Metallurgical Testing & Consulting Engineers

A.B.N.: 65 402 291 450

Office: 2 Sales Avenue
Silverdale NSW 2752
Phone/fax: (02) 4774 1017
Mobile: 0419 498 115
Domain: www.mtce.com.au

ATOMIC PERFORMANCE PRODUCTS
9/7 BIRMINGHAM AVENUE,
VILLAWOOD. NSW. 2163

22 June 2013
REPORT NO: 13-076/1591
ORDER NO: -

ATTN: Brad Girdwood

EXAMINATION OF ENGINE FAILURE

This report covers the examination of the engine components out of a turbocharged Ford XR6 engine, identified by serial number JGCM8A60735. It is understood that the engine had been reconditioned, was prematurely withdrawn from a tuning facility in Queensland, and was returned by the owner after it made noises.

We were requested to determine the possible cause of premature failure of the engine.

It was understood that Atomic Performance Products test ran the reconditioned engine for up to 2 hours prior to delivery to the owner. Documentation indicated that the engine ran satisfactorily with good oil pressure over the operating speed range, and no debris was evident in the oil filter after the testing sessions.

VISUAL EXAMINATION

The engine had been removed from the vehicle and was returned to Atomic Performance Products without the cylinder head. It was understood that the owner or his agent took it upon themselves to recondition the cylinder head for problems unknown to Atomic Performance Products. The head gasket surface revealed no evidence of combustion gas or water leakage.

The cylinder bores revealed scuffing on the thrust surfaces. Cylinder #6 revealed the worse scoring and scuffing (figure 1), and was probably the source of the engine noises reported by the owner.

The cylinder bores revealed fresh honing marks. It was confirmed with measuring instruments that the bores were machined to provide a 0.0025" clearance to the pistons. The clearances did agree with the engine builders specification.

The piston rings revealed the original machining marks on the working surfaces, indicating that the engine had not been satisfactorily run-in. The piston rings revealed no evidence of adhesive wear due to breakdown of the lubricant film.

The piston crowns revealed dimpled blast-like patterns in the squish bands and valve pockets indicative of detonation operating conditions (figure 2). There was no evidence of contact of the piston with the valves or combustion chambers.

Piston #6 revealed galling and metal flow on the thrust skirt (figure 3), corresponding with the scuffing damage to the cylinder bore. Measurements on the skirt diameter revealed a collapse of the piston, resulting in a piston to bore clearance of 0.011". The cylinder bore diameter remote from the scuffig damage was found to be within tolerance.

The big-end bearings revealed burnishing at the 12 o'clock position that was indicative of detonation conditions (figure 4). The big-end bearing crush tensions were normal.

The crankshaft journals and bearing surfaces revealed no evidence of gross lubrication failure.

../2

CONCLUSIONS

The engine revealed evidence of partial seizure of the piston skirts in their cylinder bores. The piston crowns and bearing surfaces of the engine revealed evidence that it was operating under conditions that induced detonation, resulting in high-localised pressures and operating temperatures. The resulting combustion gas blow-by would have resulted in localised breakdown of the lubricant film between the pistons and the cylinder bores, leading to scuffing failure.

Detonation is an abnormal combustion process that can be attributed to inadequate octane fuel, early ignition timing, lean air/fuel ratios, and high engine running temperatures.

There was no evidence of assembly errors that may have contributed to the failure.

Stephen Hooker. BSc(Tech)
Metallurgist

DECLARATION OF EXPERT WITNESS

The author of this signed document has read, and agrees to be bound by, the "Code of Conduct for Expert Witnesses" set out in Schedule K of the Rules of the Supreme Court of NSW, and Schedule 7 of the Uniform Civil Procedure Rules 2005 (NSW).

Figure 1: The cylinder bore on #6 revealed scuffing and scoring. All of the bores revealed fresh honing marks, indicating that the engine had not been satisfactorily run-in.

Figure 2: The #6 piston crown was typical of all the other pistons, and revealed dimpling of the squish bands and valve pockets that was characteristic of detonation.

Figure 3: The #6 piston revealed severe adhesive wear and galling of the thrust skirt surface. The green solid film lubricant applied by Cosworth (piston manufacturer) had been eroded from the skirt surface. Localised lubricant film breakdown in this area is commonly experienced with excessive blow-by caused by high combustion pressures resulting from detonation.

Figure 4: The #6 big-end bearing revealed burnishing at the 12 o'clock position that was indicative of detonation operating conditions. There was no evidence of gross lubrication failure evident on the bearing surface.