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|--|--|---|---|---|
|  | CUMMINS ENGINE COMPANY, INC Columbus, Indiana 47201 ENGINE PERFORMANCE CURVE | Basic Engine Model: 4BT3.9-G4 | Curve Number: FR-90802 @ 1500 RPM FR-90801 @ 1800 RPM | G-DRIVE B3.9 1 |
| | | Engine Critical Parts List: CPL: 2377 | Date: 23Oct00 | |
| Displacement : 3.92 litre (239.3 in³) | | Bore : 102 mm (4.02 in.) Stroke : 120 mm (4.72 in.) | | |
| No. of Cylinders : 4 | | Aspiration : Turbocharged | | |

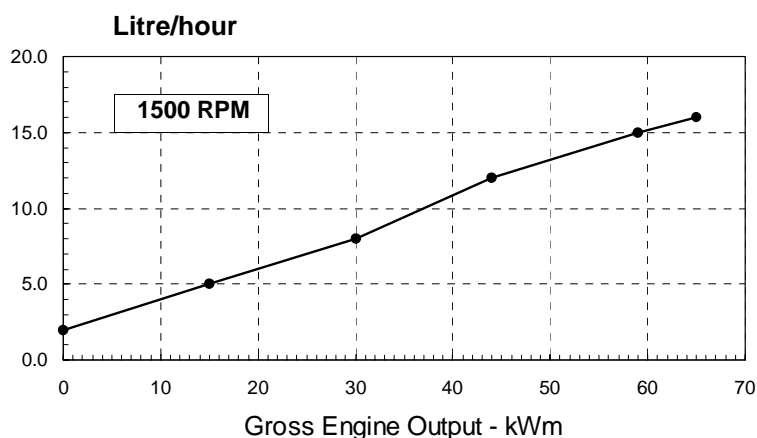
•• PRELIMINARY ••

| Engine Speed RPM | Standby Power | | Prime Power | | Continuous Power | |
|---------------------|---------------|-----|-------------|-----|------------------|-----|
| | kWm | BHP | kWm | BHP | kWm | BHP |
| 1500 | 65 | 87 | 59 | 79 | 41 | 55 |
| 1800 | 76 | 102 | 69 | 93 | 48 | 64 |

Emissions Certification: This engine complies with certain emissions requirements established by US EPA/CARB and by the German TA-Luft. See Exhaust Emissions Data Sheet for conformance specifics.

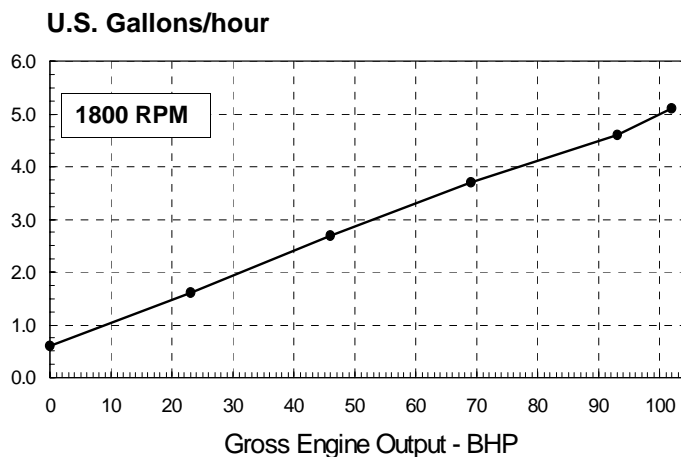
Engine Performance Data @ 1500 RPM

| OUTPUT POWER | | | FUEL CONSUMPTION | | | |
|-------------------------|-----|-----|------------------|--------------|----------------|-------------------|
| % | kWm | BHP | kg/ kWm-h | lb/ BHP-h | litre/ hour | U.S. Gal/ hour |
| STANDBY POWER | | | | | | |
| 100 | 65 | 87 | 0.210 | 0.345 | 16 | 4.3 |
| PRIME POWER | | | | | | |
| 100 | 59 | 79 | 0.210 | 0.346 | 15 | 4.0 |
| 75 | 44 | 59 | 0.215 | 0.354 | 12 | 3.0 |
| 50 | 30 | 40 | 0.227 | 0.373 | 8 | 2.1 |
| 25 | 15 | 20 | 0.258 | 0.424 | 5 | 1.2 |
| CONTINUOUS POWER | | | | | | |
| 100 | 41 | 55 | 0.217 | 0.358 | 11 | 2.8 |



Engine Performance Data @ 1800 RPM

| OUTPUT POWER | | | FUEL CONSUMPTION | | | |
|-------------------------|-----|-----|------------------|--------------|----------------|-------------------|
| % | kWm | BHP | kg/ kWm-h | lb/ BHP-h | litre/ hour | U.S. Gal/ hour |
| STANDBY POWER | | | | | | |
| 100 | 76 | 102 | 0.209 | 0.344 | 19 | 5.1 |
| PRIME POWER | | | | | | |
| 100 | 69 | 93 | 0.212 | 0.348 | 18 | 4.6 |
| 75 | 51 | 69 | 0.225 | 0.370 | 14 | 3.7 |
| 50 | 34 | 46 | 0.246 | 0.404 | 10 | 2.7 |
| 25 | 17 | 23 | 0.291 | 0.479 | 6 | 1.6 |
| CONTINUOUS POWER | | | | | | |
| 100 | 48 | 64 | 0.229 | 0.377 | 13 | 3.5 |



CONVERSIONS: (Litres = U.S. Gal x 3.785) (kWm = BHP x 0.746) (U.S. Gal = Litres x 0.2642) (BHP = Engine kWm x 1.34)

Data shown above represent gross engine performance capabilities obtained and corrected in accordance with ISO-3046 conditions of 100 kPa (29.53 in Hg) barometric pressure [110 m (361 ft) altitude], 25 °C (77 °F) air inlet temperature, and relative humidity of 30% with No. 2 diesel or a fuel corresponding to ASTM D2. See reverse side for application rating guidelines.

The fuel consumption data is based on No. 2 diesel fuel weight at 0.85 kg/litre (7.1 lbs/U.S. gal).

Power output curves are based on the engine operating with fuel system, water pump and lubricating oil pump; not included are battery charging alternator, fan, optional equipment and driven components.

M. Butcher
CHIEF ENGINEER

POWER RATING APPLICATION GUIDELINES FOR GENERATOR DRIVE ENGINES

These guidelines have been formulated to ensure proper application of generator drive engines in A.C. generator set installations. Generator drive engines are not designed for and shall not be used in variable speed D.C. generator set applications.

STANDBY POWER RATING is applicable for supplying emergency power for the duration of the utility power outage. No overload capability is available for this rating. Under no condition is an engine allowed to operate in parallel with the public utility at the Standby Power rating.

This rating should be applied where reliable utility power is available. A standby rated engine should be sized for a maximum of an 80% average load factor and 200 hours of operation per year. This includes less than 25 hours per year at the Standby Power rating. Standby ratings should never be applied except in true emergency power outages. Negotiated power outages contracted with a utility company are not considered an emergency.

CONTINUOUS POWER RATING is applicable for supplying utility power at a constant 100% load for an unlimited number of hours per year. No overload capability is available for this rating.

PRIME POWER RATING is applicable for supplying electric power in lieu of commercially purchased power. Prime Power applications must be in the form of one of the following two categories:

UNLIMITED TIME RUNNING PRIME POWER

Prime Power is available for an unlimited number of hours per year in a variable load application. Variable load should not exceed a 70% average of the Prime Power rating during any operating period of 250 hours.

The total operating time at 100% Prime Power shall not exceed 500 hours per year.

A 10% overload capability is available for a period of 1 hour within a 12-hour period of operation. Total operating time at the 10% overload power shall not exceed 25 hours per year.

LIMITED TIME RUNNING PRIME POWER

Prime Power is available for a limited number of hours in a non-variable load application. It is intended for use in situations where power outages are contracted, such as in utility power curtailment. Engines may be operated in parallel to the public utility up to 750 hours per year at power levels never to exceed the Prime Power rating. The customer should be aware, however, that the life of any engine will be reduced by this constant high load operation. Any operation exceeding 750 hours per year at the Prime Power rating should use the Continuous Power rating.

Reference Standards:

BS-5514 and DIN-6271 standards are based on ISO-3046.

Operation At Elevated Temperature And Altitude:

The engine may be operated at:

1800 RPM up to 4,000 ft (1220 m) and 104 °F (40 °C) without power deration.

1500 RPM up to 1,970 ft (600 m) and 104 °F (40 °C) without power deration.

For sustained operation above these conditions, derate by 4% per 1,000 ft (300 m), and 1% per 10 °F (2% per 11 °C).

ENGINE MODEL : 4BT3.9-G4

CONFIGURATION NUMBER : D382012GX02

DATA SHEET : DS-90801
DATE : 23Oct00
PERFORMANCE CURVE : FR-90802 @1500
FR-90801 @1800

INSTALLATION DIAGRAM

• Fan to Flywheel : 3170307

CPL NUMBER

• Engine Critical Parts List : 2377

GENERAL ENGINE DATA

| | |
|---|-------------------------------------|
| Type | 4-Cycle; In-line; 4-Cylinder Diesel |
| Aspiration | Turbocharged |
| Bore x Stroke..... — in x in (mm x mm) | 4.02 x 4.72 (102 x 120) |
| Displacement..... — in ³ (liter) | 239 (3.92) |
| Compression Ratio..... | 16.5 : 1 |
| Dry Weight | |
| Fan to Flywheel Engine..... — lb (kg) | 707 (321) |
| Heat Exchanger Cooled Engine..... — lb (kg) | N/A |
| Wet Weight | |
| Fan to Flywheel Engine..... — lb (kg) | 742 (337) |
| Heat Exchanger Cooled Engine..... — lb (kg) | N/A |
| Moment of Inertia of Rotating Components | |
| • with FW 9016 Flywheel..... — lb _m • ft ² (kg • m ²) | 33.1 (1.39) |
| • with FW 9017 Flywheel..... — lb _m • ft ² (kg • m ²) | 23.5 (0.99) |
| Center of Gravity from Rear Face of Flywheel Housing..... — in (mm) | 14.7 (373) |
| Center of Gravity Above Crankshaft Centerline..... — in (mm) | 6.4 (163) |
| Maximum Static Loading at Rear Main Bearing..... — lb (kg) | N.A. |

ENGINE MOUNTING

Maximum Bending Moment at Rear Face of Block..... — lb • ft (N • m) 1000 (1356)

EXHAUST SYSTEM

Maximum Back Pressure..... — in Hg (mm Hg) 3 (76)

AIR INDUCTION SYSTEM

| | | |
|--|----|-------|
| Maximum Intake Air Restriction | | |
| • with Dirty Filter Element..... — in H ₂ O (mm H ₂ O) | 25 | (635) |
| • with Normal Duty Air Cleaner and Clean Filter Element..... — in H ₂ O (mm H ₂ O) | 10 | (254) |
| • with Heavy Duty Air Cleaner and Clean Filter Element..... — in H ₂ O (mm H ₂ O) | 15 | (381) |

COOLING SYSTEM

| | | |
|--|-----------|-------------|
| Coolant Capacity — Engine Only..... — US gal (liter) | 1.9 | (7.2) |
| — with HX — Heat Exchanger..... — US gal (liter) | | N/A |
| Maximum Coolant Friction Head External to Engine — 1800 rpm..... — psi (kPa) | 5 | (35) |
| — 1500 rpm..... — psi (kPa) | 4 | (28) |
| Maximum Static Head of Coolant Above Engine Crank Centerline..... — ft (m) | 46 | (14) |
| Standard Thermostat (Modulating) Range..... — °F (°C) | 180 - 203 | (82 - 95) |
| Minimum Pressure Cap..... — psi (kPa) | 10 | (69) |
| Maximum Top Tank Temperature for Standby / Prime Power..... — °F (°C) | 220 / 212 | (104 / 100) |
| Minimum Raw Water Flow @ 90°F to HX — Heat Exchanger..... — US gpm (liter / min) | | N/A |
| Maximum Raw Water Inlet Pressure at HX — Heat Exchanger..... — psi (kPa) | | N/A |

LUBRICATION SYSTEM

| | | |
|--|------------|-------------|
| Oil Pressure @ Idle Speed..... — psi (kPa) | 30 | (207) |
| @ Governed Speed..... — psi (kPa) | 50 | (345) |
| Maximum Oil Temperature..... — °F (°C) | 250 | (121) |
| Oil Capacity with OP 9017 Oil Pan : High - Low..... — US gal (liter) | 2.5 - 2.25 | (9.5 - 8.5) |
| Total System Capacity (Including Full Flow Filter)..... — US gal (liter) | 2.88 | (10.9) |
| Angularity of OP 9017 Oil Pan — Front Down..... | | 40° |
| — Front Up..... | | 40° |
| — Side to Side..... | | 40° |

FUEL SYSTEM

| | |
|--|--------------------------------|
| Type Injection System | Stanadyne DB4 Direct Injection |
| Maximum Inlet Restriction at Lift Pump | — in Hg (mm Hg) 4 (102) |
| Maximum Allowable Head on Injector Return Line (Consisting of Friction Head and Static Head) | — in Hg (mm Hg) 20 (508) |
| Total Drain Flow (Constant for All Loads) | — US gph (liter / hr) 8 (30) |

ELECTRICAL SYSTEM

| | | | |
|--|-----------|---------|-------|
| Cranking Motor (Heavy Duty, Positive Engagement) | — volt | 12 | 24 |
| Battery Charging System, Negative Ground | — ampere | 63 | 40 |
| Maximum Allowable Resistance of Cranking Circuit | — ohm | 0.00075 | 0.002 |
| Minimum Recommended Battery Capacity | | | |
| • Cold Soak @ 10 °F (-12 °C) and Above | — 0°F CCA | 625 | (312) |

COLD START CAPABILITY

| | | | |
|--|-----------|----|-------|
| Minimum Ambient Temperature for Aided (with Coolant Heater) Cold Start within 10 seconds | — °F (°C) | 50 | (10) |
| Minimum Ambient Temperature for Unaided Cold Start | — °F (°C) | 10 | (-12) |

PERFORMANCE DATA

- All data is based on:
- Engine operating with fuel system, water pump, lubricating oil pump, air cleaner and exhaust silencer; not included are battery charging alternator, fan, and optional driven components.
 - Engine operating with fuel corresponding to grade No. 2-D per ASTM D975.
 - Air Intake Restriction : 254mm H₂O (10 in H₂O)
 - Exhaust Restriction : 51 mm Hg (2 in Hg)
 - ISO 3046, Part 1, Standard Reference Conditions of:

| | | | |
|---------------------|-------------------------|-------------------|-----------------|
| Barometric Pressure | : 100 kPa (29.53 in Hg) | Air Temperature | : 25 °C (77 °F) |
| Altitude | : 110 m (361 ft) | Relative Humidity | : 30% |

| | | |
|---|-------|----------|
| Steady State Stability Band at any Constant Load | — % | +/- 0.50 |
| Estimated Free Field Sound Pressure Level of a Typical Generator Set; | | |
| Excludes Exhaust Noise; at Rated Load and 7.5 m (24.6 ft); 1800 rpm / 1500 rpm | — dBA | N.A. |
| Exhaust Noise at 1 m Horizontally from Centerline of Exhaust Pipe Outlet Upwards at 45° | — dBA | N.A. |

| | |
|---|--------------------------|
| Governed Engine Speed | — rpm |
| Engine Idle Speed | — rpm |
| Gross Engine Power Output | — BHP (kW _m) |
| Brake Mean Effective Pressure | — psi (kPa) |
| Piston Speed | — ft / min (m / s) |
| Friction Horsepower | — HP (kW _m) |
| Engine Water Flow at Stated Friction Head External to Engine: | |
| • 1 psi Friction Head | — US gpm (liter / s) |
| • Maximum Friction Head | — US gpm (liter / s) |

| | STANDBY POWER | | PRIME POWER | |
|--|---------------|-------------|-------------|-------------|
| | 60 hz | 50 hz | 60 hz | 50 hz |
| | 1800 | 1500 | 1800 | 1500 |
| | 950 - 1150 | 950 - 1150 | 950 - 1150 | 950 - 1150 |
| Gross Engine Power Output | 102 (76) | 87 (65) | 93 (69) | 79 (59) |
| Brake Mean Effective Pressure | 190 (1312) | 194 (1338) | 169 (1168) | 177 (1218) |
| Piston Speed | 1416 (7.2) | 1180 (6.0) | 1416 (7.2) | 1180 (6.0) |
| Friction Horsepower | 16 (11.9) | 11 (8.2) | 16 (11.9) | 11 (8.2) |
| Engine Water Flow at 1 psi Friction Head | 45 (2.8) | 35 (2.2) | 45 (2.8) | 35 (2.2) |
| Engine Water Flow at Maximum Friction Head | 35 (2.2) | 26 (1.6) | 35 (2.2) | 26 (1.6) |
| Intake Air Flow | 212 (100) | 155 (73) | 208 (98) | 152 (72) |
| Exhaust Gas Temperature | 919 (493) | 1012 (544) | 877 (469) | 964 (518) |
| Exhaust Gas Flow | 516 (244) | 405 (191) | 489 (231) | 383 (181) |
| Air to Fuel Ratio | 25.7 : 1 | 22.0 : 1 | 27.7 : 1 | 23.4 : 1 |
| Radiated Heat to Ambient | 1045 (18.3) | 1030 (18.0) | 985 (17.3) | 970 (17.1) |
| Heat Rejection to Coolant | 2240 (39.3) | 1995 (35.0) | 2035 (35.8) | 1750 (30.8) |
| Heat Rejection to Exhaust | 3390 (59.5) | 2870 (50.4) | 3125 (54.9) | 2585 (45.4) |

Engine Data with Dry Type Exhaust Manifold

| | |
|---------------------------------|--------------------------------|
| Intake Air Flow | — cfm (liter / s) |
| Exhaust Gas Temperature | — °F (°C) |
| Exhaust Gas Flow | — cfm (liter / s) |
| Air to Fuel Ratio | — air : fuel |
| Radiated Heat to Ambient | — BTU / min (kW _m) |
| Heat Rejection to Coolant | — BTU / min (kW _m) |
| Heat Rejection to Exhaust | — BTU / min (kW _m) |

N.A. - Data is Not Available
 N/A - Not Applicable to this Engine
 TBD - To Be Determined

•• PRELIMINARY ••

ENGINE MODEL : 4BT3.9-G4
DATA SHEET : DS-90801
DATE : 23Oct00
CURVE NO. : FR-90802 @1500 RPM
FR-90801 @1800 RPM