

F-14 TF30-P-414 TO F110-GE-400 ENGINE UPGRADE TECHNICAL COMPARISON

TF30 TURBOFAN ENGINE

F110 TURBOFAN ENGINE

GENERAL DESCRIPTION

The TF30-P-414 engine is a mixed-flow, dual spool afterburning low-bypass turbofan designed and manufactured by Pratt and Whitney Aircraft of West Palm Beach, Florida. The engine incorporates a nine-stage low pressure compressor including a three-stage fan driven by a three-stage low pressure turbine; and a 7-stage axial flow high-pressure compressor driven by a single-stage high-pressure turbine. The combustor is a through flow annular type. The variable-area exhaust nozzle is hydraulically actuated. The engine-mounted accessory gearbox provides the necessary extracted power needed to drive the accessories. The engine control system regulates speeds, temperature levels and fuel flow for afterburning and non-afterburning operation.

PRODUCTION/SERVICE HISTORY

Development of TF30-P-414 was initiated in March 1969. TF30-P-414A was placed in service in October 1982. 929 TF30-P-414's were converted to P-414A's with conversion kits; conversion completed November 1987. 269 P-414A's were purchased new.

SPECIFICATIONS

Compressor: Low Pressure Compressor (LPC): 9 Stage including 3 fan stages High Pressure Compressor (HPC): 7 Stage	Exhaust Nozzle: Variable area, convergent-divergent iris type, hydraulically actuated, 508 to 1080 sq. in.
Max Design Pressure Ratio, SLS: Fan: 2.14 to 1 Overall: 19.8 to 1	Temperatures (SLS): Max rated turbine inlet: 2150F
Airflow Capacity: Bypass airflow ratio: 0.878 to 1 Max allowable air bleed: Max rated airflow: 242.0 lbs/s	Electrical System:
Combustion Chamber: Can-annular, through-flow, 8 cans	Ignition: Two 4-Joule stored energy ignition exciters and spark igniters powered by an engine-driven variable speed alternator; automatic relight
Turbine: LP Rotor: Three stage HP Rotor: Single stage, aircooled	Power Control: Hydromechanical main and afterburner fuel controls and nozzle area control
Thrust to Weight Ratio: 5.26 to 1	Fuel: Primary MIL-T-5624, Grade JP-4, JP-5, and JP-8
Accessory Drive Provisions: Six: Starter, power take-off, hydraulic pump (2), tachometer (2)	Oil: MIL-L-23699, -7808 Capacity: 5.0 gallon Oil Consumption: 0.2 gal/hr

SIZE & WEIGHT		UTILIZATION
Length - Overall:	235.5 inches	F14A Fighter, JF-14A Tomcat Special Test Aircraft (2 engines) F-14A (Iran)
Maximum Diameter:	51.4 inches	
Max Height:	51.8 inches	
Weight, Dry:	4251 lbs	

PERFORMANCE

PERFORMANCE RATINGS AT STATIC SEA LEVEL STANDARD DAY CONDITIONS					
RATING	THRUST (lb)	RPM (HPC/LPC)	SFC (lb/hr/lb)	TURBINE INLET TEMP (degrees F)	AIRFLOW (lb/sec)
Maximum	20,900	14,780 / 10,000	2.78	2,040	242.0
Intermediate (Military)	12,350	14,800 / 9,950	0.689	2,040	242.0
Max Continuous (Normal)	10,800	14,300 / 9,375	0.631	1,845	234.0

PERFORMANCE RATINGS AT STANDARD ALTITUDE CONDITIONS						
RATING	ALTITUDE (ft)	MACH NR	THRUST (lb)	SFC (lb/hr/lb)	TURBINE INLET TEMP (degrees F)	AIRFLOW (lb/sec)
Maximum	35,000	1.8	21,390	2.584	2,110	244.1
Intermediate	20,000	0.6	5,287	0.852	1,958	144.8
Max Continuous	38,000	0.75	2,700	0.874	1,845	77.7

This table was published by the US Navy, and compares the specifications of the TF30 and F110.

The TF30-P-414 fitted to the F-14D is virtually identical in performance to the TF30-P-109 being fitted to the F-111C/G.

The F110-GE-400 is an early variant of the F110 and delivers lower performance in comparison with the more recent F110-GE-129 IPE or EFE variants.

GENERAL DESCRIPTION

The F110-GE-400 engine is a mixed-flow, dual spool afterburning low-bypass turbofan designed and manufactured by General Electric Aircraft Engines in Lynn, Massachusetts. The engine is of modular construction, consisting of six engine modules, and an accessories gearbox. The engine incorporates a 3-stage fan driven by a two-stage low pressure turbine; and a 9-stage axial flow high-pressure compressor driven by a single-stage high-pressure turbine. To moderate engine performance at various power levels the engine features a variable geometry system. The combustor is a through flow annular type. The hinged flap cam-linked exhaust nozzle is hydraulically actuated. The engine-mounted accessory gearbox provides the necessary extracted power needed to drive the accessories. The engine control system regulates speeds, temperature levels and fuel flow for afterburning and non-afterburning operation. The lubrication and ignition system are self-contained on the engine.

SERVICE HISTORY

Development was initiated April 1984 and engine was placed in service in late 1986

SPECIFICATIONS

Compressor: Fan: 3 Stage, variable Inlet Guide Vanes (IGV) High Pressure Compressor (HPC): 7 Stage, variable geometry	Exhaust Nozzle: hinged flap, cam-linked variable converging/diverging
Max Design Pressure Ratio, SLS: Fan: 3.2 to 1 HPC: 9.3 to 1 Overall: 29.9 to 1	Temperatures: Max rated turbine inlet: 2750F (SLS) Max rated turbine exhaust: 1716F (SLS)
Airflow Capacity: Bypass airflow ratio: Max allowable air bleed: 7.0% Max rated airflow: 270 lbs/s	Electrical System: Self-contained
Combustion Chamber: Through flow, annular	Ignition: AC capacitor discharge dual
Turbine: LP Rotor: Two stage, aircooled HP Rotor: Single stage, aircooled	Power Control: Primary - Hydromechanical Secondary - Electrical
Thrust to Weight Ratio: 6.1 to 1	Fuel: Primary MIL-T-5624, Grade JP-4, JP-5, and JP-8
Accessory Drive: Tandem gearbox	Oil: MIL-L-23699, -7808 Oil Consumption: 0.1 gal/hr

SIZE & WEIGHT		UTILIZATION
Length - Overall:	232.2 inches	F-14B, F-14D Super Tomcat (2 engines)
Nominal Diameter:	46.5 inches	
Max Radial Projection:	52.0 inches	
Weight, Dry:	4494 lbs	
Weight, Wet:	4592 lbs	

PERFORMANCE

PERFORMANCE RATINGS AT STATIC SEA LEVEL STANDARD DAY CONDITIONS					
RATING	THRUST (lb)	RPM (HPC/LPC)	SFC (lb/hr/lb)	TURBINE DISCHARGE TEMP (degrees F)	AIRFLOW (lb/sec)
Maximum	26,950	14,666 / 8,257	2.104	1597	261.2
Intermediate	16,333	14,673 / 14,666	0.688	1593	261.2
Max Continuous	14,696	14,459 / 8,038	0.576	1528	245.7

PERFORMANCE RATINGS AT STANDARD ALTITUDE CONDITIONS						
RATING	ALTITUDE (ft)	MACH NR	THRUST (lb)	SFC (lb/hr/lb)	TURBINE DISCHARGE TEMP (degrees R)	AIRFLOW (lb/sec)
Intermediate	35,000	0.8	4,734	0.885	1426	269.4
Maximum	35,000	0.8	9,656	2.288	1432	269.4
Maximum	35,000	1.6	20,966	2.261	1715	238.6