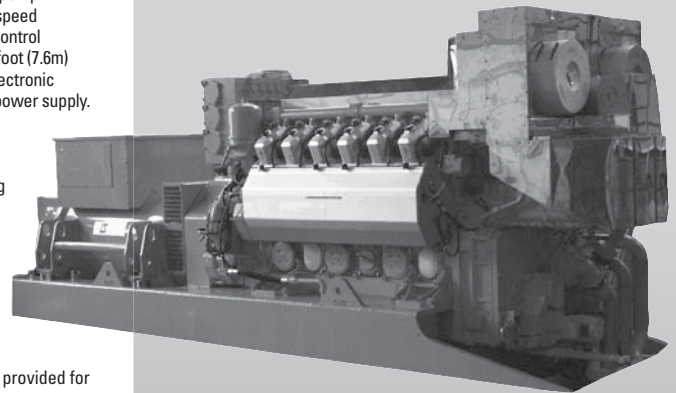


STANDARD EQUIPMENT

- AFR** – Air Fuel Ratio control included with ESM®. Load based control with continuous feedback. Requires kW input.
- BARRING DEVICE** – Manual, mounted.
- BASE** – Engine, generator are mounted and aligned on a welded steel, wide flange base with lifting outriggers. Designed for flexible elastic mounting on isolators. May also be solid mounted.
- BEARINGS** – Heavy-duty, bi-metal, Sputterlager type, replaceable, precision type.
- BREATHER** – Open, customer to vent from connection on engine.
- CAMSHAFTS** – Case hardened individual segments (two per bank) bolted together.
- CONNECTING RODS** – Forged high tensile steel, fully machined and balanced with oil jet piston pin lubrication.
- COOLING SYSTEM** – Standard three (3) circuits (HT, LT & Lube oil) for CHP application using a separate lube oil cooling circuit. HT and LT controlled by a built-in thermostatic valve. Designed for temperature range: LT 45°C (113°F) or LT 55°C (131°F) and HT 100°C (212°F). External lube oil cooler and thermostat, external radiator (or) cooling tower (or) raw water are customer supplied. Optional design with two separate cooling circuits – Low temperature (LT) second stage circuit for charge air cooler and lube oil cooler and high temperature (HT) circuit for jacket water, cylinder heads, first stage charge air cooler and exhaust system water. Both HT and LT cooling water are circulated by an engine driven twin pump.
- CONTROL SYSTEM** – Waukesha Engine System Manager (ESM®) integrates fuel injection, spark timing control, speed governing, detonation protection, start-stop control, diagnostic tools, fault logging and engine safeties. Engine Control Unit (ECU) is central brain of the control system and main customer interface. Interface with ESM is through 25 foot (7.6m) harness to local panel, through MODBUS RTU slave connection RS-485 multidrop hardware, and through the Electronic Service Program (ESP). Customer's connections are only required to the local panel, fuel valve, and for 24V DC power supply. Compatible with Woodward load sharing module. ESM meets Canadian Standard Association Class I, Division 2, Group D, hazardous location requirements. Logic provided for engine preheat, engine prelude, gas train and exhaust venting.
- CRANKCASE** – Nodular cast iron, fully ribbed, integral with cylinder frame. Hydraulically fastened main bearing caps. Optimal compact and rigid design including large inspection doors.
- CRANKSHAFT** – Forged high tensile steel, counterweighted and fully dynamically balanced.
- CYLINDERS** – Removable wet type cylinder liners, centrifugally cast iron with anti polishing ring.
- CYLINDER HEADS** – Twelve interchangeable robust design cylinder heads with hydraulically tensioned studs. Grey cast iron. Four valves per head - two intake and two exhaust valve with replaceable intake and exhaust valve seats, stellite-coated seat faces and chromium-plated stems. Water-cooled flame deck and prechamber. Prechamber is heat resistant alloy steel.
- ELECTRONIC SERVICE PROGRAM (ESP)** – Microsoft Windows based program provided on CD-ROM for programming and interface to ESM®. Includes E-Help for troubleshooting any ESM faults. Serial harness is provided for connection of a customer supplied laptop to the ECU RS-232 port.
- ENGINE MONITORING DEVICES** – Factory mounted and wired sensors for lube oil pressure and temperature, intake manifold temperature and pressure, overspeed, jacket water temperature, and exhaust temperatures, all accessible through ESM. ESM continuously monitors combustion performance through individual knock sensors to provide detonation protection. Dual magnetic pickups are used for accurate engine speed and position monitoring. ESM provides predictive spark plug diagnostics as well as advanced diagnostics of engine and all ESM sensors and logs any faults into non-volatile flash memory.
- EXHAUST SYSTEM** – Insulated removable covers for exhaust manifold and turbochargers. Single DIN 250 outlet flange at each turbocharger. Includes two DIN 250 stainless steel exhaust flex connections (shipped loose).
- FUEL SYSTEM** – Gas is supplied through common pipes running along the engine (DIN 80), with individual feed pipes to each main and prechamber fuel injector on each cylinder head. Two common pipes per bank, one for the main and one for the prechamber gas supply. Includes a pre-packaged gas train (shipped loose) including fuel pressure regulator, coalescing filter, two blocking valves, ventilation system and temperature and pressure gauges and sensors. The gas pressure to be delivered to the gas train is 58-87 psig (4-6 barG).
- GENERATOR** – Open, drip-proof, direct connected, synchronous, fan cooled, AC revolving field type, two-bearing generator with AREP excitation system for 270% short circuit sustain and motor starting, cross current compensation, 100 ohm platinum RTD's for the stator windings and both bearings, and 230V single phase, 50-/60 Hz generator space heater. TIF and Deviation Factor within NEMA MG-1.32. Voltage: 480V or 4.16kV or 13.8kV, 3 phase, 6 wire Wye, 60 Hz, and 400V or 6.3kV or 11kV, 3 phase, 6 wire Wye, 50 Hz. Temperature rise within NEMA 105° C for continuous duty. Voltage regulation is ±0.5%. All generators are mounted to engine via flexible coupling.
- GOVERNOR** – Fuel injected. No throttle actuator. Governor tuning is performed using ESP. ESM includes a load-coming feature to high step load engine response to step loads.
- IGNITION SYSTEM** – Designed for industrial gas engines to achieve long lifetime and reliability. The ignition system is controlled by ESM which automatically adjusts the ignition timing according to the data received from the engine. Optimizes combustion in every cylinder. The diagnostics feature of ESM can be used to help monitor spark plug life and aid in predictive maintenance.
- JUNCTION BOX** – Separate AC, I/O junction boxes for engine wiring and external connections. Includes motor starters and relays to operate the prelude pump, HT preheat circulating pump, HT heaters and generator space heater.
- LUBRICATION SYSTEM** – Wet oil sump and single lube oil circuit including glass fiber cartridge filters. Centrifugal filter in the bypass to remove fine particles from lubricating oil. Engine connections provided for customer supplied oil cooler and thermostats for CHP application. Mounted pre-lubrication system with pump for rapid starts. Lube oil level controller.
- OIL PAN** – Base type.
- PAINT** – Oilfield Orange.
- PISTONS** – Composite type with aluminum skirt and a steel crown. Piston gallery cooled via large flow oil jets. The piston skirt and cylinder liner lubricated by piston skirt lubrication through two bores in a groove in the piston skirt.
- STARTING SYSTEM** – Air starting system includes one air starter with silencer, relay valve and strainer. Low air consumption and noise level.
- TURBOCHARGER** – Two (2) single stage, oil lubricated, high pressure ratio turbochargers. ESM controlled wastegate. Front mounted.
- VOLTAGE REGULATOR** – Automatic type with 3-phase sensing (shipped loose).
- WATER CIRCULATING SYSTEM** – Engine driven twin pump fitted on free end of the engine. The LT & HT twin pump feeds water directly into the cooling channels of the engine block.
- AUXILIARY CIRCUIT (LT)** – Second stage charge air cooler and oil cooler piped in parallel, 45°C (113°F) or 55°C (131°F) inlet water temperature.
- JACKET WATER CIRCUIT (HT)** – First stage charge air cooler and engine jacket in series, 100°C (212°F) outlet water temperature. Includes jacket water preheater and circulating pump.
- ENGINE CONTROL PANEL** – ECP5000E panel with alarm horn, NEMA 12 enclosure, Human Machine Interface (HMI), programmable Logic Controller (PLC) with engine control logic, AC Power Monitor, protective functions, kilowatt transducer for ESM-AFR, synchronizing check relay, Modbus TCP communication, Supervisory Control and Data Acquisition (SCADA) for historical logging and report generation visible on HMI.

**APG™ Series Gas
Enginator® Generating
System Featuring
ESM® Technology**

1860 - 2100 kW



Engine shown with options.

Model APG2000

Turbocharged and Intercooled,
Lean Combustion Gas Fueled Enginator

SPECIFICATIONS

Cylinders	Lube Oil Capacity
V 12	159 gal. (600 L)
Piston	Starting System
6682 cu. in. (109.5 L)	Air Starter
Bore & Stroke	Dry Weight
8.7" x 9.4" (220 x 240 mm)	60,000 lb. (27216 kg)
Compression Ratio	
11:1	
Jacket Water System Capacity	
92 gal. (348 L)	



PERFORMANCE DATA: APG2000 GAS ENGINE[®] GENERATING SYSTEM

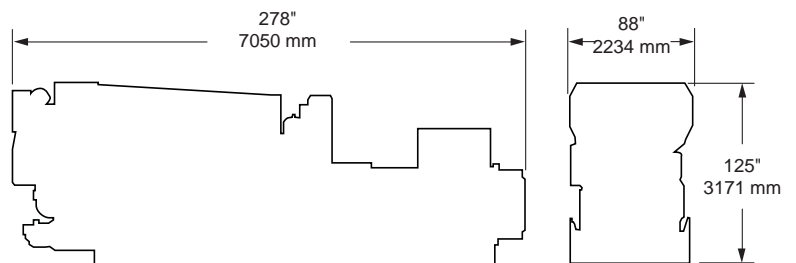
Intercooler Water: 113°F (45°C)	CONTINUOUS POWER		
	1200 rpm 60 Hz	1500 rpm 50 Hz	
kW RATING			
KWe @ 1.0 Power Factor	1895	2140	
KWe @ 0.8 Power Factor	1875	2115	
Electrical Efficiency @ 1.0 Power Factor (%)	42.7 ²	41.4 ²	
Electrical Efficiency @ 0.8 Power Factor(%)	42.2	40.8	
BMEP PSI (Bar)	258 (17.8)	232 (16)	
Emissions	TA Luft * (1.2 g/bhp-hr)		
Engine Heat Balance	BTU/hr x 1000 (kW)	60 Hz	50 Hz
Fuel Consumption - LHV		15174 (4443) ²	17681 (5177) ²
HT Total Cooling Circuit		1974 (578)	2365 (693)
Jacket Water		1290 (378)	1560 (457)
Charge Air HT - 1 st pass intercooler		648 (190)	805 (236)
LT Total Cooling Circuit (with internal LOC)		1505 ³ (441) ³	1686 ³ (494) ³
Charge Air LT - 2 nd pass intercooler		747 ⁴ (219) ⁴	608 ⁴ (178) ⁴
Lube oil circuit		758 (222)	1079 (316)
Exhaust Energy		4556 ⁵ (1334) ⁵	5557 ⁵ (1627) ⁵
Radiation and Generator Ventilation		700 (205)	799 (234)
System Flow Data		60 Hz	50 Hz
Water Cooling Circuits			
HT Flow - gpm (m ³ /h)		260 ⁶ (59) ⁶	260 ⁶ (59) ⁶
LT Flow with internal LOC - gpm (m ³ /h)		216 ⁶ (49) ⁶	216 ⁶ (49) ⁶
LT Flow with external LOC - gpm (m ³ /h)		44 ⁶ (10) ⁶	44 ⁶ (10) ⁶
Lube oil flow - gpm (m ³ /h)		207 (47)	207 (47)
Suction air flow - lb/s (kg/s)		8 (3.48)	9 (3.86)
Exhaust gas flow - lb/s (kg/s)		8 (3.58)	9 (3.97)
Exhaust temperature - °F (°C)		666 (352)	716 (380)

NOTES:

Continuous Power Rating: The highest electrical power output of the engine available for an unlimited number of hours per year, less maintenance.

Rating Standard: The power rating descriptions are in accordance to ISO 8528, DIN6271 and BS5514. It is also valid for ISO 3046/1-1995 with an engine mechanical efficiency of 90% and Tera (clause 10.0) is limited to ± 10° F (5° C).

- 1 No overload available.
 - 2 Fuel consumption per ISO 3046/1 +5 %. Includes engine-driven pumps
 - 3 LOC = Lube Oil Cooler
 - 4 For engines with external LOC, charge air LT is LT total rejection
 - 5 Heat rejection based on cooling exhaust gas to 25°C
 - 6 HT and LT Water Flow for 1.5 bar External Pressure Drop
 - LT water temperature of 55°C available for hot climates
 - * ½ TA Luft emissions available upon request
- Typical heat balance data is shown, however no guarantee is expressed or implied. Consult your Dresser Waukesha Application Engineering Department for system application assistance.
- All natural gas engine ratings are based on a fuel of 900 Btu/ft³ (35.3 MJ/nm³) SLHV, with a 91 WKI[®]. For conditions or fuels other than standard, consult the Dresser Waukesha Application Engineering Department.



Consult your local Waukesha Distributor for system application assistance. The manufacturer reserves the right to change or modify without notice, the design or equipment specifications as herein set forth without incurring any obligation either with respect to equipment previously sold or in the process of construction except where otherwise specifically guaranteed by the manufacturer.