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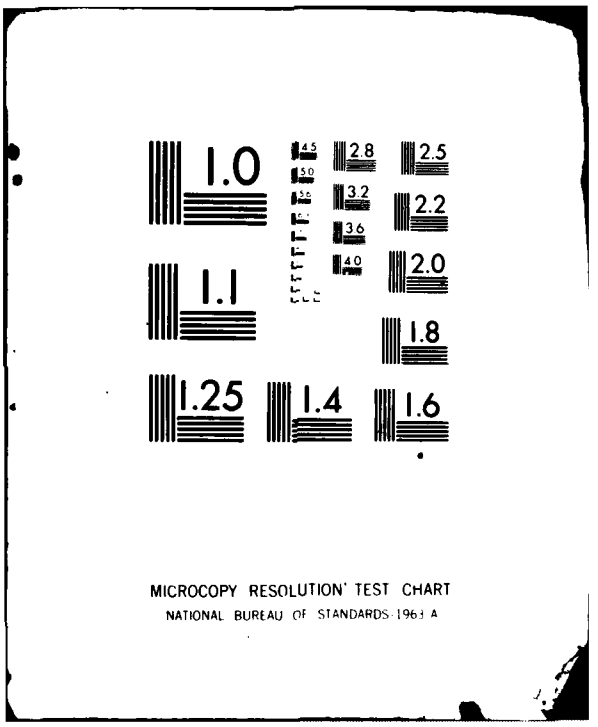
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Review 6-81

AEROMEDICAL REVIEW

USAF DENTAL SERVICE MERCURY HYGIENE REPORT, CALENDAR YEAR 1980

Theodore C. Almquist, Colonel, USAF, DC
David A. Kaiser, Lieutenant Colonel, USAFR, DC
Albert C. Jerman, Colonel, USAF, DC
John M. Young, Colonel, USAF, DC

December 1981

Approved for public release; distribution unlimited.

USAF SCHOOL OF AEROSPACE MEDICINE
Aerospace Medical Division (AFSC)
Brooks Air Force Base, Texas 78235

NOTICES

This review was submitted by personnel of the Dental Investigation Service Branch, Clinical Sciences Division, USAF School of Aerospace Medicine, Aerospace Medical Division, AFSC, Brooks Air Force Base, Texas, under job order DSB38100.

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This report has been reviewed by the Office of Public Affairs (PA) and is releasable to the National Technical Information Service (NTIS). At NTIS, it will be available to the general public, including foreign nations.

This technical report has been reviewed and is approved for publication.

THEODORE C. ALMQUIST, Colonel, USAF, DC
Project Scientist

JOHN M. YOUNG, Colonel, USAF, DC
Supervisor

ROY L. DEHART
Colonel, USAF, MC
Commander

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20 ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

Mercury hygiene is a concern in both military and civilian dental facilities. The purpose of this report was to determine the adequacy of the mercury hygiene practiced in USAF dental facilities. The data was derived from mercury vapor surveys accomplished over a one-year period from 120 USAF dental clinics. The surveys were accomplished by bioenvironmental engineers at the respective bases. Results of the survey indicate that the mercury levels in USAF dental facilities are within acceptable limits.

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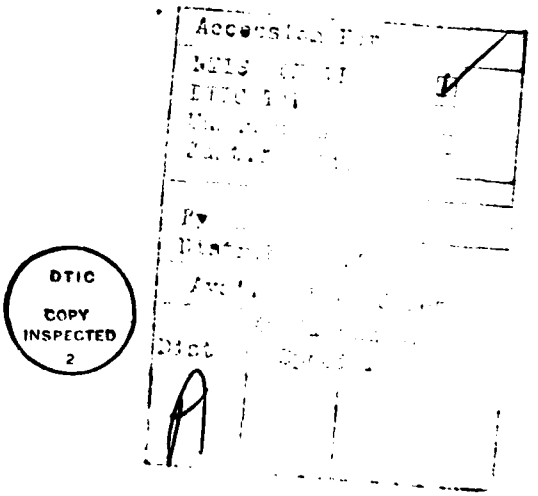


USAF DENTAL SERVICE MERCURY HYGIENE REPORT, CALENDAR YEAR 1980

INTRODUCTION

In 1976, the Dental Investigation Service (DIS), USAF School of Aerospace Medicine, Brooks AFB, Texas, was instructed by HQ USAF/SGD to "monitor all developments in dental mercury hygiene and report significant findings." Subsequently, DIS prepared annual in-depth status reports on the subject of mercury hygiene. The DIS also completed numerous test and evaluation (T&E) projects in the area of mercury hygiene. These results, along with other pertinent information on techniques and equipment associated with mercury hygiene, were regularly reported in the DIS information letter, *Dental Items of Significance*.

In spite of the information DIS published on the subject of mercury hygiene, no data were gathered and analyzed that would demonstrate the control of mercury vapor in USAF dental clinics. Since AFR 161-33, para 4-4a(4)(a), requires bioenvironmental engineers to conduct annual mercury vapor surveys on all USAF dental clinics, DIS utilized these surveys to obtain the mercury vapor data for this report (1). In November 1980, mercury vapor surveys for calendar year 1980 (CY 80) were requested from the Command Dental Surgeons.

The following report is a compilation of the data arising from those surveys. The report is based on information provided by 120 dental clinics located on 115 USAF bases. In clinics submitting more than one report for CY 80, only the most recent report was included.

DEFINITIONS

The term permissible exposure limit (PEL), as used by the U.S. Air Force, is synonymous with the more commonly used term threshold limit value (TLV). Permissible exposure limit values are derived from the TLVs set by the American Conference of Governmental and Industrial Hygienists. AFOSH Standard 161-8 (20 Jun 78) contains the PEL values for chemical substances in workroom air, including mercury vapor (2). The PEL for mercury most commonly used is the time weighted average (TWA) which is 0.05 mg/m^3 of air. This is the maximum amount of mercury vapor to which a person can be exposed for 8 hours a day, day after day, without adverse effects. It is important to note that PEL or TWA is an 8-hour day or 40-hour week. This must not be confused with the short-term exposure limit (STEL) which is the maximum amount of mercury vapor a person can be exposed to (up to 15 minutes, 4 times a day, with 60 minutes between exposures) without adverse effects. The STEL for mercury vapor is 3 times as high as the TWA (0.15 STEL vs 0.05 TWA). Time weighted average and STEL are meaningful only when used with the breathing-zone sampling. Area or spot sampling indicate the adequacy of mercury hygiene practice only--not TWA or STEL. The action level is one-half the TWA.

SURVEY

This is a preliminary survey. Since there were no guidelines for the method of gathering or format for reporting the data, the findings are somewhat inconsistent.

FINDINGS

Area Sampled

It is important to note that under most circumstances mercury vapor must be inhaled to create adverse effects; therefore, samples from the breathing zone are more significant than samples taken from other areas. Floor-level readings, for example, are popular since they are associated with mercury spills. Although mercury may be secondarily ingested or inhaled due to contaminated fingers, clothes, cigarettes, or food, these sources are not nearly as significant as those from the operator's or assistant's breathing zone.

The survey found that a total of 46 different areas were used for mercury vapor sampling. The most common area sampled was the breathing zone; however, only 58, or 48%, out of the 120 clinics sampled this crucial area. It is very significant that the TWA for mercury vapor was not exceeded in any of the 58 samples from the breathing zone.

Some surveys were suspect because the mercury vapor levels were determined by using a "worst case" situation. This determination was done by stirring up a carpeted area of a known mercury spill and then making a short-term exposure reading (i.e., 15 minutes or less) at floor level.

Floor Coverings

The type of floor covering was noted in only 43 (36%) out of 120 clinics. In these 43 clinics, 10 were uncarpeted and 33 were carpeted. Recent evidence seems to point out that the type of floor covering is not a significant factor in mercury vapor exposure in DTRs (3). In our survey, area spot checking revealed that elevated mercury concentrations were no more common in carpeted than noncarpeted DTRs.

Reporting Results

The results of the mercury vapor survey were given in two ways:

a. In 82 (68%) reports numerical figures were given.

b. In 38 (32%) reports verbal descriptions, such as "well within acceptable limits" or "several areas above TLV," were used.

Samples Greater than 0.05 mg/m^3

No mercury vapor report which sampled the breathing zone showed a TWA above 0.05 mg/m^3 of air. Nineteen (16%) out of 120 clinics reported one or more areas in which the mercury vapor sampling yielded results above the TWA. The total number of areas sampled could not be determined since results were not reported consistently (see Reporting Results); however, it could be determined that 36 samples exceeded the TWA for mercury vapor. None of the 36 samples was from the breathing zone, 15 were from the floor, 10 were from the amalgamator, 7 were from the mercury storage area, 2 were from the vacuum cleaner, and 2 were from under the operating cabinet. The highest reading reported was 3.960 mg/m^3 from the "general mixing area" of one clinic. The device used for that measurement was not reported. Typical elevated readings were from 0.06 to 0.15 near the amalgamator and mercury storage areas and from 0.2 to 1.0 on the floor.

Mercury Vapor Analyzer Used

	No. of clinics	Percent	No. calibration reported
MV2 - Bacharach	81	67.5	14
Hopcalite tubes	8	6.7	
Jerome model 401	7	5.8	1
3M - monitor	3	2.5	
Unreported	21	17.5	

The capabilities of the various mercury vapor analyzers vary greatly. The decision on which unit would be used for these surveys appeared to be based primarily on the unit available at each base. The Bacharach MV2 and the Jerome model 401 (without dosimeter coils) are intended to spot check for the presence of mercury vapor. The field calibration of the MV2 was shown to be unreliable (4). The MV2 is temperature and humidity sensitive which makes for inaccurate readings in an environment of varying conditions. At the present time the recommended mercury vapor analyzer is the Jerome model 401; however, when dosimeter coils are not used, even the Jerome model 401 can only take a 20-second sample and therefore cannot accurately determine the TWA. The MV2 and the Jerome (without dosimeter coils) instruments were used in 83 (84%) out of the 99 surveys reporting the type of analyzer used. The type of analyzer used was not reported in 21 of the surveys. Sixteen (16%) surveys were done with instruments which could determine TWA: hopcalite tubes (8), Jerome with dosimeter coils (5), and 3M monitor (3). All 16 of these surveys showed mercury vapor levels well below 0.05 mg/m^3. All 19 surveys reporting mercury vapor levels above the TWA were spot samples using the unreliable Bacharach MV2 or the Jerome model 401 (without dosimeter coils).

DISCUSSION

Findings in this summary of mercury vapor sampling reports of USAF dental clinics suggest:

1. a lack of standardized mercury sampling procedures;

2. an inconsistency in areas sampled;

3. an inconsistency in reporting the type of floor covering;

4. a lack of standardized reporting format;

5. an inconsistency of reporting mercury vapor present (numerical versus verbal descriptions);

6. a variety of analyzers being used;

7. a lack of calibration of mercury vapor analyzers; and

8. quantitative values (TWA) widely reported with analyzers that are incapable of providing such information.

CONCLUSION

Results of this survey indicate that the mercury levels in USAF dental facilities are within acceptable limits. However, since the data for this survey were not standardized, before any definitive conclusions can be drawn a more thorough survey with well-defined objectives should be conducted. It would appear that if the trend over the past 5 years to use less bulk mercury in USAF dental facilities continues (Appendix A), and with the increased use of precapsulated amalgam, exposure to mercury vapor should be even further minimized.

RECOMMENDATIONS

Use a reliable analyzing device.

1. Preliminary Survey--Use the Jerome model 401 mercury vapor analyzer for the preliminary surveys (5). The purpose of the preliminary survey is to area sample and detect mercury vapor elevated above the action level, not to accurately quantify it. If less than the action level is measured, no further sampling is necessary. If a measurement above the action level is found from the area sampling, a more quantitative survey should be performed.

2. Followup Survey--The purpose of the followup survey is to accurately quantify mercury vapor levels. This quantification requires sampling using the Jerome with a dosimeter coil, hopcalite tubes, or the 3M monitor.

The USAF Occupational and Environmental Health Laboratory (USAF OEHL) recommends using the Jerome with an active dosimeter coil. The dosimeter coil has been found to be more accurate than the hopcalite method (considering sample loss during shipment and analytical error). In addition, the Jerome dosimeter coil can be analyzed the same day as opposed to 4-6 weeks for hopcalite analysis. Instructions for this method have recently been developed by USAF OEHL (6).

A less desirable means to quantify airborne mercury vapor is the hopcalite tube. The tube is attached to an air pump and an 8-hour sample of air is taken. The tube is then sealed and sent to USAF OEHL, Brooks AFB, Texas, to be analyzed using atomic absorption techniques.

The cost of the passive 3M monitor (approximately $25.00 per sample) and the fact that it must be sent to 3M for analysis makes this the third choice as a means to accurately quantify mercury vapor levels behind the Jerome with dosimeter coil and hopcalite tubes.

Require accurate calibration of the analyzing device prior to, during, and after use.

Require breathing-zone samples:

1. By far the most important area to be sampled is the breathing zone of the dentist and assistant.

2. If the breathing zone sample is above the PEL (TWA), spot checking of suspected sources should be undertaken.

Require a similar format for mercury vapor reports (Appendix B).

Eliminate bulk mercury in the dental clinic by encouraging the use of precapsulated amalgam.

Continue to emphasize mercury hygiene in dental treatment rooms.

REFERENCES

1. AFR 161-33, Aerospace Medicine Program. Washington D.C., 21 Oct. 1977.

2. AFOSH Standard 161-8, Permissible Exposure Limits for Chemical Substances. 20 June 1978.

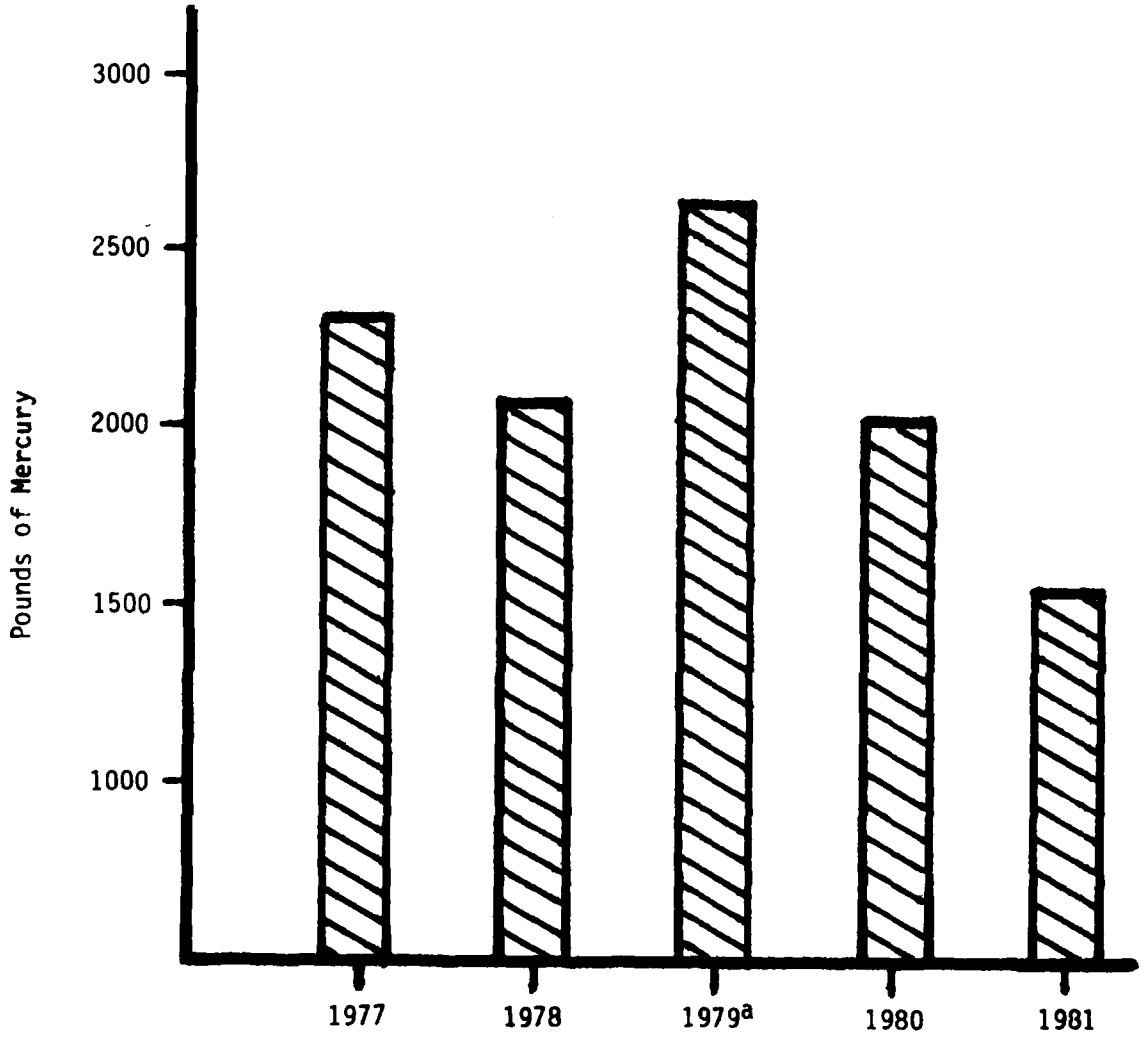
3. Kanter, M. L., and R. C. Woodcock. Mercury vapor exposure in the dental office - does carpeting make a difference? JADA 103:402 (Sept. 1981).

4. Mercury vapor detection. USAF OEHL Newsletter, Vol 2, No 3, p. 24, July 1979.

5. Jerome instrument's model 401, mercury vapor analyzer, operational test and evaluation. OEHL report No. 81-21, April 1981.

6. Description and operating instructions for model 401 gold film mercury vapor analyzer. Loan Units, USAF OEHL/ECH, Brooks AFB TX 78235.

APPENDIX A. AIR FORCE BULK MERCURY USAGE



[a]In 1979 there was severe difficulty with procurement of precapsulated amalgam due to problems with acquisition advice code (AAC) "H" contracts.

APPENDIX B. MERCURY VAPOR SURVEY REPORT FORMAT

I. Introduction

A. Clinic:

Building No.:

Base:

B. Date:

C. Type Survey: (Preliminary or followup)

D. Background: (History of mercury spills)

E. Instrumentation:

1. Analyzer (make and number)
2. Calibration data
3. Name of operator(s)
4. Sample time

II. Findings:

A. Area(s) surveyed (DTR, supply, reception, etc.)

B. Floor covering (carpet, tile, seamless vinyl, wood, etc.)

C. Breathing zone mercury vapor values

D. Source(s) of contamination (if any)

III. Discussion: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