Lap Report

Considering a Mini-Turbojet

30/05/2022

AERO2360

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Task 1 – Calculate Mass Flow Rate and Compare with Engine Rotation

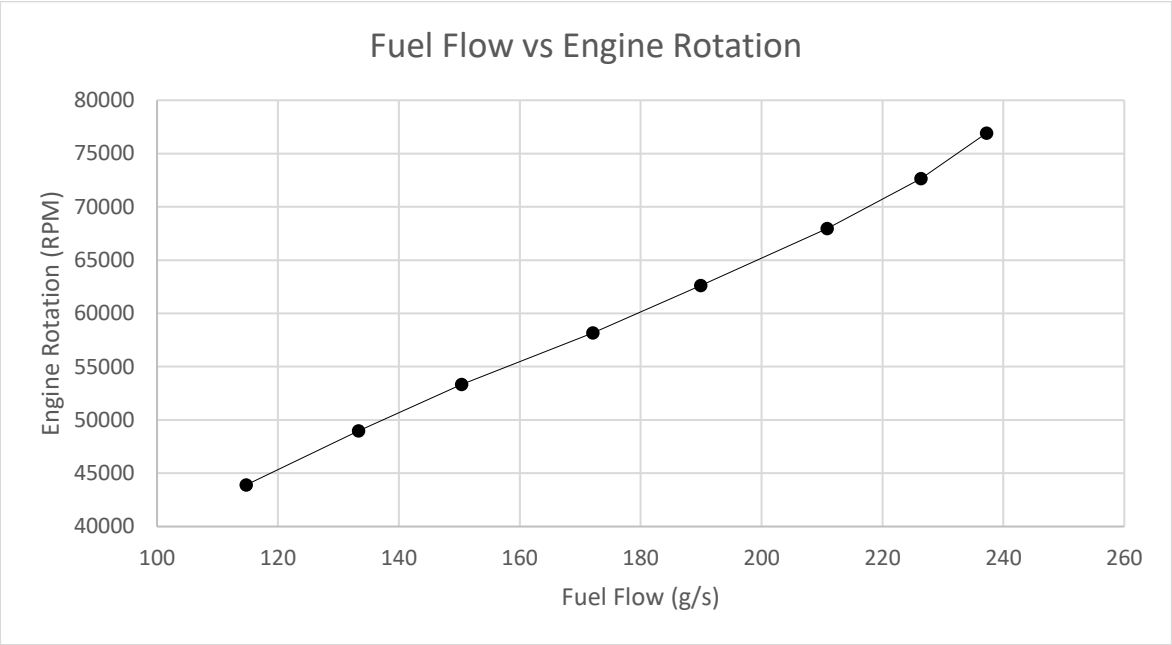

Figure 1 – Fuel flow at each experimental value for RPM

Task 2 – Compare Compressor Exit Pressure to Engine Rotation

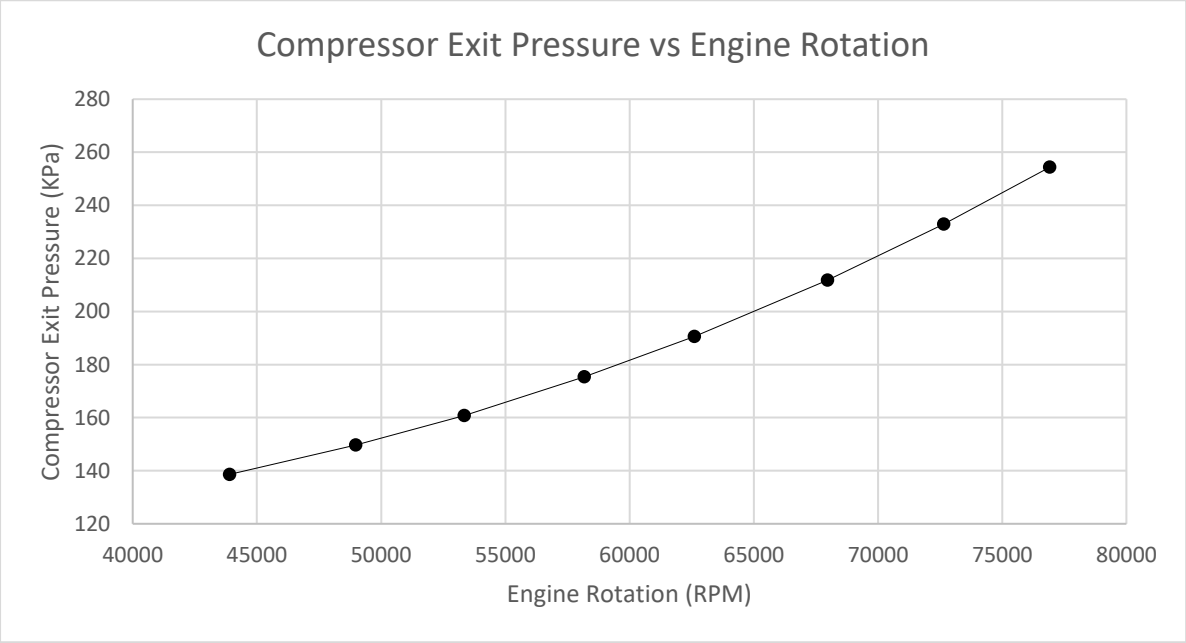

Figure 2 – Compressor exit pressure at each experimental value for RPM

Task 3 – Calculate TSFC

Table 1 – Calculating TSFC for each value of RPM

RPM	Fuel Flow	Thrust	Mass Flow	TSFC
	[m3 / s]	[N]	[g/s]	[g/Ns]
43904.4384	0.000142	10.35	113.24	10.94
48976.6848	0.000165	14.17	131.60	9.29
53340.7968	0.000186	18.20	148.43	8.16
58174.1568	0.000213	23.43	169.86	7.25
62612.5344	0.000235	29.37	187.45	6.38
67970.4864	0.000261	50.03	208.11	4.16
72647.6832	0.000280	47.21	223.42	4.73
76916.6016	0.000294	56.51	234.13	4.14

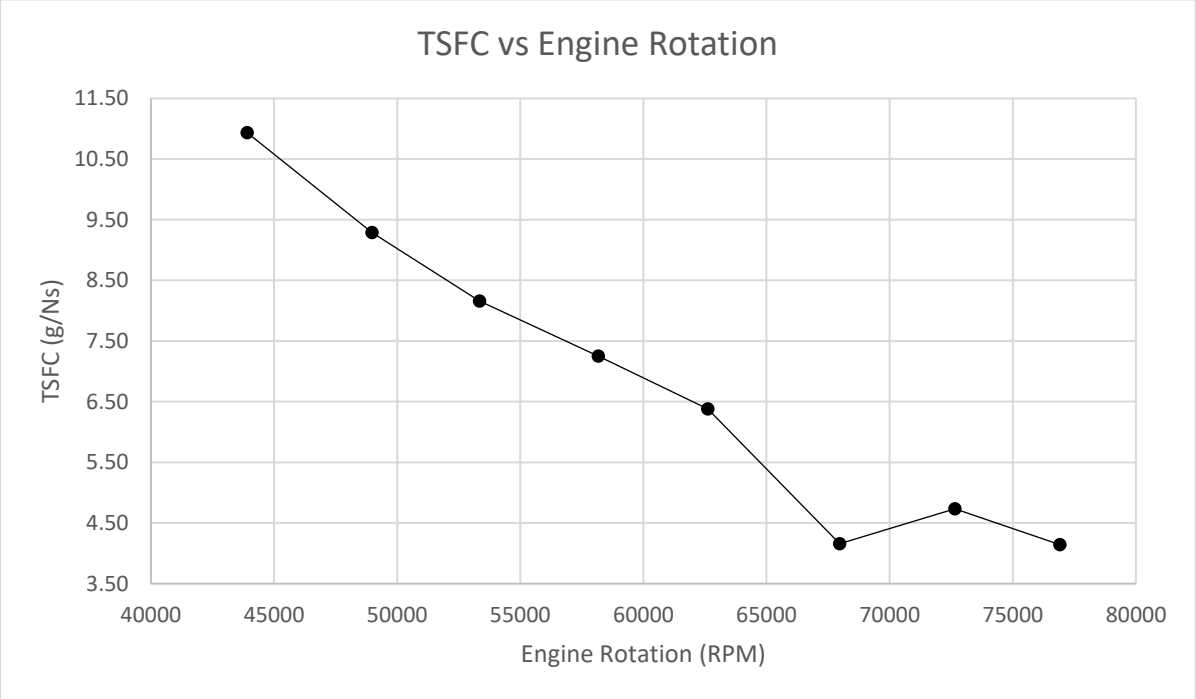

Figure 3 – TSFC compared to Experimental Values for Engine Rotation

Task 4 – Calculate Stagnation Temperature and Compressor Radius

Table 2 – Calculations for Stagnation Temperature and Corresponding match line based on K Value with error consideration.

T02 (Ambient)	P03 (Comp Outlet)	P02 (Comp Inlet)	Gamma	T03	T03s	RPM	T03s/Ta	T03/Ta (K Value)	Error
[K]	Pa	Pa		[K]	[K]				%
288	138625	101873	1.401	602.55	555.36	43904.44	1.93	1.49	22.80
288	149652	102037	1.401	609.36	561.16	48976.68	1.95	1.61	17.46
288	160766	102193	1.401	615.88	566.70	53340.80	1.97	1.72	12.52
288	175311	102422	1.401	623.89	573.51	58174.16	1.99	1.86	6.69
288	190534	102649	1.401	631.78	580.21	62612.53	2.01	1.99	1.02
288	211820	103006	1.401	642.01	588.90	67970.49	2.04	2.17	6.19
288	232945	103366	1.401	651.41	596.90	72647.68	2.07	2.34	12.81
288	254385	103720	1.401	660.32	604.47	76916.60	2.10	2.50	19.11

Table 3 – Containing Considerations and Values

K Value	**1.5**
Compressor Adiabatic Efficiency	85 %
Maximum Error	22.8 %

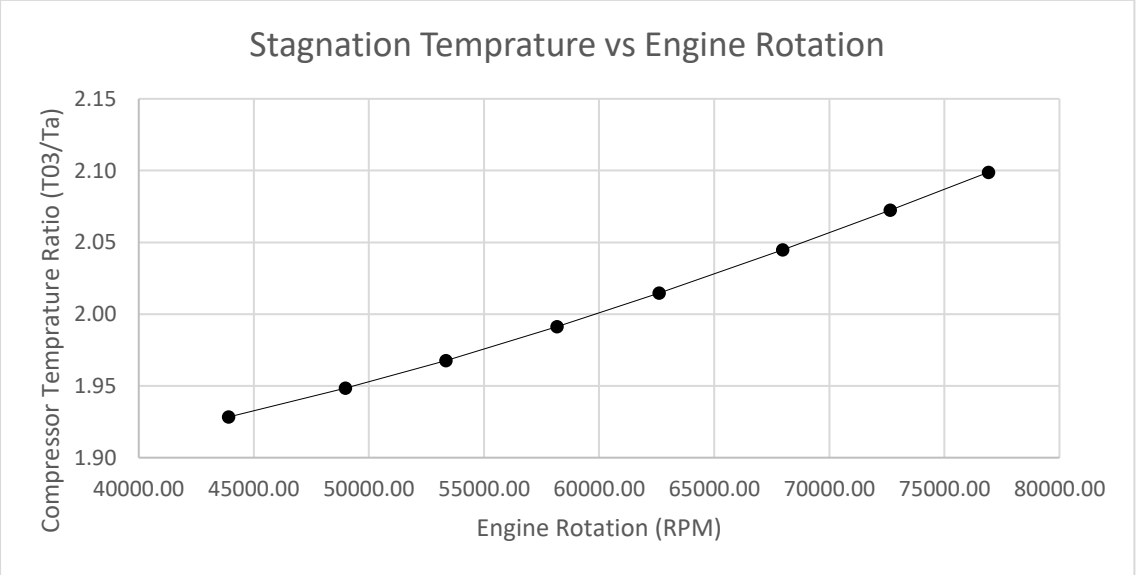

Figure 4 – Stagnation Temperature vs Engine Rotation for all experimental values of RPM.

Radius Calculated from K Value:

$$k\left(\frac{\Omega}{\Omega_{max}}\right)^2 = \frac{r^2\Omega^2}{c_p T_a}$$

R = 26 mm

Task 5 – Turbojet Flameout due to a Rapid Change in Fuel Supply.

Changing the amount of fuel in the system rapidly will not allow enough time for the compressor to slow down and so will create conditions where the air flow rate is too high for the respective fuel-air mixture to continue combustion. In normal operating conditions once the combustion process has started it is self-sustaining. But a quick change in the fuel flow will disrupt the mixture balance and will not leave enough time for the systems RPM to drop. This results in a flame out and the system would have to be re-ignited. Hence changing the fuel flow gradually will allow the compressor to slow and maintain the fuel-air mixture required.