

INDUSTRIAL
DEVELOPMENT
BULLETIN

Lead Industries Association, Inc.
292 Madison Ave.
New York 17, N. Y.



Look Ahead with Lead

March 20, 1964

SUBJECT: NOISE CONTROL

To Members of the Lead Industries Association, Inc.:

Attached is the second detailed report of a case history of a successful experimental installation of lead for noise control. It follows the first case history sent to you with our letter of December 4, 1962.

Because of the obvious success of the installation and the satisfaction expressed by the owner, an article on this installation has been cleared for publication in an early issue of "Lead," and a brief description was included in an article for "American City Magazine" to be published shortly. In addition, an article on the subject bylined by Detective Allmers of the Bergen County, N. J. Prosecutor's Office will soon appear in the magazine "Law and Order" which will reach hundreds, and perhaps thousands, of others with a similar problem. Eventually reprints of both the "American City" and "Law and Order" articles will be made available to members.

We hope you will find the information contained in this most recent case history useful in your own promotion and sale of lead for noise control.

Very truly yours,

Executive Vice President

RLZ:mk

LEAD INDUSTRIES DEVELOPMENT BULLETIN

Lead Industries Association, Inc.
292 Madison Ave.
New York 17, N. Y.



Look Ahead with Lead

March 9, 1964

LEAD FOR NOISE CONTROL -- CASE HISTORY # 2

Bergen County Polygraph Room

Summary: In October, 1961, Detective Herbert Allmers of the Bergen County, N. J., Prosecutor's Office came to LIA for advice and help in soundproofing a room used for polygraph ("lie detector") tests. His requirements were quite high, and the existing room was quite poor in terms of acoustical privacy and noise level. To further complicate the matter, radical revision of the room could not be undertaken without authorization under a county budget, incurring indefinite delay. Thus any alteration had to be in the general category of "minor alteration or additions" rather than "capital improvement".

Approximate measurements of the room were 9 x 12 x 9 feet high and it was flanked by corridors on two sides, an office on the remaining long side, and an observation room (with one-way mirror) on the remaining short side. All walls except the short wall adjacent to a corridor were sheet steel office partitions. The remaining wall was plastered masonry. A soundproof door had been purchased and installed before Allmers brought this problem to us.

Supplying sheet lead, cement, and leaded plastic (for door gasketing), LIA planned and supervised addition of 4-pound sheet lead to all walls. Additional materials (lumber, acoustical tile for interior finish, glass

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fiber, hardware) and all labor were furnished by the County. The results, tabulated below, were:

	Noise Reduction (nine-frequency average) before after		Improvement
From hall to polygraph room	23.5 db	40.5	17 db
From observation to polygraph room	35	41.5	6.5
From office to polygraph room	32.5	44	11.5

These results are impressive and the achieved level of noise reduction is good. The effect, however, was disappointing. The polygraph room had become so quiet that the noise leaking into it, though small, was still quite disturbing.

This was remedied by using a fan in the polygraph room. It supplies, in addition to air movement, a masking noise which is not, itself, objectionable in any way. This masking noise is so great in comparison to the small amount of external noise leaking in that virtually nothing outside the room can be heard. In our tests we employed a noise source in the observation room which was approximately as intense as the noise produced by a subway train. The accompanying plotted data show that this noise was not perceptible over the fan noise in the polygraph room.

Total materials cost for the job was \$600, of which \$400 was borne by LIA. Labor, other than supervisory and testing, was 8 man days by carpenters and painters and is valued at \$1000.

These results were not achieved easily or directly. Door gasketing, especially, required repeated visits by LIA staff members and the American Smelting and Refining Company R & D people who furnished testing equipment and worked with LIA on the project. Both organizations can say they learned much, but the outstanding lesson is that there is no single, simple, sure-fire way of soundproofing an existing room.

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The Bergen County Prosecutor's Office and Detective Allmers are well pleased with the room. They are satisfied that it meets their acoustical requirements and probably is much better than the majority of rooms used for this purpose.

Polygraph Room Requirements:

Polygraphs are used in police work and have been shown to pay for themselves quickly by saving vast amounts of time in investigations -- not infrequently just when time is precious. In an examination, the voluntary subject is told exactly what questions will be asked ahead of time. He is then asked these questions and a record of his pulse, breathing pattern, and other responses is made. Qualified polygraph examiners like Detective Allmers can analyze such records and tell whether the subject has answered truthfully.

Noise, or any other distraction, can itself induce the involuntary reactions which the polygraph records. Thus, a subject answering "yes" truthfully to a question, might unconsciously react to a sudden noise and indicate that he was lying or, at least might have been lying.

While we are not aware of any published acoustical standards for polygraph rooms, it is evident that the noise level in them should be low enough for conversation at comfortably low levels. More important, it is essential that no distracting noise be allowed to confuse the recorded findings.

Problem and Action Taken:

Initial inspection of the room did not, at once, indicate what steps were needed. It was evident that the following conditions needed to be remedied:

- serious cracks and gaps where panels of the steel office partition joined (it was possible to slip a business card "through the wall" in several of these places)
- serious gaps around a "soundproof" door
- flanking paths through ventilating ducts common to other rooms
- low transmission loss through the steel panels themselves
- leakage through the masonry wall on the short end of the room
- low transmission loss through the one-way mirror to the observation room

Subsequent remedial steps and testing revealed that all these were, in truth, serious sources of sound leakage. But, in addition, the

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following conditions were suspected early in the project:

- leakage through ceilings into the plenum between the hung plaster ceiling and the slab above and then through the ceiling of the polygraph room
- leakage through the hollow floor slab in wiring raceways
- leakage around fluorescent fixtures and ceiling grills from the plenum

While all of these sound paths no doubt contribute to the lack of acoustical isolation, their contribution, in the light of the final results, is judged to be minor.

Because of the great number of apparent conditions to be handled, there were some false starts on planning a soundproofing procedure. The plan finally agreed and called for these steps to be taken:

- four-pound sheet lead to be adhered directly to the three steel walls of the room with a viscoelastic ("Contact" type) cement
- furring strips to be fastened over the masonry wall with four-pound lead over them, all seams to be sealed with cement in lap joints in addition to nailing to the furring
- filling the space between the furred out lead and the masonry wall with glass fiber or mineral wool
- gasketing the door
- blocking the air return of the adjacent office with four-pound sheet lead to close the leakage path through the common duct (ventilation for the adjacent office by undercutting its door)
- lining the feed and return air ducts of the polygraph room with about 10 square feet each of glass fiber

Conventional construction procedures were used throughout. The sheet lead for the steel walls was cut into square "tiles" 20 inches on a side. (This happened to be a convenient module for the room dimensions and the tiles were judged to be easily handled.) The lead was washed with an alkaline cleaner and flushed with water. This removed any oil and produced a matte surface which accepted adhesive well. Tiles were cemented in place by painting cement on the tile and the wall in the area to be covered. Starting at the mopboard, each tile was positioned so that its bottom edge was in place, and then eased up against the wall. In higher rows, previously set tiles were used to align the new ones. At corners, the lead was dressed to give a tight fit into the corner where it joined the dissimilar masonry wall or butted at the steel wall corners and later calked.

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It had been hoped that the seams of the tiles could be caulked, smoothed and painted with texture paint for a satisfactory surface finish on the steel walls. This proved to be too difficult to do. Furthermore, tapping of the lead tiles with short lengths of plank to make sure the adhesive bond was bubble-free had scarred the surface of the lead to an extent where paint could not cover the blemish. Various finishing materials were considered and acoustical ceiling tile was used because it was available and because it was thought that with it the room would have a deadness, or lack of reverberation, which might prove helpful. (In the opinion of Bolt, Beranek and Newman, who later analyzed the results of test on the room, if acoustical tile had not been used, the room might have been satisfactory for its purpose without the introduction of masking noise though this cannot be stated definitely on the basis of the tests which were made.)

It had been planned to surface the short masonry wall with homocote wallboard over the lead and acoustical tile finish in any event, and this procedure was followed.

It is worth noting that the two carpenters who worked on this job were county employees and had not had any previous experience with sheet lead. Their work was quite good from the start and they had no difficulty in dressing lead into and around corners -- including the forming of a "frame" for the one-way mirror which shows in the finished job.

Results:

Several sets of tests were made. The first tests were made before any work was started and represent the condition of the room with no treatment other than caulking the cracks. Most of the intermediate tests were concerned with checking out various schemes for gasketing the door. The final set of tests were made after the door gaskets and the room had been in service for about six months and so represent the real improvement after the sound-proofing had been subjected to some normal wear and tear.

The following test results were obtained:

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NOISE REDUCTION ACHIEVED

(Based on tests with a 25 watt Grayson-Stadtler noise generator and an Industrial Acoustics Corp. Sound Spectrometer, octave band instrument -- NR at the stated frequencies estimated from the plotted data)

Freq. cps	From HALL to POLY			From ADJACENT OFFICE to POLY			From OBS. RM. to POLY		
	NR in decibels			NR in decibels			NR in decibels		
	before	after	diff.	before	after	diff.	before	after	diff.
125	18.5	30	11.5	18	34	16	28	30.5*	2.5
170	19.5	33	13.5	23	37.5	14.5	29.5	31 *	1.5
250	21.5	36.5	15	28	40	12	32	35 *	3
350	24	40.5	16.5	33	42	9	35	41	6
500	26	42.5	16.5	36	44.5	7.5	36.5	44	7.5
700	27.5	43.5	16	37.5	46	8.5	37.5	46	8.5
1000	28	45	17	39	48	9	39.5	48	8.5
2000	25	47	22	40	52.5	12.5	42	50	8
4000	23	47	24	38.5	52.5	14	36	50	14
average (9 freq.)	23.5	40.5	17	32.5	44	11.5	35	41.5	6.5

*When plotted, the "after" curve for Noise Reduction from the Observation Room to the Polygraph Room shows a noticeable dip in this region. The dip is thought to represent the leak through the one-way glass mirror. No remedial action was taken in this case for two reasons: first, the average noise reduction from the observation room to the polygraph room is good and this dip does not occur in a critical portion of the sound spectrum, and, second, it can be safely assumed that during a test the occupants of the observation room, if any, will take care to be reasonably quiet.

As has been pointed out, the noise reduction achieved is generally good, but the polygraph room had become so quiet that even the small amount of sound leaking in was quite noticeable. For this reason a 15 inch fan is used in the polygraph room to provide a high enough ambient noise level to mask these incoming sounds. The real test of whether this works is listening. In order to demonstrate it on paper, however, the following test was run. The noise source was adjusted in the observation room to the spectrum shown. This noise intensity roughly approximates the noise of a subway train. The fan was run in the polygraph room and the octave band sound levels were recorded there under these conditions. These were compared to the ambient noise with the fan running but without the noise source running in the observation room.

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The following results were obtained:

OCTAVE BAND NOISE LEVELS IN DECIBELS

Freq. band (cps)	Source in Obs. Room	Total in Poly. Room	Fan Only in Poly. Room	Difference (in Poly. Room)
37.5 - 75	73.5	57	52	5
75 - 150	71	62	63	- 1
150 - 300	74	52	52	0
300 - 600	79	46	46	0
600 - 1200	84	45	46	- 1
1200 - 2400	88	43	41.5	1.5
2400 - 4800	86	36	35	1
4800 - 9600	80	27	27	0

It is generally accepted that in tests of this type differences of less than 6 db are not significant. With the exception of the difference (5 db) in the first band, all differences can be assigned to experimental error. The first band difference may, and probably does, represent sound leaking into the polygraph room. It is judged to be a very minor leak and not troublesome in the intended use of the room.

Conclusions:

The results achieved in soundproofing the polygraph room have been excellent. Detective Allmers is well pleased with the room and has no reservations about its acoustical performance. The materials and direct labor costs, it is felt, were not excessive in terms of what was accomplished.

On the other hand, the amount of care, supervision, and detail work by those directing the project was considerable. Much of the technical and supervisory labor can be accounted for by testing, of course. But, in fairness, it must be said that the existing results would not have been achieved without a good many man-hours of experimenting and testing of provisional measures.

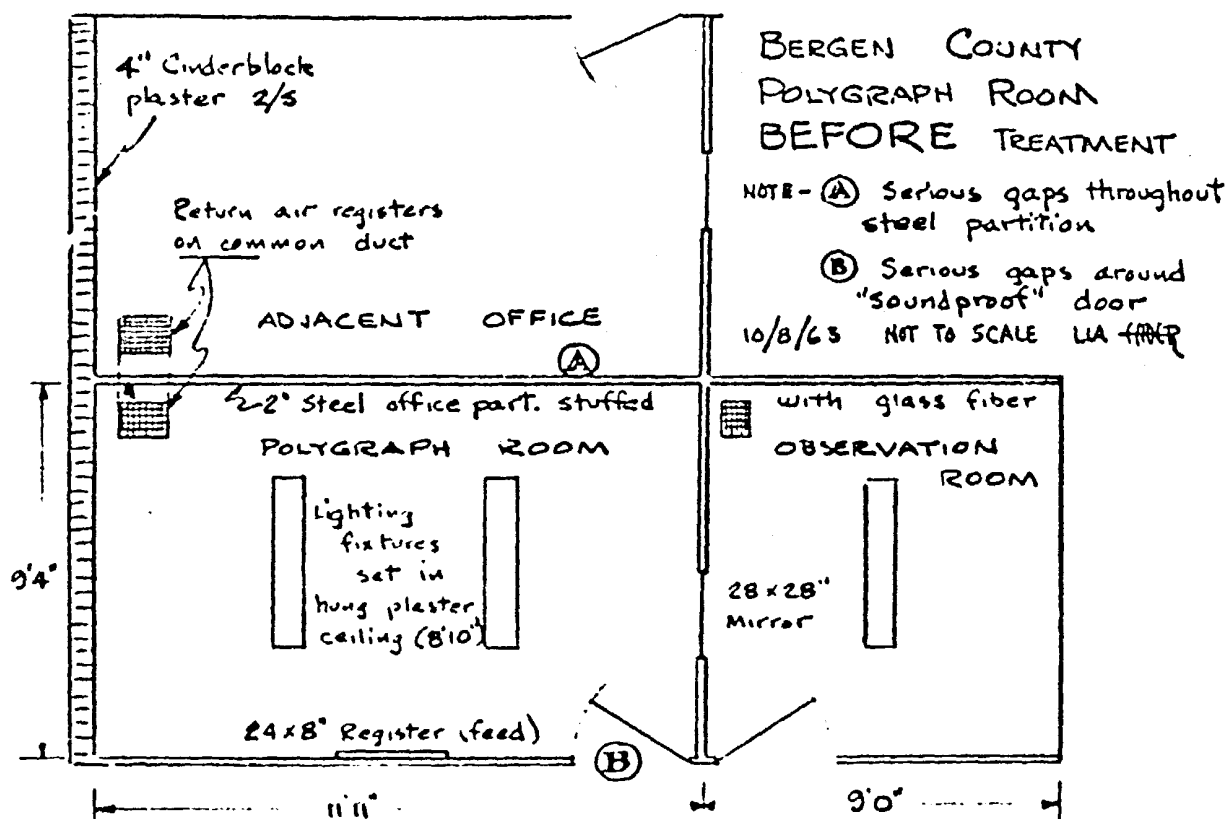
This detailed technical work showed that the general scheme employed was sound and workable. The total materials and direct labor costs exclusive of supervisory, testing, and experiment, were about \$1000.

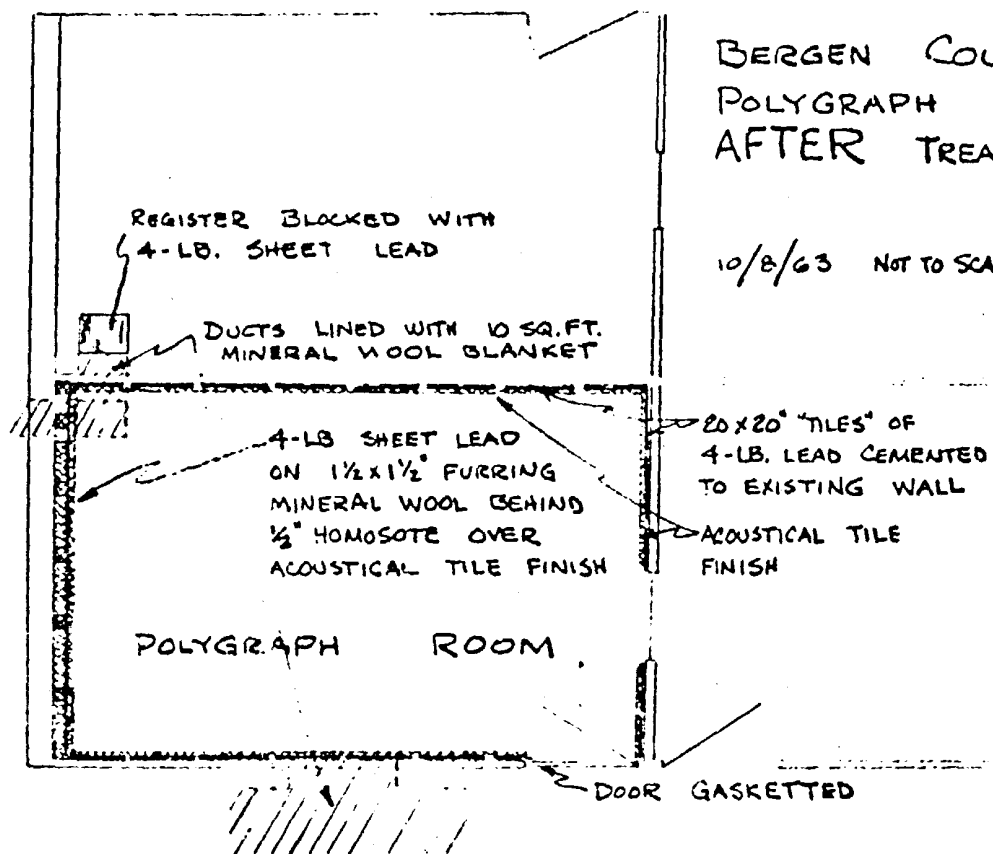
The findings of the LIA staff in this case have been reviewed and found substantially correct.

Respectfully submitted,

Bruce Fader
Bruce Fader
Manager, Technical Services

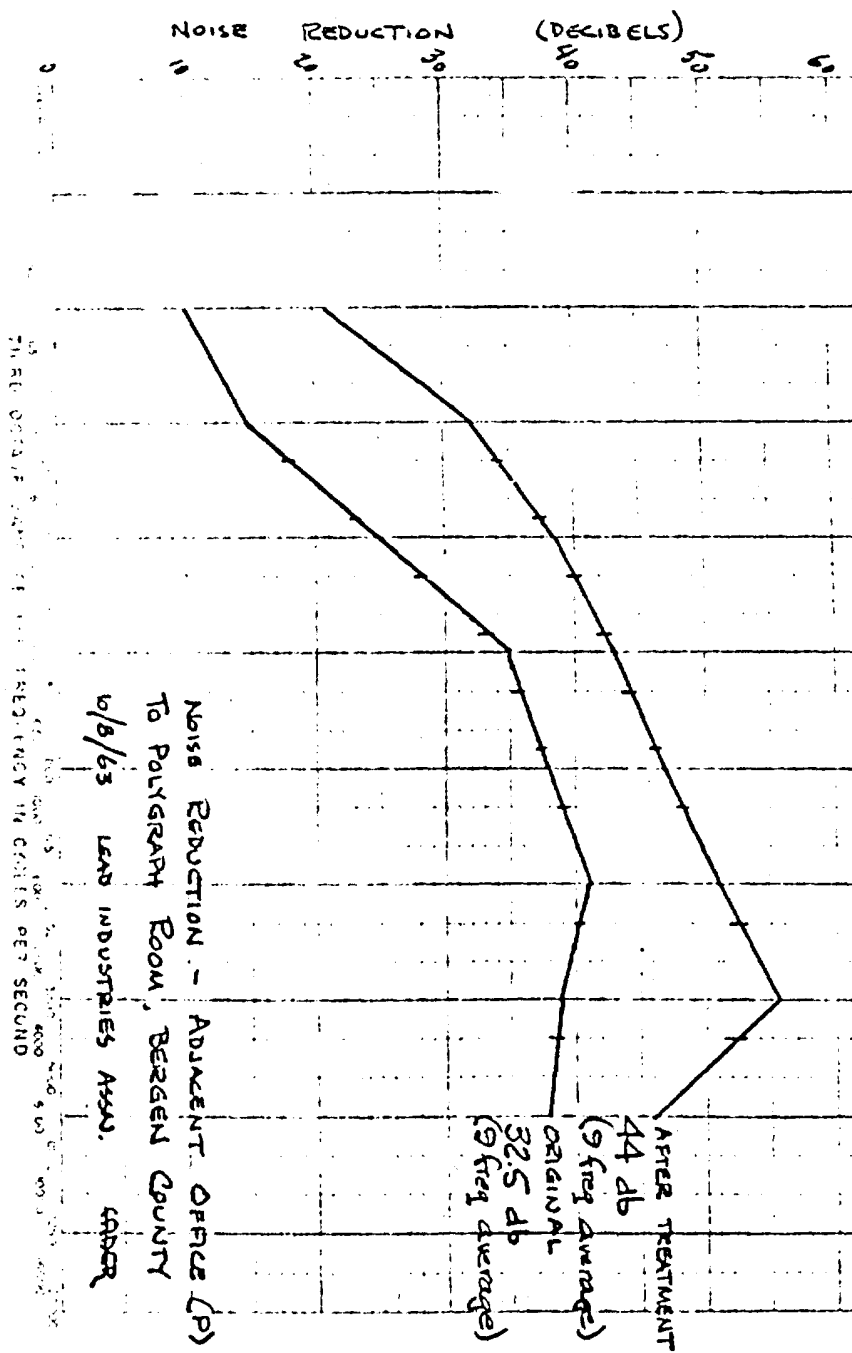
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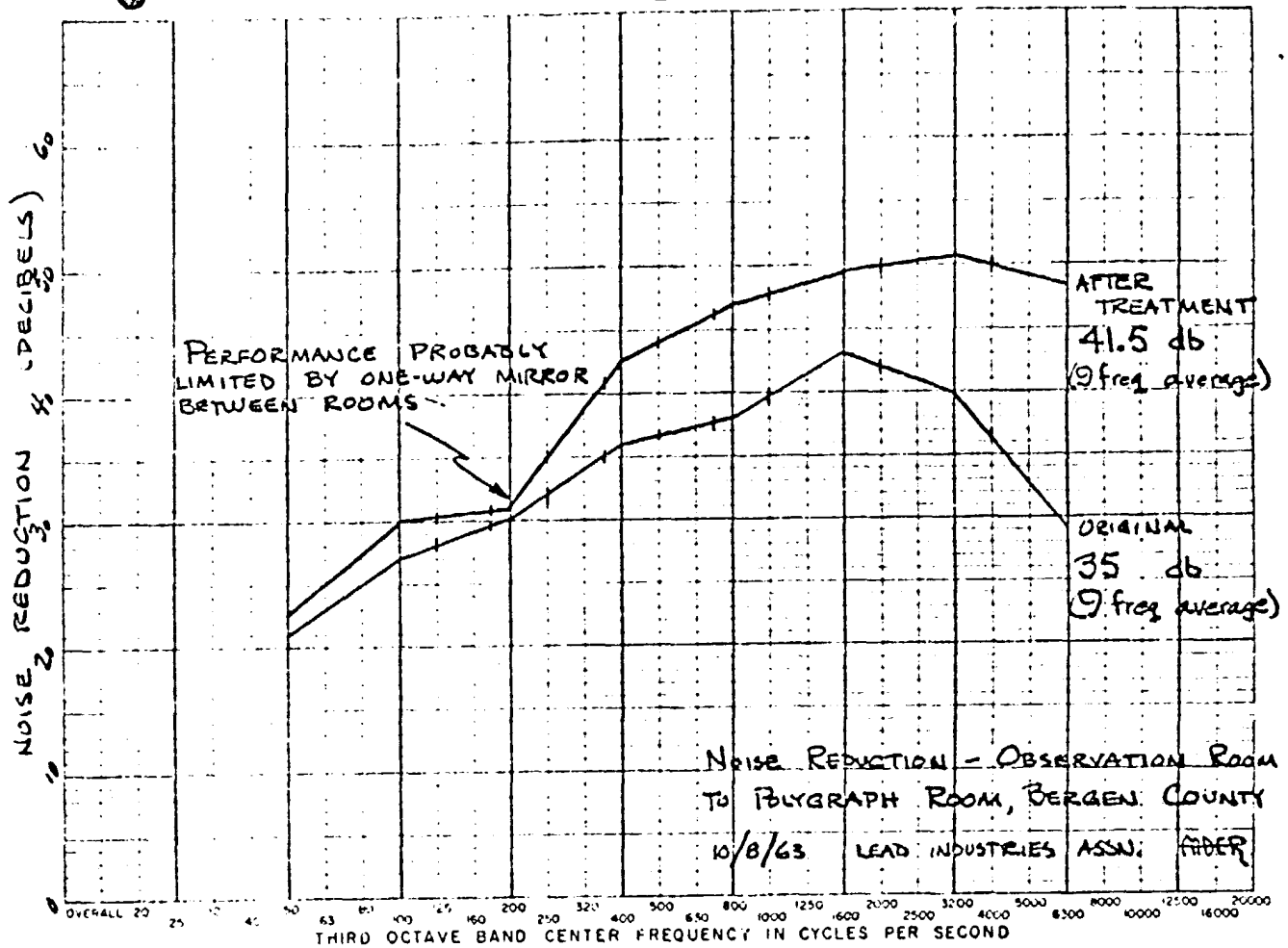


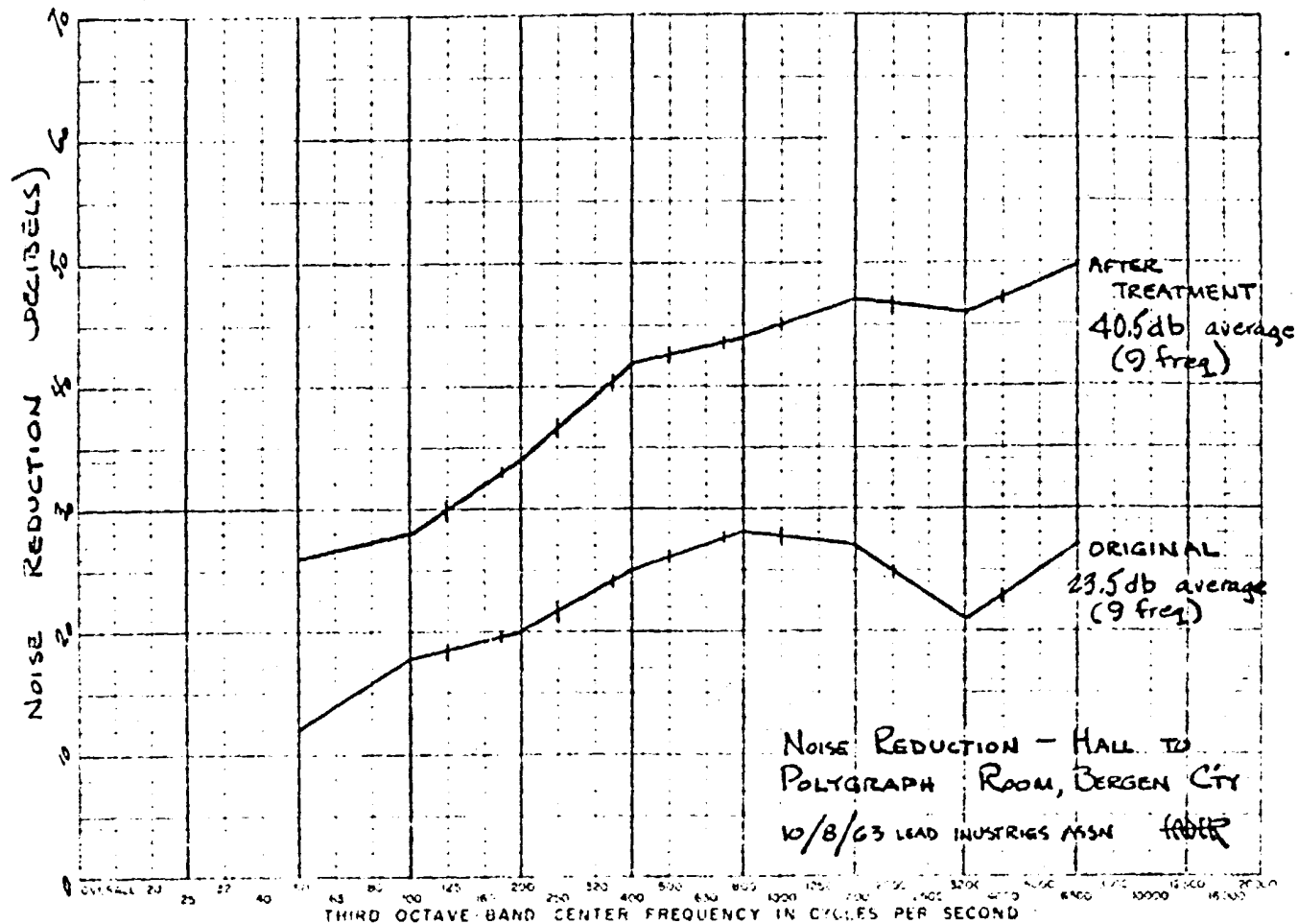


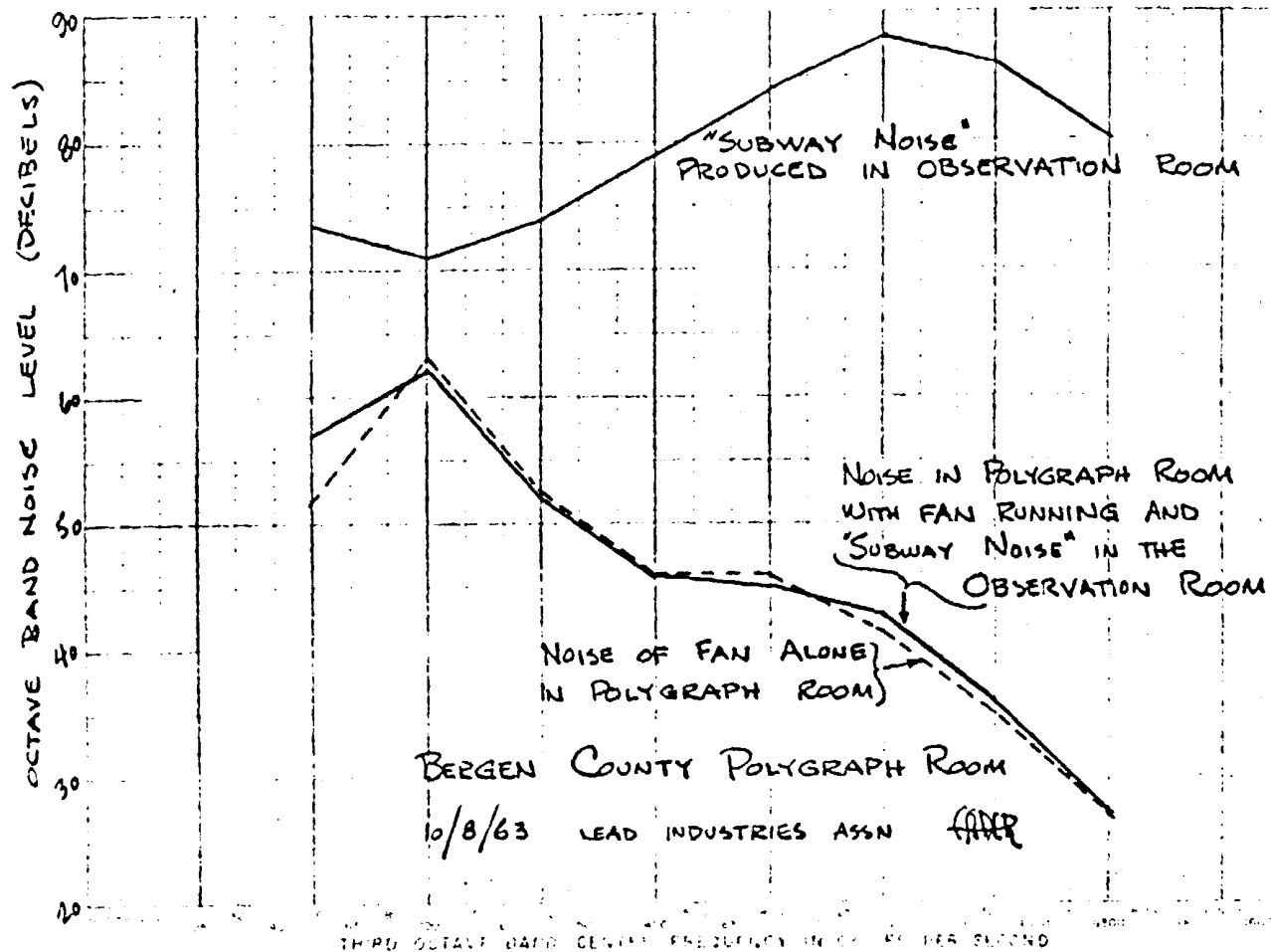
BERGEN COUNTY
POLYGRAPH ROOM
AFTER TREATMENT

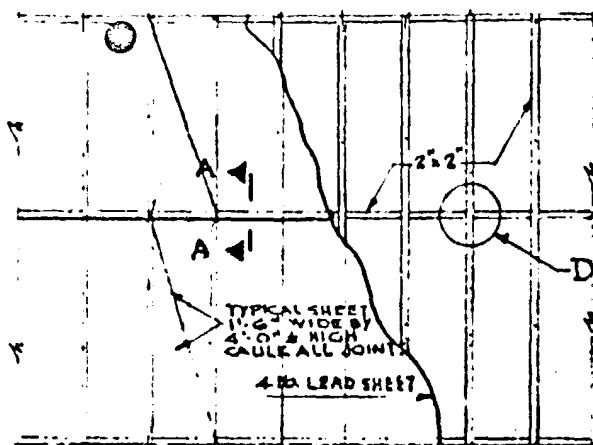
10/8/63 NOT TO SCALE LIA ~~INTER~~



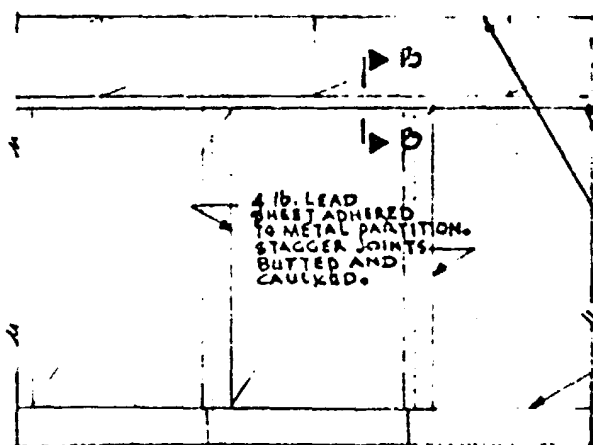




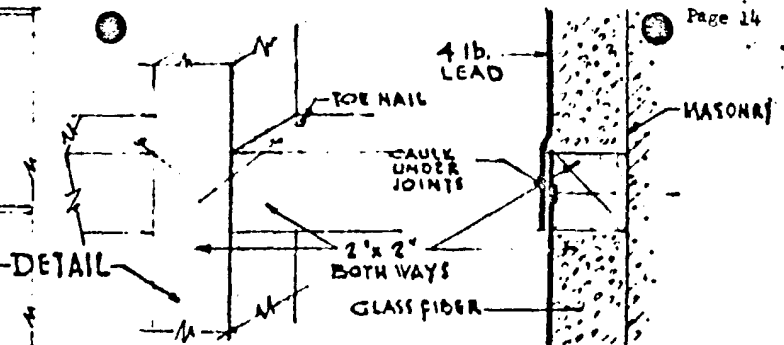




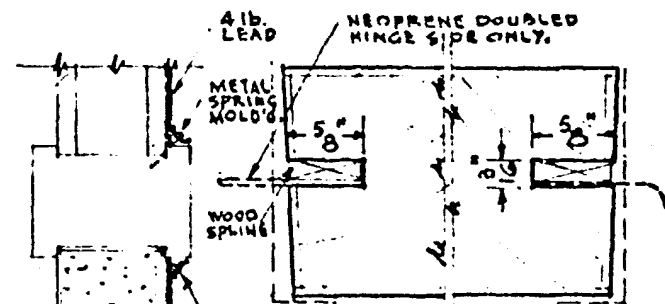
ELEVATION-MASONRY



ELEVATION-METAL 3' x 10'



DETAIL

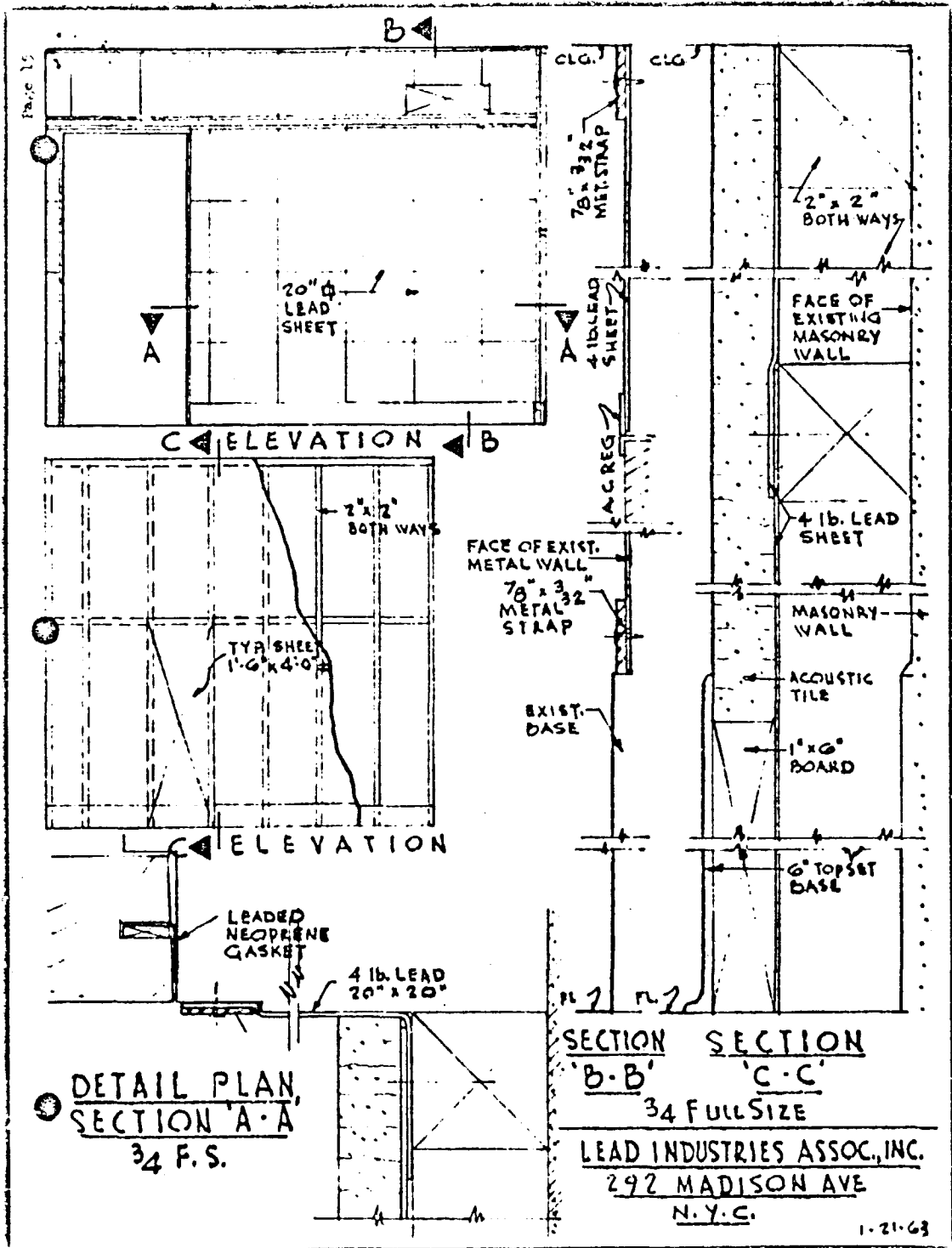
SECTION A-A'
(HORIZONTAL SECTION
SIMILAR)

F.S.

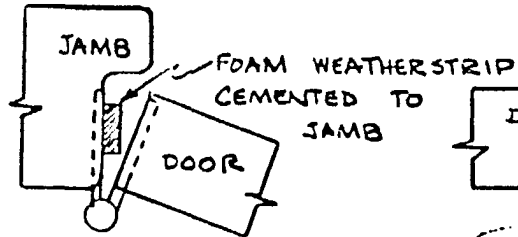
DETAIL OF DOOR
GROOVESECTION B-B'
NO SCALE

GROOVE DOOR FOUR SIDES AS SHOWN. PROVIDE 5/8" x 3/32" SPLINES. INSERT 0.35 lb. NEOPRENE SHEET, DOUBLED ON HINGE SIDE, SINGLE ON OTHER THREE EDGES. WEDGE AND GLUE SPLINES.

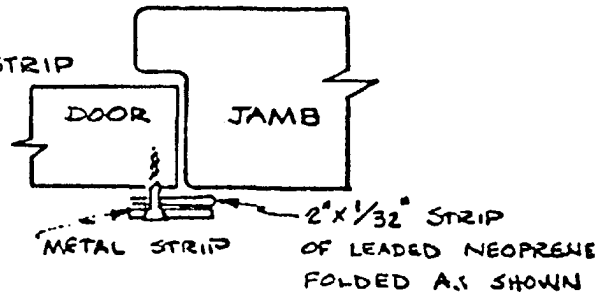
LEAD INDUSTRIES ASSOC.
By E.D. MARTIN, A.I.A. 4/12/62



HINGE SIDE

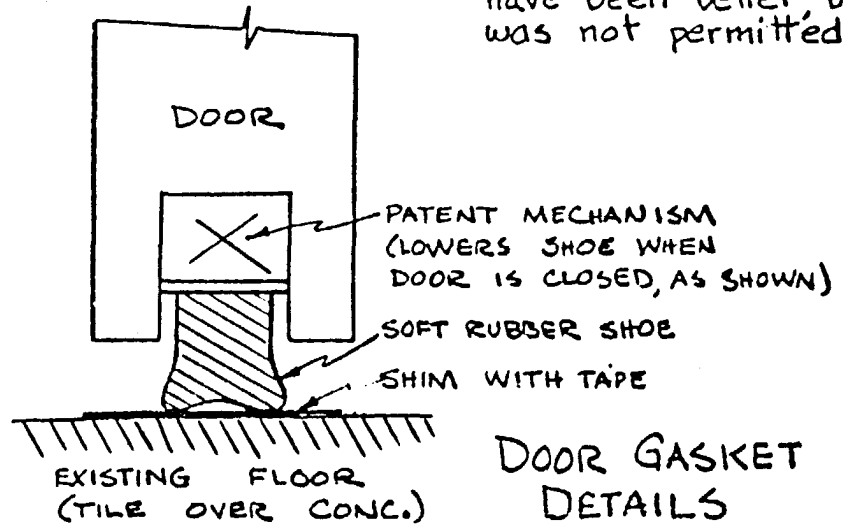


TOP & LATCH SIDE



AT FLOOR*

* Use of a threshold would have been better but was not permitted.



DOOR GASKET
DETAILS

BERGEN COUNTY POLY. RM.
10/14/63 L.I.A. ~~FABER~~