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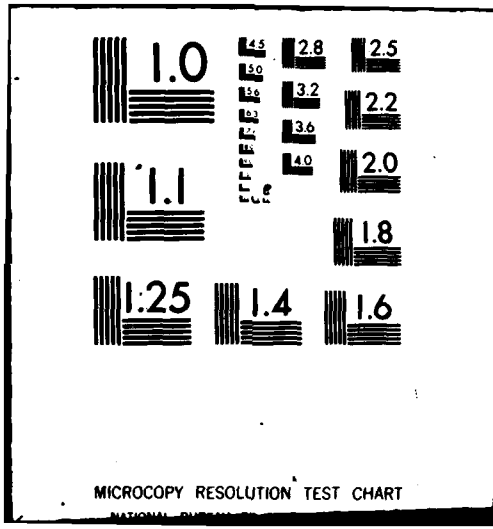
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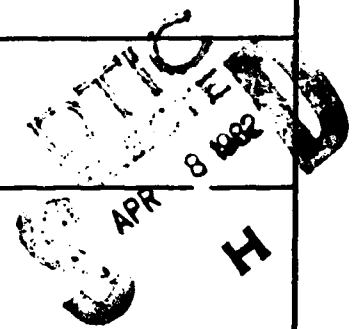
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) <b>Nitrous oxide levels were determined in a dental clinic to evaluate the performance of gas anesthesia equipment. The Porter MXR gas anesthesia machine and scavenging mask, the Fraser-Harlake machine, and the Narco-McKesson Brown scavenging mask were used during the survey. When the Porter MXR machine was used with Brown mask, the nitrous oxide level was below the NIOSH recommended standard of 50 ppm TWA.</b>		



REPORT NUMBER 82-1

USAF OCCUPATIONAL AND ENVIRONMENTAL  
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EVALUATION OF DENTAL N<sub>2</sub>O ANESTHESIA EQUIPMENT

December 1981

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## I. INTRODUCTION

Nitrous oxide is widely used as an inhalation sedative-analgesic during dental procedures. As a result, the dentist and his lab assistants are chronically exposed to trace amounts of nitrous oxide. Epidemiological and laboratory studies suggest that chronic exposure to anesthetic gases may be a health hazard. An increased incidence of spontaneous abortions in exposed females and the wives of exposed males is the most consistently observed health effect. In order to minimize any health effects caused by chronic exposure to trace amounts of nitrous oxide in dental facilities, NIOSH recommends a 50 ppm Time Weighted Average (TWA).

This standard cannot be achieved without the use of control measures, most importantly, the use of adequate scavenging equipment and leak-free anesthesia machines. This report presents the results of nitrous oxide monitoring during the use of the Porter MXR gas anesthesia machine and scavenging mask. The USAF OEHL conducted the survey on 14 Dec 81 at Benjamin W. Dunn Dental Clinic, Lackland Air Force Base, upon the request of Col Theodore C. Almquist, Chief of Clinical Dentistry, USAFSAM. During the course of the day-long survey, nitrous oxide levels were also monitored during the use of the Narco-McKesson Brown scavenging mask attached to the Fraser-Barlake and then to the Porter MXR gas anesthesia machines to compare the effectiveness of the different equipment in controlling nitrous oxide levels.

## II. METHODS AND MATERIALS

### A. Instrumentation and Calibration

A precalibrated MIRAN-1A infrared Analyzer was used to measure nitrous oxide levels. The MIRAN-1A was calibrated by injecting known concentrations of nitrous oxide into the instrument and noting the absorbance. Figure 1 shows the calibration curve with absorbance as a function of the concentration of nitrous oxide in ppm.

### B. Sampling Procedure

During the survey, a strip chart recorder allowed continuous monitoring of absorbance levels in the sampling cell. The sample intake was occasionally extended into the dentist's breathing zone to determine the actual level inhaled, and around the nose mask, hose connections, and anesthesia machine to test for leaks.

The sampling extended over a period of one workday during which nitrous oxide was administered to four patients in five separate procedures. The same dentist performed each procedure in the same room. The first three patients used the Porter MXR gas anesthesia machine and the attached scavenging mask. The fourth patient used the Brown mask attached to the Fraser-Barlake machine. The second patient returned in the afternoon and used the Brown mask attached to the Porter machine.

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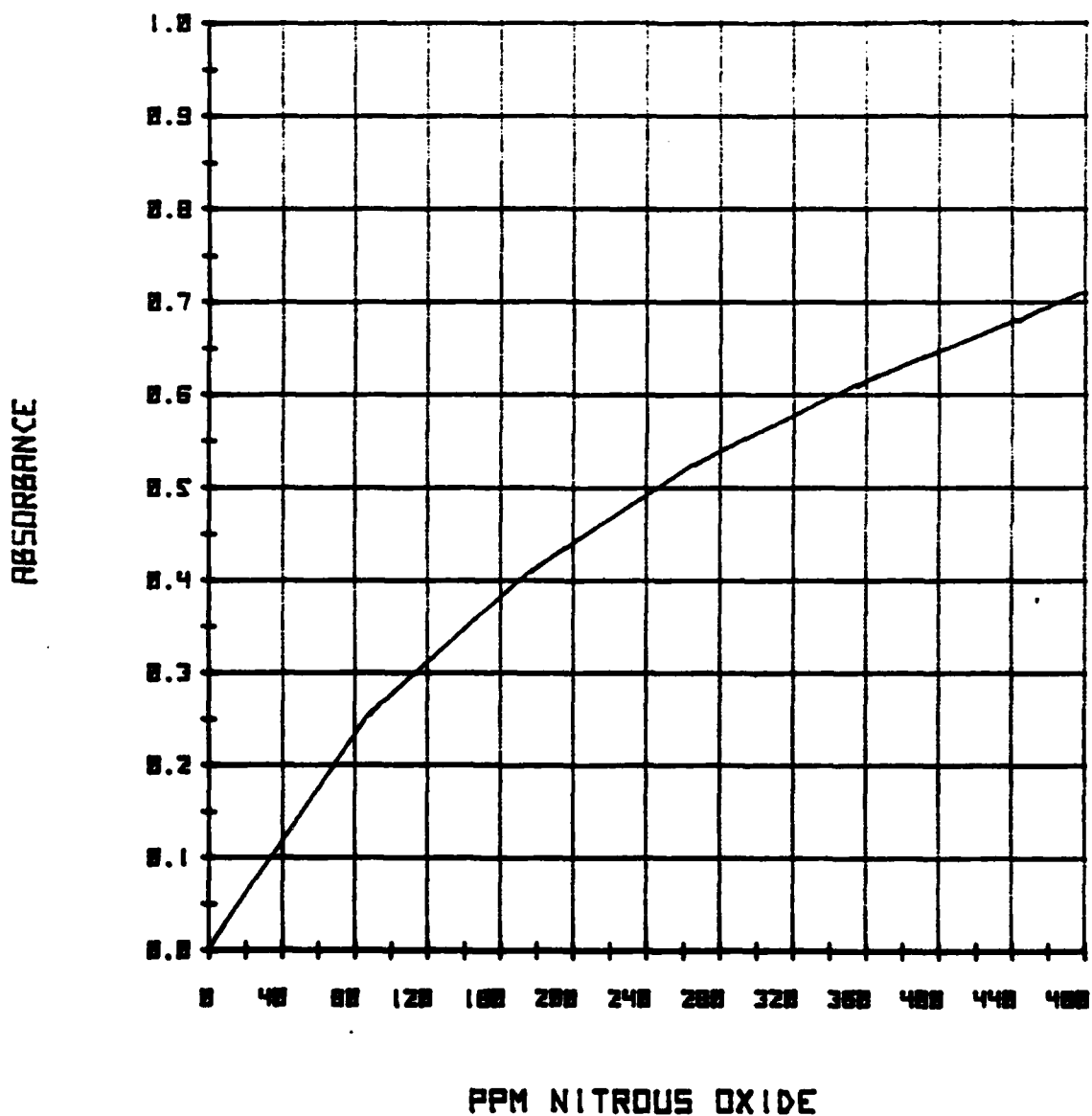


FIGURE 1. NITROUS OXIDE CALIBRATION CURVE

### III. RESULTS AND DISCUSSION

Table 1 shows nitrous oxide concentrations obtained during sampling. Nitrous oxide concentrations were determined by averaging the levels continuously recorded by the strip chart recorder for each procedure.

The use of the Porter machine and mask resulted in average nitrous oxide room air concentrations of 140-240 ppm. There was continuous leaking from the mask with no leaks detected from the machine. The Brown mask used with the Fraser-Harlake anesthesia machine gave an average nitrous oxide room air concentration of 60 ppm, only slightly above the recommended standard of 50 ppm. No leaks were detected from the Brown mask. However, the pop-off valve on the Fraser-Harlake anesthesia machine leaked, causing an elevation of nitrous oxide concentration of 140-240 ppm in the dentist breathing zone. The best results, 20 ppm average room air concentration and 35 ppm concentration in the dentist's breathing zone, were obtained using the Brown mask with the Porter machine. When the Brown mask and Porter machine were used together no leaks from the equipment were detected; the main source of nitrous oxide concentration the room air and the dentist's breathing zone was the patient's breath.

### IV. CONCLUSIONS

The Narco-McKesson (Brown) scavenging mask used during this survey was a completely leak-free scavenging mask and clearly superior to the inadequate Porter mask. In a previous survey (USAF OEHL TR 80-30) completed in October 1980, the Brown mask was also found to be the best scavenging mask tested. The Brown mask's major advantage appears to be the flexibility of its construction, which allows it to form fit the facial features of different patients.

The Porter MKR anesthesia machine used during this survey was new and leak-free. The Fraser-Harlake machine was used and leaked through the pop-off valve. It is not possible to state whether the relative performance of these two machines during this survey was due to design or to maintenance.

The results of this survey basically substantiate the conclusions presented in DHEW (NIOSH) Publication No. 77-171, "Control of Occupational Exposure to  $N_2O$  in the Dental Operator." That is, a standard of 50 ppm nitrous oxide is reasonably achievable in the dental operator using leak-free scavenging masks and anesthesia equipment, and with proper outside venting of the waste gases.

TABLE 1

NITROUS OXIDE CONCENTRATIONS

PT	MASK	MACHINE	ROOM CONCENTRATION (ppm)	AVERAGE	LEAKAGE (ppm)	MASK	MACHINE	BREATHING ZONE (ppm)	DENTIST'S
A	Porter	Porter	240		> 800	0	0	560	
B	Porter	Porter	150		> 800	0	0	800	
C	Porter	Porter	140		> 800	0	0	520	
D	Brown	Fraser-Harlake	60		0	> 800	Pop-off-Valve	140-240	
B	Brown	Porter	20		0	0	0	35	

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