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WHITE PAPER

Understanding Commercial and Industrial Generator Noise

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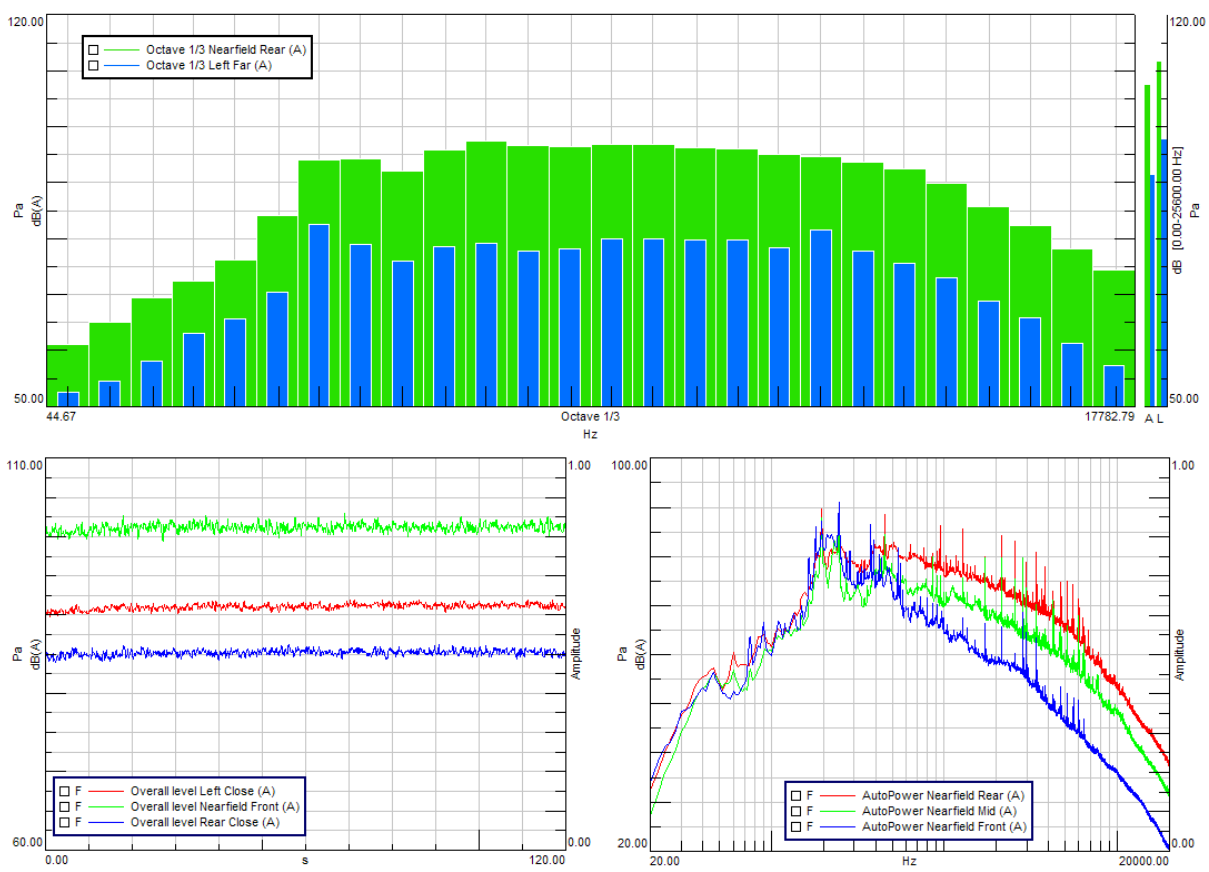
INTRODUCTION

Commercial and Industrial generators are becoming a common and necessary addition for commercial businesses and industrial manufacturing. Their increased presence in cities and industrial parks has brought attention to the noise created by generators and how that noise should be assessed. This brief will explain the various operating modes of commercial/industrial generators as well as the challenges of predicting and measuring noise in order to comply with regulations.



OPERATING MODES

A standby generator will have three modes of operation:

- Standby / monitoring
- Regular maintenance / exercise
- Emergency power generation

During **standby mode,** the generator is monitoring the power provided by utility and watching for outages. The engine is not running, no power is being generated, and the unit is silent. Field data shows that standby mode accounts for more than 95% of a residential standby's time in any given month.

Exercise mode (if equipped) is a regularly scheduled maintenance function that verifies the generator is in proper working order when it is needed. Because there is no power requirement during low speed exercise, the generator will run at a lower engine speed. This further reduces the noise generated by the unit and conserves fuel. Figure 1 illustrates the potential difference between exercise and standby mode sound levels.

It is the responsibility of the owner to set the maintenance schedule such that it falls within the noise community guidelines for acceptable noise.

During **emergency power generation mode** the generator has sensed that there is a utility loss. Within seconds, it starts the engine and provides voltage to the business. This keeps various emergency circuits active such as computer systems and lights, preventing loss of production and keeping the business operating. Because the generator is only active during emergency conditions, it should be exempt from noise regulations under clauses that include necessary equipment operation during an emergency.

MANUFACTURER NOISE SPECIFICATIONS AND NOISE ORDINANCES

Product specification sheets will often list noise emissions as a sound pressure level. It is important to remember that sound pressure level is an observed value rather than a guaranteed value under all conditions. This means that a generator listed with a sound pressure of 75 dB(A)-SPL will not automatically violate a noise ordinance of 65 dB(A) at the property edge per AHJ.

Every sound pressure measurement is impacted by the following factors:

- Distance
- Ambient noise conditions
- Reflective surfaces

Accurate predictions of sound pressure levels at a given site or installation is a complex problem that would require highly accurate models and complicated software. The most accurate way to is to measure an installed, running unit at the installation site.

DISTANCE

A common request is to predict the change in sound pressure level over a given distance. The behavior of a noise source in a free field is relatively predictable using the simple math shown below (Equation 1). The caveat is that generators are rarely installed in the same idealized conditions under which they are tested. The presence of a building or wall near the unit will make prediction much more difficult, but the formula below is useful for rough estimates.

Where L1 is the measured level (in dB), d2 is the desired distance, and d1 is the distance at which L1 was measured.

Example: A unit was measured to have a sound pressure level of 70 dB(A) at 7 m. A customer needs to know how loud the unit will be at a shorter distance of 3 m. The above formula shows an increase of 7 dB(A) for a predicted value of 77 dB(A). The formula works for greater distances, as well. Doubling the desired distance to 14 m yields a reduction of 6 dB(A) for a predicted value of 64 dB(A).

$$L_2 = L_1 - 20\log\left(\frac{d_2}{d_1}\right)$$

Equation 1 - Free Field Sound Divergence

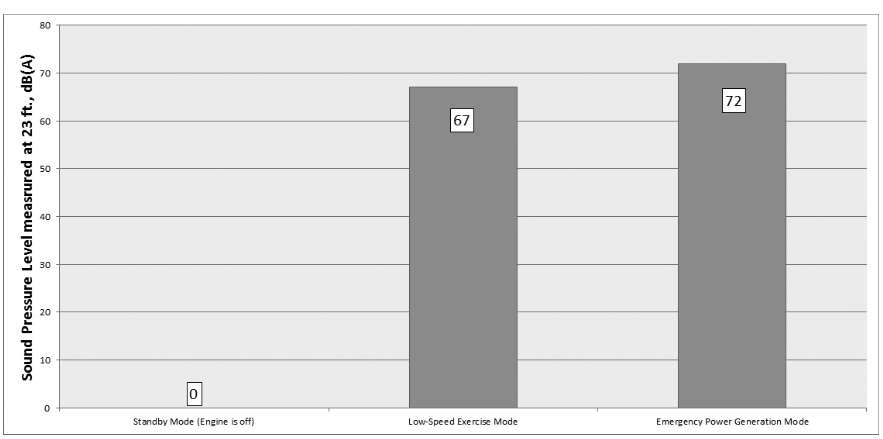


Figure 1 - Example Commercial Generator Sound Levels

AMBIENT NOISE CONDITIONS

Municipal codes should be reviewed and assessed to make ensure that their requirements are achievable. A common requirement is an upper limit of 70 dB(A) during the day. The noise floor due to human activity (traffic, etc.) can easily bring the ambient conditions above 55 to 60 db(A) during the daytime (Figure 2). Certain activities such as yard work (lawn mowing, leaf blowing, snow removal) will exceed such ordinances on a regular basis.

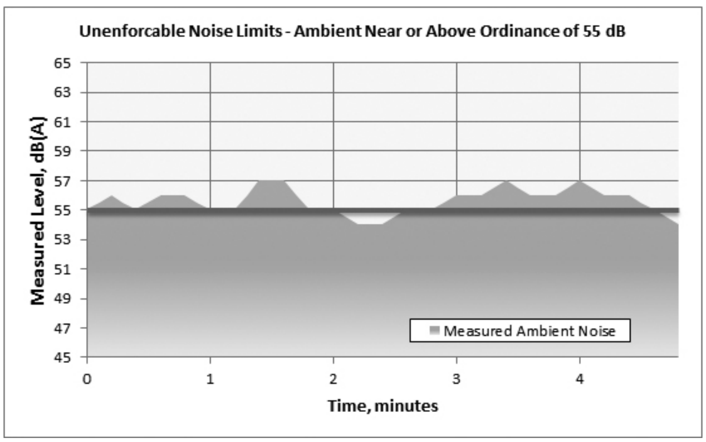


Figure 2 - Ambient Noise Conditions

Example 1

A generator noise measurement is taken at the property line of 57 dB(A). The ambient noise conditions are 49 dB(A). 57-49 = 8, yielding a correction factor of -1. The 57 dB(A) measurement is corrected to 56 dB(A).

Example 2

A generator noise measurement is taken at the property line with a generator active and measures 53 dB(A). The ambient noise is measured with the generator off and yields 52 dB(A). Because the difference is less than 2 dB, the generator has a negligible impact compared to ambient.

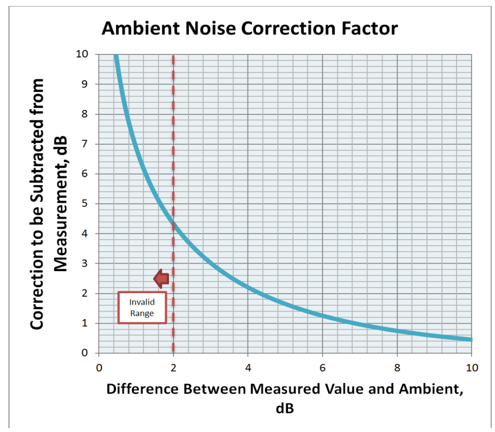


Figure 3 - Logarithmic Difference Chart

CORRECTING NOISE MEASUREMENTS FOR AMBIENT CONDITIONS

Any outdoor acoustic measurement should begin with an assessment of the ambient noise. This will determine if the noise source in question can accurately be measured. If possible, the noise source should be turned off, an ambient measurement taken, and then another measurement is taken with the noise source on. The difference between those two measurements will determine if a correction factor is needed or if the measurement is valid. Table 1 offers a quick reference for making these corrections. If more accuracy is needed, Figure 3 shows the curve used to populate the table, which was created using logarithmic subtraction of two noise sources.

Measured Source – Ambient	Correction Factor
0-2	Invalid measurement
3	-3
4-5	-2
6-9	-1

Table 1 - Ambient Noise Correction (Coarse)

REFLECTIVE SURFACES

Generators are measured by manufacturers under idealized conditions. This is done in a free field, or a completely unobstructed measurement area with no reflective surfaces other than a ground plane. This is done for the sake of repeatability and accuracy. Generators are rarely installed in a free field, however, and on-site measurements will incorporate the influence of reflective surfaces from houses, fences, and other structures. This will increase the measured level as the meter will be displaying the contribution from multiple sources. The first will be the direct source, or the noise coming from the generator itself. While a reflection from a nearby source will be weaker than the direct source, it has the potential to sum with the original level and increase the measured reading.