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Generator sizing guide

Contents

EATON
Powering Business Worldwide

Important notice

This booklet is designed to familiarize estimators and installers with proper sizing guidelines for residential and commercial generators. The information is not comprehensive, nor does it replace or supersede any material contained in any of the written documents shipped with the equipment. This booklet should only be used in conjunction with the Owner's Manual, Installation Manual, and other technical documents shipped with each product. Always read all accompanying documentation carefully before attempting to install any generator, transfer switch, or related equipment.

How to use this booklet

Within this booklet, you will find electrical load information, plus an outline of generator surge capability, fuel pipe sizing, liquid propane tank sizing, and UPS/generator compatibility. The worksheet pages can be removed from the book and photocopied to create additional On-site Estimating Sheets for use with individual jobs.

Safety information

Proper sizing of the generator is crucial to the success of any installation and requires a good working knowledge of electricity and its characteristics, as well as the varying requirements of the electrical equipment comprising the load. When analyzing the electrical load, consult the manufacturer's nameplate on each major appliance or piece of equipment to determine its starting and running requirements in terms of watts, amps, and voltage. When choosing the generator output for commercial or industrial applications, select a rating that is approximately 20 to 25% higher than the peak load (for example, if the load is about 40 kilowatts, select a 50 kW genset). A higher rated generator will operate comfortably at approximately 80% of its full capacity and will provide a margin of flexibility if the load increases in the future.

For safety reasons, Eaton recommends that the backup power system be installed, serviced, and repaired by an Eaton Authorized Service Dealer or a competent, qualified electrician or installation technician who is familiar with applicable codes, standards, and regulations.

It is essential to comply with all regulations established by the Occupational Safety & Health Administration (OSHA) and strict adherence to all local, state, and national codes is mandatory. Before selecting a generator, check for municipal ordinances that may dictate requirements regarding placement of the unit (setback from building and/or lot line), electrical wiring, gas piping, fuel storage (for liquid propane or diesel tanks), sound and exhaust emissions.

If you have a technical question regarding sizing or installation, contact EatonCare's Technical Resource Center toll free at 1-877-386-2273, option 2 during normal business hours (8 a.m. to 4 p.m. CST).

Table 1. Motor load reference

ac and heat pumps		Running load					Starting load				
			Single-phase	Three-phase			Single-phase	Three-phase			
Description	hp	Running kW	Amps at 240 V	Amps at 208 V	Amps at 240 V	Amps at 480 V	LR amps at 240 V	LR amps at 208 V	LR amps at 240 V	LR amps at 480 V	kW
1 ton (12,000 BTU)	1	1	5	3	3	1	33	22	19	10	2.5
2 ton (24,000 BTU)	2	2	10	7	6	3	67	44	38	19	5
3 ton (36,000 BTU)	3	3	15	10	8	4	100	67	58	29	7.5
4 ton (48,000 BTU)	4	4	20	13	11	6	117	78	67	34	10
5 ton (60,000 BTU)	5	5	25	16	14	7	145	97	84	42	12.5
7.5 ton (85,000 BTU)	7.5	7.5	37	24	21	11	219	146	126	63	17
10 ton (120,000 BTU) ①	5 (x2)	10	49	33	28	14	145	97	84	42	12.5
10 ton (120,000 BTU)	10	10	49	33	28	14	250	167	144	72	20
15 ton (180,000 BTU) ①	7.5 (x2)	15	74	49	42	21	219	146	126	63	17
15 ton (180,000 BTU)	15	15	74	49	42	21	375	250	217	108	30
20 ton (240,000 BTU) ①	10 (x2)	20	98	65	57	28	250	167	144	72	20
20 ton (240,000 BTU)	20	20	N/A	65	57	28	500	333	289	144	40
25 ton (300,000 BTU)	25	25	N/A	82	71	35	625	416	361	180	50
30 ton (360,000 BTU) ①	15 (x2)	30	N/A	98	85	42	375	250	217	108	30
30 ton (360,000 BTU)	30	30	N/A	98	85	42	750	500	433	217	60
40 ton (480,000 BTU) ①	20 (x2)	40	N/A	131	113	57	500	333	289	144	40
40 ton (480,000 BTU)	40	40	N/A	131	113	57	1000	666	577	289	80
50 ton (480,000 BTU) ①	25 (x2)	50	N/A	163	142	71	625	416	361	180	50
50 ton (480,000 BTU)	50	50	N/A	163	142	71	1250	833	722	361	100

General residential							
			Single-phase		Single-phase		
Description	hp	Running kW	Amps at 120 V	4.9 amps at 240 V	LR amps at 240 V	LR amps at 120 V	kW
Refrigerator pump, sump, furnace, garage opener	0.5	0.5	4.9	2.5	13	25	1.5
Freezer, washer, septic grinder	0.75	0.75	7.4	3.7	19	38	2.3
General 1 hp	1	1	9.8	4.9	25	50	3
Well and septic lift pump	2	2	19.6	9.8	50	100	6

① For multiple motor configurations, sequence starting is assumed.

⚠ CAUTION

DO NOT SIZE THE GENERATOR BASED ON STARTING KW ALONE.YOU MUST COMPARE LR AMPS TO GENERATOR SURGE CAPABILITY (TABLE 3). SIZE THE GENERATOR BY FOLLOWING THE SIZING INSTRUCTIONS.

Table 2. Non-motor load reference

Residential			
	Running load ①		
		Single-phase	
Description	Running kW	Amps at 120 V	Amps at 240 V
Electric heat per 1000 ft^2	12	N/A	50
Heat pump elements per 1000 ft^2	7	N/A	29
Dryer	5.5	N/A	23
Hot tub	10	N/A	50
Range oven/stove top per burner	8	N/A	30
Hot water	4.5	N/A	19
General lighting and receptacles per 1000 ft^2	3	24.9	N/A
Blow dryer	1.25	10.4	N/A
Dishwasher	1.5	12.5	N/A
Microwave	1	8.3	N/A
Toasters	1	8.3	N/A
Home entertainment center	1	8.3	N/A
Computer	1	8.3	N/A
Kitchen	1.5	12.5	N/A
Laundry	1.5	12.5	N/A
Commercial			
Please refer to equipment data plate and/or billing history for commercial details.			

① Always check data plate for actual running amps.

Table 3. Surge capability

Generators (operating at less than 3600 RPM)

	Rated output (running amps)				Commercial (LR amps at 15% voltage dip)				Residential (LR amps at 30% voltage dip)			
	Single-phase		Three-phase		Single-phase		Three-phase		Single-phase		Three-phase	
Size (kW)	240 V	208 V	240 V	480 V	240 V	208 V	240 V	480 V	240 V	208 V	240 V	480 V
22	92	76	N/A	N/A	71	48	N/A	N/A	134	92	N/A	N/A
25	104	87	75	38	71	48	46	30	138	92	91	59
27	113	94	81	41	100	67	58	33	153	137	118	64
30	125	104	90	45	100	67	65	43	205	137	130	87
35	146	121	105	52	113	75	60	43	225	150	118	87
36	150	125	108	54	113	75	65	44	225	151	131	87
40	167	139	120	60	129	86	75	49	254	169	147	97
45	188	156	135	68	146	98	94	57	292	195	168	112
48	200	167	144	72	163	109	94	57	321	214	185	112
70	292	243	210	105	275	164	159	95	550	330	318	190
80	333	278	240	120	275	183	159	106	550	366	318	212
100	417	347	300	150	369	222	214	128	738	441	426	255
130	542	451	390	195	546	364	315	209	1088	724	628	419
Generators (operating at 3600 RPM)												
7	29	N/A	N/A	N/A	23	N/A	N/A	N/A	46	N/A	N/A	N/A
8	33	N/A	N/A	N/A	26	N/A	N/A	N/A	51	N/A	N/A	N/A
10	42	N/A	N/A	N/A	31	N/A	N/A	N/A	63	N/A	N/A	N/A
13	54	N/A	N/A	N/A	48	N/A	N/A	N/A	95	N/A	N/A	N/A
14	58	N/A	N/A	N/A	52	N/A	N/A	N/A	102	N/A	N/A	N/A
16	67	N/A	N/A	N/A	59	N/A	N/A	N/A	117	N/A	N/A	N/A
17	71	N/A	N/A	N/A	63	N/A	N/A	N/A	125	N/A	N/A	N/A
18	75	N/A	N/A	N/A	67	N/A	N/A	N/A	133	N/A	N/A	N/A
20	83	N/A	N/A	N/A	73	N/A	N/A	N/A	145	N/A	N/A	N/A
25	104	87	75	38	71	48	46	30	138	92	91	60
30	125	104	90	45	100	67	60	43	205	137	130	87
35	146	121	105	52	113	75	60	43	225	150	118	87
45	188	156	135	68	146	98	94	57	292	195	168	112
60	250	208	180	90	179	120	103	69	350	234	204	136
70	292	243	210	105	275	164	142	95	550	330	286	190
80	333	278	240	120	275	183	158	106	550	366	318	212
100	417	347	300	150	369	222	214	128	738	441	426	255
150	625	520	451	226	558	372	322	215	1121	747	647	431

Note: All nominal ratings based upon LP fuel. Refer to specification sheet for NG ratings and deration adjustments for ambient temperature and altitude.

Table 4. Fuel pipe sizing

Natural gas (values are maximum pipe run in ft)

kW	Pipe size (in inches)						
	0.75	1	1.25	1.5	2	2.5	3
7–8	55	200	820				
10	20	85	370	800			
13–14	10	50	245	545			
16–17		40	190	425			
20		20	130	305	945		
22		15	115	260	799		
25		10	95	220	739		
27			85	203	552		
30			60	147	565		
35–36			35	95	370	915	
40			25	75	315	790	
45			15	60	260	650	
48				50	230	585	
50				50	220	560	
60				25	145	390	1185
70				5	75	225	710
80					65	195	630
100					40	140	460
130						50	215
150						30	150

LP vapor (values are maximum pipe run in ft)

kW	Pipe size (in inches)						
	0.75	1	1.25	1.5	2	2.5	3
7–8	165	570					
10	70	255	1000				
13–14	45	170	690				
16–17	25	130	540				
20	15	115	480				
22		85	365				
25		60	275	605			
27		55	260	575			
30		40	195	435			
35–36		20	125	290	1030		
40		15	107	250	890		
45			82	195	725		
48			70	165	620		
50			70	160	610		
60			45	115	445	1095	
70			20	60	260	660	
80			15	50	230	590	
100				30	165	430	1305
130					70	205	660
150					45	150	490

LP

- LPG: 8.55 ft^3/lb, 4.24 lb/gal, 2500 btu/ft^3
- LPG: 36.3 ft^3 = 1 gal

Natural gas

- 1 cubic foot = 1,000 BTU
- 1 therm = 100,000 BTU
- Gas consumption = 13,000–16,000 BTU per kW/hr

Pressure

- 1 inch mercury = 13.61 inches water column
- 1 inch water column = 0.036 psi
- 5–14 inches water column = 0.18 psi to 0.50 psi

Note:

- Pipe sizing is based on 0.5 in H_2O pressure drop
- Sizing includes a nominal number of elbows and tees
- Please verify adequate service and meter sizing

Table 5. LP vapor (LPV) tank sizing

Vapor withdrawal (dimensions are given in inches)

Tank capacity total (gal)	Tank capacity useable (gal)	Minimum temp (°F)	Tank capacity (btu/hr)	Length	Diameter	Overall height
120	72	40 20 0	246,240 164,160 82,080	57	24	33
150	90	40 20 0	293,760 195,840 97,920	68	24	33
250	150	40 20 0	507,600 338,400 169,200	94	30	39
325	195	40 20 0	642,600 428,400 214,200	119	30	39
500	300	40 20 0	792,540 528,360 264,180	119	37	46
850	510	40 20 0	1,217,700 811,800 405,900	165	41	50
1000	600	40 20 0	1,416,960 944,640 472,320	192	41	50

Load (kW)	BTU/hr	LP gal/hr	NG ft³/hr	NG therms/hr
5	110,000	1.2	110	1.1
10	176,400	2	156	1.6
15	231,800	2.5	220	2.2
20	267,100	2.8	262	2.6
25	352,800	3.8	316	3.2
30	418,300	4.5	417	4.2
35	467,400	5.1	485	4.8
40	550,000	6.1	550	5.5
50	675,000	7.5	675	6.7
60	836,600	9	862	8.6
70	1,035,700	11	1,020	10.2
80	1,170,000	12.7	1,154	11.5
90	1,200,000	13	1,200	12.0
100	1,280,000	13.8	1,260	12.6
110	1,550,000	17.1	1,550	15.5
120	1,675,000	18.5	1,675	16.7
130	1,800,000	19.5	1,786	17.8
140	1,925,000	21.3	1,925	19.2
150	2,050,000	22.7	2,050	20.5
200	2,800,000	30.9	2,800	28.0
300	4,100,000	45.3	4,100	49.0

Note: Operating cost per hour = NG therms/hr x cost of NG therms.

Gas required for common appliances

Appliance	Approximate input (btu/hr)
Warm air furnace	
Single family	100,000
Multifamily, per unit	60,000
Hydronic boiler, space heating	
Single family	100,000
Multifamily, per unit	60,000
Hydronic boiler, space and water heating	
Single family	120,000
Multifamily, per unit	75,000
Range, free standing, domestic	65,000
Built-in oven or broiler unit, domestic	25,000
Built-in top unit, domestic	40,000
Water heater, automatic storage, 30 to 40 gal. tank	35,000
Water heater, automatic storage, 50 gal. tank	50,000
Water healer, automatic storage, instantaneous	
2 gpm	142,800
4 gpm	285,000
6 gpm	428,000
Water heater, domestic, circulating or side-arm	35,000
Refrigerator	3,000
Clothes dryer, Type 1 (domestic)	35,000
Gas fireplace direct vent	40,000
Gas log	80,000
Barbecue	40,000
Gas light	2,500
Incinerator, domestic	35,000

Note: Tank BTU capacity and generator run times based upon maintaining a minimum tank fuel level of 20%. Tanks are typically filled to 80% full. Typical fuel consumption based on a generator 100% loaded.

UPS—generator compatibility

Passive (also referenced as standby or offline) and line-interactive

These technologies are most common for personal workstations and point-of-sale applications. They are typically single-phase equipment with size ranges of 350–2000 VA for passive and 500 VA to 5000 VA for line-interactive.

Passive UPSs are the simplest type. Under normal conditions, ac power passes straight through to the UPS load. When the input power supply goes outside of specifications, the UPS transfers the load from input power to the internal dc to ac power inverter. Passive UPSs do not correct for voltage or frequency deviations under "normal" operation.

Line-interactive is similar to the passive technology except it has circuitry that attempts to correct for standard voltage deviations. Frequency deviations under "normal" power operation are not corrected.

Equipment notes

These devices tend to be electrically/harmonically very noisy. A single small UPS is not a significant concern, but applications with multiple UPSs can be problematic.

Passive UPS technology typically has normal tolerances of 10–25% on voltage and 3 Hz on frequency. If the input source goes outside of these tolerances, the UPS will switch onto the UPS battery source. Some line-interactive units may have frequency tolerances factory set to 0.5 Hz. These units will need to have their frequency tolerance increased to a minimum of 2 Hz.

Generator sizing recommendation

- Limit the total UPS loading to 15%–20% of the generator capacity

Double-conversion

This technology is most common for critical load applications. Double-conversion UPSs constantly rectify ac to dc and then invert the dc back into ac. This configuration results in an output that corrects for voltage and frequency deviations.

There are single- and three-phase models covering small to large applications. Most UPS applications larger than 5000 VA use double-conversion technology. This approach is also the preferred technology for generator applications.

Equipment notes

Double-conversion UPSs that are single-phase or unfiltered three-phase models tend to create a significant level of electrical/harmonic noise. This is illustrated by harmonic current distortions that are greater than 35%. Minuteman UPS products could have current distortion of 8%. When three-phase models are supplied with harmonic filters (current distortion less than 10%), this concern is no longer an issue.

Generator sizing recommendations

- Single-phase models: Limit the total UPS loading to 25% of the generator capacity
- Single-phase Minuteman UPS models: Limit the total UPS loading to 50% of the generator capacity
- Three-phase models without filters (current distortion > 30%): Limit the UPS loading to 35% of the generator capacity
- Three-phase models with filters (current distortion < 10%): Limit the UPS loading to 80% of the generator capacity

Supplier(s)	Passive (standby)	Line-interactive	Double-conversion
Powerware	3000 series	5000 series	9000 series
Minuteman UPS	Enspire	Enterprise Plus	Endeavor
APC	Back-UPS Series	Smart-UPS Series	Symmetra Series
Liebert	PowerSure PST & PSP	PowerSure PSA & PSI	UPStation & Nfinity

Table 6. Online estimating sheet

Contractor: _____ Email: _____

Phone: (___) _____ Fax: (___) _____

Job name: _____

Date: ___/ ___/ _____ Location: _____

Voltage ☐ 120/240 1 Ø ☐ 120/208 3 Ø ☐ 120/240 3 Ø ☐ 277/480 3 Ø

Type ☐ Natural gas ☐ LP vapor (LPV)

Electric service ☐ 100 amp ☐ 200 amp ☐ 400 amp ☐ 600 amp ☐ Other: _____

Note: Before installation, contact local jurisdiction to confirm all requirements are met. Jurisdictions may vary. Eaton recommends contacting local authorities prior to installation.

Loads: Look for heavy building loads such as refrigeration, air conditioning, pumps or UPS systems.

Motor load table (refer to Table 1) Use the following for sizing and determining generator kW.

Device	hp	RA	LRA	kW running (= hp)	Starting kW

- Starting kW for hp < 7.5 starting kW = hp x 3
- Starting kW for hp > 7.5 starting kW = hp x 2
- Starting kW for loading with no listed hp, calculate hp based on running amps in the chart on the right

Non-motor load table (refer to Table 2)
Use the following for sizing and determining generator kW.

Device	Amps	kW

Install notes

- Suggested concrete pad minimum thickness of 4 inches with 6 inches overhang on all sides. Composite pad included with air-cooled products
- Consult manual for installation recommendations
- Consult local authority having jurisdiction for local requirements

Transfer switch availability

Single-phase ①	Amps
Service Entrance	100, 200, 400, 600, 800
Non-Service Entrance	50, 100, 200, 400, 600, 800
Three-phase	
Service Entrance	100, 225, 300, 400, 600, 800
Non-Service Entrance	100, 200, 300, 400, 600, 800

① Single-phase ATSs from 100 to 400 amps have intelligent load management standard.

To calculate kW

120 V, single-phase	Amps x 120/1000 = kW
240 V, single-phase	Amps x 240/1000 = kW
208 V, three-phase	(Amps x 208 x 1.732 x PF) /1000 = kW
240 V, three-phase	(Amps x 240 x 1.732 x PF) /1000 = kW
480 V, three-phase	(Amps x 480 x 1.732 x PF) /1000 = kW

Recommended generator size

Refer to "Generator sizing instructions" on other side of this sheet.

Applications

The QT Series does not meet the necessary requirements for the following applications:

- NEC 695 fire pumps
- NEC 700 emergency systems
- NFPA 20 fire pumps
- NFPA 99 healthcare
- NFPA 110 emergency systems

Reference codes

Related codes and standards:

- NEC 225 branch circuits and feeders
- NEC 240 overcurrent protection
- NEC 250 grounding
- NEC 445 generators
- NEC 700 Emergency Systems
- NEC 701 legally required standby
- NEC 702 optional standby
- NFPA 37 installation and use of stationary engines
- NFPA 54 national fuel gas code
- NFPA 58LP gas code

On-site estimating sheet

Generator sizing instructions

There is not a single correct sizing solution. Following are several methods that, when mixed with good judgement, should result in an appropriately sized generator. Remember to consider load growth, seasonality, and effects of starting motors.

Always check with the local inspection department to confirm which NEC code cycle will affect your install.

Never add amps when sizing a generator. Convert amps to kW and add kW to determine the required generator size. Power factors for various motor loads vary widely. Adding amps without properly accounting for the power factor and/or mixing voltages will result in improperly sizing the generator.

When motors start, they create a current surge that step loads the generator and creates a voltage dip. After selecting a generator, reference the generator's surge capability using **Table 3**. Verify that voltage dip is adequate for the application. Most commercial applications should be limited to about 15% voltage dip and residential applications should be limited to a 30% voltage dip. Some applications utilize an uninterruptible power supply (UPS) to back up critical loads. Please read sizing guide for this load type.

Measurement method

Use a clamp-on amp meter or power analyzer to measure facility load levels. Clamp each leg separately and take the measurement during peak usage levels.

240 V, single-phase applications: To determine peak usage in kW, add the highest amp readings from the two legs, multiply by 120 and divide by 1000.

(L1 + L2)120 / 1000

Size the generator 10 to 20% larger than the peak measured load.

Three-phase applications: Add the peak amp readings from all three legs and divide by 3 to determine peak amps. Multiply peak amps by volts, multiply the result by 1.732 (square root of 3), and then divide by 1000 to convert amps to kW.

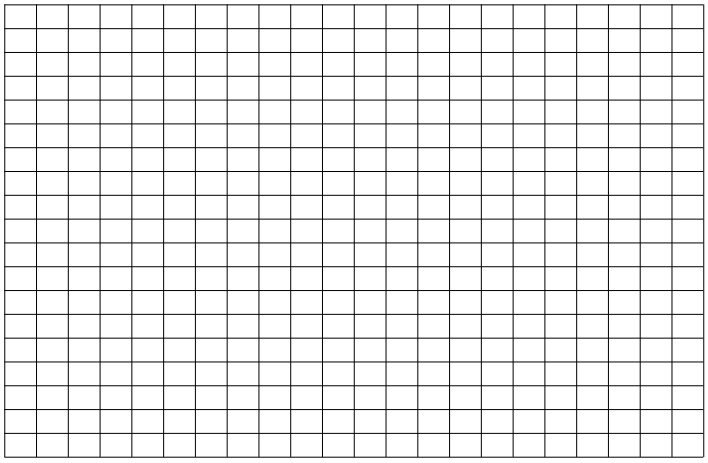
Peak Amps = (L1 + L2 + L3) / 3
kW = [(Peak Amps x Volts) x 1.732] / 1000 ①

① Assumes power factor of 1.0

Size the generator 20 to 25% larger than the peak measured load.

Peak Amps = _____ Peak kW= _____

Project layout



Billing history method commercial

Many commercial customers have a utility rate structure that has a peak demand charge. Using a year's worth of electric bills, size the generator 25% larger than the largest peak demand.

Verify motor and UPS load compatibility: Peak Demand = _____

Load summation method

- Enter running kW for all motor loads (except the largest) expected to run during peak load levels into **Table 6**. Refer to **Table 1** for typical motor load sizes and electrical requirements.
- Enter kW for all non-motor loads expected to run during peak load levels into **Table 2**. Refer to **Table 2** for typical residential loads and rules of thumb.
- Add the running motor load kW, non-motor load kW, and the starting kW of the largest motor load.

Motor load running total (minus largest motor): _____ kW
(ref. **Table 6**)

Non-motor load total: (ref. **Table 2**): _____ kW

Starting load from largest cycling motor:: _____ kW
(ref. **Table 6**)

Total electrical loads: = _____ kW

Select generator: Commercial (add 20 to 25% to total kW)
Residential (add 10 to 20% to total kW)

- Confirm that voltage dip is within acceptable limits by comparing motor LRA to generator surge capability (see **Table 3**)
- Confirm UPS compatibility (see **Table 4**)

Ball park estimates (do not use for final sizing)

Estimate based on 60% service size: (commercial)

240 V, single-phase: _____ Amps x 0.15 = _____ kW
208 V, three-phase: _____ Amps x 0.22 = _____ kW
240 V, three-phase: _____ Amps x 0.25 = _____ kW
480 V, three-phase: _____ Amps x 0.50 = _____ kW

Estimate based on 40% service size: (residential)

240 V, single-phase: _____ Amps x 0.10 = _____ kW
208 V, three-phase: _____ Amps x 0.15 = _____ kW
240 V, three-phase: _____ Amps x 0.17 = _____ kW
480 V, three-phase: _____ Amps x 0.34 = _____ kW

Estimate based on square footage

Fast food, convenience stores, restaurants, grocery stores	kW = 50 kW + 10 watts/sq ft
Other commercial applications	kW = 30 kW + 5 watts/sq ft
Square footage = _____	Estimated kW = _____

Amps to kW rule-of-thumb (assumes .8 pf)

For 480 V	Amps = kW x 1.5
For 208 V	Amps = kW x 3.5
For 240 V, three-phase systems	Amps = kW x 3
For 240 V, single-phase systems	Amps = kW x 4

Typical single-phase generator/transfer switch combinations

Air-cooled generators		Liquid-cooled generators	
kW	**Transfer switch**	**kW**	**Transfer switch**
9	EGSX50L12 EGSX50L12R EGSX100A EGSX100NSEA EGSX100L24RA EGSU100ACA EGSU100NSEACA EGSU100L24RACA	22	EGSX150NSEA EGSX200A EGSX200NSEA EGSU150NSEACA EGSU200ACA EGSU200NSEACA
11	EGSX50L12 EGSX50L12R EGSX100A EGSX100NSEA EGSX100L24RA EGSU100ACA EGSU100NSEACA EGSU100L24RACA	25	EGSX150NSEA EGSX200A EGSX200NSEA EGSU150NSEACA EGSU200ACA EGSU200NSEACA
16	EGSX100A EGSX100NSEA EGSX100L24RA EGSX150NSEA EGSU100ACA EGSU100NSEACA EGSU100L24RACA EGSU150NSEACA EGSU200ACA EGSU200NSEACA	27	EGSX150NSEA EGSX200A EGSX200NSEA EGSX400NSEA EGSU150NSEACA EGSU200ACA EGSU200NSEACA EGSU400NSEACA
20	EGSX150NSEA EGSX200A EGSX200NSEA EGSU150NSEACA EGSU200ACA EGSU200NSEACA	30	EGSX150NSEA EGSX200A EGSX200NSEA EGSX400NSEA EGSU150NSEACA EGSU200ACA EGSU200NSEACA EGSU400NSEACA
22	EGSX150NSEA EGSX200A EGSX200NSEA EGSX400NSEA EGSU150NSEACA EGSU200ACA EGSU200NSEACA EGSU400NSEACA	70–150	ATC, ATV and ATH switches

NEC (700, 701, 702) comparison

NEC Comparison Table to be used as a general guideline in determining the proper generator for specific applications.
Refer to architectural documents for final selection.

	Article 700 emergency	Article 701 standby	Article 702 optional standby
Scope	Legally required life safety	Legally required critical support (fire fighting, health hazards, etc)	Protect property and facilities
Equipment approval	For emergency / (UL 2200)	For intended use / (UL 2200)	For intended use / (UL 2200) / Not in 2008
Testing			
Witness testing (on-sight)	At install and periodically	At install	None
Periodic testing	Yes	Yes	None
Battery maintenance	Yes	Yes	None
Maintenance records	Yes	Yes	None
Load testing	Yes	Yes	None
Capacity	All loads	All loads intended to operate at one time	All loads intended to operate at one time Not in 2008
Other standby loads allowed	Yes with load shedding	Yes with load shedding	2008—yes with load shedding
Peak shaving allowed	Yes	Yes	Yes
Transfer switch			
Automatic	Yes	Yes	No
Equipment approval	For emergency / (UL 1008)	For standby / (UL 1008)	For intended use / (UL 1008)
Means to permit bypass	Yes	No	No
Elect. operated—mech. held	Yes	No	No
Other loads	No	Yes with load shedding	N/A
Max. fault current capable	Yes	Yes	Yes
Signals (audible and visual)			
Derangement	Yes / standard common alarm	Yes / standard common alarm	Yes / standard common alarm
Carrying load	Yes / displayed at ATS	Yes / displayed at ATS	Yes / displayed at ATS
Battery charger failed	Yes	Yes	No
Ground fault indication	Yes (480 V and 1000 A)	No	No
NFPA 110 signaling	Yes / optional annunciator	Yes / optional annunciator	No
Signs			
At service	Yes / type and location	Yes / type and location	Yes / type and location
At neutral to ground bonding	Yes (if remote)	Yes (if remote)	Yes (if remote)
Wiring kept independent	Yes	No	No
Fire protection (ref 700-9d)	Yes (1000 persons or 75 ft building)	No	No
Maximum power outage	10 sec	60 sec	N/A
Retransfer delay	15 min. setting	15 min. setting	No
Automatic starting	Yes	Yes	No
On-site fuel requirements	2 hours (see NFPA 110)	2 hours	None
Battery charger	Yes	Yes	No
Ground fault	Indication only	No	No

Electrical formulas

To find:	Known values	Single-phase	Three-phase
KILOWATTS (kW)	Volts, current, power factor	E x I 1000	E x I x 1.73 x PF 1000
KVA	Volts, current	E x I 1000	E x I x 1.73 1000
AMPERES	kW, volts, power factor	kW x 1000 E	kW x 1000 E x 1.73 x PF
WATTS	Volts, amps, power factor	Volts x amps	E x I x 1.73 x PF
NO. OF ROTOR POLES	Frequency, RPM	2 x 60 x frequency RPM	2 x 60 x frequency RPM
FREQUENCY	RPM, no. of rotor poles	RPM x poles 2 x 60	RPM x poles 2 x 60
RPM	Frequency, no. of rotor poles	2 x 60 x frequency Rotor poles	2 x 60 x frequency Rotor poles
kW (required for motor)	Motor horsepower, efficiency	hp x 0.746 Efficiency	hp x 0.746 Efficiency
RESISTANCE	Volts, amperes	E I	E I
VOLTS	Ohms, amperes	I x R	I x R
AMPERES	Ohms, volts	E R	E R

- E = VOLTS
- I = AMPERES
- R = RESISTANCE (OHMS)
- PF = POWER FACTOR

Weights and measures

U.S. weights and measures

Linear measurements				
		1 inch	=	2.540 centimeters
12 inches	=	1 foot	=	3.048 decimeters
3 feet	=	1 yard	=	9.144 decimeters
5.5 yards	=	1 rod	=	5.029 meters
40 rods	=	1 furlong	=	2.018 hectometers
8 furlongs	=	1 mile	=	1.609 kilometers
Mile measurements				
1 Statute	=	5,280 feet		
1 Scots	=	5,952 feet		
1 Irish	=	6,720 feet		
1 Russian	=	3,504 feet		
1 Italian	=	4,401 feet		
1 Spanish	=	15,084 feet		

Other linear measurements					
1 hand	=	4 inches	1 link	=	7.92 inches
1 span	=	9 inches	1 fathom	=	6 feet
1 chain	=	22 yards	1 furlong	=	10 chains
			1 cable	=	608 feet

Square measurements		
144 square inches	=	1 square foot
9 square feet	=	1 square yard
30 1/4 yards	=	1 square rod
40 rods	=	1 rood
4 roods	=	1 acre
640 acres	=	1 square mile
1 square mile	=	1 section
36 sections	=	1 township
Cubic or solid measure		
1 cu foot	=	1728 cu inches
1 cu yard	=	27 cu feet
1 cu foot	=	7.48 gallons
1 gallon (water)	=	8.34 lb
1 gallon (U.S.)	=	231 cu inches of water
1 gallon (Imperial)	=	277 1/4 cu inches or water

Metric system

Cube measure (The unit is the meter = 39.37 inches)				
1 cu centimeter	=	1000 cu millimeters	=	0.06102 cu inches
1 cu decimeter	=	1000 cu centimeters	=	61.02374 cu inches
1 cu meter	=	1000 cu decimeters	=	35.31467 cu feet
	=	1 steer	=	1.30795 cu yards
1 cu centimeter (water)	=	1 gram		
1000 cu centimeter (water)	=	1 liter	=	1 kilogram
1 cu meter (1000 liters)	=	1 metric ton		
Measures of weight (The unit is the gram = 0.035274 ounces)				
1 milligram	=	0.015432 grains		
1 centigram	=	10 milligrams	=	0.15432 grains
1 decigram	=	10 centigrams	=	1.5432 grains
1 gram	=	10 decigrams	=	15.4323 grains
1 dekagram	=	10 grains	=	5.6438 drams
1 hectogram	=	10 dekagrams	=	3.5274 ounces
1 kilogram	=	10 hectograms	=	2.2046223 pounds
1 myriagram	=	10 kilograms	=	22.046223 pounds
1 quintal	=	10 myriagrams	=	1.986412 cwt.
1 metric ton	=	10 quintal	=	2,2045.622 pounds
1 gram	=	0.056438 drams		
1 dram	=	1.77186 grams 27.3438 grains		
1 metric ton	=	2,204.6223 pounds		
Measures of capacity (The unit is the liter = 1.0567 liquid quarts)				
1 centiliter	=	10 milliliters	=	0.338 fluid ounces
1 deciliter	=	10 centiliters	=	3.38 fluid ounces
1 liter	=	10 deciliters	=	33.8 fluid ounces
1 dekaliter	=	10 liters	=	0.284 bushel
1 hectoliter	=	10 dekaliters	=	2.84 bushels
1 kiloliter	=	10 hectoliters	=	264.2 gallons

Note: $\frac{\text{Kilometers}}{8} \times 5 = \text{Miles}$ or $\frac{\text{Miles}}{5} \times 8 = \text{Kilometers}$

Weights and measures, continued

Metric system

Prefixes					
a. mega	=	1,000,000	e. deci	=	0.1
b. kilo	=	1,000	f. centi	=	0.01
c. hecto	=	100	g. milli	=	0.001
d. deka	=	10	h. micro	=	0.000001

Linear measurement (the unit is the meter = 39.37 inches)				
1 centimeter	=	10 millimeters	=	0.3937011 inches
1 decimeter	=	10 centimeters	=	3.9370113 inches
1 meter	=	10 decimeters	=	1.0936143 yards 3.2808429 feet
1 dekameter	=	10 meters	=	10.936143 yards
1 hectometer	=	10 dekameters	=	109.36143 yards
1 kilometer	=	10 hectometers	=	0.62137 mile
1 myriameter	=	10,000 meters		

Square measurement (the unit is the square meter = 1549.9969 square inches)				
1 sq centimeter	=	100 sq millimeters	=	0.1550 sq inches
1 sq decimeter	=	100 sq centimeters	=	15.550 sq inches
1 sq meter	=	100 sq decimeters	=	10.7639 sq feet
1 sq dekameter	=	100 sq meters	=	119.60 sq yards
1 sq hectometer	=	100 sq dekameters		
1 sq kilometer	=	100 sq hectometers		
(The unit is the "are" = 100 square meters)				
1 centiare	=	10 milliares	=	10.7643 sq feet
1 deciare	=	10 centiares	=	11.96033 sq yards
1 are	=	10 deciares	=	119.6033 sq yards
1 dekare	=	10 ares	=	0.247110 acres
1 hektare	=	10 dekares	=	2.471098 acres
1 sq kilometer	=	100 hektares	=	0.38611 sq mile

Cubic measure (the unit is the "stere" = 61,025.38659 cubic inches)				
1 decistere	=	10 centisteres	=	3.531562 cubic inches
1 stere	=	10 decisteres	=	1.307986 cubic yards
1 dekastere	=	10 steres	=	13.07986 cubic yards

Metric designator and trade sizes

Metric designator											
12	16	27	35	41	53	63	78	91	103	129	155
Grade size											
3/8	1/2	1	1 1/4	1 1/2	2	2 1/2	3	3 1/2	4	5	6

U.S. weights and measures / metric equivalent chart

	In	**Ft**	**Yd**	**Mile**	**mm**	**cm**	**m**	**km**
1 inch =	1	.0833	.0278	1.578 x 10-5	25.4	2.54	.0254	2.54 x 10-5
1 foot =	12	1	.333	1.894 x 10-4	304.8	30.48	.3048	3.048 x 10-4
1 yard =	36	3	1	5.6818 x 10-4	914.4	91.44	.9144	9.144 x 10-4
1 mile =	63,360	5,280	1,760	1	1,609,344	160,934.4	1,690.344	1.609344
1 mm =	.03937	.0032808	1.0936 x 10-3	6.2137 x 10-7	1	0.1	0.001	0.000001
1 cm =	.3937	.0328084	.0109361	6.2137 x 10-6	10	1	0.01	0.00001
1 m =	39.37	3.28084	1.09361	6.2137 x 10-4	1000	100	1	0.001
1 km =	39,370	3,280.84	1,093.61	0.62137	1,000,000	100,000	1,000	1

Scientific notation

A way of expressing very large or very small numbers in a more compact format. Any number can be expressed as a number between 1 and 10, multiplied by a power of 10 (which indicates the correct position of the decimal point in the original number). Numbers greater than 10 have positive powers of 10, and numbers less than 1 have negative powers of 10.

Useful conversions / equivalents

1 BTU	Raises 1 lb of water 1 °F
1 gram calorie	Raises 1 gram of water 1 °C
1 circular mil	= 0.7854 sq mil
1 sq mil	= 1.27 cir mils
1 mil	= 0.001

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Depending on the type of work you will be doing and how much electrical load you will need to select the generator. Let us know your job type and requirements and we can help you choose the right generator.