



ACOUSTICS GROUP, INC.
Consultants in Acoustics, Noise & Vibration

September 9, 2012

Mitzi Mills
Sun City Grand
Community Association Management
19726 N. Remington Dr.
Surprise, AZ 85374

Subject: Noise Study for the Cimarron Pickleball Courts in Surprise, AZ.

Dear Ms. Mills:

Acoustics Group, Inc., has reviewed the Sun City Noise Ordinance, conducted ambient and operations noise level measurements, analyzed the future noise levels from the Cimarron facility, assessed the impact of the future operations and evaluated noise control measures. The following provides the results of our work:

NOISE AND THE A-WEIGHTED SOUND LEVEL

Noise is most often defined as unwanted sound. Although sound can be easily measured, the perceptibility is subjective and the physical response to sound complicates the analysis of its impact on people. People judge the relative magnitude of sound sensation in subjective terms such as "noisiness" or "loudness." Sound pressure magnitude is measured and quantified using a logarithmic ratio of pressures, the scale of which gives the level of sound in decibels (dB).

The human hearing system is not equally sensitive to sound at all frequencies. Therefore, to approximate this human, frequency-dependent response, the A-weighting filter system is used to adjust measured sound levels. The A-weighted sound level is expressed in "dBA" or "dB(A)." Figure 1 provides typical A-weighted sound levels measured for various sources, as well as people's responses to these levels.

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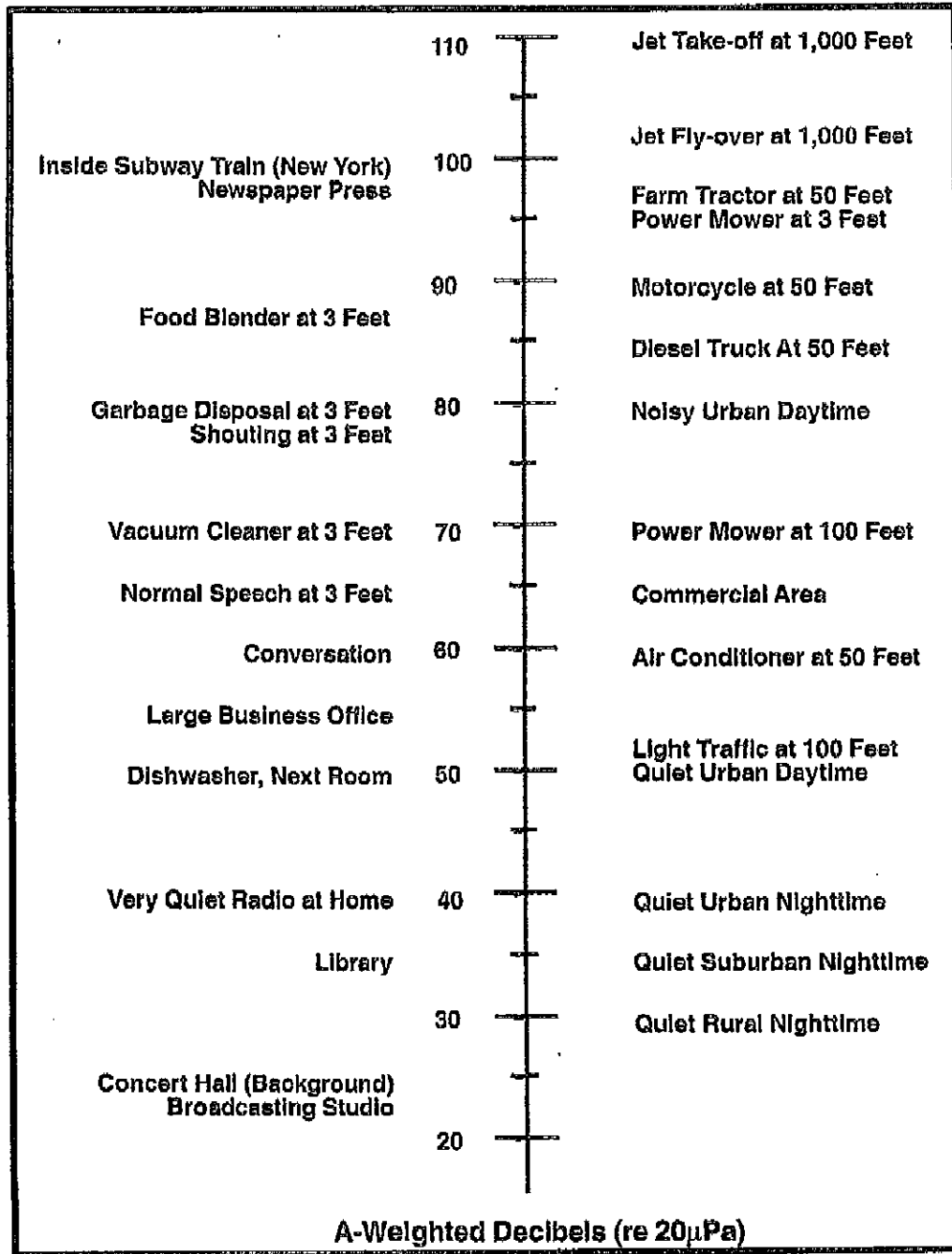


Figure 1. Typical A-weighted Sound Levels from Indoor and Outdoor Noise Sources.



When sound is measured for distinct time intervals, the statistical distribution of the overall sound level can be obtained during that period. The energy-equivalent sound level (Leq) is the most common parameter associated with such measurements. The Leq metric is a single-number noise descriptor which represents the average sound level over a given period of time, where the actual sound level varies with time. Lmax, Lmin, and Lxx are also common noise descriptors. Lmax and Lmin are the maximum and minimum noise levels, respectively, and Lxx, known as a statistical sound level, is the time-varying noise level which would be exceeded xx percent of the time.

NOISE STANDARDS & GUIDELINES

The City of Surprise Municipal Code does not specifically adopt noise standards to regulate noise from recreational activity within parks. However, the 2030 General Plan cites the World Health Organization's "Guidelines for Community Noise, 1999" as a guideline for the city to implement noise regulations. A noise level limit of 50 – 55 dBA at outdoor living areas is identified as a limit of acceptable noise exposure in the general plan.

AMBIENT SURVEY AND NOISE MEASUREMENTS

Ambient Survey

AGI conducted an ambient noise survey on June 10-11, 2012 to document the baseline ambient noise levels directly east of the Cimarron Pickleball Courts. A noise measurement was conducted at the front yard of 18692 W Marcos De Niza Drive, directly facing the pickleball court area. The measurement was conducted with a Larson Davis Model 870 Noise Analyzer and the instrument was operated in accordance with manufacturer's standards. Construction operations occurred during the late night hours between midnight and 9 am and the measurement data obtained during the construction period was omitted from this report.

The Leq measured during the ambient survey ranged from 40.8 to 49.5 dBA. The sources of noise that contributed to the ambient baseline were distant traffic, wildlife birds, and insects. Noise levels during the evening period were generally between 44 and 47 dBA. During the late night and early morning hours, the ambient baseline dropped to nearly 40 dBA. The measured baseline ambient noise levels are considered very quiet for a residential community. Table 1 summarizes the ambient noise measurement data. Figure 2 shows the location of the noise measurement relative to the Cimarron Pickleball courts and the nearby residences.

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Table 1
Measured Ambient Noise Levels Adjacent to the Cimarron Pickleball Courts

Date	Time	Leq, dBA	Description
June 10, 2012	7:00 pm	44.2	Evening Ambient Distant Traffic, Wildlife, Insects
June 10, 2012	8:00 pm	45.3	" "
June 10, 2012	9:00 pm	46.6	" "
June 10, 2012	10:00 pm	43.5	Nighttime Ambient Distant Traffic, Wildlife, Insects
June 10, 2012	11:00 pm	40.8	" "
June 11, 2012	10:00 am	49.5	Morning Ambient Distant Traffic, Wildlife, Insects

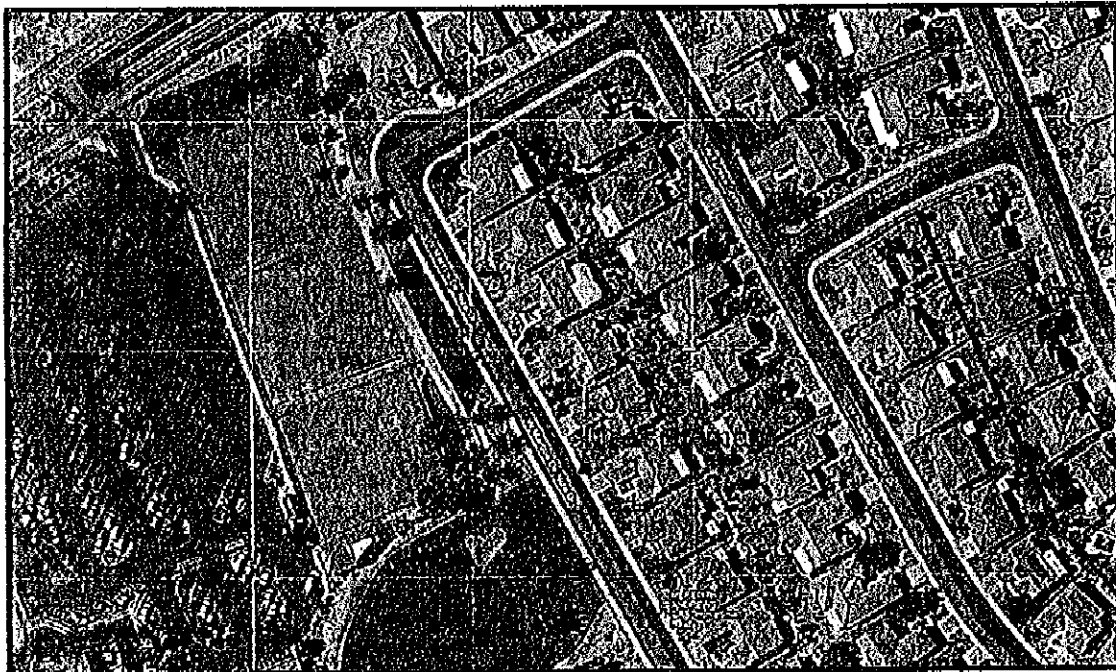


Figure 2. Location of the Ambient Noise Measurement



Pickleball Noise Measurements

AGI conducted acoustical tests on June 12 and 20, 2012 to measure the noise from pickleball operations, different paddle types, and a noise barrier system. The measurements were conducted at a nearby facility while the Cimarron courts were being renovated. A controlled test was conducted on June 12, 2012 with 32 players playing pickleball simultaneously. Noise measurements were also conducted with four players playing pickleball with various paddle types. The tests were then repeated on June 20, 2012 after the installation of an Acoustifence noise barrier system. On August 22, 2012, additional noise measurements were conducted utilizing 8 different pickleball paddles, but without the Acoustifence. For each acoustical test, both A-weighted sound level and One-Third Octave Band Sound Levels were measured from a position 10 feet from the sideline fence.

The initial test conducted with 32 players resulted in an Leq of 66.9 dBA. Paddle tests with the Whipper Snapper, Graphite, ZZT, Blaster, Striker, Graphite Magnum, Prolite Magnum, and Paddle Tech, resulted in an Leq of 64.7, 60.1, 57.0, 61.4, 61.3, 57.9, 62.8, and 59.3 dBA, respectively. After the installation of acoustifence, the 32 players test resulted in an Leq of 51.1 dBA. The Paddle tests with the Whipper Snapper, Graphite, ZZT, Blaster, Striker, Graphite Magnum, Prolite Magnum, and Paddle Tech paddles resulted in an Leq of 54.9, 48.8, 46.7, 50.9, 49.1, 46.2, 50.8, and 49.4 dBA, respectively. As a result of the acoustifence, noise reductions of 15.8, 9.8, 11.3, 10.3, 10.5, 12.2, 11.7, 12.0, and 9.9 dB were achieved for the 32 players and the respective paddles. The average noise reduction achieved by the acoustifence was approximately 13 dB. Table 2 summarizes the test data and noise reduction for each paddle type.

Additional paddle tests were conducted on August 22, 2012, but without acoustifence. The paddle tests with the Pro Lite Enforcer, Pro Lite Aero D, Pro Lite Power, Brian Jensen Designs, Pickleball Now Classic Lite, Pickleball Now MetaLite, Pickleball Now Force, and Pickleball Now The Force resulted in an Leq of 58.9, 61.4, 60.1, 61.0, 63.3, 58.1, 64.0, and 57.2 dBA, respectively. Table 3 summarizes the test data for the eight additional paddles. Refer to the Appendix for plots of the noise measurement data.

ESTIMATED CIMARRON COURT NOISE LEVELS

Future pickleball noise at the Cimarron Courts was analyzed using the measurement data and the layout of the new facility and relative geometry to the nearby residences. As summarized in Table 4, the pickleball noise is estimated to be approximately 61 dBA at the front yard of the residences on W Marcos De Niza Drive, which directly face the courts. When compared with the City's General Plan noise guideline of 50 dBA, the noise would exceed the guideline.

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**Table 2
Measured A-Weighted Sound Levels
at Sun City Grand's Pickleball Courts with and without Acoustifence**

Test Description/ Paddle	Pickleball Noise Level, Leg, dBA at 10-ft from edge of court		Noise Reduction
	Without Acoustifence	With Acoustifence	
32 players	66.9	51.1	15.8 dB
Whipper Snapper	64.7	54.9	9.8 dB
Graphite	60.1	48.8	11.3 dB
ZZT	57.0	46.7	10.3 dB
Blaster	61.4	50.9	10.5 dB
Striker	61.3	49.1	12.2 dB
Graphite Magnum	57.9	46.2	11.7 dB
Prolite Magnum	62.8	50.8	12.0 dB
Paddle Tech	59.3	49.4	9.9 dB

**Table 3
Measured A-Weighted Sound Levels at Sun City Grand's
Pickleball Courts with Additional Paddles - without Acoustifence**

Paddle	Pickleball Noise Level, Leg, dBA at 10-ft from edge of court
Pro Lite Enforcer	58.9
Pro Lite Aero D	61.4
Pro Lite Power	60.1
Brian Jensen Designs	61.0
Pickleball Now Classic Lite	63.3
Pickleball Now MetaLite	58.1
Pickleball Now Force	64.0
Pickleball Now The Force	57.2

**Table 4
Estimated Pickleball Noise from Cimarron Courts with and without Acoustifence**

Description/Paddle	Pickleball Noise Level, Leg, dBA at 100-ft from edge of court		Noise Guideline
	Without Acoustifence	With Acoustifence	
32 players	61	48	50 dBA



NOISE CONTROL MEASURES

The following measures are identified to minimize pickleball noise at the nearest homes to the Cimarron Courts:

1. Install a full height (minimum height of 10-ft) continuous noise barrier on the north, east and south sides of the chain link fence surrounding the pickleball courts. A material acoustically equivalent to the Acoustifence product should provide the sound transmission needed.
2. Require pickleball players at the Cimarron Courts to only use the quietest or quieter paddles identified in Table 5.
3. Consider limiting the hours of pickleball play to time periods that are less intrusive to nearby homeowners.

**Table 5
Ranking of the Tested Pickleball Paddles by Sound Level**

Paddle	Pickleball Noise Level, Leg, dBA at 10-ft from edge of court	Description
ZZT	57.0	Quietest
Pickleball Now The Force	57.2	Quietest
Graphite Magnum	57.9	Quieter
Pickleball Now MetaLite	58.1	Quieter
Pro Lite Enforcer	58.9	Quieter
Paddle Tech	59.3	Quieter
Graphite	60.1	Moderately Quiet
Pro Lite Power	60.1	Moderately Quiet
Brian Jensen Designs	61.0	Moderately Quiet
Striker	61.3	Moderately Quiet
Blaster	61.4	Moderately Quiet
Pro Lite Aero D	61.4	Moderately Quiet
Prolite Magnum	62.8	Moderately Quiet
Pickleball Now Classic Lite	63.3	Loudest
Pickleball Now Force	64.0	Loudest
Whipper Snapper	64.7	Loudest

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CONCLUSION

AGI has reviewed the Sun City Noise Ordinance, conducted ambient and operations noise level measurements, analyzed the future noise levels from the Cimarron facility, assessed the impact of the future operations and evaluated noise control measures. Noise control measures have been identified for reducing the future noise at the Cimarron Courts.

Please contact Mr. Robert Woo at 602-635-6196 if you have any questions regarding this report.

Sincerely,
ACOUSTICS GROUP, INC.

Robert Woo
Principal Consultant



APPENDIX

PLOTS OF THE PADDLE TEST DATA

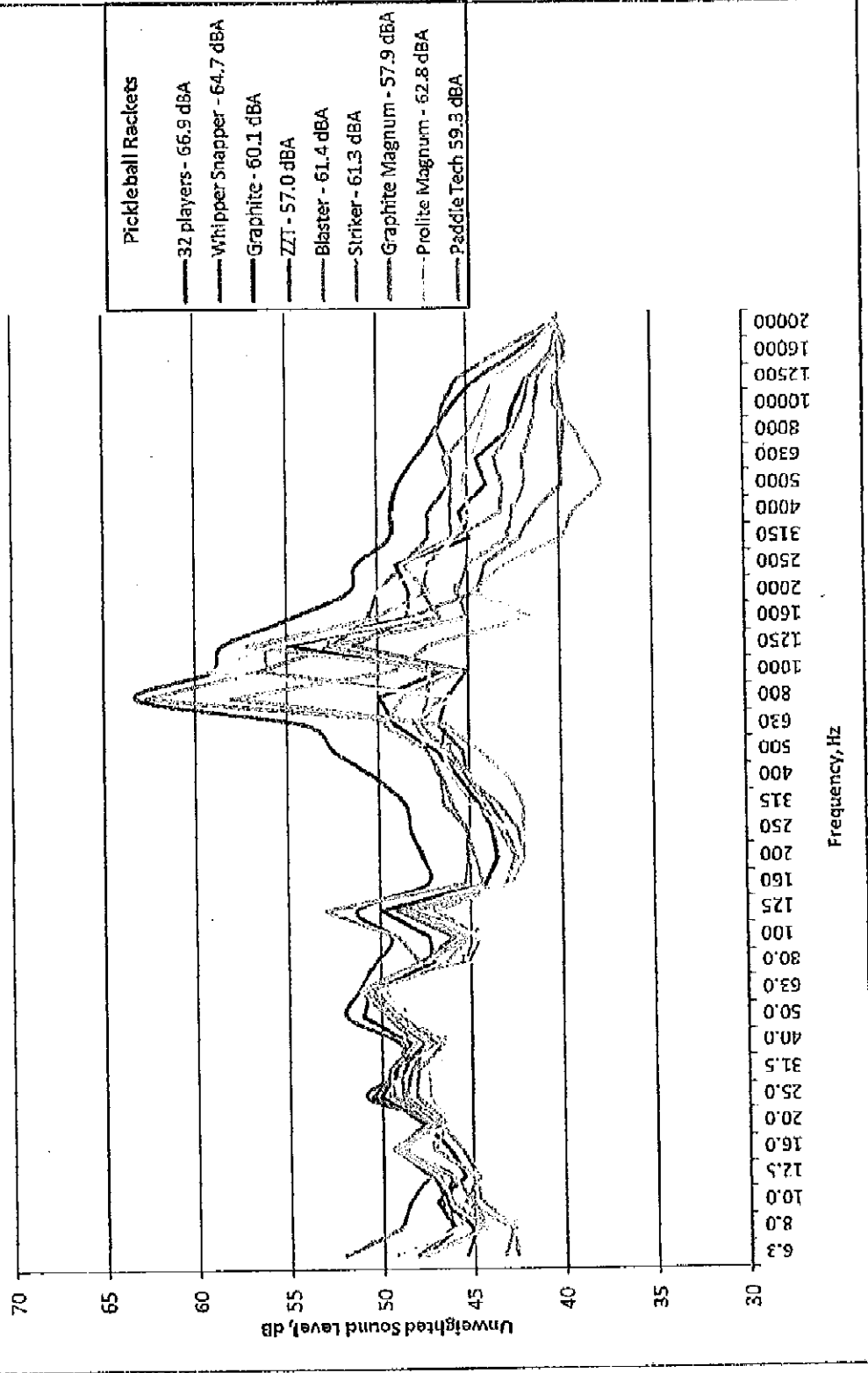
Figure X-1 depicts the measured one-third octave band sound levels without acoustifence and Figure X-2 depicts the measured one-third octave band sound levels with acoustifence. Figure X-3 compares the measured sound levels of the 32 players with and without acoustifence. Figure X-4 through X-11 compares the measured sound levels of the paddles with and without acoustifence.

Figure X-12 represents the measured one-third octave band sound levels from eight additional paddles tested on August 22, 2012. Figures X-13 through X-20 depict the frequency data for each paddle individually.



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Figure X-1. Measured One-Third Octave Band Sound Levels without Acoustifence - 6/12/12



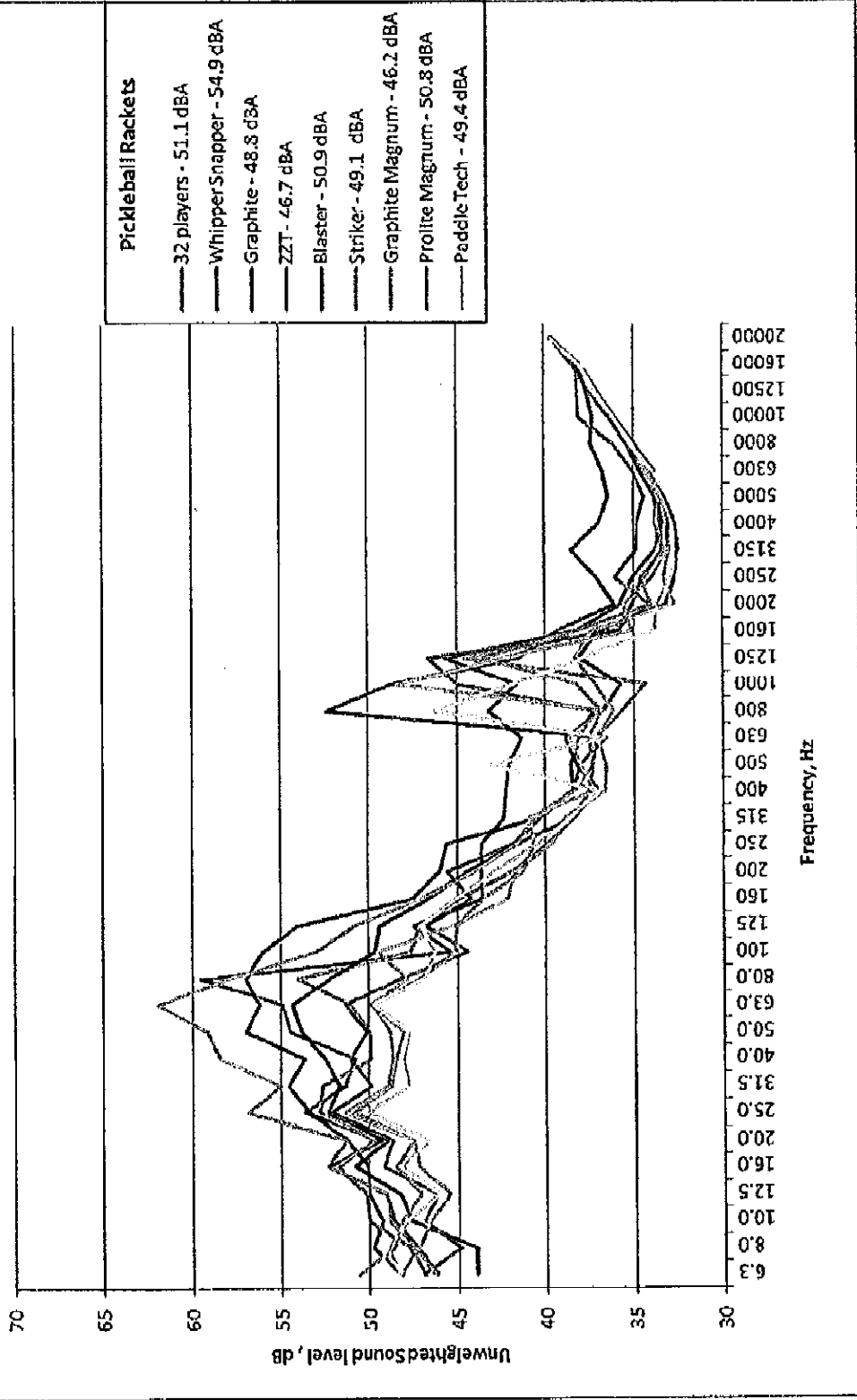
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Figure X-2. Measured One-Third Octave Band Sound Levels with Acoustifence - 6/20/12



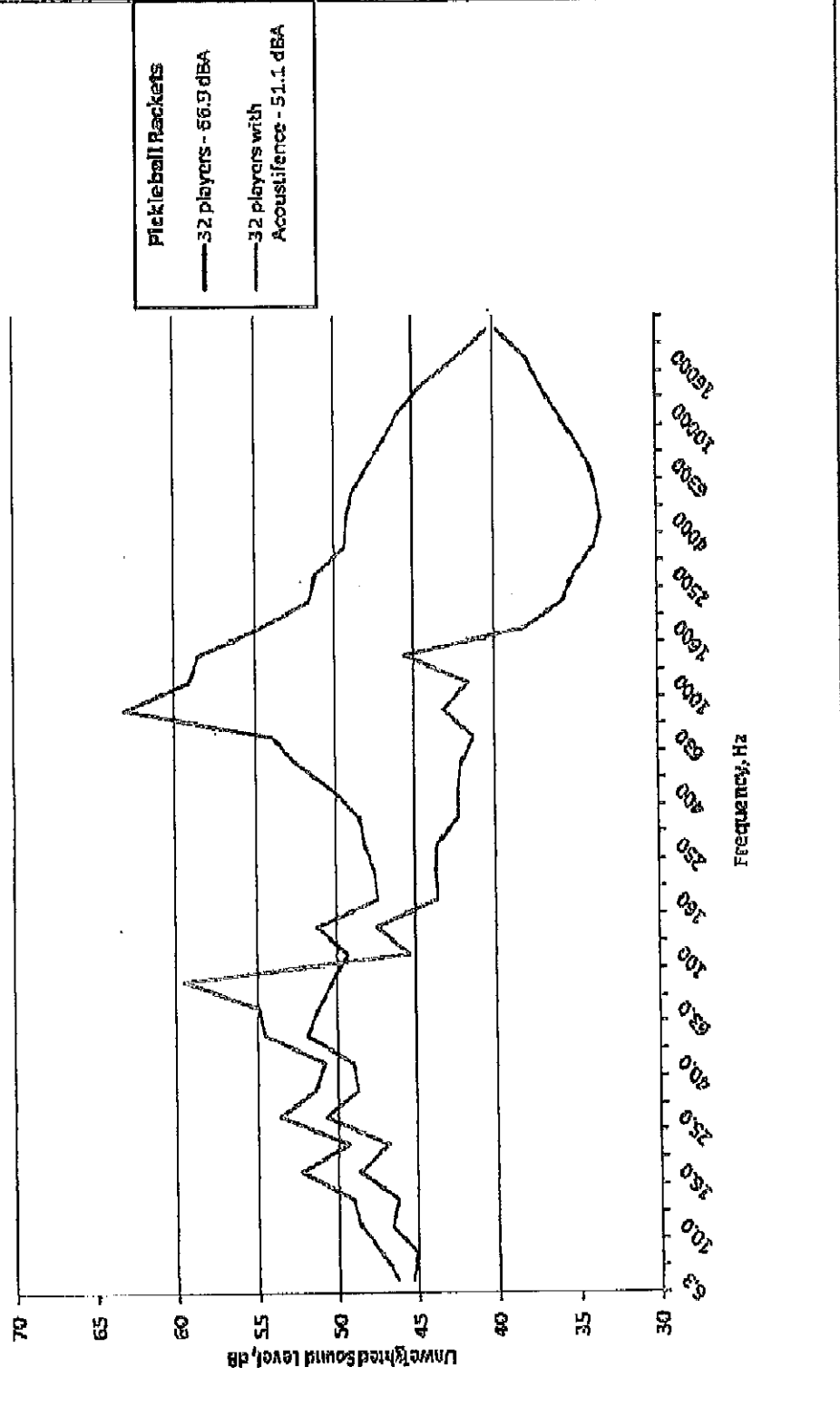
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Figure X-3. Measured One-Third Octave Band Sound Levels with and without Acoustifence



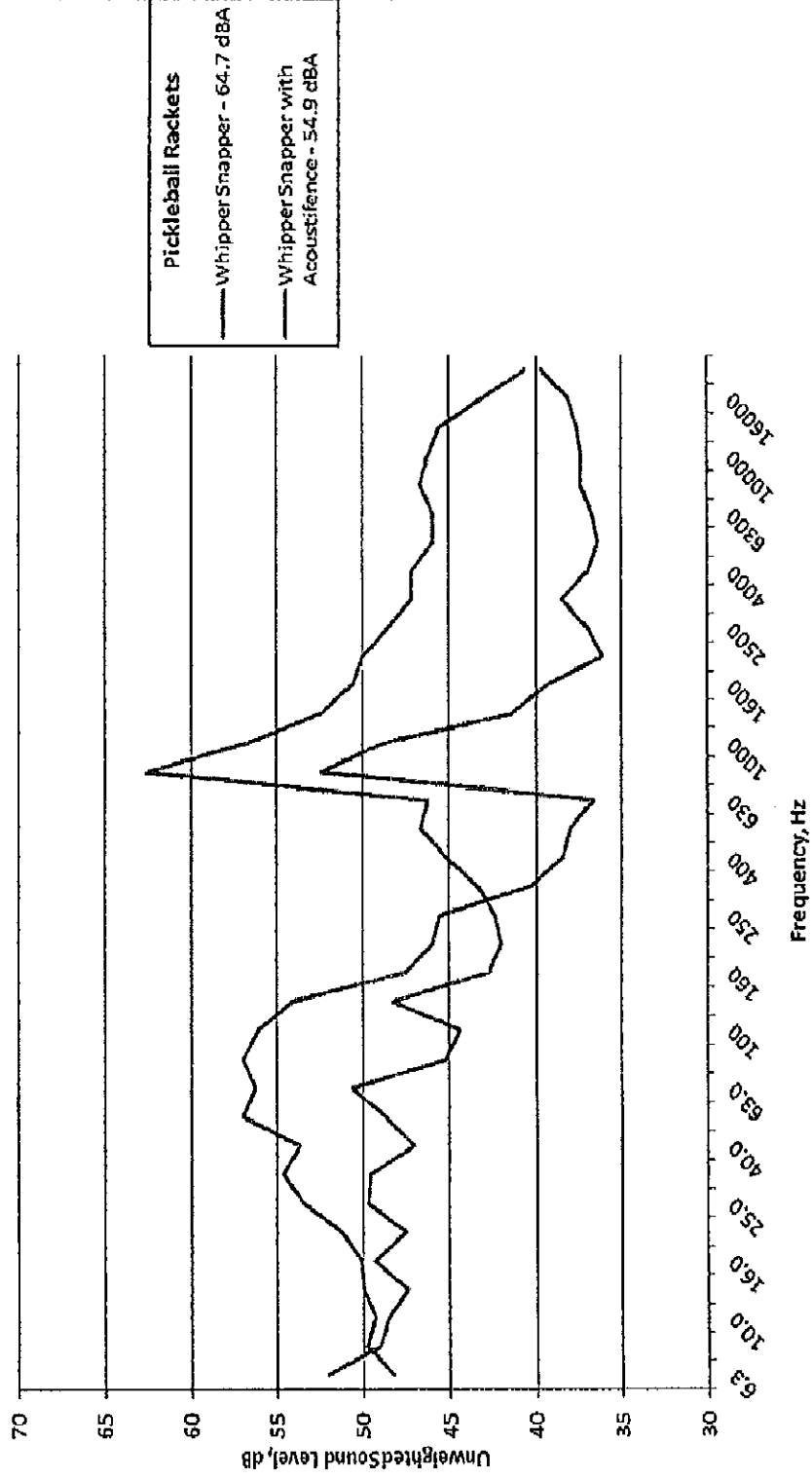
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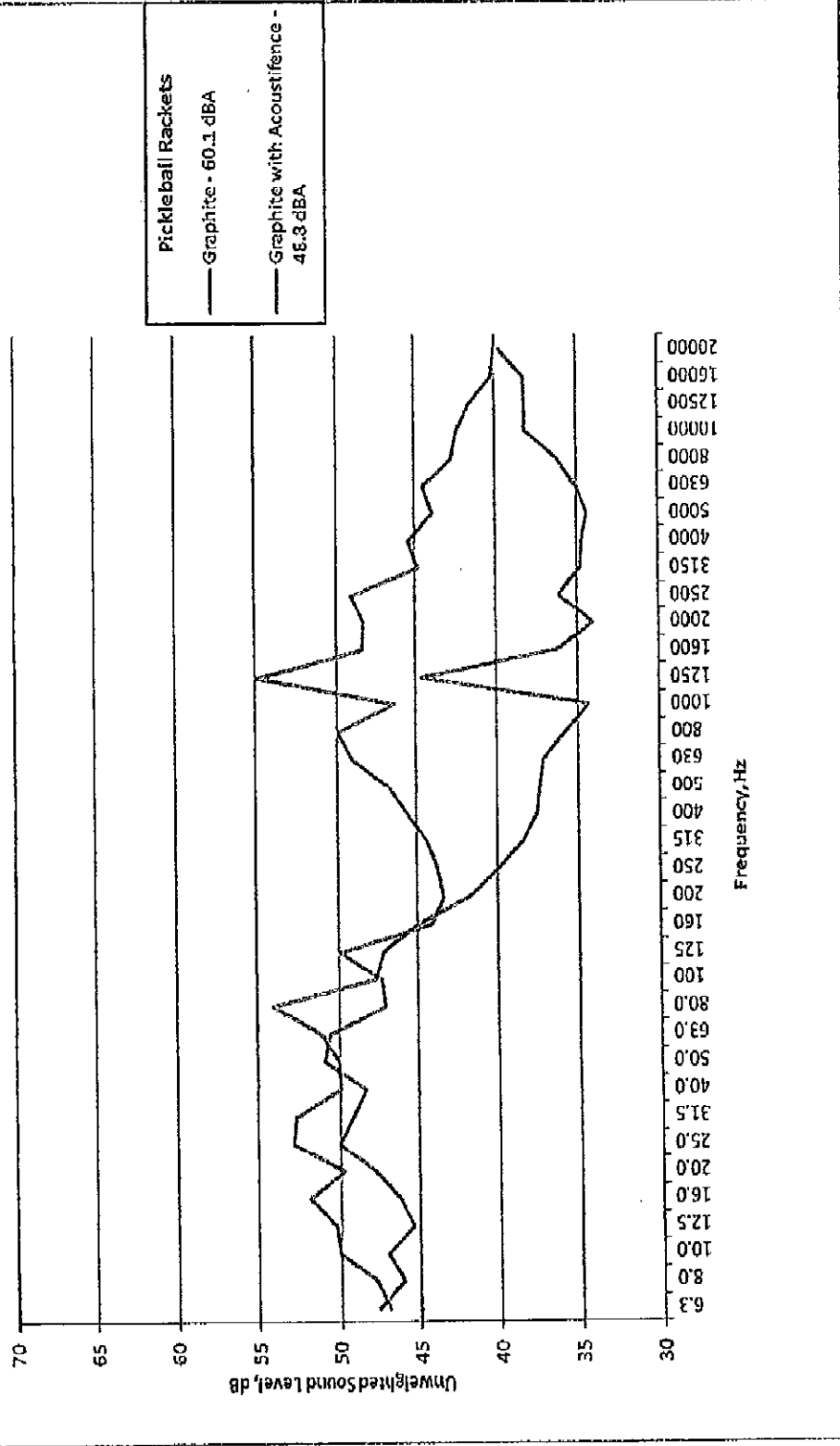
Figure X-4. Measured One-Third Octave Band Sound Levels with and without Acoustifence





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Figure X-5. Measured One-Third Octave Band Sound Levels with and without Acoustifence



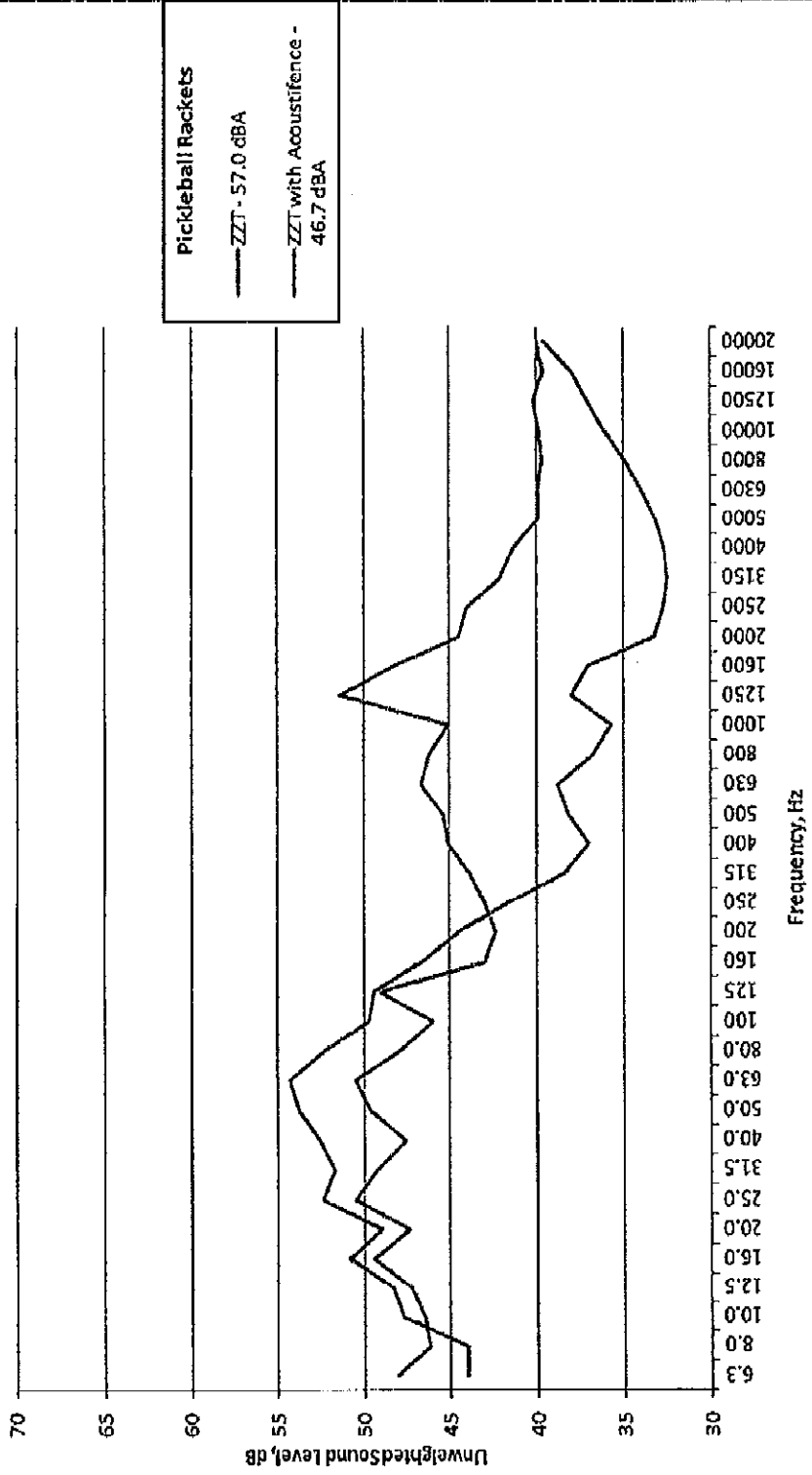
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Figure X-6. Measured One-Third Octave Band Sound Levels with and without Acoustifence

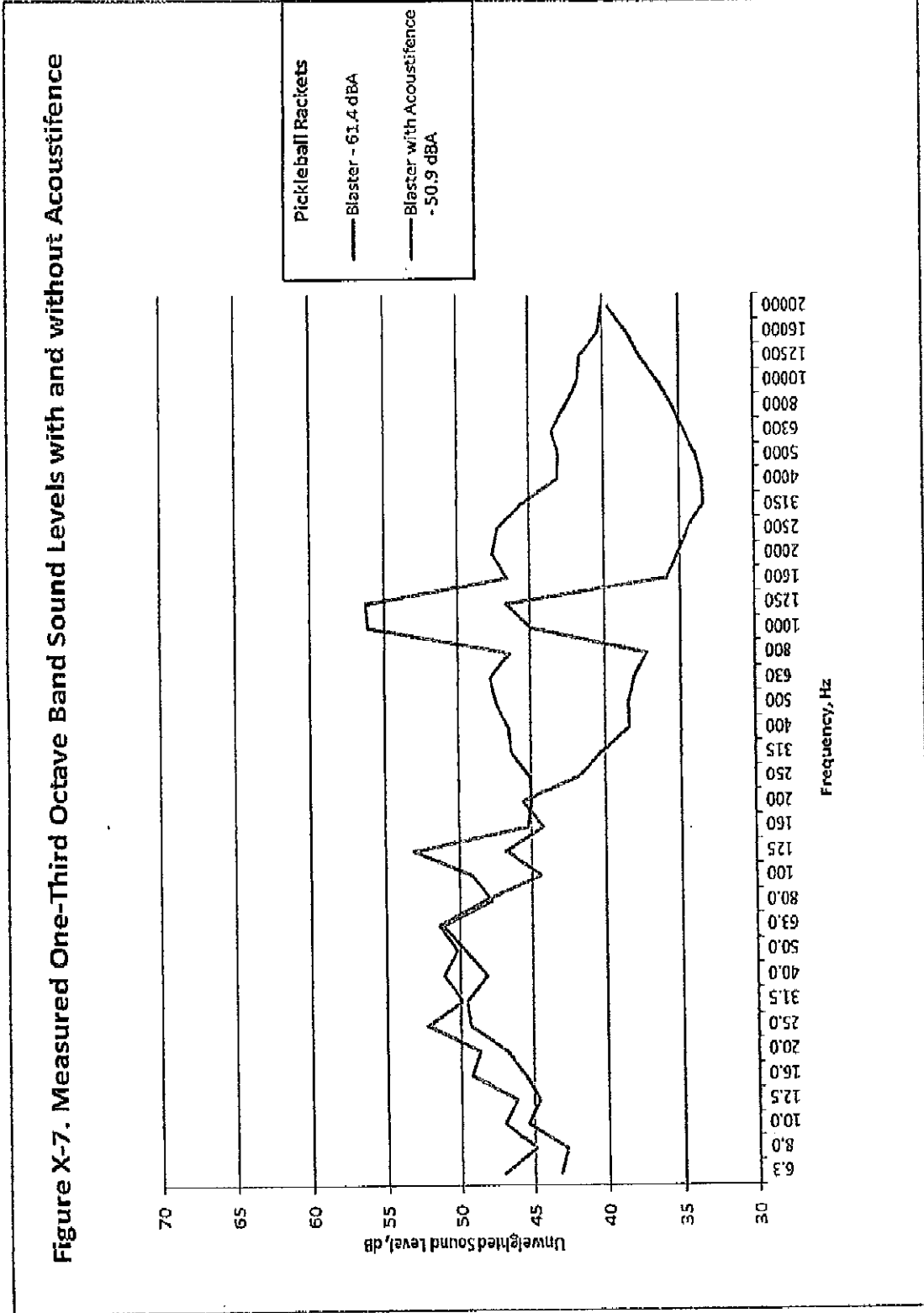


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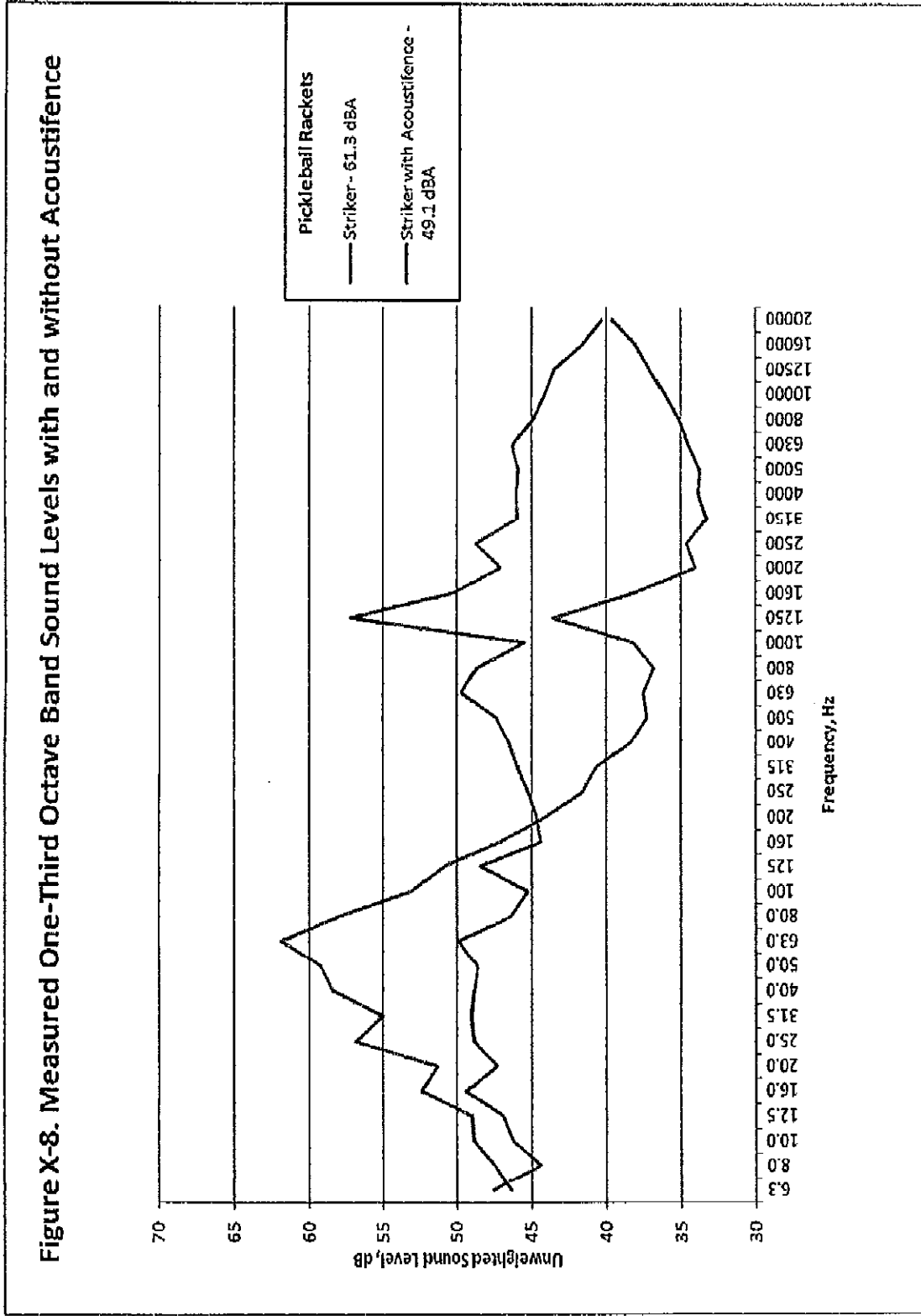


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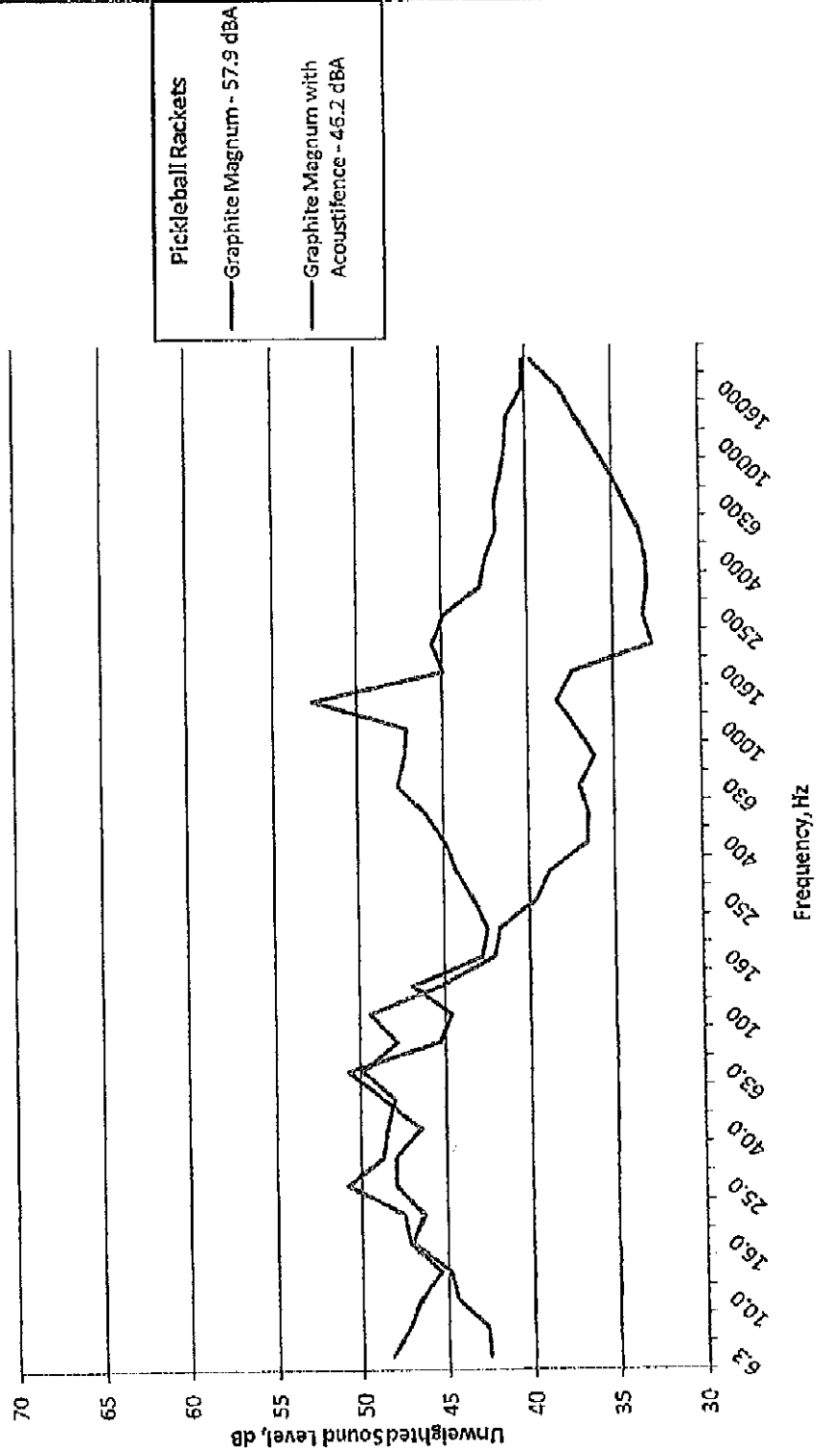
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Figure X-9. Measured One-Third Octave Band Sound Levels with and without Acoustifence

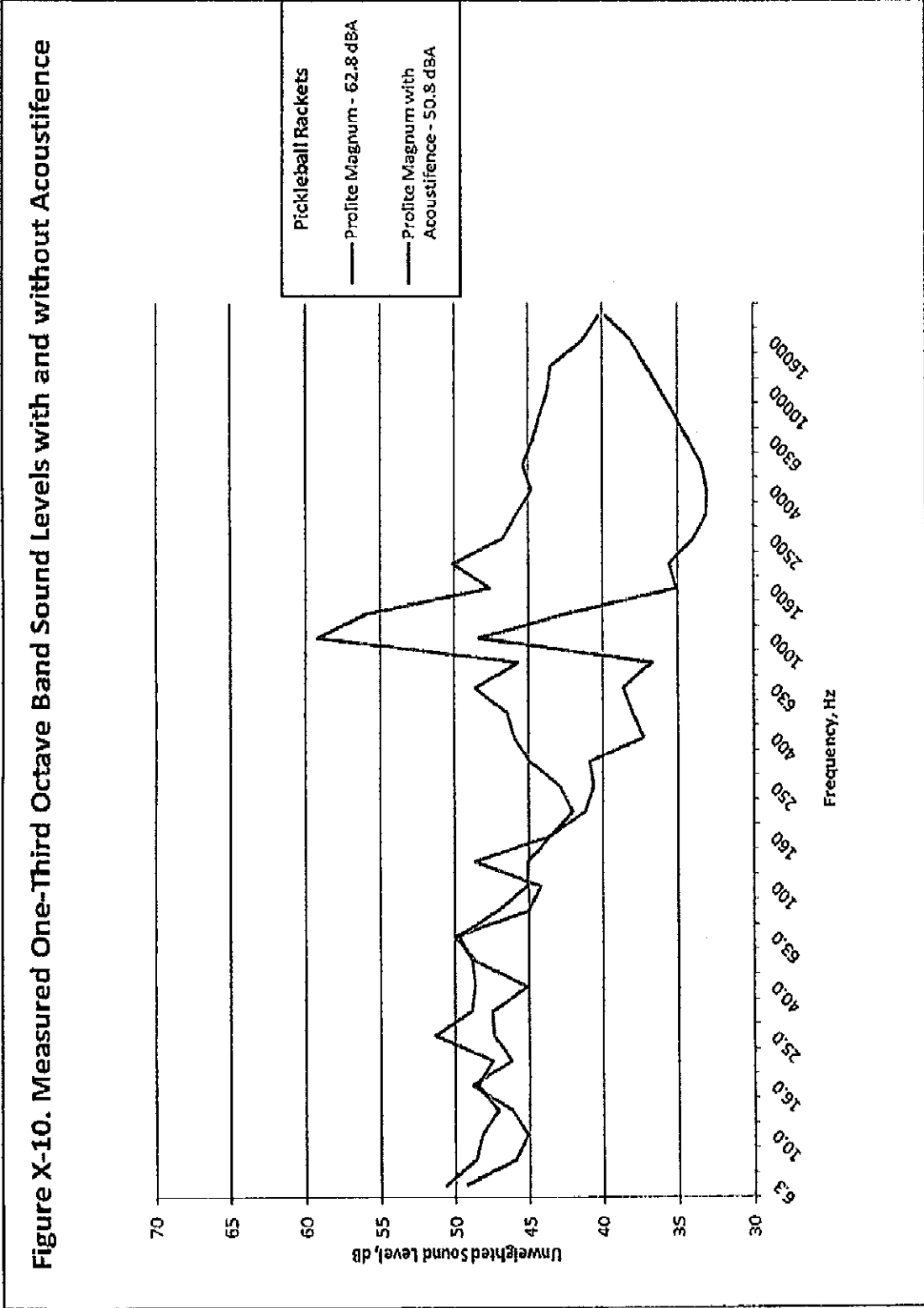


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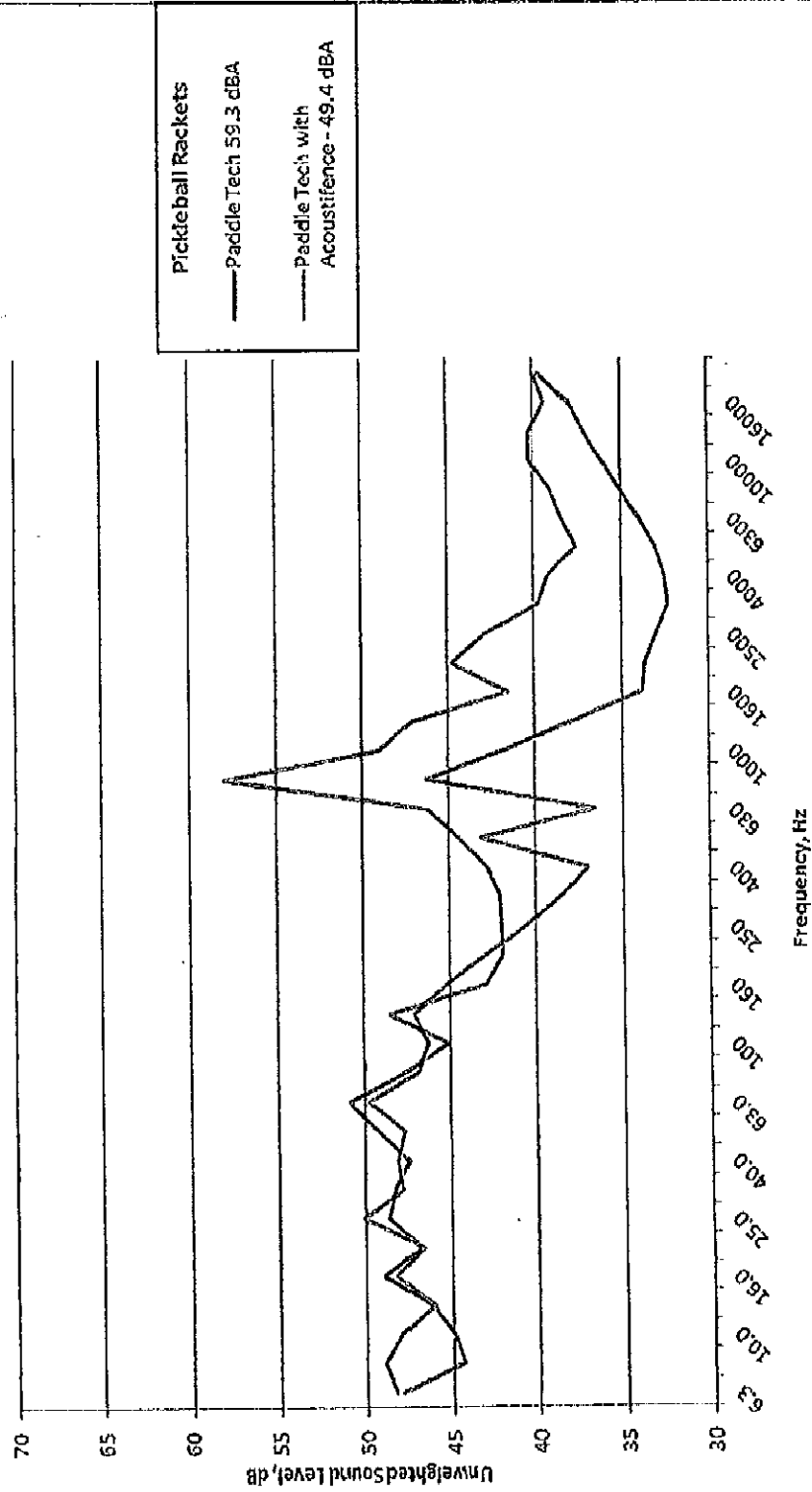
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Figure X-11. Measured One-Third Octave Band Sound Levels with and without Acoustifence



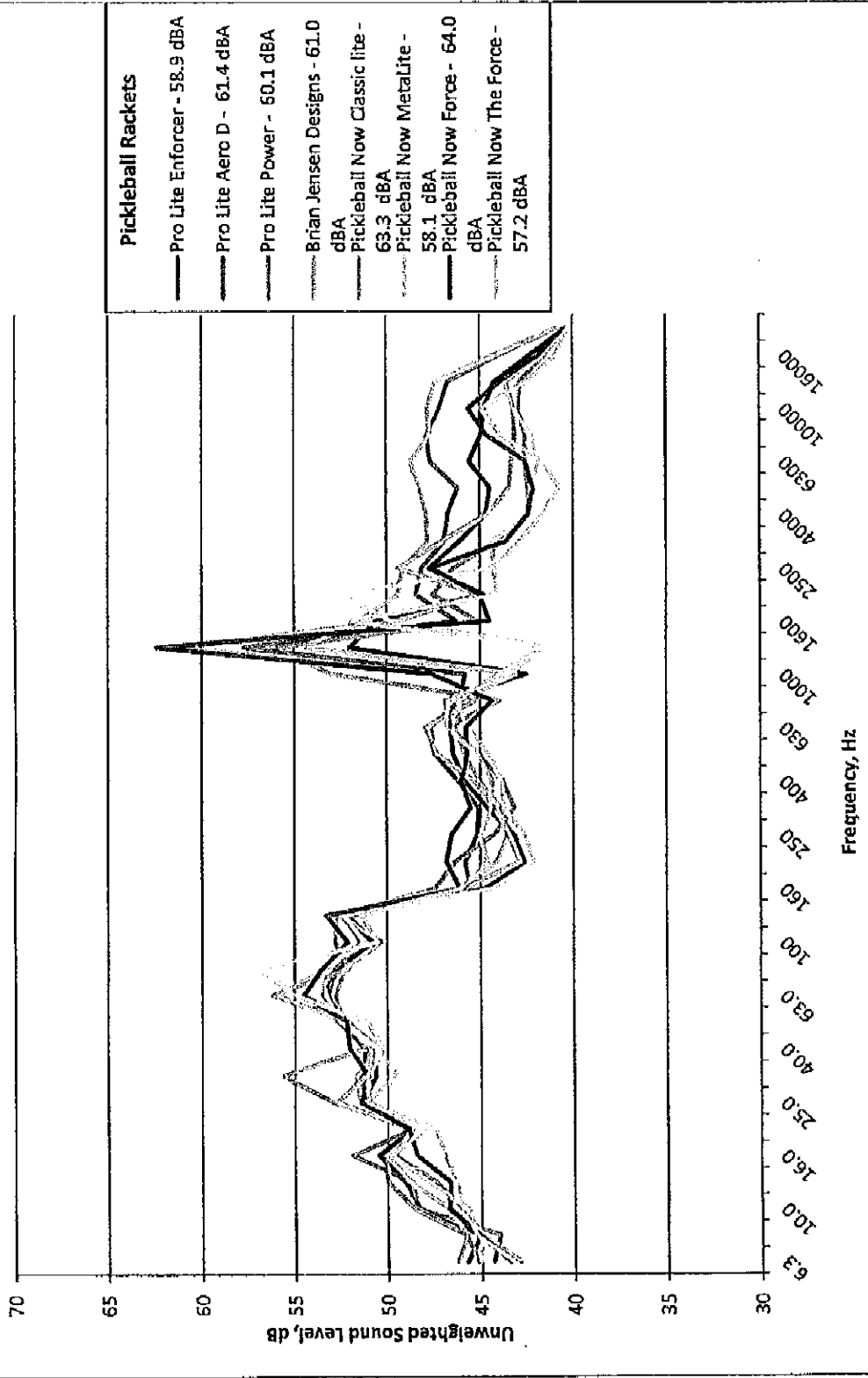
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Figure X-12. Measured One-Third Octave Band Sound Levels with New Racket Types without Acoustifence - 8/22/12



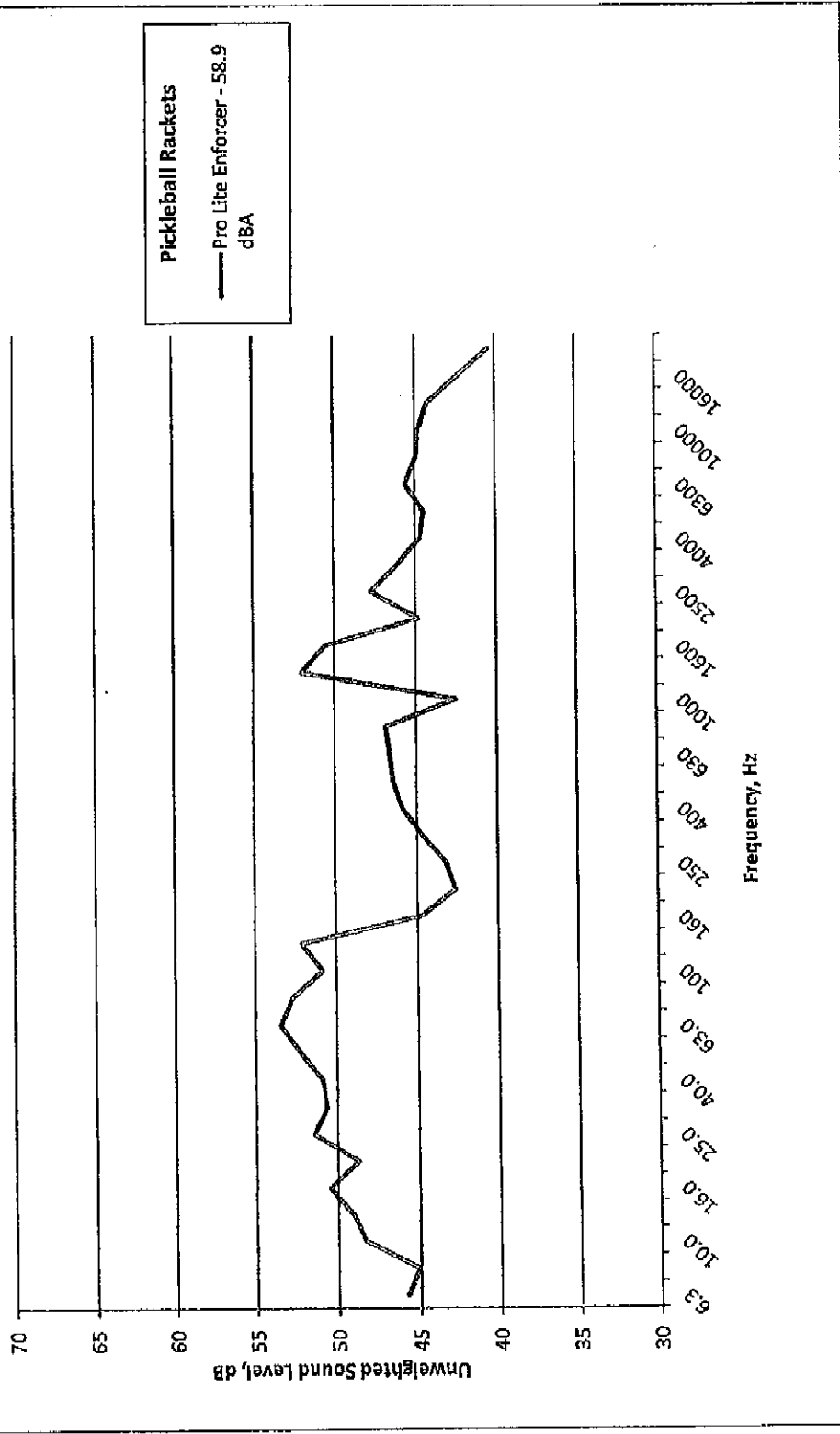
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Figure X-13. Measured One-Third Octave Band Sound Levels with Pro Lite Enforcer



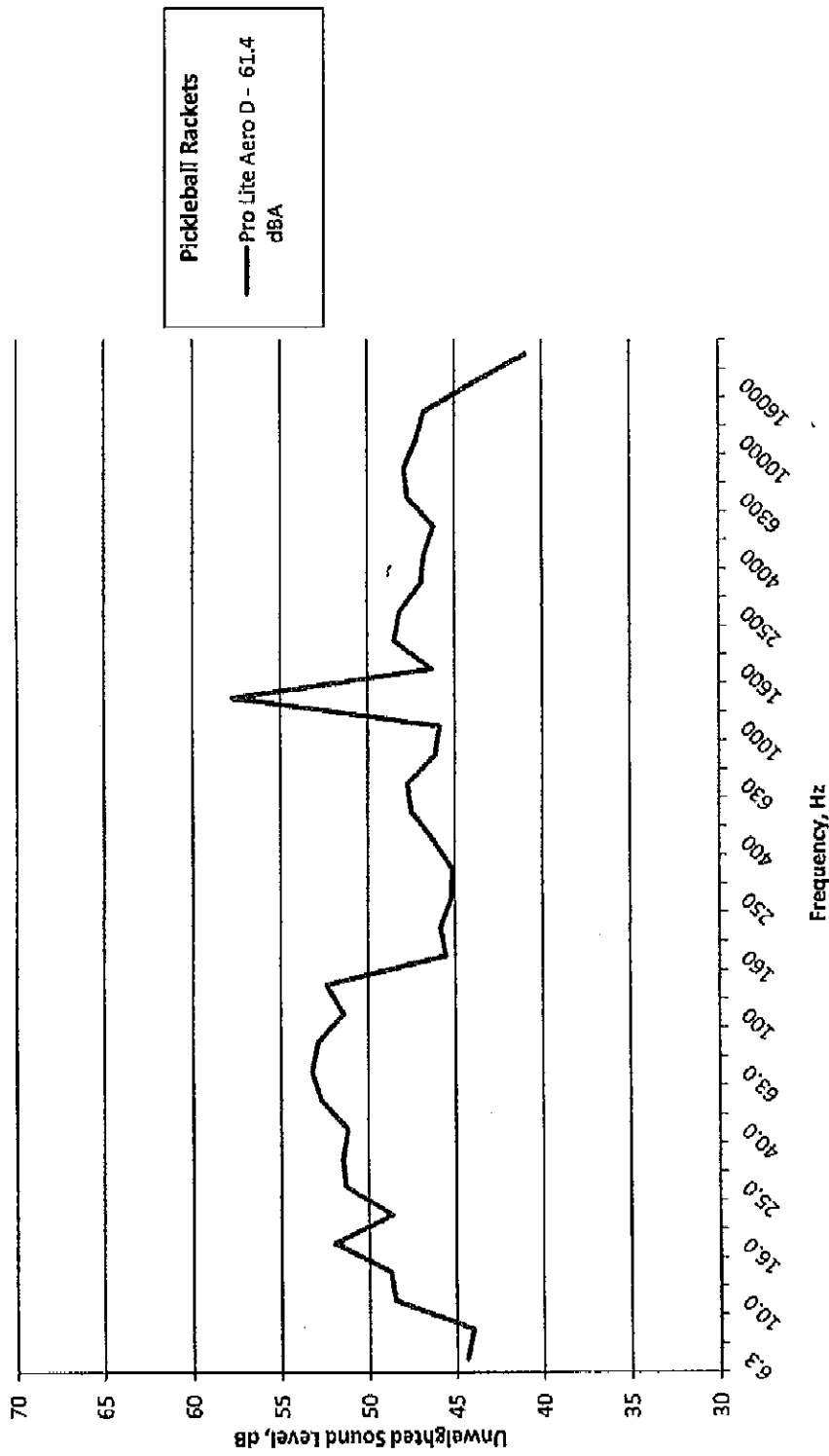
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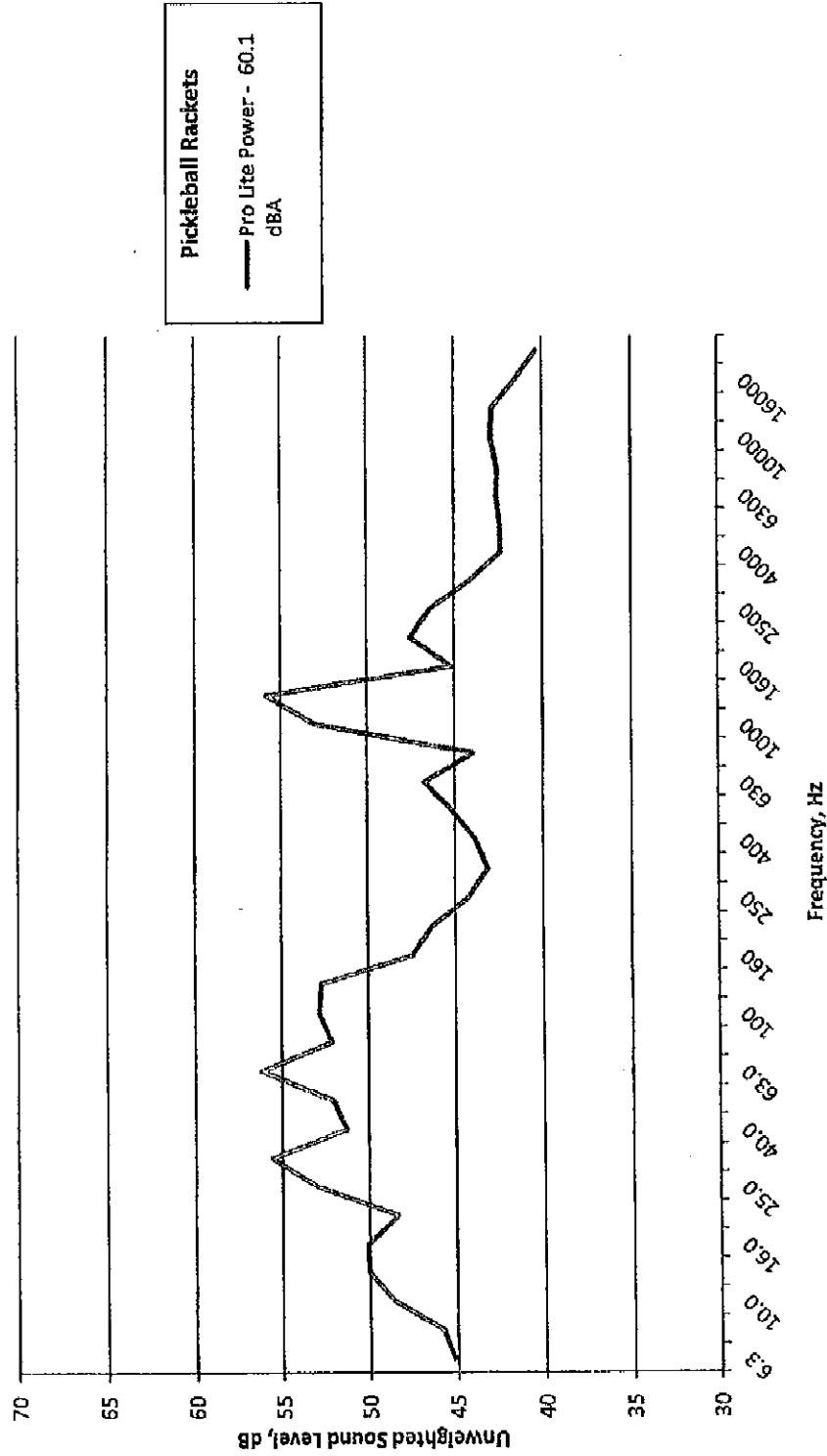
Figure X-14. Measured One-Third Octave Band Sound Levels with Pro Lite Aero D





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Figure X-15. Measured One-Third Octave Band Sound Levels with Pro Lite Power

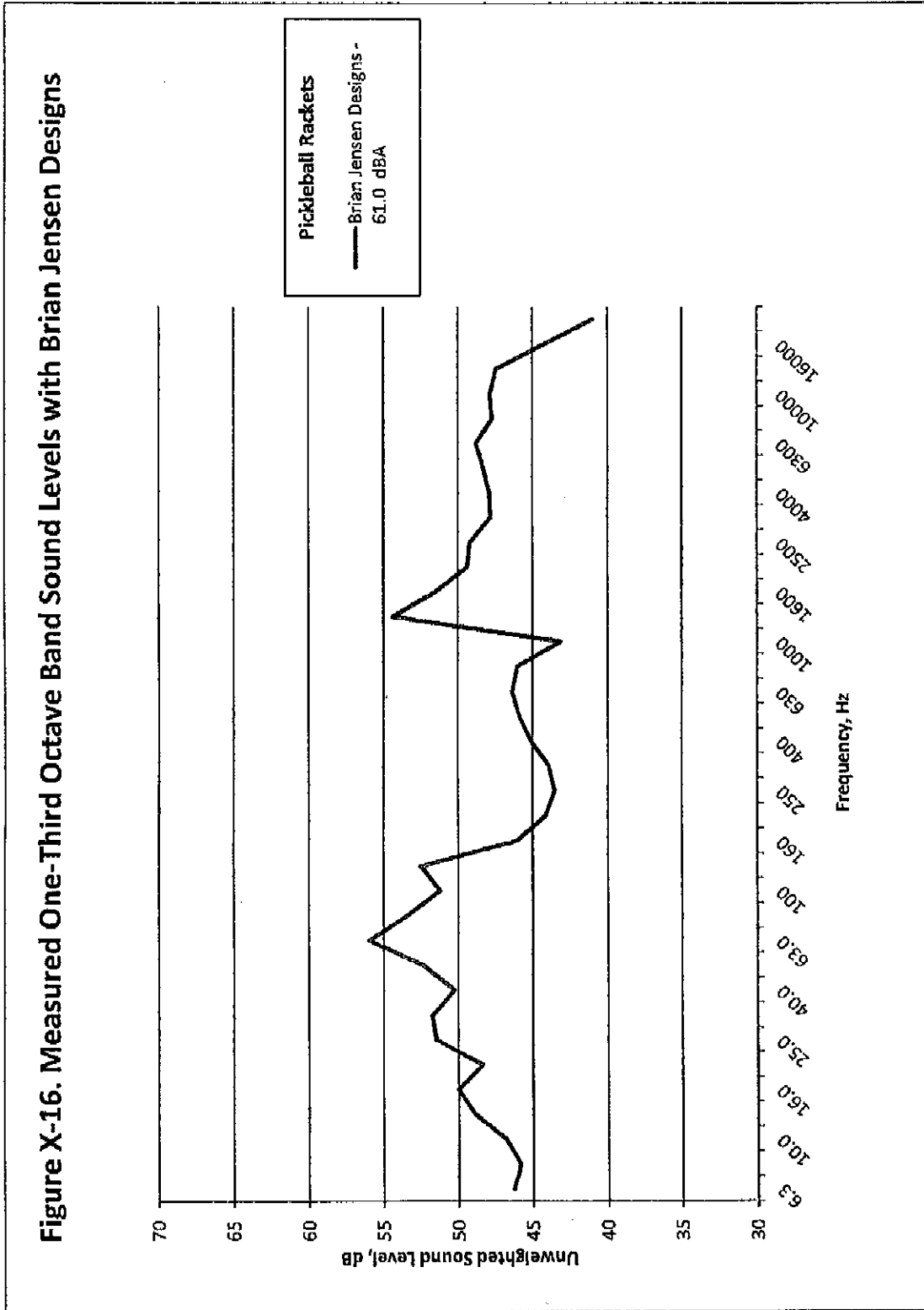


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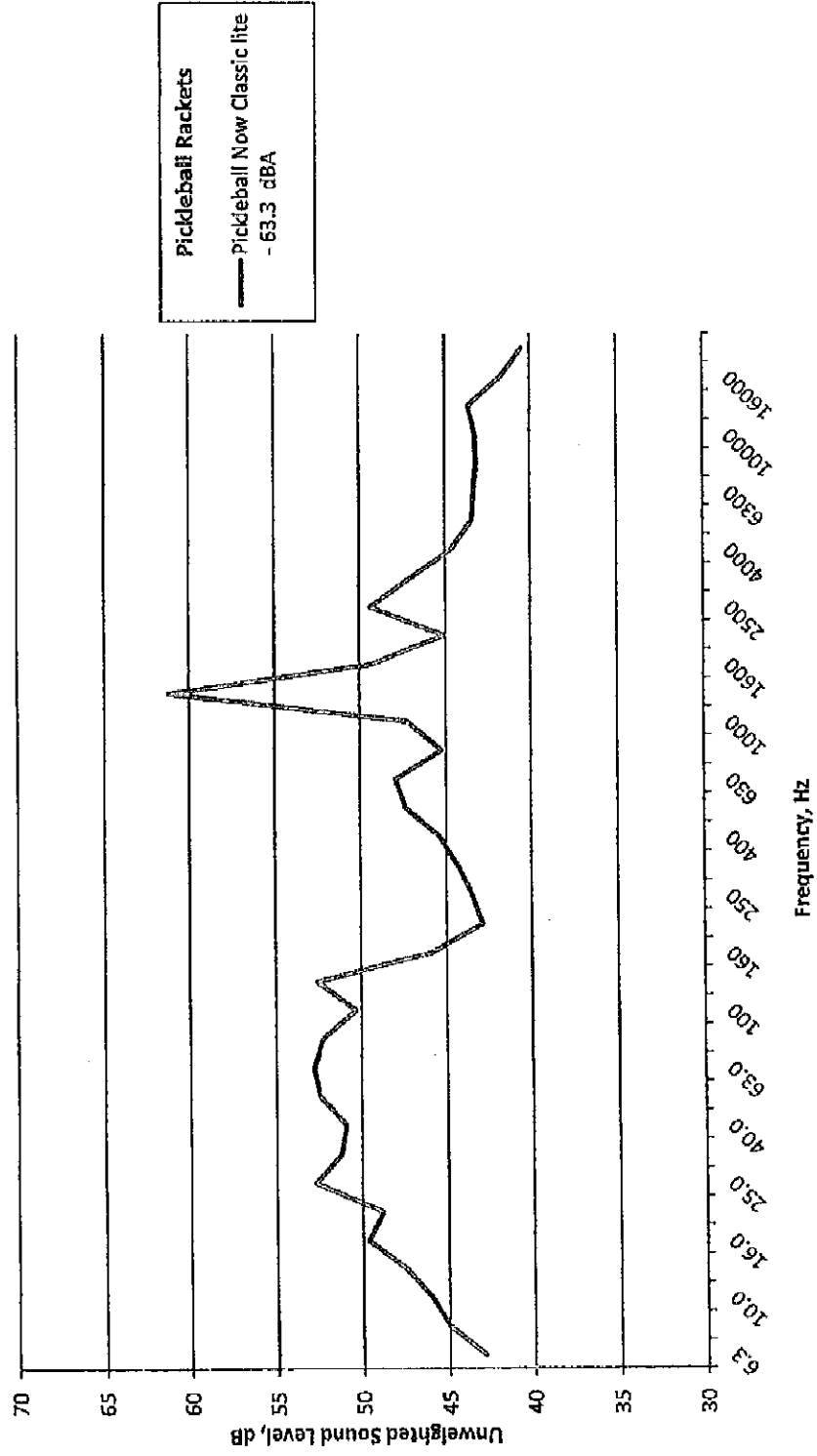
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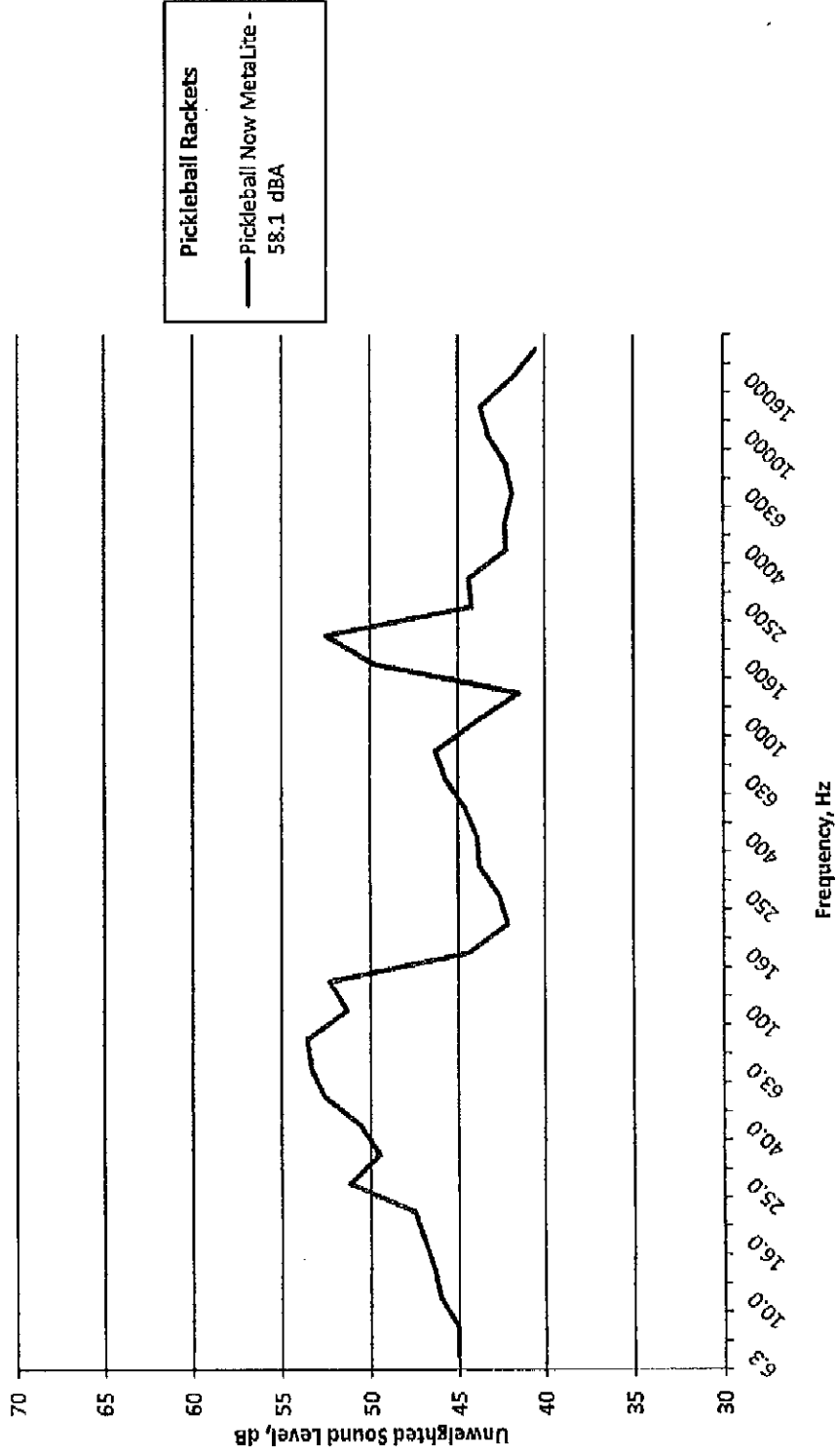
Figure X-17. Measured One-Third Octave Band Sound Levels with Pickleball Now Classic lite





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Figure X-18. Measured One-Third Octave Band Sound Levels with Pickleball Now Meta Lite



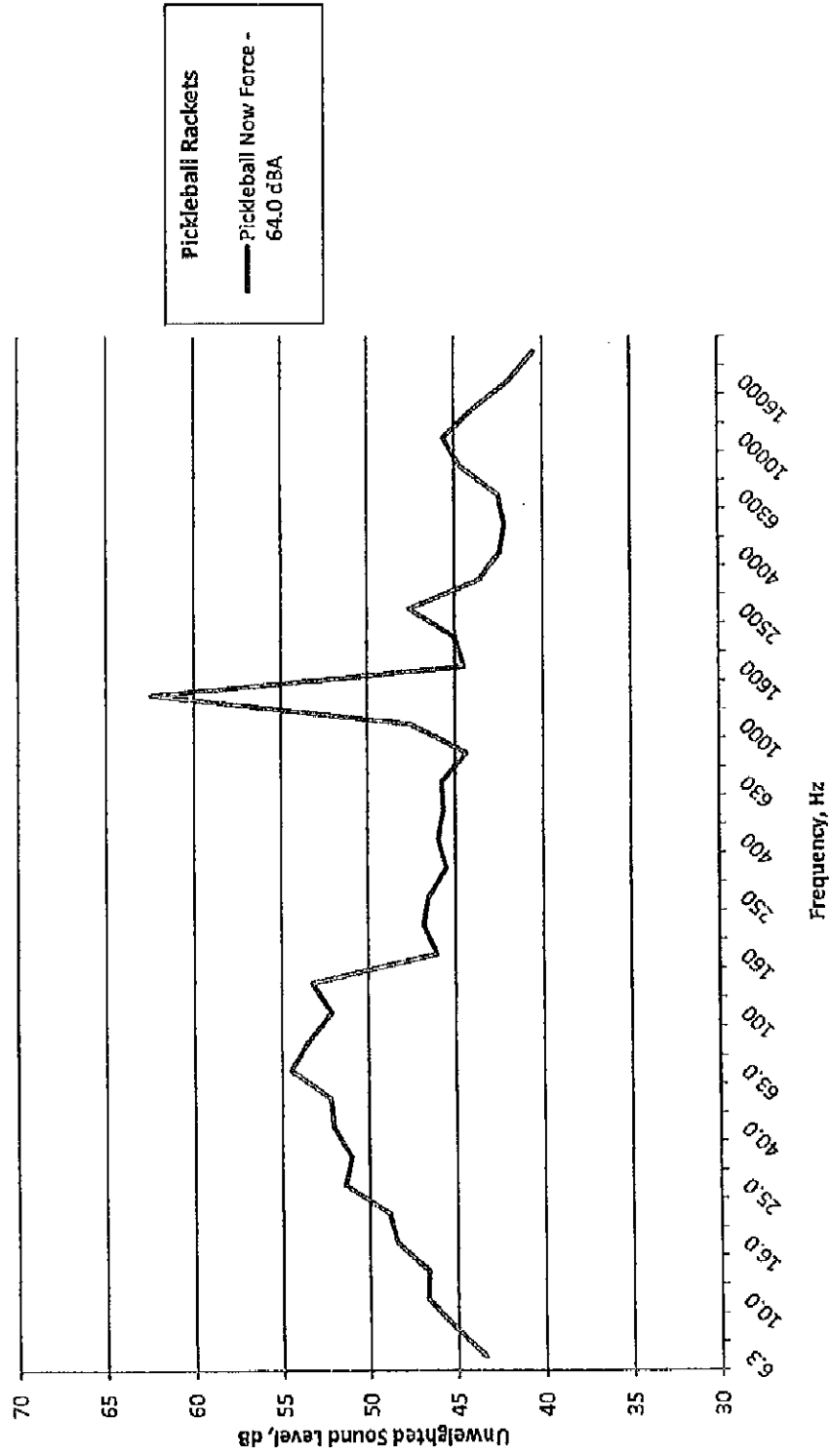
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Figure X-19. Measured One-Third Octave Band Sound Levels with Pickleball Now Force



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