CAT® ENGINE SPECIFICATIONS

V-16, 4-Stroke-Cycle-Diesel

Emissions ...................... EPA Marine Tier 2, IMO Tier II
Bore .............................. 170 mm (6.7 in)
Stroke ............................. 215 mm (8.5 in)
Displacement .................... 78 L (4764 in³)
Aspiration ...................... Turbocharged-Aftercooled
Governor and Protection ...... Electronic ADEM™ A3
Refill Capacity
  Lube Oil System (refill)1 ....... 405.0 L (107 U.S. gal)
  Engine Cooling System ......... 234.7 L (62 U.S. gal)
Oil Change Interval ............ 1000 hours

15° tilt sump

FEATURES

Engine Design
- Proven reliability and durability
- Robust diesel strength design prolongs life and lowers owning an operating costs
- Assembled, tested, and validated as a package to minimize package vibration and maximize component life
- Market-leading power density
- Long overhaul life proven in oilfield applications
- Core engine components designed for reconditioning and reuse at overhaul

Ease of Installation
Engine and generator are mounted to an inner base, which mounts to an outer base assembly with vibration isolators. Installed with an integral drip tray to provide a single lift installation and to reduce the shipyard scope of work complexity.

Safety
- E-stop pushbutton on instrument panel
- Air shutoff and explosion relief valves
- Configurable alarm and shutdown features
- Extra alarm switches available for customer-supplied panel

Improved Serviceability
Large inspection openings allow convenient access to core engine internals

Reduction of Owning and Operating Costs
- Long filter change intervals, aligned with service intervals
- Excellent fuel economy — direct injection electronic unit injectors precisely meter fuel

Custom Packaging
For any petroleum application, trust Caterpillar to meet your exact needs with a factory custom package. Cat® engines, generators, enclosures, controls, radiators, transmissions — anything your project requires — can be custom designed and matched to create a one-of-a-kind solution. Custom packages are globally supported and are covered by a one-year warranty after startup.

Testing
Every Cat engine is full-load tested to ensure proper engine performance.

Product Support Offered Through Global Cat Dealer Network
More than 2,200 dealer outlets
Caterpillar factory-trained dealer technicians service every aspect of your petroleum engine
Caterpillar parts and labor warranty
Preventive maintenance agreements available for repair-before-failure options
S•O•S™ program matches your oil and coolant samples against Caterpillar set standards to determine:
  - Internal engine component condition
  - Presence of unwanted fluids
  - Presence of combustion by-products
  - Site-specific oil change interval

Over 80 Years of Engine Manufacturing Experience
Ownership of these manufacturing processes enables Caterpillar to produce high quality, dependable products.
  - Cast engine blocks, heads, cylinder liners, and flywheel housings
  - Machine critical components
  - Assemble complete engine

Web Site
For all your petroleum power requirements, visit www.catoilandgasinfo.com.
STANDARD EQUIPMENT

Air Inlet System
Aftercooler core — corrosion resistant coating
Air cleaners — dual element, installed
Air inlet shutoff

Base Arrangement
Engine and generator three-point mounted into outer base
Oil drain extension
Oil drip pan

Control Panel
J1939 control and rigid rail wiring harness
(meets MCS wiring requirements)

Control System
ADEM A3 electronic control module with electronically controlled unit injectors (24V DC power source required)

Cooling System
To ensure emissions compliance, optional or customer-supplied heat exchangers or radiators must be capable of rejecting enough heat to allow proper operation at worst case site conditions and also must supply 50°C (122°F) SCAC cooling water to the aftercooler inlet, with an SCAC flow rate of at least 200-230 gpm with an ambient temperature of 30°C (86°F) and at site conditions.

Radiation Cooled Offshore:
Outlet controlled thermostat and housing
Jacket water pump — gear-driven, single outlet
Aftercooler fresh water cooling pump — gear-driven centrifugal
SCAC pump circuit contains a thermostat to keep the aftercooler coolant from falling below 30°C (86°F)
Single water outlet connection

Exhaust System
Dry gas-tight manifolds with thermo-laminated heat shields
Dual turbochargers with thermo-laminated heat shields and watercooled bearing housing
Flexible exhaust fitting/weldable exhaust flange

Flywheels and Flywheel Housings
Flywheel — SAE No. 00, 183 teeth
Flywheel housing — SAE No. 00, SAE standard rotation
Torsional coupling and generator hub

Fuel System
Electrically controlled unit injectors
Fuel filter — LH
Fuel transfer and priming pumps
Flexible fuel lines

Generator
See generator data, page 6

Instrumentation
Graphic unit (Marine Power Display), LH for analog or digital display of: engine oil and fuel pressure, engine water temperature, system DC voltage, air inlet restriction, RH & LH exhaust temperature, oil and fuel filter differential, service meter, engine speed, instantaneous fuel consumption, total fuel consumed
Operator programmable display, monitoring, alarms and shutdowns

Lube System
Crankcase breather — top-mounted
Deep sump oil pan — 1000 hour
Oil drain and valve
Oil filler and dipstick
Oil filter — cartridge-type, LH
Oil pump — gear-type

Protection System
ADEM A3 monitoring system provides engine deration, alarm, or shutdown strategies to protect against adverse operating conditions. Selected parameters are customer programmable. Status available on engine-mounted instrument panel, and can be broadcast through MODBUS to the rig's power management system.

Safety shutoff protection — electrical:
Oil pressure
Water temperature
Overspeed
Crankcase pressure
Aftercooler temperature (SCAC only)
Air inlet shutoff activated on overspeed or emergency stop included

Alarms — electrical:
ECU voltage
Oil pressure
Water temperature (low and high)
Overspeed
Crankcase pressure
Aftercooler temperature (SCAC only)
Low water level (sensor shipped loose if no mounted expansion tank or radiator)
Air inlet restriction
Exhaust stack temperature
Filter differential pressure (oil and fuel)

Derate — electrical:
High water temperature
Crankcase pressure
Aftercooler temperature
Air inlet restriction
Altitude
Exhaust temperature
Emergency stop pushbutton (on instrument panel)
Alarm switches (oil pressure and water temperature), for connection to customer-supplied alarm panel — unwired

Starting and Control
Air silencer
Air starting motor
Electric start control

General
Lifting eyes — front and rear
Paint — Cat yellow
Vibration damper and guard
ACCESSORY EQUIPMENT

- Crankcase explosion relief valves
- Duplex fuel and oil filters
- Jacket water heaters
- Mufflers — spark arresting
- Primary fuel filter
- Fuel cooler
- Pyrometer and cylinder thermocouples
- Additional instrumentation:
  - Air cleaner restriction (2)
  - Intake manifold temperature
  - Lubricating oil temperature
  - Fuel filter differential
- Direct rack control interface, 0-200 mA signal
- Marine society and IMO certificates
- Bypass centrifugal oil filters
- Metal particle detector
- Fuel/water separator
- 15° and 25° tilt capability
- Redundant start with selector switch (air-electric, air-air, or electric-electric)
- Single-point customer connection
- Heat exchanger cooling (front engine-mounted including expansion tank)
- Air prelube

GENERATOR

- Designed, tested, and sized for SCR drill rig service
- 90°C over 50°C ambient temperature rise
- Form wound stator and rotor
- Class insulated using Vacuum Pressure Impregnated (VPI) temperature-resistant materials
- Imbedded temperature detectors and generator space heater are standard
- Terminal box and copper bus bars for easy, dependable connections
- Two-bearing generators
- Optional bearing RTDs

RIG BASE

- For use with Cat or other manufacturers’ generators
- Built-in three-point mounting system maintains alignment of engine-generator on uneven surface and from substructure flexing that can twist the base and cause engine-generator misalignment.
3516C (HD) Engine — 1603 bkW (1200 rpm)

ENGINE SPEED (rpm): 1200  
RATING: Prime

COMPRESSION RATIO: 14.7:1  
CERTIFICATION: IMO/EPA MARINE TIER II

AFTERCOOLER WATER (°C): 50  
TURBOCHARGER PART #: 307-7553

JACKET WATER OUTLET (°C): 99  
FUEL TYPE: Distillate

IGNITION SYSTEM: EUI

EXHAUST MANIFOLD: DRY

<table>
<thead>
<tr>
<th>ENGINE POWER</th>
<th>NOTES</th>
<th>LOAD</th>
<th>100%</th>
<th>75%</th>
<th>50%</th>
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<tr>
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<td>g/kw-hr</td>
<td>210.3</td>
<td>219.4</td>
<td>224.8</td>
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<tr>
<td>kPa</td>
<td>m3/min</td>
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<td>127.1</td>
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<td>kPa (abs)</td>
<td>268.0</td>
<td>232.7</td>
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<tr>
<td></td>
<td>°C</td>
<td>58.6</td>
<td>57.3</td>
<td>55.5</td>
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</tr>
<tr>
<td></td>
<td>°C</td>
<td>435.7</td>
<td>387.5</td>
<td>365.5</td>
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<tr>
<td></td>
<td>m3/min</td>
<td>344.8</td>
<td>293.3</td>
<td>213.9</td>
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<tr>
<td></td>
<td>kg/hr</td>
<td>10150</td>
<td>-</td>
<td>-</td>
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ENERGY BALANCE DATA

FUEL INPUT ENERGY (LHV) (NOMINAL) (1)  
KW 4006 3135 2141

HEAT REJ. TO JACKET WATER (NOMINAL) (3)  
KW 618 515 388

HEAT REJ. TO ATMOSPHERE (NOMINAL) (4)  
KW 133 116 103

HEAT REJ. TO OIL COOLER (NOMINAL) (5)  
KW 200 157 107

HEAT REJ. TO EXH. (LHV to 25°C) (NOMINAL) (3)  
KW 1742 1167 817

HEAT REJ. TO EXH. (LHV to 177°C) (NOMINAL) (3)  
KW 750 550 369

HEAT REJ. TO AFTERCOOLER (NOMINAL) (6) (7)  
KW 442 340 171

NOTES
1) FUEL CONSUMPTION TOLERANCE. ISO 3046/1 IS 0, + 5% OF FULL LOAD DATA. NOMINAL IS ± 3% OF FULL LOAD DATA
2) ENGINE POWER TOLERANCE IS ± 3% OF FULL LOAD DATA.
3) HEAT REJECTION TO JACKET AND EXHAUST TOLERANCE IS ± 10% OF FULL LOAD DATA. (heat rate based on treated water)
4) HEAT REJECTION TO ATMOSPHERE TOLERANCE IS ± 50% OF FULL LOAD DATA. (heat rate based on treated water)
5) HEAT REJECTION TO LUBE OIL TOLERANCE IS ± 20% OF FULL LOAD DATA. (heat rate based on treated water)
6) HEAT REJECTION TO AFTERCOOLER TOLERANCE IS ± 5% OF FULL LOAD DATA. (heat rate based on treated water)
7) TOTAL AFTERCOOLER HEAT = AFTERCOOLER HEAT x ACHR F (heat rate based on treated water)

GENERATOR EFFICIENCY

Generator power determined with an assumed generator efficiency of 96% [generator power = engine power x 0.96]. If the actual generator efficiency is less than 96% [and greater than 94.5%], the generator power [ekW] listed in the technical data can still be achieved. The BSFC values must be increased by a factor.

The factor is a percentage = 96% - actual generator efficiency.
GENERATOR TECHNICAL DATA

Cat Drilling Generator*

Specifications
- Poles: 6
- Excitation: PMG
- Pitch: 0.778
- Connection: Wye
- Max. Overspeed (60 sec): 125%
- Number of Bearings: 2
- Number of Leads: 6
- Number of Terminals: 4

Ratings
- Power: 1833.3 ekW
- kVA: 2619
- pf: 0.7
- Voltage — L.L.: 600 V
- Voltage — L.N.: 346 V
- Current — L.L.: 2520 A
- Frequency: 60 Hz
- Speed: 1200 rpm

Exciter Armature Data (at full load, 0.7 pf)
- Voltage: 192.0 V
- Current: 102.0 A

Temperature and Insulation Data
- Ambient Temperature: 50°C
- Temperature Rise: 90°C
- Insulation Class: F
- Insulation Resistance (as shipped): 100 Megaohms (at 40°C)

Resistances
- Base Impedence: 0.137 ohms
- Stator (at 25°C): 0.001 ohms
- Field (at 25°C): 1.30 ohms
- Zero Sequence R0: 0.00 ohms
- Positive Sequence R1: 0.00 ohms
- Short Circuit Ratio: 0.68

Fault Currents
- Instantaneous 3-∅ symmetrical fault current: 12,001 amps
- Instantaneous L-N symmetrical fault current: 13,747 amps
- Instantaneous L-L symmetrical fault current: 9489 amps

Efficiency and Heat Dissipation
(per NEMA and IEC at 95°C)

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<tr>
<th>Load PU</th>
<th>Kilowatts</th>
<th>Efficiency</th>
<th>Heat Rejection</th>
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<tr>
<td>0.25</td>
<td>458.3</td>
<td>90.9%</td>
<td>156,598 Btu/hr</td>
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<tr>
<td>0.50</td>
<td>916.7</td>
<td>94.3%</td>
<td>189,105 Btu/hr</td>
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<td>0.75</td>
<td>1375.0</td>
<td>95.1%</td>
<td>241,795 Btu/hr</td>
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<td>1.00</td>
<td>1833.3</td>
<td>94.8%</td>
<td>343,214 Btu/hr</td>
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Time Constants

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<tr>
<td>T'DO</td>
<td>2.955 sec</td>
<td>0.557 sec</td>
<td>0.030 sec</td>
<td>0.022 sec</td>
<td>0.015 sec</td>
<td>0.004 sec</td>
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Reactances

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<tr>
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<th>Saturated</th>
<th>Unsaturated</th>
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<tbody>
<tr>
<td></td>
<td>Per Unit</td>
<td>Ohms</td>
</tr>
<tr>
<td>Subtransient — Direct Axis</td>
<td>X'D</td>
<td>0.210</td>
</tr>
<tr>
<td>Subtransient — Quadrature Axis</td>
<td>X'Q</td>
<td>0.280</td>
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<tr>
<td>Transient — Direct Axis</td>
<td>X'D</td>
<td>0.280</td>
</tr>
<tr>
<td>Transient — Quadrature Axis</td>
<td>X'Q</td>
<td>0.820</td>
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<tr>
<td>Synchronous — Direct Axis</td>
<td>XD</td>
<td>1.470</td>
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<tr>
<td>Synchronous — Quadrature Axis</td>
<td>XQ</td>
<td>0.820</td>
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<tr>
<td>Negative Sequence</td>
<td>X2</td>
<td>0.250</td>
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<tr>
<td>Zero Sequence</td>
<td>X0</td>
<td>0.090</td>
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*Other generators are available.
3516C (HD) OFFSHORE GENERATOR SET
1539 ekW 60 Hz

DIMENSIONS

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<thead>
<tr>
<th>Dimensions and Weight</th>
</tr>
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<tbody>
<tr>
<td>Length</td>
</tr>
<tr>
<td>Width</td>
</tr>
<tr>
<td>Height</td>
</tr>
<tr>
<td>Weight – dry</td>
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</tbody>
</table>

Note: Dimensions are dependent on generator and options selected. See general installation drawings for detail.

Note: Weight includes engine, generator, base, coupling, and all auxiliary components. Weight may vary depending upon individual configuration.

RATING DEFINITIONS AND CONDITIONS

Rating Definition — Maximum Continuous Rating (MCR) following reference conditions according to the International Association of Classification Societies (IACS) for main and auxiliary engines. An overload of 10% is permitted for one hour within 12 hours of operation.

Conditions are based on SAE J1995 standard conditions of 100 kPa (29.61 in Hg) and 25°C (77°F). These ratings also apply at ISO3046/1, DIN6271, and BS5514 standard conditions of 100 kPa (29.61 in Hg), 27°C (81°F), and 60% relative humidity. Ratings are valid for air cleaner inlet temperatures up to and including 60°C (140°F).

Fuel Consumption — 5% tolerance and based on fuel oil of 35° API [16°C (60°F)] gravity having an LHV of 62 780 kJ/kg (18,390 Btu/lb) when used at 29°C (85°F) and weighing 838.9 g/liter (7.001 lbs/U.S. gal). Fuel consumption is shown with all engine-driven oil, fuel, and water pumps.