DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE IWS-63-11B

October 18, 1967

Mr. Darrel D. Douglas
Chief Industrial Hygiene Engineer
Oregon State Board of Health
Portland, Oregon

Dear Darrel:

The data on Hanna Nickel Smelting Company are now complete and tabulated. The results, as you will see, pretty much confirm our observations.

Particulates

The use of two-stage personal samplers permitted a simultaneous evaluation for dust by gravimetric analysis and the analysis for nickel by chemical means.

A suggested exposure limit against which respirable dust concentrations can be compared is based on studies in the granite industry and tested in several foundries. This suggested value is:

$$\text{Exposure limit } (mg/m^3) = \frac{10}{\%\ SiO_2^* + 2}$$

*Percent free silica in the respirable fraction.

The percent free silica in the respirable fraction was 3% for the smelter building and 14% for the crusher building. By employing these values in our formula we obtain exposure limits of 2 mg/m^3 and 0.6 mg/m^3, respectively. As you can see by scanning Table 1, these values are frequently exceeded. As a matter of fact, over three-fourths of the workers sampled were subjected to excessive dust exposures.

For comparing the severity of exposure Glen Sutton suggests an exposure index which he defines as the ratio of the respirable mass concentration

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to the exposure limit. An E.I. of greater than one would mean that the exposure concentration exceeds the exposure limit and an E.I. of two would be an exposure twice the permissible level.

Results of dust samples taken within the calcining building are not included. Unfortunately, because of mechanical problems (Isleworth dilutriator failed to operate properly; personal monitor became disconnected), an insufficient sample was obtained. You may wish to re-evaluate this area at a later date.

Nickel exposures, as evidenced by air concentrations, were quite low. On the other hand, nickel urine excretions were markedly elevated (see Table 2) which would suggest that an additional portal of entry for nickel was through ingestion. As far as we know there is no toxicological data to support physiological damage resulting from exposure to elemental nickel as indicated by high urinary excretion. Perhaps, you may have some information on this.

Noise

The power densities taped at various locations were analyzed for frequency and plotted on graphs developed by Jones and Church.[2] Noise levels were, generally, in the low frequency range but were excessive.

The tape was submitted to Cincinnati for narrow-band analysis. In the event that additional information is obtained, I will see that you receive it.

Heat Stress

The Belding and Hatch[3] criterion was used to calculate heat stress. Table 3 indicates the severity of this exposure.

The problem, as you are well aware, is one primarily of radiant heat exposure. Reflective shielding was noticeably absent and, although exposures were not continuous, the amount of actual exposure, in most instances, greatly exceeded the allowable exposure time.

Gordon and I enjoyed the opportunity of assisting in the survey and--- if you can provide more favorable working hours, we will promise to return. Best wishes.

Sincerely yours,

P. G. Rentos
Health Services Officer

Enclosures

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References

1. Mastromatteo, E.: Nickel: A Review of its Occupational Health Aspects, J. of Occ. Medicine 9:3, 1967.

2. Jones, Allen R. and Church, P. W.: A Criterian for Evaluation of Noise Exposures, Medical Research Division, Esso Research and Engineering Co., Linden, N. J.

3. Belding, H. S., and Hatch, T. F.: Index for Evaluating Heat Stress in Terms of Resulting Physiological Strain, Heating, Piping and Air Conditioning 27:8, 1955.

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Table 1, Airborne Particulate Concentrations within Respirable Fraction

Smelter Building

	Operation	Respirable Mass Concentration mg/m^3	Exposure Index	*Nickel Concentration mg/m^3
Day shift	Welder	11.4	5.7	0.25
	Sweeper	14.2	7.1	0.36
	Crane operator	3.5	1.8	≤0.01
	" "	3.9	2.0	<0.01
	" "	3.3	1.6	<0.01
	Forklift operator	3.7	1.8	<0.01
	Tapper helper	5.5	2.8	<0.01
	Skull driller	4.3	2.2	<0.01
	Crane chaser	4.8	2.4	<0.01
Swing shift	Crane operator	3.9	2.0	0.11
	" "	1.4	0.7	0.10
	Ferro-silicon furnace charger	7.7	3.8	<0.01
	Furnace charger - 2nd helper	6.8	3.4	0.19
	Tapper	1.6	0.8	<0.01
	Skull driller	0.8	0.4	<0.01
	Melters - 1st helper	5.6	2.8	0.20
Graveyard shift	Crane operator	1.1	0.6	<0.01
	" "	6.2	3.1	0.08
	Tapper	5.8	2.9	<0.01
	Skull driller	6.5	3.3	<0.01
	Ferro-silicon furnace charger	0.9	0.4	<0.01
	Crane chaser	0.2	0.1	<0.01

*Threshold limit value, based on an eight-hour daily exposure of 1 milligram per cubic meter of air.

Table 1 - Continued

Airborne Particulate Concentrations
within Respirable Fraction

Crusher Building

Work Shift	Operation	Respirable Mass Concentration mg/m^3	Exposure Index
Day	Crusher operator	6.2	10
Swing	Crusher operator	2.4	3.9
Graveyard	Crusher operator	2.3	3.7

Table 2, Nickel Urine Concentrations

Name	Job Title	Nickel Urine* Micrograms per Liter
Norman Done	Sweeper	40
Larry Powel	Welder	360
Vernon Church	Crane operator	70
Earl Keele	Crane operator	40
Noel Larsen	Crane operator and tapper	30
Mark Osmond	Skull driller	70
Miles Falls	Tapper helper	10
Jay Childress	Furnace operator	20
Pete Rytrek	Skull driller	10
Jesse Trandez	Smelter	40
Charles Swabes	Smelter helper	140
Floyd Carr	Mixer operator	40
Clinton Osborne	Crane operator	60
Don Anderson	Slag handler	10
Ken Kobos	Crane operator	10
Harry Baker	Crane operator	30
Richard Kremer	Melt furnace helper	30
Jake Tavenner	Crane chaser	(insufficient sample)
O. W. Hobbs	Tapper	20
Normal Johnson	Craneman	60
William Graham	Furnace charger	< 10
Morse Henderson	Skull driller	< 10
C. D. Meeks	Craneman	40

*Normal urinary excretion[1]: 7.6 - 11 µg nickel per liter.

Table 3, Heat Stress Evaluation

Location	Temperature (°F) Dry Bulb	Wet Bulb	Globe	Movement Feet/Min.	$E_{required}$ BTU/hr.	$E_{maximum}$ BTU/hr.	H.S.I.*	Maximum Exposure (Time(Hrs)
Ferro-silicon furnace Loading area	100	68	130	43	2121	1540	138	0.4
Tapping area	100	69	122	1750	3336	2400	140	0.3
Number two granulator platform, 3rd floor	94	66	99	45	603	1570	38	8.0
Refining furnace	82	60	122	60	1659	1840	91	6.6

*Heat Stress Index

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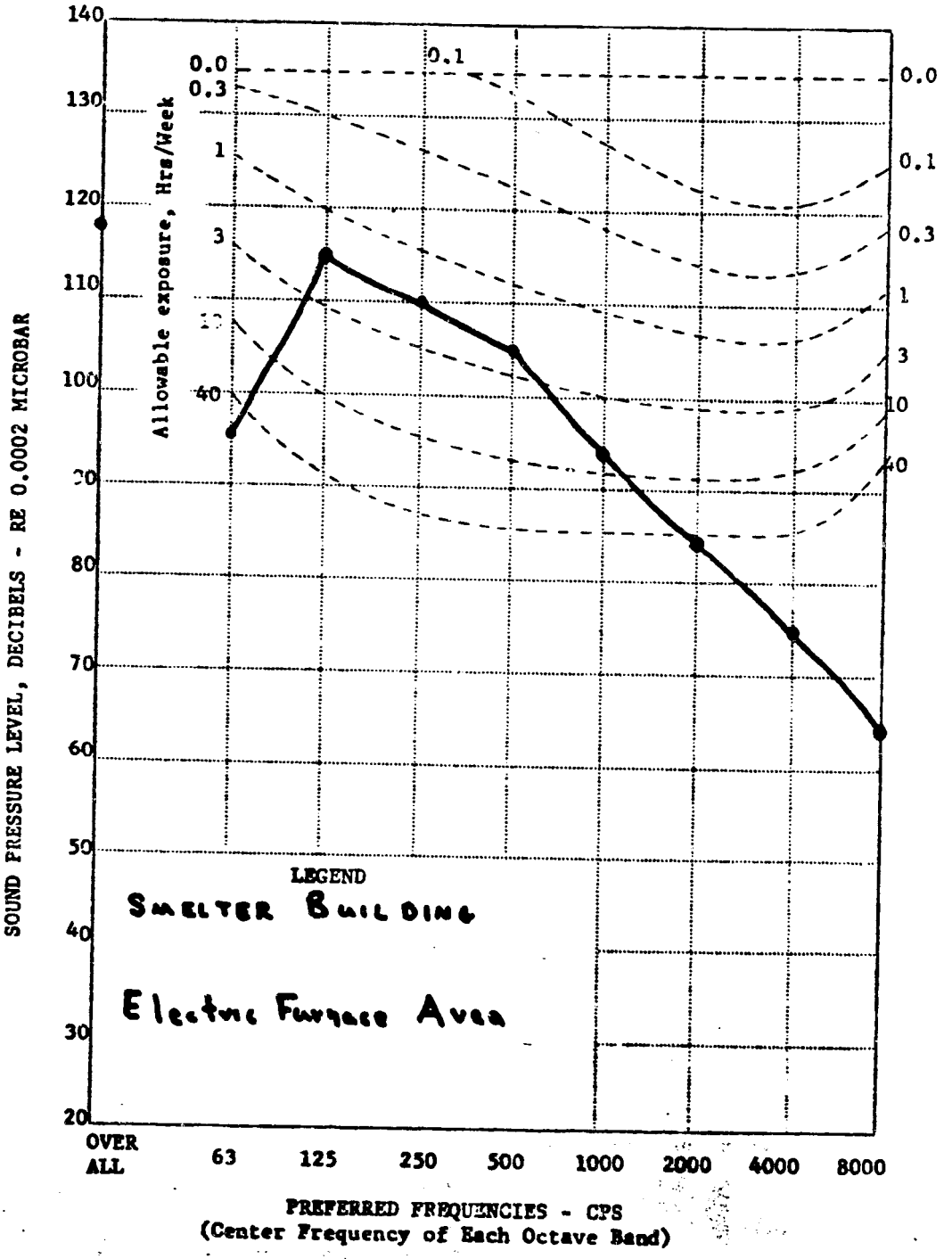

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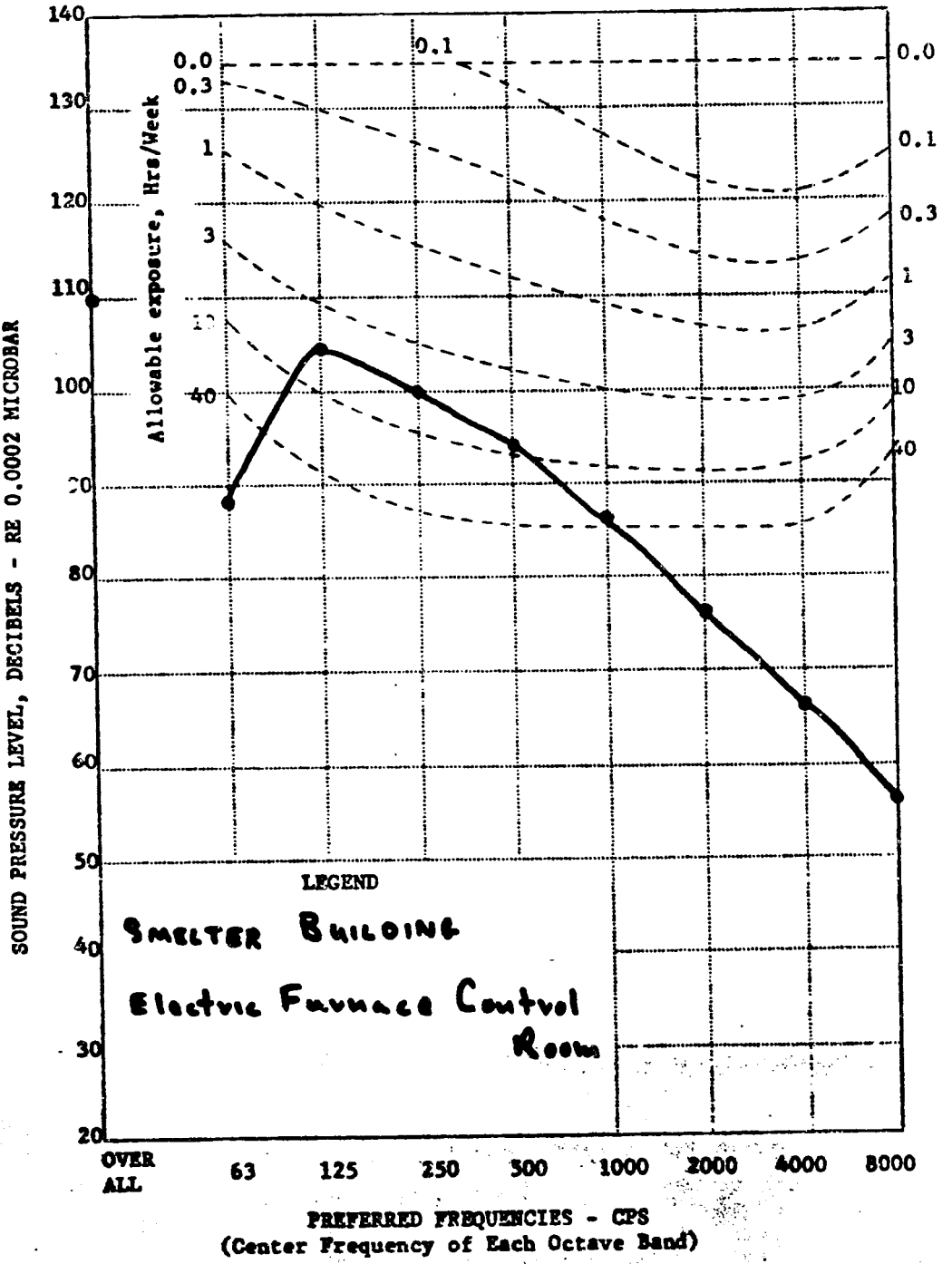

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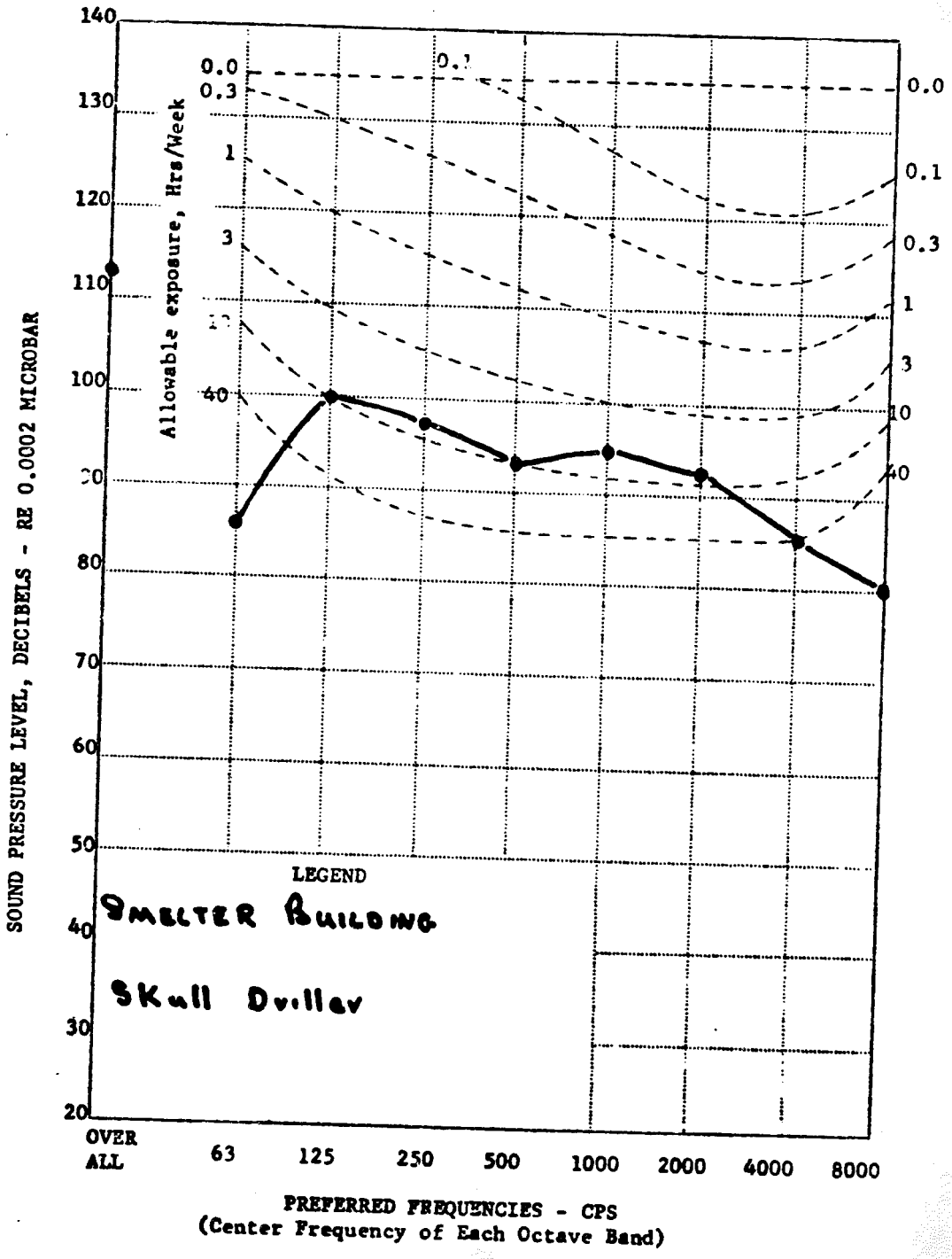

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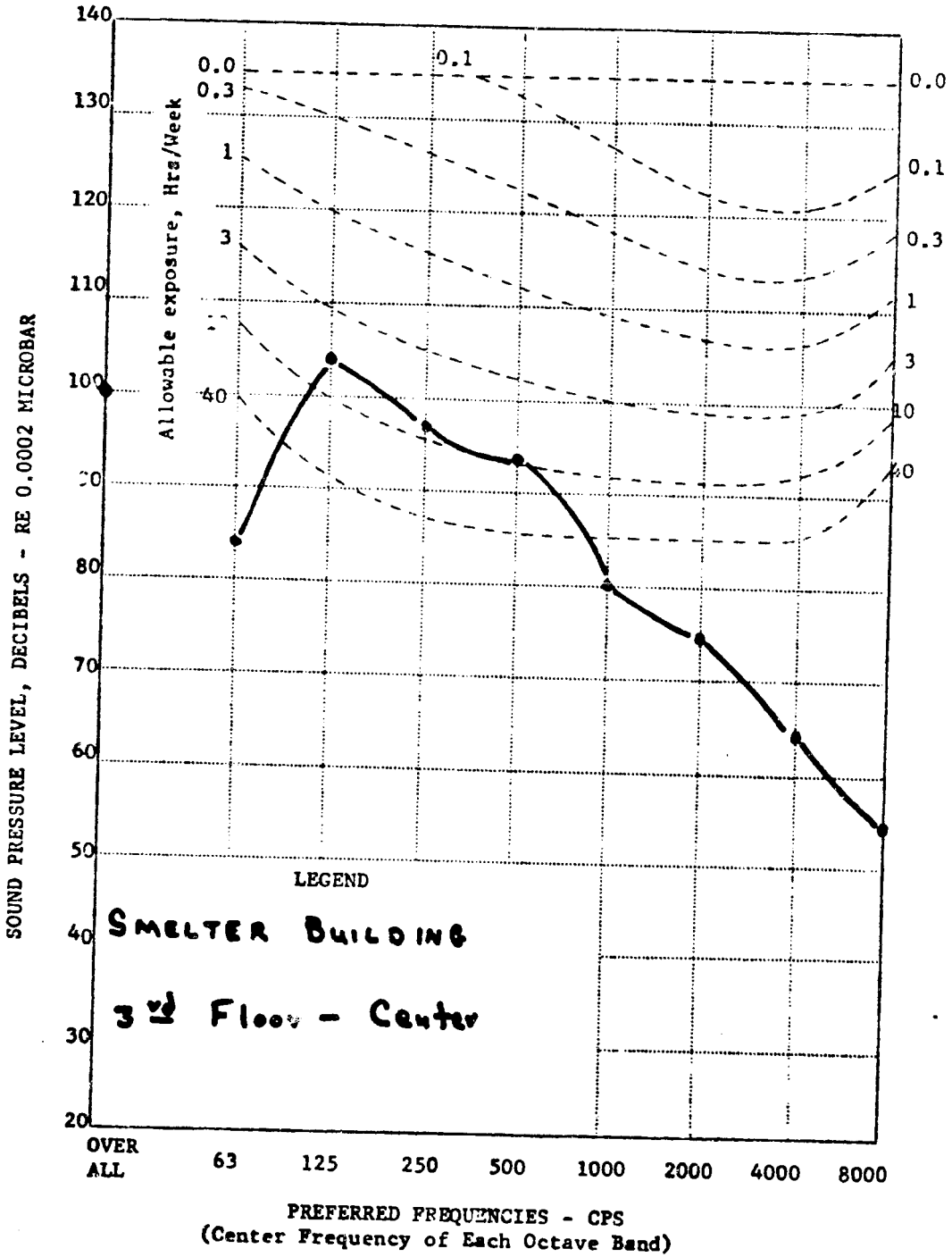

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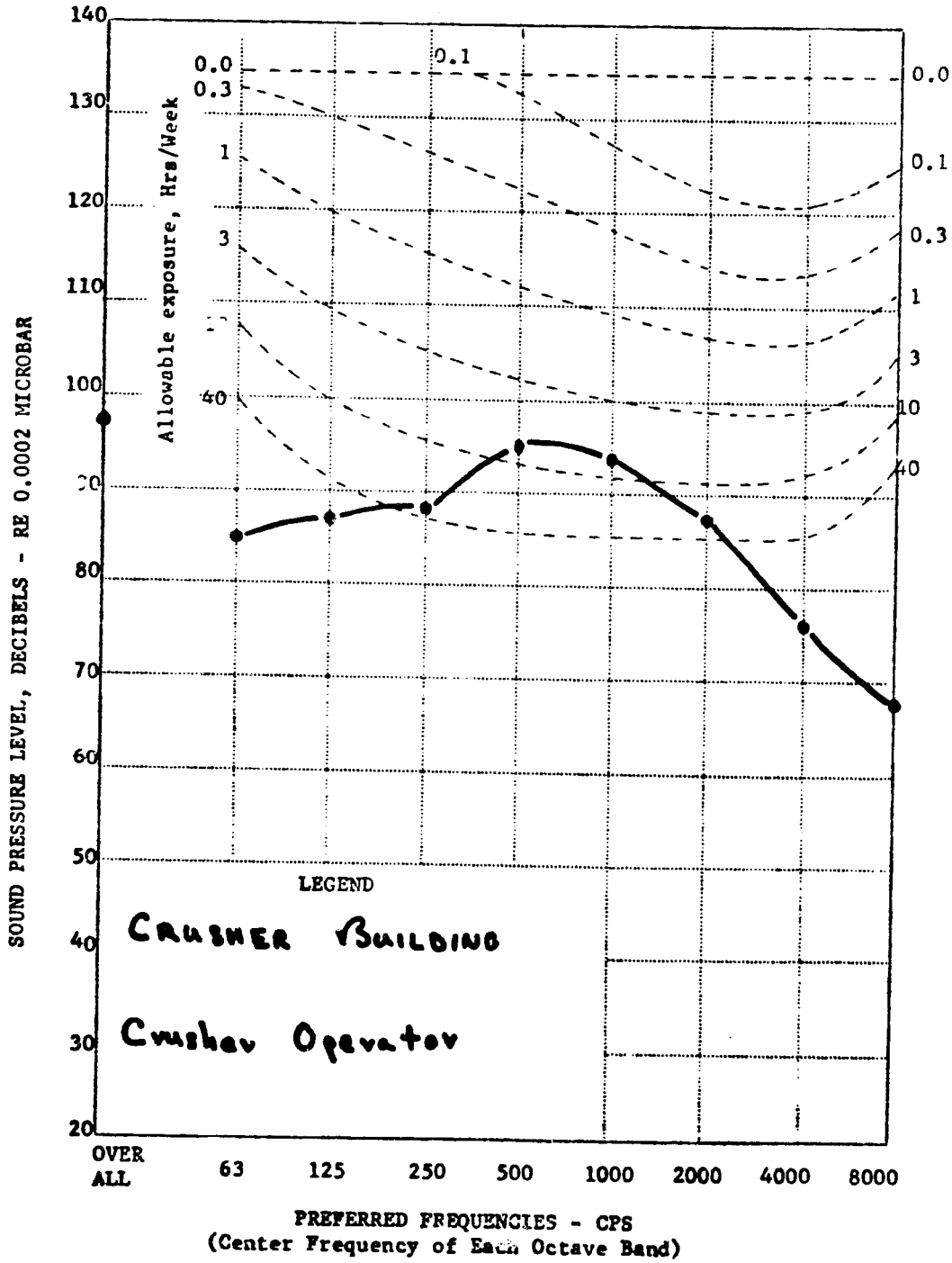

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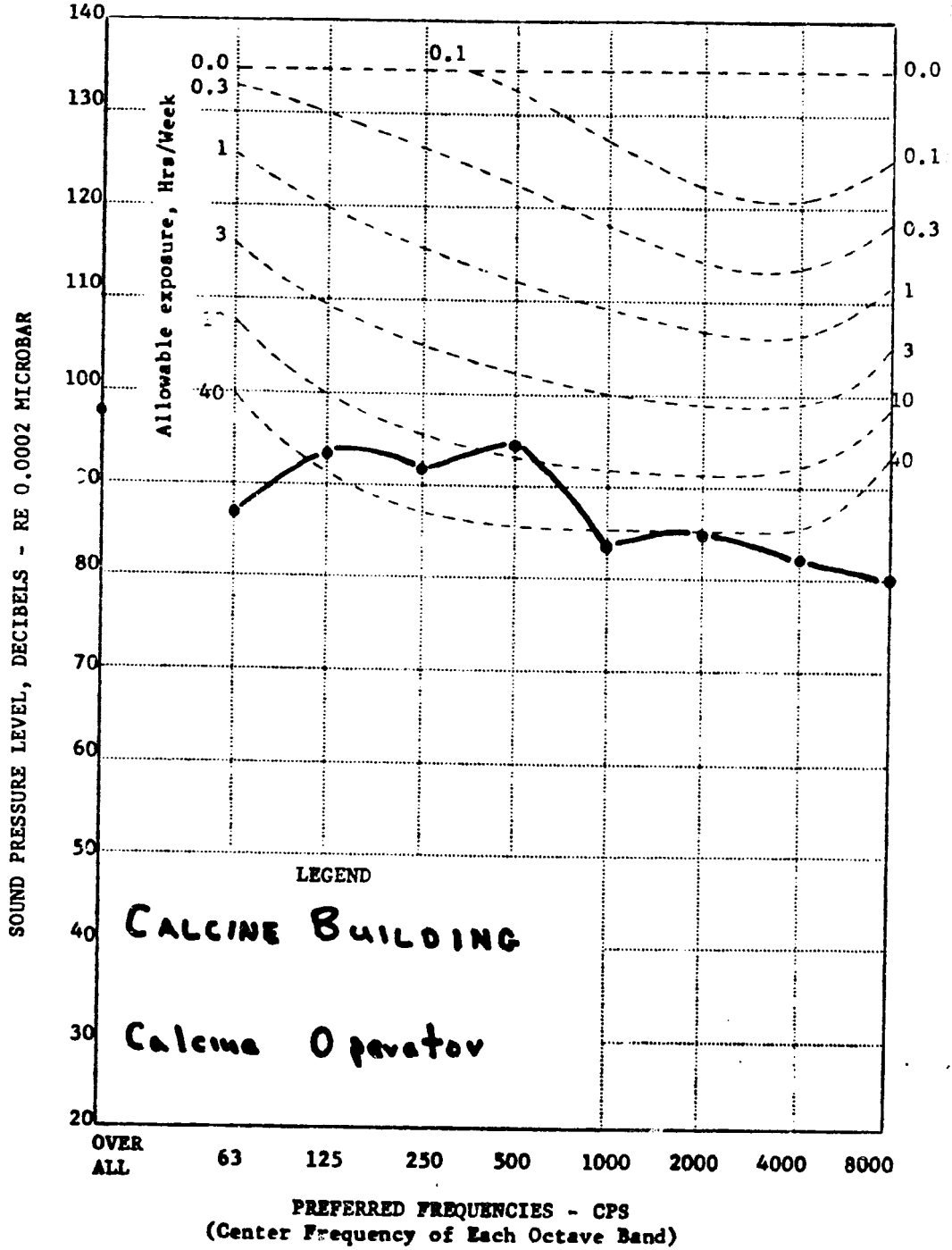

Index of Heat Stress	Physiological and Hygienic Implications of 8-hr. Exposures to Various Heat Stresses
0	No thermal strain
+10	Mild to moderate heat strain. Where a job involves higher intellectual functions, dexterity, or alertness, subtle to substantial decrements in performance may be expected. In performance of heavy physical work, little decrement expected unless ability of individuals to perform such work under no thermal stress is marginal.
30	Severe heat strain, involving a threat to health unless men are physically fit. Break-in period required for men not previously acclimatized. Some decrement in performance of physical work is to be expected. Medical selection of personnel desirable because these conditions are unsuitable for those with cardiovascular or respiratory impairment or with chronic dermatitis. These working conditions are also unsuitable for activities requiring sustained mental effort.
70	Very severe heat strain. Only a small percentage of the population may be expected to qualify for this work. Personnel should be selected (a) by medical examination, and (b) by trial on the job (after acclimatization). Special measures are needed to assure adequate water and salt intake.
90	Amelioration of working conditions by any feasible means is highly desirable, any may be expected to decrease the health hazard while increasing efficiency on the job. Slight "indisposition" which in most jobs would be insufficient to affect performance may render workers unfit for this exposure.
100	The maximum strain tolerated daily by fit, acclimatized young men.