M88 : the state-of-the-art combat engine

The M88 engine that powers Dassault’s Rafale omnirole fighter is designed, developed and produced by Snecma (Safran group). It is the cornerstone of a new family of engines based on a common core.

M88: A compact, high-tech powerhouse

The M88 is a state-of-the-art combat engine, with non-polluting combustor, single-crystal turbine blades and powder metallurgy disks, as well as the latest technologies to reduce electromagnetic and infrared signatures. Developing 50 to 75 kN of thrust with afterburner (11,250 to 17,000 lb), the M88-2 is a very compact engine with a high power-to-weight ratio and exceptionally carefree handling, plus outstanding acceleration.

The M88 features a state-of-the-art modular design (comprising 21 major modules), for quick return-to-service after maintenance, since the module in question can be quickly removed for servicing without grounding the aircraft. Furthermore, the M88 is the only engine of its kind that can be returned to flight after changing modules without requiring a new ground acceptance test – all it needs is a simple leaktightness test.

Snecma’s extensive capabilities in research, technology, development and engineering underpin the company’s leadership in all of its core markets. Snecma applies a sustained R&D policy to support the continuous improvement of engine performance, and the M88 is a perfect reflection of the company’s innovative mindset. At the same time, Snecma conducts basic research to achieve new technology breakthroughs for tomorrow’s engines.

M88-4E engine program on track

Development of the enhanced M88-4E (formerly designated the “TCO Pack” version), is proceeding very satisfactorily.

Following a series of ground tests in an altitude chamber, completed in February 2010, a Rafale fighter powered by the M88-4E engine made its first test flight on March 22, 2010 at the Istres air base in southern France. The M88-4E engine received its flightreadiness certificate at the end of 2010, after a total of 70 test flights. The development engines are now undergoing endurance tests, and the qualification and delivery of the first production-standard M88-4E is scheduled for the end of 2011.

The aim of this program is to extend the engine’s service life and time between inspections for several key parts. Upgrades are planned to the high-pressure compressor and high-pressure turbine, and are derived from various technologies tested during the ECO development program*.

* The ECO program, designed to demonstrate new technologies that could reduce operating costs and increase dispatch reliability, was completed at the end of 2007. It satisfied all initial objectives, including longer engine parts life, lower cost of ownership (including reduced operating costs) and higher performance (4,000 total accumulated cycles/TAC).

### M88 characteristics

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
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<tbody>
<tr>
<td>Twin-shaft turbofan engine</td>
<td>Single-stage cooled LP turbine</td>
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<tr>
<td>3-stage LP compressor with variable inlet guide vanes</td>
<td>Radial A/B chamber</td>
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<tr>
<td>6-stage HP compressor (3 stages with variable stator vanes)</td>
<td>Variable-section convergent flap-type nozzle</td>
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<tr>
<td>Annular combustor</td>
<td>Full authority digital engine control (FADEC)</td>
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<tr>
<td>Single-stage cooled HP turbine</td>
<td>Modular on-condition maintenance (21 modules)</td>
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</tbody>
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