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working conditions, machinery, equipment and personal safety protective devices and apparel where necessary.

Recommendations from the National Safety Council, presidential conferences, or other groups, that refer to education are of no real value unless there is instituted effective training programs for supervisors and employees.

The working force of American industry represents a highly skilled and impressive background of experience to be tapped for ideas, and we must do a better job in the future of encouraging employees to offer suggestions, advice and recommendations for the improvement of safety.

If safety is primarily the obligation of the employer, let's have no confusion and uncertainty insofar as management having the complete authority necessary to carry out its responsibility. Cooperation for safety is a moral obligation of every individual employee, and, in unionized plants, the welfare of the employee places upon the labor union a moral obligation to cooperate in accident prevention within the framework of its agreed-upon participation.

Mr. John Q. Public is a very patient individual, and a very important one. And I believe he is getting a little fed up on the never-ending brawls between management and labor—and both of these groups can regain a great deal of prestige, which has been lost, by honestly and conscientiously getting together in the field of industrial safety which, in far too many cases, has only had lip service from both sides. We cannot afford to take as much time as we have in the past making a radical improvement in our national safety record, and I can say to you this morning, as Marcus Aurelius once warned himself, "don't act as if you had a thousand years to live."

The development of a safety program can too easily be one of the matters that a busy executive can continually put ahead in his follow-up file, which gets it out of sight until it comes out again. I suggest that the responsible executive ask for the previous day's accident record as he now asks for the previous day's sales, production and employment data, and, in cases where the accident record falls short of the desired goal, take the necessary steps, as he would in cases of disappointing sales and production, to remedy the situation.

But again I say, remember, it is later than you think! Safety is a job for everyone. I don't care whether you make bricks, lay them, or throw them. It is a purely practical matter. We are beginning to slowly realize that it does not pay to get hurt. Forgetting the human relations angle entirely—lost wages, medical expenses, workmen's compensation, do a job on the efficiency of our industrial management that we should keep in mind when we are inclined to boast how efficient we are. The record of industrial safety in the future, and the relationship that it bears to the present appalling toll of life and limb will be governed by the ability of management and labor and the working force to cooperate! Therefore, if no one wins and everybody loses, let's get on the ball and do something about it!

# What the Safety Engineer Should Know About Industrial Health Hazards

## Broadening the Accident Prevention Program Through a Progressive Industrial Health Program

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For many years the Navy has had an accident prevention program with a staff in the Executive offices of the Secretary in Washington. Close liaison has been maintained with the Bureau of Medicine and Surgery so that the Navy followed the slow evolution of industrial health services as they developed in industry. In 1940, when expansion of Naval activities started at an accelerated pace it was recognized that the accident prevention program should be broadened by the institution of an industrial health program. In 1941 an Industrial Health Section was formed under the Preventive Medicine Division of the Bureau of Medicine and Surgery. Through the cooperation of this Section with the Safety Branch of the Office of Industrial Relations an industrial health program developed and is presently outlined in Navy Civilian Personnel Instructions No. 88. This step broadened considerably the accident prevention program during the war and post-war periods.

Considerable progress has been made toward reducing accident frequency and severity rates, and much of the credit for this fine achievement is due the accident prevention program, and the safety people directing it. More can and undoubtedly will be done in order to hold to this fine record and even to improve it. We are sure that all present realize full well the large measure of help that can be given to the success of an accident prevention program by the medical department through an enlightened and progressive industrial health program.

Our attack should begin the very first moment the prospective employee opens the door in search of a job. Good job analysis and proper job placement is of first importance in prevention of the accidents in which these prospective employees will surely become involved if they are not properly placed.

One trend of the past few years has been to place considerable emphasis on psychological and social factors, in addition to physical factors, in maintaining the health of employees. For example, many of our larger, forward-looking industrial organizations require, in addition to an interview and physical examination, some form of a test to determine the individual's aptitude. Experience has shown the wisdom and economy of applying the results of the various pre-employment examination data in the placement of individuals in jobs commensurate with their abilities and aptitude. Greater output, greater contentment, less labor turnover, less sick absenteeism, and the like, have demonstrated the importance of such a procedure.

Many persons seeking employment are trained or skilled in a specialized field, and they have become so because they liked the particular work. In all probability they will make good, stable, contented employees. Many others have been attracted to certain skills and have become trained in them for various other reasons, for example, easy money, good pay, prestige, health reasons,

*(Note: The opinions or assertions contained herein are the private ones of the writer and are not to be construed as official or reflecting the views of the Navy Department or the naval service.)*

etc. Many of these people have been able to put aside known disagreeable factors as being inconsequential, when compared to the ultimate objective, and have made contented efficient workers.

Others have received training in certain skills without ever having been completely satisfied in their own minds as to what they really want. It is among this group of gropers, so to speak, and in the large group of unskilled employees, that the results of pre-placement aptitude and physical examinations can be most profitably applied.

It takes doctors who are familiar with the plant set-up and operations to derive the best results from a program involving job analysis and job placement from the point of view of physical compatibility of an individual with the requirements of the job.

It is obvious that a weak person, or one with definite physical defects, should not be placed in a job which would require expending great quantities of physical energy. In other words, "don't send a boy to a man's job." Jobs requiring great physical effort should be reserved for those who possess the capacity to cope with them. It is just as obvious that it would be unwise to place someone with little or no patience on a tedious job which requires great precision and attention to minute details, or to place a psycho-neurotic in a noisy place such as a boilermaker shop.

Malplacement of an employee frequently starts him off with the idea that his welfare is of no concern to the employer. Such ideas can, and frequently do, grow in his mind and come to fill a large part of his thoughts. This may result in resentment against management and may figure in bad labor-management relationships with all that this entails. So much of the employee's time may be consumed in thinking of ways to protect his welfare that he becomes physically and mentally inefficient. No physical labor that is required today will fatigue one as quickly as a bad mental attitude.

The least the pre-employment examination should do is give the personnel manager sufficient knowledge of the individual as a whole to be able to start him off in the right job.

We all know the importance of the periodic examination of all persons, and especially of those engaged in hazardous occupations in the prevention of accidents as well as occupational diseases. At times periodic examinations have revealed cases of pathology which have necessarily resulted in taking an individual away from a job because its hazardous nature, and his physical condition together, might easily result in injury to himself or a fellow employee.

Cases have been cited of cranemen who have been taken off cranes who complained bitterly about it at first because they felt that an injustice had been done to them. After being away from this type of work and experiencing a relaxation they had never before had these men have stated that it was the best thing that could have happened to them and were deeply grateful for the interest of management in their personal welfare.

If on periodic examination of a painter, for example, we found that he had high blood pressure or was a diabetic, or had a history of epilepsy, and forced him to do work that required him to be on a high scaffold we would be inviting disaster. If it is ascertained that a person is subject to frequent respiratory ailments, it would hardly be fair to allow him to continue on a job we know has associated with it a high rate of pulmonary diseases such as one in which he may be subject to frequent and sharp changes in temperature.

The surveying of all employees periodically, as in the chest x-ray survey, can hardly be overlooked as a means of broadening the accident prevention program, in addition to its other many benefits to employee and industry. Our experience in the Navy to date has shown that not only do we pick out cases of tuberculosis, but such other diseases as heart disease of a type which may show up as an enlarged heart, or aortic disease, and the like. These persons may not be working at hazardous occupations, and therefore, if not for the chest x-ray, would not have been recently examined. Such individuals can be advised to see their family physician regarding their condition. It is not hard to imagine an individual with an aortic aneurysm large enough to show up on the chest x-ray suffering a sudden fainting spell that would cause a serious accident resulting in injury to not only himself but to others as well.



Special examinations could also serve to pick out an individual who is potentially a bad accident risk because of a physical defect or pathological state of which he is not aware. These special examinations may be to ascertain an employee's physical ability to perform the work assigned; it may be to determine the nature of an illness when an employee becomes sick at work; it may be to determine fitness of an employee for continuing an assignment because of alcoholism, acute emotional imbalance, psychopathic personality, contagious disease, etc.; it may be to determine the need for change of duty; to determine the degree of progress occurring in cases requiring rehabilitation; or it may be to determine the physical condition upon return to work after personal illness.

Accurate and good health records on each employee can be utilized as a basis for medical counseling. By accurate maintenance of the health records each visit to the dispensary and each examination will be recorded in the individual's health record. Some progressive illnesses undoubtedly could be detected by the physician reading the individual's complete records, and such counsel as necessary given to the individual to avoid or remedy conditions which he has never suspected.

Not the least important of the functions generally considered in a good industrial health program is a well planned industrial hygiene service, which in addition to studying environmental health problems from a toxicological and physical point of view, includes a psychological approach to keep up the morale of employees. More and more it is becoming clear that poor morale and psychological health is a prime factor in the causation of accidents. Mental hygiene counsel has been shown to be beneficial in such a program. When the patient visits the dispensary an opportunity is provided for the physician to give him counsel of this nature.

A health education program contributes greatly to the health of employees, and includes such topics as nutrition, environmental hygiene, and communicable disease control such as the control of syphilis, tuberculosis, poliomyelitis, the common cold, and others. The inclusion in the program of the latest developments in preventive medicine practices is desirable, to keep employees informed on such matters as the fluoride treatment of children's teeth to reduce decay, and to provide them with literature on cancer, heart disease, group hospitalization, etc. Things of a general nature that could affect the health and welfare of his family have great appeal for the employee's interest.

In following a trend we should be careful not to go overboard on one aspect of health control or improvement to the neglect of another. We should certainly satisfy ourselves that all is well as regards such common toxic hazards as we ordinarily encounter in industry, before expending too much energy on the psychological approach. [illegible] might be found in the form of [illegible], asbestos, lead and [illegible] dust, etc.; in the form of vapors such as benzene, chlorinated hydrocarbons, and the like; metal fumes of many varieties; gases, such as carbon monoxide, hydrogen cyanide, hydrogen sulfide, methane, oxides of nitrogen; alkalies and acids; or other numerous materials which, in contact with the skin, cause dermatitis. It is obvious that the presence of these toxic substances may of themselves be responsible for some accidents.

As an illustration—in one plant of the Navy, it was found, during a survey, that an employee was cleaning cavities of metal ordnance equipment by spraying Stoddard Solvent. The great danger here would seem to be the hazard of explosion in view of the low order of toxicity of this particular substance. However, all fat solvents can, when inhaled in sufficient quantity, cause intoxication. The man in question, since doing this work, had been getting quite dizzy and groggy, and on many occasions while driving home in his car had to turn the driving over to another occupant for fear of an accident. This was a condition that existed not only at the end of a work day, but was present a good part of the time while actually engaged at work. It is easy to understand that a great variety of situations could very easily develop in a machine shop where a man in this condition would present a definite risk.

We might consider the case of persons working with chlorinated hydrocarbons such as carbon tetrachloride or trichlorethylene. It is common knowledge that inhalation of these vapors will give a per-

son a "jag" in quick order. Many persons like the sweet odor of these solvents and addiction, for the purpose of getting a "jag," is seen at times especially among persons using trichloroethylene.

Almost every operator of a degreasing tank, if asked whether he is ever affected by the vapors, will answer that it has made him feel drunk on occasion. This happens at times in places which are very carefully controlled. Such a situation arising only very infrequently may not be considered a serious health hazard, however, during the time when it does arise, the individual becomes an extraordinary risk as regards an accident. The answer to the situation, of course, is to rectify the process by eliminating the chances of vapor exceeding the maximum permissible limit. Almost unlimited examples might be quoted of how toxic materials could affect accident rates. However, suffice it to say, that any material of a toxic nature which upsets one physiologically because of pain or has an effect on the central nervous system will place the individual in the situation of being a candidate for an accident. Even a case of food poisoning, or a painful bunion, may cause one to center his attention on himself and away from his work—a condition not conducive to the best interest of accident prevention.

Other environments besides the chemical, such as the physical, should not be omitted from the present discussion. Such conditions as excessive noise, especially in the higher pitch ranges, can become quite monotonous and cause undue fatigue. Illumination may be placed in a like category. Absence of sufficient light is a factor of considerable importance in many accidents, and on the other hand, too much light without regard for what it does in the way of glare and after-images, which appear after exposure to too intense illumination, take their share of responsibility in accident causation.

Improper ventilation, as in warehouses, where gasoline-operated trucks are in use may result in fouling the atmosphere with carbon monoxide. Such exposures can and do give rise to intense headaches with nausea and blurring of vision which can be distracting to employees from the work at hand. Actinic rays which are emitted from certain operations cause burning of the eyes with blurring of vision. Excessive humidity to the point of fogging and obstructing vision during work occurs at times. These are a few of the physical conditions usually considered as industrial health problems which no doubt figure in many accidents, and the correction of these conditions should aid in reducing the number of accidents which are often occurring.

An advancement in the prevention of accidents to which defective vision is contributory and which has received considerable attention within the past two years in the Navy, is the Eye-Protection Eye-Correction Program. This program was started after available statistics showed that many accidents were being caused by persons who were found to have defective vision and who were not corrected. The mere fact that approximately 40 per cent of all those persons screened in this program require eye refractions and prescription lenses is indicative of the general need for such a program.

There are many things that could occur in persons with uncorrected poor vision that could figure in the causation of accidents, for example, headaches traceable to eye strain, blurring of vision, watering of eyes, etc. This is not meant to exclude the possibility of these conditions occurring in persons with good vision, but merely to suggest that these conditions may be much more prevalent in persons with faulty vision, and this may be cleared up by correction. It is important, too, that the corrective device be of the proper type. After an automobile accident it was found that the operator was wearing a lens that corrected his vision, but it contained a cylinder, which means that the lens has to be held in the frame at a given angle. This was a round lens in a round frame which had become loose enough for the lens to rotate in the frame. As a result the driver's vision was worse than if he had no glasses, and this was presumed to be the cause of the accident. Of course, corrective lenses are not now put in this type of frame.

In prescribing lenses it is necessary that the job be analyzed to determine the working distance and the proper correction for each individual for use in his job. In job placement, it is also important to determine if the employee has faulty depth perception,

Some jobs, such as crane and vehicle operation, require good depth perception.

All of the above factors play their individual roles in a good overall industrial health program. At the same time as the health of employees is improved, we are moving in the direction of reducing accidents as well, because we know that those accidents in which the human factor is most important are caused in the main by persons who are either physically or emotionally disturbed, at least temporarily. Recent work on the accident-prone individual has shown that this individual is subject to becoming emotionally upset easily and may be upset because of a wide variety of reasons.

Some of you probably heard the lectures by Doctor Rosenstein in Chicago a year ago in which he stressed, among other things, the desirability of putting safety campaigns on a more personal basis rather than on a general plane. Supervisors should be thoroughly coached and trained in safety and through them safety education could be spread to employees in a very personal way. The supervisor in the course of the day, while talking to his employees individually, could spread a few pearls of wisdom regarding safety, and put it in such a way as to impress the man.

Show him how laxity in carrying out safe practices could influence the remainder of his life as well as the lives of those whom he holds dear. When the campaign is put on in general terms by posters, signs, etc., giving statistics on how many thousands lost their lives because of avoidable accidents last year, the average person is not too thoroughly impressed. When, however, we pick an example of someone we both know and show how such an accident to "John Doe" would affect him, the impression becomes much deeper.

Along the same line of spreading safety through the supervisor, the supervisor can be of great service to his men by being a very patient and sympathetic listener. Many of the worries and anxieties to which man falls heir are without basis and cannot stand up under cross examination. They have developed and become exaggerated in the individual's mind by constant repetition of the thought to himself, and in many cases they just won't stand the logical telling of a story just as a dream in many cases shows no logic when we try to reconstruct it. When an individual airs his troubles to someone, many times he comes to realize that there is no basis for his fears or anxieties.

A progressive industrial health program without doubt will broaden the accident prevention program. To operate effectively, it requires the ultimate cooperation of all concerned — doctors, industrial hygienists, safety personnel, nurses, management, and employees. A real employees' health program takes teamwork, with the aforementioned making up the team.

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# The Flammability, Toxicity, and Allowable Limits of Some Industrial Gases

**(Summary of a Talk)**

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It is easy to visualize the injury that may be caused by an unguarded machine, but it is not so easy to visualize the injury that may be caused by unclean or abnormal air. To understand fully the effect that a noxious gas may have upon the respiratory system, one must know the composition of normal air.

The composition of normal air and the diffusion of gases are demonstrated by allowing a 1-quart jar of oxygen to diffuse into a 4-quart jar of nitrogen. The specific gravity of gases is demonstrated by filling balloons with different gases and dropping them simultaneously from the same height and watching their rate of descent.

The hazards of gasoline vapors and hydrogen sulfide can be seen by observing the