

# 1904-2004 a century of innovation in 100 facts

#01



Car advert  
+

When Rolls and Royce founded Rolls-Royce Ltd, they set out to prove that the car could become a major means of transport to rival the train and the horse

An early advert for the company carried the testimonial from an owner "I may say my car is a perfect dream. It is so reliable that I have done away with my carriages and horses"

#02



Rubber spinner tip  
+

On a civil aerospace Trent engine, the tip of the spinner is an off-centre cone made of rubber

In flight, the constant vibration this creates as it spins, prevents the potentially damaging build-up of ice on the front of the engine.

#03

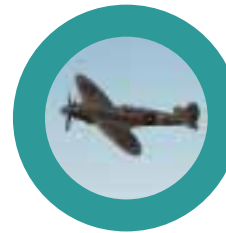


The hyphen  
+

Rolls-Royce should always be written complete with a hyphen

It is often said that the hyphen represents Claude Johnson, a recognised authority on motoring matters at the time of the company's formation and the man who is accredited with building the name into what it is today. Pivotal in the early development of the company, quite literally 'the hyphen' was the link between the two founders.

#04



World War II  
+

Rolls-Royce was responsible for 26% of British aero engines produced during WWII

Rolls-Royce Merlin powered Spitfires and Hurricanes played a key role in winning the Battle of Britain.

#05

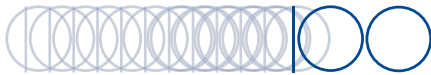


Fuel cells  
+

Fuel cells have the potential to produce energy more efficiently and compactly than the most powerful gas turbine

These cells are made from the same material as ceramic bathroom tiles.

Rolls-Royce has experience in the system integration of several different types of fuel cells and believes the Solid-Oxide Fuel Cell is the best for stationary power generation applications.



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## #06



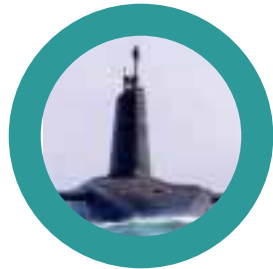
Record breaker

+

**The R engine is the only engine type to have held air, land and water world speed records**

In 1931, the Rolls-Royce R engine in a Supermarine S6 airframe won the Schneider Trophy, setting an air speed record of 407.5 mph. The R engine was then modified for use by car and boat racers of the 1930s.

## #07



Submarines

+

**The latest nuclear reactors powering the Astute class nuclear submarine fleet do not need to be refuelled throughout the 25 year life span of the submarines**

Rolls-Royce is the design authority for the Royal Navy's naval nuclear plant.

## #08



Crack detection

+

**During repair and overhaul of an engine, Rolls-Royce would analyse components for cracks or potential problems**

In order to check for any such cracks, titanium compressor disks are sprayed with Penetrant fluid and suspended under an ultraviolet light. Any cracks are highlighted in green by the fluid, thus allowing for problems to be spotted and averted.

## #09



Spirit of Ecstasy

+

**The Spirit of Ecstasy was designed by Charles Sykes as a statue to adorn Rolls-Royce cars**

The mascot was commissioned by Claude Johnson to counteract a craze among motorists for fixing golliwogs, toy policemen and other unseemly objects to their cars.

Royce's car rarely carried the mascot as it had been designed and added during his period of absence due to illness, and he thought it spoilt the clear line of the car's bow.

No two figurines are the same as the 'cire perdue' process by which they are made resulted in the casting being broken.

## #10



Spiral nose cones

+

**All the larger Rolls-Royce turbofans turn clockwise**

Our aerospace engines have swirls painted onto their spinners in order to indicate when the engine is rotating while on the ground. In flight these swirls flicker as the engine rotates at high speed, scaring birds and allowing them to fly clear of the engine.

#11



Global company  
+

**Global expertise with regional focus**

Rolls-Royce is a global company with offices, service centres and manufacturing bases in 48 countries around the world.

#12



STOVL  
+

**Rolls-Royce research is responsible for Britain's leadership in the field of jet-borne short take-off and vertical landing**

This capability has been exemplified by the Harrier with its Pegasus engine, and the Joint Strike Fighter and its Liftsystem™.

#13



Electrical energy  
+

**A standard Industrial Trent engine outputs 52 million watts**

This is enough electrical energy to power an average television set for 40 years, keep a 60 watt light bulb turned on continuously for 99 years, or make over 1,700,000 pieces of toast.

#14



Rolls meets Royce  
+

**Henry Edmonds, a motoring enthusiast aware of Rolls' aims and a director of Royce Ltd, persuaded Charles Rolls and Henry Royce to meet**

On 4th May 1904 they had lunch at the Midland Hotel in Manchester, and upon immediately recognising each others' talents, they agreed to work together on a range of Rolls-Royce cars, leading to the foundation of Rolls-Royce Ltd in 1906.

#15



Joystick control  
+

**Our Marine Electrical Systems business delivers Integrated Bridge Systems**

These cutting-edge capabilities employ the latest Human Machine Interface techniques in a novel range of multi-functional joysticks for the naval and commercial marine markets.

## #16



Trent reliability  
+

**The Trent achieves around 13,000 flying hours between major overhauls**

This is equivalent to 7 million miles or flying to the moon and back over 14 times, demonstrating the reliability typical of larger Rolls-Royce engines.

## #17



Silver Ghost  
+

**In 1907 a Silver Ghost, one of the first 40/50hp cars, was driven repeatedly from London to Scotland**

The car travelled for 40 days and over 14,000 miles before requiring a service. The total cost of replacement parts was the equivalent of £2.13 in today's terms.

## #18



Bird strike  
+

**As one of the aircraft engine safety tests, dead birds of specific weights are fired at the engine aimed at a range of locations on the fan**

This simulates a flock of birds hitting an engine at aircraft rotation. The engine has to prove it could continue take-off, circle and re-land safely, so demonstrating the integrity of the individual blades and the engine's ability to cope with both the resulting impact and any debris ingested through the engine core.

## #19



Technology investment  
+

**Our philosophy is to develop once and to use many times**

We invest in technology that can be applied in each of the global markets we serve. In the last five years we have invested over £3 billion in research and development.

The aero Trent programme in our civil business exemplifies our ability to maximise our research and development investments.

## #20



Powering military fleets  
+

**Rolls-Royce is the world's second largest defence engine supplier**

We power approximately 25 per cent of the world's military fleet, with offerings in all the major market sectors.

#21



Gas pipelines

+

**Rolls-Royce engines are installed on pipelines whose combined length would circle the earth more than three times**

These engines are either pumping oil or compressing gas around the world.

#22



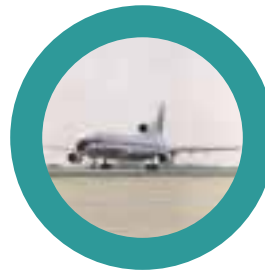
Cost of aircraft

+

**Charles Rolls bought his first aircraft at a cost of £950 in 1909**

Ten years later a surplus military plane could be purchased for as little as one pound ten shillings, the equivalent of £1.50 today.

#23



RB211 reliability

+

**In 1991 a Rolls-Royce RB211 in a Delta Air Lines TriStar became the first engine to exceed 21,000 hours without removal**

In 1994 it went on to set a new world record 27,523 hours before being removed.

#24



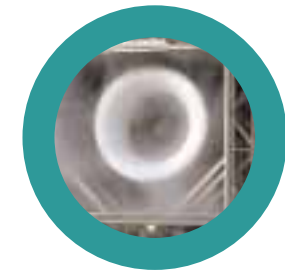
Spanner set

+

**The owner of each Rolls-Royce vintage car was issued with a set of specially-branded maintenance tools**

Rolls used to repair his car at university and was referred to as 'Dirty Rolls', a nickname acquired at Eton because of his willingness to take-off his jacket and get his hands dirty in the true tradition of engineering. Rolls was also able to write his own maintenance manuals based on the skills he learned as a practical engineer.

#25



Cold start

+

**We test our engines' ability to perform in extremes of temperature**

An engine is sprayed with atomised liquid nitrogen until it is frozen along with its oil and fuel supplies to temperatures of minus 40°C or lower. The engine then has to start successfully within 90 seconds to pass the cold start test.

#26



Our company  
+

Rolls-Royce today is a global power systems company providing power for land, sea and air

We are establishing leading positions in civil aerospace, defence aerospace, marine and energy markets.

In 1906, when Rolls-Royce Limited was formed, the words used in the Memorandum of Association were quite remarkable in stating that the Company be established to provide *'motor vehicles for use on land, water or in the air'*; as they aptly describe the business as it is today.

#27

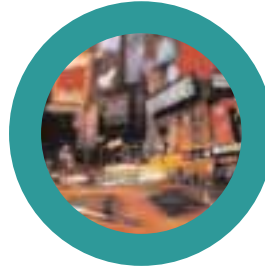


Joint Strike Fighter  
+

Rolls-Royce has developed the LiftSystem for the Joint Strike Fighter, and is a partner in the development of the engine core for the F-136 model

The power transmitted to the JSF LiftFan (29,000 horsepower) is enough to raise ten elephants to the top of the Eiffel tower in just six seconds.

#28



Power generation  
+

In the area of power generation, Rolls-Royce has sold sets which can generate a total of 21,500MW

This is enough to supply power to New York, Mexico or Seoul.

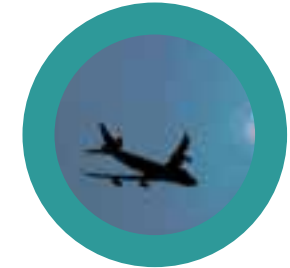
#29



Memorial window  
+

In 1962 a memorial window was unveiled in Westminster Abbey dedicated to the memory of Henry Royce, an exceptional honour for an engineer

#30



Operational life  
+

Rolls-Royce gas turbines in service today have operational lives of 25 years or more

This generates an assured aftermarket demand for the provision of spare parts and services.

The company's strategy is therefore to maximise aftermarket revenues, an area which has increased by 60 per cent over the past five years, due to the development of a comprehensive services capability.

Annual sales total nearly £6 billion, of which 50 per cent currently comes from aftermarket services.

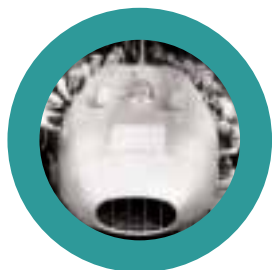


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Rolls-Royce

#31



Desire for speed

+

Rolls-Royce plc ceased manufacturing motor cars in 1971

Since then licensed cars have been manufactured by Vickers, Volkswagen and most recently BMW.

Ironically in its desire for speed, the world of motor sport has often used aero-derivative engines, notably the Rolls-Royce R engine, Avon and Spey to achieve land speed records.

#32



Water ingestion

+

We test our aero engines to ensure an aircraft could fly through a severe rainstorm

The equivalent of 33,000 gallons of water an hour is sprayed through a civil aerospace Trent engine. For the engine to be given certification this test must not result in any loss of rated thrust.

#33



Customer base

+

Whether providing energy or marine solutions, travelling on business or for pleasure, Rolls-Royce products are never far away

Rolls-Royce powers 500 airlines; 4,000 corporate, utility aircraft and helicopter operators; 160 armed forces; 2,000 marine customers and has energy customers in 120 countries.

#34



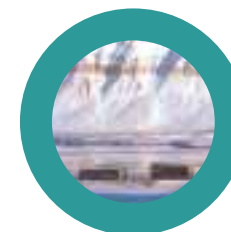
Harrier jet

+

In vertical thrust, the maximum thrust supplied by a Rolls-Royce Pegasus engine for the Harrier aircraft could support the weight of ten small cars

This combination of aircraft and engine eliminates the need for conventional runways and is a major advantage at sea, where Harriers can operate from a wide variety of ships.

#35



Extreme installations

+

Rolls-Royce power station installations at the top and bottom of the world

Our furthest north energy installation is a reciprocating diesel engine station at Spits Bergen, near the Arctic circle, while our southern most power station is an Industrial RB211 gas turbine installation at Tierra del Fuego, near the Antarctic.

## #36

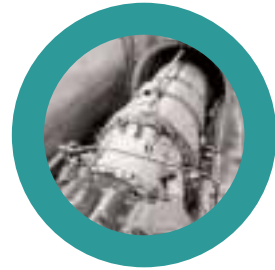


Eagle  
+

### First non-stop aerial crossing of the Atlantic

Captain John Alcock and Lieutenant Arthur Whitten Brown made the first non-stop aerial crossing of the Atlantic in a Rolls-Royce Eagle powered Vickers Vimy. The crossing from Newfoundland to Ireland took 16 hours and 27 minutes.

## #37



Avon reliability  
+

### Avon gas pumping installations

In 1982 an Avon engine on gas pumping duty in a Canadian installation ran for 53,000 hours before requiring a major overhaul.

In 1994 another Industrial Avon engine ran non-stop for 476 days.

## #38

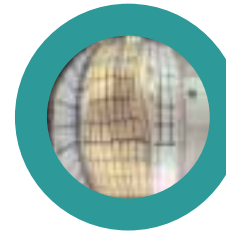


Silver plating  
+

### In total just over 6,000 Silver Ghosts were produced between 1906 and 1925

The original Silver Ghost was given its name due to the silver-plating of the metal trim, while the 'ghost' implied its quiet operation. This later became the generic name for all the 40/50hp cars.

## #39



Blade containment  
+

### Operational safety is paramount in all our engine development planning

In a full aircraft engine test, a fan blade is deliberately released at a maximum engine rotation speed, in order to demonstrate the engine carcass's ability to contain the impact of the blade. This impact is absorbed as vibration through the armoured titanium or kevlar containment system which will surround the engine in flight.

## #40



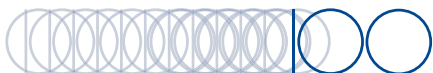
54,000 engines  
+

### There are over 54,000 Rolls-Royce gas turbines providing power in the air, on land and at sea worldwide

The success of these products is demonstrated by the company's rapid and substantial gains in market share over recent years.

Annual sales total nearly £6 billion, of which 50 per cent currently comes from aftermarket services. The order book stands at more than £18 billion, which, together with aftermarket demand, provides visibility as to future activity levels.





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Rolls-Royce

# #41



Eurofighter

+

Rolls-Royce is a partner in Eurojet, the team which developed the EJ200 engine which powers the Eurofighter aircraft

The engine has an overall compression ratio of 25:1, the equivalent to squeezing all the air in a phone box into the volume of a television set.

# #42



Supermarine

+

In 1931, the Rolls-Royce R engine in a Supermarine S6 airframe won the Schneider Trophy, setting an air speed record of 407.5 mph

# #43



Habitat for Humanity

+

Habitat for Humanity is an innovative employee-volunteering scheme

The US-based scheme sees our employees in Indianapolis building homes for low-income families and providing them with interest-free mortgages.

Since 1997 six houses have been built. In one project in 2002, 175 employees built a five-bedroom house for a local family in a record eight working days compared to the usual build time of two weeks.

# #44



Miniature gas turbines

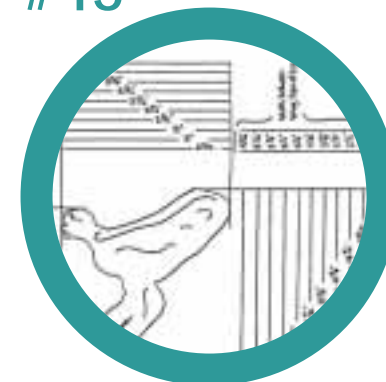
+

Rolls-Royce has recently revamped its graduate training programme to include an initiative called the 'whole engine project'

In order to manage engine production across different geographical sites, Rolls-Royce uses dedicated functional groups as a necessary means of breaking up complex technology into manageable elements. As a result, in normal daily routines different groups in the business become more aware of each others' activities.

This 'whole engine project' (Wep) initiative allows budding graduate engineers to gain a good all-round and hands-on product awareness of engine technology, adding to their appreciation of component interaction.

# #45



Spirit sizes

+

Over the years, subtle changes have been made to the Spirit of Ecstasy mascot's shape and size

Different 'Flying Lady' mascot sizes were used in proportion to the individual car designs, ranging from the Silver Ghost to the Silver Shadow.

Most notably however this was seen with the production of the so-called 'kneeling lady' for certain Phantom IIIs, Silver Wraiths and Silver Dawns.

## #46



Supersonic

+

**Four Rolls-Royce/Snecma Olympus engines powered Concorde, the first and only supersonic passenger aircraft in the world**

Concorde amassed more supersonic flying hours than the combined total of the Western world's military fleet.

## #47



Rolls-Royce community

+

**On average we invest nearly £30 million a year training and educating our workforce**

At Rolls-Royce, achieving business performance and promoting individual development go hand in hand.

We invest in improving individual and business capability by offering training programmes and development opportunities which ensure effective business learning and continuous professional development. We have enhanced the frameworks for leadership, professional and business management development by strengthening their global application. Working with academic partners around the world, we have a broad range of programmes including managerial, technical and operating skills.

## #48



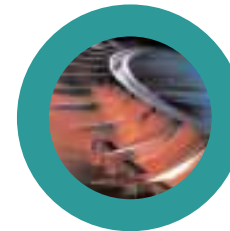
Tornado

+

**The Tornado multi-role combat aircraft is powered by two Turbo Union RB199 engines**

At sea-level, each of the engine's high pressure shafts transmit 14995kW of power. This is equivalent to the combined output power of 25 Formula One racing cars.

## #49



Bling

+

**The LiftFan in the Joint Strike Fighter will use Rolls-Royce bling technology**

The Rolls-Royce LiftFan® currently incorporates a two stage, contra-rotating fan which uses Rolls-Royce proprietary linear-friction welded hollow blisks.

Blisks will eventually be replaced by 'Blings' which use MMC (metal matrix composites) offering up to a 70% weight saving.

The bling or 'bladed ring' eliminates the bore of the conventional disk by using a fibre reinforced ring to carry the hoop stresses.

## #50



Micrometer accuracy

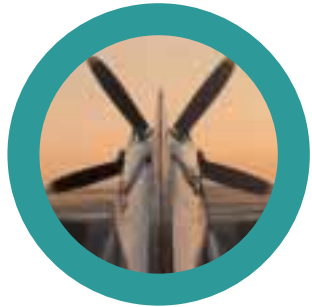
+

**A typical Trent turbine blade contains about 200 cooling holes**

This enables a film of cooling air to surround the blade while the engine is running, allowing it to perform in temperatures above its component metal's melting point.

Film cool holes on a high pressure turbine blade are measured on a totally automated Vision system with accuracy of +/- 15 micron.

#51



Merlin powered Spitfire  
+

**Uncertain of Government support for the Merlin, Royce launched the engine as a private venture**

He died before its first test run, never to witness the success of perhaps his greatest work. The Merlin went on to become one of the most famous and influential engines ever built.

#52



Factory shifts  
+

**The end of a day's shift at Main Works in Derby**

Women were able to leave work two minutes before the men, so as to not get caught in the crowds.

#53



Engine power  
+

**The power a Trent engine generates at take-off is about 90,000 horsepower**

This is equivalent to the power of 1,200 family-sized cars and the same amount of energy used as 250,000 people jogging at the same time.

#54



Universities  
+

**Rolls-Royce sponsors research at University Technology Centres across the world to stay at the cutting edge of engineering excellence**

#55



Hawk jet  
+

**The Hawk trainer is powered by the Rolls-Royce Turbomeca Adour engine**

The Adour's high pressure turbine blade cooling system is so effective that if the technology were applied to an ice cube, it would be able to survive indefinitely in an oven without melting.



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Rolls-Royce

#56



Propellers  
+

Most Rolls-Royce marine propellers are made from a nickel aluminium and bronze alloy

However, propellers which are made to cut through ice are silver in colour as they are made of stainless steel.

#57



Titanium disks  
+

Compressor disks have to withstand enormous pressure and are made of titanium

Gold plated carbide cutting tools are used to make the fir tree and dovetail slots in the titanium compressor disks into which high pressure 3D aero compressor blades are slotted. The broaches are cut to a degree of accuracy between 0.025 and 0.07mm and as the titanium is so strong, the tools are recalibrated every 12 disks they cut.

#58



Henry Royce  
+

**Sir Henry Royce, ever the perfectionist, belittled leisure activities such as golf and tennis**

He considered these activities to be non-creative and non-productive. For those who desired some form of exercise he recommended gardening.

#59



Smallest engine  
+

The smallest engine Rolls-Royce currently makes is the Model 250-C20B turboshaft

It weighs in at 163 lb and measures 40.8 by 19 by 22.6 inches, 420 shaft horsepower. This is lighter than an average sized man.

#60



High pressure blades  
+

In a Trent engine, the total power generated by the turbines in order to drive the fan and compressors is about 250,000 horsepower

There are 92 high pressure turbine blades in a Trent 800 engine. Each of these blades generates about 800 horsepower, which is equivalent to the power of a Formula One racing car.

## #61



Orchestra  
+

Through ViVA, the Orchestra of the East Midlands, we bring music right into the heart of our business

Musicians from ViVA, working with a team of our noise engineers, composed music from recordings of engine fan noise.

This became part of a course to give our people a better appreciation of what 'noise' is and how it relates to our products and businesses.

## #62



Helicopters  
+

**The Rolls-Royce RTM322 turboshaft engine powers a Merlin helicopter**

Although this turboshaft has a similar size to the engine in a sports car, it can produce 70 times the output power. While a sports car can achieve 375 horsepower, a Merlin could achieve 26,000 horsepower.

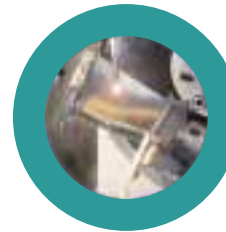
## #63



Marine customers  
+

**Rolls-Royce has more than 2,000 commercial marine customers and over 50 navies use our propulsion systems and products**

## #64



Ionised water  
+

**In the production of high pressure turbine blades, environmentally-friendly ionised water is used as a dielectric, a process which shapes the blade by oxidation**

A spark travels through the ionised water spray at 25°C and allows the blade component material to evaporate and the debris is flushed away. The use of ionised water significantly speeds up the production of components and is less harmful to the environment than an alternative oil based substance.

## #65



Swept fan  
+

**The swept fan design introduces a third generation to the successful Rolls-Royce wide chord fan family**

The wide chord fan family has already gained over 80 million hours of experience. This technology helps reduce engine noise, improve bird strike capability and allows a potential fuel saving of approximately \$1.5 million over the life of the aircraft.



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## #66



Warships

+

**Rolls-Royce powered the first gas turbine driven warship, HMS Grey Goose in 1953**

This first solely gas turbine driven warship was powered by the Rolls-Royce RM60, a complex engine developed in the late 1940s.

## #67



Engine efficiency

+

**The Boeing 777, which is powered by two Trent 800 engines, carries around 330 passengers and gives about 120 passenger-miles to the gallon**

This is equivalent to a family-sized car travelling at 40 mph. However, the Boeing 777 travels ten times faster.

## #68



Arts

+

**Our Modern Apprentices are working with TATE Liverpool in a new team-based project**

Alongside resident artists, around 40 of our young people are exploring their approaches to work, to help inspire creative thinking and develop new skills.

This ambitious project will bring an added dimension to our modern apprenticeship programme in the UK.

## #69



Tugs

+

**Rolls-Royce powers tug boats with Ulstein Acquamaster azimuth thrusters**

This allows these boats to handle vessels which are 300 metres long, and have a displacement of 150,000 tonnes.

These tugs have excellent manoeuvrability, being able to turn on their axis and move sideways at a speed of 8 knots.

## #70



Extended range operations

+

**Until the 1990s, planes were limited as to where and how far they could fly**

Airworthiness authorities stated that a twin-engined aircraft would have to remain within three hours distance from any airport, as contingency for one of the engines failing. The Rolls-Royce RB211 powered Boeing 757 was the first aircraft to be cleared to fly beyond this limit.

## #71



Photographs  
+

There are no known photographs of Rolls and Royce together

Pictured is Sir John Montagu opening the Derby factory, with Rolls sitting centre and Royce hidden behind him.

## #72

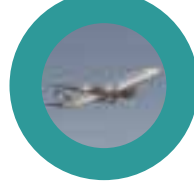


Largest engine  
+

The largest engine produced by Rolls-Royce is the Bergen B diesel engine

This engine measures 10m by 6.3m by 4.6m; weighs a staggering 56.5 tonnes; and produces 8.5MW of power.

## #73



Longest flight  
+

Rolls-Royce powers the longest commercial flight

Rolls-Royce aero engines powered into the record books when the longest non-stop commercial flight in aviation history touched down in Los Angeles.

A Singapore Airlines Airbus A340-500 powered by four Rolls-Royce Trent 500 engines took 16 hours to complete the 7,609-nautical mile journey from Singapore's Changi International Airport. The flight beat the previous record distance by 540 nautical miles.

The return flight takes around 18 and a half hours, making it the longest commercial flight by duration, but still saving passengers between one and a half to two hours compared to the previous one-stop flights. A similar daily service from Singapore to New York will follow in the middle of 2004 and will take 18 hours in each direction.

## #74



Engine airflow  
+

While generating its 92,000lb thrust, the Trent engine sucks in more than one ton of air per second at about 350 mph

This is equivalent to emptying a squash court of air in less than one second.

## #75



Speed  
+

Helicopter speed record

In 1986 a Rolls-Royce Gem powered Westland Lynx set a new helicopter speed record of 249 mph.



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Rolls-Royce

#76



Waterjets  
+

**Rolls-Royce produces the world's largest waterjets**

These will propel the new 14,500gt Japanese Techno-Superliner at a speed of 38 knots. These waterjets measure 2.35m in diameter and are based on sewage pumping technology.

#77



Stamps  
+

**Rolls-Royce powered the first scheduled transatlantic jet service**

The Avon powered De Havilland Comet 4 flew the first scheduled transatlantic jet service in 1958.

#78

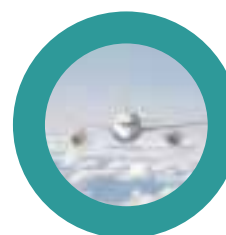


CS Rolls  
+

**Rolls was a pioneer of motoring and aviation in Britain**

He was a pioneer of practical motoring, a founder member of the Automobile Club of Great Britain and Ireland (later to become the RAC), one of the three founders of the Royal Aero Club and the first aviator to complete a double crossing of the English Channel.

#79

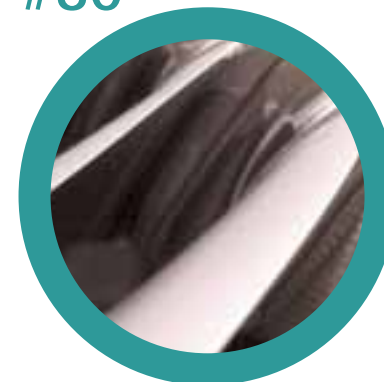


Trent 1000  
+

**Rolls-Royce has been selected by Boeing to supply a new generation of Trent engine for the 7E7 Dreamliner**

The engine will be called the Trent 1000. In April 2004 Sir John Rose, Chief Executive of Rolls-Royce, said: *"I welcome this highly significant decision. We expect this programme to provide good financial returns and to build on our successful engine portfolio which has allowed us to develop a strong market position in the civil airlines sector."*

#80



Blisk technology  
+

**In March 2003, Rolls-Royce produced its first LiftFan blisk for the Joint Strike Fighter**

A blisk (also called an integrally bladed rotor or IBR) is a one-piece component, consisting of a disk and blades.

One of its major advantages over the conventional disk and blade arrangement is the potential weight saving through the elimination of the fixings that secure the blade root to the disk.





1904 - 2004 a century of innovation



Rolls-Royce

#81



Engine temperatures

**Fuel burns in the Trent engine's combustion chamber at temperatures up to 2,000°C**

This is well above the 1,300°C at which some component metals used would start to melt. A sophisticated air cooling system, which achieves a heat transfer rate equivalent to a domestic central-heating boiler or air-conditioning unit, is needed in each of the 90 six inch high pressure turbine blades.

#82



Virtual reality

**Rolls-Royce bases design of manufacturing cells on efficiency studies using virtual reality computer simulation**

These measures, a unique technology developed by Rolls-Royce, help reduce manufacturing costs and improve upon efficiency improvements. Rolls-Royce also uses a number of processes which use robots to streamline workflow.

#83



Power density

**One of the benefits of a marine gas turbine like the MT30 is that it packs power into a small space**

The MT30 boasts a market leading power-to-weight ratio, delivering up to 36MW of power. The MT30 also maintains efficient fuel consumption compared to other gas turbines and high speed diesels. A slow speed marine diesel of the same power as the MT30 weighs in at over 1,300 tonnes more than the MT30.

#84



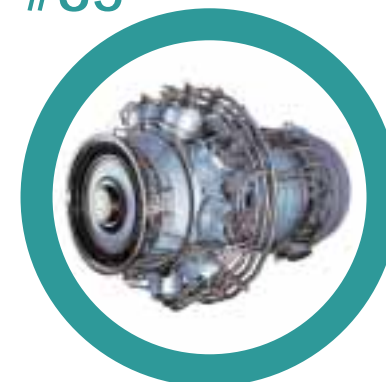
Schools

**Rolls-Royce is committed to supporting education**

Rolls-Royce supports a wide range of initiatives intended to improve the environment and well being of the communities in which we operate. Support for education is a significant part of this effort and we are committed to improving the quality of education at all levels.

Our education policy commits us to supporting schools in raising standards, ensures that our resources are targeted and helps to equip young people with the skills and abilities demanded by the economy of today and the future.

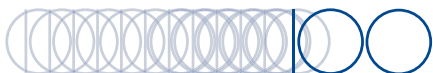
#85



DLE

**Rolls-Royce is continually investigating means to reduce fossil fuel emissions**

The RB211 utilises Dry Low Emissions (DLE) combustion technology to guarantee NOx and CO levels of less than 25 vppm, while maintaining performance and reliability. The Industrial RB211 became the world's first DLE gas turbine by pioneering technology which maintained combustion temperature within a narrow band. Rolls-Royce DLE technology has since amassed over 2 million hours.



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Rolls-Royce

#86



Eurofighter pilots  
+

A Eurofighter pilot cannot see the ground while he is in the cockpit of the plane

... unless he's flying upside down!

#87



WLE  
+

The Rolls-Royce WR-21 marine engine cools air in the compressor using water

This process of Wet Low Emissions makes it easier to compress the air in the engine before it is heated and pushed to the exhaust to create jet force more efficiently.

#88



Fan blade strength  
+

Components in the Trent are subject to extreme forces which make high demands on the special alloys used in their construction

The force on a fan blade at take-off is equivalent to a load of almost 100 tonnes. This is equivalent to hanging a main-line diesel locomotive or a Boeing 757 on each blade.

#89



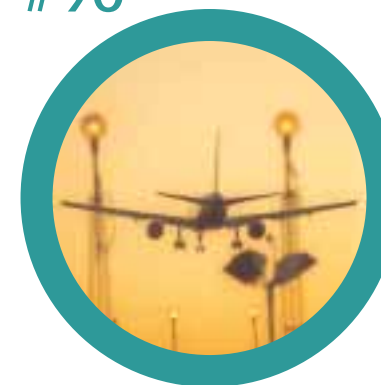
Restoration  
+

Rolls-Royce has been involved in the restoration of the Frauenkirche cathedral in Dresden

Since its destruction during World War II, the Frauenkirche lay in ruins until 1990, when a call from Dresden for help with its rebuilding, gained worldwide interest and support.

In response to the appeal, the Dresden Trust was formed in Britain. Many individuals and some companies, including Rolls-Royce plc, helped to sponsor the restoration work.

#90



Safe journey  
+

An RB211-535 powered Boeing 757 takes off or lands every 25 seconds

Rolls-Royce powers over 600 Boeing 757 aircraft around the world

## #91



FastShip  
+

The five Rolls-Royce waterjets and MT30 gas turbines which power a FastShip have a throughput of water equivalent to 90% of Niagara Falls

## #92



Fan blade production  
+

The internal structure of a fan blade is hollow

In order to create this structure fan blades are inflated during production.

## #93

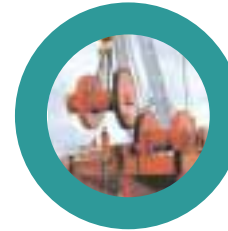


Red arrows  
+

The Rolls-Royce Turbomeca Adour engine provides power for the Red Arrows aerobatic display team

The engine life of these planes depend on where they were positioned when flying in formation. The lead plane's engine life would be 30 times the length of a corner plane, as the latters' positioning was maintained by revving the engine. The Red Arrows now use air brakes in order to maintain the engine life.

## #94



Winches  
+

Oil and gas exploration and production is moving into ever greater water depths

As a result there is a corresponding need for support vessels which can handle heavy anchors and moorings.

Rolls-Royce is a major supplier of specialised winches for these vessels, designing and building Rauma Brattvaag winches for handling chain, wire and synthetic fibre rope.

## #95



Fan blade speeds  
+

The tip speed of the Trent fan blades and first stage turbine blades is about 1,500 ft per second or over 1,000 mph

The force in one of these blades is powerful enough to throw a medium-sized car 100 feet into the air.

## #96



Record breaker  
+

### Civil aerospace record breaker

In 1997, a Trent 800 powered Boeing 777 aircraft recorded longest commercial flight of 10,823 nautical miles and achieved a further round the world speed record 553 mph.

## #97



Ship design  
+

### More than 500 vessels of UT 700 design have been supplied around the world

Every one of these vessels is a result of a collaboration between our specialised companies and the specific customer, making us a market leader in the offshore market.

## #98



3BSM  
+

### The three Bearing Swivel Module is one of three key modules of the Rolls-Royce LiftSystem®

These components together enable short take-off and vertical landing operations for the Joint Strike Fighter.

The 3BSM can achieve transition through 95 degrees in 2.5 seconds.

## #99



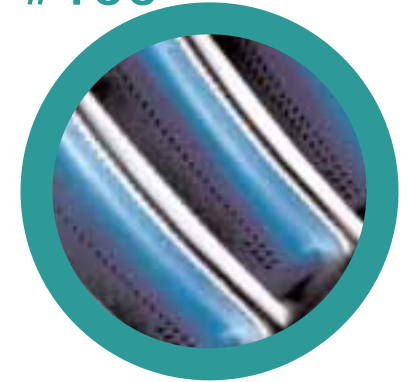
Donations  
+

### In 2003, the Group's total charitable donations amounted to £1.1 million

As a forward-looking, innovative and global company, Rolls-Royce plc is committed to being a good corporate citizen in its operations throughout the world.

The Group's policy on donations is to direct its support primarily to causes with educational, engineering and scientific objectives, as well as to social objectives connected with the Company's business and place in the wider community.

## #100



Blade cooling  
+

### A typical Trent turbine blade contains about 200 holes to enable a film of cooling air to surround the blade while the engine is running

This allows the engine to perform in temperatures above its component metal's melting point. The accuracy of these holes is measured by a co-ordinate measuring machine to +/-4 micron.