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Technical Reference

Capstone Model C30 Performance

Introduction

This document presents performance information for the Capstone Turbine Corporation® Capstone (recuperated) Model C30 MicroTurbine™ operating on natural gas fuel.

The Capstone Model C30 MicroTurbine system is a compact, low emission, power generator providing up to 30 kW of electrical power. The Model C30 MicroTurbine generates electricity from various fuels with low exhaust emissions. Solid-state power electronics allow Grid Connect, Stand Alone, or HEV operation.

ISO Full Load Performance

Performance is listed at full load power and ISO conditions for the Capstone Model C30 MicroTurbine operating on natural gas fuel. ISO conditions are defined as: 15 °C (59 °F), 60% relative humidity, and 101.325 kPa (14.696 psia) (standard sea level pressure). Other items are defined as: HHV: Higher Heating Value, LHV: Lower Heating Value, HPNG: High Pressure Natural Gas, and LPNG: Low Pressure Natural Gas.

Table 1 presents the (recuperated) Model C30 MicroTurbine performance for HPNG, LPNG, and Liquid Fuel applications.

Table 1. Model C30 MicroTurbine Performance (Grid Connect/Stand Alone)

Performance	HPNG Values	LPNG Values (@5 psig inlet pressure)	Liquid Fuel Values
Rated Output	30.0 (+0/-1) kW	28.0 (+0/-1) kW	29.0 (+0/-1) kW
Thermal Efficiency	26.0 (±2)% LHV	25.0 (±2)% LHV	25.0 (±2)% LHV
Fuel Flow (LHV Based) (See Notes 1 and 2)	415,000 kJ/hr (394,000 Btu/hr)	404,000 kJ/hr (382,000 Btu/hr)	417,000 kJ/hr (395,000 Btu/hr)
Fuel Flow (HHV Based) (See Notes 1 and 2)	457,000 kJ/hr (433,000 Btu/hr)	444,000 kJ/hr (420,000 Btu/hr)	459,000 kJ/hr (435,000 Btu/hr)
Heat Rate (LHV Based) (See Notes 1 and 2)	13,800 kJ/kWhr (13,100 Btu/kWhr)	14,400 kJ/kWhr (13,700 Btu/kWhr)	14,400 kJ/kWhr (13,700 Btu/kWhr)
Exhaust Temperature	275 °C (530 °F)	275 °C (530 °F)	275 °C (530 °F)
Exhaust Heat Energy	327,000 kJ/hr (310,000 Btu/hr)	327,000 kJ/hr (310,000 Btu/hr)	327,000 kJ/hr (310,000 Btu/hr)
Exhaust Mass Flow	0.31 kg/s (0.68 lbm/s)	0.31 kg/s (0.68 lbm/s)	0.31 kg/s (0.68 lbm/s)

NOTES	1. These parameters are fuel-type dependent. 2. Higher Heating Value (HHV) to Lower Heating Value (LHV) ratio is to be assumed 1:1.

Fuel Parameters

Refer to the Capstone MicroTurbine Fuel Requirements Technical Reference 410002 for detailed information regarding fuel parameters for the Model C30 MicroTurbine.

How to Use This Document

The following pages present several tables and graphs for determining the nominal net power output, efficiency, and other parameter values for various operating conditions.

To calculate the expected net power output, proceed as follows:

- ❑ Look up the estimated power using Temperature Derating table.
- ❑ Apply Ambient Pressure/Elevation Derating.
- ❑ Apply Back Pressure Derating.
- ❑ Apply Inlet Pressure Loss Derating.
- ❑ Subtract parasitic loads (RFC, Battery charging) – See Note 3 below.

NOTE	For Low Pressure systems, subtract 2.0 kW from the value found in Table 2 for 34.5 kPa (5.0 psig) inlet pressure, and then subtract 2.6 kW total for 1.4 kPa (0.2 psig) inlet pressure (see Examples 1 and 2 below). For Liquid Fuel systems, subtract 1.0 kW from the value found in Table 2.

Example 1

Conditions:

C30 Grid Connect, Natural gas, Foil Bearing RFC (FBRFC) at 5.0 psig inlet pressure, ambient temperature of 75 °F, and 500 ft above sea level.

Calculations:

Power based on temperature = 27.8 kW

RFC Loss = 2.0 kW

Elevation Derating = 0.982

Expected Power = (27.8 x 0.982) – 2.0 = 25.3 kW

Example 2

Conditions:

C30 Grid Connect, Natural gas, FBRFC at 0.2 psig inlet pressure, ambient temperature of 76 °F, and 500 ft above sea level.

Calculations:

Power based on temperature = 27.6 kW

RFC Loss = 2.6 kW

Elevation Derating = 0.982

Expected Power = (27.6 x 0.982) – 2.6 = 24.5 kW

Temperature Derating

Nominal net power output and efficiency versus ambient temperature at sea level for the Model C30 MicroTurbine operating on high-pressure natural gas fuel is presented in Table 2. These values are estimated from nominal performance curves.

Table 2. Nominal Net Power Output and Efficiency versus Ambient Temperature at Standard Sea Level Pressure

Ambient Temp (F)	Net Power (kW)	Net Efficiency (%)	Exhaust Temp (F)	Exhaust Mass Flow Rate (lbm/s)	Exhaust Energy (Btu/hr)	Fuel Flow Energy (Btu/hr LHV)	Heat Rate (Btu/kWhr LHV)
-4	30.0	27.9	442	0.67	278000	367000	12200
-3	30.0	27.9	443	0.66	278000	367000	12200
-2	30.0	27.9	445	0.66	278000	367000	12200
-1	30.0	27.9	446	0.66	278000	367000	12200
0	30.0	27.9	448	0.66	278000	367000	12200
1	30.0	27.9	450	0.66	279000	367000	12200
2	30.0	27.9	451	0.66	279000	367000	12200
3	30.0	27.9	453	0.66	279000	367000	12200
4	30.0	27.9	454	0.66	279000	367000	12200
5	30.0	27.9	456	0.65	279000	367000	12200
6	30.0	27.9	457	0.65	279000	367000	12200
7	30.0	27.9	459	0.65	279000	367000	12200
8	30.0	27.9	461	0.65	279000	367000	12200
9	30.0	27.9	462	0.65	279000	367000	12200
10	30.0	27.9	464	0.65	279000	367000	12200
11	30.0	27.9	465	0.65	279000	367000	12200
12	30.0	27.9	467	0.65	279000	367000	12200
13	30.0	27.8	468	0.65	279000	368000	12300
14	30.0	27.8	469	0.65	280000	368000	12300
15	30.0	27.8	471	0.65	280000	369000	12300
16	30.0	27.7	472	0.65	281000	369000	12300
17	30.0	27.7	473	0.65	281000	369000	12300
18	30.0	27.7	474	0.65	282000	370000	12300
19	30.0	27.6	476	0.65	282000	370000	12300
20	30.0	27.6	477	0.65	283000	371000	12400
21	30.0	27.6	478	0.65	283000	371000	12400
22	30.0	27.5	479	0.65	284000	372000	12400
23	30.0	27.5	480	0.65	284000	372000	12400
24	30.0	27.5	482	0.65	285000	372000	12400
25	30.0	27.5	483	0.65	285000	373000	12400
26	30.0	27.4	484	0.65	286000	373000	12400
27	30.0	27.4	485	0.66	286000	374000	12500
28	30.0	27.4	487	0.66	286000	374000	12500
29	30.0	27.3	488	0.66	287000	374000	12500
30	30.0	27.3	489	0.66	288000	375000	12500

Table 2. Nominal Net Power Output and Efficiency versus Ambient Temperature at Standard Sea Level Pressure (Cont'd)

Ambient Temp (F)	Net Power (kW)	Net Efficiency (%)	Exhaust Temp (F)	Exhaust Mass Flow Rate (lbm/s)	Exhaust Energy (Btu/hr)	Fuel Flow Energy (Btu/hr LHV)	Heat Rate (Btu/kWhr LHV)
31	30.0	27.3	490	0.66	288000	375000	12500
32	30.0	27.2	492	0.66	289000	376000	12500
33	30.0	27.2	493	0.66	289000	376000	12500
34	30.0	27.2	494	0.66	290000	377000	12600
35	30.0	27.1	495	0.66	290000	377000	12600
36	30.0	27.1	497	0.66	291000	378000	12600
37	30.0	27.1	498	0.66	292000	378000	12600
38	30.0	27.0	499	0.66	292000	379000	12600
39	30.0	27.0	500	0.66	293000	379000	12600
40	30.0	27.0	502	0.66	293000	380000	12700
41	30.0	26.9	503	0.66	294000	380000	12700
42	30.0	26.9	504	0.67	295000	381000	12700
43	30.0	26.8	506	0.67	295000	381000	12700
44	30.0	26.8	507	0.67	296000	382000	12700
45	30.0	26.8	508	0.67	297000	383000	12800
46	30.0	26.7	510	0.67	297000	383000	12800
47	30.0	26.7	511	0.67	298000	384000	12800
48	30.0	26.6	512	0.67	299000	384000	12800
49	30.0	26.6	514	0.67	300000	385000	12800
50	30.0	26.5	515	0.67	301000	386000	12900
51	30.0	26.5	517	0.67	302000	387000	12900
52	30.0	26.4	518	0.68	303000	388000	12900
53	30.0	26.3	520	0.68	304000	389000	13000
54	30.0	26.3	521	0.68	305000	390000	13000
55	30.0	26.2	523	0.68	306000	390000	13000
56	30.0	26.2	524	0.68	307000	391000	13000
57	30.0	26.1	526	0.68	308000	392000	13100
58	30.0	26.1	527	0.68	309000	393000	13100
59	30.0	26.0	529	0.68	310000	394000	13100
60	30.0	25.9	530	0.68	311000	394000	13100
61	30.0	25.9	531	0.69	312000	395000	13200
62	30.0	25.8	533	0.69	313000	396000	13200
63	30.0	25.8	534	0.69	314000	397000	13200
64	29.9	25.7	535	0.69	314000	397000	13300
65	29.7	25.7	536	0.69	313000	395000	13300
66	29.5	25.6	536	0.68	312000	393000	13300
67	29.3	25.6	537	0.68	311000	392000	13300
68	29.1	25.5	537	0.68	310000	390000	13400
69	29.0	25.4	538	0.68	309000	388000	13400

Table 2. Nominal Net Power Output and Efficiency versus Ambient Temperature at Standard Sea Level Pressure (Cont'd)

Ambient Temp (F)	Net Power (kW)	Net Efficiency (%)	Exhaust Temp (F)	Exhaust Mass Flow Rate (lbm/s)	Exhaust Energy (Btu/hr)	Fuel Flow Energy (Btu/hr LHV)	Heat Rate (Btu/kWhr LHV)
70	28.8	25.4	538	0.68	308000	387000	13400
71	28.6	25.3	539	0.68	307000	385000	13500
72	28.4	25.3	539	0.67	306000	383000	13500
73	28.2	25.2	540	0.67	305000	382000	13500
74	28.0	25.1	540	0.67	304000	380000	13600
75	27.8	25.1	540	0.67	303000	379000	13600
76	27.6	25.0	541	0.67	302000	377000	13600
77	27.4	24.9	541	0.66	301000	375000	13700
78	27.3	24.9	542	0.66	300000	374000	13700
79	27.1	24.8	542	0.66	299000	372000	13700
80	26.9	24.8	543	0.66	298000	371000	13800
81	26.7	24.7	543	0.66	298000	369000	13800
82	26.6	24.6	544	0.66	297000	368000	13800
83	26.4	24.6	544	0.65	296000	366000	13900
84	26.2	24.5	545	0.65	295000	365000	13900
85	26.0	24.5	545	0.65	294000	363000	14000
86	25.8	24.4	545	0.65	293000	362000	14000
87	25.7	24.3	546	0.65	292000	360000	14000
88	25.5	24.2	546	0.65	291000	358000	14100
89	25.3	24.2	547	0.64	290000	357000	14100
90	25.1	24.1	547	0.64	289000	355000	14200
91	24.9	24.0	548	0.64	288000	354000	14200
92	24.7	23.9	548	0.64	287000	352000	14200
93	24.5	23.9	549	0.64	287000	351000	14300
94	24.4	23.8	549	0.64	286000	349000	14300
95	24.2	23.7	550	0.63	285000	348000	14400
96	24.0	23.7	550	0.63	284000	346000	14400
97	23.8	23.6	551	0.63	283000	345000	14500
98	23.7	23.5	551	0.63	282000	343000	14500
99	23.5	23.4	551	0.63	281000	342000	14600
100	23.3	23.4	552	0.63	280000	340000	14600
101	23.1	23.3	552	0.62	280000	339000	14700
102	23.0	23.2	553	0.62	279000	338000	14700
103	22.8	23.1	553	0.62	278000	336000	14700
104	22.6	23.1	554	0.62	277000	335000	14800
105	22.5	23.0	554	0.62	276000	333000	14800
106	22.3	22.9	555	0.62	275000	332000	14900
107	22.1	22.9	555	0.61	275000	331000	14900
108	22.0	22.8	555	0.61	274000	329000	15000

Table 2. Nominal Net Power Output and Efficiency versus Ambient Temperature at Standard Sea Level Pressure (Cont'd)

Ambient Temp (F)	Net Power (kW)	Net Efficiency (%)	Exhaust Temp (F)	Exhaust Mass Flow Rate (lbm/s)	Exhaust Energy (Btu/hr)	Fuel Flow Energy (Btu/hr LHV)	Heat Rate (Btu/kWhr LHV)
109	21.8	22.7	556	0.61	273000	328000	15000
110	21.6	22.6	556	0.61	272000	326000	15100
111	21.5	22.5	557	0.61	271000	325000	15100
112	21.3	22.5	557	0.60	270000	323000	15200
113	21.1	22.4	558	0.60	270000	322000	15200
114	21.0	22.3	558	0.60	269000	321000	15300
115	20.8	22.2	558	0.60	268000	319000	15400
116	20.6	22.1	559	0.60	267000	318000	15400
117	20.5	22.1	559	0.60	266000	317000	15500
118	20.3	22.0	560	0.59	266000	315000	15500
119	20.1	21.9	560	0.59	265000	314000	15600
120	20.0	21.8	561	0.59	264000	312000	15600
121	19.8	21.7	561	0.59	263000	311000	15700
122	19.7	21.7	561	0.59	262000	310000	15800

Figure 1 presents a chart illustrating the nominal net power output and efficiency versus ambient temperature at sea level for the Model C30 MicroTurbine operating on high pressure natural gas fuel.

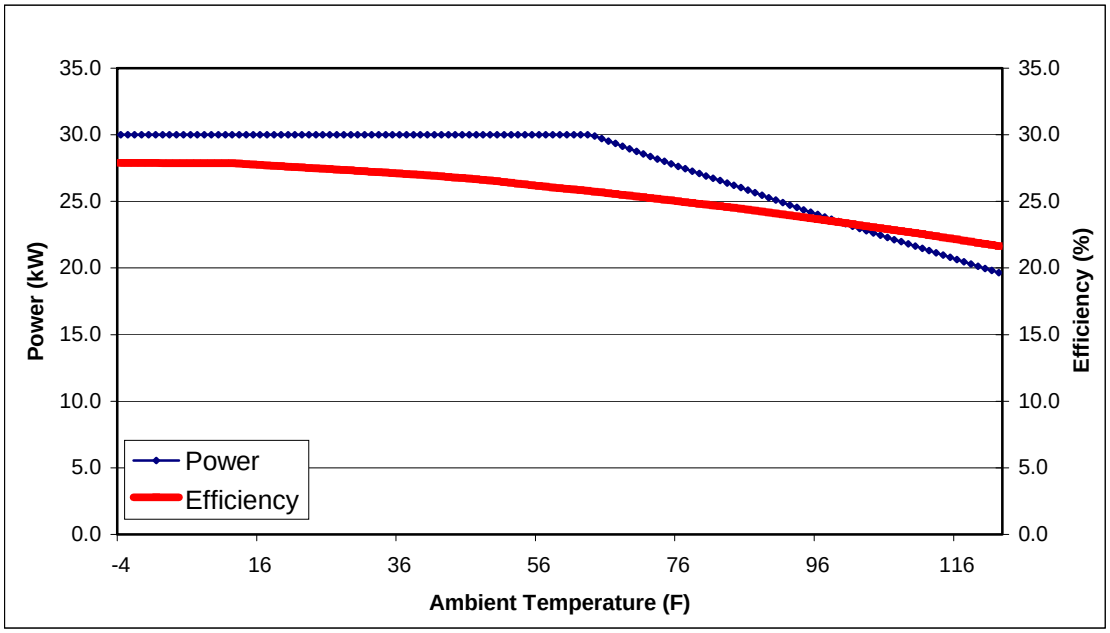

Figure 1. Nominal Net Power Output and Efficiency versus Ambient Temperature at Standard Sea Level Pressure

Ambient Pressure Derating

Ambient pressure affects power output by changing the density of the air. The ambient pressure power ratio versus ambient pressure is presented in Table 3. Current ambient conditions may be obtained from MicroTurbine or external measurements.

Use the following equation to determine power ratio:

$$\text{Ambient Pressure Power Ratio} = \frac{\text{Power Output at ambient pressure}}{\text{Power Output at standard sea level pressure}}$$

Table 3. Ambient Pressure Power Ratio

Ambient Pressure (psia)	Power Ratio	Ambient Pressure (psia)	Power Ratio	Ambient Pressure (psia)	Power Ratio
14.696	1.000	12.135	0.826	9.948	0.677
14.590	0.993	12.044	0.820	9.870	0.672
14.485	0.986	11.954	0.813	9.794	0.666
14.380	0.978	11.864	0.807	9.717	0.661
14.276	0.971	11.775	0.801	9.641	0.656
14.172	0.964	11.686	0.795	9.566	0.651
14.069	0.957	11.598	0.789	9.491	0.646
13.967	0.950	11.511	0.783	9.417	0.641
13.865	0.943	11.424	0.777	9.343	0.636
13.764	0.937	11.338	0.771	9.270	0.631
13.664	0.930	11.252	0.766	9.197	0.626
13.564	0.923	11.166	0.760	9.124	0.621
13.464	0.916	11.081	0.754	9.052	0.616
13.366	0.909	10.997	0.748	8.981	0.611
13.268	0.903	10.913	0.743	8.910	0.606
13.170	0.896	10.830	0.737	8.839	0.601
13.073	0.890	10.747	0.731	8.769	0.597
12.977	0.883	10.665	0.726	8.699	0.592
12.881	0.876	10.583	0.720	8.630	0.587
12.786	0.870	10.502	0.715	8.561	0.583
12.691	0.864	10.421	0.709	8.492	0.578
12.597	0.857	10.341	0.704	8.424	0.573
12.503	0.851	10.261	0.698	8.357	0.569
12.410	0.844	10.182	0.693	8.290	0.564

NOTES	
	1. When derating power for elevation, use Table 3 together with Table 4 (Ambient Pressure versus Altitude) shown for reference in the next section.
	2. The effect of ambient pressure on efficiency is negligible.

Ambient Pressure Derating (Continued)

Ambient pressure power ratio versus ambient pressure is presented in Figure 2.

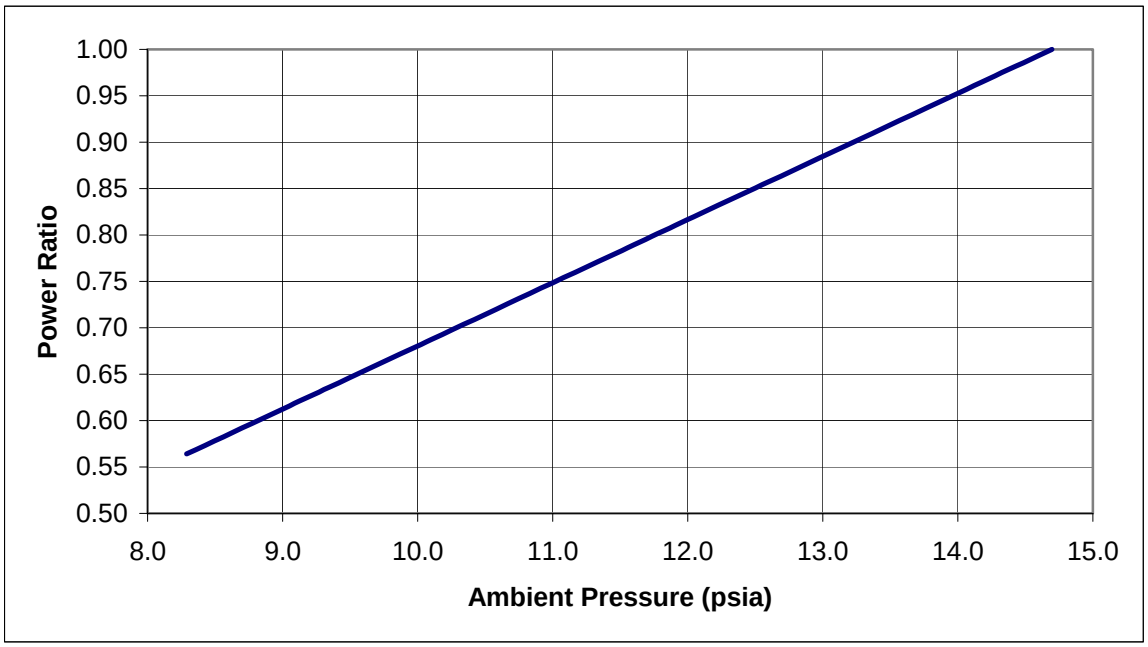

Figure 2. Ambient Pressure Power Ratio

Ambient Pressure versus Altitude (Reference)

Table 4 lists ambient pressure as a function of altitude as defined by the 1976 US Standard Atmosphere model. Altitude is shown in feet and meters and ambient pressure is shown in pounds per square inch absolute (psia) and kilopascals.

Table 4. Ambient Pressure versus Altitude

Altitude		Ambient Pressure		Altitude		Ambient Pressure	
(ft)	(m)	(psia)	(kPa)	(ft)	(m)	(psia)	(kPa)
0	0.00	14.696	101.325	7600	2316.48	11.081	76.404
200	60.96	14.590	100.594	7800	2377.44	10.997	75.823
400	121.92	14.485	99.868	8000	2438.40	10.913	75.245
600	182.88	14.380	99.146	8200	2499.36	10.830	74.671
800	243.84	14.276	98.428	8400	2560.32	10.747	74.100
1000	304.80	14.172	97.714	8600	2621.28	10.665	73.533
1200	365.76	14.069	97.004	8800	2682.24	10.583	72.969
1400	426.72	13.967	96.299	9000	2743.20	10.502	72.409
1600	487.68	13.865	95.598	9200	2804.16	10.421	71.853
1800	548.64	13.764	94.900	9400	2865.12	10.341	71.300
2000	609.60	13.664	94.208	9600	2926.08	10.261	70.750
2200	670.56	13.564	93.519	9800	2987.04	10.182	70.204
2400	731.52	13.464	92.834	10000	3048.00	10.104	69.661
2600	792.48	13.366	92.153	10200	3108.96	10.025	69.122
2800	853.44	13.268	91.476	10400	3169.92	9.948	68.586
3000	914.40	13.170	90.804	10600	3230.88	9.870	68.053
3200	975.36	13.073	90.135	10800	3291.84	9.794	67.524
3400	1036.32	12.977	89.471	11000	3352.80	9.717	66.998
3600	1097.28	12.881	88.810	11200	3413.76	9.641	66.475
3800	1158.24	12.786	88.153	11400	3474.72	9.566	65.956
4000	1219.20	12.691	87.500	11600	3535.68	9.491	65.440
4200	1280.16	12.597	86.852	11800	3596.64	9.417	64.927
4400	1341.12	12.503	86.207	12000	3657.60	9.343	64.418
4600	1402.08	12.410	85.566	12200	3718.56	9.270	63.912
4800	1463.04	12.318	84.928	12400	3779.52	9.197	63.409
5000	1524.00	12.226	84.295	12600	3840.48	9.124	62.909
5200	1584.96	12.135	83.666	12800	3901.44	9.052	62.412
5400	1645.92	12.044	83.040	13000	3962.40	8.981	61.919
5600	1706.88	11.954	82.418	13200	4023.36	8.910	61.429
5800	1767.84	11.864	81.800	13400	4084.32	8.839	60.942
6000	1828.80	11.775	81.186	13600	4145.28	8.769	60.458
6200	1889.76	11.686	80.575	13800	4206.24	8.699	59.977
6400	1950.72	11.598	79.968	14000	4267.20	8.630	59.499
6600	2011.68	11.511	79.365	14200	4328.16	8.561	59.024
6800	2072.64	11.424	78.765	14400	4389.12	8.492	58.553
7000	2133.60	11.338	78.169	14600	4450.08	8.424	58.084
7200	2194.56	11.252	77.577	14800	4511.04	8.357	57.619
7400	2255.52	11.166	76.989	15000	4572.00	8.290	57.156

Inlet Pressure Loss Derating

On some applications, such as HEV or OEM, the air inlet design can affect engine performance. The amount of debris on the inlet filter can also affect engine performance for all engine applications.

The maximum allowable inlet pressure loss is 10 inches of water. Nominal fraction of ISO zero inlet pressure loss power and efficiency versus inlet pressure loss at ISO ambient conditions for the Model C30 MicroTurbine operating on natural gas fuel is presented in Table 5. These values are estimated from nominal performance curves.

The inlet pressure loss power and efficiency ratios are defined as follows:

$$\text{Inlet Pressure Loss Power Ratio} = \frac{\text{Net power output}}{\text{Net power output at zero (0) inlet pressure loss}}$$

$$\text{Inlet Pressure Loss Efficiency Ratio} = \frac{\text{Net efficiency}}{\text{Net efficiency at zero (0) inlet pressure loss}}$$

Table 5. Nominal Fraction of ISO Zero Inlet Pressure Loss Power and Efficiency versus Inlet Pressure Loss at ISO Ambient Conditions

Inlet Pressure Loss (Inches of Water)	Inlet Pressure Loss Power Ratio	Inlet Pressure Loss Efficiency Ratio
0	1.000	1.000
1	0.993	0.997
2	0.986	0.994
3	0.979	0.991
4	0.973	0.988
5	0.966	0.985
6	0.959	0.982
7	0.952	0.979
8	0.945	0.976
9	0.938	0.973
10	0.931	0.970

Nominal fraction of ISO zero inlet pressure loss power and efficiency versus inlet pressure loss at ISO ambient conditions for the Model C30 HEV MicroTurbine operating on natural gas fuel is presented in Figure 3.

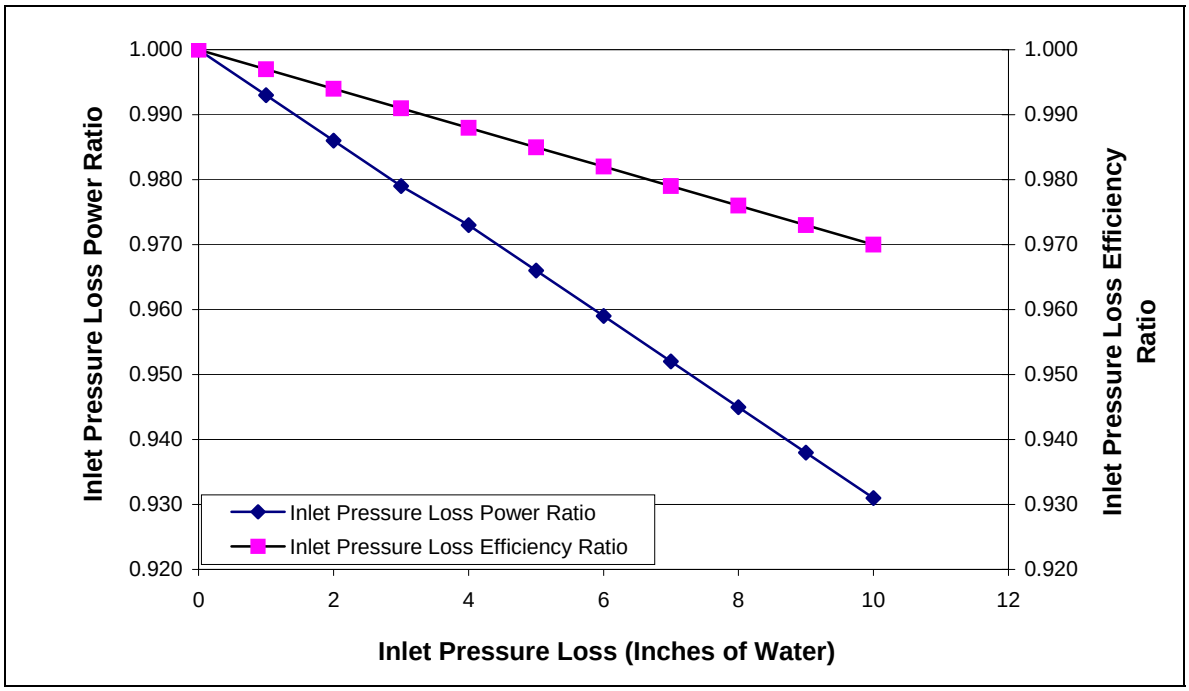

Figure 3. Nominal Fraction of ISO Zero Inlet Pressure Loss Power and Efficiency versus Inlet Pressure Loss at ISO Ambient Conditions

Back Pressure Derating

The maximum allowable exhaust back pressure is eight inches of water. Nominal fraction of ISO net power output and efficiency versus back pressure at ISO ambient conditions for the Model C30 MicroTurbine operating on natural gas fuel is presented in Table 6. These values are estimated from nominal performance curves.

The inlet loss power and efficiency ratios are defined as follows:

$$\text{Exhaust Back Pressure Power Ratio} = \frac{\text{Net power output}}{\text{Net power output at zero (0) back pressure}}$$

$$\text{Exhaust Back Pressure Efficiency Ratio} = \frac{\text{Net efficiency}}{\text{Net efficiency at zero (0) back pressure}}$$

Table 6. Nominal Fraction of ISO Net Power Output and Efficiency versus Back Pressure at ISO Ambient Conditions

Back Pressure (Inches of Water)	Back Pressure Power Ratio	Back Pressure Efficiency Ratio
0	1.000	1.000
1	0.996	0.997
2	0.992	0.994
3	0.987	0.991
4	0.983	0.988
5	0.979	0.985
6	0.975	0.982
7	0.971	0.979
8	0.966	0.976

Nominal fraction of ISO zero back pressure power output and efficiency versus back pressure at ISO ambient conditions for the Model C30 MicroTurbine operating on natural gas fuel is presented in Figure 4.

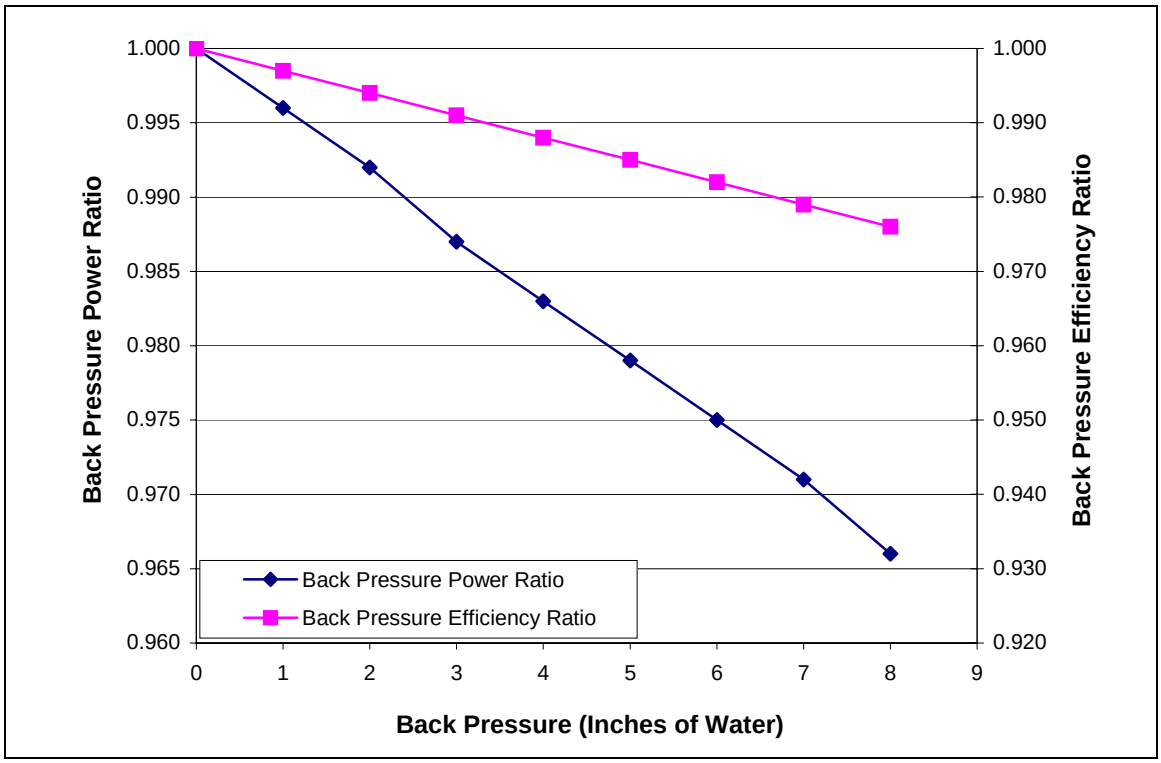

Figure 4. Nominal Fraction of ISO Zero Back Pressure Power Output and Efficiency versus Back Pressure at ISO Ambient Conditions

ISO Partial Load Performance

Performance at partial load and ISO ambient conditions for the Capstone Model C30 MicroTurbine operating on high pressure natural gas fuel is presented in Table 7. These values are estimated from nominal performance curves.

Table 7. Partial Load Performance at ISO Ambient Conditions

Net Power (kW)	Net Efficiency (%)	Exhaust Temp (F)	Exhaust Mass Flow Rate (lbm/s)	Exhaust Energy (Btu/hr)	Fuel Flow Energy (Btu/hr LHV)	Heat Rate (Btu/kWhr LHV)
2.0	8.8	395	0.24	74700	77900	38900
3.0	11.5	386	0.27	81900	89000	29700
4.0	13.6	392	0.29	90200	100000	25100
5.0	15.2	398	0.31	98700	112000	22400
6.0	16.6	405	0.33	107000	123000	20600
7.0	17.7	411	0.35	115000	135000	19200
8.0	18.8	416	0.37	123000	145000	18200
9.0	19.8	421	0.38	130000	155000	17300
10.0	20.6	426	0.40	138000	166000	16600
11.0	21.2	432	0.41	145000	177000	16100
12.0	21.8	438	0.43	153000	188000	15600
13.0	22.3	443	0.44	161000	199000	15300
14.0	22.8	448	0.46	169000	209000	15000
15.0	23.2	454	0.47	177000	220000	14700
16.0	23.6	459	0.49	185000	231000	14400
17.0	24.0	464	0.50	193000	242000	14200
18.0	24.3	468	0.52	201000	253000	14000
19.0	24.6	473	0.53	209000	263000	13900
20.0	24.9	478	0.54	217000	274000	13700
21.0	25.1	483	0.56	226000	286000	13600
22.0	25.3	488	0.57	234000	297000	13500
23.0	25.4	493	0.58	243000	308000	13400
24.0	25.6	498	0.60	252000	320000	13300
25.0	25.7	503	0.61	261000	332000	13300
26.0	25.8	509	0.63	271000	344000	13200
27.0	25.8	514	0.64	281000	357000	13200
28.0	25.9	518	0.65	290000	368000	13200
29.0	26.0	523	0.67	299000	381000	13100
30.0	26.0	529	0.68	310000	394000	13100