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Introduction

The following Engineering Reports have been prepared as a result of requests by Government Departments, Shire Councils, Fleet Owners and Motorists for certified reports on how Bell Additives Fuel and Oil Treatments perform under Australian conditions.

We are grateful to the Townsville College of Technical and Further Education for their cooperation and interest in the Project, and for making their Engine Dynamometer and Test Equipment available.

The Engineering Reports have been certified as to accuracy by Mr. John Wensley, Ass. Dip. EE., MSc., (Strathclyde) Grad I.E.Aust., M.R.I.P.A.

The tests were conducted by T.A.F.E. Technical Teachers, Terry Atkinson, M.I.A.M.E., who has had wide experience in New South Wales and Queensland, and Bryan Roebuck, B. Ed., Dip. T., A.M.I.A.M.E., J.P., a former Motor Vehicle Inspector with the Queensland Government.

The test procedures were formulated and directed by Philip Morcom, Automotive Engineer, who has had 40 years' experience in the Automotive Industry covering Automotive, Aeronautical, Marine and Earthmoving Equipment. He is an Indentured Fitter and Turner/Toolmaker, an "A" Grade Mechanic, and holds a Diploma in Automobile Engineering. He is a full Member of the Society of Automotive Engineers, Australasia.

His experience covers Engine Reconditioning, a Technical engineer for R.A.C.Q., and Ford Motor Co. of Australia, and he has been a Service Manager in Ford, Mitsubishi and Honda Dealerships.

These Reports show a significant benefit can be obtained in available horsepower, engine efficiency, and fuel economy. Long term benefits in preventive maintenance, engine cleanliness and a very considerably reduction in environmental pollution result from continuous use of these Products.

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BELL ADDITIVES MIX-I-GO (MXO) GAS TREATMENT TEST MAY 1985
TOWNSVILLE COLLEGE OF TECHNICAL AND FURTHER EDUCATION

This test was undertaken at the Townsville College of T.A.F.E. to provide an accurate comparison of results on a locally manufactured engine, before and after treatment with Mix-I-Go gas treatment under Australian conditions.

We obtained an H.Q. Holden 202 C.I.D. engine with sufficient kilometerage to represent normal wear and combustion chamber deposits.

The Manufacturers of the above product claim that their Fuel Treatment, which is formulated in Florida, U.S.A., performs four functions when used as directed and added to the fuel tank of a gas engine.

1. A SURFACTANT which eliminates water and condensation from fuel tanks and fuel systems.
2. A DETERGENT or Solvent to reduce carbon and gum deposits from the engine and fuel system.
3. A TOP OIL or upper cylinder lubricant to keep the upper cylinder, compression rings, and valves (if fitted) lubricated and working freely.
4. A COMBUSTION MODIFIER to improve the combustion process, giving better fuel economy, longer spark plug life and reduced exhaust emissions.

Test Procedure

The engine was installed in a test rig, and coupled to a GO-POWER Model DA Hydrostatic Dynamometer (Photograph 1), and connected to a CRYPTON Model 350 Computerized Diagnostic Unit (Photograph 2). These units were able to show and record the performance of the engine's mechanical and electrical systems during the tests.

The Computer can print out readings on command, and some of them are shown on attachment 1.

The cylinder head was removed and the thickness of the combustion chamber deposits measured with a depth micrometer. These were found to be between 1.35 mm and 1.45 mm thick.

The deposits were fairly even on the cylinder head (photograph 3) and the piston crowns (photograph 4) but the depth is not readily obvious due to the necessary angle of the photographs, and the fact that the deposits were oily. This resulted in flash bounce.

The thickness of the deposits is indicated by the pieces of carbon which dropped into the cylinders when the head was removed (photograph 4).

Nothing was disturbed and the cylinder head was reinstalled using new gaskets.

The engine oil and filter were changed, and the engine brought to operating temperature.

Next the cylinder compression pressures were measured and recorded on the Engine Analysis Data Sheet. The variation between cylinders indicated difference in deposits, valve, and piston ring sealing. Three of the readings were above the specified 1035 Kilopascals pressure.

The spark plugs were photographed, and were found to be coated with heavy black deposits.

The spark plugs were refitted, and the engine was run through a full test cycle without any additive in the 97 Octane leader Super fuel. The results of the tests are shown in Engine Analysis Data Sheet Test 1.

Next, a double dosage of MXO Gas Treatment was added to the fuel tank as recommended by the Manufacturer, and the engine was run under variable load for a period of 8 hours.

This would allow the detergent or solvent action to commence the clean up of the engine combustion chambers and the fuel system.

When the 8 hour load test was completed, the fuel system was changed over to another fuel tank which had been treated with a single dosage of the Gas Treatment.

After a short run period to clear the fuel lines, an identical sequence of Dynamometer tests was performed, and the results are recorded on Engine Analysis Data Sheet Test 2.

As the tests were carried out on different days, the horsepower figures were corrected for humidity, temperature, and barometric variations.

The test results were then set out in graph form on attachment sheet No. 2. The dotted lines show the results before treatment, and the solid lines the results after treatment with the Gas Treatment.

The compression pressures were again recorded and the cylinder head removed. We photographed the combustion chambers (photograph 6), the cylinders (photograph 7), and the spark plugs (photograph 8).

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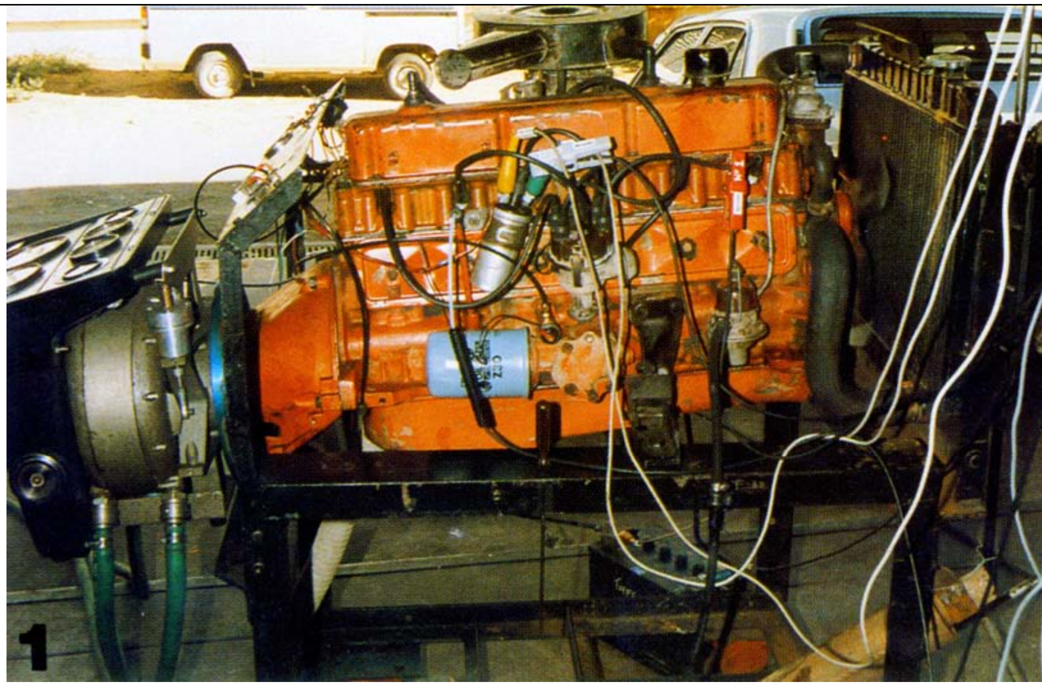

Photograph 1 – Engine in Test Rig with Dynamometer

Photograph 2 – Computerised Diagnostic Unit

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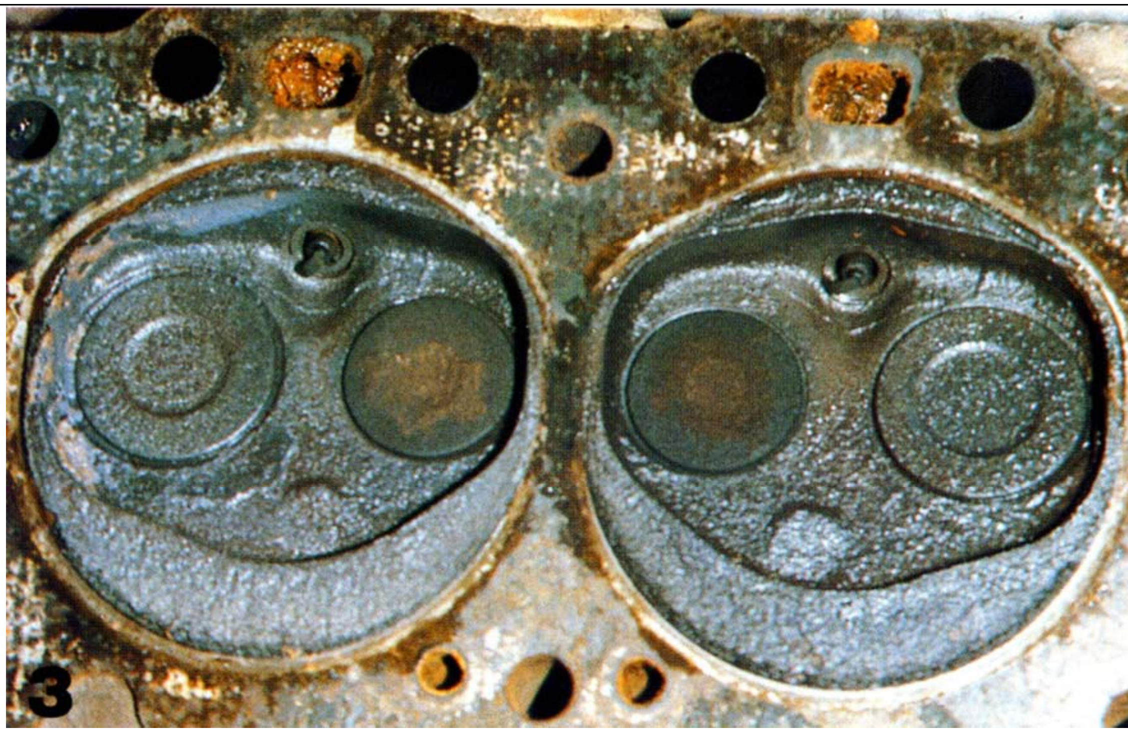
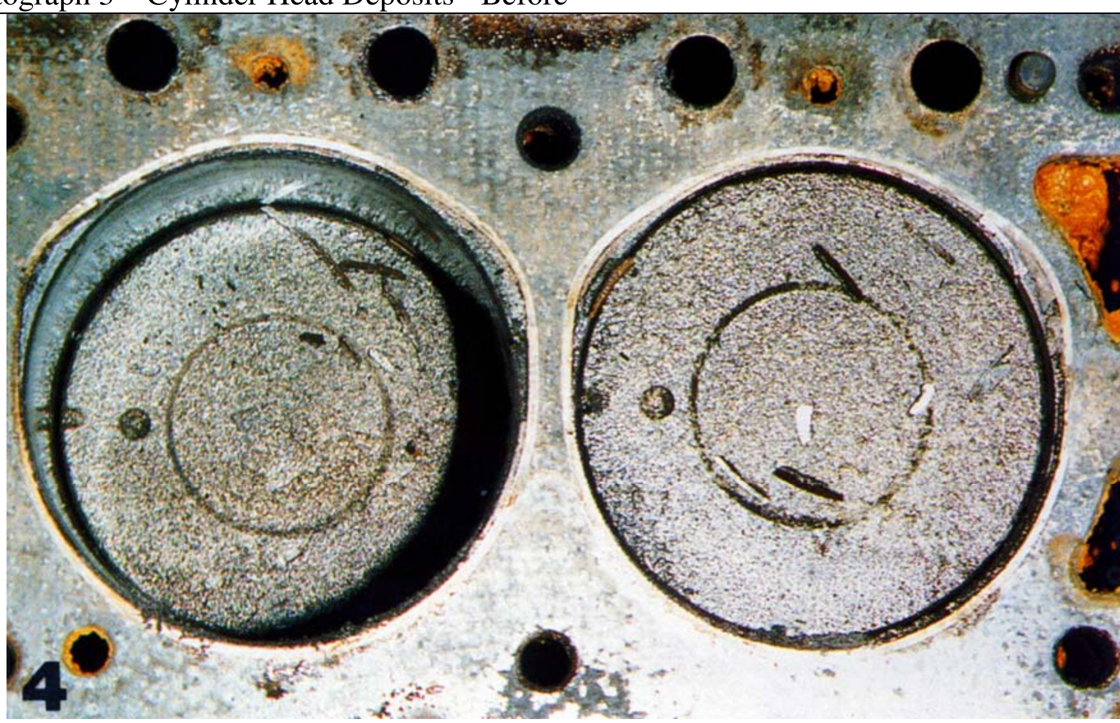


Photograph 3 – Cylinder Head Deposits - Before



Photograph 4 – Piston Crown Deposits - Before

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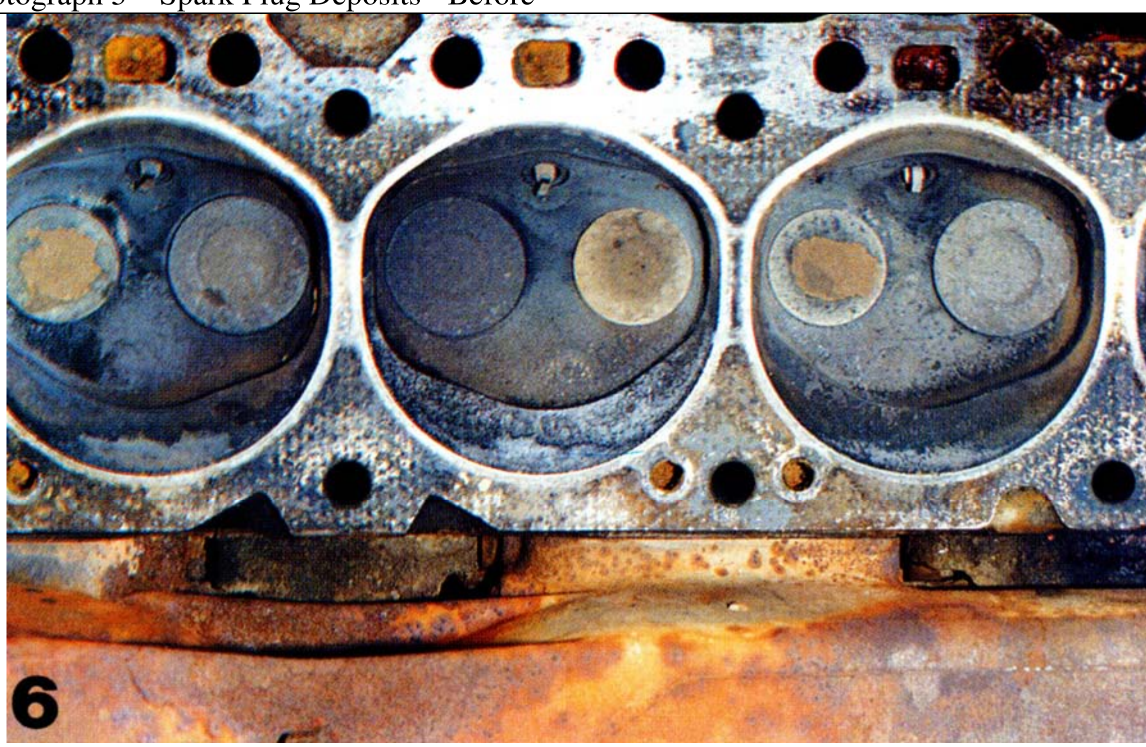
Photograph 5 – Spark Plug Deposits - Before



Photograph 6 – Cylinder Heads - After

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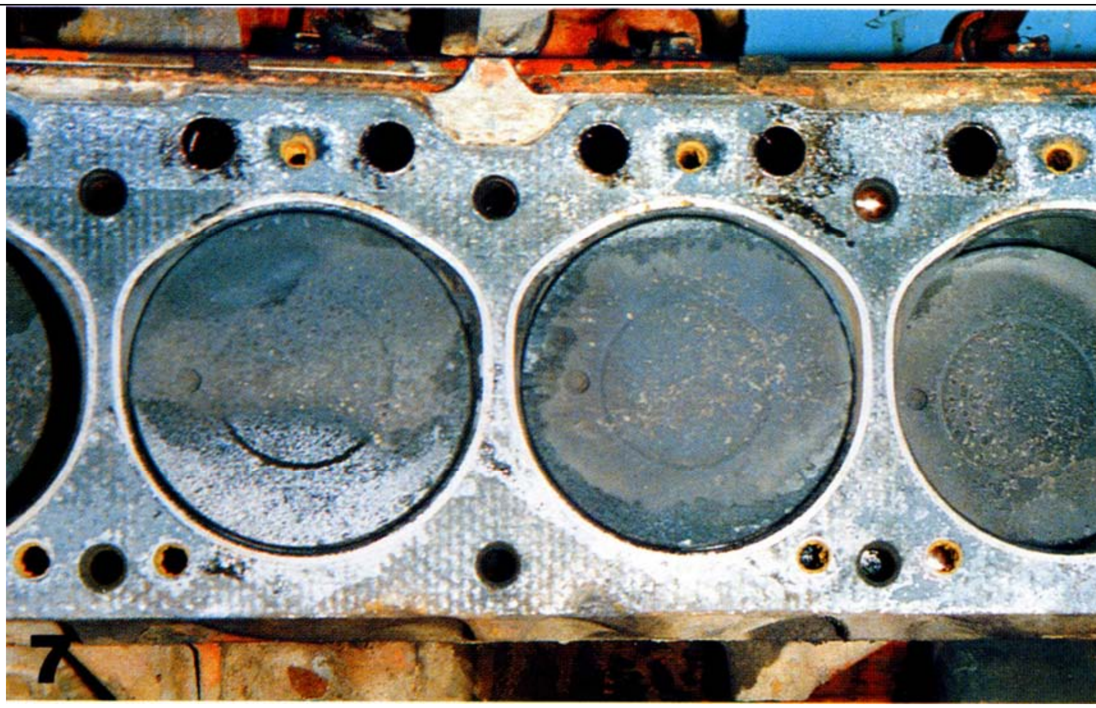

Photograph 7 – Piston Crown – After

Photograph 8 – Spark Plugs - After

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Analysis of Test Results

1. **SURFACTANT**. Addition of the Gas treatment to water produces an immediate breakdown in surface tension, and we were able to suspend water in solution by agitation, however the water settled out if allow to stand for some time. Normal road movement and vibration provides the necessary agitation to reduce droplets to 1 micron in size, allowing the water to pass through filters and jets without restriction, and pass out through the exhaust system as steam.

2. **DETERGENT ACTION.** Combustion chamber deposits varied in thickness from 1.35 mm to 1.45 mm at the start of the test, when measured with a depth micrometer. At the end of the test, the deposit thickness in the combustion chamber varied from 0 to 0.35 mm. The areas where the carbon had been removed completely are clearly visible on the side opposite to the spark plugs (photograph 6).

   Also clearly visible is the clean up of the smaller exhaust valves. Approximately half of the heads of these valves have been cleaned. The inlet valve heads are already clean. It is probably preferable to show the clean up in process rather than when it is completed.

   The clean up process can be clearly seen on the crowns of the pistons (photograph 7).

   At the start of the test the spark plugs were black and oily (photograph 5), and attachment sheet 1 shows the Computer printout recording 16.5 KV to fire the spark plugs. This is twice the ideal voltage, and could result in misfiring under load, and increased strain on the electrical system and insulation.

   As the clean up progressed, we noted the spark plug firing voltage dropping, so we recorded the improvement and the time of day until the voltage dropped to the ideal level.

   At the end of the test the spark plugs were clean and coated with a grey/white powder (photograph 8).

   The detergent action also improved the valve and piston ring seating as some of the compression pressures improved despite the carbon removal. We will refer to No.1 cylinder in the additional comments section.

   During the 8 hour run period the exhaust color changed from black to light grey, and the engine ran more smoothly and more quietly, and was easier to start.

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Had the test been run for a period of 20 hours, then the clean up process would have been complete.

We also removed the carburetor cover and found the float chamber to look as though it had just been removed from a solvent bath.

3. **TOP OIL.** This was not easy to evaluate. However starting and compression pressures improved in most cases indicating improved piston ring and valve sealing.

   The top oil would eventually become evident in the exhaust and reduce acid action and corrosion.

4. **COMBUSTION MODIFIER**. Carbon monoxide emissions improved from 4.4% at 1,000 RPM to 2.2%, and from 0.25% to 0.20% at 3,000 RPM. Carbon monoxide is emitted in heaviest concentrations at idle and under heavy acceleration. At 2,500 RPM and cruise load, the level dropped to 0.02% (photograph 2).

   Hydrocarbons dropped from 800 parts per million (ppm) at 1,000 RPM to 220 ppm, and from 600 ppm at 3,000 RPM to 120 ppm after treatment. On light load at 2,500 RPM, the hydrocarbon level was fluctuating between 0 and 20 ppm, indicating that the fuel was being consumed almost completely in the cylinders, extracting more heat energy from the fuel and converting it into additional useful work. At the time photograph 2 was taken, the HC Meter was showing 150 ppm at 2,500 RPM.

   Horsepower. The full load test at 3,000 RPM shows an increase of corrected horsepower from 67 to 73, an increase of 9%. This is the result of more complete combustion of the fuel and less lose of heat energy to the combustion chamber deposits. The graph shows an improvement over almost the entire normal speed range.

   Brake Mean Effect Pressure (BMEP) is a measure of the pressure developed in the cylinders. This improved from a maximum of 94.5 PSI to 96.4 PSI despite the lowering of compression pressure due to the removal of deposits. This also shows the improvement in valve and piston ring sealing.

   Thermal Efficiency is the ratio of the power available in the fuel to the power the engine delivers at the crankshaft. The test results show an increase of 13% in this area. This will result in increased torque or pulling power, as well as more horsepower.

   Specific Fuel Consumption is a measure of efficiency that indicates the amount of fuel an engine consumes for the work it produces. The **lower** the specific fuel

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consumption, the more efficient is the engine. The test shows a minimum improvement of 13% over the lowest specific fuel consumption before the addition of the Gas treatment. This engine bettered this percentage above and below 2,500 RPM.

Compression Pressures No. 1 cylinder was significantly below the pressures recorded for the other five cylinders at the start of the test and was lower again when the carbon had been removed. When the cylinder head had been removed for the second time, we looked for a cause to the low reading. We found that No. 1 cylinder was out of round and that the piston rings were not sealing in the top of the cylinder. Further investigation revealed that the thermostat valve had been removed in the past, and that the cooler water flowing unrestricted from the radiator had resulted in the cylinder distortion.

The remainder of the cylinder pressures leveled out and in three cases improved despite the carbon removal. This was the result of improved piston ring and valve sealing.

Power Check. This test allows one cylinder to be shorted out at a time and is a measure of cylinder balance. The larger the drop, the stronger the cylinder. Refer attachment No. 1.

Unleaded Fuel will be introduced Australia-wide from the first of July 1985 as a result of Government Legislation to reduce vehicle exhaust emission levels. Many of the current metallic compounds used as Octane Boosters in leaded fuels will not be able to be used in unleaded fuel as they will poison the catalytic converters, which is a necessary addition to the vehicle's exhaust system. Consequently any fuel additive which contains metallic additives will do the same.

The Mix-I-Go Gas Treatment manufacturer states that their product is "a balanced blend of ashless, non-phosphorus, non-metallic compounds", and as such does not contain anything to harm a catalytic converter. From the above tests it would be reasonable to deduce that its continuous use would reduce the load on a catalytic converter, by minimizing the carbon monoxide and hydrocarbons in the exhaust, thereby increasing the effective life of the converter.

The very high initial boiling point of 318 degrees F should assist in raising the lower initial boiling points of unleaded fuel, thus assisting starting during the hot soak period and reducing any tendency for vapor lock.

CONCLUSIONS

The tests we have carried out substantiate the Manufacturer's claims in respect of the Mix-I-Go Gas Treatment. Continuous use of this product should result in a cleaner, more efficient engine and fuel system. Fuel economy improvements are affected by so many variables, that they will depend on the operating conditions and the manner in which the vehicle is operated.

Test Performed By:

T.A.F.E. Technical Teacher
Bryan Roebuck, B. Ed., Dip. T., A.M.I.A.M.E., J.P.

Automotive Engineer
Philip Morcom, M.-SAE-A., A.M.I.E.T.

Test Results Verified By:

John Wensley, Ass. Dip.EE., MSc. (Strathclyde)
Grad.I.E.Aust., M.R.I.P.A.
Officer in Charge of Technology

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ATT. 1

T.I. CRYPTON ENGINE DIAGNOSTIC EQUIPMENT

Engine No: XQL-763407 Date: 9/5/85
Customer: PRO-MA SYSTEMS (AUST.) P/L

T.I. CRYPTON 350 + 301 PRINTER

TEST		VALUE	SPEED
8.00 a.m. 9/5/1985			
BATTERY VOLTAGE	+	12.6	2090
COIL SWITCH VOLTAGE	+	11.1	2100
CB VOLTAGE		0.06	2100
AVERAGE DWELL		0.0	2110
STROBE TIMING		199.9	2100
SENSOR TIMING	+	199.9	2100
OVERALL PLUG KV		16.5	2100
OVERALL PEAK KV		17.9	2100
OVERALL SPARK LINE KV		15.0	2080
CO EMISSION		0.0	2100
POWER CHECK	–	0	
INDIVIDUAL PLUG KV		13.8	2100
INDIVIDUAL PLUG KV		8.7	2080
INDIVIDUAL PLUG KV		13.4	2090
INDIVIDUAL PLUG KV		11.1	2100
INDIVIDUAL PLUG KV		11.2	2110
INDIVIDUAL PLUG KV		11.5	2110
OVERALL PLUG KV		15.4	2100
OVERALL PLUG KV		14.5	2130
OVERALL PLUG KV		10.1	2100
1.45 p.m. 9/5/1985			
OVERALL PLUG KV		14.2	2610
2.15 p.m. 9/5/1985			
OVERALL PLUG KV		11.5	2600
3.00 p.m. 9/5/1985			
INDIVIDUAL PLUG KV		9.9	2730
INDIVIDUAL PLUG KV		11.1	2730
INDIVIDUAL PLUG KV		8.1	2730
INDIVIDUAL PLUG KV		8.1	2730
INDIVIDUAL PLUG KV		8.4	2720
INDIVIDUAL PLUG KV		8.7	2730

T.I. CRYPTON ENGINE DIAGNOSTIC EQUIPMENT

Engine No: XQL-763407 Date: 9TH & 10TH
Customer: PRO-MA SYSTEMS (AUST.) PTY. LTD.

T.I. CRYPTON 350 + 301 PRINTER

TEST		VALUE	SPEED
4.00 p.m. 9/5/1985			
POWER CHECK	–	150	
POWER CHECK	–	210	
POWER CHECK	–	220	
POWER CHECK	–	180	
POWER CHECK	–	150	
POWER CHECK	–	210	
5.00 p.m. 9/5/1985			
INDIVIDUAL PLUG KV		9.3	2570
INDIVIDUAL PLUG KV		9.5	2560
INDIVIDUAL PLUG KV		9.2	2530
INDIVIDUAL PLUG KV		8.8	2540
INDIVIDUAL PLUG KV		8.8	2530
INDIVIDUAL PLUG KV		8.9	2550
8.00 a.m. 10/5/1985			
INDIVIDUAL PLUG KV		8.4	2850
INDIVIDUAL PLUG KV		8.4	2860
INDIVIDUAL PLUG KV		7.6	2860
INDIVIDUAL PLUG KV		7.5	2840
INDIVIDUAL PLUG KV		7.9	2850
INDIVIDUAL PLUG KV		8.1	2860
9.00 a.m. 10/5/1985			
POWER CHECK	–	120	
POWER CHECK	–	190	
POWER CHECK	–	120	
POWER CHECK	–	150	
POWER CHECK	–	180	
POWER CHECK	–	150	

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TEST 1

Engine Manufacturer: G.M.H. Model: HQ. Test Date: 9/5/1985
Engine Type: 6 Cylinder Automatic Serial No.: XQL 763407
Engine Displacement: 202 CID. Bore: 3.625'' Stroke: 3.250''
Fuel Type: Leaded Super 97 Octane Ignition Advance: 5° BTDC. (Specification)
Oil Type: 20 W 40 SF Specific Gravity:
Fuel/Oil Ratio (2-cycle):
Air Temperature: 83 °F Barometric Pressure: 29.95 Inches of Mercury
Wet Bulb Air Temperature: 76 °F
Correction Factor for Horsepower: 1.036
Test Observers: Bryan Roebuck, B.Ed., Dip.T., AMIAME, J.P.
Philip Morcom, M. SAE. A., AMIET.

All tests were carried out at wide open throttle.

1. ENGINE RPM	1000	1500	2000	2500	3000	3500	4000	4500	5000	5500
2. TORQUE (LBS.-FT.)	105	100	118	120	112					
3. AIR METER (IN./H_2O)										
4. FUEL METER										
5. CARBON MONOXIDE %	4.4				.25					
6. HYDROCARBON PPM	800				600					
7. HORSEPOWER	20	29	45	57	64					
8. CORR. HORSEPOWER	21	30	47	59	67					
9. AIR FLOW (LBS./HR.)										
10. CORR. AIR FLOW										
11. FUEL FLOW (LBS./HR.)	16.5	24	32	36	43					
12. AIR/FUEL RATIO										
13. SPECIFIC FUEL CONSP.	.79	.80	.68	.61	.64					
14. VOLUMETRIC EFF. (%)										
15. BMEP (PSI)	82.6	78.7	93.0	94.5	88.2					
16. THERMAL EFF. (%)	16.6	16.3	19.2	21.5	20.5					
17. SPARK PLUGS Kv.	14				8					
CHAMPION BL 13 Y										

Compression Pressures:— 1. 880 Kp. Specification 1035 Kp.
2. 1160
3. 1020
4. 1160
5. 1090
6. 1020

Combustion Chamber Deposit thickness:— 1.35 m.m. - 1.45 m.m.

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TEST 2

Engine Manufacturer G.M.H. Model H.Q. Test Date 9/5/1985 Serial No. XQL 763407
Engine Type 6 Cylinder Automatic Bore 3.625'' Stroke 3.250''
Engine Displacement 202 CID. Ignition Advance 5° BTDC.
Fuel Type Leaded Super 97 Octane Specific Gravity
Oil Type 20 W 40 SF Fuel/Oil Ratio (2-cycle)
Air Temperature 83 °F Barometric Pressure 29.97 Inches of Mercury
Wet Bulb Air Temperature 71 °F
Correction Factor for Horsepower 1.033
Test Observers Bryan Roebuck, B. Ed., Dip.T., AMIAME, J.P.
Philip Morcom, M.SAE.A., AMIET.

ENGINE RUN FOR 8 HOURS Double Dose THE PERFORMANCE GAS TREATMENT, then this test carried out on normal dose of THE PERFORMANCE GAS TREATMENT.

1. ENGINE RPM	1000	1500	2000	2500	3000	3500	4000	4500	5000	5500
2. TORQUE (LBS.-FT.)	100	110	121	122	123					
3. AIR METER (IN./H_2O)										
4. FUEL METER										
5. CARBON MONOXIDE %	2.2				.20					
6. HYDROCARBON PPM	220				120					
7. HORSEPOWER	19	32	46	58	70					
8. CORR. HORSEPOWER	20	33	48	60	73					
9. AIR FLOW (LBS./HR.)										
10. CORR. AIR FLOW										
11. FUEL FLOW (LBS./HR.)	11	20	26	34	40					
12. AIR/FUEL RATIO										
13. SPECIFIC FUEL CONSP.	.55	.61	.54	.57	.56					
14. VOLUMETRIC EFF. (%)										
15. BMEP (PSI)	78.7	86.5	95.2	96.0	96.4					
16. THERMAL EFF. (%)	23.8	21.5	24.3	23.0	24.0					
17. SPARK PLUGS Kv.	12				8					

Compression Pressures:— 1. 810 Kp.
2. 1140
3. 1030
4. 1100
5. 1060
6. 1040

Combustion Chamber Deposit thickness:— 0-.35 m.m.

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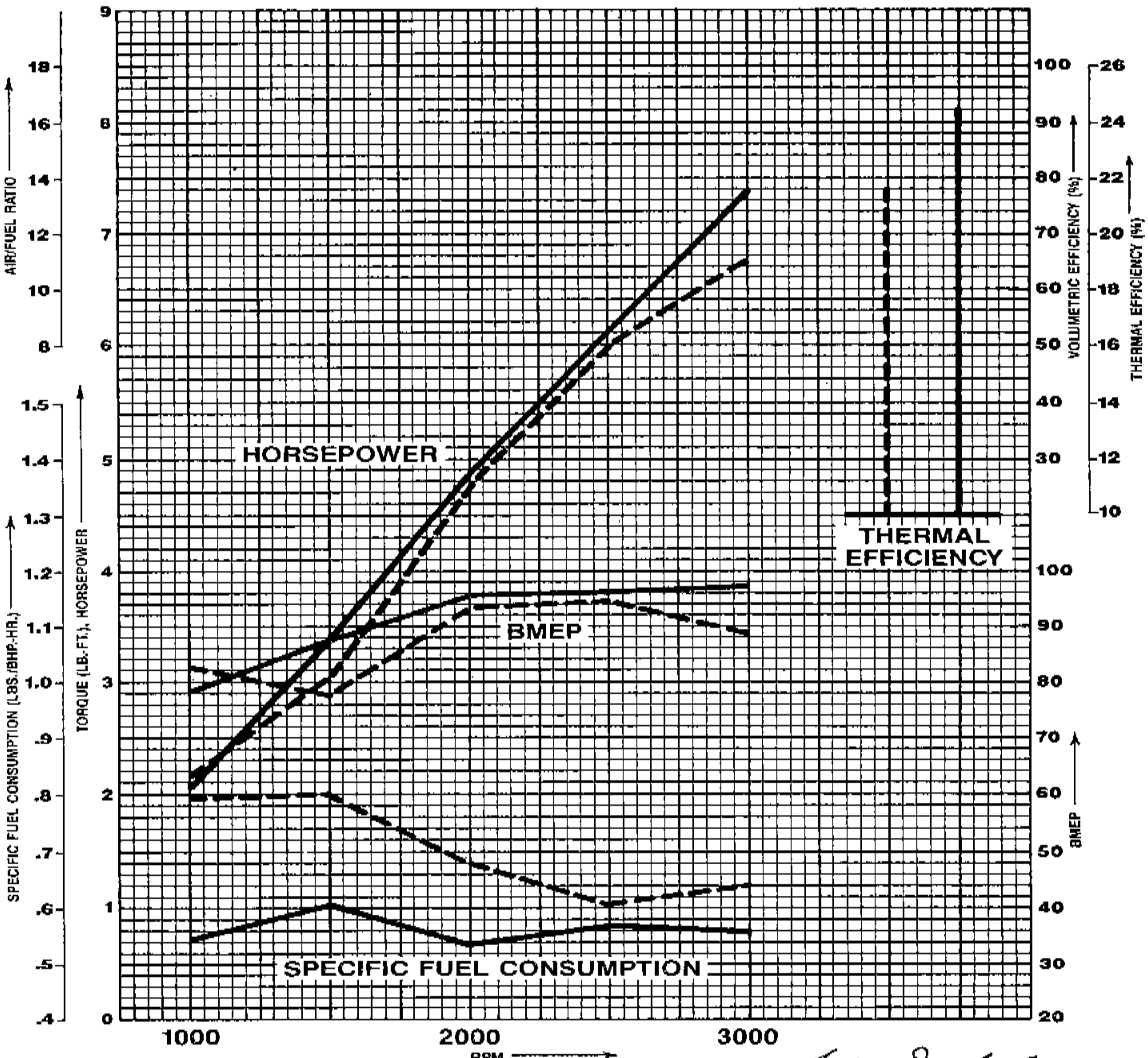
ENGINE TEST DATA GRAPH ATT. 2

ENGINE TYPE: HOLDEN HQ 6 Cylinder Automatic
ENGINE DISPL.: 202 CID. **FUEL:** Leaded Super 97 **DATE:** 9/5/85



John Wasley [signature]

CODE
- - - - - WITHOUT THE PERFORMANCE GAS TREATMENT.
——— WITH THE PERFORMANCE GAS TREATMENT.