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January 18, 1965

DR. ROBERT A. KEHOE
Kettering Laboratory
College of Medicine
Cincinnati 19, Ohio

Dear Dr. Kehoe:

Per our phone conversation on January 8, 1965, attached are two copies of a paper which we are calling "Industrial Health Program Guidelines: Lead and Its Compounds". This paper will form the basis for our Company's industrial health program associated with lead and its compounds.

I would appreciate your reviewing and commenting on this document. You can mark-up both copies and send one back to me. I will include your suggestions and comments in the final draft.

We appreciate you taking the time out of your busy schedule to review this paper and we want to pay a consultation fee for this service. Please direct your bill to my attention.

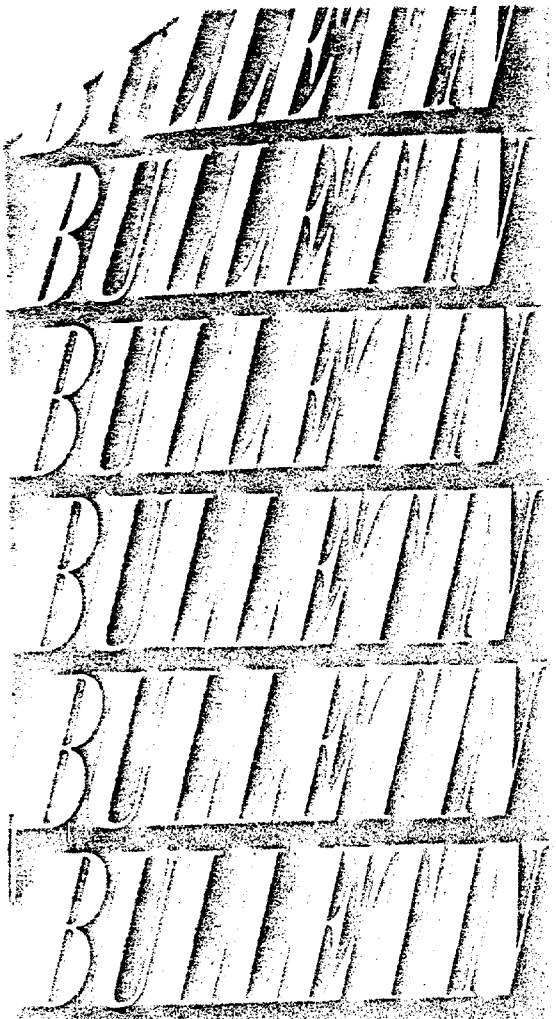
Thank you for your cooperation.

Very truly yours,

F. X. WORDEN
Industrial Hygiene Coordinator

FXW:KN

Att.



INDUSTRIAL HEALTH

General Medical Director's Organization

Western Electric Company
INCORPORATED

To Company file in plants in Kettering laboratory

(Guidelines for the)

INDUSTRIAL HEALTH PROGRAM ~~GUIDELINES~~ Concerning

Lead and Its Compounds

F. X. WORDEN
J. P. DUNN, M.D.

PREFACE

The purpose of this document is to set forth guidelines for a uniform program of industrial health ~~program~~ in connection with the storage and use of lead and its compounds.

Measures of Control in Safety & Industrial Hygiene matters of

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I POTENTIAL LEAD EXPOSURES

Any process or operation that causes lead and its compounds to become airborne and respirable or where ~~hand~~ contamination makes ingestion a ~~possibility~~ constitutes a potential lead exposure (e.g. handling, grinding, spraying lead paints, welding or cutting lead or lead-containing materials, certain soldering operations employing lead, solder coating, solder spraying and tinning operations; also, sanding, filing or scratchbrushing of lead or solder-coated surfaces).

II SEVERITY OF EXPOSURE

Lead is normally absorbed under industrial conditions in two ways: (1) via the respiratory tract, through the inhalation of dust, vapor, fume or mist, and (2) by ingestion. At present, tetraethyl lead is the only widely distributed form of lead capable of being absorbed through the skin, but Western Electric's industrial operations do not involve ~~its~~ use of this compound of lead.

Since most of the cases of lead intoxication in industry result from the inhalation of lead dust and fumes, the severity of the exposure depends to a large extent on the amount of lead in the breathing zone of the worker. The ~~lead control program~~, therefore, should insure that the atmospheric concentration of lead is kept to a minimum and that employees working with lead and its compounds develop and practice good habits of personal hygiene.

Many of Western Electric's processes involving lead require the metal to be heated until it reaches a molten state. At different temperatures metallic lead can ~~be produced as a~~ give rise to dust, fume or vapor.

At 650°F (343°C), lead is easily oxidized at its surface and when it is skimmed, stirred, poured or otherwise agitated in the presence of air, it may release quantities of finely divided lead oxide into the air.

Between 650-900°F (343-482°C), there is not sufficient heat to bring about a build-up of lead vapor in the work environment. However, as the temperature rises above this level, larger ~~dangerous~~ quantities of vaporized lead begin to be emitted into the environment.

At 2777°F (1525°C), dangerous concentrations of vaporized lead can be present in the environment.

III TECHNICAL DATA

A. Chemical and Physical Properties of Lead

Chemical Symbol	Pb
Molecular Weight	207
Atomic Number	82
Valence	2, 4
Color	bluish-gray
Specific Gravity (Water = 1)	11.34
Melting Point	620°F
Boiling Point	2777°F

B. Hygienic Standards . Safe limits of Concentration .

1. Occupational, 8-Hour	0.2 milligrams per cubic meter of air
2. Occupational, ~~Acute:~~ Single brief period of hours	Not known quantitatively ~~but is a factor of time and dose~~
3. Fire Hazard:	None

IV INDUSTRIAL HYGIENE AND SAFETY ~~CONTROL~~ MEASURES OF Nature of the

Engineering ~~control~~ measures will depend on the operations ~~where~~ in which lead is used. The following summarizes recommended control measures:

1. In setting up an operation employing lead, the process should be designed to minimize the release of any contamination, and hazardous operations should normally be grouped so as to localize the need for controls.

2. Local exhaust ventilation should be used to control processes capable of releasing significant quantities of lead to the work environment. Local exhausts should discharge their effluent outside the building.

3. Local exhaust systems should be designed to insure that lead will not be reintroduced into the plant. The exhaust discharge stack should be located away from fresh air intakes. When excessive lead dust, fume or vapors are generated, the effluent should be ~~filtered~~ before it is discharged to the outside air.

4. A regular program should be instituted for checking all local exhaust systems to insure that the flow of air ~~in the exhaust hood~~ is adequate to capture the lead dust, fumes or vapors and carry them ~~out of the building~~ away.

5. Meticulous housekeeping practices should be developed ar enforced at all times.

A. Particular care should be used in removing and handling powdery dross and skimmings from solder r lead melting operations to prevent the rom being dispersed into the air and to ze the contamination of bench tops, or other urfaces, Dross should be removed with a le skimming tool and placed immediately in a tightly red container provided for this purpose.

B. Dross and solder drippings which may accumulate on ~~the~~ bench~~es~~ or work surfaces should be removed at least once a shift by means of an approved vacuum cleaner or by wiping with a damp cloth.

C. Dross or solder drippings should ~~not~~ Never be brushed ~~onto the~~ up, floor.

D. Compressed air should not be so used in areas where lead dust, fume or vapor is produced, as to redistribute

VI

E. Exhaust from portable vacuum cleaning units should be discharged through flexible rubber or metal hose to suitable connections to prevent the so-called "clean air" from being redischarged to the working environment at high velocity.

6. Areas and equipment that need to be vacuumed periodically, should be smooth, regular and free of all unnecessary obstructions, and sharp angles.

7. Employees working with lead and its compounds should receive periodic instructions on the precautions, procedures and practices to be followed to control the lead exposure and the need for adhering to established precautionary procedures.

8. Food, candy, beverages or other edibles, tobacco, etc. should not be stored or consumed in areas ~~where~~ lead, solder or other lead compounds ~~contaminate the work area~~. Signs reading "Food should not be stored or consumed in this area" should be conspicuously ~~posted~~ in all such areas.

9. Employees should be required to wash their hands ~~frequently~~ before eating and particularly when leaving the work area; if necessary, extra washroom facilities should be provided.

10. Areas where lead is used should be inspected frequently to insure that proper practices and procedures are being followed.

11. A regular quantitative air sampling program ~~(at least an annual survey of all lead operations)~~ should be ~~established~~ to evaluate the adequacy of control measures, and to determine what, if any, changes should be made. Methods for determining the concentration of lead in dust, fumes, and vapors are covered in references 3, 6, 7, 8 and 9.

12. Personal Protective Equipment and Clothing

The use of personal protective equipment will vary depending on the nature and the degree of the employee's exposure, ~~and on the circumstances or other concomitant~~ under ordinary circumstances, and under unusual intercurrent circumstances

A. If Industrial Hygiene ~~studies~~ indicate that an employee's clothing is exposed to excessive lead bearing dust, he should be provided with suitable protective work clothing. Such clothing should be laundered and maintained by the Company. Separate lockers for dress and protective work clothing should be provided.

B. Shower facilities should be provided ~~where~~ conditions are severe enough to require protective work clothes.

C. A respirator may be used occasionally for short periods of time when an employee works in an environment that has a high lead concentration to minimize the inhalation and ingestion of lead dust and fumes. The respirator should, however, have the proper Bureau of Mines approval for lead, ~~and~~ cannot be used as a substitute for a local exhaust system.

D. A ~~respirator~~ cleaning, maintenance, ~~and~~ instruction ~~program~~ should accompany the use of respirators. Periodic reindoctrination instruction should also be provided.

13. All personnel working at operations ~~with~~ measurable exposure to lead* should have a pre-employment, preplacement, periodic and a terminal medical examination.

*Measurable exposure to lead - exists where the air samples taken in the work environment consistently indicate levels greater than 0.15 milligrams of lead per cubic meter.

V MEDICAL CONTROL MEASURES OF

The ~~medical control measures~~ set forth in this section of the guide are intended to assist the physician (1) in screening candidates for employment in areas where lead is used, (2) in properly monitoring the employee who has had a measurable exposure to lead, and (3) in establishing guidelines for the interpretation of ~~biological lead samples~~.

A. Pre-Employment and Preplacement Examinations

The examination should consist of:

1. A ~~review of~~ the candidate's past employment ~~data~~ to determine his history of lead exposures;
2. A determination of the presence of any organic diseases, especially those of the blood and nervous system; and
3. A quantitative lead in blood analysis to establish a baseline for the employee.

The examining physician should evaluate the candidate's medical history and the results of the examination in order to determine whether or not the candidate should be permitted to work in an area where lead is used.

B. Periodic Examinations

Periodic examinations should be given to those employees who have a measurable exposure to lead (defined earlier). The engineer responsible for industrial hygiene and the local physician should determine what employees should have a periodic medical examination.

In addition to evaluating the general health of the employee, a lead in blood determination should be performed. Procedures for this analysis are covered in references 3 and 6.

C. Termination Examinations

A complete medical examination should be given to all employees on the periodic lead examination program when they are reassigned to other jobs not involving a lead exposure or when their employment is terminated.

The final examination should include a determination of the quantity of lead present in the blood.

D. Interpretation of Laboratory Results

Lead in Blood

Below 0.06 milligrams/100 grams - safe industrial exposure

0.06 - 0.08 milligrams/100 grams - indication of lead absorption warranting further observation (see Page 6, Section F, 2b)

Above 0.08 milligrams/100 grams - excessive absorption and indicates immediate need to remove employee from lead environment. This is required because an individual having this quantity of lead in his blood is in danger of developing an episode of lead intoxication without warning.

Lead in Urine

Spot Sample

0.08 milligrams/liter - safe industrial exposure

0.15 milligrams/liter - potential indication of lead absorption

0.20 milligrams/liter - excessive excretion and need to recheck the blood lead level. This is required because the quantity of lead in urine varies considerably and may cause false conclusions.

E. ~~Typical~~ Lead Intoxication Symptoms

1. ~~Metallic~~ taste in mouth
2. ~~Headache~~
3. ~~Weakness, generalized or confined to either wrist or ankle~~
4. Lassitude
5. Loss of appetite
6. Constipation
7. ~~Nervousness~~
8. ~~Insomnia~~
9. ~~Intestinal~~ colic

These above symptoms are a late indicator of lead absorption and should not be observed if the recommended practices set forth in this guide are followed.

F. Guide for Evaluating ~~Examination~~ Results

1. Preplacement Examination

Any candidate who has the following conditions should not be placed in occupations involving lead exposure:

a. ~~An~~ organic disease involving the blood ~~and/or~~ liver ~~or~~ nervous system

b. ~~A~~ history of ~~lead exposures with laboratory results indicating significant lead absorption~~

2. Periodic Examination

The following procedures and practices are intended to guide the physician in interpreting the results of the periodic medical examinations:

a. Refer to Section V, D, Page 5 to interpret the laboratory results.

b. If ~~an~~ employee's blood ~~lead concentration~~ is between 0.06 and 0.08 milligrams per 100 grams, his blood should be checked ~~monthly until the lead concentration goes below 0.06 milligrams per 100 grams~~. The physician should ~~contact the~~ industrial hygienist and request a study of the employee's work environment to determine what factors may have contributed to the exposure and what changes have to be made in the work environment to reduce the lead exposure.

c. If an employee has a blood lead level ~~greater than 0.08~~ (of 0.08 established) milligrams per 100 grams of whole blood but exhibits no other abnormal findings, he should be immediately removed from further exposure while another blood lead determination is made. If the second test also indicates a lead level greater than 0.08 milligrams, the employee should remain away from further ~~lead~~ exposure ~~and be placed under the surveillance of a Company physician~~. The physician should contact the industrial hygienist as described in Section F, 2b, Page 6.

d. If an employee develops symptoms ~~suggesting~~ suggestive of lead intoxication without confirmatory laboratory data, the employee should be removed immediately from the ~~lead~~ exposure, additional laboratory tests should be performed, ~~and the employee should be placed under the surveillance of a Company physician~~. The physician should contact the industrial hygienist as described in Section F, 2b, Page 6.

e. If an employee develops lead intoxication symptoms with ~~confirmatory~~ laboratory data, the employee should be removed immediately from ~~his~~ lead environment, ~~and placed under the supervision of a Company physician who will institute necessary therapeutic measures~~. The physician should contact the industrial hygienist as described in Section F, 2b, Page 6.

f. The employee may be returned to his normal duties when the following conditions are met:

(1) he no longer has lead intoxication symptoms;

(2) he no longer has excess ~~levels~~ of lead in his blood;

(3) the air analysis of the work environment indicates that the lead concentration is below the level stated in Section III, B1, Page 2, and further engineering controls, if necessary, have been put into operation, and,

(4) the examining physician is satisfied that the employee can be returned to his former assignment.

3. Termination Examination

The examining physician should ascertain the general health of the employee, determine the ~~lead~~ concentration of lead in the employee's blood, and should make a permanent record of his findings.

VI RECOMMENDATIONS

1. The local Medical Director in collaboration with the Industrial Hygienist should determine the frequency of periodic examinations for employees exposed to lead.

2. The blood lead level should be used to assess ~~whether or not the employee has any lead absorption.~~ the degree of the employee's absorption of lead. However, a single blood lead determination should not be relied upon as conclusive evidence of abnormal lead absorption (see Section V, F 2c). A consensus of authorities in the field[2, 5, 10, 11] state that the following tests are useful technical procedures ~~possibly useful~~ in diagnostic rather than preventive medicine:

abnormal coproporphyrin, blood basophilic stippled cell count, abnormal hemoglobin or hematocrit

3. Operations in the Manufacturing and Service Divisions should be resurveyed periodically to determine what employees should have periodic medical examinations because of their ~~lead~~ lead exposure.

4. Standard Industrial Hygiene instrumentation and test methods should be used to estimate the quantity of respirable lead in the breathing zone of the worker.

5. Provision of a satisfactory central laboratory, especially equipped for this purpose, should be considered so that the concentration of lead in air and biological samples can be determined for all units of the Company, with the precision required.

VII DEFINITIONS

DUST - solid particles of matter produced by grinding, crushing, etc. The size may range from 0.5 to 100 microns (1 micron = 1/25,000 of an inch). 90% of air-borne dust will ~~normally~~ usually be in the size range of 0.5 to 5.0 microns.

FUME - solid particles formed by the condensation of vapors. The size of the particles usually ranges between 0.01 and 0.5 microns.

MIST - liquid particles produced by processes such as spraying, atomization, or mechanical agitation.

VAPOR - gaseous state of a material which is solid or liquid at normal temperature.

VIII REFERENCES

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10. Fowler, D. F., Personal Communication, February 11, 1963

11. Castrop, V. J., Personal Communication, November 30, 1964

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13. Kumler, K. and Schreiber, T. P., "Lead in Blood A Rapid Method For Spectrochemical Analysis", American Industrial Hygiene Association Quarterly, 16:4, December, 1955

now obsolete in certain respects especially as [illegible]

must be viewed with some reservation because of intrinsic variability – especially in the [illegible] precise critical range

the critical 0.08 may be as low as 0.06 and as high as 0.10 due to analytical variation alone ...