The Oil Report
August 2019

Oil the News that's Fit to Print!

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This Ain't Your Daddy's ATF

From "lifetime" ATF to using the wrong oil, transmissions aren't simple any longer.

by Ryan Stark

It's been about ten years since we wrote about transmissions. Since that time, a fair amount has changed in the transmission world, both in the machines themselves and the oil they use, as well as what we know about them. "Lifetime" transmission fluids are pretty common now, as are CVT (continuously variable transmission) units. Transmission oil has changed too, with certain transmissions requiring special oils, so we thought it was high time for an update.

Figure 1: GM Turbo-Hydramatic

MI/HR on Oil	
MI/HR on Unit	
Sample Date	9/19/2011
Make Up Oil Added	
ALUMINUM	23
CHROMIUM	0
IRON	**273**
COPPER	155
LEAD	**411**
TIN	9
MOLYBDENUM	1
NICKEL	1
MANGANESE	2
SILVER	0
TITANIUM	1
POTASSIUM	0
BORON	53
SILICON	16
SODIUM	14
CALCIUM	118
MAGNESIUM	9
PHOSPHORUS	312
ZINC	56
BARIUM	0

Learning about CVTs

While manual transmissions are fairly simple machines that tend to run forever, automatic and CVT transmissions are more mysterious in how they work. When we hire new report writers, training them on the ins and outs of transmissions and transmission oil takes quite a bit of time and a lot of internet searching to find good videos on how they work. From time to time, a little "hands-on" training is required. Over the years we have purchased several different junkyard transmissions and torn them down, looking to see how they work and where the metals might be coming from. Dissections like these tend to be a lot of fun and we learn quite a bit from the process. They're also low-stress affairs because we don't have to worry about putting anything back together!

One of the first transmissions we took apart was a classic GM Turbo-Hydramatic, which was used in GM cars and trucks from the 1960s to 1990s (see Figure 1). It was

always a bit of a mystery as to where lead came from in that type of transmission and it turns out, it's a bearing metal, just like what used to be common in engines.

Shaking up the world of transmission oil

For years and years, automatic transmissions like the GM one we dissected didn't have any special oil requirements. They all pretty much ran on Mercon/Dexron ATF (automatic transmission fluid). This is a light oil (normally 10W) containing only a little boron, calcium, and phosphorus as additive. It was also traditionally dyed red, so when it started leaking you knew where it was from.

Figure 2: Virgin ATF +3

MI/HR on Oil	0
MI/HR on Unit	0
Sample Date	1/23/2001
Make Up Oil Added	
ALUMINUM	0
CHROMIUM	0
IRON	0
COPPER	0
LEAD	0
TIN	0
MOLYBDENUM	0
NICKEL	0
MANGANESE	0
SILVER	0
TITANIUM	0
POTASSIUM	0
BORON	0
SILICON	11
SODIUM	3
CALCIUM	2081
MAGNESIUM	4
PHOSPHORUS	494
ZINC	723
BARIUM	1774

Then in the early ’90s, Chrysler came out with ATF+3 and this shook everything up in the transmission world. This oil is still a 10W in viscosity and still has a red dye, but the oil additives were significantly different than anything we'd seen before (or since) — see Figure 2. This oil and the transmissions they were used in worked just fine; problems only came about when a different type of ATF was added by mistake. This caused the transmission to burn up because the new oil's additive package wasn't correct. We started getting a lot of calls about this type of transmission where the mechanic thought someone added engine oil to it, but it was actually ATF that had just turned brown due to excess heat. So this problem has been around for a while, but for the longest time it was limited to Chrysler products — until CVT transmissions hit the market.

CVT transmissions & oil

A CVT transmission is also known as a shiftless transmission and is similar in operation to what you might find on a snowmobile. It has a steel belt connecting two sets of cones. Both cones can change their diameter, which essentially allows the unit to have an infinite number of “gear ratios” available.

Figure 3: a CVT transmission

MI/HR on Oil	
MI/HR on Unit	
Sample Date	10/3/2017
Make Up Oil Added	
ALUMINUM	15
CHROMIUM	1
IRON	142
COPPER	43
LEAD	**144**
TIN	2
MOLYBDENUM	0
NICKEL	**7**
MANGANESE	3
SILVER	0
TITANIUM	0
POTASSIUM	6
BORON	30
SILICON	17
SODIUM	7
CALCIUM	193
MAGNESIUM	0
PHOSPHORUS	253
ZINC	69
BARIUM	0

We dissected one of these a few years back (see Figure 3) to see what made them tick. These units tend to work well but are extremely sensitive to the oil they use. Again, most of these oils are light in viscosity (10W) but they have a unique additive package, and they also tend to be dyed blue or green to differentiate them from the typical red ATF that many transmissions run. Unfortunately, we see a lot of samples from CVT transmissions where the wrong oil has been used. This causes the units to burn up because the belt driving the cones relies on the oil's additives to maintain the correct friction.

“Lifetime” transmission oil

The early 2000s brought about the rise of “lifetime” transmission fluids, which sparked a lot of debate about what that meant and how it could even be possible. The idea that there is a fluid in your vehicle that never needs to be changed goes against some people’s religion, and I'll admit it was a little difficult to understand at first. My 2003 Volkswagen Passat had that type of transmission, and it didn’t even

have a dipstick, so I couldn't run any tests on it to verify that the fluid was in good condition. The lifetime of that transmission for me was 91,000 miles (that's when I sold the car) and I will admit I never had any problems with it.

Still, it just seems wrong not to change the transmission fluid every now and then. Up until that point, I had always regularly changed the transmission fluid in my cars and trucks, but after a lot of thought on the subject, I'm starting to wonder if that's really necessary. For a lot of vehicles, changing the transmission oil could cause more problems than it could help, due to the possibility of the wrong oil being used to refill it. Also, it's quite possible that the wear accumulation in transmission oil doesn't have the same abrasive affect that it does in engines. To demonstrate this, I'd like to show you the first sample from my 1984 Chevy Custom Deluxe K20 pickup truck. You might remember this truck from such classic newsletters as "Rebuilding a GM 350", "ZDDWhat?", and "The Renuzit Experiment."

Figure 4: First sample from my '84 Chevy's transmission

MI/HR on Oil	
MI/HR on Unit	161,071
Sample Date	12/3/1999
Make Up Oil Added	
ALUMINUM	48
CHROMIUM	0
IRON	287
COPPER	458
LEAD	99
TIN	15
MOLYBDENUM	1
NICKEL	1
MANGANESE	3
SILVER	0
TITANIUM	0
POTASSIUM	0
BORON	83
SILICON	11
SODIUM	13
CALCIUM	100
MAGNESIUM	5
PHOSPHORUS	344
ZINC	188
BARIUM	1

When I first bought this truck in 1999, I took a sample from the transmission and was sickened by the amount of metal that was present (see Figure 4). I immediately changed the oil several times myself and then got in the habit of having a shop change it every year or so. I expected that thing to give up the ghost at any moment and just hoped I wasn't far out of town when it happened. The funny things is, it's still running to this very day.

Now maybe all of the oil changes that I did early on made that possible, but at this point I'm leaning towards another explanation: transmissions can make a lot of metal and still be perfectly normal. I think that's because the oil in transmissions has a significantly different life than engine oil does. Transmission oils are mainly used as a hydraulic fluid to shift the gears though an ingenious invention called the valve body. This is like a circuit board that uses oil rather than electricity, and apparently the cleanliness of the oil doesn't much affect its operation. Sure the oil also lubricates the gears, but as far as an oil's jobs go, that's one of the easiest things for it to do. The oil really doesn't even have to be very clean to do that job well. So if the cleanliness of the oil isn't that critical, then lifetime transmission oils start to make sense.

What kills transmissions?

It has been our experience that what kills most transmissions is heat. If the oil gets too hot it actually loses its viscosity and is no longer able to lubricate properly, which in turn causes more heat and eventually a total failure. What's the number-one cause of the oil becoming too hot? Oil volume lost due to a leak. With less oil circulating through the system, the remaining oil is stretched thinner (so to speak) and gets hot faster. It's a vicious cycle, one to avoid if possible.

So in closing, if you have a "lifetime transmission oil," rest easy — there is probably no need to worry about changing it. You'll likely get sick of looking at the vehicle before the tranny dies. However, if you notice your transmission starting to leak oil, that's the time you'll want to have it fixed because its lifetime will quickly expire if you don't. Just be sure they put the right oil back in!

Report of the Month

This 2001 Mustang Bullit got significantly worse from 2016 to 2017.
What went wrong?
To learn more about where the elements are coming from, click here.

ELEMENTS IN PARTS PER MILLION			UNIT / LOCATION AVERAGES						UNIVERSAL AVERAGES
	MI/HR on Oil	4,380		4,105					
	MI/HR on Unit	126,165		121,785					
	Sample Date	3/29/2017		5/1/2016					
	Make Up Oil Added	0 qts		0 qts					
	ALUMINUM	**255**	111	**60**					4
	CHROMIUM	2	2	1					1
	IRON	**66**	77	24					15
	COPPER	**14**	9	5					4
	LEAD	0	0	0					1
	TIN	0	1	4					1
	MOLYBDENUM	22	20	19					63
	NICKEL	2	1	1					1
	MANGANESE	1	1	0					3
	SILVER	0	0	0					0
	TITANIUM	1	0	0					1
	POTASSIUM	0	1	0					2
	BORON	74	69	82					55
	SILICON	**55**	115	**32**					15
	SODIUM	5	6	4					43
	CALCIUM	2429	2239	2215					2033
	MAGNESIUM	13	12	11					175
	PHOSPHORUS	761	713	716					711
	ZINC	895	789	764					833
	BARIUM	0	0	0					1

PROPERTIES			Values Should Be*					
	SUS Viscosity @ 210°F	**53.6**	58-65	**53.4**				
	cSt Viscosity @ 100°C	**8.37**	9.7-11.9	**8.30**				
	Flashpoint in °F	**365**	>375	385				
	Fuel %	0.5	<2.0	<0.5				
	Antifreeze %	0.0	0.0	0.0				
	Water %	0.0	<0.1	0.0				
	Insolubles %	0.2	<0.6	0.2				
	TBN							
	TAN							
	ISO Code							

When we saw the metal in this sample, we called the owner to tell him about it. He reported that the engine was running great, no signs of a problem at all. The owner decided to run compression checks on the cylinders and every cylinder held for 30+ minutes between 200-207 psi across the board. A digital borescope suggested the cylinders were clean and still had cross hatches after 125,000 miles. This led the owner to disassembly for further diagnosis. After pulling the timing chain cover, he found the chain had deeply worn into the guide on the passenger side. He replaced the timing chain and gaskets, and the engine avoided a serious problem.

Report of the Month

This Cummins ISX 15 engine has a lot of metal in the oil.
Is it bad enough to take action?
To learn more about where the elements are coming from, click here.

ELEMENTS IN PARTS PER MILLION	MI/HR on Oil	30,775	UNIT / LOCATION AVERAGES	27,414	24,720	25,373			UNIVERSAL AVERAGES
	MI/HR on Unit	806,080		775,305	722,725	698,005			
	Sample Date	6/6/2019		4/3/2019	10/29/2018	10/3/2018			
	Make Up Oil Added	0 qts		0 qts	0 qts	0 qts			
	ALUMINUM	4	2	3	2	2			3
	CHROMIUM	1	1	1	1	1			1
	IRON	**172**	47	14	8	9			16
	COPPER	**44**	13	**5**	0	1			2
	LEAD	**88**	44	**12**	1	3			3
	TIN	**17**	5	1	0	0			0
	MOLYBDENUM	4	4	2	5	5			40
	NICKEL	1	0	0	0	0			0
	MANGANESE	4	1	0	0	0			0
	SILVER	0	0	0	0	0			0
	TITANIUM	1	0	0	0	0			2
	POTASSIUM	11	11	12	12	11			6
	BORON	24	69	71	100	56			76
	SILICON	5	5	7	4	5			6
	SODIUM	10	6	5	6	6			6
	CALCIUM	2196	2263	2280	2421	2460			1835
	MAGNESIUM	47	32	14	29	27			462
	PHOSPHORUS	979	1015	1012	1091	1102			1011
	ZINC	1228	1201	1193	1218	1313			1172
	BARIUM	0	0	0	0	0			0

			Values Should Be*					
PROPERTIES	SUS Viscosity @ 210°	74.4	69-79	72.9	76.8	74.6		
	cSt Viscosity @ 100°C	14.11	12.7-15.5	13.71	14.71	14.14		
	Flashpoint in °F	440	>415	**415**	440	440		
	Fuel %	<0.5	<2.0	TR	<0.5	<0.5		
	Antifreeze %	0.0	0.0	0.0	0.0	0.0		
	Water %	0.0	0.0	0.0	0.0	0.0		
	Insolubles %	0.2	<0.6	0.3	0.3	0.3		
	TBN							
	TAN							
	ISO Code							

Yes, this engine is headed for serious trouble. The two 2018 samples had normal wear - actually better than average for most ISX diesels. But the April sample started showing higher lead and minor copper wear. In the span of two months that developed into a full-on bearing problem. In June the bearings had worn through the lead babbit layer and were into the bronze layer underneath (see copper and tin). There's no significant contamination in the oil that would be causing it, but we suggested taking a close look at what's going on to avoid a spun bearing.

Report of the Month

This 1976 Honda CB550 race bike isn't showing a lot of change, but something's not right. What's going on?

To learn more about where the elements are coming from, click here.

ELEMENTS IN PARTS PER MILLION			UNIT / LOCATION AVERAGES						UNIVERSAL AVERAGES
	MI/HR on Oil	157		86	160	119	87	110	
	MI/HR on Unit	609		452	366	206	87	1,100	
	Sample Date	10/20/2018		9/4/2018	8/1/2018	6/12/2018	6/4/2018	12/9/2017	
	Make Up Oil Added	0 qts		0 qts		0 qts	0 qts	0 qts	
	ALUMINUM	7	9	4	16	10	7	7	10
	CHROMIUM	1	1	1	2	1	1	1	1
	IRON	9	12	11	17	15	11	7	12
	COPPER	**9**	4	4	7	7	3	3	5
	LEAD	562	446	436	791	543	310	431	386
	TIN	1	1	0	2	4	0	1	1
	MOLYBDENUM	1	1	1	0	0	1	0	2
	NICKEL	1	2	1	2	2	2	1	1
	MANGANESE	0	0	0	0	0	0	0	0
	SILVER	0	0	0	0	0	0	0	0
	TITANIUM	0	0	0	0	1	1	0	0
	POTASSIUM	0	1	0	0	0	0	0	1
	BORON	3	25	1	3	3	2	4	32
	SILICON	12	12	14	15	15	10	14	11
	SODIUM	3	3	4	4	4	3	2	3
	CALCIUM	2258	1639	2337	2613	2480	2413	2358	1685
	MAGNESIUM	10	517	9	17	13	11	52	447
	PHOSPHORUS	1670	1618	1880	1943	1962	1562	1061	1493
	ZINC	1871	1871	2095	2202	2196	1742	1167	1730
	BARIUM	0	0	0	0	0	0	0	0

PROPERTIES			Values Should Be*					
	SUS Viscosity @ 210°	71.5	65-76	73.2	73.4	70.8	65.8	74.6
	cSt Viscosity @ 100°C	13.34	11.6-14.8	13.78	13.84	13.17	11.83	14.16
	Flashpoint in °F	395	>375	420	425	410	410	410
	Fuel %	<0.5	<2.0	<0.5	<0.5	<0.5	<0.5	<0.5
	Antifreeze %	-	0.0	-	-	-	-	-
	Water %	0.0	<0.1	0.0	0.0	0.0	0.0	0.0
	Insolubles %	0.1	<0.6	0.1	0.2	0.2	TR	TR
	TBN							
	TAN							
	ISO Code							

When we wrote the report, we pointed out the change in copper. The increase was not a major change, but copper used to read as low as 3 ppm so we wondered if something was developing. Because it's a race bike, the owner tears down the engine every winter to check for wear and renew any parts as needed. When he did the teardown after this report, he found an internal oil line had failed and the rod bearings were on their way to seizing. Finding the problem before failure saved the rods, crank, and potentially the entire engine.