes Leo Villa refers to an R18 engine , but according to Holter this may have been R17 converted to clockwise rotation at the request of Malcolm Campbell rather than an additional example . There was no R13 as Rolls @-@ Royce never used the number 13 in any of their designations . A summary production list is given below :

1929 Development engines

R1 , R3 and R5

1929 Schneider Trophy engines
R7 , R9 and R15
1930 Development engine
R11
1930 Wakefield order for Miss England II
R17 and R19
1931 Schneider Trophy engines
R21 , R23 , R25 , R27 , R29 and R31
1931 Development / factory spare engines
R33 , R35 , R37 and R39

== Individual history table ==

== Applications ==

Aircraft
Supermarine S.6
Supermarine S.6A
Supermarine S.6B
Cars
Campbell @-@ Railton Blue Bird
Thunderbolt
Boats
Blue Bird K3
Blue Bird K4
Miss England II
Miss England III

== Engines on display ==

R25

The Royal Air Force Museum London at Hendon has a Rolls @-@ Royce R on display (museum number 65E1139) that came to the museum in November 1965 from RAF Cranwell . According to the museum 's records , before that it was with George Eyston as one of Thunderbolt 's record engines . Its data plate states that it is R25 under Air Ministry contract number A106961 which makes it the second 1931 race engine delivered to RAF Calshot .

R27

The London Science Museum has an R engine on display which is catalogued as a stand @-@ alone item , inventory number 1948 @-@ 310 . This is R27 , the second sprint engine prepared for the successful air speed record attempt , and later used in Thunderbolt . The Science Museum also has S.6B , S1595 , (winner of the 1931 race and the final air speed record aircraft) on display .

R37

The Filching Manor Motor Museum has R37 which is destined to be fitted in its restoration of the Blue Bird K3 water speed record boat .

These three engines are the only ones listed by the British Aircraft Preservation Council / Rolls @-@ Royce Heritage Trust . The Solent Sky museum 's S.6A , N248 , (a competing aircraft in the 1929 race as an S.6 , and stand @-@ by for the 1931 race , modified as an S.6A) does not contain an R engine .

== Specifications (R ? 1931) ==

Data from Lumsden and Holter .

=== General characteristics ===

Type : 12 @-@ cylinder , supercharged , liquid @-@ cooled , 60 ° " V " , aircraft piston engine
Bore : 6 in (152 @. @ 4 mm)
Stroke : 6 @. @ 6 in (167 @. @ 6 mm)
Displacement : 2 @, @ 239 cu in (36 @. @ 7 L)
Length : 100 in (2 @, @ 540 mm)
Width : 32 in (813 mm)
Height : 42 in (1 @, @ 067 mm)
Dry weight : 1 @, @ 640 lb (744 kg)

=== Components ===

Valvetrain : Two intake and two exhaust valves per cylinder with sodium @-@ cooled exhaust valve stems , actuated via a single overhead camshaft on each bank
Supercharger : Single @-@ speed centrifugal type supercharger , ratio 7 @. @ 47 : 1 , maximum + 18 lb boost at 24 @, @ 000 impeller rpm
Fuel system : Four duplex updraught Rolls @-@ Royce / Claudel @-@ Hobson carburettors
Fuel type : 30 % benzole , 60 % methanol , 10 % acetone , plus 4 @. @ 2 cc of tetra @-@ ethyl lead per gallon
Oil system : Dry sump with one pressure pump and two scavenge pumps , pure castor oil
Cooling system : 70 % water and 30 % ethylene glycol coolant mixture , pressurised
Reduction gear : 0 @. @ 605 : 1 , right @-@ hand tractor

=== Performance ===

Power output : 2 @, @ 530 hp (1 @, @ 887 kW) at 3 @, @ 200 rpm
Specific power : 1 @. @ 13 hp / cu in (51 @. @ 41 kW / L)
Compression ratio : 6 : 1
Fuel consumption : 3 @. @ 5 gal / min (16 L / min)
Specific fuel consumption : 0 @. @ 85 pt / hp / hr
Oil consumption : 14 gal / hr (64 L / hr)
Power @-@ to @-@ weight ratio : 1 @. @ 54 hp / lb (2 @. @ 54 kW / kg)