

# ELECTRIC POWER RATINGS GUIDE

Generator Sets



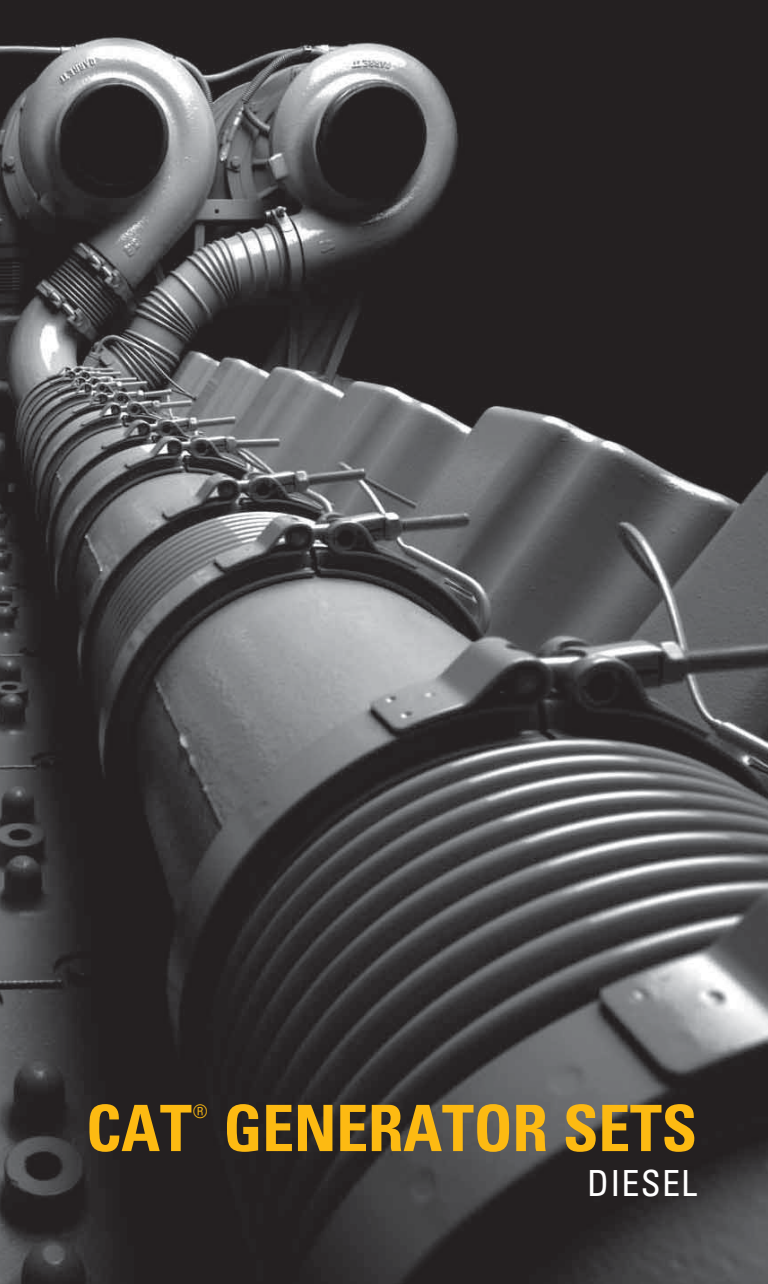


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# CAT<sup>®</sup> GENERATOR SETS

DIESEL

# DIESEL

50 Hz

## CAT® 50 Hz DIESEL RATINGS, 275 kVA - 3100 kVA

kVA			Generator Set Model	Configuration
Standby	Prime	Continuous		
<b>1500 rpm</b>				
300	275	–	3406C	Low BSFC
350	320	–	3406C	Low BSFC
400	365	–	3406C	Low BSFC
400	365	–	C15 ACERT™	EU Stage II, Low BSFC
450	410	–	C15 ACERT	EU Stage II, Low BSFC
500	455	–	C15 ACERT	EU Stage II, Low BSFC
550	500	–	C15 ACERT	EU Stage II, Low BSFC
600	545	–	C18 ACERT	Low BSFC
605	550	–	C18 ACERT	EU Stage II
650	591	–	C18 ACERT	EU Stage II, Low BSFC
700	635	–	C18 ACERT	Low BSFC
750	680	–	3412C	Low BSFC
800	725	–	3412C	Low BSFC
900	810	–	3412C	Low BSFC
1100	1000	910	C32 ACERT	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

\*Rating does not include package mounted radiator

## CAT 50 Hz DIESEL RATINGS, 2200 kVA - 17463 kVA

Standby	kVA		Generator Set Model	Configuration
	Prime	Continuous		
<b>1000 rpm</b>				
2688	2425	2200	3606	Low BSFC
3575	3250	2938	3608	Low BSFC
5375	4850	4400	3612	Low BSFC
7150	6500	5875	3616	Low BSFC
<b>750 rpm</b>				
2163	1963	1775	3606	Low BSFC
2863	2600	2363	3608	Low BSFC
4325	3925	3550	3612	Low BSFC
5725	5200	4725	3616	Low BSFC
–	–	6988	12CM32	Low BSFC
–	–	9313	16CM32	Low BSFC
<b>600 rpm</b>				
–	–	3456	6CM32	Low BSFC
–	–	4656	8CM32	Low BSFC
–	–	5238	9CM32	Low BSFC
<b>500 rpm</b>				
–	–	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, 12 ekW - 175 ekW

Available only for North America

ekW		Generator Set		Configuration
Standby	Prime	Model	Engine	
<b>Single Phase Output* 1800 rpm</b>				
12.1	11.2	D13S	C1.5	EPA Tier 4 Interim
18	17	D20S	C2.2	EPA Tier 4 Interim
21.2	20	D25S	C2.2	EPA Tier 4 Interim
23.3	22	D30S	C2.2	EPA Tier 4 Interim
36	34	D40S	C4.4	EPA Tier 3
37.1	35	D50S	C4.4	EPA Tier 3
46.6	44	D60S	C4.4	EPA Tier 3
60.4	57	D80S	C4.4	EPA Tier 3
77.3	73	D100S	C4.4	EPA Tier 3
<b>3-Phase Output** 1800 rpm</b>				
13	12	D13	C1.5	EPA Tier 4 Interim
18	16	D18	C2.2	EPA Tier 4 Interim
20	18	D20	C2.2	EPA Tier 4 Interim
25	22	D25	C2.2	EPA Tier 4 Interim
30	27	D30	C2.2	EPA Tier 4 Interim
40	36	D40	C4.4	EPA Tier 3
50	45	D50	C4.4	EPA Tier 3
60	55	D60	C4.4	EPA Tier 3
80	72	D80	C4.4	EPA Tier 3
100	90	D100	C4.4	EPA Tier 3
125	114	D125	C6.6	EPA Stationary Emergency
150	136	D150	C6.6	EPA ESE
175	158	D175	C6.6	EPA ESE

\*All ratings at 1.0 pf    \*\*All ratings at 0.8 pf

## CAT 60 Hz DIESEL RATINGS, 180 ekW - 250 ekW

ekW			Generator Set Model	Configuration
Standby	Prime	Continuous		
<b>1800 rpm</b>				
200	180	–	C9 ACERT™	EPA ESE
230	210	–	3306B	Low BSFC
250	225	–	3306B	Low BSFC
250	225	–	C9 ACERT™	EPA ESE

# DIESEL

60 Hz

## CAT 60 Hz DIESEL RATINGS, 275 ekW - 3100 ekW

Standby	ekW		Generator Set Model	Configuration
	Prime	Continuous		
<b>1800 rpm</b>				
300	275	–	C9 ACERT™	EPA ESE
300	275	–	3406C	Low BSFC
350	320	–	3406C	Low BSFC
350	320	–	C15 ACERT	EPA ESE, Low BSFC
400	365	–	3406C	Low BSFC
400	365	–	C15 ACERT	EPA ESE, Low BSFC
450	410	–	C15 ACERT	EPA, Low BSFC
500	455	–	C15 ACERT	EPA Tier 4 Interim, Low BSFC
550 (ESP)	–	–	C15 ACERT	EPA, Low BSFC
550	500	–	C18 ACERT	EPA, Low BSFC
600	545	–	C18 ACERT	EPA, Low BSFC
650	591	–	C27 ACERT	EPA, Low BSFC
700	635	–	C27 ACERT	EPA, Low BSFC
750	680	–	C27 ACERT	EPA, Low BSFC
800	725	–	C27 ACERT	EPA Tier 4 Interim, ESE, Low BSFC
1000	910	830	C32 ACERT	EPA, Low BSFC
650	591	–	3412C	Low BSFC
700	635	–	3412C	Low BSFC
750	680	–	3412C	Low BSFC
800	725	–	3412C	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	EPA ESE
1750	1600	1450	3516	Low BSFC
2000	1825	1640	3516B	Low BSFC, Low Emissions
2000	1825	1650	3516C	EPA ESE
2250	–	–	3516B	Low BSFC
2500	2250	2050	3516C-HD	EPA ESE
3000	2725	2500	C175-16	Low BSFC, EPA ESE
3100*	2825*	2600*	C175-16	Low BSFC, EPA ESE

(ESP) Emergency Standby Rating

\*Rating does not include package mounted radiator

# DIESEL

60 Hz

## CAT 60 Hz DIESEL RATINGS, 1650 ekW - 13970 ekW

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

# DIESEL

## RENTAL POWER RATINGS

### CAT 60 Hz RENTAL POWER RATINGS, 18 ekW - 2000 ekW

Standby	ekW		Rental Generator Model	Configuration
	Prime	Continuous		
<b>1800 rpm</b>				
20	18	–	XQ20	EPA Tier 4 Interim
30	27	–	XQ30	EPA Tier 4 Interim
45	41	–	XQ45	EPA Tier 3
60	54	–	XQ60	EPA Tier 3
80	70	–	XQ80	EPA Tier 3
100	90	–	XQ100	EPA Tier 3
175	158	–	XQ175	EPA Tier 3*
230*	210	–	XQ230	EPA Tier 3
300*	275	–	XQ300	EPA Tier 3
400*	365	–	XQ400	EPA Tier 3
500	455	–	XQ500	Tier 4
800	725	–	XQ800	Tier 4
1000*	910	–	XQ1000	EPA Tier 2*
–	–	1250	XQ1250G	EPA NSPS SI Capable

\*Subject to availability

# 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 in accordance with ISO8528. Fuel stop power in accordance with ISO3046.

#### **Standby Power**

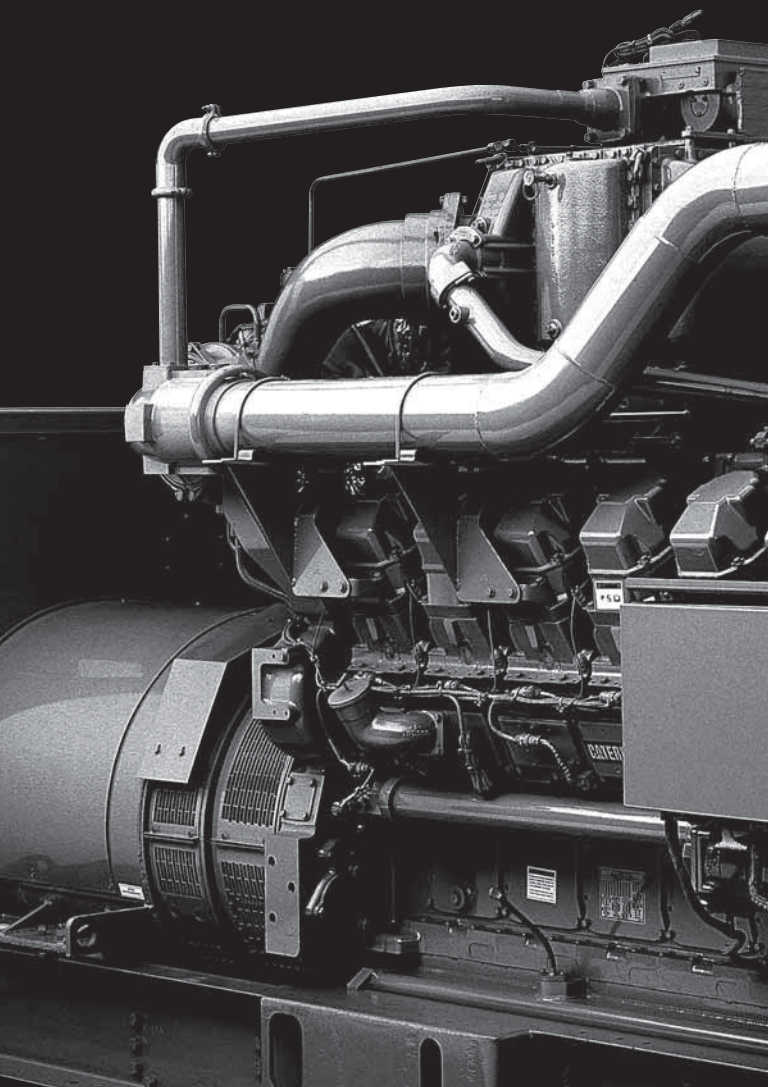
Output available with varying load for the duration of the interruption of the normal source power. Average power output is 70% of the standby power rating. Typical operation is 200 hours per year, with maximum expected usage of 500 hours per year. Fuel stop power in accordance with ISO3046.

### **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 kW with 10% of overload capability for emergency use for a maximum of 1 hour in 12. Overload operation cannot exceed 25 hours per year. Prime power in accordance with ISO8528. Fuel stop power in accordance with ISO3046.

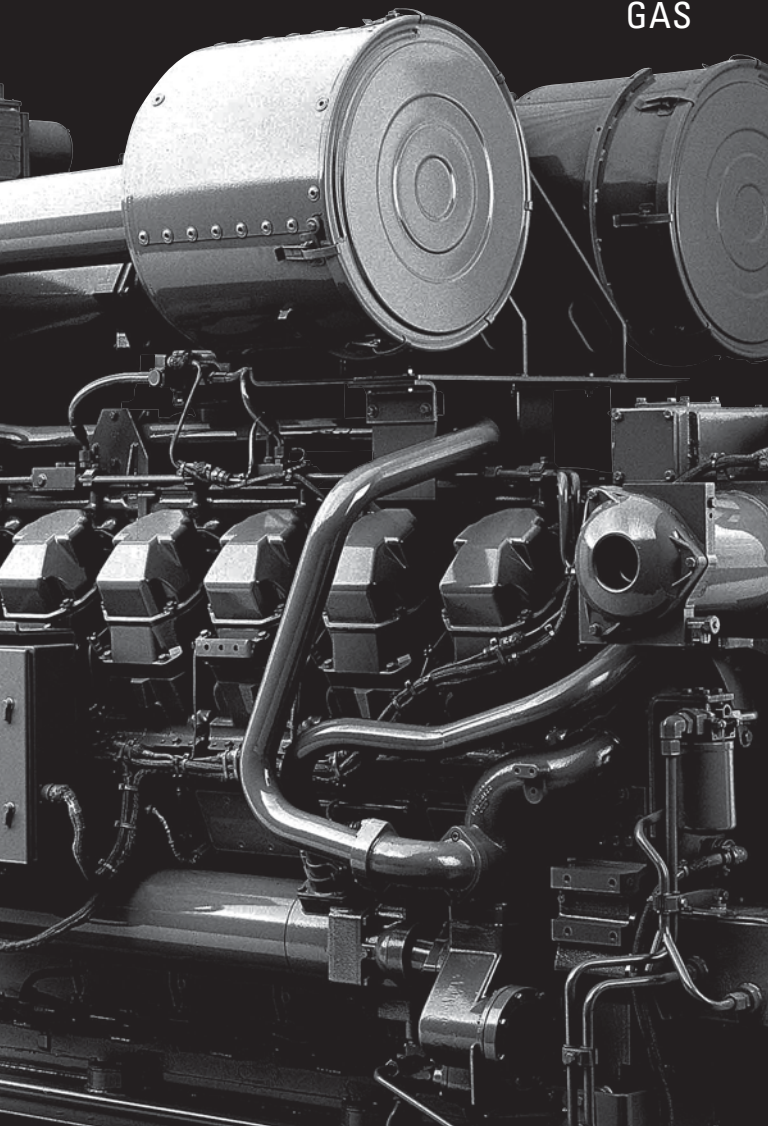
### **Continuous Power**

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 kW for 100% of operating hours. Continuous power is in accordance with ISO8528. Fuel stop power in accordance with ISO3046.



# CAT GENERATOR SETS

GAS



# GAS

50 Hz

## CAT 50 Hz CONTINUOUS GAS RATINGS, 66 kW - 6520 kW

kW 720 rpm	kW 1000 rpm	kW 1500 rpm	Natural Gas	Propane	Low Energy Gas
–	–	66	–	–	G3306 NA
–	–	70	G3306 NA	–	–
–	–	85	G3306 NA	–	–
–	–	106	–	–	G3406 NA
–	–	110	G3306 TA	–	–
–	–	125	G3406 NA	–	–
–	–	160	G3406 TA	–	–
–	–	172	–	–	G3412 NA
–	–	280	G3412 TA	–	–
–	–	360	G3412 LE	–	–
–	–	480	G3508 LE	G3508 LE	–
–	–	725	G3512 LE	G3512 LE	–
–	–	765	G3512 LE	–	–
–	–	975	G3516 LE	G3516 LE	–
–	–	1000	G3512E LE	–	–
–	–	1030	–	–	G3516 LE
–	–	1085	G3516B LE	–	–
–	–	1100	–	–	G3516 LE*,***
–	–	1200	G3512E LE	–	–
–	–	1589	G3516C LE	–	–
–	–	1600	G3516E LE*	–	–
–	1715	–	G3608 LE	–	–
–	–	1950	G3520C LE	–	–
–	–	1966	G3520C LE	–	G3520C LE
–	–	2000	G3520C LE	–	–
–	–	2022	G3520E LE	–	–
–	2575	–	G3612 LE	–	–
–	3425	–	G3616 LE	–	–
6520	–	–	G16CM34 LE	–	–

\*43°C SCAC

\*\*\*Design To Order Rating

## CAT 60 Hz STANDBY GAS RATINGS, 185 kW - 1040 kW

<b>kW 1800 rpm</b>	<b>Natural Gas</b>	<b>Propane</b>	<b>Low Energy Gas</b>
185		G3406 TA**	-
235	G3406 TA**	-	-
430	G3412 TA**	-	-
450	G3412 TA	-	-
1040	G3516 LE	-	-

# GAS

60 Hz

## CAT 60 Hz CONTINUOUS GAS RATINGS, 75 kW - 6520 kW

kW 720 rpm	kW 900 rpm	kW 1200 rpm	kW 1800 rpm	Natural Gas	Propane	Low Energy Gas
			75			G3306 NA
			85	G3306 NA		
			100	G3306 NA**	G3306 NA**	
			135	G3306 TA**	G3306 TA**	
			137			G3406 NA
			150	G3406 NA**	G3406 NA**	
			170	G3406 TA**	G3406 TA**	
			190	G3406 TA		
			191			G3412 NA
			250	G3412 NA**	G3412 NA**	
			350	G3412 TA		
		360		G3508 LE	G3508 LE	
		370		G3508 TA**		
			375	G3412C LE		
			375	G3412 TA**		
		375		G3508 LE		
		555		G3512 TA		
		570		G3512 LE		
		750		G3516 TA	G3516 TA	
		770		G3516 LE	G3516 LE	
		815				G3516 LE
		935				G3516 LE*,***
		1300		G3516B LE		
	1540			G3608 LE		
		1600		G3520C LE		G3520C LE
			1660	G3516C LE		
			2009	G3520E LE***		
			2055	G3520C LE		
	2310			G3612 LE		
	3105			G3616 LE		
6520				G16CM34 LE		

\*43°C SCAC

\*\*Available as a Catalyst Rating

\*\*\*Design To Order Rating

### CAT GAS RATING DEFINITIONS

#### **Standby Power**

These ratings are applicable for supplying continuous electrical power (at variable load) in the event of a utility power failure. No overload is permitted on these ratings. Natural gas ratings have been established on natural gas with net calorific Low Heat Value (LHV) of approximately  $35.6 \text{ MJ/N}\cdot\text{m}^3$  ( $905 \text{ Btu/ft}^3$ ) and 80 Cat methane number (MN).

#### **Continuous Power**

Output available without varying load for an unlimited time. Continuous power in accordance with ISO8528, AS2789, and BS5514. Natural gas ratings have been established on natural gas with net calorific Low Heat Value (LHV) of approximately  $35.6 \text{ MJ/N}\cdot\text{m}^3$  ( $905 \text{ Btu/ft}^3$ ) and 80 Cat methane number (MN).

#### **General Notes**

NA = Naturally Aspirated, TA = Turbocharged and Aftercooled,  
LE = Turbocharged and Aftercooled, Lean Burn

All LE and TA Ratings Shown are with  $53^\circ\text{C}$  Aftercooler Temperature unless otherwise noted.

All kW ratings @ 0.8 PF, nominal ambient conditions and tolerances.

Low Energy Ratings for use with  $16.5$  to  $23.6 \text{ MJ/N}\cdot\text{m}^3$  gas ( $420$  to  $600 \text{ Btu/scf}$ ).

Natural Gas Ratings for use with  $31.5$  to  $47.2 \text{ MJ/N}\cdot\text{m}^3$  gas ( $800$  to  $1,200 \text{ Btu/scf}$ ).

CAT



ACK      RESET      EVENT LOG

RUN      AUTO      STOP

F1      F2      F3      F4

CONTROL      AC      ENGINE      MAIN MENU



EMCP 4.4



AUTO

Hz



# 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 CHARGING VOLTAGE		•	•	
BATT CHARGER AC FAILURE		•	•	
EPS SUPPLYING LOAD		•	•	
ENGINE RUNNING		•	•	
ENGINE EMISSIONS SYSTEM FAILURE		•	•	
MOBILE NETWORK STATUS		•	•	

700 4007



# 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 4.3**

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 15 kV

Human Machine Interface (HMI) Controls

Typical applications:

- Emergency Standby

- Utility Paralleling

- Load Management

## **EPIC (Engine Paralleling and Integration Control)**

Generator Set Paralleling Controls (customer supplied electrically operated breaker)

Human Machine Interface (HMI) Controls

Field expandable

Typical applications:

- Emergency Standby

- Utility Paralleling

- Load Management

# SYSTEMS PRODUCTS

## UPS 50 Hz

Output kVA (Single Module)	Output kVA (Parallel Module)	UPS Model	UPS Type	Energy Storage
60-120	120-500	UPSB125	Double Conversion	Battery
160-500	320-4000	UPSB505	Double Conversion	Battery
120-250	–	UPS250i	Line Interactive	Flywheel
250-500	500-3500	UPS500iG	Line Interactive	Flywheel
750-1000	1500-7000	UPS1000iZ	Line Interactive	Flywheel

## 60 Hz

Output kVA (Single Module)	Output kVA (Parallel Module)	UPS Model	UPS Type	Energy Storage
40-130	80-540	UPSB130	Double Conversion	Battery
150-225	300-900	UPSB220	Double Conversion	Battery
150-300	–	UPS300	Line Interactive	Flywheel
300-600	600-4200	UPS600G	Line Interactive	Flywheel
900-1200	1800-8400	UPS1200Z	Line Interactive	Flywheel

## ATS

Amp Rating	Poles	Model	Type
40-4000	2, 3, 4	MX	Contactator
100-1200	2, 3, 4	ATC	Contactator
100-5000	2, 3, 4	ATC	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 PROTECTIVE

OVERHEAT

SPARK 1

SPARK 2

SPARK 3

FAULT SHUTDOWN

FAULT ALARM

00 hr

POWER METER

AC METER

ENGINE METER

LAMP TEST

ALARM CODES

EXIT

SERVICE MODE



STOP

H2

# CONVERSIONS

## FUEL SYSTEM - DIESEL

### Day Tank Sizing

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

x Hours Between Refilling  
+ Reserve Requirement

OR

### Rule of Thumb for tank size with 25% reserve

$$0.056 \times \text{Ave. BHP demand} \times \text{Hours between refills} \times 1.25 = \text{_____ gal.}$$

$$0.27 \times \text{Ave. BKW demand} \times \text{Hours between refills} \times 1.25 = \text{_____ liters.}$$

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

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### 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 - 300kW 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)	$\frac{kW}{.746 \times \text{EFF. (Gen)}}$	$\frac{kW}{.746 \times \text{EFF. (Gen)}}$	$\frac{kW}{.746 \times \text{EFF. (Gen)}}$
kW input when HP known (Motor)	$\frac{HP \times .746}{\text{EFF. (Mot.)}}$	$\frac{HP \times .746}{\text{EFF. (Mot.)}}$	$\frac{HP \times .746}{\text{EFF. (Mot.)}}$
Amperes when HP known	$\frac{HP \times .746}{V \times P.F. \times \text{EFF.}}$	$\frac{HP \times .746}{1.732 \times V \times \text{EFF.} \times P.F.}$	$\frac{HP \times .746}{V \times \text{EFF.}}$
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	$\frac{\text{Poles} \times \text{RPM}}{120}$	$\frac{\text{Poles} \times \text{RPM}}{120}$	
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

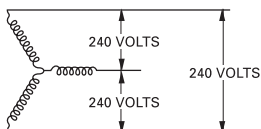
**FL** - full load

**P.F.** - power factor

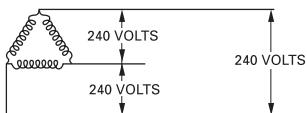
Note: DC kW = DC kVA

# CONVERSIONS

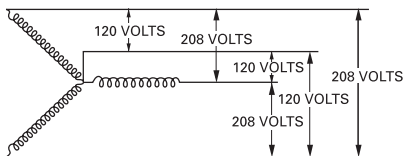
## THREE-PHASE CONNECTION SYSTEMS



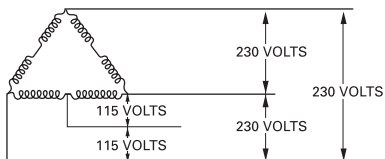
THREE-PHASE, THREE-WIRE (WYE)  
A



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

# CONVERSIONS

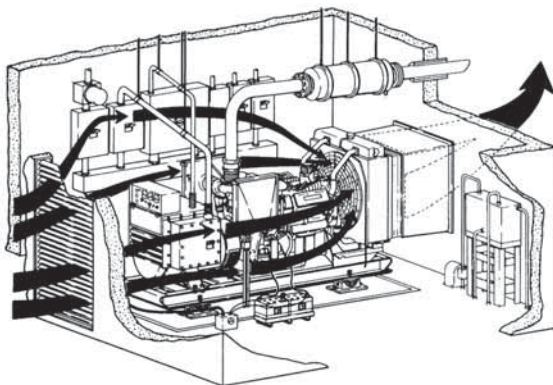
## COMPARISON OF REDUCED VOLTAGE STARTING METHODS

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:

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

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

**V** = Ventilation air (cfm) (m<sup>3</sup>/min).

**H** = Heat radiation (Btu/min) (kW).

**ΔT** = Permissible temperature rise in engine room (°F) (°C).

Density of air at 100°F = 0.070 lb/cu ft (1.099 kg/m<sup>3</sup>).

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	.03937	.003281	.001094	.001	.0000 01	—
in	25.4	1	0.083 33	0.027 78	0.0254	0.000 03	—
ft	304.8	12	1	0.333 33	0.3048	0.000 30	—
yd	914.4	36	3	1	0.9144	0.000 91	—
m	1000	39.3701	3.280 84	1.093 61	1	0.001	0.000 62
km	100 0000	39 370.1	3208.84	1093.61	1000	1	0.621 37
mi	160 9340	63 360	5280	1760	1609.34	1.609 34	1

Area				
Unit	mm <sup>2</sup>	in <sup>2</sup>	m <sup>2</sup>	ft <sup>2</sup>
mm <sup>2</sup>	1	0.00155	—	—
in <sup>2</sup>	645.16	1	0.000 645 16	0.006 944
m <sup>2</sup>	10 00000	1550	1	10.764
ft <sup>2</sup>	92903	144	0.0929	1

1 sq mile = 640 acres  
1 acre = 4840 yd<sup>2</sup>

1 cir mil = 7.854 x 10<sup>-7</sup>in<sup>2</sup>  
1 cir mil = .7854 x mils<sup>2</sup>

1 cir mil = 5.067 x 10<sup>-6</sup>cm<sup>2</sup>

Weight						
Unit	Kilograms	Ounces	Pounds	— Tons —		
		Avoirdupois	Avoirdupois	Short	Long	Metric
1 Kilogram	1	35.27	2.205	—	—	—
1 Ounce	0.02835	1	0.0625	—	—	—
1 Pound	0.4536	16	1	—	—	—
1 Short Ton	907.2	32,000	2,000	1	0.8929	0.9072
1 Long Ton	1,016	35,840	2,240	1.12	1	1.016
1 Metric Ton	1,000	35,300	2,205	1.102	0.9842	1

1 grain = 0.064799 gram

# CONVERSIONS

## CONVERSION FACTORS

Flow					
Unit	U.S. gal/min	million U.S. gal/day	ft <sup>3</sup> /s	m <sup>3</sup> /h	L/s
U.S. gpm	1	0.001 440	0.002 23	0.2270	0.0631
1 million gal/day	694.5	1	1.547	157.73	43.8
ft <sup>3</sup> /s	448.8	0.0646	1	101.9	28.32
m <sup>3</sup> /h	4.403	0.006 34	0.009 81	1	0.2778
L/s	15.85	0.0228	0.0353	3.60	1

MCFD = 1000 ft<sup>3</sup>/day

MMCFD = 1,000,000 ft<sup>3</sup>/day

lb/bhp-hr x 607.73 = g/kW-hr

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	100,000	396.8254	128.5347	94.78169	0.39682	1

1 Therm = 1,000,000 Btu

Btu/ft<sup>2</sup>/min = 0.1220 Watts/in<sup>2</sup>

Btu/ft<sup>3</sup> = 8.899 kg-cal/m<sup>3</sup>

Btu/lb = .5556 kg-cal/kg

# CONVERSIONS

## CONVERSION FACTORS

### Volume and Capacity

Unit	in <sup>3</sup>	ft <sup>3</sup>	yd <sup>3</sup>	mm <sup>3</sup>
in <sup>3</sup>	1	0.000 58	0.000 02	16387.1
ft <sup>3</sup>	1728	1	0.037 04	28 320 000
yd <sup>3</sup>	46656	27	1	764 554 858
mm <sup>3</sup>	6.1 x 10 <sup>-5</sup>	4.0 x 10 <sup>-8</sup>	—	1
m <sup>3</sup>	61 023.7	35.3147	1.307 95	1,000,000,000
U.S.gal	231	0.133 68	0.004 95	3785420
Imp gal	277.419	0.160 54	0.005 95	4540090
liter	61.023 7	0.035 31	0.001 31	1000 000
acre-ft	—	43 560	1613.33	—

1 board-foot = 144 in<sup>3</sup>

1 bushel = 1.244 ft<sup>3</sup>

1 bushel = 4 pecks

### Power

Unit	Btu/min	ft-lb/min	hp
Btu/min	1	778.2	0.02358
ft-lb/min	0.00128	1	0.00003
Horsepower	42.456	33000	1
Joules/min	0.00095	0.7405	0.000223
Metric hp	41.827	32550	0.98632
Kilowatt	59	44250	1.34102
Watt	0.05687	44.25	0.00134

### Pressure and Head

Unit	mm/Hg (0°C)	in./Hg (0°C)	in. H <sub>2</sub> O (60°F)	ft. H <sub>2</sub> O (60°F)
mm/Hg	1	0.039 37	0.5357	0.04464
in./Hg	25.4	1	13.61	1.134
in. H <sub>2</sub> O	1.868 27	0.07 355	1	0.083 33
ft. H <sub>2</sub> O	22.4192	0.882 65	12	1
lb/in <sup>2</sup>	51.7149	2.036 02	27.70	2.309
kg/cm <sup>2</sup>	735.559	28.959	395	32.84
bar	750.062	29.530	401.8	33.49
kPa	7.500 62	0.295 30	4.01835	0.33486

# CONVERSIONS

## CONVERSION FACTORS

<b>m<sup>3</sup></b>	<b>U.S. gal</b>	<b>Imp gal</b>	<b>liter</b>
0.000 02	0.004 32	0.003 61	0.01639
0.028 32	7.480 52	5.228 83	28.3169
0.76455	201.974	168.178	764.555
–	$2.6 \times 10^{-7}$	$2.2 \times 10^{-7}$	$1.0 \times 10^{-6}$
1	264.192	219.969	1000
0.003 78	1	–	3.785 41
0.004 55	1.200 95	1	4.546 09
0.001	0.264 17	0.219 97	1
1233.48	325 851	271 335	–

<b>J/min</b>	<b>Metric hp</b>	<b>kW</b>	<b>W</b>
1055.000	0.02391	0.0175843	17.5843
1.3504	0.00003	0.0000226	0.0226
44791	1.014	0.74570	745.7
1	0.0000226	0.0000166	0.016668
44127	1	0.73549	735.498
59997	1.35962	1	1000
59.9968	0.00136	0.001	1

<b>lb/in<sup>2</sup></b>	<b>kg/cm<sup>2</sup></b>	<b>bar</b>	<b>Atmospheres</b>	
			<b>101.4Pa (14.7 psi)</b>	<b>kPa</b>
0.019 34	0.001 36	0.001 33	0.001 315	–
0.491 15	0.034 53	0.033 86	0.033 42	–
0.036 13	0.002 54	0.002 49	0.002 46	0.249
0.433 52	0.030 479	0.029 89	0.029 50	2.989
1	0.070 31	0.068 95	0.068 05	6.895
14.2257	1	0.980 67	0.967 84	98.067
14.504	1.019 72	1	0.98692	101.325
0.145 038	0.010 1972	0.010 000	0.009 869 20	1

# CONVERSIONS

## CONVERSION FACTORS

### Temperature Conversion

$$^{\circ}\text{F} = (1.8 \times ^{\circ}\text{C}) + 32$$

$$^{\circ}\text{C} = 0.5555 (^{\circ}\text{F} - 32)$$

### Angle

$$1 \text{ quadrant} = 90 \text{ degrees}$$

$$1 \text{ quadrant} = 1.57 \text{ radians}$$

$$1 \text{ radian} = 57.3 \text{ degrees}$$

$$1 \text{ degree} = 60 \text{ minutes}$$

$$1 \text{ minute} = 2.9 \times 10^{-4} \text{ radians}$$

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 engine model and application, Silver, Gold or Platinum and Platinum plus coverage levels are available from Cat Insurance 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.

<b>Equipment</b>	<b>Coverage Option</b>
New engines	New ESC
Used engines	Advantage ESC
Overhauls	OPC*

Electric Power Extended Service Coverage reimburse 100% of the parts at customer list price, labor at selling rates and travel and mileage charges (less any deductibles) for covered repairs.

Available worldwide, Extended Service Coverage (ESC) provides 100% of usual and customary parts and labor costs for system failures due to defects in materials and workmanship on components over the duration of the covered period.

\*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.
- Trained dealer technicians assist you by maintaining your equipment 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 <sup>SM</sup> 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/rg](http://www.catelectricpowerinfo.com/rg)

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