Appendix G

Generator Information*

Sizing a Generator - How to Determine What Size You Need

Getting a generator that can handle all your power generation needs is one of the most critical aspects of the purchasing decision. Whether you are interested in prime or standby power, if your new generator can't meet your specific requirements then it simply won't be doing anyone any good because it can put undue stress on the unit and even damage some of the devices connected to it. Unfortunately, determining exactly what size of generator to get is often very difficult and involves a number of factors and considerations.

Making a choice amongst single phase, three phase, kW, KVA, welder, standby or motor starting generators can be mind-boggling. To prevent such confusion, this article was developed to help you get a better idea of how the sizing process works and some key things to keep in mind. This is not a substitute for a certified electrician, which we always suggest talking to before buying, but it should provide you with enough information to get a solid understanding of some of the key things that are involved.

Generator Size Variations: With the latest advancements in the field of electrical engineering, generators are now available in a wide range of sizes. Generators with power supply capacities of 5kW to 50kW are readily available in the personal and home use markets, while industrial generators are anywhere from 50kW to over 3 Megawatts. Handy and portable gensets are available for homes, RV's and small offices, but larger businesses, data centers, buildings, plants, and industrial applications need to use the much larger sized industrial generators to meet their higher power requirements.

Generator Sizing - How Much Power? Many people believe smaller generators can be used for standby electric power because they are not running all the time. This is not only a myth but can actually be very detrimental. Unfortunately, generator under sizing is one of the most common mistakes committed by buyers. Not only does it involve the risks of damaging your new asset (the generator), but also it can damage other assets connected to it, create hazardous situations, and even limit overall productivity of the unit and/or the business relying on it. If nothing else, the key thing to remember here is that more is always better than less.

How to Determine the Right Size Engine or Generator: While there is no substitute for having a certified electrician perform an inspection and calculate everything for you, the guidelines below do offer some great starting points and should at least get you started in the right direction:

Know Your Requirements: Going to a dealer and buying the best or cheapest generator available without any other consideration is clearly not the best approach. It is always better to delve deep into your power generation requirements before making a choice. You can do this in the following ways:

- Make a list of the items that need to be powered by the generator
- Make a note of the starting and running wattage of the respective items

- Calculate the total power requirements in KVA or KW

How to Find the Starting and Running Wattage: Getting the right starting and running wattage of the devices you intend to power is crucial for calculating the accurate power requirements. Normally, you will find these in the identification plate or the owner's manual in the buyer's kit of each respective device, tool, appliance, or other electrical equipment.

Ampere - Watt Conversion: You may often find power requirements of tools stated in amperes. In order to convert the power requirement of a tool from ampere to watts, follow these calculations.

For resistive load: Wattage = amperes x volts

For reactive load: Wattage = (amperes x volts) x load factor

Power Requirement Charting: It often happens that you lose the owner's manual or for some reason can't find the power requirement specification of the tools and/or other electrical devices you're running. Attached is a sample power consumption chart that demonstrates some of the typical wattages used for common appliances and tools. The chart is simply provided as an example to demonstrate how starting and running wattages differ, and how each device has specific consumption needs. If you have questions over any particular items you can contact the manufacturer, consult an electrician, or contact us for a free consultation.

Different ways of Calculating: Depending upon the type and number of devices, and the way the generator is scheduled to be used, there are a few different ways of calculating power requirements:

- Single motor running
- Multiple motors running simultaneously
- No electric motors.

Advantages of choosing the right size generator: Now that you have an idea on how to choose the appropriate size of generator to suit your needs, here's just a few of the benefits obtained by going through that process:

- No unexpected system failures
- No shutdowns due to capacity overload
- Increased longevity of the generator
- Guaranteed performance
- Smoother hassle-free maintenance
- Increased system life span
- Assured personal safety
- Much smaller chance of asset damage

Maintenance- Generators need to be started and run a minimum of 4 times a year or according to manufacturer recommendations.

Standard Electrical Formulas Used for Power Consumption Calculations

TO DETERMINE:	SINGLE-PHASE	THREE-PHASE	DIRECT CURRENT
KVA	$\frac{I \times E}{1000}$	$\frac{I \times E \times 1.73}{1000}$	--------
Kilowatts	$\frac{I \times E \times PF}{1000}$	$\frac{I \times E \times 1.73 \times PF}{1000}$	$\frac{I \times E}{1000}$
Horsepower	$\frac{I \times E \times \%EFF \times PF}{746}$	$\frac{I \times E \times 1.732 \times \%EFF \times PF}{746}$	$\frac{I \times E \times \%EFF}{746}$
Amperes (when HP is known)	$\frac{HP \times 746}{E \times \%EFF \times PF}$	$\frac{HP \times 746}{1.73 \times E \times \%EFF \times PF}$	$\frac{HP \times 746}{E \times \%EFF}$
Amperes (when kW is known)	$\frac{KW \times 1000}{E \times PF}$	$\frac{KW \times 1000}{1.73 \times E \times PF}$	$\frac{KW \times 1000}{E}$
Amperes (when KVA is known)	$\frac{KVA \times 1000}{E}$	$\frac{KVA \times 1000}{1.73 \times E}$	--------

Guide to Standard Uints	
Kilo Volt Amperes	kVA
KiloWatts (1000 watts = 1 kW)	kW
Ampere (Volt-Amperes or Current)	I
Volts	E
Power Factor	PE
Percent Efficiency	%EFF
Horse Power	HP

A very useful power conversion calculator is located on the following website:
www.dieselserviceandsupply.com/Power_Calculator.aspx

Power Consumption Chart

This chart is provided as an example as to how wattage varies between various electrical devices. It is not meant to be a strict guide to calculate your requirements. For the most accurate calculations refer to the owners manual of each device, tool, appliance, etc., or most preferably, consult a professional electrician:

Item	Starting Wattage (W)	Running Wattage (W)
Circular Saw	2400	1200
Drill	1800	720
Edger	2400	960
Electric Chainsaw	2400	1200
Electric Lawn Mower	4320	1440
Electric Pressure Washer	3600	1200
Electric String Trimmer	1500	600
Jig Saw	1800	720
Miter Saw	2100	840
Orbital Sander	1800	600
Paint Sprayer	1080	360
Planer	2400	960
Router	1500	600
Water Pump	3000	1000
Wet/Dry Vacuum	2500	888
Winch	5400	1800
Furnace Fan, gas/fuel oil furnace		
1/8 horsepower (hp)	500	300
1/6 horsepower (hp)	750	500
1/4 horsepower (hp)	1000	600
2/5 horsepower (hp)	1400	700
3/5 horsepower (hp)	2350	875
Central Air Conditioner		
10,000 BTU	2200	1500
20,000 BTU	3300	2500
24,000 BTU	4950	3800
32,000 BTU	6500	5000
40,000 BTU	6700	6000
1/4' Drill	300	300
Jigsaw	300	300
Electric Weed Trimmer	500	500
Belt Sander	1000	1000
Disc Sander	1200	1200
Chain Saw	1200	1200
Worm Drive Saw	3100	1560
12' Concrete Cutter	3600	1800
7 1/4' Circular Saw	3000	1500
Disc Grinder	4000	2000
Air Compressor (Average)	4000	2000

kVa/kW Amperage Chart

This chart estimates the output amperage of a generator based on the operating power and voltage. Please note that this table is intended to be used as an estimate of how many amps a generator outputs during operation and is not an exact representation due to various factors that can increase or decrease this value.

80 % Power Factor

kVa	kW	208V	220V	240V	380V	400V	440V	450V	480V	600V	2400V	3300V	4160V
8	6.3	**17.5**	16.5	15.2	9.6	9.1	8.3	8.1	**7.6**	6.1			
9.4	7.5	**26.1**	24.7	22.6	14.3	13.6	12.3	12	**11.3**	9.1			
12.5	10	**34.7**	33	30.1	19.2	18.2	16.6	16.2	**15.1**	12			
18.7	15	**52**	49.5	45	28.8	27.3	24.9	24.4	**22.5**	18			
25	20	**69.5**	66	60.2	38.4	36.4	33.2	30.1	**24**	6	4.4	3.5	
31.3	25	**87**	82.5	75.5	48	45.5	41.5	40.5	**37.8**	30	7.5	5.5	4.4
37.5	30	**104**	99	90.3	57.6	54.6	49.8	48.7	**45.2**	36	9.1	6.6	5.2
50	40	**139**	132	120	77	73	66.5	65	**60**	48	12.1	8.8	7
62.5	50	**173**	165	152	96	91	83	81	**76**	61	15.1	10.9	8.7
75	60	**208**	198	181	115	109	99.6	97.5	**91**	72	18.1	13.1	10.5
93.8	75	**261**	247	226	143	136	123	120	**113**	90	22.6	16.4	13
100	80	**278**	264	240	154	146	133	130	**120**	96	21.1	17.6	13.9
125	100	**347**	330	301	192	182	166	162	**150**	120	30	21.8	17.5
156	125	**433**	413	375	240	228	208	204	**188**	150	38	27.3	22
187	150	**520**	495	450	288	273	249	244	**225**	180	45	33	26
219	175	**608**	577	527	335	318	289	283	**264**	211	53	38	31
250	200	**694**	660	601	384	364	332	324	**301**	241	60	44	35
312	250	**866**	825	751	480	455	415	405	**376**	300	75	55	43
375	300	**1040**	990	903	576	546	498	487	**451**	361	90	66	52
438	350	**1220**	1155	1053	672	637	581	568	**527**	422	105	77	61
500	400	**1390**	1320	1203	770	730	665	650	**602**	481	120	88	69
625	500	**1735**	1650	1504	960	910	830	810	**752**	602	150	109	87
750	600	**2080**	1980	1803	1150	1090	996	975	**902**	721	180	131	104
875	700	**2430**	2310	2104	1344	1274	1162	1136	**1052**	842	210	153	121
1000	800	**2780**	2640	2405	1540	1460	1330	1300	**1203**	962	241	176	139
1125	900	**3120**	2970	2709	1730	1640	1495	1460	**1354**	1082	271	197	156
1250	1000	**3470**	3300	3009	1920	1820	1660	1620	**1504**	1202	301	218	174
1563	1250	**4350**	4130	3765	2400	2280	2080	2040	**1885**	1503	376	273	218
1875	1500	**5205**	4950	4520	2880	2730	2490	2440	**2260**	1805	452	327	261
2188	1750			5280	3350	3180	2890	2830	**2640**	2106	528	380	304
2500	2000			6020	3840	3640	3320	3240	**3015**	2405	602	436	348
2812	2250			6780	4320	4095	3735	3645	**3400**	2710	678	491	392
3130	2500			7520	4800	4560	4160	4080	**3765**	3005	752	546	435
3750	3000			9040	5760	5460	4980	4880	**4525**	3610	904	654	522
4375	3500			10550	6700	6360	5780	5660	**5285**	4220	1055	760	610
5000	4000			12040	7680	7280	6640	6480	**6035**	4810	1204	872	695

Approximate Fuel Consumption Chart

This chart approximates the fuel consumption of a diesel generator based on the size of the generator and the load at which the generator is operating at. Please note that this table is intended to be used as an estimate of how much fuel a generator uses during operation and is not an exact representation due to various factors that can increase or decrease the amount of fuel consumed.

Generator Size (kW)	1/4 Load (gal/hr)	1/2 Load (gal/hr)	3/4 Load (gal/hr)	Full Load (gal/hr)
20	0.6	0.9	1.3	1.6
30	1.3	1.8	2.4	2.9
40	1.6	2.3	3.2	4.0
60	1.8	2.9	3.8	4.8
75	2.4	3.4	4.6	6.1
100	2.6	4.1	5.8	7.4
125	3.1	5.0	7.1	9.1
135	3.3	5.4	7.6	9.8
150	3.6	5.9	8.4	10.9
175	4.1	6.8	9.7	12.7
200	4.7	7.7	11.0	14.4
230	5.3	8.8	12.5	16.6
250	5.7	9.5	13.6	18.0
300	6.8	11.3	16.1	21.5
350	7.9	13.1	18.7	25.1
400	8.9	14.9	21.3	28.6
500	11.0	18.5	26.4	35.7
600	13.2	22.0	31.5	42.8
750	16.3	27.4	39.3	53.4
1000	21.6	36.4	52.1	71.1
1250	26.9	45.3	65.0	88.8
1500	32.2	54.3	77.8	106.5
1750	37.5	63.2	90.7	124.2
2000	42.8	72.2	103.5	141.9
2250	48.1	81.1	116.4	159.6

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