

UWTSD

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Engine Performance Characteristics

ACHA4003

Finn Flye

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1. Introduction

The purpose of this assignment is to understand how an engine dynamometer functions and what data can be produced when running an engine at different Rpm's and loads. The engine dynamometer is 'a means of measuring torque, force and power from a rotating shaft (Killedar, 2012)'. For this assignment an experiment will be undergone to collect numerical data, using the data collected other figures can be calculated to find out the overall Specific Fuel Consumption (SFC) and the Thermal Efficiency of the engine, this will show how much fuel is consumed per Kilogram per Kilowatt hours and how efficient the engine is and how much power is lost due to heat. Additionally, graphs will be plotted to show the relationship between the Torque, Brake power and the SFC against the engine speed to determine what occurs at different Rpm's and why variations can arise.

Furthermore, there will be an analysis of the performance of the task carried out and how changes could have been made to personal performance and how the overall investigation could have been improved.

2. Methodology and Equipment

To conduct this experiment the Sweep test was used, using the P-curve system within the dynamometer. This allowed increments of 50 rpm to be measured as the engine was revved, using the sensors built into the dynamometer to 'feed data back into the engine management system, also enabling precise control (Zuccato, 2006)' this precise control can either be conducted manually through the dials or parameters set within the management system. For this experiment parameters were set with the boundaries of rpm reading the max at 5500rpm and the timed and logged intervals. Although, using this system meant the sensors would have to keep up with the engine this meant that the 'engine wouldn't overheat and cause overburdening strain onto the dynamometer (Fall, 2021)'.

The data fed back consisted of the Rpm of the engine showing the intervals of 50 from 1000rpm to 5500rpm, while showing the increasing load applied by the Calibration arms. With the exterior systems in place the Lambda values were recorded through the Lambda sensor that was plugged into the engine and the fuel flow rate was retrieved by the flow sensors.



Figure 2-1 Photograph of Engine Dynamometer (F. Flye, 2025)

This figure shows the engine dynamometer that is attached to the 1.6L engine. The dynamometer consists of an inner and outer casing, the inner casing rotates freely with the rotating shaft while the outer casing holds 'electromagnetic current that can be used to resist the motion of the rotating shaft to try and halt the engine as if it were a brake (Fall, 2021)'.

The white box in the figure above is the throttle actuator box which supplies the engine management system with recorded readings of the throttle position throughout the system. 'When the actuator is closed this causes the engine to run at idle as if it were an accelerator pedal in a car (2CarPros, 2022)' This is more precisely done through the usage of a dial which can be found in the control room.

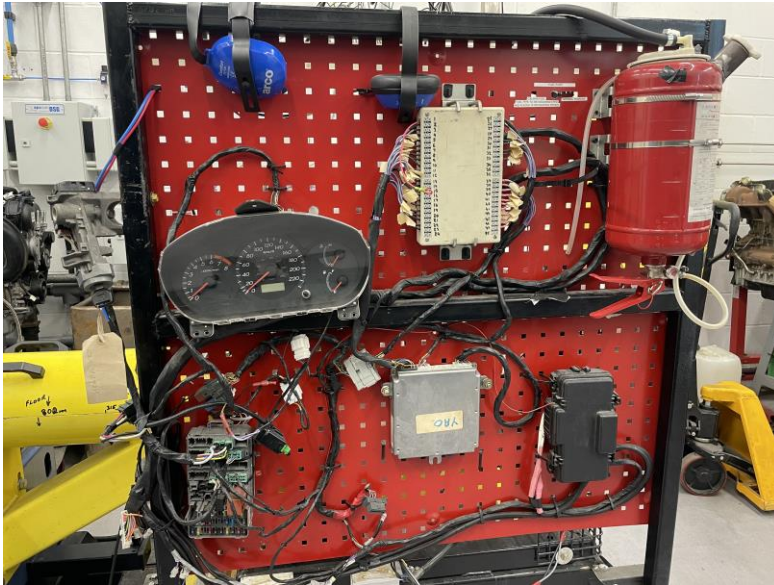


Figure 2-2 Photograph of the self-containing engine rig (F. Flye, 2025)

This figure contains the rig that the engine is self-contained on, having the basic functions and main functions ultimately implemented through the sensor modules, which are then controlled by the management system in the control room.

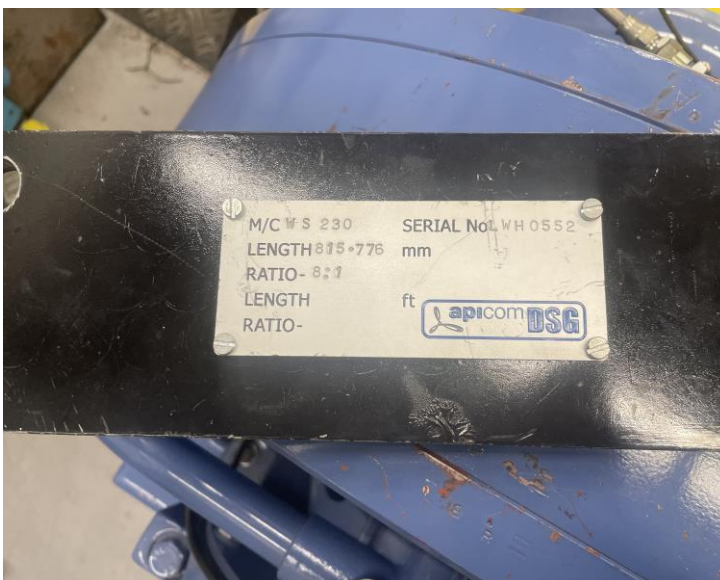


Figure 2-3 Photograph of Calibration arm (F. Flye, 2025)

Within this figure is the Calibration arm that is used to control the load on the outer casing of the dynamometer causing the resistance against the direction the engine is rotating. When the load is changed the torque changes as well due to the increase in electromagnetic current in the casing.

The length shown on the Calibration Arm shows the 'distance between the pivot in the centre of the dynamometer to the hook eye (Fall, 2021)'. The hook eye is the location where the masses are hung from.



Figure 2-4 Photograph of the Dynamometer/ Engine speed and torque (F. Flye, 2025)

Figure 2-4 shows the system that was used to observe the torque and speed of both the Engine and Dynamometer, this was useful in the understanding of how the controls of the dynamometer effect the torque and how the increase effects the rpm of the engine. This screen also displays the value of torque being used manually with the dial in the control room as shown with the larger gauge, this helps keep a readily control over how much torque is fed into the dynamometer.

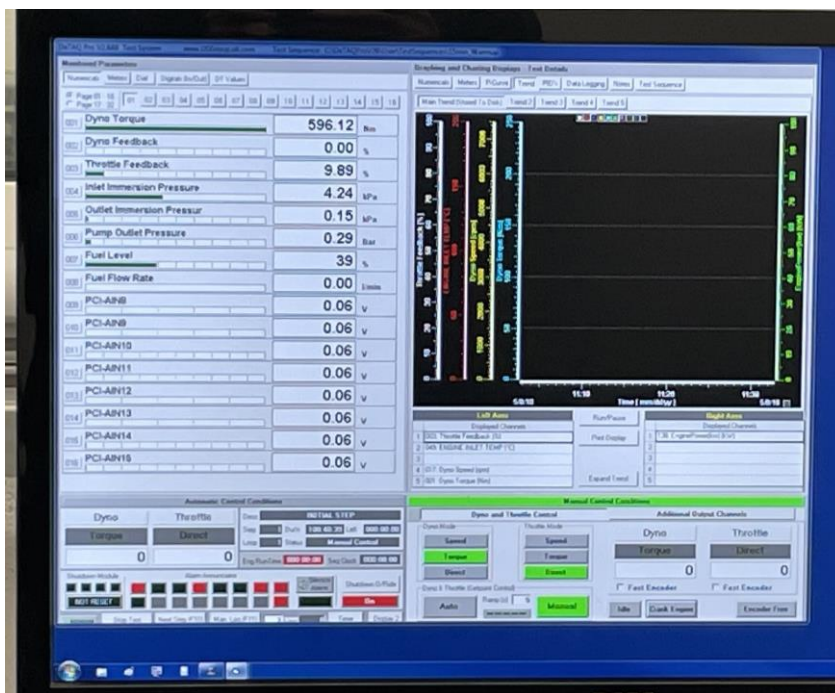


Figure 2-5 Photograph of the Dynamometer testing system (F. Flye, 2021)

This figure shows the system that displays the real time graph that is collected when the dynamometer is manually operated where torque is from 0 to 200Nm and Throttle is between 0 and 100% direct. This graph also conveys the values of Lambda and the rate at which the fuel is flowing. Using manual mode will allow for targeted Rpm and loads to find exact values. However, this system will also allow for the sweep test to be conducted, allowing for more accurate and quicker results.

3. Dynamometer Data

	4	Load	Dyno Speed	Fuel Flow Rate	Fuel Flow Rate	Lambda	Torque	Torque	BHP	Power (P)	Corrected P	BMEP	BMEP	M of fuel per hour	BSCF	SFC	Energy Input	Thermal Efficiency
	5	Newtons	rpm	l/min	l/hour	Lambda	Nm	lb.ft	HP	kW	kW	Pa	kPa	kg/h	g/kwh	kg/kwh	MJ/h	%
	6	102.275	1000	0.0704	4.224	1.2658	83.43	61.54	11.72	8.74	9.05	46012.19	46.01	3.168	1260.06	0.350	145.09	22.46
	7	102.756	1050	0.0724	4.344	1.2658	83.83	61.83	12.36	9.22	9.55	46228.59	46.23	3.258	1228.373	0.341	149.22	23.04
	8	103.689	1100	0.0737	4.422	1.2658	84.59	62.39	13.07	9.74	10.09	46648.33	46.65	3.3165	1182.852	0.329	151.90	23.92
	9	104.209	1150	0.0728	4.368	1.2658	85.01	62.70	13.73	10.24	10.61	46882.27	46.88	3.276	1112.03	0.309	150.04	25.45
	10	105.811	1200	0.0744	4.464	1.2658	86.32	63.66	14.55	10.85	11.24	47602.99	47.60	3.348	1072.628	0.298	153.34	26.38
	11	107.51	1250	0.07895	4.737	1.2658	87.70	64.69	15.40	11.48	11.89	48367.35	48.37	3.55275	1075.428	0.299	162.72	26.31
	12	109.488	1300	0.079	4.74	1.2658	89.32	65.88	16.31	12.16	12.60	49257.23	49.26	3.555	1016.027	0.282	162.82	27.85
	13	111.797	1350	0.0796	4.776	1.2658	91.20	67.27	17.29	12.89	13.36	50296.02	50.30	3.582	965.4667	0.268	164.06	29.31
	14	114.268	1400	0.0835	5.01	1.2658	93.22	68.75	18.33	13.67	14.16	51407.69	51.41	3.7575	955.4808	0.265	172.09	29.62
	15	115.783	1450	0.0847	5.082	1.2658	94.45	69.66	19.23	14.34	14.86	52089.27	52.09	3.8115	923.5465	0.257	174.57	30.64
	16	116.985	1500	0.08865	5.319	1.2658	95.43	70.39	20.10	14.99	15.53	52630.03	52.63	3.98925	924.795	0.257	182.71	30.60
	17	117.788	1550	0.0932	5.592	1.2658	96.09	70.87	20.92	15.60	16.16	52991.29	52.99	4.194	934.4828	0.260	192.09	30.28
	18	118.471	1600	0.0959	5.754	1.2658	96.65	71.28	21.72	16.19	16.77	53298.56	53.30	4.3155	926.1359	0.257	197.65	30.55
	19	118.772	1650	0.09875	5.925	1.2658	96.89	71.46	22.45	16.74	17.34	53433.98	53.43	4.44375	922.4169	0.256	203.52	30.68
	20	118.656	1700	0.10005	6.003	1.2658	96.80	71.39	23.11	17.23	17.85	53381.79	53.38	4.50225	907.9598	0.252	206.20	31.17
	21	118.861	1750	0.10305	6.183	1.2658	96.96	71.52	23.83	17.77	18.41	53474.02	53.47	4.63725	906.8986	0.252	212.39	31.20
	22	119.584	1800	0.1093	6.558	1.2658	97.55	71.95	24.66	18.39	19.05	53799.29	53.80	4.9185	929.5286	0.258	225.27	30.44
	23	119.934	1850	0.11415	6.849	1.2658	97.84	72.16	25.42	18.96	19.64	53956.75	53.96	5.13675	941.7812	0.262	235.26	30.05
	24	120.176	1900	0.11745	7.047	1.2658	98.04	72.31	26.16	19.51	20.21	54065.62	54.07	5.28525	941.6074	0.262	242.06	30.05
	25	120.948	1950	0.12055	7.233	1.2658	98.67	72.77	27.02	20.15	20.87	54412.93	54.41	5.42475	935.6687	0.260	248.45	30.24
	26	122.157	2000	0.12555	7.533	1.2658	99.65	73.50	27.99	20.87	21.62	54956.85	54.96	5.64975	940.7117	0.261	258.76	30.08
	27	122.845	2050	0.12785	7.671	1.2658	100.21	73.91	28.85	21.51	22.29	55266.37	55.27	5.75325	929.3463	0.258	263.50	30.45
	28	123.796	2100	0.1309	7.854	1.2658	100.99	74.49	29.78	22.21	23.01	55694.21	55.69	5.8905	921.7261	0.256	269.78	30.70
	29	124.794	2150	0.13435	8.061	1.2658	101.80	75.09	30.74	22.92	23.74	56143.2	56.14	6.04575	916.6292	0.255	276.90	30.87
	30	125.137	2200	0.1377	8.262	1.2658	102.08	75.29	31.54	23.52	24.36	56297.51	56.30	6.1965	915.6167	0.254	283.80	30.90
	31	126.028	2250	0.14105	8.463	1.2658	102.81	75.83	32.49	24.22	25.09	56698.36	56.70	6.34725	910.5666	0.253	290.70	31.08
	32	126.66	2300	0.14495	8.697	1.2658	103.33	76.21	33.37	24.89	25.78	56982.69	56.98	6.52275	910.8336	0.253	298.74	31.07
	33	126.822	2350	0.14985	8.991	1.2658	103.46	76.31	34.14	25.46	26.37	57055.57	57.06	6.74325	920.4124	0.256	308.84	30.74
	34	126.69	2400	0.1537	9.222	1.2658	103.35	76.23	34.83	25.98	26.91	56996.18	57.00	6.9165	925.3552	0.257	316.78	30.58
	35	126.552	2450	0.15565	9.339	1.2658	103.24	76.14	35.52	26.49	27.44	56934.1	56.93	7.00425	918.9718	0.255	320.79	30.79
	36	126.438	2500	0.1596	9.576	1.2658	103.15	76.08	36.21	27.00	27.97	56882.81	56.88	7.182	924.2797	0.257	328.94	30.62
	37	126.239	2550	0.1626	9.756	1.2658	102.98	75.96	36.88	27.50	28.49	56793.29	56.79	7.317	924.6449	0.257	335.12	30.60
	38	126.161	2600	0.16805	10.083	1.2658	102.92	75.91	37.58	28.02	29.03	56758.19	56.76	7.56225	937.8388	0.261	346.35	30.17
	39	125.847	2650	0.17145	10.287	1.2658	102.66	75.72	38.21	28.49	29.51	56616.93	56.62	7.71525	941.1025	0.261	353.36	30.07
	40	124.911	2700	0.17465	10.479	1.2658	101.90	75.16	38.64	28.81	29.85	56195.84	56.20	7.85925	947.965	0.263	359.95	29.85
	41	123.927	2750	0.1784	10.704	1.2658	101.10	74.56	39.04	29.11	30.16	55753.15	55.75	8.028	958.2623	0.266	367.68	29.53
	42	123.689	2800	0.18005	10.803	1.2658	100.90	74.42	39.68	29.59	30.65	55646.07	55.65	8.10225	951.6827	0.264	371.08	29.73
	43	123.389	2850	0.1831	10.986	1.2658	100.66	74.24	40.29	30.04	31.12	55511.11	55.51	8.2395	953.1367	0.265	377.37	29.69
	44	122.519	2900	0.1879	11.274	1.2658	99.95	73.42	40.70	30.35	31.44	55119.71	55.12	8.4555	968.085	0.269	387.26	29.23

Figure 3-1 Calculated Data up until 2900rpm (F. Flye, 2025)

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
43	123.389	2850	0.1831	10.986	1.2658	100.66	74.24	40.29	30.04	31.12	55511.11	55.51	8.2395	953.1367	0.265	377.37	29.69
44	122.519	2900	0.1879	11.274	1.2658	99.95	73.72	40.70	30.35	31.44	55119.71	55.12	8.4555	968.085	0.269	387.26	29.23
45	121.837	2950	0.19255	11.553	1.2658	99.39	73.31	41.18	30.71	31.81	54812.88	54.81	8.66475	980.6871	0.272	396.85	28.85
46	121.709	3000	0.199	11.94	1.2658	98.29	73.23	41.83	31.19	32.31	54755.3	54.76	8.955	997.6938	0.277	410.14	28.36
47	121.123	3050	0.20605	12.363	1.2658	98.81	72.88	42.32	31.56	32.69	54491.66	54.49	9.27225	1021.02	0.284	424.67	27.71
48	121.124	3100	0.21005	12.603	1.2658	98.81	72.88	43.02	32.08	33.23	54492.11	54.49	9.45225	1024.045	0.284	432.91	27.63
49	120.851	3150	0.21605	12.963	1.2658	98.59	72.71	43.61	32.52	33.69	54369.29	54.37	9.72225	1038.919	0.289	445.28	27.24
50	120.596	3200	0.21795	13.077	1.2658	98.38	72.56	44.21	32.97	34.15	54254.57	54.25	9.80775	1033.861	0.287	449.19	27.37
51	120.84	3250	0.22305	13.383	1.2658	98.58	72.71	44.99	33.55	34.76	54364.35	54.36	10.03725	1039.672	0.289	459.71	27.22
52	121.633	3300	0.2255	13.53	1.2658	99.23	73.18	45.98	34.29	35.52	54721.11	54.72	10.1475	1028.417	0.286	464.76	27.52
53	122.181	3350	0.2285	13.71	1.2658	99.67	73.51	46.89	34.97	36.22	54967.64	54.97	10.2825	1021.941	0.284	470.94	27.69
54	122.933	3400	0.2342	14.052	1.2658	100.29	73.97	47.88	35.71	36.99	55305.96	55.31	10.539	1025.717	0.285	482.69	27.59
55	123.475	3450	0.23605	14.163	1.2658	100.73	74.29	48.80	36.39	37.70	55549.8	55.55	10.62225	1014.364	0.282	486.50	27.90
56	123.428	3500	0.24195	14.517	1.2658	100.69	74.26	49.49	36.91	38.23	55528.65	55.53	10.88775	1025.255	0.285	498.66	27.60
57	124.205	3550	0.24545	14.727	1.2658	101.32	74.73	50.51	37.67	39.02	55878.22	55.88	11.04525	1019.022	0.283	505.87	27.77
58	124.066	3600	0.25505	15.303	1.2658	101.21	74.65	51.17	38.16	39.53	55815.68	55.82	11.47725	1045.342	0.290	525.66	27.07
59	123.967	3650	0.25755	15.453	1.2658	101.13	74.59	51.84	38.66	40.04	55771.14	55.77	11.58975	1041.959	0.289	530.81	27.16
60	123.815	3700	0.26445	15.867	1.2658	101.01	74.50	52.48	39.14	40.54	55702.76	55.70	11.90025	1056.712	0.294	545.03	26.78
61	123.767	3750	0.2651	15.906	1.2658	100.97	74.47	53.17	39.65	41.07	55681.16	55.68	11.9295	1045.591	0.290	546.37	27.06
62	123.509	3800	0.2693	16.158	1.2658	100.76	74.31	53.77	40.10	41.53	55565.09	55.57	12.1185	1050.37	0.292	555.03	26.94
63	122.672	3850	0.27375	16.425	1.2658	100.07	73.81	54.11	40.35	41.80	55188.54	55.19	12.31875	1061.051	0.295	564.20	26.67
64	122.157	3900	0.2759	16.554	1.2658	99.65	73.50	54.58	40.72	42.16	54956.85	54.96	12.4155	1060.125	0.294	568.63	26.69
65	121.184	3950	0.28285	16.971	1.2658	98.86	72.91	54.94	40.89	42.36	54519.11	54.52	12.72825	1081.688	0.300	582.95	26.16
66	120.004	4000	0.28455	17.073	1.2658	97.90	72.20	54.49	41.01	42.48	53988.24	53.99	12.80475	1085.153	0.301	586.46	26.08
67	118.734	4050	0.2871	17.226	1.2658	96.86	71.44	55.09	41.08	42.56	53416.88	53.42	12.9195	1092.927	0.304	591.71	25.89
68	117.442	4100	0.28895	17.337	1.2658	95.81	70.66	55.16	41.14	42.61	52835.63	52.84	13.00275	1098.509	0.305	595.53	25.76
69	116.5	4150	0.29305	17.583	1.2658	95.04	70.10	55.39	41.30	42.79	52411.84	52.41	13.18725	1109.573	0.308	603.98	25.50
70	115.931	4200	0.2949	17.694	1.2658	94.57	69.75	55.78	41.60	43.09	52155.85	52.16	13.2705	1108.7	0.308	607.79	25.52
71	115.034	4250	0.29715	17.829	1.2658	93.84	69.21	56.01	41.77	43.27	51752.3	51.75	13.37175	1112.625	0.309	612.43	25.43
72	114.391	4300	0.3022	18.132	1.2658	93.32	68.83	56.35	42.02	43.53	51463.02	51.46	13.599	1124.663	0.312	622.83	25.16
73	114.016	4350	0.30605	18.363	1.2658	93.01	68.60	56.82	42.37	43.89	51294.32	51.29	13.77225	1129.602	0.314	630.77	25.05
74	113.871	4400	0.3092	18.552	1.2658	92.89	68.51	57.40	42.80	44.34	51229.08	51.23	13.914	1129.697	0.314	637.26	25.05
75	113.985	4450	0.3099	18.594	1.2658	92.99	68.58	58.11	43.33	44.89	51280.37	51.28	13.9455	1118.413	0.311	638.70	25.30
76	113.306	4500	0.31445	18.867	1.2658	92.43	68.17	58.41	43.56	45.12	50974.9	50.97	14.15025	1128.949	0.314	648.08	25.06
77	113.074	4550	0.3171	19.026	1.2658	92.24	68.03	58.94	43.95	45.53	50870.52	50.87	14.2695	1128.263	0.313	653.54	25.08
78	112.195	4600	0.3194	19.164	1.2658	91.53	67.51	59.13	44.09	45.67	50475.07	50.48	14.373	1132.9	0.315	658.28	24.98
79	111.061	4650	0.32055	19.233	1.2658	90.60	66.82	59.16	44.12	45.70	49964.9	49.96	14.42475	1136.238	0.316	660.65	24.90
80	109.973	4700	0.3207	19.242	1.2658	89.71	66.17	59.21	44.16	45.74	49475.42	49.48	14.5315	1135.803	0.316	660.96	24.91
81	108.654	4750	0.32485	19.491	1.2658	88.64	65.38	59.13	44.09	45.67	48882.02	48.88	14.61825	1152.21	0.320	669.52	24.56
82	107.076	4800	0.32455	19.473	1.2658	87.35	64.43	58.88	43.91	45.48	48172.1	48.17	14.60475	1155.943	0.321	668.90	24.48
83	105.24	4850	0.3257	19.542	1.2658	85.85	63.32	58.47	43.60	45.17	47346.11	47.35	14.6565	1168.109	0.324	671.27	24.22
84	103.632	4900	0.3277	19.662	1.2658	84.54	62.35	58.17	43.38	44.94	46622.69	46.62	14.7465	1181.339	0.328	675.39	23.95
85	102.335	4950	0.32845	19.707	1.2658	83.48	61.57	58.03	43.28	44.83	46039.19	46.04	14.78025	1186.938	0.330	676.94	23.84
86	101.106	5000	0.3287	19.722	1.2658	82.48	60.83	57.91	43.19	44.74	45486.28	45.49	14.7915	1190.258	0.331	677.45	23.77
87	99.3149	5050	0.32985	19.791	1.2658	81.02	59.76	57.46	42.85	44.38	44680.48	44.68	14.84325	1203.923	0.334	679.82	23.50

85	102.335	4950	0.32845	19.707	1.2658	83.48	61.57	58.03	43.28	44.83	46099.19	46.04	14.78025	1186.938	0.330	676.94	23.84
86	101.106	5000	0.3287	19.722	1.2658	82.48	60.83	57.91	43.19	44.74	45486.28	45.49	14.7915	1190.258	0.331	677.45	23.77
87	99.3149	5050	0.32985	19.791	1.2658	81.02	59.76	57.46	42.85	44.38	44680.48	44.68	14.84325	1203.923	0.334	679.82	23.50
88	97.5815	5100	0.3297	19.782	1.2658	79.60	58.71	57.01	42.52	44.04	43900.65	43.90	14.8365	1212.745	0.337	679.51	23.33
89	95.8486	5150	0.33095	19.857	1.2658	78.19	57.67	56.55	42.17	43.68	43121.04	43.12	14.89275	1227.319	0.341	682.09	23.06
90	94.8033	5200	0.3338	20.028	1.2658	77.34	57.04	56.48	42.12	43.63	42650.77	42.65	15.021	1239.503	0.344	687.96	22.83
91	93.0976	5250	0.3313	19.878	1.2658	75.95	56.02	55.99	41.76	43.25	41883.4	41.88	14.9085	1240.829	0.345	682.81	22.80
92	91.7886	5300	0.3324	19.944	1.2658	74.88	55.23	55.73	41.56	43.05	41294.5	41.29	14.958	1250.79	0.347	685.08	22.62
93	90.5938	5350	0.3308	19.848	1.2658	73.90	54.51	55.53	41.41	42.89	40756.97	40.76	14.886	1249.4	0.347	681.78	22.65
94	89.6374	5400	0.3388	20.328	1.2658	73.12	53.93	55.45	41.35	42.84	40326.7	40.33	15.246	1281.293	0.356	698.27	22.08
95	88.9256	5450	0.3438	20.628	1.2658	72.54	53.51	55.52	41.40	42.89	40006.47	40.01	15.471	1298.586	0.361	708.57	21.79
96	88.6474	5500	0.3488	20.928	1.2658	72.32	53.34	55.86	41.65	43.15	39881.31	39.88	15.696	1309.592	0.364	718.88	21.61
97																	

Figure 3-3 Calculated data up to Maximum rpm of 5500 (F. Flye, 2025)

The method used to calculate torque comes from the ‘handout master Pt.1 (Summerfield, 2019)’ using the formula $T = W \cdot R$

W being the load and R being the radius (the length of the calibration arm)

To calculate the Specific fuel consumption the equation $SFC = \frac{\text{Corrected Power}}{\text{Mass of fuel per hour}}$ was used which is a deviation of the equation found in the ‘handout master Pt.1 (Summerfield, 2019)’

Nm - lb.ft	Correction Factor	Baro	Humidity	Ambient temp	St Temp	AP	St P	AT	ST	St P	kW - MJ/h
		mBar	%	Deg C	Deg C	kPa	kPa	K	K	mBar	
0.73756	1.035890421	1018.9	46	27	15	101.89	101.325	300	288	1013.25	3.6

Figure 3-3 Data given and Collected conversions (F. Flye, 2025)

1					
2	R (D)	0.815776	m		
3	Bore	75	mm	37.5	mm
4	Stroke	90	mm		
5	Swept Vol	397607.82	mm ³	397.61	cm ³
6	Temp	27	°C		
7	AP	101.89	kPa		
8	CV Petrol	45.8	MJ/kg		
9	Fuel Mass	0.75	kg/L		
10	cc	1590.4	cc	1.6	liters
11	No. Cyl	4			
12	Standard Pressure	101.325	kPa		
13	Standard Temperature	15	°C		
14					

Figure 3-5 Data given and collected from the engine specifications and Calculated (F. Flye, 2025)

To calculate the Swept volume of a cylinder the equation $\pi \cdot r^2 \cdot l$ was used to then calculate the Engine capacity using the value recorded times the number of cylinders.

$$Cc = \text{swept volume} \cdot 4$$

This equation derives from the one stated in the 'handout master Pt.1 (Summerfield, 2019)'

4. Graphical Data

4.1. Why does SFC vary with Engine Speed?

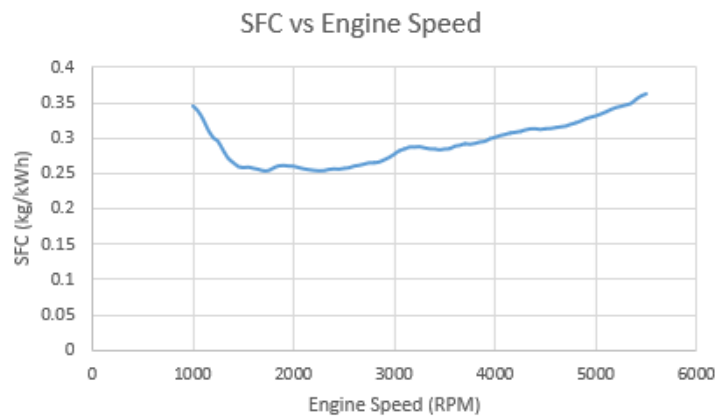


Figure 4-1 Smoothed SFC against Engine Speed (F. Flye, 2025)

There are many reasons why the specific fuel consumption varies within the rpm of the engine as a 'higher speed and load will increase the fuel mass flow rate (Stark, 2017)', thus increasing the specific fuel consumption as shown in the figure above. Where the Consumption falls is where engine is becoming more optimal up until a certain speed, thus the SFC reduces before its gradual increase as more elements come into effect as at higher speeds the engine is prone to mechanical losses, 'through friction in the pistons and crankshaft (X-Engineer, 2025)'. Alternatively, the SFC could be affected by the way the throttle is used as at low speeds the throttle operates partially meaning more fuel is consumed as a result of the inefficiency.

4.2. Why does Torque vary with Engine Speed?

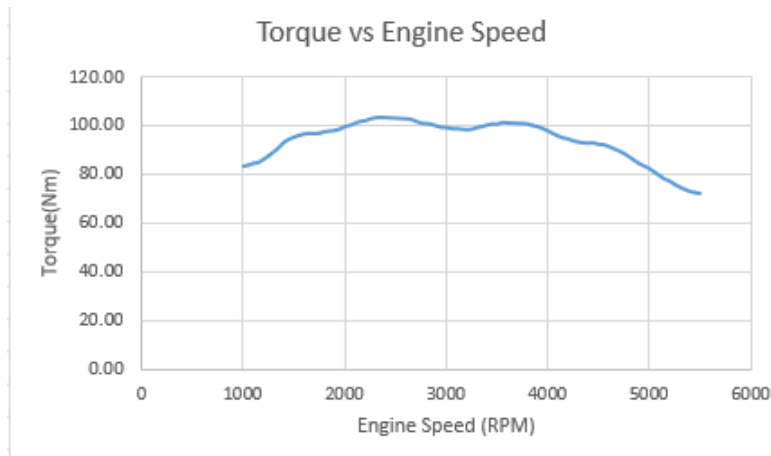


Figure 4-2 Torque against Engine Speed (F. Flye, 2025)

Figure 4-2 shows how torque is affected by the engine speed, typically in petrol engines there will be a peak torque where the engine has reached its maximum efficiency and as shown in the graph above the peak is around 2400rpm and 'any speed after this the torque decreases due to an increase in friction within the moving parts (CarBikeTech, 2015)'. The peak being at a relatively low rpm is due to the fact that the engine can generate more force to propel itself than at higher speeds. Furthermore, this could be due to 'exhaust back pressure as it will reduce the volume of fresh air in the engine thus decreasing volumetric efficiency (Sivaram, Rajavel, Vinothkumar, 2017)', which in turn reduces torque as the engines ability to combust air mixtures will reduce.

4.3. Why does Brake Power vary with Engine Speed?

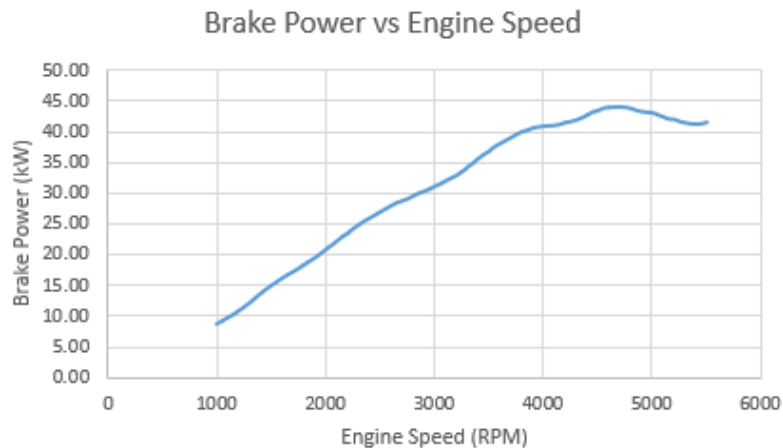


Figure 4-3 Graph of Brake Power against Engine Speed (F. Flye, 2025)

The figure above shows the relationship between Brake Power and Engine Speed, brake power also has correlation to the value of torque as shown in the equation ' $BHP = \text{Torque} \times \text{Rpm} / 5252$ ' (Sherman, 2016) so as torque increase the brake power increases, however also being determined by the rpm so although torque is large the rpm is small so the overall brake power is low. This relates back to the fact that torque reaches a maximum and the 'overall performance of the engine decreases causing the drop in brake power at the higher rpms (BMW, 2025)' This could be the reason why the power reduces towards the maximum rpm. Another factor that the brake power deviates is the 'frictional power becomes more significant as the engine speed increases (University of Idaho, 2020)'

5. Conclusion

To conclude the overall thermal efficiency of the engine was relatively low at a peak of 31.17%, why the value is so low could be due to a number of factors including that of 'mechanical friction and heat losses (Thermal engineering, 2019)', the reason for heat losses will always 'primarily lost to the atmosphere through the exhaust (Lafayette,2014)', however there could be combustion problems and engine cooling systems problems within the engine as itself and some parts are relatively old.

Furthermore, the engine didn't produce a lot of power this could be due to the fact of higher torque so the engine can't generate high enough force for the torque input. Thus, reducing the overall performance of the engine as well.

6. Evaluation

Unfortunately, this experiment couldn't be carried out properly as the engine dynamometer wasn't working. If this had been done when the dynamometer was functional, other precautions would've been made individually, ensuring that all the sensors were plugged in, and all extractions were in place. Furthermore, I would have asked for a detailed tutorial of how the dynamometer is used and all of its functions so that I could confidently understand the fundamentals and use it ensuring that all of the data was accurate.

Finally, if the chance had arisen, I would have used the manual settings on the system to further check over my work to ensure that there are no obscurities within the collected data. As this would allow me to have full control over how much throttle and torque are implemented into the dynamometer, thus allowing my final calculations to be as close as possible to the engine results itself.

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