OIL AND LUBRICATION

OIL AND FRICTION

A motorcycle engine contains many moving parts that contact and rub each other while the engine is running. Pistons and piston rings rub against cylinder walls thousands of times per minute. The big end of the connecting rod rotates on the crankshaft rod journals. These rotating and sliding motions create friction.

Friction is defined as the force resisting the motion of solid surfaces sliding against each other – solid surfaces such as engine parts. This sliding motion that produces friction transforms kinetic energy into heat. If these parts do not receive enough lubrication, they will wear out quickly. If these steel surfaces do not receive any lubrication at all, the heat build-up is so high that the parts will seize up and lock together. An engine that receives no lubrication will experience complete engine failure in a matter of minutes.

FUNCTIONS OF OIL

Lubrication

Moving parts require lubrication in the form of oil to reduce friction. When friction is reduced, wear on the parts is also reduced. Oil lubricates by coating metal surfaces with a thin film of oil. This thin film of oil is sandwiched between the rubbing parts and prevents the parts from having direct contact with each other.

Cooling

Oil helps cool an engine by absorbing engine heat and then flowing to a different location where it can receive cooling. Oil receives some cooling by flowing back into the crankcase, or by being pumped back into an external oil tank that receives cooling from outside air flowing over it. Oil can also be cooled with an oil cooler if the bike is equipped with one.

Motorcycles like Harley Davidsons and BMW flat twin touring bikes have relied on oil and air-cooling alone for many years. Imagine the heat

generated by these engines due to the fact that they have traditionally used no water-cooling. If the bike is laboring in slow traffic or sitting at a stop light, the engine is receiving nearly all its cooling from oil, because little or no air is flowing over the engine. The cooling function of the oil becomes a huge factor in preventing these “air-cooled” engines from melting down from the heat of friction.

Some popular lubricants are WD-40 for frozen bolts, silicon spray for brake or throttle cables, and chain lube. Brake cleaner is best for cleaning smaller oily and dirty parts.

Inside the engine case, oil is the principal agent for cooling connecting rod bearings and crankshaft main bearings, regardless of whether the engine is water-cooled or air-cooled. For example, water jackets for cooling cannot be installed in all places in a water-cooled engine, and some cooling must come from the oil.

Cleaning

Engine combustion chambers produce the waste product of tiny carbon particles that get scraped off the cylinder walls and enter the oil in the crankcase. In addition, all of the metal parts that rub together in the engine produce tiny metallic particles that also fall down into the oil. It is the job of the oil to carry these carbon and metallic particles to the oil filter where they can be filtered out of the oil.

Oil is the vehicle by which carbon and metal particles - “dirt” - is cleaned out of the engine. Additives called detergents are added to the oil in order to keep the carbon and metal particles in suspension, so they can flow with the oil on their journey to the oil filter.

Sealing

Oil is the major player in the job of sealing the combustion chamber during the compression and power strokes. The thin film of oil between the piston rings and the cylinder wall prevents the air-fuel mix being compressed in the combustion chamber, from slipping by the rings and escaping into the engine case. This would reduce compression and subsequently the force of combustion.

This oil film also prevents a majority of “blow-by”. Blow-by is when some of the combustion gasses slip past the piston rings and escape into the crankcase during the power stroke. Blow-by can be particularly bad in an engine that has high mileage, and there is a lot of wear on the piston rings and cylinder walls. Such an engine may not hold very good compression during a compression test.

REGIMES OF LUBRICATION

Oil lubricates by way of three different methods called regimes. These regimes address lubrication requirements under different circumstances in the engine. These regimes are referred to as Hydrodynamic, Boundary and Mixed Lubrication.

Hydrodynamic Lubrication

Hydrodynamic lubrication is where a thin film of oil sits between two mating metal surfaces, and prevents the two metal parts from actually touching each other.

The most graphic example of this is the hole in the crankshaft connecting rod journal, that pumps oil directly under the connecting rod bearing. This causes the connecting rod bearing to “skate” on this film of oil, and not actually contact the crankshaft connecting rod journal. The film of oil is wedged in under hydraulic pressure between the connecting rod bearing and the rod journal on the crankshaft.

Boundary Lubrication

When a motorcycle is not running, eventually all of the “excess” oil drips off the metal parts. However, some of the oil continues to stick to the metal parts and does not drip off. This oil that continues to stick represents what is called boundary lubrication. This allows the motorcycle parts to have at least some lubrication when the bike is first started, after it has been idle and has sat for a period of time.

Boundary lubrication is very critical because most engine wear occurs during start-up when the engine parts have not yet received a full flow of oil lubrication from the oil pump.

Mixed Film Lubrication

Mixed lubrication represents a combination (mix) of hydrodynamic lubrication and boundary lubrication. Mixed lubrication comes into effect when lubrication is minimal such as during heavy load situations, as well as light load situations where there may not be enough oil pump pressure to adequately lubricate parts.

For example, when an engine is under heavy acceleration, the rod bearings are pounding against the crankshaft rod journals with great force. This