BLACKSTONE LABORATORIES

The Oil Report
March 2013

Oil the News that's Fit to Print!

We will be at Oshkosh! Wait, you say you've never heard of Oshkosh? Billed as "The World's Greatest Aviation Celebration," Oshkosh is the world's largest airshow. It takes place the last week of July in Oshkosh, Wisconsin, and it's definitely worth seeing if you are interested in anything aircraft. We will have a booth, so if you are in the area, stop by and say hi!

Magnetic Drain Plugs

Cheap insurance or a waste of money?

by Alex Miller

There are lots of products on the market today claiming to be the best thing since sliced bread for your engine- among them, magnetic oil plugs and filters. Manufacturers of these devices are making some pretty enticing claims as to what their products are capable of and the benefits that you'll realize by using them.

Figure 1: New magnetic drain plugs. Note the gold tip on each one.

Magnets have been used in automotive applications for a long time, and some manufacturers even install them in oil pans straight from the factory. But are they any good? We get lots of emails asking us that very question, so I wanted to do an experiment to find out. My bosses agreed to not only support me in my quest for magnetic truth, but even subsidize me.

Figure 2: The Saturn's magnetic plug after one oil change. It's hard to tell, but the black is metal, not oil.

So I went to www.goldplug.com (the first one that came up in a Google search) and ordered one plug for my 2002 Saturn SL and one for my wife's 2008 Honda Fit (see the picture of the new plugs on the right). The plan was to run four oil change intervals on each car, going back and forth between the factory plug and the magnetic one. I would take a sample after each run and in the case of the magnetic plugs themselves, any ferrous metal on the plug would be documented. I used the same type of oil in all of the samples, and the same type of oil filter. For the Saturn, that oil was Meijer brand conventional 5W/30 with a Drive Works filter. The Honda used Quaker State conventional 5W/20 and a basic Fram oil filter.

Figure 3: The Honda's magnetic plug after use.

First: factory drain plug samples

The first samples served as controls. They were taken with factory drain plugs in place, after around 2,000 miles on the oil. My trusty old Saturn went first (the September 2011 sample) and with it comes a disclaimer. Several samples before this I used the additive Restore (just messing around, not endorsing it, save the emails), which contains a ton of lead and copper. That's still washing out, so the engine doesn't, to my knowledge, have a bearing problem. The magnetic plug is only going to remove iron, and iron read 8 ppm. This is a pretty small amount and can be considered normal for such a short run. It did make me wonder though, with so little iron actually

present, would the magnet actually have time to do anything useful?

That concern was compounded when I saw the sample from the Honda. It was producing wear metals like, well—a Honda. Low wear is great, don't get me wrong, but it's not what I wanted here. Iron read at a measly 3 ppm (see the August 2011 sample) starting out.

So, is 2,000 miles on the oil enough to really get a good idea of a magnet's usefulness (or lack thereof)? In all honestly, probably not. A longer oil run would be more informative, but that would take a lot longer than the year I've already spent on this project.

Honda

ELEMENTS IN PARTS PER MILLION							
	MI/HR on Oil	2,380	UNIT/ LOCATION AVERAGES	2,005	2,049	2,163	UNIVERSAL AVERAGES
	MI/HR on Unit	26,130		23,750	21,745	19,696	
	Sample Date	04/01/12		01/07/12	11/04/11	08/30/11	
	ALUMINUM	3	3	2	2	2	4
	CHROME	0	0	0	0	0	1
	IRON	2	5	3	2	3	8
	COPPER	0	1	0	1	1	3
	LEAD	0	1	1	1	1	2
	TIN	3	2	3	0	0	1
	MOLYBDENUM	114	101	120	129	98	79
	NICKEL	0	0	0	0	0	0
	POTASSIUM	4	1	0	0	0	4
	BORON	172	144	186	208	165	47
	SILICON	4	6	7	5	6	11
	SODIUM	3	11	4	5	11	50
	CALCIUM	2149	2006	2276	2020	2034	2190
	MAGNESIUM	9	12	11	9	11	97
	PHOSPHORUS	720	712	791	732	716	704
	ZINC	823	813	897	804	865	827
	BARIUM	0	0	0	0	0	0

The Honda's tests. The August 2011 sample served as a control with the factory plug. The magnetic plug was in place for the Nov. 2011 and April 2012 samples.

Going magnetic

Now for the first sample from the magnetic plugs. The sample from the Saturn (November 2011) shows an increase in iron. There was a small amount of fuzz on the magnet. Figure 1 shows the magnetic plugs when new, and as you can see they've got a gold tip. With the magnetic fuzz collected on the tip, the end of the Saturn's plug is black (Figure 2—sorry for the terrible picture). It didn't seem excessive to me, but I didn't really know what was excessive yet. So what's with iron's increase? The magnet is obviously working and it seems unlikely that it would cause wear. At this point I don't know why iron increased. Let's see how trends develop over the next few samples.

The first magnetic drain plug sample from the Honda (see the November 2011 sample) shows a small amount of fuzz on the magnet (Figure 3). In fact, the first thing I noticed is how much less fuzz there is on this plug, compared to the Saturn's magnet. That follows the lab data as the Honda's 1.5L generally makes less metal than my Saturn's 1.9L. Iron did improve by 1 ppm. That's not enough to really be statistically significant, but it is a finding. It could show an improvement in ferrous metal due to the magnet, but it's hard to say for sure at this point.

Saturn

ELEMENTS IN PARTS PER MILLION							
	MI/HR on Oil	2,074	UNIT/ LOCATION AVERAGES	1,851	1,974	2,108	UNIVERSAL AVERAGES
	MI/HR on Unit	111,727		109,653	107,802	105,828	
	Sample Date	03/26/12		01/21/12	11/19/11	09/12/11	
	ALUMINUM	2	3	3	3	2	3
	CHROME	0	1	0	0	0	1
	IRON	7	14	11	13	8	14
	COPPER	6	77	6	6	11	4
	LEAD	4	72	5	5	9	1
	TIN	0	1	1	0	0	0
	MOLYBDENUM	32	29	46	39	38	64
	NICKEL	0	1	1	1	0	0
	POTASSIUM	1	1	0	0	2	1
	BORON	1	8	1	5	4	37
	SILICON	4	7	6	7	7	13
	SODIUM	15	134	28	57	87	33
	CALCIUM	2327	2161	2822	2599	2351	2006
	MAGNESIUM	10	18	14	13	12	183
	PHOSPHORUS	727	799	881	856	775	770
	ZINC	824	940	1000	897	889	914
	BARIUM	0	0	0	0	0	1

The Saturn's tests. The September 2011 sample served as a control with the factory plug. The magnetic plug was in place for the Nov. 2011 and March 2012 samples.

Back to factory plugs

I re-installed the factory plugs in both cars and again ran 2,000 miles. The sample from the Saturn showed a slight drop in iron (January 2012). This oil saw a little less use than last time, and the type of use on the engine changed a bit. The weather was getting colder, so the engine saw a little more idling on this sample in order to melt the frost off the windows. That is a little harder use, but it didn't seem to have any measurable effect on the oil.

Wear is quite low in the Honda sample (January 2012), but iron increased by one ppm with the stock drain plug back in use. The car sits in the garage, so there was no excessive idling or anything like that to warm it up. Hmmm—I'm starting to see a trend of slightly lower iron with the magnet…very interesting.

Magnetic once more

And now, the last go-round. I put the magnetic plugs back in and ran another 2,000 miles. Iron dropped quite a bit in the Saturn's sample (March 2012), which is odd because the results from the first test with the magnet were the opposite-iron increased. It's possible that the magnet lowered wear this time, but since we didn't really see that the first time it's hard to draw that conclusion.

Honda

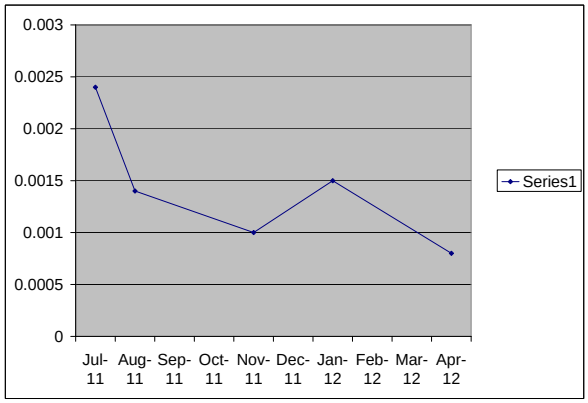


Figure 4: The Honda's wear rates as time goes on in ppm per mile. The magnetic plug was in place for the November 2011 and April 2012 samples.

The Honda report is predictable—low wear (April 2012). But, there was another improvement in iron of one ppm. There is indeed a trend that's showing up. The magnet does appear to be resulting in less iron. Of course, there are a lot of other things that can result in improvements of 1 ppm, including a stiff tail wind, a freshly washed car, and a Chinese butterfly that flaps its wings just right. But results are results.

Correcting for variables

As we discussed this test and whether we could draw any conclusions, we noted that the Saturn has had varying amounts of oil added as make-up oil (Saturns are notorious oil-burners), so we decided to correct for that. Make-up oil affects wear about the way you'd expect it to—if you have a 4-quart pan and you add two quarts over the course of your oil run, wear will be diluted by about 50%. We took that into account for all the Saturn's samples, and then we also calculated iron's wear rates (divide iron by miles on the oil) to eliminate the variable of differing oil change intervals. Then we did the same for the Honda (which never had any oil added). We charted the results, which you can see in Figures 4 and 5. For the Honda, wear rates went down when the magnetic plug was in use. For the Saturn, wear rates went *up* when the magnetic plug was in use.

Conclusion?

So, to answer the original question for the four or five of you that are still with me: Are magnetic drain plugs worth the money?

Saturn

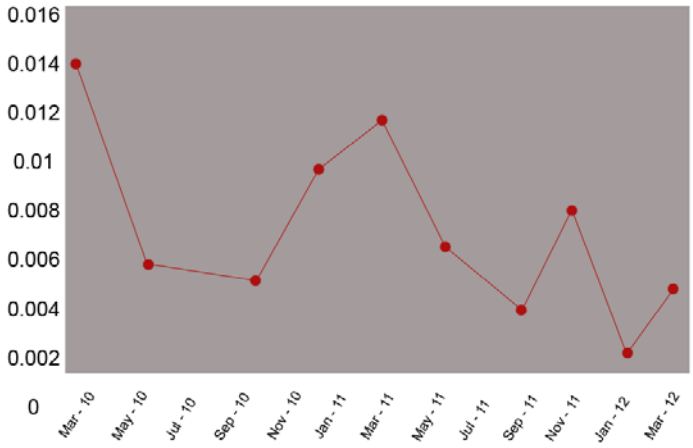


Figure 5: The Saturn's wear rates as time goes on in ppm per mile. The magnetic plug was in place for the November 2011 and March 2012 samples.

Visually, they certainly seem to work. All you have to do is look at the magnet to see that it's doing what magnets do. But there's not really enough evidence here for us to say that magnet drain plugs improve the way your engine wears. We might find less metal in the oil—in fact, for the Honda the magnet did seem to have a clear (but very small) correlation with iron in the report. When the magnetic plug was in place, iron dropped by 1 ppm. For the Saturn, however, the case was not so clear. In terms of raw numbers, the first time the magnet was in place, iron increased. The second time, iron decreased. But after correcting for make-up oil dilution and differing oil change intervals, iron increased both times the magnetic plug was used. We tossed around speculation about the magnet "stirring up sludge" and wondered whether that was the reason iron went up. But that's too much speculation. Because we had different results for the two vehicles, the results are inconclusive.

Are there any downsides to using magnets? Probably not, though I did read an interesting debate on a forum where one guy claimed that any metal that might break free of the magnet or pass over the magnet without getting captured could, in turn, become magnetic and then proceed to stick to other internal iron parts. What you would then have is tiny shards of metal attached to operating parts, which doesn't seem healthy. Of course, that's all a bit speculative for my taste, but maybe there are others reading this who are smarter than me who might take a crack at proving or disproving that hypothesis.

These findings do help answer one question that we get a lot—will using a magnetic drain plug throw off my oil analysis results? From what my tests show, the answer is maybe. It depends on the engine. Keep in mind that a magnet only affects iron, so it won't change any of the other metals. If you do decide to use a magnetic drain plug, use it consistently. That way, you'll still have a level playing field when looking at wear trends and be able to see if wear at steel parts is holding steady or not.

So, should you spend your own hard-earned money on one of these drain plugs? There is not enough evidence here for me to recommend their use. But they shouldn't hurt anything either and if it helps you sleep better at night, then go for it. They might be useful in assessing wear at steel parts. The more metal on the plug, the more metal the engine is making. But if you really want to see what's going on in the engine, you still can't beat following an oil analysis regimen. Since that's the case, you might as well do it with us. After all, we love you enough to do experiments that don't really tell you anything for certain. Where else are you going to get that kind of service?

Postscript for the eBay Oils: We Were Fooled!

If you remember our eBay oil articles last year, you may remember one of the oils we tested was vintage Castrol R. The R stands for racing and it billed itself as "The Masterpiece in Oils." Well, after receiving email from several of our clients and some double-checking on our end, we realized Castrol R was actually castor oil—the stuff made from castor beans. We should have picked up on that. We can actually test castor oil, and we see a few samples a year from older racing engines using it, but it doesn't mix with kerosene like regular petroleum or synthetic base oil does, so we have to run a special dilution to get it to run correctly on our spectrometer. (That type of oil does mix with alcohol and that's good information for anybody that has had to clean up an engine that used it.) Anyway, we re-ran the Castrol R using the correct method and a comparison of the two results is to the right. The February 2012 sample was run incorrectly. February 2013 was run with the correct dilution. Perhaps tin is from the can itself?

Castrol "R" Racing Oil

ELEMENTS IN PARTS PER MILLION			UNIT/ LOCATION AVERAGES	
	MI/HR on Oil			
	MI/HR on Unit			
	Sample Date	02/21/13		02/18/12
	ALUMINUM	0		0
	CHROME	0		0
	IRON	8		1
	COPPER	0		0
	LEAD	6		0
	TIN	126		0
	MOLYBDENUM	0		0
	NICKEL	0		0
	POTASSIUM	0		2
	BORON	42		0
	SILICON	0		0
	SODIUM	8		2
	CALCIUM	10		8
	MAGNESIUM	0		1
	PHOSPHORUS	550		528
	ZINC	2		10
	BARIUM	2		1

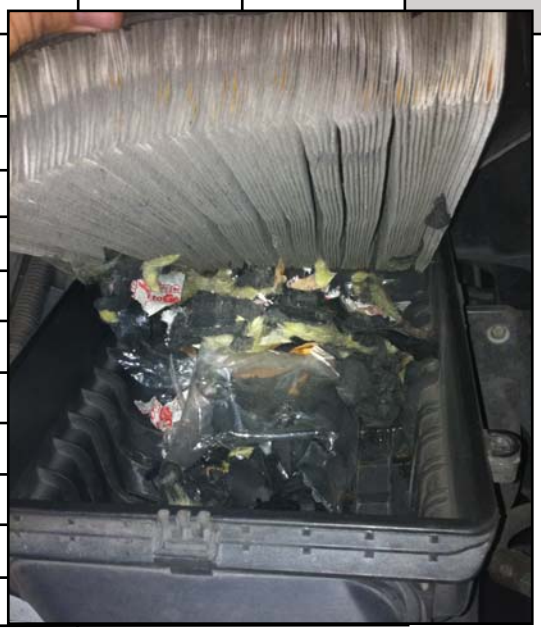
Report of the Month

You can kick the tires, pop the hood, and make sure the heat works, but many people wouldn't think to check the air filter when they're buying a used car. Maybe it's time to add that to the checklist.

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	4,233		10,000				
	MI/HR on Unit	126,733		122,500				
	Sample Date	07/01/12		02/19/12				
	ALUMINUM	4	12	**20**				3
	CHROME	1	4	**6**				1
	IRON	13	65	**117**				14
	COPPER	2	5	7				4
	LEAD	3	7	11				7
	TIN	0	1	2				1
	MO LYBDENUM	18	110	201				65
	NICKEL	1	3	4				0
	PO TASSIUM	4	2	0				11
	BORON	5	14	23				39
	SILICON	24	24	**75**				17
	SODIUM	286	165	44				42
	CALCIUM	1891	2087	2282				2017
	MAGNESIUM	11	15	18				138
	PHOSPHORUS	645	669	692				718
	ZINC	691	820	820				864
	BARIUM	0	0	0				0

PROPERTIES		Values Should Be*			
	SUS Viscosity @210°F	57.9	56-63	-	
	cSt Viscosity @ 100°C	9.61	9.1-11.3	**THICK**	
	Flashpoint in °F	395	>365	**320**	
	Fuel %	<0.5	<2.0	**2.3**	
	Antifreeze %	0.0	0.0	0.0	
	Water %	0.0	<0.1	0.0	
	Insolubles %	0.4	0.6	0.4	
	TBN				
	TAN				
	ISO Code				



*THIS COLUMN APPLIES ONLY TO THE CURRENT SAMPLE

It's not often that you find a literal rat's nest in your engine, but that's exactly what was causing the poor wear in this Silverado. After his first sample, the shop that took the sample advised the owner to check the air box, and what he found is pictured above. The guy had just bought this truck, so he inherited the rat's nest. With air not circulating properly through the engine, it's no wonder aluminum, chrome, and iron were so high. The upper end was getting hot and dirt was causing serious piston, ring, and cylinder wear. Note to self: when buying a new vehicle, send in a sample first.