

New Folder Name Noise Level Measurements
and testing T950027

26 April 1995

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Acentech

LIGO - T9500271 - 00 -

cc: B. Aithouse
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R. Spero
R. Vogt

Dear Mr. Schmidt:

Per your request, Acentech measured the noise levels from several pieces of LIGO equipment when mounted in a Knürr rack. The measurements were taken on 21 April 1995 from 9 to 12 in the Knürr facilities in Simi Valley, California. The measurements followed the method presented in ANSI S12.10-1985 (R1990) with the following exceptions: (1) The room did not provide free field conditions or reverberant conditions specified in the test procedure. However, in our calculations a free field condition was assumed. (2) Per your request the noise levels were measured down to the 8 Hz octave band instead of the 125 Hz band as specified in the procedure.

The following summarizes our results.

MEASUREMENT EQUIPMENT

The measurements were made using a Larson Davis Model 3100 two-channel analyzer equipped with two Brüel and Kjær Type 4155 microphones. The system conforms to the requirements for a Type 1 sound level meter according to ANSI S1.4-1983. The meter was set to record one-third octave band levels. The system was calibrated before and after the measurements using a Brüel and Kjær Type 4230 calibrator with a calibration history traceable to the National Institute of Standards and Technology. The microphones were attached to tripods and were equipped with windscreens.

ROOM CHARACTERISTICS

The tests were conducted in a room at the Knürr facilities in Simi Valley, California. The room dimensions were approximately 14 feet by 25 feet by 8 feet-10 inches tall. The west wall was constructed of painted concrete block and the other three walls were constructed of gypsum wallboard. The walls were lined with desks, consoles, and equipment racks. The ceiling consisted of lay-in mineral tile panels. The floor was carpeted with typical commercial/office space carpeting. There was a window in the southwest corner and a door in the southeast corner.

The rack to be tested was identified as a Miracel number MR15414 cabinet. The cabinet was noted to be approximately 6 feet tall and 32 inches by 24 inches wide. The rack contained six fans and an air inlet at the bottom of the unit and an air outlet at the top.

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During the tests, two pieces of LIGO equipment were mounted in the rack. The equipment was described as VME crates Model Number 0721C21H3001F-1001 with serial numbers 00003 and 00004. Each crate included four cooling fans.

During the tests the rack was located approximately 4 feet from each of the east and south walls.

MEASUREMENT RESULTS

Measurements were made at nine locations on a parallelepiped as described in ANSI S12.10-1985 (R1990) Section 10.6 (see sketch attached) with the exception that the top of the measurement surface was only 1 foot above the rack instead of 1 meter due to space constraints. Measurement locations 1 through 4 were positioned 1 meter out from the center of each side of the rack. Locations 5 through 8 were located at the corners of the parallelepiped 1 meter from each side and 1 foot above the top. Location 9 was above the center of the rack approximately 1 foot above the surface.

Four sets of measurements were taken at all nine locations. For the first, the rack was lined with the optional 0.5 inch open cell foam, all the equipment was turned on, and the doors and sides were closed. For the second measurement, the foam was removed but the doors were still closed. For the third test, the sides, top, and doors of the rack were all open. For the final set of measurements, all equipment was turned off and the ambient noise levels recorded.

The sound pressure levels at each location were averaged for 20 seconds. The data were then downloaded in our laboratory and the measured values averaged for each one-third octave band. The measurement results are presented in Fig. 1.

The results show that the cabinet provides approximately a 5 dB reduction in overall A-weighted levels and the lining provides approximately an additional 4 dB reduction. As would be expected for these materials, the noise reduction is most noticeable above 500 Hz (see Fig. 1). Since the measured levels below 100 Hz are so close to the measured ambient levels, they give little information other than to provide an upper limit on the noise contribution in these bands. Much of the noise appeared to be coming from the air intake located at the bottom of the cabinet. Based upon our observations, it can be expected that the noise could be reduced if the air intake (and possibly the exhaust) was ducted.

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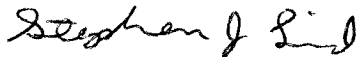
No noise criteria selected by LIGO for the equipment were provided to Acentech. However, for your use I have included the test results for the rack with the lining included along with the NCB 45 curve. The actual NCB rating in the laboratory will depend upon room characteristics and the number and loudness of noise-generating equipment.

Typically, we would recommend noise criteria of NCB 40-50 for laboratory spaces. This provides for fair listening conditions. This compares to NCB 30 to 40, which is recommended for office spaces and provides good listening conditions.

If you have any questions please call.

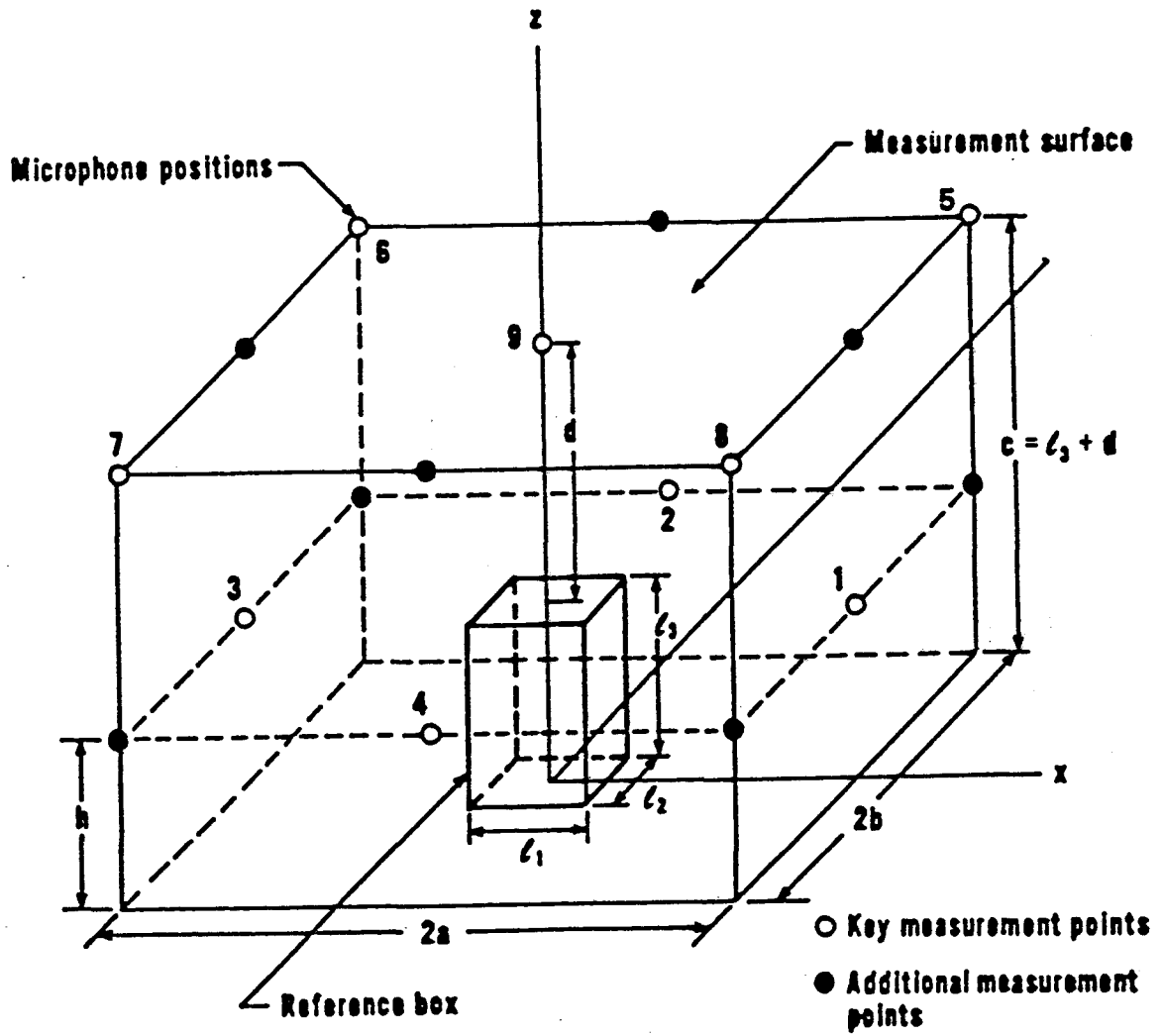
Sincerely yours,

ACENTECH INCORPORATED



Stephen J. Lind

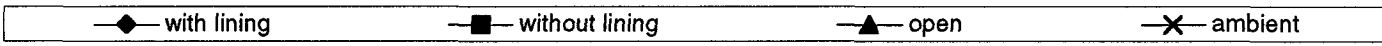
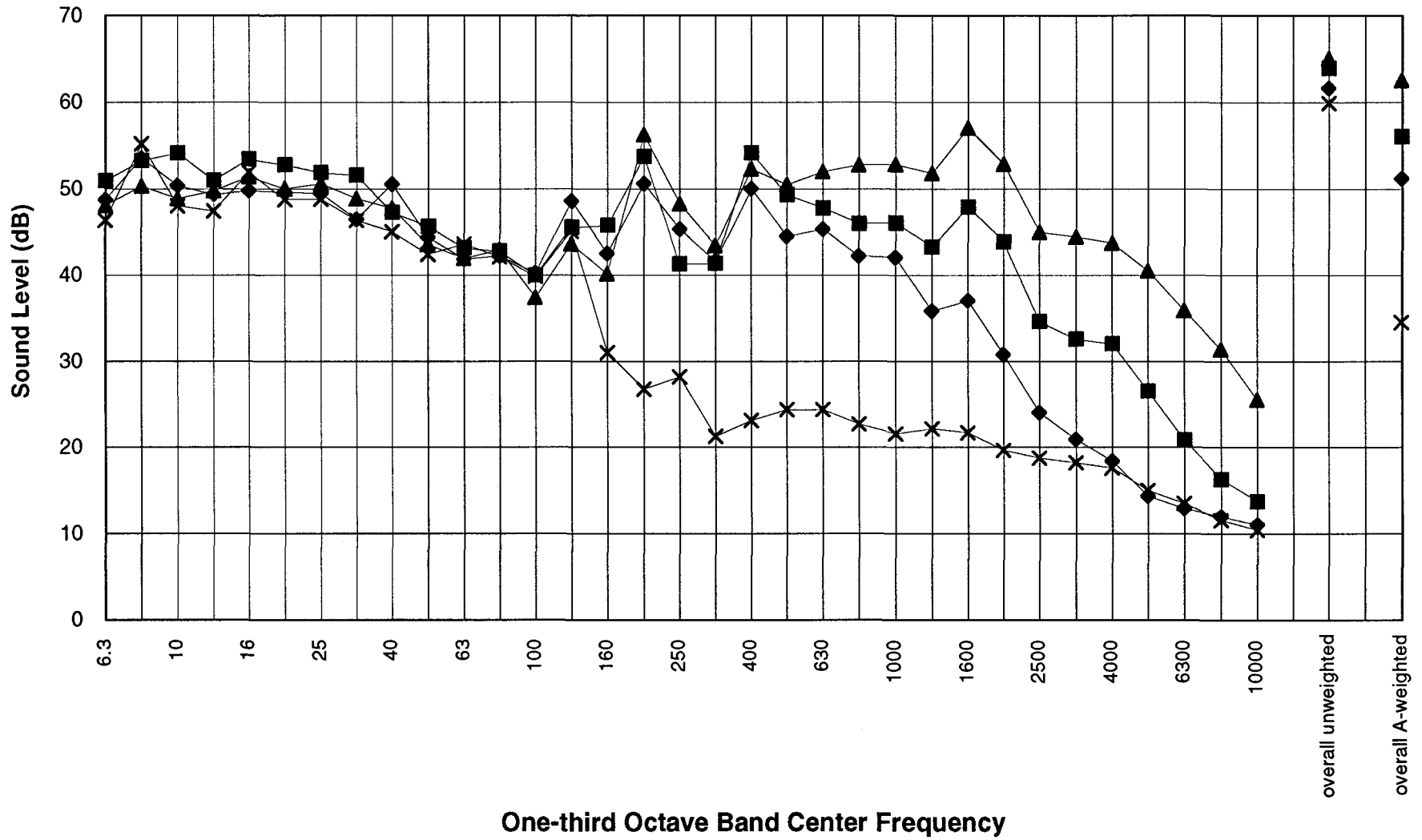
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Enclosures



Sketch

Noise Levels for LIGO Equipment Mounted in Knürr Rack

Figure 1



LIGO Equipment in Knürr Rack

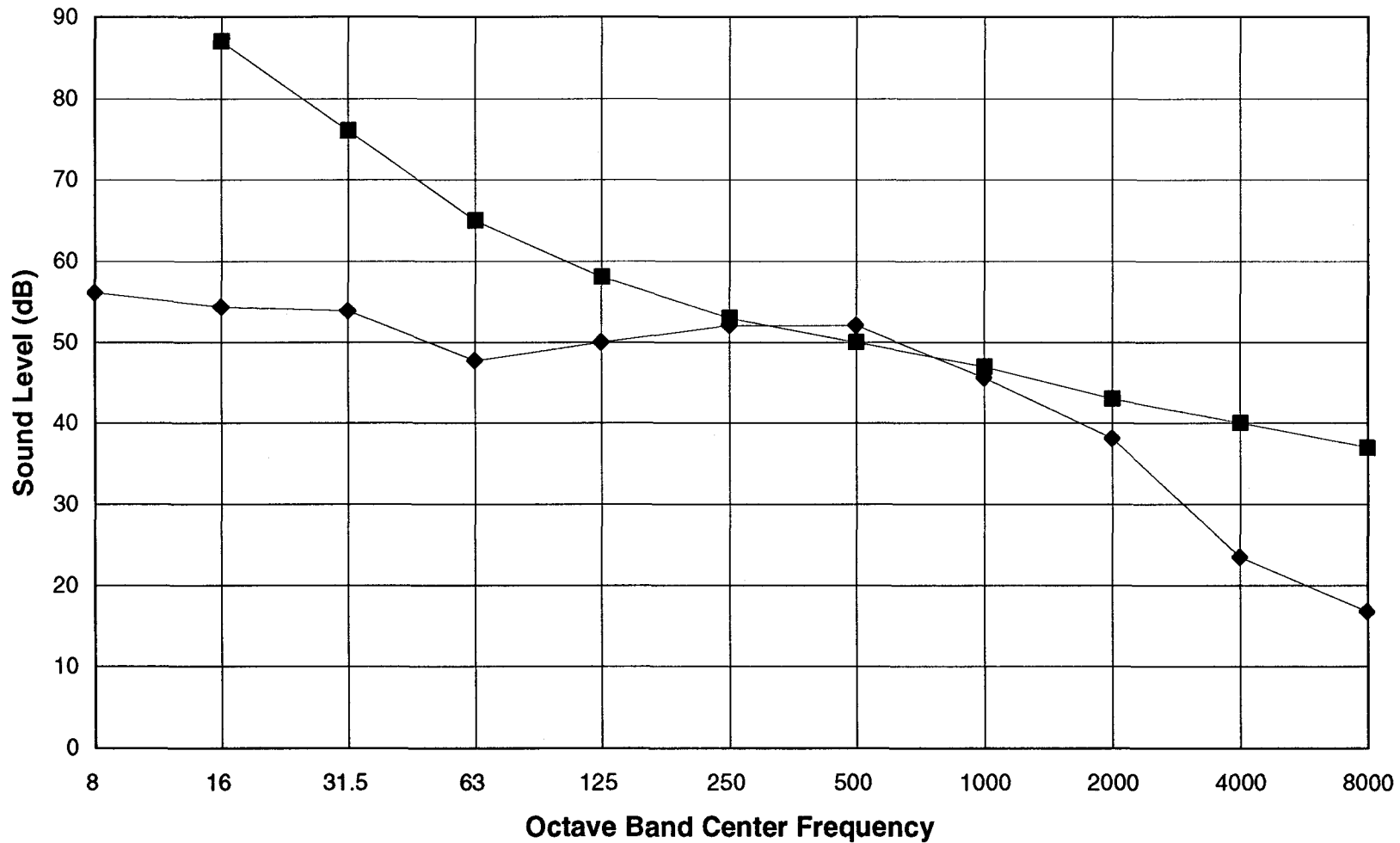


Figure 2

—◆— with lining —■— NCB 45