# Reasons for Engine Oil Consumption

**What is excess oil consumption**

All engine manufacturers have specific warrantable levels of oil consumption - what they expect their engines to go through as a part of normal operating conditions. These levels really help to define what is excessive in a given engine.

**Engine, Age, and Oil Consumption**

Oil consumption changes as your engine ages. Typically, a new engine will have a "breaking-in" period which might call for a high consumption of oil.

The increased oil consumption tends to fall off after the engine breaks in. And then as the engine ages – as you get toward the end of the life cycle of the engine – the oil consumption tends to rise again. We will discuss the mechanical reasons for this further below.

**Heavy Loads, Extreme Conditions, Increased Demand**

There are many other factors that affect oil consumption. If you are pulling heavy loads in the mountains, you are going to consume a lot more oil than if you are pulling a light load on a flat surface.

The harder a diesel engine works, the more oil it will consume. Idle time also must be taken into consideration. If you are sitting there idling, you are going to use more oil than you should.

**Does Viscosity Effect Consumption?**

Changing the viscosity of your engine oil can also make a difference. For example, if you change from a 15W-40 to a 10W-30, you should see a slight increase in oil consumption because you now have slightly lighter viscosity oil in your engine.

**Do The Right Thing**

Similarly, extending drain intervals beyond reasonable limits can also lead to excessive oil consumption.
With this in mind, the simplest definition of excessive consumption is anything that exceeds the engine manufacturer's recommended guidelines, bearing in mind all of these other factors for conditions.

**Stresses**

When you are consuming an excessive amount of oil, and constantly running a liter(s) or more lower than you should be, you are putting excessive stress on the oil that is left in the engine.

For example, when you have a situation where 25 liters is having to do the work of 30, the additives in the oil are going to be consumed at a faster rate. You can actually wear out the oil.

**Deposits and Lost Performance**

Additional problems can occur if you are burning the oil – carbon deposits will form on the valves and in the combustion chamber.

If the oil is getting up into the combustion chamber, it also can cause deposits to form on top of the pistons. Burning also will cause deposits on the exhaust valves. Then you are not going to have the proper airflow through the engine, which will result in a loss of power and overall engine performance.

**The Environment**

There also are environmental problems that can occur. If you are leaking oil, it is going on the ground. This should be a concern for anyone operating a truck or off-road machinery. Excessive burning brings about another environmental matter. This could easily create a situation where unsafe particulates from your emissions are coming out of the exhaust.

**What causes excess oil consumption**

Under normal operating conditions, excess oil consumption is generally a mechanical problem.

**Technically Speaking**

Oil is consumed in one of two ways:
1: you either burn it
2: you leak it

**Leaking**

In the majority of cases where oil consumption problems have been investigated, it usually turns out to be a leak issue – either the valve cover gasket is leaking, crankshaft seals leaking, or one of the main seals is leaking. A bad gasket down in the pan could also cause the leaking.

**Burning**

When you are burning too much oil, it might also be because you are not using high enough quality oil.

The reason for this statement is because if you are using high quality oil, it is going to keep the piston ring areas clean, and the ring belt areas clean. If those areas are kept clean and free of carbon deposits and such, you will not consume as much oil. But when those get dirty and covered with carbon and the rings can not move freely, you will start to have a high oil consumption rate.

# Oil Consumption - Troubleshooting

Before reviewing the reasons why oil consumption occurs, it should be noted that a degree of consumption should be anticipated in all engines. What is considered normal or acceptable, however, will vary from one engine application to the next. For large diesel engines e.g. used in over the road trucking or off-road machinery applications, many manufacturers are not concerned until consumption reaches 4 liters oil per 15,000 kilometers of operation or approx. 200 hours for equipment engines.

**Improper Break-In Procedure**

When a cylinder is new the inner wall surface is not smooth as might be imagined. The objective of the break-in procedure is to rub off any high spots, both on the cylinder wall and the piston rings, so that the rings can create a tight gas seal for normal operation. This requires the piston ring to break through the oil film and allow a certain amount of metal-to-metal contact between the components. Once this matching has occurred, the break-in is considered to be complete and very little contact will occur thereafter.

The anomaly is obviously that the lubricating oil is there to prevent metal-to-metal contact, but the process described requires that we rupture the oil film. Two actions that can critically impair this film rupture and therefore prevent adequate break-in are; low power settings and the use of improper lubricating oils.

**Bore Glazing**

Glazed cylinder bore: is when troughs (honing pattern) is filled with varnish or lacquer, so oil is not able to fill the troughs, (rings are skating on the surface) causing overheating and damage.

The use of incorrect oils or mixing additives in the lube oil during break-in, creates the risk that an higher film-strength will prevent the piston rings from rupturing the oil film and therefore the necessary abrasion on the cylinder wall will not occur. Secondly, the frictional process creates unusually high surface temperatures on the cylinder wall and this can cause the additives in the oils to form a glaze in the honing groves on the surface of the cylinder wall. When a cylinder is manufactured, a cross-hatch hone is used to score a diamond pattern into the surface of the cylinder liner; this is necessary to allow an oil film to be held on the surface of the cylinder wall and lubricate the piston during operation. If this glazing of these honing grooves occurs before the break-in period is complete, then the piston ring will not seal properly, and the cylinder wall will no longer have the surface groves necessary to carry lubricant, and the combination will result in a poor gas seal and high oil consumption. The only way to remove such a glaze is by re-honing the cylinder wall - meaning expensive and avoidable additional maintenance. However, successful break-in require the correct use of adequate power settings. High power settings mean high combustion pressures which, due to the piston ring design, forces the piston ring out to rupture the oil film. This is the key to the break-in process. Lightly loaded engines can also lead to problems iwth bore glazing.

**External Oil Leaks;** Some of the many points where external leaks occur may include: oil lines, crankcase drain plug, oil pan gasket, valve cover gaskets, oil pump gasket, fuel pump gasket, timing cover and camshaft bearing seal. No possible source of leakage should be neglected because even a very small leak will cause extremely high oil consumption. For example, it has been estimated that a leak of one drop of oil every 20 feet is approximately equal to a loss of one liter every 1,500 kilometers. The best way to check for external leaks is to road test the vehicle with a large piece of light colored cloth tied under the engine. Oil on the cloth will indicate a leak which should be traced back to its source.

**Front or Rear Crankshaft Seals;** Worn front or rear crankshaft seals almost always result in oil leakage. This can only be determined when the engine is operated under load conditions. Crankshaft seals should be renewed when worn because a slight leak will result in extremely high oil consumption just as it would with an external oil leak.

**Worn or Damaged Main Bearings;** Worn or damaged main bearings throw off an excessive amount of oil which flows along the crankshaft and is thrown up into the cylinders. The amount of oil throw off increases rapidly when bearing wear increases. For instance, if the bearing is designed to have 0.0015 inch clearance for proper lubrication and cooling, the throw off of oil will be normal as long as this clearance is maintained and the bearing is not damaged in any way. However, when the bearing clearance increases to 0.003 inch, the throw off will be five times the normal. If the clearance is increased to 0.006, the throw off will be 25 times normal. When the main bearings throw off too much oil, the cylinders are usually flooded with more than can be controlled by the piston and rings. This causes burning of the oil in the combustion chamber and carboning of the piston and rings.

In a conventional, full-pressure lubricated engine, a large loss of oil at the main bearings may starve the downstream connecting rod bearings of lubrication to such an extent that sometimes, especially at low speeds, insufficient oil may be thrown on the cylinder walls. This will cause the pistons and rings to wear to such an extent that they will not be able to control the oil at high speeds. The effect of main bearing wear will be high oil consumption.

**Worn or Damaged Connecting Rod Bearings**

Clearances on connecting rod bearings affect the throw off of oil in the same proportions as mentioned for main bearings. In addition to this, the oil is thrown more directly into the cylinders. Worn or damaged connecting rod bearings flood the cylinders with such a large volume of oil that the pistons and rings, which re designed to control a normal amount of oil or a reasonable increase in the normal amount, are overloaded to such an extent that some oil escapes past them to the combustion chamber and causes high oil consumption. CAUTION - Insufficient bearing clearance can also produce piston, ring and cylinder damage as well as damage to the bearing itself.

**Worn or Damaged Camshaft Bearings**

Camshaft bearings are generally lubricated under pressure, and if the clearances are too large, excess oil will be thrown off. Large quantities of this oil may flood valve guide and stem areas resulting in increased oil consumption (top camshafts).

**Worn Crankshaft Journals**

Worn crankshaft journals will have the same effect on oil consumption as worn bearings. When they are worn out-of-round, they cannot be set up with round bearings to give uniform oil clearance. A bearing fit to the larger dimension of a worn journal will be loose at the smaller dimension and throw off many times the proper amount of oil. Journals which are out-of-round, rough or scuffed, should be reground and fitted with undersize bearings of the correct size.

**Tapered and Out-of-Round Cylinders**

In slightly tapered and out-of-round cylinders, the oil can be controlled by the pistons and rings. However, with increased taper and out-of-roundness, satisfactory oil control becomes more difficult to maintain. This is due to a combination of many factors. The increased piston clearances permit the pistons to rock in the worn cylinders. While tilted momentarily, an abnormally large volume of oil is permitted to enter on one side of the piston. The rings, also tilted in the cylinder, permit oil to enter on one side. Upon reversal of the piston on each stroke, some of this oil is passed into the combustion chamber.

For each revolution of the crankshaft, the pistons make two strokes - one up and one down. When an engine is running at 1500 R.P.M. the rings in tapered and out-of-round cylinders are changing their size and shape 3000 times per minute. Consequently, at high speeds, the rings may not have time to conform perfectly to all worn parts of the cylinders on every stroke. Whenever this occurs, the engine consumes higher amounts of oil due to what is commonly referred to as oil pumping.

**Distorted Cylinders**

Cylinders which are distorted so that they are out of shape - not from wear, as described under "Tapered and Out-of-Round Cylinders", but from other causes, such as unequal heat distribution or unequal tightening of cylinder head bolts, present a surface which the rings may not be able to follow completely. In this case, there may be areas where the rings will not remove all of the excess oil. When combustion takes place, this oil will be burned and cause high oil consumption.

**Clogged "PCV" Valve**

The main purpose of the PCV (positive crankcase ventilation) valve is to recirculate blow-by gases back from the crankcase area through the engine to consume unburned hydrocarbons. Blowby is a mixture of air, fuel and combustion gases forced past the rings on the combustion stroke. The PCV system usually has a tube leading from the crankcase to the intake manifold. Vacuum within the engine intake manifold pulls blowby gases out of the crankcase into the combustion chamber along with the regular intake of air and fuel.

A valve can become clogged with sludge and varnish deposits and trap blowby gases in the crankcase. This degrades the oil, promoting additional formation of deposit material. If left uncorrected, the result is plugged oil rings, oil consumption, rapid ring wear due to sludge buildup, ruptured gaskets and seals due to crankcase pressurization, oil thrown out around the filler cap and consequent rough engine operation.

**Honing Abrasive**

If cylinder honing or glaze breaking is performed on an engine, cleaning instructions should be carefully followed to prevent metal fragmentation or abrasive damage to the rings' seating surfaces.

Cleaning instructions for reconditioned cylinders; After honing, thoroughly wash cylinder walls with soapy water and a scrub brush and oil immediately thereafter, or swab cylinders with Nr. 10 oil and carefully wipe clean. Repeat until all evidence of foreign matter is removed. In either method that is used, a white cloth wiped on the surface should remain clean.

Note: Do not use gasoline or kerosene to clean the cylinder walls after honing. Solvents of this nature will not remove the grit from the cylinder wall and often carry particles of abrasives into the pores of the metal. Failure to properly clean the cylinder walls will leave abrasives that will cause rapid wear and ring failure and will result in elevated oil consumption.

**Worn Ring Grooves**

For piston rings to form a good seal, the sides of the ring grooves must be true and flat - not flared or shouldered - and the rings must have the correct side clearance in the grooves. Normally, automotive ring groove side clearance should not exceed .002-.004. As the pistons move up and down, the rings must seat on the sides of the grooves in very much the same way that valves must seat to prevent leakage. New rings in tapered or irregular grooves will not seat properly and, consequently, oil will pass around behind the rings into the combustion chamber. Worn grooves are usually flared or tapered causing increased side clearances which permit more than the normal amount of oil to pass the rings into the combustion chamber. Excessive side clearances also create a pounding effect by the rings on the sides of the piston grooves. This promotes piston groove wear and, if the condition is not corrected, breakage of rings lands may occur.

**Cracked or Broken Ring Lands**

Cracked or broken ring lands prevent the rings from seating completely on their sides and cause oil pumping by a process similar to that described above in "Tapered and Out-of-Round Cylinders". In addition to this, they also lead to serious damage of the cylinders as well as complete destruction of the pistons and rings. Cracked or broken ring lands cannot be corrected by any means other than piston replacement and this should be done as soon as there is the slightest indication of a crack.

**Worn Valve Stems and Guides**

When wear has taken place on valve stems and valve guides, the vacuum in the intake manifold will draw oil and oil vapor between the intake valve stems and guides, into the intake manifold and then into the cylinder where it will be burned. If this condition is not corrected when new piston rings are installed, an engine is likely to use more oil than it did before because the new piston rings will increase the vacuum in the intake manifold. When gum or deposits on the valve stems are removed - a procedure recommended when overhauling an engine - the seal previously formed will be removed and leakage will be more pronounced. This is particularly true on overhead valve engines where loss of oil may occur on the exhaust valves as well as on the intake valves. High oil consumption caused by too much valve guide clearance can frequently be cured by reaming or nerraling the valve stem. In some cases new valves may also be required. Use of a permanently bonded valve stem seal will give added insurance against oil leakage on complete engine overhauls or on valve jobs.

**Bent or Misaligned Connecting Rods**

Bent or misaligned connecting rods will not allow the pistons to ride straight in the cylinders. This will prevent the pistons and rings from forming a proper seal with the cylinder walls and promote oil consumption. In addition to this, it is possible that a bearing in a bent rod will not have uniform clearance on the crankpin. Under these conditions, the bearing will wear rapidly and throw off an excessive amount of oil into the cylinder.

**Worn or Improperly Fit Piston Pins**

The use of worn or improperly fitted piston pins or the installation of the wrong pins, as in the case of rifle drilled rods where oil is forced to the piston pins under pressure, can cause such an excessive throw off of oil onto the cylinder walls that the piston rings may not be able to control it. This will not only result in the direct loss of the excess oil but also in the formulation of carbon which will clog the oil passages and cause the rings to become stuck in the grooves.

**Piston Pins Fit Too Tightly**

Piston pins that are fitted too tightly at both ends prevent the pistons from expanding and contacting freely under the repeated heating and cooling encountered in engine operation. The piston distortion results in scuffing or scoring, which inevitably leads to blow-by and high oil consumption.

**Clogged Oil Passages**

After an engine has had long hard service, the oil passages in piston rings and pistons will likely become clogged from carbon or an accumulation of foreign matter in the oil. The passages are designed for carrying oil - in excess of the amount needed for lubricating the cylinders - back to the crankcase. When the passages become clogged, oil may be trapped in areas reducing the indicated level of oil within the engine. It may also pool in areas such as above the valve guides, which can further promote consumption.

Clogged passages in the rifle drilled rods or any clogged oil line will starve the engine of lubrication, promote wear and lead to high oil consumption. To avoid clogging of oil passages, the same precaution should be taken as recommended in "Pistons Rings Stuck in Grooves". Initial side clearance is not applicable in this case.

**Unequal Tightening of Main Bearing Bolts or Connecting Rod Bolts**

Unequal tightening of main bearing bolts or connecting rod bolts will throw the bearing bores out-of-round enough to shorten bearing life and to cause an abnormally large throw off of oil from the bearings. The effect on oil consumption is described in "Worn or Damaged Main Bearings" and "Worn or Damaged Connecting Rod Bearings". When bearing bores are originally machined, at the time of engine manufacture, the bolts are tightened to the manufacturer's torque. A torque wrench must be used to insure roundness of the bearing bores whenever the bolts are tightened after having been removed and reinstalled. Unequal tightening of connecting rod bolts may also cause connecting rod distortion, with results similar to those described in "Bent or Misaligned Connecting Rods".

**Unequal Tightening of Cylinder Head Bolts**

The strains developed by unequal tightening of cylinder head bolts may cause serious cylinder distortion and result in oil pumping as mentioned in "Tapered and Out-of-Round Cylinders" and "Distorted Cylinders". When re-installing a cylinder head, a torque wrench should always be used on the head bolts. The engine manufacturer's instructions should be followed for the torque readings and the sequence in which the bolts are tightened.

**Dirty Cooling Systems**

Rust, scale, sediment or other formations in the water jacket and radiator, or corrosion of the water distributing tube, will prevent a cooling system from performing its duties efficiently. This is likely to cause cylinder distortion with a direct loss of oil as mentioned in "Tapered and Out-of-Round Cylinders" and "Distorted Cylinders".

A defective cooling system causes overheating of the engine with the possibility of developing localized hot spots in some of the cylinders. This may also lead to scuffing and scoring of cylinders, pistons and rings which results in high oil consumption.

**Dirty Oil**

Failure to change the oil at proper intervals or to take proper care of the oil filter, may cause the oil to be so dirty that it will promote clogging of the oil passages in the piston rings and pistons. This will increase the oil consumption as described in "Clogged Oil Passages". Dirty oil will also increase the rate of wear on bearings, cylinders, pistons and piston rings. All of these worn parts, as explained in individual items on each part, will contribute to a further waste of oil. Note: as a rule, dirty oil by nature is also consumed at a higher rate than cleaner oil.

**Too Much Oil in Crankcase**

Due to an error in inserting the oil dip stick so that it does not come to a seat on its shoulders, a low reading may be obtained. Additional oil may be added to make the reading appear normal with the stick in this incorrect position, which will actually make the oil level too high. If it gets so high that the lower ends of the connecting rods touch the oil in a pressure lubricated engine, or the dippers go too deep into the oil in a splash lubricated engine, excessive quantities of oil will be thrown on the cylinder walls and some of it will work its way up into the combustion chamber.

**Incorrect Piston Rings for Type of Engine or Type of Service (Cat 3100 and 3200 series)**

If rings of an incorrect size are installed (for instance, .020" oversize rings in .040" oversize cylinders) they can readily cause oil pumping because they will not fit the cylinders and will be unable to keep the oil down from the upper cylinder walls. In this example, ring end gap will also be greater, resulting in additional oil loss, as described in "Piston Rings Fit with Too Little End Clearance". Different types of engines and their use in different types of service require individually engineering ring sets which vary in many ways. Each set has been designed for a particular purpose, but if one is used in an engine for which it is not intended, it may be incapable of controlling the oil in that engine. It is extremely important to always make sure that the correct set is used.

**High Engine Vacuum**

Engine vacuum has increased in modern engines due to the fact that engine rpm, valve overlap and compression habits have also increased with these models. Some of the late model engines will draw as high as twenty five inches of vacuum on deceleration, as compared to twenty inches in older engines. This high vacuum characteristic has made it necessary for the development of an oil ring to seal both (top & bottom) sides of the ring grooves and eliminate oil from passing around the back and sides under high vacuum or deceleration. Such vacuum could be the main cause of smoking and oil consumption so it is important that you use a side sealing piston ring when called for.

**Worn Timing Gears**

Worn timing gears can cause the valves (and sometimes the fuel distributor) to be out of time with the crankshaft. The large amount of backlash, which is caused by this wear, will prevent proper engine adjustment because timing may vary from one revolution of the crankshaft to another. When the valve and piston motions are not synchronized, extremely high oil consumption may result. This will be caused by excessive vacuum which draws large quantities of oil into the combustion chamber where it will be burned.

**Piston Rings Fit with Too Little End Clearance**

When fitting new rings, care must be taken to see that, with the rings in the smallest part of the cylinder, sufficient end clearance is allowed for expansion due to heat. Normal gap clearance in medium/high speed engines with cast iron rings usually runs .003-.005 per inch of bore diameter. The rings will heat more rapidly and will operate at a higher temperature than the cylinder, because they are exposed to the direct heat of the burning gases from the combustion chamber. The cylinder walls are kept at a lower temperature by the water in the water jacket. This means that the rings expand more than the cylinder and this expansion must be allowed for by use of a gap - known as end clearance - between the two ends of each ring. If sufficient end clearance is not provided, the ends of the rings will butt while the engine is in operation.

Butting will cause scuffing and scoring of rings and cylinders which leads to oil consumption. If the engine is allowed to be used for continued operation, especially under heavy load, scoring will become more severe. The ends of the rings will be forced inward - away from the cylinder wall - so that a space opens up between the rings and the cylinder. This provides a direct path for hot gases from the combustion chamber to burn the oil on the cylinder and greatly increases the oil consumption of the engine. Severe cases of butting may also cause ring breakage, with the same results as described in "Worn or Broken Piston Rings". Excessive ring end clearance leads to increase oil consumption as well.

**Worn or Broken Piston Rings**

When piston rings are broken or are worn to such an extent that the correct tension and clearances are not maintained, they will allow oil to be drawn into the combustion chamber on the intake stroke and hot gases of combustion to be blown down the cylinder past the piston on the power stroke. Both of these actions will result in burning and carboning of the oil on the cylinders, pistons and rings.

Broken rings are especially damaging because their loose pieces with jagged ends are likely to cut into the sides of the piston grooves. This causes land breakage which results in the complete destruction of the piston assembly. Instead of reinstalling worn rings during engine overhaul, it is always advisable to replace them. New rings have quick-seating surfaces which enable the rings to control oil instantly, unlike rings which have been used in the past. Used rings, even those that have only slightly worn will still have polished surfaces that will not seat-in properly and will lead to excessive oil consumption.

**Pistons Rings Stuck in Grooves**

Obviously, oil cannot be controlled by piston rings which are stuck in their grooves, so every effort should be made to prevent rings from becoming stuck.

**First,** they should be installed with sufficient side clearance to enable them to remain free while the engine is working under load at normal operating temperatures.

**Second,** every precaution should be taken at the time of assembly to see that all parts of the engine are clean of any dirt particles which might cause the rings to stick.

**Third,** a good grade of oil should be used to lessen the possibility of carbon or varnish.

**Fourth,** the oil should be kept clean by regularly scheduled oil changes and proper care of the oil filter.

**Fifth,** every precaution should be taken to keep the engine from becoming overheated from any cause.

**Late Valve Timing**

Late valve timing will keep the intake valve closed too long after the intake stroke has started, and will increase the vacuum in the cylinder. The high vacuum will have a tendency to suck oil up past the piston and rings into the upper part of the cylinder where it will be burned.

**Oil Pressure Too High**

An incorrect oil pressure setting or a faulty relief valve may cause the oil pressure to be too high. The result will be that the engine will be flooded with an abnormally large amount of oil in a manner similar to that which occurs with worn bearings.

**Oil Viscosity**

The use of oil with a viscosity that is too light may result in high oil consumption. Refer to the engine owner's manual for the proper oil viscosity to be used under specific driving conditions or ambient temperatures.

**Piston Slap**

Some late model engines meeting the latest emission requirements have changed their piston design. This can sometimes lead to a light "knock" at startup. In some cases this can increase oil consumption levels.

**Internal Gasket/Intake Breach**

Newer engine designs sometimes implement a combination of composite materials and metals. Gaskets and seals can sometimes breach of become stressed over time to differences in heat expansion and contraction differences causing oil consumption levels to increase.

**Lugging Engine**

Lugging is running the engine at a lower RPM in a condition where a high RPM (more power/torque) should be implemented. This causes more stress loading on the piston and can lead to increases in engine oil consumption.

**Leaking Turbocharger Seal**

A leaking turbocharger seal will draw oil into the combustion chamber where it will burn and form carbon deposits which contribute to further oil consumption as they interfere with proper engine function.

**Restricted Air Intake**

Excessive restriction in the air intake system will increase engine vacuum and can increase oil consumption as noted in "High Engine Vacuum". A heavily plugged air filter would be one example of this situation.

**Fuel Dilution**

If unburnt fuel is allowed to enter the lubrication system, the oil will become thinner and more volatile. Both will result in higher oil consumption. Excess fuel can enter and mix with the oil via a leaking fuel injector, fuel pump problem, restricted air intake or through excessive idling. Fuel dilution can sometimes be detected by placing a drop on a paper shop towel. As the oil is absorbed into the cloth it will form a dark circle. If fuel is present it will form a lighter ring or "halo" around the outside of the darker circcle formed by the oil. The greater the amount of fuel, the larger the lighter olorder ring will be.