# Forensic Examination of Truck Repair

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# Preamble

Gary Waterman owned a Mack truck equipped with a large water tank. His job was to keep dust down by watering the roads during roadbuilding, hence his name as anonymized[1]. Gary's client, the road builder, complained about Gary's truck leaking oil on the roadway so Gary took his truck to Car-Bunc Pty Ltd to get the leaks fixed. On completion Larry Parker, principal of Car-Bunc Pty Ltd, handed Gary a bill of nearly $20,000. Gary refused to pay and Larry sued for the money. Larry did not show up to give evidence but sent a letter to the court instead. Her Honour was not impressed and awarded Gary $4000 for his troubles and ordered retrieval of the truck from the premises of Car-Bunc Pty Ltd. Part A of this report was the initial report submitted to the Court.

Gary appealed and as a result, the $4000 was struck down as being *ultra vires* to Her Honour's authority. Her original ruling to allow retrieval of the truck without payment was affirmed.

Part B of this report is in response to Larry's letter to the court. The anonymized version of the Appeals Court Decision is appended as Part C.

This report has value beyond general interest, as follows:

- Budding forensic engineers have opportunity to study a real expert report.
- The report contains a wealth of knowledge, the author's as well as cited knowledge, of benefit to mechanics and mechanical engineers alike.
- A hard-done-by consumer can take heart that the "little guy" can win.

# Contents – Part A



[1] All names are anonymous including company names.

# Figures

# 1. Introduction

This report discusses truck repair work some of which was requested by Mr Gary Waterman of Car-bunc Pty. Ltd. and the repairs carried out on a Mack Truck Model R600 (the truck) currently located at the premises of in Chinchilla Queensland.

This report will dissert the technical aspects considering the truck performance including at time of issuance of the defect notice and subsequent running observations during the author's inspection.

Videos taken in relation to this report can be viewed at http://www.tinyurl.com/Dr-Brell. Videos are under the tab *Private* and needs the password ***MackR600*** to access.

Further information coming to light subsequent to this report may require a revision of this report.

## 1.1 Basis of Report

The report is based upon interviews, inspections and perusals from the following:

- Interview Mr Gary Waterman on 8/12/2013.
- Interview with Mr Larry Parker Principal of Car-bunc Pty Ltd on 13/12/2013.
- Inspection of the vehicle at Chinchilla by the author on 13/12/2013.
- Interview Mr Ron Mathers former Workshop Manager for Car-bunc on 13/12/2013
- Telephone interview on 13/12/2013 with Mr Saul Branbilt former employee of DIAT who was the mechanic who performed the work on the truck.
- Materials supplied by Mr Waterman, as follows:
    1. Email from Mr Waterman including attached chronology of events.
    2. Application for minor civil disputes – lodged by Mr Parker of Car-bunc 3/5/2013 claiming $19,449.53.
    3. Tax Invoice #554 by Car-bunc for $4,969.80 dated 18/05/2012.
    4. Estimate #62 by Car-bunc for a total of $14,204.73 dated 3/11/2012.
    5. Injector test report by Mack Trucks of Australia Pty Ltd dated 21/08/2012.
    6. Defect Notice by Queensland Transport for Mack Truck Reg. No. 827MZU dated 18/08/2012:
    7. Quotation for an engine rebuilding proposal by Northside Diesel for $14,894.16.
    8. Emailed copy of letter from Gary Waterman to his Solicitor outlining matters relevant to the case.
    9. Emailed copy of request to purchase cylinder heads and engine rebuild kit by Car-bunc from Gleeman Truck Parts to Mr Waterman dated 30/04/2012.
    10. Forwarded email from Mr Ron Mathers (Car-bunc) to Mr Waterman recommending replacement of three pistons including photographs of two pistons posted to this report as Figure 18.
    11. Copy of fax to Mr Waterman's Solicitor from Car-bunc's Lawyers.

12. Copy of invoice from Gleeman Truck Parts to DIAT for rocker arms dated 20/06/2012.
13. Email from G Waterman 22/12/2012: “Dalby Engine Rebuilders told me a lot of work had been on the heads due to being very hot at some stage”.

## 1.2 The Heart of the Matter

The author has been informed of the following:

*“Mr Waterman drove his Mack Truck to have oil leaks repaired from approximately 40 km on 13/03/2012. Mr Waterman reported that prior to and on the day the truck engine was performing properly, starting well, smooth running, exhibiting good oil pressure and delivering adequate torque. The exhaust plume was a very light grey.*

*Mr Waterman took delivery of the vehicle on 15/08/2012 for purposes of getting a Roadworthy Certificate. During the nominal 400m trip to the Local Transport Office he found the engine to run very rough, emitting a “chuff, chuff” noise and producing exhaust smoke puffs of strong white appearance.*

*He received a Defect Notice for leaking Diesel fuel from the engine, amongst other things.”*

*The condition of the vehicle at hand-back was well short of Mr Waterman’s expectations.*

## 1.3 Assumptions

For this report, it is assumed as follows:

1. The Mack Truck, Queensland Registered Number 827MZU was delivered to Carbunc to have oil leaks repaired on 13/03/2012.
2. The oil leaks manifested themselves by engine oil floating on top of the radiator water each morning during start-up sequences as well as visibly from the engine block inspection covers.
3. The engine was not burning oil excessively during running.
4. There was no Diesel leakage from the engine prior to the above date.
5. There were no knocking noises coming from the engine prior to handover date other than normal Diesel engine noises.
6. The truck engine had been in continuous duty up to the time of delivery to Carbunc exhibiting no impediment for work.
7. Before-after compression tests had not been performed.
8. Cylinder heads had been removed and replaced.
9. Six pistons and rings were replaced.
10. Stethoscope examinations of engine noises had not been performed.
11. Main and big end bearings were replaced.
12. Oil cooler supplied by Mr Waterman had been fitted.
13. Injector pump had been removed and replaced.

14. Injector pump timing had not been checked after re-installation.
15. Neither the mechanic who performed the actual work on the truck, his supervisor nor Mr Parker were aware that timing lights for Diesel engines were commercially available.
16. New puffer valve (aneroid) had been purchased by Mr Waterman and was fitted by Car-bunc.

Figure 1 is added to permit better understanding and reduce ambiguity of terms used.

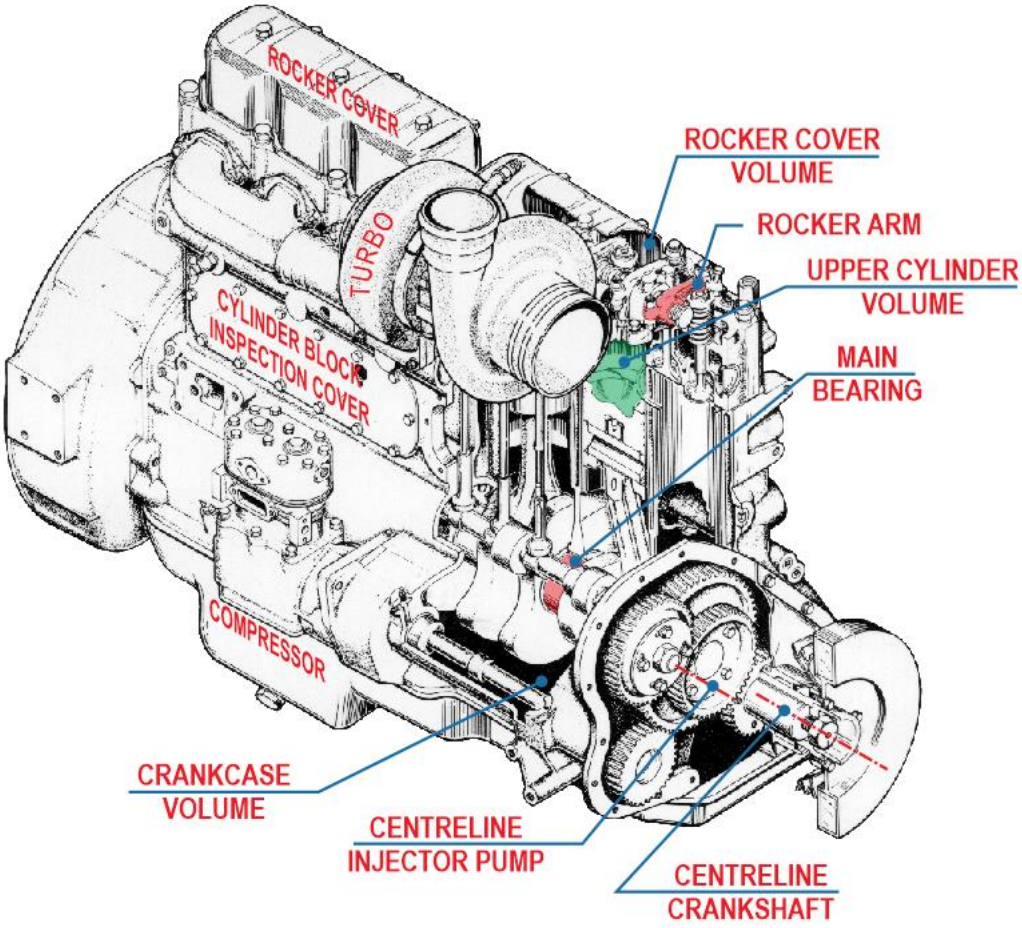


**Figure 1 - Nomenclature.**

# 2. Summary of Interviews

## 2.1 Interview with Mr Saul Branbilt

The telephone interview took place on the morning of 13/12/2013. Highlights of the conversation are posted below:

- Mr Saul Branbilt is no longer employed by Car-bunc.
- Mr Branbilt performed the repair work on the truck.
- He is a qualified mechanic.
- He had never worked on an engine of the type in question.
- Injector timing was performed “as per the Mack instructions”.
- Mack instructions included specialized tools which were not made available to him.
- He admitted that the injector timing was not checked.
- He was unaware that a timing strobe light was available for Diesels.
- His responses in relation to diagnostic tests were limited and defensive stating that all the work was performed under the instruction from Mr Russell Maher: “I just did as I was told.”

## 2.2 Interview with Mr Ron Mathers

The interview took place at Chinchilla on the morning of 13/12/2013. Highlights of the conversation are posted below:

- Mr Ron Mathers was Workshop Manager for Car-bunc during all of the repairs on the subject truck.
- He left Car-bunc’s employ 9 months ago.
- He preferred not to discuss the reasons for termination of employment.
- Compression tests were not performed due to an injector being stuck.
- He assumed other simple diagnostic tests were performed routinely.
- Mack instructions included specialized tools which were not available to him.
- He admitted that the injector timing was not checked.
- He was unaware that a timing strobe light was available for Diesels.
- His responses were limited and defensive stating: “I just let him get on with the job.”

## 2.3 Interview with Mr Gary Waterman

The main interview with Mr Gary Waterman took place on 8/12/2013 at Landsborough Queensland. There were a number of subsequent telephone interviews to clarify some points. The following is a summary of these interviews:

1. The Mack Truck, Queensland Registered Number 827MZU was delivered to Car-Bunc to have oil leaks repaired on 13/03/2012.
2. Key dates were supplied as follows:
    - 13/04/2012 - Truck handover to Car-Bunc.

- 22/03/2012 - Ordering of puffer valve and cylinder inspection plate gasket kit.
- 5/04/2012 - Test run by Car-Bunc to edge of town resulting in breakdown.
- 8/05/2012 - Rebuild kit delivered to Chinchilla.
- 15/08/2012 - Defect Notice issued by Transport Queensland
- 22/08/2012 – Mr Waterman took delivery of truck and drove approximately 40 km to Kenya Qld.
- 22/08/2012 – Mr Waterman took truck to Morton from Power Fluids Chinchilla to have the truck looked at.
- 22/08/2012 – Mr Waterman returned the truck to Car-Bunc.

3. The oil leaks manifested themselves by engine oil floating on top of the radiator water each morning during start-up sequences as well as visibly from the engine block inspection covers.
4. The condition of the engine prior to booking in for repair is described as follows:
    a. The engine was not burning oil excessively during running.
    b. There was no Diesel leakage from the engine.
    c. There were no knocking noises coming from the engine
    d. The truck engine had been in continuous duty up to the time of delivery to Car-Bunc exhibiting no impediment for work.
    e. The truck was not hard to start.
    f. Engine emissions would have passed EPA standards prior to delivery of truck to Car-Bunc.
5. Exhaust emissions after taking receipt of truck from Car-bunc on 22/08/2012 were thick white plumes of smoke under acceleration and at constant speed. This is shown in Figure 2 which is a screen capture of a video taken by Mr Waterman on 22/08/2013.

**Figure 2 – Heavy white smoke (after delivery of truck)**
(Screen capture of video supplied by Mr Waterman)

6. When the truck was taken to Queensland Transport (22/08/2012) the white smoke in Figure 2 was observed and was the basis of the defect notice. Black smoke during acceleration was not evident at this time.
7. The engine was making a “chuff chuff” sound after delivery of truck.
8. The engine exhibited less power than prior to handover of the truck.

## 2.4 Interviews with Mr Larry Parker

The first contact with Mr Parker was by telephone to arrange an inspection. During the telephone discussion it became apparent that the author could not expect much co-operation: “Hope you bring your own jumper lead and compressor.”

After further discussions Mr Parker agreed render what assistance I might need.

The second contact with Mr Parker was on 9:00 am 13/12/2013 interacting intermittently with him for the ensuing two hours of the inspection. Highlights of the conversation are posted below:

- Mr Parker remarked at the outset that new oil leaks had developed on account of “dried-out seals” caused by the truck being idle for a long time.
- He was unaware whether compression tests or other simple diagnostic tests were performed.
- To the question of injector timing he informed he assumed it was checked.
- He was unaware that a timing strobe light was available for Diesels laughing at my “confusion” because Diesels have no spark.
- When asked to comment on the heavy metal clunking, he first remarked it was a normal Diesel sound. Then he changed his diagnosis saying it was in the gearbox and not emanating from the engine. When informed that the truck was in neutral he changed his diagnosis again and implicated the clutch. When informing him that strong springs hold the clutch pressure plate Mr Parker insisted it was the clutch.
- When asked about the black exhaust emission Mr Parker reiterated: “Fuel pump was wound out for maximum fuel.”
- The author’s request for inspection of the replaced parts was met with: “We threw them away”.
- After some discussions three pistons, five rocker arms and two big-end bearing halves were produced and held out as the replaced parts. These are shown in the photo taken by the author and posted to Figure 3.

**Figure 3 – Photo (by the author) of parts held out as the replaced parts.**

- It was unclear what was meant by the invoice report: “Main cap lost coating.” Alluding to a hardness coating, Mr Parker explained using a sketch (Figure 4) drafted to help in the explanation.
    - Mr Parker explained that a face of a main baring cap was damaged where shown in Figure 4 as X X X.
    - Mr Parker then informed the damage was caused by normal engine wear.
    - This surface was then filed down to the dotted line and replaced with a shim to balance with the opposite non-filed surface.
- Mr Parker also explained with the help of the sketch what was meant by “got used longer bolt” in his invoice report.
    - “There was a crack in the engine block that prevented from achieving the required torque value for the bolt” he informed.
    - A longer bolt was sought to engage with deeper thread (extra thread).
    - The extra engagement together with *Loctite* (anaerobic glue) allowed the required torque value to be achieved.
    - Main bearing caps were stamped STD meaning the bearing diameter was the original size.

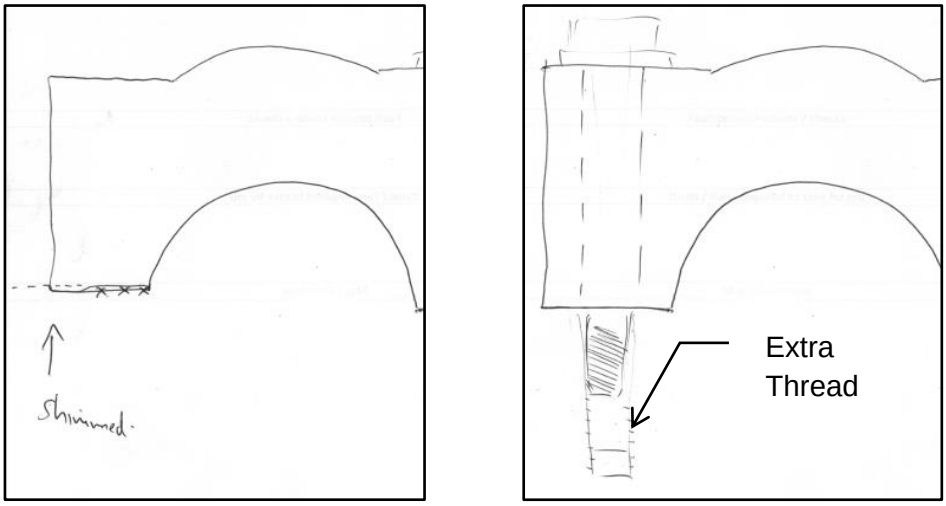


**Figure 4 – Explanation Sketches (by Mr Parker)**

# 3. Summary of Reports

## 3.1 Invoice #554

Invoice #554 by Car-Bunc Pty Ltd for $4,969.80 dated 18/05/2012 is enumerated (by the author) below:

1. Look over truck, rectify all evident oil leaks, injector pump, and PTO pump needs seals.
2. Replace oil cooler, drain radiator and refill, start and run to check leaks.
3. Took truck for test drive and motor stopped could not restart.
4. Checked fuel, bled injectors, checked valves - all exhaust valves were loose.
5. Float back to yard after taking for test drive as it broke down
6. Remove heads, found burnt out valves, remove sump, removed pistons,
7. Send heads away for quote.
8. Advised client who ordered necessary parts to fix truck.

## 3.2 Estimate #62

Estimate #62 by Car-Bunc for a total of $14,204.73 dated 3/11/2012 relating to period 17th May - 15th September 2012 is enumerated (by the author) below:

1. Remove liners from engine with liner puller.
2. Clean and fit new liners.
3. Assemble new pistons and rings.
4. Fit in engine.
5. Remove crankshaft main caps.
6. Fit new bearings in place and torque up.
7. Crank kept locking up.
8. Find fault with main cap lost coating and too tight.
9. Also found block had split where main cap bolt thread is.
10. Customer got used longer bolt and fitted to catch more thread.
11. Loctite'd in to correct torque - ok.
12. Continue assembling all engine parts.
13. Found valve rockers worn out.
14. Customer supplied used parts, just ground down fitted and adjusted.
15. Started and run, check all items.
16. Reset timing for injection pump.
17. Pump fuel wound out for maximum fuel which is too much for reconditioned engine.
18. Need to take to a Diesel specialist
19. Parts: Dalby Engine Rebuilders
    - Rocker box gaskets
    - Clean injector nozzles
    - Fuel Hose
    - Booster

## 3.3 Injector test report

Injector test report by Mack Trucks of Australia Pty Ltd dated 21/08/2012 is summarized below:

**Table 1 - Results of Injector Tests**

| Injector | Result |
|---|---|
| 1 | Fair |
| 2 | OK |
| 3 | Fair |
| 4 | Fair |
| 5 | Fair |
| 6 | Fail |

## 3.4 Defect Notice

Relevant requirements by Queensland Transport on the Defect Notice for Mack Truck Reg. No. 827MZU dated 18/08/2012 are summarized below:

1. Ensure exhaust emissions meet the manufacturer's specifications.
2. Rectify the cause of oil leaks near engine.
3. Rectify cause of Diesel leak near engine.

# 4. Inspection of the Truck.

## 4.1 Observations During Engine Running

Tests performed by the author were in the Car-Bunc compound under no-load conditions. The truck was no longer registered and thus could not be driven on road.

The author observed thick plumes of black smoke at start-up and during acceleration of engine speed from a lower revolution count (RPM) to a higher RPM. Figure 5 is a screen capture of movie taken by the author.

**Figure 5 – Thick black plume of exhaust smoke during start and acceleration.**

Running the engine at constant speed produced white exhaust emissions that may not pass EPA specification.

After 10 minutes of running the engine the breather pipe started to blow thick white emissions also (Blow-by). Figure 6 is a screen capture of movie taken by the author.

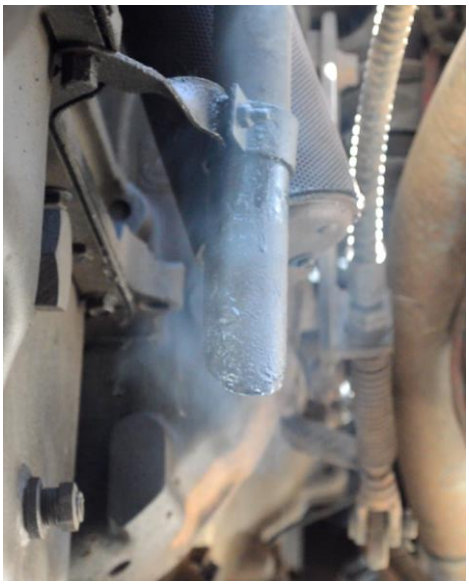

**Figure 6 – Breather pipe emissions showing white smoke.**

When the engine was stopped, a “clunk, clunk, clunk” could be heard during final throes of crankshaft turning and bouncing back into reverse rotation (angular not revolutional). The sound was consistent with heavy metal objects being impacted against each other inside the engine.

## 4.2 Rocker Arms Inspection

Measurement of rocker arm bores disclosed no ovality indicating little or no wear.

This is an indication of the overall condition of the machine.

A superficial inspection of the rocker arms revealed deep wear on the contact surfaces highlighted by the red dot in Figure 7. This may be the result of prior grinding and associated removal of the flame hardening during a prior repair.

The depth of wear and shape of wear would have effectively prevented feeler gauges from finding the gap.

**Figure 7 – Examination of a rocker arm highlighting wear by red dot.**

## 4.3 Inspection of Pistons

Figure 8 is a photograph taken by the author with background removed for clarity (by the author). Pistons were measured across two diameters and disclosed no ovality indicating little or no wear. It would be expected that in the piston slap area of the piston periphery (left and right of the gudgeon) one might find some wear.

Instead, the cylindrical surfaces of the pistons examined showed the original machining marks indicating little or no wear.

This lack of wear is indicative of the overall condition of the engine.

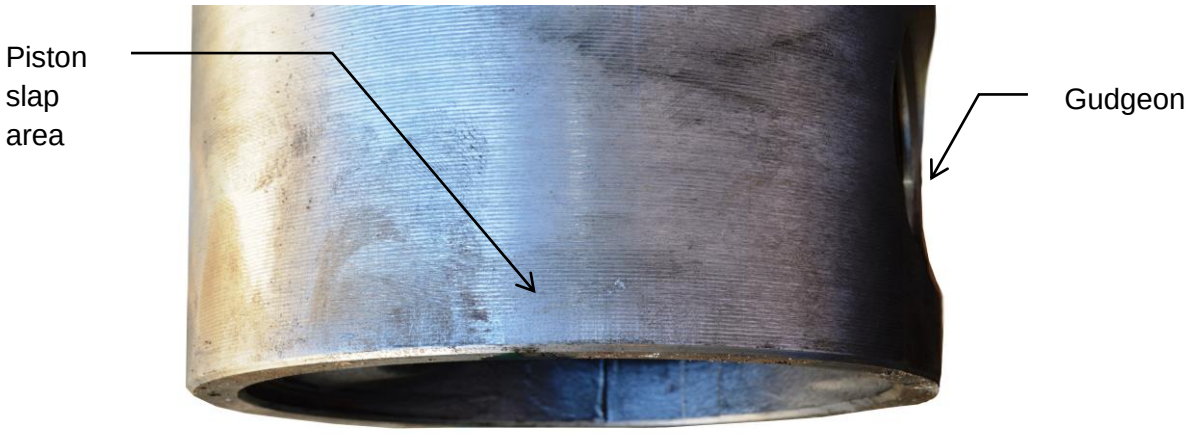


**Figure 8 – Examination of piston showing original machining marks.**

## 4.4 Other Observations

During inspection of the truck, the author noted a number of items to be discussed here as follows:

1. Leaking exhaust manifold
2. Exhaust manifold stud missing
3. Diesel fuel leakage
4. Injector mounting gasket missing

**1. Leaking Exhaust Manifold**

The exhaust manifold gasket leaked shown smoky in the left-hand side of Figure 10. This photo is a screen capture of a video taken by the author.


**Figure 9 – Photo taken by the author highlighting exhaust gas leakage.**

**Figure 10 – Exhaust manifold leakage showing white smoke emission.**
(Screen capture of movie taken by the author from kerb-side)
(Dotted outline of smoke by author)

## 2. Exhaust Manifold Stud Missing

Figure 11 shows a photograph taken by the author of a stud which had not been replaced. Noteworthy is the tab washer which indicates a burnish mark from recent removal of this missing bolt.

**Figure 11 – Exhaust manifold stud missing**

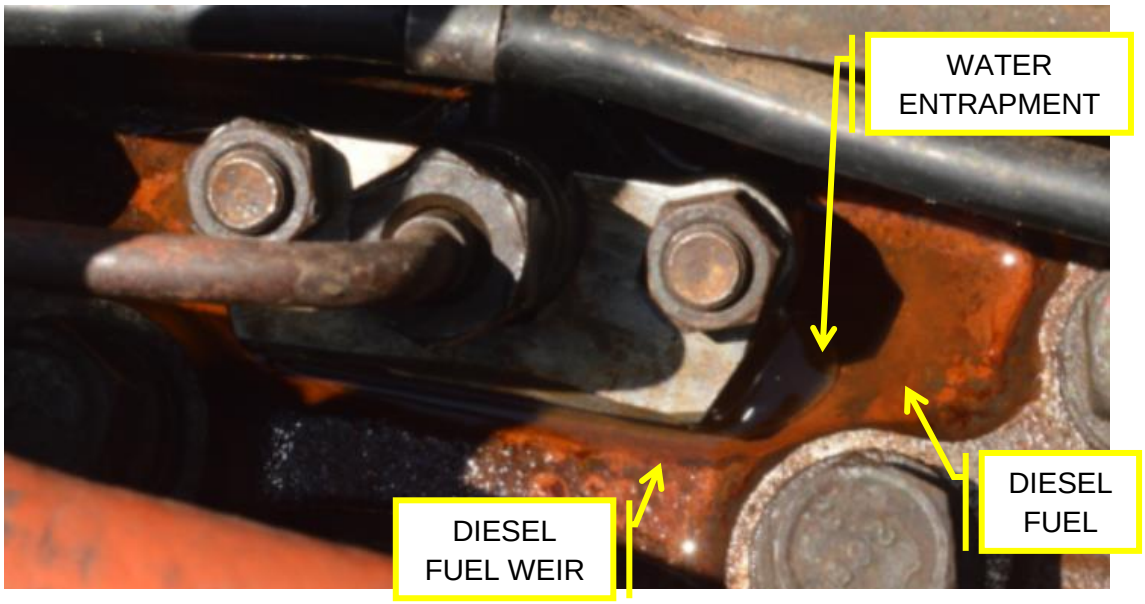


**Figure 12 – Diesel fuel leakage**

## 3. Diesel Fuel Leakage

After only 10 minutes running the engine the weir surrounding an injector filled with Diesel to overflowing and dripping to ground. Diesel was identified by smell and contradistinction of specific gravities, water being heavier than Diesel formed a water bubble under the Diesel.

## 4. Injector Pump Mounting Gasket Missing

The mounting flange of the injector pump requires gasket to seal the faces against the engine block. This is highlighted by a red arrow in Figure 13. Application of a Silastic style of gue is a valid procedure only as a temporary fix.

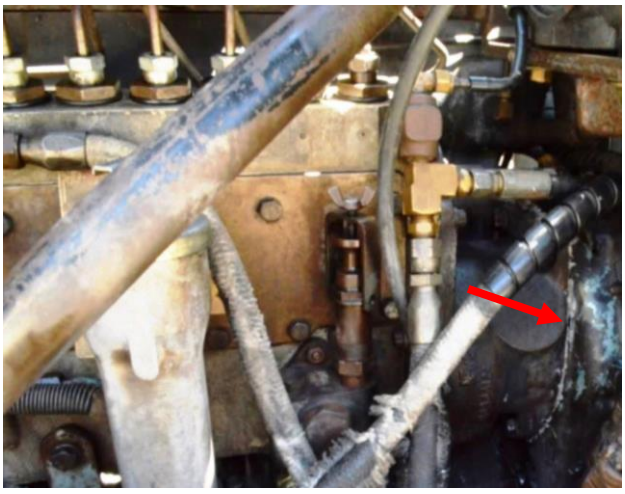

**Figure 13** - **Using gasket gue instead of a proper injector pump gasket.**
(Photograph and highlighting with red arrow by author)

# 5. Hypotheses for Damaged Main Bearing Cap

This study embraces issues gleaned from the interview with Mr Parker and other sources, as follows:

1. The susceptibility of surface area of one side of the main bearing cap to damage from normal running.
2. The crack in the block which purportedly prevented from achieving the specified bolt-up torque.

These items are discussed in context of either pre-existing damage or damage caused by the repair procedure.

## 5.1 Prior Damage

The largest force on a main bearing cap is exerted by the explosion of fuel in the upper cylinder volume. This is a force tending to prise the bolted surfaces apart. The explanation that accompanies Figure 4 alludes to a compression failure. Only bolt force applies compression forces to the mating faces. The surface area of the mating faces is far greater than the root bolt area. Therefore bolting load cannot damage the mating faces.

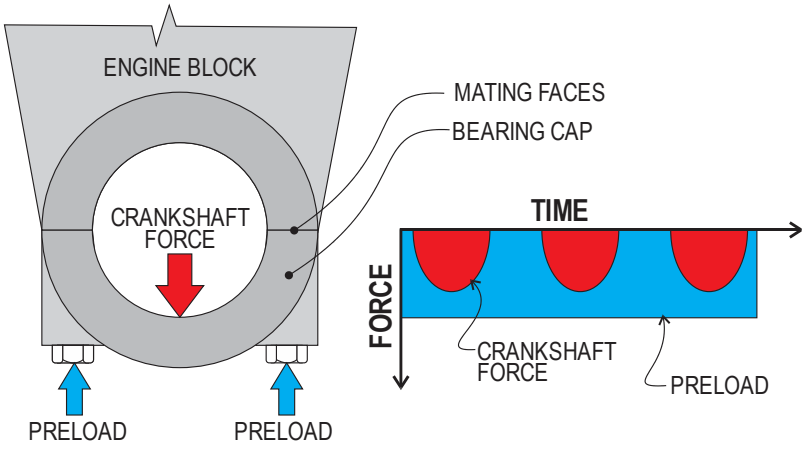


**Figure 14 – Schematic of preloading of bearing cap**
(To prevent separation at the mating faces.)

The recommended torque on the bearing cap bolts is designed to apply a preload on the cap that preload force is always greater than the applied crankshaft force. This ensures there is no separation of the mating faces. The idea is embodied in the force-time graph in Figure 4.

In an event of loss of preload (for example inadequate bolting up) separation of the mating faces would create sever hammering on the bolt followed by bolt failure and crankshaft bending and break.

The sound made by such a scenario would be audible even to the untrained ear.

Because the hammering force is downwards, the mating faces could not be damaged as suggested during normal running.

In an event of loss of preload for example crack in engine block thread, as suggested, the faces would open up and hammering would quickly release the bolt in the thread weakened by the crack followed by bolt thread failure, crankshaft bending, then a complete break of the crankshaft.

The mechanics of such hammering would also be very audible.

## 5.2 Subsequent Damage

In this section, the feasibility of damaging the mating face in the bearing cap during installation is explored.

Replacing main bearings with the engine still in the truck is a difficult task. It should only be done in an emergency where proper facilities are not available.

**Figure 15 – Locating lug (red arrow)**

(To mate with corresponding notch in engine block.)

To achieve the replacement of main-bearings the crankshaft must be loosened by a small amount. This is achieved by loosening all main-bearing caps. The top half of each main-bearing half must be slid into place on top of the crankshaft journal. The main-bearing cap must then be fitted and bolted up. At this point there is no certainty that the locating lug highlighted in Figure 15 is properly mated.

The Mack E6/672 Engine Overhaul Manual makes the point: “Insert the upper half of the bearing in the block bore making certain that the locating lug fits into the notch provided.”

In an insitu installation, the bearing half needs to be fitted upside down and thus does not necessarily remain in position. Grease is often used as a temporary “glue” to keep the bearing half in place. It is not always a successful procedure and thus there is risk that the locating lugs are not properly seated.

In such an event there is risk of damaging the mating faces indicated in Figure 14 and Figure 4.

## **5.3** Summary

In the “Prior” hypothesis it was shown that a compressive failure of the mating faces is not possible from mere bolting up. No noise was reported emanating from a loose main bearing at handover. Accordingly, the “Prior” hypothesis must be rejected.

The Car-Bunc Estimate reports on the process of replacing main bearings as follows:

5. *Remove crankshaft main caps.*
6. *Fit new bearings in place and torque up.*
7. *Crank kept locking up.*
8. *Find fault with main cap lost coating and too tight.*
9. *Also found block had split where main cap bolt thread is.*
10. *Customer got used longer bolt and fitted to catch more thread.*

The main bearings fitted were stamped STD meaning that they could be fitted without any risk of locking up the crankshaft as might occur with undersize bearing halves.

The case can be summarized in simple logical steps:

A. The crank was not locked up at handover.
B. The crank was locked up after refitting main bearing caps.
C. Conclusion: Something was introduced to make it lock up.

Given the difficulty of mating the locating lugs, it is entirely possible that misalignment here caused the lock up of the crankshaft. It is the author’s opinion that the other item, *split in block*, resulted from this misalignment and is in reality a stripped thread from attempting to bolt up against this misalignment.

There remains a concern that the heavy clunking discerned after stopping the engine as reported to Mr Parker may be symptomatic of crankshaft issues related to the damage during fitment of main bearings. The concern is that the glued-in longer bolt is no longer holding fast. The clunking sound can be clearly heard at the video address given above.

# 6. Hypotheses for Burnt Exhaust Valves

This chapter examines the causes of the burnt exhaust valves in the framework of two hypotheses, as follows:

1. The valves were burnt prior to Mr Waterman delivering the vehicle to Car-Bunc.
2. The valves were burnt as a result of work performed by Car-Bunc.

It is noted that the valves were not offered for inspection.

Photographs supplied by Car-Bunc appear in Figure 16. It is assumed these photographs pertain to the subject engine. To permit better examination of the damage, close-ups are posted in Figure 17 and Figure 18.

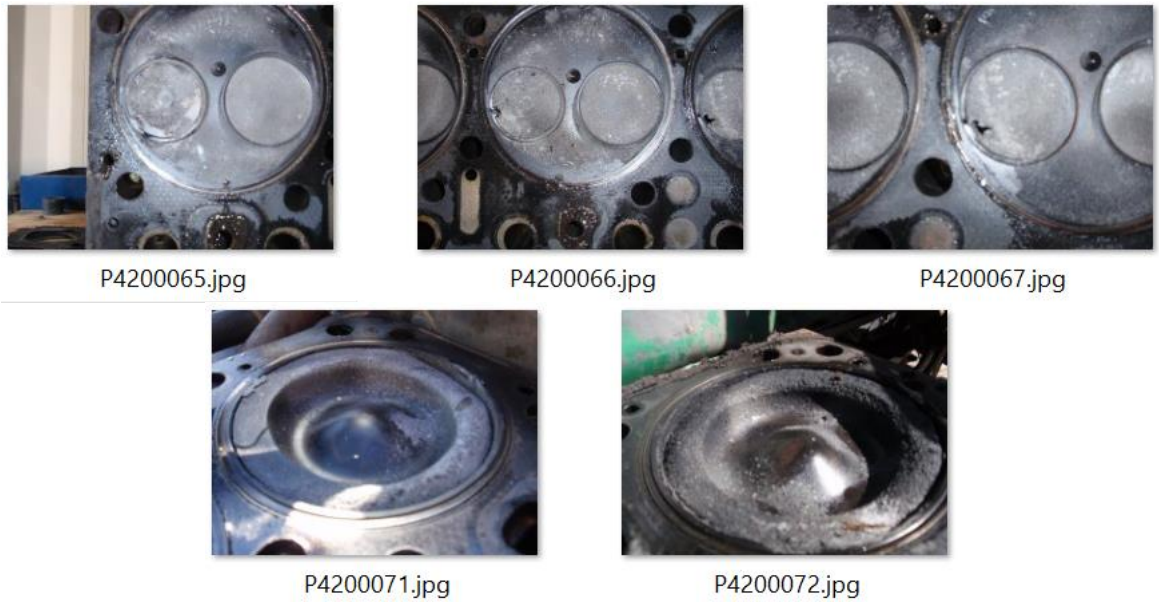


**Figure 16 - Photographs supplied by Mr Parker.**

**Figure 17 - Close-ups of burnt exhaust valves.**

It is worth noting in Figure 17 that the surfaces were clean in regard to Carbon build-up.

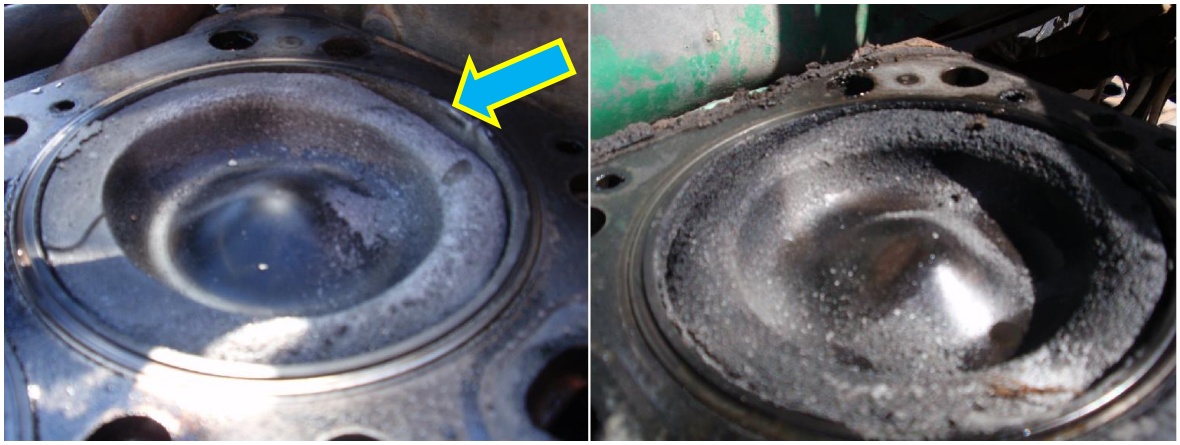

**Figure 18 - Close-ups of piston photographs.**

The burnt holes in the exhaust valves are highlighted by red arrows. Blue arrow highlights burnt piston. It should be noted that the cylinder heads shown are relatively clean. So too is one piston. The significance of this will be discussed under the relevant hypothesis.

## 6.1 Prior Damage

If it were possible that the engine could run under the severity of damage shown by the photographs, then significant noise would have been generated during running. Such noises could be characterized by “chuff chuff” sounds and would have attracted some attention.

The truck would have exhibited loss of power and be hard to start if at all possible to start.

No such noises were reported during handover. Moreover, it should be noted that the truck was merely booked in for oil leaks and not burnt valves. The burnt valves were only discovered after the test run when the engine stopped and could not be restarted.

## 6.2 Subsequent Damage

In this hypothesis, the engine was delivered to Car-Bunc in serviceable condition. As part of the requirement to fix the oil leaks it was necessary to remove the injector pump to gain access to the inspection panel behind. During re-installation, the timing of the injector pump is incorrectly set and so the engine will not start.

On Thursday 5th April 2012, Car-Bunc took the truck for a test run. Their report: “Float back to yard after taking for test drive as it broke down” refers. As at this date the only work performed on the engine was to replace the oil cooler and fix oil leaks. The engine ran well prior to this relatively minor work. The place where the engine broke down was “just outside of town”, the trip being 2 - 3 km approximately. The engine would not start.

On cold days a Diesel engine may be hard to start. In such situations it is common practice to use a product called “Start Ya Bastard” as depicted in Figure 20.

It was cold on the day of engine breakdown as can be seen on the graph of Figure 19.

The minimum temperatures reported by the Bureau of Meteorology (BOM) indicate that it was cold in the general area for most of April 2012 at the nearest weather station.

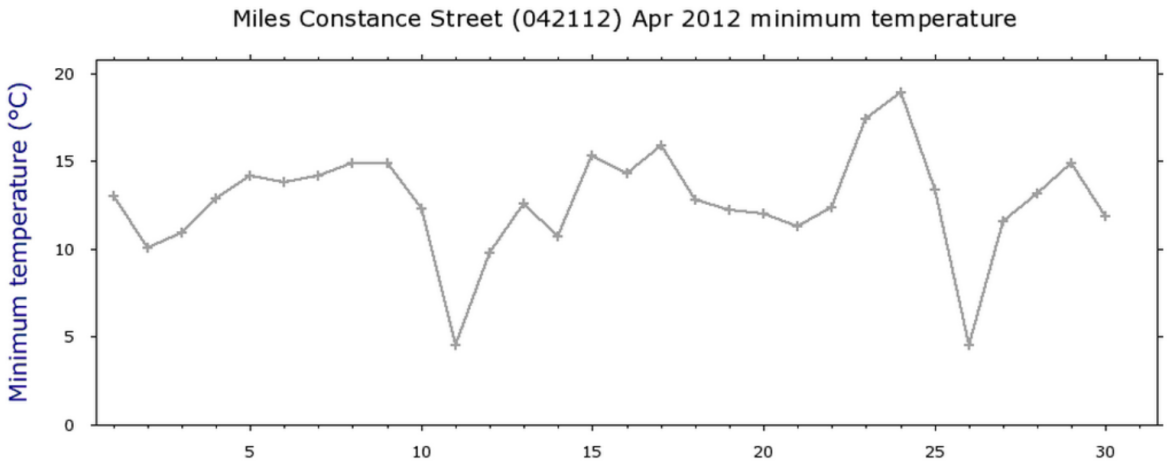


**Figure 19 – Graph of minimum temperatures recorded near Chinchilla for April 2012**


**Figure 20 - Spray Can of "Start Ya Bastard".**

A short spray in the air intake during the start cranking procedure assists in starting. Although the Nulon spray can states a composition of only 25% Ether, the Material Safety Data Sheet (MSDS) by Nulon gives the ingredients as follows:

- 30-60% naphtha petroleum
- 30-60% dimethyl ether
- 10-30% diethyl ether
- <10% hydroquinone

Other formulations of starting aids are commercially available under the brand name *Aerostart*. Other starting aids include addition of Petrol into the fuel tank.

Industry knowledge in Internet forums advises against use of Ether on a regular basis coining the phrase “Engine Ether Addiction” or Ether Addicted Diesels”. More formal advice on Dimethyl Ether (DME) is that DME is corrosive[1]. When used as “clean fuel”[2] engine timing is tailored to suit.

Excerpts from various Internet forums offer some insight:

- *As far as the term goes, I believe if too much is used too many times it washes out all of the carbon build up on valves and on the cylinder walls so more blow by is created.* (See Figure 6 for photograph of blow-by)
- *The Ether is dry (no lubrication) and very hot burning. Gas and Diesel engines do not handle Ether well so limit its use to a minimum.*
- *The detonation from Ether breaks rings and burns valves. It ignites too early and it is easy to use too much.*
- *Carbon build up is incomplete combustion from oil and or fuel. When the engine has worn to the point it needs to be rebuilt the carbon can plug the gaps or slop in the worn parts.*
- *If you use Ether to start an engine in warm weather you have other problems you need to deal with, the Ether is causing more harm than help.*

To achieve a better understanding of how Ether performs in an engine, burn rates for Diesel and Ether are compared for a duration of a critical 1 millisecond (1/1000 seconds) when the temperature rises dramatically. The support data for the graphs were sourced from two publications and graphed by the author, shown here as Figure 21:

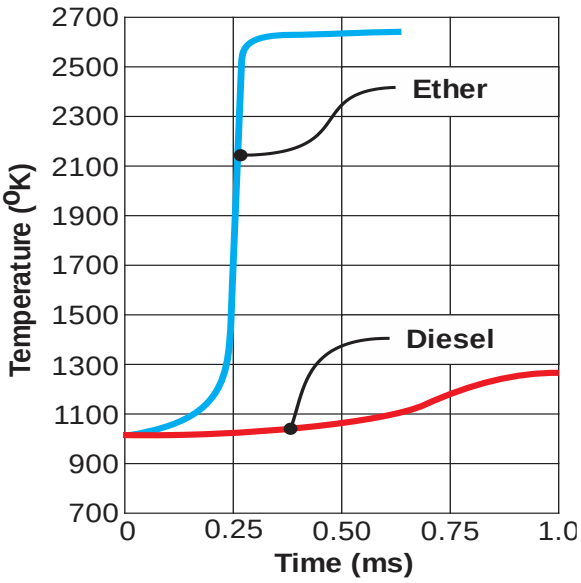


**Figure 21 - Comparison of Ether vs Diesel**
(for 1 millisecond to peak temperature)
**(*Lakshminarayanan[3] et al and G. Fast[4] et al)***

Figure 21 teaches that the maximum burn temperature of Ether is much higher than for Diesel. The maximum temperature is achieved much earlier. This indicates that the whole upper cylinder surfaces are exposed to higher temperature for a longer period.

Carbon deposits which are a combination of carbon and unburnt fuel leave merely ash as a result of Ether. Moreover, cylinder walls are stripped of lubricant and rings must rub on an unlubricated raw metal surface. Figure 21 supports the forum opinions listed.

Figure 22 is a photograph taken by the author of the parts held out to be the replaced parts. It shows two pistons dirty with Carbon deposits and one piston clean. This strongly suggests that a starting agent was used. It is noted that the three other pistons were not offered for inspection.

**Figure 22 - Photo by the author of replaced parts**

## 6.3 Summary

It is unlikely that an engine with valves burnt to the extent shown in Figure 17 could run. Further, starting may be possible if the other 4 cylinder were working with a starting aid.

The noise emitted under such circumstances would have been noticed especially to mechanics skilled in the art. No noise was reported during the handover procedure. Moreover, the vehicle was driven some 40 km just prior to handover. Thus the “Prior” hypothesis is untenable.

It is noted that the truck stopped during a test run (“a couple of miles”) just before Easter (5/04/2012) and could not be started but had to be recovered on a float. It is also noted that around Easter 2012 Chinchilla experienced cold days. (Ref Bureau of Meteorology Figure 19). The cause of the engine stopping was not offered by Mr Parker.

In the absence of a competing hypothesis, the author has formed the opinion that a substance was used to start the engine to overcome starting difficulties caused by late engine timing and the cold weather. Further, this substance caused the burnt valves.

# 7. Discussion

## 7.1 Justification for Repairs

Before any stripping down, repair or replacement is carried out on a project of this size simple tests should have been performed among which are:

- Colour of exhaust plume. Thick black smoke would indicate that the aneroid is not working or the injectors are dirty. White smoke means unburnt fuel indicating late injector pump timing and blue means burning engine lubricating oil excessively.
- An inexpensive compression test would have revealed the health of piston rings and valve seating.
- A quick look at the breather pipe could have given insight the health of piston rings.
- Listening to the noises an engine makes can help in the diagnosis to determine the need of bearing replacements.
- Listening with a stethoscope for structure-borne sound of characteristic rumbling or knocking would have improved the accuracy of diagnosing main or big end issues respectively.

Good case management would demand that the results of tests be recorded and reported to the customer prior to proceeding to the next phase.

## 7.2 Filing of Main Bearing Cap

Mr Parker informed that the surface damage on the main bearing cap was removed by placing the cap into a vice and filing the metal until the damage was removed. To ensure that a shim would restore the height the cap was measured on both sides.

Whilst this could be condoned in an emergency, the filing procedure is beset with problems, as follows:

- The action of filing a piece of metal in a vice causes a curved surface.
- It requires much training and the use of a surface plate[2] to achieve a flat surface.
- Even if a flat surface were achieved there remains the problem of achieving parallelism with the surface on opposite side of the cap.
- If these faces are not on parallel planes stress is imparted into the cap with potentially unwelcome results.
- The correct procedure for removing the defect in the surface of the cap would have been to use a surface grinder.

The quality of the engine is compromised as a result of this repair.

[2] A surface plate is a solid, flat plate used as the main horizontal reference plane for precision work.

## 7.3 Injector Timing

There are two ways the engine is timed, as follows:

1. Manual timing adjustment
2. Automatic adjustment during running

A basic level of knowledge of the timing of injector pumps is helpful in understanding the issues covered by this report. A short primer on injector timing follows.

When pressure and the corresponding temperature of compression in the upper cylinder volume is above the critical burn point for Diesel, the Diesel fuel injected into the cylinder will ignite. The timing of injection of Diesel fuel into the volume is therefore critical. If injection is too early the engine will not start or may even rotate the wrong way. If injection is too late the engine will not start or run poorly and exhaust unburnt fuel. Figure 23 may be helpful in visualizing the concept.

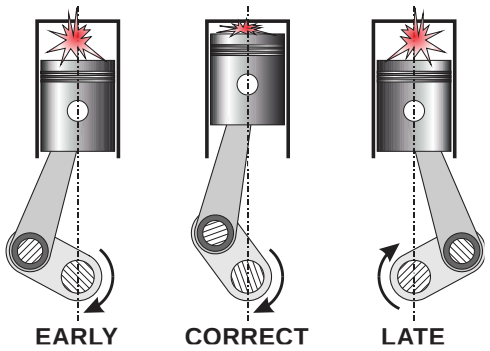


**Figure 23** – **Concept sketch to visualize injector timing.**

**1. Manual Timing Adjustments**

The subject truck engine has a facility to advance the timing and so make ignition early. The same facility can also retard ignition making it late. This facility is shown in Figure 24.

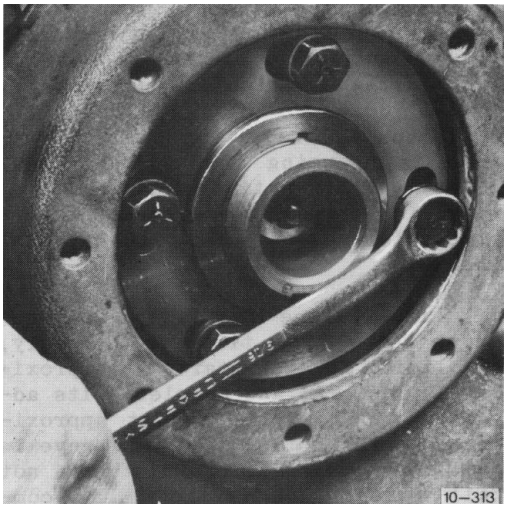


**Figure 24** – **Facility to adjust injector timing**
(Mack E6/672 Engine Overhaul Manual)

Rotation of the bolt cluster in relation to the backing plate will advance or retard the timing of the engine ignition points. The advance/retard sense is shown below in Figure 25. A degree adjustment corresponds to two degrees of change in timing under the injectors.

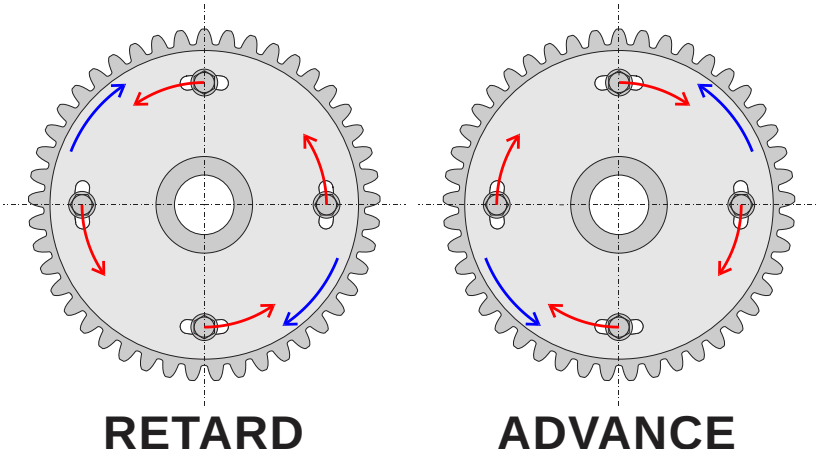


**Figure 25** – **Schematic of advance/retard adjustment of the injector pump.**

The procedure to adjust the timing requires[3] some specialized tools:

- Part Number J29599-4 Hub Nut Socket
- Part Number 72-7010 Portable High Pressure Timing Unit
- Part Number J-29539 Top Dead Centre Locator
- Part Number J-29599-2 Assembly Advance Tool
- Part Number J-29599-3 Extravance Wrench

## 2. Automatic Adjustment During Running

Diesel fuel in a Diesel engine does not explode instantaneously but burns at a rate determined by the quality of fuel and other factors. Lakshminarayanan et al[5] (2010) give insight into the process of burning Diesel fuel in a Diesel engine, segmenting the process into three regimes in a given timeframe. Their graph in Figure 26 illustrates.

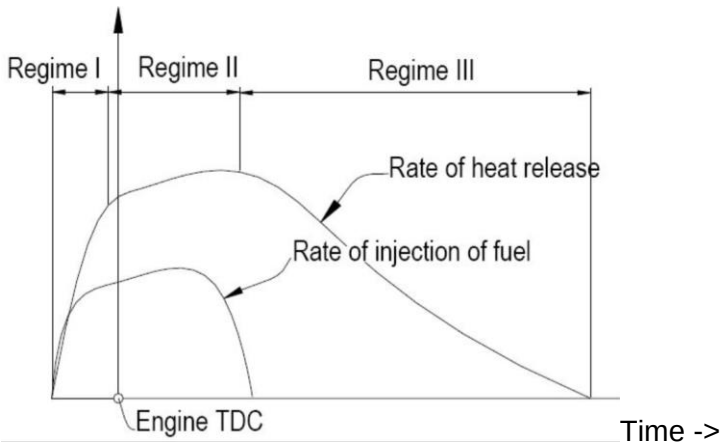


**Figure 26** - **Three burn regimes plotted with injection of fuel**

[3] Mack E6/672 Engine Overhaul Manual

It will be noted in Figure 26 that injection starts before engine top dead centre (TDC). As the engine speeds up it must make allowance for burn time. To achieve this, the injector pump is equipped with a device called *Extravance.* This device begins to operate at approximately 1300 RPM and advances by up to $7^0$ of engine rotation at 2000 RPM.

The Mack E6/672 Engine Overhaul Manual advises that if the Extravance unit does not meet specification, it should be replaced.

To check the timing and efficacy of the Extravance unit special equipment required by the Mack E6/672 Engine Overhaul Manual is advised as Part Number CT4000 Diesel Tach-Time.


**Figure 27 – Top Dead Centre Indicator and CT4000 Diesel Tach-Time**

For under $300 adapters are available on eBay and other sources that utilize standard timing lights available from AutoBarn, Repco, etc. These come with a piezo head (as shown in Figure 28) that bolts onto the high pressure fuel line connecting the injector pump with the injector. The piezo measures a slight increase in the diameter of the fuel line and convert this into a signal for the adapter which in turn lights up a standard timing light.


**Figure 28 - Timing light adapter for Diesel engines.**

## 7.4 Puff Control

A naturally aspirated Diesel engine requires less fuel to be injected per revolution than an engine fitted with a turbocharger. This is because there is less air to burn the fuel.

It takes time for the turbocharger to develop pressure in the intake manifold to match the fuel charge that would be delivered by the accelerator pedal setting of the injector pump.

This is where the puff control device or otherwise known as the aneroid comes in. This device senses the pressure in the manifold and modulates the fuel charge to a level matching the quantity of available air.

Figure 28 is a photograph taken by the author of the injector pump and puff control device which can be identified as a shiny cylindrical object highlighted by the red arrow.

**Figure 29 - Puff control device highlighted by red arrow.**

The malfunction of this device causes emission of large plumes of black smoke when depressing the accelerator pedal to maximum. (See Figure 5)

## 7.5 What Causes Valves to Burn

Valves do not burn literally. Burning implies catching on fire and sustaining the process until ashes remain. A Google search for "images of burnt valves" reveals the following images showing from surface aberrations to actual holes in a mushroom valve:


**Figure 30 – Google search for "images of burnt valves"**

The various Internet forums have a common thread that excessive heat causes valves to burn. Here are some excerpts:

- *The most common being too much heat in the combustion chambers. The heat literally melts slots in the valve face.*
- *There are all kinds of ways to kill a valve, and most of them -- like cracking, warping, flaking and pitting -- have to do with heat.*
- *Excess heat in the valve will damage the metal's crystalline matrix, causing cracks that range in scale from microscopic to visual.*

When a valve heats up it expands in diameter creating a tensile stress (hoop stress) in the periphery. Micro cracks form as a result of this stress. Crack tips have a concentration of crack tip energy which causes the crack tip to propagate further. Once a crack is opened wide enough it admits hot gases focussing on the crack tip so compounding the problem. Under these conditions holes form quickly and leak compression gases until such time as the engine will not start.

Carbon steel melts at 1425-1540 $^{o}$C[4]. A quick reflection on Figure 21 will reveal that Ether burn temperature is in excess of 2400 $^{o}$C. Thus it can be concluded that burning Ether in a Diesel engine has the potential to burn valves.

[4] http://www.engineeringtoolbox.com/melting-temperature-metals-d_860.html

# 8. Summary and Conclusions

Repairs have been performed on a Mack Truck Model R600 owned by Mr Waterman between 13/03/2012 and 22/8/2012 at the premises of Car-Bunc Pty Ltd.

The black exhaust emission observed by the author during his inspection was absent during the inspection by Queensland Transport. The white exhaust emission was less during the author's inspection as that which can be observed by the video taken on 22/08/2012. There is no mechanism by which to ascribe passage of time as the cause of this change. Accordingly, it is concluded that the truck had been altered in some way after 22/08/2012.

The truck was handed over in serviceable condition in all respects, the requirements being merely to have oil leaks repaired. Significant repairs were performed without the support of diagnostic tests. This is seen as unprofessional by the author or even considered unscrupulous, if motives were transparent enough to demonstrate overservicing.

After the repair period a number of major flaws were detected by the truck owner, Queensland Transport and the author, among which were:

- Leaking oil
- Leaking Diesel fuel
- Leaking exhaust manifold
- Unsatisfactory main bearing installation
- Excessive exhaust emission
- Excessive blow-by from breather pipe.
- Burnt exhaust valves

A number of minor flaws were detected that also have scope for forming opinions on the care, attention and competence of Car-Bunc. Among these were:

- Omission of manifold bolt
- Omission of injector pump gasket

A number of hypotheses were considered in pre-existing vs repair-caused contexts. The pre-existing hypotheses were rejected mainly on the grounds of lack of notification at the outset of very discernable flaws. Leaks, noises and heavy smoke emissions are stock-in-trade diagnostic tools for mechanics. In the absence of other viable hypotheses and on balance of probability it was concluded that:

A. Burnt exhaust valves were caused by the substantial use of starting aid to start the engine with starting difficulty due to cold weather, late ignition or both.
B. Excessive blow-by detected at the breather pipe indicates internal leakage past piston rings and valve stems despite all the repairs that are claimed to have been made.
C. Damage to the mating surface of the main bearing cap was as a result of improper fitting of a bearing half.
D. Damage to the thread was the result of an attempt to bolt up with an obstruction at the mating faces.
E. Filing of the mating surface of the end cap is non-tradesmanlike.

Other observations and study lead to the following conclusions:

F. White blow-by and white exhaust emission are unburnt fuel and indicate late ignition in turn as a result of failing to check injector timing.
G. Not having prescribed tools to perform a timing test erodes confidence that DIAT is capable of performing tasks of this size and nature.
H. Using a mechanic who has never worked on this type of engine also erodes confidence.
I. There remain concerns relating to the poor fitting practice of a main bearing cap and the associated longer bolt held in place with anaerobic glue and a connection that may exist with the clunking noises deep in the engine heard and recorded by the author.
J. Omitting a bolt or using inappropriate gasketing is indicative of a lack of care.
K. Simple diagnostic tests were not performed that would have had value in justifying the need for these major repairs. Management assumed they were performed while the operative "just did as he was told" attest to a lack of quality procedures in the organisation.
L. Doing and reporting of diagnostic tests before and after is an essential part of customer care. Its lack points to poor quality of management and/or lack of care.
M. Replacement of pistons that still exhibit original machining marks potentially suggests overservicing.
N. Guarded responses from the mechanic and his supervisors suggest there are many more issues than they were willing to reveal.
O. Lack of willing co-operation followed by selective presentation of replaced component parts could be symptomatic of hiding information that may have an adverse bearing on the Car-Bunc repair.
P. The repair period between 13/03/2012 and 22/8/2012 is inordinately long given the size of project even when factoring in the logistics of customer supplied parts.

In summary, the truck was booked in to have oil leaks fixed but instead, without justifying the need, had much work performed, took a long time, with oil leaks still remaining but compounded by Diesel fuel leaks and many other flaws as well.

In compliance with the *Uniform Civil Procedure Rules* the author's Curriculum Vitae is attached. In addition, the author confirms that:

- the factual matters stated in the report are, as far as the expert knows, true; and
- the expert has made all enquiries considered appropriate; and
- the opinions stated in the report are genuinely held by the expert; and
- the report contains reference to all matters the expert considers significant; and
- the expert understands his duty to the court and has complied with the duty.

Dr Edward Brell - 23 December 2013

# 9. Report Focussed Experience

During his final years of a 5 year apprenticeship the author has worked on Diesel locomotives and Diesel rail motors in Parkes NSW and Enfield NSW.

In the final year of apprenticeship he undertook a year-long course called “Heat Engines” which included Diesel engines.

As an undergraduate he undertook a semester of a subject “Applied Heat” dealing with Diesel engines.

For 7 years he investigated all fraudulent claims for Fortress Insurance in Queensland. Many of the investigations concerned Diesel engines.

A comprehensive examination of a Freightliner Diesel truck involved in a double fatality was performed for Philips and Fox – Lawyers for the Federal Court of Australia.

As Secretary for the Queensland Chapter of the Society of Automotive Engineers for 13 years he organized and attended many technical meetings concerning the industry generally and Diesel engines specifically.

# 10. References

[1] Klaus Mollenhauer & Helmut Tschoeke (2010) “Handbook of Diesel Engines” Section 4.2.3.3 Dimethyl Ether (DME)

[2] Wang Hewu and Zhou Longbao (2003) Proceedings of the Institution of Mechanical Engineers

[3] P. A. Lakshminarayanan & Yogesh V. Aghav (2009) “Modelling Diesel Combustion” Springer Dordrecht Heidelberg

[4] Fast et al “Combustion and Flame” 156 (2009) 200–213

[5] P. A. Lakshminarayanan & Yogesh V. Aghav (2009) “Modelling Diesel Combustion” Springer Dordrecht Heidelberg

# Part B

# Contents



# Figures

# 1. Preamble

This report supplements Part A, a report by the author dated 23 December 2013. The present report (Part B) responds to Mr Parker's letter dated 21 January 2014. This letter was lodged with and stamped by the Chinchilla Magistrates Court. The Court set a deadline by which Mr Parker could respond to Dr Brell's report (Part A) by 21 February 2014. Despite an offer by the respondent's solicitor to extend the date, the opportunity to respond has not been taken up by Mr Parker on behalf of Car-Bunc Pty Ltd

# 2. Point by Point Response

Point by point response to Mr Parker's letter to the Court appears below:

| Mr Parker's Letter Point | Dr Brell's Response |
|---|---|
| *1. While Dr Brell was inspecting the truck at our premises, it was found that his understanding and experience in engine rebuilds is extremely limited — this was evident in the basic questions he asked regarding operation of this engine, inspecting parts that were irrelevant to the repairs undertaken and even asking how to start the truck. His limited understanding shines through strongly in the report he has compiled.* | A nascent type of interview technique provides better insights than a show-off style.<br><br>The mission was to gather facts that might help a Court to adjudicate rather than air one's knowledge.<br><br>A better insight into the author's competence can be gleaned from his CV. |
| *1a. A Diesel Engine Rebuild Specialist would have been much better suited to inspecting the work completed by us to correctly ascertain if the repairs completed were done to satisfaction or not.* | The issues raised in Part A go far beyond an engine rebuilder' level of competence. Such a specialist lays claim to expertise in fitting & machining.<br><br>The author has achieved distinctions in fitting and machining during his 5 year apprenticeship. (AEU prize – Best Apprentice and NSW Railways Commissioner's Best Apprentice Award) |
| *2. The correct fuel timing procedure was done to manufacturer's specifications, despite his report stating we never correctly timed it.* | Do not agree. The required tools as specified by Mack Trucks were not used neither was the Mack Truck Repair Manual held in possession by Car-Bunc.<br><br>It is noted Car-Bunc's invoice admitted lack of competence alluding to a *"Need to take to a Diesel Specialist."* |

| | |
|---|---|
| *2a. This particular engine requires a spill timing procedure*. | Spill timing involves observing diesel fuel spill from an uncoupled injector pipe. It is extremely inaccurate and only suitable for emergency repairs when proper facilities are not available.<br><br>Notably, the Mack Truck E6/672 CID Engine Overhaul Repair Manual makes no mention of using spill timing as an alternate technique. |
| *3. In regards to the pistons, which Dr Brell states were in a 'reusable state', it shows his very poor work ethic in regards to checking items as anyone with a small amount of knowledge would visibly see they definitely were not in a reusable state due to extreme wear.* | Machining marks are very shallow undulations that wear very quickly in the piston slap area (explained below). The pistons were hardly worn in this prone area indicating that they did not require replacement (Prior to possible damage caused by starting aid).<br><br>A compression test (not performed) is a much better indicator of wear in an engine and does not require any dismantling. |
| *4. He has also stated that we have introduced an object or misaligned the bearing shell, which is not correct! Rather it was explained, the reason for the crank locking up was hard surfacing flaked off the bearing cap on one side* | A bearing cap never ever needs hard surfacing, either in new condition or remanufactured. Thus flaking off of hard-surfacing is nonsense. (See below) |
| *5. He states that piston knock is rather the crank shaft knocking which again proves his in—experience because the crank shaft cannot knock.* | Worn big-end bearings make an audible characteristic sound of knocking.<br><br>Worn main bearings make an audible characteristic sound of rumbling.<br><br>Both have a unique signature structure-born sound that can be unmistakeably detected with a stethoscope. |

| | |
|---|---|
| *He thinks that the 'glued in' (we call it locktite) bolt is not holding, which is not our problem as there is no warranty as second hand parts provided by Cherlocks A and the engine block should have been removed and welded up as advised to Cherlocks.* | Loctite is an anaerobic glue. Setting of the glue is achieved by the exclusion of air.<br><br>The issues here are not warranty provisions but unprofessional practice. The "*not our problem*" attitude appears contrary to a duty of care owed by Car-Bunc.<br><br>The thread should not have been stripped by CarBunc in the first place. Having stripped the thread a threadsert system (see below) would have been a proper repair. |
| *6. Further proving lack of his knowledge, he states that exhaust valves were burnt out by us in a short period of the engine running and that we used Ether, burning the valves out, which is incorrect as we never used this product at all, and it takes a long period of time for the burning process to happen, not a short period of time.* | Peer-reviewed material was presented to show the high and early temperatures achieved by burning Ether as a starting aid. (Temperatures above the melting point of steel)<br><br>Other starting aids are often used especially in the colder climates like NZ. Brake cleaner is often used as a starting aid, some containing Butane, Propane and Hexane.<br><br>It is noted that approximately $150 was charged for consumables, (***brake cleaner*** *& rags).*<br><br>It is noted Mr Parker is native to NZ.<br><br>It is noted that the ambient temperature around Chinchilla at material time was cold. |
| *It is very obvious and evident to us that Dr Brell has just further wasted time in relation to this matter and was not the correct person to inspect the truck. The points stated above are just some of our concerns in response to his report.* | Not only has Dr Brell experience exceeding the suggested type of expert, he adds practical experience with repair & maintenance of diesel engines, as well as knowledge of structure-borne sound, all of which may help a Court, rather than waste its time. |
| *If required, we are happy to provide more in depth responses to each of his points/notes, however would require further time to compile this as we only received this report recently.* | The opportunity for Mr Parker to elucidate has been offered by the Court, then extended by the plaintiff, and still not provided. |

# 3. Primers on Technical Issues

The following provides further explanations of technical matters to help understand the issues under discussion.

## 3.1 Piston Slap

All reciprocating engines suffer from wear caused by side forces from the angle of the connecting rod (conrod) which connects the piston little-end to the crankshaft big-end.

The conrod angle changes with rotation of the crankshaft. Under a power stroke a side vector force onto the cylinder-piston interface in Figure 1 is generated, the force increasing with conrod angle[1]. Depending on the position of the little-end on the piston[2], the side vector force is applied as a pressure distributed as a gradient approximately as shown. Friction in the little end exacerbates this pressure gradient.

In the theory that wear is proportional to pressure, it is not hard to formulate that the piston skirt wears more on the left-hand side of Figure 1 as compared to the right-hand side.

The clearance caused by this wear allows the piston to perform a rocking motion. The sound and action of the rocking motion is called piston slap.

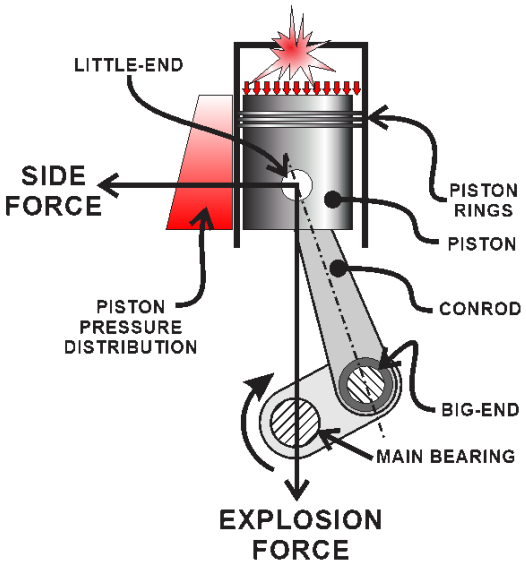


**Figure 1 - Notional Force Diagram of Piston under Power (Piston clearances exaggerated for display clarity)**

The piston slap signal is distinct and can be compared with bearing knock as shown in Figure 2.

[1] *Ceteris paribus* – other thing being constant

[2] Determined by the engine designers.

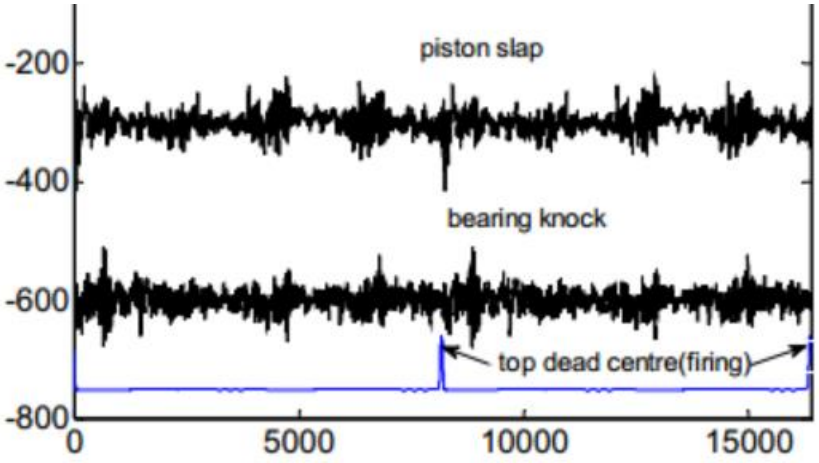


**Figure 2 – Structure-borne sound signals of Piston Slap and Bearing Knock[3].**

The pistons observed at the premises of Car-Bunc and held out as being the pistons removed from the subject truck showed no signs of wear indicating that they had relatively recently been replaced (Figure 3). Thus the absence of bearing slap would have made bearing knock more discernible, audible even to the naked ear.

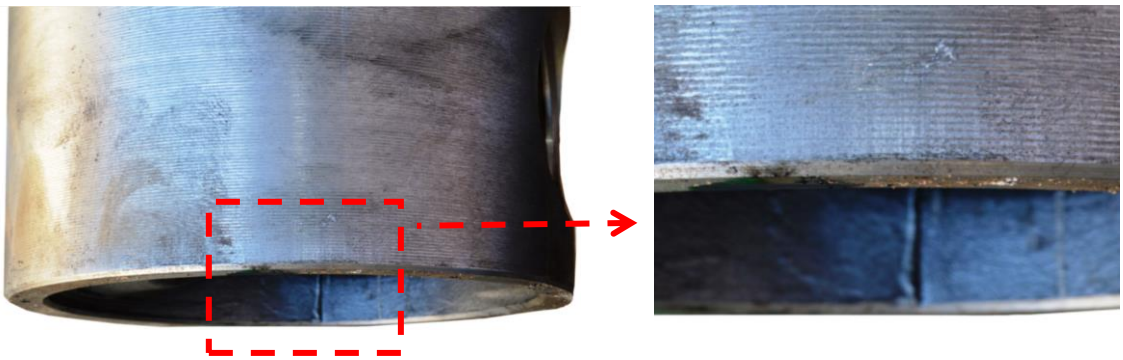

**Figure 3 – Photo (by Author) of Piston Skirt Showing Original Machining Marks**

## 3.2 Damaged Thread

The most common way that threads are damaged is by over tightening. Ordinary engine forces do not damage main bearing cap threads.

The bearing cap bolt is screwed into the engine block bolting the cap into place. To admit the bearing cap bolt the engine block has a corresponding blind hole drilled and tapped during manufacture. Both the drilling depth and the tapping depth are slightly deeper than is needed for bolt engagement. The purpose of the extra depth is to allow full thread shape formation. A longer bolt would engage with an incompletely formed thread and give false tension wrench readings. As well it ensures that the bolt cannot bottom out. It is

[3] Vibration Signal Processing of Piston Slap and Bearing Knock in IC Engines
Jian Chen, Robert Randall - School of Mechanical and Manufacturing Engineering, University of New South Wales.

not the designer's intent that the extra depth should ever be used as opportunity to compensate for a stripped thread event.

The depth of thread engagement is a carefully determined design parameter. A longer bolt would not have replaced the design length of engagement. A reduction of thread engagement seriously compromises the engine's reliability. A failure of this thread could potentially ruin the engine.

Further, there is risk that the longer bolt bottomed out or engaged with partially formed thread, giving the assembly mechanic the false impression that the torque setting had been achieved where in fact a gap would remain. This hypothesis could explain the noise heard on the video supplied indicating a hammering of the crankshaft against a loose bearing cap. Under such conditions a serious failure would be imminent. The gap under the bolt is idealized in the sketch in Figure 4.

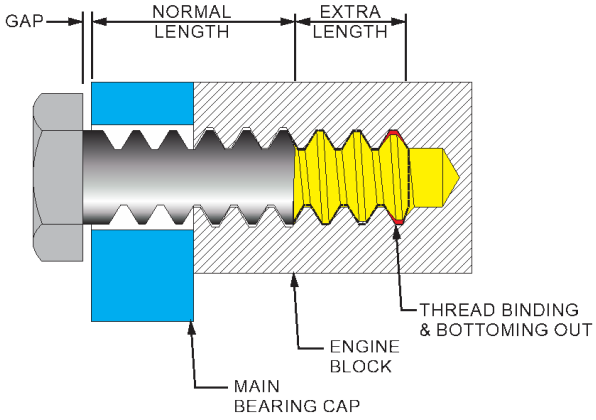


**Figure 4 - Gap Effect of Using a Longer Bolt**

The use of Loctite on threads is to prevent thread disengagement from vibration rather than rely on any strength it might impart.

Both reducing the number of threads in engagement and the mere idea of gluing for strength are professionally repugnant.

A proper method of repair is the use of threadserts. A threadsert is a high strength piece of metal with threads on the inside as well as the outside. The procedure is to drill and tap the engine bock oversize to suit the threadsert outside diameter thread and then insert the threadsert ready for a standard bolt.

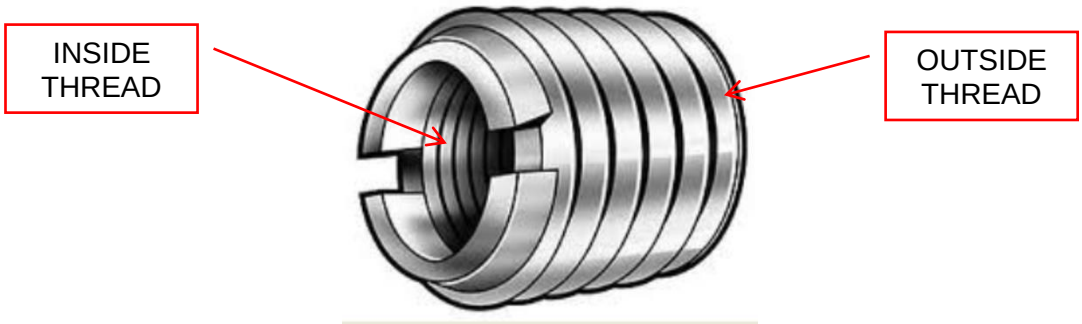


**Figure 5 – Typical Threadsert**

## 3.3 Flaking of Bearing Cap Surface

Some distinction here may be helpful between hard surfacing and case hardening. ***Case hardening*** is the impregnation of Carbon into a surface typically 0.4 mm deep followed by heating and quenching to achieve hardness. ***Hard surfacing*** is achieved by Chrome electroplating or Plasma spraying. Neither process is relevant to main bearing caps.

Main bearing caps are typically manufactured from a forging or a meehanite casting. Both exhibit good strength & ductility characteristics. The bearing cap does not have any direct contact with moving or sliding parts requiring no resistance to wear and thus do not require any degree of hardness beyond what is desirable for ultimate strength.

To suggest that hard surfacing has been applied either during manufacture or during repair is utter nonsense. Thus if no hard-surfacing had ever been applied, it is not possible to flake.

# 4. Summary

A point by point response to Mr Parker's letter to the Court has been provided. It had been hoped that Mr Parker's letter offered a viable explanation as to why an engine exhibiting no indication of burnt valves at initial handover should suddenly stop and fail to restart. Despite interview requests on Mechanic, Manager and Owner for an explanation as to why the engine should suddenly stop, despite opportunity afforded by the Court to elucidate, despite an extension of time offered by the respondent, this important question remains unanswered, save for the hypotheses offered in Part A.

Reviewing the material offered by Mr Parker's letter, no item of any substance could be found that might require a review of the conclusions posted to Part A. On the contrary, it provided opportunity to offer greater clarity of the salient issues.

In compliance with the *Uniform Civil Procedure Rules* the author's Curriculum Vitae is attached. In addition, the author confirms that:

- the factual matters stated in the report are, as far as the expert knows, true; and
- the expert has made all enquiries considered appropriate; and
- the opinions stated in the report are genuinely held by the expert; and
- the report contains reference to all matters the expert considers significant; and
- the expert understands his duty to the court and has complied with the duty.

Dr Edward Brell – 4 March 2014

**Queensland Civil and Administrative Tribunal**
**Justice Thomas, President**
**26 August 2014**
**Matter type: Appeals**

**HEARD AT:** Brisbane
**DECISION OF: Justice Thomas, President**
**DELIVERED ON:** 26 August 2014
**DELIVERED AT:** Brisbane

**ORDERS MADE:**

**1. Leave to appeal granted.**
**2. Appeal allowed.**
**3. The decision of 13 March 2014 dismissing the claim by Car-Bunc Pty Ltd is confirmed.**
**4. The decision of 13 March 2014 ordering Car-Bunc pay Waterman travel costs of $4,640 is set aside.**

**APPEARANCES and REPRESENTATION (if any):**
This matter was heard and determined on the papers pursuant to s 32 of the *Queensland Civil and Administrative Tribunal Act* 2009 (Qld) (QCAT Act).

**REASONS FOR DECISION**

**[1]** In 2012, Car-Bunc Pty Ltd did some work on the engine of a diesel truck owned by Gary Waterman. It rendered two invoices, totalling $19,174.53. Waterman paid nothing. Car-Bunc filed an application in the tribunal claiming the amounts invoiced.

**[2]** A Magistrate, sitting as a member of the tribunal in its minor civil disputes jurisdiction, dismissed Car-Bunc's claim pursuant to sections 48(1)(a) and (g) of the QCAT Act. The learned Magistrate also ordered Car-Bunc pay Waterman his costs of appearing at the hearing, fixed at $4,640.

**[3]** Diverse wants to appeal that decision. It says that "the respondent" signed a repayment agreement, so should be required to pay the invoices. It says the tribunal originally made a decision in its favour, so it cannot understand why the decision is wholly reversed. It disputes the order that it pays Waterman's travel expenses.

**[4]** Because this is an appeal from a decision of the tribunal in its minor civil disputes jurisdiction, leave is necessary.[1] Leave to appeal will usually be granted where there is a *reasonable argument* that the decision is attended by error, and an appeal is necessary to correct a *substantial injustice* to the applicant caused by that error.

**[5]** The learned Magistrate did not give reasons for her decision. The failure to give reasons is a denial of natural justice, which is an error of law for which leave to appeal should be given. The absence of reasons necessarily means that the appeal should be upheld.

**[6]** For the reasons I have given in a related matter, the learned Magistrate's order that Car-Bunc pay Waterman's costs of attending the hearing should be set aside. The tribunal simply has no power to order these costs.

**[7]** Car-Bunc's argument that Waterman should pay the invoices because of a repayment agreement is misconceived. The agreement in evidence is between Car-Bunc and Waterman personally,

**[8]** It is clear from Waterman's response that it disputed the quality of, and need for, the work. It produced a report from Dr Edward Brell to support that proposition. Car-Bunc wrote a letter in response to that report but did not commission its own expert evidence.

**[9]** Dr Brell's report is comprehensive, detailed and compelling. I prefer his evidence over the evidence by way of Car-Bunc's letter of explanation. I am, therefore, satisfied that Car-Bunc's work was performed in a way that created the need for further work, or that the work completed was not required by Car-Bunc's initial concerns with the truck. For different reasons, the learned Magistrate's decision to dismiss Car-Bunc's claim is confirmed.