U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CINCINNATI, OHIO 45202

HEALTH HAZARD EVALUATION DETERMINATION
REPORT NO. 73-67

THE BOEING COMPANY
Plant 77
HILL AIR FORCE BASE, UTAH
OCTOBER 1973

I. TOXICITY DETERMINATION

It has been determined through environmental and biological sampling and medical interviews that no health hazard exists from this exposure to p-nitrophenol.

II. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

Copies of this Determination Report are available upon request from the Hazard Evaluation Services Branch, NIOSH, U.S. Post Office Building, Room 508, 5th and Walnut Streets, Cincinnati, Ohio 45202. Copies have been sent to:

a) The Boeing Company, Hill Air Force Base, Utah
b) Authorized Representative of Employees
c) U.S. Department of Labor - Region VIII
d) NIOSH - Region VIII

For the purposes of informing the affected employees, the employer will promptly "post" the Determination Report in a prominent place(s) near where exposed employees work for a period of 30 calendar days.

III. INTRODUCTION

Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6), authorizes the Secretary of Health, Education, and Welfare, following a written request by any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The National Institute for Occupational Safety and Health (NIOSH) received such a request from an authorized representative of employees to evaluate the potential hazards associated with the alleged exposure to p-nitrophenol during touch-up and handling of cork impregnated with this substance in the Minuteman Missile Assembly Plant of the Boeing Company, Hill Air Force Base, Utah.

IV. HEALTH HAZARD EVALUATION

A. Plant Process - Conditions of Use

A 15% solution of p-nitrophenol in methanol is painted on the exposed cork surfaces of the Minuteman Missile before it arrives at the assembly plant at Hill Air Force Base. If this surface is damaged in transit, it is necessary to apply small amounts of the p-nitrophenol solution to the repaired areas of cork. This operation is accomplished while the worker wears an organic vapor cartridge respirator, a face shield, cotton gloves, and is completely covered with protective clothing; rubber gloves are also worn over the cotton gloves. The touch-up operation is performed approximately once a week as needed and takes about 10 minutes to complete. Workers who are repairing and/or assembling parts of the missile may also handle the dryed impregnated cork during their work.

B. Evaluation Methods

Environmental sampling at the time of this survey involved two operations: (1) Painting a 20 square inch area with a p-nitrophenol solution. (2) Sanding two 5" x 7" areas in order to place decals on the cork.

Airborne samples were collected in the breathing zone of the worker during the entire operation in which the p-nitrophenol was painted and while the surface was sanded in preparation for the placement of the decals. Samples were collected in a solution of sodium hydroxide with a midget impinger and dust samples were collected utilizing a membrane filter.

The airborne samples were analyzed by gas chromatography according to the EPA Manual of Analytical Methods.[1] The method outlined is for p-nitrophenol in urine, therefore minor modification of the analysis was necessary.

Medical: An employee who initiated the health hazard evaluation request complained of fatigue, joint pain, abdominal cramps, and diarrhea and attributed these symptoms to his exposure to the dryed cork impregnated with p-nitrophenol during his work as a mechanic. This employee gave permission to examine his personal medical records at a local hospital, to speak to his physician, and make further investigation. Because of subsequent findings the levels of two immunoglobulins, IgA and IgD were also studied. This was accomplished by drawing blood samples from 9 workers who handled dry impregnated cork as mechanics and who painted p-nitrophenol on bare cork, and by drawing blood from 9 office workers at the plant who were not exposed to p-nitrophenol, i.e. controls.

C. Evaluation Criteria

At the present time no environmental standards or biological norms exist for p-nitrophenol; however, in the literature[2,3] there is evidence that p-nitrophenol causes a reduction of hemoglobin to methemoglobin, is rapidly absorbed through the skin and in small doses stimulates and in large doses depresses the parasympathetic system. It appears, however, that no reports have been published on human poisoning with p-nitrophenol.

D. Evaluation Results and Discussion

1. Environmental (See Table 1)

2. Medical (See Table 2)

From the medical records of the worker who initiated the request, it was found that all medical parameters were within normal limits except for the following findings:

1. A change in normal microstructure of the small intestine (blunting of the villae demonstrated in a small bowel biopsy).

2. Complete absence of IgA and IgD.

3. A negative mumps skin reaction.

The impression of the employee's physician was that the lack of the above immunoglobulins was the cause for his diarrhea, arthralgias, and fatigue. He was given medication to provide symptomatic relief and shots of gamma globulin.

Discussion

IgA and IgD are secretory antibodies which are primarily produced in the respiratory and digestive tract rather than in the bloodstream. It is thought that the primary purpose of these antibodies is to protect against invasion of the mucous membranes from viruses. A deficiency of IgA in particular is found in 1/500th of the normal population as well as in an increased incident of patients with recurrent infection and several other disorders such as connective tissue diseases. The role of IgD in body metabolism is not clear. Administration of gamma globulin as therapy to subjects with IgA deficiency is of questionable therapeutic effectiveness.[4]

Although the known effects of p-nitrophenol demonstrated in animal experiments are methemoglobinemia, shortness of breath, progressive

depression, and initial stimulation, it was decided to determine if other exposed workers also had a selective absence of IgA and/or IgD. Blood was collected in plain vacutainers from 9 office workers and 9 workers exposed to p-nitrophenol. Four of the nine exposed workers were those suggested by the worker initiating the request as being most heavily exposed and as having the most complaints. Table 2 shows the results of these blood samples. One of the nine exposed workers had a IgA level slightly below the normal level, but was asymptomatic as were all the other workers and controls tested.

Based on the environmental and medical data we obtained, it appears that no health hazard exists at this time. Based on medical judgement and the existing literature, the requestee's lack of IgA and IgD is not caused by exposure to p-nitrophenol.

V. REFERENCES

1. "Analysis of Pesticide Residues in Human and Environmental Samples," edited by J.F. Thompson, EPA Manual of Analytical Methods, EPA, Pervine, Florida. Sec. 6,A,(2),(b). November, 1972.

2. Patty, F.: Industrial Hygiene and Toxicology, p. 2147, 1963.

3. Gleason, et al: Clinical Toxicology of Commercial Products, pp. 15-17, 85, 128-129, 1963.

4. New England Journal of Medicine: Vol. 287, pp. 500-506, September 7, 1972.

5. Normal Values as established by Department of Laboratory Medicine, St. Benedict's Hospital, Ogden, Utah.

VI. AUTHORSHIP AND ACKNOWLEGMENTS

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TABLE 1

Environmental Samples

Sample Number	mg/M3* Concentrations of p-nitrophenol
1**	Equal to or less than 0.05
2**	" " " " 0.05
3**	" " " " 0.05
Blank	Less than 0.05

All samples collected in the worker's breathing zone.

*milligrams per cubic meter (mg/M^3) of air by volume.

**All samples taken simultaneously during entire operation.

TABLE 2

Immunoglobulin Studies Performed 7/25/73

Normal Values for IgA[5] - mean = 170 mg/100ml
Range = 60" -490 mg/100ml

Normal Values for IgD[5] - mean = 3 mg/100ml

Workers Exposed to p-nitrophenol

Name	IgA (mg/100ml)	IgD (mg/100ml)
R.S.	260	3.6
R.A.	140	2.6
R.N.	105	4.8
H.W.	300	5.0
S.A.	300	3.6
J.A.	148	1.8
D.W.	210	1.8
T.C.	40	2.6
H.H.	60	1.8

Controls

Name	IgA (mg/100ml)	IgD (mg/100ml)
J.D.	160	2.5
G.K.	140	2.3
E.H.	340	9.1
N.K.	187	3.2
J.A.	185	3.3
F.B.	105	1.8
J.C.	105	2.9
M.A.	140	1.8
J.T.	400	3.6