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Amana® Brand PTAC Sound Report

As a manufacturer of PTAC equipment we realize the importance of product acoustics and sound levels to overall customer satisfaction. As a long standing member of the American Heating and Refrigeration Institute (AHRI) it is our practice to utilize U.S. based, accredited third party acoustical laboratories to test our equipment and to validate our test results from our U.S. based engineering, test, and production facilities. We also believe that back-to-back testing with our and competitive products by these third party testing facilities provide the best, most unbiased product performance comparisons. This report will discuss the various definitions regarding sound, how it is measured and the methods by which we design and test our PTAC equipment to meet industry standards. We will also show comparative results from third party testing facilities of our Amana® brand and our competitor's PTAC products.

Acoustics is the branch of science dealing with the production, control, transmission, reception and effects of longitudinal pressure waves in a material medium (gas or liquid). Sound is the sensation perceived by the sense of hearing. What can be measured and how is it measured? The sensors available measure the amplitude of the longitude pressure waves, similar to the human ear. The amplitude of these pressure waves is the **Sound Pressure** in units of Pascals (Pa). What is a longitudinal wave? It is a compression and expansion wave. The air pressure on your ear (or a microphone) increases and decreases by a small amount which is then perceived as sound. **What is a decibel or dB?** Since Sound Pressure is non-linear with respect to the human ear, the standard unit of sound measurement is the decibel. The decibel is a logarithm unit based on the threshold of human hearing. Another unit of sound measurement is the Bel (typically used for sound power levels), named after Alexander Graham Bell. Decibels are 1/10th of a Bel. **What is dBA?** dBA is an A-weighted decibel. It is a frequency weighting of the sound signal and is another attempt to calculate sound magnitude in a way that follows the human ear. Since some frequencies are perceived to be louder than others, this weighting provides a way to account for that perception. To better understand sound pressure and sound power measurements is to think in terms of an electric light bulb. **Sound Pressure Level** = Brightness, which varies at different locations around the bulb. Sound Pressure level depends on a variety of factors including distance from the sound source (PTAC in motel room), the surroundings including floor coverings, hard or soft, walls, curtains, and articles in the room or space. On the other hand **Sound Power Level** = Bulb Wattage, which has only 1 value, i.e. 75 watts.

We design and manufacture our Amana brand PTAC products to meet the Sound Rating System and Industry Standard calling out the applicable test and rating for PTAC equipment. The independent, nationally accredited and certified acoustical laboratory tested both the Amana brand and competitive equipment in accordance to ASTM Standard E90 and calculated with E413 for the Sound Transmission Classification and E1332 for the Outdoor-Indoor Transmission Classification. The Outdoor/Indoor tests were conducted in accordance with ARI Standards 350 and 270 respectively. Breul & Kjaer instrumentation were used for acoustical data acquisition during all tests.

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Each of these methods was developed for specific applications; not all methods are equally suitable for the rating of HVAC related sound in the variety of applications encountered. Several background sound rating methods are used to rate indoor sound:

Sound Transmission Class
Outdoor-Indoor Transmission Class
A-weighted sound power level (dBA or Bels)
A-weighted sound pressure level (dBA)
Noise Criteria (NC)

The A-weighted sound level is widely used to state acoustical design goals as a single number and is expressed as a number followed by dBA, for example 55 dBA. But usefulness is limited because it gives no information on the spectral content. Many different-sounding spectra can have the same numeric rating, but due to each individual's hearing capabilities, have quite different subjective qualities. Thus, **A-weighted levels** should be used with sounds that sound alike but are different in level. A-weighted sound levels correlate well with human judgments of relative loudness, but give no information on spectral balance. Thus, they do not necessarily correlate well with the potential annoyances caused by sound.

Both Sound Pressure and Sound Power are recorded and stated as dB, but when stating Sound Pressure you must also state the distance from the unit and volume of space in order to qualify the measurement.

A-weighted **sound pressure levels** are used extensively in outdoor environmental sound standards in situations with known measurement environmental factors.

A-weighted **sound power levels** are used extensively in outdoor environmental sound standards where measurement environment is a non-factor.

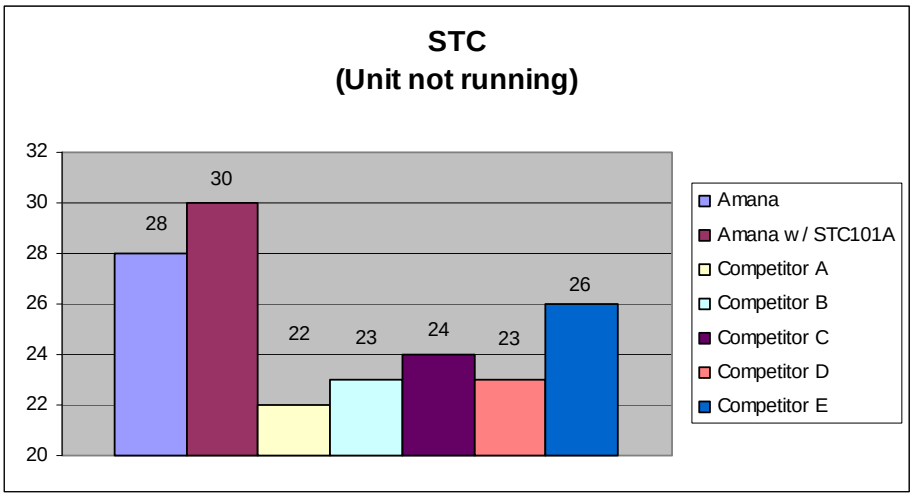
The laboratory also tested for **NC (Noise Criteria),** to provide spectral distribution of the sound using a single number. This rating has been popular in the HVAC industry for some time**.** NC ratings are used to calculate ratings for some HVAC components such as terminal units and diffusers.

For a given sound spectrum, the NC rating can be obtained by plotting its octave band levels on the set of NC curves. The sound spectrum is specified as having a NC rating same as the lowest NC curve which is not exceeded by the spectrum. NC puts more emphasis on the speech communication mid range frequencies.

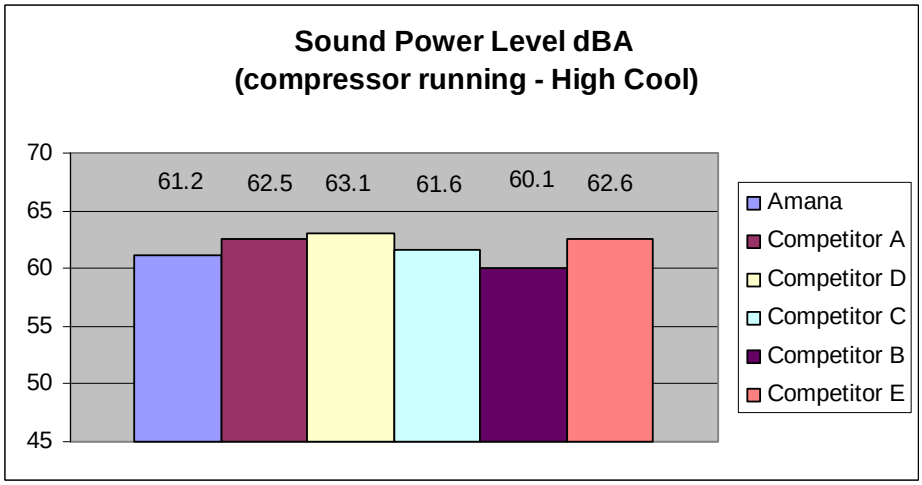
Tests were conducted to determine sound transmission loss as reported as **STC** (Sound Transmission Class) and **OITC** (Outdoor/Indoor Transmission Class). The purpose of the **STC** is to provide a single value rating that can be used to compare the sound insulating properties of partition elements for general building design purposes. The higher the **STC** rating is the greater (or better) the sound insulating properties of the tested partition. The units are not operating during the **STC** tests.

The **OITC** purpose is also to provide a single number rating that can be used for comparing building façade designs including exterior walls, doors, windows, air conditioning units and a combination thereof. This rating is designed to correlate with subjective impressions of the ability of building elements to reduce the overall loudness of ground and transportation sounds. It is intended to be used as a rank-ordering device. The higher the **OITC** rating is, the greater the sound insulating properties of the partition. The units also, are not operating during the **OITC** tests.

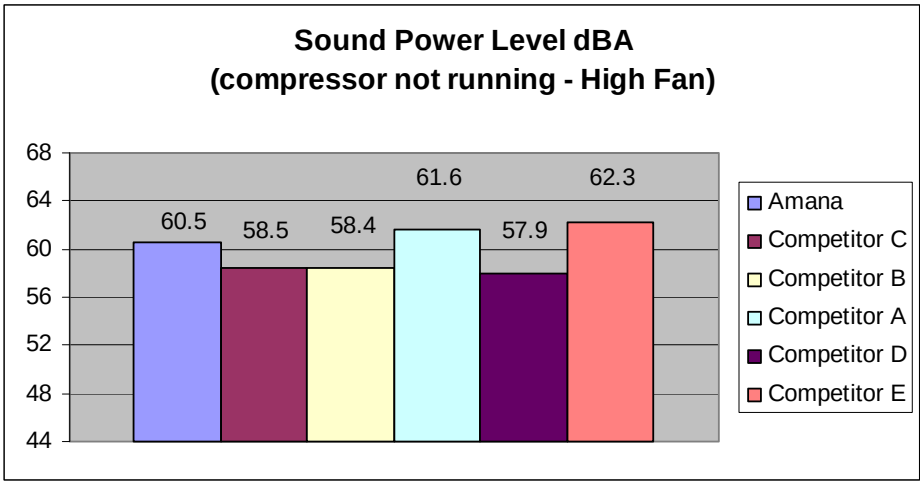
Below are the results of testing completed by our 3rd party, U.S. based accredited acoustical laboratory. The results are from testing our major competitors 12K PTAC units and our Amana 12K PTAC.



The higher the STC number the better the sound insulation of the PTAC partition.



The lower the Sound Power number the less sound is generated during operation.



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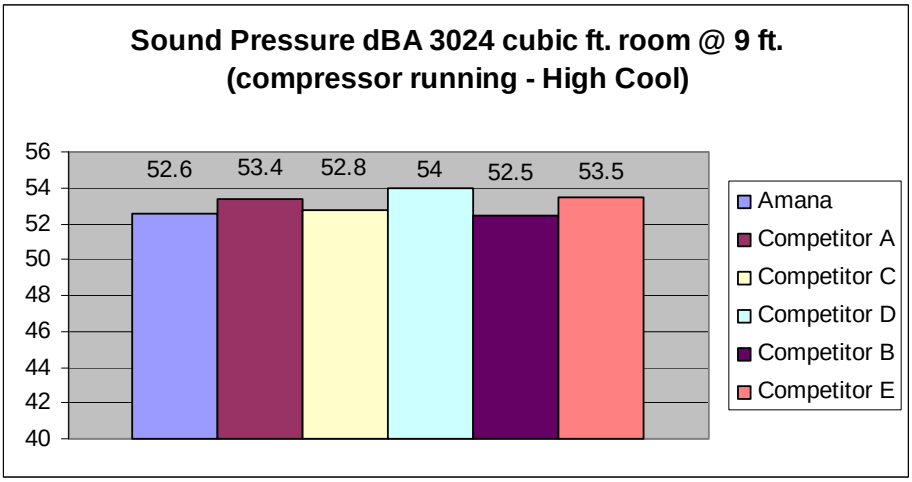

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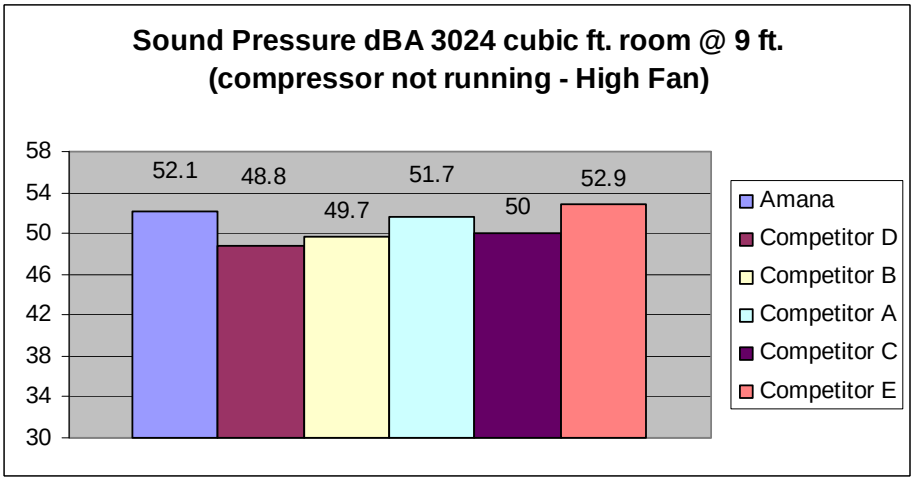

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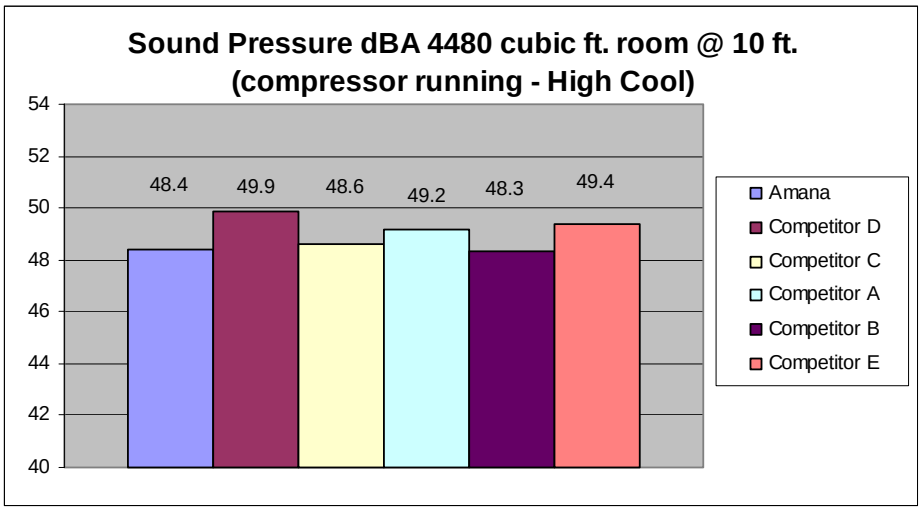

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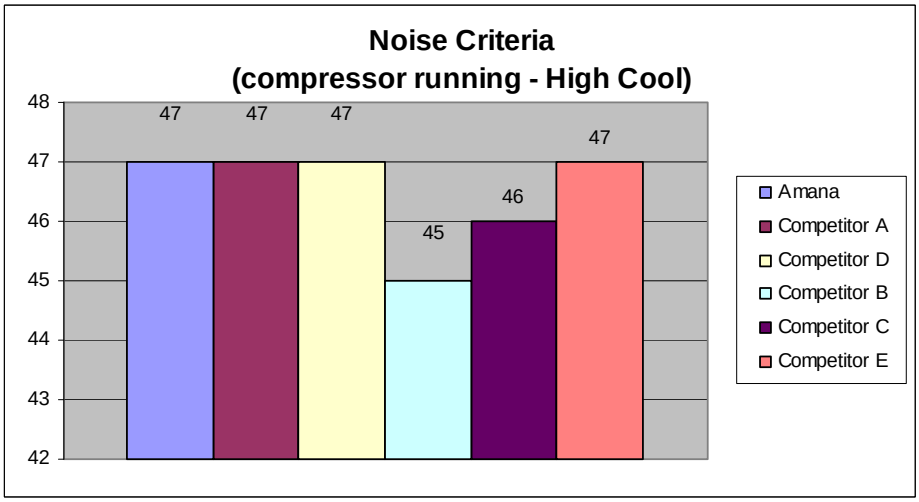

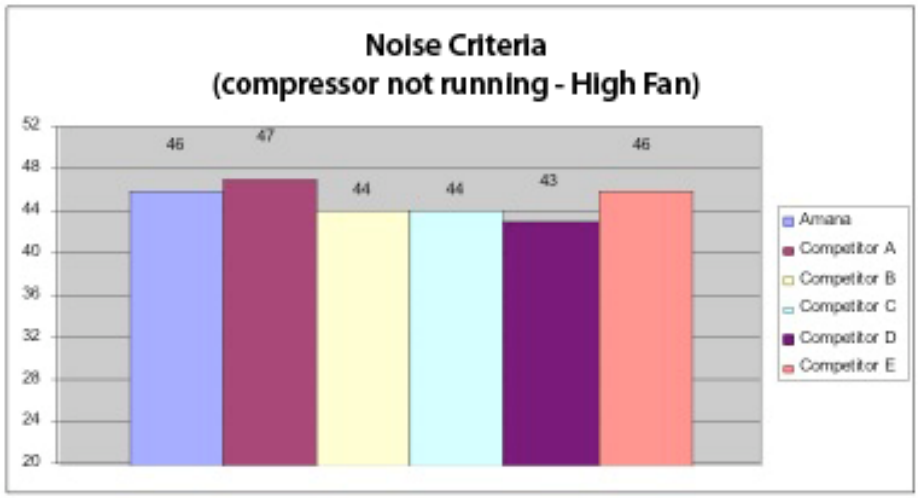

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	Amana / Amana w/ STC101A kit	Competitor A	Competitor B	Competitor C	Competitor D	Competitor E
STC (unit off)	**28/30**	**22**	**23**	**24**	**23**	**26**
Sound Power Level dBA (compressor running - High Cool)	**61.2**	**62.5**	**60.1**	**61.6**	**63.1**	**62.6**
Sound Power Level dBA (Compressor off- High Fan)	**60.5**	**61.6**	**58.4**	**58.5**	**57.9**	**62.3**
Sound Pressure dBA 3024 cubic ft room @ 9 ft (compressor running - High Cool)	**52.6**	**53.4**	**52.5**	**52.8**	**54**	**53.5**
Sound Pressure dBA 3024 cubic ft room @ 9 ft (compressor off - High Fan)	**52.1**	**51.7**	**49.7**	**50**	**48.8**	**52.9**
Sound Pressure dBA 4480 cubic ft room @ 10 ft (compressor running - High Cool)	**48.4**	**49.2**	**48.3**	**48.6**	**49.9**	**49.4**
NC - compressor running (High Cool)	**47**	**47**	**45**	**46**	**47**	**47**
NC - compressor off (High Fan)	**46**	**47**	**44**	**44**	**43**	**46**

Test Methods:
The laboratory method used in conducting these tests is in accordance with ARI 300-2000 "Sound Rating and Sound Transmission Loss of Packaged Terminal Equipment". The air conditioner was mounted in the wall of a 16,640 cu. Ft. reverberation room. The wall was constructed to minimize any wall vibration effects. Indoor/outdoor tests were conducted in accordance with ARI Standard 350 and 270 respectively. During cooling and heating tests temperature and humidity conditions in the outdoor and indoor rooms were in accordance with the standards and were held steady for one-half hour prior to and during the test.

The Bruel & Kjaer Type 4204 reference sound source (RSS) was used to obtain the sound power level data. The sound pressure levels were obtained on a Bruel & Kjaer Digital Frequency Analyzer Model 2131, analyzed on a Compaq Prolinea 4/33 Computer and printed using an Epson LQ-850 printer.

We believe that as a domestic manufacturer of PTAC equipment, we must strive to meet or exceed the demands of our customers. We strive to produce products that provide long-life and economical operation at a competitive price. The accredited, third party test data provided above validates that our Amana® brand PTAC products rank among the best in sound testing in the industry. As a long standing member of AHRI, we will continue to develop new products and drive continuous improvements to meet the needs of our customers in all areas of performance including sound and efficiency and impartially 3rd party test to standards as prescribed by AHRI and the American Society of Heating, Refrigeration and Air-conditioning Engineers.