

Everyone's favorite part of the newsletter is the Report of the Month, so we thought this month we'd give you what you really want to see -- aircraft problems that you don't have to deal with! Below are four aircraft samples, each with some sort of problem. We have reported what the owner or mechanic told us in the comments below each report. But before you look at the answer, take a minute to study the data. Can you figure out what went wrong?

### Report of the Month

This IO-520-BA has chrome cylinders, so don't let that metal throw you. Can you tell what the real problem is?

To learn more about where the elements are coming from, [click here](#).

ELEMENTS IN PARTS PER MILLION	MI/HR on Oil	31	UNIT/ LOCATION AVERAGES	34	36	40	35	UNIVERSAL AVERAGES
	MI/HR on Unit	2058		1991	1817	1781	1700	
	Sample Date	2/25/2015		10/20/2014	5/18/2014	3/5/2014	7/18/2013	
	ALUMINUM	5	7	7	7	8	7	7
	CHROME	56	26	24	18	29	13	7
	IRON	26	18	16	16	20	14	32
	COPPER	7	7	6	7	7	6	3
	LEAD	4098	4341	4301	4461	4614	4420	3976
	TIN	1	2	3	5	0	1	1
	MO LYBDENUM	1	1	0	0	1	1	3
NICKEL	19	9	7	6	9	4	5	
POTASSIUM	4	2	3	3	1	2	1	
BORON	1	1	1	1	0	2	1	
SILICON	4	5	4	5	8	3	6	
SODIUM	1	2	1	0	1	3	1	
CALCIUM	1	1	1	0	0	1	18	
MAGNESIUM	0	1	0	2	0	4	1	
PHOSPHORUS	1212	1249	1222	1341	1199	1280	479	
ZINC	2	2	2	2	2	2	5	
BARIUM	0	0	0	0	0	0	0	

"I received your email report while on a trip deep in Mexico. Six flight hours later I did the compression check. The origin of the 200% increase in nickel was valve related. Your suggestion to check compressions and possibly borescope were right on! Five cylinders, seventy plus, and #6 was (almost) twenty lbs. Didn't need to borescope to find the problem child. After removal of the cylinder, the exhaust valve was obviously the issue. Colors like a Christmas tree...dark on one side, then dark green, then green, and finally sunset red. The mechanic estimated failure within fifty hours or thereabouts. That cylinder had over 1600 hours time in service. Since the annual and compression checks were six months away, your oil analysis saved me from unexpected maintenance, probably occurring far from home base while on a trip, and who knows what else!"

# Report of the Month

Just when we started thinking high iron is normal for this IO-540, the owner fixed something that helped bring it down. Can you tell what?

To learn more about where the elements are coming from, [click here](#).

ELEMENTS IN PARTS PER MILLION	MI/HR on Oil	23	UNIT/ LOCATION AVERAGES	26	29	26	26	UNIVERSAL AVERAGES
	MI/HR on Unit	2013		1983	1956	1928	1902	
	Sample Date	1/24/2015		9/26/2014	8/16/2014	7/11/2014	6/7/2014	
ALUMINUM	6	5	4	3	4	5	7	
CHROME	3	3	3	3	3	4	4	
IRON	53	64	78	78	75	68	29	
COPPER	2	3	3	3	3	3	9	
LEAD	3675	4242	4684	4271	3839	3657	4200	
TIN	0	1	1	0	0	3	1	
MO LYBDENUM	2	1	1	1	1	1	0	
NICKEL	4	4	5	3	7	6	2	
PO TASSIUM	0	1	3	1	0	0	1	
BORON	0	1	1	1	0	2	1	
SILICON	5	4	5	3	4	4	6	
SODIUM	1	2	2	2	2	1	1	
CALCIUM	136	103	131	120	121	103	8	
MAGNESIUM	6	4	4	5	3	4	6	
PHOSPHORUS	125	114	143	90	122	96	801	
ZINC	10	9	10	8	9	19	9	
BARIUM	0	0	0	0	0	0	0	

Should Be\*

PROPERTIES	SUS Viscosity @210°F	91.4	86-105	98.2	95.9	97.3	94.5
	cSt Viscosity @ 100°C	18.31	17.0-21.8	19.94	19.40	19.73	19.05
	Flashpoint in °F	465	>460	495	500	515	500
	Fuel %	<0.5	<1.0	<0.5	<0.5	<0.5	<0.5
	Antifreeze %	-	-	-	-	-	-
	Water %	0.0	0.1	0.0	0.0	0.0	0.0
	Insolubles %	0.5	<0.6	0.5	0.3	0.4	0.3
	TBN						
	TAN						
	ISO Code						

\*THIS COLUMN APPLIES ONLY TO THE CURRENT SAMPLE

The comments from the customer were short and sweet for this one: "Turns out the magnetos had corrosion on them and the impulse coupling failed." The most recent sample on the page was taken after the mags were overahuled at annual, and as you can see, iron is already looking better. It might be another oil change or two before all the extra iron washes out of the system, but before long that metal should be close to average again.

# Report of the Month

This IO-520-F used to look better than average. What changed for the Sept. 2014 sample? This is a hard one -- look carefully.

To learn more about where the elements are coming from, [click here](#).

ELEMENTS IN PARTS PER MILLION	MI/HR on Oil	46	UNIT/ LOCATION AVERAGES	37	48	48	51	UNIVERSAL AVERAGES
	MI/HR on Unit	149		1621	1527	1423	1327	
	Sample Date	9/1/2014		1/6/2014	10/1/2013	6/20/2013	3/25/2013	
ALUMINUM	29	13	5	9	11	9	10	
CHROME	4	8	3	3	4	4	7	
IRON	46	53	20	27	29	30	45	
COPPER	9	4	2	3	4	4	5	
LEAD	5415	6722	4643	7158	7963	7840	5541	
TIN	2	2	2	0	2	3	1	
MO LYBDENUM	9	5	2	3	5	5	4	
NICKEL	17	12	9	8	14	13	7	
POTASSIUM	0	1	1	0	3	3	1	
BORON	1	1	0	1	1	1	1	
SILICON	9	6	3	3	4	4	8	
SODIUM	1	1	0	0	1	1	1	
CALCIUM	1	5	1	1	1	1	11	
MAGNESIUM	0	1	0	1	1	0	1	
PHOSPHORUS	997	222	913	908	1012	1049	373	
ZINC	5	2	2	2	3	3	5	
BARIUM	0	0	0	0	0	0	0	

Values  
Should Be\*

SUS Viscosity @210°F	85.8	86-105	88.4	86.4	86.6	88.8
cSt Viscosity @ 100°C	16.97	17.0-21.8	17.59	17.10	17.15	17.70
Flashpoint in °F	505	>460	460	535	470	435
Fuel %	<0.5	<1.0	TR	<0.5	<0.5	1.3
Antifreeze %	-	-	-	-	-	-
Water %	0.0	0.1	0.0	0.0	0.0	0.0
Insolubles %	0.3	<0.6	0.5	0.4	0.4	0.5
TBN						
TAN						
ISO Code						

\*THIS COLUMN APPLIES ONLY TO THE CURRENT SAMPLE

This came from the chief of maintenance at the shop where the aircraft is serviced: "Thank you for the latest report on this aircraft. You mentioned higher than normal wear levels, including silicon. When the oil sample was taken at the last inspection, we found the air filter was beginning to deteriorate. It was replaced with a new unit. We will inspect the air filter and airbox again for issues and schedule another oil sample to be taken at the next oil change. Hopefully the numbers will go back down. The engine is only 150 hours out of overhaul, compressions are extremely good, and we've not done any work to it."

# Report of the Month

Wear was going up in this O-470-R25A, but then it went back down again. What's going on?

To learn more about where the elements are coming from, [click here](#).

ELEMENTS IN PARTS PER MILLION	MI/HR on Oil	12	UNIT/ LOCATION AVERAGES	40	39	10	28	UNIVERSAL AVERAGES
	MI/HR on Unit	2044		2035	1991	1953	1935	
	Sample Date	7/8/2015		4/29/2015	9/22/2014	6/5/2014	9/10/2013	
ALUMINUM	13	12	24	15	11	11	11	
CHROME	6	5	10	6	4	6	8	
IRON	97	106	158	143	108	66	57	
COPPER	9	7	14	8	5	5	7	
LEAD	2209	2895	3730	3060	1904	3170	2915	
TIN	1	2	2	3	3	1	1	
MO LYBDENUM	2	2	3	2	2	2	1	
NICKEL	25	23	42	25	19	21	5	
POTASSIUM	7	1	0	1	0	0	1	
BORON	1	1	1	1	1	0	0	
SILICON	6	9	8	10	15	6	11	
SODIUM	1	1	1	0	0	1	1	
CALCIUM	2	23	4	5	8	10	17	
MAGNESIUM	1	2	2	2	0	1	1	
PHOSPHORUS	9	38	14	3	5	0	250	
ZINC	3	7	4	4	5	4	4	
BARIUM	0	0	0	0	0	0	0	

Values  
Should Be\*

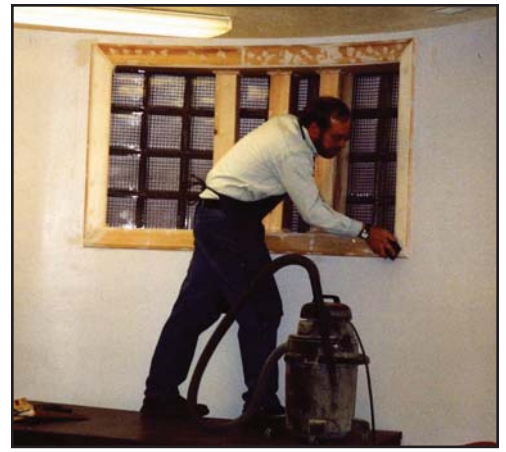
SUS Viscosity @210°F	97.0	86-105	89.0	88.9	68.3	93.9
cSt Viscosity @ 100°C	19.66	17.0-21.8	17.73	17.72	12.49	18.92
Flashpoint in °F	500	>460	460	500	485	445
Fuel %	<0.5	<1.0	TR	<0.5	<0.5	<0.5
Antifreeze %	-	-	-	-	-	-
Water %	0.0	0.1	0.0	0.0	0.0	0.0
Insolubles %	0.4	<0.6	0.5	0.4	0.3	0.4
TBN						
TAN						
ISO Code						

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Don't be fooled by the lower wear in the most recent sample. That oil only had 12 hours on it, and that's why everything dropped. Per-hour, those wear levels are actually worse than before. The customer says: "We found the issue! It was the cam or lifters going bad. Our tach quit working and on investigating the problem, we found a broken drive pin on the oil pump gear and metal in the accessory case. The engine is already out of the plane and at the rebuilder."



Jim in the original Blackstone office, November 2000.



Jim renovates the new Blackstone office in 2005.

Jim Stark passed away peacefully at his home in Ossian, Indiana on Nov. 20, 2015. He was 73.

Jim was an inventor, entrepreneur, pilot, musician, writer, workshop tinkerer, mechanic, and an all-around interesting guy.

He enjoyed happy hour (three-beer limit unless scotch was available), playing guitar and the ukulele, traveling and camping with his wife Kathy, passionately rooting for Purdue, hot tubbing, writing stories, John Prine music, and checking himself out of the hospital. Jim and Kathy played music wherever they went on their travels across the country.

He founded Blackstone Laboratories in 1985, a world-class oil analysis company devoted to helping people learn more about the engines and machines by testing oil. He started this company with his brothers Bob and John, and was later joined by his son, Ryan, daughter Kristin, and a whole host of dedicated hard-working employees. He was building his own airplane – a Van's RV12 – just before he died.

Jim survived a tour in Vietnam (a First Cavalry helicopter mechanic), crashing an airplane, two heart attacks and two heart surgeries, jumping out of an airplane when he was 70 (barely), and the doctors in Indianapolis before lung cancer and a fall got him in the end.

His spirit is among the stars, and he will be greatly missed by all who loved him.



World-beaters Jim Stark and his brother Bob show off their new spectrometer in 1985.