General Electric Catalyst

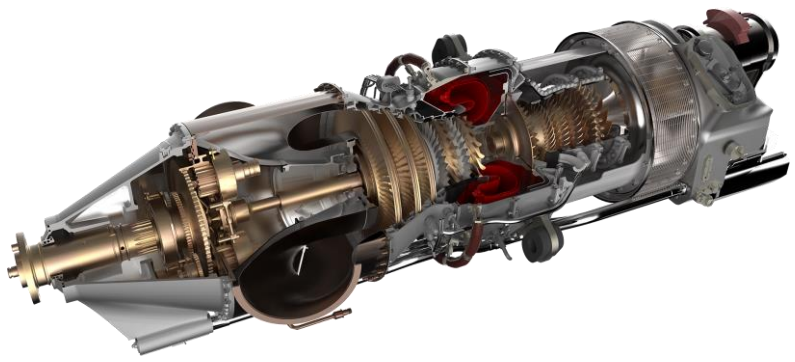
Turboprops
February 2020

Program Briefing

GE officially launched its new 1,000- to 1,600-shp Advanced Turboprop (ATP) family in November 2015 when it announced that Textron had selected the 1,240-shp variant for the new single-engine Cessna Denali. In May 2028, GE renamed the ATP, Catalyst.

The Catalyst will be assembled in GE's Czech facility in Prague. The family is competing against the monolithic Pratt Canada PT6A, as well as Honeywell's TPE331.

We forecast the production of 882 Catalysts (including development engines) over the next 10 years. Of these, the production installs and initial complete engines are projected to have a total retail value of $705.6 million.



Source: GE Aviation

Quick Specs:

Power Class:	1,000 – 1,600 shp
Pressure Ratio:	16:1
Airflow:	n/a
SFC:	n/a
Configuration:	5A + 1C HPC; Annular; 2 HPT; 3 LPT

Manufacturer

General Electric Co.
GE Aviation
Business & General Aviation Turboprops
Beranových 65
199 02 Praha 9 – Letnany
Czech Republic

Technical Description

Components

Layout
Twin-shaft turboprop.

Compressor
All-titanium, 3D aerodynamic five-stage axial plus single-stage centrifugal compressor. The first two stages of stator vanes are variable. Overall pressure ratio is 16:1.

Combustor
Single reverse-flow annular combustor. Liner is additive-manufactured.

HP Turbine
Two-stage unit driving the compressor. Cooled blades.

LP Turbine
Three-stage turbine driving the propeller via a gearbox.

Summary Forecast

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	Total
Units Produced	—	23	51	62	76	103	123	143	147	154	882
Value (2020 $ Millions)	—	18.4	40.8	49.6	60.8	82.4	98.4	114.4	117.6	123.2	705.6

Other Features

Twelve additive manufactured components replace what would have been 855 conventionally manufactures parts. This includes sumps, bearing housings, frames, exhaust case, combustor liner, heat exchangers and stationary flow path components.

The engine features the first Full-Authority Digital Engine and Propeller Control (FADEPC) in the general aviation market.

Variants

GE93—Original in-house designation for the Catalyst.

Catalyst—Official name of the GE93.

Specifications

(Imperial Units)

Model	Max. Power Sea Level (shp)	Pressure Ratio	Comp./Tur. Config.	TIT (°F)	SFC (lb/shp-hr)	Max. Dia. (in)	Length (in)	Weight (lb)
Catalyst	1,240	16:1	5A/1C + 2A/3A	n/a	n/a	n/a	n/a	n/a

(Metric Units)

Model	Max. Power Sea Level (kW)	Pressure Ratio	Comp./Tur. Config.	TIT (°C)	SFC (g/kWhr)	Max. Dia (m)	Length (m)	Weight (kg)
Catalyst	924.7	16:1	5A/1C + 2A/3A	n/a	n/a	n/a	n/a	n/a

Applications

Engine	Aircraft	Engines per A/C
Catalyst	Cessna Denali	1

Marketing Data

Costs

We estimate the retail cost of the Catalyst to be in the range of $800,000.

The Competition

The Catalyst competes directly with the upper power range of the Pratt & Whitney Canada PT6A. Also, in the mix will be the Honeywell TPE331.

Milestones

Date	***Milestone***
2012	ATP concept development begins
Nov. 16, 2015	GE announces selection of ATP for Cessna Denali
May 23, 2016	Initial combustor tests completed
Dec. 22, 2017	First run of the ATP
Mar. 7, 2018	ATP given new name, Catalyst
July 23, 2029	Catalyst selected for TriFan 600 hybrid propulsion system
2020	GE Turboprop Center of Excellence to open
2020	First flight of Denali planned

2021 Certification of Denali planned

Program Overview

Background

Origins

In 2012, GE aviation began studying concepts for a new clean-sheet 1,000- to 1,600-shp general aviation turboprop. The company officially launched the new Advanced Turboprop (ATP) family in November 2015 when it announced that Textron had selected the 1,240-shp variant (inhouse designation was GE93) for the new single-engine Cessna Denali.

Plans called for detailed design review for the ATP to be conducted in 2017 with first full engine test in late 2017.

GE Turboprop Center of Excellence

In January 2016, GE announced plans to build a new turboprop development, test and production facility located at its Prague (ex-Walter) location. Officially called the GE Turboprop Center of Excellence, when it opens in 2020 it will be the site of ATP production.

In October 2016, GE reported that it had finalized negotiations with the Czech government on an investment agreement to build the new facility.

First ATP Components Tested

In May 2016, GE completed initial combustor tests for ATP at the company's US facility in Cincinnati.

Additive Manufacturing

In October 2016, at the Orlando NBAA show, GE announced that it had completed testing a 35%-additive manufactured demonstrator engine. The engine, based on the CT7-2E1, and dubbed the a-CT7, was aimed at validating the additive manufacturing process that will be used ATP production. The demonstrator featured 16 additive-manufactured parts that would normally comprise more than 900 individual subtractive-manufactured (e.g., milled) parts. Twelve additive-manufactured parts will be used in the ATP, including: sumps, bearing housings, frames, exhaust case, combustor liner, heat exchangers and stationary flowpath components.

MRO

TBO

The initial planned time between overhaul (TBO) for the Catalyst is 4,000 hr.

Current Developments

Development

GE announced that a complete ATP had its first run in December 2017. Certification testing would begin in June 2018. The company said that a second engine was near completion at that time.

ATP Gets a New Name

In March 2018, GE Aviation announced that the ATP had been officially named Catalyst.

Catalyst/Denali Development Program

In May 2018, GE reported that it would soon start certification testing on the Catalyst. Further reported was that the first engine to test was running at full power and that a second engine, that would be used for altitude testing, was nearing completion.

In April 2019, a Catalyst equipped with a new, state-of-the-art, 105-inch, composite McCauley propeller, ran at full power and max RPM at the Czech Technical University's new test cell in Prague. According to reports, the engine and propeller exercised the pitch system using a Full Authority Digital Engine Control (FADEC) with integrated propeller control. The full-range pitch testing included beta, fine pitch, course pitch and feather – all integrated and controlled by the FADEC. The Catalyst will be the first turboprop in the business and general aviation market to use a FADEC.

By May 2019, the international Catalyst team had completed more than 1,000 hr of testing between three engines and 300 hr of testing on the FADEC in Textron Aviation's iron bird, which is used to validate integration between systems and the Denali aircraft. Initial testing up to 41,000 ft in an altitude chamber was completed in May 2019, validating performance and operability. Tests included chops, bursts and bodies at different points in the envelope, cold-soak starts and auto relight capability.

GE said, in May 2019, that five Catalysts had been assembled with another five scheduled to be completed in the second half of the year for certification testing.

Hybrid Propulsion

In July 2019, GE Aviation and XTI Aircraft Company announced that XTI had selected the Catalyst engine as the core of its TriFan 600 hybrid-electric propulsion system. The two companies would work together to define a series hybrid architecture that would meet the TriFan performance requirements.

The TriFan 600 is planned to have the speed, range and comfort of a business jet and the ability to take off and land vertically, like a helicopter. Using three ducted fans, the TriFan 600 will lift off vertically. Its two wing fans then would rotate forward for a seamless transition to cruise speed and its initial climb. It will be designed to reach 30,000 ft and cruise to the destination as a business aircraft. The TriFan 600 will incorporate advanced safety features, including autopilot and computerized controls for takeoff and landing.

At the time of the announcement, XTI claimed customers had placed 80 orders for the TriFan 600 under XTI's presale program.

Program Status

As of mid-2020, GE Aviation reported that it expected the first flight of the Catalyst on a King Air 350 flying testbed and delivery of the first engine to Textron Aviation later in 2020 to power the first Cessna Denali. Further reported was that test engines had more than 1,800 hours of combined operation and that 10 engines had been assembled. GE said had completed development testing for icing certification. Other development tests had included altitude (41,000 ft in an altitude chamber), vibration, durability, ingestion, and integrated prop controls.

At NBAA-BACE in October 2019, GE officials had explained that newer turboprop testing standards and engine preparations for the flying testbed were delaying Catalyst's flight testing and delivery. GE and Textron Aviation originally expected first flight of the Denali in late 2019.

Teal Group Evaluation

The launch of the ATP confirmed GE's goal to seriously take on Pratt & Whitney Canada's near monopoly of the small- to mid-size turboprop market with its PT6A (500-1,650 shp). First, in 2008, GE acquired the Czech company Walter Aircraft Engines, which built the M601 turboprop in the 550- to 778-shp range. Then the company injected some of its advanced technology into the M601 and came up with the new H series of small turboprops (see report herein) in 2012. This gave GE a creditable PT6A competitor in the 750- to 850-shp power band, which has had some initial successes. Now, with the new Catalyst (1,000-1,600 shp), GE will have an answer to the entire PT6A line of props.

Success will not be easy for GE. Pratt Canada has a broad and well entrenched product line in the PT6A, with a wide range of applications and a proven aftermarket presence. Unlike the battle in the larger engine segments, a single application won cannot tip the balance of power. It will be a long-term contest of winning new applications, and perhaps stealing a few.

The Denali just represents the start of the battle, but it is significant, nonetheless. We see further successes and have included an 'undetermined" line in our forecast below to represent this.

It is too early to asses the technical and market viability of the TriFan 600, so we don't include a dedicated line for the aircraft in our forecast below. The "undetermined" line, however, covers the likelihood that the Catalyst will garner more applications, perhaps including the novel XTI aircraft.

We forecast the production of 882 Catalysts (including development engines) over the next 10 years. Of these, the production installs and initial complete engines are projected to have a total retail value of $705.6 million.

Production Forecast

Units	Through 2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	Total
Catalyst												
development engines	10	—	—	—	—	—	—	—	—	—	—	10
Denali	—	—	23	51	56	56	63	63	63	67	74	516
undetermined	—	—	—	—	6	20	40	60	80	80	80	366
Total	**10**	**—**	**23**	**51**	**62**	**76**	**103**	**123**	**143**	**147**	**154**	**892**

Value (2020 $Millions)	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	Total
Catalyst											
Denali	—	18.4	40.8	44.8	44.8	50.4	50.4	50.4	53.6	59.2	412.8
undetermined	—	—	—	4.8	16.0	32.0	48.0	64.0	64.0	64.0	292.8
Total	**—**	**18.4**	**40.8**	**49.6**	**60.8**	**82.4**	**98.4**	**114.4**	**117.6**	**123.2**	**705.6**