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MACMAHON CONTRACTORS KOMATSU 785-3 & 630E HAUL TRUCK FUEL EFFICIENCY TRIALS

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Report prepared by:

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EXECUTIVE SUMMARY

Fuel Technology Pty Ltd initiated trials with F K Kanny & Son in Western Australia mid 1987. Initial carbon balance trials were conducted on two low loader prime movers. Following the success of these trials in reducing fuel consumption under a given load condition, trials were conducted at the Golden Valley mine site in Western Australia on a fleet of Caterpillar 773 dump trucks which showed a 7.4% reduction in fuel consumption following FTC treatment of fuel.

A number of further tests were conducted at Kanny, then MacMahon contract sites, namely Eneabba, Orebody 25, Alcoa, Youanmi and Kurara.

The fuel at all MacMahon contract mine sites in Western Australia is FTC treated.

Following discussion with MacMahon's Eastern Region Maintenance Management, agreement was reached to evaluate the performance of FTC in a Caterpillar 777C at Giralambone mine site employing the engineering standard Specific Fuel Consumption test procedure.

The reduction in fuel consumption measured following FTC treatment was 7.6% following correction for variation in inlet air temperature.

The addition of a new contract open cut mining site to MacMahon WA's workbook namely, Mt Edon Gold Mine's, Tarmoola operation presented the opportunity to conduct fuel consumption tests to verify the improvement in combustion efficiency provided by FTC. Evaluation methods used to test the effect of FTC were the Carbon Balance test of exhaust emissions on a sample of the Komatsu 785-3 and 630E dump truck fleet and a Volumetric Fuel Consumption test on Dump Truck 2173 (Komatsu 785-3).

Performed on a back to back, untreated-treated basis, the tests **resulted in an efficiency gain of 6.8% by Carbon Balance Test procedure and 6.7% by Volumetric Fuel Consumption Test procedure.** The results were proved to be significant by student t-Test at a 99% confidence level.

INTRODUCTION

Since incorporation in 1982 Fuel Technology Pty Ltd has been supplying a ferrous iron based Organometallic combustion catalyst, FTC, to the mining industry to provide improved fuel efficiency and maintenance.

As part of the on going verification of the fuel efficiency benefits of FTC Combustion Catalysts, Fuel Technology, in conjunction with MacMahon Contractors have been engaged in a series of static fuel consumption tests using the exhaust emission Carbon Balance test procedure based on AS2077-1982.

With the acquisition of flow measurement equipment, which could be retro-fitted to the vehicle for the trial, a controlled test was devised (Haul Truck Volumetric Fuel Measurement Procedure) which could be used to evaluate FTC in an actual operational environment. Initiated at the Giralambone operations in NSW, the objective of the test was to measure the absolute amount of fuel consumed against work done over a defined haul.

The tests demonstrated a fuel consumption improvement of 7.6%.

Following further discussions with the WA division, it was agreed to test a fleet of Komatsu 785-3 and 630E dump trucks operating under contract at Mt Edon's Tarmoola Gold Mine. Three 785-3 and two 630E dump trucks were tested by Carbon Balance method. In addition dump truck 2173 (785-3) was test by the Haul Truck Volumetric Fuel Consumption method.

Performed on a back to back, untreated-treated basis, the baseline (untreated) test was commenced on the 18/3/97 followed by the treated tests on 22/4/97.

This report details the test procedures and results measured.

TEST PROCEDURE

1. Haul Truck Volumetric Fuel Measurement

The basis of the Haul Truck Volumetric Fuel Measurement test is to measure the absolute amount of fuel consumed against the work done.

A start point at the base of the pit ramp and a finish point at the top of pit ramp were marked with sighting posts and the distance was measured with a surveyors wheel.

Flow transducers fitted with thermocouple probes were connected to the dump truck's fuel tank outlet and inlet pipework (*Photograph No. 1*).

These transducers, calibrated to \pm 0.25% by a NATA Certified Laboratory, were then coupled to a Minitrol totaliser mounted in the cab (*Photograph No. 2*).

Because the temperature of engine return fuel is considerably higher than inlet fuel together with the fact that the fuel temperature continues to rise during the working cycle resulting in density variations, the fuel temperatures at each flow transducer was measured via a Fluke digital dual readout thermometer also mounted in the cab.

Prior to the test commencing a fuel sample was drawn from the test truck and density measured at observed temperature. Density was then corrected to industry standard of 15°C using the Institute of Petroleum Density Correction Table, Volume VIII, Table 53B.

Following loading of the dump truck for each cycle and allowing the load monitor to register, load in kilograms (kg) was recorded. Upon arrival at pit ramp marker the test truck stopped and the Minitrol totaliser and stop watch were zeroed. At signal "GO" the driver accelerated and the test engineer activated the stop watch and Minitrol totaliser.

To avoid any driver variables the test truck was driven at full throttle over the test circuit. Fuel temperatures were recorded and upon arrival at the top marker the stop watch and Minitrol unit readings are recorded. Tests were conducted throughout the day on all available runs.

The results achieved by the test trucks are shown in Table I. The results are reported as fuel consumed in kilograms/tonne which relates to a more accurate mass measurement compared to the usual mine operations method of recording litres/hour. However, to fully assess fuel consumed for a given amount of work done the formula:-

Load carried x Distance travelled Fuel consumed

Should be employed, thus reporting efficiency as *Tonne kilometres/kilogram (Tkm/kg)*. (Koehler & Doglio, 1987)

2. Carbon Balance (CB)

Carbon Balance test (AS2077-1982) works on the principle that carbon entering the engine as a component of fuel must be exhausted from the engine as components of the exhaust gas, namely carbon monoxide (CO), carbon dioxide (CO₂) and unburned hydrocarbon (HC). By measuring the exhaust gas volumetric flow rate by a pitot tube inserted into the exhaust stack and measuring exhaust temperatures and pressure, a mass per unit volume of components containing carbon (CO, CO₂ and HC) can be taken and used to calculate the carbon flow in grams/second (fuel consumption). In back to back, untreated and treated tests, the objective of the test is to measure the percentage change in carbon flow under as close to identical load conditions as possible.

3. Bosch Smoke Tests

Bosch smoke tests were also conducted to analyse soot particulate in exhaust emissions. A Bosch sampling pump was used to take a defined quantity of exhaust smoke and pass it through a filter disc. The resultant darkened filter disc is photoelectronically evaluated with a Bosch smoke meter evaluation unit. The result is expressed as a value between 0.0 (clean) to 9.9 (dirty)

TEST RESULTS

1. HAUL TRUCK VOLUMETRIC FUEL CONSUMPTION KOMATSU 785-3 DUMP TRUCK No 2173

A test run was marked out with marker post from the bottom of the north pit to the pit ramp just prior to the intersection of the waste dump haul road (785m). Gross tonnes hauled by the haul distance per kilogram of fuel (T km/kg) was calculated and the arithmetic mean determined.

TABLE 1 **TEST DATA & RESULTS**

SPECIFIC	FUEL CON				NIAL											
Customer:		MacMahor	n Contr	actors		Engine	Hrs	_	13184							
Location		Tarmoola				Amb; Te	emp; Start deg	g; C	21.1						D	
Date:		26/03/9/ DT 2172				Amb; Te	emp; Finish de Distance Mate	eg; C	34					Fuel Sample	Density	Temp Deg C
Make/Mod	اما	Komateu 7	85_3			Truck E	mpty Weight	es	61800					Corrected	0.820	37.2
UNTREA	TED	Komatsu 7	05-5			TIUCK L	mpty weight		01000					concettu	0.042	15
Run No	Time	Gross	Haul	Time	Fuel	(Lt)	Fuel (Lt)	Fuel	Temp	Der	nsitv	Fuel	(kg)	Fuel (kg)	Fuel (kg)	Tonne km
		Load kg	Mins	Sec	In	Out	Consumed	In	Out	In	Out	In	Out	Consumed	/Tonne	/ Fuel kg
1	7.00	141800) 4	06	34.81	21.51	13.30	42.0	50.9	0.823	0.816	28.63	17.56	11.08	0.0781	10.05
2	7.25	141800	4	06	34.86	21.54	13.32	42.2	52.5	0.823	0.815	28.67	17.56	11.11	0.0784	10.02
3	8.15	136800	4	05	34.48	21.21	13.27	43.4	54.2	0.822	0.814	28.33	17.26	11.06	0.0809	9.71
4	8.40	136800	4	08	34.61	21.32	13.29	43.8	54.0	0.821	0.814	28.43	17.36	11.07	0.0809	9.70
5	9.05	132800	4	07	34.50	21.21	13.29	44.0	56.6	0.821	0.813	28.32	17.25	10.07	0.0798	9.84
7	10.10	140800	4	16	35 51	21.85	13.10	45.8	55.4	0.820	0.812	29.11	17.77	11.35	0.0821	9.74
8	10.40	144800	4	25	36.48	22.43	14.05	47.3	57.0	0.819	0.812	29.87	18.21	11.66	0.0805	9.75
9	11.10	139800	4	11	34.80	21.39	13.41	49.2	59.6	0.818	0.810	28.45	17.33	11.12	0.0795	9.87
10	11.25	135800) 4	13	34.92	21.54	13.38	50.5	60.6	0.817	0.810	28.52	17.44	11.08	0.0816	9.62
11	11.45	136800) 4	18	35.17	22.04	13.13	51.8	61.6	0.816	0.809	28.69	17.83	10.86	0.0794	9.89
12	12.00	134800	4	15	34.92	21.51	13.41	53.3	63.3	0.815	0.808	28.45	17.37	11.08	0.0822	9.55
13	12.15	135800	4	07	34.23	21.05	13.18	54.5	64.0	0.814	0.807	27.86	16.99	10.87	0.0800	9.81
14	12.45	137800	4	09	35.03	21.59	13.44	34.2	49.9	0.828	0.817	29.01	17.64	11.37	0.0825	9.51
15	13.00	132800	4	15	34.41	21.22	13.19	36.2	52.2	0.827	0.815	28.45	17.30	11.14	0.0839	9.35
10	15.15	156600		15	55.62	22.10	15.04	56.0	55.7	0.820	0.014	27.51	10.00	11.51	0.0827).47
Mean		137925	i				13.38							11.146	0.0808	9.72
Std Dev		3324.154					0.2388							0.2217	0.0016	0.1957
C.V		2.4%					1.8%							2.0%	2.0%	2.0%
Customer: Location		MacMahor	n Contr	actors		Engine	Hrs		13646							
Deter		Tarmoola	,			Amb; Te	emp; Start deg	;; C	8.1					End Constr	Densites	Turne Day C
Date: Truck No:		7/05/97 7/2173				Amb; To Amb; To	emp; Start deg emp; Finish de Distance Metre	g; C eg; C es	8.1 22.5 785					Fuel Sample	Density	Temp Deg C
Date: Truck No; Make/Mod	lel	7/05/97 DT 2173 Komatsu 7	85-3			Amb; Te Amb; Te Circuit I Truck E	emp; Start deg emp; Finish de Distance Metre mpty Weight	;; C eg; C es	8.1 22.5 785 61800					Fuel Sample	Density 0.836 0.840	Temp Deg C 21 15
Date: Truck No; Make/Mod TREATEI	lel D	7/05/97 DT 2173 Komatsu 7	85-3			Amb; Te Amb; Te Circuit I Truck E	emp; Start deg emp; Finish de Distance Metre mpty Weight	;; C eg; C es	8.1 22.5 785 61800					Fuel Sample Corrected	Density 0.836 0.840	Temp Deg C 21 15
Date: Truck No; Make/Mod TREATEI Run No	lel D Time	7/05/97 DT 2173 Komatsu 7 Gross	85-3 Haul	Time	Fuel	Amb; Te Amb; Te Circuit I Truck E (Lt)	emp; Start deg emp; Finish de Distance Metre mpty Weight Fuel (Lt)	g; C eg; C es Fuel	8.1 22.5 785 61800 Temp	Den	nsity	Fuel	(kg)	Fuel Sample Corrected Fuel (kg)	Density 0.836 0.840 Fuel (kg)	Temp Deg C 21 15 Tonne km
Date: Truck No; Make/Mod TREATEI Run No	lel D Time	7/05/97 DT 2173 Komatsu 7 Gross Load kg	85-3 Haul Mins	Time Sec	Fuel In	Amb; Te Amb; Te Circuit I Truck E (Lt) Out	emp; Start deg emp; Finish de Distance Metro mpty Weight Fuel (Lt) Consumed	;; C eg; C es Fuel In	8.1 22.5 785 61800 Temp Out	Den In	nsity Out	Fuel In	(kg) Out	Fuel Sample Corrected Fuel (kg) Consumed	Density 0.836 0.840 Fuel (kg) / Gross Tonne	Temp Deg C 21 15 Tonne km / Fuel kg
Date: Truck No; Make/Mod TREATED Run No	lel D Time 6.45	Tarmoola 7/05/97 DT 2173 Komatsu 7 Gross Load kg 138800	85-3 Haul Mins	Time Sec 52	Fuel In 32.95	Amb; Te Amb; Te Circuit I Truck E (Lt) Out 20.18	emp; Start deg emp; Finish de Distance Metro mpty Weight Fuel (Lt) Consumed 12.77	r; C eg; C es Fuel In 15.4	8.1 22.5 785 61800 Temp Out 26.6	Den In 0.840	out Out 0.832	Fuel In 27.67	(kg) Out 16.79	Fuel Sample Corrected Fuel (kg) Consumed 10.88	Density 0.836 0.840 Fuel (kg) / Gross Tonne 0.0784	Temp Deg C 21 15 Tonne km / Fuel kg 10.01
Date: Truck No; Make/Mod TREATEI Run No	tel D 6.45 7.10	7/05/97 DT 2173 Komatsu 7 Gross Load kg 138800 155800	85-3 Haul Mins 3 4	Time Sec 52 16	Fuel In 32.95 35.88	Amb; Te Amb; Te Circuit I Truck E (Lt) 0ut 20.18 22.15	emp; Start deg emp; Finish de Distance Metro mpty Weight Fuel (Lt) Consumed 12.77 13.73	r; C eg; C es Fuel In 15.4 16.4	8.1 22.5 785 61800 Temp Out 26.6 30.1	Der In 0.840 0.839	o.832	Fuel In 27.67 30.11	(kg) Out 16.79 18.37	Fuel Sample Corrected Fuel (kg) Consumed 10.88 11.74	Density 0.836 0.840 Fuel (kg) / Gross Tonne 0.0784 0.0753	Temp Deg C 21 15 Tonne km / Fuel kg 10.01 10.42
Date: Truck No; Make/Mod TREATEI Run No 1 2 3	lel D 6.45 7.10 7.30	Tarmoola 7/05/97 DT 2173 Komatsu 7 Gross Load kg 138800 155800 142800	85-3 Haul Mins 3 4 3	Time Sec 52 16 52	Fuel In 32.95 35.88 33.27	Amb; Te Amb; Te Circuit I Truck E (Lt) 0ut 20.18 22.15 20.27	emp; Start deg emp; Finish de Distance Metro mpty Weight Fuel (Lt) Consumed 12.77 13.73 13.00	r; C eg; C es Fuel In 15.4 16.4 14.1	8.1 22.5 785 61800 Temp Out 26.6 30.1 31.9	Den In 0.840 0.839 0.841	Out 0.832 0.830 0.828	Fuel In 27.67 30.11 27.98	(kg) Out 16.79 18.37 16.79	Fuel Sample Corrected Fuel (kg) Consumed 10.88 11.74 11.19	Density 0.836 0.840 Fuel (kg) / Gross Tonne 0.0784 0.0753 0.0783	Temp Deg C 21 15 Tonne km / Fuel kg 10.01 10.42 10.02
Date: Truck No; Make/Mod TREATEI Run No 1 2 3 4 5	lel Time 6.45 7.10 7.30 7.50 8.05	Tarmoola 7/05/97 DT 2173 Komatsu 7 Gross Load kg 138800 155800 142800 147800 147800	85-3 Haul Mins 3 4 3 3 3 3	Time Sec 52 16 52 54	Fuel In 32.95 35.88 33.27 34.00 22.50	Amb; Te Amb; Te Circuit I Truck E (Lt) 0ut 20.18 22.15 20.27 20.84	emp; Start deg emp; Finish de Distance Metre mpty Weight Fuel (Lt) Consumed 12.77 13.73 13.00 13.16	;; C eg; C es Fuel In 15.4 16.4 14.1 17.8	8.1 22.5 785 61800 Temp Out 26.6 30.1 31.9 32.8 24.1	Derr In 0.840 0.839 0.841 0.838 0.838	Out 0.832 0.830 0.828 0.828 0.828	Fuel In 27.67 30.11 27.98 28.50 27.20	(kg) Out 16.79 18.37 16.79 17.25	Fuel Sample Corrected Fuel (kg) Consumed 10.88 11.74 11.19 11.25	Density 0.836 0.840 Fuel (kg) / Gross Tonne 0.0784 0.0753 0.0783 0.07783	Temp Deg C 21 15 Tonne km / Fuel kg 10.01 10.42 10.02 10.31
Date: Truck No; Make/Mod TREATEI Run No 1 1 2 3 4 5 6 6	lel D Time 6.45 7.10 7.30 7.50 8.05 8.25	Tarmoola 7/05/97 DT 2173 Komatsu 7 Gross Load kg 138800 155800 142800 147800 145800	85-3 Haul Mins 4 3 3 3 3 3	Time Sec 52 16 52 54 47 49	Fuel In 32.95 35.88 33.27 34.00 32.50 32.84	Amb; Te Amb; Te Circuit I Truck E (Lt) 0ut 20.18 22.15 20.27 20.84 19.77 20.01	emp; Start deg emp; Finish de Distance Metri mpty Weight Fuel (Lt) Consumed 12.77 13.73 13.00 13.16 12.73 12.83	;; C eg; C es Fuel In 15.4 16.4 14.1 17.8 19.7 20.1	8.1 22.5 785 61800 Temp Out 26.6 30.1 31.9 32.8 34.1 33.9	Dem In 0.840 0.839 0.841 0.838 0.837 0.837	sity Out 0.832 0.830 0.828 0.828 0.827	Fuel In 27.67 30.11 27.98 28.50 27.20 27.20	(kg) Out 16.79 18.37 16.79 17.25 16.34 16.54	Fuel Sample Corrected Fuel (kg) Consumed 10.88 11.74 11.19 11.25 10.86 10.93	Density 0.836 0.840 Fuel (kg) / Gross Tonne 0.0784 0.0753 0.0783 0.0761 0.0771 0.0771	Temp Deg C 21 15 Tonne km / Fuel kg 10.01 10.42 10.02 10.31 10.18 10.47
Date: Truck No; Make/Mod TREATEI Run No 1 1 2 3 4 4 5 6 6 7	lel Time 6.45 7.10 7.30 7.50 8.05 8.25 8.25	Tarmoola 7/05/97 DT 2173 Komatsu 7 Gross Load kg 138800 155800 142800 142800 147800 145800 145800 152800	85-3 Haul Mins 3 3 3 3 3 3 3 4	Time Sec 52 16 52 54 47 49 06	Fuel In 32.95 35.88 33.27 34.00 32.50 32.84 35.11	Amb; Te Amb; Te Circuit I Truck E (Lt) 0ut 20.18 22.15 20.27 20.84 19.77 20.01 21.54	emp; Start deg emp; Finish de Distance Metre mpty Weight Fuel (Lt) Consumed 12.77 13.73 13.00 13.16 12.73 12.83 13.57	;; C eg; C es Fuel In 15.4 16.4 14.1 17.8 19.7 20.1 21.0	8.1 22.5 785 61800 Temp Out 26.6 30.1 31.9 32.8 34.1 33.9 34.7	Derr In 0.840 0.839 0.841 0.838 0.837 0.837 0.837	usity Out 0.832 0.830 0.828 0.828 0.827 0.827 0.826	Fuel In 27.67 30.11 27.98 28.50 27.20 27.47 29.35	(kg) Out 16.79 18.37 16.79 17.25 16.34 16.54 17.80	Fuel Sample Corrected Fuel (kg) Consumed 10.88 11.74 11.19 11.25 10.86 10.93 11.55	Density 0.836 0.840 Fuel (kg) / Gross Tonne 0.0784 0.0753 0.07783 0.07761 0.0771 0.07750 0.0756	Temp Deg C 21 15 Tonne km / Fuel kg 10.01 10.42 10.02 10.31 10.18 10.47 10.38
Date: Truck No; Make/Mod TREATEI Run No 1 1 2 3 3 4 4 5 6 6 7 7	lel D 7.100 7.300 7.500 8.825 8.55 9.35	Tarmoola 7/05/97 DT 2173 Komatsu 7 Gross Load kg 138800 155800 142800 1442800 1447800 1445800 152800 146800	85-3 Haul Mins 3 4 3 3 3 3 3 3 4 3 3 3 3 3 3 3 3 3 3		Fuel In 32.95 35.88 33.27 34.00 32.50 32.84 35.11 33.15	Amb; Te Amb; Te Circuit I Truck E (Lt) 0ut 20.18 22.15 20.27 20.84 19.77 20.01 21.54 20.30	emp; Start deg emp; Finish de Distance Metri mpty Weight Fuel (Lt) Consumed 12.77 13.73 13.00 13.16 12.73 12.83 13.57 12.85	;; C eg; C es Fuel In 15.4 16.4 14.1 17.8 19.7 20.1 21.0 23.6	8.1 22.5 785 61800 Temp 0ut 26.6 30.1 31.9 32.8 34.1 33.9 34.7 37.8	Derr In 0.840 0.839 0.841 0.837 0.837 0.837 0.836 0.834	sity Out 0.832 0.830 0.828 0.828 0.827 0.827 0.827 0.826 0.824	Fuel In 27.67 30.11 27.98 28.50 27.20 27.47 29.35 27.65	(kg) Out 16.79 18.37 16.79 17.25 16.34 16.54 17.80 16.73	Fuel Sample Corrected Fuel (kg) Consumed 10.88 11.74 11.19 11.25 10.86 10.93 11.55 10.92	Density 0.836 0.840 Fuel (kg) / Gross Tonne 0.0784 0.0753 0.0783 0.07761 0.07711 0.0750 0.0756 0.0754	Temp Deg C 21 15 Tonne km / Fuel kg 10.01 10.42 10.02 10.31 10.18 10.47 10.38 10.47
Date: Truck No; Make/Mod TREATEI Run No 11 22 33 44 55 66 77 88 99	Lel Time 6.45 7.10 7.30 7.50 8.05 8.25 9.35 9.55	Tarmoola 7/05/97 DT 2173 Komatsu 7 Gross Load kg 138800 142800 142800 142800 1445800 145800 145800 145800 155400 154800	85-3 Haul Mins 3 3 3 3 3 3 3 3 4 4 3 3 3 3 4 4 3	Time Sec 52 16 52 54 47 49 06 51 07	Fuel In 32.95 35.88 33.27 34.00 32.50 32.84 35.11 33.15 35.04	Amb; Te Amb; Te Circuit I Truck E (Lt) 0ut 20.18 22.15 20.27 20.84 19.77 20.01 21.54 20.30 21.44	emp; Start deg emp; Finish de Distance Metri mpty Weight Fuel (Lt) Consumed 12.77 13.73 13.00 13.16 12.73 12.83 13.57 12.85 13.60	;; C eg; C es Fuel In 15.4 16.4 14.1 17.8 19.7 20.1 21.0 23.6 25.3	8.1 22.5 785 61800 Temp 0ut 26.6 30.1 31.9 32.9 34.1 33.9 34.1 33.9 34.7 37.8 38.2	Derr In 0.840 0.839 0.841 0.837 0.837 0.837 0.836 0.834 0.834	Next Contemporation C	Fuel In 27.67 30.11 27.98 28.50 27.20 27.20 27.47 29.35 27.65 29.18	(kg) Out 16.79 18.37 16.79 17.25 16.34 16.54 17.80 16.73 17.66	Fuel Sample Corrected Fuel (kg) Consumed 10.88 11.74 11.19 11.25 10.86 10.93 11.55 10.92 11.52	Density 0.836 0.840 Fuel (kg) / Gross Tonne 0.0784 0.0753 0.0773 0.0773 0.07761 0.0771 0.0770 0.0756 0.0744	Temp Deg C 21 15 Tonne km / Fuel kg 10.01 10.42 10.02 10.31 10.18 10.47 10.38 10.45 10.55
Date: Truck No; Make/Mod TREATEE Run No 1 2 3 4 4 5 6 7 8 9 9 10	lel Time 6.45 7.10 7.30 7.50 8.05 8.25 9.35 9.35 9.35 9.35 10.35	Tarmoola 7/05/97 DT 2173 Komatsu 7 Gross Load kg 138800 142800 142800 144800 1445800 1445800 1445800 1558800	85-3 Haul Mins 3 4 3 3 3 3 3 4 4 4 4 4	Time Sec 52 16 52 54 47 49 06 51 07 17	Fuel In 32.95 35.88 33.27 34.00 32.50 32.84 35.11 33.15 35.04 36.02	Amb; Te Amb; Te Circuit I Truck E (Lt) 0ut 20.18 22.15 20.27 20.84 19.77 20.01 21.54 20.30 21.44 22.21	emp; Start deg emp; Finish de Distance Metro mpty Weight Fuel (Lt) Consumed 12.77 13.73 13.00 13.16 12.73 12.83 13.57 12.85 13.60 13.81	;; C eg; C es Fuel In 15.4 16.4 14.1 17.8 19.7 20.1 21.0 23.6 25.3 26.8	8.1 22.5 785 61800 Temp 0ut 26.6 30.1 31.9 32.9 34.1 33.9 34.1 33.9 34.7 37.8 38.2 39.6	Der In 0.840 0.839 0.841 0.838 0.837 0.836 0.834 0.833 0.834	Out 0.832 0.830 0.828 0.827 0.826 0.827 0.826 0.824 0.824 0.824	Fuel In 27.67 30.11 27.98 28.50 27.20 27.20 27.47 29.35 27.65 29.18 29.97	(kg) Out 16.79 18.37 16.79 17.25 16.34 16.54 17.80 16.73 17.66 18.27	Fuel Sample Corrected Fuel (kg) Consumed 10.88 11.74 11.19 11.25 10.86 10.93 11.55 10.92 11.52 11.69	Density 0.836 0.840 Fuel (kg) / Gross Tonne 0.0784 0.0753 0.0783 0.07761 0.0771 0.0750 0.0756 0.0774 0.0774 0.0774	Temp Deg C 21 15 Tonne km / Fuel kg 10.01 10.42 10.02 10.31 10.18 10.47 10.38 10.55 10.66
Date: Truck No; Make/Mod TREATEE Run No 1 2 3 4 4 5 6 6 7 8 9 9 10 11 -	lel Time 6.45 7.10 7.30 7.50 8.05 8.25 8.55 9.35 9.35 10.35 11.00	Tarmoola 7/05/97 DT 2173 Komatsu 7 Gross Load kg 138800 155800 142800 142800 1442800 1442800 1442800 1445800 1445800 1458800 1558800 1558800 1558800	85-3 Haul Mins 3 4 3 3 3 3 3 4 4 4 4 4 4 4	Time Sec 52 54 47 49 06 51 07 77 177 08	Fuel In 32.95 35.88 33.27 34.00 32.50 32.84 35.11 33.15 35.04 36.02 35.19	Amb; Te Amb; Te Circuit I Truck E (Lt) 0ut 20.18 22.15 20.27 20.84 19.77 20.01 21.54 20.30 21.44 22.21 21.61	emp; Start deg emp; Finish de Distance Metrr mpty Weight Fuel (Lt) Consumed 12.77 13.73 13.00 13.16 12.73 12.83 13.57 12.85 13.60 13.81 13.58	Fuel In 15.4 16.4 14.1 17.8 19.7 20.1 21.0 23.6 25.3 26.8 27.7	8.1 22.5 785 61800 Temp Out 26.6 30.1 31.9 32.8 34.1 33.9 34.7 37.8 38.2 39.6 41.1	Der In 0.840 0.839 0.841 0.838 0.837 0.836 0.834 0.833 0.832 0.831	sity Out 0.832 0.830 0.828 0.827 0.826 0.824 0.824 0.824 0.823 0.822	Fuel In 27.67 30.11 27.98 28.50 27.20 27.47 29.35 27.65 29.18 29.97 29.25	(kg) Out 16.79 18.37 16.79 17.25 16.34 16.54 17.80 16.73 17.66 18.27 17.76	Fuel Sample Corrected Fuel (kg) Consumed 10.88 11.74 11.19 11.25 10.86 10.93 11.55 10.92 11.52 11.69 11.49	Density 0.836 0.840 Fuel (kg) / Gross Tonne 0.0784 0.0753 0.0783 0.0763 0.0771 0.07750 0.0756 0.0744 0.0736 0.0744 0.0736 0.0757 0.0744 0.0756 0.0744 0.0756 0.0757 0.0756 0.0757 0.0756 0.0757 0.0757 0.0756 0.0757 0.0757 0.0757 0.0757 0.0757 0.0757 0.0757 0.0757 0.0757 0.0757 0.0757 0.0757 0.0757 0.0757 0.0778 0.0775 0.07	Temp Deg C 21 15 Tonne km / Fuel kg 10.01 10.42 10.02 10.31 10.18 10.47 10.38 10.55 10.55 10.66 10.37
Date: Truck No; Make/Mod TREATEI Run No 1 2 3 4 5 6 6 7 8 9 10 11 12 12 12 12 12	lel D Time 6.45 7.10 7.30 7.50 8.05 8.25 8.55 9.35 9.35 10.35 11.00 11.20 11.20 11.20	Tarmoola 7/05/97 DT 2173 Komatsu 7 Gross Load kg 138800 155800 142800 142800 144800 144800 152800 144800 151800 151800 151800	85-3 Haul Mins 3 3 3 3 3 3 3 3 3 3 3 4 4 4 4 4 4 4 4	Time Sec 52 16 52 54 47 49 06 51 07 17 7 08 59 9 77	Fuel In 32.95 35.88 33.27 34.00 32.50 32.84 35.11 33.15 35.04 36.02 35.19 34.20	Amb; Tc Amb; Tc Circuit I Truck E (Lt) Out 20.18 22.15 20.27 20.84 19.77 20.01 21.54 20.30 21.44 22.21 21.61 20.92	emp; Start deg emp; Finish de Distance Metri- mpty Weight Fuel (Lt) Consumed 12.77 13.73 13.00 13.16 12.73 12.83 13.57 12.85 13.60 13.81 13.58 13.28	Fuel In 15.4 16.4 14.1 17.8 19.7 20.1 21.0 23.6 25.3 26.8 27.7 29.1 20.1	8.1 22.5 785 61800 Temp Out 26.6 30.1 31.9 32.8 34.1 33.9 34.7 37.8 38.2 39.6 41.1 42.2	Der In 0.840 0.839 0.841 0.838 0.837 0.836 0.833 0.832 0.831 0.831 0.831	sity Out 0.832 0.830 0.828 0.827 0.826 0.824 0.824 0.824 0.823 0.822 0.821 0.821	Fuel In 27.67 30.11 27.98 28.50 27.20 27.47 29.35 27.65 29.18 29.97 29.25 28.39 20.25 28.39	(kg) Out 16.79 18.37 16.79 17.25 16.34 16.54 17.80 16.73 17.66 18.27 17.76 17.18	Fuel Sample Corrected Fuel (kg) Consumed 10.88 11.74 11.19 11.25 10.86 10.93 11.55 10.92 11.52 11.69 11.49	Density 0.836 0.840 Fuel (kg) / Gross Tonne 0.0783 0.0783 0.0773 0.0773 0.07750 0.0756 0.07744 0.0736 0.07757 0.0769 0.0754 0.0754 0.0754 0.0754 0.0754 0.0754 0.0755 0.0755 0.0755 0.0754 0.0754 0.0755 0.0756 0.0754 0.0756 0.0754 0.0755 0.0756 0.0774 0.0756 0.0756 0.0756 0.0775 0.0756 0.0775 0.0756 0.0775 0.0756 0.0775 0.0756 0.0775 0.0756 0.0757 0.0756 0.0756 0.0756 0.0757 0.0756 0.0756 0.0756 0.0756 0.0757 0.0756 0.0756 0.0757 0.0756 0.0756 0.0757 0.0756 0.0756 0.0757 0.0756 0.0756 0.0757 0.0756 0.0757 0.0756 0.0756 0.0757 0.0757 0.	Temp Deg C 21 15 Tonne km / Fuel kg 10.01 10.42 10.02 10.31 10.18 10.47 10.38 10.55 10.55 10.66 10.37 10.20
Date: Truck No; Make/Mod TREATEI Run No 11 2 33 4 4 55 66 77 88 99 100 111 122 13 14 ⁴	lel D Time 6.45 7.10 7.30 7.50 8.05 9.35 9.35 9.55 10.35 11.00 11.20 11.40 12.05 11.40 12.05 11.40 12.05 11.00 12.05 11.00 12.05 11.00 12.05 11.00 12.05 11.00 12.05 11.00 12.05 11.00 12.05 10.	Tarmoola 7/05/97 DT 2173 Komatsu 7 Gross Load kg 138800 155800 142800 142800 144800 144800 144800 152800 151800 151800 151800	85-3 Haul Mins 3 3 3 3 3 3 3 3 3 3 3 3 3 4 4 4 4 4 4	Time Sec 52 16 52 54 47 49 06 51 07 17 708 59 07	Fuel In 32.95 35.88 33.27 34.00 32.84 35.11 33.15 35.04 36.00 35.19 34.20 35.08	Amb; Tc Amb; Tc Circuit I Truck E (Lt) 0ut 20.18 22.15 20.27 20.84 19.77 20.01 21.54 20.30 21.44 22.21 21.61 20.92 21.51	emp; Start deg emp; Finish de Distance Metri mpty Weight Fuel (Lt) Consumed 12.77 13.73 13.00 13.16 12.73 12.83 13.57 12.85 13.60 13.81 13.58 13.28 13.57 13.28 14.28 14	Fuel In 15.4 16.4 19.7 20.1 21.00 23.6 25.3 26.8 27.7 29.1 30.0 31.6	8.1 22.5 785 61800 Temp 0ut 26.6 30.1 31.9 32.8 34.1 33.9 34.7 37.8 38.2 39.6 41.1 42.2 43.3 44.2	Der In 0.840 0.839 0.841 0.838 0.837 0.837 0.836 0.834 0.833 0.832 0.831 0.830 0.830 0.830 0.830	Isity Out 0.832 0.830 0.828 0.827 0.827 0.827 0.826 0.824 0.824 0.823 0.822 0.821 0.821 0.820	Fuel In 27.67 30.11 27.98 28.500 27.20 27.47 29.35 27.65 29.18 29.97 29.25 28.39 29.10 28.45	(kg) Out 16.79 18.37 16.79 17.25 16.34 16.54 17.80 16.73 17.66 18.27 17.76 17.18 17.64	Fuel Sample Corrected Fuel (kg) Consumed 10.88 11.74 11.19 11.25 10.86 10.93 11.55 10.92 11.52 11.69 11.49 11.49 11.22 11.46 11.49	Density 0.836 0.840 Fuel (kg) / Gross Tonne 0.0784 0.0753 0.07783 0.07783 0.07761 0.0771 0.0750 0.0756 0.0744 0.0754 0.0757 0.0769 0.0750 0.0759 0.0750 0.0759 0.0779 0.0759 0.	Temp Deg C 21 15 Tonne km / Fuel kg 10.01 10.42 10.02 10.31 10.18 10.55 10.55 10.55 10.66 10.37 10.20 10.47
Date: Truck No; Make/Modo TREATEI Run No 11 2 3 4 5 6 6 7 8 9 9 10 11 12 13 14 15 10 10 10 10 10 10 10 10 10 10	lel D Time 6.45 7.10 7.30 7.50 8.25 8.25 9.35 9.35 9.35 10.35 11.00 11.20 11.40 12.05 12.30	Tarmoola 7/05/97 DT 2173 Komatsu 7 Gross Load kg 138800 155800 142800 1442800 144800 144800 154800 154800 154800 154800 154800 152800 145800	85-3 Haul Mins 3 3 4 4 3 3 3 4 4 4 3 3 4 4 4 4 3 3 4 4 4 3 3 3 4 4 4 5 3 3 4 4 4 5 3 3 4 4 4 5 3 3 5 4 4 5 3 3 3 5 5 5 6 1 9 1 9 1 9 1 9 1 9 1 9 1 9 1 9 1 9 1	Time Sec 52 54 47 49 06 51 07 17 08 59 07 759 58	Fuel In 32.95 35.88 33.27 34.00 32.50 32.84 35.11 33.15 35.04 36.02 35.19 34.20 35.19 34.20 35.08 34.34 34.34	Amb; To Amb; To Amb; Tr Circuit I Truck E (Lt) 0ut 20.18 20.27 20.84 19.77 20.01 21.54 20.30 21.44 20.30 21.44 20.30 21.44 20.92 21.51 21.00	emp; Start deg emp; Finish de Distance Metry mpty Weight Fuel (Lt) Consumed 12.77 13.73 13.00 13.16 12.73 12.83 13.57 12.85 13.60 13.81 13.58 13.28 13.57 13.28 13.57 13.28 13.57 13.28 13.57	Fuel In 15.4 16.4 17.8 19.7 20.1 21.0 23.6 25.3 26.8 27.7 29.1 30.0 31.6 32.7	8.1 22.5 785 61800 Temp Out 26.6 30.1 31.9 32.8 34.1 33.9 34.7 37.8 38.2 39.6 41.1 42.2 43.3 44.2 45.6	Der In 0.840 0.839 0.841 0.837 0.837 0.836 0.833 0.833 0.832 0.831 0.830 0.830 0.830 0.830 0.829	sity Out 0.832 0.830 0.828 0.828 0.827 0.827 0.827 0.826 0.824 0.824 0.823 0.822 0.821 0.820 0.820 0.820	Fuel In 27.67 30.11 27.98 28.500 27.20 27.47 29.35 27.65 29.18 29.97 29.25 28.39 29.10 28.45 28.45 28.28	(kg) Out 16.79 18.37 16.79 17.25 16.34 16.54 17.80 16.73 17.66 18.27 17.76 17.76 17.76 17.76 17.78	Fuel Sample Corrected Fuel (kg) Consumed 10.88 11.74 11.19 11.25 10.86 10.93 11.55 10.92 11.52 11.69 11.49 11.22 11.46 11.19	Density 0.836 0.840 Fuel (kg) / Gross Tonne 0.0753 0.07783 0.07761 0.0771 0.0750 0.0756 0.0756 0.0757 0.0769 0.0757 0.0769 0.0757 0.0767 0.0767 0.0767 0.0750	Temp Deg C 21 15 Tonne km / Fuel kg 10.01 10.42 10.02 10.31 10.18 10.55 10.66 10.37 10.20 10.47 10.20
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Date: Truck No; Make/Mod TREATEI Run No 1 2 3 4 5 6 6 7 8 9 100 111 122 133 144 155 16	lel Time 6.45 7.10 7.30 7.50 8.05 8.25 9.35 9.55 10.35 11.00 11.20 11.20 11.40 12.05 12.30 12.45	Tarmoola 7/05/97 DT 2173 Komatsu 7 Gross Load kg 138800 155800 142800 144800 144800 154800 154800 154800 154800 145800 144800 144800 144800	Haul Mins 3 4 3 </td <td>Time Sec 52 54 47 49 06 51 07 17 70 8 59 07 59 58 47</td> <td>Fuel In 32.95 35.88 33.27 34.00 32.50 32.84 35.11 33.15 35.04 36.02 35.19 34.20 35.19 34.20 35.08 34.34 34.34 34.34 34.17 32.83</td> <td>Amb; Te Amb; Tr Circuit I Truck E (Lt) 0ut 20.18 22.15 20.27 20.01 21.54 20.01 21.54 20.01 21.44 22.21 21.61 21.61 21.06 21.01 21.01</td> <td>emp; Start deg emp; Finish de Distance Metro mpty Weight Fuel (Lt) Consumed 12.77 13.73 13.00 13.16 12.73 12.83 13.57 12.85 13.60 13.81 13.58 13.28 13.28 13.28 13.28 13.28 13.28</td> <td>;; C eg; C es Fuel In 15.4 4.6.4 16.4 14.1 17.8 19.7 20.1 20.1 20.1 20.1 20.1 20.1 20.1 20.1</td> <td>8.1 22.5 785 61800 Temp Out 26.6 30.1 31.9 32.8 34.1 33.9 34.7 37.8 38.2 39.6 41.1 42.2 43.3 44.2 43.3 44.2 45.6 45.8</td> <td>Der In 0.840 0.839 0.841 0.838 0.837 0.836 0.834 0.833 0.832 0.831 0.830 0.830 0.830 0.830 0.829 0.828 0.827</td> <td>asity Out 0.832 0.828 0.828 0.827 0.826 0.824 0.824 0.823 0.822 0.821 0.820 0.820 0.820 0.819 0.818</td> <td>Fuel In 27.67 30.111 27.98 28.50 27.20 27.47 29.35 29.97 29.25 29.97 29.25 28.39 29.10 28.45 28.28 27.16</td> <td>(kg) Out 16.79 18.37 16.79 17.25 16.34 16.54 17.80 16.73 17.66 18.27 17.76 17.18 17.64 17.20 16.47</td> <td>Fuel Sample Corrected Fuel (kg) Consumed 10.88 11.74 11.19 11.25 10.86 10.93 11.55 10.92 11.52 11.69 11.49 11.22 11.46 11.19 11.08 10.68</td> <td>Density 0.836 0.840 Fuel (kg) / Gross Tonne 0.0784 0.0753 0.0783 0.0761 0.0771 0.0756 0.0754 0.0754 0.0757 0.0766 0.0757 0.0750 0.0750 0.0750 0.0750 0.0750 0.0750 0.0750 0.0750 0.0750 0.0750 0.0750 0.0750 0.0750 0.0750 0.0750 0.0753 0.0755 0.0753 0.0755 0.0754 0.0755 0.0754 0.0754 0.0754 0.0756 0.0754 0.0756 0.0754 0.0756 0.0750 0.075</td> <td>Temp Deg C 21 15 Tonne km / Fuel kg 10.01 10.42 10.02 10.31 10.47 10.38 10.55 10.66 10.37 10.20 10.47 10.23 10.47 10.23</td>	Time Sec 52 54 47 49 06 51 07 17 70 8 59 07 59 58 47	Fuel In 32.95 35.88 33.27 34.00 32.50 32.84 35.11 33.15 35.04 36.02 35.19 34.20 35.19 34.20 35.08 34.34 34.34 34.34 34.17 32.83	Amb; Te Amb; Tr Circuit I Truck E (Lt) 0ut 20.18 22.15 20.27 20.01 21.54 20.01 21.54 20.01 21.44 22.21 21.61 21.61 21.06 21.01 21.01	emp; Start deg emp; Finish de Distance Metro mpty Weight Fuel (Lt) Consumed 12.77 13.73 13.00 13.16 12.73 12.83 13.57 12.85 13.60 13.81 13.58 13.28 13.28 13.28 13.28 13.28 13.28	;; C eg; C es Fuel In 15.4 4.6.4 16.4 14.1 17.8 19.7 20.1 20.1 20.1 20.1 20.1 20.1 20.1 20.1	8.1 22.5 785 61800 Temp Out 26.6 30.1 31.9 32.8 34.1 33.9 34.7 37.8 38.2 39.6 41.1 42.2 43.3 44.2 43.3 44.2 45.6 45.8	Der In 0.840 0.839 0.841 0.838 0.837 0.836 0.834 0.833 0.832 0.831 0.830 0.830 0.830 0.830 0.829 0.828 0.827	asity Out 0.832 0.828 0.828 0.827 0.826 0.824 0.824 0.823 0.822 0.821 0.820 0.820 0.820 0.819 0.818	Fuel In 27.67 30.111 27.98 28.50 27.20 27.47 29.35 29.97 29.25 29.97 29.25 28.39 29.10 28.45 28.28 27.16	(kg) Out 16.79 18.37 16.79 17.25 16.34 16.54 17.80 16.73 17.66 18.27 17.76 17.18 17.64 17.20 16.47	Fuel Sample Corrected Fuel (kg) Consumed 10.88 11.74 11.19 11.25 10.86 10.93 11.55 10.92 11.52 11.69 11.49 11.22 11.46 11.19 11.08 10.68	Density 0.836 0.840 Fuel (kg) / Gross Tonne 0.0784 0.0753 0.0783 0.0761 0.0771 0.0756 0.0754 0.0754 0.0757 0.0766 0.0757 0.0750 0.0750 0.0750 0.0750 0.0750 0.0750 0.0750 0.0750 0.0750 0.0750 0.0750 0.0750 0.0750 0.0750 0.0750 0.0753 0.0755 0.0753 0.0755 0.0754 0.0755 0.0754 0.0754 0.0754 0.0756 0.0754 0.0756 0.0754 0.0756 0.0750 0.075	Temp Deg C 21 15 Tonne km / Fuel kg 10.01 10.42 10.02 10.31 10.47 10.38 10.55 10.66 10.37 10.20 10.47 10.23 10.47 10.23
Date: Truck No; Make/Mod TREATEI Run No 1 2 3 4 5 6 6 7 8 9 9 10 11 12 13 14 4 15 16 16 16 16 16 16 16 16 16 16	lel Time 6.45 7.10 7.30 7.30 7.50 8.05 8.25 9.35 9.35 9.35 10.35 11.00 11.20 11.40 12.05 12.30 12.45	Tarmoola 7/05/97 DT 2173 Komatsu 7 Gross Load kg 138800 155800 142800 144800 144800 144800 155800 145800 155800 151800 154800 154800 154800 145800 145800 145800 145800 145800	Haul Mins 3 4 3 </td <td>Time Sec 52 54 47 49 06 51 07 17 70 8 59 07 59 58 47</td> <td>Fuel In 32.95 35.88 33.27 34.00 32.50 32.84 35.11 33.15 35.04 36.02 35.19 34.20 35.19 34.20 35.08 34.34 34.34 34.17 32.83</td> <td>Amb; Tc Amb; Tc Circuit I Truck E (Lt) 0ut 20.18 22.15 20.27 20.84 19.77 20.01 21.54 20.30 21.44 22.21 21.61 20.92 21.41 21.06 21.01 21.04</td> <td>emp; Start deg emp; Finish de Distance Metri Fuel (Lt) Consumed 12.77 13.73 13.00 13.16 12.73 12.83 13.57 12.85 13.60 13.81 13.58 13.28 13.28 13.28 13.28 13.28 13.29</td> <td>;; C esg; C ess Fuel In 15.4 16.4 14.1 17.8 19.7, 20.1 21.0 23.6 25.3 26.8 27.7, 29.1 30.0 31.6 32.7 33.4</td> <td>8.1 22.5 785 61800 Temp Que 30.1 31.9 32.8 34.1 33.9 34.7 37.8 38.2 39.6 41.1 42.2 43.3 44.2 45.6 45.8</td> <td>Den In 0.840 0.839 0.841 0.837 0.836 0.837 0.836 0.832 0.831 0.830 0.830 0.830 0.832 0.831</td> <td>sity Out 0.832 0.830 0.828 0.827 0.827 0.826 0.824 0.823 0.822 0.821 0.820 0.821 0.820 0.821 0.820 0.820 0.821 0.820 0.820 0.820 0.821 0.822 0.821 0.822 0.821 0.823 0.823 0.824 0.824 0.824 0.824 0.824 0.824 0.825 0.825 0.825 0.825 0.825 0.827 0.826 0.827 0.826 0.827 0.826 0.827 0.826 0.827 0.826 0.827 0.826 0.827 0.826 0.827 0.826 0.827 0.826 0.827 0.826 0.827 0.826 0.827 0.826 0.827 0.826 0.827 0.826 0.827 0.826 0.827 0.828 0.827 0.828 0.827 0.828 0.827 0.828 0.827 0.828 0.827 0.828 0.827 0.828 0.827 0.828 0.827 0.828 0.827 0.828 0.827 0.828 0.827 0.828 0.828 0.827 0.828 0.889 0.818</td> <td>Fuel In 27.67 30.11 27.98 27.20 27.20 27.20 29.35 29.918 29.97 29.25 29.10 29.97 29.25 28.39 29.10 29.25 28.28 29.10 6 28.45 28.28 27.167</td> <td>(kg) Out 16.79 18.37 16.79 17.25 16.34 16.54 17.80 16.73 17.66 18.27 17.76 18.27 17.76 17.18 17.64 17.20 16.47</td> <td>Fuel Sample Corrected Fuel (kg) Consumed 10.88 11.74 11.19 11.25 10.86 10.93 11.55 10.92 11.52 11.69 11.49 11.22 11.46 11.19 11.28 11.69</td> <td>Density 0.836 0.840 Fuel (kg) / Gross Tonne 0.0784 0.0753 0.0783 0.0761 0.07750 0.0756 0.07744 0.0756 0.0754 0.0759 0.0759 0.0750 0.0750 0.0750 0.0750 0.0750 0.0750 0.0750 0.0750 0.0750 0.0750 0.0750 0.0750 0.0750 0.0750 0.0750 0.0750 0.0753 0.0753 0.0753 0.0754 0.0754 0.0754 0.0754 0.0754 0.0754 0.0755 0.0754 0.0755 0.0754 0.0755 0.0754 0.0755 0.0754 0.0755 0.0</td> <td>Temp Deg C 21 15 Tonne km / Fuel kg 10.01 10.42 10.02 10.31 10.18 10.47 10.38 10.55 10.66 10.37 10.20 10.47 10.23 10.47</td>	Time Sec 52 54 47 49 06 51 07 17 70 8 59 07 59 58 47	Fuel In 32.95 35.88 33.27 34.00 32.50 32.84 35.11 33.15 35.04 36.02 35.19 34.20 35.19 34.20 35.08 34.34 34.34 34.17 32.83	Amb; 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Date: Truck No; Make/Mod TREATEI Run No 1 2 3 4 5 6 6 7 8 9 10 11 12 13 14 15 6 6 7 8 9 10 11 12 13 14 15 16 16 17 16 16 16 16 16 16 16 16 16 16	lel D Time 6.45 7.10 7.30 7.50 8.05 8.25 9.35 9.35 9.55 10.35 11.00 11.20 11.40 12.05 12.30 12.45	Tarmoola 7/05/97 DT 2173 Komatsu 7 Gross Load kg 138800 145800 144800 144800 144800 145800 155800 145800 155800 145800 145800 145800 145800 143800 143800 143800 143800 143800	85-3 Haul Mins 3 3 3 3 3 3 3 3 3 3 3 3 3 4 4 4 4 4 4	Time Sec 52 16 52 54 47 49 06 51 07 7 7 7 9 08 59 07 59 58 8 47	Fuel In 32.95 35.88 33.27 34.00 32.54 35.11 33.15 35.04 36.02 35.19 34.20 35.08 34.34 34.17 32.83	Amb; Tc Amb; Tc Amb; Tc Circuit 1 Truck E (Lt) 0ut 20.18 20.17 20.27 20.01 21.54 20.30 21.44 20.30 21.44 20.30 21.44 20.21 21.61 20.92 21.51 20.92 21.51 20.92 21.51 20.02 20.13	emp; Start deg emp; Finish de Distance Metry mpty Weight Fuel (Lt) Consumed 12.77 13.73 13.00 13.16 12.73 12.83 13.57 12.85 13.60 13.81 13.58 13.28 13.57	;; C eg; C es Fuel In 15.4 16.4 14.1 17.8 19.7 20.1 20.1 20.1 20.1 20.1 20.1 20.1 20.1	8.1 22.5 785 61800 Temp Out 226.6 30.1 31.9 32.8 34.1 33.9 34.7 37.8 38.2 39.6 41.1 42.2 43.3 44.2 45.6 45.8	Der In 0.840 0.839 0.841 0.838 0.837 0.837 0.836 0.834 0.833 0.832 0.831 0.830 0.830 0.830 0.828 0.827	Isity Out 0.832 0.830 0.828 0.827 0.827 0.827 0.826 0.824 0.824 0.823 0.822 0.821 0.820 0.820 0.820 0.820	Fuel In 27.67 30.11 27.98 28.50 27.20 29.35 27.47 29.35 29.97 29.25 28.39 29.97 29.25 28.39 29.10 28.45 29.4	(kg) Out 16.79 18.37 16.79 17.25 16.34 17.66 17.80 16.73 17.66 17.18 17.64 17.26 17.26 17.25 16.47 17.26 17.25 16.34 17.25 16.34 17.25 16.34 17.25 16.34 17.25 16.34 17.25 16.34 17.25 16.34 17.25 16.34 17.25 16.34 17.25 16.34 17.25 16.34 17.25 16.34 17.25 16.34 17.25 16.34 17.25 16.34 17.25 16.34 17.26 17.25 16.34 17.26 17.25 16.34 17.26 17.25 16.34 17.26 17.25 16.34 17.26 17.26 17.25 16.34 17.26 17.26 17.26 17.26 17.26 17.26 17.26 16.34 17.26	Fuel Sample Corrected Fuel (kg) Consumed 10.88 11.74 11.19 11.25 10.86 10.93 11.55 10.92 11.55 11.69 11.49 11.22 11.49 11.22 11.49 11.22 11.68 10.68	Density 0.836 0.840 Fuel (kg) / Gross Tonne 0.0784 0.0753 0.0783 0.0764 0.0771 0.0750 0.0756 0.0744 0.0736 0.0757 0.0769 0.0750 0.0750 0.0753 0.0758 0.0758 0.00743	Temp Deg C 21 15 Tonne km / Fuel kg 10.01 10.42 10.02 10.31 10.55 10.55 10.55 10.66 10.37 10.20 10.47 10.23 10.47 10.23 10.47 10.23 10.47 10.23 10.47 10.23 10.47 10.23 10.47 10.23 10.47 10.23 10.47 10.23 10.47 10.23 10.47 10.23 10.47 10.23 10.42 10.55 10.
Date: Truck No; Make/Mod TREATEI Run No 1 2 3 4 4 5 6 6 7 8 9 10 11 12 13 14 15 16 16 Mean Std Dev C.V	lel D Time 6.45 7.10 7.30 7.50 8.25 8.25 9.35 9.35 9.35 10.35 11.00 11.20 11.40 12.45 12.45	Tarmoola 7/05/97 DT 2173 Komatsu 7 Gross Load kg 138800 142800 142800 144800 144800 145800 1588000 158800 1588000 1588000 158800	85-3 Haul Mins 3 3 4 4 3 3 3 3 3 4 4 4 4 4 4 4 4 4 4	Time Sec 52 54 47 49 06 51 07 17 08 59 07 07 59 58 8 47	Fuel In 32.95 35.88 33.27 34.00 32.84 35.11 33.15 35.04 36.02 35.19 34.20 35.08 34.34 34.34 34.34 34.34 34.34	Amb; Tc Amb; Tc Amb; Tc Circuit 1 Truck E (Lt) 0ut 20.18 22.15 20.27 20.84 19.77 20.01 21.54 20.30 21.51 20.30 21.44 22.31 20.92 21.51 20.92 21.51 20.92 21.51 20.03	emp; Start deg emp; Finish de Distance Metri- mpty Weight Fuel (Lt) Consumed 12.77 13.73 13.00 13.16 12.73 12.83 13.57 12.85 13.60 13.81 13.58 13.28 13.57 13.28 13.57 13.28 13.57 13.28 13.57 13.28 13.57 13.28 13.57 13.28 13.57 13.28 13.57 13.28 13.57 13.28 13.57 13.28 13.57 13.28 13.57 13.28 13.57 13.28 13.57 13.58 13.57	;; C eg; C es Fuel 16.4 16.4 14.1 17.8 19.7 20.1 20.1 20.1 20.1 20.1 20.1 20.1 20.1	8.1 22.5 785 61800 Temp Out 26.6 30.1 31.9 32.8 34.1 33.9 34.7 37.8 38.2 39.6 41.1 42.2 43.3 44.2 45.6 45.8	Der In 0.840 0.839 0.841 0.838 0.837 0.837 0.833 0.832 0.832 0.830 0.830 0.830 0.829 0.827	sity Out 0.832 0.830 0.828 0.828 0.827 0.827 0.826 0.824 0.824 0.822 0.821 0.820 0.820 0.818	Fuel In 27.67 30.11 27.98 28.50 27.20 29.25 29.25 28.39 29.10 29.25 28.39 29.10 28.45 22.25 28.39 29.10 28.45 27.16	(kg) Out 16.79 18.37 16.79 17.25 16.34 16.54 17.80 16.73 17.66 17.18 17.64 17.18 17.64 17.26 17.26	Fuel Sample Corrected Fuel (kg) Consumed 10.88 11.74 11.19 11.25 10.86 10.93 11.55 10.92 11.52 11.69 11.49 11.22 11.46 11.19 11.08 10.68	Density 0.836 0.840 Fuel (kg) / Gross Tonne 0.0753 0.07783 0.07761 0.0771 0.07750 0.0750 0.0756 0.07744 0.0744 0.0736 0.0757 0.0769 0.0750 0.0750 0.0750 0.0758 0.0014	Temp Deg C 21 15 Tonne km / Fuel kg 10.01 10.42 10.02 10.31 10.18 10.47 10.38 10.55 10.66 10.37 10.20 10.47 10.23 10.47 10.23 10.47 10.57 10.57 10.57 10.57 10.57 10.37 10.931
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GRAPH 1 FUEL EFFICIENCY CHANGE



FUEL EFFICIENCY CHANGE

	Tkm/kg
Untreated	9.71
FTC-1 Treated	10.37
% CHANGE	- 6.7%

To prove the statistical significance of the difference in means between baseline and treated test a Students t-test was performed.

Formula: $t = x_1 - x_2$ $\frac{(n_1 - 1) S_1^2 + (n_2 - 1) S_2^2 - 1 + 1}{(n_1 - n_2 - 2)}$

Hypothesis: $H_0: U_1 - U_2 = 0$

$$H_1: U_1 - U_2 \neq 0$$

where:-

Baseline	Treated	1
$x_1 = 9.72$	$x_2 = 10$.37
n ₁ = 16	$n_2 = 16$	
s ₁ =	$S_2 = 0.1$	193080373
0.195655419		
Confidence Level	=	99%
α	=	0.005
degrees of freedom	=	30
Critical t value	=	2.75
t	=	-9.48

Since -9.48 is outside the range +/-2.75 we reject H₀ and accept H₁ and conclude that the difference between truck efficiency means is significant at a 99% confidence level.

T-test spreadsheet is included in the appendices.

2. CARBON BALANCE TESTS

The dump trucks were tested adjacent the haul road to the south waste dump and atop the north waste dump. Each unit was driven to the test location where unit numbers (630E) 2183, 2184 and (785-3) 2174, 2178 and 2179 had brakes applied, transmission set to park and engine RPM set to (630E) 1900 and (785-3) 2000 RPM.

Once the exhaust temperature had stabilised five readings were taken for each parameter and a Bosch Smoke sample drawn.

A summary of the results of the individual Carbon Balance and smoke tests are shown in Tables II and III.

CARBON BALANCE								
Equipment	Unit No.	Carbon Flow g/sec						
Komatsu Dump truck		Baseline	Treated	% Variation				
630E (Top Exhaust)	2183	4.985	4.604	-7.6				
630E (Bottom Exhaust)		5.099	4.674	-8.3				
Subtotal		10.084	9.278	-8.0				
630E (Top Exhaust)	2184	5.137	4.917	-4.3				
630E (Bottom Exhaust)		5.158	4.880	-5.4				
Subtotal		10.295	9.797	-4.8				
785-3	2174	10.047	9.356	-6.9				
785-3	2178	12.608	11.359	-9.9				
785-3	2179	10.307	9.938	-3.6				

TABLE II					
ARBON	RAI	Δ	NC		

FLEET AVERAGE	10.668	9.946	- 6.8

3. BOSCH SMOKE MEASUREMENTS

Bosch Smoke measurements using a Bosch Smoke meter were taken. The Bosch scale ranges from 0.0 (Clean) to 9.9 (Dirty).

Unit No.	Baseline	Treated	% Variation
2183 (Top)	0.3	0.2	-33
2183 (Bottom)	0.3	0.2	-33
2184 (Top)	0.4	0.4	N/C
2184 (Bottom)	0.6	0.3	-50
2174	0.5	0.5	N/C
2178	0.9	0.6	-33
2179	0.8	0.4	-50
FLEET AVERAGE	0.54	0.37	- 31

Table IIBOSCH SMOKE MEASUREMENTS

Smoke patches are included in Appendix A.

CONCLUSION

The controlled fuel efficiency studies conducted at MacMahon Contractor's Tarmoola mine site have provided clear evidence of reduced fuel consumption following the introduction of Fuel Technology's Combustion Catalyst, FTC.

The Measured average reduction in Tonnes kilometre per kilograms of fuel represents an efficiency gain in the order of 6.7%. The Carbon Balance test confirmed the fuel the fuel efficiency improvement with a 6.8% reduction in fuel consumption measured. Improved smoke emissions also demonstrates improved combustion providing the potential for substantial maintenance benefits.

The Student t-Test applied to the Haul Truck Volumetric Fuel Consumption Test confirms that the difference between untreated and treated tests is significant at a 99% confidence level.

BIBLIOGRAPHY

Koehler, D. & Doglio, J. (1987). <u>SAE Technical Paper 872146: Benefits of Multifunctional Diesel</u> <u>Fuel Additives Demonstration in a Fleet Test.</u> The Engineering Society For Advanced Mobility Land Sea Air And Space.

Appendix "A"

TEST WORKSHEETS

Appendix "*B*"

CARBON BALANCE SPREADSHEETS

Appendix "D"

BOSCH SMOKE PATCHES

Appendix "C"

STUDENT t-TEST