July 2008

The Oil Report

"Oil the News That's Fit to Print!"

BLACKSTONE LABORATORIES

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Transmission Translation

by Kristin Huff and Jim Stark

Most of us drive cars and trucks with transmissions in them, but few of us really know much about them. If you're interested, read on! If not, hey, isn't it time to go change your oil and send a sample to Blackstone?

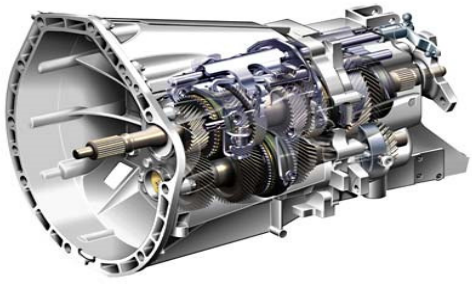
A Little History Lesson

Direct drives for cars and trucks disappeared with steam engines and chains. The first transmissions were two-speed manuals, linked to the engine with pedals. Just before WWII, Chrysler introduced the "fluid drive," which was a semi-automatic transmission that still used a clutch pedal. You could start driving without using the clutch, but shifting between low and high gears required some pedal action. Semi-automatic and, later, automatic transmissions, were a big hit and fed the growing American love affair with cars. To improve fuel economy, overdrives were added after WWII. Simply put, an overdrive is a gear arrangement that allows more revolutions on the shaft going to the wheels than on the crankshaft in the engine. Overdrives improved fuel efficiency and reduced engine wear.

Three-speed transmissions were developed after two-speeds, and they had the longest run historically. Next came four-speeds, then five-speeds and now, six-speeds. The three-speeds worked well and little has been gained in efficiency (in our opinion) with the following generations of weightier transmissions. "High gear" is the gear that allows direct drive; that is, 1:1 input to output. For three-speeds, high is third gear.

How Stuff Works

The purpose of any transmission is to transfer the engine's power to the wheels. Gears inside the transmission change the ratios of speed and power produced by the engine.

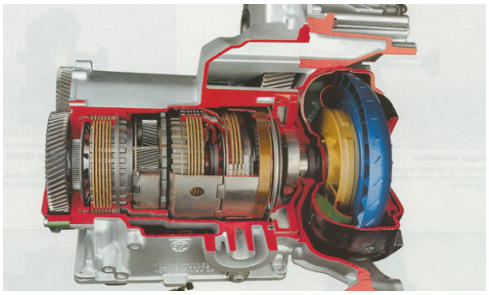


Manual transmission

Automatics differ from manual transmissions in how they shift. In a manual, the shifting is done with the clutch whenever the driver decides it should happen. In an automatic, the shifting is done with the torque converter. Basically, the torque converter transfers the turning power that the engine provides through hydraulic coupling.

Both types of transmissions work basically the same way: they contain gear sets that are engaged and turn together to amplify power. To keep the gears from mashing into each other, most transmissions use "synchronizer" rings. A synchro ring does just what it sounds like: it stops the motion of the gears so that two gears can align and engage. All gears in early manual transmissions were spur gears without synchros. Before synchro gears were invented, shifting required double-clutching to get the gears to the similar speeds before meshing.

In an automatic, the torque converter works like this (and thank you Edmunds.com for providing an analogy to make this easy to understand): Imagine two fans in a line, both facing the same direction. If you put them close enough and turn on the rear fan, the



Automatic transmission

blades of the second fan will start to turn as well. This is what happens in a torque converter, only hydraulic fluid takes the place of air. Inside the torque converter, there are other parts that help convert the power provided by the engine. Through centrifugal force, the fluid moves to the outside of the fan blades and, with the help of another fan, back again. The continual flow of fluid is what causes the power to be multiplied.

In front-wheel drive vehicles, the transmission and differential are contained in one unit, called the transaxle. A transaxle is lighter, so it improves your gas mileage and saves space. (Do we test transaxle oil? Why yes, we do!)

The transmission connects to the wheels using something called an output (or drive) shaft, which joins to the axles in one of several possible ways, depending on how your car is set up. The transmission turns the output shaft, which turns the axle, and next thing you know you're flying down the street with a cop behind you flashing his lights. (Or maybe that's just us.)

There's No Sneaking Around in Reverse, Buddy

The reason reverse is a noisy gear is because it is a "spur" gear, a flat-cut gear made on a hub. All forward gears today are helical (cut on an angle), which allows gears to mesh more easily, run quieter, and absorb more force. Because reverse gears aren't engaged nearly as often as forward gears, engineers aren't as worried about them wearing out so they don't have to be as precise when engaging.

Spur gear

The Oil They Need

The gear boxes of manual and automatic transmissions are very similar. One obvious difference — other than a clutch pedal on the floor — is the oil used. For manuals, most any lube grade will work. Commonly, 75W/90s are employed, though light oil can be used as well. Gear grades run as high as 85W/140 and some specify "EP lubes," which means the oil contains more stinky sulfur. Gear boxes with bronze parts don't do well with EP lubes. In the presence of moisture, the sulfur in the EP oil can turn into sulfuric acid, which eats bronze like potato chips.

The same gear sets on automatics work with 10W or 20W oil, which is what automatic transmission fluid is. Why do automatics need such a light oil? Because shifting an automatic transmission is done with hydraulics and hydraulic fluids are by nature light-weight fluids. For the same reason, ATF needs to be kept clean and contamination-free, or shifting difficulties will arise.

Helical gear

Since hydraulics aren't used for shifting manual transmissions, manual transmission fluid can be thicker and can tolerate a much higher level of contamination than can automatics. Most ATFs need to be changed out much more frequently than manual fluids. Changing ATF and servicing the filter is often done at 25,000-mile intervals, though your particular ATF's change interval can vary wildly from this number. The condition of your transmission, as well as the environment you drive in and how you drive it, all play a part in how often your transmission oil needs to be changed. Do you rev it in neutral and them slam it into gear to impress your friends? Your ATF may need changing more often than the little old lady who gingerly drives only to church and back on Sunday mornings.

Either an automatic or manual transmission will outlast the car or truck chassis if they are serviced regularly. If they aren't, the fluids become abrasive and damage the seals. Leaky seals allow the oil to get low. The excessive heat that builds up from low levels of oil is the most common cause of transmission failure.

We've been getting a lot of questions lately about testing transmission oil. Do we test it? You betcha. The sample kit is the same as for engine oil, and the cost is the same as well. We run the same tests as we do on engine oil. People get their transmission oil analyzed for a variety of reasons, but mostly to find out the condition of the transmission, whether they need to change their oil, and to try and pinpoint a problem. Click here to request a free test kit.

Report of the Month

This is a sample from a transmission with a problem. What went wrong? Take a guess, then look at the caption below to see if you're right.

Click here to see where the elements are coming from.

Elements in Parts Per Million								
	MI/HR ON OIL		UNIT/ LOCATION AVERAGES					UNIVERSAL AVERAGES
	MI/HR ON UNIT	105,011						
	SAMPLE DATE	06/02/08						
	ALUMINUM	35	19					11
	CHROMIUM	1	0					1
	IRON	576	188					93
	COPPER	234	193					73
	LEAD	113	69					25
	TIN	9	5					2
	MOLYBDENUM	2	1					4
	NICKEL	1	2					1
	POTASSIUM	2	8					3
	BORON	201	148					21
	SILICON	20	22					21
	SODIUM	8	11					13
	CALCIUM	296	327					926
	MAGNESIUM	12	10					92
	PHOSPHORUS	442	402					733
	ZINC	67	112					428
	BARIUM	0	207					386

PROPERTIES		Values Should Be				
SUS Viscosity @ 210	41.3	42-51				
cST Viscosity @ 100C	4.56	4.8-7.9				
Flashpoint	365	>335				
Fuel %	-	-				
Antifreeze %	-	-				
Water %	0.0	<0.1				
Insolubles %	**0.2**	<0.1				

The metals are too high, which could be due to a mechanical problem OR running the oil too long. But the giveaway is the low viscosity and high insolubles -- two excellent indications that this ATF has seen excessive heat from running it too many miles. In this case, the oil was run too long, which caused excessive metals to build up in the oil. The metals are mostly coming from the clutch plates, though aluminum is from the torque converter. The only source we know of for lead in a transmission is marking compound used at the factory, so it's possible that this is the original fill of oil, and it has never been changed.

416 E. Pettit Ave. Fort Wayne IN 46806 (260) 744-2380