CESSNA 200 SERIES ASSOCIATION

The Newsletter of the Cessna 200 Series Association
Issue Number 2 June 2009

The President's Corner

Welcome everybody to the second edition of our newsletter. I find that for an organisation that meets only twice a year, an informative newsletter is a mandatory tool to bind us together between physical meetings.

Thanks go out to members Neil Richardson for editing the newsletter and John Weston for printing it for us.

While on the subject of 'Thank yous', I would like to point out the large contribution made by so many to ensure that our fledgling organisation received the good start that it did.

Unfortunately the contributors and supporters are too numerous to list individually but let me try to name those that come to mind – but also apologise to those I have missed.

To start with Bill Bristow, who designed our club logo (isn't it great?!), Marjorie for putting us on to Bill. Annie and David from Naracoorte (our secretary and treasurer) who put on a fly-in to remember this past ANZAC weekend, and to Suzy, who helped them with the fly-in and also organised the club merchandise, which is now available for sale.

As you will read elsewhere, our next fly-in will be held at Mudgee about 45 minutes flying northeast of Sydney. Mudgee is a prime wine growing area and there is a lot to see and do. Please put the 16th, 17th, 18th, October in your diaries now and come join us for a weekend of friendship and camaraderie.

I have had some members approach me and ask that we have a significant technical content in our fly-ins and newsletter (apparently we have a lot of rev-heads in our group). It will be my pleasure to do that because as a LAME and President of the CPAA, I am immersed in the technical side of Cessna aircraft for a significant part of every week.

I must say that we must also have a balance in the club, so those that are not technically minded do not get bored with the tech talk. I am confident that we will achieve the balance we want.

Please come to the next fly-in in Mudgee. Bring your family, your friends and the kids, as they are the next generation of Cessna owners and pilots.

Spend your government incentive money on something for your aircraft!

See you all at YMDG.
GARTH BARTLETT
President.

Inside Today

Cheers
NEIL RICHARDSON – Editor
C200news@njr.com.au

Naracoorte Fly-In Report – See page 2

Naracoorte Fly-In Report

Report by secretary and local – Annie Hayes

Well it seems we need to organise a Fly In to get some well-needed rain down south! Real winter conditions were experienced just like the 'old days' when the Anzac weekend traditionally heralded the break in the season.

The very welcome couple of inches were accompanied by very strong and gusting winds, which unfortunately was a barrier for some who had intended to be in Naracoorte for the 1st Fly In.

On arrival participants received a 'show bag' with information about the region they were visiting and some local produce. By 5 pm we were ready to pop on the bus and head to our accommodation at Chardonnay Lodge in the Coonawarra – one chap from Queensland was a bit chilly in his shorts - obviously forgot he was heading south!

A casual dinner that night provided an excellent opportunity to catch up and there was much laughter around the tables.

Next morning we held a general meeting at which the main points of discussion were about our new merchandise - polo shirts - $30.00, chambray shirts - $40.00 and caps - $15.00 – all of which are available for purchase, and the venue for our next Fly-In which will be in Mudgee.

Following the meeting the bus departed for the Naracoorte Aerodrome for the technical talk by our LAME president Garth with regard to corrosion in aging aircraft, which went down very well by all accounts.

Some of the girls headed into Penola and the shops, which we forgot, would be closed, as it was Anzac Day. However, coffee was available after we toured Penola's historic sites.

Lunch was in Naracoorte and the president of the Naracoorte Aero Club - Gary Burgess – made the C200 Series Association members feel most welcome. We joined with their members to enjoy delicious BBQ meats and salads.

Time was marching on so back on the bus for our winery tour.

A mix of art and wine at the various cellar doors was enjoyed and purchases were made at one or other of the wineries. The vines were all turning various shades of stunning autumn colours and the sun came out late in the afternoon and danced on the leaves for us.

Our dinner Saturday night was at a new restaurant 'Fodder' and our guest speaker for the night was the most entertaining and local Ian Oswald Jacobs whose child hood interests in photography and flying have been interwoven into a long and successful career in aerial photography. Ian has in excess of 7000hours in a 210.

He showed us images that were exceptional in clarity and detail taken with a 50-mega-pixel camera. I'm no photographer but even I understood that to be a lot of pixels! When asked if he used autopilot much in his work he that he quipped that he found his left knee to have a better response time when trying to get a shot.

Good food, good wine, good company, a great night!

Sunday morning, check out time and onto the bus heading to the World Heritage Naracoorte Caves and Fossil Centre. Our guide Amy was most interesting and informative and it is eye opening to see things under the ground that are many thousands of years old. Much of Australia really is an archaeologist's wonderland.

Back to the Aerodrome to pick up our packed lunches and say our farewells until October 16th 2009 where we will meet again in Mudgee.

Our thanks go to the Naracoorte Aero club for their interest and friendship. To Garth Bartlett our very pro-active president, local lad Ian Oswald Jacobs for his hilarious talk – we have him on board as a member too - and to our SA committee members Annie, David and Suzy for their organisation of a great weekend.

Notes from the Committee

Your committee met in Naracoorte in April 2009. Items up for discussion were:

- Merchandise
- Proposed Website
- Purchase of a banner for display at airshows
- Next Fly-In Destination
- Group insurance

Our many thanks to John Weston of Westonprint, Kiama for the final layout of this Newsletter and its superb reproduction.

Mudgee Fly-In – 16-18 October 2009

Mark it in your diaries – the 16th to 18th of October 2009 - our next fly-in to Mudgee, NSW.

Mudgee is a 45-minute flight north west of Sydney. It is one of Australia's premium wine growing regions and is particularly famous for Oatley Wines (formerly Poet's Corner), Pieter van Gent Winery, Andrew Harris and Elliot Rocke Estate. Not that wine is the only reason to go there!

Mudgee is a pretty town with lots to do, including an art gallery of aerial photographs taken by local C182 pilot, Noel Dawson, an amazing Pioneer museum in nearby Gulgong (home for poet Henry Lawson), a cheese factory… Olives are grown locally so you can add olive oil tasting to the usual list of wine cellar doors. There's also a quirky motorbike museum – and of course lots of good eateries.

Put simply, there's so much to do – and I'm trying to get some of the ideas above into a weekend plan for the fly-in, and of course, not forgetting a technical talk and an AGM!

As soon as an itinerary is assembled, I'll let you know all the details.

In the meantime – put it in your diary now: 16th – 18th October!

CERI BARTLETT.

My Aircraft....

This is the first of hopefully an ongoing series of articles submitted by members about their aircraft – where they've been in it – what's happened to it – what they're doing with it – all, no doubt, with an underlying sense of how much they love it!

The following article has been submitted by member John Lillyston on the upgrade to the avionics of his Cessna 210 VH-TFE.

When completed, TFE will have a modern-looking, clutter-free instrument panel to envy:

The left hand panel will consist of

- two screens for the Chelton Flight Logic System
- stand-by electric AI, electric Turn Co-ordinator, HSI, ASI, altimeter and some annunciators

The centre stack will house

- Garmin 530 with Stormscope
- Garmin SL40 VHF/Com 2
- Garmin Transponder – mode S
- Garmin 340 Audio Panel
- ADF
- S-TEC 55X Autopilot
- Iridium 9555 Sat Phone

The right hand panel will contain

- Xerion Auracle Engine Management System

WHY DID I CHOOSE THE ABOVE?

The Chelton Flight Logic system is highly advanced, in truth more appropriate for executive and commercial aircraft, than a 210. There are two screens, a PFD (Primary Flight Display) and a Navigational Display, which is also a reversionary PFD. The PFD has synthetic vision whereby the terrain is displayed as if you were looking outside. It also uses Highway In The Sky (HITS).

Chelton's competitors are Garmin and Avidyne. Garmin has just adopted synthetic vision and the latest offering from Avidyne reads a lot like the Flight Logic. The difference is Chelton has many years of experience and they use class A software, as required for airliners, the others don't.

I am so committed to mastering this powerful tool I'm bringing an instructor out from the States for a week. He's an 18,000-hour pilot who works for Cobham (Chelton's parent company) instructing on the Flight Logic System.

The old satellite phone, a Globalstar, has been replaced with an Iridium 9555. The Iridium constellation has 66 satellites compared to Globalstar's 44, plus Iridium supply an aviation antenna, whereas the Globalstar was a clunky vehicle antenna.

In the right hand panel, Xerion's Auracle Engine Management System is more than just an engine monitor – it helps you manage your total powerplant operation, and is certified for primary replacement of all existing engine instruments.

Because I won't have any vacuum instruments, I've removed the existing vac pump and replaced it with a standby alternator.

Finally, how long? Well, it went into the hangar on April 20, the cut out of the panel, a mild steel mock-up is due this week. Most of the components are mounted in various parts of the fuselage and the looms are mostly completed. So I reckon 4-6 weeks, but that's just an uneducated guess!

For anyone who wants more detail, Australian Flying magazine is planning an article, complete with before, during and after pictures.

This picture is where we're up to at the moment!

REGARDS, JOHN

Insurance Offer – Benefit from a Group Scheme

In these difficult economic times, it is always welcome when someone makes an offer to save some money.

Committee member, Ralph Aikin of Kenney Aikin Aircraft Insurance Brokers has made an offer to our membership that will result in savings on our aircraft insurance.

Ralph suggests that we form a group and insure our aircraft together. The combined numbers of the group will result in a strong commercial force which should lead to significantly discounted premiums from insurance companies.

To join the insurance group of the Cessna 200 Series Association, your aircraft must be used only in private flying operations and you have to be a financial member of the Cessna 200 Series Association.

Even though you will be a part of a group, your policy will be individual and the terms and conditions will apply to you as an individual. If someone within the group has a claim, this will not affect you. For example you will not lose your no-claim bonus if another group member makes a claim.

For further information contact Ralph on
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Cessna 200 Series Merchandise

A great range of merchandise has been arranged and photos and details are as follows:
CAPS $15.00: Caps are all ecru and one size fits all .
POLO'S $30.00: Polo's are available in men's L, XL, XXL, XXXL or women's 12,14,16,18,20 – colours: black/white trim: white/red trim: or sky blue/navy trim:
CHAMBRAYS $40.00 – long and short sleeve, available in men's and women's same sizing as polos.
Email me with requirements - sizes and colours.

Cheers
Annie – a.haynes@bigpond.com

Avalon Airshow Display

Our President, Garth Bartlett represented both the Cessna Pilots Association of Australia and the Cessna 200 Series Association at the Avalon Airshow in Melbourne in March 2009.

Garth was at the Aeromil Pacific (Australian Cessna Dealer) stand which allowed a strong presence at the show. Copies of our first newsletter along with the membership form were handed out to interested passers-by.

Pictured left at Avalon from the CPAA Committee are Tim Brooks (Vice President), Tanya Richardson (Secretary) and Garth Bartlett (President)

Six "Tools" That Tell Engine Health

Along with the social aspect of the association, we also hope to feature regular technical items. We may have Garth discussing things from a LAME's point of view or as with this issue, inclusion of a relevant Technical Publication.
The following Note 008 on "Engine Health" was issued by the Cessna Pilots Association.

If there is one subject that generates more talk among aircraft owners than any other it has to be that of engine condition. Everyone wants their engine to last forever and gets concerned when there may be indications that it won't. Most owners believe their engine will make it to the manufacturer's recommended overhaul time. Time Between Overhaul (TBO) and few want to operate their aircraft with engines that have gone beyond this magical number of hours referred to as TBO.

Unfortunately in the real world things are not quite as clear cut as we would like them. Many engines can and do have serious troubles long before TBO while a much smaller number of engines not only make it to TBO but are in such good shape that they could go many hours beyond TBO. The technical staff of the Cessna Pilots association has never put much stock in TBO as being an indicator of the life of an individual engine, TBO is really an arbitrary number the engine manufacturer has come up with through that manufacturers experiences with a large number of that engine model. It is a hour number beyond which the manufacturer says that continued operation is likely to cause such wear that the overhaul will be less economically practical than if the engine is overhauled at the recommended Time Between Overhaul. TBO can be a useful number for making some engine maintenance decisions. For example, if the O-470 engine in a 182 were to develop a couple of bad cylinders at 700 hours since overhaul on an engine model with a 1500 TBO, the maintenance decision would be probably be that it is practical to do a top overhaul on this engine, that is remove all the cylinders (referred to in mechanics jargon as the "top end") and overhaul them but leave the engine case, crankshaft and accessory drives (which obviously mechanics will refer to as the "bottom end") intact and saving about half to two thirds the cost of a complete overhaul. This decision is based on the ideal that with a TBO of 1500 hours the bottom end is probably in pretty good shape and by doing just the cylinders there is still reasonable likelihood that the engine will be able to be used for at least another 700 hours without further major repairs. On the other hand if the two bad cylinders showed up with 1400 hours on a 1500 hour TBO engine the

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Membership Application Form

On behalf of the committee of the newly formed Cessna 200 Series Association Incorporated, I extend an invitation to you to join this exciting new Association.

The purpose of the formation of the C200 Series Association is for likeminded aviation enthusiasts to meet several times a year in different locations within Australia to promote and enjoy safe flying and to further their technical knowledge in an enthusiastic atmosphere.

The inaugural committee anticipates 2 fly-ins per year to a chosen destination within Australia plus 2 extra committee meetings to be held at a destination agreed by those on the committee.

Membership has been set for the first year @ $100.00 per member and is open to anyone with an interest in things aviation and particularly if they are an owner and or operator of a Cessna 200 series.

Please find attached an Application for Membership form.

Please send to PO BOX 297 Lucindale SA 5272 or email to a.haynes@bigond.com if you would like further information.

We look forward to meeting you soon and to many happy fly-ins.

Cheers
ANNIE HAYNES
Secretary C200 Series Association
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decision will probably be just the opposite, putting the money into a top overhaul probably isn't practical as the bottom end of the engine is much more likely to give problems in the next few hundred hours than our previous 700 hour example. Better to pay now for a complete overhaul and risk having to pay for a complete overhaul as well in just a few hundred hours.

The technical staff of the Cessna Pilots Association are great believers in making most engine maintenance decisions based on engine health rather than engine hours. The big question mark with this sort of policy is how does one go about determining the engine's health? What we base our decision on are the indications we are given by the use os six "tools" that are available to us to determine an engine health.

THE SIX "TOOLS"

Tool One- Oil Consumption

As the parts of and engine that have metal to metal contact with each other, either all the time or part of the time, wear clearances become greater. This allows more room for oil to go by valve guides, piston rings, bearings, etc. As this occurs there is more opportunity for oil to make its way by the various sealing devices and either be consumed in the combustion process or make its way out the crankcase breather.

An engine will use some oil, how much depends on the model engine, its condition and the use it is subjected to. As a general rule aircraft used for training will use more oil than the same aircraft used for pleasure flight. This is due to the unusual attitudes and the on-off power applications associated with training. Those engines with a lot of hours will generally use more oil than low time engines. The type of oil, frequency of use and change can all have a bearing on oil consumption. While it is difficult to say exactly what the proper oil consumption for an aircraft engine should be, I can bring forth some general guidelines that we see here at the Cessna Pilots Association. Lycoming engines will generally have oil consumption better than a quart every six hours of operation. Continental engines will generally use more oil than this, around a quart every four to five hours of operation, unless the Continental engine is using "steel belted" pistons, in which case oil consumption can be as little as a quart in every fifteen hours of operation. The "steel belted" pistons is one that has an insert cast in the aluminium piston to hold one of the piston rings. This change was introduced by Continental in the early 1980s on the 520 series engine and has been slowly introduced throughout the Continental engine models. This change coupled with the center slotted oil control ring has dramatically decreased oil consumption in Continental engines.

As a side note I should point out that even though the "steel belted" pistons do reduce oil consumption they are an improvement that the Cessna Pilots Association technical staff is not very high on. We have seen an increasing amount of cylinder problems, most notably cracks in the barrels, since the introduction of the "steel belted" piston and believe there is a correlation. Both Mike Busch and I went to great lengths when we overhauled our engines a while back to see that we did not use "steel belted" pistons.

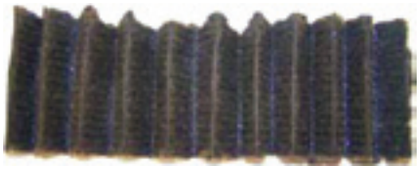
Continental engines can also use an excessive amount of oil when their crankcases are kept full to the brim. It is a well known fact that a O-470 in a Cessna 182 will use a lot more oil when the sump is kept at the ten quart or above mark than if the oil is maintained in the seven to nine quart range. The reason is that the camshaft mounted low in the engine case will throw a lot of oil around and out the breather when the oil level in the sump is very high. The subject is treated in greater depth in the Cessna Pilots Association TechNote "Excessive Oil Discharge Out the Crankcase Breather" which is available to CPA members upon request.

Oil consumption is valuable as a tool for telling an engine's health in two ways. First when the oil consumption gets flat out excessive. Obviously if an aircraft engine in one of our Cessna is using a quart of oil an hour, this engine is not in good health. The grey area is when the engine is using a quart in every three to four hours. Is it time to tear the engine apart or can it run on? This is a situation that we look at all of the tools available to us before making a decision.

What should get our attention as pilots and owners is when oil consumption changes. If an aircraft has been using a quart of oil in ten hours and suddenly is using a quart in every five hours, the reason need to be determined. It may be something simple such as the aircraft being used recently for training or touch and goes and when the aircraft returns to it's normal use pattern the oil consumption will also return to normal. Or maybe a new partner is now flying the aircraft and he taken to filling the sump to the brim before each flight. These are simple things to deal with. However if the cause of the increase oil consumption is not readily apparent, then it is time to do some serious investigation, including using the other tools that are available to you.

Tool Two- Oil Screen/Filter Inspection

In my travels around the country I spend a lot of time in aircraft maintenance shops. I have always make it a point to look in the trash to see what that particular shop is doing with oil filters. If I see a bunch of oil filters that have not been cut open and inspected then I know this is a shop I wouldn't want to bring my aircraft to for maintenance, for there is a wealth of information that can be gained from inspecting an oil filter.



Originally most aircraft engines came only with an oil screen but in more recent days the engines have had oil filters installed with many engines being retrofitted with filters in the field. The filter is a better way to go as it will filter out particulate matter one/fifth the size that will pass through an oil screen./

If your aircraft is equipped only with oil screen inspection is very simple. At each oil change remove the screen and inspect it for trapped material, most notably particles of metal. A few shreds of metal are not unusual, especially on a new engine that is still breaking in or on an engine that has had

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major maintenance, such as a top overhaul, performed recently.

The basic inspection is the same with a paper oil filter, just a little more difficult to perform. On a spin-on filter the filter can must be cut open with a special tool and then the filter element cut from it's housing for inspection. What I do is take the cut open element out into the sunlight and pull it out so that I can inspect the outside pleats of the paper for contamination. Again a few flecks of metal and carbon are normal. If something I see has me concerned, either because of the amount of the metal or the nature of the material trapped in the filter, I will wash the filter element in a jar filled with Stoddard solvent and then strain the liquid through a coffee filter. This allows me to see just how much material was trapped in the filter.

The question is often asked as to how much trapped material is too much? There is no clear cut answer to this question. A few flecks of metal is nothing to be concerned with and a filter element jammed with metal indicates an engine that has destroyed itself. But where do you draw the line in between? This will have to be a subjective call between you and your mechanic. What I tell people is that if there is more than a half dozen flecks or so of metal trapped in the filter without a clear cut reason such as a brand new engine it is a situation that should be monitored closely. If there is as much as a third of a sewing thimble full it is a situation of concern and a serious effort to determine the source should be made. If there is more metal than that and the source cannot be determined serious consideration must be given to engine tear down to determine where the metal is coming from.

Determining the type of metal in the filter can help in figuring out where the metal came from. Bronze can be determined by colour and if found would make one suspicious of value wear, copper would lead us to think of bearings. However the two most common metals likely to show up in the filter are iron/steel and aluminium. A magnet can be used to figure out if the particles are ferrous and thus coming from a steel part such as a cylinder wall, lifter or gear. Not being attracted by a magnet would indicate aluminium which

Sample Oil Analysis

Sample Number	Taken Processed	Oil Hours Oil Added	TSN TSO	Aluminum	Iron	Copper	Nickel	Chrome
843502	06/15/04	50		26	99.5	12.3	15	12
	06/21/04		1,201	***	***			
847203	07/29/04	50		21	56.8	13.0	7	9
	08/05/04	1	1,250	***				
850623	09/14/04	62		8	40.5	6.5	6	5
	09/20/04	2	1,312					
873263	07/18/05	50		17	53.7	9.1	8	8
	08/02/05		1,427	***				
879163	10/04/05	50		13	39.2	9.8	6	7
	10/14/05		1,479					
898196	06/30/06	50		17	94.2	14.3	8	9
	07/12/06	3	1,511		***			

is almost always piston material. Further analysis can be obtained by sending the filter element and any material from the filter to the engine manufacturer, either Continental or Lycoming. The manufacturer will run a laboratory analysis on the material and get back to you with some suggestions as to where the problem might be.

Tool Three- Oil Analysis

Oil filter inspection detects the larger pieces of material that might be in your engine, oil analysis counts the microscopic particles of material that are contained in the engine oil. After a couple of life experiences with oil analysis, one in which an engine failure, probably on the next takeoff, was prevented and another one where a problem was detected before it caused serious internal damage to the engine. I have become a strong proponent of engine oil analysis.

At each oil change you take a sample of the oil being drained out and send it to a laboratory analyses the oil sample and sends you a report that indicates what contaminates are in the oil. The unit of measurement is Particles Per Million or PPM. That is to say that the report might show that in a million particles of sample there will be 120 PPM of Iron or silicon or lead or any of the other items the procedure that the lab uses is set up to detect. Due to slight methods, using one lab for all samples through one engine's life works best.

One sample will tell us very little but after a few oil changes with a sample taken at each change a pattern will begin to appear. Let's take iron for example. I won't site any actual numbers because one lab's system may report differently than another lab's, but the trends will be the same. When we send in the first sample on a new engine just being broken in we can expect the iron count, as well as a number of other elements, to be rather high. This is normal, the engine is breaking-in and there is a fair amount of friction that is causing some initial wear. However this high iron count should drop very significantly with the next sample as the engine is breaking-in and remain at a low level for several hundred hours. Usually as the engine gets in the area of six hundred to eight hundred hours there will begin to rise in iron and other elements as the engine begins to wear with use. This gradual rise is normal and not an area of concern.

It is when there is a dramatic rise in an element from one sample to another or when one element's PPM just keeps rising from one sample to another that concern needs to be given. Sometimes it can indicate a serious problem such as a sudden rise in iron might indicate a cylinder problem like a broken ring. On the other hand a rise in an element like silicon might indicate some simple problem that is easily remedied. Silicon is sand/dirt and a rise in the element indicates that dirt is getting into the engine. The air filter might be bad, the induction system might have a hole in it or some other relatively minor problem that can be easily fixed.

In the old days we used to graph out the results of each sample on graph paper with a different colour pencil foe each element.

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Today there are fancy computer programs such as Lotus 123 to do all this for us. I have heard people say that they aren't using oil analysis because there engine is brand new but they will start it when there engine is older. I have also heard others say that there is no point in using oil analysis on a high time engine. Both attitudes are wrong. The more data we can gather on an engine through out it's life the more information we will have to base decisions on and even if we don't start oil analysis until the engine is high time, having some information available is better than none at all. I have also heard people say they don't believe in oil analysis because Joe Pilot in the hanger next to theirs had a camshaft lunch itself in his airplane and the oil analysis gave no advance warning. This is operating under the false notion that oil analysis can detect almost any engine problem. This is not the case. Oil analysis is simply a tool to show how the engine is wearing internally and it will not point to any parts that might fail suddenly without prior wear or where parts are breaking apart in chunks rather than wearing out, an example of this would be lifter spalling which leads to camshaft failure. Of course this sort of problem where chunks of metal are coming off of parts should be detected by the above mentioned oil filter inspection.

Tool Four – Compression Tests

Compression testing is the old standby for testing an engine's health and is also one of the most misunderstood. In this test air is pumped into a cylinder through a spark plug hole while the piston is positioned at Top Dead CENTRE (TDC). If the cylinder wall, piston rings, piston, valves and valve seats, which are the components that form the combustion chamber seal of the cylinder, all sealed perfectly there would be no air leakage and the cylinder would hold the amount of air we pump in. Of course no cylinder seals perfectly but by measuring the amount of air that is leaking out and determining where it is leaking we can get a good idea of the condition of the combustion chamber seal in that particular cylinder. While you can run this test by pumping any amount of air into the cylinder, the industry accepted standard is to apply eighty PSI of air pressure to the cylinder and measure the amount of air pressure that is retained in the cylinder while the 80 PSI is being applied. There are no clear cut regulations as to how much pressure a cylinder should retain to be considered healthy but generally any cylinder that measurers 70/80 is considered to be in good shape, 60/80 is acceptable and below this is the area for concern . It is not the intent of this article to be a detailed primer on compression checks but there are a couple of points to keep in mind. First of all the compression check should be done with the engine warm. Second, if compression readings are marginally poor the aircraft should be flown and another test performed. It has been our experience at the Cessna Pilots Association that readings on big bore Continentals such as the 470 and 520 series can fluctuate greatly from one test to the next so a little use between test can make a big difference in results. That's not to say that a cylinder reading 20/80 is going to miraculously recover to 70/80 but it is possible for a cylinder that is reading 55/80 on the first test to read 65/80 after a little flight time and another test.

Continental Motors has their own version of this test, outlined in Service Bulletin M84-15. In which a calibrated orifice is used to determine the maximum leakage allowed. In the field either form of the Compression test can be used to generate data on which to make informed maintenance decisions.

Where leakage is occurring is as important as how much leakage is occurring. By listening for the leakage the point of the leakage can be determined. If one hears air coming out of the induction system then the air is leaking by the intake valve. Air noises at the oil filler spout indicated that air is making it's way it's the piston rings into the engine case. This type of leakage is commonly called blow-by. Finally, if air is heard from the exhaust pipe it means that air is leaking around the exhaust valve. This is the most serious kind of leakage because by manufacturer's specifications no leakage by the exhaust is permitted. In the real world if we were to adhere to this specification exactly we would be replacing cylinders much more frequently, a little discretion in this area is required. However leakage around the exhaust valve is serious and will only get worse with time.

While a compression text is a very useful tool to telling the health of the valve sealing and piston ring sealing, it must be remembered that a compression check is testing the combustion chamber seal at the top of the stroke only; pitting of the cylinder walls or wear at mid-stroke will not be detected.

Fifth Tool – Borescope

A borescope is a optical device that is inserted through a spark plug hole into a cylinder. The most basic borescopes are simply a tube with a lens and a light. These can be used to look at a cylinder walls for sign of damage or glazing. The more sophisticated borescopes use fiber optics with TV camera and monitors to not only show what the conditions are but record them for more detailed examination. The fiber optics can even be worked in behind the valves to see the condition of the seats. Unless a shop does heavy turbine maintenance they aren't likely to have fiber optic borescope but even a basic tube borescope can be very useful in inspecting a general aviation aircraft engine.

The main purpose of a borescope inspection is to determine the condition of the cylinder walls. Generally we won't be performing a borescope inspection unless one of our other "tools" indicated a need to perform such an inspection. Let's say that we have a high oil consumption but compression remains fairly good. This might be cause for doing a borescope inspection. A kind of

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golden hue to the cylinder walls would be an indication that the piston rings hadn't seated properly and the cylinder walls are glazes. This would cause high oil consumption.

Another case that could cause high oil consumption might be mid-stroke pitting caused by disuse and corrosion. Or lets say our oil analysis indicates a rise in iron and aluminium. This is cylinder and piston wall wear. But which cylinder? A borescope inspection might reveal a score mark on one cylinder indicating a broken ring. Instead of doing a full top overhaul only one cylinder need be replaced.

Before borescopes became fairly common in shops I used to have a unusual solution for getting a look inside cylinders. I would borrow a device from a proctologist that was used for medical inspections in, shall we say, tight, dark places. I believed it was called a proctoscope and it worked just fine. Of course there were all sorts of jokes around the shop but what the heck, it got the job done.

Tool Six – trend Monitoring

This is a more subjective tool than our other five. Over the years and hours as you fly your aircraft you gain experience with it and know what's normal behaviour is. You know how easily it starts and how smooth it runs. You know what it's normal oil pressure and oil temperature are, what the usual cylinder head temperatures are and how fast the prop changes RPM during runup. Any deviation from the norm has a reason and that reason should be determined. Sometimes it can be very simple. Late last summer I took off out of Santa Maria with a ground temperature of 65 degrees on a clearance that called for me to climb to 13.000 feet. During the climb I noticed that the oil temperature was higher than I was used to seeing in a climb and that there was a corresponding drop in oil pressure. A quick glance at the OAT indicated the cause of the deviation, the outside air temperature was in excess of 100 degrees at 6,000 feet! While I am used to encountering an inversion layer when climbing out of California coastal airports, this inversion was by far deeper than most accounted for the higher than normal temperature

On another occasion a friend was discussing a trip he had just completed to Colorado and back in his P337. He reported that the airplane has run great and the only problem he had experienced was that the rear vacuum pump had failed. He also mentioned that his oil pressure had dropped a bit on the rear engine for awhile but had stayed in the green and returned to normal indication after a few minutes and had remained that way for the rest of the trip. This mention of the fluctuating oil pressure set off bells and whistles in my mind because oil pressure shouldn't fluctuate like that without a good reason. Now it could have been something like a small piece of trash sticking under the oil pressure relief valve but it could be something more serious. The 'coincidence' of the vacuum pump failing on the same engine on the same flight added to my concern. Unfortunately in this case my concern was warranted as investigation found that the vacuum pump drive, which on this engine has two bevel gears to make a ninety degree turn, had come apart and filled the engine with metal. The vacuum pump itself hadn't failed it was the drive assembly that had come apart in a most expensive manner.

As pilots and owners it is important that we monitor our aircraft for these subtle changes from one flight to the next and also over a longer period of time. When changes occur it should be discussed with your mechanic and the reasons determined

Summary

It is extremely rare for an engine to experience a catastrophic failure without giving some warning in some fashion. By using the "six tools" listed here in the manner prescribed one can closely monitor an engine's health. I would be reluctant to have any confidence in an engine that even through it might be low time was indicating difficulties by way of one or more of these "tools". On the other hand I would not hesitate to operate an aircraft engine beyond the manufacturer's recommended TBO if all the indications from these "tools" were positive.

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