Shop Class: Exploring The Causes of Excessive Oil Consumption

Behind The Blue Smoke

It’s not just the mega-mileage ’75 F-100 blowing blue smoke out the tailpipe any more. Over the past decade a large number of low-mileage, late-model car and truck engines have been consuming excessive amounts of motor oil. The mechanical failures vary, but the root cause seems to be each manufacturer’s hurry-up need to meet EPA fuel economy and emissions requirements.

Yes, every four-stroke engine does normally burn a small amount of oil.

Before we get into the technical aspects of oil consumption, let’s look at how much is too much. Most manufacturers publish what we consider “cover-your-butt” specifications – commonly one quart burned every 1,000 miles being the normal threshold. Now let’s think about this. With recommended oil change intervals increasing from the old-faithful 3,000 miles and getting closer to 7,000, you could be adding 6 or 7 quarts of oil between services. Say your engine has a 5-quart oil capacity, you’re now buying up to 12 quarts per service, and all that extra oil is burned up and discharged into the atmosphere. Not to mention the carbon buildup in the combustion chamber and back of valves,

rendering further harm to the engine's performance and lifespan.
These oil consumption specs seem ridiculous, and thankfully most, but not all, manufacturers and dealership service departments will perform a repair before oil consumption reaches that degree.
Typical entry points of oil into the combustion chamber are past the piston rings and valve guides. Each piston utilizes rings, which are spring-loaded against the cylinder wall. These piston rings seal the high pressure in the combustion chamber, from the motor oil flying around inside the crankcase.

Piston Rings
Common configurations involve a top compression ring and a second compression ring, followed by two much thinner oil rings separated by a spacer. Each ring moves freely inside its specific ring groove. Made up of cast iron (or steel), a piston ring is not a complete circle, utilizing an "end gap" to allow for spring-tension against the cylinder wall and expansion and contraction with heat.
Ring end gaps must be staggered during assembly to prevent them from lining up with each other. End gaps directly above or below one another provide a path for compression loss and excess oil entry to the combustion chamber.
A finished cylinder wall is honed with a cross-hatch pattern of tiny channels. This allows a very small amount of oil from the crankcase to be retained on the cylinder wall and lubricate the piston rings, as the piston travels up and down in its cylinder bore.
Here's a look at the process. The piston travels upward on the compression stroke, and both intake and exhaust valves close. The top two compression rings provide a seal between the cylinder wall and piston head (top) and the air/fuel mixture is compressed. A spark ignites pressurized air/fuel mixture, causing combustion and expansion in the combustion chamber above the piston. This expansion drives the piston down on the power-stroke, where the piston, attached by a connecting rod, rotates the crankshaft.
The high pressure from combustion also forces the piston rings into their respective grooves and against the cylinder wall, which enhances sealing properties even further. While all this is going on, the oil rings (with help from #2 compression ring) are scraping excess oil from the cylinder wall and

preventing most of it from entering the combustion chamber. The small amount of oil in the cross-hatched channels lubricating the piston rings does get by and burns up in the combustion chamber (normally).

Excessive oil consumption will eventually take place with any engine that reaches a certain high-mileage plateau, dependent on engine design, proper service, and driving conditions. As far as piston rings and ring grooves are concerned, they may be worn to the point where adequate sealing of combustion pressure, and/or oil control is no longer possible. Excessive carbon buildup in the ring grooves can prevent the rings from moving freely (sticking). Cylinder walls scored, worn too large, or no longer straight (excessive taper or out-of-round) can also hamper compression and oil control by weakening the piston rings' sealing capabilities. Of course, improper machining, assembly, and low-grade parts will play a role following a repair.

Valve Guides

Inside the cylinder head are the intake and exhaust valves, which allow air and fuel entry and exhaust gas exit, respectively. Each valve has a shaft referred to as a valve stem that travels up and down within a valve guide. The guide is simply a bored hole for the valve stem to travel, with a specified clearance between the two. The top of the valve is driven downward by a pivoting rocker (controlled by camshaft rotation) to open and close each valve. The rocker and top of the valve stem are within the crankcase environment, and lubricated with motor oil. To prevent excessive oil from traveling past the valve stem and guide, a valve seal made up of various rubber and synthetic materials is affixed to the top of the valve guide.

Again, normal wear will eventually degrade valve seals, and widen valve stem to guide clearance, allowing excess oil entry past the valves and into the combustion chamber.

Additional Sources

Other means of excessive oil consumption are overfilling, blockage of a crankcase ventilation system, or even excessive sludge obstructing oil return passages. Oil is pumped up to the cylinder head in order to lubricate valve train components. If the oil can no longer drain back to the oil pan (reservoir), the valve guides become completely submerged in oil, and valve seals don't have the capability to shelter the guides to that extent.

Symptoms

The annoyance to drivers is the need to add oil between services. Manufacturers generally recommend checking oil level at every fuel tank fill-up, but the mass majority of drivers don't. This leads to not knowing about the low oil level until it reaches an extreme. The symptoms vary from the low oil pressure (or oil level) light flashing, malfunction indicator lamp, engine noise, and finally engine damage (seizure) if early warning signs go unchecked.

Why the high consumption on young engines?

One not-so-relevant issue is oil viscosity. Thinner oil is tougher to seal than thicker (0W20 versus 10W40). And carmakers have steadily decreased recommended viscosity to reduce their engines' rotational friction and therefore increase fuel economy. However, current engine technology overcomes the lubrication differential.

Certain manufacturers insist adding a quart of oil in the 1,000-mile range is normal, especially with specific performance and turbocharged engines. This statement is semi-fathomable, maybe, but doesn't explain high oil consumption problems in a large range of non-performance, normally aspirated engine designs.

This all leads back to rotational friction or the force required to rotate an engine at the crankshaft. Leaving compression out of the equation (spark plugs removed), total engine friction includes everywhere a moving part makes contact, along with spring tension. A good example is the rotation of a camshaft. There's friction at the cam bearings, which are lubricated with oil (viscosity-relative), along with the force required to open the valves, which are held closed by valve springs.

Significant contributors to engine friction are piston rings—more than 20 percent of the total. Engineers have been studying this factor for years, trying to find a happy medium to reduce piston ring friction to aid in fuel economy, while keeping them durable enough to withstand a normal engine lifespan under real-world driving conditions.

This is a personal analysis based on up-close experience and shared by many others but typically undisclosed by manufacturers. Engineers simply went over the top reducing piston ring friction (spring tension) to improve fuel economy, but the design does not hold up on-road.

The piston rings' ability to seal motor oil from the combustion chamber is sufficient right out of the box on the dyno, but as normal wear takes place, oil gets by. In several circumstances the oil consumption isn't notable early, but when the excess oil forms carbon deposits on the oil rings (seizing them in the groove) oil consumption goes off the wall.

Another factor has been variable displacement technology, which is available on some vehicles. In low-load light-throttle driving conditions, specific cylinders are shutdown to improve fuel economy. In the process, fuel is turned off while intake and exhaust valves are held closed. The lack of combustion pressure reduces the piston rings' ability to seal, so when that cylinder fires once again, the excess oil adds to the oil ring carbon build up. There are also cases of the ring end gaps on the deactivated cylinders tending to lineup. The combination of the two cab lead to such a high volume of consumption that the effected cylinders oil foul sparkplugs. In these cases, drivers experience a rough-running condition from the misfire, a misfire diagnostic trouble code, and the check-engine light illuminating.

Responsibility

Consumer Reports published an article in June 2015 in reference to the problem. In a survey involving nearly 500,000 '10-'14 model-year vehicles, oil consumption complaints were analyzed. Specific Audi, BMW, and Subaru engines topped the list of oil-burners according to customers.

Engine repairs are expensive to car and truck owners and even more so for manufacturers correcting high-volume engine defects. Additionally, carmakers are known to fight tooth-and-nail to avoid responsibility. Dealing with oil consumption, stage one is to explain to customers that it's normal and keep topping off. The next stage is to perform out-of-warranty engine repairs (goodwill) on a case-by-case basis to satisfy customers and nullify publicity. Next is to battle a class-action lawsuit. The last stage is to be legally bound to issue an extended warranty providing repairs free of charge beyond the powertrain warranty, and reimbursement for previously paid-for repairs.

Audi, Subaru, Honda and Toyota are currently in the process of class-action suits for oil consumption of specific models/engines or have settled and are performing repairs under an extended powertrain warranty.

Repairs

The extended warranty fixes vary, but most involve replacement of piston rings, pistons, a powertrain control module software update, or all of the above. Some of the software updates have involved decreasing the "on-time" of variable displacement, which does affect fuel economy.

There are some big questions on these repairs: are they installing adequately modified parts to prevent the oil consumption from reoccurring, or is it just enough to get the vehicle outside of the extended warranty period? And what about all the residual carbon buildup left behind?

Before buying a used car or truck, research any involvement in an oil consumption class-action suit, extended warranty, or high number of complaints. This will have an effect on repair costs and future vehicle value.

Drivers should *not* be filling up with gas and oil every tankful.