SPARK PLUG - II

Heat range

The operating temperature of a spark plug is the actual physical temperature at the tip of the spark plug within the running engine. This is determined by a number of factors, but primarily the actual temperature within the combustion chamber. There is no direct relationship between the actual operating temperature of the spark plug and spark voltage. However the level of torque currently being produced by the engine will strongly influence spark plug operating temperature because the maximum temperature and pressure occurs when the engine is operating near peak torque output (torque and RPM directly determine the power output). The temperature of the insulator responds to the thermal conditions it is exposed to in the combustion chamber but not vice versa. If the tip of the spark plug is too hot it can cause pre-ignition leading to detonation/knocking and damage may occur. If it is too cold, electrically conductive deposits may form on the insulator causing a loss of spark energy or the actual shorting-out of the spark current.

A spark plug is said to be "hot" if it is a better heat insulator, keeping more heat in the tip of the spark plug. A spark plug is said to be "cold" if it can conduct more heat out of the spark plug tip and lower the tip's temperature. Whether a spark plug is "hot" or "cold" is known as the heat range of the spark plug. The heat range of a spark plug is typically specified as a number, with some manufacturers using ascending numbers for hotter plugs and others doing the opposite, using descending numbers for hotter plugs.

The heat range of a spark plug (i.e. in scientific terms its thermal conductivity[[25]] characteristics) is affected by the construction of the spark plug: the types of materials used, the length of insulator and the surface areaof the plug exposed within the combustion chamber. For normal use, the selection of a spark plug heat range is a balance between keeping the tip hot enough at idle to prevent fouling and cold enough at maximum power to prevent pre-ignition leading to engine knocking. By examining "hotter" and "cooler" spark plugs of the same manufacturer side by side, the principle involved can be very clearly seen; the cooler plugs have more substantial ceramic insulators filling the gap between the center electrode and the shell, effectively carrying off the

heat, while the hotter plugs have less ceramic material, so that the tip is more isolated from the body of the plug and retains heat better.

Heat from the combustion chamber escapes through the exhaust gases, the side walls of the cylinder and the spark plug itself. The heat range of a spark plug has only a minute effect on combustion chamber and overall engine temperature. A cold plug will not materially cool down an engine's running temperature. (Too hot of a plug may, however, indirectly lead to a runaway pre-ignition condition that can increase engine temperature.) Rather, the main effect of a "hot" or "cold" plug is to affect the temperature of the tip of the spark plug.

It was common before the modern era of computerized fuel injection to specify at least a couple of different heat ranges for plugs for an automobile engine; a hotter plug for cars which were mostly driven mildly around the city, and a colder plug for sustained high speed highway use. This practice has, however, largely become obsolete now that cars' fuel/air mixtures and cylinder temperatures are maintained within a narrow range, for purposes of limiting emissions. Racing engines, however, still benefit from picking a proper plug heat range. Very old racing engines will sometimes have two sets of plugs, one just for starting and another to be installed once the engine is warmed up, for actually driving the car.

Reading spark plugs

The spark plug's firing end will be affected by the internal environment of the combustion chamber. As the spark plug can be removed for inspection, the effects of combustion on the plug can be examined. An examination, or "reading" of the characteristic markings on the firing end of the spark plug can indicate conditions within the running engine. The spark plug tip will bear the marks as evidence of what is happening inside the engine. Usually there is no other way to know what is going on inside an engine running at peak power. Engine and spark plug manufacturers will publish information about the characteristic markings in spark plug reading charts (e.g. a general spark plug reading chart)

A light brownish discoloration of the tip of the block indicates proper operation; other conditions may indicate malfunction. For example, a sandblasted look to the tip of the spark plug means persistent, light detonation is occurring, often unheard. The damage that is occurring to the tip of the spark plug is also occurring on the inside of the cylinder. Heavy detonation can cause outright breakage of the spark plug insulator and internal engine parts before appearing as sandblasted erosion but is easily heard. As another example, if the plug is too cold, there will be deposits on the nose of the plug. Conversely if the plug is too hot, the porcelain will be porous looking, almost like sugar. The material which seals the center electrode to the insulator will boil out. Sometimes the end of the plug will appear glazed, as the deposits have melted.

An idling engine will have a different impact on the spark plugs than one running at full throttle. Spark plug readings are only valid for the most recent engine operating conditions and running the engine under different conditions may erase or obscure characteristic marks previously left on the spark plugs. Thus, the most valuable information is gathered by running the engine at high speed and full load, immediately cutting the ignition off and stopping without idling or low speed operation, and removing the plugs for reading.

Spark plug reading viewers, which are simply combined flashlight/magnifiers, are available to improve the reading of the spark plugs.

Two spark plug viewers

Once again, however, the practice of reading spark plugs has largely become obsolete now that cars' fuel/air mixtures and cylinder temperatures are maintained within a narrow range, but is still valuable for racing applications.

Indexing spark plugs

A matter of some debate is the "indexing" of plugs upon installation, usually only for high performance or racing applications; this involves installing them so that the open area of the spark gap, not shrouded by the ground electrode, faces the center of the combustion chamber, towards the intake valve, rather than the wall. Many experts believe that this will maximize the exposure of the fuel-air mixture to the spark, and therefore result in better ignition; others, however, believe that this is useful only to keep the ground electrode out of the way of the piston in ultra-high-compression engines if clearance is insufficient. In any event, this is accomplished by marking the location of the gap on the outside of the plug, installing it, and noting the direction in which the mark faces; then the plug is removed and additional washers are added so as to change the orientation of the tightened plug. This must be done individually for each plug, as the orientation of the gap with respect to the threads of the shell is random[[26]].

Source : http://engineering.wikia.com/wiki/Spark_plug