Report of the Month

This 1995 Land Cruiser has a problem. What is it?

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

UNIT			
MAKE/MODEL:	Toyota 4.5L 6-cyl (1FZ-FE)	OIL TYPE & GRADE:	Gasoline Engine Oil
FUEL TYPE:	Gasoline (Unleaded)	OIL USE INTERVAL:	1,500 Miles
ADDITIONAL INFO:			

COMMENTS

G.: There's ambiguity due to all the oil that's been added. Sodium can come from coolant, but we're doubtful that's the source since potassium (also in coolant) is low. Instead, sodium is likely from additive in one of the oils you used. Again though, we can't be 100% sure since the fresh oil could be masking contamination. One thing that isn't hidden is the high amount of wear. Iron is most out of line, coming from steel parts like the cylinders, crank, cam, and lifters. Hopefully that's just an artifact of the neglect and improvement will follow now that the engine is in better hands.

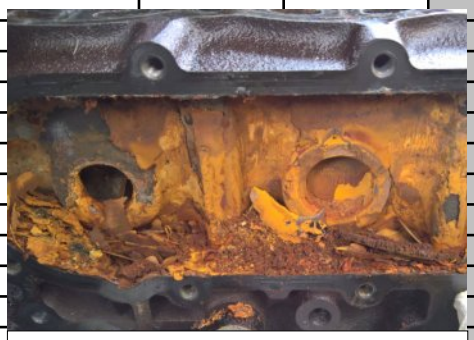
ELEMENTS IN PARTS PER MILLION

		UNIT / LOCATION AVERAGES	UNIVERSAL AVERAGES
MI/HR on Oil	1,500		
MI/HR on Unit	195,400		
Sample Date	9/9/2020		
Make Up Oil Added	7.5 qts		
ALUMINUM	**31**	2	2
CHROMIUM	1	0	0
IRON	**441**	5	6
COPPER	**8**	1	2
LEAD	**13**	5	2
TIN	2	0	0
MOLYBDENUM	44	114	65
NICKEL	1	0	0
MANGANESE	2	0	1
SILVER	0	0	0
TITANIUM	4	0	1
POTASSIUM	0	2	4
BORON	62	112	63
SILICON	19	21	12
SODIUM	**81**	20	34
CALCIUM	1634	1959	1847
MAGNESIUM	242	281	300
PHOSPHORUS	1438	788	798
ZINC	1201	938	943
BARIUM	0	0	0

#6 cylinder wall showing corrosion highlighted by mild phosphoric foaming.

#6 cylinder wall with vertical crack and horizontal corrosion line.

Crack highlighted with marker



Oil cooler full of flaking block sealer.

The owner writes: This engine started to overheat just 1500 miles after I bought it. I eventually got around to pulling the head, assuming I might have a leaking head gasket, and got a surprise. Cylinders #1-5 were in very good shape, smooth walls. Then I got to #6 and saw some staining. Closer inspection showed a *horizontal* line of corrosion and pitting, which indicates water had been sitting in that cylinder at some time in the past, before I purchased this vehicle. I also found, with my finger, a slight irregular *vertical* line, crack, or ridge on the rear wall of that cylinder going into the water jacket. To the eye it appeared just as a stain, but the finger swipe told the story.

So at some point before I got this vehicle the engine likely either hydrolocked and/or overheated and the cylinder wall cracked. Then the previous owner, undisclosed at the time of sale, had dumped in a few bottles of block sealer, then sold the vehicle to me. Also, when I took the cooling system apart, I found block sealer coating the inside of all components, everything coated in that sodium silicate stuff. So the previous owner knew he had a problem and dumped in the sealer, then sold the vehicle.

The cause of the elevated iron and couple other metals was likely from corrosion and a crack in a cylinder wall, and maybe some other minor damage causing other metals to go up a bit. The slightly elevated sodium could be explained by the sodium silicate block sealer added by the previous owner. Now I'm trying to find another block, or maybe sleeve the bad cylinder, and rebuild this block.The photos show the horizontal line of corrosion in the cylinder wall (the whitish foam is weak phosphoric acid I put there to highlight the rust and damage). Another photo was with a marker trying to outline the crack.The photo of the side of the block is where an oil cooler plate would be. That plate is removed so you're looking where the oil cooler normally would sit bathed in coolant. In that one you can see the old block sealer flaking off the surfaces of the water jacket that the previous owner had dumped in the cooling system to try to seal the crack in the cylinder wall.

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Report of the Month

This 2016 Subaru BRZ has a problem. What is it?

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

UNIT

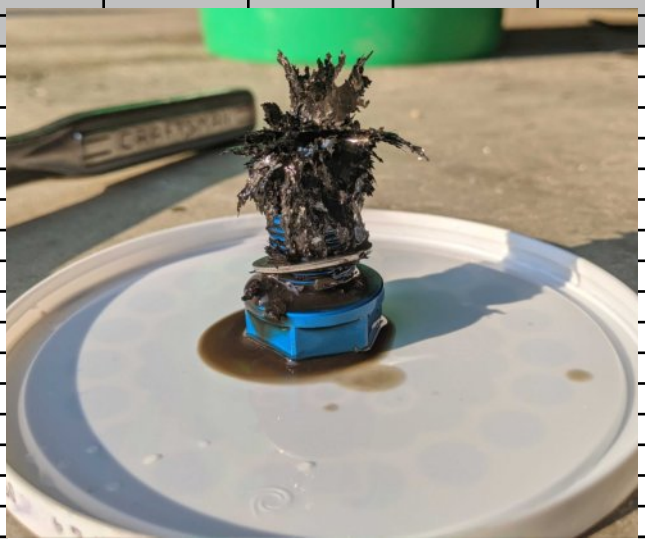
MAKE/MODEL: Subaru 2.0L (FA20/4UGSE) 4-cyl
FUEL TYPE: Gasoline (Unleaded)
ADDITIONAL INFO:
OIL TYPE & GRADE: Motul 300V 0W/20
OIL USE INTERVAL: 250 Miles

COMMENTS

TIMOTHY: There's a lot of metal and silicon present, especially for just 250 miles. Race engines do tend to wear more than their street-only counterparts, but we're not sure that's the only reason why metals are so much higher than universal averages (based on ~5K miles). Parts like pistons/bearings (aluminum), steel shafts and cylinder liners (iron), and brass/bronze bushings (copper) might not be wearing well. Silicon might be partly to blame if it shows dirt, so check air filtration. Recent repairs could be another more harmless explanation. A trace of fuel is usually fine.

ELEMENTS IN PARTS PER MILLION

		UNIT / LOCATION AVERAGES	UNIVERSAL AVERAGES
MI/HR on Oil	250		
MI/HR on Unit	30,275		
Sample Date	4/10/2021		
Make Up Oil Added			
ALUMINUM	**25**	2	3
CHROMIUM	2	0	0
IRON	**57**	9	10
COPPER	**7**	2	3
LEAD	0	0	0
TIN	2	0	0
MOLYBDENUM	669	373	162
NICKEL	0	0	0
MANGANESE	2	0	1
SILVER	0	0	0
TITANIUM	0	16	3
POTASSIUM	0	1	1
BORON	20	55	88
SILICON	**87**	28	25
SODIUM	6	5	29
CALCIUM	2269	1822	1756
MAGNESIUM	16	440	331
PHOSPHORUS	781	864	709
ZINC	859	1024	801
BARIUM	0	0	0



A fuzzy oil plug is never a happy find.

PROPERTIES

		Values Should Be*
SUS Viscosity @ 210°F	51.5	46-57
cSt Viscosity @ 100°C	7.74	6.0-9.7
Flashpoint in °F	**385**	>385
Fuel %	TR	<2.0
Antifreeze %	0.0	0.0
Water %	0.0	<0.1
Insolubles %	0.2	<0.6
TBN		
TAN		
ISO Code		

The owner writes: About 120 stage miles (so a good chunk of them with the engine at redline) after this report, the engine blew up. You'd correctly called out the high metal content, and a spun bearing on cylinder four finally came apart completely. Attached is a photo of the oil plug. We debated sending what drained out of the pan in for analysis, but decided that we weren't really hunting for trace amounts at that point.

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