

MILITARY AIRCRAFT ENGINES

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AS ARMED FORCES MODERNIZE...

Heightened performance standards

Rationalized costs

Dispatch reliability imperatives



... SNECMA DELIVERS CUSTOM-TAILORED SOLUTIONS

Snecma (Safran) offers governments and armed forces from around the world engines for all types of military aircraft – combat, training, tactical and strategic transport and other missions. With the global geopolitical situation changing faster than ever, our customers require modern air forces, available at the drop of a hat and capable of operating in any type of theater. Snecma faces the same imperatives and we have shared our vision of military aviation with our partners for many years. Before becoming the world leader in commercial aircraft engines, via CFM International¹, Snecma was already a major military engine producer, for iconic aircraft such as the Mirage and Rafale fighters. Military aviation is an integral part of our history and our DNA, reflected in our proven expertise in key enabling technologies, industrial capabilities and an innovative mindset. We are fully capable of supplying propulsion systems that meet today's strategic defence needs and user requirements for outstanding performance, dispatch reliability and support. More than 4,800 of our engines now power 20 different military aircraft types for armed forces from around the world. Day after day, we provide the support services needed to keep fleets in the air and allow our customers to focus on their core defence mission.

Multirole capability

1 - CFM International is a 50/50 joint company between Snecma (Safran) and GE. It is the world's leading supplier of commercial aircraft engines, with more than 26,500 CFM56 engines delivered to date to some 530 commercial and military operators around the world.



COMBAT AND TRAINING AIRCRAFT

EXPERIENCE & PERFORMANCE

Snecma (Safran) offers a range of engines for combat and training aircraft, adapted to the wide range of missions assigned to today's armed forces. As the legacy propulsion partner of Dassault Aviation, we developed and produce the M53 and M88 engines for the Mirage 2000 and Rafale families of multirole fighters, respectively. Combat-proven and offering exceptionally carefree handling, these engines provide world-class performance, dispatch reliability and maintainability.



M53



M88



MIRAGE 2000-N/D



MIRAGE 2000-C/B



MIRAGE 2000-5/-9



RAFALE-B



RAFALE-C



RAFALE-M

REDUCING COSTS, MAXIMIZING DISPATCH RELIABILITY

Today, more than ever, countries have to count on military aircraft that are ready to go at a moment's notice, whether for armed interventions or as a visible deterrent. Armed forces demand combat and training aircraft offering top-flight performance, reliability and cost-effectiveness,

against a global backdrop of defence budget cuts. For example, France has significantly reduced its defence budget for the five year period 2014-2019, encouraging its armed forces and industry to rationalize costs, while retaining their systems' operational capabilities and dispatch reliability.

COMBAT AND TRAINING AIRCRAFT



SNECMA, A PARTNER IN SUCCESSFUL PROGRAMS

Combat aircraft engines are part of Snecma's DNA. From the start of the jet era, Snecma has always been a lead partner on French combat aircraft, alongside Dassault Aviation, teaming up to share their technology skills and expertise. Through this joint development approach, Snecma and Dassault have always provided outstanding aircraft to French armed forces. In particular, we have provided engines for the famed Alpha Jet trainer¹ and the Mirage and Rafale multirole fighters.

Snecma boasts long experience as a military engine-maker, with proven expertise in all areas, from design and engineering, to testing and production, including the challenging engine core. We are wholly responsible for the design, development and production of a line of reliable, powerful engines, recognized as benchmarks in the combat aircraft sector.

1 - The Alpha Jet's Larzac powerplant was developed jointly by Snecma and Turbomeca, a fellow Safran company, with contributions from KHB, MTU and Techspace Aero, also a Safran company.

Snecma has always been a lead partner on French combat aircraft, alongside Dassault Aviation.

M88: UNEXCELLED THRUST-TO-WEIGHT RATIO

The Rafale twin-engine multirole fighter, a perfect example of synergies between manufacturer Dassault Aviation and engine-maker Snecma, benefits from the performance of the M88, an engine designed, developed and produced by Snecma. The M88 incorporates state-of-the-art technologies, including compressor blisks (integrally-bladed disks), single-crystal high-pressure turbine blades, powder-metallurgy disks, ceramic coatings, composite materials and more. The M88 also features the latest advances in terms of reducing electromagnetic and infrared signatures, plus a redundant FADEC (full authority digital engine control).

These technologies make the M88 the most compact engine in its thrust class (in terms of weight and size), developing 16,500 lb of thrust with afterburner, and also harboring growth potential of 20%. It is suited to both low-altitude penetration and high-altitude interception missions, thanks to its exceptionally carefree handling.

In 2012 Snecma introduced a new production version, the M88-4E, which increases the lifespan of critical parts in the core. For example, the mean time between overhauls has been increased from 2,500 to 4,000 cycles, or 60% more time on-wing!

Dispatch reliability and total cost of ownership are major considerations for today's armed forces. The M88 therefore features an advanced modular design that facilitates servicing, and reduces the time aircraft are grounded for repairs. The M88 is the only engine in its class that can be certified as flightworthy after a module replacement, without having to undergo a new bench test. It can be removed and reinstalled in less than an hour by two crew members without having to be sent back to the depot – a key advantage in foreign theaters of operation.



M53, THE PILOTS' CHOICE

The M53, powerplant of the Mirage 2000 multirole fighter family, is another striking example of the successful partnership between Snecma and Dassault Aviation. Developing 20,900 lb of thrust with afterburner, the M53-P2 combines performance and reliability to ensure excellent handling and a large flight envelope, all the way from very low speeds to Mach 2.2. Selected by eight air forces on four continents, this engine is highly appreciated by pilots for its carefree handling, the result of a full authority digital engine control (FADEC), which automatically regulates engine speed and maintains the airspeed chosen by the pilot. The M53-P2 also incorporates cutting-edge technologies to reduce the number of engine removals and maintenance costs in general.

Combat-proven

Surveillance, high-altitude interception, attack, training... The M53 and M88 engines have amply demonstrated the full scope of their operational capabilities during a number of force projection missions. Entering service in 1987, the M53-P2 is a proven engine with over 1.8 million flight-hours logged to date. Air forces from around the world have deployed the M53-powered Mirage 2000 in many different theaters of operation. The M88, which entered service more recently on the Rafale, has fully demonstrated its versatility and reliability during combat missions by the French air force in Libya, Mali and Afghanistan.



THE DISPATCH RELIABILITY IMPERATIVE

Snecma offers different types of support contracts to meet the needs of the fast-evolving military engine market, adapted to each air force's specific requirements and covering the engine's entire life cycle. We have also developed a full array of services, covering repairs and maintenance, as well as spare parts and modules to extend the service life of our mature engines (Atar, Larzac, M53). Support contracts for military customers are generally on a "life cycle" basis, which means deploying a dedicated organization, capable of carrying out all maintenance, repair and overhaul operations. For instance, Snecma can make arrangements with its government customers to take advantage of their world-class industrial capabilities and manage all MRO activities. On the M88, Snecma

supplies spare parts, based on a life-cycle "by the hour" contract, and can dispatch teams on site to support armed forces.

For life-cycle support contracts, Snecma relies on its forecasting unit, capable of anticipating the requirements of government customers for parts or module replacements, to reduce the time planes are grounded and limit engine removals. According to M88 life-cycle support contracts, for example, Snecma guarantees spare part deliveries within three days.

At Snecma we also address our customers' requirements through training, on-site technical and logistics assistance, and especially through a customer support center, open 24/7.

Larzac®, the benchmark in training jet engines

Launched back in 1969 by Snecma and Turbomeca, the Larzac is one of the first engines involving cross-border collaboration (France-Germany). Having passed the mark of 3 millions flight-hours, it still powers the Alpha Jet trainer, deployed by ten air forces worldwide. The Larzac® develops about 3,200 lb of thrust and features a fully redundant FADEC control unit. It is the benchmark in its thrust class, ideally suited to either training or tactical support missions, powering single- or twin-engine aircraft. Furthermore, the Larzac features a modular design, for easier maintenance and extended service life.



AN ALPHA JET FLOWN BY THE PATROUILLE DE FRANCE AEROBATICS TEAM





BENCHMARKS

THE M88 CAN BE REMOVED
AND REINSTALLED IN **ONE**
HOUR BY TWO
PEOPLE

THE M88-4E INCREASES
THE ON-WING SERVICE LIFE OF
CRITICAL PARTS BY
60%

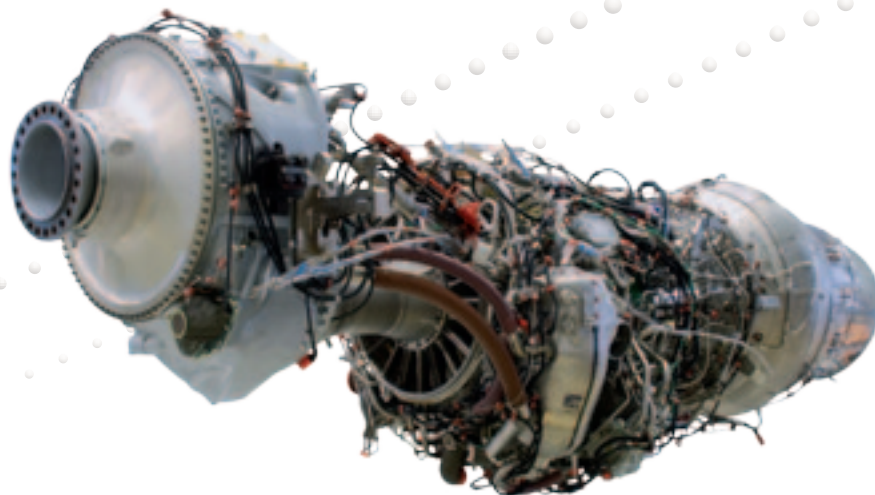
THE M53-P2 HAS
LOGGED MORE **THAN 1.8**
MILLION FLIGHT-
HOURS



STRATEGIC AND TACTICAL TRANSPORT AIRCRAFT

POWER & VERSATILITY

Snecma's engines are suited to the tactical and strategic requirements of today's armed forces. To meet military transport fleet replacement requirements, Snecma makes the TP400, the most powerful turboprop engine in the West, for the new A400M multirole transport, via Europrop International (EPI), the European consortium in charge of this engine. Snecma also teams up with GE, through their 50/50 joint company CFM International, to offer the CFM56 to armed forces for a variety of different aircraft. This engine's legendary reliability is well suited to these demanding defence missions.



TP400 TURBOPROP



AIRBUS DEFENCE AND SPACE A400M TRANSPORT

FLEET REPLACEMENT

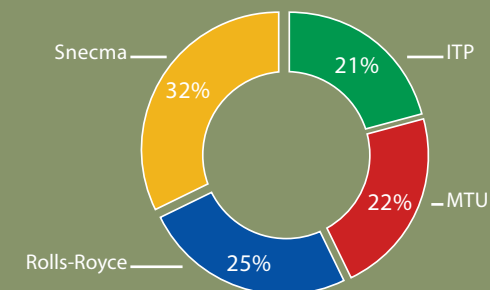
Since the Transall entered service in the 1960s, no new military transport aircraft has come along in the medium-lift class, offering payload capacity of about 40 metric tons. The A400M military transport program was therefore launched in 2003 by seven countries (Germany, France, Spain, UK, Turkey, Belgium and Luxembourg) to replace transports in this class, while addressing the cost reduction strategies of certain countries. The aim is to give countries a versatile engine-airframe combo, capable of fulfilling different tactical and strategic missions in foreign theaters of operation,

carrying maximum troop and equipment payloads, and also provide long range, including for civilian missions. A total of 174 aircraft have been ordered to date by the launch customers and Malaysia, the first export customer, and Airbus Defence and Space expects to deliver about 400 over the next 20 years.

Snecma and its partners in the European consortium EPI (see box on right) developed and now produce the new-generation TP400 turboprop engine, purpose-designed for the A400M. Snecma contributed its recognized expertise in the high-pressure components of military aircraft engines. .

Snecma and EPI

With a 32% workshare of the TP400 engine program, Snecma is the lead partner in the EPI consortium. We are responsible for the hot section of the engine (combustor and high-pressure turbine), which is the most complex part, demanding a high degree of technical expertise. Snecma also calls on contributions from other Safran companies, and coordinates the integration of critical components such as the full authority digital engine control (FADEC), from Sagem, the accessory gearbox, from Hispano-Suiza, and various lubrication system components, from Techspace Aero. We also provide our engine test cell in Istres, southern France, along with a Techspace Aero test rig in Liers, Belgium.



EPI PARTNERS' WORKSHARES

STRATEGIC AND TACTICAL TRANSPORT AIRCRAFT



TP400: THE MOST POWERFUL TURBOPROP IN THE WEST

The new-generation A400M strategic and tactical military transport entered service in 2013. It was designed to meet the multiple requirements of armed forces: air drops at low and high altitude, transportation of troops and equipment, in-flight refueling, operations from rough airfields, etc. To meet the wide range of mission requirements and high-frequency operations, Snecma and the Europrop International consortium developed the TP400, the most powerful turboprop engine in the West, rated at 11,600 shaft horsepower (SHP). This powerful engine also features reduced fuel consumption, which translates into longer range (8,700 km empty, or 4,500 km with 30 metric tons of payload), or greater payload capacity. The A400M is the first aircraft in the world to earn dual civil-military certification, which means not only enhanced flight safety, but also faster deployment to theaters of operations, since it does not need special overflight permission.

Snecma calls on its expertise as a leading engine manufacturer to provide a full slate of support services for A400M users, including repair and maintenance on wing or in specialized shops, all designed to maximize fleet dispatch reliability. Working through EPI, Snecma is in charge of module repair (combustor, high-pressure turbine, FADEC, accessory gearbox) on the French, Belgian and Luxembourg fleets. We also call on our own resources, such as the Customer Support Center for online technical assistance, and our government partners (SIAé in Bordeaux) for shop-level maintenance. Because of our long experience and capabilities in commercial engine support, we can assign dedicated reps to air bases, and provide spare parts as well as logistics support to forecast repair needs and training services. .

Extending the service life of Tyne turboprops

The Tyne turboprop engine, rated at 6,100 SHP, was produced by an international consortium including Snecma. Since 1964 it has powered the Transall C-160 transport and the Breguet Atlantic and Atlantique 2 maritime patrol aircraft. It is still in service with the Transalls deployed by the French, German and Turkish armed forces. To extend the life of these engines, Snecma offers "by the hour" support contracts, and also has the production capacity needed to ensure long-term support via part and module repairs.





BOEING P-8 POSEIDON

CFM56: PROVEN RELIABILITY FOR ARMED FORCES

The best-selling CFM56¹, known for its unexcelled reliability and low specific fuel consumption, has powered military aircraft since the 1980s. The military version of this engine, 95% identical to commercial versions, has been selected by some of the world's leading armed forces, namely the US Air Force, the UK Royal Air Force and the French air force.

Different versions of the CFM56, capitalizing on Snecma's technological excellence via CFM and the engine's civil aviation certification, are suited for a wide variety of military missions: in-flight refueling, surveillance, maritime patrol and troop transport. The first model in the family, the CFM56-2, powers more than 600 aircraft, from KC-135 tankers to AWACS airborne warning and control system aircraft. The main operator is the US Air Force, which is also the largest CFM customer to date, with more than 2,500 engines in service. The CFM56-3 and CFM56-7 engines also power several military aircraft types, including the Boeing 737 AEW&C airborne early warning and control, the Boeing C-40 transport, and the P-8A Poseidon maritime patrol aircraft, a new-generation model offering enhanced resistance

to corrosion and seawater, capable of carrying weapons under its wings. Calling on its OEM² skills, expertise and capacity, Snecma also provides day-to-day support for all military customers.

CFM: A WELL-BALANCED PARTNERSHIP

CFM engines are developed and produced according to a clearly defined, efficient industrial worksplit, in which each partner is responsible for its section of these engines: the core for GE and the low-pressure section (fan, low-pressure compressor and turbine), accessories and exhaust assembly for Snecma. Each partner has its own development facilities, assembly lines and test rigs, and assembles half of all engines. Snecma and GE also split responsibility for CFM sales and support by geographic zones.

1 - With more than 26,500 delivered to date, the CFM56 is the best selling engine in the history of commercial aviation.

2 - Original Engine Manufacturer

Benchmarks

AT 11,600 SHP,
THE TP400 IS **THE MOST**
POWERFUL TURBOPROP
IN THE WEST

174 A400M
TRANSPORTS ORDERED
TO DATE

WITH 2,500 CFM56
ENGINES IN SERVICE,
THE US AIR FORCE
IS CFM INTERNATIONAL'S
LARGEST CUSTOMER

6 MILITARY
AIRCRAFT TYPES
POWERED BY **THE**
CFM56



PRODUCTION SYSTEM

ROBUSTNESS & TECHNOLOGY

Snecma (Safran) calls on a robust production system, innovative processes and unexcelled expertise to give our customers products that set the standard for quality and reliability. To meet these requirements and uphold our global reputation as an engine-maker, we continually invest in improvements to our supply chain, our production facilities and our repair capabilities.

Snecma plants in Gennevilliers, Evry-Corbeil and Villaroche are primarily responsible for the production of high value-added parts.

ACROSS THE BOARD EXPERTISE

Snecma's own production capabilities and supply chain are supported by centers of industrial excellence, set up to support the strong current ramp-up in production rates. Reflecting a robust, efficient industrial organization, these centers are tasked with the detailed design, engineering, production (or procurement) and support of parts under their responsibility. They cover the entire range of state-of-the-art resources and skills needed for the production of military aircraft engines, including rotating parts (turbine and compressor disks and shafts, the blisks on the M88), compressor blades (fans and compressors, guide vanes), turbine blades (high and low-pressure, nozzle guide vanes and rings), combustors and cases, accessories and equipment (bearings, wiring harnesses, etc.).

Snecma's three large plants in the greater Paris area – Gennevilliers, Evry-Corbeil and Villaroche, totaling nearly 8,000 people – handle the lion's share of production for these high value-added parts. They form the backbone of our production system, spanning forge and foundry activities, machining, final assembly and testing of engines, all in conjunction with industry partners offering expertise in key technologies.

CASTING MOLD FOR AN M53
TURBINE BLADE



STATE-OF-THE-ART PRODUCTION FACILITIES

Snecma's military engines naturally take advantage of our state-of-the-art production resources. We are one of the few engine-makers in the world to master advanced casting (equiaxial structures, directional or single-crystal solidification) and forging techniques, all vital to ensure the metallurgical quality of the most highly stressed parts. Our Gennevilliers plant deploys die stamping, circular rolling, thermomechanical treatment and isothermal forging techniques using heavy-duty machines such as an 80-ton drop hammer, 200 and 565-ton circular rolling mills and a 4,000-ton hydraulic press. Also part of Snecma's technology portfolio on military engines are multi-channel cooling and ceramic coatings, indispensable to ensure that turbine blades stand up under blazing heat.

The Evry-Corbeil plant, specialized in machining, features over 400 large machines, including 300 numerical control (NC) models. They deploy advanced technologies, including inertial friction welding, electrochemical milling, laser cutting, drilling and welding, plasma projection and high-speed machining.



PREPARING LOST-WAX CASTING FOR AN M53 LOW-PRESSURE BLADE

Snecma is one of the few engine-makers in the world that masters the forge and foundry techniques needed to ensure the metallurgical quality of the most highly stressed parts.

Additive manufacturing for tomorrow's engines

Snecma has gradually developed expertise in innovative new production processes, such as additive manufacturing. Also known as 3D printing, this revolutionary process combines laser sintering with 3D computer-aided design (CAD). The process turns a 3D computer model into a part by sintering a metallic powder using a laser beam. The beam's trajectory is computer controlled, to build up the part layer by layer. This process offers a highly flexible solution for the manufacture of experimental and development parts, not only for fast prototyping, but also for short production runs. Additive manufacturing is already being used to make the hydrogen turbopump manifold for the new Vinci rocket engine, as well as the guide vanes for the new Silvercrest business jet engine. And the process is under study for the production of either original or spare parts for the M88.





AUTOMATED SPARE PARTS WAREHOUSE

UNRIVALED REPAIR CAPABILITIES

At Snecma, we invest considerable human and financial resources to support our engine fleets, by maintaining our people's skills and ensuring a secure supply chain for parts, some with unique specifications, for the next 50 years. Today, with the repair business growing in line with a fast expanding fleet, we are investing in the modernization of our industrial capabilities, especially at Châtellerault, which provide all maintenance, repair and overhaul (MRO) services for our military engines. An expert workforce 700 strong maintains and repairs the hot parts on these engines. The plant has serviced over 24,000 engines since 1966, and now has all the resources needed for the

through-life support of M88 and M53 engines (for the Rafale and M53, respectively), the Tyne turboprop (Transall and Atlantic) and Larzac (Alpha Jet trainers). We are also providing complete support services for the new-generation TP400 turboprop, including MRO, spare parts and 24/7 customer support. For their CFM56 engines, armed forces can rely on the global MRO network operated by Snecma and GE.

ANTICIPATING CUSTOMER REQUIREMENTS

To meet governments' demanding dispatch reliability requirements, Snecma calls on world-class forecasting, planning, procurement and distribution capabilities, both in-house and from outside providers, including the Military Logistics Center. We have very accurate forecasts of armed forces' production and repair requirements extending five years or more into the future. And we can supply some 10,000 different parts to our military customers.

Our Forecasting and Planning unit is tasked with reducing the lead-time for the supply of original or spare parts, thanks to help from support and engineering functions, which precisely analyze the performance of parts, subassemblies and modules, including their lifespan and reparability within our customers' operating context, including flight-hours, fleet size, fleet condition, operating environment and types of missions.

Production for the M88 and M53 is largely on an advance basis, to ensure engine availability and keep planes in the air. The Forecasting and Planning unit works closely with the Production and Logistics unit, in charge of procuring and assembling new parts and modules, as well as refurbished items.

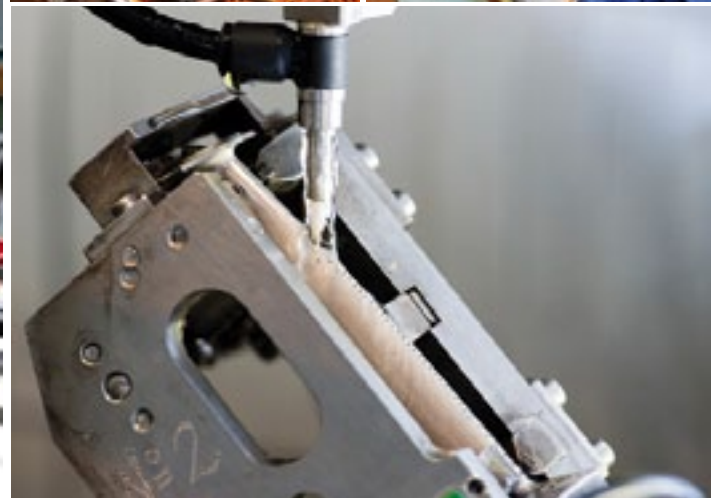
Benchmarks

**MORE THAN
24,000** MILITARY
ENGINES/MODULES
SERVICED TO DATE

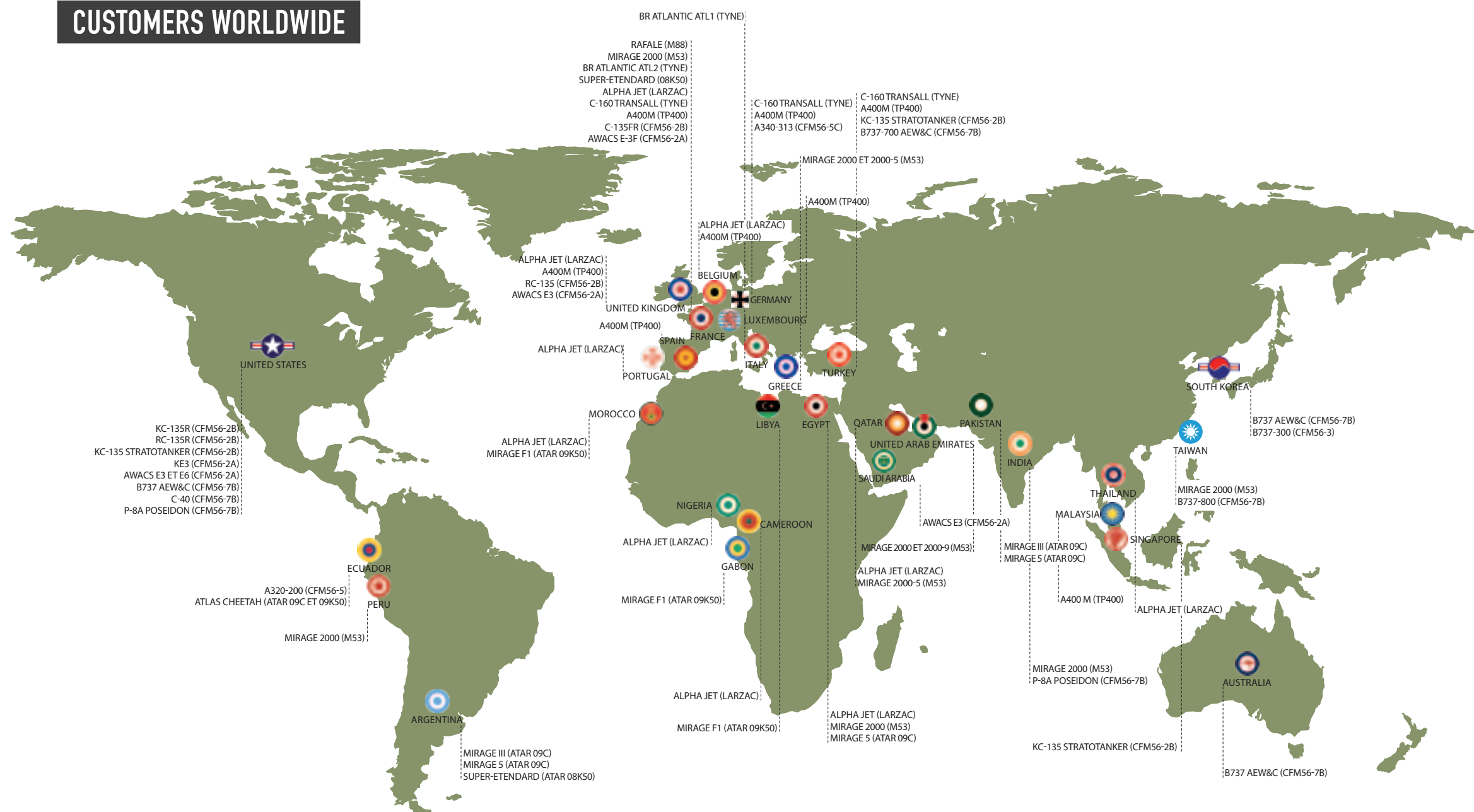
SECURE PARTS SUPPLY
FOR THE
NEXT 50 YEARS

**700 STAFF
DEDICATED**
TO MILITARY ENGINE MRO

**10,000
DIFFERENT**
SPARE PARTS



CUSTOMERS WORLDWIDE





RESEARCH & INNOVATION

SETTING TOMORROW'S TECHNOLOGY STANDARDS

Snecma deploys significant research, technology and development resources to maintain our position as a leading military engine supplier and support our customers' strategic independence. By developing breakthrough technologies for these engines, especially in the core, we meet armed forces' requirements for performance, dispatch reliability and reduced operating costs. The advanced technologies developed for military engines are also applied to the civil aviation sector.



FOCUS ON KEY TECHNOLOGIES

Snecma's approach to innovation is built on the proven expertise of the 2,500 engineers and researchers in our design departments. To deliver top-performing, highly reliable engines to today's armed forces, Snecma's R&D teams carry out advanced research into control systems and critical technologies, especially for the engine core.

For example, one of the keys to engine performance is increasing temperature in the high-pressure turbine. We can achieve this through advanced design technologies (aerothermodynamic and thermomechanical calculations), cooling circuits in the blades, advanced materials (powder metallurgy, single-crystal alloys, ceramic matrix composites, thermal coatings, etc.) and the associated production and testing processes. By incorporating these innovative solutions we can turn out high-pressure turbine blades that stand

up to temperatures 500°C higher than conventional blades. Once installed on the aircraft, these improvements translate into lower fuel burn, longer range, higher dispatch reliability and reduced cost of ownership.

In response to customer demand, we are also carrying out research to precisely determine the basic characteristics and the lifespan of the most highly loaded materials during various missions. Today's control systems manage all functional parameters under what are often extreme vibratory and thermal conditions, and also record data that will help air forces reduce their operating costs. Looking ahead, advanced control systems will call on refined understanding of materials, operating feedback and fast-paced progress in hardware and software to help extend the service life of critical engine parts.

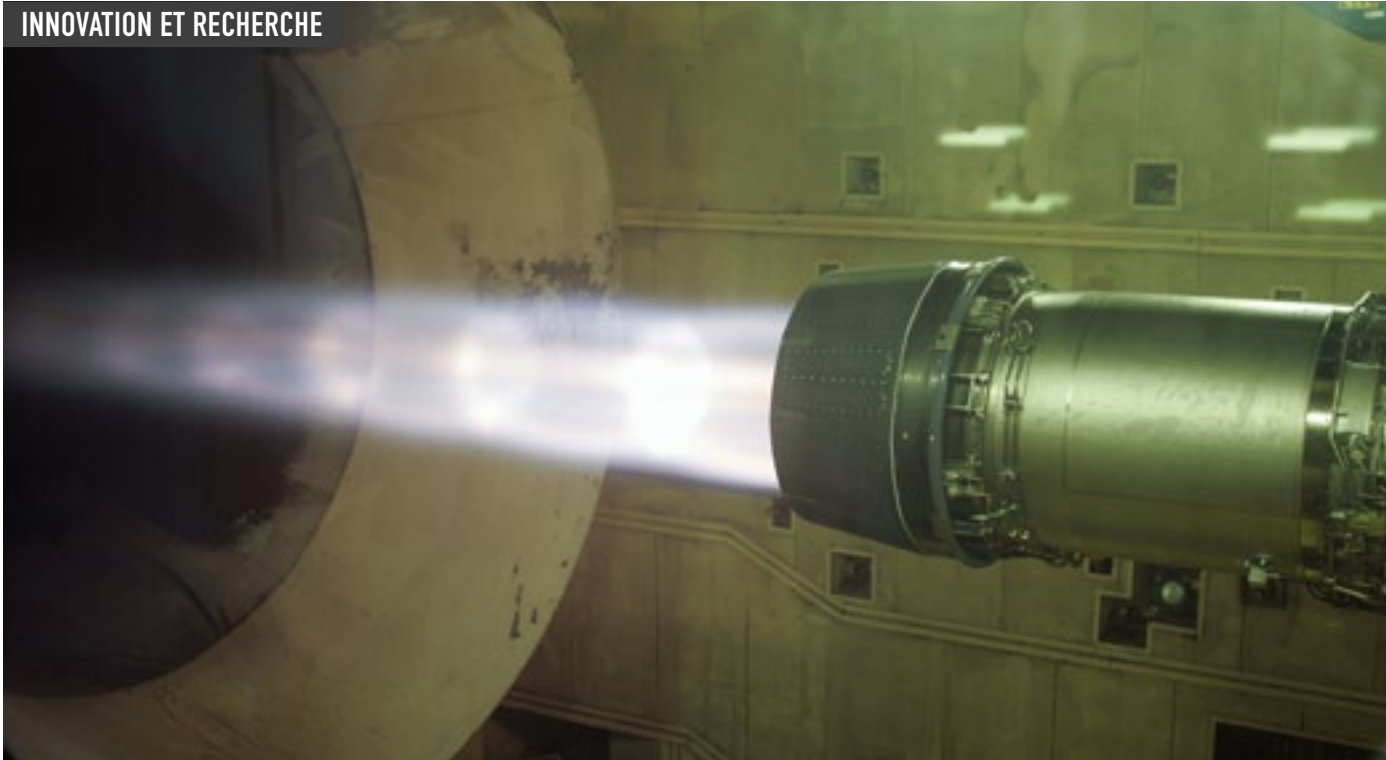
Support for our research programs from the French defence procurement agency

Thanks to support from the French defence procurement agency DGA (Direction générale de l'armement), part of the Ministry of Defence, Snecma develops advanced technologies that contribute to the development, production and maintenance of new military aircraft engines. Primarily targeting the engine core, these technologies drive the ongoing improvement in our systems' performance and reliability.

Here are a few selected examples of key technologies developed by Snecma in partnership with the DGA:

- High-pressure turbine blades with advanced cooling circuits and new-generation thermal coatings that can either reduce the need for internal ventilation or extend turbine service life or inlet temperature.
- Afterburner flame rings made of a ceramic matrix composite to reduce engine weight.
- New-generation nickel-based superalloy rotor disks using powder metallurgy, enabling an extension of service life or increase in inlet temperature.
- Metallic matrix composites, with titanium for instance, to make integrally-bladed rings.

These advanced technologies reduce engine weight, while increasing specific thrust, extending service life and reducing fuel consumption, to meet our customers' specific needs.



AN M88 TEST RIG AT VILLAROCHE.

M88: CONTINUOUS IMPROVEMENT

At Snecma, we continuously improve the M88's performance by integrating advanced technologies, which significantly decrease cost of ownership while retaining its exceptional performance, both primary concerns for today's armed forces, especially given current defence budget cuts. Initial upgrades have focused on the high-pressure compressor and nozzle, followed by the hydromechanical components and engine control unit. All of these improvements, easily retrofitted on engines already in service, will allow government customers to considerably extend the service life of their engines.

WORLD-CLASS TEST FACILITIES

Snecma deploys over 30 engine and component test rigs to support all development and qualification tests and ensure our independence. At our Paris-area plant in Villaroche, for example, we have two indoor test cells dedicated to the M88, while the Istres site in southern France features an open-air test cell, mainly used for the TP400 turboprop, as well as full flight test capabilities. Along with our in-house resources, we also call on the altitude simulation engine test facilities, unrivaled in Europe, at French defence procurement agency DGA's engine test center in Saclay. Plus, we can call on the test facilities offered by fellow Safran company Techspace Aero, and our partners in the Europrop International consortium responsible for the TP400.

Snecma's role on the Future Combat Air System (FCAS)

In 2014 the French and British governments took a major step forward in the development of the unmanned Future Combat Air System (FCAS), by signing a new agreement that paves the way to the project feasibility stage. Snecma, working with Rolls-Royce through their 50/50 joint venture Snecma Rolls-Royce Ltd., created in 2001, will be in charge of the propulsion system on this future Franco-British combat drone. The two companies have split the program tasks according to their respective areas of technological expertise. Studies have focused on the development of the enabling technologies for the propulsion of an FCAS demonstrator, and the generation of the electrical power needed by the aircraft's systems and sensors. The FCAS will be a stealthy attack drone, designed to complement modern warplanes. Offering in-flight refueling capability, this unmanned aircraft could be used, for example, to neutralize air defence systems at the outset of hostilities, thanks to its low observability. Because of the strategic nature of these emerging missions, armed forces require engines combining high performance and reliability.





Benchmarks

MORE THAN
2,500 RESEARCH,
DEVELOPMENT
AND TECHNOLOGY
SPECIALISTS

HIGH-PRESSURE
TURBINE BLADES
THAT STAND UP TO
TEMPERATURES
500°C HIGHER THAN
ON CONVENTIONAL
BLADES



BLÉRIOT XI (60-HP GNOME OMEGA)



NIEUPORT 23 (LE RHÔNE 9J)



A CENTURY OF EXPERIENCE

From the Blériot and Bloch, to the Super-Etendard and Mirage, these are all aircraft that marked the history of aviation, especially as participants in the major conflicts of the 20th century. Their history is also that of Gnome & Rhône, which became Snecma in 1945 after being merged with other companies.

But the name change didn't alter the company's DNA, largely built around military aircraft engines. The 60-HP Gnome Omega was introduced in 1909, and increasingly powerful versions would equip more than 150 different types of aircraft, including the Blériot XI. During the 1950s, Snecma developed another best-selling engine, the Atar, which would power several types of aircraft built by Dassault, in particular the Mirage and Etendard.

Over more than a century of military aviation, Snecma has developed a very strong relationship with armed forces from around the world.



POTÉZ 631 (GNOME ET RHÔNE 14M)





BLOCH MB.131 (GNOME ET RHÔNE 14N)



BREGUET BR.693 (GNOME ET RHÔNE 14M-6/7)



COLEOPTERE (ATAR 101 EV)



VAUTOUR (ATAR 101 E)



SUPER MYSTÈRE B2 (ATAR 101 G)



MIRAGE III C (ATAR 9B)



MIRAGE 2000 ET MIRAGE F1 (M53 ET ATAR 9K50)



Snecma : Safran : 25
SUPER-ETENDARD (ATAR 8K50)



COMMERCIAL AND MILITARY ENGINES

SNECMA, THE MULTIDISCIPLINARY ENGINE MANUFACTURER

In addition to our military engine business, Snecma is also one of the world's leading makers of commercial aircraft and rocket engines. Through CFM International (our 50/50 joint company with GE), Snecma makes the CFM56, the global benchmark in engines for single-aisle commercial jets, and its successor, the LEAP. We are also developing the Silvercrest business jet engine, clearly demonstrating our ability to handle the complete development of a civil engine, drawing on our long experience as a military engine-maker. In addition, we have been a key partner in Europe's Ariane space launcher since the outset in 1973, and we are still at the heart of the success of Ariane 5, the heavy launcher operated by Arianespace.



COMMERCIAL ENGINES

Snecma offers a broad range of powerful, reliable and durable engines for all segments of the civil aviation market. Through CFM International, we develop, produce and sell the CFM56, the global benchmark for single-aisle commercial jet engines, and its successor, the LEAP, which offers the best technologies from its two parent companies, Snecma and GE: composites, 3D aero design, additive manufacturing, etc. Capitalizing on our experience as a full-line engine manufacturer and our long-term vision of the market, we are now developing, totally in-house, the new Silvercrest business jet engine, capable of meeting rising demand in this sector. We are an equal partner in the SaM146 engine for regional jets, and we have a large stake in the powerful GE90 engine for long-range widebody jets. As an OEM, or original engine manufacturer, Snecma offers airlines the highest possible dispatch reliability for their fleets, through a complete MRO and customer service offering, covering the entire engine life cycle and available 24/7 worldwide.

SPACE ENGINES

Snecma designs, develops and produces propulsion systems and equipment for launchers, satellites and space vehicles. We are the prime contractor for the cryogenic propulsion systems (fueled by liquid hydrogen and oxygen) on Ariane launchers, and we were chosen to develop the cryogenic propulsion systems for the upgraded Ariane 5 ME (Midlife Evolution) and the new-generation Ariane 6. Snecma is the world's second leading cryogenic rocket propulsion company.

In the satellite propulsion market, Snecma is the European leader in electric propulsion using Hall effect plasma thrusters. We also supply thrusters and propulsion assemblies based on this technology to satellite manufacturers. Through these advanced systems, we can meet all of our customers' requirements, from orbital transfer to stationkeeping.





SAFRAN

KEY MISSIONS, KEY TECHNOLOGIES, KEY TALENTS

Safran is a leading international high-technology group and Tier-1 supplier of systems and equipment for aerospace, defence and security. Operating worldwide, Safran has 66,300 employees and generated sales of 14.7 billion euros in 2013. All Safran employees, from forge and foundry operators to researchers in the mathematical morphology lab, are united by a single overriding aim: to achieve industrial excellence that drives customer success.



SAFRAN, A WORLD LEADER IN ITS CORE MARKETS

Safran is one of the world's leading suppliers of systems and equipment for the aerospace, defence and security markets. Comprising a number of companies, Safran has 66,300 employees in over 50 countries and posted sales of 14.7 billion euros in 2013. Working alone or in partnership, Safran holds world or European leadership positions in its core markets, including commercial aircraft engines (in partnership with GE), landing gear, helicopter flight controls and biometric technologies. Safran's international reach enhances its competitiveness and underpins industrial and commercial relations with leading prime contractors and operators, while ensuring fast, local service anywhere in the world.

SAFRAN'S THREE CORE BUSINESSES

Aerospace propulsion and aircraft equipment. Safran develops, produces and sells engines and propulsion subassemblies for civil and military airplanes and helicopters, ballistic missiles, launch vehicles and satellites. It also provides a wide range of systems and equipment for airplanes and helicopters of all types.

Defence electronics. Safran operates in the optronics (electro-optical), inertial navigation, electronics and safety-critical software markets. It provides a complete range of optronic and navigation systems, optical equipment and other products for armies, navies and air forces worldwide.

Security. Safran is a global leader in multibiometric technologies and a major player in explosive detection systems, smart cards and secure ID and travel documents. It offers cutting-edge solutions to meet the changing security requirements of people, businesses and governments.

Snecma at a glance

SALES:
5.9 BILLION EUROS

EMPLOYEES*:
14,600

35 OFFICES AND
FACILITIES WORLDWIDE

Safran at a glance

SALES:
14.7 BILLION EUROS

EMPLOYEES*:
66,300 IN OVER
50 COUNTRIES

R&D INVESTMENTS:
1.8 BILLION EUROS

* At Decembre 31, 2013

KEY MISSIONS, KEY TECHNOLOGIES, KEY TALENTS



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