



TPE331 Turboprop Evolution

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TPE331 Turboprop Revolution

The following chronological reference indicates the maturity path which has positioned the TPE331 as one of the prominent turboprop propulsion engine families of all time.

The Series I/II Pre-Century Engines -- 1965

The original production TPE331-25, -43, -51, -63 etc. was a 575 SHP engine with a target TBO of 1750 hrs. No hot section was required. The Series I engines were superseded fairly rapidly by the Series II engine, such as the -25AA (MU2) and the -43BL (Commander) which were the centroid of the early production activity. Other aircraft that used the Pre-Century engine were:

1. Volpar Beech Turbo-liner
2. Carstedt Dove
3. Fairchild Porter PC6
4. DeHavilland Beaver
5. Fletcher Ag Plane
6. Piper Pawnee Conversion
7. Grumman Ag Cat Conversion
8. Piper Comanche 400 Conversion (In 1968, Garrett Corporation set a world altitude record for class.)

The T76 /OV10 Requirement and the Evolution of the Century Series Engine Family

Rockwell Standard's OV-10 won the USAF/USN competition for production of a twin engine COIN aircraft. This first iteration of the OV-10 used two 715 SHP TPE331s that externally looked like the Pre-Century engine, but internally reflected drastic improvements in the power section and gearbox. Prior to entering service, the T76 completed a very rigorous full Military Qualification Test (MQT). As a result of the aggressive development and certification activity on the T76 engine, the derivative TPE331-1/-2

FAA-certified engines provided outstanding service from the outset of their introduction into commercial use. The engine was adopted for use on the following airframes:

1. Mitsubishi MU2-F and G models
2. Swearingen Merlin IIB
3. Short Brothers SC7 Skyvan
4. Volpar Beech Turboliner

5. Carstedt Dove Conversion
6. Fairchild Peacemaker AU23
7. US Dept. of Interior Beaver
8. US Dept. of Interior Goose
9. Marsh Aviation Thrush Conversion
10. Marsh Aviation Ag Cat Conversion
11. Rockwell Aviation Services "Century Commander" retrofit replacing Pre-Century Engines
12. Capitol Aviation MU2-B/D retrofit replacing Pre-Century engines
13. Comanche 400 Conversion (Garrett Corp. Exp.)
14. Marsh Aviation T34
15. Interceptor 400
16. CASA 212 Pre-Series Aircraft for Spanish Air Force
17. Fletcher Ag Plane
18. Weatherly Ag Plane
19. Lancair 4P
20. Piper Pawnee Ag Plane

Introduction of the 840 SHP Family of Engines

The natural evolution for aircraft is to grow in size and to fly higher and faster. The Century engine was the starting point for the next generation of 331s. Retaining the same frame size, the 715 SHP turbine section was mated to a new compressor section which increased the engine pressure ratio and engine thru flow. Max turbine inlet temperature was maintained at 1840 degrees F.

The inlet up -3 engine, which was configured for use on the Swearingen Merlin III and Metro commuter aircraft, allowed a normal 840 SHP gearbox rating for takeoff and an augmented emergency limit of 940 SHP. The two other members of the 840 family were the TPE331-5 and -6 engines which both had gearbox ratings of 750/776 SHP. The -3 and -6 engines featured gearbox output speeds of 2000 RPM while the -5 engine had a 1591 RPM output speed. Other differences from the -1/-2 engine included the use of a Bendix fuel control instead of the Woodward on the -5 and -6 engines, and the incorporation of an ITT system to measure interstage turbine temperature. The -3 engine used a Woodward fuel control. Applications of this 840 SHP engine family include:

TPE331-3 Engine Applications

1. Merlin III, IIIA, IV, IVA
2. Metro/Metro II
3. Century Aviation (Volpar) Jetstream Conversion
4. Handley Page (Jetstream) CXX
5. Fabrica Pucara COIN (Argentina)
6. Sikorsky S55T Heli-Tec Conversion

TPE331-5 Engine Applications

1. Commander 690, 690A, 690B, 690C, 690D
2. CASA 212-100
3. Dornier 228-100
4. Mitsubishi MU-2N, -2P
5. Sherpa 650
6. Malibu conversion (Innova)
7. Various Ag Planes

TPE331-6 Engine Applications

1. Mitsubishi MU-2J,-2K,-2L-2M
1. Beech B100
2. Lancair IVP
3. Helio Courier (Jensen Conversion)
4. Various Ag Planes
5. Numerous examples of -1/-2 powered aircraft such as the Skyvan that had the original 331 engine replaced with a -6 engine.

Development of the Up-Rated T76 and the TPE331-10/-11

The need for an up-rated T76 for the OV10D resulted ultimately in the creation of the commercial variants which were the TPE331-10 and -11 engines. To achieve the target 1040 SHP for takeoff, the new T76 utilized the proven 840 compressor section and mated with a completely new turbine section that utilized cooling in the first stage. The use of first stage cooling allowed the turbine inlet temperature to be raised to 2040 degrees F.

Since the -10/-11 family would be limited to 1000 SHP (takeoff) the maximum turbine inlet temperature was lowered to a more conservative 2004 degrees. This new family of 331s was equipped with Woodward FCUs, an EGT system and a Single Red Line auto-start system with engine torque and temperature limiting capability.

As in the case of the original T76/715 SHP engine, the T76/1040 went through a demanding MQT certification.

The civil certification of the -10 and -11 engine was completed in 1978. In this same time period, the certification of the TPE331-8 was completed with first deliveries made to Cessna for their Conquest II aircraft. The -8 engine was rated at 865 SHP for takeoff but had markedly improved altitude performance compared to that of the 840 family. The -9 engine, which used a Woodward hydro-mechanical FCU, was also certified. It was chosen for two aircraft, the Single Engine Beech 38P and the OMAC (Laser 300).

In addition to the T76, the following TPE331-10 applications have resulted:

TPE331-10 Applications

1. Mitsubishi Marquise (MU2B-60)
2. Mitsubishi Solitaire (MU2B-40)
3. Twin Commander 980 (695)
4. Twin Commander 1000 (695A, 695B)
5. Fairchild Merlin IIIB/IIIC/300
6. CASA 212 200/300
7. Dornier 228-200
8. Jetstream 31
9. Beech Kilo Alpha C90/E90 Conversion
10. Predator B (MQ-9 Reaper)
11. DHC-2 Otter (Texas Turbine Conversions)
12. Thrush Ag Aircraft
13. Grumman Ag Cat
14. Dromader Ag Plane
15. Turbine Legend (Marty Abbott)
16. Comp Air 9
17. Malibu (Innova Conversion)
18. NXT Turbine (Nick Beck)
19. Sherpa 650 STOL
20. Epic Escape

In addition to the above applications, there were STCs that were developed to allow modification of literally every member of the 840 SHP family (-3,-5,-6) and the -8 to be updated with the -10 power section. It should be noted that all "Factory New" -10 engines had minimum gearbox ratings (mechanical limits) of 940 SHP. Converted -10 engines retained their original gearbox limits.

Approximately 1300 Dash 10 Conversions have been completed as of late 2011.

Development of the TPE331 -12 and -14 Engines

The next iteration to the -10/-11 engine was the TPE331-12 engine. While the physical dimensions remained nearly identical to the -10/-11 family, the compressor and turbine sections were changed to establish a takeoff rating (dry) of 1100 SHP. The engine was available in both inlet up and inlet down with gearbox output speeds of 2000 RPM (-12B only) and 1591 RPM. All engines used strain gauge torque sensing and utilized the SRL system.

TPE331-12 Installations

1. CASA 212-400
2. Jetstream 32
3. Metro 23
4. Shorts Tucano Trainer
5. Texas Turbines Cessna Caravan Conversion
6. Aero Twin Cessna Caravan Conversion
7. Comp Air 9
8. Texas Turbine Otter(DHC2) Conversion
9. Dromader Ag Plane

The initial -14 development program culminated in the early 1980s with the certification of the TPE331-14A/-14B for the Piper 400LS.

The -14 resulted from an approximate 20% geometric scaling of the original -10 engine design. This series is often referred to as “Big Blocks” compared to the “Small Block” TPE331-1 thru -12 family of engines. Like the T-76 engines, the -14A/-14B offered counter-rotation. The thermodynamic rating of the engine was 1645 SHP with a gearbox limit of 1250 SHP.

The -15AW was essentially the same engine as the -14A/-14B but had a gearbox limit of 1645 SHP. A later version of the -14/-15 family was the TPE331-14GR/-HR which offered a thermodynamic rating increase to 1759 SHP, a gearbox rating of 1650 SHP, and counter-rotation.

TPE331-14/-15 Applications

Piper 400LS	-14A/-14B
Marsh Aviation S2T Proto-Type	-14A
Jetstream 41	-14GR/HR
Antonov 38	-14GR
Marsh CDF/S2T Tracker	-14GR
Comp Air 12	-14GR
Comp Air 11	-14GR
Kestrel	-14GR
Air Tractor 802	-14GR
Taiwan/Argentina S2T	-15AW
Grob 520	-15AW

TPE331-10 Conversion Engines

Original Designation	Conversion Designation
TPE331-3 U	TPE331-10 UA
TPE331-5	TPE331-10 T
TPE331-6	TPE331-10 AV
TPE331-8	TPE331-10 N

Today and Tomorrow...

Today's TPE331 experience profile is built on an accumulation of a lengthy service history demonstrated in often demanding conditions throughout the world. Long service intervals (5000 to 9000 hrs.) augmented by superior installed performance attributes, provides the ultimate installed performance and cost advantages for 331 operators.