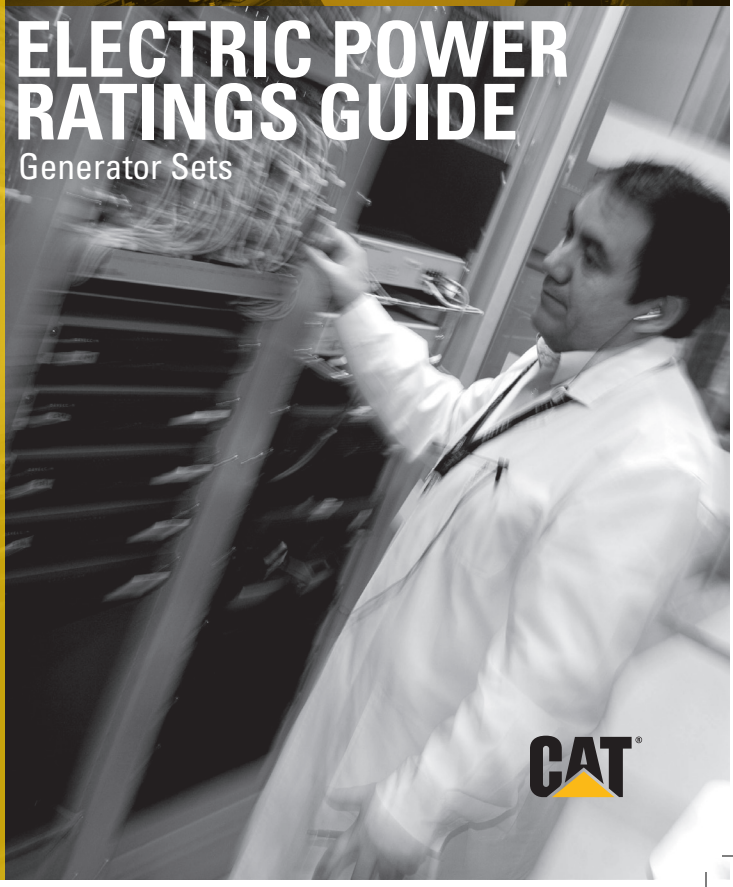
BUILT FOR IT.

ELECTRIC POWER RATINGS GUIDE

Generator Sets



CAT

CONTENTS

RATINGS GUIDE

CAT® GENERATOR SETS

DIESEL

DIESEL
50 Hz

CAT® 50 Hz DIESEL RATINGS, 275 kVA – 4000 kVA

kVA			Generator Set Model	Configuration
Standby	Prime	Continuous		
			1500 rpm	
300	275	—	3406C	Low BSFC
350	320	—	3406C	Low BSFC
400	350	—	C13	Low BSFC
400	365	—	3406C	Low BSFC
400	365	—	C15	Low BSFC
450	400	—	C13	Low BSFC
450	410	—	C15	Low BSFC
500	455	—	C15	Low BSFC
550	500	—	C15	Low BSFC
605	550	—	C18	Low BSFC
660	600	—	C18	Low BSFC
700	635	—	C18	Low BSFC
750	680	—	3412C	Low BSFC
800	725	—	3412C	Low BSFC
900	810	—	3412C	Low BSFC
1100	1000	910	C32	Low BSFC, Low Emissions
1250	1150	1000	3512	Low BSFC
1400	1275	1206	3512	Low BSFC
1500	1360	1320	3512B	Low BSFC, Low Emissions
1600	1500	—	3512B	Low BSFC, Low Emissions
1750	1600	1500	3512B-HD	Low BSFC, Low Emissions
1875	1700	—	3512B-HD	Low BSFC, Low Emissions
2000	1825	1600	3516	Low BSFC
2250	2000	1750	3516B	Low BSFC, Low Emissions
2500	2275	2000	3516B-HD	Low BSFC, Low Emissions
3000	2725	2500	C175-16	Low BSFC
3100*	2825*	2600*	C175-16	Low BSFC
4000*	3600*	3250*	C175-20	Low BSFC

*Rating does not include package mounted radiator

DIESEL
50 Hz

CAT 50 Hz DIESEL RATINGS, 1368 kVA – 17463 kVA

kVA			Generator Set	
Standby	Prime	Continuous	Model	Configuration
1000 rpm				
—	—	1368	6CM20	Low BSFC
—	—	1825	8CM20	Low BSFC
—	—	2050	9CM20	Low BSFC
2688	2425	2200	3606	Low BSFC
3575	3250	2938	3608	Low BSFC
5375	4850	4400	3612	Low BSFC
7150	6500	5875	3616	Low BSFC
750 rpm				
2163	1963	1775	3606	Low BSFC
—	—	2225	6CM25	Low BSFC
2863	2600	2363	3608	Low BSFC
—	—	2875	8CM25	Low BSFC
—	—	3238	9CM20	Low BSFC
4325	3925	3550	3612	Low BSFC
5725	5200	4725	3616	Low BSFC
—	—	6988	12CM32	Low BSFC
—	—	9313	16CM32	Low BSFC
600 rpm				
—	—	3456	6CM32	Low BSFC
—	—	4656	8CM32	Low BSFC
—	—	5238	9CM32	Low BSFC
500 rpm				
—	—	6550	6CM43	Low BSFC
—	—	7638	7CM43	Low BSFC
—	—	8725	8CM43	Low BSFC
—	—	9825	9CM43	Low BSFC
—	—	13094	12CM43	Low BSFC
—	—	17463	16CM43	Low BSFC

DIESEL
60 Hz

CAT 60 Hz DIESEL RATINGS, 36 ekW – 175 ekW

Available only for North America

ekW		Generator Set		
Standby	Prime	Model	Engine	Configuration
Single Phase Output* 1800 rpm				
40	36	D40S	C4.4	ESE
50	45	D50S	C4.4	ESE
60	55	D60S	C4.4	ESE
80	72	D80S	C4.4	ESE
100	90	D100S	C4.4	ESE
Three Phase Output 1800 rpm**				
40	36	D40	C4.4	ESE
50	45	D50	C4.4	ESE
60	55	D60	C4.4	ESE
80	72	D80	C4.4	ESE
100	90	D100	C4.4	ESE
125	114	D125	C6.6	ESE
150	136	D150	C6.6	ESE
175	158	D175	C6.6	ESE

*All ratings at 1.0 pf
**All ratings at 0.8 pf
(ESE) EPA Emergency Stationary Exempt

CAT 60 Hz DIESEL RATINGS, 180 ekW – 250 ekW

ekW			Generator Set	
Standby	Prime	Continuous	Model	Configuration
1800 rpm				
200	180	—	C9	ESE
230	210	—	3306B	Low BSFC
250	225	—	3306B	Low BSFC
250	225	—	C9	ESE

(ESE) EPA Emergency Stationary Exempt

DIESEL
60 Hz

CAT 60 Hz DIESEL RATINGS, 275 ekW – 4000 ekW

ekW			Generator Set Model	Configuration
Standby	Prime	Continuous		
1800 rpm				
300	275	–	C9	ESE
300	275	–	3406C	Low BSFC
350	320	–	3406C	Low BSFC
350	320	–	C15	ESE, Low BSFC
350	320	–	C13	Low BSFC
400	350	–	C13	Low BSFC
400	365	–	3406C	Low BSFC
400	365	–	C15	ESE, Low BSFC
450	410	–	C15	ESE, Low BSFC
500	455	–	C15	EPA Tier 4 Interim, ESE, Low BSFC
550 (ESP)	–	–	C15	ESE, Low BSFC
550	500	–	C18	ESE, Low BSFC
600	545	–	C18	ESE, Low BSFC
650	591	–	3412C	Low BSFC
700	635	–	3412C	Low BSFC
750	680	–	C27	ESE, Low BSFC
750	680	–	3412C	Low BSFC
800	725	–	C27	EPA Tier 4 Interim, ESE, Low BSFC
800	725	–	3412C	Low BSFC
1000	910	830	C32	ESE, Low BSFC
1100	1000	890	3512	Low BSFC
1250	1135	1010	3512	Low BSFC
1400	1275	1230	3512B	Low BSFC, Low Emissions
1500	1360	1230	3512B	Low BSFC, Low Emissions
1500	1360	1230	3512C	ESE
1750	1600	1450	3516	Low BSFC
2000	1825	1640	3516B	Low BSFC, Low Emissions
2000	1825	1650	3516C	EPA T4, ESE
2250	–	–	3516B	Low BSFC
2500	2250	2050	3516C-HD	EPA T4, ESE
3000	2725	2500	C175-16	EPA Tier 4 Interim, ESE, Low BSFC
3100*	2825*	2600*	C175-16	EPA Tier 4 Interim, ESE, Low BSFC
4000*	3600*	3250*	C175-20	ESE, Low BSFC

(ESE) EPA Emergency Stationary Exempt
(ESP) Emergency Standby Rating
*Rating does not include package mounted radiator

DIESEL
60 Hz

CAT 60 Hz DIESEL RATINGS, 980 ekW – 13970 ekW

ekW			Generator Set	
Standby	Prime	Continuous	Model	Configuration
900 rpm				
—	—	980	6CM20	Low BSFC
—	—	1300	8CM20	Low BSFC
—	—	1470	9CM20	Low BSFC
2000	1820	1650	3606	Low BSFC
2660	2420	2200	3608	Low BSFC
4000	3640	3300	3612	Low BSFC
5320	4840	4400	3616	Low BSFC
720 rpm				
1680	1525	1375	3606	Low BSFC
—	—	1730	6CM25	Low BSFC
2200	2020	1830	3608	Low BSFC
—	—	2230	8CM25	Low BSFC
—	—	2500	9CM20	Low BSFC
3360	3050	2750	3612	Low BSFC
4400	4040	3660	3616	Low BSFC
—	—	5590	12CM32	Low BSFC
—	—	7450	16CM32	Low BSFC
600 rpm				
—	—	2765	6CM32	Low BSFC
—	—	3725	8CM32	Low BSFC
—	—	4190	9CM32	Low BSFC
514 rpm				
—	—	5240	6CM43	Low BSFC
—	—	6110	7CM43	Low BSFC
—	—	6980	8CM43	Low BSFC
—	—	7860	9CM43	Low BSFC
—	—	10475	12CM43	Low BSFC
—	—	13970	16CM43	Low BSFC

*S

DIESEL

RENTAL POWER RATINGS

CAT 60 Hz RENTAL POWER RATINGS, 18 ekW – 1250 ekW

ekW			Rental Generator	
Standby	Prime	Continuous	Model	Configuration
1800 rpm				
20*	18	—	XQ20	EPA Tier 4 Interim
30*	27	—	XQ30	EPA Tier 4 Interim
60*	54	—	XQ60	EPA Tier 3
100*	90	—	XQ100	EPA Tier 3
200	182	—	XQ200	EPA Tier 4 Interim
350	320	—	XQ350	EPA Tier 4 Interim
500	455	—	XQ500	EPA Tier 4 Interim
800	725	—	XQ800	EPA Tier 4 Interim
—	—	1250	XQ1250G	EPA NSPS SI Capable

*Subject to availability (Flex Credits)

DIESEL
RATINGS DEFINITIONS

CAT DIESEL RATING DEFINITIONS

Emergency Standby Power (ESP)
Output available with varying load for the duration of an emergency outage. Average power output is 70% of the emergency standby power rating. Typical operation is 50 hours per year with maximum expected usage of 200 hours per year.

Standby Power
Output available with varying load for the duration of the interruption of the normal source power. Average power output is 70% of the standby power rating. Typical operation is 200 hours per year, with maximum expected usage of 500 hours per year.

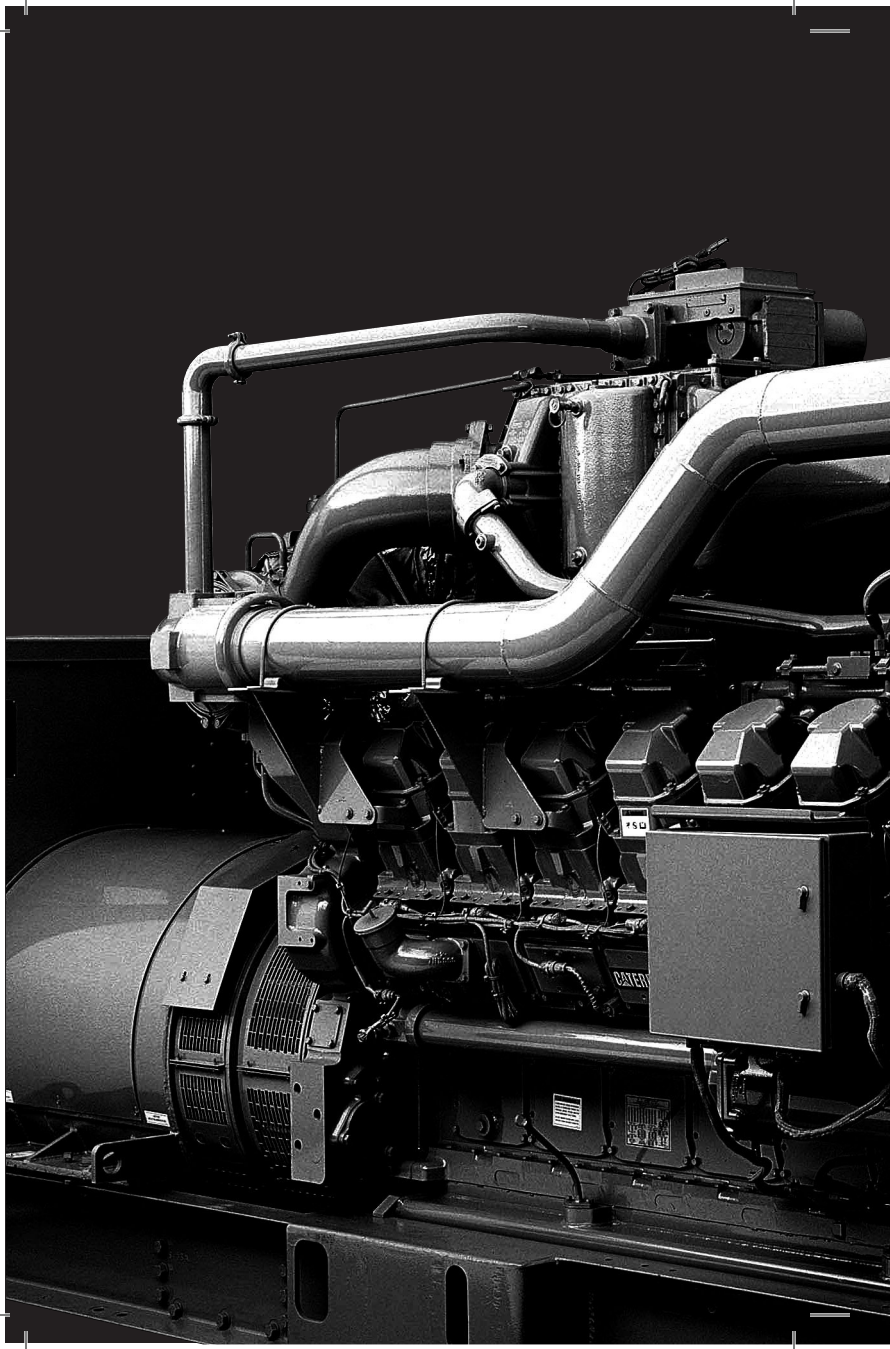
Mission Critical Standby Power
Output available with varying load for the duration of the interruption of the normal source power. Average power output is 85% of the standby power rating. Typical operation is 200 hours per year, with maximum expected usage of 500 hours per year.

DIESEL
RATINGS DEFINITIONS

Prime Power
Output available with varying load for an unlimited time. Average power output is 70% of the prime power rating. Typical peak demand of 100% of prime-rated ekW with 10% of overload capability for emergency use for a maximum of 1 hour in 12. Overload operation cannot exceed 25 hours per year.

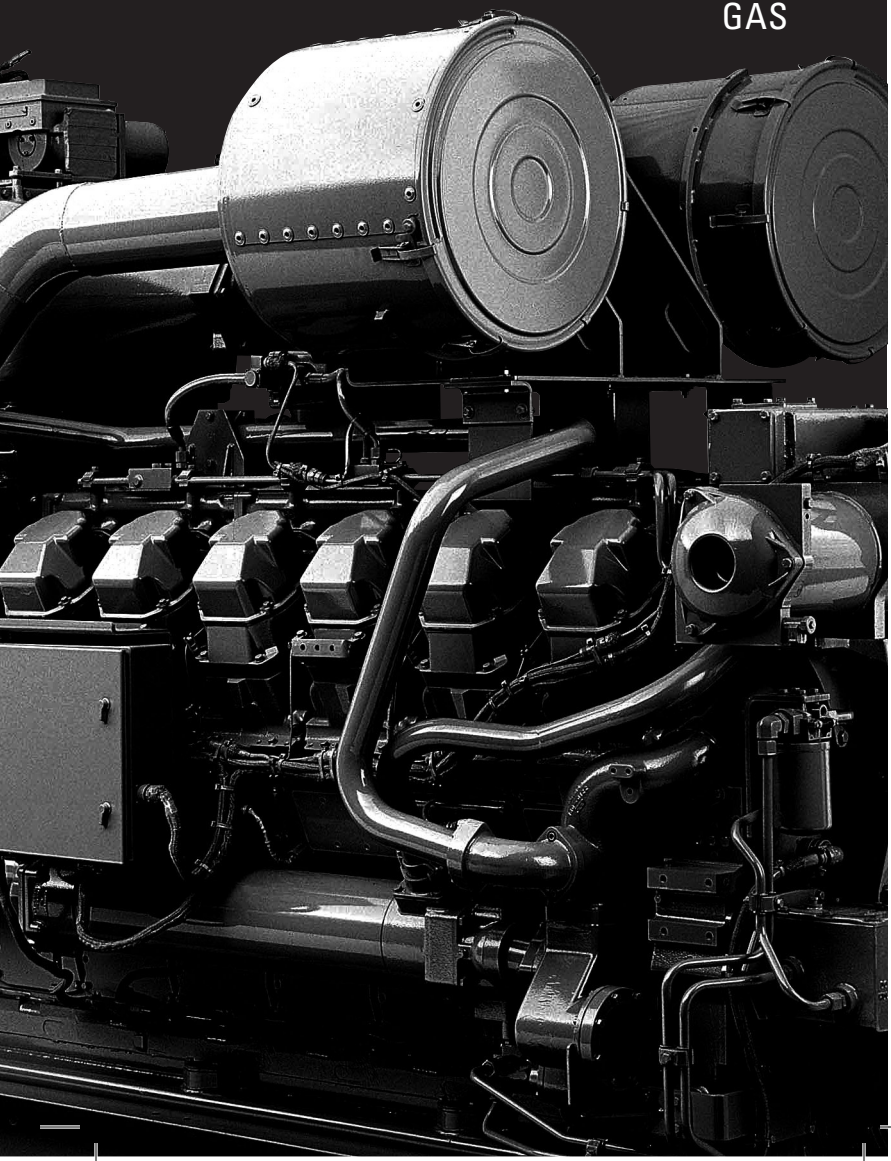
Load Management
Output available with varying load for maximum 500 hours a year. Average power output is 100% of the prime power rating. Typical peak demand of 100% of prime-rated ekW. Overload operation not available.

Continuous Power
Output available without varying load for an unlimited time. Average power output is 70 – 100% of the continuous power rating. Typical peak demand is 100% of continuous rated ekW for 100% of operating hours.



CAT GENERATOR SETS

GAS



GAS
50 Hz

CAT 50 Hz CONTINUOUS – GAS RATINGS, 66 kW – 9700 kW

kW 750 rpm	kW 1000 rpm	kW 1500 rpm	Natural Gas	Biogas
—	—	66	—	G3306 NA
—	—	86	G3306 NA*	—
—	—	107	—	G3406 NA
—	—	115	G3306 TA*	—
—	—	126	G3406 NA*	—
—	—	166	G3406 TA*	—
—	—	174	—	G3412NA
—	—	282	G3412 TA*	—
—	—	374	3412C	—
—	—	400	CG132-8	CG132-8
—	—	457	—	G3508
—	—	485	G3508	—
—	—	600	CG132-12	CG132-12
—	—	731	G3512	—
—	—	777	G3512	G3512
—	—	800	CG132-16	CG132-16
—	—	983	G3516	—
—	—	1017	G3512E	—
—	—	1041	—	G3516
—	—	1088	G3516	—
—	—	1105	—	G3516
—	—	1200	CG170-12	CG170-12
—	—	1211	G3512E	—
—	—	1560	CG170-16	CG170-16
—	—	1603	G3516E	—
—	—	1605	G3516C	—
—	1722	—	G3608	—
—	—	1976	G3520C	—
—	—	1982	G3520C	G3520C
—	—	2000	CG170-20	CG170-20
—	—	2010	G3520C	—
—	—	2027	G3516H	—
—	2582	—	G3612	—
—	2830	—	—	CG260-12
—	3333	—	CG260-12	—
—	3440	—	G3616	—
—	3770	—	—	CG260-16
—	4300	—	CG260-16	—
6520	—	—	G16CM34	—
9700	—	—	G20CM34	—

Ratings at ISO 3046-1 conditions. SCAC Temp = 40-53° C (104-127° F). PF = 1.0.
Natural Gas at 35.6 MJ/N·m^3 (905 Btu/ft^3), MN = 80.
Biogas (Landfill, Sewage, Digester Gas) at 18.0-23.6 MJ/N·m^3 (457-600 Btu/ft^3) and MN = 130-134.

NA = Naturally Aspirated, Stoichiometric Engine: *Catalyst Rating Availability
TA = Turbocharged & Aftercooled, Stoichiometric Engine: *Catalyst Rating Availability
All other engines: Lean Burn

GAS
60 Hz

CAT 60 Hz STANDBY – GAS RATINGS, 235 kW – 1040 kW

kW 1800 rpm	Natural Gas
235	G3406 TA*
450	G3412 TA*
1040	G3516

Ratings at ISO 3046-1 conditions. SCAC Temp = 53° C (127° F). Standby ratings at PF = 0.8. Natural Gas at 35.6 MJ/N·m^3 (905 Btu/ft^3), MN = 80. Contact dealer for LPG or Propane ratings. Biogas (Landfill, Sewage, Digester Gas) at 18.0-23.6 MJ/N·m^3 (457-600 Btu/ft^3) and MN = 130-134.

NA = Naturally Aspirated, Stoichiometric Engine: *Catalyst Rating Availability
TA = Turbocharged & Aftercooled, Stoichiometric Engine: *Catalyst Rating Availability
All other engines: Lean Burn

GAS
60 Hz

CAT 60 Hz CONTINUOUS – GAS RATINGS, 76 kW – 9700 kW

kW 720 rpm	kW 900 rpm	kW 1200 rpm	kW 1500 rpm	kW 1800 rpm	Natural Gas	Biogas
—	—	—	—	76	—	G3306 NA
—	—	—	—	87	G3306 NA	—
—	—	—	—	104	G3306 NA*	—
—	—	—	—	137	—	G3406 NA
—	—	—	—	143	G3306 TA*	—
—	—	—	—	155	G3406 NA*	—
—	—	—	—	192	G3406 TA*	—
—	—	—	—	194	—	G3412 NA
—	—	—	—	217	G3406 TA*	—
—	—	—	—	253	G3412 NA*	—
—	—	373	—	—	G3508 TA*	—
—	—	—	—	400	CG132-8	CG132-8
—	—	—	—	403	G3412 TA*	—
—	—	408	—	—	—	G3508
—	—	—	—	453	G3412C	—
—	—	564	—	—	G3512 TA*	—
—	—	581	—	—	G3512	—
—	—	—	—	600	CG132-12	CG132-12
—	—	615	—	—	—	G3512
—	—	779	—	—	G3516	—
—	—	—	—	800	CG132-16	CG132-16
—	—	824	—	—	—	G3516
—	—	1015	—	—	—	G3516
—	—	—	1200	—	CG170-12	CG170-12
—	—	1312	—	—	G3516B	—
—	1549	—	—	—	G3608	—
—	—	—	1550	—	CG170-16	CG170-16
—	—	1626	—	—	G3520C	G3520C
—	—	—	—	1663	G3516C	—
—	—	—	2000	—	CG170-20	CG170-20
—	—	—	2026	—	G3520E	—
—	—	—	—	2077	G3520C	—
—	2347	—	—	—	G3612	—
—	2530	—	—	—	—	CG260-12
—	3000	—	—	—	CG260-12	—
—	3121	—	—	—	G3616	—
—	3370	—	—	—	—	CG260-16
—	4000	—	—	—	CG260-16	—
6520	—	—	—	—	G16CM34	—
9700	—	—	—	—	G20CM34	—

Ratings at ISO 3046-1 conditions. SCAC Temp = 40-53° C (104-127° F). PF = 1.0.
Natural Gas at 35.6 MJ/N·m^3 (905 Btu/ft^3), MN = 80.
Biogas (Landfill, Sewage, Digester Gas) at 18.0-23.6 MJ/N·m^3 (457-600 Btu/ft^3) and MN = 130-134.

NA = Naturally Aspirated, Stoichiometric Engine: *Catalyst Rating Availability
TA = Turbocharged & Aftercooled, Stoichiometric Engine: *Catalyst Rating Availability
All other engines: Lean Burn

CAT GAS RATING DEFINITIONS

Standby Power
Output available with varying load for the duration of the interruption of the normal source power. Average power output is 70% of the standby power rating. Typical operation is 200 hours per year, with maximum expected usage of 500 hours per year. Fuel stop power in accordance with ISO 3046-1.

Continuous Power
Output available without varying load for an unlimited time. Average power output is 70-100% of the continuous power rating. Typical peak demand is 100% of continuous rated ekW for 100% of operating hours. Continuous power is in accordance with ISO 8528-1. Fuel stop power in accordance with ISO 3046-1.


CAT
ACK
RESET
EVENT LOG
RUN
AUTO
STOP
F1
F2
F3
F4
OK
CONTROL
AC
ENGINE
MAIN MENU
EMCP 4.4
AUTO
Hz
STOP
WARNING


EMCP 4
CAT
EMERGENCY STOP
OVERCRANK
HIGH COOLANT TEMPERATURE
LOW COOLANT TEMPERATURE
LOW OIL PRESSURE
OVERSPEED
LOW COOLANT LEVEL
LOW FUEL LEVEL
CONTROL SWITCH NOT IN AUTO
HIGH BATTERY VOLTAGE
LOW BATTERY VOLTAGE
LOW CRANKING VOLTAGE
BATT CHARGER AC FAILURE
EPS SUPPLYING LOAD
ENGINE RUNNING
ENGINE EMISSIONS SYSTEM FAILURE
MODULE/NETWORK STATUS
EVENT LOG
STOP
WARNING

EMCP 4

CAT EMCP 4

EMCP 4.1
The EMCP 4.1 provides basic engine controls – stop/run/auto push button controls, cycle crank, and cool down timer. The 3.8 inch graphical display supports multiple languages, including character languages such as Chinese, Arabic, Russian, and Japanese. The EMCP 4.1 provides monitoring of generator electrical output, including AC voltage, current, and frequency, and mechanical information such as oil pressure, oil temperature, coolant temperature, engine speed, and battery voltage. It also provides a number of protective functions, such as warnings and shutdowns for over/under voltage, over/under frequency, low oil pressure, high coolant temperature, low coolant level, failure to start, and overspeed.

EMCP 4.2
The EMCP 4.2 builds on the features of the EMCP 4.1 controller, offering expanded generator set protection and monitoring, such as generator kW, kVA, and kW-hr.

Flexibility is also increased with the addition of a modbus RTU communication port, remote annunciator modules, and expansion I/O modules to allow the EMCP 4 system to be configured to meet site specific design requirements.

With the additional monitoring and expansion modules available, the EMCP 4.2 is designed to provide control and protection for critical installations, such as NFPA-110 Level 1 applications.

EMCP 4

EMCP 4.3
The EMCP 4.3 further expands the EMCP 4 product line with the addition of 5.5 inch graphical display and additional context specific navigation keys.

With the addition of a modbus TCP port, the EMCP 4.3 controller can be easily integrated into complex systems requiring complete generator set monitoring.

EMCP 4.4
The EMCP 4.4 builds on the EMCP 4.3 functionality with the addition of fully automatic multi generator set paralleling. The EMCP 4.4 provides all of the functions required to automatically parallel generator sets, including dead bus arbitration, automatic or manual modes of operation, and load sharing (real and reactive). The EMCP 4.4 can also be configured to automatically cycle generator sets on line and off line based on the site load.

SYSTEMS PRODUCTS


CAT

SYSTEMS PRODUCTS

Paralleling Switchgear
50 Hz & 60 Hz
Fully customizable
Breaker Based – 220V to 27 kV
Color Touchscreen (HMI) Controls
Typical applications:
- Emergency Standby
- Utility Paralleling
- Load Management
- Prime Power

EPIC (Engine Paralleling and Integration Control)
Generator Set Paralleling Controls (customer supplied electrically operated breaker)
Color Touchscreen (HMI) Controls
Field expandable
Typical applications:
- Emergency Standby
- Utility Paralleling
- Load Management

XLM1 (Emergency Transfer and Load Management)
Parallels a single genset to a single utility
Customer Configured
Color Touchscreen (HMI) Controls
Typical applications:
- Emergency Standby
- Utility Paralleling
- Load Management

SYSTEMS PRODUCTS

UPS
50 Hz

Output kVA	Parallel Capable	UPS Model	UPS Type	Energy Storage
60-120	Y	UPSB125	Double Conversion	Battery
160-500	Y	UPSB505	Double Conversion	Battery
250	N	UPS250i	Line Interactive	Flywheel
250-500	Y	UPS500iG	Line Interactive	Flywheel
650	Y	UPS750	Line Interactive	Flywheel
750-1000	Y	UPS1000iZ	Line Interactive	Flywheel

60 Hz

Output kVA	Parallel Capable	UPS Model	UPS Type	Energy Storage
40-130	Y	UPSB130	Double Conversion	Battery
150-225	Y	UPSB220	Double Conversion	Battery
300-500	Y	UPSB500	Double Conversion	Battery
555-1100	Y	UPSB1100	Double Conversion	Battery
300	N	UPS300	Line Interactive	Flywheel
300-600	Y	UPS600G	Line Interactive	Flywheel
750	Y	UPS750	Line Interactive	Flywheel
900-1200	Y	UPS1200Z	Line Interactive	Flywheel

ATS

Amp Rating	Poles	Model	Type
40-4000	2,3,4	MX	Contactor
40-1200	2,3,4	ATC	Contactor
30-1000	2,3,4	ATC	MCCB & MCS
200-5000	2,3,4	ATC	Power Breaker

Operating Modes:
- Open Transition
- Closed Transition
- Delayed Transition
- Bypass Isolation

CONVERSIONS

RATINGS GUIDE


WARNING
CATERPILLAR
LOW OIL PRESSURE
EMERGENCY STOP
HIGH WATER TEMP
ENGINE OVERSPEED
OVERCRANK
SPARE 1
SPARE 2
SPARE 3
FAULT SHUTDOWN
FAULT ALARM
POWER METER
AC METER
ENGINE METER
LAMP TEST
ALARM CODES
EXIT
SERVICE MODE
STOP
AUTO
Hz

CONVERSIONS

FUEL SYSTEM – DIESEL

Day Tank Sizing

$$\text{Tank Size (gal)} = \frac{\text{Rated BSFC (lb/hp•hr)}}{\text{7.076 (lb/gal)}} \times \text{Rated HP} \times \text{Load Factor}$$

x Hours Between Refilling
+ Reserve Requirement

OR

Rule of Thumb for tank size with 25% reserve

0.056 x Ave. BHP demand x Hours between refills x 1.25 = _____gal.
0.27 x Ave. BKW demand x Hours between refills x 1.25 = _____liters.

Note: Additional tank capacity required for cooling of recirculated fuel in unit-injected engines. Tank should be located below level of injectors or nozzles.

On-Site Power Requirements

Based on 100,000 sq ft. of office bldg., etc and 40°N. Latitudes

- Electric Requirements
  600 kW continuous load
  (Air conditioning is absorption)
  Use three – 300 kW units
  (2 prime and 1 standby)
- Air Conditioning and Compressor
  400 tons prime load
  Use two – 200 hp engines
  (No Standby)

Refrigeration

- One ton refrigeration = 200 Btu/min = 12,000 Btu/h
- One Boiler hp = 33,475 Btu/h
- One ton compressor rating = One engine hp
- Auxiliary air conditioning equipment requires 1/4 hp/ton of compressor rating

Ice Plant

- Complete power requires 4-5 hp per daily ton capacity

Air Compressor

- hp = 1/4 x cu ft m/min at 100 psi
  Increase bhp 10% for 125 psi
  Decrease bhp 10% for 80 psi

CONVERSIONS

ELECTRICAL TABLES

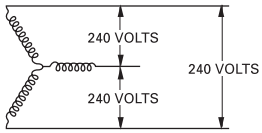
To Obtain	Alternating Current		Direct Current
	Single-Phase	Three-Phase	
kW	$\frac{V \times I \times P.F.}{1000}$	$\frac{1.732 \times V \times I \times P.F.}{1000}$	$\frac{V \times I}{1000}$
kVA	$\frac{V \times I}{1000}$	$\frac{1.732 \times V \times I}{1000}$	
Horsepower required when kW known (Generator)	$\frac{kW}{.746 \times EFF. (Gen)}$	$\frac{kW}{.746 \times EFF. (Gen)}$	$\frac{kW}{.746 \times EFF. (Gen)}$
kW input when HP known (Motor)	$\frac{HP \times .746}{EFF. (Mot.)}$	$\frac{HP \times .746}{EFF. (Mot.)}$	$\frac{HP \times .746}{EFF. (Mot.)}$
Amperes when HP known	$\frac{HP \times .746}{V \times P.F. \times EFF.}$	$\frac{HP \times .746}{1.732 \times V \times EFF. \times P.F.}$	$\frac{HP \times .746}{V \times EFF.}$
Amperes when kW known	$\frac{kW \times 1000}{V \times P.F.}$	$\frac{kW \times 1000}{1.732 \times V \times P.F.}$	$\frac{kW \times 1000}{V}$
Amperes when kVA known	$\frac{kVA \times 1000}{V}$	$\frac{kVA \times 1000}{1.732 \times V}$	
Frequency Hz	$\frac{Poles \times RPM}{120}$	$\frac{Poles \times RPM}{120}$	
Reactive kVA (kVAr)	$\frac{V \times I \times \sqrt{1-(P.F.)^2}}{1000}$	$\frac{1.732 \times V \times I \times \sqrt{1-(P.F.)^2}}{1000}$	
% Voltage Regulation	$\frac{100 (V_{NL}-V_{FL})}{V_{FL}}$	$\frac{100 (V_{NL}-V_{FL})}{V_{FL}}$	$\frac{100 (V_{NL}-V_{FL})}{V_{FL}}$

ELECTRICAL TABLE ABBREVIATIONS:

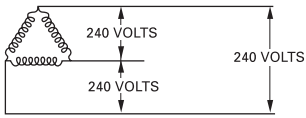
V – voltage in volts
I – current in amperes
kW – power in kilowatts (actual power)
kVA – kilovolt-amperes (apparent power)
HP – horsepower
RPM – revolutions per minute
kVAr – reactive kilovolt-amperes
EFF. – efficiency as a decimal factor
NL – no load
FL – full load
P.F. – power factor
Note: DC kW = DC kVA

CONVERSIONS

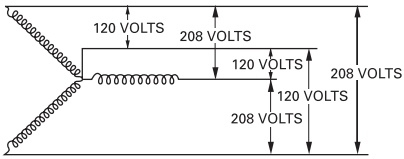
THREE-PHASE CONNECTION SYSTEMS



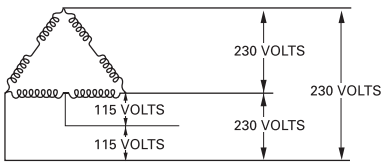
THREE-PHASE, THREE-WIRE (WYE)
A



THREE-PHASE, THREE-WIRE (DELTA)
B



THREE-PHASE, FOUR-WIRE (WYE)
C



THREE-PHASE, FOUR-WIRE (DELTA)
D

CONVERSIONS

REDUCED VOLTAGE STARTERS

Type of Starter	Motor Voltage (% Line Voltage)	Line Current (% Full Voltage) Starting Current	Starting Torque (% of Full Voltage) Starting Torque
Full Voltage Starter	100	100	100
Auto Transformer • 80% Tap • 65% Tap • 50% Tap	 80 65 50	 68 46 30	 64 42 25
Resistor Starter Single Step (adjusted for motor voltage to be 80% of line voltage)	80	80	64
Reactor • 50% Tap • 45% Tap • 37.5% Tap	 50 45 37.5	 50 45 37.5	 25 20 14
Part Winding (low-speed motors only) • 75% Winding • 80% Winding	 100 100	 75 50	 75 50

CONVERSIONS

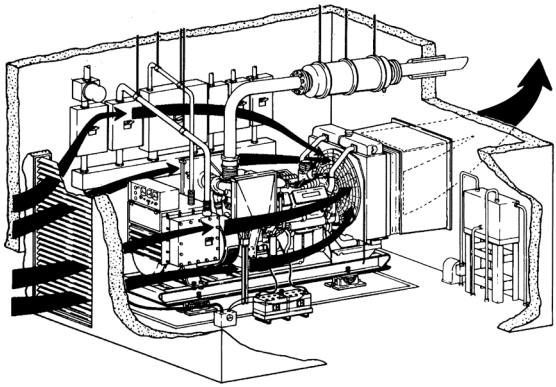
COMPARISON OF REDUCED VOLTAGE STARTING METHODS

Characteristic	Autotransformer	Primary Resistor	Reactor	Two-Step Part Winding
Starting Line Current at Same Motor Terminal Voltage	Least	—— More than autotransformer type ——		
Starting Power Factor	Low	High*	Low	Low
Power Draw from Line During Starting	Low	—— More than autotransformer type ——		
Torque	Increases slightly with speed	Increases rapidly with speed		Increases slightly with speed
Smoothness of Acceleration	Motor momentarily disconnected from line from start to run	Smooth. Transfer made with little change in motor terminal voltage		Smooth
Relative Cost	Average	Lower in small size-otherwise equal	Average	Less than others
Ease of Control	Same	Same	Same	No provision for adjustment of starting current
Maintenance	Same	Same	Same	Less than others
Line Disturbance	—— Varies with conditions and type of load ——			More than others

*Resistor starting adds considerable kW load to generator set. Total power required includes the motor kW and the kW which is lost as heat in the resistor. The series resistors account for a higher than normal starting power factor.

CONVERSIONS

ENGINE ROOM VENTILATION



Engine room ventilation can be estimated by the following formulas, assuming 100° F (38° C) ambient air temperature:

$$V\ (cfm) = \frac{H}{0.070 \times 0.24 \times \Delta T} + \text{Engine Combustion Air}$$

$$V\ (m^3/min) = \frac{H}{1.099 \times 0.017 \times \Delta T} + \text{Engine Combustion Air}$$

V = Ventilation air (cfm) (m^3/min).
H = Heat radiation (Btu/min) (kW).
Δ**T** = Permissible temperature rise in engine room (°F) (°C).
Density of air at 100° F = 0.070 lb/cu ft (1.099 kg/m^3).
Specific heat of air = 0.24 Btu/°F (0.017 kW/°C).

CONVERSIONS

CONVERSION FACTORS

Length							
Unit	**mm**	**in**	**ft**	**yd**	**m**	**km**	**mi**
mm	1	0.03937	0.003281	0.001094	0.001	0.000001	—
in	25.4	1	0.08333	0.02778	0.0254	0.000025	—
ft	304.8	12	1	0.33333	0.3048	0.000305	—
yd	914.4	36	3	1	0.9144	0.000914	—
m	1000	39.3701	3.28084	1.09361	1	0.001	0.00062
km	1000000	39370.1	3280.84	1093.61	1000	1	0.62137
mi	1609344	63360	5280	1760	1609.34	1.60934	1

Area				
Unit	**mm^2**	**in^2**	**m^2**	**ft^2**
mm^2	1	0.00155	—	—
in^2	645.16	1	0.000645	0.006944
m^2	1000000	1550	1	10.76391
ft^2	92903	144	0.0929	1

1 sq mile = 640 acres
1 acre = 4840 yd^2

1 cir mil = 7.854 x $10^{-7}$$in^2$
1 cir mil =0.7854 x $mils^2$

1 cir mil = 5.067 x $10^{-6}$$cm^2$

Weight						
				— Tons —		
Unit	**Kilograms**	**Ounces Avoirdupois**	**Pounds Avoirdupois**	**Short**	**Long**	**Metric**
Kilograms	1	35.274	2.2046	—	—	—
Ounces Avoirdupois	0.02835	1	0.0625	—	—	—
Pounds Avoirdupois	0.45359	16	1	—	—	—
Short Ton	907.185	32000	2000	1	0.8929	0.9072
Long Ton	1016.05	35840	2240	1.12	1	1.0160
Metric Ton	1000	35274	2204.62	1.1023	0.9842	1

1 grain = 0.064799 gram

CONVERSIONS

CONVERSION FACTORS

mi
—
—
—
—
.00062
.62137
1

Flow					
Unit	U.S. gal/min	million U.S. gal/day	ft^3/s	m^3/h	L/s
U.S. gpm	1	0.001440	0.00223	0.2270	0.0631
1 million gal/day	694.5	1	1.547	157.73	43.8
ft^3/s	448.8	0.0646	1	101.9	28.32
m^3/h	4.403	0.00634	0.00981	1	0.2778
L/s	15.85	0.0228	0.0353	3.60	1

MCFD = 1000 ft^3/day MMCFD = 1,000,000 ft^3/day lb/bhp-hr x 607.73 = g/kW-hr

$^6cm^2$

–
Metric
—
—
—
0.9072
1.0160
1

Energy						
Unit	BTU	Cal	ft-lb	J	Kcal	Therm
BTU	1	252	778	1055.056	0.252	0.00001
Calorie	0.00397	1	3.08866	4.187	0.001	–
Foot-Pound	0.001285	0.323765	1	1.356	0.003089	–
Joule	0.000948	0.23895	0.73745	1	0.000239	–
Kilocalorie	3.96825	1000	3089	4185	1	2.519
Therm	100000	396.8254	128.5347	94.78169	0.39682	1

1 Therm = 1,000,000 Btu Btu/ft^3 = 8.899 kg-cal/m^3

$Btu/ft^2/min$ = 0.1220 Watts/in^2 Btu/lb =0.5556 kg-cal/kg

CONVERSIONS

CONVERSION FACTORS

Volume and Capacity

Unit	in^3	ft^3	yd^3	mm^3	
in^3	1	0.00058	0.00002	16387.1	0.0
ft^3	1728	1	0.03704	28320000	0.0
yd^3	46656	27	1	764554858	0.7
mm^3	6.1×10^{-5}	4.0×10^{-8}	–	1	
m^3	61023.7	35.3147	1.30795	1000000000	
U.S.gal	231	0.13368	0.00495	3785420	0.0
Imp gal	277.419	0.16054	0.00595	4540090	0.0
liter	61.0237	0.03531	0.00131	1000000	0.
acre-ft	–	43560	1613.33	–	12

1 board-foot = 144 in^3 1 bushel = 1.244 ft^3 1 bushel = 4 pecks

Power

Unit	Btu/min	ft-lb/min	hp	
Btu/min	1	778.2	0.02358	10
ft-lb/min	0.00128	1	0.00003	1
Horsepower	42.456	33000	1	4
Joules/min	0.00095	0.7405	0.0000223	
Metric hp	41.827	32550	0.98632	4
Kilowatt	59	44250	1.34102	5
Watt	0.05687	44.25	0.00134	5

Pressure and Head

Unit	mm/Hg (0° C)	in./Hg (0° C)	in. H_2O (60° F)	ft. H_2O (60° F)	
mm/Hg	1	0.03937	0.5357	0.04464	0.0
in./Hg	25.4	1	13.61	1.134	0.4
in. H_2O	1.86827	0.07355	1	0.08333	0.0
ft. H_2O	22.4192	0.88265	12	1	0.4
lb/in^2	51.7149	2.03602	27.70	2.309	
kg/cm^2	735.559	28.959	395	32.84	14
bar	750.062	29.530	401.8	33.49	1
kPa	7.50062	0.29530	4.01835	0.33486	0.1

CONVERSIONS

CONVERSION FACTORS

m³	m³	U.S. gal	Imp gal	liter
87.1	0.00002	0.00432	0.00361	0.01639
20000	0.02832	7.48052	5.22883	28.3169
54858	0.76455	201.974	168.178	764.555
1	–	2.6×10^{-7}	2.2×10^{-7}	1.0×10^{-6}
000000	1	264.192	219.969	1000
5420	0.00378	1	–	3.78541
0090	0.00455	1.20095	1	4.54609
0000	0.001	0.26417	0.21997	1
–	1233.48	325851	271335	–

hp	J/min	Metric hp	kW	W
2358	1055.000	0.02391	0.0175843	17.5843
0003	1.3504	0.00003	0.0000226	0.0226
1	44791	1.014	0.74570	745.7
00223	1	0.0000226	0.0000166	0.016668
8632	44127	1	0.73549	735.498
4102	59997	1.35962	1	1000
0134	59.9968	0.00136	0.001	1

₂O (F)	lb/in²	kg/cm²	bar	Atmospheres 101.4Pa (14.7 psi)	kPa
64	0.01934	0.00136	0.00133	0.001315	–
4	0.49115	0.03453	0.03386	0.03342	–
33	0.03613	0.00254	0.00249	0.00246	0.249
	0.43352	0.030479	0.02989	0.02950	2.989
9	1	0.07031	0.06895	0.06805	6.895
4	14.2257	1	0.98067	0.96784	98.067
9	14.504	1.01972	1	0.98692	101.325
86	0.145038	0.0101972	0.010000	0.00986920	1

CONVERSIONS

CONVERSION FACTORS

Temperature Conversion

°F = (1.8 x °C) + 32
°C = 0.5555 (°F – 32)

Angle

1 quadrant = 90 degrees
1 quadrant = 1.57 radians
1 radian = 57.3 degrees
1 degree = 60 minutes
1 minute = 2.9 x 10 radians

Identifying Code Letters on AC Motors	
NEMA Code Letter	**Starting skVA/hp**
A	0.00 – 3.14
B	3.15 – 3.54
C	3.55 – 3.99
D	4.00 – 4.49
E	4.50 – 4.99
F	5.00 – 5.59
G	5.60 – 6.29
H	6.30 – 7.09
J	7.10 – 7.99
K	8.00 – 8.99
L	9.00 – 9.99
M	10.00 – 11.19
N	11.20 – 12.49
P	12.50 – 13.99
R	14.00 – 15.99
S	16.00 – 17.99
T	18.00 – 19.99
U	20.00 – 22.39
V	22.40

Note: Code letters apply to motors up to 200 HP.

PRODUCT SUPPORT

PRODUCT SUPPORT DEFINITIONS

Extended Service Coverage (ESC)

Depending on the model and application, Silver, Gold, Platinum and Platinum Plus coverage levels are available from Caterpillar with terms to meet most applications, whether prime or standby.

Platinum and Platinum Plus provide additional allowances for overtime emergency freight, rental, crane and rigging support. Please see the registration contract for details.

Equipment	Coverage Option
New Product	New ESC
Existing Product	Advantage ESC
Overhauls	OPC*

Electric Power ESC reimburses covered parts at customer list price, labor at selling rates and travel and mileage charges (less any deductibles) for covered repairs.

Available worldwide for all Cat® Electric Power Products, ESC provides usual and customary parts and labor costs for covered system failures due to defects in materials and workmanship on components over the duration of the covered period.

This is a brief description of Extended Coverage. See your Cat dealer for more information. The Extended Coverage contract will govern.

*Overhaul Protection Coverage

PRODUCT SUPPORT

CUSTOMER SUPPORT AGREEMENTS

- A **Customer Support Agreement** (CSA) is an arrangement between the end user and the Cat dealer that helps lower the cost per unit of production.
- Agreements are tailored to fit your business needs and can range from simple Preventive Maintenance Kits to sophisticated Total Cost Performance Guarantees.
- Qualified Factory Trained dealer technicians assist you by maintaining your Cat Electric Power Products and driving down operating costs. Perhaps the most important feature of any CSA is flexibility.
- A **Preventive Maintenance** (PM) agreement covers specified maintenance at a fixed cost. You maintain reliability and efficiency because the maintenance is performed by highly skilled technicians at guaranteed costs, giving you the ability to budget more accurately.
- A **Total Maintenance and Repair** (TM&R) agreement covers all of the maintenance and repair costs. Instead of paying for maintenance or repairs as they are needed, you pay one flat rate to cover a broad range of parts and services.

Check with your local Cat dealer for available options with each agreement.

PRODUCT SUPPORT

CUSTOMER SUPPORT AGREEMENTS

	PM	TM&R
Detailed inspections by highly skilled technicians	✔	✔
Scheduled maintenance	✔	✔
Labor and travel costs	✔	✔
Use of genuine Cat parts, fluids and filters	✔	✔
S•O•S℠ Services and interpretation	✔	✔
Component repairs		✔
All unscheduled repairs, including wear out, with no exclusions, limitations or deductibles		✔

For additional information or to find your nearest dealer go to:

www.catelectricpowerinfo.com

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