



AEROSHELL TURBINE OIL 560





Shell Aviation
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TURBINE ENGINE OIL MARKET



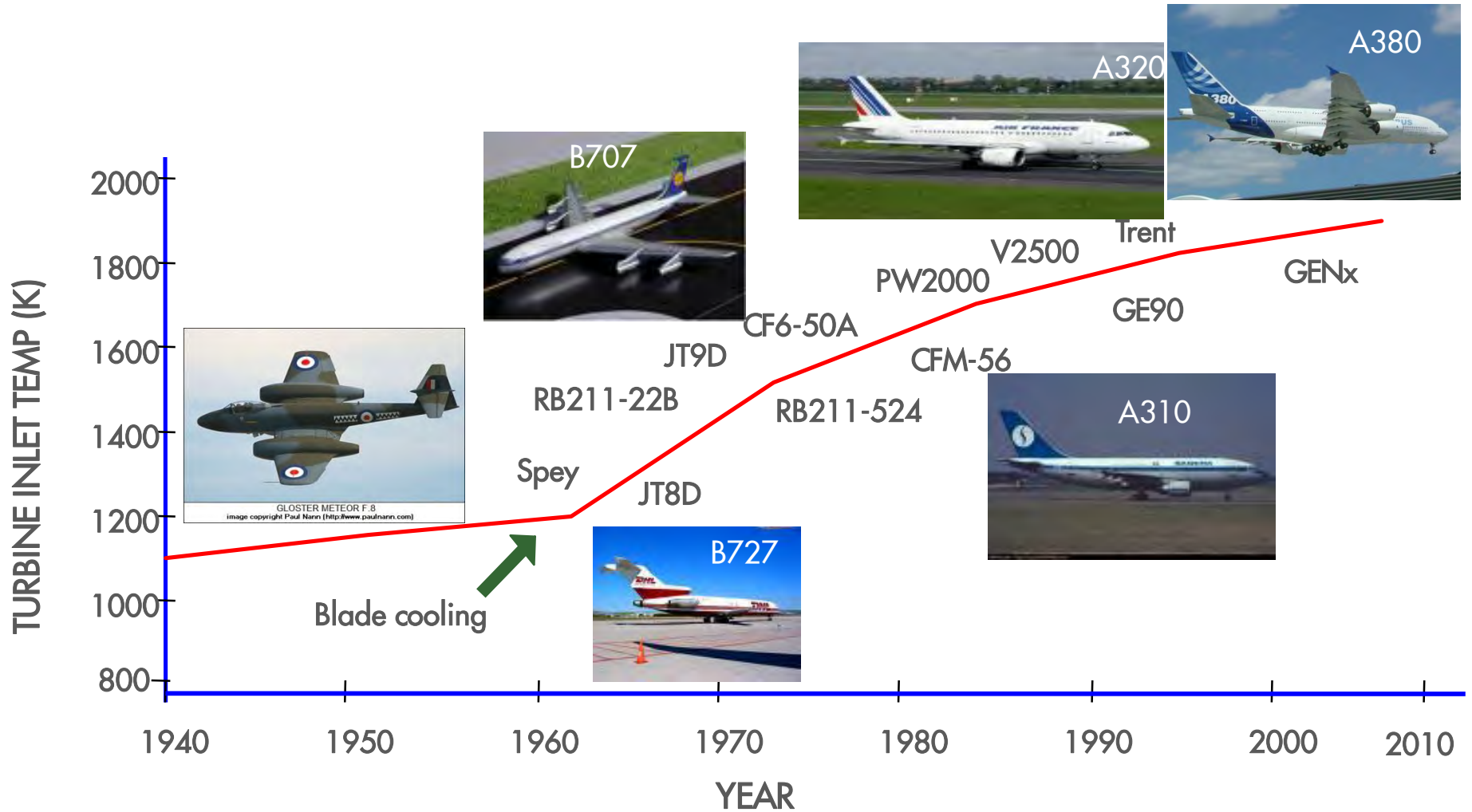
ExxonMobil

NEW	HTS / HPC	 Ascender * Newest Technology	Grandfathered into spec, lower performance vs. Shell Ascender on seal compatibility 	MJ 387 * Limited Commercial Availability	Tier 3
1980'S	HTS / SPC	ASTO 560	Eastman 2197	MJ 254	Tier 2
1960'S	STD / SPC	ASTO 500	Eastman 2380	MJ II	Tier 1

SPC – Standard Performance Capability
 HPC – High Performance Capability

The industry is trending to newer, higher performing turbine engine oil technology due to increased engine operating temperatures to drive fuel efficiency & to decrease maintenance costs.

INDUSTRY TREND: HOTTER ENGINE TEMPERATURES REQUIRE BETTER OIL



- Industry increasing engine operating temperatures to drive fuel efficiency is putting more demands on Turbine Engine Oil requiring new technology to replace older turbine engine oil technology
- Oils developed in 1960's for cooler running engines not performing to today's expectations & coking

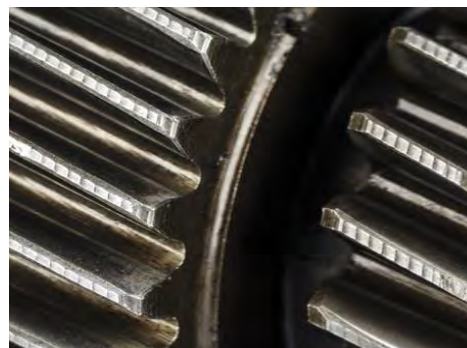
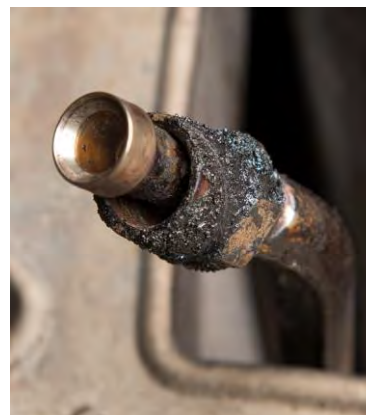
REDUCED MAINTENANCE BURDEN

- Oils that form coke at high temperatures or cause seal-compatibility issues can lead to an excessive maintenance burden
- Low coking, elastomer friendly oils mean cleaner (less deposit) engines for easier borescope inspections and problem identification



PROVEN PERFORMANCES

- Pratt and Whitney Canada has intensively tested AeroShell Turbine Oil 560
 - In laboratory
 - In service with a US based operator
- Compare to Grade STD oils results have shown:
 - Reduction of coking build up
 - Improved wear resistance
 - Long-term durability
 - Excellent elastomer compatibility



LOWER OIL CONSUMPTION

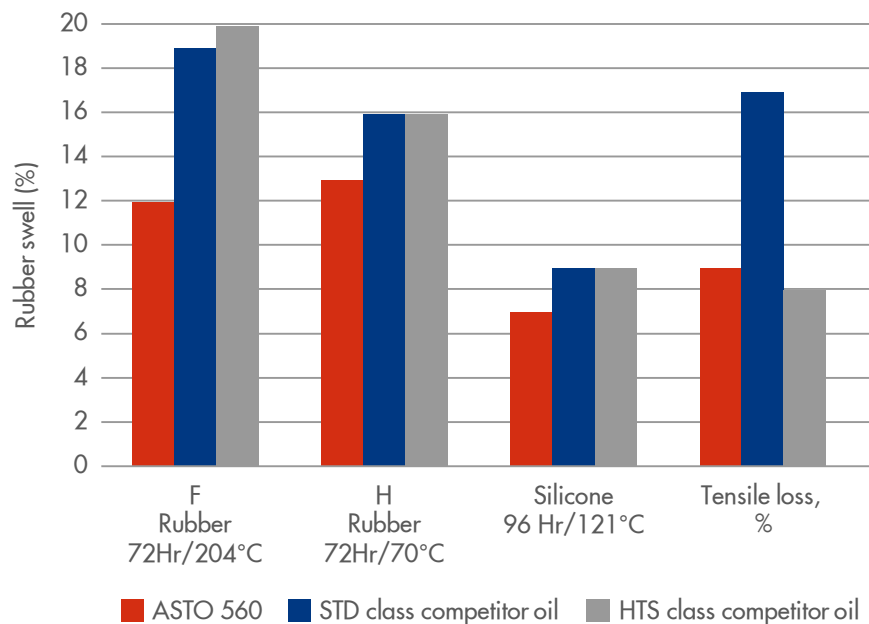
- Some oils cause elastomer seal degradation, which can cause leaks leading to high
 - **overhaul costs**
 - **carbon deposition**
 - **oil consumption**

Examples of elastomer seal degradation with a competitor's TEO in a GE CF34-3



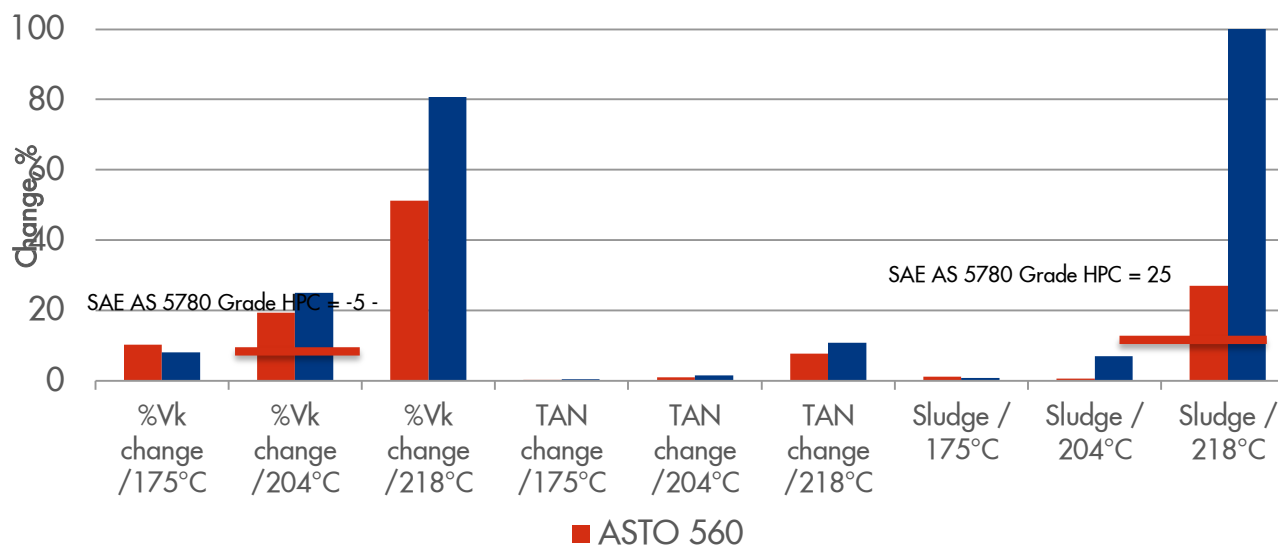
LOWER OIL CONSUMPTION

- ASTO 560 causes optimal seal swelling compared with STD and HTS class competitor oils



CUTTING COSTS THROUGH ENHANCED STABILITY

- ASTO 560 resists change in oxidation and corrosion tests*
- Total acid number (TAN) measures an oil's oxidation. A competitor's oil thickens more, has a greater TAN change and breaks down to form a lot more sludge



*FTM-791C Method 5308 (mod)

CUTTING COSTS THROUGH ENHANCED STABILITY

- Far less potentially harmful sludge was formed with ASTO 560 after 72 hours testing at 218°C The competitor's SPC grade sample required three filters to capture the sludge

ASTO 560
<27 mg sludge



Competitor SPC oil
>110 mg sludge



Filter 1



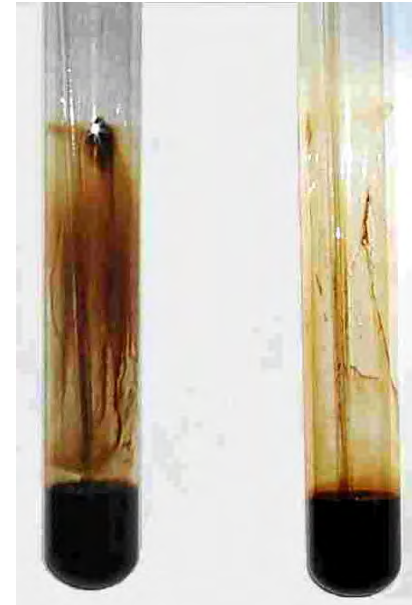
Filter 2



Filter 3

CUTTING COSTS THROUGH ENHANCED STABILITY

- Oil degradation in vapour phase can be seen in the OxCorr test where vapours condense on a glass tube
- The test demonstrates that ASTO 560 has far less sludge in the vapour phase
- This shows that it produces less sludge at high temperatures

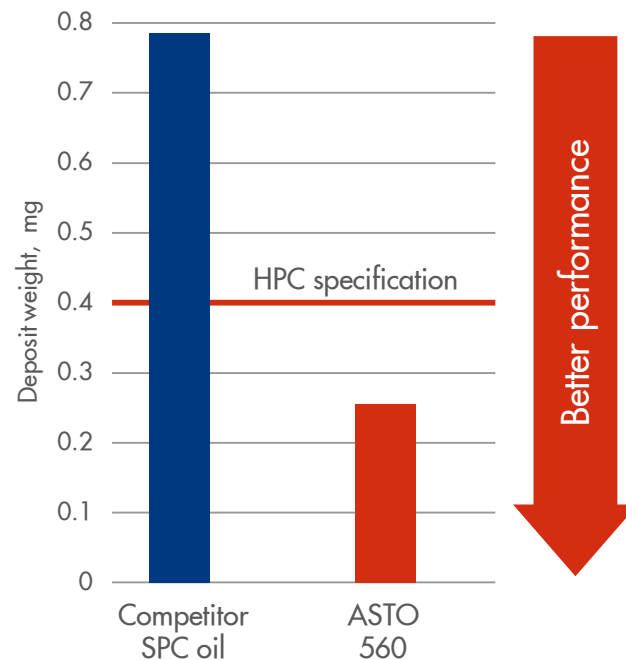


Competitor
SPC oil

ASTO
560

LOWER COSTS AND ENHANCED SAFETY

- Coking propensity is not specified by the MIL-PRF-23699F HTS standard
- Nevertheless, ASTO 560 is well below the maximum coking limit for the AS 5780A specification*



LOWER COSTS AND ENHANCED SAFETY



Sealing rings in excellent condition throughout, including this oil spray nozzle



"Cleaner than normal" gearbox casing

Borescope inspection revealed negligible levels of carbon in scavenge tubes



SUMMARY

- AeroShell Turbine Oil 560 is helping to cut costs by extending component life
- In addition to PWC SB14398 incorporation, AeroShell Turbine Oil 560 superior performances is allowing 500 FH TBO extension on PT6A-66D (850hsp) from 3000Fh to 3500Fh.
- AeroShell Turbine Oil 560 helps to keep engine oil system and exhaust area cleaner
- AeroShell Turbine Oil 560 helps to reduce oil consumption.



PT6 ENGINE FACT SHEET

PT6 is a Pratt & Whitney Canada Turbo Prop Engine

51,000 PT6 Engines produced since 1963

7200 Operators in 180 Countries

Airplanes: Beechcraft King Air, Beechcraft 1900, Cessna Caravan

Helicopters: MD Helicopters, Sikorsky, Augusta

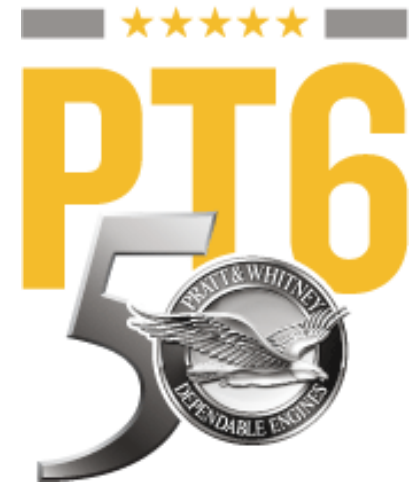
PT6 Community: www.pt6nation.com PT6 facebook page

Customer References using ASTO 500:

- Chalais Aviation (France): 7 Aircraft (Beech 1900/Beech C90)
- Twin Jet (France): 10 Aircraft (Beech 1900)
- Alpine Aviation (US): 27 Aircraft (Beech 1900, Beech 99)

BP2380 & MOBILJET 2: Standard Oils typically used

- CVP: Local logistics, Pricing, Credit/Payment Terms, Inventory Reduction, Relationships



TBM SI.2016-005: HTS ENGINE OIL INTRODUCTION

Today, following the study carried-out with all the data collected, PWC has approved new oil that will help to address carbon in oil phenomenon reported by some TBM operators. AeroShell Turbine Oil 560 (ASTO 560) is a High Thermal Stability (HTS) Type II (5 centistokes) oil approved to MIL-PRF-23699G and SAE-AS5780 specifications. Before its full approval for the PT6A engine family, this oil has been extensively tested by PWC. Laboratory and engine testing results showed that ASTO 560 possesses viable performance and benefits such as reduced coking, improved wear resistance and long-term durability when compared to standard Type II oils. ASTO 560 is fully compatible and interchangeable with other Type II lubricants. As of today, ASTO 560 is the only HTS oil approved for the PT6A engine family.

P&WC SB NO 1001R33

(6) Switching / Change over standard type II with another standard type II, standard

type II with HTS or vice versa (Ref. Tables 3 and 4)

(a) For engines with less than 100 hours since new or since complete overhaul of the entire lubrication system hardware, the top-up method or the drain and fill method are acceptable without any additional oil filter inspection or replacement requirement (Ref. EMM 72-00-00, SERVICING, Lubricating Oil System).

(b) For engines with more than 100 hours since new or since complete overhaul of the entire lubrication system hardware, the top-up method is required as follows:

1 Analyze the original engine oil per Para. 3. D. (5), (a), or alternatively drain and replace with original oil (same brand/type currently in use).

P&WC SB NO 1001R33 - CONTINUED

NOTE: Not require if unacceptable amount of carbon debris is found and flush is performed per step 4, a below.

2 Inspect main oil filter paying special attention to carbon deposits (Ref. EMM 79-20-02, OIL FILTER & CHECK VALVE - MAINTENANCE PRACTICES).

3 If no carbon debris is found (traces are acceptable) (Ref. Fig. 1), the original oil does not need to be drained and engine does not need to be flushed.

a Top-up the engine oil with candidate oil in accordance with the oil level check (top-up) procedure (Ref. EMM 72-00-00, SERVICING, Lubricating Oil System).

PT6 MARKET REFERENCE GUIDE

AMI DC-3 : PT6A-65AR

Air Tractor AT 402A/402B : PT6A-11AG, PT6A-15AG

Air Tractor AT 502B : PT6A-15AG, PT6A-34AG

Air Tractor AT 602 : PT6A-60AG, PT6A-65AG

Air Tractor AT 802/802A/802AF/802F : PT6A-65AG, PT6A-67AG, PT6A-67F

Basler Turbo BT-67 : PT6A-67R

Beechcraft 1900/1900C : PT6A-65B

Beechcraft 1900D : PT6A-67D

Beechcraft 99 : PT6A-20

Beechcraft 99A : PT6A-27, PT6A-28

Beechcraft B99 : PT6A-27

Beechcraft C12F : PT6A-42

Beechcraft C99 Airliner : PT6A-36

Beechcraft King Air 200/B200 : PT6A-41, PT6A-42

Beechcraft King Air 300/350 : PT6A-60A

Beechcraft King Air A100 : PT6A-28

Beechcraft King Air B200GT/250 : PT6A-52

Beechcraft King Air C90A/B/SE : PT6A-21

Beechcraft King Air E90 : PT6A-28

Beechcraft King Air F90-1/C90GT/C90GTi/C90GTx : PT6A-

Beechcraft T-44A : PT6A-34B

Blackhawk XP135A Cheyenne Series : PT6A-135A

Blackhawk XP135A Conquest I : PT6A-135A

Blackhawk XP135A King Air 90 Series : PT6A-135A

Blackhawk XP42 King Air 200 : PT6A-42

Blackhawk XP42A Caravan Series : PT6A-42A

Blackhawk XP52 King Air 200/B200 : PT6A-52

Blackhawk XP61 King Air 200/B200 : PT6A-61

Blue 35 : PT6A-35

Bombardier (deHavilland) DHC-6 Twin Otter Series 300 : PT6A-27

Bombardier (deHavilland) Dash 7 : PT6A-50

CATIC/HAIG Y-12 : PT6A-27

Cessna 208/208B Caravan I : PT6A-114A, PT6A-114

Cessna 208B Grand Caravan EX : PT6A-140

Cessna Conquest I : PT6A-112, PT6A-135A

Conair Aviation - S2 Turbo-Firecat : PT6A-67AF

EADS Socata TBM 700 : PT6A-64

EADS Socata TBM 850 : PT6A-66D

EPIC LT : PT6A-67A

Embraer Bandeirante EMB-110 : PT6A-27, PT6A-34

PT6 MARKET REFERENCE GUIDE

Embraer EMB-312 Tucano : PT6A-25C

Embraer EMB-314 Super Tucano : PT6A-68C

Enhanced Aero B200GTO : PT6A-52

Frakes Mallard : PT6A-34

Frakes Turbo Cat Model A/B/C : PT6A-15AG, PT6A-34AG

IAI HeronTP : PT6A-67A

Ibis Aerospace Ae 270 HP : PT6A-66A

JetPROP DLX : PT6A-34, PT6A-35

KA1-KT-1/KO-1 : PT6A-62

LET L410 : PT6A-27

Lancair International Inc. Evolution : PT6A-135A

National Aerospace Laboratories Saras : PT6A-66

PIAGGIO Avanti II : PT6A-66B

PIAGGIO Avanti P-180 : PT6A-66

PIAGGIO P-166-DL3 : PT6A-121

PZL-Okecie PZL-106 Turbo-Kruk : PT6A-34AG

PZL-Okecie PZL-130 TC-II Turbo-Orlik : PT6A-25C

PZL-Okecie PZL-130 TE Turbo-Orlik : PT6A-25A

Pacific Aerospace 750 : PT6A-34AG

Pacific Aerospace XSTOL (750XL) : PT6A-34

Pilatus PC-6 Turbo Porter : PT6A-27

Pilatus PC-7/PC-7 MKII Turbo Trainer : PT6A-25C, PT6A-25A

Pilatus PC-9 Turbo Trainer : PT6A-62

Piper Cheyenne IA : PT6A-11

Piper Cheyenne II/IIXL : PT6A-28

Piper Cheyenne III/IIIA : PT6A-41, PT6A-61

Piper Meridian : PT6A-42A

Piper T1040 : PT6A-11

Polish Aviation Factory M28 Skytruck : PT6A-65B

Quest Kodiak : PT6A-34

Reims F406 Caravan II : PT6A-112

Schweizer G-164B AG-Cat Turbine : PT6A-111AG, PT6A-15AG, PT6A-34AG

Schweizer G-164D AG-Cat Turbine : PT6A-34AG

Shorts 330 : PT6A-45A/45B, PT6A-45R

Shorts 360 / 360-300 : PT6A-67R, PT6A-65AR, PT6A-65R

Shorts C-23A Sherpa : PT6A-45R

Shorts C-23B Super Sherpa : PT6A-65AR

Silverhawk 135/StandardAero C90/E90 : PT6A-135A

PT6 MARKET REFERENCE GUIDE

StandardAero King Air 200 : PT6A-42

StandardAero King Air 200/B200 : PT6A-52

StandardAero King Air F90 : PT6A-135A

T-6A Texan II : PT6A-68

T-G Aviation Super CheyenneÂ® : PT6A-135A

Thrush 510P : PT6A-34AG

Thrush 550P : PT6A-60AG

Thrush 660 : PT6A-60AG, PT6A-65AG

Thrush 710P : PT6A-65AG, PT6A-67AG

Turbine Air Bonanza : PT6A-21

Vazar Dash 3 Turbine Otter : PT6A-135A, PT6A-34

