

Boeing 747 Engine

Did you know that a jet engine can be made of as many as 25,000 different parts and that those parts come from suppliers around the world? Read this book to find out more about airplanes, how they are manufactured, and how they help make our 21st century global economy possible.

Please note that the content of this book primarily consists of articles available from Wikipedia or other free sources online. Pages: 51. Chapters: Boeing 747-400, Boeing 747-8, Boeing 747SP, Boeing 747 Large Cargo Freighter, Boeing E-4, Boeing VC-25, Boeing YAL-1, List of Boeing 747 operators, Shuttle Carrier Aircraft. Excerpt: The Boeing 747 is a wide-body commercial airliner and cargo transport aircraft, often referred to by its original nickname, Jumbo Jet, or Queen of the Skies. It is among the world's most recognizable aircraft, and was the first wide-body ever produced. Manufactured by Boeing's Commercial Airplane unit in the United States, the original version of the 747 was two and a half times the size of the Boeing 707, one of the common large commercial aircraft of the 1960s. First flown commercially in 1970, the 747 held the passenger capacity record for 37 years. The four-engine 747 uses a double deck configuration for part of its length. It is available in passenger, freighter and other versions. Boeing designed the 747's hump-like upper deck to serve as a first class lounge or (as is the general rule today) extra seating, and to allow the aircraft to be easily converted to a cargo carrier by removing seats and installing a front cargo door. Boeing did so because the company expected supersonic airliners (whose development was announced in the early 1960s) to render the 747 and other subsonic airliners obsolete, while believing that the demand for subsonic cargo aircraft would be robust into the future. The 747 in particular was expected to become obsolete after 400 were sold, but it exceeded its critics' expectations with production passing the 1,000 mark in 1993. By September 2012, 1,448 aircraft had been built, with 81 of the 747-8 variants remaining on order. The 747-400, the most common passenger version in service, is among the fastest airliners in service with a high-subsonic cruise speed of Mach 0.85-0.855 (up to 570 mph or 920 km/h)....

With the advent of digital engine control systems, considering the use of engine thrust for emergency flight control has become feasible. Many incidents have occurred in which engine thrust supplemented or replaced normal aircraft flight controls. In most of these cases, a crash has resulted, and more than 1100 lives have been lost. The NASA Dryden Flight Research Center has developed a propulsion-controlled aircraft (PCA) system in which computer-controlled engine thrust provides emergency flight control capability. Using this PCA system, an F-15 and an MD-11 airplane have been landed without using any flight controls. In simulations, C-17, B-757, and B-747 PCA systems have also been evaluated successfully. These tests used full-authority digital electronic control systems on the engines. Developing simpler PCA systems that can operate without full-authority engine control, thus allowing PCA technology to be installed on less capable airplanes or at lower cost, is also a desire. Studies have examined simplified ?PCA Ultralite? concepts in which thrust control is provided using an autothrottle system supplemented by manual differential throttle control. Some of these concepts have worked well. The PCA Ultralite study results are presented for simulation tests of MD-11, B-757, C-17, and B-747 aircraft. Burcham, Frank W., Jr. and Kaneshige,

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John and Bull, John and Maine, Trindel A. Ames Research Center; Armstrong Flight Research Center FLIGHT CONTROL; SIMULATORS; TRANSPORT AIRCRAFT; DIGITAL SYSTEMS; ENGINE CONTROL; THRUST CONTROL; BOEING 747 AIRCRAFT; BOEING 757 AIRCRAFT; MD 11 AIRCRAFT; C-17 AIRCRAFT; F-15 AIRCRAFT; COST REDUCTION

This study supports the NASA Glenn Research Center and the U.S. Air Force Research Laboratory in their efforts to evaluate the effect of water injection on aircraft engine performance and emissions. In this study, water is only injected during the takeoff and initial climb phase of a flight. There is no water injection during engine start or ground operations, nor during climb, cruise, descent, or landing. This study determined the maintenance benefit of water injection during takeoff and initial climb and evaluated the feasibility of retrofitting a current production engine, the PW4062 (Pratt & Whitney, East Hartford, CT), with a water injection system. Predicted NO(x) emissions based on a 1:1 water-to-fuel ratio are likely to be reduced between 30 to 60 percent in Environmental Protection Agency parameter (EPAP). The maintenance cost benefit for an idealized combustor water injection system installed on a PW4062 engine in a Boeing 747-400ER aircraft (The Boeing Company, Chicago, IL) is computed to be \$22 per engine flight hour (EFH). Adding water injection as a retrofit kit would cost up to \$375,000 per engine because of the required modifications to the fuel system and addition of the water supply system. There would also be significant nonrecurring costs associated with the development and certification of the system that may drive the system price beyond affordability. Becker, Arthur Glenn Research Center WATER INJECTION; TURBOMACHINERY; RETROFITTING; COST EFFECTIVENESS; COMBUSTION PRODUCTS; EXHAUST GASES; EXHAUST EMISSION; FUEL SYSTEMS; MILITARY TECHNOLOGY; GROUND OPERATIONAL SUPPORT SYSTEM; BOEING 747 AIRCRAFT

Please note that the content of this book primarily consists of articles available from Wikipedia or other free sources online. Pages: 24. Chapters: General Electric CF6, General Electric GENx, General Electric GE90, General Electric F414, General Electric J79, General Electric F404, General Electric YF120, General Electric T700, General Electric J85, General Electric F110, General Electric J47, General Electric TF39, General Electric GE38, General Electric CF34, General Electric T58, General Electric T31, General Electric T64, General Electric F118, General Electric CJ805, General Electric J31, General Electric F101, General Electric GE4, General Electric CF700, General Electric J73, General Electric CJ610, General Electric J97, General Electric GE36, General Electric TF34, General Electric YJ101. Excerpt: The General Electric CF6 is a family of high-bypass turbofan engines. A development of the first high-power high-bypass jet engine available, the TF39, the CF6 powers a wide variety of civilian airliners. The basic engine core formed the basis for the LM2500, LM5000, and LM6000 marine and power generation turboshaft. GE Aviation intends to replace the CF6 family with the GENx. CF6 high-bypass turbofan After the successful development in the late 1960s of the TF39 for the C-5 Galaxy, GE offered a more powerful development for civilian use as the CF6, and quickly found interest in two designs being offered for a recent Eastern Airlines contract,

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the Lockheed L-1011 and McDonnell Douglas DC-10. Although the L-1011 would eventually select the Rolls-Royce RB211, the DC-10 stuck with the CF6, and entered service in 1971. It was also selected for versions of the Boeing 747. Since then, the CF6 has powered versions of the Airbus A300, 310 and 330, Boeing 767, and McDonnell Douglas MD-11. The NTSB issued warnings regarding the cracking of the high pressure compressor in 2000 and failure of the low pressure turbine rotor disks in 2010. The CF6-6 was a development of...

DOT/FAA/CT-89/16 covers the period from October 1986 to September 1987

DOT/FAA/CT-89/29 covers the period from October 1986 to September 1988

DOT/FAA/CT-90/28 covers the period from October 1986 to September 1989

The Federal Aviation Administration (FAA) Technical Center initiated a study in October 1986 to determine the numbers, weights, and species of birds which are being ingested into medium and large inlet area turbofan engines and to determine what damage, if any, results. Bird ingestion data were collected for the Boeing-737 model aircraft which uses either the Pratt and Whitney JT8D medium inlet area turbofan engine or the CFM International CFM56 large inlet area turbofan engine. This report analyzes the entire 3 years of data collected by the engine manufacturers, the FAA, and the International Civil Aviation Organization (ICAO) during the period from October 1986 through September 1989.

Probability of Ingestion, Statistical Analysis, Bird Ingestion, JT8D, Turbine Engine, CFM56, Turbofan Engine, Aircraft.

This book is an introduction to the design of modern civil and military jet engines using engine design projects.

This study supports the NASA Glenn Research Center and the U.S. Air Force Research Laboratory in their efforts to evaluate the effect of water injection on aircraft engine performance and emissions. In this study, water is only injected during the takeoff and initial climb phase of a flight. There is no water injection during engine start or ground operations, nor during climb, cruise, descent, or landing. This study determined the maintenance benefit of water injection during takeoff and initial climb and evaluated the feasibility of retrofitting a current production engine, the PW4062 (Pratt & Whitney, East Hartford, CT), with a water injection system. Predicted NO(x) emissions based on a 1:1 water-to-fuel ratio are likely to be reduced between 30 to 60 percent in Environmental Protection Agency parameter (EPAP). The maintenance cost benefit for an idealized combustor water injection system installed on a PW4062 engine in a Boeing 747-400ER aircraft (The Boeing Company, Chicago, IL) is computed to be \$22 per engine flight hour (EFH). Adding water injection as a retrofit kit would cost up to \$375,000 per engine because of the required modifications to the fuel system and addition of the water supply system. There would also be significant nonrecurring costs associated with the development and certification of the system that may drive the system price beyond affordability.

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development of the 747, the -800 model, will ply the airways for many years to come. Even as twin-engine airliners increasingly dominate long-haul operations and the story of the four-engine Airbus A380 slows, the world is still a different place thanks to the great gamble that Boeing took with its 747. From early, difficult days designing and proving the world's biggest-ever airliner, the 747 has grown into a 400-ton leviathan capable of encircling the world. Boeing took a massive billion-dollar gamble and won. Taking its maiden flight in February 1969, designing and building the 747 was a huge challenge and involved new fields of aerospace technology. Multiple fail-safe systems were designed, and problems developing the engines put the whole programme at risk. Yet the issues were solved and the 747 flew like a dream said pilots – belying its size and sheer scale. With its distinctive hump and an extended upper-deck allied to airframe, avionics and engine developments, 747 became both a blue-riband airliner and, a mass-economy class travel device. Fitted with ultra-efficient Rolls-Royce engines, 747s became long-haul champions all over the world, notably on Pacific routes. across the Atlantic in January 1970, 747 became the must-have, four-engine, long haul airframe. Japan Airlines, for example, operated over sixty 747s in the world's biggest 747 fleet. By the renowned aviation author Lance Cole, this book provides a detailed yet engaging commentary on the design engineering and operating life and times of civil aviation's greatest sub-sonic achievement.

A comprehensive history of the aircraft that transformed commercial aviation. Includes photos. A presence in our skies for over half a century, the iconic Boeing 747 has transported hundreds of thousands of passengers across the world. From its introduction with Pan American Airlines in 1970, it has persevered as one of the forerunners of commercial flight. Often labeled the "Queen of the Skies," this is an aircraft revered by passengers and aircrew alike. The first wide-body airliner ever produced, it has set new standards in air travel and opened up the air routes of the world to vast numbers of people who might otherwise have been unable to afford international air travel. This book focuses not only on the 747, but also its many variants, including the YAL-1A, which Boeing developed for the US Air Force, and the Evergreen 747 Supertanker, a 747-200, modified as an aerial application for fire-fighting. Across its types, the 747 carries around half the world's air freight. Accordingly, freight variants feature here too, including the 747-8. The sheer size of the workload carried out by this craft is astounding. From the glamorous 1970s, an era of rapid expansion that saw an unprecedented boom in the tourist trade, to the various environmental and economical imperatives that impact upon modern flight, this work shows how the Boeing 747 has been developed in accordance with the changing demands of the ages.

"The purpose of this study was to develop optimum engine-out procedures for the Boeing 747 and 767 on extended flights that will increase the range of the aircraft in case of engine failure."--Leaf iv.

Modern analytical theories of fatigue coupled with a knowledge of processing effects on metals make up the sound basis for designing machine parts that are free from unexpected failure. Fatigue Design: Life Expectancy of Machine Parts provides the information and the tools needed for optimal design. It highlights practical approaches for effectively solving fatigue problems, including minimizing the risk of hidden perils that may arise during production processes or from exposure to the environment. The material is presented with a dual approach: the excellent coverage of the theoretical aspects is accented by practical illustrations of the behavior of machine parts. The theoretical approach combines the fundamentals of solid mechanics, fatigue analysis, and crack propagation. The chapters covering fatigue theories are given special emphasis, starting with the basics and progressing to complicated multiaxial nonlinear problems. The practical approach concentrates on the effects of surface processing on fatigue life and it illustrates many faceted fatigue problems taken from case studies. The solutions demonstrate the authors' detailed analyses of failure

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and are intended to be used as preventive guidelines. The cases are a unique feature of the book. The numerical method used is the finite element method, and is presented with clear explanations and illustrations. Fatigue Design: Life Expectancy of Machine Parts is an extremely valuable tool for both practicing design engineers and engineering students. Covers: structure of the global large civil aircraft industry and the market, determinants of competitiveness, government policies influencing competitiveness, overview and comparison of R&D, Western European government budgets, aircraft agreements, and more. Glossary and bibliography. 30 charts, tables and graphs.

Can water injection be offered at a reasonable cost to large airplane operators to reduce takeoff NO_x emissions? This study suggests it may be possible. This report is a contract deliverable to NASA Glenn Research Center from the prime contractor, The Boeing Commercial Airplane Company of Seattle, WA. This study was supported by a separate contract to the Pratt & Whitney Engine Company of Hartford, CT (contract number NNC04QB58P). Aviation continues to grow and with it, environmental pressures are increasing for airports that service commercial airplanes. The feasibility and performance of an emissions-reducing technology, water injection, was studied for a large commercial airplane (e.g., Boeing 747 with PW4062 engine). The primary use of the water-injection system would be to lower NO_x emissions while an important secondary benefit might be to improve engine turbine life. A tradeoff exists between engine fuel efficiency and NO_x emissions. As engines improve fuel efficiency, by increasing the overall pressure ratio of the engine's compressor, the resulting increased gas temperature usually results in higher NO_x emissions. Low-NO_x combustors have been developed for new airplanes to control the increases in NO_x emissions associated with higher efficiency, higher pressure ratio engines. However, achieving a significant reduction of NO_x emissions at airports has been challenging. Using water injection during takeoff has the potential to cut engine NO_x emissions some 80 percent. This may eliminate operating limitations for airplanes flying into airports with emission constraints. This study suggests an important finding of being able to offer large commercial airplane owners an emission-reduction technology that may also save on operating costs. Daggett, David L. Glenn Research Center NNC0466315Q

This series provides the enthusiast with a first-ever look at the structure, design, systems, and operation of these high tech wonders of the air. Contains engineering drawings, tech manual excerpts, exploded views, overhaul handbooks, cockpit photos, pilot manual excerpts, factory assembly photos, and more.

On 27 April 2005, an aircraft lifted away from the runway of Toulouse-Blagnac Airport under the power of six massive Rolls-Royce Trent 900 turbofan engines. It carried a six-man crew, it was making its first flight, and it was making history. For this was the Airbus A380, the largest passenger aircraft in the world. Airbus Industrie was a latecomer to the commercial airliner market, and initially struggled to win orders away from the well-established US giants, Boeing and McDonnell Douglas. Part of Airbus's strategy for success was to offer customers distinct families of aircraft that could be tailored to meet a wide range of performance and capacity demands. Before 2005, the largest and arguably most important members of this family strategy were the Airbus A330 and 340 high-capacity airliners; then along came the A380. With air traffic continuing to double every 15 years, the A380 was designed to meet the needs of the passengers and airports, while also delivering the level of efficiency necessary to protect the environment for future generations. The design incorporated two full-length decks with wide-body dimensions, meaning its two passenger levels offered an entire deck's worth of additional space compared to the next largest twin-engine jetliner. With more seats than any other aircraft, the A380 offered solutions to overcrowding; needing fewer journeys to carry 60 percent more passengers, making it the perfect solution to airport congestion, fleet planning optimization and traffic growth. Typical seating capacity was 525, although the aircraft was

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certified to carry up to 853 passengers. By mid-2019, fifteen airlines were operating 238 aircraft throughout the world, the original customer being Singapore Airlines, which launched its first A380 service in October 2007. Production of the A380 peaked at 30 aircraft per year in 2012 and 2014. Then, in February 2019, the biggest customer, Emirates, announced that it was to reduce its latest order by 39 aircraft in favour of two other Airbus Models, the A350 and A330neo, a version using the same engines as the Boeing 787 Dreamliner. For Airbus, it was the last act. The Company announced that production of the A380 would cease by 2021. Boeing's 747 'heavy' has achieved a fifty-year reign of the airways, but now airlines are retiring their fleets as a different type of long-haul airliner emerges. Yet the ultimate development of the 747, the -800 model, will ply the airways for many years to come. Even as twin-engine airliners increasingly dominate long-haul operations and the story of the four-engine Airbus A380 slows, the world is still a different place thanks to the great gamble that Boeing took with its 747. From early, difficult days designing and proving the world's biggest-ever airliner, the 747 has grown into a 400-ton leviathan capable of encircling the world. Boeing took a massive billion-dollar gamble and won. Taking its maiden flight in February 1969, designing and building the 747 was a huge challenge and involved new fields of aerospace technology. Multiple fail-safe systems were designed, and problems developing the engines put the whole programme at risk. Yet the issues were solved and the 747 flew like a dream said pilots - belying its size and sheer scale. With its distinctive hump and an extended upper-deck allied to airframe, avionics and engine developments, 747 became both a blue-riband airliner and, a mass-economy class travel device. Fitted with ultra-efficient Rolls-Royce engines, 747s became long-haul champions all over the world, notably on Pacific routes. across the Atlantic in January 1970, 747 became the must-have, four-engine, long haul airframe. Japan Airlines, for example, operated over sixty 747s in the world's biggest 747 fleet. By the renowned aviation author Lance Cole, this book provides a detailed yet engaging commentary on the design engineering and operating life and times of civil aviation's greatest sub-sonic achievement.

New Scientist magazine was launched in 1956 "for all those men and women who are interested in scientific discovery, and in its industrial, commercial and social consequences". The brand's mission is no different today - for its consumers, New Scientist reports, explores and interprets the results of human endeavour set in the context of society and culture.

The Boeing 747-400 is a complete revision of the basic 747 design. Its increased range and capacity, new-generation technology and cost savings, have all improved the original Jumbo Jet. This volume covers the design, technical specifications, engine choice and production of this aircraft.

Boeing 747The Original Jumbo JetAir World

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