GENERAC®

Generator Sizing Guide

2009

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 supercede 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 Onsite 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, Generac recommends that the backup power system be installed, serviced and repaired by a Generac 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 Generac's Technical Service Center toll free at 888-GENERAC during normal business hours (8 a.m. to 5 p.m. CST).

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This guide is also available in the resources section at my.generac.com

NOTES

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 1 MOTOR LOAD REFERENCE

AC & Heat Pumps

		Running Load					Starting Load				
Description	**Hp**	**Running kW**	**Amps @ 240V 1Φ**	**Amps @ 208V 3Φ**	**Amps @ 240V 3Φ**	**Amps @ 480V 3Φ**	**LR Amps @ 240V 1Φ**	**LR Amps @ 208V 3Φ**	**LR Amps @ 240V 3Φ**	**LR Amps @ 480V 3Φ**	**Starting 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)	5 Hp (x2)	10	49	33	28	14	145	97	84	42	12.5
10 Ton (120,000 BTU)	10 Hp	10	49	33	28	14	250	167	144	72	20
15 Ton* (180,000 BTU)	7.5 Hp (x2)	15	74	49	42	21	219	146	126	63	17
15 Ton (180,000 BTU)	15 Hp	15	74	49	42	21	375	250	217	108	30
20 Ton* (240,000 BTU)	10 Hp (x2)	20	98	65	57	28	250	167	144	72	20
20 Ton (240,000 BTU)	20 Hp	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)	15 Hp (x2)	30	n/a	98	85	42	375	250	217	108	30
30 Ton (360,000 BTU)	30 Hp	30	n/a	98	85	42	750	500	433	217	60
40 Ton* (480,000 BTU)	20 Hp (x2)	40	n/a	131	113	57	500	333	289	144	40
40 Ton (480,000 BTU)	40 Hp	40	n/a	131	113	57	1000	666	577	289	80
50 Ton* (480,000 BTU)	25 Hp (x2)	50	n/a	163	142	71	625	416	361	180	50
50 Ton (480,000 BTU)	50 Hp	50	n/a	163	142	71	1250	833	722	361	100

*** For Multiple motor configurations, sequence starting is assumed.**

Air Conditioning
1 hp per 1 ton
1 ton = 12,000 BTUs

General Residential

		Running Load			Starting Load		
Description	**Hp**	**Running kW**	**Amps @ 120V 1Φ**	**4.9Amps @ 240V 1Φ**	**Starting kW**	**LR Amps @ 120V 1Φ**	**LR Amps @ 240V 1Φ**
Refrigerator pump, sump, furnace, garage opener	0.5	0.5	4.9	2.5	1.5	25	13
Freezer, washer, septic grinder	0.75	0.75	7.4	3.7	2.3	38	19
General 1 Hp	1	1	9.8	4.9	3	50	25
Well & septic lift pump	2	2	19.6	9.8	6	100	50

TABLE 2 NON-MOTOR LOAD REFERENCE

Residential

Description	Running Load*		
	kW	Amps at 120V 1ø	Amps at 240V 1ø
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

*Always check data plate for actual running amps.

Commercial

Please refer to equipment data plate and/or billing history for commercial details.

TABLE 3 SURGE CAPABILITY

Generac QT Series Generators (Operating at less than 3600 RPM)

	Rated Output (Running Amps)				Commercial Surge Capability (LR Amps @ 15% Voltage Dip)				Residential Surge Capability (LR Amps @ 30% Voltage Dip)			
Size (kW)	240V 1Φ	208V 3Φ	240V 3Φ	480V 3Φ	240V 1Φ	208V 3Φ	240V 3Φ	480V 3Φ	240V 1Φ	208V 3Φ	240V 3Φ	480V 3Φ
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

Generac QT Series Generators (Operating at 3600 RPM)

	Rated Output (Running Amps)				Commercial Surge Capability (LR Amps @ 15% Voltage Dip)				Residential Surge Capability (LR Amps @ 30% Voltage Dip)			
Size (kW)	240V 1Φ	208V 3Φ	240V 3Φ	480V 3Φ	240V 1Φ	208V 3Φ	240V 3Φ	480V 3Φ	240V 1Φ	208V 3Φ	240V 3Φ	480V 3Φ
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 (Table values are maximum pipe run in feet.)

	Pipe Size (in)						
kW	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
LPG: 8.55 ft^3/lb., 4.24 lbs./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

LP Vapor (LPV) (Table values are maximum pipe run in feet.)

	Pipe Size (in)						
kW	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

Note:
- Pipe sizing is based on 0.5" 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

Tank Capacity Total (Gal.)	Tank Capacity Useable (Gal.)	Minimum Temp (°F)	Tank Capacity (btu/hr.)	Length (Inches)	Diameter (Inches)	Overall Ht. (Inches)
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 Ft^3 / 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
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

Operating Cost Per Hour
=
NG Therms/HR x Cost of NG Therm

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
Table Reprinted From Table 5.4.2.1, NFPA 54, 2002 ed.	

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.

Note: Typical fuel consumption based on a generator 100% loaded.

UPS - GENERATOR COMPATIBILITY

Passive (also referenced as standby or off-line) 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 VA - 2000 VA for passive and 500 VA to 5000 VA for line-interactive.

Passive UPS's 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 UPS's 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 UPS's can be problematic.

Passive UPS technology typically has normal tolerances of 10-25% on voltage and 3 hertz on frequency. Minuteman UPS input tolerance is closer to 10-36%. 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 hertz. These units will need to have their frequency tolerance increased to a minimum of 2 hertz. Minuteman UPS products are close to 5 hertz and not 0.5 hertz.

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 UPS's 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 through 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 UPS's 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 Recommendation:
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
Minuteman UPS	Enspire	Enterprise Plus	Endeavor
APC	Back-UPS Series	Smart-UPS Series	Symmetra Series
Liebert	PowerSure PST & PSP	PowerSure PSA & PSI	UPStation & Nfinity
Powerware	3000 series	5000 series	9000 series

Note: Ferrups and Delta-Conversion UPS technologies not included in discussion

Onsite Estimating Sheet

Contractor_____ Email _____

Phone_____ Fax_____

Job Name _____

Date_____ Location _____

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

TYPE ☐ Natural Gas ☐ LP Vapor (LPV)

ELEC. SERVICE ☐ 100 Amp ☐ 200 Amp ☐ 400 Amp ☐ 600 Amp ☐ Other_____

Before installation contact local jurisdiction to confirm all requirements are met. Jurisdictions may vary. Generac recommends contacting local authorities prior to installation.

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

Use the following for sizing and determining generator kW.

TABLE 6 Motor Load Table (refer to Table 1)

Device	HP	RA	LRA	kW Running (= HP)	Starting kW[1]

[1] 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

TABLE 7 Non-Motor Load Table (refer to Table 2)

Device	Amps	kW

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 & Use of Stationary Engines
- NFPA 54 National Fuel Gas Code
- NFPA 58 LP Gas Code

To Calculate kW	
120 V 1ø	Amps x 120/1000 = kW
240 V 1ø	Amps x 240/1000 = kW
208 V 3ø	(Amps x 208 x 1.732 x PF) /1000 = kW
240 V 3ø	(Amps x 240 x 1.732 x PF) /1000 = kW
480 V 3ø	(Amps x 480 x 1.732 x PF) /1000 = kW

PF is application power factor (worst case 1.0)
Typical application power factor is 0.95.

UPS Information

1.5 x kVA rating for a filtered system
3 – 5 x kVA rating for an unfiltered system

Generac recommends you refer to the Generac UPS Generator Compatibility sheet and contact the manufacturer of the UPS system to assist in your installation.

Transfer Switch Availability

SE-RTS – 100, 200 and 400 Amp service entrance rated
RTS – 100, 200, 400 Amp
RTSS200A3 – Service entrance rated load shed switch
GenReady – 200 Amp service panel
RTS and GenReady switches only work with the R-controller.
HTS – 100, 150, 200, 300, 400, 600, 800 Amp
HTS switch only works with H100 controller. Avail. in NEMA 1, NEMA 3R and NEMA 12.
Refer to Generac product catalog for the appropriate transfer switch.

Recommended Generator Size _____ Refer to Generator Sizing Instructions on other side of this sheet.

INSTALL NOTES:

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

Onsite Estimating Sheet

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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.

As municipalities and states adopt the new 2008 NEC Electrical Code, there may be new sizing requirements, spelled out in the code book, which the installation technician must follow. Always check with the local inspection department to confirm which 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.

240V 1ø Applications: To determine peak usage in kW, add the highest Amp readings from the two legs, multiply by 120 and divide by 1,000.

(L1 + L2)120 / 1000

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

3ø 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), then divide by 1000 to convert Amps to kW.

Peak Amps = (L1 + L2 + L3) / 3

kW = [(Peak Amps x Volts) x 1.732] / 1000*

*Assumes power factor of 1.0

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

Peak Amps = _____ Peak kW= _____

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

1) 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.

2) Enter kW for all non-motor loads expected to run during peak load levels into **table 7**. Refer to **table 2** for typical residential loads and rules of thumb.

3) 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: _____ kW (ref. table 7)
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)

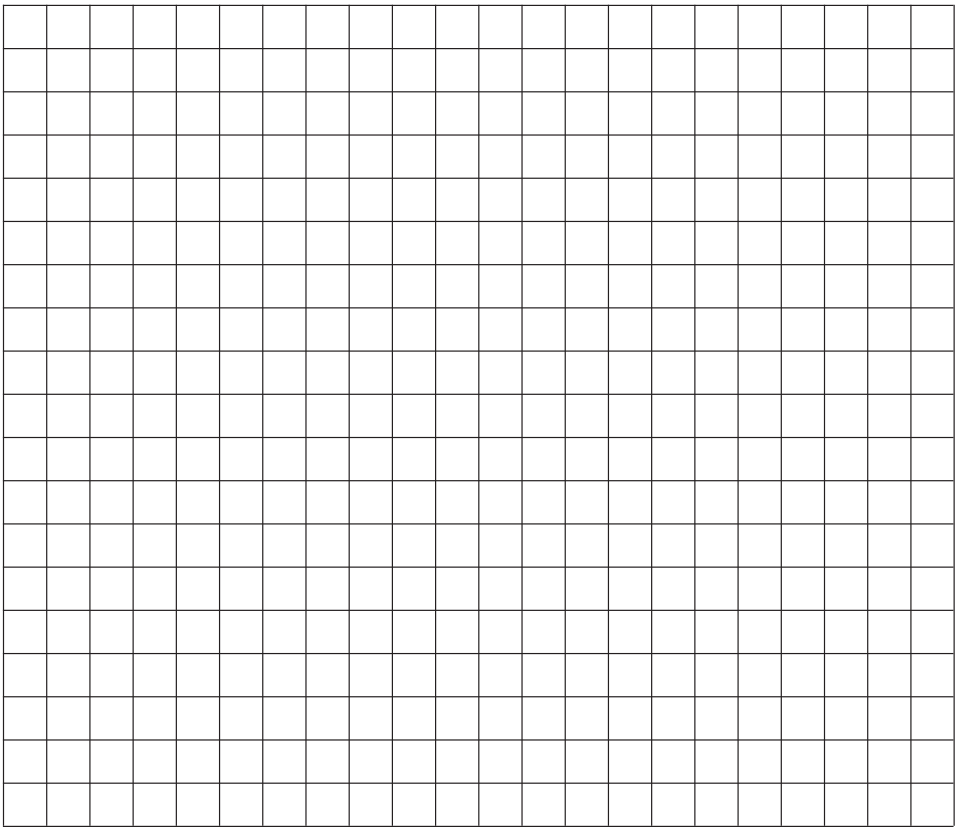
4) Confirm that voltage dip is within acceptable limits by comparing motor LRA to generator surge capability (see table #3).

5) Confirm UPS compatibility (see page 6).

System Capacity – Load Calculation

If the local municipality or state you are in has adopted the 2008 NEC Code, you may be required to use this step. Article 702 of the 2008 NEC includes a new requirement for sizing (702.5B). If no other method for sizing is acceptable, sizing of the generator shall be made in accordance with Article 220 of the NEC. The system capacity estimating sheet will guide you through this process.

Project Layout



Ball Park Estimates (Do not use for final sizing)

Estimate based on 60% service size: (commercial)

240 Volts, 1 Ø: _____ Amps x .15 = _____ kW
208 Volts, 3 Ø: _____ Amps x .22 = _____ kW
240 Volts, 3 Ø: _____ Amps x .25 = _____ kW
480 Volts, 3 Ø: _____ Amps x .50 = _____ kW

Estimate based on 40% service size: (residential)

240 Volts, 1 Ø: _____ Amps x .10 = _____ kW
208 Volts, 3 Ø: _____ Amps x .15 = _____ kW
240 Volts, 3 Ø: _____ Amps x .17 = _____ kW
480 Volts, 3 Ø: _____ Amps x .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 volt systems: Amps = kW x 1.5
For 208 volt systems: Amps = kW x 3.5
For 240 volt 3 Ø systems: Amps = kW x 3
For 240 volt 1 Ø systems: Amps = kW x 4

System Capacity – Load Calculator

DIRECTIONS FOR NEC 2008, ARTICLE 220, PART IV

220.80 Optional Feeder and Service Load Calculations (RESIDENTIAL)	**NEC REFERENCE**
SECTION CAN BE USED FOR DWELLING UNITS	220.82 (A)
• Served by a single feeder conductor (generator)	
• 120/240 volt or 208Y/120 volt service	
• Ampacity of 100 amps or greater	
The calcultated load will be the result of adding	
• 220.82 (B) General Loads, and	220.82 (B)
• 220.82 (C) Heating and Air-Conditioning Load	220.82 (C)
• Calculated neutral load determined by 220.61. (Additional 70% demand factor can be taken for cooking appliances and dryers when tables 220.54 and/or 220.55 are used)	
GENERAL LOADS	220.82 (B)
General Lighting and General-Use Receptacles	
• Calculate at 3 VA per square foot	220.82 (B) (1)
• Use exterior dimensions of the home to calculate square footage – do not include open porches, garages, or unused or unfinished spaces not adaptable for future use.	
• Add 20-amp small appliance & laundry circuits @ 1500 VA each	220.82 (B) (2)
Calculate the following loads at 100% of nameplate rating	220.82 (B) (3)
• Appliances fastened in place, permanently connected or located on a specific circuit	220.82 (B) (3) a
• Ranges, wall-mounted ovens, counter-mounted cooking units (Tables 220.54 & 220.55)	220.82 (B) (3) b
• Clothes dryers not connected to the laundry branch circuit	220.82 (B) (3) c
• Water heaters	220.82 (B) (3) d
• Permanently connected motors not included in Heat & Air-Conditioning Load section	220.82 (B) (4)
HEATING & AIR-CONDITIONING LOADS	220.82 (C)
Include the **largest** of the following six selections (kVA load) in calculation	
Air Conditioning and Cooling	220.82 (C) (1)
• 100% of nameplate rating	
Heat Pumps Without Supplemental Electric Heating	220.82 (C) (2)
• 100% of nameplate rating	
Heat Pumps With Supplemental Electric Heating	220.82 (C) (3)
• 100% of nameplate rating of the heat pump compressor*	
• 65% of nameplate rating of supplemental electric heating equipment	
– If compressor & supplemental heat cannot run at the same time do not include the compressor	
Electric Space Heating	
• Less than 4 separately controlled units @ 65% of nameplate rating	220.82 (C) (4)
• 4 or more separately controlled units @ 40% of nameplate rating	220.82 (C) (5)
• 40% of nameplate rating if 4 or more separately controlled units	
Electric Thermal Storage (or system where the load is expected to be continuous at nameplate rating	220.82 (C) (6)
• 100% of nameplate rating	
• Systems of this type cannot be calculated under any other section of 220.82 (C).	

LOAD CALCULATIONS		
General Lighting Load		3 VA x ft²
• Small Appliance & Laundry Circuits	+	1500 VA per circuit
• General Appliances & Motors (100% rated load)	+	Total general appliances
• Sum of all General Loads	=	Total General Load (VA)
APPLY DEMAND FACTORS		
– First 10 kVA @ 100%	=	10,000 VA
– Remainder of General Loads @ 40%		(Total VA - 10,000) x .40
	=	Calculated General Load (VA)
• HEAT / A-C LOAD @ 100%		Largest Heat or A-C Load (VA)
	=	TOTAL CALCULATED LOAD

Converting VA TO kW (Single-phase applications with 1.0 power factor only) 1 kVA = 1 kW

Worksheet — NEC 2008, 220 Part IV

Contractor		Email			
Phone		Fax			
Job Name					
Date	Location				
Voltage (Circle)	240V -1Ø				
Fuel		NG	LPV		
Elec. Service	100 Amp	200 Amp	400 Amp	Other	
NET SQUARE FOOTAGE					
GENERAL LOADS	Qty	Rating (Load)	Factor	Loads (VA)	Loads (kW) (VA ÷ 1,000)
General Lighting and General Use Receptacles		3 VA/ft²	100%		
Branch Circuits (1500 VA/ft²)					
Small Appliance Circuits (20 Amp)		1500	100%		
Laundry Circuits		1500	100%		
Fixed Appliances		Full Current Rating			
Well			100%		
Sump Pump			100%		
Freezer			100%		
Microwave (Not counter-top model)			100%		
Disposal			100%		
Dishwasher			100%		
Range (See Table 220.55 for multiple cooking appliances)			100%		
Wall-Mounted Oven			100%		
Counter-Mounted Cooking Surface			100%		
Water Heater			100%		
Clothes Dryer			100%		
Garage Door Opener			100%		
Septic Grinder			100%		
Other (list)			100%		
			100%		
			100%		
			100%		
			100%		
			100%		
			100%		
			100%		
			100%		
			100%		
			100%		
Total General Loads				**VA**	**kW**
HEAT / A-C LOAD					
A-C / Cooling Equipment			100%		
Heat Pump					
• Compressor (if not included as A-C)			100%		
• Supplemental Electric Heat			65%		
Electric Space Heating					
• Less than 4 separately controlled units			65%		
• 4 or more separately controlled units			40%		
System With Continuous Nameplate Load			100%		
Largest Heat / A-C Load (VA) VA kW					

GENERAL LOADS			
• 1st 10 kW of General Loads 100% kW	100%	kW	
• Remaining General Loads (kW) 40% kW	40%	kW	
CALCULATED GENERAL LOAD (kW) kW			kW
LARGEST HEAT / A-C LOAD 100% kW kW			kW
TOTAL CALCULATED LOAD (Net General Loads + Heat/A-C Load)			kW

Onsite Estimating Sheet

Contractor_____ Email _____

Phone_____ Fax_____

Job Name _____

Date_____ Location _____

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

TYPE ☐ Natural Gas ☐ LP Vapor (LPV)

ELEC. SERVICE ☐ 100 Amp ☐ 200 Amp ☐ 400 Amp ☐ 600 Amp ☐ Other_____

Before installation contact local jurisdiction to confirm all requirements are met. Jurisdictions may vary. Generac recommends contacting local authorities prior to installation.

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

Use the following for sizing and determining generator kW.

TABLE 6 Motor Load Table (refer to Table 1)

Device	HP	RA	LRA	kW Running (= HP)	Starting kW[1]

[1] 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

TABLE 7 Non-Motor Load Table (refer to Table 2)

Device	Amps	kW

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 & Use of Stationary Engines
- NFPA 54 National Fuel Gas Code
- NFPA 58 LP Gas Code

To Calculate kW	
120 V 1ø	Amps x 120/1000 = kW
240 V 1ø	Amps x 240/1000 = kW
208 V 3ø	(Amps x 208 x 1.732 x PF) /1000 = kW
240 V 3ø	(Amps x 240 x 1.732 x PF) /1000 = kW
480 V 3ø	(Amps x 480 x 1.732 x PF) /1000 = kW

PF is application power factor (worst case 1.0)
Typical application power factor is 0.95.

UPS Information

1.5 x kVA rating for a filtered system
3 – 5 x kVA rating for an unfiltered system

Generac recommends you refer to the Generac UPS Generator Compatibility sheet and contact the manufacturer of the UPS system to assist in your installation.

Transfer Switch Availability

SE-RTS – 100, 200 and 400 Amp service entrance rated
RTS – 100, 200, 400 Amp
RTSS200A3 – Service entrance rated load shed switch
GenReady – 200 Amp service panel
RTS and GenReady switches only work with the R-controller.
HTS – 100, 150, 200, 300, 400, 600, 800 Amp
HTS switch only works with H100 controller. Avail. in NEMA 1, NEMA 3R and NEMA 12.
Refer to Generac product catalog for the appropriate transfer switch.

Recommended Generator Size _____ Refer to Generator Sizing Instructions on other side of this sheet.

INSTALL NOTES:

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

Onsite Estimating Sheet

GENERAC®

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.

As municipalities and states adopt the new 2008 NEC Electrical Code, there may be new sizing requirements, spelled out in the code book, which the installation technician must follow. Always check with the local inspection department to confirm which 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.

240V 1ø Applications: To determine peak usage in kW, add the highest Amp readings from the two legs, multiply by 120 and divide by 1,000.

(L1 + L2)120 / 1000

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

3ø 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), then divide by 1000 to convert Amps to kW.

Peak Amps = (L1 + L2 + L3) / 3

kW = [(Peak Amps x Volts) x 1.732] / 1000*

*Assumes power factor of 1.0

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

Peak Amps = _____ Peak kW= _____

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

1) 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.

2) Enter kW for all non-motor loads expected to run during peak load levels into **table 7**. Refer to **table 2** for typical residential loads and rules of thumb.

3) 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: _____ kW (ref. table 7)
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)

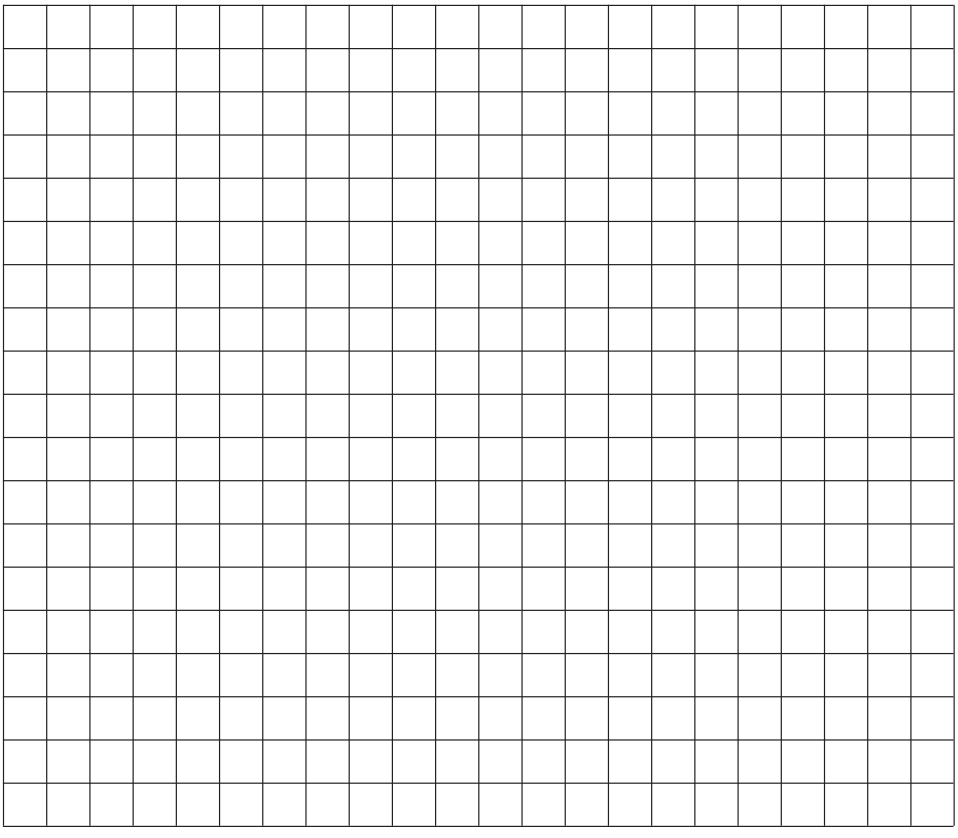
4) Confirm that voltage dip is within acceptable limits by comparing motor LRA to generator surge capability (see table #3).

5) Confirm UPS compatibility (see page 6).

System Capacity – Load Calculation

If the local municipality or state you are in has adopted the 2008 NEC Code, you may be required to use this step. Article 702 of the 2008 NEC includes a new requirement for sizing (702.5B). If no other method for sizing is acceptable, sizing of the generator shall be made in accordance with Article 220 of the NEC. The system capacity estimating sheet will guide you through this process.

Project Layout



Ball Park Estimates (Do not use for final sizing)

Estimate based on 60% service size: (commercial)

240 Volts, 1 Ø: _____ Amps x .15 = _____ kW
208 Volts, 3 Ø: _____ Amps x .22 = _____ kW
240 Volts, 3 Ø: _____ Amps x .25 = _____ kW
480 Volts, 3 Ø: _____ Amps x .50 = _____ kW

Estimate based on 40% service size: (residential)

240 Volts, 1 Ø: _____ Amps x .10 = _____ kW
208 Volts, 3 Ø: _____ Amps x .15 = _____ kW
240 Volts, 3 Ø: _____ Amps x .17 = _____ kW
480 Volts, 3 Ø: _____ Amps x .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 volt systems: Amps = kW x 1.5
For 208 volt systems: Amps = kW x 3.5
For 240 volt 3 Ø systems: Amps = kW x 3
For 240 volt 1 Ø systems: Amps = kW x 4

System Capacity – Load Calculator

DIRECTIONS FOR NEC 2008, ARTICLE 220, PART IV

220.80 Optional Feeder and Service Load Calculations (RESIDENTIAL)	**NEC REFERENCE**
SECTION CAN BE USED FOR DWELLING UNITS	220.82 (A)
• Served by a single feeder conductor (generator)	
• 120/240 volt or 208Y/120 volt service	
• Ampacity of 100 amps or greater	
The calcultated load will be the result of adding	
• 220.82 (B) General Loads, and	220.82 (B)
• 220.82 (C) Heating and Air-Conditioning Load	220.82 (C)
• Calculated neutral load determined by 220.61. (Additional 70% demand factor can be taken for cooking appliances and dryers when tables 220.54 and/or 220.55 are used)	
GENERAL LOADS	220.82 (B)
General Lighting and General-Use Receptacles	
• Calculate at 3 VA per square foot	220.82 (B) (1)
• Use exterior dimensions of the home to calculate square footage – do not include open porches, garages, or unused or unfinished spaces not adaptable for future use.	
• Add 20-amp small appliance & laundry circuits @ 1500 VA each	220.82 (B) (2)
Calculate the following loads at 100% of nameplate rating	220.82 (B) (3)
• Appliances fastened in place, permanently connected or located on a specific circuit	220.82 (B) (3) a
• Ranges, wall-mounted ovens, counter-mounted cooking units (Tables 220.54 & 220.55)	220.82 (B) (3) b
• Clothes dryers not connected to the laundry branch circuit	220.82 (B) (3) c
• Water heaters	220.82 (B) (3) d
• Permanently connected motors not included in Heat & Air-Conditioning Load section	220.82 (B) (4)
HEATING & AIR-CONDITIONING LOADS	220.82 (C)
Include the **largest** of the following six selections (kVA load) in calculation	
Air Conditioning and Cooling	220.82 (C) (1)
• 100% of nameplate rating	
Heat Pumps Without Supplemental Electric Heating	220.82 (C) (2)
• 100% of nameplate rating	
Heat Pumps With Supplemental Electric Heating	220.82 (C) (3)
• 100% of nameplate rating of the heat pump compressor*	
• 65% of nameplate rating of supplemental electric heating equipment	
– If compressor & supplemental heat cannot run at the same time do not include the compressor	
Electric Space Heating	
• Less than 4 separately controlled units @ 65% of nameplate rating	220.82 (C) (4)
• 4 or more separately controlled units @ 40% of nameplate rating	220.82 (C) (5)
• 40% of nameplate rating if 4 or more separately controlled units	
Electric Thermal Storage (or system where the load is expected to be continuous at nameplate rating	220.82 (C) (6)
• 100% of nameplate rating	
• Systems of this type cannot be calculated under any other section of 220.82 (C).	

LOAD CALCULATIONS		
General Lighting Load		3 VA x ft²
• Small Appliance & Laundry Circuits	+	1500 VA per circuit
• General Appliances & Motors (100% rated load)	+	Total general appliances
• Sum of all General Loads	=	Total General Load (VA)
APPLY DEMAND FACTORS		
– First 10 kVA @ 100%	=	10,000 VA
– Remainder of General Loads @ 40%		(Total VA - 10,000) x .40
	=	Calculated General Load (VA)
• HEAT / A-C LOAD @ 100%		Largest Heat or A-C Load (VA)
	=	TOTAL CALCULATED LOAD

Converting VA TO kW (Single-phase applications with 1.0 power factor only) 1 kVA = 1 kW

Worksheet — NEC 2008, 220 Part IV

Contractor		Email			
Phone		Fax			
Job Name					
Date	Location				
Voltage (Circle)	240V -1Ø				
Fuel		NG	LPV		
Elec. Service	100 Amp	200 Amp	400 Amp	Other	
NET SQUARE FOOTAGE					
GENERAL LOADS	Qty	Rating (Load)	Factor	Loads (VA)	Loads (kW) (VA ÷ 1,000)
General Lighting and General Use Receptacles		3 VA/ft²	100%		
Branch Circuits (1500 VA/ft²)					
Small Appliance Circuits (20 Amp)		1500	100%		
Laundry Circuits		1500	100%		
Fixed Appliances		Full Current Rating			
Well			100%		
Sump Pump			100%		
Freezer			100%		
Microwave (Not counter-top model)			100%		
Disposal			100%		
Dishwasher			100%		
Range (See Table 220.55 for multiple cooking appliances)			100%		
Wall-Mounted Oven			100%		
Counter-Mounted Cooking Surface			100%		
Water Heater			100%		
Clothes Dryer			100%		
Garage Door Opener			100%		
Septic Grinder			100%		
Other (list)			100%		
			100%		
			100%		
			100%		
			100%		
			100%		
			100%		
			100%		
			100%		
			100%		
			100%		
Total General Loads				**VA**	**kW**
HEAT / A-C LOAD					
A-C / Cooling Equipment			100%		
Heat Pump					
• Compressor (if not included as A-C)			100%		
• Supplemental Electric Heat			65%		
Electric Space Heating					
• Less than 4 separately controlled units			65%		
• 4 or more separately controlled units			40%		
System With Continuous Nameplate Load			100%		
Largest Heat / A-C Load (VA) VA kW					

GENERAL LOADS			
• 1st 10 kW of General Loads 100% kW	100%	kW	
• Remaining General Loads (kW) 40% kW	40%	kW	
CALCULATED GENERAL LOAD (kW) kW			kW
LARGEST HEAT / A-C LOAD 100% kW kW			kW
TOTAL CALCULATED LOAD (Net General Loads + Heat/A-C Load)			kW

Onsite Estimating Sheet

Contractor_____ Email _____

Phone_____ Fax_____

Job Name _____

Date_____ Location _____

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

TYPE ☐ Natural Gas ☐ LP Vapor (LPV)

ELEC. SERVICE ☐ 100 Amp ☐ 200 Amp ☐ 400 Amp ☐ 600 Amp ☐ Other_____

Before installation contact local jurisdiction to confirm all requirements are met. Jurisdictions may vary. Generac recommends contacting local authorities prior to installation.

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

Use the following for sizing and determining generator kW.

TABLE 6 Motor Load Table (refer to Table 1)

Device	HP	RA	LRA	kW Running (= HP)	Starting kW[1]

[1] 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

TABLE 7 Non-Motor Load Table (refer to Table 2)

Device	Amps	kW

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 & Use of Stationary Engines
- NFPA 54 National Fuel Gas Code
- NFPA 58 LP Gas Code

To Calculate kW	
120 V 1ø	Amps x 120/1000 = kW
240 V 1ø	Amps x 240/1000 = kW
208 V 3ø	(Amps x 208 x 1.732 x PF) /1000 = kW
240 V 3ø	(Amps x 240 x 1.732 x PF) /1000 = kW
480 V 3ø	(Amps x 480 x 1.732 x PF) /1000 = kW

PF is application power factor (worst case 1.0)
Typical application power factor is 0.95.

UPS Information

1.5 x kVA rating for a filtered system
3 – 5 x kVA rating for an unfiltered system

Generac recommends you refer to the Generac UPS Generator Compatibility sheet and contact the manufacturer of the UPS system to assist in your installation.

Transfer Switch Availability

SE-RTS – 100, 200 and 400 Amp service entrance rated
RTS – 100, 200, 400 Amp
RTSS200A3 – Service entrance rated load shed switch
GenReady – 200 Amp service panel
RTS and GenReady switches only work with the R-controller.
HTS – 100, 150, 200, 300, 400, 600, 800 Amp
HTS switch only works with H100 controller. Avail. in NEMA 1, NEMA 3R and NEMA 12.
Refer to Generac product catalog for the appropriate transfer switch.

Recommended Generator Size _____ Refer to Generator Sizing Instructions on other side of this sheet.

INSTALL NOTES:

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

Onsite Estimating Sheet

GENERAC®

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.

As municipalities and states adopt the new 2008 NEC Electrical Code, there may be new sizing requirements, spelled out in the code book, which the installation technician must follow. Always check with the local inspection department to confirm which 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.

240V 1ø Applications: To determine peak usage in kW, add the highest Amp readings from the two legs, multiply by 120 and divide by 1,000.

(L1 + L2)120 / 1000

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

3ø 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), then divide by 1000 to convert Amps to kW.

Peak Amps = (L1 + L2 + L3) / 3

kW = [(Peak Amps x Volts) x 1.732] / 1000*

*Assumes power factor of 1.0

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

Peak Amps = _____ Peak kW= _____

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

1) 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.

2) Enter kW for all non-motor loads expected to run during peak load levels into **table 7**. Refer to **table 2** for typical residential loads and rules of thumb.

3) 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: _____ kW (ref. table 7)
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)

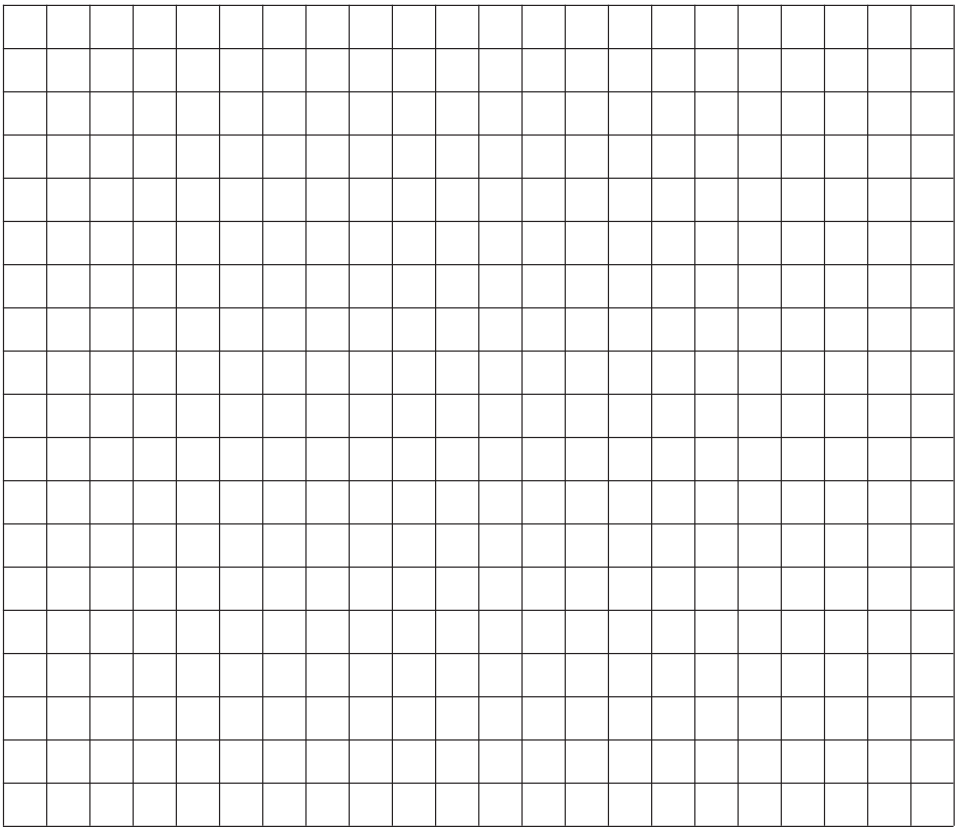
4) Confirm that voltage dip is within acceptable limits by comparing motor LRA to generator surge capability (see table #3).

5) Confirm UPS compatibility (see page 6).

System Capacity – Load Calculation

If the local municipality or state you are in has adopted the 2008 NEC Code, you may be required to use this step. Article 702 of the 2008 NEC includes a new requirement for sizing (702.5B). If no other method for sizing is acceptable, sizing of the generator shall be made in accordance with Article 220 of the NEC. The system capacity estimating sheet will guide you through this process.

Project Layout



Ball Park Estimates (Do not use for final sizing)

Estimate based on 60% service size: (commercial)

240 Volts, 1 Ø: _____ Amps x .15 = _____ kW
208 Volts, 3 Ø: _____ Amps x .22 = _____ kW
240 Volts, 3 Ø: _____ Amps x .25 = _____ kW
480 Volts, 3 Ø: _____ Amps x .50 = _____ kW

Estimate based on 40% service size: (residential)

240 Volts, 1 Ø: _____ Amps x .10 = _____ kW
208 Volts, 3 Ø: _____ Amps x .15 = _____ kW
240 Volts, 3 Ø: _____ Amps x .17 = _____ kW
480 Volts, 3 Ø: _____ Amps x .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 volt systems: Amps = kW x 1.5
For 208 volt systems: Amps = kW x 3.5
For 240 volt 3 Ø systems: Amps = kW x 3
For 240 volt 1 Ø systems: Amps = kW x 4

System Capacity – Load Calculator

DIRECTIONS FOR NEC 2008, ARTICLE 220, PART IV

220.80 Optional Feeder and Service Load Calculations (RESIDENTIAL)	**NEC REFERENCE**
SECTION CAN BE USED FOR DWELLING UNITS	220.82 (A)
• Served by a single feeder conductor (generator)	
• 120/240 volt or 208Y/120 volt service	
• Ampacity of 100 amps or greater	
The calcultated load will be the result of adding	
• 220.82 (B) General Loads, and	220.82 (B)
• 220.82 (C) Heating and Air-Conditioning Load	220.82 (C)
• Calculated neutral load determined by 220.61. (Additional 70% demand factor can be taken for cooking appliances and dryers when tables 220.54 and/or 220.55 are used)	
GENERAL LOADS	220.82 (B)
General Lighting and General-Use Receptacles	
• Calculate at 3 VA per square foot	220.82 (B) (1)
• Use exterior dimensions of the home to calculate square footage – do not include open porches, garages, or unused or unfinished spaces not adaptable for future use.	
• Add 20-amp small appliance & laundry circuits @ 1500 VA each	220.82 (B) (2)
Calculate the following loads at 100% of nameplate rating	220.82 (B) (3)
• Appliances fastened in place, permanently connected or located on a specific circuit	220.82 (B) (3) a
• Ranges, wall-mounted ovens, counter-mounted cooking units (Tables 220.54 & 220.55)	220.82 (B) (3) b
• Clothes dryers not connected to the laundry branch circuit	220.82 (B) (3) c
• Water heaters	220.82 (B) (3) d
• Permanently connected motors not included in Heat & Air-Conditioning Load section	220.82 (B) (4)
HEATING & AIR-CONDITIONING LOADS	220.82 (C)
Include the **largest** of the following six selections (kVA load) in calculation	
Air Conditioning and Cooling	220.82 (C) (1)
• 100% of nameplate rating	
Heat Pumps Without Supplemental Electric Heating	220.82 (C) (2)
• 100% of nameplate rating	
Heat Pumps With Supplemental Electric Heating	220.82 (C) (3)
• 100% of nameplate rating of the heat pump compressor*	
• 65% of nameplate rating of supplemental electric heating equipment	
– If compressor & supplemental heat cannot run at the same time do not include the compressor	
Electric Space Heating	
• Less than 4 separately controlled units @ 65% of nameplate rating	220.82 (C) (4)
• 4 or more separately controlled units @ 40% of nameplate rating	220.82 (C) (5)
• 40% of nameplate rating if 4 or more separately controlled units	
Electric Thermal Storage (or system where the load is expected to be continuous at nameplate rating	220.82 (C) (6)
• 100% of nameplate rating	
• Systems of this type cannot be calculated under any other section of 220.82 (C).	

LOAD CALCULATIONS		
General Lighting Load		3 VA x ft²
• Small Appliance & Laundry Circuits	+	1500 VA per circuit
• General Appliances & Motors (100% rated load)	+	Total general appliances
• Sum of all General Loads	=	Total General Load (VA)
APPLY DEMAND FACTORS		
– First 10 kVA @ 100%	=	10,000 VA
– Remainder of General Loads @ 40%		(Total VA - 10,000) x .40
	=	Calculated General Load (VA)
• HEAT / A-C LOAD @ 100%		Largest Heat or A-C Load (VA)
	=	TOTAL CALCULATED LOAD

Converting VA TO kW (Single-phase applications with 1.0 power factor only) 1 kVA = 1 kW

Worksheet — NEC 2008, 220 Part IV

Contractor		Email			
Phone		Fax			
Job Name					
Date	Location				
Voltage (Circle)	240V -1Ø				
Fuel		NG	LPV		
Elec. Service	100 Amp	200 Amp	400 Amp	Other	
NET SQUARE FOOTAGE					
GENERAL LOADS	Qty	Rating (Load)	Factor	Loads (VA)	Loads (kW) (VA ÷ 1,000)
General Lighting and General Use Receptacles		3 VA/ft²	100%		
Branch Circuits (1500 VA/ft²)					
Small Appliance Circuits (20 Amp)		1500	100%		
Laundry Circuits		1500	100%		
Fixed Appliances		Full Current Rating			
Well			100%		
Sump Pump			100%		
Freezer			100%		
Microwave (Not counter-top model)			100%		
Disposal			100%		
Dishwasher			100%		
Range (See Table 220.55 for multiple cooking appliances)			100%		
Wall-Mounted Oven			100%		
Counter-Mounted Cooking Surface			100%		
Water Heater			100%		
Clothes Dryer			100%		
Garage Door Opener			100%		
Septic Grinder			100%		
Other (list)			100%		
			100%		
			100%		
			100%		
			100%		
			100%		
			100%		
			100%		
			100%		
			100%		
			100%		
Total General Loads				**VA**	**kW**
HEAT / A-C LOAD					
A-C / Cooling Equipment			100%		
Heat Pump					
• Compressor (if not included as A-C)			100%		
• Supplemental Electric Heat			65%		
Electric Space Heating					
• Less than 4 separately controlled units			65%		
• 4 or more separately controlled units			40%		
System With Continuous Nameplate Load			100%		
Largest Heat / A-C Load (VA) VA kW					

GENERAL LOADS			
• 1st 10 kW of General Loads 100% kW	100%	kW	
• Remaining General Loads (kW) 40% kW	40%	kW	
CALCULATED GENERAL LOAD (kW) kW			kW
LARGEST HEAT / A-C LOAD 100% kW kW			kW
TOTAL CALCULATED LOAD (Net General Loads + Heat/A-C Load)			kW

Onsite Estimating Sheet

Contractor_____ Email _____

Phone_____ Fax_____

Job Name _____

Date_____ Location _____

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

TYPE ☐ Natural Gas ☐ LP Vapor (LPV)

ELEC. SERVICE ☐ 100 Amp ☐ 200 Amp ☐ 400 Amp ☐ 600 Amp ☐ Other_____

Before installation contact local jurisdiction to confirm all requirements are met. Jurisdictions may vary. Generac recommends contacting local authorities prior to installation.

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

Use the following for sizing and determining generator kW.

TABLE 6 Motor Load Table (refer to Table 1)

Device	HP	RA	LRA	kW Running (= HP)	Starting kW[1]

[1] 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

TABLE 7 Non-Motor Load Table (refer to Table 2)

Device	Amps	kW

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 & Use of Stationary Engines
- NFPA 54 National Fuel Gas Code
- NFPA 58 LP Gas Code

To Calculate kW	
120 V 1ø	Amps x 120/1000 = kW
240 V 1ø	Amps x 240/1000 = kW
208 V 3ø	(Amps x 208 x 1.732 x PF) /1000 = kW
240 V 3ø	(Amps x 240 x 1.732 x PF) /1000 = kW
480 V 3ø	(Amps x 480 x 1.732 x PF) /1000 = kW

PF is application power factor (worst case 1.0)
Typical application power factor is 0.95.

UPS Information

1.5 x kVA rating for a filtered system
3 – 5 x kVA rating for an unfiltered system

Generac recommends you refer to the Generac UPS Generator Compatibility sheet and contact the manufacturer of the UPS system to assist in your installation.

Transfer Switch Availability

SE-RTS – 100, 200 and 400 Amp service entrance rated
RTS – 100, 200, 400 Amp
RTSS200A3 – Service entrance rated load shed switch
GenReady – 200 Amp service panel
RTS and GenReady switches only work with the R-controller.
HTS – 100, 150, 200, 300, 400, 600, 800 Amp
HTS switch only works with H100 controller. Avail. in NEMA 1, NEMA 3R and NEMA 12.
Refer to Generac product catalog for the appropriate transfer switch.

Recommended Generator Size _____ Refer to Generator Sizing Instructions on other side of this sheet.

INSTALL NOTES:

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

Onsite Estimating Sheet

GENERAC®

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.

As municipalities and states adopt the new 2008 NEC Electrical Code, there may be new sizing requirements, spelled out in the code book, which the installation technician must follow. Always check with the local inspection department to confirm which 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.

240V 1ø Applications: To determine peak usage in kW, add the highest Amp readings from the two legs, multiply by 120 and divide by 1,000.

(L1 + L2)120 / 1000

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

3ø 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), then divide by 1000 to convert Amps to kW.

Peak Amps = (L1 + L2 + L3) / 3

kW = [(Peak Amps x Volts) x 1.732] / 1000*

*Assumes power factor of 1.0

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

Peak Amps = _____ Peak kW= _____

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

1) 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.

2) Enter kW for all non-motor loads expected to run during peak load levels into **table 7**. Refer to **table 2** for typical residential loads and rules of thumb.

3) 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: _____ kW (ref. table 7)
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)

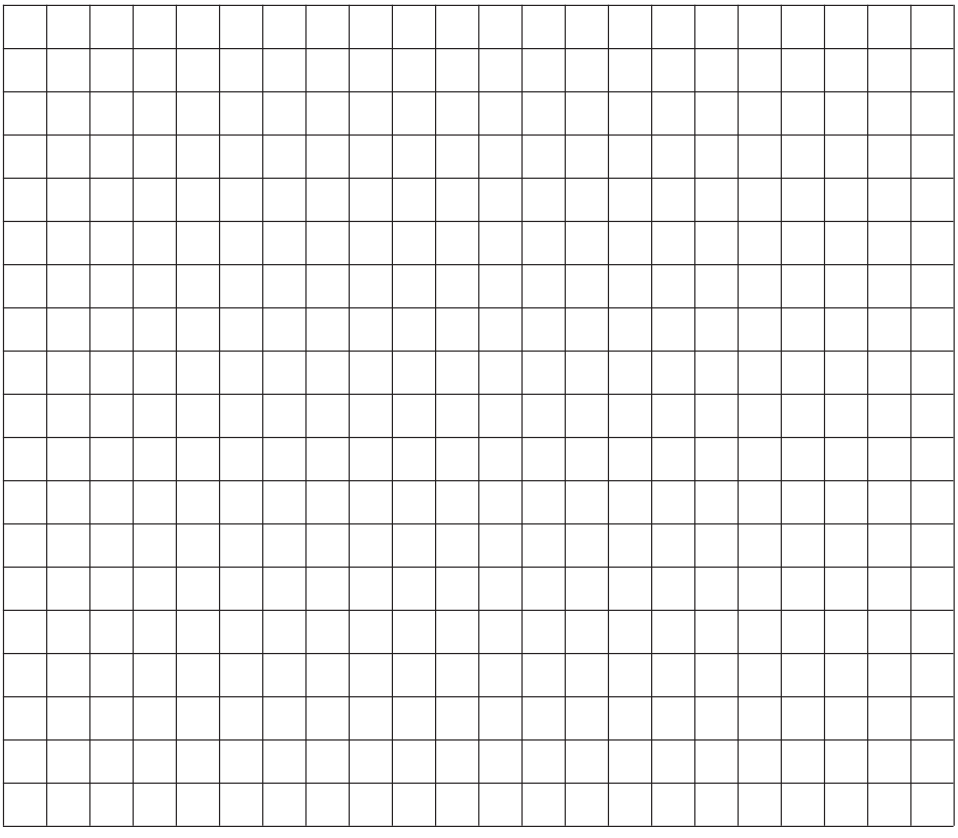
4) Confirm that voltage dip is within acceptable limits by comparing motor LRA to generator surge capability (see table #3).

5) Confirm UPS compatibility (see page 6).

System Capacity – Load Calculation

If the local municipality or state you are in has adopted the 2008 NEC Code, you may be required to use this step. Article 702 of the 2008 NEC includes a new requirement for sizing (702.5B). If no other method for sizing is acceptable, sizing of the generator shall be made in accordance with Article 220 of the NEC. The system capacity estimating sheet will guide you through this process.

Project Layout



Ball Park Estimates (Do not use for final sizing)

Estimate based on 60% service size: (commercial)

240 Volts, 1 Ø: _____ Amps x .15 = _____ kW
208 Volts, 3 Ø: _____ Amps x .22 = _____ kW
240 Volts, 3 Ø: _____ Amps x .25 = _____ kW
480 Volts, 3 Ø: _____ Amps x .50 = _____ kW

Estimate based on 40% service size: (residential)

240 Volts, 1 Ø: _____ Amps x .10 = _____ kW
208 Volts, 3 Ø: _____ Amps x .15 = _____ kW
240 Volts, 3 Ø: _____ Amps x .17 = _____ kW
480 Volts, 3 Ø: _____ Amps x .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 volt systems: Amps = kW x 1.5
For 208 volt systems: Amps = kW x 3.5
For 240 volt 3 Ø systems: Amps = kW x 3
For 240 volt 1 Ø systems: Amps = kW x 4

System Capacity – Load Calculator

DIRECTIONS FOR NEC 2008, ARTICLE 220, PART IV

220.80 Optional Feeder and Service Load Calculations (RESIDENTIAL)	**NEC REFERENCE**
SECTION CAN BE USED FOR DWELLING UNITS	220.82 (A)
• Served by a single feeder conductor (generator)	
• 120/240 volt or 208Y/120 volt service	
• Ampacity of 100 amps or greater	
The calcultated load will be the result of adding	
• 220.82 (B) General Loads, and	220.82 (B)
• 220.82 (C) Heating and Air-Conditioning Load	220.82 (C)
• Calculated neutral load determined by 220.61. (Additional 70% demand factor can be taken for cooking appliances and dryers when tables 220.54 and/or 220.55 are used)	
GENERAL LOADS	220.82 (B)
General Lighting and General-Use Receptacles	
• Calculate at 3 VA per square foot	220.82 (B) (1)
• Use exterior dimensions of the home to calculate square footage – do not include open porches, garages, or unused or unfinished spaces not adaptable for future use.	
• Add 20-amp small appliance & laundry circuits @ 1500 VA each	220.82 (B) (2)
Calculate the following loads at 100% of nameplate rating	220.82 (B) (3)
• Appliances fastened in place, permanently connected or located on a specific circuit	220.82 (B) (3) a
• Ranges, wall-mounted ovens, counter-mounted cooking units (Tables 220.54 & 220.55)	220.82 (B) (3) b
• Clothes dryers not connected to the laundry branch circuit	220.82 (B) (3) c
• Water heaters	220.82 (B) (3) d
• Permanently connected motors not included in Heat & Air-Conditioning Load section	220.82 (B) (4)
HEATING & AIR-CONDITIONING LOADS	220.82 (C)
Include the **largest** of the following six selections (kVA load) in calculation	
Air Conditioning and Cooling	220.82 (C) (1)
• 100% of nameplate rating	
Heat Pumps Without Supplemental Electric Heating	220.82 (C) (2)
• 100% of nameplate rating	
Heat Pumps With Supplemental Electric Heating	220.82 (C) (3)
• 100% of nameplate rating of the heat pump compressor*	
• 65% of nameplate rating of supplemental electric heating equipment	
– If compressor & supplemental heat cannot run at the same time do not include the compressor	
Electric Space Heating	
• Less than 4 separately controlled units @ 65% of nameplate rating	220.82 (C) (4)
• 4 or more separately controlled units @ 40% of nameplate rating	220.82 (C) (5)
• 40% of nameplate rating if 4 or more separately controlled units	
Electric Thermal Storage (or system where the load is expected to be continuous at nameplate rating	220.82 (C) (6)
• 100% of nameplate rating	
• Systems of this type cannot be calculated under any other section of 220.82 (C).	

LOAD CALCULATIONS		
General Lighting Load		3 VA x ft²
• Small Appliance & Laundry Circuits	+	1500 VA per circuit
• General Appliances & Motors (100% rated load)	+	Total general appliances
• Sum of all General Loads	=	Total General Load (VA)
APPLY DEMAND FACTORS		
– First 10 kVA @ 100%	=	10,000 VA
– Remainder of General Loads @ 40%		(Total VA - 10,000) x .40
	=	Calculated General Load (VA)
• HEAT / A-C LOAD @ 100%		Largest Heat or A-C Load (VA)
	=	TOTAL CALCULATED LOAD

Converting VA TO kW (Single-phase applications with 1.0 power factor only) 1 kVA = 1 kW

Worksheet — NEC 2008, 220 Part IV

Contractor		Email			
Phone		Fax			
Job Name					
Date	Location				
Voltage (Circle)	240V -1Ø				
Fuel		NG	LPV		
Elec. Service	100 Amp	200 Amp	400 Amp	Other	
NET SQUARE FOOTAGE					
GENERAL LOADS	Qty	Rating (Load)	Factor	Loads (VA)	Loads (kW) (VA ÷ 1,000)
General Lighting and General Use Receptacles		3 VA/ft²	100%		
Branch Circuits (1500 VA/ft²)					
Small Appliance Circuits (20 Amp)		1500	100%		
Laundry Circuits		1500	100%		
Fixed Appliances		Full Current Rating			
Well			100%		
Sump Pump			100%		
Freezer			100%		
Microwave (Not counter-top model)			100%		
Disposal			100%		
Dishwasher			100%		
Range (See Table 220.55 for multiple cooking appliances)			100%		
Wall-Mounted Oven			100%		
Counter-Mounted Cooking Surface			100%		
Water Heater			100%		
Clothes Dryer			100%		
Garage Door Opener			100%		
Septic Grinder			100%		
Other (list)			100%		
			100%		
			100%		
			100%		
			100%		
			100%		
			100%		
			100%		
			100%		
			100%		
			100%		
Total General Loads				**VA**	**kW**
HEAT / A-C LOAD					
A-C / Cooling Equipment			100%		
Heat Pump					
• Compressor (if not included as A-C)			100%		
• Supplemental Electric Heat			65%		
Electric Space Heating					
• Less than 4 separately controlled units			65%		
• 4 or more separately controlled units			40%		
System With Continuous Nameplate Load			100%		
Largest Heat / A-C Load (VA) VA kW					

GENERAL LOADS			
• 1st 10 kW of General Loads 100% kW	100%	kW	
• Remaining General Loads (kW) 40% kW	40%	kW	
CALCULATED GENERAL LOAD (kW) kW			kW
LARGEST HEAT / A-C LOAD 100% kW kW			kW
TOTAL CALCULATED LOAD (Net General Loads + Heat/A-C Load)			kW

TYPICAL GENERATOR/TRANSFER SWITCH COMBINATIONS

8 kW Air-Cooled Generator	8 Circuit Load Distribution Panel
	10 Circuit Load Distribution Panel
	RTSN100

10 kW Air-Cooled Generator	8 Circuit Load Distribution Panel
	10 Circuit Load Distribution Panel
	RTSN100
	RTSE100
	GenReady Load Center

14 kW Air-Cooled Generator	8 Circuit Load Distribution Panel
	10 Circuit Load Distribution Panel
	12 Circuit Load Distribution Panel
	14 Circuit Load Distribution Panel
	RTSN100
	RTSE100
	GenReady Load Center

17 kW Air-Cooled Generator	12 Circuit Load Distribution Panel
	14 Circuit Load Distribution Panel
	16 Circuit load Distribution Panel
	RTSN100
	RTSE100
	RTSN200
	RTSE200
	GenReady Load Center
	RTSS200 Load Shedding Switch

20 kW Air-Cooled Generator	16 Circuit load Distribution Panel
	RTSN100
	RTSE100
	RTSN200
	RTSE200
	GenReady load Center
	RTSS200 load Shedding Switch

22 kW Liquid-Cooled Generator	RTSN100
	RTSE100
	RTSN200
	RTSE200
	GenReady Load Center
	RTSS200 Load Shedding Switch

25 kW Liquld-Cooled Generator	RTSN100
	RTSE100
	RTSN200
	RTSE200
	GenReady Load Center
	RTSS200 Load Shedding Switch

27 kW Liquid-Cooled Generator	RTSN100
	RTSE100
	RTSN200
	RTSE200
	GenReady Load Center
	RTSS200 Load Shedding Switch

30 kW liquid-Cooled Generator	RTSN100
	RTSE100
	RTSN200
	RTSE200
	GenReady Load Center
	RTSS200 Load Shedding Switch

35 kW Liquid-Cooled Generator	RTSN100
	RTSE100
	RTSN200
	RTSE200

36 kW Liquid-Cooled Generator	RTSN100
	RTSE100
	RTSN200
	RTSE200

45 kW Liquid-Cooled Generator	RTSN100
	RTSE100
	RTSN200
	RTSE200

48 kW Liquid-Cooled Generator	RTSN100
	RTSE100
	RTSN200
	RTSE200
	RTSN400

60 kW, Liquid-Cooled Generator	RTSN100
	RTSN200
	RTSE200
	RTSN400
	RTSE400

70-150 kW liquid-Cooled Generator	HTS 100 - 800

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 & facilities
Equipment Approval	For Emergency / (UL2200)	For Intended Use / (UL2200)	For Intended Use / (UL2200) / Not in 2008
Testing			
Witness Testing (on-sight)	At install & 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 / (UL1008)	For Standby / (UL1008)	For Intended Use / (UL1008)
Means to Permitt 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 & 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 (480V & 1000A)	No	No
NFPA 110 Signaling	Yes / Optional annunciator	Yes / Optional annunciator	No
Signs			
At service	Yes / Type & location	Yes / Type & location	Yes / Type & 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' 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	1-PHASE	3-PHASE
KILOWATTS (kW)	Volts, Current, Power Factor	$\frac{E \times I}{1000}$	$\frac{E \times I \times 1.73 \times PF}{1000}$
KVA	Volts, Current	$\frac{E \times I}{1000}$	$\frac{E \times I \times 1.73}{1000}$
AMPERES	kW, Volts, Power Factor	$\frac{kW \times 1000}{E}$	$\frac{kW \times 1000}{E \times 1.73 \times PF}$
WATTS	Volts, Amps, Power Factor	Volts x Amps	E x I x 1.73 x PF
NO. OF ROTOR POLES	Frequency, RPM	$\frac{2 \times 60 \times Frequency}{RPM}$	$\frac{2 \times 60 \times frequency}{RPM}$
FREQUENCY	RPM, No. of Rotor Poles	$\frac{RPM \times Poles}{2 \times 60}$	$\frac{RPM \times Poles}{2 \times 60}$
RPM	Frequency, No. of Rotor Poles	$\frac{2 \times 60 \times Frequency}{Rotor\ Poles}$	$\frac{2 \times 60 \times Frequency}{Rotor\ Poles}$
kW (required for Motor)	Motor Horsepower, Efficiency	$\frac{HP \times 0.746}{Efficiency}$	$\frac{HP \times 0.746}{Efficiency}$
RESISTANCE	Volts, Amperes	$\frac{E}{I}$	$\frac{E}{I}$
VOLTS	Ohms, Amperes	I x R	I x R
AMPERES	Ohms, Volts	$\frac{E}{R}$	$\frac{E}{R}$

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

Weights and Measures

U.S. WEIGHTS AND MEASURES

LINEAR MEASURE

		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 MILE	=	5,280	FEET
1	SCOTS MILE	=	5,952	FEET
1	IRISH MILE	=	6,720	FEET
1	RUSSIAN VERST	=	3,504	FEET
1	ITALIAN MILE	=	4,401	FEET
1	SPANISH MILE	=	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 MEASURE

144	SQUARE INCHES	=	1	SQUARE FOOT
9	SQUARE FEET	=	1	SQUARE YARD
30¼	SQUARE 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	LBS.
1	GALLON (U.S.)	=	231	CU. INCHES OF WATER
1	GALLON (IMPERIAL)	=	277¼	CU. INCHES OF WATER

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 MEASURE:

(THE UNIT IS THE METER = 39.37 INCHES)

1	CENTIMETER	= 10	MILLIMETERS	=	0.3937011	IN.
1	DECIMETER	= 10	CENTIMETERS	=	3.9370113	INS.
1	METER	= 10	DECIMETERS	=	1.0936143	YDS.
				=	3.2808429	FT.
1	DEKAMETER	= 10	METERS	=	10.936143	YDS.
1	HECTOMETER	= 10	DEKAMETERS	=	109.36143	YDS.
1	KILOMETER	= 10	HECTOMETERS	=	0.62137	MILE
1	MYRIAMETER	= 10,000 METERS				

SQUARE MEASURE:

(THE UNIT IS THE SQUARE METER = 1549.9969 SQ. INCHES)

1	SQ. CENTIMETER	= 100	SQ. MILLIMETERS	=	0.1550	SQ. IN.
1	SQ. DECIMETER	= 100	SQ. CENTIMETERS	=	15.550	SQ. INS.
1	SQ. METER	= 100	SQ. DECIMETERS	=	10.7639	SQ. FT.
1	SQ. DEKAMETER	= 100	SQ. METERS	=	119.60	SQ. YDS.
1	SQ. HECTOMETER	= 100	SQ. DEKAMETERS			
1	SQ. KILOMETER	= 100	SQ. HECTOMETERS			

(THE UNIT IS THE "ARE" = 100 SQ. METERS)

1	CENTIARE	= 10	MILLIARES	=	10.7643	SQ. FT.
1	DECIARE	= 10	CENTIARES	=	11.96033	SQ. YDS.
1	ARE	= 10	DECIARES	=	119.6033	SQ. YDS.
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 CU. INS.)

1	DECISTERE	= 10	CENTISTERES	=	3.531562	CU. FT.
1	STERE	= 10	DECISTERES	=	1.307986	CU. YDS.
1	DEKASTERE	= 10	STERES	=	13.07986	CU. YDS.

METRIC SYSTEM

CUBIC MEASURE:

(THE UNIT IS THE METER = 39.37 INCHES)

1 CU. CENTIMETER	= 1000 CU. MILLIMETERS	= 0.06102	CU. IN.
1 CU. DECIMETER	= 1000 CU. CENTIMETERS	= 61.02374	CU. IN.
1 CU. METER	= 1000 CU. DECIMETERS	= 35.31467	CU. FT.
	= 1 STERE	= 1.30795	CU. YDS.
1 CU. CENTIMETER (WATER)		= 1	GRAM
1000 CU. CENTIMETERS (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	GRAMS	= 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	= 0.56438	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 $\frac{\text{MILES}}{5} \times 8 = \text{KILOMETERS}$

METRIC DESIGNATOR AND TRADE SIZES

METRIC DESIGNATOR												
12	16	21	27	35	41	53	63	78	91	103	129	155
³/₈	½	¾	1	1¼	1½	2	2½	3	3½	4	5	6
TRADE SIZE												

U.S. WEIGHTS & MEASURES / METRIC EQUIVALENT CHART

	In.	Ft.	Yd.	Mile	Mm	Cm	M	Km
1 Inch =	1	.0833	.0278	$1.578x10^{-5}$	25.4	**2.54**	.0254	$2.54x10^{-3}$
1 Foot =	12	1	.333	$1.894x10^{-4}$	304.8	**30.48**	.3048	$3.048x10^{-4}$
1 Yard =	36	3	1	$5.6818 x10^{-4}$	914.4	91.44	**.9144**	$9.144x10^{-4}$
1 Mile =	63,360	5,280	1,760	1	1,609,344	160,934.4	1,609.344	**1.609344**
1 mm =	**.03937**	.0032808	$1.0936x10^{-3}$	$6.2137x10^{-7}$	1	0.1	0.001	0.000001
1 cm =	**.3937**	.0328084	.0109361	$6.2137x10^{-6}$	10	1	0.01	0.00001
1 m =	39.37	3.28084	**1.09361**	$6.2137x10^{-4}$	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

In. = Inches Ft. = Foot Yd. = Yard Mi. = Mile Mm = Millimeter Cm = Centimeter M = Meter Km = Kilometer

EXPLANATION OF SCIENTIFIC NOTATION:

Scientific Notation is simply 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 & 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.

Example: $186{,}000 = 1.86 \times 10^5$ $0.000524 = 5.24 \times 10^{-4}$

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 . . . . . Equals 0.7854 sq. mil
1 SQ. MIL . . . . . Equals 1.27 cir. mils
1 MIL . . . . . Equals 0.001 in.

To determine circular mil of a conductor:

ROUND CONDUCTOR . . . . . CM = (Diameter in mils)²

BUS BAR . . . . . $CM = \frac{\text{Width (mils)} \times \text{Thickness (mils)}}{0.7854}$

NOTES: 1 Millimeter = 39.37 Mils 1 Cir. Millimeter = 1550 Cir. Mils
1 Sq. Millimeter = 1974 Cir. Mils

NOTES

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Bulletin 0172610SBY Printed in USA Rev. 05/09