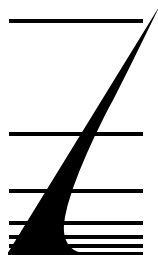


The Market for Aviation APU Engines

Product Code #F644

A Special Focused Market Segment Analysis by:



FORECAST INTERNATIONAL

Analysis 2

The Market for Aviation APU Engines

2011 - 2020

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PROGRAMS

The following reports are included in this section: (**Note:** a single report may cover several programs.)

APIC APS 500
APIC APS 1000
APIC APS 2000
APIC APS 3000
Hamilton Sundstrand Titan T-62T
Honeywell Model 36
Honeywell Model 85
Honeywell Model 131
Honeywell Model 331
Honeywell RE100
Honeywell RE220
Microturbo Rubis
Microturbo Saphir
Pratt & Whitney Canada PW901/PW980

Introduction

Included in this discussion are industry trends that affect the competitive environment, varied market statistics, and individual manufacturers' engine programs. This analysis attempts to explain how these trends affect the world APU/GPU engine market.

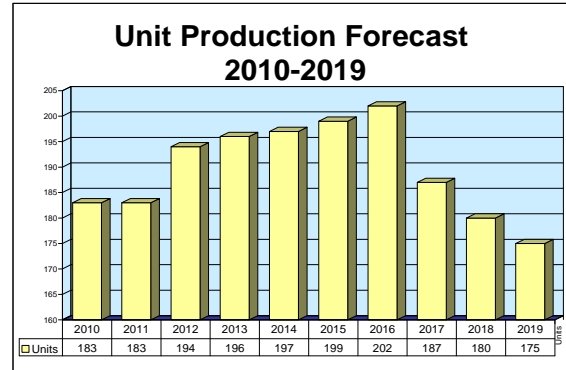
The "Market for Aviation APU Engines" is based on a review of the pertinent aircraft market segments involving commercial, civil, and military platforms. Included in this analysis are engines and machines built by prime manufacturers, co-producers, second-source producers, licensees, and consortia.

* * *

APIC APS 3000

Outlook

- A320 APU market shared with Honeywell's Model 131-9A
- USAF limiting C-5M Super Galaxy program



Orientation

Description. Advanced-technology modular-design airborne auxiliary power unit (APU) producing up to 170 shp (126.7 kW).

Power Class. Maximum shaft output (zero bleed) is approximately 170 shp (126.7 kW); maximum bleed air (zero shp) is 200 lb/min (90.71 kg/min).

Sponsor. Development of the APS 3200 member of the 3000 series was privately sponsored by APIC, now a subsidiary of Hamilton Sundstrand.

Status. In production.

Total Produced. As of June 2010, an estimated 2,007 APS 3000s had been built, for all applications.

Application. Current or proposed applications include the following:

Model Variant	Power or Thrust Rating	Application	Units per Airframe
APS 3200	(See above)	Airbus A318	1
		Airbus A319	1
		Airbus A320	1
		Airbus A321	1
APS 3400		Lockheed Martin C-5 Galaxy (re-engined)	2

Price Range. Estimated between \$550,000 and \$600,000 in 2010 U.S. dollars.

Competition. The chief competition to the APS 3200 is the Honeywell Model 131-9 for the Airbus A318/319/320/321.

Contractors

Prime

Hamilton Sundstrand Power Systems	http://www.hs-powersystems.com , PO Box 85757, San Diego, CA 85757 United States, Tel: + 1 (858) 627-6565, Fax: + 1 (858) 627-6426, Email: businessdev@hs.utc.com , Prime
--	--

APIC APS 3000

Subcontractor

Parker Aerospace Stratoflex Products Division	http://www.parker.com , 220 Roberts Cut-Off Rd, Fort Worth, TX 76114 United States, Tel: + 1 (817) 738-6543, Fax: + 1 (817) 738-9920 (Hose)
The Kahn Companies	http://www.kahn.com , 885 Wells Rd, Wethersfield, CT 06109 United States, Tel: + 1 (860) 529-8643, Fax: + 1 (860) 529-1895, Email: info@kahn.com (Dynamometer)
Unison Industries	http://www.unisonindustries.com , 7575 Baymeadows Way, Jacksonville, FL 32256 United States, Tel: + 1 (904) 739-4000, Fax: + 1 (904) 739-4093 (APS 3200 APU Exciter and Lead & Igniter Plug)

Comprehensive information on Contractors can be found in Forecast International's "International Contractors" series. For a detailed description, go to www.forecastinternational.com (see Products & Samples/Governments & Industries) or call + 1 (203) 426-0800.

Contractors are invited to submit updated information to Editor, International Contractors, Forecast International, 22 Commerce Road, Newtown, CT 06470, USA; rich.pettibone@forecast1.com

Technical Data

Design Features

Compressor. Single-stage compressor.

Combustor. Single reverse-flow annular combustor (patented Sidewinder combustor). Dual igniters, three pilot fuel nozzles, and six main fuel nozzles.

Turbine. Two-stage axial turbine.

Accessories. Two-stage fuel pump; Full Authority Digital Engine Control (FADEC) system.

Bearings. The APS 3200 is a simple two-bearing engine, built with one bearing in front of the lead compressor and one behind the turbine.

Dimensions. The approximate dimensions of the APIC APS 3200 are as follows:

	Metric Units	U.S. Units
Length	1,247 mm	49.1 in
Width	853 mm	33.6 in
Height	757 mm	29.8 in
Weight (dry, without generator)	140 kg	308 lb

Variants/Upgrades

A derivative of the APS 3200 is the APS 3400, which has been selected to power re-engined Lockheed Martin C-5 military airlift transports. The chief difference

between the two is that the APS 3400 is geared to run at 12,000 rpm for the C-5, as opposed to 24,000 rpm for the APS 3200 aboard the 320 Family aircraft.

Program Review

Background. The Auxiliary Power International Corp (APIC) APS 3200 is a high-performance, low-weight auxiliary power unit (APU) for new-build aircraft, as well as a retrofit on existing aircraft. The machine is the first engine to be jointly designed and produced by APIC and is based on proven turbine designs. The machine is a single-shaft-load compressor APU, with the load compressor driven by a two-stage axial-flow turbine. The axial-flow turbine offers a number of advantages, including improved specific fuel consumption (SFC), ease of repair, reduced exhaust noise, and greater growth capability. The first

APS 3200 machine was assembled and tested in June 1991. Deliveries to Lufthansa aboard the new Airbus A321 began in January 1994.

The APS 3200 was designed for the Airbus A319, A320, and A321 as a standard option. The machine was designed from the onset to meet the increased APU performance levels of the larger-cabin A321.

Hamilton Sundstrand announced delivery of the 1,000th APS 3200 to Airbus in June 2003. This model has now logged more than 6 million hours of service.

APIC APS 3000

Sundstrand and Labinal Create APIC, Labinal Leaves. At the Paris Air Show in July 1989, Sundstrand Corp's Sundstrand Power Systems and the former Labinal Inc (now part of Snecma) announced their intention to form a joint venture to design, produce, and market airborne APUs for commercial applications worldwide. The joint firm, Auxiliary Power International Corp (APIC), located in San Diego, California, capitalized on Sundstrand and Labinal's respective and complementary expertise and experience in the field of small gas turbine engines and auxiliary power units. The APUs developed by Sundstrand or Labinal were marketed, sold, and supported by APIC; orders for the APU machines were placed with APIC, which in turn subcontracted the production of the machines to either Sundstrand or Labinal.

Sundstrand bought out former APIC partner Labinal SA (Paris, France) in December 1996. In 2000, UTC's Hamilton Standard bought Sundstrand and became Hamilton Sundstrand.

APIC also has other APU models in production or on offer, including the APS 500, APS 1000, and APS 2000/2100/2300.

APIC APS 3200 Applications

Airbus A318/319/320/321. Although its engines have not been formally selected, the A318 is expected to be offered with the same choice of APUs as the rest of the A320 family: the Model 131-9A, the Hamilton Sundstrand (APIC) APS 3200, and possibly the Hamilton Sundstrand 36-280 or -300.

At the September 1998 Farnborough Air Show, Airbus announced plans to develop the A318. Airbus formally launched the A318 in April 1999, after having received a total of 109 orders and commitments for the aircraft.

The A318 accommodates 107 to 129 passengers. Baseline model range with 107 passengers is 1,500 nautical miles. The A318 made its initial flight in January 2002.

The A319 is a 124-passenger A320, shortened by seven fuselage frames (147 in or 373 cm). The aircraft was formally launched in the spring of 1992. ILFC

(International Lease Finance Corp) placed the first firm order in December 1992.

The A320 is a twin-turbofan-powered narrowbody commercial passenger aircraft seating up to 179 passengers depending on configuration. It has a maximum gross weight of 162,040 pounds (73,500 kg) and a maximum range (at maximum T-O weight) of 3,080 nautical miles (5,704 km). The first flight of the CFM56-powered variant took place in February 1987, with the V2500-powered variant first flying in July 1988.

The A321 is a stretched A320, seating up to 214 passengers depending on configuration. Its maximum gross weight is 181,200 pounds (82,192 kg), and it has a maximum range of 2,400 nautical miles (4,445 km). The design was launched in November 1989 and first flew with IAe V2500 engines (in March 1993). This was followed by the first CFM56-powered flight in May 1993. Deliveries began on January 27, 1994, Lufthansa being the initial recipient (of A321s powered by International Aero Engines V2500s). Deliveries of the A321, powered by the CFM International CFM56-5, began on March 18, 1994, to Alitalia (ILFC-owned).

Airbus launched the new A321-200, an 89-metric-ton growth version of the A321, in 1995. Two 32,000-lb (142.4-kN) CFM56-5B engines power the aircraft.

According to Hamilton Sundstrand, the APS 3200 has "built-in intelligence" that identifies which of these aircraft it is powering and adjusts output to the air conditioning system accordingly. Such fine-tuning reduces fuel burn aboard the A318 and A319.

Lockheed Martin C-5 Galaxy RERP. In October 2000, Lockheed Martin selected the APS 3400 variation of the APS 3200 as part of its Reliability Enhancement and Re-engining Program for the C-5 Galaxy airlifters it produced for the U.S. Air Force in 1969-73 and additionally in 1985-89.

The APU contract value could be in excess of \$110 million over the life of the program, including logistics support. The new APU replaces the Honeywell (originally Garrett) Model 165.

Funding

No funding for the APIC APS 3200 has been identified.

Timetable

<u>Month</u>	<u>Year</u>	<u>Major Development</u>
Early	1950s	T-62T Titan series development work begun
	1958	Initial T-62T production
	1960	First T-62T APU installed in CH-47A
	1989	Sundstrand and Labinal announce marketing plan
Mid		

APIC APS 3000

<u>Month</u>	<u>Year</u>	<u>Major Development</u>
Jun	1991	First APS 3200 engine assembled and operated
3Q	1992	APS 3200 chosen by Air Inter for A321
1Q	1993	APS 3200 chosen by Iberia for A321
Jul	1993	First APS 3200 delivered to Deutsche Aerospace for installation and flight testing
Jan	1994	APS 3200/Lufthansa A321 (with IAe V2500) deliveries begin
Mar	1994	APS 3200/Alitalia A321 (with CFMI CFM56-5) deliveries begin
Mid	1994	First APU deliveries to ILFC
Thru	2016	Continued production of APIC APS 3200

Worldwide Distribution/Inventories

Airlines and leasing firms owning or operating the APS 3200, or which have the engine on order, include the following: **ACES, Air France, Air Macau, All Nippon Airways, British Midland, Lufthansa, Singapore (S.A.L.E.), Aero Lloyd, Airworld, Croatia Airlines, Philippine Airlines, Sky Service, Air France, Condor Flugdienst, Dragon Air, Royal Brunei, Thomas Cook, Lauda Air Italy, Martinair, CCM Airlines, SAETA, Swiss, Air China, Air Malta, LanChile, Air Calin, Middle East Airlines (MEA), China Eastern, Air New Zealand, China Southwest, Vietnam Airlines, Air Inter Europe, Asiana, Egypt Air, Sichuan, United Airlines, Air Jamaica, Austrian, and ILFC.**

Forecast Rationale

In spite of the global economic downturn, Airbus has done a commendable job maintaining a large backlog of A320 series aircraft. The company plans to increase A320 production to 36 aircraft per month in anticipation of an improving world economy. In the coming years, both Airbus and Boeing will have new challengers in the lower end of the narrowbody segment. Bombardier's new CSeries and a possible new jet from Embraer (larger than the 195) will compete with the A319 and 737-700 for sales. At the higher end of the segment, COMAC's C919 and Irkut's MS-21 will compete with the 737-900 and A321.

C-5M Sees Program Reduction

Lockheed Martin's C-5M Super Galaxy program has been scaled back in scope due to cost growth. Originally all 112 C-5A and C-5B aircraft were to receive the avionics and engine upgrade, but the USAF has since decided to limit the program. Both the flight deck and engine of the newer C-5Bs will be upgraded, while some of the C-5As will receive only the avionics. Some of the oldest and highest-timed C-5As will be removed from service.

Overall, we expect APS 3000 series production to total 1,896 units from 2010-2019.

Ten-Year Outlook

ESTIMATED CALENDAR YEAR UNIT PRODUCTION												
Designation or Program	High Confidence					Good Confidence			Speculative			Total
	Thru 2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	
Hamilton Sundstrand Power Systems												
APS 3200 <> A318/A319/A320/A321												
	889	167	167	178	180	181	183	186	187	180	175	1,784
APS 3400 Military <> C-5 M												
	20	16	16	16	16	16	16	16	0	0	0	112
Subtotal	909	183	183	194	196	197	199	202	187	180	175	1,896
Total	909	183	183	194	196	197	199	202	187	180	175	1,896

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Binder & RT	\$45	\$85	DVD	\$50	\$95	(A Subset of G&I above)		
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