FILE NAME: Industrial Hygiene Foundation (IHF)

DATE: 1940 Nov

DOC#: IHF066

DOCUMENT DESCRIPTION: AHFA Conference Proceedings - Article - Industrial Hygiene and the Navy in National Defense

AIR HYGIENE FOUNDATION OF AMERICA, Inc.

FIFTH ANNUAL MEETING OF MEMBERS

PITTSBURGH, PENNSYLVANIA
NOVEMBER 12-13, 1940

INDUSTRIAL HYGIENE AND THE NAVY IN NATIONAL DEFENSE

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1. Introduction

One of the most important concerns of the Medical Department of the Navy today is industrial hygiene and especially in Navy Yard practice. This is a situation of ever increasing moment in view of the present era of enormous expansion in naval construction, unparalleled in the history of this country. This is bringing about a vast increase in the industrial force of our Navy Yards and, in all probability, new problems in industrial hygiene will emerge, incident to new materials and processes.

It should be remembered in this connection that the policy of the Navy Department is to allot new naval construction on an equal basis to government and commercial yards. It follows that the commercial establishments are also undergoing rapid development with an enormous rise in industrial personnel. They will therefore be confronted with the problems of industrial hygiene similar to many of those arising in Navy Yards.

Industrial hygiene is a field which is now undergoing rapid development. This appears to be due to certain significant trends, the most important of which has been the recent setting up of many Industrial Hygiene Units in state or city Departments of Health through funds released by the passage of the Social Security Act. These trends, in fact, particularly that just mentioned, reflect a definite renaissance of industrial hygiene as a phase of public health in the United States.

This movement is receiving increasing recognition in naval industrial circles, and industrial hygiene is now listed as a specialty of the naval medical officer along with other specialties outside of the purely clinical fields, such as aviation medicine, submarine medicine, chemical warfare medicine, etc.

Those just mentioned, however, are concerned primarily with naval personnel. Industrial hygiene, on the other hand, is largely occupied with federal industrial personnel. It therefore follows that the status of the Senior Medical Officer of a major Navy Yard in relation to the Industrial Department is analogous in many respects to that of the Medical Director of a large commercial industrial plant. The object of this paper is to present an outline of the administration of industrial hygiene in Navy Yards which are the chief industrial units of the Navy.

Mention should be made in this connection of the Sub-committee on Industrial Hygiene of the Health and Medical Committee of the National Defense Council which has recently been established. The Surgeon General of the Navy is represented by liaison officers in conjunction with this Sub-committee. Important recommendations pertinent to the Navy and industrial health will result and many of them will undoubtedly be put in effect.

The term, industrial hygiene, as applied in the present discussion, is used in the specific sense of the prevention and control of occupational disease. The fact may be of interest that the first compensation law for occupational diseases in this country was one passed in 1908 by Congress for U. S. Civil Service employees. Compensation laws for industrial diseases have lagged far behind legislation covering accidents. Only 16 states of the Union pro-

vided compensation for one or more occupational diseases up to the year 1937, although all but two provided legislation for accidental injuries.

2. The Industrial Organization of Navy Yards

The mission of a Navy Yard is primarily the construction, maintenance and repair of naval vessels. The central administration of Navy Yards, and in fact, of all industrial shore stations of the Navy, is vested in the Assistant Secretary of the Navy, in whose office is the Shore Establishments Division of the Navy Department.

There are eleven Navy Yards located as follows: Portsmouth, N. H.; Boston; New York City; Philadelphia; Washington, D. C.; Norfolk, Va.; Charleston, S. C.; Mare Island, Calif.; Puget Sound, Wash.; Pearl Harbor, Hawaii; and Cavite in the Philippines.

In addition, mention should also be made of the following specialized industrial plants: for the building of submarines at Portsmouth, N. H. and Mare Island, Calif.; the Naval Gun Factory at the Navy Yard, Washington, D. C., for the production of high caliber naval guns, torpedo tubes and accessories; the torpedo factories at Newport, R. I., and Alexandria, Va., for the manufacture of torpedoes; the powder plant at Indian Head, Md., for the production of Navy smokeless powder; the aircraft factory at Philadelphia for experimental air craft construction and repair; the naval armor plant at Charleston, W. Va.; and the Naval Clothing Factory at Brooklyn, N. Y.

Organization of the New York Navy Yard: The organization of the New York Navy Yard may be taken as typical of a major yard. It falls under two departments, i. e., the Industrial Department headed by a naval captain of the engineering branch and an Operations or Military Department under the direction of a naval line captain. As a conservative estimate it may be stated that 90% of the activities of a Navy Yard are industrial.

Under the Industrial Manager there are at present twenty-three shops of different types with a force per shop varying from 30 to 3,200 men. The total of civil employees of this yard is now 17,000. This is rapidly rising and, it is estimated, will exceed 20,000 in 1941.

3. Extent of the Civilian Industrial Force of the Navy

The combined industrial force of all Navy Yards is now approximately 100,000. In view of the pending program of naval construction it is estimated that this will reach 130,000 in 1941. If inclusive of all shore stations this would probably be close to 160,000.

In addition to the industrial force of Navy Yards we should also consider the employee volume in the commercial naval ship building plants such as the Newport News and Dry Dock Co., the New York Shipbuilding Corporation at Camden, N. J., and the Bethlehem concern at Quincy, Mass., which now employ from 12,000 to 15,000 men each. It is a conservative estimate that the combined industrial personnel of all such plants on both east and west coasts will reach a peak of over 100,000.

4. Organization of the Medical Department of a Navy Yard

The medical staff of the New York Yard consists of 10 medical officers, 5 dental officers, 1 nurse, 45 enlisted men and 2 civilian clerks. The chief activities with reference to industrial personnel may be summarized as fol-

lows: (a) Pre-employment physical examinations: all applicants for federal jobs are examined physically, although the standards for acceptance vary to some extent for different occupations. (b) Periodic physical examinations: these, of course, are conducted with the object of medical supervision of certain groups of employees exposed to definite potential health hazards, as foundrymen and spray painters. (c) Physical examination of federal employees for retirement: this is for evaluation of degree of disability and opinion as to disposition when total disability is alleged. (d) Diagnosis, treatment and disposition of industrial injuries and occupational diseases. (e) Administration of compensation cases. (f) Industrial hygiene and plant sanitation.

5. The Industrial Medical Officer

An officer of the medical staff of the Navy Yard is specifically detailed for industrial hygiene administration subject to the direction of the Senior Medical Officer. The accompanying slide outlines the scope of his activities.

(a) Advisor to the Safety Engineer: The adequate practice of industrial hygiene in Navy Yards, as in civil industry, is dependent upon the close and efficient correlation of the safety engineer and the industrial medical officer. It is essential to obtain a grasp of the functions of both of these officers in order to properly visualize industrial business administration.

(b) Inspections: The industrial medical officer is responsible for the general supervision of plant sanitation, i. e., ventilation. illumination, water supply, general cleanliness, adequacy and condition of sanitary facilities, etc. He also conducts shop inspections for occupational health hazards and their measures of control.

He cannot expect to evaluate working conditions and thereby detect occupational health hazards early unless he makes periodic inspections through the plant. In this way he can observe the adequacy of existing measures against specific hazards and whether such methods are being properly utilized. These inspections also have a psychological value in that they create greater respect for the medical service in the minds of the employees.

(c) Supervision of Special Physical Examinations: pre-employment cases when the applicant reports previous exposure to potential industrial health hazards such as lead fumes or foundry dust; periodic examinations of groups exposed to such potential occupational hazards, as spray painters and sandblasters; examination of cases referred for transfer to other shops where there is a question of occupational disability; clinical studies for a decision as to industrial origin in obscure cases.

(d) Medical surveys of occupational groups; this will be discussed later.

(e) Administration of the medical aspects of compensation claimed for occupational disease pending before the U. S. Employees Compensation Commission.

(f) Supervision of preparation of accident and occupational disease reports for the Navy Department.

6. The Safety Engineer

A civilian Safety Engineer is stationed at the Navy Department as the advisor to the head of the Shore Establishments Division. A naval officer is assigned to each Navy Yard as the safety engineer.

(1) Accident and unsafe practice control: Safety engineering is one of

the divisions of the Navy Yard organization. The Safety Engineer conducts an investigation of all lost-time accidents with a view to fixing the cause and advising as to measures to prevent their recurrence. The basic features of approach to the safety problem in Navy Yards are provision of safety devices, such as mechanical guarding, and the safety education of workmen and their supervisors.

Another important aspect is the competitive approach which has proved very effective in stimulating interest in accident prevention. The Navy Department publishes the comparative safety scores of all Navy Yards monthly.

The accompanying slide emphasizes the advance made by the Navy Department in accident reduction beginning with an intensive safety campaign in Navy Yards in 1926. We find the frequency accident rate lowered from 20 to practically 10 per year in a 11 year period; the severity rate reduced from 2.2 per year to 0.5. On the other hand it will be noted that the total man hours worked during the period increased to 115 million from 65 million per year, the average number of employees rising from approximately 30,000 to 66,000.

(2) Occupational Health Control: The control of occupational disease in Navy Yards naturally lies within the sphere of both the safety engineer and the industrial medical officer. Although the safety engineer is administratively charged with this task, the medical officer is actually coordinate with him in this phase.

As a matter of fact, the medical officer is the key man in the prevention of industrial disease in Navy Yards, for it is usually discovers its existence. The diagnosis having been made, the occupational history and the pre-employment examination record are carefully reviewed in order to reach a decision, if possible, whether the hazard can be traced to present or past employment. If ascribed to, or aggravated by environmental conditions, the medical officer confers with the Safety Engineer and an industrial hygiene survey is usually recommended to the Commandant.

7. The Industrial Hygiene Survey

Such a survey is of course a combined medical and engineering task.

(a) The Medical Survey.

This consists of a complete clinical study with detailed occupational histories of all exposed personnel as a case finding procedure under the supervision of the industrial medical officer. Although not directly responsible beyond the matter of the medical survey it is important that the medical officer have a reasonable grasp of the entire problem so that he will be in a position to utilize all data that have any bearing on the interpretation of his medical findings. In addition, he may act in an advisory capacity to the safety engineer with respect to certain technical phases in the planning and conduct of the engineering aspects of the survey.

(b) The Engineering Survey.

The engineering phases of an industrial hygiene survey in a Navy Yard fall, naturally, under the direction of the safety engineer. As in a commercial industry, this embraces essentially a complete story of the occupational duties, physical conditions of work, and the materials, processes, and equipment of the individual shop, in other words the environmental conditions.

Laboratory facilities: There are no facilities provided for technical

studies in the Navy Yard organization and there is no central laboratory unit in Washington which could supply industrial hygienists for field studies. This is an urgent need and recommendations have recently been made to the end of setting up such an agency.

The Department has been most fortunate in the past in securing the services of the Division of Industrial Hygiene of the Public Health Service to conduct such technical studies much in the same way that industries in the states utilize the facilities of State Bureaus of Industrial Hygiene.

The safety engineer formulates the control program of the health hazard on the basis of the data of the survey. After all once the etiology is disclosed prevention of occupational disease is largely an engineering problem.

8. The Reporting of Industrial Accidents and Illnesses

An important advance in accident prevention by the Navy was initiated on July 1st of this year when the Secretary directed that a report of each accident and illness, both "lost-time" and "no lost-time," occurring among civil personnel of Navy Shore Establishments be made to the Bureau of Medicine and Surgery. The report of each accident is submitted on a form, known as F-C, shown in the accompanying slide. This presents the diagnosis of the injury and the essential details as to the cause. Punch cards are made up from these records for mechanical tabulating and indexing through a sorting machine. This provides facilities for the statistical analysis of these accidents and diseases, and the data obtained promise to be a far-reaching contribution to the subject of accident control. Prior to this system a crude form of accident reporting to the Department was in effect but it was not adapted to statistical analysis.

9. Occupational Health Hazards in Navy Yards

The chief potential occupational health hazards in Navy Yards will now be considered, the data being based chiefly on reports to the U. S. Employees Compensation Commission over a series of years. It hardly requires emphasis that industrial medical officers must be constantly on the alert for new hazards.

(1) Dust Diseases.

(a) Silicosis: Important units of all Navy Yards are iron, steel and brass foundries.

The dust control problem is a major concern in these plants as in civil industry.

One of the difficulties met with in combating the foundry dust problem in navy yards is the fact that silicosis dust is not particularly irritating or obnoxious in concentrations which may ultimately lead to pulmonary damage. As a result we find a tendency to an indifference on the part of the workers and even supervisors and executives, which must be overcome in order to accomplish effective and permanent dust control. Another reason for this attitude is the long period of time necessary for those foundry workers exposed to only moderate concentrations of dust, such as molders, to develop silicosis.

A medical survey of the foundries of the Navy Yard, Washington, D. C., was conducted by the speaker in 1939: of 525 men surveyed, approximately 60% had a record of 10 years or over; and 36% a record of 20 years or over

of total foundry employment. Twelve cases of silicosis were found or 2.4% of the total—all in Stage I or II; these data leading to recommendations for improved dust control methods.

Industrial hygiene surveys in foundries other than the Washington Navy Yard have not as yet been carried out but would, in all probability, disclose a certain incidence of silicosis, even if not of disabling type.

The medical control of silicosis in the naval establishment consists of an x-ray of the chest before employment and an annual radiograph of all men exposed to the higher silica dust concentrations such as sandblasters and shake-out men. It is believed that medical surveys of foundries in all Navy Yards will soon be required.

(b) Asbestosis.

This is a potential occupational disease hazard from the inhalation of asbestos dust among workers engaged in the manufacture of asbestos insulating covers for flanges, valves and high temperature steam turbines.

The speaker recently conducted a medical survey of the workers of the Pipe Insulating Shop of the New York Yard inclusive of x-ray studies, the maximum working period of exposure being 17 years. No asbestosis cases were found. Similar findings have been reported from two other yards but the study should be extended to all men in this trade.

Medical control consists of an x-ray of the lungs annually. The asbestos is moistened and localized exhaust ventilation is installed over the work area. A respirator is worn during the dustiest aspect of the process.

(2) Lead and Lead Compounds.

Lead poisoning has become comparatively infrequent in recent years both among industrial and service naval personnel; apparently due in part to changes in materials and methods, and partly to improved measures of control. Zinc and titanium paints have largely replaced leaded material for ship interiors. Red lead paint is still in use as the priming coat on hull exteriors but the finishing coats contain either no lead or a greatly reduced proportion. All painters regularly handling lead-containing paint are examined semi-annually for evidences of lead absorption.

(3) Volatile Organic Solvents.

Lacquer spray painting occurs on an extensive scale in Navy Yards and therefore demands rigid medical supervision. Another important application is in degreasing measures. All spray lacquer personnel are subject to semi-annual physical examination.

(4) X-ray and Radium Hazards.

The x-ray and radium are continually utilized for the detection of flaws in castings and pipe welded joints for high pressure steam installations. Radium has an advantage in the small size of the equipment in that it is adapted to tests in the confined machinery spaces of ships.

The question of protection from irradiation of the operating and other personnel working in the vicinity of the apparatus has received thorough study, the practice of the Bureau of Standards being generally followed. Complete blood counts of all technicians are conducted quarterly and special pre-employment examinations are prescribed.

Another potential hazard of radium is that of ingestion incident to radium painting of luminous dials, more especially for fire control instru-

ments and aircraft. The control measures advised by the Public Health Service are generally in force, plus certain local regulations.

(5) Welding.

The hygienic supervision of welders is another outstanding feature of medical responsibility. Approximately 2,500 welders were on the rolls of the combined shore establishments as of January 1, 1940, including 653 at New York. This number has progressively increased and will continue to rise.

The immense volume of work in confined spaces is characteristic of naval welding. A battleship of 35,000 tons displacement under construction contains approximately 500 compartments in which electric welding is mandatory, certain of these spaces being extremely small and forcing the welder to work in very cramped positions. These conditions complicate the question of effective preventive control of the hazards.

The chief hazards which have to be considered at present are "nitrous fume" poisoning, zinc fume fever, as it is popularly termed, and actinic ophthalmia from ultraviolet radiation of the welding arc. "Nitrous fume" poisoning, while comparatively rare, is a serious condition.

No accent need be placed on the fact that these injuries would be still further reduced in number if the control measures provided were properly utilized. It may be of interest to note that of 317 cases of actinic ophthalmia reported at the New York Yard in 9 months of the current year, only 20% occurred among welders; the remaining 80% among men exposed in spaces adjacent to the welding arc but not utilizing available protective goggles.

Chronic poisoning among naval welders from manganese, fluorides or silicon, which might be ascribed to inhalation of these metallic or mineral oxides in the welding fumes originating in the rod coatings, has not been reported. Such a possibility, of course, cannot be denied. The limitation of time prevents mention of additional hazards.

10. Annual Examination of Crane Operators, Enginemen (Hoisting and Portable) and Locomotive Engineers

These classes of workers are physically examined annually with special emphasis on blood pressure, hearing and vision. In view of the nature of their duties, physical failure, such as sudden collapse, might involve critical injury to themselves and others; and in addition, damage to material. If corrective measures are impracticable the worker is retired or transferred to some other type of employment for which he may be suitable. A crane operator, for instance, presenting a marked hypertension, would be referred to his private physician and transferred to other duties.

11. Time Loss from Industrial versus Non-industrial Disabilities

In a limited study of 116 industrial companies in various parts of the United States conducted by the American College of Surgeons a few years ago, it was found that the time loss from non-industrial types of illness was approximately 15 times that industrially connected. The speaker in his capacity as Senior Medical Officer of the Washington Navy Yard made the following observations for the calendar year 1938: Total industrial force, 7,000; number of days lost from industrial accidents, 0.14; number of days lost from non-industrial illness or accident, 5.20. The number of days loss from non-industrial disability was therefore 37 times that from industrial

causes. A similar study by the speaker at the New York Yard for 1939 revealed that the non-industrial loss was roughly four times the industrial figure. The possible factors in the difference between the two yards have not been analyzed.

Disparities of the same general order have been reported in recent statistical studies by certain large commercial industries and reflect an enormous economic loss. Much of this non-industrial illness is preventable. It is believed that in the naval establishments this wastage of preventable illness can be greatly reduced, if the problem is attacked by an annual physical examination of all employees, referring cases requiring corrective treatment to their private physicians or other agencies. This would require a heavy increase in medical staffs but it would be a profitable investment by naval industry in the saving of man power for national defense. It is a question worthy of being explored.

PROFESSOR DRINKER: We were informed the other day in Washington that the Navy is now in the mining business and is confronted with the conventional mining hazards as well. Therefore we can say that their hazards are about all those we meet in all of our industries.

I am sure that Captain Brown will be glad to answer questions.

MR. WEIL: I should like to ask Captain Brown what his eye test consists of for his men in so-called key positions. We are using a keystone and we are a little at a loss as to how to interpret some of the findings.

CAPTAIN BROWN: I didn't get the drift of that.

MR. WEIL: I want to know what the eye examination consists of and what is your experience in interpreting the keystone test, if you use it.

CAPTAIN BROWN: I don't think we have had any contact with that particular test. We simply use the ordinary southern test, with definite standards.

PROFESSOR DRINKER: A teacher always judges the value of a book, first, by his ability to keep it in his own library or in his own laboratory. They have a way of disappearing, particularly if your students are eager for it. One also judges the value of a book by the general appearance of the cover, whether it begins to fall apart after a month or two.

Haggard's "Noxious Gases" is the standard book throughout the English-speaking world on the subject. I am on my fourth copy. I don't know how the rest of you are doing. Two of mine have been stolen, one is worn out, and the one I have has been rebound once. The University also has a number of them at the Medical School and at the Engineering School Libraries. I state this to show you how eager we are to use it and how much we do use it.

It is pleasant to welcome to our group—at least it is for me as a professor at Harvard—a professor in a sister university and one with whom we have friendly rivalry of all sorts. In this case I have to admit, with a good deal of professional jealousy and very sincere admiration, that there isn't any rivalry. The lead is entirely with Yale.

It is to me, therefore, a great personal privilege to be able to introduce to you Dr. Howard W. Haggard, of Yale University, who will speak on the "Absorption and Excretion of Volatile Solvents."