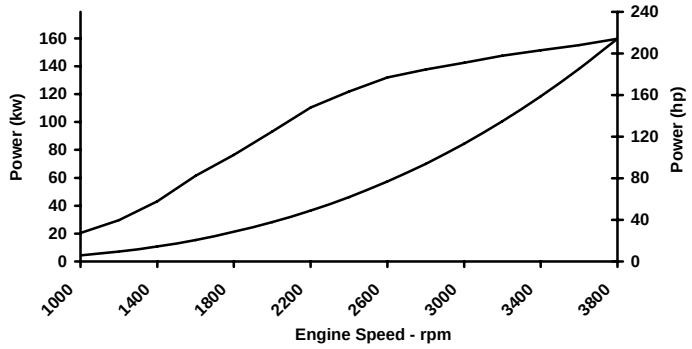
CUMMINS MERCRUISER DIESEL Charleston, SC 29405 Marine Performance Curves	Basic Engine Model QSD2.8-220 HO	Curve Number: BC9159, BC9160	
	Engine Configuration D933002MX03	CPL Code:	Date: 12-Aug-08

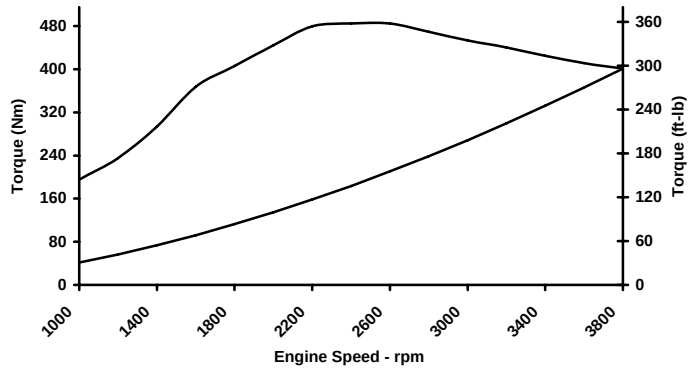
Displacement:	**2.8 liter**	**169 in³**	kW [bhp, mhp] @ rpm	
Bore:	**94 mm**	**3.70 in**	Advertised Power:	**160[214, 217]@3800**
Stroke:	**100 mm**	**3.94 in**		
Fuel System:	**Bosch Common Rail (CRS 2.0)**		Aspiration:	**Turbocharged/Sea Water Aftercooled**
Cylinders:	**4**		Rating Type:	**High Output**

CERTIFIED: This marine diesel engine complies with or is certified to the:
IMO - NOx requirements of the International Maritime Organization (IMO), MARPOL 73/78 Annex VI, Regulation 13
EPA Tier 2 - Model year requirements of the EPA marine regulation (40CFR94)



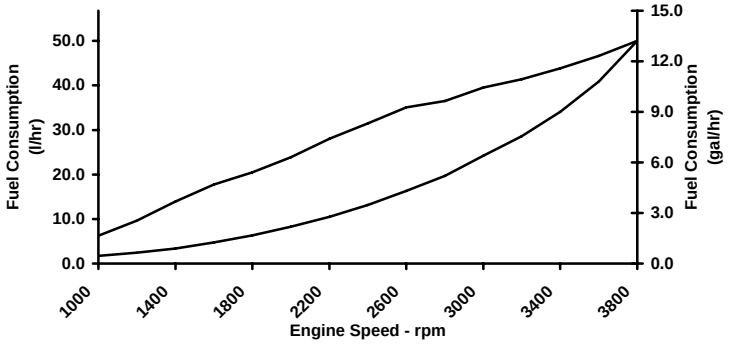
RATED POWER OUTPUT CURVE

rpm	kw	bhp
3800	160	214
3600	155	208
3400	151	203
3200	148	198
3000	143	191
2800	138	185
2600	132	177
2200	110	148
1800	77	103
1400	43	58
1200	30	40
1000	20	27



FULL LOAD TORQUE CURVE

rpm	N-m	ft-lb
3800	401	296
3600	412	304
3400	425	314
3200	441	325
3000	453	334
2800	469	346
2600	485	358
2200	479	354
1800	406	299
1400	294	217
1200	235	173
1000	195	144



FUEL CONSUMPTION - PROP CURVE

rpm	l/hr	gal/hr
3800	50.0	13.2
3600	40.9	10.8
3400	34.1	9.0
3200	28.6	7.6
3000	24.2	6.4
2800	19.7	5.2
2600	16.3	4.3
2200	10.5	2.8
1800	6.3	1.7
1400	3.4	0.9
1200	2.4	0.6
1000	1.7	0.4

Rated Conditions: Ratings are based upon ISO 8665 and SAE J1228 reference conditions; air pressure of 100 kPa [29.612 in Hg], air temperature 25deg. C [77 deg. F] and 30% relative humidy. Power is in accordance with IMCI procedure. Member NMMA.

Rated Curves (upper) represents rated power at the crankshaft for mature gross engine performance capabilities obtained and corrected in accordance with ISO 3046. Propeller Curve (lower) is based on a typical fixed propeller demand curve using a 2.7 exponent. Propeller Shaft Power is approximately 3% less than rated crankshaft power after typical reverse/reduction gear losses and may vary depending on the type of gear or propulsion system used.

Fuel Consumption is based on fuel of 35 deg. API gravity at 16 deg C [60 deg. F] having LHV of 42,780 kj/kg [18390 Btu/lb] and weighing 838.9 g/liter [7.001 lb/U.S. gal].

High Output (HO) Intended for use in variable load applications where full power is limited to one (1) hour out of every eight (8) hours of operation. Also, reduced power must be at or below 400 rpm of the maximum rated rpm. This power rating is for pleasure/non-revenue generating applications that operate 500 hours per year or less.

James D Kuhlenbeck

CHIEF ENGINEER

Propulsion Marine Engine Performance Data

Curve No. **BC9159, BC9160**
DS :
CPL :
DATE: **12-Aug-08**

General Engine Data

Engine Model		QSD2.8-220 HO
Rating Type		High Output
Rated Engine Power	kW [hp]	160 [214]
Rated Engine Speed	rpm	3800
Rated Power Production Tolerance	±%	5
Rated Engine Torque	N·m [lb·ft]	401 [296]
Peak Engine Torque @ 2600 rpm	N·m [lb·ft]	485 [358]
Brake Mean Effective Pressure	kPa [psi]	1816 [263]
Minimum Idle Speed Setting	rpm	700
Normal Idle Speed Variation	rpm	25
High Idle Speed Range Minimum	rpm	3880
Maximum	rpm	3920
Maximum Allowable Engine Speed	rpm	3900
Compression Ratio		17.5:1
Piston Speed	m/sec [ft/min]	12.7 [2493]
Firing Order		1-3-4-2
Weight (Dry) - Engine With Heat Exchanger System - Average	kg [lb]	360 [794]

Fuel System[1]

Avg. Fuel Consumption - ISO 8178 E5 Standard Test Cycle	l/hr [gal/hr]	15.7 [4]
Fuel Consumption at Rated Speed	l/hr [gal/hr]	50 [13]
Maximum Allowable Fuel Supply to Pump Temperature	°C [°F]	60.0 [140]
Approximate Fuel Return to Tank Temperature With Cooler	°C [°F]	41.1 [106]

Air System[1]

Intake Manifold Pressure	kPa [in Hg]	222 [65.6]
Intake Air Flow	l/sec [cfm]	211 [447]

TBD= To Be Determined **N/A = Not Applicable** **N.A. = Not Available**

1 All Data at Rated Conditions.
2 Consult Installation Direction Booklet for Limitations.
3 Heat rejection to coolant values are based on 50% water/50% ethylene glycol mix and do NOT include fouling factors. If sourcing your own cooler, a service fouling factor should be applied according to the cooler manufacturer's recommendation.
4 Consult option notes for flow specifications of optional Cummins seawater pumps, if applicable.
5 May not be at rated load and speed. Maximum heat rejection may occur at other than rated conditions.

CUMMINS ENGINE COMPANY, INC
COLUMBUS, INDIANA

Propulsion Marine Engine Performance Data

Curve No. **BC9159, BC9160**
DS :
CPL :
DATE: **12-Aug-08**

Exhaust System[1]

Exhaust Gas Temperature (Turbine Out) ….....°C [°F]	527 [979]
Exhaust Gas Temperature (Manifold) ….....°C [°F]	671 [1238]

Emissions (ISO 8178 Cycle E5 - for Traditional Propulsion Applications)

NOx (Oxides of Nitrogen) ……..g/kw·hr [g/hp·hr]	4.21 [3.14]
HC (Hydrocarbons) ……..g/kw·hr [g/hp·hr]	0.23 [0.17]
CO (Carbon Monoxide) ..g/kw·hr [g/hp·hr]	2.45 [1.83]
PM (Particulate Matter) ….g/kw·hr [g/hp·hr]	0.37 [0.28]

Cooling System[1]

Sea Water Pump Specifications ……..MAB 0.08.17-07/16/2001	
Pressure Cap Rating (With Heat Exchanger Option) ….kPa [psi]	103 [15]

Engines without Low Temperature Aftercooling (LTA)

Sea Water Aftercooled Engine (SWAC)

Standard Thermostat Operating Range (Start to Open) ……..°C [°F]	80 [176]
Standard Thermostat Operating Range (Full Open) ……..°C [°F]	95 [202]

TBD= To Be Determined **N/A = Not Applicable** **N.A. = Not Available**

1 **All Data at Rated Conditions.**
2 **Consult Installation Direction Booklet for Limitations.**
3 **Heat rejection to coolant values are based on 50% water/50% ethylene glycol mix and do NOT include fouling factors. If sourcing your own cooler, a service fouling factor should be applied according to the cooler manufacturer's recommendation.**
4 **Consult option notes for flow specifications of optional Cummins seawater pumps, if applicable.**
5 **May not be at rated load and speed. Maximum heat rejection may occur at other than rated conditions.**