

Demystifying electrical generators and decibel levels

This article is written by George Long at Aggreko, after I had some concerns in how close we can place the size generators we needed to our stage without there being any issues of generator noise bleeding into the film. I had asked him to help ensure we were receiving “whisper quiet” generators. Here is his very well thought out reply:

First off, there's no industry or any other standard that is “whisper quiet”, it's a marketing term.

Film grade – surprisingly the “crystal sync” phrase didn't get referred to. Film grade would simply mean that the generator has some sort of electronic governing versus mechanical speed control. Think your average gas generator that cycles according to load – you drop a higher demand on it and for a second or so, the voltage drops as the engine tries to catch up. This is caused by magnetic resistance imposed in the generator end – As the demand increases (trying to draw more out of the straw as it were), the increase causes more magnetic resistance which needs to be compensated for within the windings.



Twin pack 1.5 MW Generators capable of providing electricity to 330 households

Think of it like this – you're towing a boat down the highway and have cruise control on going 65 MPH. If that road is flat, the amount of energy required to keep it going at 65 MPH remains the same. However, if you hit a hill that load (the boat) starts to slow down the truck because the amount of available energy, assuming all factors are constant, exceeds the energy available to get up that hill – so what does the cruise control do? It applies more fuel to bring the vehicle back to 65. Typically there's a lull where the engine basically has to catch up to the load. The same works in reverse, you crest that hill and start to go down and there's less demand (load) on the truck and the cruise control doesn't need to feed as much into the engine to keep the speed up.

With generators it's roughly the same thing – as the load, in this case, amperage demand increase, it's like hitting that hill. However we want the speed to remain constant always ~ speed = frequency/Hertz. If it was just mechanically governed (some construction generators have this with a bar you pull out to set engine speed), there's a lag as the engine demands more fuel, and your lights dim, etc. With electronic

governing, the generator senses things like the RPM and voltage a lot sooner than when the demand is there and compensates earlier/faster. Think of this like if you see the hill coming and you start to feed more into the engine prior to reaching the hill with your boat. You don't notice the lag as much, if at all. Maybe another way of thinking about electronic generators control is using a super computer to calculate pi versus your I Phone app. You get there both ways but it's a lot faster with the super computer.

Typically any filming or taping needs a steady sine wave at a precise Hertz or frequency. This is to ensure that the image speed remains consistent but it's really a moot point. The plants have Deep Sea electronic controllers in them which regulate all the applicable elements to ensure this.

65db – Where? At 3 M? 7M? Engine end? Controller end? Averaged? Here's a handy chart on average noise levels –

Environmental Noise	
Weakest sound heard	0dB
Whisper Quiet Library at 6'	30dB
Normal conversation at 3'	60-65dB
Telephone dial tone	80dB
City Traffic (inside car)	85dB
Train whistle at 500', Truck Traffic	90dB
Jackhammer at 50'	95dB
Subway train at 200'	95dB
<i>Level at which sustained exposure may result in hearing loss</i>	<i>90 – 95dB</i>
Hand Drill	98dB
Power mower at 3'	107dB

Snowmobile, Motorcycle	100dB
Power saw at 3'	110dB
Sandblasting, Loud Rock Concert	115dB
<i>Pain begins</i>	<i>125dB</i>
Pneumatic riveter at 4'	125dB
<i>Even short term exposure can cause permanent damage – Loudest recommended exposure <u>WITH</u> hearing protection</i>	<i>140dB</i>
Jet engine at 100'	140dB
12 Gauge Shotgun Blast	165dB
Death of hearing tissue	180dB
Loudest sound possible	194dB

OSHA Daily Permissible Noise Level Exposure	
Hours per day	Sound level
8	90dB
6	92dB
4	95dB
3	97dB
2	100dB
1.5	102dB
1	105dB
.5	110dB
.25 or less	115dB

Perceptions of Increases in Decibel Level	
Imperceptible Change	1dB

Barely Perceptible Change	3dB
Clearly Noticeable Change	5dB
About Twice as Loud	10dB
About Four Times as Loud	20dB

Sound Levels of Music	
Normal piano practice	60 - 70dB
Fortissimo Singer, 3'	70dB
Chamber music, small auditorium	75 - 85dB
Piano Fortissimo	84 - 103dB
Violin	82 - 92dB
Cello	85 - 111dB
Oboe	95 - 112dB
Flute	92 - 103dB
Piccolo	90 - 106dB
Clarinet	85 - 114dB
French horn	90 - 106dB
Trombone	85 - 114dB
Tympani & bass drum	106dB
Walkman on 5/10	94dB
Symphonic music peak	120 - 137dB
Amplifier, rock, 4-6'	120dB
Rock music peak	150dB

NOTES:

- *One-third of the total power of a 75-piece orchestra comes from the bass drum.*
- *High frequency sounds of 2-4,000 Hz are the most damaging. The uppermost octave of the piccolo is*

2,048-4,096 Hz.

- Aging causes gradual hearing loss, mostly in the high frequencies.
- Speech reception is not seriously impaired until there is about 30 dB loss; by that time severe damage may have occurred.
- Hypertension and various psychological difficulties can be related to noise exposure.
- The incidence of hearing loss in classical musicians has been estimated at 4-43%, in rock musicians 13-30%.
- Recent NIOSH studies of sound levels from weapons fires have shown that they may range from a low of 144 dB SPL for small caliber weapons such as a 0.22 caliber rifle to as high as a 172 dB SPL for a 0.357 caliber revolver. Double ear protection is recommended for shooters, combining soft, insertable ear plugs and external ear muffs.

At 7 M, the "rating" of the 200 is 70 dbA – so less than a singer. Then add to this the inverse law of squares which says that any intensity is inversely proportional to the square of the distance from the source. A quick rule of thumb is sound level will decrease 6 db for every time the distance is doubled, although the calculations are slightly more complex than that.



SIMPLE EQUATION FOR PREDICTING A SOUND LEVEL:

*If you measure a sound level 70 = dB
at distance*

d1 = 7 m = 22.965 ft

then at distance

d2 = 20m = 65.616 ft

the inverse square law predicts a sound level

I2 = 50 dB

$i_2/i_1 = [d_1/d_2]^2$

Thank you, Geo! He also collaborated on our [Electricity Guide](#) if you would like to read up even more about power.