FW Power Guide to Generator Sizing and Installation

Welcome to our guide designed to help you through the process of selecting your Diesel Generator. We have tried to keep the document as simple as possible and to explain some of the commonly used industry terms. Should you have any further queries then please contact ***FW Power*** at info@fwpower.co.uk.

Generator Rating Definitions:

Prime Power: Variable Load: Unlimited hours usage with an average load factor of 70% of the published prime power rating over each 24 hour period. A 10% overload is available for 1 hour in every 12 hours of operation.
Standby Power: Variable Load: Limited to 500 hours annual usage up to 300 hours of which may be continuous running. No overload permitted.

One of the first terms you will come across for your Diesel Generator will be the rating, Prime or Standby. The above definitions are important and should be used strictly for new generator installations and as a guide for used generator installations. The difference – Warranty !! For a new generator, operation outside of the above criteria will void the manufacturers warranty; for used generators the manufacturers warranty is likely to have lapsed so small variations in the number of operating hours will not be a problem – however strict adherence to generator ratings should be applied to prevent overloading.

Sizing a Generator:

When sizing a generator it is important to take into consideration the running loads and the starting loads. For example, the running current of a 3 phase 10 HP induction motor will be approximately 13 Amps, however the starting current will be between 3 and 9 times the running current i.e. 39 to 117 Amps. It is easy to see how in an installation with a number of motors the currents can become quite large and therefore the required kVA of the generator itself will be quite large.

Modern alternators are designed to take up some of the slack when it comes to starting currents, normally to around twice the generators rated kVA.

There are ways to offset such large starting currents by using “soft start” systems, however that is beyond the scope of this document and you should contact ***FW Power*** to discuss their suitability for your installation.

So in summary to size your generator effectively you should determine all of your running loads, your starting loads and size accordingly. Something that is simple to do in a new installation but I am guessing that you do not have that information if you are installing a generator long after your building and it’s auxiliaries were put in place.

So what can you do to determine the size of the generator? Well to size it accurately you will need a site survey however the following will give you a guide.

Check the size of the main circuit breakers that protect the building. If for example this is sized at 400 Amps then this will be the maximum size of your generator. Be careful, there may be more than one cable incomer and circuit breaker.
Record your Amp's, kVA's and KW's using the appropriate metering at 2 hour intervals over a 3 day period, or if your load is stable over a 12 hour period.
Repeat the operation above from a "cold start" i.e. turn everything off and then turn it on again. This time pay particular attention to the maximums as this will include your starting loads.

How to Convert 3 Phase Amps to kVA:

Amps x Line Volts x 1.73 / 1000 = kVA

e.g. Maximum amps recorded as 632 on a 400 Volts system.

kVA = 632 x 400 x 1.73 / 1000 = 437 kVA

Transfer Switches:

Transfer switches do what they say – they transfer the load from the mains supply to the generator supply. They consist of a mains contactor, a generator contactor, an interlock to prevent both mains & generator being connected at the same time and a series of relays, timers and lamps.

With a manual transfer switch the operator has to physically switch over the selector from mains supply to generator supply. Not an ideal situation at 3am in the morning when it is dark and cold !

With an automatic transfer switch (ATS) the system senses that the mains supply has failed and after a preset time delay switches the supply over to the generator side of the switch and hey presto the lights come on. Be careful of any equipment that resets automatically to the off position upon a mains failure, these will need to be switched on manually – it is useful to have a procedure that indicates what to do in the event of a mains failure.

When sizing a transfer switch attention should be given to the current rating of both the generator supply and the mains supply. The generator may only have been rated for emergency loads whereas the mains supply will cover all loads. Generally the transfer switch will have two contactors of the same size inside. So if the transfer switch is sized to the generator and the mains supply is much larger, the contactor in the transfer switch will continually trip out due to an over load – be careful, you have been warned !!

Generator Cabling:

So your generator is positioned and sized perfectly, what is required to make it work.

Firstly, the power cables need to be sized and connected. For a 3 phase generator you will have 3 power cables (L1, L2 and L3) a neutral cable and an earth cable. (Note for temporary installations the generator earth cable can be substituted for an earthing rod driven into the ground near the generator).

Power cables are generally armoured when they run outside of a building but can be flexible when ran inside. So what size of power cables are required? This is an answer that is best left to our installation teams or your electrician to decide. Below is a list of cable current ratings that can be used as a guide for installation. However be aware – dependent upon the nature of the cable installation - ducts, ground, grouped, spaced, clipped, cable tray, ambient temperatures, operating temperatures, aluminium conductors, copper conductors, armoured – the list is endless, the current rating of the cables can be more than halved.

Conductor area mm^2	Maximum Current Ratings in Amps	Conductor area mm^2	Maximum Current Ratings in Amps
0.5	11	25	138
0.75	14	35	167
1.0	17	50	204
1.5	21	70	259
2.5	30	95	321
4.0	41	120	374
6.0	53	150	429
10.0	75	185	496
16	100	240	595

Secondly, if the generator is expected to start automatically when the mains fails then something needs to tell the generator to start – sounds simple and it is ! The Automatic Transfer Switch that you have previously installed will have a pair of “volt free” contacts inside the panel. This is a “volt free” generator start signal and a two core cable needs to be connected from these to the generator remote start contacts located inside the generator control panel – please don’t ask which contacts, they are different for most sets and should only be connected by a competent person ! Equally some generator control systems require a 12 or 24 Volt signal in place of the “volt free” signal which can be achieved through additional wiring and relays using the generator battery supply as a source for the additional voltage.

What size cable should you use for the generator signal cable? Well in theory because it is a volt free signal you could use cable as small as 0.5 mm^2, however you would run the risk of damage due to its fragile nature. We would suggest 1.5 mm^2 to 2.5 mm^2 two core cable. Again it is good practice, although not essential, to use armoured cabling and screened cable is only required where more than one generator is connected together.

Thirdly, most generators will require some sort of auxiliary supply to power the battery charger and jacket water heater. Battery chargers are there to keep the batteries charged when the generator is not running and the jacket water heaters keeps it nice and warm and cosy so that it both starts well and takes load quickly. Since the generator only produces electricity when it is running something else is required to power these items when the generator is stationary.

The answer is a simple single phase 240 volt supply taken off the main switchboard or more usually the Transfer Panel and connected inside the generator control panel – again don't ask which contacts, they are all different ! A battery charger often requires 3 – 5 Amps and a jacket water heater upto 16 Amps (some have two!). So the required current can be as high as 39 Amps – much larger than your standard 13 Amps plug sockets at home. We would suggest 6.0 mm^2 twin and earth cable, however you may only require 2.5 mm^2 depending upon the generator requirements. As with the signal cable it is good practice but not essential to use armoured cabling and as with the power cables be careful about the installation and the potential to reduce the current carrying capability of the cable.

The signal cable and the auxiliary cable can be combined if required into a 5 core cable.

Positioning of the generator:

Generators should be positioned on flat level solid ground, ideally a cast concrete base and ideally be secured to the ground with bolts. In some instances generators are positioned on hardcore, this is OK as long as the ground is compact and stable. Although generators are isolated for vibration, not all the vibration can be removed and unless you want your generator wandering down the road make certain it is secure!

Like you and me the generator needs lots of air to breath and also like you and me hot air makes us both hot and underperform. Therefore site the generator where it has plenty of room to suck in cold air and extract hot air. Do not position the generator 1 metre away from a wall with no means for the hot air to escape and expect it to run and cool efficiently.

Also be careful that on some generators in acoustic canopies there are often air inlet vents to the sides of the generator and not just at the control panel end – be sure not to block these.

Surprisingly exhausts are hot !! In fact a few hundred degrees hot. Be careful of anything that might get too close to the exhaust and catch fire. Trees that seem OK today may become a problem once they have grown in a few years time.

Noise and dB(A) – What does it all Mean?:

Generators in acoustic enclosures are called silent generators. Three terms are broadly used in the industry to give information about the noise ratings:

Silent – 78 to 87 dB(A)
Super Silent – 72 to 78 dB(A)
Critical Silent – Below 72 dB(A)

Please note the above is just a guide and in practice a level of overlap occurs.

Again as a guide compare the above numbers with the following:

Refrigerator = 50 dB(A)
Normal Conversation = 60 dB(A)
Normal Office = 70 dB(A)
Construction Site / Busy Road = 80 dB(A)
Underground Train = 90 dB(A)

Noise levels are logarithmic, so a 40 dB(A) noise is not twice as loud as a 20 dB(A) noise, in fact it is more than 9 times as loud.

Noise can be reduced in a number of ways but the most common are absorption and distance:

Absorption is how most silencers and generator acoustic housings work. Noise is an energy wave and each time the noise is passed through a material or bounced off a solid structure a little is absorbed – just like a football being kicked against a wall - it is retuned to you slower than when you kicked it.

Distance is quite simple, the further from a noise source you are the quieter it gets. A sound wave radiates so the further from the source the more the radiated area increases and the noise reduces As a guide the noise will reduce by 1 dB(A) per metre for the first 10 metres from the source and by 6 dB(A) for every doubling of the distance above 10 metres.

So 85 dB(A) at 1m would work as follows:

85 dB(A) @ 1m
83 dB(A) @ 3m
80 dB(A) @ 6m
76 dB(A) @ 10m
70 dB(A) @ 20m
64 dB(A) @ 40m

Again this is a very rough guide and should not be used as a rule of thumb.

Contact Information:

Hopefully this document has given you a beginner's guide into sizing and installing a generator.

For further information please feel free to contact FW Power on 01782 623139 or email us at info@fwpower.co.uk.

And now for the disclaimer:

The information provided in this document is for guidance only and represents the views of the author. Only suitable qualified personnel should be used to size, install and commission generators. Failure to follow the manufacturers recommended guidelines can result in serious injury and death.