



## **GAS COMPRESSOR STATION NOISE**



# **Mueller Environmental Designs, Inc.**



**Air Filtration**  
**Evaporative Cooling**  
**Noise Control**  
**Mist Elimination**  
**Turnkey Projects**



# **GAS COMPRESSOR STATION NOISE**

There are four major sources that contribute to the overall noise level of a compressor station: the prime mover, whether it is a reciprocating engine or gas turbine; jacket water cooling or high pressure gas fin fan coolers; gas compressors, either reciprocating or centrifugal; and relief valves including compressor, piping pressure relief, blowdown, and station ESD systems.

## **Prime Movers**

### **Reciprocating Engines**

Power produced by an internal combustion engine is the result of a spark induced explosion of natural gas and air in the power cylinder. The resultant noise is a function of horse power, RPM, scavenging means, and type of ignition. Engine noise increases primarily with increase in horse power.

The predominant sources that make up engine noise are; air intake, exhaust, and casing noise.

Air intake noise is a function of the scavenging means such as naturally aspirated, pump scavenged, blower scavenged, exhaust turbocharged, and in some cases a combination.

Engine exhaust is the predominant noise source of the reciprocating engine. Naturally aspirated and pump scavenged engines are noisier in the low frequencies. Centrifugal blower scavenged engines develop both low and high frequency noise. Exhaust turbocharged engines develop broad band noise characteristics, but are generally less noisy due to the turbocharger absorbing energy from the exhaust system.

Casing noise is produced within the engine by minute mechanical component misalignment and slip fittings. The resulting acoustical radiation and vibration migrates to the engine block, cover and accessories.

### **Gas Turbines**

Gas turbines are generally very noisy due to the high horsepower output and high speed rotating blades.

The major sources of gas turbine noise are; intake, exhaust, and casing.

Intake noise is created by the interaction of the axial air compressor blades and stator, and is the function of pressure increase, number of blades and blade tip speed. The overall level of the intake noise is somewhat less than that produced by the exhaust, but its high frequency content sounds much louder than the higher-amplitude, lower frequency exhaust noise.

Exhaust from the gas producer/power turbine section is a predominant noise source. Its increase in amplitude and shift to the lower frequencies are due to the combustion process.

Casing noise is generated by the high speed misaligned mechanical components within the turbine housing radiating to the outer casing.

### **Fin Fan Coolers**

Cooling fan noise, whether it is a simple fin fan cooler or complicated cooling tower design, is produced by the rotating cooling fan blades causing air turbulence. The frequency and amplitude is a function of blade size, pitch, number, and RPM.

### **Compressors**

Both centrifugal and reciprocating compressors are used to transport gas. They are noise producers but with totally different characteristics. Centrifugal compressor noise is produced primarily by blade-tip turbulence which is a function of horsepower, RPM, mass flow, discharged pressure, number of compression stages, and type of gas. It is primarily a high frequency noise generator.

The noise produced by a reciprocating compressor is a function of horse power, number of cylinders, bore, stroke, RPM, and compression ratio. The reciprocating compressor generates a low frequency noise (pulsation).

### **Relief Valves**

Safety relief, blowdown, and vent valves are used to relieve pressure in station piping, compressors, vessels such as filter-separators, fuel gas filters, and air starter receivers. When a vent valve is open, it is typically referred to as a "blowdown".

Vent blowdown is broad band and of high amplitude. The noise level created by the vent is a function of the upstream pressure, temperature, valve size and type, and downstream piping.



*Reciprocating Engine Intake and Exhaust Silencers*



*Suction & Discharge Piping and Unit Blowdown Vent Silencer*



*Gas Turbine Exhaust Silencer*



*Gas Turbine Intake Silencer*



*Gas Turbine Skid Enclosure*



*Gas Turbine Exhaust Regenerator Silencer*



*Centrifugal Gas Compressor In Line Discharge Silencer*



*Oil Cooler Fin Fan Exhaust Silencer*

# A BRIEF GUIDE TO ACOUSTICAL TERMS

**dBA** dBA denotes an “A” -weighted sound level. The ear has differing sensitivities to different frequencies of sound, and the “A”-weighting scale was developed to correspond to the relative frequency response of the human ear. The ear is relatively insensitive to low frequency sounds compared to mid-and high frequencies as is reflected in the “A”-weighting corrections shown below. The “A” -weighted sound level has proven to be a good indicator of community annoyance to noise and is therefore often used in design criteria and community noise standards.

|     |     |     |     |     |      |      |      |      |    |
|-----|-----|-----|-----|-----|------|------|------|------|----|
| 31  | 63  | 125 | 250 | 500 | 1000 | 2000 | 4000 | 8000 | Hz |
| -39 | -26 | -16 | -9  | -3  | 0    | +1   | +1   | -1   | dB |

**L<sub>eq</sub>** L<sub>eq</sub> is the energy sound level. It is the sound level of a steady-state sound that has the same (“equivalent”) total energy as the time-varying sound measured over a specific period of time. L<sub>eq</sub> is a single-valued level that expresses the time-averaged total energy of a varying or fluctuating sound level and is an “A”-weighted level.

**L<sub>dn</sub>** L<sub>dn</sub> is the day-night sound level, which is calculated from the following equation:

$$L_{dn} = 10 \text{ Log } 1/24 [15 \times 10^{(L_d/10)} + 9 \times 10^{((L_n+10)/10)}]$$

L<sub>d</sub> is the L<sub>eq</sub> for the 15 daytime hours between 7 A.M. and 10 P.M. and L<sub>n</sub> is the L<sub>eq</sub> for the 9 nighttime hours between 10 P.M. and 7 A.M. This equation adds a 10 dB penalty to the nighttime L<sub>eq</sub> to account for the fact that noise is more disturbing at residential locations during the typically quieter nighttime hours. Most federal agencies including the Environmental Protection Agency, Housing and Urban Development and Federal Energy Regulatory Commission use the L<sub>dn</sub> measure for their criteria; in general, an L<sub>dn</sub> of 55 dBA is considered acceptable for residential areas.

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