

Adventures at Annual

One guy's DIY journey

by Ryan Stark

Heads up! Next time you get kits, you'll find the **oil slips in the envelope, not the black mailer**. This speeds up the kit building process, getting you kits faster! You can also print slips from our website, under [Services](#).

Well, the building is over and my RV-12 is in the air. Now that I've got an airplane I can actually use to go places and have fun, life is a bit less hectic. Still, the fun has to stop sometime and for airplane owners, the opposite of fun is often the annual inspection. Since my aircraft is an experimental, I have to do what's known as a condition inspection. There is maybe less paperwork involved than the annual inspection that certified aircraft have to go through, but the potential for pain is there. To be clear, this inspection is an extremely important thing to do and the pain will often be limited to just a lack of flying, though there is always the possibility that a major repair will be needed and then the pain can quickly spread to your wallet.

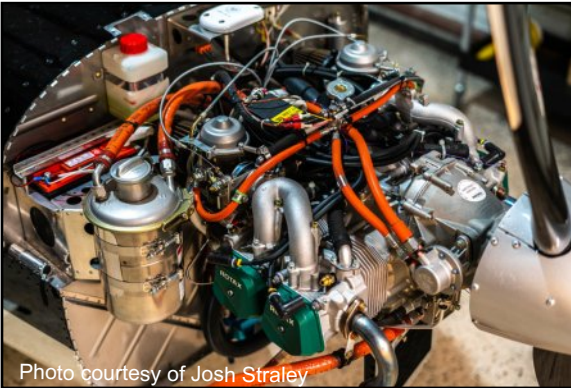


Photo courtesy of Josh Straley

The engine in Stark's RV-12

involving worn-out parts and other things that older aircraft have to deal with. Nope, just checking to make sure everything was working properly and all the fasteners were still holding fast.

This year has been different, but it's not really the plane's fault. My wife and I started the inspection in mid-July, when the weather was nice and there was still plenty of year left, but didn't get it completely done until just last weekend (the end of January). Again, the plane is still fairly new (only at 46 hours now), so there really weren't that many problems to address. No, this year the problem was with me. Life and work tend to have a way of keeping you busy and this year it's been a struggle to string a few weeks together to do the inspection.

DIY Maintenance

As many of you with experimental aircraft know, one of the perks of building an airplane is getting to do all of your own maintenance. No more having to find a mechanic and work around their schedule or pay their bills. The other side of the coin is, you have to do all your own maintenance. In fact, there isn't a mechanic in this area that will touch an experimental aircraft, so I couldn't hire this job out even if I wanted to. Thankfully, the work itself is pretty simple overall and the nice thing is there is a checklist to follow. These are printed in the maintenance manual and include a systematic checklist of everything that needs to be looked at.

I don't think you have to be especially mechanically inclined or talented to do this job yourself, but a little mechanical knowledge probably helps. I took a 2-day class in Dallas to get a light-sport repairman's certificate with an inspection rating. This is required to do your own condition inspection. The class was full of good information, but possibly the most important thing they did was show all the many ways people can die as a

result of taking shortcuts and not following the checklist. By the time I was done with that class, I was fairly gripping the chair arms with white-knuckled fists, and ready to triple check to make sure I dotted all my i's and crossed all my t's.

Oil Change at Annual

The checklist has all kinds of things on it, and I can see how it might be tempting to skip something that seems unnecessary. One of the things on that checklist is normally an oil change. This is a standard part of most annuals and often times it's done whether the oil actually needs changed or not. We see short-run samples like this all the time at Blackstone and often wonder if the owner is looking for a problem, or if the plane is just in for annual and this was on the list.

The RV-12's latest sample

MI/HR on Oil	20
MI/HR on Unit	46
Sample Date	1/21/2023
Make Up Oil Added	1 qt
ELEMENTS IN PARTS PER MILLION	
ALUMINUM	5
CHROMIUM	1
IRON	17
COPPER	11
LEAD	3
TIN	0
MOLYBDENUM	1
NICKEL	6
MANGANESE	1
SILVER	1
TITANIUM	0
POTASSIUM	0
BORON	66
SILICON	14
SODIUM	5
CALCIUM	2542
MAGNESIUM	17
PHOSPHORUS	1603
ZINC	1734
BARIUM	10

SUS Viscosity @ 210°F	58.1
cSt Viscosity @ 100°C	9.69
Flashpoint in °F	360
Fuel %	1.3
Antifreeze %	0.0
Water %	0.0
Insolubles %	0.2
TBN	
TAN	

This is one of those in-between samples; enough time on the oil to tell the engine's okay, though the oil didn't really need to be changed. The fuel is from idling but not flying.

In my mind, if there was any one item on the inspection checklist that could be skipped,

it would be an oil change that's not needed (Blackstone's lawyers would like to remind you that this is one man's opinion only; officially, Blackstone advises you to follow the checklist!). Still, with that being said, an oil change is really an excellent diagnostic tool. You can send in an oil sample to see if the engine is wearing poorly and cut open the oil filter to see if it has any visual metal present. The problem with a short-run sample is, we can rarely tell the customers a lot other than there wasn't much metal in the oil, so it looks okay from what we can see.

Unless you suspect a problem, a short-run filter inspection would also be of minimal value, for the same reason—there really isn't enough time for any significant metal to accumulate. So how about a situation where you are halfway through a typical oil change? Where you have enough time on the oil for an analysis to tell you something, but not enough time that the oil really needs to be changed? For situations like that, you might want to get an oil sample by pulling one up via the dipstick tube. We sell a pump for just that purpose. It's reusable and the money you'd save on an unnecessary oil change would likely pay for the pump in pretty short order.

Sampling From the Filter

Or, what might be an even better option is to just change the oil filter at that point. Then you can pour an oil sample right from the filter and still cut it open to look for metal. If you do follow this route, just let us know you got the oil sample from the filter. We might see a little more insoluble (solid) material in this situation, but the metals and all other results should be basically the same as if you got the oil as it was draining out of the sump.

We understand there might be some situations where it's not possible to stray from the checklist and it's just easier to dump the oil and start fresh, though if you have some leeway in that regard, skipping an oil change can save some time and money, making a potentially painful job a little less so.

INSPECTION CHECKLIST	
RV-12 Aircraft Inspection	Reg. Number:
Airframe S/N:	Engine S/N:
Airframe TT:	Engine TT:
Inspection Date:	Inspector:
Check all that apply to inspector and inspection: <input type="checkbox"/> Owner <input type="checkbox"/> Operator <input type="checkbox"/> Pilot <input type="checkbox"/> A&P <input type="checkbox"/> LSA Repairman Inspection <input type="checkbox"/> 100 hour <input type="checkbox"/> Annual <input type="checkbox"/> Extreme Conditions <input type="checkbox"/> After Hard Landing	
Category:	Check:
Documents	
Certificate of Airworthiness	Onboard and Displayed
Registration	Onboard and Accurate
POH	Onboard
Operating Limitations	Onboard
Switch and control placards	Secure / Legible
Identification Plate	Secure / Legible / Accurate
Light Sport Placard (Experimental for E-LSA)	Displayed
Weight & Balance / Equipment List	Onboard
Service Schedule	Items due for service
Systems & Controls Test	
Engine Start Procedure	Effective / Complete
Starter	Operational / Strong
Oil Pressure & Temperature @ 1800 RPM	
Engine Run-Up	Refer to Rotax Line Maintenance Manual
Continued next page	

A portion of the conditional inspection checklist in the RV-12 Repairs Manual



Report of the Month

This O-200 engine has a problem.
Can you figure out what's wrong?

To learn where the elements are coming from,
[click here](#) and scroll down.

UNIT	MAKE/MODEL: Continental O-200-A	OIL TYPE & GRADE: Phillips XC (A/C) 20W/50
	FUEL TYPE: Gasoline (Leaded)	OIL USE INTERVAL: 52 Hours
	ADDITIONAL INFO: Cessna C150	

ELEMENTS IN PARTS PER MILLION	MI/HR on Oil	52	UNIT / LOCATION AVERAGES					UNIVERSAL AVERAGES
	MI/HR on Unit	1,002						
	Sample Date	11/18/2022						
	Make Up Oil Added	3.5 qts						
ALUMINUM	14	14						7
CHROMIUM	85	85						4
IRON	72	72						35
COPPER	29	29						10
LEAD	6184	6184						2320
TIN	1	1						1
MOLYBDENUM	2	2						1
NICKEL	3	3						1
MANGANESE	2	2						1
SILVER	0	0						0
TITANIUM	0	0						0
POTASSIUM	0	0						0
BORON	0	0						1
SILICON	7	7						8
SODIUM	1	1						1
CALCIUM	1	1						19
MAGNESIUM	2	2						4
PHOSPHORUS	149	149						407
ZINC	4	4						7
BARIUM	0	0						0

Values
Should Be*

PROPERTIES	SUS Viscosity @ 210°F	94.2	86-105				
	cSt Viscosity @ 100°C	18.98	17.0-21.8				
	Flashpoint in °F	445	>430				
	Fuel %	<0.5	<1.0				
	Antifreeze %	-					
	Water %	0.0	0.0				
	Insolubles %	0.4	<0.6				
	TBN						
	TAN						
ISO Code							

* THIS COLUMN APPLIES ONLY TO THE CURRENT SAMPLE

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After taking a look at the data, we called the operations manager to give him a heads up. He later responded: Upon further investigation we found that the cylinders are in fact in a set up of 1 steel, 3 chrome, which explains the situation a bit more. After discussing these results by phone, I decided to have the engine scoped immediately. What we found was cylinders 2 and 4 were beyond what I would consider safe to fly and we will be overhauling them. This report very well could have saved me from a catastrophic issue in the air and I appreciate the call as I was heading to the field to fly.



Report of the Month

This C-85 engine has a problem.
Can you guess what's going on?

To learn where the elements are coming from,
[click here](#) and scroll down.

UNIT	MAKE/MODEL: Continental C-85	OIL TYPE & GRADE: Aeroshell W100 Plus (AD)
	FUEL TYPE: Gasoline (Leaded)	OIL USE INTERVAL: 40 Hours
	ADDITIONAL INFO: Commonwealth SkyRanger	

ELEMENTS IN PARTS PER MILLION	MI/HR on Oil	40	UNIT / LOCATION AVERAGES	40	50	50	20	UNIVERSAL AVERAGES
	MI/HR on Unit	339		298	220	125	85	
	Sample Date	6/1/2022		5/11/2022	3/23/2022	12/15/2021	10/26/2021	
	Make Up Oil Added	5 qts		5.50 qts	7 qts	4 qts	3 qts	
ALUMINIUM	24	18	16	22	11	9	7	
CHROMIUM	4	4	3	4	3	5	4	
IRON	58	60	49	78	54	107	36	
COPPER	62	51	57	60	26	27	13	
LEAD	3380	3017	3313	3834	1541	1211	1419	
TIN	8	7	8	8	3	6	2	
MOLYBDENUM	0	0	0	1	0	0	1	
NICKEL	1	1	1	2	1	1	1	
MANGANESE	1	1	1	1	1	1	1	
SILVER	0	0	0	0	0	0	0	
TITANIUM	0	0	0	0	0	0	0	
POTASSIUM	0	1	0	2	0	0	0	
BORON	2	2	2	2	1	1	1	
SILICON	6	7	6	8	9	7	8	
SODIUM	5	4	3	3	3	3	2	
CALCIUM	3	4	3	5	3	3	23	
MAGNESIUM	1	2	1	4	2	2	5	
PHOSPHORUS	1124	1132	1067	1154	1183	1030	522	
ZINC	7	7	6	9	6	8	8	
BARIUM	0	0	0	0	0	0	0	

Values
Should Be*

PROPERTIES	SUS Viscosity @ 210°F	99.4	86-105	97.9	98.1	90.7	77.5
	cSt Viscosity @ 100°C	20.21	17.0-21.8	19.86	19.92	18.14	14.90
	Flashpoint in °F	490	>460	435	485	490	445
	Fuel %	<0.5	<1.0	1.3	<0.5	<0.5	0.8
	Antifreeze %	-	-	-	-	-	-
	Water %	0.0	0.0	0.0	0.0	0.0	0.0
	Insolubles %	0.3	<0.6	0.3	0.3	0.3	0.3
	TBN						
	TAN						
	ISO Code						

* THIS COLUMN APPLIES ONLY TO THE CURRENT SAMPLE

This one was tricky. When copper started really going up, Amanda called the owner to talk about the engine. She asked if by any chance the engine has an oil cooler. The owner said he had added one in between the December 2021 and March 2022 samples. Bingo! That was, we thought, the answer. When new, oil coolers will shed copper in the form of oxides. But copper kept going up after that, when it should have improved. We found out later that the engine spun a bearing. Bearing problems are hard to see in analysis, because the lead babbitt outer shell is masked by lead from 100LL blow-by.