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Engine Performance Characteristics

Motorsport Technology ACHA4003/4004/4012

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1 Introduction

The aim of this assignment is to evaluate the performance characteristics of a Honda engine by conducting a dynamometer test. The test involves measuring key engine parameters such as torque, power, brake mean effective pressure, specific fuel consumption, and overall thermal efficiency.

Engine performance testing can allow for the assessment of an engines efficiency and can assist in the development and improvement of engines in the industry. A dyno test can measure the fuel efficiency and thermal efficiency.

2 Methodology

Engine testing is carried out by using an engine dynamometer to record measurements of engine rpm, torque.

Engine Setup – The engine would be mounted on the dynamometer, and all sensors (temperature, pressure, fuel flow) would be calibrated.

Engine Warm-up – The engine would be run at idle until it reached its normal operating temperature.

Incremental Load Testing – The engine would be tested at speeds of 1000-5500 rpm, and data would be collected for:

- Load (N)
- Torque (Nm and lbft)
- Power (kW and bhp)
- Lambda (Air-Fuel Ratio)
- Fuel Flow Rate (L/min)

The data is then entered into a spreadsheet to calculate the other data needed for graph analysis. The other data calculated is:

- Mass of fuel per hour (kg/h)
- Corrected power (kW)
- BMEP (kW and kPa)
- SFC (g/kWh)
- Thermal efficiency percentage
- Fuel energy input (MJ/h)

3 Spreadsheet data

	A	B	C	D	E	F
1	Data		Baro	Humidity	Ambient temp	
2	Radius of dyno (m)	0.815776	mBar	%	Deg C	
3	Fuel mass (kg/Lt)	0.715	1018.9	46	27	
4	CV Petrol (MJ/kg)	45.8				
5	AP (kPa)	101.89				
6	Temperature (k)	300				
7	bore (mm)	75				
8	stroke (mm)	90				
9	Engine size (cc)	400				
10	No. Cylynders	4				
11	Standard pressure (kPa)	101.325				
12	Standard temperature (k)	288				

Figure 1 Jones, R (2025) Screenshot of data for calculations. Unpublished

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
14	Load	Dyno Speed	Fuel Flow Rate	Fuel Flow Rate	Lambda	Mass of fuel/hour	T	T	Power	Power	Corrected Power	BMEP	BMEP	SFC	Thermal efficiency	Fuel energy input
15	Newton	rpm	l/min	l/hour	Lambda	kg/h	Nm	lbf	kW	hp	kW	kW	kPa	g/kWh	%	MJ/h
16	102.275	1000	0.0704	4.224	1.2658	3.168	83.4334904	61.53720518	8.737406053	11.71690883	9.050995235	23.1952635	2319.952635	4739.810251	22.45681628	145.0944
17	102.756	1050	0.0724	4.344	1.26783	3.258	83.82587866	61.82661506	9.217423038	12.36081421	9.548240322	23.30883388	2330.883388	4492.974512	23.03611723	149.2164
18	103.689	1100	0.0777	4.622	1.27344	3.3165	84.5669766	62.3078966	9.744025283	13.06679067	10.09174245	23.52027072	2352.027072	4256.157978	21.92264747	151.8957
19	104.209	1150	0.0728	4.368	1.28476	3.276	85.01120118	62.7086155	10.23802297	13.72924425	10.60546993	23.63822448	2363.822448	4045.082424	25.46620646	150.0408
20	105.811	1200	0.0744	4.464	1.29181	3.348	86.1387434	63.6647891	10.84738603	14.56403431	11.23670328	24.00161411	2400.161411	3817.845762	26.38095338	153.3384
21	107.51	1250	0.07895	4.737	1.29729	3.55275	87.70407776	64.8703591	11.48079351	15.9580626	11.89284402	24.38700639	2438.700639	3607.211187	28.1222671	162.7195
22	109.488	1300	0.079	4.74	1.29895	3.555	89.11762609	65.87715004	12.13970128	16.30622528	12.59611808	24.83648557	2483.564557	3405.811199	27.85037338	162.819
23	114.471	1600	0.0959	5.754	1.28235	4.2155	91.20120467	67.26643781	12.89388183	17.2049715	13.3564415	25.3544706	2535.544706	3211.933358	29.39080143	164.0554
24	114.268	1400	0.0835	5.01	1.2855	3.7575	91.21709197	68.75319835	13.66676393	18.32720444	14.15726984	25.91955578	2591.955578	3030.245272	29.63359595	172.0935
25	115.783	1450	0.0847	5.082	1.27818	3.8115	94.45299281	69.66477921	14.34252313	19.23341325	14.85729164	26.26361046	2626.361046	2887.471083	30.63943462	174.5667
26	116.985	1500	0.08865	5.319	1.2795	3.98925	95.43355536	70.38797309	14.99113342	20.1031911	15.52917151	26.33626586	2653.626586	2762.542739	30.9807153	182.70765
27	117.788	1550	0.0912	5.592	1.27766	4.194	96.08862349	70.8712514	15.59710896	20.91588804	16.15895792	26.71841418	2671.841418	2655.202605	30.28082897	192.0852
28	118.471	1600	0.0959	5.754	1.28235	4.2155	96.6457985	71.20207514	16.19366191	21.71578831	16.77485506	26.87342323	2687.342323	2557.398506	30.55176872	197.6489
29	118.772	1650	0.09875	5.925	1.29028	4.44375	96.89134707	71.46318195	16.74214291	22.45130431	17.34025247	26.94181959	2694.161959	2473.616848	30.67956022	203.5275
30	118.656	1700	0.10005	6.003	1.29942	4.50225	96.79671906	71.39338663	17.32863368	23.19055508	17.85112016	26.91530676	2691.530676	2403.210534	31.1654132	206.2803
31	118.861	1750	0.10305	6.183	1.31053	4.63725	96.96395114	71.5167318	17.77012404	23.8283257	18.46790128	26.96180789	2696.180789	2330.520973	31.20188155	212.38605
32	118.384	1800	0.1093	6.558	1.3187	4.75185	97.53375718	71.95114915	18.38802115	24.85977694	19.04001089	27.13249943	2712.389943	2252.05844	30.44225198	225.4673
33	119.934	1850	0.11415	6.849	1.31849	5.13675	97.8372878	72.16213846	18.9514535	25.41895024	19.63245163	27.2021016	2720.32016	2184.824696	30.04619545	235.2615
34	120.176	1900	0.11745	7.082	1.31848	5.28525	98.03696508	72.30794593	19.50672558	26.15862476	20.26683028	27.26095961	2726.095961	2123.045006	30.05174407	242.06445
35	120.948	1950	0.12055	7.233	1.31848	5.42475	98.6647565	72.7248576	20.14866766	27.0347244	20.87181183	27.43521206	2743.521206	2055.403736	30.24248286	248.45355
36	122.157	2000	0.12555	7.533	1.31653	5.64975	99.65274883	73.49988143	20.87187116	27.98929224	21.62097714	27.7094553	2770.34553	1984.18467	30.08035755	258.75835
37	122.365	2050	0.12788	7.671	1.30998	5.75925	100.2140027	73.81338985	21.54415913	28.50060039	22.38811136	27.8651782	2786.51782	1924.948427	30.44824241	263.49885
38	123.796	2100	0.1309	7.854	1.32287	5.8905	100.9880677	74.48640109	22.2059081	29.783075	23.006166	28.08123749	2808.123749	1864.680965	29.89949453	269.7894
39	124.794	2150	0.13435	8.061	1.32164	6.04575	101.8039501	75.08652147	22.9216408	30.780086	23.74428046	28.30781859	2836.761859	1806.750896	30.87065552	276.89535
40	125.137	2200	0.1377	8.262	1.31652	6.1965	102.0837613	75.2828989	23.51914074	31.59259508	24.3632526	28.5842292	2838.542292	1760.848632	30.90479284	283.7979
41	126.028	2250	0.14105	8.483	1.30485	6.34725	102.8106177	75.8289921	24.22493349	32.48576699	25.09437655	28.5875327	2789.548336	1709.548336	31.07619436	290.70405
42	126.65	2300	0.14486	8.697	1.29646	6.52275	103.3281882	76.20939334	24.80244724	33.37426109	25.7866621	28.70802228	2864.037556	1664.037556	31.17628153	296.74185
43	126.822	2350	0.14985	8.991	1.28229	6.74325	103.4503439	76.30738611	25.461002	34.14314156	26.74800808	28.76789551	2876.767895	1626.53212	30.74176028	308.84085
44	126.69	2400	0.1537	9.222	1.27304	6.9165	103.3506614	76.2671393	25.97566106	34.83550214	27.37697347	28.73769732	2873.769732	1584.325037	30.7594844	316.7757
45	126.552	2450	0.15565	9.339	1.26984	7.00425	103.2380844	76.14421819	26.48739661	35.52046642	27.41859984	28.76391412	2870.639142	1563.49086	30.7915968	320.79458
46	126.438	2500	0.1596	9.576	1.27446	7.182	103.1440589	76.07688957	27.00415904	36.11272351	27.9734968	28.88053496	2888.053496	1531.602515	30.61512918	328.9356
47	126.239	2550	0.162	9.756	1.27876	7.317	103.3627365	75.9550448	27.5009051	36.7884925	28.45790905	28.93539484	2901.539484	1466.902028	30.40303802	336.11816
48	126.161	2600	0.16805	10.083	1.27634	7.56225	103.9191159	75.90902315	28.02279835	37.57872433	29.02854838	28.61770173	2861.770173	1477.855504	30.17250104	346.33105

Figure 2 Jones, R (2025) Screenshot of raw data. Unpublished

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
49	126.161	2600	0.16805	10.083	1.27634	7.56225	102.9191159	75.90902315	28.02279835	37.57872433	29.02854838	28.61770173	2861.770173	1477.855504	30.17250104	346.35105
50	125.947	2650	0.17145	10.287	1.28027	7.81525	102.6692633	75.7200445	28.49061158	38.2006441	29.5115163	28.54647661	2854.647661	1451.509252	30.06766618	353.35845
51	124.911	2700	0.17465	10.479	1.28371	7.85925	101.8993959	75.15951487	28.8127029	38.63741048	29.8463548	28.33415826	2837.361456	1397.361456	29.85019802	359.55365
52	123.927	2750	0.1784	10.704	1.2812	8.028	101.0667274	74.56628154	29.11465836	39.04291119	30.15993313	28.11095285	2811.095285	1422.432982	29.52944999	367.6824
53	123.689	2800	0.18005	10.803	1.27448	8.10225	100.9265714	74.42115558	29.58708236	39.67843766	30.6489752	28.05866617	2805.866617	1399.720536	29.73158948	371.08305
54	123.389	2850	0.1831	10.986	1.26036	8.2395	100.6577849	74.24116693	30.04238003	40.3869943	31.12061369	27.98891574	2798.891574	1378.50752	29.68823078	377.3691
55	122.519	2900	0.1879	11.274	1.2531	8.4555	99.34805974	73.71769094	30.33898113	40.7047416	31.44112122	27.79154949	2779.154949	1364.360577	29.22801175	387.2619
56	121.837	2950	0.19255	11.553	1.23943	8.64475	99.39170051	73.30734263	30.70536355	41.17605875	31.80739197	27.63686817	2763.686817	1346.743086	28.85400061	396.54555
57	121.709	3000	0.199	11.94	1.22735	8.955	99.28728118	73.20373021	31.19298812	41.82969598	32.3215176	27.60783332	2760.783332	1327.058851	28.36235114	410.139
58	121.123	3050	0.20605	12.363	1.2193	9.27225	98.80923645	72.87774043	31.56018129	42.32237401	32.69288949	27.47490814	2747.490814	1312.211942	27.71438186	424.6065
59	121.124	3100	0.21005	12.693	1.20692	9.45225	98.81005222	72.8784212	32.07762615	43.01653857	33.22911284	27.47511408	2747.511408	1291.016574	27.63252487	432.91305
60	120.851	3150	0.21605	12.962	1.19274	9.72225	98.58734538	72.7400246	32.52174447	43.61185544	33.68862637	27.41029099	2741.120909	1272.414064	27.22691211	445.7905
61	120.596	3200	0.21795	13.077	1.18481	9.80775	98.3793225	72.5606531	32.96825133	44.12060356	34.15149576	27.35536622	2735.536622	1256.167528	27.37016182	449.15495
62	120.84	3250	0.22305	13.383	1.17578	10.03725	98.57837184	72.70746393	33.5512666	44.95242453	34.75529072	27.410713	2741.0713	1234.34444	27.2178511	459.27605
63	121.613	3300	0.2255	13.53	1.16118	10.1475	99.22528212	73.1549145	34.29806096	45.9842302	35.225744	27.5903988	2759.05988	1207.71879	27.31504131	464.755
64	122.181	3350	0.2285	13.71	1.15054	10.2825	99.67232746	73.51432184	34.9672528	46.89127355	36.2224222	27.71489933	2771.489933	1184.353124	27.68840573	470.9385
65	122.947	3400	0.2342	14.052	1.14117	10.539	100.283791	73.9678802	35.7053804	47.8049259	37.0854768	27.80475498	2788.547648	1159.728847	27.82748934	482.6862
66	123.475	3450	0.24065	14.443	1.12669	10.8465	100.729486	74.29278416	36.5823423	48.7648788	38.002439	27.8912933	2799.891293	1134.199441	27.9084578	488.6858
67	123.428	3500	0.2451	14.552	1.11917	10.8577	100.866061	74.2664217	36.90581217	49.0498937	38.2037731	27.9797629	2799.77629	1122.1443	27.95989735	498.6858
68	124.205	3550	0.25445	14.727	1.10622	11.04525	101.324581	74.74212974	37.6668533	50.51391	39.026063	28.1701291	2817.401291	1099.414827	27.70871306	505.87245
69	124.066	3600	0.26055	15.303	1.09697	11.47725	101.210652	74.6684976	38.1640876	51.1680472	39.5259292	28.1424288	2814.24288	1085.363376	27.70679509	525.6085
70	124.063	3650	0.26755	15.983	1.09403	11.88975	101.158975	74.5882913	38.6982913	51.819495	40.036939	28.1810928	2818.10928	1073.363376	27.70679509	545.6085
71	123.815	3700	0.26445	15.967	1.09659	11.90925	101.055054	74.4974708	39.1704368	52.482975	40.516886	28.0554375	2805.55475	1058.170032	27.76728576	545.03145
72	123.767	3750	0.2651	15.906	1.09808	11.93205	100.961482	74.4685922	39.6504516	53.175977	41.0761962	28.0749528	2807.46928	1046.46612	27.76011364	546.3714
73	123.659	3800	0.2693	16.158	1.09907	12.1185	100.755678	74.3135785	40.0943602	53.7682302	41.594068	28.06191591	2801.613591	1032.871951	27.69997808	555.0273
74	122.872	3850	0.2735	16.425	1.1053	12.1287	100.702778	73.8097485	40.3477933	54.5053893	41.7354667	27.8267521	2802.767521	1026.418022	27.66679752	564.19875
75	122.137	3900	0.2779	16.804	1.11794	12.155	100.620484	73.49927485	40.624155	55.1489752	42.1489752	27.8267521	2802.767521	1026.418022	27.66679752	564.19875
76	121.184	3950	0.28285	16.971	1.12259	12.7825	98.8598878	72.91444314	40.8936016	54.835471	42.812949	27.48874506	2784.874506	1012.719918	28.13998876	582.3935
77	120.004	4000	0.28455	17.073	1.12461	12.80475	97.983611	72.2045612	41.000147	55.9196978	42.72210003	27.2210003	2778.221003	1009.891532	28.07540582	584.7575
78	118.734	4050	0.2871	17.272	1.1223	13.055	96.86047378	71.4043176	41.081203	56.0513572	42.5556247	26.9329887	2769.29987	1006.02357	28.0596726	591.731
79	117.442	4100	0.2917	17.618	1.12394	13.0575	96.806469	71.2623191	41.081203	56.0513572	42.5556247	26.9329887	2769.29987	1006.02357	28.0596726	591.731
80	115.815	4150	0.2939	17.583	1.12223	13.1875	95.701794	70.0961567	41.051886	55.382445	42.7693554	26.8425099	2662.625099	1002.66638	28.0596726	603.7905
81	115.931	4200	0.2944	17.694	1.12179	13.2705	94.57572746	69.5739842	41.5969977	55.781885	43.0892325	26.2973821	2629.73821	995.592376	25.5236917	607.788
82	115.024	4250	0.29715	17.829	1.12436	13.37175	93.84187988	68.7129481	41.7665994	56.0091547	43.2653276	26.0973121	2609.37121	991.551381	25.612425	612.4215
83	114.391	4300	0.3022	18.122	1.12778	13.599	93.16720545	68.6272045	42.0127841	56.1572919	43.5260486	25.9476846	2594.76846	985.530642	25.1080777	623.844
84	114.016	4350	0.30495	18.363	1.1294	13.7725	92.779254	67.27993847	42.2798943	56.8897434	43.8957434	25.7487434	2587.748743	980.60242	25.008242	630.114
85	113.871	4400	0.3092	18.552	1.1298	13.999	92.8922289	66.8129229	42.8045661	57.3996709	44.3396609	25.8299027	2592.76037	977.530401	25.0482604	637.261

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
76	121.184	3950	0.28285	18.971	1.12259	12.72825	98.85899878	72.91444314	40.89306016	54.8385473	42.3612949	27.48874506	2748.874506	1012.716918	26.15998876	582.95385
77	120.004	4000	0.28455	17.073	1.12461	12.80479	97.8961831	72.20445632	41.0080147	54.99196978	42.47980962	27.22108003	2722.108003	1009.891532	26.07645082	586.45755
78	118.734	4050	0.2871	17.226	1.1222	12.9185	96.86034758	71.4401796	41.08120303	55.0901572	42.5556247	26.93299967	2693.299967	1008.092357	25.89096792	591.71311
79	117.442	4100	0.28895	17.337	1.12394	13.00275	95.80636499	70.66294256	41.13503504	55.16337862	42.61221811	26.83952935	2663.952935	1006.753502	25.79941249	595.52595
80	116.5	4150	0.29305	17.583	1.12233	13.18725	95.037904	70.09615647	41.30351886	55.38824245	42.78591954	26.42625099	2642.625099	1002.666308	25.50255288	603.97805
81	115.931	4200	0.2949	17.694	1.12179	13.2705	94.57372746	69.75379842	41.59698977	55.78178853	43.08992125	26.29718201	2629.718201	995.5923976	25.5226319	607.7889
82	115.034	4250	0.29715	17.829	1.12456	13.37175	93.84197638	69.2140881	41.76650954	56.00911547	43.26552716	26.09371121	2609.371121	991.5515381	25.43260077	612.42615
83	114.391	4300	0.3022	18.132	1.12278	13.599	93.37143362	68.82720545	42.02167941	56.35128159	43.52848496	25.94785666	2594.785666	985.5306422	25.34038077	622.8342
84	114.016	4350	0.30605	18.363	1.11943	13.77225	93.01151642	68.60157405	42.37093899	56.81965863	43.89164983	25.86279342	2586.279342	977.4068682	25.05036342	630.76905
85	113.871	4400	0.3092	18.552	1.11986	13.914	92.8932289	68.5143299	42.80345661	57.39966709	44.33969069	25.82990237	2582.990237	967.5304301	25.04826694	637.2612
86	113.985	4450	0.3099	18.594	1.11873	13.9455	92.98622736	68.58292185	43.33319842	58.11005374	44.88844516	25.85576154	2585.576154	955.7025165	25.30098886	638.7039
87	113.306	4500	0.31445	18.867	1.11563	14.15025	92.43231346	68.17437859	43.59955535	58.4125291	45.12240819	25.70174073	2570.174073	950.7471281	25.06485404	648.08145
88	113.071	4550	0.3171	19.025	1.10953	14.2695	92.24305542	68.09478796	43.9528644	58.94102917	45.53035121	25.44911506	2564.911506	942.2286202	25.0801002	653.5411
89	112.195	4600	0.3194	19.164	1.10569	14.373	91.52598832	67.90590795	44.09043316	59.12550962	45.67285737	25.4487273	2544.87273	939.2887257	24.97343169	658.2834
90	111.061	4650	0.32055	19.233	1.09782	14.42475	90.60089834	66.82359588	44.11919335	59.1640773	45.70264977	25.19289666	2515.249666	938.6784272	24.90405738	660.65355
91	109.973	4700	0.3207	19.242	1.09558	14.4315	89.71333405	66.18896666	44.15673579	59.2144218	45.74153963	24.94570043	2494.570043	937.8783563	24.91359084	660.9627
92	108.654	4750	0.32485	19.491	1.08827	14.61825	88.6373255	65.3753458	44.09124475	59.12659797	45.67969809	24.64850537	2464.650537	939.2714361	24.55883802	669.51585
93	107.076	4800	0.32455	19.473	1.08996	14.60475	87.35003098	64.42588885	43.90827822	58.88123885	45.48416481	24.2885601	2438.85601	943.1853961	24.47953252	668.89755
94	105.24	4850	0.3257	19.542	1.08221	14.6565	85.85226634	63.32119749	43.60493154	58.47444932	45.16993089	23.87209145	2387.209145	949.7468593	24.22457556	671.2677
95	103.632	4900	0.3277	19.662	1.0846	14.7485	84.54049843	62.35389002	43.38134279	58.1746156	44.93831745	23.50734114	2350.734114	954.6418832	23.95327382	675.3897
96	102.335	4950	0.32845	19.707	1.08823	14.78025	83.48243696	61.5733062	43.27553283	58.03272386	44.82870992	23.21313644	2321.313644	956.9760111	23.84028724	676.93545
97	101.106	5000	0.3287	19.722	1.08687	14.7915	82.47984626	60.83383688	43.1876889	57.91492468	44.73771124	22.9343565	2293.43565	958.922504	23.77379899	677.4507
98	99.3349	5050	0.32965	19.791	1.0891	14.84125	81.03771186	59.75616112	42.84684207	57.45784723	44.38463327	22.53807274	2252.807274	966.550757	23.50393928	679.82085
99	97.5815	5100	0.3297	19.782	1.09185	14.8365	79.60464574	58.71320251	42.51583342	57.01396284	44.04174458	22.13487735	2211.487735	974.078849	23.33297285	679.5317
100	95.8486	5150	0.33095	19.857	1.09407	14.89275	78.19096751	57.67004475	42.17023622	56.55051513	43.68374176	21.74179537	2174.179537	982.0586862	23.05589441	682.08795
101	94.8033	5200	0.3338	20.028	1.09346	15.021	77.33825686	57.04160473	42.1152933	56.47683637	43.6268289	21.50488498	2150.488498	983.339864	22.82925942	687.9618
102	93.0976	5250	0.3313	19.878	1.08804	14.9083	75.94678774	56.0151276	41.7552447	55.99381672	43.25383675	21.11777291	2111.777291	993.8195292	22.80487572	682.8093
103	91.7886	5300	0.3324	19.944	1.08339	14.958	74.87893695	55.22778074	41.56020168	55.7345551	43.05183482	20.82884619	2082.084619	996.473672	22.63324806	685.0764
104	90.5938	5350	0.3308	19.848	1.08007	14.886	73.90424779	54.508817	41.40619182	55.52592745	42.89227748	20.54982401	2054.982401	1000.180045	22.44844068	681.7788
105	89.6374	5400	0.3388	20.328	1.07895	15.246	73.12403962	53.9336666	41.35195455	55.45319497	42.83609361	20.33287923	2033.287923	1001.491882	22.08467285	698.2668
106	88.9256	5450	0.3438	20.628	1.07923	15.471	72.54337027	53.9058817	41.40343156	55.52222592	42.88941815	20.17418124	2017.141824	1000.246724	21.79058006	708.5718
107	88.6474	5500	0.3488	20.928	1.08366	15.696	72.31642138	53.3769975	41.65256232	55.85631162	43.14749032	20.10831281	2010.831281	994.2640854	21.60745279	718.8768
108																
109																
110																
111																

Figure 4 Jones, R (2025) Screenshot of raw data. Unpublished

4 Graphs and Analysis

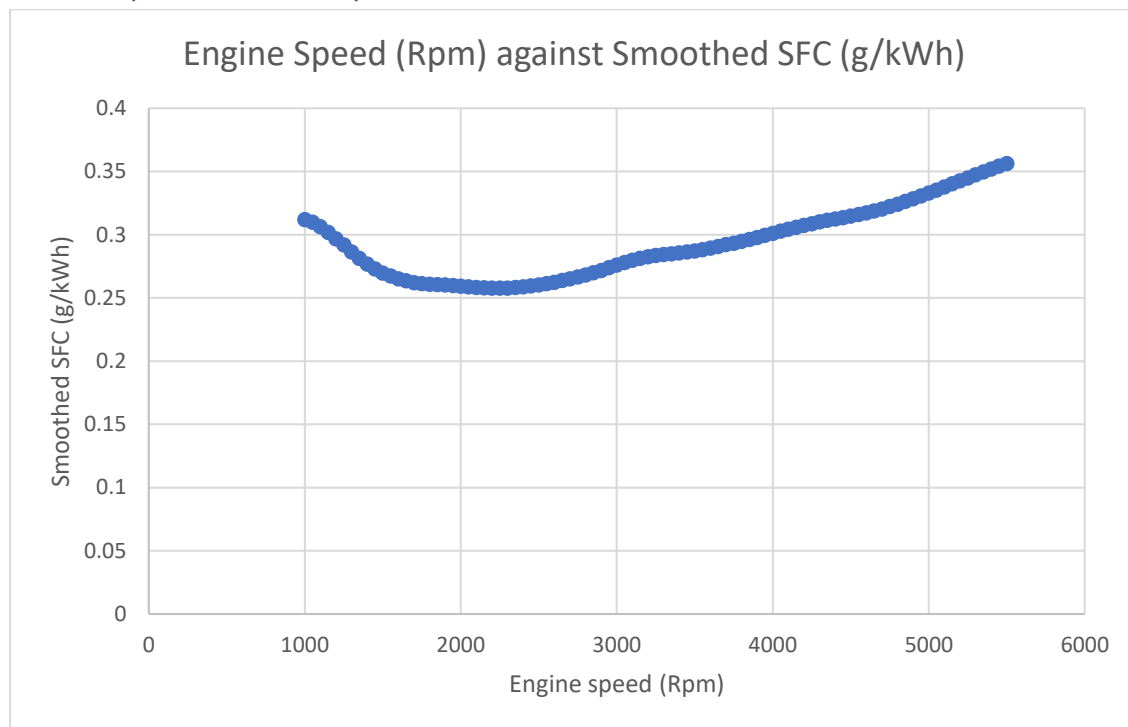


Figure 5 Jones R. (2025) Graph displaying the engine speed against SFC. Unpublished

The above graph displays the results of the engine speed measured using the dynamometer against the calculated SFC. The trendline resembles a rough U shaped curve, starting at a high inefficiency then reaching its peak efficiency at approximately 1500-1700 rpm, then the efficiency slowly becomes worse, when the growth begins to become more linear at approximately 3500 rpm.

The trendline reaches its lowest SFC between 1500 and 2800 RPM. This shows that the engine is operating at its peak efficiency in this range, producing the most power for the fuel it uses. Combustion is the most efficient in this range, reducing fuel waste and preserving robust performance. This range is perfect for striking a balance between power and efficiency because it is usually the sweet spot for fuel economy.

While the engine is running between 1000 and 1400, then again at 3500 and 5500 rpm, the specific fuel consumption is highly inefficient. This could be due to the design process of the engine, that it was not intended to run at this rpm often, or it could be due to the fuel not being fully atomised (ChatGPT.), therefore not burning as efficiently as it could be. The increase of SFC increases quite linearly from 4000 rpm to 5500, showing a consistent increase in SFC and possibly signifying that there are much higher frictional losses at higher speeds.

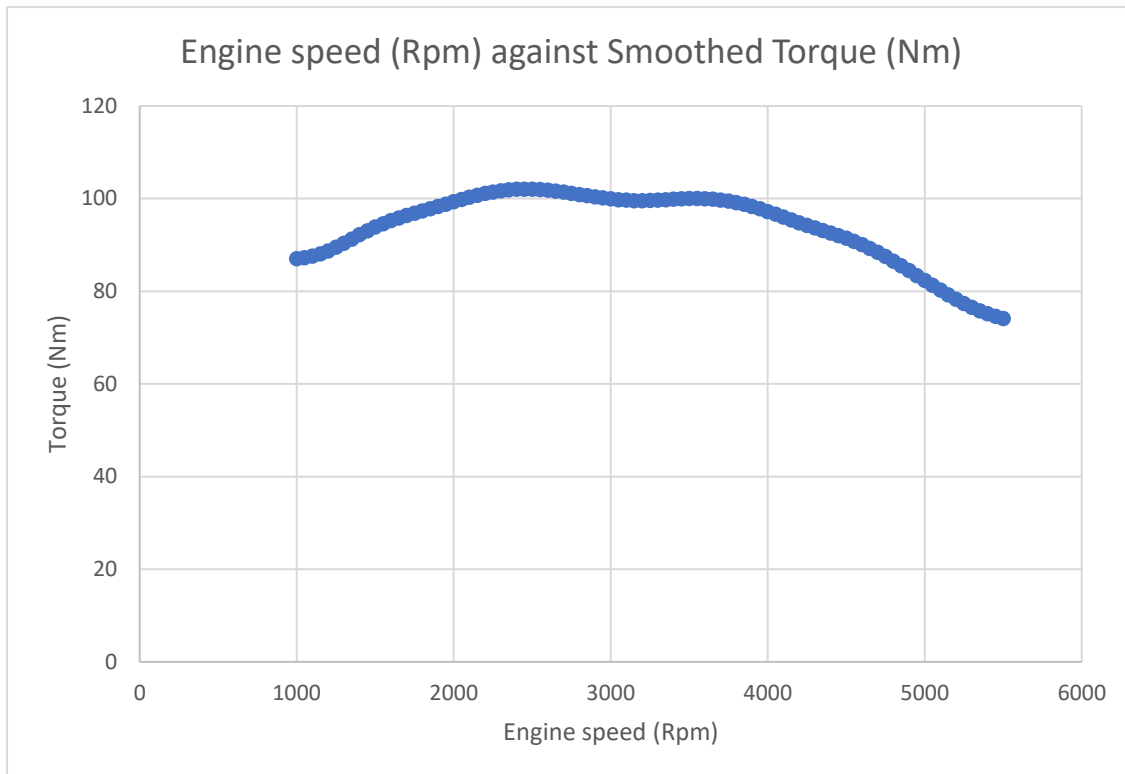


Figure 6 Jones R. (2025) Graph displaying the engine speed against Torque measured in Nm. Unpublished

This graph shows the relationship between engine speed in rpm, and torque in Nm. The peak torque is from around 2000 rpm to around 2700 rpm and continues to be close to its peak until around 4000 rpm, where it begins to drop off. This represents the engines most efficient torque producing range. At the low end rpm, the torque is around 50% of its peak, it then increases dramatically at around 1200 rpm and continues to grow until its peak.

The torque begins to drop off at 4000 rpm, showing that at higher rpm, the engine cannot burn the fuel as efficiently to produce high torque. This drop off could also be due to frictional losses, or valve timing limitations, causing the intake to be less efficient. (Bite-Sized Science, 2020.) The drop in torque at the higher engine speeds shows that higher engine speeds produce less torque compared to the fuel burned.

It could also be caused by a decline in volumetric efficiency. This is caused at high engine speeds when the air fuel mixture injected into the cylinders is reduced because there is less time to fill the cylinders due to the engine cycling much faster than lower rpm.

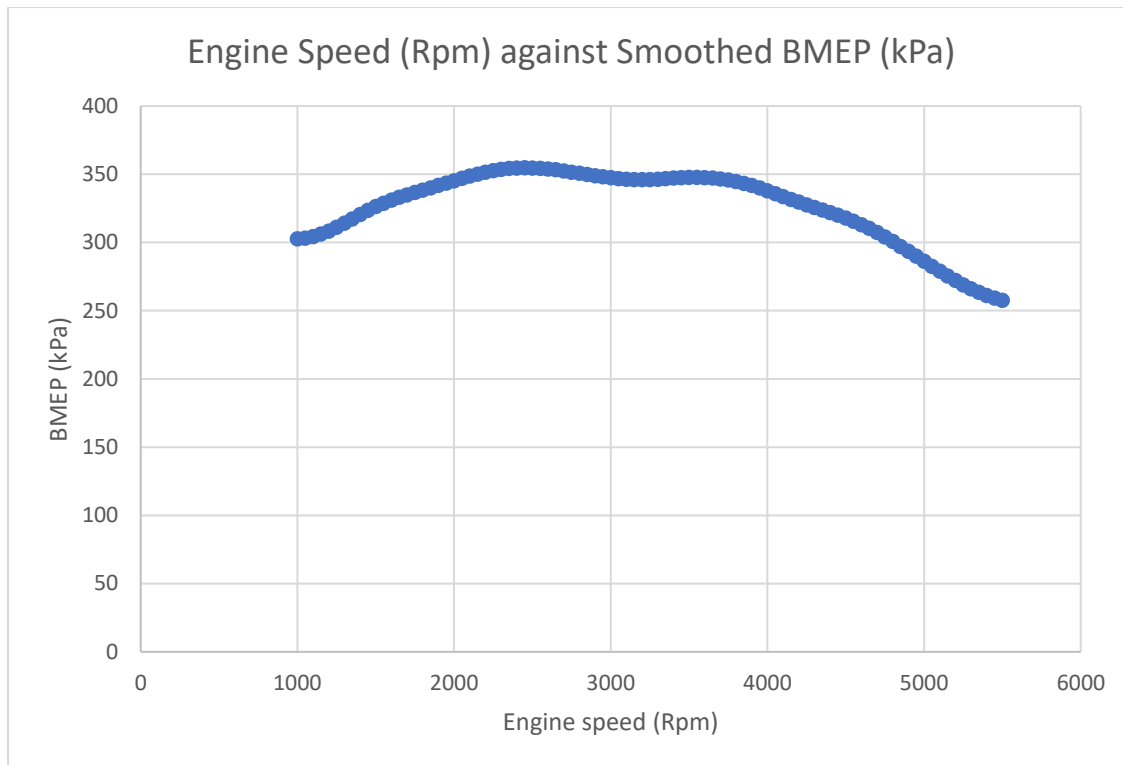


Figure 7 Jones R. (2025) Graph displaying the engine speed against BMEP measured in kPa. Unpublished

This graph showing engine speed against BMEP (kPa) follows almost the exact same trendline as the previous graph, showing a link between how BMEP and Torque change as engine speed increases. Both graphs follow the same trendline showing that BMEP and torque have a direct relationship to each other.

The equation to calculate BMEP for a 2 stroke engine is $\frac{75.4 * T}{Displacement}$

This equation shows that as there is a direct link between BMEP and Torque. As the torque used in the calculation increases, so will the calculated BMEP.

The peak BMEP is between 2000 and 4000 rpm approximately, showing that the engine performs best when the engine speed is around the mid range. This is where the engine has the highest BMEP, torque, showing this this range is the most efficient and where the engines performance and potential is optimized the best.

5 Conclusions

After analysing the data, it shows that this Honda engine is not the most efficient engine and the trends shown in the graphs show that the rate of change of SFC, Torque and BMEP are not very consistent with engine speed. There is a trend across the three graphs show that range where the engine is the most efficient is approximately between 1500 rpm and 3500 rpm, showing that this specific engine has a relatively small window where it performs efficiently. At lower engine speeds, all three graphs show a low efficiency where the engine does not perform very well and performs far from its potential.

The higher engine speeds also show a drop in efficiency where each of the three graphs spike, showing that at higher engine speeds produces less efficient performance. All three graphs show this drop in performance and efficiency starting at around 3500 to 4000 rpm. This could potentially be due to the engine not being able to burn the fuel as efficiently due to higher frictional forces.

After analysing the data and the three graphs, it can be concluded that this Honda is not very efficient and overall performance is not outstanding. It displays consistent performance in the mid range engine speed, but dramatically becomes less efficient after around 3500 rpm. This engine would be ideal for every day usage due to its decent mid range torque and fuel efficiency, but would fail to perform well when pushed harder, for example in a race. The engine displays worse efficiency and performance at high Rpm, as mentioned before, this could be due to higher frictional forces due to the engines design not intending to be used at high engine speeds often. The BMEP and Torque follow a very similar trend, making it easy to calculate and predict performance.

6 Evaluation

Unfortunately, when we were scheduled to have our dynamometer session, the dyno wasn't working and couldn't run as usual. Because of this, we were given a set of previously recorded data and calculated the rest of the data needed using excel. Due to this, the numbers would be relatively accurate, but if the dyno had been running, we could have recorded more accurate values for each data set.

Although the dyno was unfortunately not working, working with the given data helped in understanding and learning about engine trends and how different aspects change with rpm. The lack of hands on experience was unfortunate, but the demonstration of how it would work correctly still gave us an understanding of the equipment.

7 References

“At low RPMs, the **air-fuel mixture may not be fully atomized and burned**, leading to **incomplete combustion**. This results in wasted fuel and higher SFC values.” -ChatGPT, 2025. Prompt: “could you suggest some reasons why the sfc isnt that good at lower rpm between 1000 and 2000 rpm please?” – Accessed 27/03/2025

<https://www.youtube.com/watch?v=TTbqp7FcWQE&t=1s> - TORQUE - and why it reduces at high revs, [Bite-Sized Science](#) – Accessed 28/03/2025

Figures 1 through 7 - Jones R. (2025) Unpublished. Accessed 19/03/2025 through 29/03/2025.