

Cummins Inc.

Columbus, Indiana 47201

Engine Data Sheet

Basic Engine Model: **QSK23-G2**

Engine Critical Parts List:

CPL: 8352

Curve Number: FR-50009

Date:

16Jan06

G-DRIVE QSK

Bore: 170 mm (6.69 in.) Stroke: 170 mm (6.69 in.) Displacement : 23.15 litre (1413 in 3)

No. of Cylinders: 6 Aspiration: Turbocharged and Air to Air Aftercooled

Engine Speed	Standby Power		Prime Power		Continuous Power	
RPM	kWm	ВНР	kWm	ВНР	kWm	ВНР
1500	724	970	656	880	485	650
1800	847	1135	768	1030	627	840

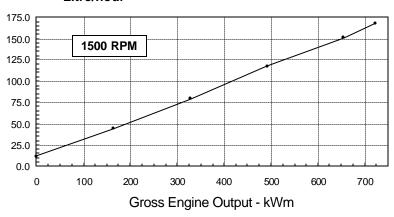
Emissions Certification (1800 RPM Only)

"For mobile applications in the U.S. and Canada, this rating may only be sold in accordance with the OEM TPEM provisions of 40 CFR 89.102. For stationary applications in the U.S. (except California), this rating may be sold through 2006 under the NSPS provisions of 40 CFR Part 60."

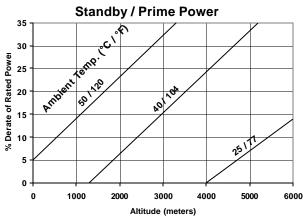
Engine Performance Data @ 1500 RPM

OUT	OUTPUT POWER			FUEL CONSUMPTION				
%	kWm	ВНР	kg/ kWm∙h	lb/ BHP∙h	litre/ hour	U.S. Gal/ hour		
STAN	DBY PO	WER						
100	724	970	0.197	0.324	168	44.3		
PRIMI	PRIME POWER							
100	656	880	0.196	0.322	151	39.9		
75	492	660	0.202	0.331	117	30.8		
50	328	440	0.205	0.339	79	21.0		
25	164	220	0.228	0.375	44	11.6		
CONT	INUOUS	POWE	R					
100	485	650	0.202	0.331	115	30.3		

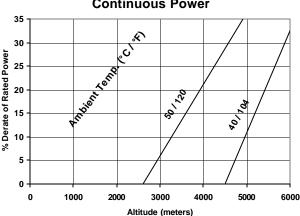
Litre/hour



Power Derate Curves @ 1500 RPM



Continuous Power



Operation At Elevated Temperature And Altitude:

For sustained operation above these conditions, derate by an additional 3.4% per 300 m (1000 ft), and 20% per 10° C (18° F).

CONVERSIONS: (litres = U.S. Gal x 3.785) (U.S.Gal = litres x 0.2642)

Reference AEB 10.47 for determining Electrical Output

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. Derates shown are based on 15 in H₂0 air intake restriction and 2 in Hg exhaust back pressure

Data Subject to Change Without Notice

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.

Data Status: Limited Production

Data Tolerance: ± 5%

Chief Engineer:

DK. Trueblood

These guidelines have been formulated to ensure proper application of generator drive engines in A.C. generator set installations. STANDBY POWER RATINS: 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 and standby fower rating. This rating should be applied where reliable utility at the Standby Power rating. This rating should be applied where reliable utility and standby fower savailable. 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. PRIME POWER RATING: 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 POW Fower applications must be in the form of one of the following two categories: <u>SNLIMITED 11 MIR RUNNING PRIME POWE</u>.

ER: 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 availability in a variability is availability in a variable load application. It is intended for use in the 10% overload power shall not exceed 25 hours per year. LIMITED TIME RUNNING PRIME POWER: Limited Time 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, 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 customers should be aware, however, that the life of any engine the reduced by this ceed 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. CONTINUOUS POWER RATING: 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.



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Engine Critical Parts List:

CPL: 8352

FR-50009

Date:

16Jan06

Curve Number:

G-DRIVE QSK

Displacement : **23.15** litre (**1413** in³) Bore : **170** mm (**6.69** in.) Stroke : **170** mm (**6.69** in.)

No. of Cylinders: 6 Aspiration: Turbocharged and Air to Air Aftercooled

Engine Speed	Standby Power		Prime Power		Continuous Power	
RPM	kWm	ВНР	kWm	ВНР	kWm	ВНР
1500	724	970	656	880	515	650
1800	847	1135	768	1030	627	840

Emissions Certification (1800 RPM Only)

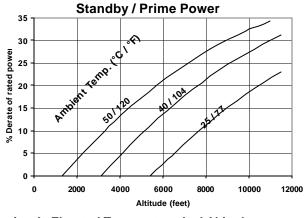
"For mobile applications in the U.S. and Canada, this rating may only be sold in accordance with the OEM TPEM provisions of 40 CFR 89.102. For stationary applications in the U.S. (except California), this rating may be sold through 2006 under the NSPS provisions of 40 CFR Part 60."

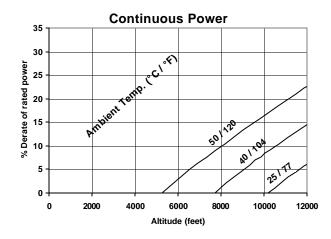
Engine Performance Data @ 1800 RPM

OUTPUT POWER			FUEL CONSUMPTION				
%	kWm	ВНР	kg/ lb/ kWm·h BHP·h		litre/ hour	U.S. Gal/ hour	
STAN	DBY PO	WER					
100	847	1135	0.195	0.195 0.321 194		51.3	
PRIMI	PRIME POWER						
100	768	1030	0.195	0.320	176	46.4	
75	576	773	0.196	0.322	133	35.1	
50	384	515	0.206	0.338	93	24.5	
25	192	258	0.243 0.400 55		14.5		
CONT	CONTINUOUS POWER						
100	627	840	0.194	0.319	143	37.7	

U.S. Gallons / hour 60.0 50.0 1800 RPM 40.0 30.0 20.0 10.0 0 250 500 750 1000 1250 Gross Engine Output - BHP

Power Derate Curves @ 1800 RPM





Operation At Elevated Temperature And Altitude:

For sustained operation above these conditions, derate by an additional 5.0% per 300 m (1000 ft), and 7% per 10° C (18° F).

CONVERSIONS: (litres = U.S. Gal x 3.785) (U.S.Gal = litres x 0.2642)

These guidelines have been formulated to ensure proper application of generator drive engines in A.C. generator set installations. STANDBY POWER RATING: 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 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. PRIME POWER RATING: 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. It available 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 writhin 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. Limited Time 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 outable save contracted, such as in utility power contact and propried in the prime Power rating. CONTINUOUS POWE

Reference AEB 10.47 for determining Electrical Output.

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. Derates shown are based on 15 in H₂0 air intake restriction and 2 in Hg exhaust back pressure.

Data Subject to Change Without Notice

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.

Data Status: Limited Production

Data Tolerance: ± 5%

Chief Engineer:

D.K. Irueblood

Cummins Inc. Engine Data Sheet

ENGINE MODEL: QSK23-G2 CONFIGURATION NUMBER: D893001GX03 DATA SHEET: LP-50009

CONFIGURATION NUMBER: D893001GX03 DATE: 16Jan06
PERFORMANCE CURVE: FR-50009

INSTALLATION DIAGRAM

• Fan to Flywheel : 3170553

<u>CPL NUMBER</u>
• Engine Critical Parts List : 8352

GENERAL ENGINE DATA			
Туре	Inline 6-Cylinder	Diesel	
Aspiration	Turbocharged and Low Temperature Aftercooled		
Bore x Stroke— mm x mm (in x in)	170 x 170 (6.69	x 6.69)	
Displacement litre (in ³)	23.15 (1413)	,	
Compression Ratio	16.0:1		
Dry Weight			
Fan to Flywheel Engine — kg (lb)	2755	(6060)	
Wet Weight	2.00	(0000)	
Fan to Flywheel Engine — kg (lb)	2805	(6170)	
Moment of Inertia of Rotating Components	2003	(0170)	
• with (SAE 0)	11.6	(270)	
Center of Gravity from Front Face of Block — — mm (in)	725	(28.5)	
Center of Gravity Above Crankshaft Centerline	240	` ,	
		(9.5)	
Maximum Static Loading at Rear Main Bearing — kg (lb)	980	(2160)	
ENGINE MOUNTING			
Maximum Bending Moment at Rear Face of Block — N • m (lb • ft)	3205	(2340)	
EXHAUST SYSTEM			
Maximum Back Pressure— mm Hg (in Hg)	76.2	(3)	
AIR INDUCTION SYSTEM			
Maximum Intake Air Restriction:			
• with Dirty Filter Element	635	(25)	
• with Clean Filter Element	381	(15)	
COOLING SYSTEM			
	40.5	(40.0)	
Coolant Capacity — Engine Only — litre (US gal)	46.5	(12.3)	
Minimum Pressure Cap — kPa (psi)	69	(10)	
Jacket Water Circuit Requirements			
Maximum Static Head of Coolant Above Engine Crank Centerline — m (ft)	18.3	(60)	
Standard Thermostat (Modulating) Range	76.5-90	(170-194)	
Maximum Top Tank Temperature for Standby . Prime Power — °C (°F)	104 - 100	(220 - 212)	
Maximum Coolant Friction Head External to the Engine - 1800 RPM kPa (psi)	48	(7)	
-1500 RPM — kPa (psi)	43	(5)	
Air-to-Air Core Requirements			
Maximum Temp. Rise Between Engine Air Intake and Intake Manifold —1500 / 1800 rpm — °C (°F)	33	(60)	
Maximum Air Press. Drop from Turbo Air Outlet to Intake Manifold — 1500 / 1800 rpm — mm hg (in Hg)	102	(4)	
LUBRICATION SYSTEM			
	1.45	(24)	
Oil Pressure @ Idle Speed	145	(21)	
@ Governed Speed	345 - 448	(50 - 65)	
Maximum Oil Temperature	120	(248)	
Oil Capacity with OP TBD Oil Pan : Low - High	66 - 95	(17 - 25)	
Total System Capacity (With Combo Filters) — litre (US gal)	74 - 103	(19 - 27)	

FUEL SYSTEM

1 022 01012			
Type Injection System		Cummir	ns HPI-PT
Maximum Restriction at Fuel Injection Pump — with Clean Fuel Filter	— mm Hg (in Hg)	120	(4.0)
— with Dirty Fuel Filter	— mm Hg (in Hg)	203	(8.0)
Maximum Allowable Head on Injector Return Line (Consisting of Friction Head and Static Head).	Q (Q)	229	(9.0)
Maximum Inlet Temperature	Q (Q)	70	(160)
Maximum Fuel Flow to Injection Pump		684	(181)
Maximum Drain Flow		662	(175)
ELECTRICAL SYSTEM			
Cranking Motor (Heavy Duty, Positive Engagement)	— volt		24
Battery Charging System, Negative Ground	— ampere		35
Maximum Allowable Resistance of Cranking Circuit	— ohm	0.0	002
Minimum Recommended Battery Capacity			
Cold Soak @ 10 °C (50 °F) and Above	0°F CCA	12	200
Cold Soak @ 0 °C to 10 °C (32 °F to 50 °F)	0°F CCA	12	280
• Cold Soak @ -18 °C to 0 °C (0 °F to 32 °F)		18	300
COLD START CAPABILITY			
Minimum Ambient Temperature for Cold Start with 1500 watt Coolant Heater to Rated Speed		-30	(-22)
Minimum Ambient Temperature for Unaided Cold Start to Idle Speed		0	(32)
Minimum Ambient Temperature for NFPA 110 Cold Start (90° F Minimum Coolant Temperature	* *	10	(50)
PERFORMANCE DATA	,,	10	(00)
All data is based on: • Engine operating with fuel system, water pump, lubricating oil pump			

- 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.
- ISO 3046, Part 1, Standard Reference Conditions of:

Barometric Pressure : 100 kPa (29.53 in Hg) : 25 °C (77 °F) Air Temperature

Altitude : 110 m (361 ft) Relative Humidity : 30%

Air Intake Restriction : 381 mm H₂O (15 in H₂O) Exhaust Restriction: 51 mm Hg (2 in Hg)

+/- 0.25 Estimated Free Field Sound Pressure Level of a Typical Generator Set;

TBD TBD

Governed Engine Speed—rpm Engine Idle Speed.....- rpm Brake Mean Effective Pressure — kPa (psi) Piston Speed — m / s (ft / min) Fric Eng

storr opood	, 0 (,)
iction Horsepower	— kW _m (HP)
ngine Jacket Water Flow at Stated Friction Head Exte	ernal to Engine:
• 3 psi Friction Head— littl	re / s (US gpm)
	, ,,,,,, ,

• Maximum Friction Head...... litre / s (US gpm)

Engine Data Intake Air Flow...... litre / s (cfm) Exhaust Gas Temperature — °C (°F) Exhaust Gas Flow...... litre / s (cfm) Air-to-Fuel Ratio— air : fuel Radiated Heat to Ambient — kW_m (BTU / min) Heat Rejection to Jacket Water Coolant...... — kW_m (BTU / min) Charge Air Cooler Heat Rejection...... — kW_m (BTU / min) Turbo Compressor Outlet Temperature - °C (°F) Turbo Compressor Outlet Pressure — kPa (psi)

	STANDBY POWER 60 hz 50 hz				PRIME 60 hz		<u>R</u> 0 hz
18	1800		500		1800	1	500
7	' 50	7	750	750		750	
847	(1135)	723	(970)	768	(1030)	656	(880)
2465	(356)	2516	(365)	2227	(323)	2282	(331)
10.3	(2010)	8.6	(1675)	10.3	(2010)	8.6	(1675)
93	(124)	72	(96)	93	(124)	72	(96)
10.4	(165)	7.9	(126)	10.4	(165)	7.9	(126)
10.1	(160)	7.6	(120)	10.1	(160)	7.6	(120)
	(2338)	821	/	1060	,	779	(/
482	(900)	550	(1022)	453	(848)	541	(1006)
2977	(6308)	2334	(4945)	2640	(5594)	2183	(4625)
25.5	25.5 : 1		23.8 : 1		5.0 : 1	24	.7 : 1
78	(4444)	67	(3832)	71	(4022)	61	(3460)
243	(13859)	227	(12920)	223	(12719)	204	(11586)
575	(32725)	536	(30530)	513	(29192)	482	(27459)
9.1	(520)	6.8	(387)	9.1	(520)	6.8	(387)
200	(11396)	122	(6954)	184	(10453)	110	(6261)
215	(419)	187	(370)	203	(398)	172	(345)
269	(39)	228	(33)	248	(36)	200	(29)

^{*} This is the maximum heat rejection to fuel, which is at low load

N.A. - Not Available

N/A - Not Applicable to this Engine

TBD - To Be Determined

ENGINE MODEL: QSK23-G2 DATA SHEET: DS-50009-LP DATE: 16Jan06 **CURVE NO.:** FR-50009