CATERPILLAR®

3516C HD Offshore Drilling Module

1383 bkW (1855 bhp)
1603 bkW (2150 bhp)
1200 rpm

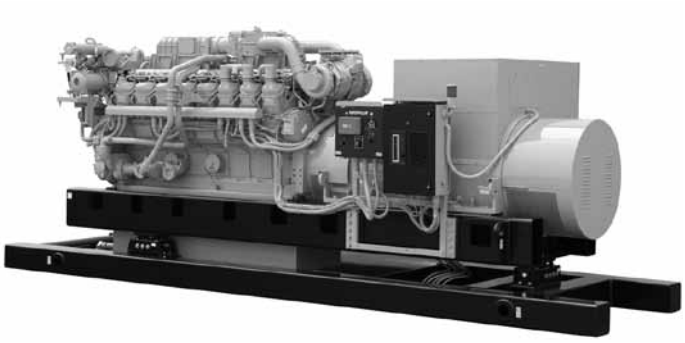

Image shown with optional attachments.

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 cu. in.)
Aspiration	Turbocharged-Aftercooled
Governor and Protection	Electronic ADEM™ A3
Module Weight, net dry (approx)	13,085 kg (28,716 lb.)
Rotation (from flywheel end)	Counterclockwise
Refill Capacity	
Lube Oil System (refill)*	405.0 L (107 U.S. gal.)
Engine Cooling System	234.7 L (62 U.S. gal.)
Oil Change Interval	1000 hours
Flywheel and Flywheel Housing	SAE No. 00
Flywheel Teeth	183

*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

Cat factory-trained dealer technicians service every aspect of your petroleum engine

Cat 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.catoilandgas.cat.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 (24 volt 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.

Radiator 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
Electronically controlled unit injectors
Fuel filter — LH
Fuel transfer and priming pumps
Flexible fuel lines

Generator
See generator data, page 7

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:
- ECM 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.

RATINGS (without fan)

Pumping and Drilling

Model	bkW[1]	(hp)[1]	rpm	kV•A[2]
3516C HD	1383	(1855)	1200	2150
3516C HD	1603	(2150)	1200	2500

[1] 10% overload capability included above setting.

[2] Generators for drilling electric low power factor requirements.

DIESEL ENGINE TECHNICAL DATA

3516C HD Engine — 1383 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	MEAN PISTON SPEED (m/s):	8.1
EXHAUST MANIFOLD:	DRY		

RATING	NOTES	LOAD	100%	75%	50%
ENGINE POWER	(2)	bkW	1383	1037.3	691.5
BMEP kPa		kPa	1771	1328	886

ENGINE DATA						
FUEL CONSUMPTION	(NOMINAL)	(1)	g/bkw-hr	208.7	218.5	228.6
AIR FLOW (@ 25°C, 101.3 kPaa)			m3/min	128.3	114.1	85.9
INLET MANIFOLD PRESSURE			kPa (abs)	245.8	200.9	127.1
INLET MANIFOLD TEMPERATURE			°C	57.4	56.1	55.2
EXHAUST STACK TEMPERATURE			°C	399.0	370.2	365.5
EXHAUST GAS FLOW (@ stack temp, 101.3 kPa)			m3/min	303.1	256.7	191.4
EXHAUST GAS MASS FLOW			kg/hr	9390	-	-

ENERGY BALANCE DATA						
FUEL INPUT ENERGY (LHV)	(NOMINAL)	(1)	KW	3428	2692	1878
HEAT REJ. TO JACKET WATER	(NOMINAL)	(3)	KW	551	460	352
HEAT REJ. TO ATMOSPHERE	(NOMINAL)	(4)	KW	120	110	100
HEAT REJ. TO OIL COOLER	(NOMINAL)	(5)	KW	172	135	94
HEAT REJ. TO EXH. (LHV to 25°C)	(NOMINAL)	(3)	KW	1236	995	728
HEAT REJ. TO EXH. (LHV to 177°C)	(NOMINAL)	(3)	KW	589	451	330
HEAT REJ. TO AFTERCOOLER	(NOMINAL)	(6) (7)	KW	362	266	128

CONDITIONS AND DEFINITIONS

ENGINE RATING OBTAINED AND PRESENTED IN ACCORDANCE WITH ISO 3046/1 AND SAE J1995 JAN90 STANDARD REFERENCE CONDITIONS OF 25°C, 100 KPA, 30% RELATIVE HUMIDITY AND 150M ALTITUDE AT THE STATED AFTERCOOLER WATER TEMPERATURE

CONSULT ALTITUDE CURVES FOR APPLICATIONS ABOVE MAXIMUM RATED ALTITUDE AND/OR TEMPERATURE

PERFORMANCE AND FUEL CONSUMPTION ARE BASED ON 35 API, 16°C FUEL HAVING A LOWER HEATING VALUE OF 42.780 KJ/KG USED AT 29°C WITH A DENSITY OF 838.9 G/LITER

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 ACHRF (heat rate based on treated water)

GENERATOR EFFICIENCY

Generator power determined with an assumed generator effeciency 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.

DIESEL ENGINE TECHNICAL DATA

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	MEAN PISTON SPEED (m/s):	8.1
EXHAUST MANIFOLD:	DRY		

RATING	NOTES	LOAD	100%	75%	50%
ENGINE POWER	(2)	bkW	1603	1202.3	801.5
BMEP kPa		kPa	2053	1540	1026

ENGINE DATA						
FUEL CONSUMPTION	(NOMINAL)	(1)	g/bkw-hr	210.3	219.4	224.8
AIR FLOW (@ 25°C, 101.3 kPaa)			m3/min	138.9	127.1	96.1
INLET MANIFOLD PRESSURE			kPa (abs)	268.0	232.7	151.2
INLET MANIFOLD TEMPERATURE			°C	58.6	57.3	55.5
EXHAUST STACK TEMPERATURE			°C	435.7	387.5	365.5
EXHAUST GAS FLOW (@ stack temp, 101.3 kPa)			m3/min	344.8	293.3	213.9
EXHAUST GAS MASS FLOW			kg/hr	10150	-	-

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	1472	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

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

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)

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

Time Constants

OC Transient — Direct Axis	T'DO	2.955 sec.
SC Transient — Direct Axis	T'D	0.557 sec.
OC Subtransient — Direct Axis	T"DO	0.030 sec.
SC Subtransient — Direct Axis	T"D	0.022 sec.
OC Subtransient — Quadrature Axis	T"QO	0.015 sec.
SC Subtransient — Quadrature Axis	T"Q	0.004 sec.
Armature SC	TA	0.079 sec.

Reactances

		Saturated		Unsaturated	
		Per Unit	Ohms	Per Unit	Ohms
Subtransient — Direct Axis	X"D	0.210	0.0	0.250	0.0
Subtransient — Quadrature Axis	X"Q	0.280	0.0	0.330	0.0
Transient — Direct Axis	X'D	0.280	0.0	0.320	0.0
Transient — Quadrature Axis	X'Q	0.820	0.1	0.990	0.1
Synchronous — Direct Axis	XD	1.470	0.2	1.780	0.2
Synchronous — Quadrature Axis	XQ	0.820	0.1	0.990	0.1
Negative Sequence	X2	0.250	0.0	0.290	0.0
Zero Sequence	X0	0.090	0.0	0.110	0.0

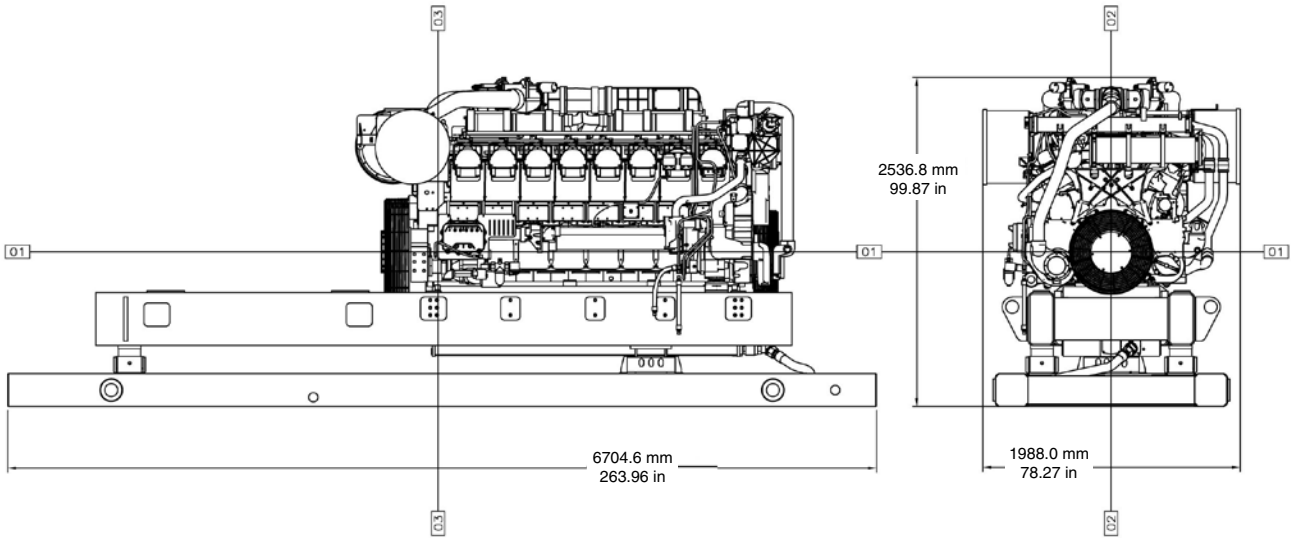
*Other generators are available.

CATERPILLAR®

3516C HD OFFSHORE DRILLING MODULE

1383 bkW (1855 bhp), 1603 bkW (2150 bhp)

DIMENSIONS



Module Dimensions		
Length	6704.6 mm	263.96 in.
Width	1988.0 mm	78.27 in.
Height	2536.8 mm	99.87 in.
Engine Weight (dry)	16,874 kg	37 200 lb.

Note: Do not use for installation design.
See general dimension drawings for detail.
(Drawing #300-6383 and #300-6384)

RATING DEFINITIONS AND CONDITIONS

Ratings 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 has a tolerance of +5% and is based on fuel oil of 35° API [16° C (60° F)] gravity having an LHV of 42 780 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 shown with all oil, fuel, and water pumps, engine driven.