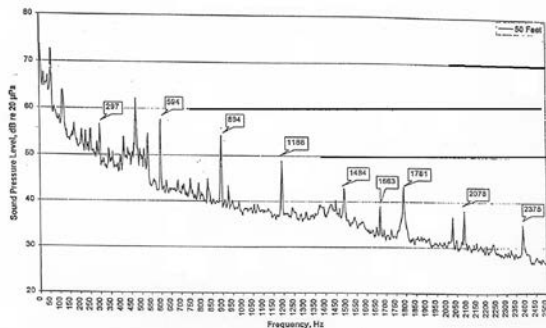


CONTROLLING CHILLER NOISE

PROBLEM DEFINITION

Air-cooled and liquid-cooled chillers utilize refrigeration compressors which generate moderate to loud levels of noise depending on the load of the chiller and the size and type of compressor used. Centrifugal models are the least noisy followed by the reciprocating, scroll, and screw designs. The tonal quality of the compressor noise, commonly referred to as the “compressor whine”, is an often overlooked or underestimated factor in assessing the noise contribution from these machines despite the fact that it is often addressed in government ordinances.



Narrowband frequency scan showing air cooled screw chiller fundamental frequency and multiple harmonics.

The narrowband frequency signature shown above is from a 140 ton air-cooled screw chiller measured at a distance of 50'. Most screw models generate their fundamental tone at the nominal 300 Hz frequency (297 Hz for the unit above). The first (600 Hz) and subsequent harmonic frequencies (nominal 900, 1200, 1500, etc. Hz) are generally of diminishing magnitude.

Condenser fans on air cooled models are a secondary contributing noise sources that may need to be addressed.

The problem is compounded by a lower tolerance for noise, lightweight modular building construction, and urban development in populated communities.

CHILLER NOISE SOURCES

- Compressors
- Vapor and oil separators
- Compressor discharge piping
- Suction elbows and piping
- Condenser fans (air-cooled)
- Building reflections
- Structural transmission
- Sheet metal housings, lagging

Screw chillers have become the specified design of choice for most new construction projects because of the low cost, high efficiency, and low maintenance they require. Screws, unfortunately, generate discrete tones that even at very low intensity levels are extremely intrusive and annoying.

Source vs. Path Control

Engineering control options must produce overall broadband dBA reductions with particular attention to attenuating the discrete compressor and condenser fan tones. The page to follow illustrates source and path control treatment strategy options and expected performance outcomes for each.



Air-Cooled Chiller with Direct Path barrier wall to block and absorb noise generated by the condenser fans and compressor circuits.

Technical Discussion

Source Control Treatments for Air-Cooled Chillers:



1) *Economy™* System



2) *Standard™* System



3) *Unitary™* System

Direct Path Treatments for Air-Cooled Chillers:



4) *Premium™* System



5) *Supreme™* System



6) *Ultimate™* System

HUSHCORE™ Noise Reduction System	Typical Noise Reduction	Application Guideline	System Description
1) <i>Economy™</i>	2 – 4 dBA	Non Critical	HUSH COVER™ removable acoustic blankets for compressors only. Patented user friendly “D” ring strapping attachment to secure blankets.
2) <i>Standard™</i>	4 – 6 dBA	Moderate Noise Reduction	HUSH COVER™ removable acoustic blankets for compressors, piping, and oil separators. Often best value in dBA reduction/\$ spent.
3) <i>Unitary™</i>	4 – 6 dBA	Condenser Fan Treatment	HUSH GUARD™ modular acoustic panels positioned to baffle the top perimeter condenser fans. Does not block unit sides.
4) <i>Premium™</i>	10 – 12 dBA	Treats Compressors and Condenser Fans	HUSH FLEX™ acoustical curtains to fully or partially enclose the unit. Exterior grade curtain construction required on outdoor applications. Ideal for chain link fence attachment.
5) <i>Supreme™</i>	12 – 15 dBA	Noise Sensitive Projects	HUSH GUARD™ modular acoustic panel barrier walls or enclosure. Horizontally stacked panels fit between vertical beam flange webs.
6) <i>Ultimate™</i>	15 – 20 dBA	Critical Projects	Same as <i>Supreme™</i> System with added HUSH DUCT™ acoustical air intake louvers and condenser fan parallel baffle exhaust.

Technical Discussion

Source Control Treatments for Liquid-Cooled Chillers:



1) *Economy™* System



2) *Standard™* System

Direct Path Treatments for Liquid-Cooled Chillers:



3) *Premium™* System



4) *Ultimate™* System

HUSHCORE™ Noise Reduction System	Typical Noise Reduction	Application Guideline	System Description
1) <i>Economy™</i>	2 – 4 dBA	Non Critical	HUSH COVER™ removable acoustic blankets for compressors only. Patented user friendly “D” ring strapping attachment to secure blankets.
2) <i>Standard™</i>	4 – 6 dBA	Moderate Noise Reduction	HUSH COVER™ removable acoustic blankets for compressors, piping and oil separators. Optional treatment of condenser shell can be included.
3) <i>Premium™</i>	12 – 15 dBA	Noise Sensitive Projects	HUSH FLEX™ acoustical curtains to fully enclose the unit. Design features include sliding perimeter panels for access, removable roof panels, complete curtain support structure, track valance, and optional control panel view window.
4) <i>Ultimate™</i>	15 – 20 dBA	Critical Projects	HUSH GUARD™ modular acoustic enclosure using 4” thick double skin solid/perf. galvanized steel panels. Design features include double front access doors, removable lift-out service access panels on the back side and cutouts for piping with split flashing coverplates.