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

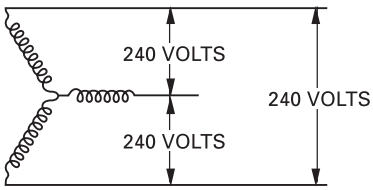
To Obtain	Alternating Current		Direct Current
	Single-Phase	Three-Phase	
kW	$\frac{V \times I \times P.F.}{1000}$	$\frac{1.732 \times V \times I \times P.F.}{1000}$	$\frac{V \times I}{1000}$
kVA	$\frac{V \times I}{1000}$	$\frac{1.732 \times V \times I}{1000}$	
Horsepower required when kW known (Generator)	$\frac{kW}{.746 \times EFF. (Gen)}$	$\frac{kW}{.746 \times EFF. (Gen)}$	$\frac{kW}{.746 \times EFF. (Gen)}$
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:

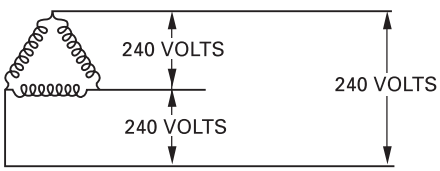
V – voltage in volts
I – current in amperes
kW – power in kilowatts (actual power)
kVA – kilovolt-amperes (apparent power)
HP – horsepower
RPM – revolutions per minute
kVAr – reactive kilovolt-amperes
EFF. – efficiency as a decimal factor
NL – no load
FL – full load
P.F. – power factor
Note: DC kW =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

CONVERSIONS

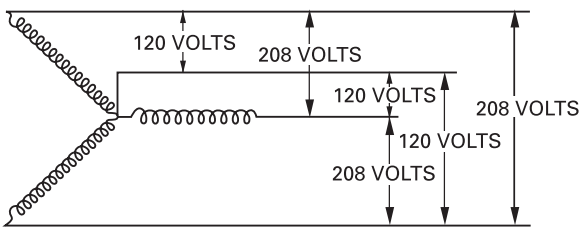
THREE-PHASE CONNECTION SYSTEMS



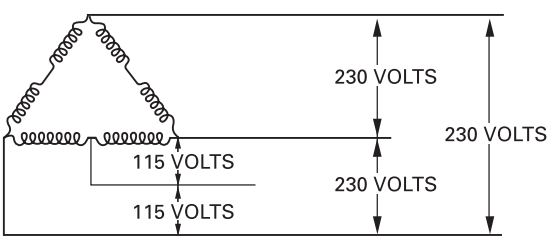
THREE-PHASE, THREE-WIRE (WYE)
A



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

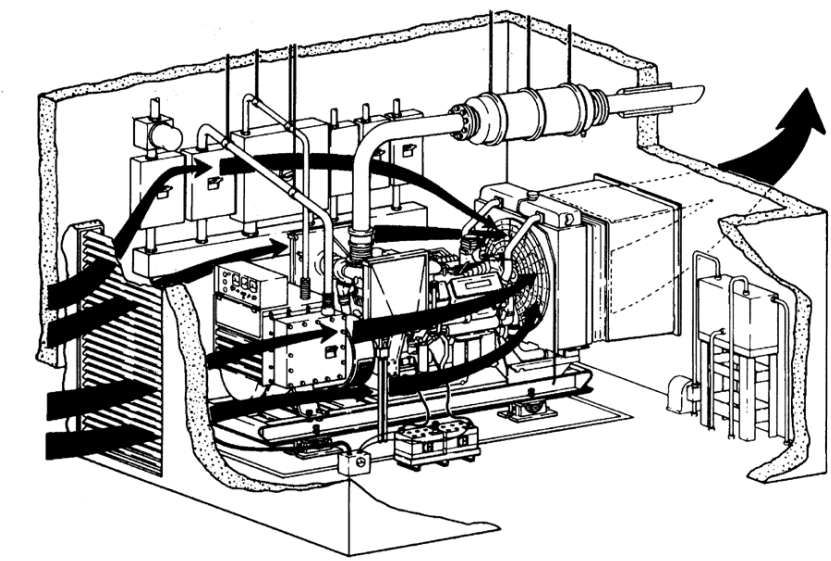
COMPARISON OF REDUCED VOLTAGE STARTING METHODS

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

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

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

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

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^2/min = 0.1220 Watts/in^2

Btu/ft^3 = 8.899 kg-cal/m^3

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
ft^3	1728	1	0.03704	28320000
yd^3	46656	27	1	764554858
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
Imp gal	277.419	0.16054	0.00595	4540090
liter	61.0237	0.03531	0.00131	1000000
acre-ft	–	43560	1613.33	–

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
ft-lb/min	0.00128	1	0.00003
Horsepower	42.456	33000	1
Joules/min	0.00095	0.7405	0.0000223
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_2O (60° F)	ft. H_2O (60° F)
mm/Hg	1	0.03937	0.5357	0.04464
in./Hg	25.4	1	13.61	1.134
in. H_2O	1.86827	0.07355	1	0.08333
ft. H_2O	22.4192	0.88265	12	1
lb/in^2	51.7149	2.03602	27.70	2.309
kg/cm^2	735.559	28.959	395	32.84
bar	750.062	29.530	401.8	33.49
kPa	7.50062	0.29530	4.01835	0.33486

CONVERSIONS

CONVERSION FACTORS

m^3	U.S. gal	Imp gal	liter
0.00002	0.00432	0.00361	0.01639
0.02832	7.48052	5.22883	28.3169
0.76455	201.974	168.178	764.555
–	2.6×10^{-7}	2.2×10^{-7}	1.0×10^{-6}
1	264.192	219.969	1000
0.00378	1	–	3.78541
0.00455	1.20095	1	4.54609
0.001	0.26417	0.21997	1
1233.48	325851	271335	–

J/min	Metric hp	kW	W
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

lb/in^2	kg/cm^2	bar	Atmospheres 101.4Pa (14.7 psi)	kPa
0.01934	0.00136	0.00133	0.001315	–
0.49115	0.03453	0.03386	0.03342	–
0.03613	0.00254	0.00249	0.00246	0.249
0.43352	0.030479	0.02989	0.02950	2.989
1	0.07031	0.06895	0.06805	6.895
14.2257	1	0.98067	0.96784	98.067
14.504	1.01972	1	0.98692	101.325
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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