ENIGMA AUTOMOTIVE FORENSIC SERVICES c.c.

(CK 97/44485/23)

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Forensic Consultancy
Failure Analysis, Damage Assessment & Technical Reporting
Vehicular Fire Investigations

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CONFIDENTIAL & PRIVELIGED IN CONTEMPLATION OF LITIGATION

7th January 2010

Mr. Morne Nel
P.O. Box 3955
Helikon Park
1771

Attention: **Mr. Morné Nel**

Order Reference No.: Verbal

TECHNICAL INVESTIGATION REPORT: LJ04-0110

Client	: Mr. Morné Nel	
Vehicle	: 2005 Mitsubishi Pajero 3.2 TD	*Reg. No.*: VYR 050 GP
VIN Number	: JMYLYV78W6J000646	*Engine No.*: 4M41GY9958
Item/s examined	: The entire vehicle and specifically the engine.	
Subject	: Condition assessment and engine damage analysis.	
Date of investigation	: 7th January 2010	

1. Introduction:

We were commissioned by Mr Morne Nel (hereinafter also referred to as the Client) to examine the engine from his Mitsubishi Pajero motor vehicle (hereinafter also referred to as the engine) and to do an investigation to determine the nature and cause of the damage exhibited by the engine.

……. / Pg 2

1.1 Information Provided:

1.1.1. The subject vehicle was purchased as a used vehicle with approximately 54000Km reflecting on the odometer. The vehicle currently has 13445Km reflecting on the odometer.

1.1.2. The client reported driving the vehicle on or about the weekend of the 5th and 6th December 2009 while on his way to a wedding in Pretoria.

1.1.3. In proximity to Rigel Avenue off ramp on the N1 Motorway, the client reported the vehicle's air conditioner switched off and he noted that the engines temperature gauge had begun escalating.

1.1.4. The client reported shutting down the engine and upon investigating found the engines cooling system expansion tank was empty and steam was emanating from the radiator cap indicating the cooling system had become pressurised.

1.1.5. The client reported waiting approximately 45 minutes before adding around two (2) litres of water to the cooling system. The engine was restarted and apparently ran normally with no indications of mis-firing or other noticeable irregularities.

1.1.6. The client reported continuing on his journey to the wedding and while at the wedding, the vehicle's engine had an opportunity to cool down. A further 500ml was reportedly added to the cooling system and the client drove the vehicle home.

1.1.7. The following morning another approximately 500ml was added to the cooling system and at this stage the client intimated he realised there was a problem.

1.1.8. On the morning of morning of the 7th December 2009, the vehicle was driven to Mitsubishi Motors in Midrand where it was detected that the engine's cylinder head gasket was leaking. (Refer to job card appended hereto in Appendix 1 below).

1.1.9. The engine's cylinder head was removed and sent to an Automotive Engineering Works in Pretoria who subsequently reported the cylinder head was cracked. (Refer to details of this assessment in the report from the engineers appended hereto in Appendix 2 below).

1.1.10. Feedback from Mitsubishi Motors (Allan Black in Springs) indicated that the damage was more than likely the result of a diesel fuel injection related irregularity in the form of over-fuelling. (Refer to information in the letter from Mr. Ferdi Gampe appended hereto in Appendix 3 below).

1.1.11. The vehicle's diesel fuel injector pump and the associated injectors were subsequently delivered to Allan Black in Springs where tests were conducted on the equipment and the report provided indicated the fuel injection equipment is normal. Refer to information appended hereto in Appendix 2 below. Minor discrepancies in terms of diesel injection pressures consistent with normal wear conditions and the mileage reflecting on the vehicle's odometer were recorded. This was subsequently confirmed by Alan Black during a telephone discussion with Alan Black.

2. Investigation:

We examined the vehicle with the partially stripped engine in position in the vehicle at the premises of Mitsubishi Motors in Midrand and the associated cylinder head at the premises of

Cylinder Head Services in Pretoria and made the following observations:

2.1 Vehicle Examination:

The vehicle in general when examined revealed a relatively good overall condition of the vehicle with no visible evidence of any structural damage or mechanical irregularities.

Examination of the engine in position in the engine compartment revealed the engine had indeed been stripped and the cylinder head and the associated covers and components had been extracted. (See photo plate 1).

2.2 Cylinder Head Examination:

The cylinder head examined at the premises of Cylinder Head Services in Pretoria exhibited no evidence of any significant thermal discoloration on the cylinder head gasket's sealing deck. The cylinder head however is cracked in the port of the leading inlet valve in number two cylinder. (See photo plate 2).
The cylinder head was assessed for warpage and distortion with an engineer's straight edge and presented no evidence of any significant warpage. Some minor distortion was noted between cylinders two and three indicating slight yielding and most likely some movement of the cylinder head had occurred in-service. No evidence of any other visible structural damage or irregular conditions was noted.

Examination of the cylinder head gasket revealed evidence of the cylinder head gasket having yielded and "blown" through between the engine block and the gasket.

2.3 Engine Examination:

Examination of the engine block in position revealed evidence of some thermal discoloration on the gasket deck, specifically between cylinders two and three and around number four cylinder. (See photo plate 3). Evidence of water entry into the combustion chamber of these cylinders was noted in the form of rust oxide precipitation in the combustion chamber area. Evidence of some coolant seepage past the cylinder head gasket to the outside of the engine block was also noted. This is in the form of light staining of the surfaces of the engine block adjacent to the area where the cylinder head gasket has yielded.

The cylinder bores all exhibit evidence of abnormally high combustion chamber temperature conditions having prevailed in this engine. This is in the form a "checker pattern" concentrated in the combustion chamber environment where a "heat soak" in the structure of the engine block has thermally discoloured as a result of significant heat dissipation through these surfaces. (See photo plate 4). The cylinder bores exhibit evidence of vertical piston to bore seizure damage commencing from the combustion chamber environment extending down the cylinder bores along the major thrust/ anti-thrust axis. (See photo plate 4).

No evidence of any damage consistent with a bona-fide cooling system related engine overheating condition having initially manifested was found in the cylinder bores. This would have been indicated by a seizure pattern concentrated along the gudgeon pin axis of the engine block as opposed to the prevailing piston to bore seizure characteristics.
Measurement of the cylinder bore surfaces revealed wear condition of approximately 0.02mm ranging from 98.50 to 98.52mm. Examination of the cross hatch honing pattern on the cylinder bore surfaces appears to be normal with no evidence of any irregular conditions prevailing.

The crown of the pistons examined in position exhibited evidence of wet carbon deposition on the crowns of cylinders one and four, and in cylinders two and three to a lesser degree.

The turbocharger attached to the engine presents as normal with no indications of any visible damage to the impeller or deviation of the turbine shaft. Some oil saturation in the compressor side of the turbocharger and in the engine's intake manifold was noted. (See photo plate 5). Examination of the turbocharger's intercooler pipes revealed evidence of similar oil saturation in the pipes between the turbocharger and the air filter housing however, the section of the air induction pipe between air filter housing and the junction of the breather pipe recycling gasses from the engine's breather system in the tappet cover into the air induction system is dry, while the section of the pipe beyond the breather pipe junction is saturated with oil. The turbocharger intercooler does exhibit some evidence of oil saturation around the intake and delivery ports of the heat exchanger. No evidence of any damage to the intercooler core was noted.

Examination of the cooling system radiator associated with this engine revealed some evidence of light "clogging" of the radiator core along the lower extremities of the radiator, however not significant enough to disturb airflow through the radiator and/ or influence the efficacy of the radiator to cool the engine's coolant. No evidence of coolant seepage from the radiator was noted.

The engine's cooling system fan, viscous unit and the fan hub appear normal with no evidence of any distress. The engine's water pump is normal.

The thermostat housing was removed to expose the thermostat unit and inspection thereof revealed evidence of distress on the rubber sealing elements deriving from steam impinging on the rubber material. (See photo plate 6).

3. Technical & General Discussion:

The nature of the damage exhibited by this engine is consistent with a localised overheating condition concentrated exclusively in the upper cylinder bore and cylinder head environment of the engine. Evidence of significant heat saturation through the engine block indicates abnormally high combustion chamber temperature conditions occurred.

The absence of any irregularities in terms of the engine's fuel injection system combined with the absence of any diesel fuel injection related damage characteristics inside the engine especially on the piston crown's precludes the likelihood of a diesel fuel injection related irregularity having occurred.

The abnormal high combustion chamber conditions had more than likely derived from the introduction of engine oil and oil vapour into the combustion chamber environment of the engine. This oil will have gained access into the engine's combustion chambers via the air induction system and this is evident through the oil saturation condition found in the turbocharger's air induction pipes between the junction of the positive crankcase ventilation pipe, the turbocharger and the throttle body.

Oil introduced into the combustion chambers will result in abnormal combustion conditions and the resulting turbulence will result in a significant escalation of combustion chamber temperature conditions. This condition will unfortunately result in localised overheating of the engine however, although most of the abnormal heat generated is vented via the exhaust system, a significant amount of heat remains inherent concentrated in the combustion chamber environment which cannot dissipate quickly enough into the engines cooling system water jacket. As a result of this, the excess heat is not circulated past the temperature sender unit to register as a problem in the engine. Therefore the driver will usually not become aware of the irregular conditions prevailing until it is too late.

These abnormally high combustion chamber temperature conditions resulted in the engine's cylinder head yielding slightly and the cylinder head gasket "blowing" through between the block and the engine and this condition resulted in a loss of coolant from the engine's cooling system. This is validated by the evidence of light staining on the side of the engine block.

A loss of coolant from the engines cooling system will result in further escalation of the temperature and this has resulted in the overheating condition that led to the cylinder head cracking in-service. Loss of coolant most likely provided space in the cooling system for steam to develop, hence the expulsion of coolant from the expansion bottle and the steam escaping from the cooling system when the condition was initially detected and the distress on the sealing elements of the thermostat.

The root cause of the damage in this engine lies in the introduction of engine oil and oil vapour into the air induction system and this condition most likely derived from increased engine "breathing" conditions. "Breathing" occurs when compression pressure and combustion gas bypasses the pistons and rings and upon reaching the crankcase begins to pressurise the crankcase. This condition will result in oil being pushed up into the tappet cover environment where it is vented from the engine via the positive crankcase ventilation valve and re-introduced into the engine via the air induction system.

This "breathing" condition is usually found in older engine's where advanced normal wear and tear is prevalent however, other known conditions leading to increased engine "breathing" include but are not limited to:

a) **Normal "breathing" of the engine developing enough pressure in the crankcase environment,**
b) **Abnormally high engine oil pressure causing aeration of the oil and/ or**
c) **The possibility of the engine's oil level being too high, i.e. too much oil in the engine.**

Abnormally high temperature conditions of this nature will not reflect on the temperature sender gauge in the dashboard instrumentation cluster and the driver will often be unaware of the condition until it has reached a point where other irregular conditions have manifested.

4. Preliminary Conclusion & Recommendations:

In the light of the above observations and findings the following conclusions can be drawn:

- **The damage exhibited by this engine is the result of abnormally high combustion chamber temperature conditions having prevailed.**
- **These abnormal temperature conditions did not derive from a diesel fuel injection irregularity. It is however recommended that the diesel fuel injection equipment be reconditioned prior to re-installing them onto the engine to preclude the possibility of a premature engine failure at a later stage.**
- **The source of the abnormally high combustion chamber temperature conditions derived from engine oil intruding into the combustion chamber environment introduced via the engine's air induction system. This is consistent with abnormally high crankcase pressure conditions having existed. This is usually due to one or a combination of the conditions described earlier in this report.**
- **No evidence of any abnormal or aggressive driving conditions were noted that could have caused or contributed to the damage occurring, similarly no indications of any wilful or negligent damage was detected.**

In closing the nature of the damage exhibited by this dictates the engine will have to be completely overhauled to restore the engine to a proper working condition. In the light of this it may be prudent to replace the engine's sub-assembly and re-use the ancillary and bolt-on components. The latter would most likely be more cost effective.

I trust that the above report is informative and will serve to assist in resolving this unfortunate matter.

Use of this report is subject to acceptance of the important notice and disclaimer of liability at the end of this report, which acceptance shall be automatically deemed to have occurred through any use of this report for whatever purposes.

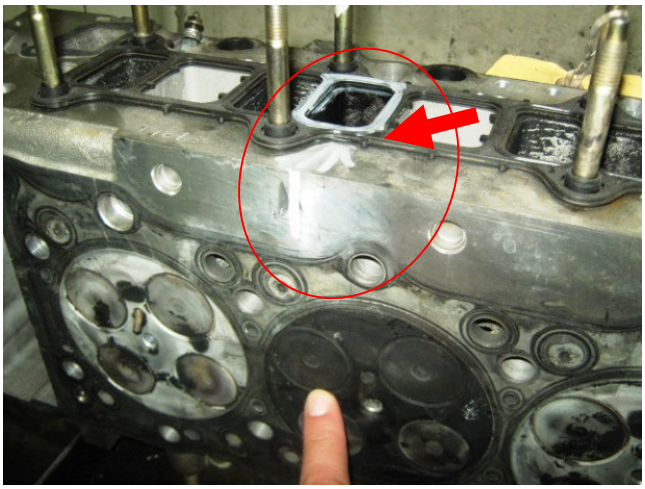
Yours sincerely,

L. Jenkinson
Technical Consultant.

Photo Plate 1:

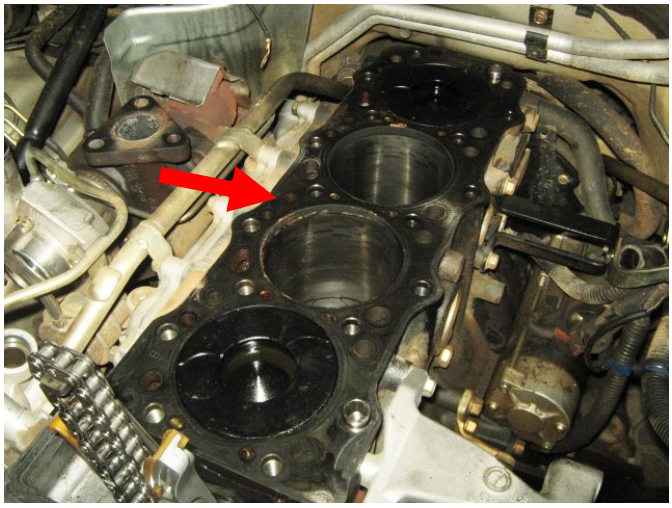
Observe the stripped condition of the engine in position in the chassis. The displaced components were stowed in the rear of the vehicle.

Photo Plate 2:



Observe the condition of the cylinder head. Note the absence of any significant thermal discoloration on the gasket deck. In the right frame the red arrow indicates the pressure test result markings indicating leakage through the inlet port.

Photo Plate 3:



Observe the thermal distress on the gasket deck of the engine block. Note the slight rust oxides forming in the cylinder bores.

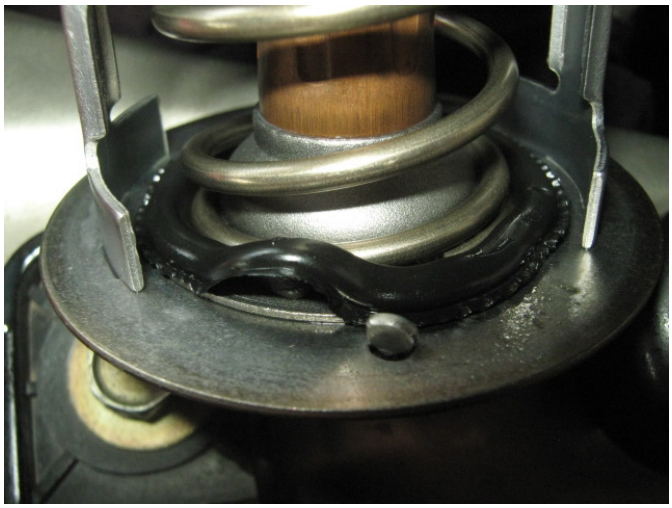
Photo Plate 4:

Observe the vertical piston to bore scuffing and seizure damage. Note also the characteristic "checker" pattern in the combustion chamber environment.

Photo Plate 5:

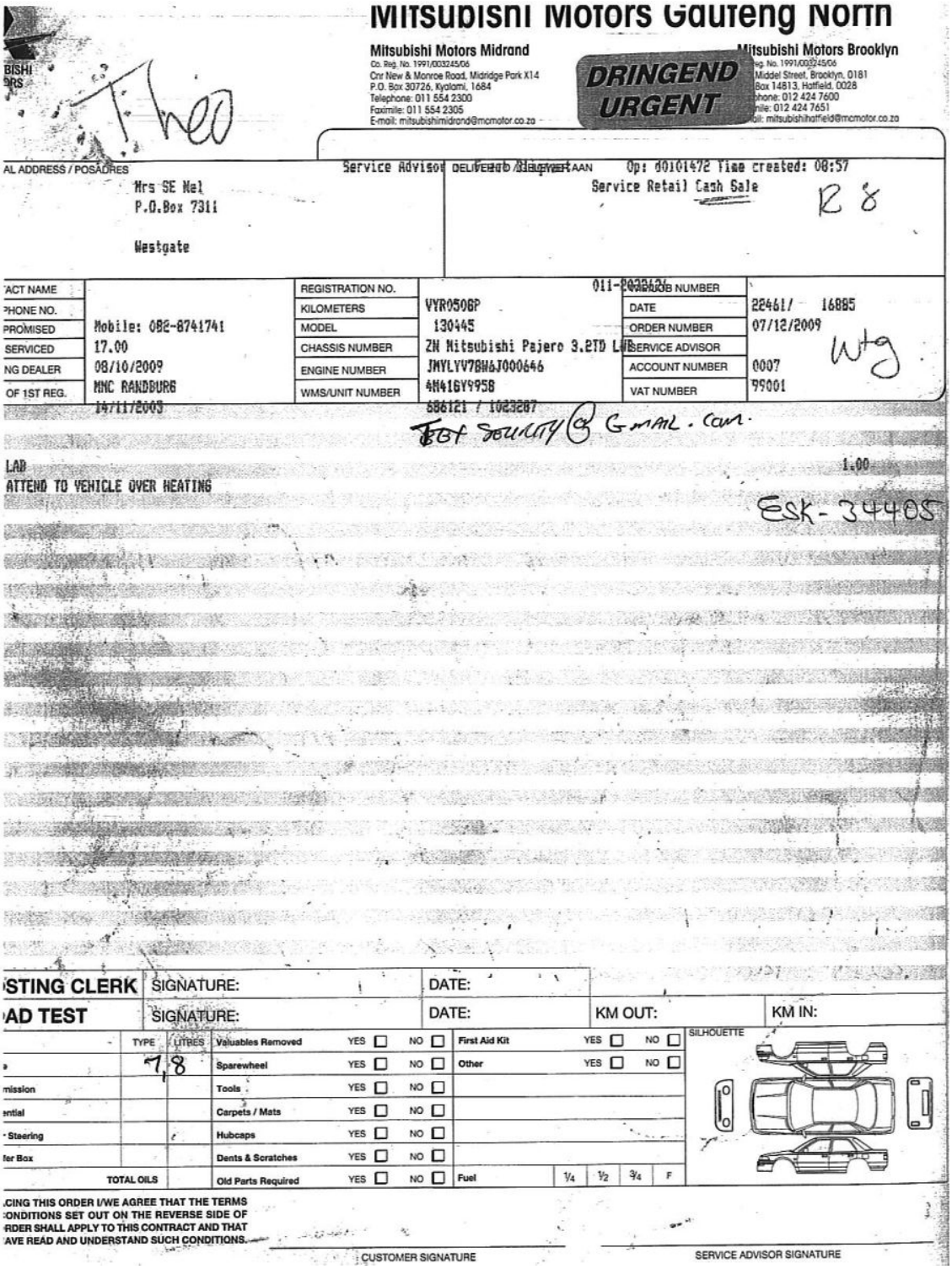
Observe the oil in the engine's air induction system manifold and turbocharger compressor side.

Photo Plate 6:



Observe the distress on the rubber sealing elements of the engine's cooling system thermostat.

Appendix 1:



MITSUBISHI MOTORS Gauteng North

Mitsubishi Motors Midrand
Co. Reg. No. 1991/003245/06
Cnr New & Monroe Road, Midridge Park X14
P.O. Box 30726, Kyalami, 1684
Telephone: 011 554 2300
Faximile: 011 554 2305
E-mail: mitsubishimidrand@mcmotor.co.za

DRINGEND URGENT

Mitsubishi Motors Brooklyn
Reg. No. 1991/003245/06
Middel Street, Brooklyn, 0181
Box 14813, Hatfield, 0028
Phone: 012 424 7600
Faxmile: 012 424 7651
E-mail: mitsubishihatfield@mcmotor.co.za

Theo

AL ADDRESS / POSADRES

Mrs SE Nel
P.O.Box 7311

Westgate

Service Advisor DELIVERED Diagnost AAN Op: 00101472 Time created: 08:57

Service Retail Cash Sale

R 8

ACT NAME		REGISTRATION NO.	011-[illegible]	CHASSIS NUMBER	
PHONE NO.	Mobile: 082-8741741	KILOMETERS	VYR0506P	DATE	22461/ 16885
PROMISED	17.00	MODEL	130445	ORDER NUMBER	07/12/2009
SERVICED	08/10/2009	CHASSIS NUMBER	ZH Mitsubishi Pajero 3.2TD L/B	SERVICE ADVISOR	Wtg
NG DEALER	MNC RANDBURG	ENGINE NUMBER	JMYLYV78W6J000646	ACCOUNT NUMBER	0007
OF 1ST REG.	14/11/2003	WMS/UNIT NUMBER	4N41GY9958	VAT NUMBER	99001
			886121 / 1023287		

Test Security@Gmail.com

LAB 1.00
ATTEND TO VEHICLE OVER HEATING

Esk-3440S

STING CLERK	SIGNATURE:			DATE:					
AD TEST	SIGNATURE:			DATE:		KM OUT:		KM IN:	
	TYPE	LITRES							
		7,8	Valuables Removed	YES ☐	NO ☐	First Aid Kit	YES ☐	NO ☐	
			Sparewheel	YES ☐	NO ☐	Other	YES ☐	NO ☐	
mission			Tools	YES ☐	NO ☐				
ential			Carpets / Mats	YES ☐	NO ☐				
Steering			Hubcaps	YES ☐	NO ☐				
fer Box			Dents & Scratches	YES ☐	NO ☐				
TOTAL OILS			Old Parts Required	YES ☐	NO ☐	Fuel	¼	½	¾ F

SILHOUETTE

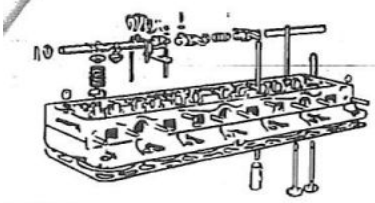
CING THIS ORDER I/WE AGREE THAT THE TERMS
ONDITIONS SET OUT ON THE REVERSE SIDE OF
RDER SHALL APPLY TO THIS CONTRACT AND THAT
AVE READ AND UNDERSTAND SUCH CONDITIONS.

CUSTOMER SIGNATURE

SERVICE ADVISOR SIGNATURE

Appendix 2:

3 03:26p Cylinder Head Services 0123238753 p.1



CYLINDER HEAD SERVICES

5 SKINNER STREET, PRETORIA
BOX 48206 HERCULES 0030
TEL: 323-4523 / 323-4700 / 326-1084
FAX: 323-8753

23/12/09

To: Mitsubishi Motors Midrand

Re: VYR 050 GP

Dear Sir/Madam

We pressure tested your Cylinder head (4m41gy9958) we found that the cylinder head is cracked and leaking. We recommend that the cylinder head be replaced.

I do hope that you find the above in order.

MGouws

AGENTS FOR:

Appendix 3:

MITSUBISHI MOTORS

Dear Sir/ Madam

Re: VYR 050 GP

Cylinder head services have tested the cylinder head of this vehicle and have found that the cylinder head is cracking and leaking. They have recommended that the cylinder head be replaced.

The diagnoses for the vehicle are as follows:

The diesel pump lost its calibration (specification) resulting in over fuelling.
Vehicle overheated as a result of running on too rich fuel mixture.
The cylinder head cracked as a result of overheating.
Pump and injectors need to be calibrated
The radiator must be cleaned as the tanks are made of a plastic, to ensure that there are no blockages.

Please contact Ferdi at 011 554 2334 for any further information

_____
Ferdi Gampe
Service Advisor

Appendix 4:

Attention

VRZ_4M41 - Inspection result

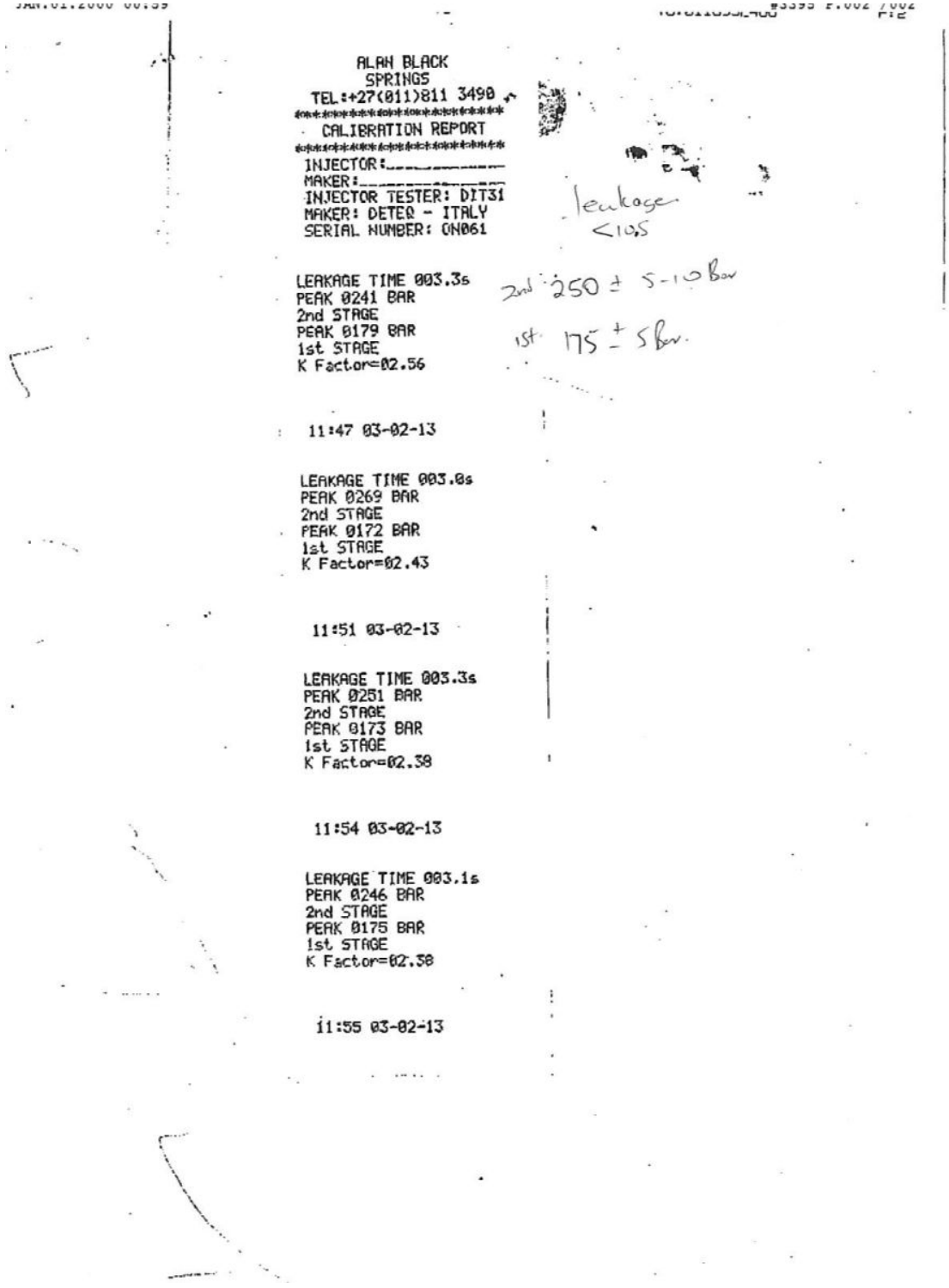
01/01/03
03:34:58
Page -1-

Alan Black (Pty) LTD
14 - 16, 12th Street Springs 1559
Tel:+2711 811 3490
Fax:+2711 811 3576

Specified part No.: 109144-8901
Pump Part No.: 109144-3062
Pump serial No.: 5690288788
GE serial No.: 50621-589-53706

Operator's name: LUCKY
Signature:

			Inspection specification							Measured values						Remarks
Step	Result	Step name	n	Us-soll	Q	Q Tol.	DTCV	TA	TA Tol	n	Us-ist	Q	Delta Q	PI	TA	
			r/min	V	mm3/st	mm3/st	%	mm	mm	r/min	V	mm3/st	mm3/st	MPa	mm	
1	O	Warm-up	300	2,80	58,0	90,0	100	---	---	300	2,81	46,2	---	---	---	✓
2	O	Warm-up	1000	2,91	90,5	50,0	100	---	---	1000	2,90	93,2	---	---	---	✓
3	O	P-charn_ADJ	1000	2,91	---	---	100	---	---	1000	2,91	---	---	0,910	---	✓
4	O	Zero_set	500	2,90	---	---	0	---	---	500	2,45	---	---	---	---	
5	O	Timer_TA	100	2,41	---	---	100	6,90	6,90	100	2,40	---	---	0,050	6,68	✓
6	O	Timer_TA	50	2,41	---	---	100	6,90	6,90	60	2,40	---	---	0,000	6,40	✓ 4
7	O	Timer_TA	325	1,83	---	---	0	10,00	10,00	325	1,51	---	---	0,640	0,00	✓
8	O	Timer_TA	375	1,53	---	---	0	10,00	10,00	375	1,52	---	---	0,650	0,00	✓
9	O	Timer_TA	375	1,53	---	---	100	11,75	0,45	375	1,67	---	---	0,673	12,20	✓
10	O	Timer_TA	500	1,53	---	---	0	0,00	1,00	500	1,51	---	---	0,680	0,00	✓
11	O	Timer_TA	1000	2,91	---	---	50	3,00	3,00	1000	2,90	---	---	0,899	3,82	4
12	O	Timer_TA	1000	2,91	---	---	100	11,75	0,45	1000	2,89	---	---	0,910	12,20	✓
13	X	Timer_TA	1900	3,73	---	---	100	11,75	0,45	1900	3,70	---	---	1,080	12,24	✓
14	O	Timer_TA	1900	3,73	---	---	0	1,60	1,60	1900	3,76	---	---	1,050	0,00	✓
15	O	Q_characteristics	2300	0,87	5,0	5,0	100	---	---	2300	0,87	0,0	0,0	---	---	
16	O	Cor-Q_INSP	1000	2,91	90,5	1,5	100	---	---	1000	2,87	91,4	2,1	---	---	
17	X	Cor-Q_INSP	1900	3,73	91,0	1,5	100	---	---	1900	3,77	93,8	0,0	---	---	
18	O	Cor-Q_INSP	2300	1,93	36,0	2,5	100	---	---	2500	1,67	34,2	2,7	---	---	
19	X	Cor-Q_INSP	600	2,20	73,5	1,5	100	---	---	600	2,21	70,1	0,0	---	---	
20	X	Cor-Q_INSP	600	1,90	42,5	1,5	100	---	---	600	1,90	38,6	2,3	---	---	
21	O	Cor-Q_INSP	375	1,66	43,0	1,5	100	---	---	375	1,62	42,4	5,0	---	---	
22	O	Cor-Q_INSP	375	1,53	14,5	6,5	100	---	---	375	1,48	10,3	2,1	---	---	
23	O	Cor-Q_INSP	325	1,66	38,5	1,5	100	---	---	325	1,91	35,5	4,6	---	---	
24	X	Cor-Q_INSP	325	1,53	9,0	3,5	100	---	---	325	1,52	4,3	1,5	---	---	
25	O	Cor-Q_INSP	100	2,41	23,5	10,0	100	---	---	100	2,56	23,4	15,0	---	---	
26	O	Stop_Q	1000	2,91	0,0	0,0	100	---	---	1000	0,86	0,0	---	---	---	



ALAN BLACK
SPRINGS
TEL:+27(011)811 3490

CALIBRATION REPORT

INJECTOR:_____
MAKER:_____
INJECTOR TESTER: DIT31
MAKER: DETEA - ITALY
SERIAL NUMBER: ON061

leakage
<10s

LEAKAGE TIME 003.3s
PEAK 0241 BAR
2nd STAGE
PEAK 0179 BAR
1st STAGE
K Factor=02.56

2nd 250 ± 5-10 Bar
1st 175 ± 5 Bar.

11:47 03-02-13

LEAKAGE TIME 003.0s
PEAK 0269 BAR
2nd STAGE
PEAK 0172 BAR
1st STAGE
K Factor=02.43

11:51 03-02-13

LEAKAGE TIME 003.3s
PEAK 0251 BAR
2nd STAGE
PEAK 0173 BAR
1st STAGE
K Factor=02.38

11:54 03-02-13

LEAKAGE TIME 003.1s
PEAK 0246 BAR
2nd STAGE
PEAK 0175 BAR
1st STAGE
K Factor=02.38

11:55 03-02-13

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