



Product Specification

Technical Specifications and Descriptions for a Single Capstone MicroTurbine (Enclosed and Recuperated)

Summary

This Product Specification describes a MicroTurbine power generating system (hereafter referred to as a MicroTurbine). The MicroTurbine provides on-site electrical power for primary or standby applications, and for peak shaving, base loading, and/or capacity additions. The MicroTurbine(s) may generate power in parallel with an electrical utility (Grid Connect mode), or isolated from the utility (Stand Alone mode). The system consists of a turbine engine, solid-state power electronics, a fuel system, and an indoor/outdoor-rated enclosure (standard or industrial-style).

The turbine engine includes a compressor, a recuperator (exhaust gas heat exchanger), a combustor, a turbine, and a generator. The MicroTurbine turbine engine is air-cooled and supported on air-lubricated compliant foil bearings. The compressor impeller, turbine rotor, and generator rotor are mounted on a single shaft, which comprises the only moving part in the engine. Power electronics are solid-state, double conversion type, producing three-phase alternating current output power from the high-frequency alternating current engine output.

Performance Ratings at Full Load Power

The performance ratings are listed at full load power and ISO conditions. ISO conditions are defined as: 15 °C (59 °F), 60% relative humidity, at sea level altitude. LHV: Lower Heating Value, HPNG: High Pressure Natural Gas, LPNG: Low Pressure Natural Gas, SG: Sour Gas, and L/DG: Landfill/Digester Gas.

Capstone	Net Power Output	Net Efficiency (LHV)	Nominal Heat Rate (LHV)
Model C60 (HPNG)	60 (+0/-2) kW net 83 kVA max at 480 Volts AC 100 Amps per phase max continuous, 50/60 Hz (without gas compression option)	28 (± 2)%	12,900 kJ (12,200 Btu) /kWh
Model C30 (HPNG, SG, or L/DG)	30 (+0/-1) kW net 38.2 kVA max at 480 Volts AC 46 Amps per phase max continuous, 50/60 Hz	26 (± 2)% (Efficiency values might be lower if fuel gas compression is required for L/DG)	13,800 kJ (13,100 Btu) /kWh
Model C30 (LPNG)	28 (+0/-1) kW net 38.2 kVA max at 480 Volts AC 46 Amps per phase max continuous, 50/60 Hz (with gas compression option)	25 (± 2)% (at 5 psig fuel inlet pressure)	14,400 kJ (13,700 Btu) /kWh
Model C30 (Liquid Fuel)	29 (+1/-1) kW net 38.2 kVA max at 480 Volts AC 46 Amps per phase max continuous, 50/60 Hz	25 (± 2)%	14,400 kJ (13,700 Btu) /kWh

Electrical Performance Ratings at Full Load Power

The following table presents the electrical performance ratings for a MicroTurbine operating in the Grid Connect mode. The Grid Connect output current harmonic distortion is less than or equal to 5%, and complies with IEEE 519. HPNG: High Pressure Natural Gas.

Capstone	Model C60 (HPNG)	Model C30 (HPNG)
Voltage Operating Range	360 to 528 VAC	360 to 528 VAC
Frequency Operating Range	50/60 Hz	50/60 Hz
Output Voltage Connection	3-phase, 3 or 4 wire wye (The Grid must be neutral grounded)	3-phase, 3 or 4 wire wye (The Grid must be neutral grounded)
Output Current	100 Amps RMS maximum steady state	46 Amps RMS maximum steady state

The following table presents the electrical performance ratings for a MicroTurbine operating in the Stand Alone mode. The Stand Alone output voltage harmonic distortion with linear load is less than or equal to 5%, and complies with IEEE 519. HPNG: High Pressure Natural Gas.

Capstone	Model C60 (HPNG)	Model C30 (HPNG)
Voltage Operating Range	360 to 480 VAC	360 to 480 VAC
Frequency Operating Range	10 to 60 Hz	10 to 60 Hz
Output Voltage Connection	3-phase, 4 wire wye (Neutral must be solidly grounded)	3-phase, 4 wire wye (Neutral must be solidly grounded)
Output Current	100 Amps RMS maximum steady state	46 Amps RMS maximum steady state

Electrical Performance/Temperature Derating

The electrical performance parameters are listed at full load power and ISO conditions, using natural gas. ISO conditions include: 15 °C (59 °F), 60% relative humidity, at sea level altitude.

Figure 1 presents the Nominal Net Power Output and Efficiency versus Ambient Temperature at Sea Level for the Model C30 MicroTurbine, operating on High Pressure Natural Gas, Landfill/Digester Gas, or Sour Gas only.

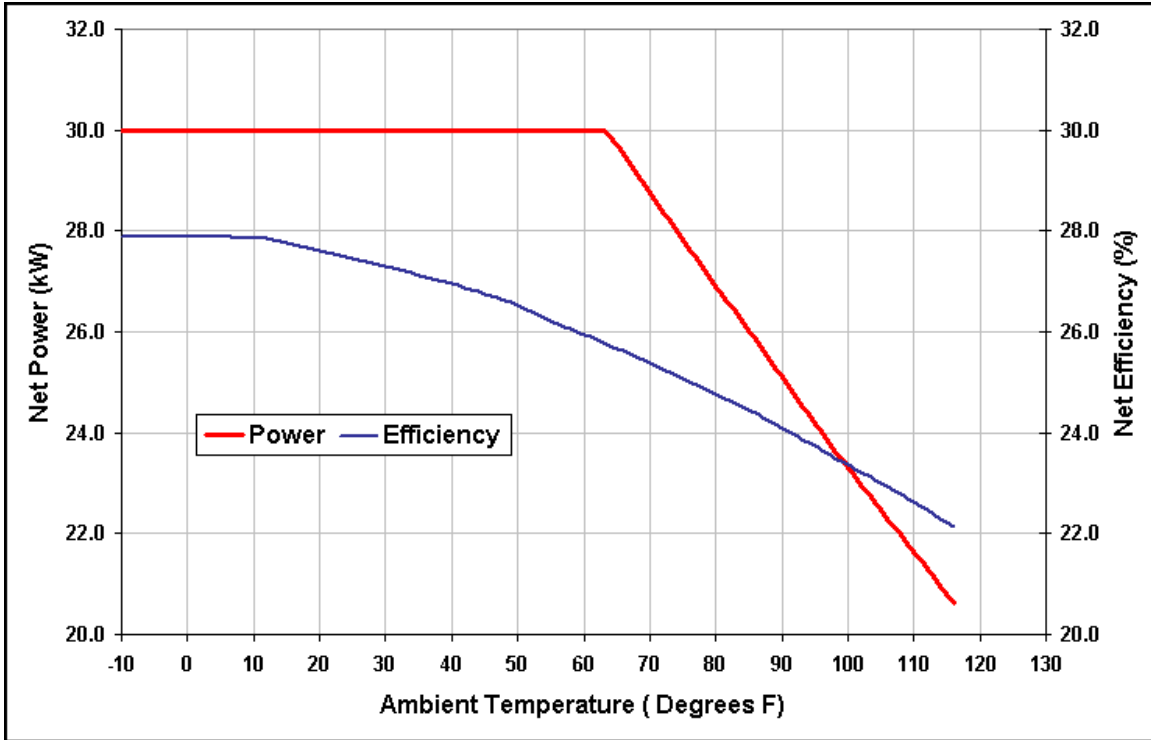


Figure 1
Nominal Net Power Output and Efficiency versus Ambient Temperature at Sea Level
for the Model C30 MicroTurbine, Operating on HPNG, L/DG, or SG Only

Electrical Performance/Temperature Derating (Continued)

Figure 2 presents the Nominal Net Power Output and Efficiency versus Ambient Temperature at Sea Level for the Model C60 MicroTurbine (without gas compression).

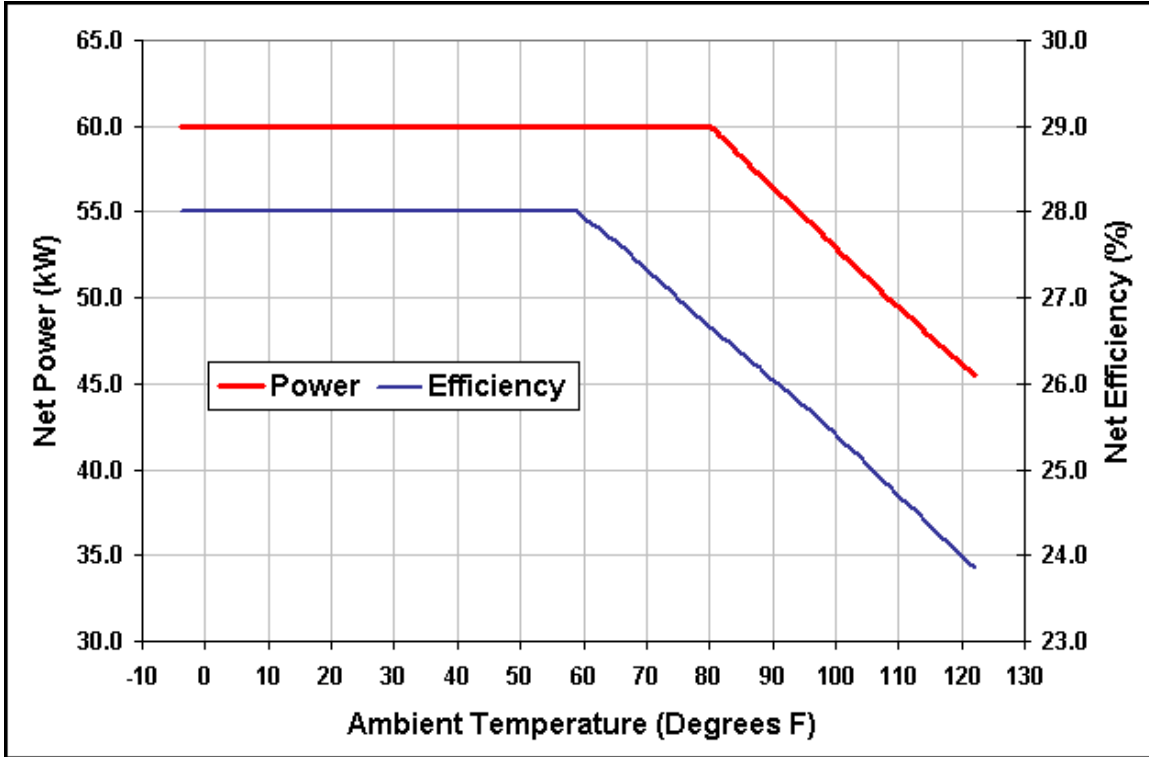


Figure 2
Nominal Net Power Output and Efficiency versus Ambient Temperature at Sea Level
for the Model C60 MicroTurbine (without Gas Compression)

Electrical Performance/Back Pressure Derating

The maximum allowable exhaust back pressure is eight Inches of water.

Figure 3 presents the 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 High Pressure Natural Gas, Landfill/Digester Gas, or Sour Gas.

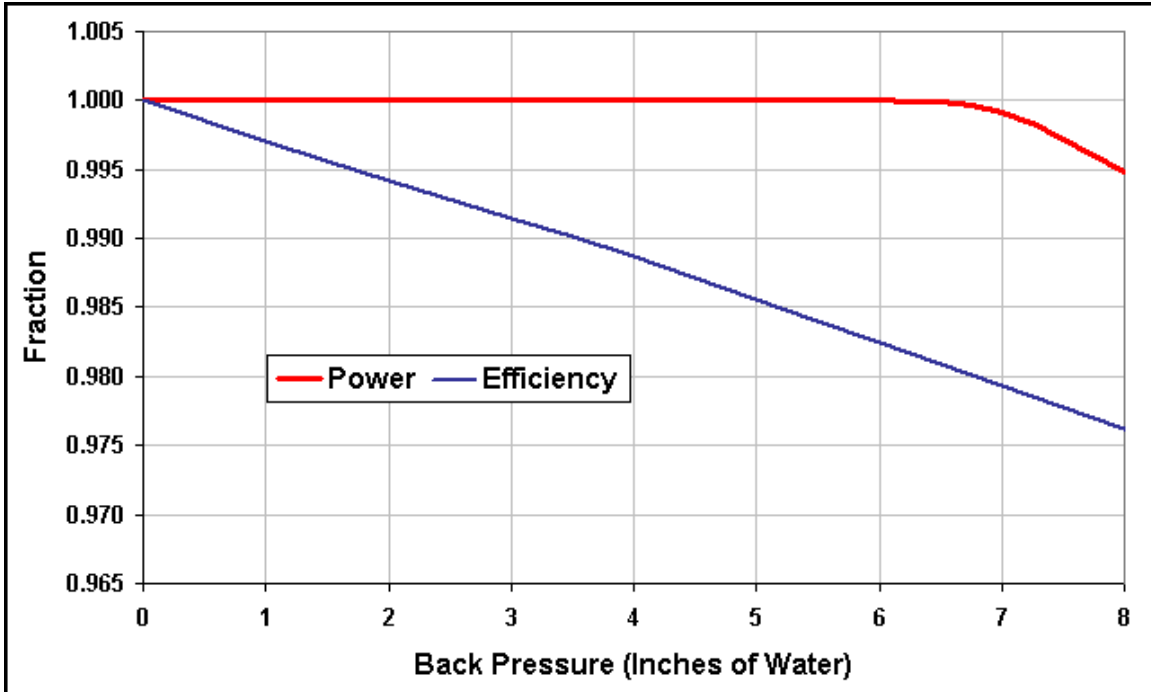


Figure 3
Nominal Fraction of ISO Zero Back Pressure Output and Efficiency versus Back Pressure at ISO Ambient Conditions for the Model C30 MicroTurbine Operating on HPNG, L/DG, or SG Only

Electrical Performance/Back Pressure Derating (Continued)

The maximum allowable exhaust back pressure is eight Inches of water.

Figure 4 presents the Nominal Fraction of ISO Zero Back Pressure Power Output and Efficiency versus Back Pressure at ISO Ambient Conditions for the Model C60 MicroTurbine (without gas compression).

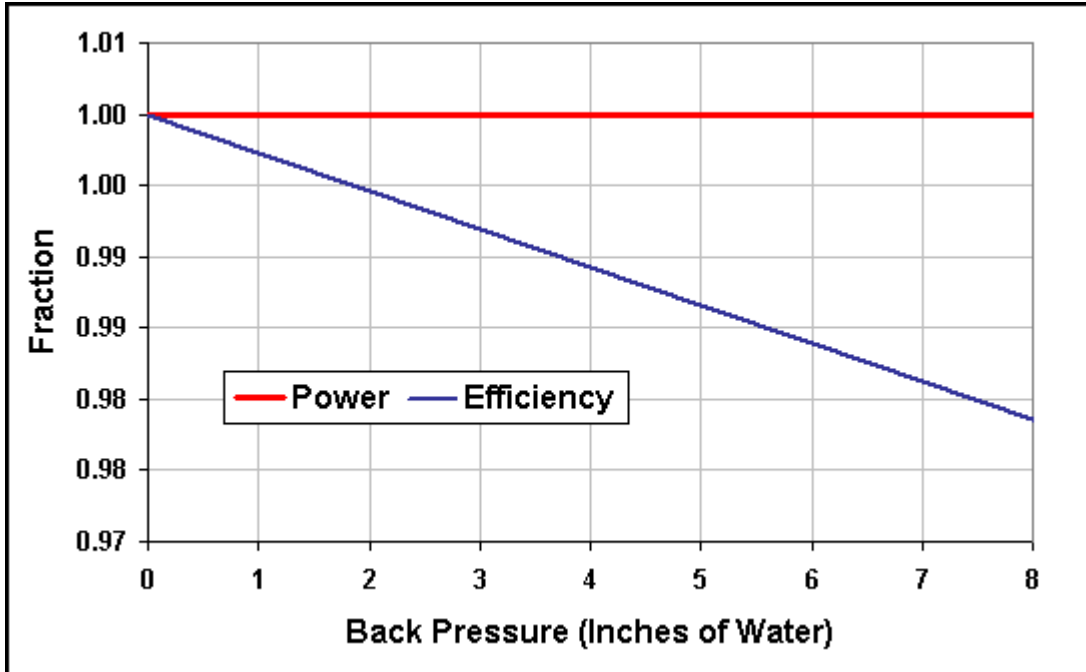


Figure 4
Nominal Fraction of ISO Zero Back Pressure Power Output and Efficiency
versus Back Pressure at ISO Ambient Conditions for the Model C60 MicroTurbine
(without Gas Compression)

Fuel Input Requirements at Full Load Power

The fuel input requirements are listed at full load power and ISO conditions. HPNG: High Pressure Natural Gas, LPNG: Low Pressure Natural Gas.

Capstone	Fuel Heat Content Range (HHV)	Nominal Fuel Flow (HHV) (Notes 1 and 2)
Model C60 (HPNG)	970 to 1130 BTU/scf Natural Gas, Methane	849,000 kJ/hr (804,000 Btu/hr)
Model C30 (HPNG, SG)	760 to 2516 Btu/scf Natural Gas, Propane, Methane, Ethane (0 to 7% volume Sour Gas)	457,000 kJ/hr (433,000 Btu/hr)
Model C30 (LPNG)	970 to 1130 BTU/scf Natural Gas, Methane	444,000 kJ/hr (420,000 Btu/hr)
Model C30 (Landfill/Digester Gas)	350 to 1130 Btu/scf Natural Gas, Methane, Landfill/Digester Gas (0 to 7% volume Sour Gas)	457,000 kJ/hr (433,000 Btu/hr)
Model C30 (Liquid Fuel)	ASTM D975 Diesel Fuel No. 2-D ASTM D3699 Kerosene No. 1-K	459,000 kJ/hr (435,000 Btu/hr)

Note 1. The ratio of Higher Heating Value (HHV) to Lower Heating Value (LHV) is assumed to be 1.1.

Note 2. At start-up, transient input fuel flow requirements might be up to 1.5 times the noted values.

Exhaust Output Ratings at Full Load Power

The exhaust output ratings are listed at full load power and ISO conditions, using natural gas. HPNG: High Pressure Natural Gas, LPNG: Low Pressure Natural Gas.

Capstone	Model C60 (HPNG)	Model C30 (HPNG)	Model C30 (LPNG)	Model C30 (Landfill/Digester Gas)	Model C30 (Liquid Fuel)
Nominal Exhaust Gas Temp	305 °C (580 °F)	275 °C (530 °F)	275 °C (530 °F)	275 °C (530 °F)	275 °C (530 °F)
Nominal Total Exhaust Energy	571,000 kJ/hr (541,000 Btu/hr)	327,000 kJ/hr (310,000 Btu/hr)	327,000 kJ/hr (310,000 Btu/hr)	327,000 kJ/hr (310,000 Btu/hr)	327,000 kJ/hr (310,000 Btu/hr)
NOx Emissions	<9 ppm V @ 15% O ₂	<9 ppm V @ 15% O ₂	<9 ppm V @ 15% O ₂	<9 ppm V @ 15% O ₂	<35 ppm V @ 15% O ₂

Air Flow Requirements at Full Load Power

The table below summarizes the nominal air flow requirements of the MicroTurbine systems.

Capstone	Model C60 (HPNG)	Model C30 (HPNG)	Model C30 (LPNG)	Model C30 (Liquid Fuel)
Engine Inlet Air Flow	425 liters/sec (900 CFM)	283 liters/sec (600 CFM)	283 liters/sec (600 CFM)	283 liters/sec (600 CFM)
Engine Inlet Air Temp (Note 1)	-20 to 50 °C (-4 to 122 °F)	-20 to 50 °C (-4 to 122 °F)	-20 to 50 °C (-4 to 122 °F)	-20 to 50 °C (-4 to 122 °F)
Electronics Controller Inlet Air Flow	236 liters/sec (500 CFM) (Note 4)	217 liters/sec (460 CFM)	217 liters/sec (460 CFM)	217 liters/sec (460 CFM)
Electronics Controller Inlet Air Temp (Note 2)	-20 to 50 °C (-4 to 122 °F)	-20 to 50 °C (-4 to 122 °F)	-20 to 50 °C (-4 to 122 °F)	-20 to 50 °C (-4 to 122 °F)
Rotary Flow Compressor Inlet Air Flow	Not Applicable	Not Applicable	123 liters/sec (260 CFM) (Note 6)	123 liters/sec (260 CFM) (Note 6)
Battery and Battery Controller Inlet Air Flow (Note 3)	175 liters/sec (370 CFM) (Note 5)	118 liters/sec (250 CFM)	118 liters/sec (250 CFM)	118 liters/sec (250 CFM)
Battery Inlet Air Temp (Note 3)	-20 to 50 °C (-4 to 122 °F)	-20 to 50 °C (-4 to 122 °F)	-20 to 50 °C (-4 to 122 °F)	-20 to 50 °C (-4 to 122 °F)

Note 1: The Engine Dump Valve exhausts air at 227 °C (441 °F) in bursts during rapid deceleration (as in the normal warmdown cycle, and also in an Emergency Stop event).

Note 2: The Electronics Controller inlet air temperature must be within 2 °C (3.6 °F) of the Engine inlet air temperature.

Note 3: The Battery and the Battery Controller are only used with the Stand Alone option. The Battery and the Battery Controller inlet air temperature must be within 2 °C (3.6 °F) of the Engine inlet air temperature.

Note 4: These values for the Model C60 are comprised of 118 liters/sec (250 CFM) for the Load Control Module and 118 liters/sec (250 CFM) for the Electronics Control Module.

Note 5: These values for the Model C60 are comprised of 118 liters/sec (250 CFM) for the Battery Control Module and 57 liters/sec (120 CFM) for the Battery.

Note 6: The Rotary Flow Compressor (RFC) cooling air temperature must be within 2 °C (3.6 °F) of the Engine inlet air temperature, and the RFC Heat Exchanger must be in the air outflow. Additionally, the RFC provides air assist functionality in the Liquid Fuel system only.

Acoustic Emissions Ratings at Full Load Power

The following table presents the nominal acoustic emissions ratings of the various Capstone MicroTurbines. The data was captured at full rated output power at 10 meters (33 feet).

Capstone	Model C60	Model C30 Standard Package	Model C30 Industrial Package
Acoustic Emissions Ratings	70 dBA	65 dBA	65 dBA

MicroTurbine Dimensions and Weights

The following table summarizes the dimensions and weights of the MicroTurbine systems.

Capstone	Model C60	Model C30 Standard Package	Model C30 Industrial Package
Height	2110 mm (83 inches)	1900 mm (74.8 inches)	1943 mm (76.5 inches)
Width	762 mm (30 inches)	714 mm (28.1 inches)	762 mm (30 inches)
Depth	1956 mm (77 inches)	1344 mm (52.9 inches)	1517 mm (59.7 inches)
Weight	758 kg (1671 pounds) (Add 363 kg or 800 pounds for the Stand Alone option)	478 kg (1052 pounds) (Add 173 kg or 380 pounds for the Stand Alone option)	405 kg (891 pounds) (Add 173 kg or 380 pounds for the Stand Alone option)

MicroTurbine Storage Temperature Ratings

The MicroTurbine may be stored within a temperature range of -40 to 65 °C (-4 to 149 °F).

Certification Information

Certification details are provided in the Capstone MicroTurbine Compliance List. Please contact Capstone for the latest Certification information.

Warranty Information

Existing warranty details are provided in the Standard Warranty, the 1-Year Extended Warranty, and in the 2-Year Extended Warranty documents.

Notes and Related Information