Oil Consumption and Oil Loss

BY **MS MOTORSERVICE INTERNATIONAL GMBH**

For a long and fault-free service life, an engine needs engine oil. Most vehicle owners give little thought to the importance of doing a regular check of the oil level. It is not until the oil level check light or warning light comes on and the dipstick shows the oil is low that the question of why the engine is losing oil comes to be asked. If an engine is low on oil, the term "oil consumption" tends to be used very generally. It is important in the repair shop to make a clear distinction between oil loss and actual oil consumption.

There are various ways of expressing levels of oil consumption. On an engine test rig, oil consumption is expressed as "grammes per kilowatt-hour". A good sealing system will achieve values of 0.5 to 1 g / kWh. This method is not suitable for use in practice as oil consumption cannot be precisely defined in grammes, nor can performance be measured with the vehicle in operation. For this reason, oil consumption is often measured in "liters per 1,000 km/600 miles "or as a "percentage of fuel consumption". The latter is most used to express measurements as it is more precise than "liters per 1,000 km/600 miles". The reason for this is that engines are also used when the vehicle is stationary, and will sometimes experience lengthy idling times (congestion, waiting at traffic lights, charging, running the air conditioning). Moreover, in some instances the engine may need to be used to operate auxiliary units, such as loading cranes or in pump operation, without the vehicle driving a single kilometer/mile.

In practice, opinions about the point at which oil consumption is excessive differ widely in different countries. Due to the running clearances required as part of the design, the moving parts in an engine, particularly the pistons and valves, are not 100% gas-tight and oil-tight. This means that oil is consumed at a low but steady rate. In the combustion chamber, the oil film on the cylinder surface is also widely subject to high-temperature combustion. This causes the engine oil to vaporize, burn and be released into the environment with the exhaust gas. Workshop manuals and operating instructions often provide information on the maximum permitted oil consumption for the engine. If the manufacturers specification is not available, max. 0.25 to 0.3% for utility vehicles and up to 0.5% oil consumption for buses can be assumed. Oil consumption in modern passenger car engines is usually less than 0.05%; the maximum permissible oil consumption stands at 0.5% (all percentage values relate to actual fuel consumption). Normal oil consumption may be

higher for older engine types, stationary engines and under special operating conditions. A decision about the need for any remedial measures can be made by comparing the actual oil consumption with the maximum permissible oil consumption. Diesel engines consume more engine oil than gas engines. Engines with a turbocharger also need more engine oil than engines without a turbocharger due to lubrication of the turbocharger. For technical reasons, oil consumption is at its lowest after the engines running-in phase and increases over the life of the engine due to wear. Wear within the engine will affect all components equally. For this reason, carrying out partial repairs, such as replacing only pistons or piston rings, often results in minimal improvement for oil consumption levels.

Oil consumption can be caused by leaky air intake systems, defective air filtering, or worn valve seals, but there are other components that could also lead to issues. The moving parts of an in-line injection pump are usually lubricated by the engine oil circuit. If pump elements are worn, engine oil can flow between the pump cylinder and the pump piston during the downstrokes and enter the pump element working spaces. Here the engine oil will mix with the diesel fuel and be injected into the combustion chamber during the injection process and burn off. This mainly affects engines

EXAMPLE CALCULATION FOR UTILITY VEHICLES

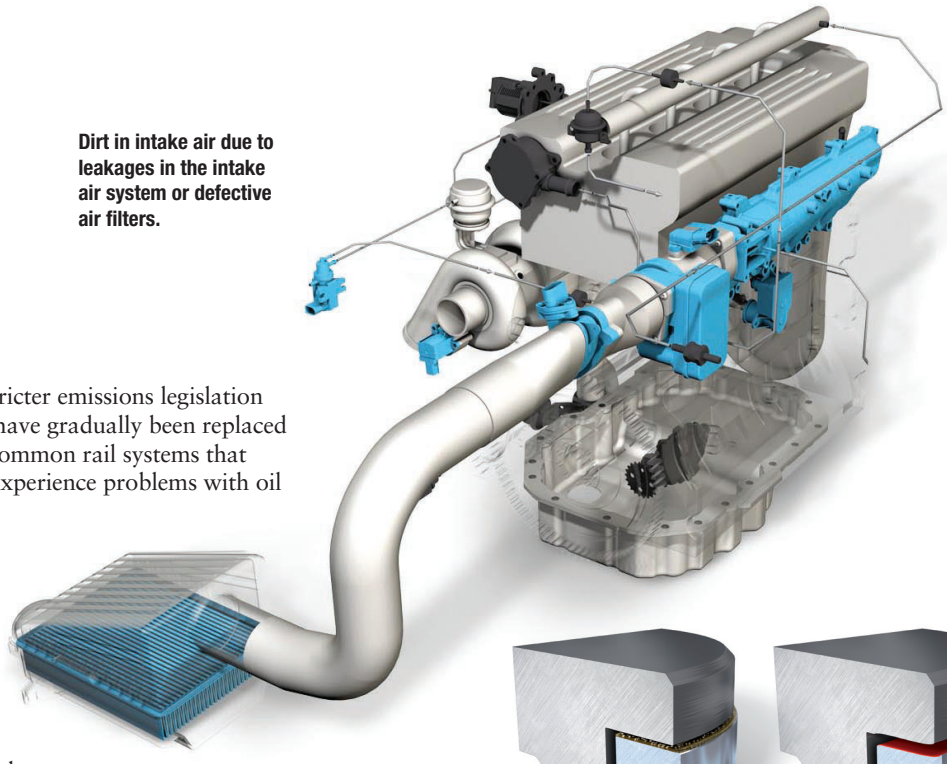
A utility vehicle consumes roughly 40 litres of fuel for 100 km travelled. This can be extrapolated to 400 litres of fuel for 1,000 km.

- **0.25% of 400 litres of fuel equals 1 litre of oil consumption / 1,000 km**
- **0.5% of 400 litres of fuel equals 2 litres of oil consumption / 1,000 km**

EXAMPLE CALCULATION FOR PASSENGER CARS

A passenger car consumes roughly 8 litres of fuel for 100 km travelled. This can be extrapolated to 80 litres of fuel for 1,000 km.

- **0.05% of 80 litres of fuel equals 0.04 litre of oil consumption / 1,000 km**
- **0.5% of 80 litres of fuel equals 0.4 litre of oil consumption / 1,000 km**

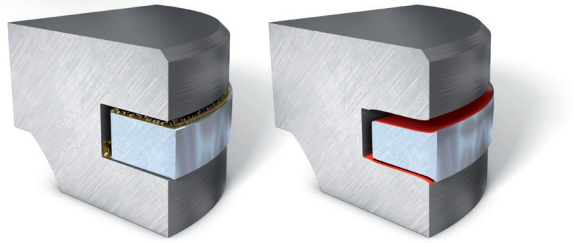


Dirt in intake air due to leakages in the intake air system or defective air filters.

manufactured up to the mid-90s. Stricter emissions legislation means that in-line injection pumps have gradually been replaced by serial pump-nozzle injectors or common rail systems that have a different design and do not experience problems with oil consumption.

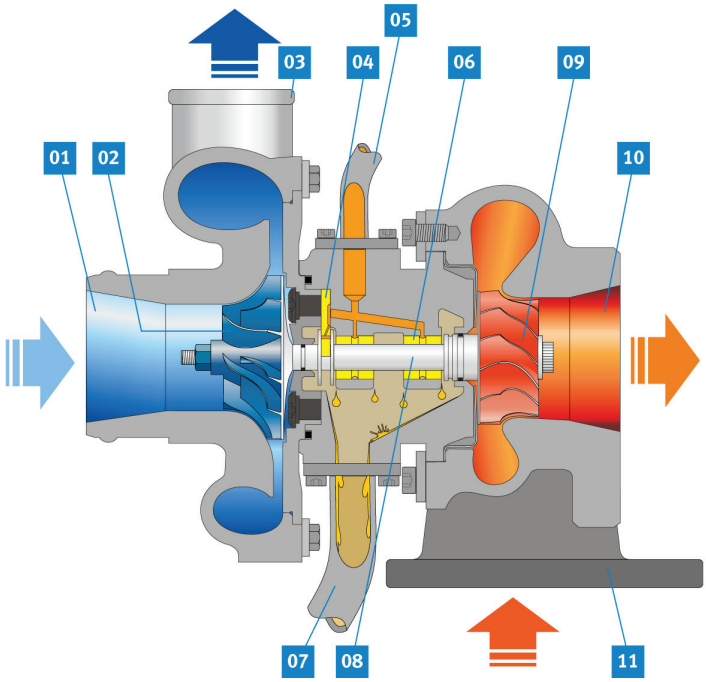
In contrast to other parts of the engine, turbochargers do not have radial oil seals made of elastomer material. This is because of the high temperatures and high engine speeds (up to 330,000 rpm) they are subject to. A labyrinth seal is located behind the turbine and compressor impeller which not only inhibits escape of engine oil, but also the entry of compressed air and hot exhaust gases into the bearing housing. The gas pressures at the turbine impeller and compressor impeller end prevent engine oil from escaping. The washers on the turbocharger shaft have the effect of forcing engine oil escaping from the bearing positions out from the shaft by centrifugal force. Engine oil escaping from the radial bearings as well as intake air and exhaust gases that find their way into the inside of the turbocharger are taken back to the oil pan via the return line. If the turbocharger is losing engine oil via the intake or exhaust gas port, this usually means the pressure equilibrium is impaired due to problems with the oil/gas return line.

NOTE: Due to the much more widespread use of turbocharged engines, oil consumption caused by unfavorable turbocharger operating conditions occurs much more commonly than in the past.



Dirt particles in the piston ring grooves.

Worn piston ring groove with worn piston ring.



01 Fresh air inlet
02 Compressor impeller
03 Fresh air outlet (compressed)
04 Axial shaft bearing (thrust washer)
05 Oil supply connection
06 Radial shaft bearing
07 Return side
08 Turbocharger shaft
09 Turbine impeller
10 Exhaust gas outlet
11 Exhaust gas inlet

Here are some other things to check when trying to diagnose oil consumption…

EXCESS PRESSURE IN CRANKCASE

Blow-by gases are pressurized combustion gases that enter the crankcase by way of the pistons and piston rings. Wear on pistons, piston rings or cylinder bores causes blow-by gas levels to increase. As a result, there will be greater strain on the crankcase ventilation and/or the crankcase bleed valve. Increased gas pressure will build up inside the crankcase and gas will leak from the engine together with the engine oil via the radial oil seals. On engines that are in good order increased pressure in the crankcase resulting from blow-by gases could also be caused by the crankcase bleed valve being faulty, dirty, or frozen up. Greater pressure in the crankcase also causes increased strain on the valve stem seals. Engine oil is forced into the exhaust tract or the intake air system where it burns up and escapes into the environment together with the exhaust gases.

OIL LEVEL BEING TOO HIGH

If the oil level is too high, the crankshaft will be immersed in the crankcase sump and additional oil mist will form. If the engine oil is unsuitable, dirty, or old, oil foam may develop. This will swamp

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the oil separator system for the crankcase ventilation and render it ineffective. Engine oil together with the blow-by gases will enter the intake air system in foam or droplet form via the crankcase bleed valve. These are then drawn in and burned off by the engine.

Reasons for oil level being too high:

- Fuel getting into the engine oil due to poor mixture formation, incomplete combustion or frequent short-distance drives
- Wrong amount used when changing oil (too much engine oil added)
- Engine oil topped up unnecessarily (vehicles without dipstick)
- Mistakes when reading the oil level (vehicle on a slope, dipstick not inserted correctly or read incorrectly)
- Wrong dipstick
- Automatic top-up systems faulty

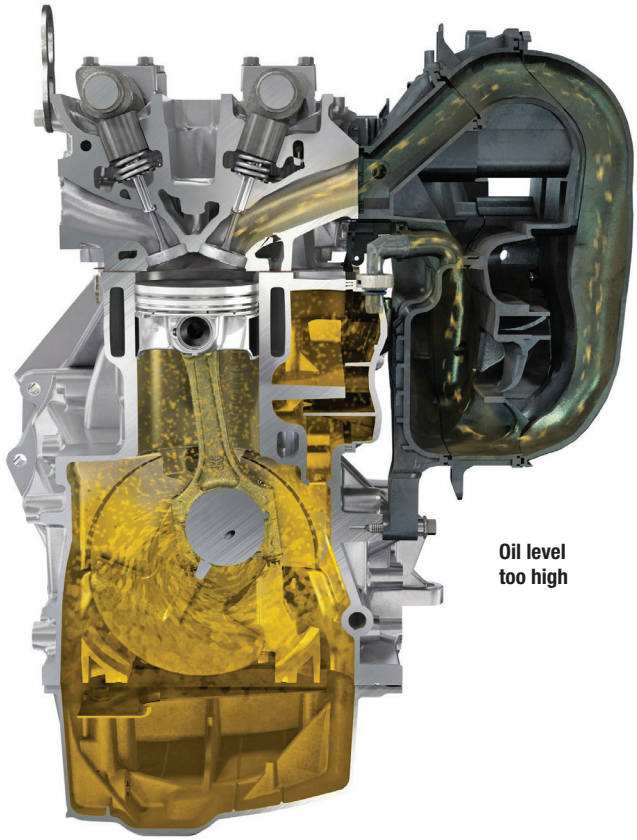
FUEL FLOODING AND MIXED FRICTION WEAR

Combustion defaults and unburned fuel often result in fuel flooding when the engine is in operation.

The unburned fuel in the combustion chamber causes the oil film on the cylinder surface to weaken as the oil film is diluted or washed off. The surfaces of the piston and cylinder bore are no longer metallically separated from one another due to the missing oil film, resulting in mixed friction wear causing engine performance to drop and oil consumption to rise.

Reasons for fuel flooding in gas engines:

- Frequent short-distance journeys with the engine not at operating temperature (oil dilution and loss of engine oil viscosity)



Oil level too high

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- Defects in the mixture formation (mixture too rich)
- Faults in the ignition system (misfiring due to defective ignition coils, spark plugs, ignition cables, etc.)
- Mechanical engine problems (wear, valve timing errors)
- Poor-quality fuel
- A combination of the problems stated above

In diesel engines, the injected fuel ignites when exposed to highly compressed air in the combustion chamber. Lack of compression (poor filling) or poor fuel quality result in ignition delays, incomplete combustion, and liquid fuel collecting in the combustion chamber.

Reasons for fuel flooding in diesel engines:

- Faulty and leaking injection nozzles
- Fault in the fuel injection pump or settings incorrect
- Incorrectly routed and poorly secured injection lines (vibrations)
- Mechanical faults (piston striking against the cylinder head due to excessive piston protrusion
- Poor filling of the combustion chamber with fresh air due to a blocked air filter, defective or worn turbocharger, intake system leaking (turbocharged engines), or worn or fractured piston rings
- Poor fuel quality (poor self-ignition and incomplete combustion)
- A combination of the problems stated above

EXCESSIVE PISTON PROTRUSION

If the piston protrusion is too great on a diesel engine, the pistons will strike against the cylinder head and jolt the injection nozzles. The results are vibrations that cause pressure fluctuations and the injection nozzles to open unpredictably. Additionally, fuel will be injected into the combustion chambers in an uncontrolled way causing combustion defaults. Unburned fuel will also be deposited on the cylinder sliding surfaces causing the lubricating film to degrade. This results in a high degree of mixed friction on the pistons, piston rings and the cylinder sliding surfaces.

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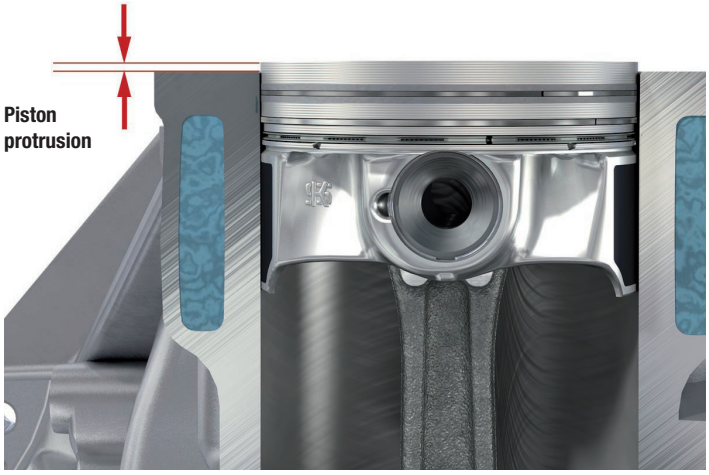

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IRREGULAR OR MISSED OIL CHANGE INTERVALS

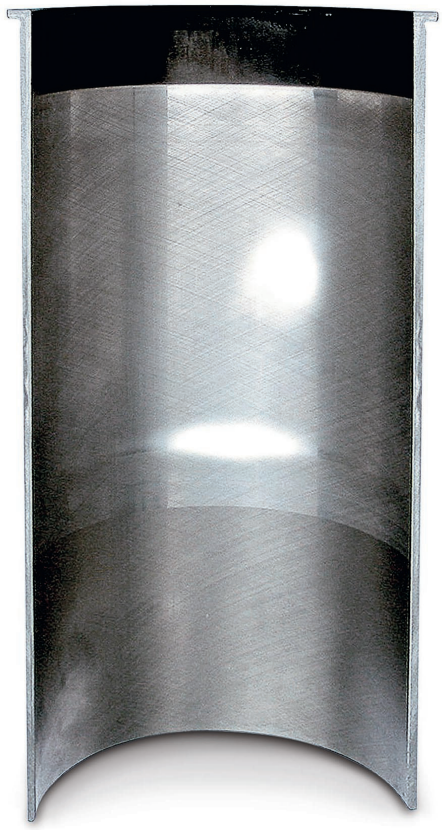
If the service intervals specified by the engine manufacturer are not complied with, old and contaminated engine oil will enter the engine. Since the required oil characteristics will no longer be present, there will be a greater risk of wear or damage. In addition to complying with the oil change intervals, it is absolutely essential to check and correct the key engine adjustment and test values as part of the service. This will help to extend the service life and is a prerequisite for optimum operating conditions.

DISTORTION OF CYLINDER BORES

Distortion of cylinder bores is easy to identify from individual, bright areas on the cylinder sliding surface. Distortion causes elevations in the cylinder sliding surface on which the honed surface becomes worn down. The piston rings are not able to reliably seal distorted or deformed cylinder bores to prevent the ingress of engine oil or combustion gases. The engine oil will not be wiped off by the piston rings in places where the distortion occurs and will find its way into the combustion chamber and be burned off. The combustion gases streaming past the piston rings increase pressure in the crankcase and may result in yet more oil consumption.

Causes:

- Incorrect tightening torque and angle of rotation used when tightening cylinder head bolts
- Uneven cylinder block and cylinder head faces
- Dirty or distorted threads on the cylinder head bolts
- Use of incorrect or unsuitable cylinder head gaskets



Wear on the sliding surface due to distortion

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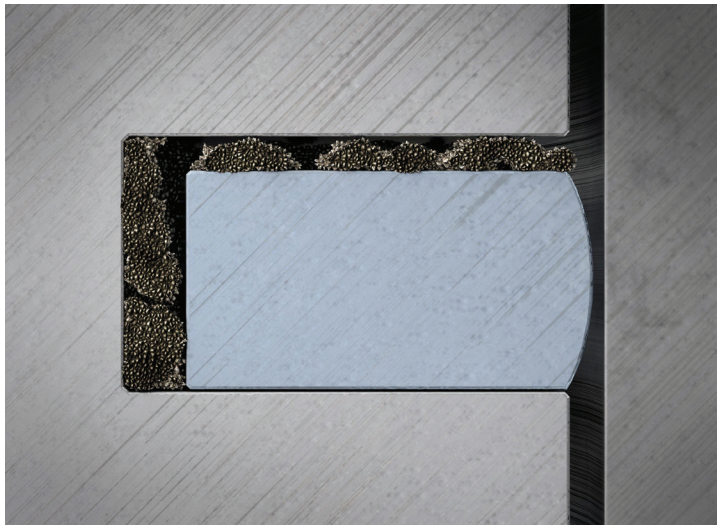
- Faulty, worn, or soiled bolt head contact surfaces on wet and dry cylinder liners
- Contact corrosion on dry cylinder liners
- Out-of-true or distorted bores on dry cylinder liners
- Incorrectly mounted or twisted O-rings on wet cylinder liners

BLOCKED PISTON RINGS

If the piston rings in a four-stroke engine are not able to move freely in the ring grooves, problems with sealing and increased oil consumption will arise.

Reasons for blocked piston rings:

- Piston rings do not have the correct dimensions
- The direction of installation for the piston rings was not observed (e.g. for one-sided keystone rings)
- The piston ring grooves are damaged, dirty, or carbonized
- Piston rings have been bent by inexpert handling (into a spiral shape)
- The connecting rods are bent, which results in a skewing of the pistons in the cylinder bores
- The cylinder bores are out-of-true and distorted
- Contaminated piston ring grooves (often caused by blasting agent that has not been completely removed after blasting with sand, steel shot or glass beads during reconditioning)



FAULTY VACUUM PUMPS

If vacuum pumps are defective, engine oil can enter the vacuum system by this route. This engine oil will not then be available for lubrication of the engine. Engine oil in the vacuum system will bring about malfunctions and component failure.

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EXCESSIVE OIL PRESSURE

If the oil pressure is too high, housing gaskets, oil filters, oil coolers and pipes may leak or crack.

Reasons for excessive oil pressure:

- Wrong oil pump or pump too big
- Blocked oil filter without overflow valve
- Wrong oil filter
- Paper element in oil filter has disintegrated
- Wrong seals, outlets for engine oil missing or too small
- Plug or cleaning cloth left behind when doing repairs
- Oil feed lines and hoses blocked, kinked, or constricted
- Faulty pressure control valves or pressure relief valves
- Malfunctions in the oil circuit due to using the wrong parts, e.g. wrong non-return valves or hoses
- Using engine oil with the wrong viscosity
- Old engine oil that has taken on a jelly-like consistency with low ambient temperatures or frost

As you can see, there are many systems in an engine that all must work together to have oil consumption and oil loss under control. For more engine technical information, go to **ms-motorservice.com**.

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