Report of the Month

This O-470-R had a problem. What happened?

To learn where the elements are coming from, click here and scroll down.

UNIT

MAKE/MODEL: Continental O-470-R
FUEL TYPE: Gasoline (Leaded)
ADDITIONAL INFO: Cessna 182N, Nickel & Superior cyls
OIL TYPE & GRADE: Aeroshell W100 (AD)
OIL USE INTERVAL: 11 Hours

COMMENTS

(We removed the first line of the comments, which gave away the problem.)
Since this engine just got two new Superior cylinders, it's no surprise to find some chrome and iron wear-in. Superior jugs often produce more chrome than nitrided steel ones, so as long as we find progress there, we wouldn't assume poor ring wear. Most of the silicon in this sample is probably sealer or lube, but it wouldn't be a bad idea to check over air filtration in case it's coming from dirt. Check back to monitor for progress.

ELEMENTS IN PARTS PER MILLION

MI/HR on Oil	11	UNIT / LOCATION AVERAGES	3	33	17			UNIVERSAL AVERAGES
MI/HR on Unit	14		52	49	17			
Sample Date	1/26/2022		6/18/2021	4/19/2021	11/4/2020			
Make Up Oil Added	1 qt		0 qts	3 qts	2 qts			
ALUMINUM	13	12	**30**	10	3			9
CHROMIUM	**23**	12	**24**	15	1			9
IRON	**66**	83	**88**	76	9			42
COPPER	9	16	9	**13**	**15**			6
LEAD	692	1556	1146	1283	273			2889
TIN	1	1	1	2	0			1
MOLYBDENUM	0	1	0	1	0			1
NICKEL	1	3	1	1	0			5
MANGANESE	3	2	1	1	1			1
SILVER	0	0	0	0	0			0
TITANIUM	0	0	0	0	0			0
POTASSIUM	0	0	0	0	0			1
BORON	0	2	1	2	3			1
SILICON	**17**	35	**17**	**37**	**60**			8
SODIUM	2	4	3	3	9			1
CALCIUM	5	17	80	7	36			34
MAGNESIUM	1	1	2	1	1			1
PHOSPHORUS	41	37	229	86	22			440
ZINC	4	3	4	3	5			6
BARIUM	0	0	0	0	0			0

PROPERTIES

		Values Should Be*					
SUS Viscosity @ 210°F	94.4	86-105	**84.9**	89.8	86.3		
cSt Viscosity @ 100°C	19.04	17.0-21.8	**16.75**	17.92	17.09		
Flashpoint in °F	515	>460	495	490	505		
Fuel %	<0.5	<1.0	<0.5	<0.5	<0.5		
Antifreeze %	-		-	-	-		
Water %	0.0	0.0	0.0	0.0	0.0		
Insolubles %	0.3	<0.6	0.3	0.3	0.2		
TBN							
TAN							
ISO Code							

When we received the 6/18/21 sample, the note with the sample said an incident was under investigation that caused very high CHTs in flight and total loss of compression in the #5 cylinder - note that there were only 3 hours on that sample. The follow-up sample in January said the engine was returned to the overhaul shop for disassembly following a detonation event in the #5 cylinder at 52 hours post-overhaul. The cause of detonation is currently unknown.

Report of the Month

This Franklin 6A has a problem. What's going on?

To learn where the elements are coming from, click here and scroll down.

UNIT

MAKE/MODEL: Franklin 6A-350-C1
FUEL TYPE: Gasoline (Leaded)
ADDITIONAL INFO: Maule M5-220C

OIL TYPE & GRADE: Aeroshell 100 Mineral
OIL USE INTERVAL: 20 Hours

COMMENTS

Thanks for noting the good borescope results. We're a little surprised to see so much aluminum in this sample. And tin too, though it only increased 1 ppm and it's not really all that high in the grand scheme of things. This engine is still young enough that we don't yet know what's going to be normal, so maybe aluminum will settle down, though we're glad you're looking for anything unusual on your end. Metals (especially aluminum) should be decreasing, not increasing, so there could be some piston wear going on. Monitor for visible metal and check back.

ELEMENTS IN PARTS PER MILLION

	MI/HR on Oil	20	UNIT / LOCATION AVERAGES	9					UNIVERSAL AVERAGES
	MI/HR on Unit	88		66					
	Sample Date	1/15/2022		5/1/2021					
	Make Up Oil Added	10.5 qts							
	ALUMINUM	**35**	25	14					9
	CHROMIUM	2	2	1					7
	IRON	31	35	38					52
	COPPER	6	6	5					8
	LEAD	1325	1235	1144					2110
	TIN	**5**	5	4					1
	MOLYBDENUM	0	0	0					0
	NICKEL	1	1	0					2
	MANGANESE	1	1	1					1
	SILVER	0	0	0					0
	TITANIUM	0	0	0					0
	POTASSIUM	0	0	0					0
	BORON	1	1	0					0
	SILICON	13	14	14					9
	SODIUM	1	2	3					1
	CALCIUM	2	19	36					15
	MAGNESIUM	2	3	3					4
	PHOSPHORUS	83	673	1263					192
	ZINC	2	3	3					3
	BARIUM	0	0	0					0

PROPERTIES

			Values Should Be*					
	SUS Viscosity @ 210°F	93.9	82-105	**82.8**				
	cSt Viscosity @ 100°C	18.91	16.0-21.8	**16.23**				
	Flashpoint in °F	500	>440	475				
	Fuel %	<0.5	<1.0	<0.5				
	Antifreeze %	-		-				
	Water %	0.0	0.0	0.0				
	Insolubles %	0.5	<0.6	0.2				
	TBN							
	TAN							
	ISO Code							

The owner writes: I appreciate your commentary on the results. After sending this sample we pulled the quick drain off to re-seal and found what ended up being quite a lot of aluminum in the pan. We also found one piece of steel that used to be the tach drive gear. The aluminum was from the mag-driven gears. Yes, on the Franklin those are alumnum. They were of course shelled out. We've cleaned things up and once the part overhauls and the annual are done, we'll run a couple hours and drop the oil and send in another sample. Hopefully that tin will settle back down.

Report of the Month

This Lycoming IO-320 has a problem. What is it?

To learn where the elements are coming from, click here and scroll down.

UNIT

MAKE/MODEL: Lycoming IO-320-E2A
OIL TYPE & GRADE: Aircraft Engine Oil
FUEL TYPE: Gasoline (Leaded)
OIL USE INTERVAL: 5 Hours
ADDITIONAL INFO: Piper PA18-160, Chrome Cyls

COMMENTS

Thanks for discussing this sample with us on the phone. As you know, we're concerned about the amount of chrome this IO-320 is making. To give the engine some credit, chrome did improve nearly 400 ppm compared to the first sample, though the shorter run helped significantly. But at the same time, you only did a partial oil change after the first sample, so a good portion of the chrome could be carryover. We suggest 1. Compression test/borescope of cylinders 2. Looking into why the engine's running hot 3. Another run of 5 hours to see how chrome trends.

ELEMENTS IN PARTS PER MILLION

			UNIT / LOCATION AVERAGES					UNIVERSAL AVERAGES
MI/HR on Oil	5		30					
MI/HR on Unit			220					
Sample Date	11/30/2020		8/4/2020					
Make Up Oil Added			5 qts					
ALUMINUM	**17**	27	**27**					7
CHROMIUM	**219**	611	**611**					5
IRON	**43**	129	**129**					35
COPPER	3	9	9					6
LEAD	1516	4275	4275					2254
TIN	1	3	3					1
MOLYBDENUM	0	1	1					0
NICKEL	1	3	3					2
MANGANESE	1	2	2					0
SILVER	0	0	0					0
TITANIUM	0	0	0					0
POTASSIUM	0	1	1					1
BORON	1	2	2					1
SILICON	6	10	**10**					5
SODIUM	3	4	4					1
CALCIUM	5	33	33					19
MAGNESIUM	1	2	2					1
PHOSPHORUS	28	104	104					821
ZINC	2	6	6					4
BARIUM	0	0	0					0

Note the sides of the pistons. You don't want yours to look like that.

The owner writes: Symptoms of the problem were mainly high oil temps in cruise (210-230°F), and high CHTs in #1 & #3 cylinders, as well as rough running/vibrations in cruise & climb. Additionally the engine felt very underpowered. My engine is supposed to be rated at 160HP, but we had quite a difficult time getting off the water with two passengers, and one instructor who flew it said it felt like it had about as much power as his 100HP super cub.

Since I bought the aircraft used and didn't know the complete history on it, and since the engine only had ~225 hours on it in the 20 years since the major overhaul was done, I decided that I'd play it safe and pull all the cylinders after getting your oil analysis results of the extremely high chrome content, twice in a row.

The company who is inspecting and fixing/replacing my cylinders called me yesterday saying the following was wrong with my cylinders:

- the wrong piston rings were installed for chrome cylinders
- heavy wear in every cylinder
- scratches/gouges in #1 & #3 which tells him the plane likely sat for over a year in between startups
- evidence of blow by in #1 & #3
- small cracks in the cylinders
- several valves installed backwards (intake installed on exhaust side, & vice versa). He said this isn't a huge issue, but shows the laziness or inattention to detail by the mechanic who installed them (aka a warning sign that they did other things wrong, like use the completely wrong piston rings)

I'm getting two new (reman'd) cylinders to replace the ones with cracks. And overhauling everything else.