

Lotus Turbo Esprit excessive oil pressure problems

Owning and operating a specialized business such as Lotus Marques for 16 years does not necessarily mean that problem solving gets any easier. The following record is typical of what happens when vehicles are first taken to less experienced operators and when things get difficult, the car ultimately ends up in our workshop.

The following article is about a 1990 Turbo Esprit fitted with Delco fuel injection but not charge cooled. The engine had an oil pressure problem where it had approximately 110psi at idle speed. When the owner finally contacted us, the vehicle had been residing in another workshop at a European exotic car specialist for twelve weeks.

From details contained on the final invoice it appears some basic diagnostics were carried out that included checking all oil hoses for blockages, plus inspecting the oil pump. The excessive oil pressure problem was diagnosed as a blocked oil passage caused by a "spun bearing". However during the investigation process a number of problems were introduced into the vehicle. This included broken inlet manifold studs, broken stud removal tool bit, metal debris/swarf from attempting to drill out the broken studs. The metal debris from drilling exercise had entered the inlet ports, oil pump body and oil cooler sandwich plate.

After evaluating the numerous problems a decision was made to remove the cylinder head. This was necessary to achieve the following objectives:

- a. The removal of the broken studs and tool bit
- b. To heli-coil the cylinder head to accept new stainless steel studs
- c. The removal of swarf from the inlet ports and cylinders.

From experience, there are usually two components that can cause excessive oil pressure related problems. These components are the oil filter and the oil pump pressure relief valve. The engine oil and filter had already been changed. This left the oil pump and pressure relief valve that had previously been "checked".



Metal debris inside and outside the engine



Broken stud removal tool bit



Leaking manifold gasket and corroded studs



Broken stud retained in manifold



Flip side of broken inlet manifold stud

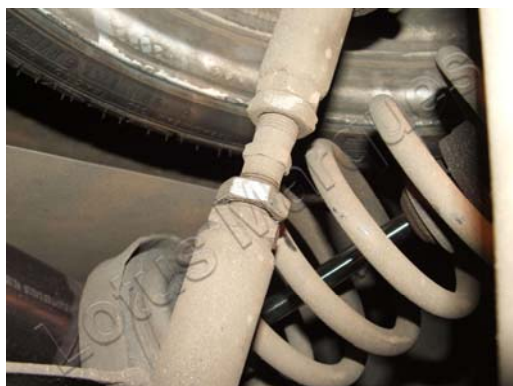


Cylinder head off and liner clamps on
Coolant left in engine block for a good reason!

To accurately determine whether or not the oil pressure relief valve was causing the problem, a flow-rig was designed and constructed in our workshop. The objectives were to quickly and effectively determine the valve characteristics and if it was sticking. Ultimately the flow-rig enabled measurements to be made of the differential pressure drop across the relief valve when subjected to a range of primary input pressures. This exercise also provided additional information that indicated the stock oil pump is capable of delivering in excess of 400psi if not regulated. Normal start-up oil pressure on a cold engine is approximately 50-60psi at 1600rpm with SAE 5W-50 oil.



Damaged pulley from previous belt change



Rear adjustable top link lock nut unfastened



View of luggage compartment and engine bay



Guess what this bottle is used for?



Cylinder head serial number

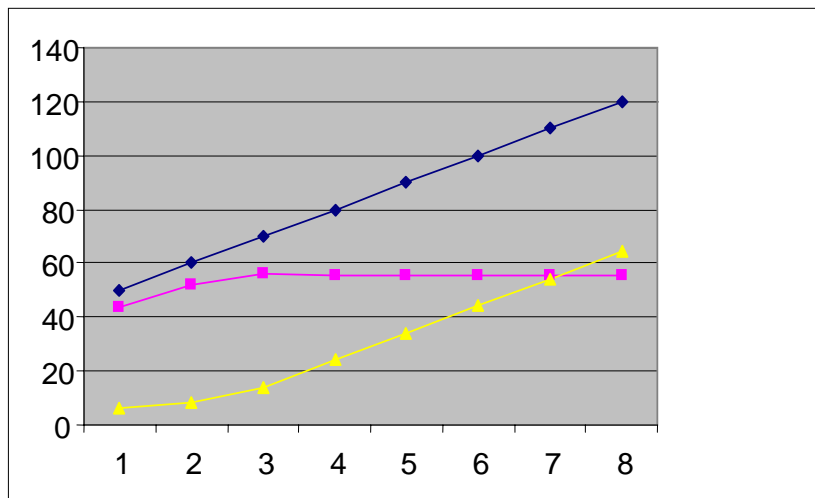


Overhauled cylinder head ready for installation

Whilst resolving the cylinder head and oil pump pressure issues, several other problems were observed. The forward edge of the camshaft timing belt was slightly “feathered”. This was caused by sharp edges of witness marks on the alloy crankshaft V pulley. The witness marks plus damaged grooves indicated the pulley had been difficult to remove and someone had hit it with a hammer. This was subsequently remedied by straightening the squashed V groove and machining off the sharp witness marks. In addition to this, the timing belt had been recently changed but the tensioner bearing and front camshaft oil seals had not been routinely replaced. When the tensioner bearing was checked, it was found to be dry which indicated there was no grease present to lubricate the internal ball race. The belt tensioner bearing, camshaft seals and timing belt were subsequently changed.

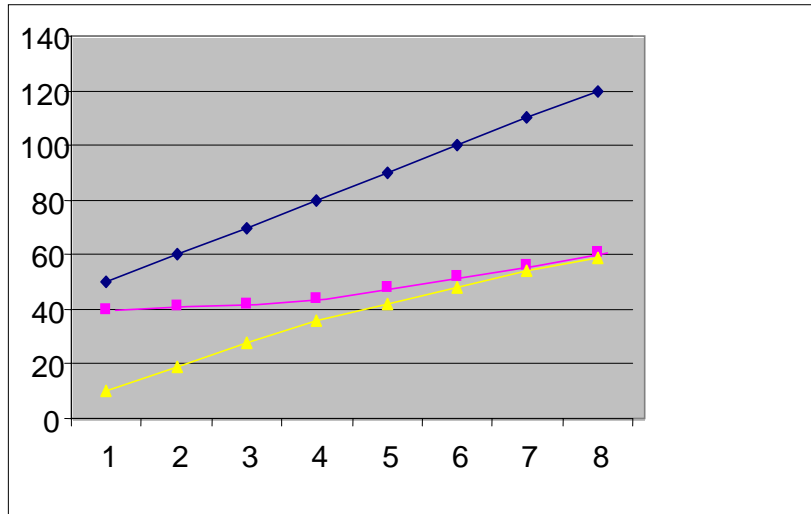
The rear top suspension link had been modified by making it adjustable but one of the lock nuts had come undone. This is not unusual as the link twists as the suspension moves from full bump to full droop. The force behind this twisting action is sufficient to unfasten the lock-nuts. This is one of the reasons why Lotus Marques manufacture a superior designed adjustable top link with spherical bearings that eliminates the twisting force applied to the lock-nuts.

Results from testing the original pressure relief valve



The above graph shows the characteristics of the original oil pressure relief valve that was removed from the vehicle for testing. The relief valve maxed out at about 55psi (purple line) and refused to dump any more pressure as the primary input pressure was increased (uppermost dark blue line). This means that the resultant pressure that is applied to engine oil galleries (lower yellow line) continues to climb rapidly rather than regulating the pressure to desirable design limits. If this problem were left unchecked, then damage to the pump and/or driveshaft keyway would most likely occur.

Results from testing the new pressure relief valve



The above graph shows the characteristics of the new oil pressure relief valve that was subject to testing prior to installation. The relief valve still continues to dump pressure (purple line) as the primary input pressure (uppermost dark blue line) was increased. This means that the resultant pressure that is applied to engine oil galleries (lower yellow line) is regulated and maintained within the design parameters.

Summary

The original excessive oil pressure problem should have been resolved simply by replacing the faulty pump with a new item. It appears this problem was incorrectly diagnosed due to the lack of experience in being able to determine whether or not the oil pressure relief valve operated correctly.

If this Esprit had been presented on the first occasion to Lotus Marques, we would have had a slightly different approach before reaching a conclusion of "spun bearings" For the less technically minded readers, there are usually a unique set of circumstances that cause main crankshaft bearings to spin. This occurs when a crankshaft has been reground and the crankshaft to bearing shell clearance is insufficient. The Esprit engine in question had not recently been rebuilt which made this hypothesis highly unlikely. If this were the case, then the action of the bearing spinning would result in metal to being removed from the bearing shell and cylinder block journal. The resultant metal debris would end up in the oil, the sump and ultimately the oil filter. There are several well defined steps to identify this problem which are as follows:

1. Drain the sump contents into a large shallow stainless steel tray where any metal debris could be seen by the naked eye.
2. Cut open the oil filter and examine the filter media for metal fragments
3. Submit a sample of the engine oil for "oil analysis" where the smallest of metal particles can be detected.

The recommended procedure to rectify a "spun bearing" is to carry out a full engine rebuild. It is only possible to speculate what would happen if the Esprit engine in question had been dismantled and there was no evidence of a spun bearing.

This challenge was completed by having a systematic approach to trouble shooting whilst being cognizant of the customers' time frame and containing costs. The end result was a happy customer who had his Esprit returned just in time to take on holiday.

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