

The Rolls-Royce Allison T56 is fifty

The Rolls-Royce T56 engine is celebrating its Golden Anniversary. With over 180 million flight hours, 16,000 engines produced and 70 countries served, the T56 is the longest-running large turboprop engine in continuous production. The latest Series IV engine is destined to serve well into the twenty-first century. *Phillip McKinnon* considers this engine in New Zealand military and civil service



Outwardly the T56 design concept remains unchanged over the 50 years of its life. The non unitary construction with extension shaft driven propeller reduction box is a distinctive feature.

When The Royal New Zealand Air Force ordered the Lockheed C130- E Hercules to replace their Handley Page Hastings the new Hercules were to be powered by four Allison T56 - A -7 turboprop engines. Subsequently when the order was changed to the new C 130 H model one of the major improvements incorporated in the new model was the installation of T56 - A -15 engines. The Allison T56 series engines was developed from the successful T38 series against a requirement to provide power for the USAF's new tactical transport aircraft, the C130 Hercules.

The T56 is a single shaft, modular design, turbo-prop engine with a 14-stage axial flow compressor driven by a four-stage turbine unit. The reduction gearbox has two stages of gear reduction that features a propeller brake. Also, somewhat unusually, the reduction gearbox is not unitary with the engine and is connected to the power section via a shaft and torque meter assembly. Combustion takes place in six can-annular type combustors while engine accessory drive is taken from the engine housing with propeller and aircraft accessory drive taken from the reduction gear box. Start power is via a bleed air driven mechanical drive. In almost all applications turning the engines power output into propulsive effort is a Hamilton Standard 54H60 series propeller.

Allison failed to make the deadline for delivery of the first engine to Lockheed in May 1953, as the T56-A-1 would only produce 3,000 horsepower instead of 3,750 required by Lockheed for Hercules. The whole T56 project almost collapsed in August 1953 during engine testing. After running for only six and a half hours, a T56-A-1 engine exploded on the test stand. After redesign it failed again in September. However following another redesign it ran successfully on the third try.

Development of the T56 series has been relatively straightforward essentially following the path of increased temperature and



On the wing the T56 has proven to be a remarkably resilient engine in RNZAF service.

pressure ratio. The T56-A -14 engines produce 4591 shp with a pressure of 9.25 /1 while the ultimate development of the T56 series, the

T56 -A- 427 which powers the Northrop Grumman E-2 Hawkeye produces 5250 shp at a pressure ratio of 12 /1. As well as the shaft output the T56 series also contributes around 750 lb thrust via the exhaust. Since the engine entered production in 1954 nearly 17,000 T56 and their civil counterparts the T56 -501-D turboprops have been installed on a wide variety of aircraft. It was to be expected then that when Lockheed was considering the options for powering the Electra airliner the Allison T56 series was at the top of the list. Allison was not alone in the running however with the Rolls Royce Tyne coming close to winning selection. Rolls Royce won the deal in the end however taking control of Allison in 1995.

New Zealand service

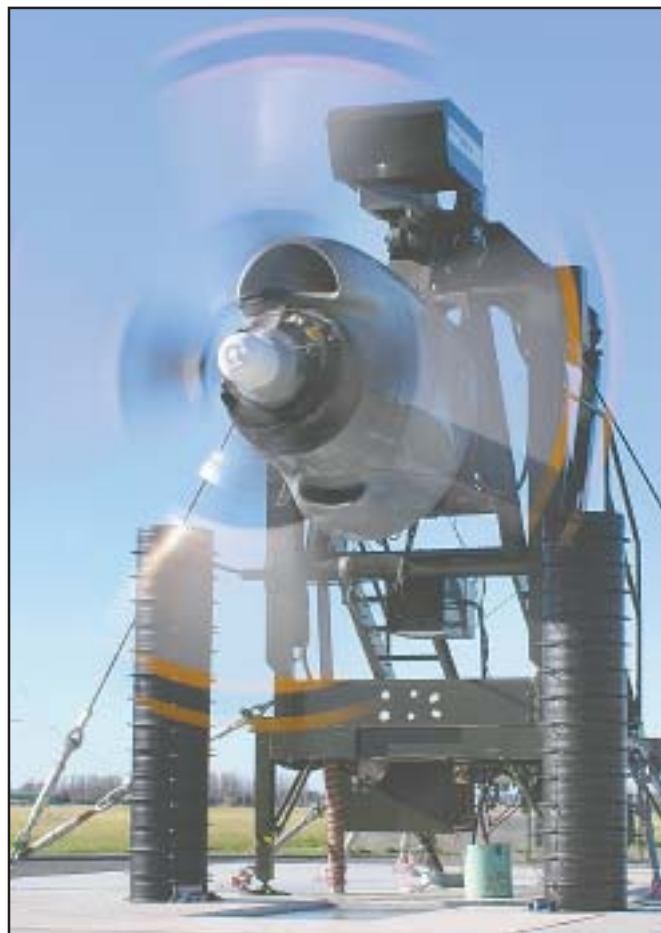
The RNZAF operate two models of the T56. In the Hercules it is the T56 -A -15 while on the Orion it is the T56- A -14. The main difference is that the C130 engine hangs under the wing and the surrounding engine structure and gearbox configuration support that, whilst the P3 engine sits on top of the wing and thus its engine structure and gearbox configuration is slightly different. Essentially however, the engines are nearly identical. The T56 has proven to be an exceedingly dependable engine in RNZAF

Left: The RNZAF has replacement overhauled engines ready for installation for both C130 H Hercules and P3-K Orion aircraft. Field installation can be carried out if necessary.



service. With twenty nine T56-A-15, 20 on wings and nine spares, for the Hercules fleet and thirty one T56-A-14, 24 on wings and seven spares for the Orion's. At a total of 60 engines the RNZAF is by far the biggest T56 operator of New Zealand is likely to see. Civilian operators are covered by the General Dynamics Allison Convair 340/580 and 440/580 series which are operated by Air freight Ltd, Air Chathams Ltd and Pionair Adventures Ltd. More than 20 engines are included in this fleet. Talking to a selection of RNZAF Flight Engineers it is hard to come up with any issues regarding the T56. The general consensus is that if the engine starts it will probably run happily. By far the most common reason for engine shutdowns in both the Orion and Hercules is a problem with the propeller rather than the engine. Being an engine of 1950's heritage however it does tend to lose power quickly in hot and high conditions, more a problem for the Hercules than the Orion. Cold is not a problem with the T56 regularly being asked to start in sub zero conditions but operations in the Middle East often see the engine operating at temperatures in excess of 40 deg C. About the only condition

the T 56 does not like is wind directly up the tail pipe on starting. The RNZAF run their T 56 engines on condition with an engine normally giving five to six thousand hours between overhauls. It is rare for an engine to fail before being removed for overhaul, normally an engines performance degrades to a point where it is either hard to start or it fails to met the required output mandating an overhaul. Currently SAFE Air at Blenheim is responsible for the overhaul of the RNZAF T56 engines as part of their commercial contract to operate the Air Forces No 1 Repair Depot. As well as handling all the RNZAF engines SAFE Air also carry out maintenance and overhaul on T 56 engines for a range of military and civil third party customers including the RAAF.



Above: Blenheim based Safe Air overhauls all RNZAF T56 engines and has a dedicated outdoor test rig for performance testing following comprehensive overhaul.

Left: Generally the T56 series engine has proven reliable in service world-wide although the RNZAF is fully equipped for an in field engine change if necessary.



Below: Civil operators of the T56 in New Zealand include Convair 580 operators. The airframe was originally powered with Pratt and Whitney R2800 engines. An extensive STC programme saw a number of turbine engines tried, the most common being the Allison T56.

