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28 March, 1996

Mr. Harold Boyer
International Cellulose Corp.
PO Box 450006
Houston, TX 77245-0006

Subject: **Noise Control Benefit of K-13 for Rain Impact, Final Report**

Dear Mr. Boyer.

This draft report summarizes the results of tests conducted at International Cellulose on 23 February, 1996. The purpose of these tests was to illustrate the reduction of rain impact noise brought about by application of International Cellulose K-13 to a sheet metal structure.

The metal structure used in the tests consisted of four walls and roof constructed of approximately 0.019 inch thick (26 gage) ribbed sheet steel, with major ribs approximately 1.25 inches tall on 12 inch centers. The floor of the structure was the host room concrete floor. The overall interior plan dimensions of the structure were approximately 38 by 72 inches; the ceiling was sloped and varied in elevation from approximately 36 to 42 inches. Construction was such that individual wall or ceiling panels could be replaced to simulate different configurations

A microphone was positioned near one of the lower trihedral comers to monitor the interior sound pressure level (SPL) within the structure. An accelerometer was positioned atop the roof panel to monitor the vibration levels of the roof panels.

The rain impact on the structure was generated using two sprinkler head assemblies, firing upwards into a large C-channel located approximately S feet above floor elevation. The water spray collected at the edges of the C-channel into larger drops, which then fell onto the roof surface directly below. The water volume flow and pressure was regulated by a pump. This apparatus produced remarkably consistent results, both in terms of water flow and of time-averaged sound pressure and vibration levels. Total water volume flow was 7.8 ± 0.2 gallons per minute for all tests.

Three configurations were considered:
1. ceiling treated, bare walls,
2. walls and ceiling treated, and
3. bare walls and ceiling.

The treatment consisted of a nominal 2-inch thick layer of International Cellulose K-13 spray-applied to the indicated interior surfaces of the structure.

Application of K-13 significantly reduced the interior SPL. The SPL reduction in octave bands and A-weighted SPL, relative to the untreated ("bare") sheet metal structure configuration, is given below in Table I, and graphically in Figure 1 on page 3.

Octave Band (Hz)/ Surfaces Treated	63	125	250	500	1000	2000	4000	8000	dBA
1. Ceiling	6	7	8	6	11	14	16	16	9
2. Ceiling and Walls	7	7	13	15	25	31	34	40	18

Table I: Octave-Band Sound Pressure Level Reduction

The sound level reductions brought about by treating the ceiling appear to be related primarily to damping of structural vibration by K-13, and secondarily to damping of sound inside the enclosure. The treatment of the walls further damps the sound inside the enclosure, by greatly increasing the average sound absorption coefficient of the enclosure interior surfaces.

This completes our summary of these tests. If you have any questions or comments, please do not hesitate to call.

Sincerely,
HOOVER & KEITH INC.

David A. Nelson

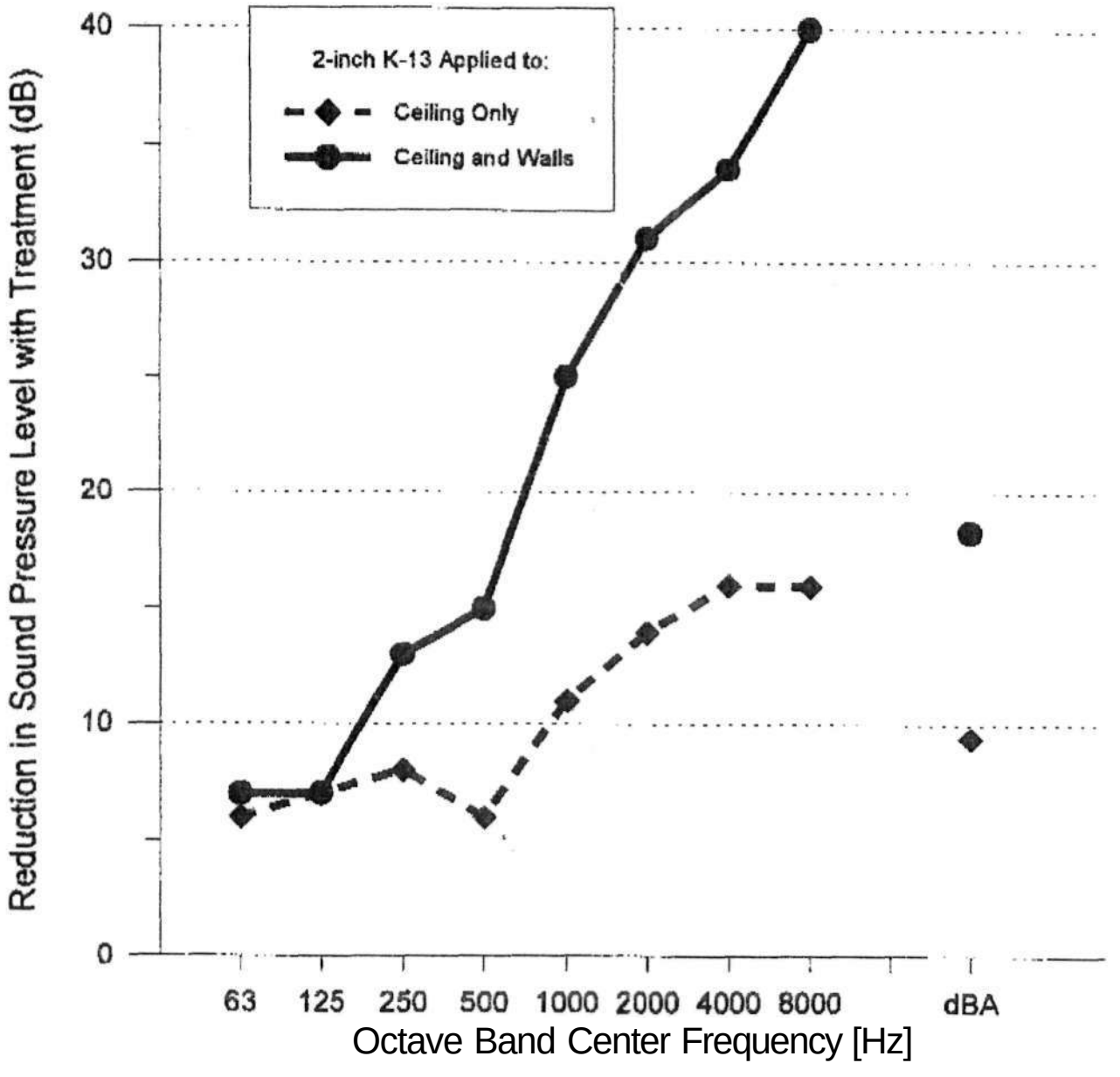
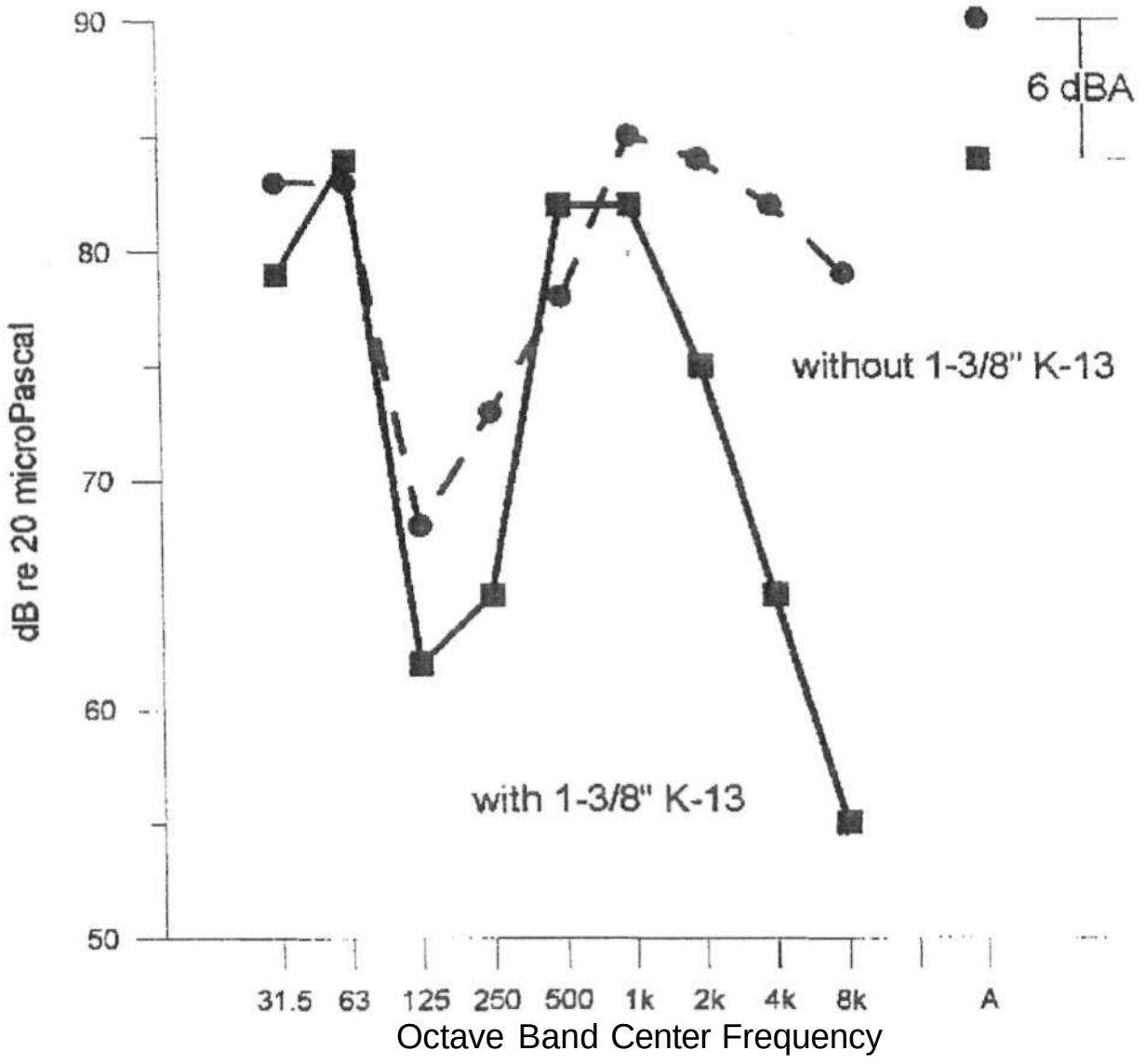
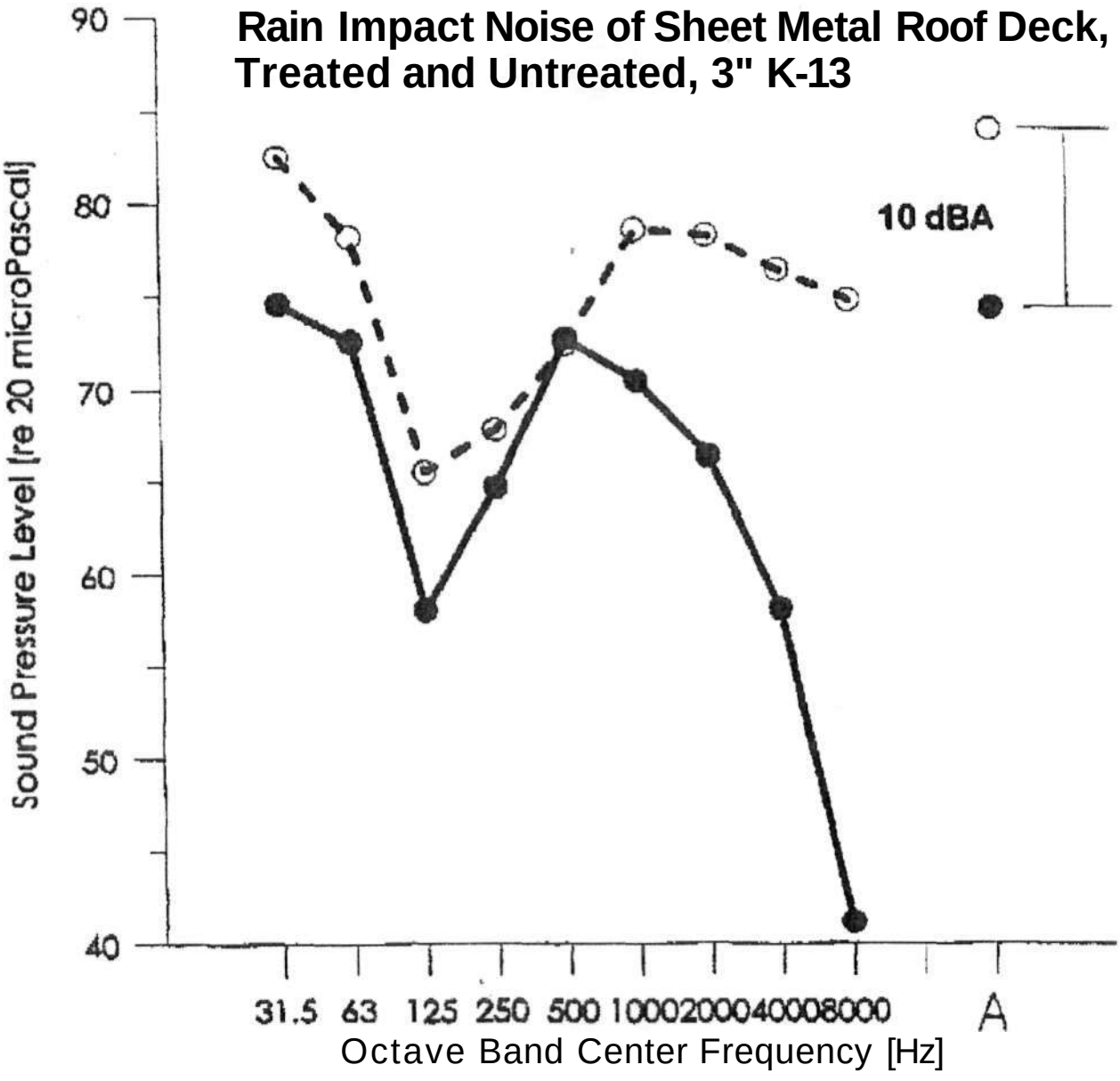


Figure 1: Octave-Band Noise Level Reduction

Rain impact Noise of Sheet Metal Roof Deck, Treated and Untreated




Rain Impact Noise of Sheet Metal Roof Deck, Treated and Untreated, 3" K-13
10 dBA
Sound Pressure Level [re 20 microPascal]
90
80
70
60
50
40
31.5 63 125 250 500 1000 2000 4000 8000 A
Octave Band Center Frequency [Hz]