Replacement engine option (Chevy V8) for Pawnee

PawnEight

Issue: 0.1

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Confidentiality Request

This document is for the use of the DDSC Committee only. There are some aspects of it that should not be broadcast to the greater public. There are some aspects of the document the author does not want projecting beyond the DDSC Committee. The Nominated Engineer and the Aeronautical Engineer are known to the Committee.

Contents

1 OVERVIEW

The Darling Downs Soaring Club has two tug aircraft. These aircraft are fitted with Lycoming 0-540 engines rated at 235HP at 15C sea level.

At some stage both tugs will need replacement or refurbishment of their engines.

Replacement engines have been projected at being required at 2000hrs and the replacements are due within the next year (now May 2005).

There has been much discussion amongst many people regarding the financial situation of DDSC, monies put aside for engines, what would be the best way forward and ways to save monies etc.

The subjects covered have at times highlighted much of misinformation amongst many well meaning people. The way forward has divided allegiances and documentation is low. This document is about trying to start a trail of documentation and allowing some real facts and figures to be viewed and discussed. Please note the following facts and figures are NOT necessarily 100% accurate although a fairly thorough investigation has been made.

2 DO WE HAVE TO REPLACE THE ENGINES AT 2000 HOURS?

It does appear that the first misconception is that we need to replace at 2000hrs. It is an “expectation” that engines need replacement at 2000hrs however it is not mandatory. Engines are always “on condition” and should the engine burn oil, have compression reduction, metal in the oil or any number of more obvious failure modes then the LAME will ground the aircraft until the LAME is happy. The LAME can ground the aircraft due to engine problems at 100hrs, 85hrs or 3500hrs!

It is believed that 2000hrs does align with some commercial operational aircraft. Our aircraft are private use only. Lycoming recommend 2000hrs between major overhauls.

3 HOW MANY HOURS DO OUR TUGS FLY PER YEAR?

Working on figures for the past two years we do an average of 190 tows per month and that yields 400 hours per year flown on the tacho.

4 HOW MUCH FUEL DO WE USE AND HOW MUCH IS IT TO RUN THE TUGS?

There have been many discussions on fuel usage ane servicing costs. Servicing is normally due at 100 hour intervals and the cost of the 100 hourly covers both engine and airframe checks. A review of costs for 100 hourlys over the past few years does not allow an average cost to be generated, nor does it allow us to view how much of the cost is engine related as against airframe related.

A much-bandied around figure is the amount of fuel the tugs use. This has been reported as being 60 litres per hour. However whilst this follows the industry advice the tugs do descend for part of their flight. A review of amount of fuel purchased divided by the amount of hours flown indicates an average using 2000-2004 figures of 48 litres per hour are indicated.

5 ANECDOTAL FEEL FOR COST TO RUN THE TUGS, THAT IS HOW MUCH FOR AIRFRAME AND HOW MUCH FOR FUEL AND OIL?

As advised above, the figures are hard to generalise. That said a generalised approach is a look at the bills for 100 hourlys, a bit of a look at incidences and ensure everything is covered.

A review of the figures for 2004 show with a fair degree of accuracy that the breakdown of the 100 hourly costs can be divvied up to show that we average $20,000 per year on maintenance. It is believed $5,000 per year is attributed to the engine and $15,000 on the airframe.

6 WHAT IS THE COST TO REFURBISH A LYCOMING?

Various figures have been quoted. They range form $60,000 to $35,000. Various people have varying ways to work this out. Some quotes are for engine refurbishment only, others are removal, storage of aircraft, refurbishment and re-fitment. It is obvious that the lower figures are for refurbishment of the bare engine only.

It is also evident that the Lycoming can be refurbished several ways! It is believed that Lycoming have a list of parts that are recommended as being replaced, however these parts may already have been replaced at the 1900hourly and can be reused at the refurbishment! It depends on the LAME and its organisation which what parts, may be re-used.

Best guess for a refurbishment is $5,000 in labour for rebuilding the engine, $38,000 - $42,000 for parts inside engine, an allowance for incidentals found during the process. Total $44,000 - $60,000!

7 WHAT IS THE ALTERNATIVE TO A LYCOMING?

One alternative exists in the much talked about AutoTug project. The AutoTug process has many merits, it projects many cost savings, it is these cost savings that are perhaps the real driver for this report.

8 HOW MUCH WOULD IT COST TO BUILD A CHEVY V8 AUTOTUG?

Let us go straight to the point. Much background exists with the AutoTug. There is a Chevrolet V8 motor available which has a reduction drive (to reduce the engine revolution of a car engine to the revolutions required for a propeller). It is not a simple figure to derive. Many spreadsheets have been worked up to come out with a “ROBUST” figure.

Two such worked out spreadsheets are attached. They appear to be robust. The figure is $65,000 The figures have been reviewed by the “Aeronautical Engineer” and considered appropriate!

9 WHAT IS THE BUILD PROCESS?

Many a long conversation has been undertaken on the subject. The most crucial matter of all these conversations should include “the advice and technical guidance and sign off of the aeronautical engineer”. Conversations without this reference would leave any undertaking without a way forward.

Conversations with the “Nominated Engineer” advise their process as being:

1. Supply of Pawnee with life expired engine

2. Acquire all the documentation pertaining to the Kingaroy AutoTug project

3. Apply to the “Nominated Engineer” and apply for a prototype case to be raised and hence experimental certificate to be made out. That is a certificate with partial justification and limitations.

4. Develop the theme with an “Aeronautical Engineer”.

5. Review the project.

6. If project successful then apply for STC (Supplementary Type Certificate) if not retire the prototype to restricted private aircraft.

7. The documentation trail of what is required and the basis of all the testings is secured within the original AutoTug project. To reinvent the wheel and follow a different process is just NOT possible.

The “Nominated Engineer” reiterated several times that an “Aeronautical Engineer” is a must do item.

10 WHAT IS THE SITUATION OF PROTOTYPE?

It was advised by the “Nominated Engineer” that a **single** prototype could exist. The prototype would follow on the lines of “an aircraft using a automobile engine to investigate the feasibility of its use as a Restricted Use Glider Tug”. Such a prototype could be a Cub with a Subaru engine or a Husky with a V6 Commodore engine or a Pawnee with a Chev V8 engine.

Once there is one prototype in existence in Australia it is doubtful that another prototype certificate could be issued.

It is uncertain what the procedure would be if the 1st prototype faltered due to bad management or lack of money etc. Would a second happen?

11 THE ROLE OF AN AERONAUTICAL ENGINEER AND FINDINGS.

The advice of An Aeronautical Engineering group was sought.

Their business thrives on such things as engine mountings and such. They advised on the process that “Nominated Engineer” had described. The reiterated the process and advised on the engine mount system and the reduction drive.

Basically a full engineering model needs to be completed from the rear of the wing attachments through to the propeller (that is all the framework). The engineering report that would be supplied with the mount would be the only possible way of progressing the project. That is we cannot expect to build an engine mount ourselves and have this certified and progressed by the “Nominated Engineer”.

The process would be to either get a full set of airframe drawings or more likely take the spare airframe and measure and document and model it on the computer. Take the Chev engine and reduction drive and weigh it, find the C of G and a few other measurements. Make allowances and estimate additional items such as radiators and oil coolers. Model and design a mount.

The mount would be a two step process. Mock up and build a cheap version. Then build the proper version.

The builder of the engine mount MUST have a CASA welding certificate. The Aeronautical Engineers could do this but are too busy with other projects and can advise on other builders in Ballina, Archerfield and Toowoomba.

12 WHAT HAPPENS WHEN THE ENGINE IS MOUNTED AND ALL PLUMBED UP?

It should be possible to take on the role of test pilot once the mounts are made! Getting everything fitted like cowls and such are needed to complete the job.

Then it is “Snoopy Time”!

13 WHAT HAPPENS IF THE AIRCRAFT MEETS WITH HOPES?

If the Chev V8 shows the promise that people expect and the oil cooling and water cooling work and everything is developed then the STC process can be applied for.

The STC in the form of engineering is more or less complete by the engine mount system. Other documentation is expected as well.

Maintenance procedures, things like oil pressure gauges, things that are there to provide essential operations such as air filtering, ignition systems. Exhaust system attachment and noise levels. All these need to be considered and catered for. All these things add up!

How much extra work is uncertain but it is expected that an “Aeronautical Engineers” advice will be required and payment made.

14 AIRFRAME CONSIDERATIONS AND WHO WOULD FLY A PAWNEE V8?

It is unlikely that should the Pawnee V8 get to fruition that tug pilots would wish to fly it should the airframe not have full LAME sign-off. There are two ways for the possible C of A to be written.

1. The Airframe C of A is the responsibility of the person nominated by the DDSC Committee. In that case the DDSC can nominate it to be a LAME or a suitable member that meets with the tug pilots and the committees risk analysis.

2. The Airframe must be certified by a LAME.

Either way. A Pawnee V8 should be airworthy.

15 PAWNEE CHEV ENGINE CONSIDERATIONS.

The whole process of putting an uncertified engine in an aircraft needs careful consideration. Car manufacturers do not build in any excesses these days.

Car engines do not run at 100% output for any real duration. It has been advised that the risks in using a car engine should be advised as below.

Car crankshaft bearings (main and conrod) can overheat easily. The oil takes this overheating of these bearings away. The mitigating action of adding oil coolers has been considered but the risk still exists.

A review of the internet shows that car racing engines are fitted with harder plain metal bearings and are needed for sustained racing conditions. It does show a matter for consideration.

16 HOW MUCH FUEL WILL A CHEVY V8 PAWNEE USE?

It has been reported that the AutoTug uses somewhere in the region of 36litres/hour. With the larger Chevy engine it is estimated that fuel usage would be 40 litres/hour.

17 COMPARISONS REGARDING RUNNING AND ENGINE MTCE COSTS WRT BUILD COST?

It does appear that to refurbish a Lycoming and provide fuel and engine maintenance compared to a Chev V8 should include a 1000 hour freshen up for the engines.

A top end overhaul is anecdotally advised for the Lycoming as $10,000 and on the Chev V8 a similar amount of work including reduction drive bearings is estimated at $8,000.

Then we should consider build costs and fuel and service costs.

Pawnee

Build $55,000, Fuel for 5 years $96,000, Servicing of Engine for 5 years $25,000, mid life freshen up $10,000

Chev V8

Build $65,000, Fuel for 5 years $80,000, Servicing of Engine for 5 years $15,000, mid life freshen up $8,000

This adds up to a difference of $17,000 over 5 years or $3,400 per year. That does NOT include any additional costs for the “Aeronautical Engineer” to review systems, provide further analysis for the STC nor does it include any costs for rework! Rework on cowls, radiators, exhausts etc are all potential costs. There are no costs added for incidental labour.

18 HAS THIS REPORT CLEARED UP THE PROCESSES?

It was hoped that a clear yes or no would come out of the investigations.

Sorry it is not that clear.

19 FURTHER ADVICE AND CONSIDERATIONS!

It just may be that the Chev V8 is just too much for the Pawnee airframe.

The Chev weighs 465lb, add the reduction drive of 65lb for an all up weight of 530lb without radiators and fittings.

The Lycoming 0-540 weighs 366lb but does not include magnetos etc or fittings.

The Chev produces 345HP

The Lycoming produces 235HP

Modelling of the airframe to check if the Chev V8 can fit or can fit with a placard to de-rate the system will cost $2000.

The “Aeronautical Engineer” showed some computer models and some included modifications to the airframe such that extra longerons (length way frame tubes) were added to the rear of the wing spars. How much extra strength a Pawnee has is unknown until modelling. Extra and strengthened longerons would incur extra costs.

A more easily achieved model may be the use of a Holden V6 Alloytec Engine from the current Holden Commodore that produces 175KW or 235HP, but perhaps that is a bit too close to the Lycoming which produces it's max power and torque quite close together in the rev band.

20 WHAT IS THE DECISSION? SHALL THE COMMITTEE PROGRESS TOWARDS A CHEV V8 AUTOTUG?

Above shows a lot of information conflict. There are potential savings to be made, but are these potential savings worth chasing?

There are risks of blow-outs that should be considered that could take the potential savings.

Safety is paramount and doing it right. Gauges, procedures, safety systems, fall backs all need to be documented, it is agreed that as it stands the pilot should know the systems and the documents that they should know about actually exist. The effort to achieve the documentation is huge! Who will do this?