PI Fuel Temperature (Or, keep your fuel tank full in summer)

By Bob Ritchie

Gasoline (known to some as petrol) is a complicated chemical compound. Its stored, pumped and metered in a liquid state but in order to work in the engine it has got to be vaporised. Vaporisation is a function of pressure and temperature. The lower the pressure the lower the temperature required for vaporisation and conversely higher pressures require higher temperatures. Gasoline at atmospheric pressure in a carburettor or fuel tank is OK up to 38^{O} C but somewhere about 43^{O} C problems with vaporising begin to occur. High pressure gasoline on the discharge side of a PI fuel pump at 105 psi will not vaporise under any normal conditions until the fuel is discharged from the injectors where it once again is at atmospheric pressure.

In a TC, the heat causing vaporising or vapour lock is from the engine or perhaps more specifically the exhaust manifold. In a PI the threat of vaporising occurs in the electric driven fuel pump located in the boot (trunk actually). The heat causing PI vapour lock can be due to radiation from the exhaust pipe under the floor but is more likely to be from the heat of the electric pump.

PI electric pumps operate on about 4 amps and this equates to about 180 Btu/hr produced in the electric windings in the motor. Since Lucas pumps have no inherent cooling, this heat goes directly into the pump and also into the air around the pump. The pump and air space just get hotter and hotter and at some point fuel in the pump will start to vaporise. When this occurs, the pump simply can not produce any pressure and the fuel system stops operating.

Some PIs, such as mine, use Bosch fuel pumps and they are a different design to Lucas. The Bosch pump is a "canned" (or hermetic) design. The motor and pump are totally enclosed in a single casing and fuel from the pump flows directly over the motor thus providing direct cooling. The fuel is discharged to the pressure relief valve where most of the fuel is returned to the fuel tank.

With this design, the heat from the electric motor is transferred into the fuel tank with the result that fuel temperature will gradually increase. How fast temperature increases will depend on how full the fuel tank is. The more fuel in the tank, the less temperature will rise in a given time. (A full tank will not solve the problem with TC vapour lock; consider shielding the carburettor from engine heat sources.)

For a PI I have calculated that fuel temperature will increase about 4½^{O} C/hr when the tank is half full. If fuel temperature in the tank is 28^{O} C (for example in the morning after a warm night) and the tank is half full then there is 3-4 hours driving time available until fuel problems will begin to occur. Of course the condition of the fuel pump is also important. A badly worn pump will give more problems than one in good condition. But no pump can overcome the problem of vaporisation if the temperature gets too high. As stated above, vaporising temperature is related to pressure.

If the filter on the suction side of the PI pump is partly blocked or dirty, then there will additional pressure drop through the filter and the pressure at the inlet of the pump

may be less than atmospheric. In this case fuel will vaporising at temperatures below 38^{O} C.

We typically don't have temperature gauges on our fuel tanks but I believe we should. One day last Nov-Dec I had a pump failure after driving about 3 hours around the city. Maximum air temperature was about 35^{O} C and my fuel tank was a bit more than half-full. I had driven one hour to work, one hour at lunchtime and then one hour home in the afternoon. The car stalled at a traffic light on the way home and would not start.

The fuel pump was very hot to the touch and took about half an hour to cool down to where it would start. I then filled the tank and the pump cooled right down due to the addition of cool gasoline. I then did the calculations referred to above and decided to fit a temporary indoor/outdoor temperature indicator from Dick Smith. Driving around town over the past couple of weeks has indicated the predicted temperature rise of 4½^{O} C/hr is about right. The highest temperature indicated so far is about 40^{O} C without problems.

I propose to fit a better temperature gauge to the fuel system and to keep the fuel tank generally filled. I also plan to fit a pressure switch and warning light, or electric pressure gauge to the fuel system (Note: No mechanical fuel pressure gauge should be fitted inside the car). I also believe providing increased air ventilation to the pump will be a benefit and perhaps shielding the pump area from the exhaust pipe. More on this at some future time but in the meantime, keep a full tank.